



# Indian Journal of Dental Sciences

... an insight into DENTISTRY

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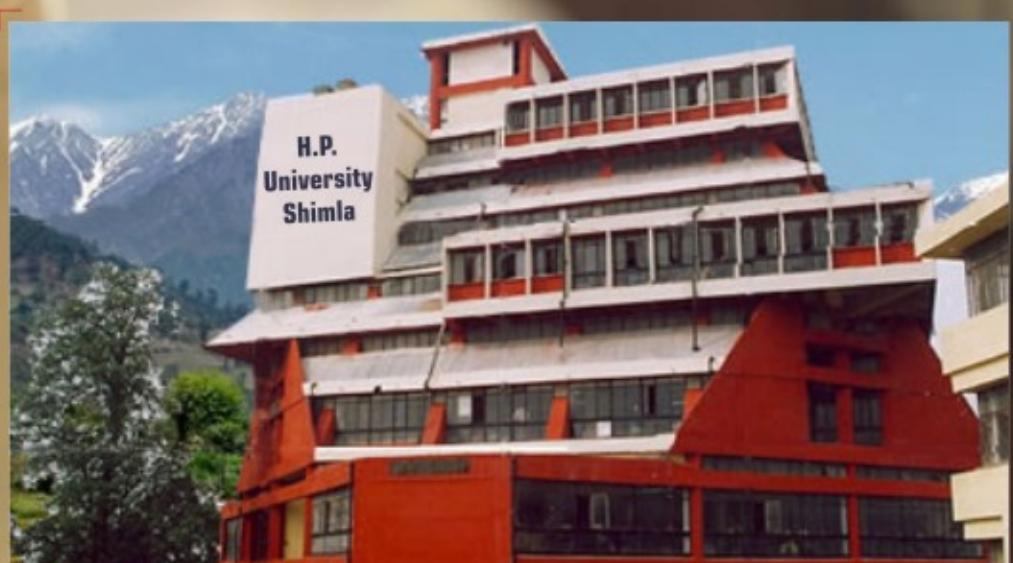
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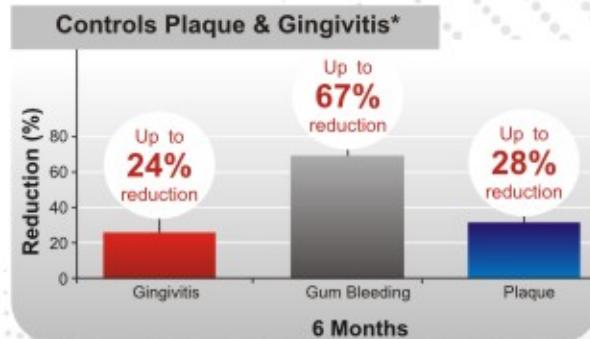
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# Indian Journal of Dental Sciences

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IJDS strictly wish to communicate to all its readers, contributors, authors and co-authors and other concerned not to indulge in this activity.

The Editorial Board and the Review Committee has decided to take a Serious View in the above matter and shall resort to appropriate action as and when required.

We regret to inform that one of the article published in March 2012 "**Titled: Observational Study on the Association between Gingival Recession and Other Clinical Variables in an Adult Population in India**" is a copy of "**Observational Study on the Association Between Gingival Recession and Other Clinical Variables in an Adult Population in Greece.**" as has been pointed out by the original author "**Nikolaos Andr. Chrysanthakopoulos**" After going through the facts of the same the board has decided that the Article "**Titled: Observational Study on the Association between Gingival Recession and Other Clinical Variables in an Adult Population in India**" stands withdrawn from the Database.

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Dr. Vikas Jindal (Editor in chief)  
Indian Journal of Dental Sciences

# Guest Editorial

As the co-editor of the IJDS, an official publication of HIMACHAL PRADESH UNIVERSITY, I would like to thank all the members of the editorial board for the honour bestowed upon me and confidence reposed in me by giving me the responsibility for editing the journal

The pillars of this journal are the conceptual focus, creative thinking and achievement of strived goals. It is providing us a platform to publish our ideas and thoughts through original research articles, case reports, review articles and make significant contribution in advancing our respective fields. As it covers all dental specialties, it is covering wide range of topics since its inception. By doing so, it has paved a path to share our knowledge with fellow colleagues

In today's world of growing knowledge and technology savvy workforce, information needed is available with just the click of the mouse. But as the information becomes readily accessible, the significance of this information and its source advances. Looking at the mushrooming growth of scientific journals and piling up of the volumes, it becomes all the more important to be critical in assessing the authenticity of the content being published. IJDS is doing its best to provide its readers the relevant, authentic and genuine work through critical analysis of the work submitted.

All Editors' strive for 100% accuracy and IJDS is no exception. Unfortunately, even the best journal must occasionally publish a correction or retraction. The Editorial Board encourages for improvement and elevation of standards of IJDS through feedback from its readers. Your contribution, suggestions and critical evaluation will help us to take the journal to a new level, which is only possible with continuous improvement and lasting quality.

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Dr. Anil Singla (Director)  
HDC, Sundernagar

## A Cephalometric Clue For Canine Guided Or Group Function Occlusion

### Abstract

**Objective:** The aim of this study was to determine the relationship of Frankfort Mandibular Plane Angle (FMA) and vertical overlap to eccentric occlusal groups.

**Material and Methods:** Total of 60 patients; 15 males and 15 females matched age wise were enrolled in Group function occlusion and Canine guided occlusion group. Lateral head cephalogram was taken for each individual. Each lateral head cephalogram was analysed for FMA, Incisor Mandibular Plane Angle (IMPA), Inter-Incisor Angle (IIA), Gonial angle (GA). Depending upon FMA, each group was divided into two groups; one with FMA of 15-24 degrees and second with FMA of 25-34 degrees. Overbite at central incisor and at canine was evaluated by specially designed Vernier calipers. These readings were compared for each group. For statistical analysis, Student 't' test was used.

**Results:** The mean FMA for Canine guided occlusion group was  $21.667 \pm 5.238$  while in Group function it was  $27.250 \pm 2.149$ . The mean IMPA was higher in Canine guided group ( $101.550 \pm 9.004$ ) as compared to Group function occlusion group ( $98.267 \pm 5.359$ ). However, mean IIA and GA were found to be significantly higher in Group function occlusion ( $129.483 \pm 6.492$ ,  $125.600 \pm 7.826$ ) as compared to Canine guided occlusion group ( $124.533 \pm 9.975$ ,  $120.983 \pm 9.101$ ). Overbite at central incisor as well as at canine was found to be significantly higher ( $P < 0.001$ ) in Canine guided group as compared to Group function occlusion group.

**Conclusion:** Depending upon FMA, the type of occlusion present in natural dentition can be studied and while replacing the natural dentition, FMA can be used as a diagnostic tool in occlusal rehabilitation.

### Key Words

Frankfort Mandibular Plane Angle (FMA), Canine guided occlusion group, Group function occlusion

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### Quick Response Code



### Introduction

The conflict in the objectives of occlusion that exists in dentistry often finds its origin in semantics and in the interpretation and application of research. The most important phase of dental treatment is to restore the dentition to its best possible form and health with minimum intervention.<sup>[1]</sup>



Figure 1 : Group function occlusion

One clinical procedure which has gained popularity in the prosthodontics sphere is the practice of "Full mouth Rehabilitation". It implies the employment of all diagnostic, therapeutic and restorative procedures at the dentist's command for the treatment and prevention of dental diseases.<sup>[2]</sup>



Figure 2 : Canine guided occlusion

Natural dentition can be categorized into two groups (D'Amico A. 1958)<sup>[3]</sup> according to their functional occlusal pattern i.e.

- (i) Those individuals who exhibited occlusal contacts on several teeth on
- (ii) Those individuals who exhibited only cuspid contacts with all the posterior

teeth out of contact; on the working side in eccentric mandibular excursion has a Canine Guided Occlusion (Figure 2).

Occlusion rehabilitation in patients with grossly attrited or severely compromised occlusion requires a proper diagnosis and treatment planning. The newer techniques developed that helps in diagnosis and treatment planning include the use of cephalometry. Different cephalometric analysis can easily guide the dentist to the prediction of the final outcome of treatment.<sup>[4]</sup>

The purpose of this study was to find the relationship of Frankfort mandibular plane angle and vertical overlap to eccentric occlusal groups.

### Materials And Methods

#### Patient Selection Criteria

A total of 88 patients of age group 19-30 years, were screened from those

working side in eccentric mandibular excursions classified as a Group Function Occlusion (Figure 1).

attending the O.P.D of Department of Prosthodontics and amongst the student population of Sardar Patel Post Graduate Institute of Dental and Medical Sciences (SPPGIDMS) Lucknow. Of these, 34 (18 males, 16 females) were found to be falling under group function occlusion category. Out of 34, thirty patients; 15 males and 15 females matched agewise were enrolled in this group. From the remaining 54 patients, 30 patients (15 males and 15 females) matched agewise comprised the Canine guided group.

The general criteria for selecting the patients for the study was; irrespective of cast, creed, religion, with Angle's class I molar relationship, without anterior crowding, without anterior and posterior crossbite, all permanent teeth being present (excluding third molar), with good periodontal health, with optimum TMJ condition, with no history of any orthodontic treatment, and no or minimum amount of attrition.

Depending upon FMA, each group was further divided into two; one group with FMA of 15-24 degrees and second with FMA of 25-34 degrees.

### Overbite

Specially designed Vernier calipers (**Figure 3**) was used to measure the overbite at central incisor and at canine. Mandibular teeth were dried with cotton.



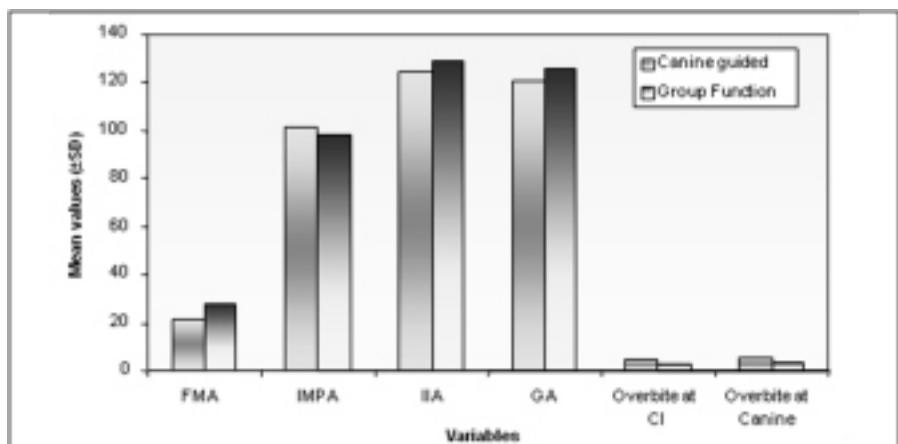
Figure 3 : Marking of incisal edges of maxillary incisor and canine at mandibular teeth



Figure 4 : Modified Vernier calipers at edges

Table 1: Comparison of cephalometric variables for Canine guided and Group function occlusion (overall)  
(n=60)

Variable	Canine guided (n=30)			Group Function (n=30)			Comparison	
	Mean	SD	SEM	Mean	SD	SEM	t'	t'P
FMA <sup>(9)</sup>	21.667	5.238	0.956	27.250	2.149	0.392	-5.402	<0.001
IMPA <sup>(9)</sup>	101.550	9.004	1.644	98.267	5.359	0.978	1.716	0.091
IIA <sup>(9)</sup>	124.533	9.975	1.821	129.483	6.492	1.185	-2.278	0.026
GA <sup>(9)</sup>	120.983	9.101	1.662	125.600	7.826	1.429	-2.107	0.039
Overbite at CI (mm)	4.583	0.831	0.152	3.017	0.676	0.123	8.010	<0.001
Overbite at Canine (mm)	5.183	0.825	0.151	3.517	0.663	0.121	8.625	<0.001



Graph 1: Comparison of cephalometric variables for Canine guided and Group function occlusion (overall) (n=60)

A lead marking pencil was used to mark the overbite at the labial surface of mandibular central incisor at level of incisal edge of central incisor (either right or left) when patient closes in CO. Distance from incisal edge of mandibular central incisor to the marked line was measured (**Figure 4**). Then a line was extended towards the mesiobuccal surface of mandibular canine and distance from tip of mandibular canine to the marked line was measured. Alginate impression with dentulous trays was made for each subject.

### Positioning of the Patient for Lateral Head Cephalogram

The patient was then positioned within the ear rods of the cephalostat exerting moderate pressure on the external auditory meatus. The central beam of the X-ray coincides with the transmeatal axis, i.e. with the ear rods of the cephalostat. The patient's head was placed with the Frankfort plane parallel to the floor. A nasal pointer was then secured against the bridge of the patient's nose to eliminate rotation around the ear rods in the sagittal plane.

### Lateral Cephalogram analysis

Each lateral head cephalogram was analysed for FMA, IMPA, IIA, GA.<sup>[5]</sup> Case sheet for each patient was filled as a record. All data was collected for statistical analysis. The data was analyzed for mean value, standard deviation, for comparison and correlation between different groups student 't' test was used, and for significance 'P' value was calculated.

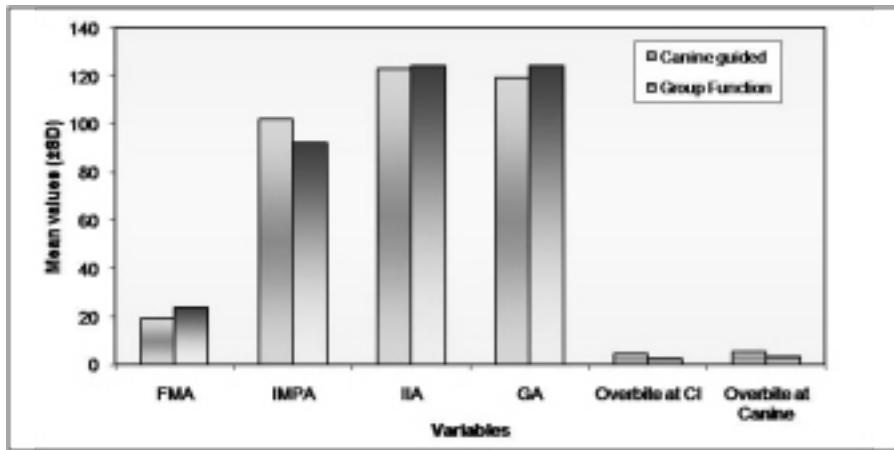
### Results

When both the groups were compared, statistically significant difference ( $P<0.001$ ) was found with higher mean FMA for Canine guided occlusion group. However, no significant difference was seen in mean IMPA between the two groups, though the mean IMPA was higher in Canine guided group. The mean IIA and mean GA were found to be significantly higher in Group function occlusion. However, overbite at central incisor as well as at canine was found to be significantly higher ( $P<0.001$ ) in Canine guided group as compared to Group function occlusion group (**Table 1**). Distribution of the sample is illustrated in (**Graph 1**).

When the sample was categorized

Table 2: Comparison of cephalometric variables for Canine guided and Group function occlusion (FMA range 15 to 24) (n=27)

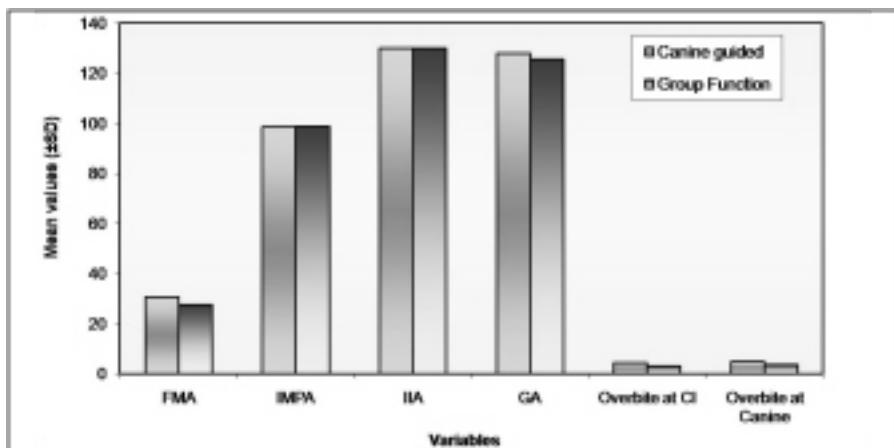
Variable	Canine guided (n=24)			Group Function (n=3)			Comparison	
	Mean	SD	SEM	Mean	SD	SEM	$\chi^2$	$P$
FMA <sup>(6)</sup>	19.417	2.479	0.506	23.833	0.289	0.167	3.032	0.006
IMPA <sup>(6)</sup>	102.250	8.614	1.758	92.333	2.517	1.453	1.953	0.062
IIA <sup>(6)</sup>	123.125	9.696	1.979	124.333	2.021	1.167	0.212	0.834
GA <sup>(6)</sup>	119.229	8.848	1.806	124.333	0.289	0.167	0.982	0.335
Overbite at CI (mm)	4.604	0.766	0.156	2.667	0.764	0.441	4.132	<0.001
Overbite at Canine (mm)	5.250	0.780	0.159	3.167	0.764	0.441	4.368	<0.001



Graph 2: Comparison of cephalometric variables for canine guided and group function occlusion (males) (n=30)

Table 3: Comparison of cephalometric variables for Canine guided and Group function occlusion (FMA range 25 and above) (n=33)

Variable	Canine guided (n=6)			Group Function (n=27)			Comparison	
	Mean	SD	SEM	Mean	SD	SEM	$\chi^2$	$P$
FMA <sup>(6)</sup>	30.667	3.061	1.249	27.630	1.909	0.367	3.148	0.004
IMPA <sup>(6)</sup>	98.750	10.825	4.419	98.926	5.199	1.001	0.060	0.952
IIA <sup>(6)</sup>	130.167	9.852	4.022	130.056	6.580	1.266	0.034	0.184
GA <sup>(6)</sup>	128.000	6.819	2.784	125.741	8.252	1.588	0.623	0.538
Overbite at CI (mm)	4.500	1.140	0.465	3.056	0.670	0.129	4.181	<0.001
Overbite at Canine (mm)	4.917	1.021	0.417	3.556	0.655	0.126	4.149	<0.001



Graph 3: Comparison of cephalometric variables for canine guided and group function occlusion (females) (n=30)

according to FMA, 27 cases were found to be in FMA range of 15 to 24 degrees out of sixty cases. There were 24 cases in Canine guided occlusion group and 3 cases in Group function occlusion group. When two groups were compared, statistically significant ( $P=0.006$ ) higher FMA was seen amongst Group function patients (Table 2, Graph 2).

Out of total, 33 patients, 6 in Canine guided group and 27 in Group function group, were in FMA range 25 and above. When comparison was made between both groups, mean FMA was significantly ( $P=0.004$ ) higher in Canine guided group (Table 3, Graph 3).

## Discussion

A good understanding of occlusion is essential to ensure optimum dental health. But, the fact is that Occlusion is the least understood subject from past to today's modern dentistry. Occlusion is the base of dentistry, but it is often overlooked by many dentists as they may not be able to implement the concept of occlusion into the clinical practice. So, a thorough knowledge of occlusion is mandatory to achieve good, satisfactory and acceptable results in the patient.

Treating occlusal disharmonies of natural dentition is one of the most difficult jobs. Any interference between the maxillary and mandibular teeth during eccentric movements can affect the harmony of stomatognathic system. Phased treatment plans can be proposed for long term oral rehabilitation patients.

The significance of FMA in Prosthodontic diagnosis and treatment planning plays an important role in full mouth rehabilitation.<sup>[2]</sup> In this study, the comparison of cephalometric variables depending on FMA for Canine guided and Group function occlusion was made to find their relevance in occlusal rehabilitation.

Dipietro and Moergeli<sup>[6]</sup> concluded that the anterior guidance requires stable posterior contacts at the proper VDO. It requires correct lingual contours to redirect and redistribute occlusal forces during protrusive disclusion.

O' Leary<sup>[7]</sup> concluded that the mean mobility of canine in Canine protected occlusion is more than in Group function occlusion, indicating that for providing

canine guided occlusion the cuspid teeth should be periodontally sound.

Cephalometrics can be of great value as a diagnostic tool when restoring the anterior dentition to proper function. The patient's anterior tooth positions can be analyzed. The plane of occlusion, skeletal classification and facial type can be determined. The exact treatment outcome depends upon the expert diagnosis and implementation of different concepts of occlusal rehabilitation. For the post treatment comfort of the patient one can use all the available diagnostic tools<sup>[2],[8]</sup>, this study was a step towards the same. By using the method of cephalometry, one can implement the analysis made by the lateral cephalograms in determining the type of occlusion during the rehabilitation procedures.

### Correlating with Clinical Findings of Vertical Overlap

When mean values of Canine protected and Group function occlusion were compared for central incisor and canine vertical overlap, it was observed that the canine vertical overlap had a greater mean values than incisor vertical overlap. This may be because of greater projection of cusp tips of maxillary and mandibular canines occlusally in comparison to incisors. But, when mean values of incisor and canine vertical overlap were compared in both the groups, it was Canine protected occlusion which had greater mean values than group function occlusion. This may be argued, by the fact that the increased anterior vertical overlap is a guiding factor of the Canine protected occlusion.

When the anterior vertical overlaps were

compared with the FMA, GA and IIA of the present study, they showed an inverse relation i.e. greater mean values of FMA, GA and IIA were associated with lesser mean values of overbite both at central incisor and at canine of group function occlusion group and vice versa in Canine protected occlusion. This inverse relation between vertical overlap and FMA, GA and IIA is in accordance with the study done by DiPietro.<sup>[9]</sup> This finding may be of great clinical value in deciding the amount of anterior vertical overlap (overbite) to be provided during occlusion rehabilitation.

### Conclusions

1. While replacing the natural dentition, FMA can be used as a diagnostic tool in occlusal rehabilitation.
2. The comparisons made either independently (irrespective of gender) or dependent on gender; or dependent on FMA between 0-24 degrees, statistically
  - a) higher mean values of FMA, GA and IIA were obtained for Group function occlusion as compared to Canine guided occlusion.
  - b) greater overbite at central incisor and at canine was found with Canine guided occlusion as compared to Group function occlusion.
  - c) higher mean IMPA was for Canine guided occlusion.
3. In individuals with FMA between 25-34 degrees, statistically
  - a) higher mean FMA was in Group function occlusion males.
  - b) higher mean values of IIA, GA and overbite were found at central incisor and at canine in canine guided occlusion in females..
  - c) higher mean IMPA was found in

Canine guided occlusion in males.

4. An inverse relationship between FMA, GA and IIA was seen with overbite both at central incisor and at canine.
5. Along with FMA, Gonial angle can also be used as a determinant of type of eccentric occlusion.

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## A - Histopathological Study Of Ossifying Fibroma Using Van Gieson Stain And Polarizing Microscopy

### Abstract

**Background :** Ossifying fibromas have formed an intriguing aspect of a variety of fibro-osseous lesions, probably owing to its wide histo-morphologic spectrum, including differentiation of bone, cementum and other calcifications and its differential diagnosis from fibrous dysplasia. Aims: 1) evaluate the occurrence of various types of calcific deposits ossifying fibroma. 2) Study of collagen fiber orientation, width, overall configuration in stroma and in calcific deposits ossifying fibroma.

**Materials and Methods :** 50 cases of Ossifying fibromas [25 cases central and 25 cases peripheral] inclusive of cemento-ossifying fibromas. Sections were stained with Van Gieson stain and were viewed under polarized light microscopy.

**Results :** Polarization studies of stromal collagen in both POF and COF were essentially the same in that they showed the presence of normal collagen, belonging to mainly type I and III, with no pathologic types noted. Such an analysis appears to be unreported earlier.

### Key Words

Ossifying Fibroma, Van Gieson Stain, Polarizing Microscopy, Cemento Ossifying Fibroma, Collagen.

### Introduction

Ossifying fibromas have formed an intriguing aspect of a variety of fibro-osseous lesions, probably owing to its wide histo-morphologic spectrum, including differentiation of bone, cementum and other calcifications and its differential diagnosis from fibrous dysplasia. It was Menzel in 1872, who first described this entity and in 1927 it was Montogmery who coined the term "Ossifying fibroma". Ossifying fibromas occur in both central and peripheral locations of the jaw bones<sup>1</sup>. Histologically, the lesion is composed of varying amounts of immature and mature bony trabeculae, cementum like tissue, dystrophic calcifications, all in different configurations with varied stromal collagen content and cellularity. Collagen content of connective tissue has also been studied under polarized light using Picosirius stain<sup>2</sup>. There appears to be no attempts to study the ossifying fibromas using van Gieson stain under polarized light, this study attempts to evaluate the stromal collagen with regard to fiber thickness & in various hard tissue elements of ossifying fibromas.

### Aims and objectives of study

1) To evaluate the occurrence of various types of calcific deposits in ossifying

fibroma.

2) To study the collagen fiber orientation, width, overall configuration in stroma and in calcific deposits ossifying fibroma.

### Materials and methods

The present study was conducted in the Department of Oral Pathology, S.D.M Dental College and Hospital, Dharwad and included a histochemical study of 50 cases of Ossifying fibromas [25 cases central and 25 cases peripheral] inclusive of cemento-ossifying fibromas. Paraffin blocks of these cases were retrieved and non serial sections varying from 4 to 5 µm in thickness were cut on a semiautomatic Leica microtome and stained by Van Gieson stain. The corresponding hematoxylin and eosin stained slides were obtained for purpose of study and for comparison with Van Gieson stain. Staining results of van Gieson are as follows Nuclei-appear black colour, Collagen and bone- appear red colour, and other tissues including muscle and RBC'S-yellow colour. Both the Hematoxylin and eosin and van Gieson stained slides were then evaluated microscopically. Only Van Gieson stained slides, were viewed under polarized light microscopy.

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### Results

**Table No. 1 and 2** explains the nature of stromal collagen in POF and COF cases respectively, as viewed under polarizing microscopy, using Van Gieson Stain. Thickness, colour, orientation and length of the collagen fibers were examined. Majority of the fibers observed in POF cases were a combination of thick and thin fibers (20/25 cases). Only 4 cases exhibited predominantly thin fibers and 1

TABLE NO.1 Study of stromal collagen in POF under polarizing microscopy (van gieson stain)

Thickness	Colour	Orientation	Length	No. Of Cases
Thin fibers	Green (few)	Random	Short - 1	4
	Greenish yellow (more)		Long - 1	
			Short & Long - 2	
Thick fibers	Greenish Yellow (few)	Random	Long - 1	1
	Yellow (more)			
	Yellowish Orange (more)			
	Orange red (few)			
Thin & Thick fibers	Same polarization colours as for thin and thick fibers.	Random	Short - 1	20
			Long - 1	
			Short & Long - 18	

TABLE NO.2 Study of stromal collagen in COF under polarizing microscopy (van gieson stain)

Thickness	Colour	Orientation	Length	No. Of Cases
Thin-Green (few)	Random-23 cases	Short - 4	Long - 2	
Greenish-Yellow (more)	Whorled	Short		25
Thick-&	& parallel-	&	Long - 19	
Greenish-Yellow (few)	parallel-			
Yellow (more)	2 cases			
Yellowish-Orange (more)	None	None		
Orange-Red (few)				

case showed predominantly thick fibers. Color ranges from green to orange red. (Fig 1 and 2)

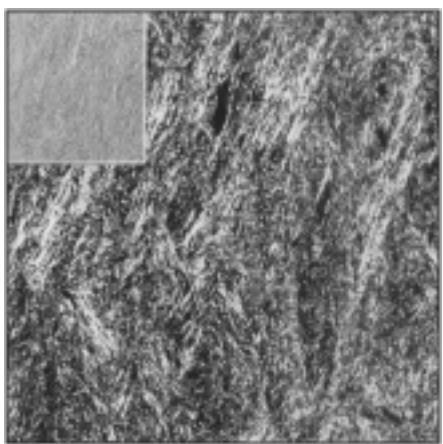


FIGURE 1. Photomicrograph, showing thick, long, greenish yellow (few), and many yellowish orange and orange red stromal collagen fibers, in a whorled arrangement. (PL, VG, x 100) inset shows the same under lm (VG, x 100)

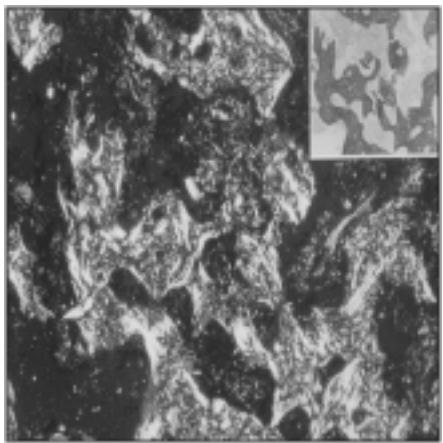


FIGURE 2. Photomicrograph, showing thick, yellow and yellowish orange in a quilt pattern, in a curvilinear deposits. (PL, VG, x100) inset shows the same in lm (VG, x 100)

**Table No. 3** explains the total number of cases showing each type of hard tissue product elaborated and the osteoblastic

TABLE NO.3 Number of POF & COF cases showing each of the different hard tissue products and cell activity [h&e and van gieson (vg) stain]

POF	No. of Cases H & E / VG	%	COF	No. of Cases H & E / VG	%
Osteoid	6	24	Osteoid	8	32
Woven Bone	18	72	Woven Bone	17	68
Lamellar Bone	7	28	Lamellar Bone	13	52
Spheroid & Curvoid Deposits	9	36	Spheroid & Curvoid Deposits	10	40
Curvilinear trabeculae	1	4	Curvilinear trabeculae	1	4
Osteoblastic Activity	7	28	Osteoblastic Activity	4	16

TABLE NO.4 Study of collagen in hard tissue elements in peripheral ossifying fibromas under polarizing microscopy (van gieson stain)

Hard tissues elements	Polarizing	Non Polarizing	Orientation	Thickness	Colour
Osteoid	Yes	-	Random	Thin & Thick	Greenish yellow, Yellow
Woven bone	Yes	-	Cross-hatched	Thin & Thick	Thin: Greenish yellow Thick: Greenish Yellow(few), Yellow (more)
Lamellar bone	Yes	-	Parallel Lamellar	Thin (few) Thick (more)	Thin : Yellow (very few ) Thick : Yellow (more) Orange red (more)
Spheroid & curvoid deposits	Yes, Many	Few	Radial arrangement at periphery & random arrangement within.	Thick	Yellow(more) Yellowish-Orange(few)
			Random	Thick	Yellow(more) (at periphery) Orange-Red(few) (within)
			Lamellar	Thick	Greenish-Yellow (few) Yellow (more) Yellowish-Orange (more)
Curvilinear trabeculae	Yes	-	Haphazard/quilt Microlamellar	Thick	Yellow to Yellowish-Orange

and osteoclastic activity in both POF and COF cases. Both H & E and Van Gieson (VG) stained sections were examined and compared. Since there was no difference in the identification of the hard tissue elements between the H & E and VG stained sections, observations of both are considered under a single heading. The hard tissue elements were categorized as being osteoid, woven bone, lamellar bone, spheroid and curvoid deposits, curvilinear trabeculae based on the observations made by Eversole L R et al (1985)<sup>15</sup>.

**Table No. 4** shows the nature of collagen in various hard tissue elements in POF studied under polarization microscopy using Van Gieson stain. Osteoid showed thin and thick fibers, in random arrangement and were greenish yellow and yellow in colour. Woven bone, exhibited both thin and thick fibers in cross-hatched arrangement, with the thin fibers in the greenish yellow range. The majority of thick fibers were yellow coloured and few were greenish yellow. In lamellar bone, more thick fibers were

seen in a parallel or lamellar arrangement and were yellow and orange red coloured. Very few thin yellow coloured fibers were noted. (Fig 3 and 4)

All the COF cases (**Table No.5**) showed both thin and thick fibers (25 cases) and majority of the cases showed both short and long fibers (19/25) and were in random arrangement in 23/25 cases. 2 cases, however exhibited a whorled pattern and parallel arrangement. The polarization colour of majority of the thin fibers was greenish yellow, with few in the green colour and the majority of the thick fibers showed yellow to yellowish orange and few with greenish yellow to orange red polarization colours. (Fig 2 and 5)

## Discussion

Ossifying fibromas have been queried repeatedly, to gain a better insight into the nature of the various hard tissue configurations. Though the various hard tissue products have been observed in light microscopy, attempts were made to study with the help of polarization microscopy<sup>3,4,5,6</sup> to the birefringent nature

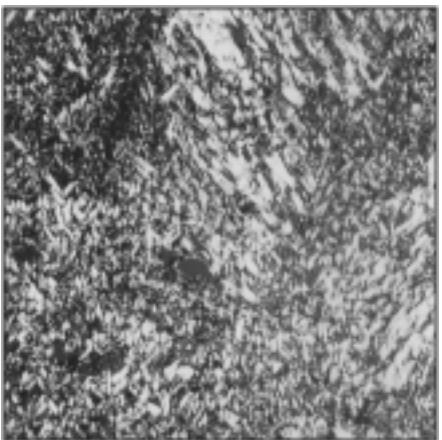


FIGURE 3. Photomicrograph showing few thick, short, greenish yellow & orange red fibers & many thick, short & yellow fibers in random arrangement. Few thin, short, green to greenish yellow stromal collagen fibers in random arrangement are also seen. (PL, VG, x 250)

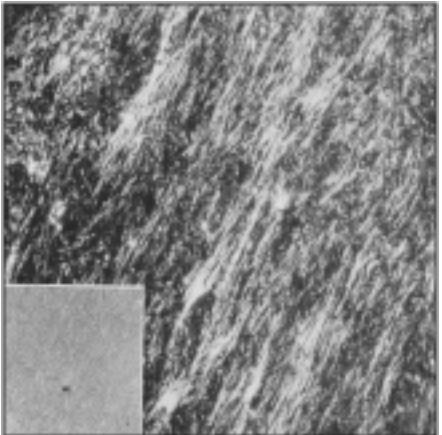


FIGURE 4. Photomicrograph showing thick, long, yellow, yellowish orange and orange red stromal collagen fibers, in parallel arrangement. (PL, VG x 100). Inset shows the same under lm. (VG, x 100)

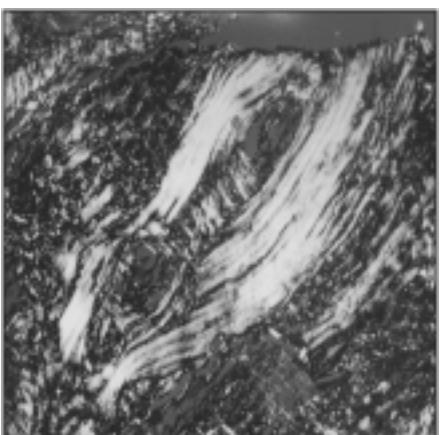


FIGURE 5. Photomicrograph, showing thick, yellow, broad lamellar pattern of collagen fibers, in lamellar trabecular bone. (PL, VG, x 250)

TABLE NO.5 Study of Collagen In Hard Tissue Elements In Central Ossifying Fibromas Under Polarizing Microscopy (Van Gieson Stain)

Hard tissues elements	Polarizing	Non Polarizing	Orientation	Thickness	Colour
Osteoid	Yes	-	Random	Thin & Thick	Greenish Yellow, Yellow
Woven bone	Yes	-	Cross-hatched	Thin & Thick	Thin: Greenish Yellow Thick: Greenish Yellow(few), Yellow (more)
Lamellar bone	Yes	-	Parallel Lamellar	Thick	Thick : Yellow (more) Orange red (more)
Spheroid & curvoid deposits	Yes, Many	Few	Radial arrangement at periphery & random arrangement within.	Thick	Yellow(more) Yellowish-Orange(few)
			Random	Thick	Yellow(more) (at periphery) Orange-Red(few) (within)
			Lamellar	Thick	Greenish-Yellow (few) Yellow (more) Yellowish-Orange (more)
Curvilinear trabeculae	Yes	-	Haphazard/quilt Microlamellar	Thick	Yellow to Yellowish-Orange

of collagen and because it forms the frame work of all hard tissue elements. It was noted that based on collagen, cementum could be differentiated from bone<sup>6</sup>. All these studies were based on H & E sections. Since Van Gieson, stains collagen selectively, this study was undertaken to study the collagen content both in the stroma & in various hard tissue elements of ossifying fibromas (OF) in depth, under Light (LM) and Polarizing Microscopy (PM).

When VG sections were studied under polarizing microscopy, osteoid showed thin and thick fibers in random arrangement and were greenish - yellow and yellow in colour. Woven bone exhibited both thin and thick fibers in cross-hatched arrangement, with the thin fibers in the greenish-yellow range. The majority of thick fibers were yellow coloured and few were greenish yellow. In lamellar trabecular bone, more thick fibers were seen in a parallel or lamellar arrangement and were yellow and orange red coloured. Very few thin yellow coloured fibers were noted. Many of the spheroid and curvoid deposits polarized. 3 patterns were observed.

The first type, showed birefringence of peripheral collagen fibers and were in a radial arrangement(fringe), being yellow and yellowish orange coloured and composed of thick fibers. Very few thick fibers also polarized faintly within the masses, were in random arrangement and yellowish orange coloured.

In the second type, intersecting \ randomly arranged, short thick orange red fibers were seen within the mass, with more yellow coloured fibers at periphery. The third type showed lamellar orientation composed of thick fibers of yellow and yellowish orange colours & few of greenish yellow colours. Curvilinear trabeculae were made up of thick fibers in a quilt pattern or haphazard orientation and were thick yellow and yellowish orange.

On comparing POF & COF, lamellar bone showed only thick fibers more in the yellow and orange red range in COF cases. Otherwise, both POF and COF cases, exhibited same collagenous nature of hard tissue elements.

Polarization study of hard tissue elements have been evaluated so far, only in H&E sections and are observed as only dark & light lines of birefringence. Broad lamellar parallel fiber orientations (dark and light lines) were seen in lamellar bony trabeculae. A cross hatched fiber pattern <sup>4, 3, 9</sup> or a random pattern <sup>6</sup> with parallel oriented fibers but showing no lamellation was seen in woven bone. The dark and light lines of parallel birefringence in bony trabeculae were more widely spaced than those in cementoid tumor<sup>6</sup>. Spheroid, curvoid deposits (cemental deposits) seldom polarized and showed non specific birefringence with peripheral radiating fibers \ brush border \ brightly

birefringent feather edge periphery<sup>4, 6, 17</sup> directed at right angles to the nidus. Fused globular cemental masses presented a mixed pattern of swirls and occasionally intersecting groups of short and thick fibers<sup>17</sup>. Many spheroid deposits, failed to polarize but some deposits revealed a radial fringe under polarized light resembling Sharpey's fibers, and were similar to normal cementicles<sup>3</sup>. The appearances of calcifications were consistent with cementum.

The acellular basophilic type (type I) revealed a paucity of collagen and a brush border. The second type, showing less basophilia and with cellular inclusions but with no osteoblasts showed a quilted pattern and a parallel fiber pattern. The third type showing an eosinophilic dense cellular cemental mass having the appearance of bone, presented a quilt pattern, a coalescing globule pattern, or a parallel fiber pattern. In addition, these trabeculae were "molded" with rounded corners<sup>9</sup>. The curvilinear deposits exhibited a finely lamellar \ microlamellar \ haphazard \ quilted fiber pattern similar to cementum<sup>3, 4</sup>. Dystrophic calcifications showed a fairly diffuse birefringence with long, slender and parallel lines<sup>6</sup>.

Observation from our polarization microscopy study of hard tissue elements was similar to studies<sup>3, 4</sup> except that of spheroid \ curvoid deposits. However the polarization colours could not be compared, as Van Gieson stain was not used in previous studies. Many of the spheroid \ curvoid deposits in our study on the contrary polarized and showed 3 different types of polarization. Our Type I collagen was in accordance with other studies<sup>3, 4</sup> and the first type of cemental deposit described, and showing birefringence with peripheral radiating fibers<sup>9</sup>. In addition our study showed faint birefringence of few thick fibers within the masses, which were in random arrangement and yellowish orange coloured. This has not been observed by previous workers. Type II showed a prominent peripheral birefringence<sup>17</sup>, and type III both acellular & cellular<sup>9</sup>. Based on picrosirius study of collagen<sup>19</sup> and the collagen present in all the hard tissue elements were normal collagen, of type I and to some extent of type II<sup>20</sup>. Thus Van Gieson stain under polarizing

microscopy, helps in delineating the nature of collagen apart from studying its orientation, fiber thickness and collagen thus stained, stands out clearly in hard tissue elements, compared to H & E sections under polarization microscopy. Thus polarizing microscopy helps in identifying hard tissue better than conventional microscopy<sup>9</sup>.

The lesions showing mainly spheroid / curvoid deposits and curvilinear trabeculae were considered to be cementoid lesions and lesions with an admixture of the above with osseous tissue as cemento-ossifying fibromas<sup>4</sup>. In accordance with it, in our study, Of 25 cases of POF, 7 cases were cementifying fibromas (CF), 3 were cemento-ossifying fibromas and the rest were OF and in 25 cases of COF studied, 4 cases were CF, 9 cases were cemento-ossifying fibromas and the rest were OF. But much against this myth, is the presence of ovoid calcifications in extragnathic lesions like meningiomas, prostatic adenocarcinomas etc<sup>4</sup>. Curvilinear deposits representing cementum also have been seen in lesions other than cemental lesions like ossifying fibromas & fibrous dysplasias<sup>4</sup>.

A detailed study of fibro-osseous lesions of jaws in general showed that irrespective of them being reactive, or benignly neoplastic, they could involve factors which influenced differentiation along true osseous lines or by virtue of their anatomical proximity to periodontal structures were affected by factors which involved cemental differentiation<sup>9</sup>. The amorphous basophilic rounded calcified masses were considered to be cementum and though lesions containing such calcifications were designated as cementifying fibromas, it was difficult to explain the morphological difference between such cementum like masses and identical calcified masses seen in some fibro-osseous lesions of skull and in other bones. They concluded that though the lesions continue to be diagnosed on the basis of the dominant calcified part, there was no conclusive evidence as to whether the calcified masses in their cases were cementum or bony tissue but they diagnosed it to be a cemento-ossifying fibroma based on previous observations<sup>21</sup>.

Though COF & CF to represent 2 facets of the same tumor, with one arising from

osteoblasts & the other from cementoblasts<sup>8, 22</sup> differentiated cementum & bone based on their birefringent patterns under polarized light, it has not been possible to entirely separate these lesions. The findings of ovoid calcifications characteristic of cementum in any ossifying tumor of membrane of bone & not confined to the jaws<sup>13</sup>, led to conclude that these calcified globules were not necessarily cementum and were not specific to lesions that originate in periodontal membrane and since the so called cemental globules could be seen in fibro-osseous lesions in all membrane bones; it was unrealistic to separate the ossifying & cementifying lesions.

Though, some studies clearly point out the differences between cementum and bone, both under light and polarizing microscopic observations<sup>3, 4, 6</sup>. Regarding spheroid, curvoid deposits in cementum recorded as nonspecific birefringence with only peripheral polarization<sup>3</sup>.

Our observations & those of other studies showed birefringence within the mass in various patterns and some contained cellular inclusions. Even the basophilic masses showed occasional cell inclusions<sup>9, 17</sup>. The analysis observed similar phenotypic expression - similar receptors, similar staining pattern with monoclonal antibody E11, of osteoblasts, osteocytes and cementoblasts & cementocytes, associated with cellular cementum. However the cells of primary cementum, showed a different phenotypic expression. Differences in their origins were also noted, with cellular cementum being formed by cells migrating from non-follicular sources like endosteal spaces. Hence, keeping observations of cementoid masses in extragnathic lesions and our and other author's findings of polarization microscopy of spheroid/curvoid deposits & curvilinear trabeculae, one strongly believes that cemental masses are nothing but bone tissues showing varied fiber content and orientations and sometimes containing cells<sup>23</sup>. Thus, there appears no point in exhausting our intellectual potency to classify OF into cementifying lesions & cemento-ossifying lesions and aptly consider all of them under the general heading of Ossifying fibromas of jaws.

## Conclusion:

- Polarization studies of stromal collagen in both POF and COF were essentially the same in that they showed the presence of normal collagen, belonging to mainly type I and III, with no pathologic types noted. Such an analysis appears to be unreported earlier.
  - Lamellar trabecular bone and woven bone in COF were seen more frequently than in previous studies. Spheroid, curvoid deposits occurring as single hard tissue product in COF was seen more than in previous studies. More of spheroid and curvoid deposits polarized in our study and showed 3 types of polarization patterns. The configuration of collagen in other hard tissues was similar to previous studies. Polarization study of hard tissue deposits, stained with Van Gieson appears to be unreported earlier.
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## Stereomicroscopic Study Comparing The Adaptability Of Gutta Flow Paste To Root Canal Walls With Conventional Lateral Condensed Gutta Percha Using Ah-plus As A Sealer - A Clinical Study

### Abstract

**Aim and Objectives:** The present ex-vivo study was designed to evaluate the adaptability of Gutta Flow paste to root canal walls by viewing under a zoom stereomicroscope. The conventional method of laterally condensed gutta-percha using AH plus as a sealer was used as control group.

**Method:** For the purpose of study, 120 single rooted extracted human premolar teeth with intact crown were selected. After visual examination, surface deposits and soft tissue attachment were removed with an ultrasonic scaler. All the teeth were stored in 5.25% sodium hypochlorite solution for 48 hours to eliminate remaining organic debris. The teeth were washed under tap water and stored in normal saline.

**Result:** The number of individual voids in Gutta Flow group was comparatively less than conventional laterally condensed Gutta Percha group.

**Conclusion:** Gutta Flow sub group without gutta-percha & with single cone guttapercha showed minute and lesser number of voids and better adaptation to the root canal walls. Gutta Flow uniformly adapted to the root canal walls.

### Key Words

Endodontic therapy, Gutta Flow, Obturation, Root canal walls.

### Introduction

The three dimensional obturation of the root canal system is widely accepted as a key factor for successful endodontic therapy. Its success is dependent on excellence of endodontic design and thorough cleaning and shaping. The aim of endodontic treatment is to fill the entire root canal system and all its complex anatomic pathways completely and densely with non-irritating hermetic sealing agents to prevent re-infection and percolation of bacterial substrates, which could cause biological breakdown of attachment apparatus<sup>[1],[2]</sup>. Total obliteration of the canal space and perfect sealing of the apical foramen at the dentin cementum junction and accessory canals at locations other than the root apex with an inert, dimensionally stable, and biological compatible material are the goals of successful endodontic treatment<sup>[3]</sup>.

Nearly 60% of endodontic failures are apparently caused by incomplete

obliteration of the canal space.<sup>[4]</sup> Unless, a dense, well adapted root canal filling is achieved, the prognosis may be compromised regardless of how other phases of the treatment are carried out. Seltzer noted that metabolites are exchanged on a permanent basis between the root canal and the saliva.<sup>[5]</sup> Naidorf indicated that improper obturation can allow fluids to enter the root canal space which as a result may become infected.<sup>[6],[7]</sup> Over many years, different obturating materials, techniques and endodontic sealers have been introduced in a hope to increase the quality of apical seal.

A wide range of root canal materials have been used from time to time. Guttapercha introduced by Bowman in 1867 is the most widely used and accepted root canal filling material. It exists in various phases such as alpha, beta & gamma phase, which are interchangeable. Taking advantage of the phase changes of guttapercha and the resultant differences

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in physical properties recent developments have dealt with heating or thermoplasticizing the material to 42°C temperature or even higher. The delivery system employed for thermoplasticized guttapercha is, heating it by electricity or a rotating instrument, resulting in a single mass. The softened material is then distributed into the canal often with an injection tip to develop homogeneity which in turn results in reduction of voids.<sup>[4],[7]</sup> As handling thermoplasticized guttapercha requires lot of skill, often canals were overfilled by inexperienced operators. Maintenance of uniform temperature during obturation is also quite difficult.

In recent years a silicon based sealer, Roeko Seal Automix was introduced

which has shown to provide a hermetic seal over a period of 18 months.<sup>[8]</sup> An innovative root canal paste named Gutta Flow is developed recently which is a modification over RoekoSeal. It has an improved seal and better adaptability to the root canal wall because of the increased flowability and expansion on setting.<sup>[9]</sup>

Gutta Flow is a cold flowable guttapercha filling system for the obturation of root canals. It is composed of a polydimethylsiloxane matrix incorporating sealer and very finely ground guttapercha in one product. It has extraordinary chemical and physical properties that offer maximum sealing ability and biocompatibility. It does not shrink but expands slightly on setting when inserted in the root canal resulting in an excellent seal. It also has a superior flow which allows for optimal distribution of the material throughout the root canal. The material is thixotropic its viscosity diminishes under pressure thus allowing it to flow into the smallest of lateral as well as accessory canals. This new root canal obturation material was developed to overcome the shortcomings of lateral condensation technique.

With the above background the present study was designed to compare the adaptability of Gutta Flow paste and conventional laterally condensed guttapercha using AH-plus as a sealer, to the root canal walls using a stereo zoom microscope.

### Materials & Methods

This ex-vivo study was conducted in the Department of Conservative Dentistry and Endodontics at Saraswati Dental College and Hospital, Lucknow, India and further work regarding stereozoommicroscopic procedures and observations were carried out at Division of Toxicology, Central Drug Research Institute (CDRI), Lucknow, India. For the purpose of study, 120 single rooted extracted human premolar teeth with intact crown were selected. After visual examination, surface deposits and soft tissue attachment were removed with an ultrasonic scaler. All the teeth were stored in 5.25% sodium hypochlorite solution (Prime Dental Products, India) for 48 hours to eliminate remaining organic debris. The teeth were washed under tap water and stored in normal saline.

### Access Cavity Preparation

After measuring the shape, size and the extension of the pulp chamber radiographically, access was gained through the occlusal surface. No. 2 round bur in a high speed contra-angle hand piece was used to open the pulp chamber the bur felt to "drop" when the pulp chamber was reached. While removing the bur, the orifice was widened buccolingually in an ovoid shape. Buccolingual extension and finish of cavity wall was done with a 701 U fissure bur at high speed. Final preparation provided unhindered access to canal orifices which was made extensive enough to allow for instruments and filling materials needed to enlarge and fill canals.

### Estimation Of Working Length

A#10 K file (Mani, Japan) was introduced into canal until the tip was just visible at the apical foramen. The working length was determined by subtracting 1 mm from this length.

### Biomechanical Preparation Of The Specimens

Using a step back technique, the canals were cleaned, shaped & enlarged with K files (Mani, Japan) to the working length at the apex, initially they were prepared by # 10 K file (Mani, Japan) followed by sizes 15, 20, 25 & 30 and preflaring was carried out with Protapers (Dentsply Co. U.S.A.) at 300 rpm with a torque control micro motor having a preprogrammed setting (X-Smart, Dentsply USA). RC prep (Premier Dental Co. USA) was used along with the Protaper NiTi rotary instruments for adequate lubrication, cleaning and shaping. Frequent recapitulation and copious irrigation with 5.25 % Sodium Hypochlorite solution was carried out before progressing to next instrument, final preparation was done till # 50 file.

After biomechanical preparation, all the specimens were thoroughly irrigated with 17 % EDTA, 10 ml of 5.25 % Sodium Hypochlorite (NaOCl) and finally with 10 ml of normal saline. The irrigating solutions were delivered from a 26-gauge needle which was made blunt at the tip. At this stage, 120 teeth were divided into four groups using stratified randomization. All the teeth were stored in normal saline until obturation to simulate oral environmental conditions.

### Obturation

Group A (Control) consisted of 30 teeth that were obturated with Lateral condensation technique using AH plus as a sealer. (Fig-1) Group B (Experimental) consisted of the remaining 90 teeth. This group was further sub divided into three subgroups consisting of 30 teeth each.

### These subgroups were:

- B1 Obturation was done only with Gutta flow. (Fig-2)
- B2 One guttapercha cone was introduced in the canal and the obturation was carried out similar to as B1 sub group. (Fig-3)
- B3 Two guttapercha cones were introduced in the canal and the obturation was carried out in the similar manner as B1 subgroup. (Fig-4)

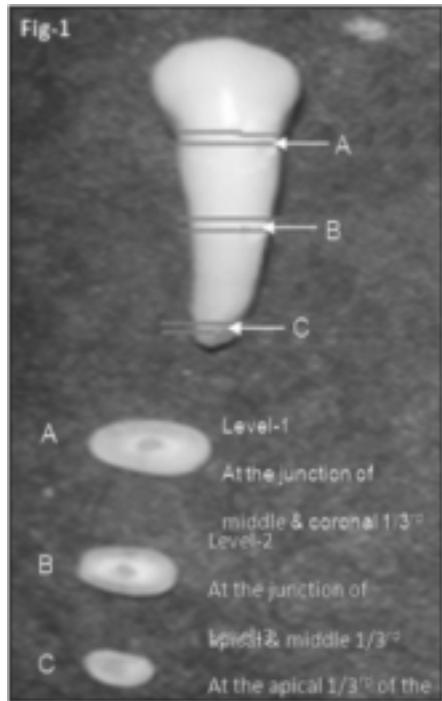


Fig-1 : Sectioning levels

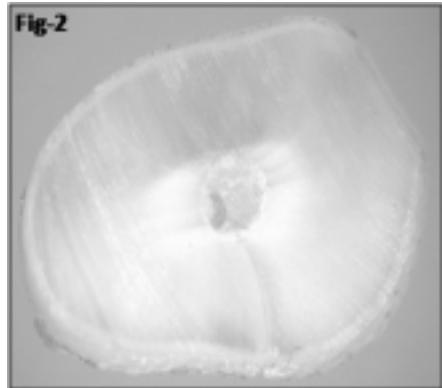


Fig-2 : GROUP-A (laterally condensed GP with AH plus)

### Sectioning Of Teeth And Observations

After obturation the roots were sectioned transversally. Sectioning of the teeth was not performed at a predetermined distance from the apex (because sectioning at a predetermined distance from the apex does not give information about the position of the sectioning levels in relation to coronal access cavity), but rather according to the individual root length. This was done to obtain comparable information regarding obturation at specific root level for e.g. Obturating a root canal at a level 5mm short of the apex may be easier to perform in short root canals than in long ones.

The thickness of the sections was 1 to 2mm. Sectioning was carried out using a Diamond saw (Cir-Saw, Confident Dental Co., India) at slow speed with constant water cooling to avoid excess heat generation which could result in softening of guttapercha point and also can cause its extrusion from root canal.

**Level 1 :** At the apical 1/3rd of the root 1mm from the apex as fins and narrow oval canals are very common in these regions which are difficult to prepare, irrigants do penetrate easily and obturation is difficult.

**Level 2 :** At the junction of the middle and coronal 1/3rd. Because at the coronal part of the canal, adaptation of the filling material is easier as there is ease of accessibility and preflaring of the root canal.

**Level 3 :** At the middle and coronal 1/3rd (Fig-5)

These sections were observed and measured using a Stereomicroscope with zooming facility for the number of voids in Periphery & Core. These observations were subsequently labeled, digitally photographed and voids were measured using Biovis Image Plus (Software for image analysis and processing), Exper Vision Labs Pvt. Ltd, Mumbai, India. The data so collected were statistically analyzed using one way ANOVA followed with Tukey's test.

### Result

The findings and observations on this study have been summarized hereunder and wherever deemed necessary, it has been presented in the form of figures and illustrations (Table -1 & Fig. 1 to 6). The area of voids were found to be insignificant when subgroup **B1** was

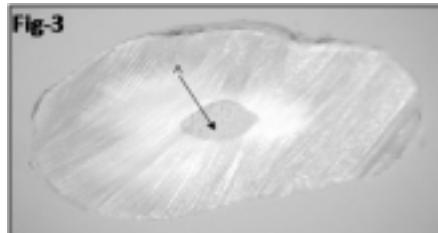


Fig-3 : SUB GROUP - B1 A-Obturation with only Gutta Flow

Table 1: Comparison of cephalometric variables for Canine guided and Group function occlusion (overall) (n=60)

Groups	Periphery	Core	Periphery & Core (P&C)	Total
A	3	10	4	17
B1	3	4	4	10
B2	3	7	4	14
B3	8	12	7	27
Total	17	33	19	68



Fig-4 : SUB GROUP - B2 A-Obturation with Gutta Flow and B - single GP

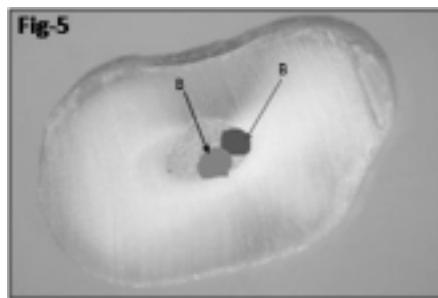


Fig-5 : SUB GROUP - B3 Obturation with Gutta Flow and B - two GP points

compared with group A and subgroup **B2** ( $P>0.05$ ), where as a significant number of voids have been observed in sub group **B3** when it was compared to other sub groups and group A ( $P<0.01$ ). The variance of all the four groups was found to be homogeneous.

Numbers of voids in locations of four groups were shown graphically. Locations wise **B1** showed the least number of voids (4 in core & 3 at the periphery) whereas **B3** demonstrated maximum number of voids (12 in core & 8 at the periphery). A highest percentage of number of voids could be noted among the teeth of subgroup **B3** (47.1% in core and 36.4% at the periphery) while B1 show the least number of voids (17.6 % in core and 12.1% at the periphery). The lowest mean of area of voids was recorded statistically in the Gutta Flow subgroup, which was obturated without using any guttapercha.

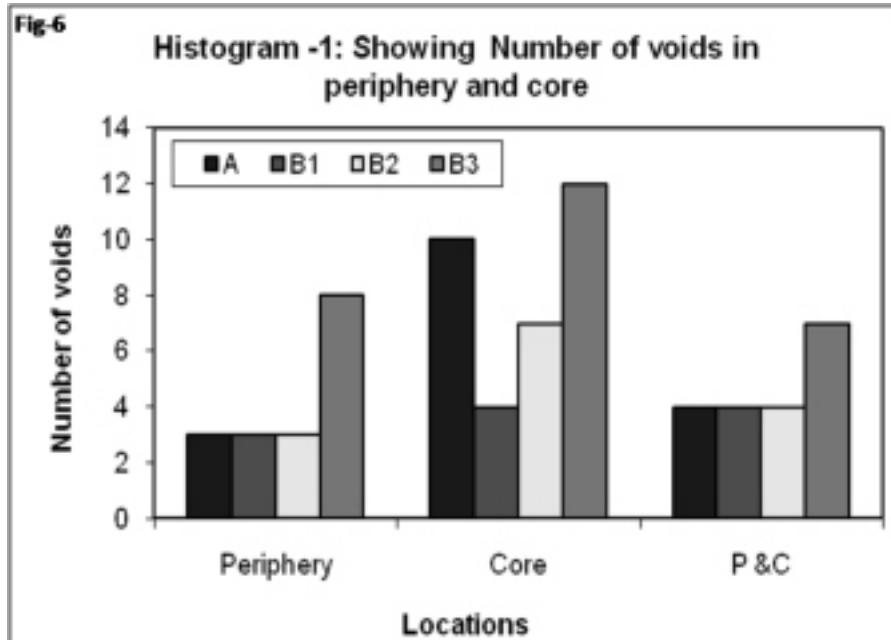


Fig-6 : Histogram showing number of voids on periphery and core.

Statistically there was no difference in the area of voids in Gutta Flow subgroup using a single cone when compared with the conventional lateral condensation group using AH plus as a sealer. The highest frequency of sections with voids was observed in Gutta Flow subgroup in which obturation was done utilizing two cones. It was statistically significant when compared to the other groups.

When the sectioning levels were separately analyzed the sections made at the middle 1/3<sup>rd</sup> showed the maximum number of voids among all the groups. The maximum numbers of voids were located at the core of the filling. The sizes of individual voids in all the groups were statistically insignificant except in the Gutta Flow group having two cones.

### Discussion

Three-dimensional ‘fluid tight’ obturation and a well-fitting ‘leakage-free’ coronal restoration prevent percolation and micro leakage of periapical exudate into the root canal space thus reducing the chances of re-infection. It also creates a favorable biological environment for tissue healing to take place.<sup>[10]</sup>

Incomplete root canal obturation has generally been considered as one of the principal cause of endodontic failure.<sup>[11]</sup> In the past various materials and techniques were tried to obtain a hermetic seal. The sealing ability & adaptability of various root canal filling materials were studied over the years and it was found that none of the available materials satisfactorily provide a hermetic seal.<sup>[12]</sup> Because of the above reason currently used techniques utilize several materials for obturation, the most common being a combination of guttapercha and sealer. Numerous techniques have been developed to improve adaptation of the sealer to the root canal walls and to reduce its film thickness to minimum.<sup>[13]</sup>

This ex-vivo study was undertaken to comparatively evaluate the adaptability of cold flowable gutta-percha paste i.e. Gutta Flow and conventional laterally condensed guttapercha using AH-Plus as a sealer, to the root canal walls. Gutta-flow was compared to conventional lateral condensation, because this technique is believed to be the gold standard for obturation. Selection of the

teeth and their assignment into different study groups was done using stratified and block randomization, which resulted in comparable groups with respect to tooth type and form. (Long/short and straight/curved).

In the present study only extracted single rooted (premolar) human teeth having intact crowns were considered, so as to simulate the clinical conditions because decoronation of teeth can result in easy accessibility to root canals<sup>[14]</sup>. The root canal sealer used was AH plus with prefabricated, standardized guttapercha cones. Cold lateral condensation technique was used for Obturation as for years lateral condensation of guttapercha has been a benchmark for obturation. This technique has been credited to Callahan in 1914<sup>[15]</sup> and the technical details of application were provided by Sommer in 1946.<sup>[16]</sup> The effectiveness in obtaining three dimensional (3D) seal was confirmed by the studies of Marshall and Massler<sup>[17]</sup> and Weine.<sup>[18]</sup> However, this technique still remains the gold standard and most of the studies utilizing new obturation systems use lateral condensation for comparison purposes.<sup>[19]</sup>

Stereomicroscopic examination was chosen for this study, as it gives a 3-D view of the surface to be examined, needs no pretreatment of the specimen (as in SEM Examination). The area of voids was calculated utilizing Software for Image Analysis (Biovis Image Plus) thus eliminating human error in interpretation of the data.

Based on the results of this study, the first and the second sub group i.e. Gutta Flow obturation without guttapercha and with a single cone guttapercha showed a lesser number of voids in the sections as compared to the one obturated with two cones respectively. Nearly all the voids in this group were found mainly in the core or between the core and periphery. The minute voids in the core can be either because of using lentulo spiral or due to manufacturing process. On the other hand when obturation was done using two cones the number and size of voids was comparatively larger and was present in all regions of the root canal it can be due to entrapment of air when second guttapercha point is inserted or because of absence of lateral condensation. Among all the sub groups negligible voids were found at the

periphery of the root canal wall, suggesting that the adaptation of the material to the walls was nearly complete. This can be attributed to the property of Gutta Flow which does not shrink but expands slightly (0.2%) on setting resulting in an excellent seal of the root canal.

In Group B the number and the size of voids were statistically insignificant when compared to **Group A**. The minute voids observed can be due to difficulty in lateral condensation of the curved canals. The walls of the root canal showed good adaptation of AH-plus sealer.

Number of voids was ascertained by examining the periphery or core of the root canal. Locations wise B1 showed the least number of voids (4 in core & 3 at the periphery) whereas B3 demonstrated maximum number of voids (12 in core & 8 at the periphery).

A highest percentage of number of voids could be noted among the teeth of subgroup B3 (47.1% in core and 36.4% at the periphery) whereas B1 show the least number of voids (17.6 % in core and 12.1% at the periphery) which is again in conformity with the above findings.

Gutta Flow group, which was obturated without using any guttapercha cone and obturation utilizing a single cone showed no difference in the area of voids statistically when compared to the conventional lateral condensation group using AH plus as a sealer. The highest frequency of voids was observed in Gutta Flow group in which obturation was done utilizing two cones. It was statistically significantly higher when compared to other groups.

When the sectioning levels were separately analyzed the sections made at the middle showed the maximum number of voids in all the groups. The maximum numbers of voids were located at the core of the filling. The sizes of individual voids in all the groups were statistically insignificant except in the Gutta Flow group having two cones.

### Conclusion

Based on the results shown, the following conclusions were drawn from the study

1. The Gutta Flow sub group without gutta-percha & with single cone guttapercha showed minute and

- lesser number of voids and better adaptation to the root canal walls.
2. There was presence of small voids within the core of the material in all the groups.
  3. Gutta Flow uniformly adapted to the root canal walls.
- In the light of the above results and paucity of literature, it is apparent that this approach is use full for the purpose however, further study is called for to substantiate the view.
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## Recasting of Base Metals, Its Effect On Bond Strength Of Porcelain - A Laboratory Study

### Abstract

**Background:** The surplus metal separated from the casting procedure is known as "button". It can be reused with the addition of 1/3rd new metal to produce an acceptable casting. By adding new metal, composition of the alloy that might be altered in the earlier casting procedures may be replenished and sufficient to restore the required physical properties. Also it is likely that the previously cast metal may exhibit altered surface chemistry and texture which is vital for producing a bond of adequate strength between metal and porcelain.

**Objective:** The present study was undertaken with an aim to determine the effect of base metal alloy castings and recasting with one-third of new base metal alloy on bond strength of porcelain

**Materials and method:** Nickel-Chromium and Cobalt-Chromium were used for this study. copings cast from the new ingots of Nickel-Chromium were termed as A-I, from recast of the button as A-II and from recast of the button with the addition of 1/3rd new metal as A-III. The same was repeated for Cobalt-Chromium B-I, B-II and B-III respectively. Each batch contained 16 copings. A metal die with a flat base was prepared. All the 96 metal copings were fused to porcelain by batch wise and were checked for the fit over the metal die. Later, the specimens were tested on Universal testing machine to assess bond strength.

**Results:** The mean and standard deviation values of three batches of Nickel-Chromium alloy were Batch -I (new metal) 9.038, Batch-II (only the button) 7.517 and Batch-III (button plus the addition of 1/3 new metal) 8.722 The mean and standard deviation values of three batches of Cobalt-Chromium alloy were Batch -I (new metal) 6.289, Batch-II (only the button) 5.374 and Batch-III (button plus the addition of 1/3 new metal) 6.546 respectively.

It was observed that the addition of 1/3rd new metal to the alloy once cast, restores the bonding Characteristics of porcelain fused to metal and also that Nickel-Chromium alloy has superior bonding properties with porcelain than Cobalt-Chromium alloy.

### Key Words

Nickel-Chromium, Cobalt-Chromium, Recasting, Porcelain, Bond strength

### Introduction

The base metal alloys like Cobalt-Chromium were introduced into dentistry by H. STELLITE in 1929. These alloys then, were so inexpensive that the new ingots were melted, cast and the surplus metal was either discarded or sold back to the supplier by weight as scrap, even though they were purchased at a very meagre price. When using these inexpensive non-precious alloys for casting procedures, technician used to melt the new ingots rather than mixing the cast metal with new ingots, as it was the practice with precious metal alloys<sup>[6]</sup>.

Casting procedure requires more molten metal to be forced than is needed to fill the mould. The surplus metal separated from the casting is known as "button". The possibility for the "button" to be reused with the addition of 1/3<sup>rd</sup> new metal to produce an acceptable casting is a matter of economy<sup>[10]</sup>.

Thus, by adding new metal, composition of the alloy that might be altered in the earlier casting procedures may be replenished. This practice is especially important with metal ceramic alloys, which contain trace elements essential for bonding of porcelain. Mclean and Sced<sup>[12]</sup> suggested that, addition of 1/3<sup>rd</sup> new metal during recycling would be sufficient to restore the required physical properties<sup>[8]</sup>.

Bonding of porcelain to metal is thought to result from mechanical inter-locking<sup>[2]</sup>, vander waals forces<sup>[2]</sup> chemical bonding<sup>[2],[4],[5]</sup> and compressive bonding. All these mechanisms require wetting of the metal surface with porcelain during sintering<sup>[9]</sup>. The contribution of various bonding mechanisms has been debated, but the chemical bond is considered necessary to achieve the adequate bond strength for metal ceramic restoration.

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### Quick Response Code



Experiments and Research regarding matching of the co-efficient of thermal expansion of metal and porcelain and determining the role of metal oxides<sup>[1]</sup>,<sup>[2],[3]</sup> on the bond strength has, produced successful metal-ceramic restoration.

It has been observed that the "button" or previously cast metal/alloy melts at a higher temperature than that of new ingot due to the inclusion of surface oxide layer. Also it is likely that the previously cast metal may exhibit altered surface chemistry<sup>[12]</sup> and texture which is vital for producing a bond of adequate strength between metal and porcelain.

These possible alterations in surface chemistry, texture and melting temperature raise the question, whether the recast base metal with and without the addition of 1/3<sup>rd</sup> new metal would produce similar bond strength. The present study was undertaken with an aim

to determine the effect of base metal alloy castings and recasting with one-third of new base metal alloy on bond strength of porcelain in vitro.

## Materials And Method

**Study location:** This study was conducted in the department of Prosthodontics, S.D.M College of Dental Sciences and Hospital, Dharwad, Karnataka.

**Preparation:** Standardized sprue of 15mm length and a diameter of 2mm was attached to plastic copings. To the sprue, a reservoir of 3mm diameter was attached 2mm away from the plastic copings. On a 3 X crucible former (Whipmix) four of plastic copings were arranged diagonally opposite to each other with an angle of 60° to the horizontal plane. The 3 X casting ring was lined with Kera Vlies (cellulose) liner. These patterns were sprayed with Lubrofilm(DENTAURUM, Germany) to reduce the surface tension.

**Mixing and investment:** The preproportioned packets of Castorit Super C (150 gms) with the Castorit Super C mixing liquid 34 ml (DENTAURUM, Germany) were mixed, and invested in the 3 X casting ring. After 40 minutes the casting ring was separated from the crucible former and transferred to the cold burnout furnace (KAVO, Germany). The casting ring was placed vertically with the crucible facing downwards to facilitate the free flow of molten wax. The casting ring was preheated to dry at 250°C for 60 minutes, there after it was heated to the final temperature of 950°C gradually at a rate of 5° C/minute and was heat soaked at 950°C for 30 minutes.

**Casting procedure:** Two types porcelain compatible alloys, Nickel-Chromium (Remanium CS, DENTAURUM, Germany) and Cobalt-Chromium (Remanium CD, DENTAURUM Germany) were used for this study. Six pellets of Nickel-Chromium alloy were placed in crucible and introduced into the furnace for preheating for 10 minutes and later cast in the induction casting machine (Degutron, Degussa Germany). Then the casting ring was allowed to cool for 5 minutes and quenched in cold water. The same investing, burnout and casting procedure was repeated for three other rings to have the casting in Nickel-Chromium and four other rings in Cobalt-

Chromium alloys to obtain I<sup>st</sup> batch of 16 copings each of Nickel-Chromium and Cobalt-Chromium alloys. Four rings were cast with the sand blasted and cleaned buttons, obtained from the first casting, to produce 16 copings of each metal (Nickel-Chromium, and Cobalt-Chromium) consequently which were termed as II<sup>nd</sup> batch.

The remaining buttons after the first casting were weighted in an electronic weighing machine (Precisa, Switzerland) and approximately 1/3<sup>rd</sup> of the new metal added for the next batch of casting. The addition of 1/3<sup>rd</sup> new metal was repeated for both the alloys and cast in the 4 rings for both of the metals to obtain III<sup>rd</sup> batch of 16 copings of each alloy

Retrieved castings were sand blasted with 100 grit of aluminum oxide, placing metal copings vertical to the outlet with 60 psi of compressed air. These metal copings were separated from the button and finished with a Tungsten carbide trimmer. Then each of the specimens were sand blasted with 60 grit of aluminum oxide for 30 seconds and the specimens were subjected to ultrasonic cleaning (BANDELIN SONOREX Super, Germany) for 5 minutes (Plate No.7). Separate containers were used to differentiate among different alloy types and batches. The three batches of Nickel-Chromium and Cobalt-Chromium are designed by alphabets A and B respectively. Thus the copings cast from the new ingots were termed as A-I, from recast of the button as A-II and from recast of the button with the addition of 1/3<sup>rd</sup> new metal as A-III. The same was repeated for Cobalt-Chromium B-I, B-II and B-III respectively.

It was required to prepare a metal die with a flat base on which the porcelain fused specimens could be tested using the Universal testing machine.. All the 96 metal copings by batch wise were checked for the fit over the metal die.

These Nickel-Chromium and Cobalt-Chromium alloy copings were dried and transferred on to the silicon nitride firing tray (Ivoclar, Leischtenstein) and placed in the porcelain furnace (Ivoclar, Programat P-90, Leischtenstein) for oxidation, with 140° C. Ten milli-grams of D4 shade opaquer (Duceram of Germany) was dispensed on to the porcelain tile and mixed with 10ml of

mixing liquid

These specimens were cooled and a silky layer of D4 shade porcelain opaquer was applied and placed in the furnace. This was gradually fired upto 925° C for 2 minutes without vacuum. This was cooled gradually to the room temperature, another layer (II layer) of opaquer over the I<sup>st</sup> layer was applied over each coping to completely mask the colour of the underlying metal. This was placed back into the furnace and gradually fired up to 925° C, with vacuum from 620° to 925° C and held at that temperature for 2 minutes before releasing the vacuum. These specimens were cooled to the room temperature. 10 mg of D4 shade dentine porcelain powder (body porcelain) was dispensed on a porcelain tile and 10ml of liquid was added to it. This was mixed uniformly to build the coping with the dentine material having the mesio-distal width of 7mm incisally and thickness of 1.1mm approximately and having a height of 11mm cervico-incisally on the labial aspect. This dentine layer was carved to simulate the anatomy of natural tooth and the excess liquid was removed by condensation and placed back into the furnace and fired gradually upto 920° C with a holding time of 1 minute. It was then allowed to cool gradually to the room temperature. This same method was followed for the remaining 95 copings.

**Assessing the bond strength:** Later, the specimens were tested on Universal testing machine. They were subjected to analysis at a cross head speed of 0.002 inch/minute in a compressive mode until the separation of the bond. The amount of force required to fracture and separate porcelain from metal was noted for each specimen of all batches of both alloys which formed the basis data for this study. This basic data for each alloy and batch was tabulated and subject to statistical analysis. Descriptive statistics were analyzed and Analysis of Variance was used to compare means between three batches of alloys. Student t test was used to compare bond strengths between two different alloys

## Results

**Table 1** shows bond strength values in Mega Newton /m<sup>2</sup> (kg/mm<sup>2</sup> converted to Mega Newton / m<sup>2</sup>) between porcelain and base metal alloy of Nickel-

Table 1: Bond Strength Values Of The Test Samples In Mega Newton/m<sup>2</sup>

Test Samples	Batch A-I New Metal	Batch A-II Only button	Batch A-III Button + 1/3 New Metal
1	8.19	6.85	9.64
2	9.24	8.03	8.83
3	8.60	7.63	9.31
4	8.43	7.22	7.87
5	8.92	7.15	7.95
6	8.76	7.55	7.15
7	9.24	8.51	9.16
8	9.56	6.83	9.56
9	10.04	7.63	8.35
10	9.40	7.79	9.40

Table 2: Bond Strength Of The Test Samples In Mega Newton/m<sup>2</sup>

Test Samples	Batch A-I New Metal	Batch A-II Only button	Batch A-III Button + 1/3 New Metal
1	5.62	6.02	8.03
2	5.46	5.22	6.83
3	7.22	5.62	6.10
4	5.46	5.46	6.02
5	6.59	5.14	5.46
6	6.27	6.77	7.15
7	7.07	6.02	6.59
8	6.10	5.06	6.10
9	6.83	4.42	6.99
10	6.27	4.01	6.19

Table 3: Mean And Standard Deviation Of Three Batches Of Nickel-chromium Alloy In Mega Newton/m<sup>2</sup>

Bond Strength	Batch A-I New Metal	Batch A-II Only button	Batch A-III Button + 1/3 New Metal
Maximum	10.04	8.51	9.64
Minimum	8.19	6.83	7.15
Mean	9.038	7.517	8.722
S.D.	0.5638	0.5288	0.8488

Table 4: Mean And Standard Deviation Of Three Batches Of Cobalt-chromium Alloy In Mega Newton/m<sup>2</sup>

Bond Strength	Batch A-I New Metal	Batch A-II Only button	Batch A-III Button + 1/3 New Metal
Maximum	7.22	6.77	8.03
Minimum	5.46	4.01	5.46
Mean	6.289	5.374	6.548
S.D.	0.6427	0.8027	0.7323

Chromium. Kilograms to Newtons conversion is achieved by the formula  $N = K \times 9.8 / 122 \times 10^6$ . Ten samples were tested in each of the three batches. Batch A-I consisted of new metal, Batch A-II only the button of new metal and the Batch A-III consisted of the button with the addition of 1/3 of new metal.

**Table 2** shows the Bond strength values between porcelain and base metal alloy of Cobalt-Chromium. Ten samples were tested in three batches. Batch-I consisted of new metal, Batch-II had only the button of new metal and Batch-III consisted of button with the addition of 1/3 of new metal.

The mean and standard deviation values of three batches of Nickel-Chromium alloy are shown in **Table 3**.

For the Batch-I (new metal) the mean value was 9.038 and standard deviation, 0.5638. The mean value of Batch-II (only the button) was 7.517 with the standard deviation, 0.5288. The mean value of the Batch-III (button plus the addition of 1/3 new metal) was 8.722 and the standard deviation being 0.8488 showed little variation from that of the Batch-I.

The mean and standard deviation values of bond strength of three batches of Cobalt-Chromium alloy are shown in **Table 4**.

Mean value of the bond strength in Batch I (new metal) was 6.289 with the standard deviation of 0.6427. For the Batch-II (only button) the mean value was lower than the Batch I that is 5.374 and the standard deviation, 0.8027. The mean value of the Batch III (button plus the addition of 1/3 new metal) was 6.548 with little variation from that of the Batch I and the standard deviation being 0.7233.

**Table 5** shows the statistical comparison between the three batches of Nickel-Chromium alloy using ANOVA (Analysis of Variance) test.

There was a difference of high significance between the two batches, that is Batch I (new metal) and Batch II (only button); and between the Batch III (button plus the addition of 1/3 new metal) and Batch II (only button). The F-Ratio (Fisher's ratio) was 14. 185776 at ( $P < 0.05$ ).

Table 5: Anova Table Showing The Comparison Between The Three Batches Of Nickel - Chromium

Sl.No.	Square Of Variation	d.f	Sum Of Squares	Mean Of Square	"F" Ratio
1	Between The Classes	2	12.6458	6.3229	4.185776
2	Error	27	12.1012	0.4481	-----
3	Total	29	24.7479	-----	-----

(2,27) VALUE = 3.35 \*\* HS at  $P < 0.05$

Table 6: Anova Table Showing The Comparison Between The Three Batches Of Cobalt - Chromium

Sl.No.	Square Of Variation	d.f	Sum Of Squares	Mean Of Square	"F" Ratio
1	Between The Classes	3-1=2	7.5895	3.7948	7.399
2	Error	29-2=27	14.3447	0.5313	----
3	Total	30-1=29	21.9343	----	----

\* d. f(2, 27) = 3.35

\*\*HS at  $P < 0.05$

\*\*HS = Highly significant

Table 7 : 't'-value Between The Three Batches Of Nickel-Chromium

Sl.No.	Batches	Mean	S.D.	"T" Value	"P" Value
1	I-II	1.521	0.629	7.6	$P < 0.05$ Hs **
2	II-III	-1.25	0.9848	4.01	$P < 0.05$ Hs **
3	III-I	0.458	0.9059	1.59	$P > 0.05$ Ns *

\*\* HS = Highly significant

\* NS = Not significant

Table 8: "t" Value Between The Three Batches Of Cobalt-Chromium

Sl.No.	Batches	Mean	S.D.	"T" Value	"P" Value
1	I-II	0.82	1.0329	2.56	$P < 0.05$ S *
2	II-III	1.17	0.8466	4.48	$P < 0.05$ S *
3	III-I	-0.257	1.1008	0.76	$P > 0.05$ NS **

\*\* S = Significant

\* NS = Not Significant

Table 9: Showing "t" Value (Unpaired) Between The Three Batches Of Nickel-Chromium And Cobalt-Chromium

Sl.No.	Batches	"t"	"P"	Significant
1	I - Batch	-9.6465	<0.05	**HS
2	II - Batch	-6.6885	<0.05	**HS
3	III - Batch	-5.8233	<0.05	**HS

\*\*HS = Highly Significant

**Table 6** shows the statistical comparison between the three batches of Cobalt-Chromium I Batch (new metal), II Batch (only button) and III batch (button plus the addition of 1/3 new metal) using Anova (Analysis of Variance ) test. The result from the analysis show a difference high significance between the three batches with the F-Ratio(Fisher's ratio) being 7.399 at ( $P<0.05$ ).

**Table 7** shows that 't'-value (paired student's 't' test) between the three batches of Nickel-Chromium Batch I (new metal) and Batch II (only button) was highly significant, ( $t=7.6$  at  $P<0.05$ ), similarly the 't' value between the Batch II and Batch III (button plus addition of 1/3<sup>rd</sup> new metal) was 4.01 which was highly significant at ( $P<0.5$ ). No significant difference was noticed between the Batch I (new metal) and Batch III (button plus the addition 1/3rd new metal as the 't' value was 1.59 at ( $P>0.05$ ).

**Table 8** shows that 't' value (paired) between the three batches of Cobalt-Chromium Batch I (new metal) and Batch II (only button) the value was 2.56, significant at ( $P<0.05$ ). Similarly the 't'-value between the Batch II (only button) and Batch III (button plus the addition of 1/3 new metal) was 4.48, significant at ( $P<0.05$ ) while there was no significant difference between the Batch I (new metal) and Batch III ( new metal plus the addition of 1/3 new metal) of Cobalt Chromium, that is the 't'-value was less, 0.73 at ( $P>0.05$ ).

**Table 9** shows that 't' value (unpaired student's 't'-test) between the three batches of Nickel Chromium and Cobalt-Chromium.

The 't' value between the Batch I of A & B (new metal) of Nickel-Chromium and Cobalt-Chromium was -9.6465; significant at ( $P<0.05$ ), suggesting the higher bond strength values of Nickel significance,  $t = -6.6885$  at ( $P<0.05$ ), between the Batch II of A & B suggesting the higher bond strength values of Nickel Chromium again Cobalt Chromium the Batch III of A & B (button plus addition 1/3 new metal ) also, there was high significance between Nickel - Chromium and Cobalt-Chromium,  $t = -5.8233$  at ( $P<0.05$ ). These results also conclude that the bond strength values of Nickel-Chromium over the Cobalt-Chromium were higher.

## Discussion

Though, there was no significant change reported in physical properties on recasting up to four generations<sup>[6]</sup>, from the results of this study it appeared that the bond strength values between Nickel-Chromium and Cobalt-Chromium with porcelain were higher than the values obtained from the recast metal which could be of potential clinical importance, that is for Nickel-Chromium alloy the mean bond strength value of Batch-I (new metal) was 9.038 (SD=0.5638) and that of the Batch-II (only button) was less, that is a mean value of 7.517 with (SD=0.5288). Similarly for Cobalt-Chromium alloy the mean bond strength value of Batch-I (new metal) was 6.289 (SD=0.6427) and that of the Batch-II (only button) was less, that is the mean value being 5.374 with (SD=0.8027). These results indicate the reduction in the bond strength at the interface for the recast metal (only button) for both the base metal alloys. This could be attributed to more metallic oxide dispersion at the ceramo metal interface<sup>[1]</sup>, as well as the thickness of the micro porosities at the internal oxidation zone which increase as the metal is recast without the addition of 1/3<sup>rd</sup> new metal/alloy<sup>[8]</sup>.

In concurrent to this, Moffa et al<sup>[11]</sup> claimed that the presence of oxide layer augmented bonding by contributing to compressive bonding forces as postulated by Vickery and Bandenelly (1968). The decrease in the bond strength could also be explained by the depletion of few essential trace elements which oxide readily during the initial casting procedure.

Donald et al indicated that the procedure of adding varying amounts of new metal to the old is not necessary claiming that the physical properties are not changed when cast for four generations<sup>[6]</sup>.

Proof to the contrary noticed in the present study when the "Buttons" were used for casting Batch II of alloy A & B showed less bond strength with porcelain as compared to Batch I of A & B (table 3&4). The difference in mean value of bond strength between Batch I & II of both alloys was statistically significant as per **Table 7 & 8**. Therefore it is recommended that only button should not be used for recasting. However when 1/3<sup>rd</sup> new metal was added to the button,

the bond strength was not significantly affected. The evaluation of results showed that the mean bond strength of Batch III (button plus the addition of 1/3 new metal) of Nickel-Chromium alloy was 8.722 (SD=0.8488) showing little variation from the mean bond strength value of Batch I (new metal), that is ( $t=1.59$  and  $P>0.05$  i.e. not significant). Similar was the case with Cobalt-Chromium alloy, where the mean bond strength of the Batch III (button plus the addition of 1/3 new metal) was 6.546 (SD=0.7323) again showing little variation from the Batch I (new metal), that is ( $t=0.73$  and  $P>0.05$  i.e. not significant). These results suggest that the strength of the bond at the interface can be restored with the addition of 1/3 new metal to the once cast metal. From the literature available it is understood that the components of the alloy lost/ altered in the earlier castings might have been replenished after the addition of 1/3 new metal thus maintaining the physical property of bond strength.

Though in 1986 Donald thought that the recasting with the addition of new metal was not cost effective considering the cost of the alloy a decade ago, compared to the present economic situation. However, in Third world countries like India the factors like labour and time are not included in consideration.

Due to devaluation of currency, changes in duties and other taxation the recycling of metal is an economic solution to reduce the cost factor particularly if the required properties are not unduly altered. In the present situation, recycling of costlier ceramo metal alloy with the addition of 1/3 new metal effectively proves the point.

## Summary And Conclusion

In this project it was observed that the addition of 1/3<sup>rd</sup> new metal to the alloy once cast, restores the bonding Characteristics of porcelain fused to metal and also that Nickel-Chromium alloy has superior bonding properties with porcelain than Cobalt-Chromium alloy.

Hence, before definitive recommendation can be made for the recycling of an alloy with the addition of 1/3<sup>rd</sup> new metal, further research is necessary to determine the nature and extent of alteration in the chemical

composition of the alloy at the interface between metal and porcelain on a larger sample size.

The values of bond strength of porcelain with various groups and batches of two commercially available base metal alloys are pertained to the materials, their nature and fabrication as well as testing methodology employed in the present study were technique sensitive. The values may not be repeated if the materials and methodology differs.

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## Malocclusion Pattern In Orthodontic Patients

### Abstract

**Background:** The human face holds an absorbing and consuming interest the world over. The study of orthodontics is indissolubly connected with the human face, as the mouth is the most potent factor in making or marring the beauty and character of the face. One of the primary goals of orthodontic treatment is to attain and preserve optimal facial attractiveness.

**Aims and Objectives:** In the present study attempt was made to check the prevalence of various malocclusion characteristics in the orthodontic patient population. The aim of the study was to provide quantitative information regarding the pattern of dentofacial characteristics in orthodontic patients and to find frequencies of Angle's classes and other dentofacial characteristics in orthodontic patients along with gender differences if any.

**Material and Method:** Pre-treatment orthodontic records of 102 patients, 44 males and 58 females, were obtained and used for study. The following dentofacial characteristics were recorded: chief complaint, Angle's malocclusion, Irregularity index i.e. arch length discrepancy; crowding and spacing, overjet, overbite, diastema, crossbite, cephalometric skeletal analysis. Data collected were pooled to determine frequencies and cross-tabulation of dentofacial characteristics with Angle's malocclusion classes.

**Statistical Analysis:** The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 15.0 for Windows).

**Results:** Results showed that there is no gender difference in the number of male and female patients seeking orthodontic treatment. Dentofacial characteristics concerned with esthetics i.e. forwardly placed teeth and malpositioned teeth are of prime importance to the patients and there are no prevalent gender trends in the different characteristics of malocclusion.

### Key Words

Dentofacial characteristics, esthetics, malocclusion.

### Introduction

The malocclusion can be defined as an occlusion in which there is malrelationship between the arches in any of the planes or there are anomalies in tooth position beyond normal limits. The etiology of malocclusion can be genetic or environmental and/or a combination of both along with various local factors such as oral habits, tooth anomalies etc. The malocclusion has been shown to affect oral health, increase prevalence of caries and can cause temporomandibular disorders. The benefits of orthodontic treatment are prevention of tissue damage, improvement in aesthetics and physical function. The uptake of orthodontic treatment is influenced by the desire to look attractive, self-esteem and self-perception of dental appearance. Satisfaction with one's appearance is related to social functioning. As malocclusion is often conspicuous, it might lead to adverse social reactions and a deficient self-concept. Concern for and a desire to improve one's appearance is a significant motive for most people who seek orthodontic treatment. People equate good facial and dental appearance with

many social aspects of life. Rather than physical function malocclusion has greater impact on individual in terms of quality of life and social limitations. In the present study attempt was made to check the prevalence of various malocclusion characteristics in the orthodontic patient population. This can give an indication about which dental characteristics are perceived by the patients and the parents as being the most unpleasant so that they have to opt for orthodontic treatment.

**Aims and Objectives :** The aim of the study was to provide quantitative information regarding the pattern of dentofacial characteristics in orthodontic patients and to find frequencies of Angle's classes and other dentofacial characteristics in orthodontic patients along with gender differences if any.

**Materials and Method :** This cross-sectional study included orthodontic patients who visited the department of Orthodontics and Dentofacial Orthopaedics, Luxmi Bai Institute of Dental Sciences and Hospital, Patiala. Pre-treatment orthodontic records of 102

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patients, 44 males (mean age 25.9 years) and 58 females (mean age 21.3 years), were obtained and used for study. The inclusion criteria for the sample included those with complete pre-treatment records and undergoing orthodontic treatment; while those who came for consultation only or had previously undergone orthodontic treatment were not included in the study. Data collection was based on written case records, dental casts and cephalometric radiographs.

The following dentofacial characteristics were recorded: chief complaint, Angle's malocclusion, Irregularity index i.e. arch length discrepancy, crowding and spacing (0-1 Ideal, -3 mild, 4-6 moderate, 7-10 severe, > 10 extreme) overjet (1-2 Ideal, 3-4 mild, 5-6 moderate, 7-10 severe, > 10 extreme, reverse overjet), overbite (0-2 Ideal, 3-4 moderate, 5-7 severe, > extreme, open bite), diastema > 2mm, crossbite, cephalometric skeletal analysis (ANB-skeletal Class I: 0-4\*, skeletal Class II: > 4, skeletal Class III: < 0). Data collected were pooled to determine frequencies and cross-tabulation of dentofacial characteristics with Angle's malocclusion classes.

**Statistical Analysis :** The statistical

analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 15.0 for Windows). Our data was of qualitative or categorical variables which were described as frequencies and proportions. Proportions were compared using Chi square or Fisher's exact test whichever was applicable. All statistical tests were two-sided and performed at a significance level of  $\alpha=0.05$ .

**Results :** **Table 1** gives the distribution of subjects on the basis of gender and malocclusion classes. Within each malocclusion class there was no significant difference between the numbers of male and female patients as shown by the p-value of 0.76, when Chi-square test was applied. **Table 2** gives the number of patients who came with a particular chief complaint. These subjects were again divided on gender basis. Chi-square test was applied to check for any specific trend in chief complaints in males and females and the difference between the two was statistically insignificant as shown by the p -value. **Table 3** shows the distribution of malocclusion classes based on maxillomandibular skeletal relation. Chi - square test shows the skeletal classes were related to the angles classes significantly. **Table 4** gives the distribution of various dental malocclusion characteristics in both male and female subject. Any prevalent trends on gender basis for any dentofacial characteristics were checked. It was demonstrated that there was no statistically significant variation between males and females for crowding as shown by a p value of 0.3 for maxillary crowding and 0.7 for mandibular crowding. Similarly there was no statistically significant difference in the prevalence of maxillary and mandibular spacing between males and females as shown by p value of 0.7 and 0.2 respectively. A p value of 0.7 and 0.9 for overjet and overbite again show no prevalent gender differences.

**Discussion :** This study shows the Table 1: Distribution of subjects on the basis of gender and malocclusion classes.

ANGLE'S CLASSIFICATION	TOTAL NUMBER = 102 (no%)	Males Total No.=44	Females Total No.=58
CLASS I	49 (48.03%)	18	31
CLASS II	53 (51.9%)	21	32
CLASS III	0 (0%)	0	0
	Chi Sq = .09	p - val = .7642	

distribution of various malocclusion characteristics in the orthodontic patients coming to the department. The results show that there is comparable number of male and female patients seeking orthodontic treatment. Similar results were reported by Oluranti OD, Ifeoma LU (2009)<sup>[1]</sup> in their study that showed 45.5% males and 54.5% females attending the orthodontic unit of the hospital. This study evaluated the traits which were of greater concern to the patients. The dentofacial characteristics which were of prime importance to the

patients were recorded. This study demonstrates that most of the patients came with the chief complaint of forwardly placed teeth. This is followed by the chief complaint of malpositioned teeth. This was followed by a chief complaint of increased spacing, diastema, high placed canines, crossbites and rotations. Similar results were reported in study by Gul E Erum(2008)<sup>[2]</sup> in which majority of patients reported with a chief complaint of 'upper front teeth forward' and 'malaligned teeth'.

The study further demonstrates that there

Table 2: Distribution of patients on the basis of chief complaint.

CHIEF COMPLAINT	NUMBER (TOTAL = 102)	Males (Total = 44)	Females (Total = 58)	Chi sq	P - val
MALPOSITIONED TEETH	26 (25.49%)	11	15	.01	.9203
FORWARDLY PLACED TEETH	35 (34.31%)	16	19	.14	.7082
CROSSBITE	7 (6.86%)	2	5		.4689
DIASTEMA	10 (9.8%)	4	6		1
SPACING	12 (11.76%)	5	7	.04	.8414
ROTATION	1 (0.09%)	1	0		.4314
OPEN BITE	1 (0.09%)	1	0		.4314

Table 3: Distribution of malocclusion classes based on maxillomandibular relation.

SKELETAL CLASSES	ANGLES CLASS I (no. %)	ANGLES CLASS II (no. %)	ANGLES CLASS III (no. %)	TOTAL
SKELETAL CLASS I	29 (28.43%)	15 (14.7%)	0	44 (43.13%)
SKELETAL CLASS II	22 (21.56%)	34 (33.33%)	0	56 (54.90%)
SKELETAL CLASS III	2 (1.96%)	0	0	2 (1.96%)

Chi Sq. = 8.88, p - val. = .0118

Table4 : Distribution of various dental malocclusal characteristics in both male and female subjects.

DENTOFACIAL CHARACTERISTICS			ANGLE'S CLASS I	ANGLE'S CLASS II	TOTAL	Males	Females
CROWDING	0-1 NORMAL	MAXILLARY	1	0	1 (0%)	1	0
		MANDIBULAR	4	6	10 (9.8%)	3	7
	2-3 MILD	MAXILLARY	8	5	13 (11.74%)	6	7
		MANDIBULAR	5	7	12 (11.76%)	6	6
	4-6 MODERATE	MAXILLARY	7	7	14 (13.72%)	5	9
		MANDIBULAR	7	8	15 (14.70%)	5	10
	> 7 SEVERE	MAXILLARY	5	9	14 (13.72%)	3	11
SPACING	0-1 NORMAL	MANDIBULAR	7	9	16 (15.6%)	6	10
		MAXILLARY	0	1	1 (0%)	0	1
	2-3 MILD	MANDIBULAR	7	8	15 (14.7%)	8	7
		MAXILLARY	4	2	6 (5.88%)	3	3
	4-6 MODERATE	MANDIBULAR	4	2	6 (5.88%)	5	1
		MAXILLARY	7	12	19 (18.62%)	9	10
	> 7 SEVERE	MANDIBULAR	1	2	3 (2.94%)	1	2
OVERJET	1-2 NORMAL		15	1	21 (20.58%)	8	13
	3-4 MILD		17	6	23 (22.54%)	10	13
	5-6 MODERATE		7	5	12 (11.76%)	5	7
	> 7 SEVERE		4	31	35 (34.3%)	18	17
OVERBITE	0-2 NORMAL		19	2	21 (20.58%)	9	12
	3-4 MILD		18	10	28 (27.45%)	12	16
	5-6 MODERATE		5	28	33 (32.35%)	14	19
	> 7 SEVERE		0	11	11 (10.78%)	4	7
CROSSBITE			5	2	7 (6.86%)	2	5

is no statistically significant difference in the number of patients coming with Class I and Class II malocclusions, whereas the number of patients reporting with Class III malocclusion is very less. The research of Proffit et al for untreated White American subjects between 8 and 50 years showed incidence of Class I malocclusions as 52.2%, 42.4% as Class II and less than 5% as Class III malocclusions.<sup>[2]</sup> In the hospital based study by Gul E Erum(2008), the frequency of Class I, Class II and Class III malocclusion was found to be 18.6%, 70.5% and 10.9% respectively. Another study on the pattern of malocclusion in Africa by Onyeaso CO, Aderinokun GA, Arowojolu MO(2002)<sup>[3]</sup> showed the molar relationship among those as: Class I 76.5%, Class II 15.5% and Class III 8.0%. A study on rural children by Guaba K, Ashima G, Tewari A, Utreja A (1998) found 29.2% subjects to have malocclusion; among them Class I malocclusion was found to be 14.4%, Class II 13.5% and Class III 1.35% of the whole sample. Willems G (2001)[5] showed the prevalence of Angle Class I, Class II div. 1, Class II div. 2 and Class III malocclusions as, respectively, 31%, 52%, 11% and 6%. Oluranti OD, Ifeoma LU (2009)<sup>[1]</sup> found Class I molar relationship was predominantly occurring seen in 76.7% of patients.

The results of the study showed 20.58 percent of patients to have a normal overjet, 22.54 to have mild overjet, 11.76 percent had moderate overjet while 34.3 percent had severe overjet. For overjet, there was greater number of patients with normal or mild overjet in Class I malocclusion. There was greater number of patients with moderate and severe overjet in Class II category. Study by Gul E Erum(2008)<sup>[2]</sup> showed normal overjet in 16 percent, mild in 28 percent, moderate in 20 percent and severe in 30 percent. Onyeaso CO, Aderinokun GA, Arowojolu MO(2002)<sup>[3]</sup> demonstrated increased overjet in 16.2% of the patients, reduced overjet in 0.7% while 2.1% had reversed overjet. Oluranti OD, Ifeoma LU (2009)<sup>[1]</sup> in their study reported marked increase in overjet in 32.2%. The results of study by E. Tausche, O. Luck, and W. Harzer (2004)<sup>[6]</sup> showed that overjet (more than 3.5 mm) affected 37.5% of the subjects.

This study showed that 20.58 percent had normal overbite, 27.45 percent had mild overbite, 32.35 percent had moderate overbite and 10.78 presented with severe

overbite. Study by Gul E Erum(2008)<sup>[2]</sup> showed 25.6 percent as normal, 48.7 percent as mild, 17.9 percent as moderate and 3.8 percent as severe overbite. Onyeaso CO, Aderinokun GA, Arowojolu MO(2002)<sup>[3]</sup> reported increased overbite (3.8%), reduced overbite (1.4%); anterior open bite (5.2%). Oluranti OD, Ifeoma LU(2009)<sup>[1]</sup> reported Overbite discrepancies in 26.2% of patients with deep bite and 11.2% of patients with anterior open bite. E. Tausche, O. Luck, and W. Harzer (2004)<sup>[6]</sup> showed that deep overbite affected 46.2%.

This study demonstrates that a total of 39.18 percent patients had maxillary crowding and 51.86 percent had mandibular crowding. The results showed that almost the same number of patient came for treatment for mild, moderate and severe crowding. This can be explained on the basis that even moderate crowding is associated with malposed front teeth which are esthetically unacceptable to the patient. Oluranti OD, Ifeoma LU (2009)<sup>[1]</sup> Anterior segment crowding was recorded in 38.7% and 43.2% of the patients for the upper and lower arch respectively. Onyeaso CO, Aderinokun GA, Arowojolu MO (2002)<sup>[3]</sup> Crowding, spacing and retained primary incisors constituted 29.7%, 1.4% and 40.1%, respectively. E. Tausche, O. Luck, and W. Harzer (2004)<sup>[6]</sup> Anterior crowding greater than 3.0 mm was recorded in 14.3% of the subjects in the mandible and in 12.0% in the maxilla. The study demonstrates that a total of 47.04 percent patient presented with maxillary spacing while 35.28 percent patients presented with mandibular spacing. However the number of patients increases as the severity of spacing increases i.e. mild, moderate, and severe.

Chi square test applied to check any prevalent gender trend in the different characteristics of malocclusion demonstrated no statistically significant difference. Similar results were reported by Gul E Erum (2008)<sup>[2]</sup> who also reported no significant differences in distribution of Angle's classes and dentofacial characteristics between males and females. In study by Willems G (2001) no significant difference in the prevalence of the Angle classes between the sexes was found.

This result is in contrast to the results of studies by that showed higher tendency for class II and III in males as compared

to females. Onyeaso CO, Aderinokun GA, Arowojolu MO(2002)<sup>[3]</sup> reported males to have significantly more of classes II and III molar relationships than females ( $P < 0.05$ ). Occurrence of retained primary teeth as well as overjet deviation from normal was significantly higher in females ( $P < 0.05$ ). No significant sex differences were found in the other occlusal disorders ( $P > 0.05$ ).

**Conclusions :** There is no gender difference in the number of male and female patients seeking orthodontic treatment.

Dentofacial characteristics concerned with esthetics i.e. forwardly placed teeth and malpositioned teeth are of prime importance to the patients while seeking orthodontic treatment. No statistically significant difference in the number of patients coming with Class I and Class II malocclusions, whereas the number of patients reporting with Class III malocclusion is very less.

No prevalent gender trend in the different characteristics of malocclusion.

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## Influence Of Repair Material, Surface Design And Chemical Treatment On The Transverse Strength Of Repaired Denture Base - An In-vitro Study

### Abstract

The aim of the study was to investigate and compare the effect of different joint surface contours and repair materials on transverse strength of repair acrylic resin with or without chemical treatment with ethyl acetate.

A total of 60 rectangular heat cure acrylic specimens were fabricated and cut in the centre. The cut specimens were repaired by using heat cure acrylic resin, heat cure acrylic resin with chemical treatment self cure resin, self cure acrylic resin with chemical treatment, self cure acrylic resin with rounded joint surface contour, self cure acrylic with 45 degree bevel joint surface contour. The repaired specimens were tested for transverse strength in an Instron Universal Testing Machine and data thus collected was subjected to statistical analysis. One way ANOVATEST ( $p > 0.05$ ) was used to determine the differences between the individual groups.

The results showed that specimens repaired with heat cure acrylic resin with chemical treatment exhibited the highest transverse strength. Also rounded and 45 degree beveled joint surface enhanced the bond strength of repair material. Thus choice of material and method of repair have significant effect on strength of repaired denture.

### Key Words

Repair, Transverse strength, acrylic resin, contours

### Introduction

Heat polymerizing acrylic resin has been the most common denture base material. This material is preferred as denture base resin because of its physical and esthetic properties as well as the material availability, reasonable cost and ease of manipulation. However, the mechanical strength of polymethyl methacrylate based denture base materials remain far from ideal for maintaining the longevity of dentures<sup>[1]</sup>. So the fracture of acrylic resin dentures is a common clinical occurrence. The strength of a denture depends on shape, residual stresses, and conditions of loading and mechanical properties of the material. Intrinsic strength of the material is affected by the composition which depends partly on the technique used. The principal factor in this respect is the amount of unpolymerised monomer remaining after curing. Fracture of repaired denture often occurs at the junction of an old and new material rather than through the center of the repair.

Regardless of the reason for fracture or the method for repair, the ultimate goal of denture repair is to restore original

strength of the denture and to avoid further fracture. The repair of the fractured prosthesis can be accomplished using acrylic resins that are heat polymerized, auto polymerized or light polymerized. Out of these the repair strength of heat polymerized resin is highest and ranges from 75-80% of the original material<sup>[2]</sup>. Various joint interface contours as butt, rounded and 45 degree bevel joint designs have also been found to influence strength of the repairing unit<sup>[3],[4]</sup>. Mechanical modifications improve the bond strength by increasing the surface area and mechanical retention.<sup>[5]</sup> Organic solvents such as ethyl acetate, methylene chloride, chloroform causes etching of the surface of denture base resins and increases mechanical interlocking thereby significantly improving the bond strength between acrylic denture base and repair resin.<sup>[6]</sup>

### Methodology

#### Preparation of test samples

Test samples of heat cure acrylic resin (Trevalon H1) of dimensions 60mm x 4mm x 6mm were prepared. The metal

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blocks were coated with petroleum jelly and invested in dental flasks. After the setting of the Plaster Of Paris, the flasks were opened and the metal blocks were removed. These formed plaster moulds in the flasks. Cold mold seal was applied. Heat cure acrylic resin (Trevalon H1) was mixed and packed in these plaster moulds. Then processing was done in a water bath at a temperature of 74 C for approximately 2 hours and then the temperature of the water bath was increased to 1000C and processing was continued for another hour. After curing the samples were removed and finished. These samples were divided into six groups of 10 specimens each.

1. Specimens were repaired with heat cure acrylic resin.
2. Specimens were chemically treated with ethylacetate and repaired with heat cure acrylic resin.
3. Specimens were repaired with self cure acrylic resin.

- Specimens were chemically treated with ethylacetate and repaired with self cure acrylic resin.
- Edges of specimens were made rounded before repairing with self cure acrylic resin.
- The edges of cut specimens were made at 45° beveled before repairing with self cure acrylic resin.

#### **Preparation Of Repair Indices**

For preparing repair indices larger sized (65mm x 4mm x 6mm) metal blocks were used so as to leave a gap of 5mm for the repair material. After coating the metal blocks with petroleum jelly, these blocks were invested in denture flasks. After the plaster was set, the metal blocks were carefully removed from the working plaster mould. Acrylic specimens were cut in the centre to form 2 parts of 30 mm length.

**Repair with heat cure acrylic resin:** The two halves of acrylic specimens were placed on both sides of the repair index with a gap of 5 mm between them. The two surfaces facing each other were made rough with a bur. Heat cure resin was mixed in a clean container and in the dough stage it was packed in the gap between the two specimens. The repaired specimen was cured at 74°C for 2 hours and then at 100°C for 1 hour.

**Repair with heat cure acrylic resin after Chemical Treatment:** The two halves were treated with ethylacetate. One face each of both specimens was dipped in ethyl acetate liquid for 60 seconds and then dried. Then these specimens were placed in the repair index with the treated edges faces each other and repaired with heat cure resin.

**Repair with self cure acrylic resin:** The two halves were placed in the repair index with a gap of 5mm in between. Now the self cure acrylic resin was mixed in a clear container and packed in the gap between the specimens. Then the self cure resin was allowed to cure.

**Repair with Self cure acrylic resin with chemical treatment:** The two halves were treated with ethylacetate. One face each of both specimens was dipped in ethyl acetate liquid for 60 seconds and then dried. The specimens were then placed in repair index with treated edges facing each other and repaired with self cure resin.

**Repair with self cure resin with 45° bevel edges:** In this one face each of both halves was made beveled at 45° with the help of a carbide bur. Then the halves

with the 45° bevel face facing each other were placed in the repair index and repair was done with self cure resin.

**Repair with Self cure resin with round edges:** One face of both halves was made rounded with the help of a carbide bur. Then halves with the rounded face facing each other were placed in the repair index and repaired with self cure resin.

#### **Testing of Repaired specimens**

All repaired specimens were tested for transverse strength in an **Instron Universal Testing Machine**. For testing, the specimens were placed between the two holding clamps of Universal Testing Machine & locked. Now the tensile load was set to zero and increased progressively until the specimen was broken. The reading in machine was noted. (Using the main and vernier scale)

#### **Statistical Analysis**

Statistical analysis was done with standard computer software. One way ANOVA TEST ( $p \leq 0.05$ ) was used to determine the differences between the individual groups.

#### **Results**

**Group 1** specimens repaired with heat cure acrylic resin, range of transverse strength is 67.30-69.50 kg and mean is 68.53 kg.

**Group 2** specimens repaired with heat cure acrylic resin after chemical treatment, range is 73.20-75.60 kg and mean is 74.18 kg.

**Group 3** specimens repaired with self cure acrylic resin, range is 36.40-38.10 kg and mean is 37.3 kg.

**Group 4** specimens repaired with self cure acrylic resin after chemical treatment, range is 42.10-44.00 kg and mean is 43.12 kg.

**Group 5** specimens repaired with self cure acrylic resin with rounded joint surface contour, range is 54.30-56.00 kg and mean is 54.97 kg.

**Group 6** specimens repaired with self cure acrylic resin with 45 degree joint surface contour, range is 50.20-52.10 kg and mean is 51.23 kg.

#### **Statistical Results**

One way ANOVA TEST ( $p \leq 0.05$ ) with standard error of 0.31207 showed that mean difference between all possible paired combinations among the six

groups were statistically highly significant Group2 having specimens repaired with heat cure acrylic resin after chemical treatment exhibited highest transverse strength.

#### **Discussion**

The fracture of acrylic dentures is a long standing problem and a common clinical occurrence. Denture fracture is usually due to faulty design, fabrication and material choice in prosthodontic practice. The repair of the fractured prosthesis can be accomplished using acrylic resins that are heat polymerized auto polymerized or light polymerized. Various joint interface contours as butt, rounded and 45 degree bevel joint designs have also been found to influence strength of the repairing unit. Several authors suggested chemical surface modifications using organic solvents as ethyl acetate, methylene chloride and chloroform to improve the bond strength of a repair material to denture base.<sup>[6],[7]</sup>

The purpose of the present study was to compare the effect of repair material, surface design and chemical treatment on the transverse strength of repaired acrylic denture base. 60 test samples of heat sure acrylic resin (Trevalon HI) were repaired with Heat cure acrylic resin, Heat cure acrylic resin with chemical treatment, Self cure acrylic resin, Self cure acrylic resin with chemical treatment, Self cure acrylic resin with 45° bevel joint surface contours and Self cure acrylic resin with rounded joint surface contours

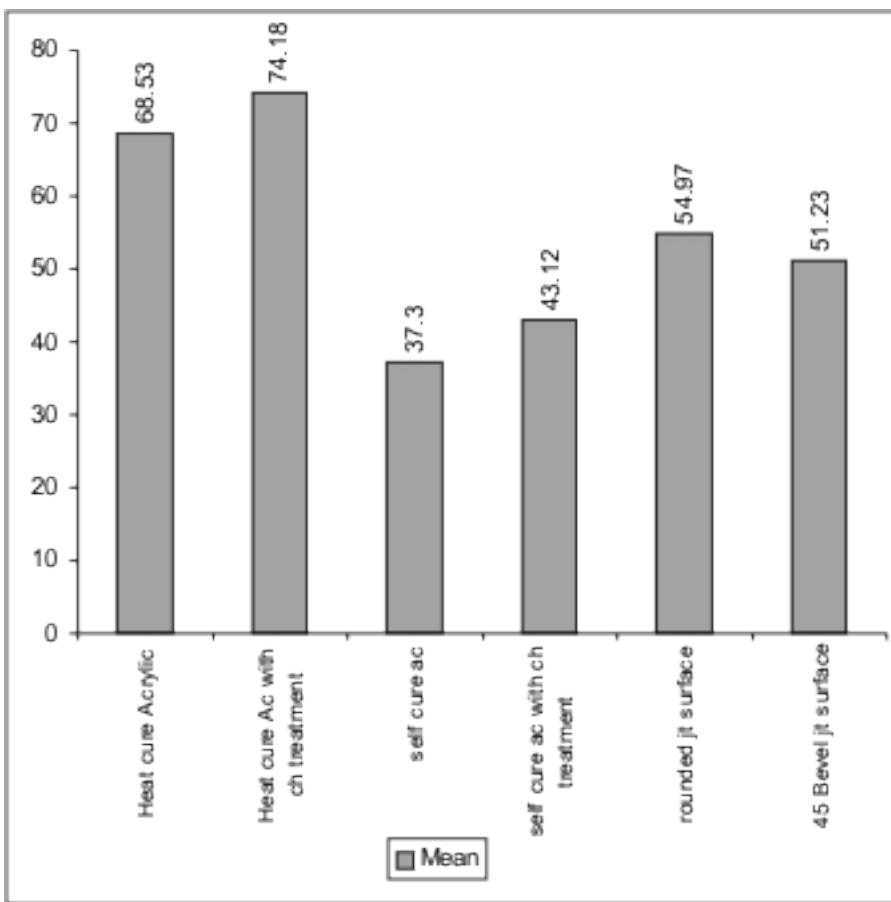
The results of this study demonstrated that transverse strength of specimens repaired with heat cured acrylic resin ( $68.53 \text{ kg} \pm 0.79$ ) was higher than that of self cure acrylic resin ( $37.3 \text{ kg} \pm 0.57$ ), self cure acrylic resin with chemical treatment ( $43.12 \pm 0.63$ ), with 450 bevel joint surface contour ( $51.23 \text{ kg} \pm 0.74$ ) and with rounded joint surface contour ( $54.97 \text{ kg} \pm 0.59$ ).

The present study demonstrated higher transverse strength value of  $68.53 \text{ kg} \pm 0.79$  for heat polymerized resin and  $37.2 \text{ kg} \pm 0.57$  for self cure resins. These results were in agreement with the studies done by Skinners EW (1954),<sup>[8]</sup> Carl HJ and Sweeny WT (1955),<sup>[9]</sup> Anderson (1958), Beyli MS et al (1980),<sup>[10]</sup> Stanford JW (1989).<sup>[11]</sup>

The greater values of bond strength of heat cured resins over self cured resins as repair materials can be attributed to higher degree of polymerization and

Table Showing Mean And Standard Deviation Values Of Tranverse Strength Of Repaired Specimens

	N	Mean	Std. Deviation	Std. Error	Descriptive treatment		Minimum	Maximum
					95% Confidence Interval for Mean			
					Lower Bound	Upper Bound		
Heat cure Acrylic	10	68.5300	.79449	.25124	67.9617	69.0983	67.30	69.50
Heat cure Acrylic with chemical treatment	10	74.1800	.80250	.25377	73.6059	74.7541	73.20	75.60
self cure acrylic	10	37.3000	.57155	.18074	36.8911	37.7089	36.40	38.10
self cure acrylic with chemical treatment	10	43.1200	.63736	.20155	42.6641	43.5759	42.10	44.00
Rounded joint surface	10	54.9700	.59264	.18741	54.5461	55.3939	54.30	56.00
45 Bevel joint surface	10	51.2300	.74989	.23714	50.6936	51.7664	50.20	52.10
Total	60	54.8883	13.16213	1.69922	51.4882	58.2885	36.40	75.60



Bar Diagram Showing Mean And Standard Deviation Values Of Tranverse Strength Of Repaired Specimens

ANOVA treatment					
1	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10194.967	5	2038.993	4187.322	.000
Within Groups	26.295	54	.487		
Total	10221.262	59			

lower residual monomer content of heat polymerized resin (Skinner EW, 1954).<sup>[8]</sup> Attempts to improve the bond strength of repair material to denture base resins by means of chemical treatment of repair surfaces were advocated by several investigators. It had been reported by Skinner EW (1954)<sup>[8]</sup> that such surface treatment caused superficial crack propagation as well as formation of numerous pits approximately 2 mm in diameter. Etching the repair surface with chemical etchants as chloroform, acetone, methylmethacrylate, methylene chloride, ethylacetate was suggested by various investigators. In the present study maximum transverse strength ( $74.18 \pm 0.28$ ) was observed with repair using heat cure acrylic resin after chemical treatment of broken edges with ethylacetate.

The transverse strength of repair with self cure resin with chemical treatment was greater ( $43.12 \pm 0.63$ ) than that of repair with self cure resin ( $37.3 \pm 0.57$ ) without chemical modification of repair surfaces. However it was less than that of repair with heat cured acrylic resin with chemical treatment ( $74.18 \pm 0.28$ ).

Nagai E et al (2001)<sup>[12]</sup> evaluated the strength and modulus of elasticity of repaired acrylic resin specimen reinforced with various processes and observed that surface pretreatment with methylene chloride created tight adhesion of auto polymerizing and heat polymerizing resin.

Ward JE et al (1992)<sup>[4]</sup> reported that the surface design that provides the greatest strength would decrease the number of adhesive failures.

To assess the effect of type of repair joint on the strength of repaired acrylic denture base, edges of the specimen instead of making butt joint were (i) rounded and (ii) contoured to  $45^\circ$  bevels before repairing with self cure acrylic resin. It was observed that strengths of repair made by self cure resin with round joint surface contours ( $54.97 \pm 0.59$ ) and  $45^\circ$  bevel joint surface contour ( $51.23 \pm 0.74$ ) was greater than the repair with chemical treatment ( $48.12 \pm 0.63$ ). The transverse bond strength of  $45^\circ$  bevels joint was slightly higher than rounded joint but the differences were not statistically significant. However the repair strength of butt joint ( $37.3 \pm 0.57$ ) was significantly less than that of rounded or  $45^\circ$  bevel joint.

The results of this study are in accordance with previous studies by Harrison WM

and Stausbury BE (1970),<sup>[3]</sup> Beyli K (1980) and Ward JE (1991).<sup>[4]</sup> Improved transverse strength of repair with round and 45° bevel joint designs is due to greater area of contact between repair and base material than repair with butt joint. The fact that the rounded joint is superior to butt joint support the general principal that sharp angled surface promote stress concentration and that the amount of stress concentration is directly related to the degree and abruptness of surface change. Therefore, since residual stress is produced and sharp angled surface concentrate the stresses when repairing fractured acrylic resin prosthesis, one should attempt to prevent recurrent structural fracture by distributing these stresses as evenly as possible by preparing a joint with rounded interface. According to the results obtained in this study, transverse strength of repaired acrylic denture base was highest when repair was done using heat cure acrylic resin, particularly after chemical treatment with ethyl acetate. The study also exhibited that repair joint surface configuration influences the transverse strength of repair material. Rounded and 45° bevel joint contours had significantly improved repair strength than repair with butt joint.

At present no repair material meets the ideal requisites as optimal transverse strength, ease of manipulation, cost and inconspicuousness. As fabrication of new denture is an expensive and time consuming procedure, clinical knowledge about the choice of material and method of repair is important till a definite prosthesis can be fabricated for the patient.

Although this in vitro study evaluated the effect of repair material, surface design and chemical treatment on transverse strength of repaired acrylic denture base, it did not simulate the clinical condition, ideally, as repaired dentures are exposed to repeated mechanical stresses during mastication. Also the use of a simple rectangular shaped specimen rather than a complex denture design contributes to the limitations of the present study. Therefore further investigations are necessary to evaluate the strength of repair under more closely simulated clinical conditions.

### **Summary and Conclusion**

Within the limits of the study, it can be concluded that choice of material and method of repair have significant effect

on strength of repaired denture. Chemical treatment prior to repair with heat cure acrylic resin as well as rounded and 45 degree beveled joints enhance the bond strength of repair material.

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## The Utility Of The Bapna Test For Accessing Pathogens In Periodontal Disease

### Abstract

Traditionally, treatment modality for periodontitis has been debridement of plaque and calculus from crown and root surfaces. But, if periodontitis is caused by group of specific microorganisms then antimicrobial agents must have been indicated. So, scaling and root planing (SRP) plus Metronidazole provides benefits beyond that obtained with debridement alone. Cultural tests, Dark or Phase contrast microscopy, DNA and RNA probes etc. are traditional techniques to diagnose the infection but now newer diagnostic procedures like BAPNA test are increasingly used for evaluation of periodontal infection due to *P.gingivalis*, *T.denticola* and *B.forsythus*.

**Methodology:** For the present study 15 patients aged between 35-65 years irrespective of sex were selected. Subgingival plaque sample was collected with sterilized curettes and transferred to microtitre plate containing BAPNA solution. The test sites were divided into two groups Group A - Subjects on Metronidazole therapy only, Group B - Metronidazole + SRP therapy. At baseline, pocket depth measurements were taken. Pocket depth were measured and classified into 3 ranges for study:- 1-3mm, 4-6mm, 7mm and more. The plaque sample in BAPNA working solution was incubated for 24 hours at 37°C. The outcome of hydrolysis was recorded and tabulated.

**Result:** The outcome of BAPNA test was significant. It is useful as a reliable indicator of BAPNA positive species in subgingival plaque.

**Conclusion:** The results from the present study emphasized the use of newer diagnostic techniques such as BAPNA test, as the diagnosis of periodontal diseases is possible by this test in early stages of the disease.

### Key Words

Periodontal disease, BAPNA test, *P.gingivalis*, *T.denticola*, *B.forsythus*.

### Introduction

Periodontal disease is a chronic microbial infection that triggers inflammation leading to loss of periodontal ligament and alveolar bone that supports the teeth. It is known that the periodontitis has an episodic nature that is period of activity and inactivity<sup>[1],[2]</sup>. Conventional diagnostic methods that is Bleeding on probing, Probing pocket depth, Attachment loss or gain and assessment of alveolar bone destruction cannot discriminate between disease activity and inactivity. These methods can detect only the past tissue destruction<sup>[3],[4]</sup>. So, new diagnostic techniques need to be developed to detect both active and inactive sites.

Cultural test that involve a quantitative anaerobic methods are considered the best means of enumerating actual number of colony forming units (CFU's) present in plaque. But the drawback is uncultured Spirochetes remains undetected. Dark or

phase contrast microscopy has its ability to detect motile bacteria and spirochetes. But most of main putative periodontopathogens including *A g g r e g a t i b a c t e r a c t i n o m y c e t e m c o m i t a n s*, *P o r p h y r o m o n a s g i n g i v a l i s*, *P r e v o t e l l a i n t e r m e d i u s*, *E i k e n e l l a c o r r o d e n s* and *E u b a c t e r i u m* species are non motile and this technique is not able to identify these species. Other methods are Subtraction radiography, Nuclear medicine techniques, Computerized tomography, DNA probing.

BAPNA hydrolysis test is designed to tackle the synthesis of tripsinoid enzyme produced by 3 pathogens:- *P.gingivalis*, *T.forsythus* and *T.denticola*<sup>[5],[6]</sup>. This enzyme not only degrades the extracellular matrix proteins of the host, it is also capable of hydrolyzing the Benzoyl arginine P-nitroanilide and Benzoyl DL-arginine naphtylamide. Several Capnocytophaga and non

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pigmented Bacteroids species are variable in giving a weak BAPNA reaction. Fifty one other plaque species are not able to hydrolyse BAPNA and BANA. BANA hydrolysis will detect *P o r p h y r o m o n a s g i n g i v a l i s* and *T r e p o n e m a d e n t i c o l a* with a sensitivity of 92% and specificity of 70% with highly specific polyclonal antibodies to these organisms in an ELISA assay being used as the reference standard. Early detection of periodontal disease using BAPNA hydrolysis provides rationale for implementing treatment and allows the operator to intercept the disease at a primary level. The testing of innocuous sites in healthy and diseased individuals would help to clarify their true nature at a cellular level and expose vulnerable areas. This quality would also indirectly enable the clinician to monitor sites for the development of active periodontal disease and even predict future

attachment loss. Chair side microbial and enzyme diagnosis are simple rapid and reliable in office tests. So, it was thought to carry out a controlled study with following objectives:-

- 1) To correlate between clinical parameters and BAPNA in periodontal disease.
- 2) To test utility of BAPNA test in clinical trial of efficacy of Metronidazole with and without scaling and root planing.

#### Materials And Methods

The present clinical study included 15 subjects aged between 35 and 65 years of age irrespective of sex were selected. 1607 pockets were observed for the baseline recording of two parameters- BAPNA test and Probing pocket depth. In each patient the maxillary and mandibular arch of any one side, either right or left, was scaled and root planed. and patients were given 400mg Metronidazole tablet three times a day for 7 days and evaluation done after 14 days

#### Patient's Site Category

**Group A** - Subjects on Metronidazole therapy only.

**Group B** - Subjects with combined Metronidazole plus scaling and root planing.

#### Inclusion Criteria

15 patients were selected randomly of age 35-65 years, exhibiting chronic periodontitis who met the following selection criteria

- 1) Patient who complaint of bleeding during brushing of teeth or chewing of food or both, at least for past one week.
- 2) Patient with ten or more than ten natural teeth with clinical evidence of periodontal disease that is deep pocket associated with bleeding on probing were included in the study.
- 3) Individuals without any history of systemic disease.
- 4) Patient without recent history of antibiotic therapy in the last 3 months.

#### Probing Pocket Depth:

Pocket measurements were taken with William's periodontal probe. They were measured at four sites around each tooth that is mesio-buccal, mid buccal/facial, disto-buccal, mid lingual/palatal. Pocket

depths that were measured are classified into 3 ranges: 1-3 mm, 4-6mm, 7mm & more..

#### Armamentarium:

Working solution- 0.174gm BAPNA was dissolved in 5 ml dimethylsulfoxide. 50 ml of trihydrochloride buffer, PH 8.2 and 10 ml of calcium chloride was added to it make the final volume of 100 ml.

#### Principle behind BAPNA test:

When the plaque sample was made to react with the substrate, i.e Benzoyl arginine P-nitroanilide (BAPNA), enzyme produced by the bacteria i.e trypsin acts on the BAPNA reagent producing benzoyl arginine and nitroanilide.

#### Benzoyl arginine p-nitroanilide + water -> Benzoyl arginine +nitroaniline

With the amount of P-nitroaniline released, the colour of the solution changes from colourless to deep yellow. The intensity of yellow colour is directly proportional to the trypsin activity. The working solution is prepared from the stock solution as the diluted trypsin reaction mixture precipitate if kept for more than the required time of 10 days in the refrigerator. So, it is freshly prepared every 10 days. Erlanger described the properties and preparation of BAPNA solution in the similar way<sup>[7]</sup>.

The ability to detect BAPNA hydrolyzing activity in subgingival plaque appears to be a simple & inexpensive means of monitoring periodontopathic bacteria like T. denticola, P. gingivalis & B. forsythus.

#### Plaque Sample Collection:

Subgingival plaque sample was collected with sterilized curettes (Colombia curettes 2R-2L, 4R-4L). This sample was immediately transferred to microtiter plate containing 0.1 ml of BAPNA solution. Plaque sample from the mesial surface of upper right central incisor was transferred to microtiter well labelled A1. Similarly, plaque sample from mid facial area of upper right central incisor was taken to the microtiter well labelled A2, A3 and A4 contained plaque sample from disto-buccal and palatal surface of upper right central incisor. Every fifth well of microtiter plate contained only the BAPNA working solution and not the plaque sample. This would act as a

control for a colour change that were taking place in right and left wells.

#### Enzymatic Procedures:

The sample in BAPNA working solution was incubated for 24 hours at 37°C<sup>[8],[9]</sup>. The colour change was read by naked eye. Similar criteria that was used for the colour change in BANA test (Loesche 1987) was utilized in the present study for BAPNA test. The results obtained for BAPNA were categorized as:

0-No colour change (absence of Treponema denticola, Porphyromonas gingivalis and Bacteroid forsythus)

1-Light yellow (minimum concentration of Treponema denticola, Porphyromonas gingivalis and Bacteroid forsythus)

2-Yellow (medium concentration of Treponema denticola, Porphyromonas gingivalis and Bacteroid forsythus)

3-Deep yellow (maximum concentration of Treponema denticola, Porphyromonas gingivalis and Bacteroid forsythus)

On an average the time taken for the recording was about 30 minutes.

#### Results

In the present study 15 patients were selected and 1607 pockets were observed for the baseline recording of the 2 parameters- BAPNA test and probing pocket depth.

**Group A** - 727 pockets at baseline received only Metronidazole therapy.

**Group B** - 880 pockets at baseline and received Metronidazole plus SRP. Statistical analysis was done in which

**Group A and B** after treatment compared with baseline and **Group A and B** compared to each other after treatment as baseline in both groups were similar.

In BAPNA score '0' maximum distribution in pocket depth of 1-3 mm is 86.02% in **Group A** (baseline) and 84.02% in **Group B** (baseline). In BAPNA score '1' maximum distribution in pocket depth of 1-3 mm is 13.90% in **Group A** (baseline) and 15.64% in **Group B** (baseline). BAPNA score '2' is absent at baseline (**Table-1,3**).

In pocket depth of 4-6 mm maximum

Table 1: Percentage distribution of pocket depth with different BAPNA test scores in Group A at baseline (non scaled sites without Metronidazole therapy)

Bapna Score	0		1		2		Total	
Pocket Depth	N	%	N	%	N	%	N	%
1-3 Mm	196	86.02	32	13.90	0	0	228	100
4-6 Mm	62	18.07	248	72.32	33	9.62	343	100
>7 Mm	0	0	25	16.02	131	83.92	156	100

X<sup>2</sup><sub>4</sub> =728.748, p<0.001

Table 2: Percentage distribution of pocket depths in different BAPNA test scores in Group A after Metronidazole therapy

Bapna Score	0		1		2		Total	
Pocket Depth	N	%	N	%	N	%	N	%
1-3 Mm	205	90.02	23	9.98	0	0	228	100
4-6 Mm	257	75.17	49	14.28	24	6.99	343	100
>7 Mm	66	42.30	20	12.82	50	31.53	156	100

X<sup>2</sup><sub>4</sub> =141.692, p<0.001

Table 3: Percentage distribution of pocket depth with different BAPNA test scores in Group B at baseline

Bapna Score	0		1		2		Total	
Pocket Depth	N	%	N	%	N	%	N	%
1-3 Mm	320	84.02	60	15.64	0	0	380	100
4-6 Mm	38	15.82	176	73.3	26	10.81	240	100
>7 Mm	4	1.53	53	20.43	203	78.32	260	100

X<sup>2</sup><sub>4</sub> =864.492, p<0.001

Table 4: Percentage distribution of pocket depth with different BAPNA test scores in Group B after treatment (scaled sites with metronidazole therapy)

Bapna Score	0		1		2		Total	
Pocket Depth	N	%	N	%	N	%	N	%
1-3 Mm	362	95.42	18	4.58	0	0	380	100
4-6 Mm	192	80.00	28	14.50	20	8.33	240	100
>7 Mm	76	29.24	80	30.76	104	37.24	260	100

X<sup>2</sup><sub>4</sub> =363.888, p<0.001

Table 5: Comparison of BAPNA score in different pockets depths in group A at baseline and after treatment

Pocket Depth	1-3 mm		4-6mm		>7mm	
Bapna Score	Z	P	Z	P	Z	P
0	2.2941	P<0.001	1.2941	P<0.001	0.0000	NS
1	18.6251	P<0.001	18.5166	P<0.001	1.2688	NS
2	9.1492	P<0.001	2.09104	P<0.05	9.2915	P<0.001

Table 6: Comparison of BAPNA score in different pockets depths in Group B at baseline and after treatment

Pocket Depth	1-3 mm		4-6mm		>7mm	
Bapna Score	Z	P	Z	P	Z	P
0	5.02015	P<0.001	5.02015	P<0.001	8.7511	P<0.001
1	14.07043	P<0.001	14.07043	P<0.001	2.93033	P<0.001
2	0.0	NS	2.7138	P<0.01	8.8283	P<0.001

Table 7: Change of BAPNA score with different pocket depths in Group A and B at baseline and after treatment

Bapna Score	0		1		2	
Pocket Depth	Z	P	Z	P	Z	P
1-3mm	3.5969	P<0.01	3.05960	P<0.01	0.0	NS
4-6mm	11.7734	P<0.01	13.0788	P<0.001	0.09299	NS
>7mm	3.0651	P<0.01	2.20505	P<0.05	0.2081	NS

percentage of BAPNA score'0' increases from 18.07% to 75.17% in **Group A**.

This increase was statistically significant (P<0.001). BAPNA score '2' from 9.62% to 6.99% after Metronidazole therapy alone there has been decreased in BAPNA positive periodontopathic bacteria.

**(Table-3, 4 and 6)** BAPNA score' 0' is higher in group B after treatment than baseline(80% to 15.82%) showing statistically significant change. Score '1' is increased significantly from 73.3% to 14.50% in 4-6mm, but there is no appreciable change in score '2'.

When two different treatment modalities were compared it is observed that the percentage increased in BAPNA score '0' is higher in **Group B** than **Group A**.

In **(Table-1 & 2)**, in pocket >7mm the percentage of BAPNA score '2' decreases from 83.92% to 65.81% in Metronidazole therapy while it is 78.32% to 40% in Metronidazole plus scaling root planing.

**(Table 7)** shows the comparison of BAPNA score and pocket depth in Group A and Group B after treatment.

## Discussion

Diagnostic tests should be such that it is cost effective, rapid, useful and ideally leading to a choice of treatment that would be beneficial to the patient. One such diagnostic aid is BAPNA test that not only fulfills all the above requirements but also is hydrolysed by a Trypsin like enzyme released by the putative pathogens like *Treponema denticola*, *Porphyromonas gingivalis* and *Bacteroides forsythus* which are mostly present in all forms of periodontal diseases.

Bretz reported that there was no difference in hydrolysis of BANA and BAPNA substrates and both of them gave similar results<sup>[10]</sup>. Tsustui (1987) isolated the trypsin like enzyme from *Bacteroides gingivalis* which hydrolysed BAPNA<sup>[11]</sup>.

In the present study 15 patients were selected and 1607 pockets were observed for the baseline recording of the 2 parameters-BAPNA test and probing pocket depth. In each patient the maxillary and mandibular arch on any

one side either right or left was scaled and root planed. The patients were then given oral metronidazole therapy which showed its effect on both the arches while the other was local that is scaling and root planning, which was done in only two selected quadrants. So each patient received 2 different lines of treatment. Two quadrants received only metronidazole therapy and the other 2 quadrants received combined metronidazole and scaling and root planing.

In pockets of 1-3 mm BAPNA score is negative in maximum number of pockets in score '0'. That means absence of *T. denticola*, *P. gingivalis* & *B. forsythus*. The results of our study are in harmony with the result of Loesche et al (1987) who in their study determined the relationship of the BAPNA / BANA test and probing pocket depth. They found that sites with pocket depth of 2 or 3 mm had significantly lower proportion of Spirochetes and only 10% gave BANA / BAPNA positive reactions<sup>[12]</sup>.

In pockets of 4-6 mm show weak BAPNA positive reaction that is minimum concentration of *T. denticola*, *P. gingivalis*, *B. forsythus*. The result are in accordance with the study of Loesche et al (1987) who showed that probing depth of 4 mm had 16% Spirochetes but were also associated with 26% BANA / BAPNA positive reactions and half of them were of weakly positive type. 5-6mm deep sites exhibited a significant increase in the proportion of spirochetes but the average value of 30% Spirochetes was associated with 52-57% of positive BANA / BAPNA reactions with the majority being of the positive type (score 2)[12]. In pockets of >7 mm range maximum pockets with positive BAPNA score i.e maximum concentration of *T. denticola*, *P. gingivalis* & *B. forsythus*.

After metronidazole therapy in pockets of range 1-3 mm, 4-6 mm and >7 mm there is increase in BAPNA negative sites. There is also increase in BAPNA negative sites treated with scaling and root planing. The BAPNA negative sites are much more in metronidazole plus SRP as compared to metronidazole alone but in >7mm there is not much change in two groups<sup>[13]</sup>. This could be explained by the fact that at pockets of greater than 6 mm, the efficacy of mechanical debridement decreases due to instrument

inaccessibility of deep root surfaces and furcations. These sites however, are apparently bathed by sufficient levels of Metronidazole to effect a significant reduction in BAPNA positive periodontopathic bacteria.

So, it has been shown that BAPNA positive sites are converted to BAPNA negative sites which reduces the need of surgical intervention. This is dependent on host factors like host immune responses or maintenance of oral hygiene by patient at optimum level. These factors determine the tooth's sites specific response to a certain extent. The important utilization of BAPNA test would be its ability to diagnose anaerobic infection which enables the clinician to prescribe Metronidazole as an adjunct to SRP. The most important property of BAPNA test is that it indicates future attachment loss. Positive BAPNA test following active initial therapy supports this statement.

### Conclusion

BAPNA hydrolysis by the plaque bacteria that is *P.gingivalis*, *T. denticola*, *B. forsythus* utilized for the management of anaerobic infections in periodontal disease. BAPNA test forms a basic forms a basis for the diagnosis of anaerobic infection. So, BAPNA test is reliable, easy & predict future attachment loss indicating a helpful technique for management of periodontally diseased patients.

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## Dental Arch Width As Related To Intercondylar Distance

### Abstract

A Correlation between craniofacial skeleton and dental structures has attracted researchers since ages. Such correlations when found help us as guidelines in prosthetic rehabilitation of patients. This study was planned to find a correlation between intercondylar width and dental arch width in molar and canine region. Cephalometric analysis was used to group patients under different face forms. Results showed a definite correlation between dental arch width in intercanine region and intermolar region with intercondylar width. Different face forms have definite relationships for these measurements, typical among themselves.

### Key Words

Intercondylar width, dental arch, intercanine width, intermolar width, cephalometric, face forms.

### Introduction:

The influence of the craniofacial region on the dental structures has been an area of great interest to research workers in dentistry. Various investigators from time to time have tried to ascertain the possibilities of correlation among the various craniofacial and dental width dimensions and have come up with varying results. Studies of growth and development of the craniofacial complex indicate the interdependence of growth of the cranial base and mandibular condyles. Notable in this are the studies of Hardlicka(1940)<sup>[3]</sup> and Heneriques (1953)<sup>[6]</sup> in which they observed similar trend of growth for the intercondylar width and dental arch width. Frankel & Kronmann (1966)<sup>[11]</sup> found a correlation among above dimensions and hypothesised that mandibular arch width in first molar area is governed by the growth in width of the cranial base.

The present study comprised of twenty-five north Indian subjects of each sex aged between 18 to 28 years. All subjects were healthy with properly aligned arches and with no H/O orthodontic treatment.

The impressions of mandibular dental arches were made for dental arch width measurements with irreversible hydrocolloid impression material using perforated stock trays. Impressions thus obtained were poured immediately in dental stone. The following measurements were then made on the mandibular casts.

1. Mandibular intermolar width (B) : Measured between two points at the greatest heights of contour on the buccal side of the buccal developmental groove of the first molar teeth on either side (Williams 1917)<sup>[2]</sup>

2. Mandibular Intercanine width (C) : Measured between two points at the greatest height of contour at vertical line drawn from the tip on the labial side of canines on either side (Williams 1917)<sup>[2]</sup>

Postero-anterior cephalograms of all subjects were taken with 'Universal Cephalostat' using standard brand of X-ray film. The films were developed using standard dark room technique.

Cephalograms were traced on acetate paper and following landmarks were located:-

**EURYON (E & E')** : -A point located over each parietal bone at the greatest transverse diameter measured in the horizontal plane above the supero-

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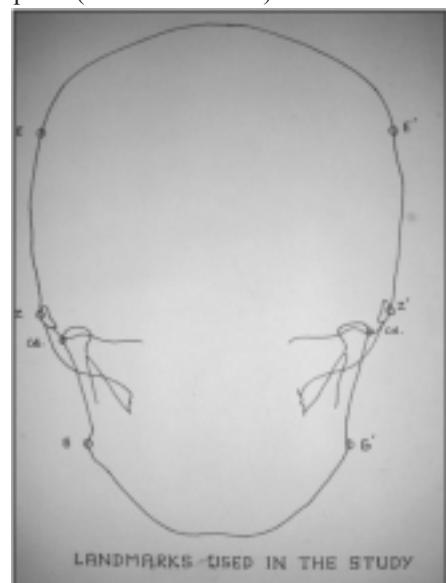
mastoid and zygomatic crest (Salzmann 1966)<sup>[12]</sup>

**ZYGION (Z & Z')** : -The most lateral point on the zygomatic bone. (Sassouni 1957)<sup>[7]</sup>

### Lateral Pole Of The Mandibular CONDYLE (Cd & Cd')

**CONDYLE (Cd & Cd')** : The most lateral projection of the mandibular condyle.

**GONION (G & G')** : The most lateral point at the gonial region in the horizontal plane (Richardson 1967)<sup>[13]</sup>.



### Aims & Objectives:

Taking clues from above studies this study was undertaken to help prosthodontists to be able to arrange and verify the posterior teeth in most physiologic position in complete denture cases. To be able to make the study more discrete subjects were grouped under different face forms after cephalometric analysis.

### Material & Methods:

The following widths were measured on the tracings obtained from the cephalograms:

### 1. INTERCONDYLAR DISTANCE

(A) : Maximum transverse distance measured between lateral poles of the two mandibular condyles ( $Cd-Cd'$ ).

### 2. Determination Of Skeletal Face Form-

Square Face Form	$\angle E'E'Z = 810 - 900$
	$\angle ZZ'G = 810 - 900$
Tapering Face Form	$\angle E'E'Z = 810 - 710 \text{ OR LESS}$
	$\angle ZZ'G = 810 - 710 \text{ OR LESS}$
Square - Tapering Face Form	$\angle E'E'Z = 810 - 900$
	$\angle ZZ'G = 810 - 710 \text{ OR LESS}$
Ovoid Face Form	$\angle E'E'Z = \geq 900$
	$\angle ZZ'G = \leq 840$

Where:-

$\angle E'E'Z$  - is the angle formed at the point Euryon by the lines joining the corresponding Zygion and Euryon on the other side (upper face angle).

$\angle ZZ'G$  - is the angle formed at the point Zygion by the lines joining the corresponding Gonion and Zygion on the other side (lower face angle)

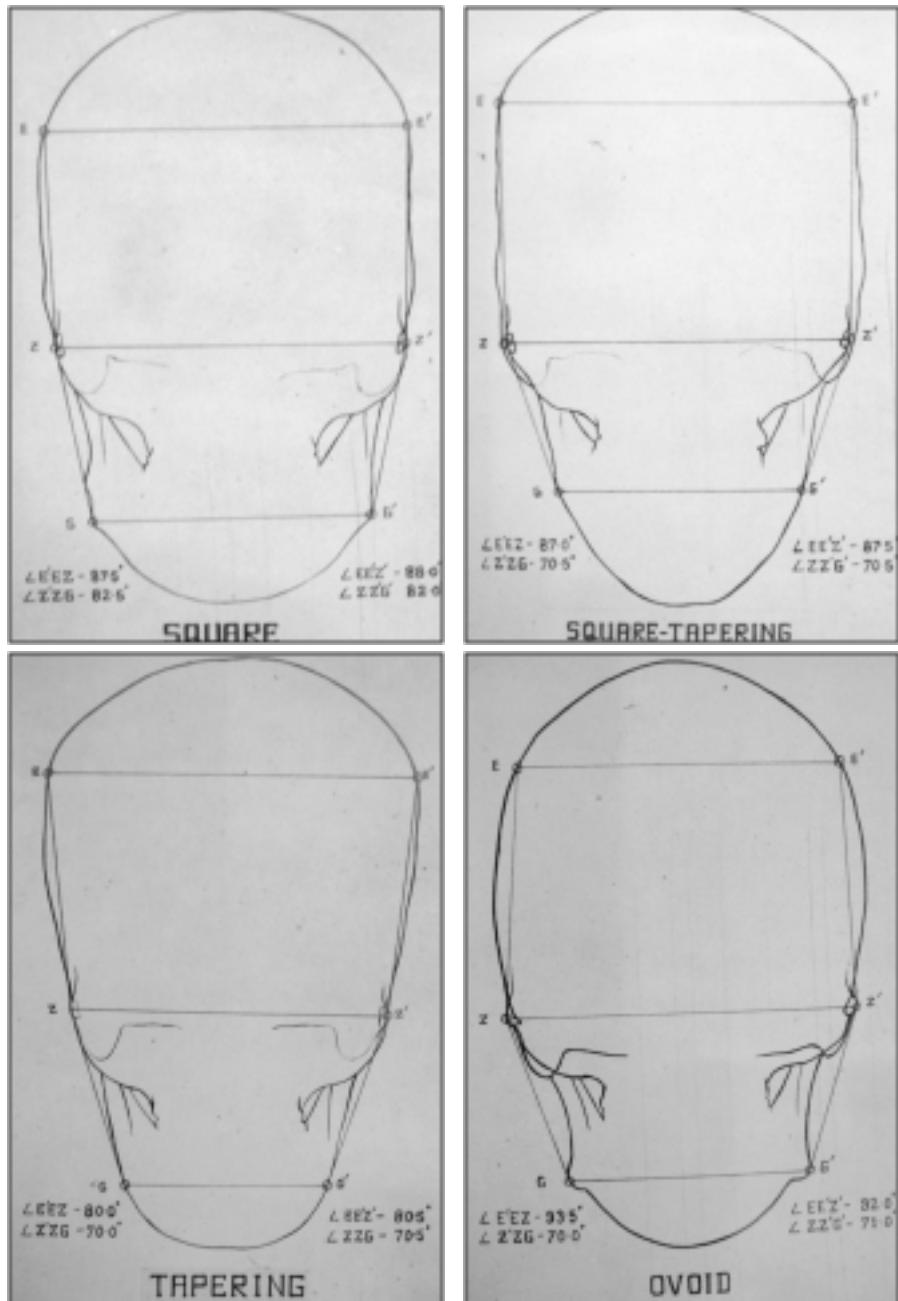
### Observations:

- It was observed that the ratio of "Bicondylar Width" (A), "Intermolar" (B) and "Intercanine" widths in overall sample was = 4.02 : 1.81 : 1.
- For males this correlation ratio was= 4.02 : 1.79 : 1.
- For females this ratio was = 4.02 : 1.83 : 1.
- There was a statistically significant difference ( $P = 0.001$ ) between the mean values of three width measurements of males and females. Mean values of all the measurements were found greater for males.
- Distribution of subjects according to skeletal face form was as follows:-

Face Form Sex	Square	Tapering	Square - Tapering	Ovoid
Male = 25	3	0	21	1
Female = 25	2	6	16	1
Total = 50	5	6	37	2

- Three width measurements on the basis of skeletal face forms were as follows:-

Mean Values Groups	Intercondylar	Intermolar	Intercanine
Square	11.74	5.35	2.92
Tapering	11.00	5.05	2.78
Square-Tapering	11.89	5.24	2.96



\*a very small sample of ovoid face form (2) was found, hence not considered significant for computing and tabulation

- The ratio of above observations was:-

Mean Values Groups	Intercondylar	Intermolar	Intercanine
Square	4.01	1.83	1
Tapering	3.96	1.81	1
Square-Tapering	4.01	1.77	1

### Discussion:

The present study was based upon the

hypothesis that there exist varying correlations among various craniofacial and dental arch width dimensions; there could be a positive correlation between dental arch width and intercondylar distance.

This would provide an objective guideline to the Prosthodontist for the optimal placement of artificial posterior teeth particularly in mutilated and challenging cases.

The observation of overall samples when analyzed as a whole, the mean values of intercondylar, intermolar and Intercanine widths showed a ratio of 4.02: 1.81: 1. When same ratio was analysed separately

for males and females, almost similar ratio was observed with a negligible variation of + 0.02 in intermolar widths. The mean ratio for intermolar width in females (1.83) was higher as compared to males (1.79), was due to the fact that the mean values of all the three measurements were lesser than those in males; & this was because the Intercanine width in females was lesser in proportion, the effect of which on ratio showed apparent higher value of intermolar width. This signifies that the position of canines have direct bearing upon the dental arch form.

Furthermore the Intercanine and intercondylar distances showed constancy in proportions for overall samples as well as in gender variation. This signifies that the dental arch width in the canine region has more constant relationship with the intercondylar distance.

The mean values of three width dimensions were analysed in the three face forms. It was observed that the mean values of all the three measurements varied in different face forms. This showed the possibility of dominance of corresponding dental arch forms. The square and square-tapering groups showed significant positive correlation among the three dimensions.

Although the difference of mean values of square and square-tapering face forms was not significant, the tapering face group showed a significant difference which signifies the dominance of its typical arch form. These findings are in accordance to the findings of Agarwal, Tandon and Arora (1977)<sup>[16]</sup>. This shows that the ratios of the said dimensions is fairly constant for corresponding face forms.

A negative correlation for both sets of measurements was observed in tapering face group. Although it was found statistically insignificant, it could be because of narrowing of arches with the increase in intercondylar distance. This seems to be an important finding of the study but needs to be further investigated.

A positive correlation was observed

between intercondylar and intermolar width dimensions for the overall samples. This finding is in accordance to the findings of Frankel & Kronmann (1966)<sup>[11]</sup>. This confirms that intercondylar distance and dental arch width in 1st molar region have definite correlation between them. A highly significant positive correlation was observed between intercondylar distance and Intercanine width for females. However an insignificant positive correlation was observed for the same in males. The cause of this variation need to be further investigated.

### **Conclusions:**

To ascertain the possibilities of correlation between mandibular dental arch width and intercondylar distance, the present study was conducted on adult North Indian subjects. The following conclusions were drawn:-

1. A definitive correlation does exist between intercondylar distance and mandibular arch width.
2. The overall analysis showed more strong relationship of Intercanine width with intercondylar distance.
3. The three widths have a definitive ratio among them.
4. Different face forms have definite relationships for these measurements, typical among themselves.
5. In tapering face form, dental arch has a tendency to narrow down with increase of intercondylar distance and vice-versa.

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## Correlation Of Brain Function With Haemoglobin Level Among Dental Students

### Abstract

Nutrition is a fundamental pillar of human life. Nutrition by affecting the brain function may influence the occupational performance of an individual. This study was designed to evaluate the co-relationship between the brain function and hemoglobin level of more than 200 students studying dentistry for assessing the possible impact of nutritional status on brain function. Study was conducted in two stages; first stage involved estimation of hemoglobin and the second stage involved assessment of brain function test by 3 set of tests based on self answering questionnaires. Results of our study show that the quality of brain function does depend but not limited to the hemoglobin level of the study participants.

### Key Words

Nutritional status, Hemoglobin, Anemia, Brain Function, Work pattern, Cognition.

### Introduction

Nutrition by affecting the brain function may influence the occupational performance of an individual.<sup>[1],[2]</sup> Many investigators have found that iron deficiency anaemia has a great influence on brain functioning in infants and children.<sup>[3],[4],[5],[6],[7],[8],[9],[10],[11]</sup> Studies related to this in adult population are few and the outcomes are inconclusive.<sup>[12],[13],[14],[15],[16],[17],[18]</sup> However inadequate nutrition during adulthood may lead to decreased work efficiency and poor exercise tolerance. Keeping this in view our study was designed to assess the possible impact of nutritional status on brain function among dental students; as the profession of dentistry requires keen recognizing abilities, decision making skills and ample physical stamina.

### Materials And Method

After obtaining the ethical clearance from the concerned authority, students of dental sciences were registered for further procedure. First stage of the study involved estimation of haemoglobin level of the participants, by Sahli's method. The second stage of the study involved assessment of the brain function using three set of tests that involved self answering questionnaires.

The first test represented learning style

inventory by which learning experience of an individual was analyzed. This inventory contained statements reflecting dependant or directive learning preference, collaborative learning preference and independent learning preference. This practical model is developed by Ronne Toker Jacobs and Barbera Schneider Fuhrmann.<sup>[19]</sup> As the original inventory did not offer the grading system, it was modified accordingly for the use in our study [Table-1]. The questionnaire contained thirty-six exercises.

The second test (Inventory of Barriers to Creative Thought and Innovative Action) was adopted to identify and measure the degree of inhibitors affecting a person's ability to create and innovate. The questionnaire consisted of thirty-six exercises, set up in a six point Likert-scale format. Each trait was graded according to the scores obtained for classifying each trait into different categories [Table-2,3,4]. The original inventory was developed by Lorna P Martin.<sup>[19]</sup> This test identifies barriers related to concept of self, need for conformity, ability to abstract, ability to use systematic analysis, task achievement and physical environment. Out of these six traits only scores indicating barriers related to concept of self, task achievement and physical

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Tables-1, Grading For Learning Style Inventory, (Test-1)

Score	Category	Grade
1-7	Very Poor	I
8-14	Poor	II
15-21	Average	III
22-28	Good	IV
29-36	Very Good	V

Table-2, Grading For Confidence Level, (Test-2A)

Score	Category	Grade
36-31	Total Lack Of Confidence	I
30-25	Less Confident	II
24-19	Somewhat Confident	III
18-13	Confident	IV
<13	Highly Confident	V

Table-3, Grading For Work Pattern, (Test-2B)

Score	Category	Grade
36-31	Highly Restricted	I
30-25	Restricted	II
24-19	Somewhat Restricted	III
18-13	Less Restricted	IV
<13	Non Restricted	V

Table-4, Grading For Physical Distraction, (Test-2C)

Score	Category	Grade
36-31	Highly Distracted	I
30-25	Distracted	II
24-19	Somewhat Distracted	III
18-13	Less Distracted	IV
<13	Not At All Distracted	V

Table-5, Grading For Cognitive Style, (Test-3)

Score	Category	Grade
Sys & Int Both Below 60	Undifferentiated	I
Sys Below 60; Int 80-100	Intuitive	II
Sys 60-80; Int 60-80	Split	III
Sys 80-100; Int 80-100	Integrated	IV
Sys 80-100; Int Below 60	Systematic	V

Table-6, Comparison Between The Grades Of Test-1 And Hb%.

Test-1	Female			Male		
	n (%)	Mean Hb%	Std. Dev. Hb%	n (%)	Mean Hb%	Std. Dev. Hb%
I	0	-	-	0	-	-
II	6 (4%)	9.30	± 0.94	1 (2%)	10.40	± 0.0
III	11 (8%)	10.69	± 0.88	7 (12%)	11.51	± 0.60
IV	60 (40%)	10.55	± 0.93	25 (45%)	11.66	± 0.95
V	73 (48%)	10.36	± 1.03	23 (41%)	11.85	± 0.80

Table-7, Comparison Between The Grades Of Test-2a And Hb%.

Test-1	Female			Male		
	n (%)	Mean Hb%	Std. Dev. Hb%	n (%)	Mean Hb%	Std. Dev. Hb%
I	0	-	-	0	-	-
II	12 (8%)	10.60	± 0.98	4 (7%)	11.65	± 0.34
III	52 (35%)	10.48	± 0.99	17 (30%)	11.39	± 0.78
IV	71 (47%)	10.40	± 1.02	32 (57%)	11.83	± 0.87
V	15 (10%)	10.11	± 0.97	3 (6%)	12.07	± 1.45

environment were considered for evaluation; as remaining ones were found to be insignificant for our study objectives.

The questions evaluating confidence level examined variables associated with individual's self esteem, self confidence, handling of rejection and ability to confront differing opinions. Work pattern was determined by exploring variables associated with individual's task achievement qualities, attitudes toward others and resourcefulness. Questions determining physical distraction examined variables associated with individual's preferences as to physical surroundings, dealing with distractions, use of personal space and need for privacy.

The third test evaluated Cognitive Style. The questionnaire consisted of forty exercises, half of which pertained to the systematic style and half to the intuitive style set up in a six point Likert-scale format.<sup>[19]</sup> [Table-5] The test identified patterns of behaviour that demonstrate a person's approach to critical activities. This multidimensional model of cognitive style reflecting people's behaviour with regard to thinking, learning, especially problem solving and decision making, was created by Martin, where as the descriptions of the systematic and intuitive styles were based on the model created by Kenney & Keen.<sup>[19]</sup>

The study participants were asked to identify and to 'tic' mark for the appropriate answer key, and scoring was done accordingly.

### Results And Discussion

The cross-sectional study was designed and conducted in the Department of Oral Medicine and Radiology, Darshan Dental College & Hospital, Udaipur, Rajasthan. A total of 206 participants involving undergraduate and postgraduate students of the institution were evaluated, out of which 150 (73%) were female, and 56 (27%) were male candidates.

The first stage of the study revealed that the mean haemoglobin level of female participants was 10.4gm/dL and that of male participants was found to be 11.6gm/dL. Only 13 (8%) female participants had the haemoglobin level within the normal range.

On evaluating the results of the first brain test representing Learning Experience it was found that no participant scored Grade-I, and the minimum score (Grade-II) obtained by the female participant(n=1) was 12 and by the male participant (n=1) was 14, and their corresponding haemoglobin levels were 10g/dL and 10.4g/dL respectively. The maximum test score (Grade-V) was 36 in females (n=1) and 34 in males (n=1), their corresponding haemoglobin levels were 12g/dL and 12.6g/dL. The scores of the majority of individuals (n=96; f=73; m=23) ranged between 29 and 36 (Grade-V), and their corresponding mean haemoglobin level was 10.36g/dL and 11.85g/dL respectively. [Table-6]

The outcome of first brain function test revealed that no participant had very poor learning experience, whereas majority of female and male participants scored good and very good scores. [Table-6] The observations of our study indicate that better learning experience was associated with higher haemoglobin level in both female and male participants. Correlation of different grades of this test with haemoglobin level revealed significant results in female participants ( $R=0.05$ ) and male participants ( $r=0.21$ ) [Table-11]. Similar observations have been reported by R. Bandhu<sup>[4]</sup>, Gabr M. Sayed<sup>[5]</sup>, D. Ivanovic<sup>[2]</sup>, R. Sungthong<sup>[7]</sup>, and A. Nemati<sup>[10]</sup>.

On evaluating the scores representing Confidence Level it was found that minimum score (Grade-V) attained by the female participant (n=1) was 11 and by the male participant (n=1) was 9, and their corresponding haemoglobin levels were 12.4g/dL and 12g/dL. The maximum score (Grade-II) in female and male participants was 28 (n=1) and 33 (n=1), and their corresponding haemoglobin levels were 10.6g/dL and 10.4g/dL. The majority (n=103; f=71; m=32) had score between 13 and 18 (Grade-IV), their corresponding mean haemoglobin level was 10.40g/dL and 11.83g/dL respectively. [Table-7]

The above findings suggest that individuals with who were found to be more confident were having higher haemoglobin level compared with the individuals who were less confident.

On evaluating the scores representing

Table-8, Comparison Between The Grades Of Test-2b And Hb%.

Test-1	Female			Male		
	n (%)	Mean Hb%	Std. Dev. Hb%	n (%)	Mean Hb%	Std. Dev. Hb%
I	0	-	-	0	-	-
II	0	-	-	1 (2%)	10.60	±0.0
III	32 (22%)	10.21	±1.17	14 (25%)	11.31	±0.71
IV	92 (61%)	10.46	±0.97	30 (53%)	11.89	±0.80
V	26 (17%)	10.53	±0.85	11 (20%)	11.77	±1.04

Table-9, Comparison Between The Grades Of Test-2c And Hb%.

Test-1	Female			Male		
	n (%)	Mean Hb%	Std. Dev. Hb%	n (%)	Mean Hb%	Std. Dev. Hb%
I	0	-	-	0	-	-
II	0	-	-	2 (4%)	11.90	±0.14
III	38 (25%)	10.33	±1.14	17 (30%)	10.76	±0.84
IV	75 (50%)	10.36	±0.93	32 (57%)	10.77	±0.83
V	37 (25%)	10.63	±0.98	5 (9%)	10.71	±1.29

Table-10, Comparison Between The Grades Of Test-3 And Hb%.

Test-1	Female			Male		
	n (%)	Mean Hb%	Std. Dev. Hb%	n (%)	Mean Hb%	Std. Dev. Hb%
I	4 (3%)	11.20	±0.98	4 (7%)	11.35	±0.72
II	2 (2%)	9.80	±0.0	1 (2%)	10.40	±0.0
III	123 (82%)	10.39	±1.02	41 (73%)	11.65	±0.87
IV	16 (11%)	10.55	±0.85	5 (9%)	12.08	±0.77
V	5 (3%)	10.24	±0.89	5 (9%)	12.24	±0.59

Table-11, Results Of Statistical Analysis For Coeficiency Of Correlation

Coef. Of Correlation ( $r$ )	Test-1	Test-2A	Test-2B	Test-2C	Test-3
Male ( $r$ )	0.21	0.20	0.25	-0.09	0.28
P - Value	≤0.05 (S)	≤0.05 (S)	0.05 (S)	NS	≤0.05 (S)
Female ( $r$ )	0.05	-0.11	0.10	0.10	-0.05
P - Value	≤0.05 (S)	NS	0.05 (S)	≤0.05(S)	NS

Work Pattern it was found that minimum score (Grade-V) attained by the female participant (n=1) was 8 and by the male participant (n=1) was 7, and their corresponding haemoglobin level was 12.2g/dL. The maximum score (Grade-III) in female (n=3) was 22 and their corresponding haemoglobin levels were 9.6g/dL, 10g/dL and 11.4g/dL respectively. The maximum score (Grade-II) in male participant (n=1) was

27, and his corresponding haemoglobin level was 10.6g/dL. The majority (n=122; F=92; M=30) had score between 13 and 18 (Grade-IV), and their corresponding mean haemoglobin levels were 10.46g/dL and 11.89g/dL respectively. [Table-8]

On evaluating the scores representing Physical Distraction it was found that minimum score (Grade-V) attained by the female participants (n=2) was 8 and their corresponding haemoglobin levels were 11.2g/dL and 11.6g/dL. The minimum score (Grade-V) by the male participant (n=1) was 10, and his corresponding haemoglobin level was 12.6g/dL. The maximum score (Grade-III) in female (n=2) was 23 and in male participants (n=1) was 26 (Grade-II) respectively. The corresponding haemoglobin levels of these two female participants were 10g/dL and 11g/dL. The haemoglobin level of the male participant was found to be 12g/dL. The majority (n=107; f=75; m=32) had score between 13 and 18 (Grade-IV) and their corresponding mean haemoglobin level was 10.36g/dL and 11.74g/dL respectively. [Table-9]

Net outcome of second set of test revealed that no study participant scored grade 1, and maximum number of participants scored grade 4 indicating good level of confidence, less restricted work pattern and less amount of physical distraction respectively [Table-7,8,9]. Coefficient of Correlation of different grades of each of the three parameter of second test with haemoglobin level revealed significant results for work pattern and physical distraction ( $r=0.1$  &  $0.1$ ) among female participants, and for confidence level and work pattern among male participants ( $r=0.20$ ,  $0.25$ ). [Table-11] Similar observations have been made by MJ Kretsch. [12]

Evaluation of results of the third test representing Cognitive Style revealed that minimum score (Grade-I) obtained by the female participant (n=1) was Sys-58; Int-61 and male participant (n=1) was Sys-57; Int-58. The maximum score (Grade-V) in female participant (n=1) was Sys-94; Int-64 and in male participant (n=1) was Sys-94; Int-64. It was found that majority of study participants (n=164; f=123; m=41) had scores in the following range Sys-60 to 80; Int-60 to 80 (Grade-III). The

haemoglobin level of female and male participant who were having minimum score (Grade-I) in the above test was found to be 10g/dL and 10.4g/dL and maximum score (Grade-V) was found to be 12.2g/dL and 11.8g/dL respectively. The majority of females and males had mean haemoglobin of 10.39g/dL and 11.65g/dL respectively. [Table-10]

The above findings revealed that very few study participants had entirely intuitive approach or systematic approach in solving problems. Majority had the split style that showed individual rating in the middle range on both the systematic and the intuitive scale, involving fairly equal (average) degrees of systematic and intuitive specialization. The observations further indicate that better cognitive ability was associated with higher haemoglobin level among female and male participants. Coefficient of Correlation of different grades of this test with haemoglobin level revealed significant results in females ( $r=-0.05$ ) and male participants ( $r= 0.28$ ). [Table-11]

## Conclusion

The impact of nutrition on intelligence is one of the most important factors in understanding the differences in brain function among humans. Nutrition by affecting the brain function may influence the occupational performance of an individual. [11],[2],[5] In last two decades, many interdisciplinary studies have been carried out to determine the factors that influence functioning of brain. One theory is partially accepted is that anaemia via cerebral hypoxia and other possible mechanisms, to have a major influence on brain function. [6],[7],[8]

To best of our knowledge no previous reports are available regarding any study been conducted on students of dentistry. The criteria for planning the study are derived from suggestions made by Paul B Jacobson, [13] Te Pin NG, [14] and Duska Petranovic. [3] Almost all the studies that were referred dealt only with the influence of nutrition upon cognitive abilities. Our study involved assessment of personal skill as well as overall brain function of students of dentistry as the profession of dentistry demands keen ability to recognize, understand and apply the knowledge of the science, as well as ample physical stamina to perform operative procedures and

withstanding stress.

Observations of our study indicates that the performance of the study participants depended significantly on the level of haemoglobin concentration and the correlation was directly proportional in majority of study objectives. At the same time the non significant results of our study dose remind us about the fact that the brain function also depends on other factors especially the interest of doing and the basic knowledge about the system. We recommend further studies in this regard.

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## Comparative Evaluation Of Salivary Contamination On Shear Bond Strength Of One Step Self Etching Adhesive Systems - An Invitro Study

### Abstract

The aim of this study was to evaluate (1) The effect of salivary contamination before and after curing of one step Self Etching Bonding Agents ,(2) Efficacy of decontamination method on shear bond strength (3) Effect of reapplication of bonding agent on shear bond strength. A total of one hundred and five freshly extracted maxillary premolar teeth were mounted in a cylindrical mould filled with self curing denture base resin. The specimens were randomly divided into three major groups (Group A, B, C) according to salivary contamination protocol. Group A (salivary contamination was done before curing of bonding agent), Group B (salivary contamination was done after curing of bonding agents), and Group C served as control in which no salivary contamination was done. The results showed statistically significant difference between group A, Group B and control. A2 subgroups, showed lowest bond strength ( $p<.01$ ) Subgroup B3 yielded the highest bond strength. Salivary contamination and decontamination methods significantly affected the bond strength of one step self etching adhesive system to dentin regardless of the adhesive systems evaluated.

### Key Words

Salivary contamination, Self etch adhesive systems, shear bond strength

### Introduction

Adhesive dentistry has revolutionised restorative dental practice during the last 30 years. Improved adhesive materials have made resin based composite restorations more reliable and long lasting<sup>[1]</sup>. With continuous improvement in material science, the indications for composites have progressively shifted from the anterior to the posterior segments of the dental arches<sup>[2]</sup>. Clinicians are encouraged to place resin composites in increments to ensure complete polymerization of large restorations<sup>[3]</sup>.

It has been hypothesized that dentin surface can absorb salivary glycoprotein, rendering the surface less favourable to bonding<sup>[4]</sup>. The so called one bottle systems have gained broad acceptance based on the hypothesis that the hydrophilic adhesive solutions in particular the acetone or ethanol based products, may displace or diffuse through a saliva film to reach the underlying hydroxyapatite or collagen as a condition for firm bonding after polymerization.<sup>[5]</sup>

The purpose of this study was to evaluate (1) The effect of salivary contamination before and after curing of one step self etching bonding agents , (2) efficacy of decontamination method on shear bond strength, (3) effect of reapplication of bonding agent on shear bond strength.

### Methods And Materials.

Bonding agents were applied according to manufacturer's instructions. All teeth were restored with Filtek Z250 (3M ESPE, St Paul, MN, USA). A total of one hundred and five freshly extracted non carious permanent intact maxillary premolar teeth were selected for this study. Following extraction, teeth were cleaned by removing any remaining soft tissue tags and then stored in 0.5% thymol solution along with distilled water at 4°C.

### Sample Preparation

Teeth were mounted in a cylindrical mould filled with self curing denture base resin upto cervical region (**Fig 1**). Occlusal surfaces of teeth were reduced along the long axis of the tooth on a water cooled, model trimming wheel to create a

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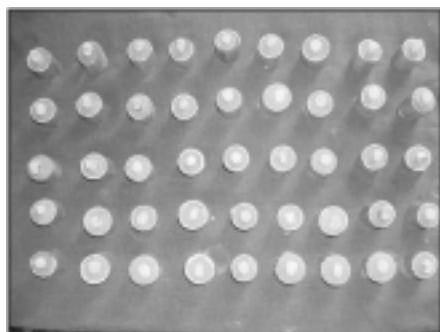


Fig 1 Mounted Samples

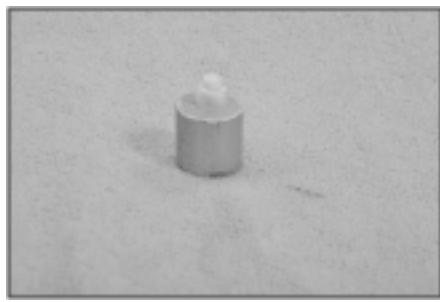


Fig 2 Occlusal Surface Ground

flat dentin surface (**Fig 2**). Immediately prior to the bonding procedure, fresh human saliva was collected from a single individual. The specimens were randomly divided into three major groups (Group A, B, C) of 45 samples each according to salivary contamination protocol. Group A (salivary contamination was done before curing of bonding agent), Group B (salivary contamination was done after curing of bonding agents) and Group C served as control in which no salivary contamination was done. These groups were further subdivided into three subgroups (I, II, III) of 15 samples each according to bonding agents used which were Xeno III, Adper SE Plus, Clearfil S3. These subgroups were further divided into three mini groups (A1, A2, A3, B1, B2, B3) of 5 samples each, according to decontamination method undertaken. Control Group was divided into three subgroups of 5 samples each (I, II, III) according to bonding agents used, in which no contamination or decontamination protocol was undertaken.

#### Methodology:

**Control Group (C).** Adhesive was applied to dentin surface according to the manufacturer's instructions and cured. A tube of an internal diameter 5mm was cut into 2 mm long pieces using a measuring gauge and BP Knife blade to ensure parallel ends. These tubes were placed on the teeth. Resin composite Filtek Z250 (3M ESPE) was carried into the tubes with the help of composite placing instrument, and was cured with the curing light for 20 seconds. The tubes were carefully removed with the scalpel blade prior to testing. All specimens were stored in distilled water at 37°C for 24 hours.

**Group A** Bonding procedure was carried out as in control; however fresh saliva was applied with an applicator tip to dentin bonded layer before light curing of bonding agent and was left undisturbed for 15 seconds.

#### Subgroups were as follows:

##### SubGroups

**A1:-** Saliva was removed with a gentle air blast. Adhesive was not reapplied. The adhesive was light cured for 20 seconds.

**A2:-** Saliva was rinsed with an air water spray from an air water

syringe for 10 seconds and then dried with a gentle air blast. The adhesive was then light cured for 20 seconds.

##### A3:-

Saliva was rinsed dried as in A2, a single coat of adhesive was reapplied to dentin surface and light cured for 20 seconds.

#### Group B

Bonding procedure was carried out as in control; however surface was contaminated with fresh saliva after curing the adhesive. The saliva was left undisturbed for 15 seconds and decontamination protocol was followed as described earlier leading to formation of subgroup B1, subgroup B2 and subgroup B3.

Specimens in each group were tested in shear mode using chisel shaped rod in an universal testing Machine (Model 5582, Instron). A shear force was applied to each specimen at a crosshead speed of 1 mm/minute (**Fig 3**). The microshear bond strength was calculated by dividing maximum load at failure by cross sectional surface area of the bonded surface using the formula SHEAR STRESS=LOAD(N)/AREA(mm<sup>2</sup>)

Stress was recorded in Mega Pascal(MPa). Load was recorded in Newton (N). Area was calculated by using formula  $\pi r^2$ . Radius of the tube was 2.5mm, so by applying the formula calculated area was 19.625 mm<sup>2</sup> for each specimen.

#### Statistical Analysis

The data was subjected to unpaired t Test to make comparison among the groups (**Fig 4**)

#### Results

**Table 1** summarizes the mean shear bond strengths in MPa and standard deviation for the different groups and subgroups (Mean  $\pm$  SD). Statistically significant difference between Group A, Group B and control were observed.

When an intergroup comparison of the shear bond strength values between the subgroups of all the three adhesives, significant difference was observed for A1-B1, A2-B2 and A3-B3.

By using unpaired t test, a significant level of difference between A1-A2, A2-A3, A1-A3 and B1-B2, B2-B3, for the

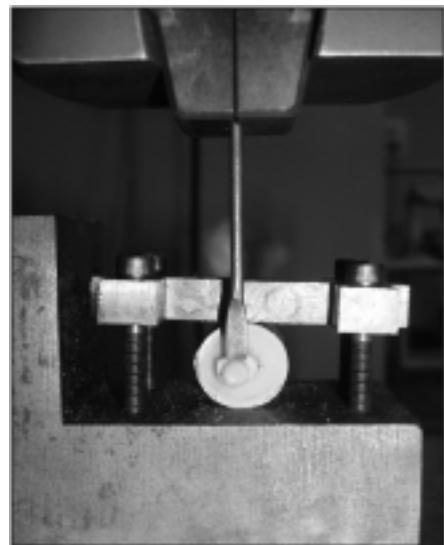


Fig 3 Application Of Shear Force

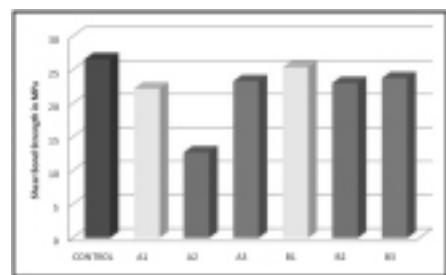


Fig 4 Statistical Analysis

Table 1 Summarizes the mean shear bond strengths in MPa and Standard Deviation for the different groups and subgroups (Mean  $\pm$  SD)

Groups	Xeno III	Adper SE	Clearfil S3
C	26.61 $\pm$ 1.5936	24.694 $\pm$ 1.6645	25.2 $\pm$ 1.2257
A1	20.228 $\pm$ 0.7476	21.518 $\pm$ 1.1650	19.48 $\pm$ 0.7789
A2	12.72 $\pm$ 1.2727	13.596 $\pm$ 0.7980	12.606 $\pm$ 0.6431
A3	23.322 $\pm$ 0.9058	22.4 $\pm$ 1.0275	20.594 $\pm$ 1.1452
B1	25.398 $\pm$ 0.8992	19.81 $\pm$ 1.2767	22.792 $\pm$ 1.2440
B2	23.048 $\pm$ 0.8992	15.6 $\pm$ 1.0539	21.786 $\pm$ 0.7933
B3	25.774 $\pm$ 1.0229	20.158 $\pm$ 0.8040	23.586 $\pm$ 0.6216

Table 2: A comparative evaluation within the same group amongst the subgroups

	Xeno III		Adper SE plus		Clearfil S3	
	t value	P	t value	P	t value	P
A1-A2	.00001	p<.01	.00001	p<.01	.000001	p<.01
A1-A3	.00042	p<.01	.02404	p<.01	.0614	p<.01
A2-A3	.000001	p<.01	.0000001	p<.01	.000001	p<.01
B1-B2	.0023	p<.01	.000052	p<.01	.1725	p<.01
B2-B3	.0022	p<.01	.00001	p<.01	.0045	p<.01
B1-B3	.5293	p>.01	.6225	p>.01	.2498	p<.01

three material Xeno III, Adper SE plus ,Clearfill S3, was observed among subgroups. No significant difference was observed among subgroup B1-B3 for Adper SE plus and Xeno III.

## Discussion

It has been an established fact for decades now that bonding protocol needs proper isolation of the preparation for prevention from contamination of any kind. Indeed moisture and in particular saliva can affect the quality of the bond, leading to micro leakage or even bond failure. This would result in post operative sensitivity, discoloration, recurrent caries and even loss of restoration<sup>[6]</sup>. Protein contamination of the operating field from inadvertent contact with blood or saliva is a frequent problem in dentistry when rubber dam isolation is not practised.<sup>[7]</sup>

Only about 17% of professionals routinely use the rubber dam. In this context, the contamination of the operating field is a recurrent reality that emphasizes the value of studies in this area.<sup>[8]</sup>

To obtain a durable adhesion at the resin-tooth interface, it is necessary to avoid contamination of the preparation with oral fluids, such as saliva, blood, or gingival crevicular fluid.<sup>[1]</sup> Salivary contamination causes plugging of porosities produced by acid etching, leading to insufficient penetration of adhesive resin into enamel surface and eventual reduction of micromechanical retention.<sup>[9]</sup>

As pointed out by Pashley et al in the year 1988<sup>[10]</sup>, dentin bonding systems are sensitive to contamination by excess water, artificial saliva and even plasma. This has been attributed to the absorption of macromolecules from contaminating materials into dentinal tubules. Therefore, adhesive systems capable of tolerating contamination are highly desirable.<sup>[11]</sup>

One step dentin bonding agents provide an increased user reliability with faster application and reduced number of components and application steps. This reduces the risk of salivary contamination in the field of operation. However, many clinical situation which require the use of dentin bonding agents for optimum restorations are difficult

areas to isolate where salivary contamination is more likely.<sup>[12]</sup>

The present in vitro study was designed to evaluate the influence of salivary contamination on three “One step, self Etch” adhesive systems using a microshear bond strength.

In this present study in general salivary contamination caused the reduction of bond strengths to dentin, which is in agreement with the results published in many studies. For all the adhesives there was significant difference between the control group and the experimental group regardless of decontamination method used and time of salivary contamination.

Results showed statistically significant difference between group A and control. The mixture of water with a bonding resin has been reported to influence the degree of conversion of resins.<sup>[13]</sup>

As the water content increases, the conversion level of bonding resin decreases and drastically affects the bond strength. Hitmi et al in their study in year 1999 observed formation of tag fractures and some sites of low cohesion in a SEM evaluation, which resulted in low shear bond strengths.

Statistically significant difference was seen between GroupB and control. This is in agreement with the results of the study done by Fritz et al using one bottle adhesive systems. They put forward mainly three different hypotheses for the reduction in shear bond strength values:

- 1) Adsorption of glycoproteins to the poorly polymerized adhesive surface, thus preventing adequate co-polymerization.
- 2) Compromise of the co-polymerization with the subsequent resin layer, by removal of the oxygen inhibited un-polymerized surface layer, during rinsing and drying.
- 3) Insufficient filling of the collagen mesh with resin.

Furthermore Hitmi(1999) suggested that there is no diffusion of saliva after the adhesive is cured.

In the current study Adper SE plus showed a higher bond strength in group A as compared to group B but showed a statistically significant difference with

control ( $p<.01$ ). Xeno III and Clearfill S3 showed a higher bond strength in group B as compared to group A but showed a statistically significant difference with control ( $p<.01$ ).

Davidson et al<sup>[14]</sup> postulated that minimum bond strength of 17-20 MPa to enamel and dentin is needed to resist contraction forces of resin composite materials. In the present study, all the self-etching adhesives showed optimal bond strength values greater than 20 MPa for both uncontaminated and contaminated dentin except A2 subgroup(salivary contamination before curing of bonding agents and decontamination with wash and dry protocol)

The result of present study showed that for Group A and Group B of all adhesives, A2 subgroups and B2 subgroups, showed lowest bond strength.

Decreased bond strength values ,which were obtained from this study ,were connected to the possibility of oxygen-inhibited layer removal as a result of rinsing which leads to compromise of a copolymerization with subsequent resin layer.

A very significant difference was also observed between subgroup A1 and control and subgroup B1, and control for all the three adhesives tested( $p<.01$ ). When saliva on etched dentin was air dried, the bond strength was dramatically reduced. Air drying means that the water filled collagen layer will collapse and that a dried protein film will be adsorbed to dentin surface. The protein adsorbing properties of dentin have been reported by Pashley<sup>[15]</sup>. This prevent penetration of the adhesive into the exposed collagen meshwork and thus formation of a sound hybrid layer.

Among the subgroups A1, A2 and A3, subgroup A3 revealed the highest bond strength for all the three tested adhesives, suggesting that if salivary contamination occurs before light curing the adhesive, reapplication is recommended as it makes the dried protein layer permeable again and helps in hybrid layer reformation as mentioned above.

When the subgroups B1, B2 and B3 were compared not much difference was observed among subgroup B1 and B3 for

all the three adhesives (**Table 1**), as their bond strength obtained were in range between 17-20 Mpa (Davidson et al), which could be because of polymerization of the some of the monomer. So it is suggested that if salivary contamination occurs after light curing the best method of decontamination would be wash ,drying and reapplication, even though subgroup B1 also gave acceptable bond strength values.

The results of present study suggests that salivary contamination significantly affects the bond strength of One -step self etch adhesive system to dentin, therefore salivary contamination must be avoided when ever these systems are in clinical use.

### Conclusion

Within the limitation of the present study, it could be concluded that:

1. Salivary contamination and decontamination methods significantly affected the bond strength of one step self etching adhesive system to dentin regardless of the adhesive systems evaluated.

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## To Evaluate The Efficacy Of Neem Chip As An Adjunct To Scaling And Root Planing (SRP) In Patients With Periodontitis

### Abstract

Neem has been used for the treatment of several diseases in medicine and dentistry due to its antiseptic property. The present study aims in evaluating the therapeutic effects of neem chip when used as adjunct to SRP.

**Materials and Method :** 60 sites with 30 on each side (periodontal pockets) were selected and were divided into 2 groups. Group I consisted of periodontal pockets (30 sites), in which the scaling and root planing (SRP) was done (control). Group II consisted of periodontal pockets (30 sites), in which SRP was followed by the placement of the neem chip in the pocket (SRP+ Neem chip) (study).

**Results :** Probing pocket depth, Clinical attachment level, Plaque index - Turskey et al modification of Quigley Hein index and Gingival index (Loe and Sillness 1964) were evaluated in both the sites at baseline, 6 weeks, 3 months and compared. In the test group the results showed significant reduction in the probing depth from baseline to 3 months and in the gingival index score at 3 month as compared to control group. The plaque score was comparable for both the groups after 6 weeks and 3 months. Though there was gain in the clinical attachment level in both the groups but the results were not significant when the two groups were compared at 6 week and at 3<sup>rd</sup> month.

**Conclusion :** Neem chip may be beneficial in the treatment of periodontal pockets.

### Key Words

plaque index, gingival index, neem chip.

### Introduction

Periodontal disease is a complex multifactorial disease characterized by destruction of periodontal tissues and loss of connective tissue attachment. Periodontal diseases are considered infections of the periodontium, because there is bacterial etiology. The microorganisms may exert pathogenic effects directly by causing tissue destruction or indirectly by stimulating and modulating host responses. The local alteration and destruction of host tissues as a result of microbial-host interactions may manifest as periodontal disease.<sup>[1]</sup>

The standard treatment of periodontitis consists of phase I periodontal therapy with the objective of reducing the total bacterial load and changing the environmental conditions of these microbial niches. Although mechanical treatment (scaling and root planing) reduces the level of subgingival bacteria, it does not eliminate all the pathogens which reside deep into the connective tissue and destroy the bone.

To overcome the limitations of this conventional treatment, antibiotics and antiseptics have been used successfully to treat moderate to severe periodontal disease by systemic and local

administration. Systemic antibiotics require the administration of large dosages to obtain suitable concentrations at the site of disease, which potentially promote the development of bacterial resistance, drug interactions, and inconsistent patient compliance.

To overcome the shortcomings of systemic administration, a different approach has been introduced that uses local delivery systems that contain antibiotic or antiseptic agents. These systems allow the therapeutic agents to be delivered to the disease site with no appreciable systemic effects. Various locally delivered agents that are successfully used include tetracycline fibres<sup>[2]</sup>, 10% doxycycline<sup>[3],[4]</sup>, 2% minocycline<sup>[5]</sup>, metronidazole<sup>[6]</sup> and chlorhexidine gluconate<sup>[7]</sup>, but none are without side effects. To overcome the side effects of these drugs, research is being conducted for the use of the natural products. With the growing interest and increasing knowledge about the medicinal value of natural products, various formulations have been made commercially available. Natural products lead to a pathway of true and a healthy healing. One such natural plant which holds the medicinal value is Neem

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### Quick Response Code



(Azadirachta indica).

Neem, a native tree of India is an incredible plant that has been declared the “Tree of the 21st century” by the United Nations. In India, it is variously known as “Divine Tree”, “Life giving tree”, “Nature’s Drugstore”, “Village Pharmacy” and “Panacea for all diseases”. The neem leaves, flowers, seeds, roots, bark and fruits are utilized to treat inflammation, infections, skin diseases and have been proved to be useful in dental care also. Neem has been used as the preferred tool to maintain healthy gums and teeth. It contains the alkaloid margosine, resins, gums, chloride, fluoride silica, sulphur, tannins, oils, flavonoids and calcium etc. Various other compounds like nimbin, nimbidin, ninbidol, sodium nimbidate and azadirachtin are also found in neem which act as anti-inflammatory, antipyretic and antihistaminic, antifungal, antimarial, vasodilator, analgesic, antibacterial and antiulcer agents.<sup>[8]</sup> Neem oil suppresses various species of pathogenic bacteria such as *Staphylococcus aureus* and *salmonella typhosa*. The ethanolic extract has shown inhibitory effect on *Escherichia Coli*.<sup>[9],[10]</sup>

Neem has been used in various forms such as neem twigs, mouthwashes and gels for the cure of gums. Based on the assumption of obtaining better efficacy of neem extract in the oral cavity when delivered in the form of indigenously prepared chip, this clinical study was planned to evaluate the effect of neem chip when inserted into the periodontal pocket as an adjunct to SRP.

### Materials and Method

30 otherwise healthy patients with chronic periodontitis in the age range of 35-55 years seeking dental treatment in the department of Periodontology of the institute were included in this study. All the patients were clinically diagnosed as having chronic periodontitis with at least one site presenting a pocket depth of  $\geq 5$  mm bilaterally and presented with bleeding on probing.

This study was approved by the college ethical committee and the official permission was obtained from the Principal of the institution. Written informed consent was received from all the patients before their enrollment in the study. All the patients were in good health and had not received treatment with antibiotics/ anti-inflammatory drugs in last 3 months. Smokers and the patients with the history of systemic diseases were not included in the study. All patients were motivated and instructed for daily plaque control. Motivation for daily plaque control was reinforced at each visit. Education and motivation was followed by full mouth supragingival scaling using hand and ultrasonic scalers. Thorough subgingival scaling was done under local anesthesia in the selected sites using cures. 60 sites in total with 30 on each side (periodontal pockets) were selected and were divided into 2 groups.

**Group I-** It consisted of periodontal pockets (30 sites), in which only scaling and root planing (SRP) was done (control group).

**Group II-** It consisted of periodontal pockets (30 sites), in which scaling and root planing was followed by the placement of the neem chip inside the pocket (SRP+ Neem chip) (study group). The day of completion of SRP was taken as baseline. Clinical parameters- Gingival index (Loe and Silness 1964)<sup>[11]</sup>, Plaque index - Turskey et al modification of Quigley Hein index, probing pocket depth (PPD) and clinical attachment level (CAL) were recorded. The neem chip was inserted at the baseline in Group II.

The patients were instructed to avoid eating sticky food for one week, to postpone brushing for 12 hours and to avoid using any mouth rinse or any irrigation device. The parameters were recorded again at 6 weeks and 3 months. Neem chip for the study was indigenously prepared in the laboratory in Guru Nanak Institute of Pharmacy, Ibrahimpatnam, Hyderabad, under the supervision of Dr. S.A Sreenivas (Principal and Professor).

### The composition of the neem chip along with the function is given as under.

Ingredients	Quantity	Function
-Neem	5%	Antibacterial
-Hydroxy Propyl Cellulose	800 Mg	Polymer
-Sodium Carboxy Methyl Cellulose	200 Mg	Gelling Agent
-Polyvinyl Pyrrolidone	100 Mg	Polymer
-Polyethylene Glycol	100 Mg	Viscosity Enhancer
-Ethanol/Water	10 ML	Solvent

### Results & observations

All the patients did report for the two recall visits held at 6 weeks and 3 months. The data obtained was tabulated and analysed statistically.

The data was interpreted at a confidence interval of 95% and the levels of significance were as follows:

- P $\geq$ 0.05 - Not significant
- P $\leq$ 0.05 - Significant
- P $\leq$ 0.001 - Highly significant.

**The mean probing pocket depth (mm)** for group 1 (SRP) at baseline, 6 weeks and at 3 months were ( $5.40 \pm 0.77$  mm,  $3.97 \pm 0.67$  mm,  $3.33 \pm 0.88$  mm) respectively. The mean probing depth scores for group 2 (SRP+ Neem chip) at Baseline, 6 weeks, and at 3 months were ( $5.60 \pm 0.81$  mm,  $3.67 \pm 0.96$  mm,  $3.20 \pm 0.89$  mm) respectively. (**Table-I**)

**The mean gingival score** for group 1 (SRP) at baseline, 6 weeks and at 3 months were ( $1.84 \pm 0.19$ ,  $1.38 \pm 0.38$ ,  $1.37 \pm 0.36$ ) respectively. The mean gingival score for group 2 (SRP+ Neem chip) at baseline, 6 weeks and at 3 months were ( $1.87 \pm 0.21$ ,  $1.49 \pm 0.39$ ,  $1.19 \pm 0.30$ ) respectively. (**Table-II**)

**Plaque scores** were brought to minimum at baseline. The mean plaque scores for group 1(SRP) at baseline, 6 weeks and at 3 months were ( $0.00 \pm 0.00$ ,  $3.02 \pm 0.59$ ,  $3.22 \pm 0.57$ ) respectively. The mean plaque scores for group 2 (SRP+ Neem chip) at baseline, 6 weeks and at 3 months were ( $0.00 \pm 0.00$ ,  $2.93 \pm 0.67$ ,  $3.20 \pm 0.57$ ) respectively. (**Table-III**)

**The mean CAL score (mm)** for group 1(SRP) at baseline, 6 weeks and at 3 months were ( $4.23 \pm 0.57$  mm,  $3.97 \pm 0.56$  mm,  $3.47 \pm 0.63$  mm) respectively. The mean CAL score for group 2 (SRP+ Neem chip) at baseline, 6 weeks and at 3 months were ( $4.23 \pm 0.57$  mm,  $4.13 \pm 0.63$  mm,  $3.57 \pm 0.68$  mm) respectively. (**Table-IV**)

For the comparison of the all the parameters between the two groups from baseline to 3 months t-test for equality of means (independent samples test) was

Table - I Probing Pocket Depth

Group		Probing Depth Scores B/L	Probing Depth Scores 6 Weeks	Probing Depth Scores 3 Months
1	Mean	5.4000	3.9667	3.3333
	N	30	30	30
	Std. Deviation	.77013	.66868	.88409
	Minimum	5.00	3.00	2.00
	Maximum	8.00	6.00	6.00
2	Mean	5.6000	3.6667	3.2000
	N	30	30	30
	Std. Deviation	.81368	.95893	.88668
	Minimum	5.00	2.00	2.00
	Maximum	8.00	6.00	6.00

Table- II Gingival Index

Group		Gingival Index B/L	Gingival Index 6 weeks	Gingival Index 3 Month
1	Mean	1.8417	1.3833	1.3667
	N	30	30	30
	Std. Deviation	.19122	.38132	.36397
	Minimum	1.50	.50	.50
	Maximum	2.25	2.25	2.00
2	Mean	1.8750	1.4917	1.1917
	N	30	30	30
	Std. Deviation	.21526	.39655	.30572
	Minimum	1.50	.50	.50
	Maximum	2.25	2.00	1.75

Table - III Plaque Index Scores

Group		Plaque Index Scores B/L	Plaque Index Scores 6 WEEK	Plaque Index Scores 3 Month
1	Mean	.0000	3.0167	3.2167
	N	30	30	30
	Std. Deviation	.00000	.59427	.56756
	Minimum	.00	1.50	2.00
	Maximum	.00	4.00	4.50
2	Mean	.0000	2.9333	3.2000
	N	30	30	30
	Std. Deviation	.00000	.66609	.56629
	Minimum	.00	2.00	2.50
	Maximum	.00	4.00	4.00

Table - IV Clinical Attachment Level (CAL)

Group		CAL B/L	6 Week	CAL 3 Month
1	Mean	4.2333	3.9667	3.4667
	N	30	30	30
	Std. Deviation	.56832	.55605	.62881
	Minimum	3.00	3.00	3.00
	Maximum	6.00	5.00	5.00
2	Mean	4.2333	4.1333	3.5667
	N	30	30	30
	Std. Deviation	.56832	.62881	.67891
	Minimum	3.00	3.00	3.00
	Maximum	6.00	6.00	5.00

applied. The findings showed statistically significant reduction in probing depth in group 2 (SRP+Neem chip) as compared to group 1(SRP) from baseline to 6 weeks ( $p = 0.001$ ) and from baseline to 3 months ( $p= 0.045$ ). The results were not statistically significant during changes observed from 6 weeks to 3 months ( $p= 0.257$ ). (Table-V) .The results showed that there was reduction in the gingival scores in both the groups but were not statistically significant at 6 weeks ( $p= 0.285$ ) whereas the results were statistically significant at 3rd month evaluation showing that there was reduction in the gingival scores significantly in group 2(SRP+Neem chip) ( $p= 0.048$ ). (Table-VI)

There was accumulation of plaque in both the groups at 6 weeks and 3 months but the plaque scores were comparable for both the groups, showing that the results were not statistically significant. ( $p= 0.61$ and  $p= 0.91$  at 6 weeks and 3 months respectively) (Table-VII)

There was a gain in the clinical attachment level in both the groups from baseline to 3 months but the scores were comparable, showing no statistically significant results.The  $p$  value at baseline, 6 weeks and 3 months was 1.00, 0.28 and 0.56 respectively. (Table-VIII)

## Discussion

This clinical study evaluated the effectiveness of natural product 'neem', indigenously prepared in the form of neem chips. Neem has been long considered to have an antiseptic property. The antibacterial activity of neem has been evaluated and known from ancient times.<sup>[12]</sup> A study by Rao et al (1986) has proved its efficacy in reducing plaque cultures and gram-negative bacteria compared to the commercially available dentifrice.<sup>[13]</sup> The results of present study supported the efficacy of

Table -V Probing Pocket Depth (Intergroup Comparison)

Independent Samples Test							
	t-test for Equality of Means						
	T	Df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Change Probing Depth bl to 6 Weeks	-3.363	58	.001	-.50000	.14869	-.79763	-.20237
Change Probing Depth bl to 3 Months	-2.047	58	.045	-.33333	.16283	-.65927	-.00739
Change Probing Depth 6 weeks to 3 Months	1.145	58	.257	.16667	.14556	-.12470	.45804

Table - VI Gingival Index (Intergroup Comparison)

Independent Samples Test							
	t-test for Equality of Means						
	T	Df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Gingival Index B/L	-.634	58	.529	-.03333	.05257	-.13856	.07189
Gingival Index 6 Week	-1.079	58	.285	-.10833	.10044	-.30939	.09272
Gingival Index 3 Month	2.017	58	.048	.17500	.08678	.00129	.34871

Table - VII Plaque scores (Intergroup Comparison)

Independent Samples Test							
	t-test for Equality of Means						
	T	Df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Plaque Index Scores 6 Week	.511	58	.611	.08333	.16298	-.24290	.40957
Plaque Index Scores 3 Month	.114	58	.910	.01667	.14638	-.27635	.30968

Table - VIII Clinical Attachment Level (CAL) (Intergroup Comparison)

Independent Samples Test							
	t-test for Equality of Means						
	T	Df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Clinical Attachment Level B/L	.000	58	1.000	.00000	.14674	-.29373	.29373
Clinical Attachment Level 6 Week	-1.088	58	.281	-.16667	.15325	-.47344	.14010
Clinical Attachment Level 3 Month	-.592	58	.556	-.10000	.16895	-.43819	.23819

neem in treating the periodontal disease also. In order to avoid the bitter taste of the various neem formulations, the neem chip was prepared for this study. The clinical evaluation of the neem chip showed a statistical significant reduction in probing pocket depth (PPD) at 6 weeks and 3 months, and a significant reduction in gingival index score was also found at 3 month as compared to SRP alone. There was decrease in the plaque index scores and gain in the clinical attachment levels and the results were comparable in both the groups at 6 weeks and 3 month evaluation. The results may be attributed to various chemical compounds present in Neem such Nimbin; Nimbidin- anti-inflammatory, anti-bacterial, anti-fungal; Gedunin- vasodilator, anti-malarial, anti-fungal; Quercetin-anti-protozoal; Salannin- insect repellent; Azadirachtin-anti-malarial.<sup>[14]</sup> The neem chip had an additive effect when used as an adjunct to scaling and root planing. The greater improvement in the clinical parameters and relatively lesser plaque accumulation

in the SRP + neem group can be due to the adjunctive effect of the antimicrobial property of the slow released drug from the chip. The complete concentration of neem was released in 2 days, maintaining a concentration of 21.12 mcg/ml at 48 hrs post insertion in the subgingival environment. Carbopol was used as a gelling polymer due to its mucoadhesive property.

The antibacterial activity of neem has already been evaluated since ancient times.<sup>[15]</sup> The leaf extract of the neem has shown superior antiviral and antihyperglycemic activity in vitro and in vivo on animals.<sup>[16]</sup> Leaf extract has also shown hepatoprotective activity.<sup>[17]</sup>

A study was conducted by M. Raveendra Pai et al in 2003, evaluating effectiveness of neem leaf extract in the form of mucoadhesive dental gel comparing it with commercially available chlorhexidine gluconate mouthwash. They found that the patients (test group) using dental gel containing neem showed significant reduction of plaque index and

a decrease in salivary bacterial count of streptococcus mutans and lactobacillus than the ones using chlorhexidine (control group).<sup>[18]</sup> Another study by Prashant GM et al in 2007 showed the antibacterial effect of neem and mango on streptococcus mitis.<sup>[19]</sup>

Neem showed better efficacy in reducing the human plaque cultures and gram-negative bacteria compared to the commercially available dentifrice. It has been reported to show minimal to almost no adverse effects. The patients in this study did not report with any complaints of allergy or discomfort due to the chip. This study indicates the use of neem in treating the periodontal diseases due to its antimicrobial effects as claimed by the traditional medicine. It concludes that the Neem chip formulated with a mucoadhesive polymer can significantly improve the periodontal conditions when used as adjunct to scaling and root planing. To prove it more beneficial further research is required for the formulation of more sustained drug release products using neem so that the drug is maintained at the site for a longer duration or by the insertion of the neem chip for the second time. The neem chip had a drug release for 2-4 days as compared to chlorhexidine chip which has 7 days.<sup>[7],[20]</sup> The results obtained present a valid premise for further long term studies with a larger sample size and microbiological parameters to evaluate the efficacy of neem chip for the management of chronic periodontitis. Thus inclining us to treat the diseases with natural products in order to avoid the side effects of other antimicrobial agents used locally. Thus making us believe in being natural and buying natural to be the pathway to true cure and healing.

### Conclusion

This study establishes the use of natural product neem in the form of neem chip as an adjunct to scaling and root planing for treating the periodontal pockets. Neem chip formulated with a mucoadhesive polymer have additional benefits due to its antimicrobial property.

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## Comparative Study Of Soft Tissue Changes With Bionator And Twin Block Treatment

### Abstract

Facial analysis is used to identify positive and negative facial traits in an effort to optimize facial changes. During the last few decades, orthodontics researchers have put on increasing amount of efforts into the investigation of evaluating changes in the soft tissue profile produced by various means of Orthodontics treatment. This is because of the fact that attainment of optimum soft tissue facial balance and harmony is now considered as one of the main goals of orthodontics treatment rather than setting for a good occlusion. In the field of dentofacial orthopedics correcting the skeletal, dental and soft tissues morphology at an young age provide a basis for continuing normal development of this structure. Serial lateral cephalometric radiographs were taken before and after successful treatment in cases of treated groups with class - 1 molar relationship and acceptable soft tissue profile.

This study was conducted to compare the soft tissue changes in the facial profile brought about by a removable functional appliance. The Removable functional appliances chosen in this study were the Bionator and Twin Block appliances. Pre and post treatment lateral Cephalometrics radiographs were study.

**In this Present study:** There was comparison of soft tissues changes between the bionator group and twin block group. The bionator and the twin block groups showed significant changes in the soft tissue facial complex as compared to the untreated group.

Pre and post treatment lateral Cephlometric radiographs of 30 children having class II division I malocclusion and aged between 9-13 years were obtained out of these 10 children were successfully treated with Bionator and 10 were successfully treated with Twin Block & remaining 10 children consisted of untreated group.

It would be reasonable to assume that the result of the study could be used as an additional guide to the Orthodontist regarding his choice of functional appliances.

### Key Words

Twin block (T1), Bionator (T2), Class II div 1,Cephalometrics, Soft tissue landmark

### Introduction

Soft tissue goals are not given importance it deserved; hence it was not until the 1950's that attempts were made to study soft tissue profile relation to orthodontics treatment. After 1950 soft tissue measurements' were introduced into cephalometrics and were quickly recognized as important factor in treatment planning

In modern orthodontics era Dr. Edward H angle was one of the first to write about facial harmony, emphasizing the importance of soft tissue in orthodontics treatment planning. Importance of soft tissue in orthodontics diagnosis and treatment planning was also emphasized by Dr. Charles tweed, Dr. William downs, stoner Lindquist etc.

### Aims and Objectives

The objective of this study is to cephalometrically compare the soft

tissue changes occurred between Bionator and twin block appliances in class-II div-1 cases over a period of nine months.

### Material and Methods

The 30 subjects were selected for the study from general Indian population. These patients were having class-II div-1 malocclusion between age group ranging 9-12 years. These 30 subjects were selected from general population by fulfilling the following selection criteria.

1. Skeletal and dental angle's class-II div-1 malocclusion.
2. AngleANB } 5
3. Positive VTO (visualise treatment objective)
4. Horizontal growth pattern with angle FMA { 25
5. Overjet 6-10 mm.
6. Positive overbite
7. L a t e r a l c e p h a l o g r a m orthopentamograph and handwrite

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radiographs were obtained from each of the subject.

The 30 patients were divided into the following three groups of 10 patients each.

- The Bionator removable appliance were given to 10 indian patients taken from general population
- The twin block removable appliance were given to 10 indian patients taken from general population
- 10 Patients with untreated group.

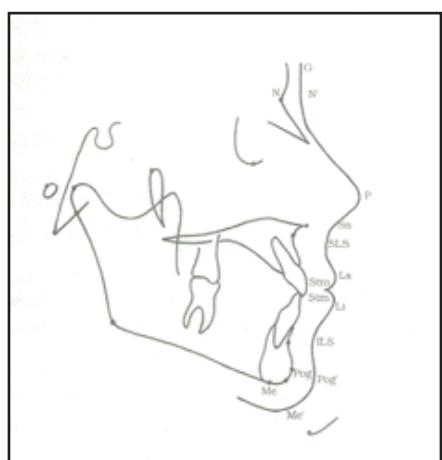
Sr No	Number Of Patients	Appliance Treatment Given
1	10	Bionator Appliance
2	10	Twin Block
3	10	Untreated Group

The study was undertaken to compare soft tissue changes in skeletal and dental class-II div-1 cases. The cephalometric analysis was done on the lateral cephalograms of these patients.

**Cephalometric Analysis:** The following points were traced on the soft tissue profile as seen on the lateral cephalogram. The following measurements were obtained from these lateral cephalograms. The values obtained from cephalograms were statistically analyzed and results were obtained.

The following points were traced on the soft tissue profile as seen on the lateral cephalogram.

1. Glabella (G)- The prominent point in mid-saggital plane on the forehead.
2. Soft Tissue Nasion (N)- The soft tissue counterpart of the hard tissue nasion (N).
3. Point 'P' - The most prominent point on the tip of the nose.
4. Subnasale (Sn) - The point of which the nasal septum merges with the upper cutaneous lip in the mid saggital plane.
5. Labrale superius(Ls) - A point indicating the mucocutaneous border of the upper lip.
6. Stomion superius ( Stms ) - Lowermost point on the vermillion of upper lip.
7. Stomion inferius (Stmi)- Upper most point on the vermillion of the lower lip.
8. Labrale Inferius (Li)- A point indicating the mucocutaneous border of lower lip.
9. Mentolabial sulcus(Ils) - The point of greatest concavity in the midline between the lower lip & chin.



10. Soft tissue pogonion ( Pog)- The most anterior point on soft tissue chin.
11. Soft tissue menton ( Me)- The most inferior point on the soft tissue chin.

## Results

**1. Angle anb:** Angle anb decreased by 3.3% ( $p<0.001$ ) in group and by 2.2% ( $p<0.001$ ) in t2 group.

**2. Lower anterior facial height:** The lower anterior facial height increased.

**a.Facial convexity:** Decrease in facial convexity t2 group was more than t1 group.

**b. inter labial gap:** The interlabial gap decreased after treatment by 2.2mm( $p<0.05$ )in the t1 group and by 3.2 mm

**3. Lower anterior facial height (soft issues):** These findings indicate that like the skeletal LAFH, the soft tissue LAFH also increased after functional therapy. This increase was however more after Twin block treatment than after bionator treatment.

**4. Maxillary Prognathism:** This was no significant post-treatment change in position of maxillary in either of the 2 study groups

Comparison Of Soft Tissue Changes Between Bionator And Twin Block Groups

1 2	MEASUREMENT	TREATMENT GRP. (T1)		CONTROL GRP (C)		MEAN DIFF.	't' VALUE	'p' Value
		Mean	S.D.	Mean	S.D.			
A	SKELETAL							
1.	Angle ANB	-3.3°	0.4216	-2.2°	0.4216	-1.1°	5.8341	<0.001
2.	LAFH (ANS-Me)	+3.15mm	0.4743	+4.8mm	1.6855	1.6mm	2.9783	<0.01
B	SOFT TISSUE							
I	FACIAL							
1.	Facial convexity	-4.15°	0.5297	-2.4°	2.9515	-1.75°	1.8455	NS
2.	Interlabial Gap	-2.2mm	0.8882	-3.2mm	2.2509	1.0mm	1.3068	NS
3.	LAFH (Sn-Me')	+3.25mm	0.6687	+4.8mm	0.9189	-1.55mm	4.3130	<0.001
II	MAXILLA							
	Max. Prognathism	+1.6mm	0.8433	+0.9mm	0.8759	0.7mm	1.8209	NS
III	MANDIBULE							
	Mand. Prognathism	-5.2mm	1.1832	-6.95mm	1.5961	0.3mm	0.4777	NS
IV	UPPER LIP							
1.	Length	+2.2mm	1.6865	+2.6mm	1.8974	-0.4mm	0.4983	NS
2.	Thickness	+0.25mm	1.3176	+1.6mm	2.0111	-1.35mm	1.7756	NS
3.	Procumbency							
a.	U.Lip-'S' line	-2.2mm	1.8135	-2mm	1.4142	-0.2mm	0.2756	NS
b.	U.Lip-'E' line	-1.3mm	2.0028	-2.3mm	1.0593		1.3957	NS
c.	Nasolabial Angle	+6.85°	4.8256	+8.8°	8.0939	-1.95°	0.6544	NS
d.	H-Angle	-3.7°	4.2960	-4.5°	2.6771	-0.8°	0.4998	NS
V	LOWER LIP							
1.	Length	+2.25mm	1.1365	+2.1mm	0.9944	.15mm	0.3414	NS
2.	Thickness	-1.35mm	1.0554	-2.1mm	3.4785	.75mm	0.6524	NS
3.	'B' thickness	+0.1mm	1.8529	+1.2mm	0.4216	-1.1mm	1.8305	NS
4.	Procumbency							
a.	1 lip to 'S' line	+2.25mm	0.7528	+0.45mm	1.3427	1.75mm	1.4507	NS
b.	1 lip to 'E' line	+1.65mm	0.4743	+1.2mm	1.3984	0.45mm	0.9437	NS
c.	Mento labial sulcus	-2.1mm	0.6146	-2.05mm	1.3006	-0.05mm	0.1099	NS
d.	Mentalobial Angle	+22.85°	1.4347	+23.1°	3.8118	-0.25°	0.0569	NS
VI	NOSE							
	Prominence	+1.7mm	0.6749	+1.4mm	2.7568	0.3mm	0.3343	NS
VII	CHIN							
1.	Pog' thickness	+1 mm	1.4337	+0.6mm	1.4298	+0.4mm	0.6247	NS
2.	'Z'-Angle	+6.1°	1.005	+5.5°	1.8409	+0.6°	0.9046	NS

**5.Mandibular Prognathism:** All these findings indicated that the improvement in the soft tissue facial convexity was brought about more by the forward movement of the pg point rather than any restrictive effect.

**6. Nasolabial Angle:** Although it increased

**7. H-Angle:** Post-treatment evaluation of H-Angle showed a reduction

**8. Lower Lip Length:** The length of the lower lip increased

**9 .Mentolabial:** The depth of Mentolabial sulcus decreased

**10.Mentolabial Angle:** After treatment the lower lip uncurled. Thus increasing the Mentolabial angle.

**11. Nose Prominence:** Significant change in the prominence of the nose.

**12. Z Angle:** This angle increased after treatment.

### Discussion

When treatment is done in a mixed dentition stage, functional appliances are said to bring about marked improvement in the skeletal relationships, while these functional appliances affect the hard tissues, they also produce a marked improvement in the soft tissue facial balance and harmony.

**Skeletal:** A significant decrease in angle SNA along with an angle SNB with the use of functional appliances.

**Lower anterior facial height:** There was a significant post-treatment increase in the skeletal lower anterior facial height in both the treatment groups as compared to minimal changes in control group.

**Facial:** Facial convexity showed a significant post-treatment decrease this decrease in facial convexity was, to a greater extent, the result of soft-tissue pogonion coming forward.

### Summary and conclusion

The purpose of this study was to compare the changes in the soft tissue profile brought about by the removable functional appliances. The removable functional appliances chosen in this study were the bionator and twin block

appliances.

Thus, based on the sample of this study, the following conclusions can be drawn:

- Treatment with the bionator as well as twin block leads to appreciable decrease in soft tissue facial convexity.
- No restraining effect on the maxilla was observed after bionator or twin block treatment.
- Minimal effect on upper lip length and thickness was observed after treatment with either of these functional appliances.
- In case of treatment with a removable functional appliance, patient cooperation is a very important factor if this factor is overcome, then this appliance can be equally efficient as affixed functional appliance.

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### Aesthetic Management Of Fractured Endodontically Treated Tooth - Case Report

#### Abstract

Healthy oral cavity is primary requisite for beautiful looks. Aesthetic requirement of severely mutilated teeth has been a challenge to dentist. This paper presents endodontic treatment of grossly decayed tooth followed by the placement of a fibre-reinforced composite resin post. The crown reconstruction was done with full ceramic crown. Resin fibre post has best properties in elasticity, translucency, adaptability and resistance to traction.

#### Key Words

Aesthetic restoration, Post and core, Fibre resin post

#### Introduction

Aesthetic requirement of severely mutilated teeth has always been a challenge for a dentist. Endodontically treated teeth fractures more often than the vital teeth. Fracture occurrence is more in posterior teeth than anterior teeth as the masticatory forces are higher and teeth are weaker<sup>[1]</sup>. In cases where the teeth are severely decayed, endodontic treatment and placement of intracanal post or retainers become necessary before crown restoration. Posts maybe constructed of various materials including resins, composites, metals and biologic materials<sup>[2]</sup>. Recent years various types of fibre reinforcement have come into wide spread use as an alternative to cast or prefabricated metal posts in a restoration of endodontically treated teeth<sup>[3]</sup>. The advantages of using fibre post to construct an intracanal post include resin composite crown reinforcement, translucency, and relative ease of manipulation<sup>[4]</sup>. A post and core is a dental restoration used to sufficiently build up tooth structure for further restoration with a crown when there is not enough tooth structure to properly retain the crown due to loss of tooth structure to either decay or fracture. An anchor placed in the tooth root following a root canal to strengthen the tooth and help hold a crown in place<sup>[5]</sup>.

Endodontics with fractured mandibular right first premolar tooth for which root canal was done one year back without post endodontic restoration. The treatment plan was divided into two steps;



Figure 1 : Crown fracture of 44

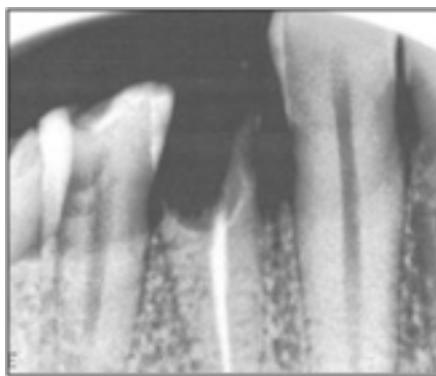


Figure 2 : IOPA of 44

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#### Step 1:- Clinical Examination:

Crown fracture was seen with 44 (Fig1). IOPA were taken in relation to 44 (Fig2). On radiographic examination the obturation was found to be intact and as the tooth was asymptomatic.

#### Step 2:- Construction of Restoration

On the basis of clinical and radiographic findings following treatment plan was made, restoration of the tooth with pre fabricated post, core build up and a porcelain jacket crown. For Post space preparation 4mm of guttapercha was removed from the pulp chamber using a thin straight fissure bur. Post space was prepared with size no.2 piezo reamer supplied by manufacturer. FRC post of sizes number 2 (TANEX- fibre trans esthetic post system, Coltene Whaledent, Fig 3) with its diameter 1.06 was selected. The prepared space was cleaned with normal saline, air dried and para bond non rinse conditioner (Fig 3) was applied with help of an applicator tip for

#### Case Report

A male patient aged 48 years reported to the Department of Conservative and



Figure 3 : Fibre esthetic post system



Figure 4 : Fibre post and composite were cured

20 seconds. After that two drops of each para bond adhesive A and adhesive B (**Fig 3**) were mixed in dispenser with help of applicator tip. It was uniformly applied in the prepared post space. It was then light cured for 20 seconds. Dual cure flowable composite resin cement (Para Core) was inserted into the post space after which the fibre post was inserted (**Fig 4**). The fibre post and composite were cured together for 60 seconds. The excess coronal portion of the fibre post was cut with the help of a diamond bur. Final finishing and polishing was done with finishing burs and crown preparation for porcelain jacket crown was done (**Fig 5**). The crown was finally cemented with tooth using GIC luting cement (**Fig 6**).

### Conclusion

If certain basic principles are followed in restoration of endodontically treated teeth, it is possible to achieve high levels of clinical success with. Therefore, restoration of teeth after endodontic treatment is becoming an integral part of restorative dentistry. The treatment described in case report is simple and effective and represents a promising alternative for rehabilitation of grossly destructed or fractured teeth.

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Figure 5 : Crown preparation of 44

**Source of Support :** Nil, **Conflict of Interest :** None declared



Figure 6 : Porcelain jacket crown cemented.

## Anterior Maxillary Osteotomy For Correction Of Maxillary Excess - A Case Report

### Abstract

Anterior maxillary osteotomy is frequently applied to skeletal Class II cases with maxillary protrusion. Surgical approach with anterior segmental maxillary osteotomy has produced excellent treatment results. This clinical case typically exemplifies the effect of anterior segmental maxillary osteotomy on improving the skeletal, dental, soft tissue and over all aesthetics of the patient.

### Key Words

Anterior maxillary excess, Anterior maxillary osteotomy, Cupar technique

### Introduction

With the widening of horizons of surgical orthodontics, it has become apparent that neither surgery nor orthodontic tooth movement alone is sufficient for treatment of many patients. To obtain optimum results, a combination of surgery and orthodontic tooth movement is required in a majority of cases. The primary indication for a combined surgical-orthodontic treatment is the presence of severe malocclusion in an adult, whether it be largely a skeletal problem or primarily dental in origin. A careful evaluation of the diagnostic records should be done before planning treatment.<sup>[1]</sup> Close cooperation between orthodontist and oral surgeon is essential for proper treatment planning. Orthodontists must be aware of the variety of surgical procedures that are possible and about the relative difficulty and stability of each, and the surgeons must know the limits and possibility of orthodontic tooth movement. Both must aim towards the best occlusal and facial results possible for the patient.<sup>[2]</sup>

Anterior maxillary osteotomy is frequently applied to cases of maxillary excess. In addition to the anteroposterior problem, these cases are often accompanied with a long midfacial appearance and display of incisors and gingiva during smiling. To treat these patients, it is necessary to move the anterior maxillary segments upward as well as backward by anterior maxillary osteotomy. Anterior segmental

osteotomies can be accomplished intraorally without any facial require and do not require prolonged intermaxillary fixation.<sup>[4]</sup>

### Case Report

A female patient aged 20yrs presented for treatment to the Department of Orthodontics, Himachal Dental College, Sundernagar with a chief complaint of prominent upper front teeth and that her gums showed when she smiled. **Dentofacial proportions and Esthetic evaluation :** On extraoral examination, no facial asymmetry was seen. Her profile demonstrated a marked protraction of the maxilla. The frontal facial appearance showed a large vertical height and display of an entire incisor crown with a few millimeters of gingiva on smile. There was lip incompetence and excessive exposure of upper front teeth.

**Intraoral Examination :** Intraoral examination revealed a Class II molar relation with increased overjet of 10mm. Crowding of anteriors was seen in lower arch.

### Image 1 [Pre-Treatment]

**Cephalometric Evaluation :** Cephalometric examination revealed a moderately large ANB difference of 6°, a steep mandibular plane angle and proclined upper incisors. COGS analysis revealed increased anterior midfacial length, increased lower anterior facial height, increased posterior maxillary height, increased maxillary and

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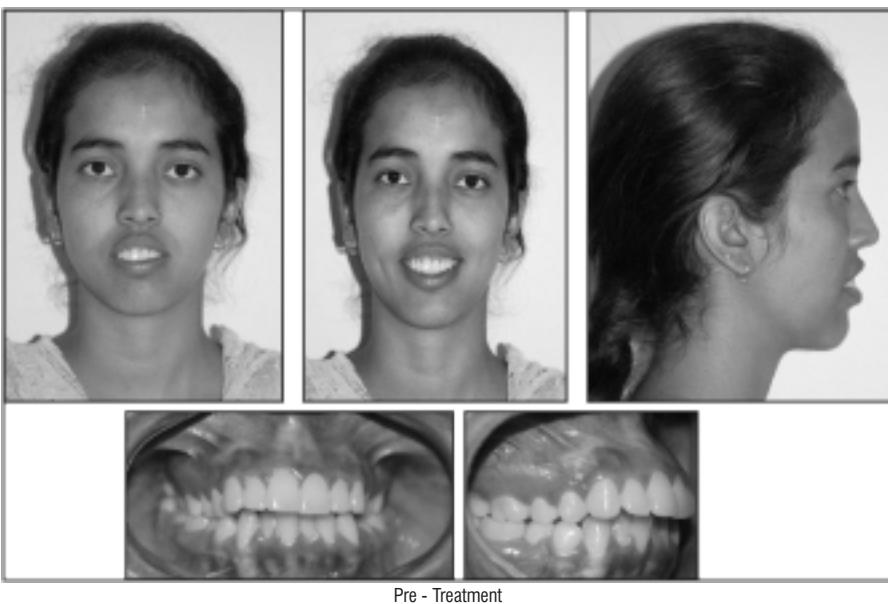
mandibular dentoalveolar height and increased ramal length.

**Model analysis :** Examination of the models showed crowding in the lower arch with good arch symmetry and form in both upper and lower arch. Lower arch showed an increased curve of spee. A class II molar relation was present on both sides and increased overjet of 10mm was also seen.

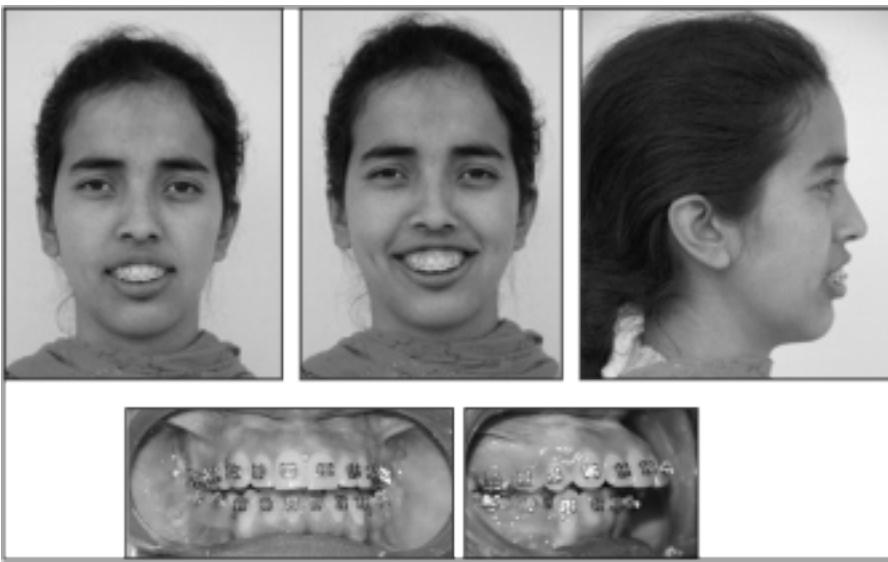
The most significant problems were the protraction and excessive vertical height of the maxilla. Therefore, the treatment plan was to move the anterior maxillary segment upward and backward by anterior maxillary osteotomy

### Pre-Surgical Orthodontics:

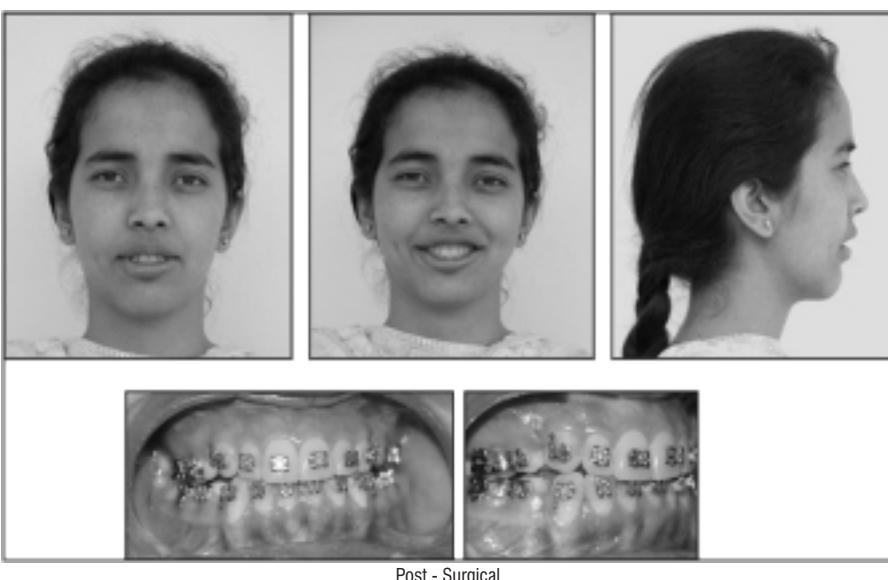
A pre-adjusted edgewise appliance was placed and pre-surgical orthodontics was carried out with leveling and alignment of both arches and extraction of 1st



Pre - Treatment



Pre - Surgical Orthodontics



Post - Surgical

premolars in lower arch to increase the overjet. Retraction of the anterior segment was done using sliding mechanics. Upper and lower arches were stabilized with  $0.019 \times 0.025"$  ss wire. The presurgical orthodontics was completed in 14 months.

#### **Image 2 [Pre - Surgical Orthodontics]**

#### **Surgical Treatment (Cupar technique)<sup>[5]</sup>**

Patient underwent surgery under general anesthesia with nasotracheal intubation. After infiltrating the mucosa with 2% lignocaine HCl with adrenaline 1: 80000 above the canines and premolars bilaterally, a vertical mucosal incision was made between canines and premolar from the gingival margin superiorly to the level of the anterior nasal floor, superior to root apex of the maxillary canine. The maxillary first premolars were extracted on both the sides. The measured amount of alveolar bone was removed and the osteotomy extended anteriorly to nasal aperture and same procedure performed on opposite side. A mucoperiosteal incision was made transversely across the palate just anterior to the osteotomy site. After the palatal bone was also removed, the anterior maxillary segment was down fractured and posterior and superior repositioning was done. The segments were immobilized with L-shaped miniplates. Suturing was done. No operative and postoperative complications were observed.

A decrease in maxillary dentoalveolar height and decrease in proclination of incisors was found postsurgically.

#### **Image 3 - [Post - Surgical]**

#### **Post Surgical Orthodontics**

Two months after surgery, a step was found between canine and premolars, so leveling and alignment was continued for correction of discrepancy.

#### **Discussion**

Although surgical procedures for treatment of Class III malocclusion has been an accepted treatment for many years, surgical procedures for correction of Class I and Class II malocclusion has gained tremendous interest in recent years. The major decision for correction of Class II malocclusion must be repositioning the maxilla distally or mandible forward. Treatment options for maxillary excess includes superior repositioning of the maxilla via total or

segmental maxillary osteotomy , mandibular ramus osteotomy as a secondary procedure after maxilla is positioned vertically.<sup>[6]</sup> When the esthetic and functional requirements of the individual case can be satisfied by anterior maxillary surgery, this is the preferred operative approach since the surgical procedure is simple and the treatment results, including stability, are excellent.<sup>[7]</sup> The first report of an anterior segmental anterior maxillary osteotomy (ASMO) was published by Cohn-Stock in 1921.<sup>[8]</sup> After a transverse incision in the palatal mucosa, he made a wedge shaped osteomypalatalto the anterior teeth. A greenstick fracture was then created at the osteotomy site, and the anterior maxilla was retracted. The anterior segment, however, relapsed within 4 weeks. Since then, the method has been developed and refined .The biologic process of healing of various modifications of this osteotomy has been studied in experimental models. Currently, mainly three variations of ASMO are used; the Wassmund, Wunderer, and downfracture methods. When the Wassmund<sup>[9]</sup> method is used, the anterior maxillary segment derives its blood supply from both the facial and the palatal gingiva, as no flaps are raised. The planned osteotomy sites are reached by tunneling under the mucoperiosteum. The Wunderer<sup>[10]</sup> method involves a palatal flap raised by means of a transverse incision of the palate. The anterior osteotomy is made after tunneling, leaving the buccal blood supply intact.

In the downfracture method, on the other hand, a buccal flap is raised, and the palatal osteotomy is made after tunneling, leaving the palatal blood supply intact.

The usual indications for ASMO are excessive vertical or anteroposterior development of the maxillary alveolar process in patients where the relationships between the posterior teeth are acceptable. When superior repositioning of the anterior part of the maxilla is the primary objective, the downfracture method is usually recommended, while the Wunderer method is more practical for posterior repositioning.

The main advantage of the Wassmund method is the excellent postoperative blood supply, and this technique is recommended by some authors for all cases other than those requiring superior repositioning.

We corrected maxillary prognathism with anterior maxillary osteotomy (Cupar technique). No operative and postoperative complications were encountered.

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### Intraoral Pleomorphic Adenoma - Report Of A Case And Literature Review

#### Abstract

Pleomorphic adenoma (PA) is the most common benign salivary gland tumor, accounting for 45-74% of all salivary gland tumors. Parotid gland is the most commonly affected of the major salivary glands and palate is the most common site intra orally. A wide spectrum of histological findings exist because of the expression of varying proportions of epithelial and mesenchymal features and due to this architectural pleomorphism in light microscopy, it derives its name. The knowledge of diverse clinical, radiological presentation, wide variety of cellular and morphological architecture makes the diagnosis of this lesion difficult.

This article presents a case of Pleomorphic Adenoma with a histological review of this entity.

#### Key Words

Mixed tumor, Epithelial component, Stromal component, Myoepithelial cells, Parotid gland

#### Introduction:

Pleomorphic adenoma (PA) known as mixed tumor is the most common salivary gland neoplasm<sup>[1]</sup>. It was designated by terms like branchioma, enclavoma, teratoma, myxochondrocarcinoma, cylindroma, endothelioma, myxochondrosarcoma, chondromyxohemangioendothelioma, enchondroma<sup>[2]</sup>. The term Pleomorphic adenoma given by Willis, does not strictly imply cellular/ nuclear pleomorphism. Microscopically PA's are characterized by myriad of morphological diversity, composed of epithelial and myoepithelial cells arranged in variable patterns and demarcated from surrounding tissues by fibrous capsule. Three main histological subtypes are identified: 1) myxoid (stroma rich), 2) cellular (myoepithelial predominant) and 3) mixed (classic) type<sup>[3]</sup>.



Figure 1: Clinical picture showing no extraoral abnormality

#### Case Report:

A 40yr female patient presented with a painless slow growing swelling on palate. The lesion was noticed 1 month back by the patient. Her medical history was noncontributory with no significant abnormalities on general physical examination. Patient underwent extraction of grossly decayed teeth two years back. Extraorally no abnormality was detected (Figure 1). Intraoral examination revealed a 3X3X3 cm

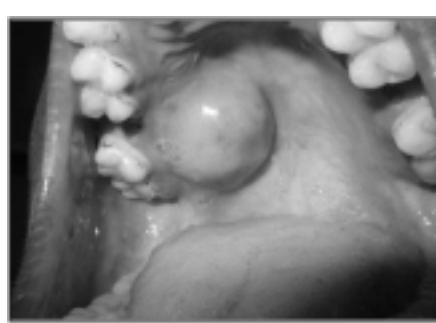


Figure 2: Clinical picture showing intraoral swelling on hard palate

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swelling over hard palate just right to midline. (Figure 2). Anteroposteriorly, the swelling extended from the distal aspect of 14, posteriorly to the distal aspect of 18. Mediolaterally, the swelling extended from the mid - palatal area to the palatal surface of maxillary molar teeth. The mucosa over the swelling appeared to be normal with no secondary changes. Intraorally on palpation, the swelling was non - tender, firm in consistency, non-compressible and did not show any fluctuation or pus discharge. Patient had missing teeth in relation to 16, 26. Occlusal radiograph was taken and it revealed bony destruction (Figure 3). Provisional diagnosis of Pleomorphic adenoma was given, differential diagnosis included Adenoid Cystic Carcinoma, Mucoepidermoid Carcinoma, Adenocarcinoma, odontogenic and non-odontogenic cysts. Incisional biopsy was done. Histologically, the tumor mass showed glandular epithelial cells arranged in

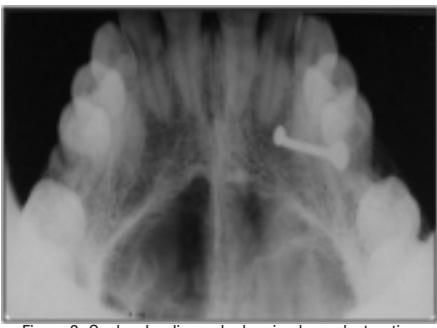


Figure 3: Occlusal radiograph showing bone destruction

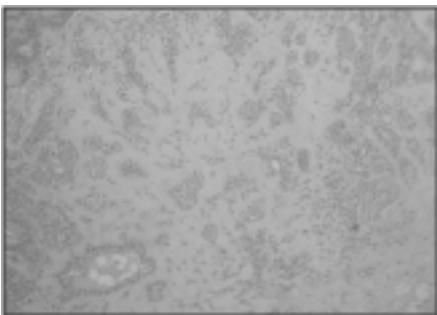


Figure 4: Photomicrograph showing ductal and myoepithelial cells (H & E 10x)

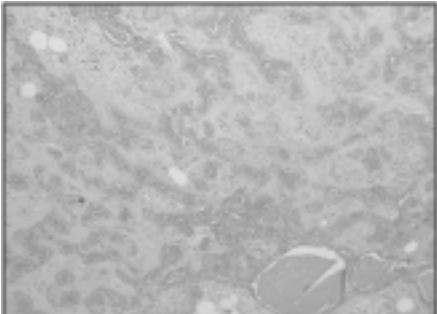


Figure 5: Photomicrograph showing eosinophilic material in ducts (H & E 10x)

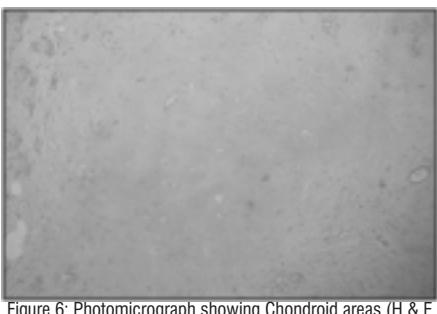


Figure 6: Photomicrograph showing Chondroid areas (H & E 40x)

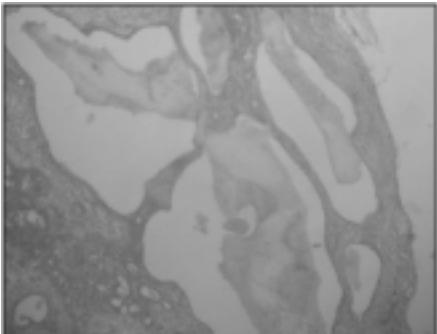


Figure 7: Photomicrograph showing Hyalinized areas (H & E 40x)

ductal pattern, eosinophilic material was present in the ducts (**Figure 4, 5**). Numerous myoepithelial cells arranged in the form of sheets were also seen. The supporting connective tissue stroma is moderately collagenous. Chondroid material is seen between cells (**Figure 6**). Hyalinized areas are seen in few areas (**Figure 7**). Inflammatory cell infiltrate is minimal. Treatment included tumor excision with a wide margin.

#### Discussion:

Pleomorphic adenomas over a wide age range, with peak incidence in fourth to sixth decade<sup>[4]</sup>. There is a slight female predilection. It commonly arises in parotid gland and may also occur in other major salivary glands, minor salivary glands, extra-salivary tissues like nasal cavity, paranasal sinus, larynx, bronchus, breast, soft tissues, ear, lacrimal gland and skin<sup>[5]</sup>. PA's are the most common salivary tumors showing synchronous<sup>[6]</sup> or metachronous<sup>[7]</sup> association with other salivary gland neoplasm, especially with Warthin's tumor. As the lesions are asymptomatic, there is a large interval between the first symptoms and the actual time of diagnosis ranging from 2 days to 15 years, with average time period of 25 months<sup>[8]</sup>. Pleomorphic adenoma clinically presents as a slow growing, painless, quiescent mass which slowly begins to increase in size, sometimes showing intermittent growth. They are round to oval in shape, showing lobulations when it increases in size. Recurrent tumors are multinodular. Size of the lesion varies from 2-6 cm in diameter<sup>[1]</sup>; few cases reported giant PA's measuring up to 28cm in size<sup>[9]</sup>. Smaller lesions have smooth surface, whereas the larger lesions show bosselations and are occasionally crossed by deep furrows. Fixation to either underlying or overlying skin is not seen, except in palatal tumors which are often fixed to mucoperiosteum. On palpation PA's are firm to rubbery with cystic degeneration occasionally if they are superficial. Overlying skin or mucosa is normal without ulcerations. Facial nerve palsy or pain may be seen in cases where the tumors have undergone infarction or become infected.

On gross examination, PA's appear as well circumscribed, round to ovoid mass with smooth or bosselated surface. There is variation in presence and thickness of capsule. They are often encapsulated and a clear demarcation between the tumor

and adjacent salivary gland tissue is present. In minor gland PA, capsule is poorly formed or absent. Focal absence or complete absence of encapsulation with tumor merging into normal parotid gland is seen predominantly in mucoid tumors<sup>[10]</sup>. Recurrent lesions are multinodular and the nodules may bulge through capsule like pseudopodia<sup>[11]</sup>; satellite nodules are also reported<sup>[10]</sup>. Cut surface is solid and white with variable areas of firmer, translucent, bluish tissue. It may have gritty areas and gelatinous foci which correspond to cartilage like material seen microscopically. Necrosis and cystic degeneration may be seen in long standing cases.

Microscopically, PA has a biphasic appearance resulting from admixture of inner layer of epithelial cells which are large, cuboidal cells with vacuolated nuclei without prominent nucleoli, outer myoepithelial cells which have variably eosinophilic to clear cytoplasm and condensed, smaller, darker nuclei with flattened or triangular shaped cells in stromal background in a centrifugal or melting pattern in variable proportions<sup>[1],[2]</sup>. Foote and Frazell categorized them into principally myxoid, myxoid and cellular components in equal proportions, predominantly cellular, extremely cellular<sup>[12]</sup>. Siefert has classified based on the amount of extracellular stroma into Type 1: extracellular stroma comprises 30-50% of tumor (30% cases) Type 2: extracellular stroma comprises 80% of tumor (55% cases) Type 3: extracellular stroma comprises 20-30% of tumor (9% cases) Type 4: extracellular stroma attains a similar proportion to that of type 3 but there is focal monomorphic differentiation in the epithelial component<sup>[13]</sup>.

Epithelial component shows cuboidal, basaloid, squamous cells arranged in the form of ducts, cords, cysts, islands, sheets, nests, trabeculae, tubules, ribbons. Rarely mucous, spindle, clear, oncocyte, sebaceous, adipose cells, serous acinar cells are also seen. Ducts often contain eosinophilic secretory material. Myoepithelial cells are not readily identifiable by light microscopy as they may be small, dark and non descript, spindle shaped, plasmacytoid, polygonal, clear cells.<sup>[1],[2],[3]</sup>.

Plasmacytoid cells are most prominent in

PA especially in minor salivary glands<sup>[2]</sup> and strongly support diagnosis of PA. They are diffuse masses of round cells with hyalinized eosinophilic cytoplasm and eccentric nuclei that resemble plasma cell. Plump, eosinophilic staining, spindle shaped cells that form anastomosing bands or fascicles may be frequently seen after plasmacytoid cells<sup>[3]</sup>. Nuclear palisading may be present and the pattern may resemble leiomyoma or schwannoma however immunohistochemistry aids in differentiation. Cuboidal cells are the third most common cellular type<sup>[3]</sup>, and the presence of this basaloid cells resemble basal cell adenoma. However, BCA's do not have Chondroid areas thus can be differentiated. Polygonal cells may have fine reticular arrangement. Epithelial islands with a cribriform structure are occasionally seen which resemble Adenoid cystic carcinoma (ACC). Presence of infiltration and perineural invasion, absence of squamous and chondroid metaplasia helps in differentiating from ACC from PA. Mucous goblet cells may be found in association with squamous cells and isolated foci may resemble Mucoepidermoid carcinoma. Absence of mucous metaplasia and presence of plasmacytoid cells and spindle cells help in differentiating PA from MEC. Foci of squamous metaplasia with keratin pearl formation may be seen<sup>[1]</sup>. Clear cells are seen occasionally which can be confused with that of Epithelial-myoepithelial carcinoma but clear cells in PA are small, hyperchromatic, angulate, whereas in EMC they are large and vesicular<sup>[1]</sup>. Occasionally tumors have areas of sebaceous metaplasia, mucinous and/or mucoepidermoid like material<sup>[1]</sup>. Focal areas of oncocytes may be seen and also adipose cells<sup>[2]</sup>. Tumors that have lipomatous stromal component of 90% or more are called lipomatous PA's<sup>[1]</sup>.

Myoepithelial cells produce mesenchymal component, which may be myxoid, cartilaginous, hyalinized, calcified. Myxoid is the predominant type where epithelial cells are widely separated, surrounded by mucoid material. True cartilage formation containing type II collagen and keratin sulphate is present as a result of extensive accumulation of mucoid material around individual myoepithelial cells, vacuolar degeneration of these cells occur subsequently. Eosinophilic hyaline

material which shows propensity for malignant change<sup>[3]</sup> appears as foci within cellular masses or form bands that separate epithelial cells into either small nests or strands of cells. Bone may form by a process similar to endochondral ossification or directly by stromal osseous metaplasia rather than from ossification of preexisting chondroid stroma.<sup>[1],[2]</sup>

Crystallloid deposition may be seen in PA's. Tyrosine rich crystals occur in association with myoepithelial cells in both benign and malignant neoplasms; they are glossy, eosinophilic structureless masses surrounding central core, refractile and are seen arranged in petal shaped clusters. Collagen crystalloids found in benign neoplasms are more common and are non-refractile, needle shaped structures that are arranged radially or form stellate structures<sup>[14]</sup>. Oxalate crystals have also been reported in few cases<sup>[2]</sup>. Occasionally stromal amyloid or the corpora amylacea like condensations can be seen<sup>[1]</sup>. Areas of chronic inflammation particularly in subcapsular region are seen. More extensive inflammation and prominent central necrosis may be seen in long standing cases. Necrosis may be result of spontaneous infarction.<sup>[15]</sup> Elastic fibres are seen in long standing cases in form of thick, fluffy branching fibres; this fibrotic change/ scarring is frequent finding in malignant cases of PA's.

Immunohistochemistry can be performed to aid in the diagnosis of PA. Myoepithelial cells show positivity for Keratin, S100, GFAP, Actin, Vimentin, Calponin, Maspin, HHF-35, BMP, Aggrecan; whereas Ductal epithelial cells show Cytokeratin, Carcinoembryonic antigen, Epithelial membrane antigen, Antiepithelial membrane antigen, CAM 5.2.

Various histogenetic concepts have been suggested for the development of PA's, relating to myoepithelial cell and a reserve cell in intercalated duct. Hubner et al<sup>[12]</sup> postulated that the myoepithelial cell is responsible for production of fibrous, mucinous, chondroid, osseous areas. Regezei and Batsakis et al<sup>[12]</sup> postulated that the intercalated duct reserve cell can differentiate into ductal and myoepithelial cells and later in turn can undergo mesenchymal metaplasia due to its smooth muscle like properties.

Dardick et al<sup>[12]</sup> stated that a neoplastically altered epithelial cell is responsible for the PA histogenetically due to its potential for multidirectional differentiation. PA's have been shown consistent cytogenetic abnormalities chiefly involving the chromosome region 12q 13-15. The putative pleomorphic adenoma gene (PLAG1) has been mapped to chromosome 8q 12.<sup>[12]</sup>

Treatment of choice of PA's is superficial parotidectomy with preservation of facial nerve for tumors arising within parotid; for PA's in minor salivary gland wide local excision with the removal of periosteum or bone if they are involved.<sup>[4]</sup> The same treatment modality was followed in the case reported in the present article.

Recurrence may be associated due to incomplete capsule, intraoperative tumor rupture in which tumor contents spill into operative field, tumors, with high mesenchymal content, particularly chondroid, myxoid stroma<sup>[16]</sup>. Malignant transformation is very uncommon and incidence ranges from 1.9-23.3%.<sup>[9]</sup>

### Conclusion:

Pleomorphic adenoma presents the characteristic microscopic appearance of epithelial and myoepithelial cells in stromal background. However, certain variations from the usual may be found which are believed to be because of myoepithelial cells differentiation. Though diagnosis can be made because of this characteristic histological appearance, pathologist has to be aware of the variants of Pleomorphic adenoma which could lead to misdiagnosis.

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## Intercepting The Developing CI-II Div1 Malocclusion

### Abstract

In our day to day practice, we come across many cases in which a class-II div1 malocclusion is developing due to mesial drifting of maxillary permanent 1st molars. This mesial drift could be the result of loss of tooth material due to caries, 1 premature exfoliation/ extraction of deciduous molars 2 or ectopic eruption of Maxillary permanent 1st molars.3 A common advise at this juncture by general practitioner is to wait till the eruption of full compliment of teeth before initiating orthodontic treatment thereby increasing the chances of premolar extractions for correction of a full blown class-II div1 malocclusion. Presented in this article are cases in which a developing Class-II div1 malocclusion was successfully intercepted & corrected in mixed dentition period.

### Key Words

Developing CI-II Div1 malocclusion, Molar distallization, Pendulum appliance.

### Discussion:

Class-II Div1 malocclusion i.e. the anterior positioning of upper 1<sup>st</sup> molars in relation to the lower 1<sup>st</sup> molars is a very common problem in the children today. Though the genetic component does dominate the incidence,<sup>[4]</sup> the lifestyle changes in the urban population has given a new dimension to the same. The recent evidences show an increased incidence of nursing bottle caries, rampant caries, early exfoliation of deciduous teeth especially in the upper arch, thus leading to mesial migration of upper 1<sup>st</sup> molar thereby developing a Class-II Div1 malocclusion . A skeletal Class-II Div1 malocclusion is indeed easily managed in the mixed dentition stage with functional appliances but a developing dental Class-II Div1 malocclusion is somewhat mis understood & mismanaged by general practitioners. An interceptive treatment is often not suggested, rather the patient is advised to wait till the eruption of full compliment of permanent teeth. Intercepting these cases early by upper molar distallisation before the eruption of 2<sup>nd</sup> molars gives the advantage of bringing the molar to its naturally destined position thereby creating room for the normal eruption of anterior teeth & a class-I intercuspsation of the upper & lower 1<sup>st</sup> molars.<sup>[5],[6]</sup>

### Case Report 1:

The patient reported to the clinic at the age of 8 yrs with missing upper right & left deciduous 2<sup>nd</sup> molars. On examination it was found that the patient had a dental class-II molar relation. Both upper first permanent molars had migrated mesially and were rotated mesiopalatally, leaving little space for the erupting 2<sup>nd</sup> bicuspids. The consequences of this developing malocclusion were discussed with the parents of the patient and it was decided to intercept the developing malocclusion. Patient's impressions were made & a pendulum appliance was fabricated to distallize the maxillary 1<sup>st</sup> permanent molars. The pendulum appliance was activated to deliver distally directed forces on the upper 1<sup>st</sup> permanent molars thus pushing them back into the maxillary arch in order to create a sufficient space in the maxillary arch for the erupting 2<sup>nd</sup> bicuspids. The appliance was kept in place for a period of eight months in which time the molars were sufficiently distallized to create adequate space for the erupting premolars And a super CI-I molar relation was achieved.

At the end of eight months the maxillary molars had been pushed back in Class-I relationship with respect to lower 1<sup>st</sup> permanent molars. After the correction had been achieved the appliance was removed and a Nance button was cemented in the upper arch & a lingual

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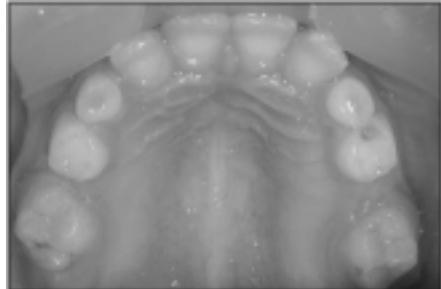




Fig:1 ( Before Interception) showing premature loss of maxillary deciduous molars & mesially migrated & severely rotated upper right first permanent molar and Cl-II molar relationship of the upper and lower dental arches.

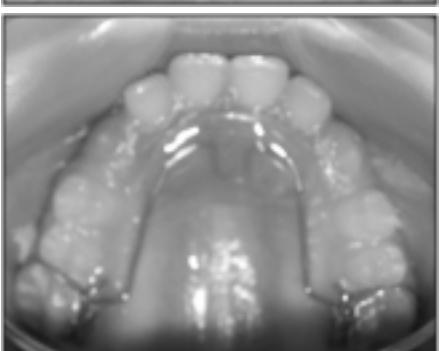


Fig:2 (Post-interception) showing the corrected upper molars which have been derotated & distalized . The correction is being maintained by the use of a Nance's button. Note: adequate space has been created for the eruption of the subsequent permanent teeth .

arch was cemented on the lower arch till the eruption of the cuspids & bicuspids was complete. The developing malocclusion was thus successfully intercepted and the treatment ended without the need for braces or active orthodontic treatment.

### Case Report 2:

The patient reported to the clinic at the age of 9 yrs. with a developing Class-II Div1 subdivision on left side with inadequate space for the eruption of maxillary canines. The treatment planning included the distalization of the maxillary 1<sup>st</sup> permanent molars to create space for the normal eruption of cuspids & premolars and to achieve a Class-I molar relationship. A pendulum appliance was fabricated & cemented on the maxillary arch. The appliance was kept in place for a period of five months in which time an adequate distalization of the maxillary molars was achieved to bring the molars in a class- I relationship, as well as an adequate space was achieved for the subsequent eruption of all maxillary cuspids & bicuspids.

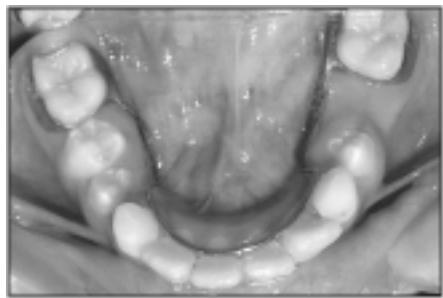


Fig:3 (Before Interception) showing a developing Cl-II Div1 malocclusion with an increased overjet , proclined upper/lower anterior teeth & buccally blocked out right canine. The Upper occlusal view shows retained Left & right deciduous canines and inadequate space for erupting permanent canines.



Fig: 4 showing the amount of activation built into the pendulum appliance and the pendulum appliance in place exerting a distalizing force on the molars.



Since the patient also had proclined upper anterior teeth and an increased overjet, the corrective orthodontic treatment with braces was followed to retract the upper anterior teeth in Class-I occlusion. And we were able to treat the case nonextraction thus saving the upper 1<sup>st</sup> bicuspids from being extracted if the case was delayed till after the eruption of 2<sup>nd</sup> permanent molars.



### Case Report 3:

A patient aged 8 yrs. reported to the clinic with a history of premature extraction of upper right deciduous canine & first molar and subsequent loss of space by mesial migration of permanent 1<sup>st</sup> premolar into the extraction space of deciduous canine so that there was no space left for the eruption of upper right permanent cuspid. The patient presented with a developing Class-II Div1 Subdivision on the right side. It was decided to intercept the developing malocclusion without any further delay. The upper right molar was planned to be distalized with the Jones jig appliance. The appliance was cemented in position with bands on upper right first premolar and permanent right first molar.



Fig:7 Showing post-treatment results with proper alignment of the blocked out upper right canine into the arch after successful distalization of upper right 1<sup>st</sup> molar and a good CI-I intercuspaton in the posterior segment.

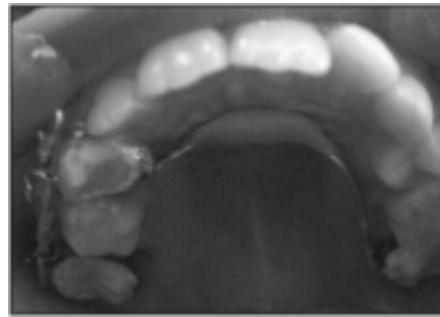
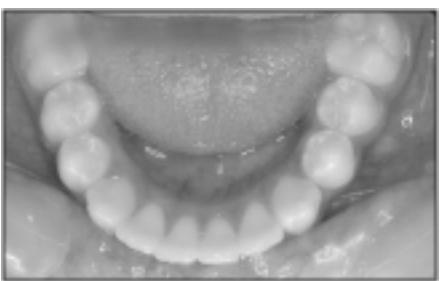


Fig: 6 showing a labially blocked out upper right canine with no space for its eruption in the arch and distalization of upper right 1<sup>st</sup> molar with a jones jig appliance.



The distalization of maxillary right 1<sup>st</sup> molar took place in a period of eight months creating enough room for the maxillary right cuspid to erupt in the right place as well as a Class-I molar relationship was also achieved on the right side. A Nance button was cemented in place till the eruption of all permanent teeth was complete. The interceptive treatment was followed by the corrective orthodontic treatment for minor correction of alignment after a gap of one year when all the permanent teeth had erupted.

Fig: 5 Post-treatment photographs of the patient showing a good CI-I intercuspaton on the right & left side and a normal overjet & overbite.

### Conclusion:

The interception of a developing Class-II Div1 malocclusion of dental origin due to the mesial migration of upper 1<sup>st</sup> permanent molars in the late mixed dentition stage before the eruption of permanent 2<sup>nd</sup> molars has much greater chances of success as less resistance is experienced by the distalizing 1<sup>st</sup> molars in the absence of the second molars. This gives the clinician enough room in the maxilla to attain an ideal Class-I molar relationship of teeth as well as avoid the extraction of upper 1<sup>st</sup> bicuspid which is the line of treatment for the correction of increased overjet in a full blown Class-II Div1 malocclusion of dental origin. The amount of distal movement of the maxillary first molars is significantly greater and the anchorage loss is significantly less before the eruption of the second molars. The time taken for molar distalization is also significantly shorter before the eruption of second molars.<sup>[7]</sup> The reason why it is more effective to move the maxillary first molars distally before the second molars have erupted is, of course, that there is one more tooth, and thus, a larger area of root surface to be moved when the second

molars have erupted. Thus, if one has to decide whether to move the maxillary molars distally in the mixed dentition or in the permanent dentition, it is always an advantage to make this intervention at an early age.

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## Management Of Multiple Avulsions And Multiple Extrusive Luxations In A Child Patient- A Case Report

### Abstract

Treatment of multiple permanent tooth avulsions with multiple extrusive luxations in children poses significant difficulties for the dental clinician. This article reports on the management of a paediatric patient with multiple avulsions of permanent incisors, primary canine and primary molar, and traumatically extruded maxillary and mandibular permanent incisors. The patient was managed within twenty-four hours of injury and the teeth showed satisfactory healing. More emphasis has been given for the management of extrusive luxation injuries. Suture splint has been described, which is a passive, non rigid and functional splint.

### Key Words

avulsion; extrusion; suture composite splint.

### Introduction

Extrusive luxation or partial avulsion is the partial displacement of a tooth from its bony socket. Clinically the tooth appears elongated and mobile, and is most often displaced towards the palatal side<sup>[1]</sup>. Radiographically, an extruded tooth exhibits an increased periodontal ligament space after accident<sup>[2]</sup>. This type of dental injury is uncommon in the permanent dentition, and accounts for only 0.05 to 7% of all traumatized permanent teeth<sup>[2],[3]</sup>. Early treatment for dental extrusion (within 24 hours) is recommended in order to achieve optimal healing<sup>[4],[5]</sup>. The recommended treatment for dental extrusion is gentle repositioning and non-rigid splinting for 2 to 3 weeks<sup>[2],[6],[7]</sup>. This report describes the dental management of a girl with a traumatically extruded maxillary and mandibular incisors and multiple avulsion of maxillary teeth.

### Case Report

An 8-year-old girl sought treatment for dental trauma in the Department of Paediatric and Preventive Dentistry that happened during the previous evening, about 18 hours prior to her presentation. She was treated at the Emergency ward of Government Medical Hospital immediately after trauma. The child gave history of fall from the first floor of a building while playing. Her medical history was unremarkable and all her vaccinations are up-to-date. There was no



Figure I; Preoperative photograph of the patient.

history of convulsions or vomiting and loss of consciousness. There was a positive history of bleeding from mouth and nose. Extra oral examination revealed swelling of upper and lower lips with tenderness on palpation; sutures were present on the lower lip. Intraoral examination revealed, avulsed 11, 21, 63 and 64. Tooth 22 was mobile, appeared elongated and displaced palatally. Teeth 31 and 41 were also mobile and appeared elongated (Fig. I). Radiographic examination revealed coronal displacement of teeth 22, 31 and 41 (Fig. II). A diagnosis of extrusive luxation of 22, 31 and 41 was made. Under local anaesthesia, the mucosal wound was examined and no alveolar fracture was observed. Teeth 31 and 41 were then gently repositioned manually, and splinted to adjacent teeth with a 0.016-inch round stainless steel wire and composite resin. Tooth 22 was also gently repositioned manually, and splinted with

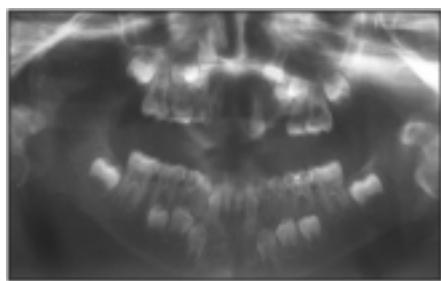


Figure II; Preoperative radiograph showing avulsed 11, 21, 63, 64 and extruded 22, 31 and 41.

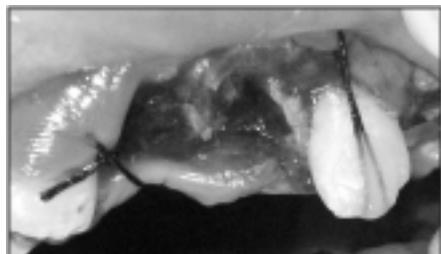


Figure III; Suture splint used for the stabilisation of repositioned 22.

suture splint as there was no tooth on either side of extruded 22 to support the splint (Fig. III). A cross suture with a nonresorbable silk suture material was placed over tooth 22 and the support was taken from the labial and palatal marginal gingiva. Light cure composite was cured

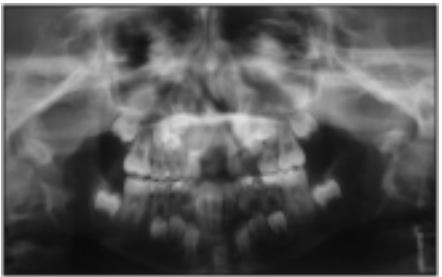


Figure IV; Postoperative radiograph of the patient.



Figure V; Postoperative photograph after six months (without removable partial denture for missing teeth).

over the suture material at the incisal third of the tooth so that the material does not slip. The sutures and splint were removed after one and two weeks respectively, and healing was uneventful (**Fig. IV**). The patient was reviewed after 6 weeks and 6 months and subsequently annually. All the traumatised incisors showed a positive response to the ethyl chloride test at all the review visits. Clinical and radiographic examination revealed satisfactory healing of the extruded incisors after 6 months (**Fig. V**).

## Discussion

The prevalence of pulp necrosis following extrusive luxations was noted in two studies as 26 and 43%, respectively<sup>[8],[9]</sup>. Lee et al. Reported that pulp canal obliteration is the second most common healing complication following extrusive luxation injuries, as seen in 35% of the cases<sup>[9]</sup>. They reported that root resorptions are an uncommon outcome following extrusions. Andreasen and Vestergaard<sup>[9]</sup> found a significantly higher level of pulp necrosis in mature teeth; on the contrary, Lee et al.<sup>[9]</sup> noted the degree of extrusion as the main predictor for pulp necrosis as well as pulp canal obliteration after extrusions. The major factor influencing pulp healing after extrusive luxation was the stage of root development; immature teeth showed better healing potential compared with mature teeth<sup>[9]</sup>. In this case satisfactory healing was achieved in the traumatised incisors. The recommended treatment for dental extrusion is gentle repositioning and non-rigid splinting for 2 to 3 weeks<sup>[2],[6],[7]</sup>. Early treatment for

traumatically extruded teeth is recommended, as delayed treatment might result in organization of the apical blood clot, making complete repositioning difficult<sup>[2],[4]</sup>. In this case the extruded teeth were repositioned with digital pressure on the same day. Fixation methods used for dental splints vary according to authors and with the type of dental trauma. Many different types of dental splints have been described in literature<sup>[9],[10],[11],[12]</sup>. Fixation after repositioning in case of mandibular central incisors was done with light cure composite and wire splint. This is one of the common methods of splinting opted for such kind of cases. But it was very difficult to stabilise the extruded maxillary central incisor after repositioning as teeth on either side of it were avulsed during trauma. Then it was decided to use suture splint<sup>[12]</sup> to stabilise this tooth. It is passive, semi rigid and functional splint<sup>[12]</sup>. It has been shown to be successful for stabilisation of such kind of injuries<sup>[13]</sup>. The splints were removed after two weeks. There was sufficient periodontal and gingival healing. Endodontic treatment, even for teeth with closed apices, should only be initiated when there is evidence of pulp necrosis or inflammatory root resorption<sup>[2]</sup>. The patient was reviewed after 6 weeks and 6 months and subsequently annually. All the traumatised incisors showed a positive response to the ethyl chloride test at all the review visits.

## Conclusion

General dentists should familiarize themselves with the latest treatment protocols for dental trauma. A correct diagnosis and prompt treatment offers a better chance of optimal healing with fewer complications. Suture splints have been described, which are essential splints for the stabilisation of teeth under such conditions.

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## Unusual Presentation of Squamous Cell Carcinoma of Alveolus in a Young Female

### Abstract

Oral squamous cell carcinoma (OSCC) is the most common oral malignant neoplasm, mainly affecting individuals over 50 years old with a history of tobacco and alcohol use. The occurrence of this alveolar cancer in young individuals less than 20 years is unusual and, when it does occur, shows a weaker relation to those risk factors and a more aggressive clinical course. Due to the paucity of reports in this population, it is difficult to prove its increasing trend. A rare case of alveolar squamous cell carcinoma in a 16-year-young female with no history of tobacco or alcohol use is reported. Clinicopathological findings, etiology, and treatment are discussed. The increasing trend of oral squamous cell carcinoma in young women without known risk factors highlights the need for clinicians to be prepared to diagnose these lesions quickly and precisely, providing a better prognosis, chance of survival, and quality of life for the patient.

### Key Words

Alveolar carcinoma, Squamous cell, Mouth neoplasms, Risk factors

### Introduction

Throughout the last century, the number of cancer cases increased worldwide, now representing one of the most important public health problems in the world. The incidence of oral cancer has also increased.<sup>[1]</sup> Oral squamous cell carcinoma (OSCC) represents between 90- 95% of all malignant neoplasms of the oral cavity. Lesions are located mainly on the tongue, especially on the lateral posterior border.<sup>[2]</sup>

Historically, scientific literature has demonstrated a preferential incidence of oral cancers in men aged 50 to 70 years.<sup>[2,3]</sup> However, recent epidemiological studies have shown an increase in the development of OSCC in patients under 45 years old.<sup>[4]</sup> In those cases, tumor behaviour is different and patients have a poor prognosis in comparison to cancer in older adults.<sup>[5]</sup>

The modification of social and cultural habits, specifically those concerning male and female behaviours, could be related to the increase in the occurrence in women.<sup>[1],[6],[7]</sup> However, the absence of traditional risk factors such as alcoholism and excessive tobacco use<sup>[2]</sup> in young patients has suggested that in these cases cancer may be a different disease from

that occurring in older patients, and may have a different etiology and clinical progress.<sup>[8],[9]</sup>

In this article, we report the case of alveolar carcinoma in a sixteen year young female with no history of tobacco or alcohol use, and discuss the clinicopathological findings, etiology and treatment.

### Case Summary

A sixteen years young female presented with 2 months history of odynophagia and ulcerated lesion in the oral cavity. There was no history of bleeding from the oral cavity, change in voice and weight loss. She was non-smoker and there was no history of alcoholism or any other harmful habit. Menstrual history of the patient was normal with menarche at 14 years. General physical and systemic examination was normal. Clinically, facial asymmetry with tumefaction at the right side was observed. Local examination revealed two ulcerated lesions in the oral cavity, with irregular borders, and necrotic bed, one was an ulcero-proliferative growth of 5x1 cm size involving lower alveolus, gingiva, gingivo-buccal sulcus posteriorly and another lesion of 3x1 cm size involving the lower alveolus, gingiva, anteriorly on

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### Quick Response Code



the right side of the oral cavity (**Figure: 1**). Whitish areas could be observed in the



Figure 1: The intraoral clinical view showing ulcero-proliferative lesion with irregular margins and necrotic bed growth involving the lower alveolus, gingiva, gingivo-buccal sulcus anteriorly and posteriorly with white pseudomembrane in the posterior mandibular gingiva.

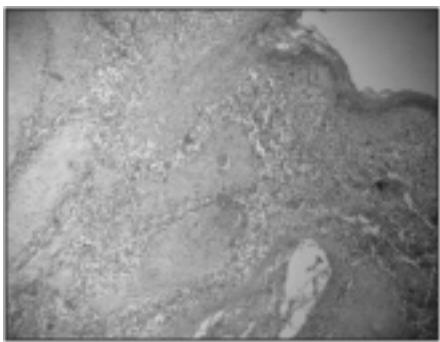
periphery of the ulceration. There was no other lesion seen in the oral cavity. Complete hemogram and routine blood biochemistry of the patient were within normal limits. Mantoux test of the patient was negative. No significant cervical lymphadenopathy was observed. The radiographic examination / Orthopantomogram did not reveal any signs of bone destruction (**Figure: 2**), and the proposed clinical diagnosis was a traumatic ulcer. Patient underwent incisional biopsy from both the lesions. Areas of great inflammatory infiltrate were identified as well as hornish pearls, intact stratified pavmented epithelium, islets of neoplastic epithelium, polymorphism, and hyperchromatism, thus establishing the diagnosis as well differentiated squamous cell carcinoma with infiltration of the underlying connective tissue and the margins were infiltrated by the tumor (**Figure 3A & 3B**). The tumor-node-metastasis (TNM) staging system revealed was stage III disease (T3N0M0) based on the mouth cancer TNM classification criteria of the American Joint Committee for Cancer Staging (UICC/AJC). Patient was given external beam radical radiotherapy by conventional fractionation (64Gy / 32fractions / 6.2weeks) by parallel opposed lateral fields to face and neck and patient was disease free for six months and later has lost the follow-up.

## Discussion

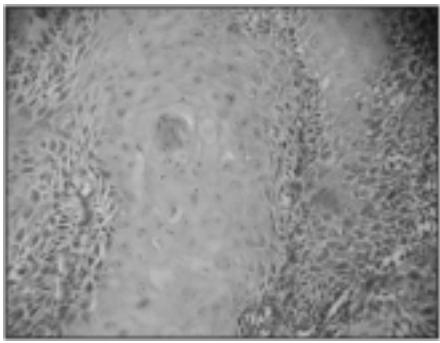
OSCC occurs less frequently in young individuals (<20 years). Those cases represent 3-6% of all OSCCs.<sup>[3]</sup> In up to 72% of these younger patients; one or more behavioural risk factors are present. Also, men are affected twice as often as women.<sup>[10]</sup> Of the many different factors associated with an increased risk for OSCC, tobacco and alcohol seem to be the most studied. Individuals who smoke more than 20 cigarettes a day and consume more than 100 g of alcohol a day are at increased risk of oral epithelial dysplasia. Few reports have shown distinct molecular differences between younger and older patients with OSCC, as well as between non-smoking and smoking patients, supporting the hypothesis that different subgroups of OSCC exist, especially with respect to exposure to tobacco carcinogens.<sup>[2],[3],[11]</sup> It is hypothesised that a subgroup of individuals, characterised by the development of the disease at early ages and by shorter exposure time to



**Figure 2:** The panoramic x-ray examination did not reveal any signs of bone destruction. Additionally, there was a broad area of well and poorly circumscribed radiolucency, with no evidence of alveolar crest involvement.



**Figure 3 A**



**Figure 3 B**

**Figure 3 A & B:** Photomicrograph (H&E stain; original magnification  $\times 40$ ) showing unremarkable overlying mucosa and underlying connective tissue with infiltration by tumor.

behavioural risk factors, develops a histologically similar, but genetically different OSCC, as compared to their older counterparts. This may be due to an increased susceptibility to the development of oral cancer as a result of a lower expression of single nucleotide polymorphisms of the GSTP1 gene. This encodes an enzyme that functions in xenobiotic metabolism of polycyclic aromatic hydrocarbons, which is involved in the metabolism of carcinogens and/or DNA repair, as seen in other tumor types.<sup>[3]</sup>

Clinical manifestations of OSCC in younger patients have no features to distinguish them from that of older patients; nevertheless, many clinicians tend not to include OSCC as a differential diagnosis in young patients, simply because such disease does not often present in that age range.<sup>[2]</sup>

The reported case presents different characteristics from the OSCC usually reported in epidemiological studies; the patient was young and without a history of alcoholism or excessive tobacco use. This is consistent with the observation of other workers who report OSCC without a history of alcoholism or excessive tobacco use.<sup>[11]</sup> Alcoholism or excessive tobacco use have been reported in only a small number of young patients, and even in cases where a correlation is found, the exposure to carcinogens was not sufficient for the development of a malignant lesion.<sup>[7]</sup> A viral association, particularly the human papilloma virus (HPV), has been implicated in the pathogenesis. The prevalence of HPV, mainly HPV 16, is high in oropharyngeal SCC, but concerning the prevalence of HPV in the oral cavity- mostly tongue SCC as a main location for oral cavity cancer-the data from the literature are not concordant, ranging from 2.6 to 98%. Moreover many people are exposed to such risk factors and only a small percentage develops the disease, which determines the necessity of searching for other risk factors such as immunological or nutritional deficiencies, genetic factors, and microbiological agents in etiogenesis. Among these factors, human papillomavirus and Epstein-Barr virus have already been suggested as etiological factors.<sup>[1],[7]</sup>

In summary, the factors that should be investigated in order to explain the etiology of OSCC in young female patients, include genetic predisposition, previous viral infections, nutritional patterns, immunodeficiency, occupational exposure to carcinogens, socioeconomic conditions, and oral hygiene.<sup>[2]</sup> There is some agreement regarding the poor prognosis and short survival rates in younger patients who develop OSCC in the absence of the usual risk factors,<sup>[11]</sup> although some studies were based on small numbers of patients.<sup>[9]</sup>

## Conclusion

We described the case of a 16-year-young female who was diagnosed to have OSCC of the lower alveolus. There were no known risk factors. OSCC in this age and alveolar site is rare, but should always be considered in the differential diagnosis of non-healing ulcers. The association a young female patient without exposure to the most common risk factors, and more aggressive tumoral behavior in an unusual area, suggest that OSCC, when occurring in non-smokers, represents a different clinical and molecular disease. Further studies would be necessary to identify other risk factors involved in tumoral development in order to improve prevention programmes and early detection.

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### Apexification With Mineral Trioxide Aggregate - A Case Report

#### Abstract

Complicated crown fractures of recently erupted or young permanent teeth have immature roots. Difficulties are encountered in obturating the root canal with gutta-percha cones achieving adequate apical seal. Apexification procedure is the treatment of choice which can be performed by calcium hydroxide or a recent material i.e. MTA. This case report describes the apexification of a 14 year old male patient with a fractured right central incisor with a blunder-buss apex, with MTA as the material of choice over calcium hydroxide with six months follow up.

#### Key Words

open-apex, mineral trioxide aggregate (MTA)

#### Introduction

Trauma causes cessation of root development. Fragile root canals becomes weak. It is difficult to create an artificial barrier or induce closure of apical foramen with calcified tissue.<sup>[1]</sup>

MTA was first described in dental scientific literature in 1993<sup>[2]</sup> and was given approval for endodontic use by the US Food and Drug Administration in 1998. Upto 2002, only one MTA material consisting of grey coloured powder was available and then white MTA was introduced. Both formulae contain 75% Portland cement, 20% bismuth oxide and 5% gypsum by weight.

The aim of this procedure is to limit bacterial infection and production of mineralized apical tissues in immature anterior tooth.

The inadequacy of calcium hydroxide apexification due to its long time span and re-infection because of temporary seal<sup>[3],[4]</sup> led the use of MTA.

This forms a barrier and prevents micro leakage. It is bio- compatible and forms dentinal bridge, cementum and periodontal ligament regeneration.<sup>[5]</sup> It has the ability to stimulate cytocline release from the bone cells, indicating that it actively promotes hard tissue formation.<sup>[6]</sup>

#### Case Report

A 14 year old male presented with fractured maxillary right central incisor (**Fig. 1**). The patient reported of no tooth ache. The treatment of tooth was attempted by other dentist. Pulpectomy alongwith calcium hydroxide had been used as apical barrier for his last 6 months. But the treatment was not successful as seen in the radiograph (**Fig. 2**). The treatment involved was endodontic retreatment followed by esthetic enhancement by composite restoration of the tooth.

#### Clinical Steps

The tooth was isolated and access cavity re-negotiated. Canal was cleaned by endodontic files and 5% NaOCL and the length determined. The length was recorded for further reference. (**Fig. 3**).

The canal was dried with sterile paper points and once again calcium hydroxide



Figure 1

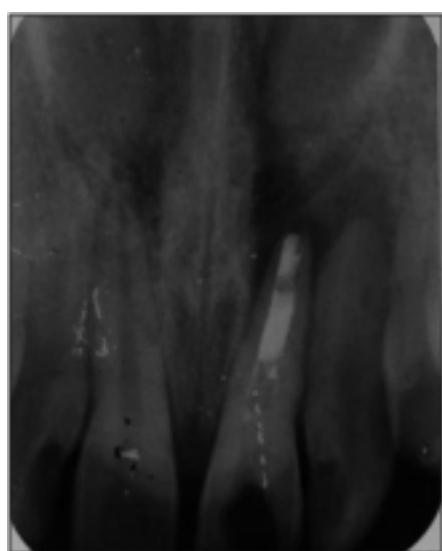


Figure 2

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dressing was given for 1 week by placing it with leutulo spirals (Dentsply Inc.).

After 1 week the calcium hydroxide was removed and rinsing of canal was done again with NaOcl and EDTA alternately. Finally after rinsing with sterile water canal was dried. MTA (Angelus,

Londrina, PR, Brazil) was prepared according to manufacturer recommendation (Fig. 4). Mineral trioxide aggregate was placed in the apical portions of canals with a thickness of 3-5 mm. (Fig. 5).

A sterile moist cotton pellet was placed over the canal orifice and the access cavity was sealed temporarily.

Correct placement was confirmed radiographically (Fig. 6). After one week the canal was filled with gutta percha points (Dentsply Tulsa) (Fig. 7). The esthetics of the fractured central incisor was restored with composite (shofu Inc. Japan) (Fig. 8).

Case was reviewed radiographically after an interval of 6 months (Fig. 9). The tooth was free of any visible or radiographic symptoms. Radiographically periapical tissue was normal and tooth was healthy.

## Discussion

For many years the calcium hydroxide has been used in apexification in procedures. MTA is the material of choice which has been suggested with a choice which has been suggested with a repairing mechanism similar to calcium hydroxide but in a shorter period of time. It causes significantly less inflammation and also provides a hard-setting, non-resorbable surface without the presence of tunnels in the dentinal barrier.<sup>[7],[8],[9]</sup> Therefore in the case presented, MTA was used as material for apexification.

Many in vivo and histological studies have reported the superior physical and biological properties of MTA in a short follow-up period.<sup>[10],[11],[12]</sup>

Calcium hydroxide is unpredictable and have lengthy course of treatment and presents a challenge of re-infection as studied by Magura ME et al.<sup>[13]</sup>

Felipe WE et al.<sup>[14]</sup> & Regan JD<sup>[1]</sup> et al<sup>[15]</sup> used MTA as root end filling with promising results.

## Conclusion

Long-term follow-up of MTA as root end filling shows good prognosis for immature fractured permanent teeth. One-step obstruction with MTA allows permanent restoration in a short time. Attempts are being conducted to improve the working properties of MTA via the addition of setting accelerators, shorter

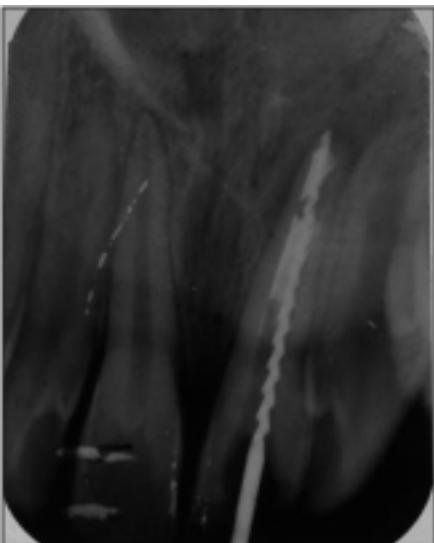


Figure 3

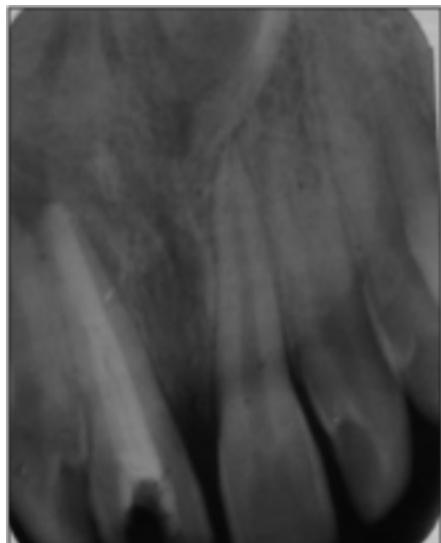


Figure 7



Figure 4



Figure 8



Figure 5

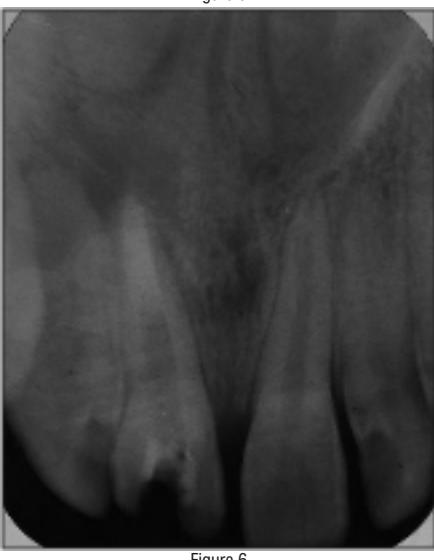


Figure 6

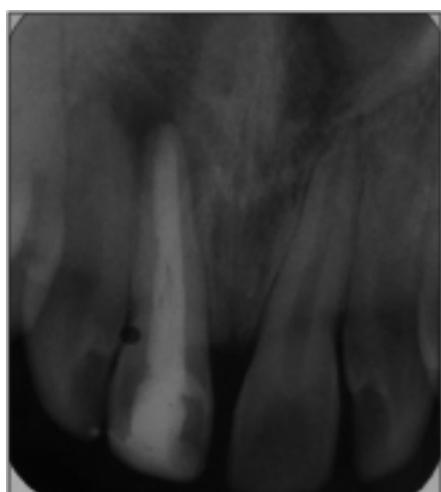


Figure 9

setting time, better handling properties and a similar sealing ability.

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## An Unusual Case Of Non-syndrome Associated Multiple Supernumerary Teeth, An Overview Of Diagnosis And Management-A Case Report

### Abstract

Dental anomalies have been known to occur in man due to variety of genetic and environmental factors. The prevalence of supernumerary teeth in Caucasians is between 1% to 3%, out of which 76% to 86% of cases represent only single tooth hyperdontia, with 2 supernumerary teeth noted in 2%-20% and three or more extra teeth in only 1% of the cases. It has been reported that the prevalence for non syndrome associated multiple supernumerary teeth is less than 1%. This article presents a case of non syndrome associated multiple supernumerary teeth in three quadrants of mouth. The goal of this article is to emphasize the diagnostic criteria's necessary to rule out various syndrome associations and the need for routine orthopantomograms in such patients. A brief review of the literature on the incidence, possible risk to the patient in the later life and practice guidelines are also presented.

### Key Words

supernumerary teeth, syndrome, hyperdontia

### Introduction

Dental anomalies have been known to occur in man due to variety of genetic and environmental factors. Supernumerary teeth or hyperdontia is comparatively infrequent developmental alteration<sup>[1]</sup>. Brook found the incidence of supernumerary teeth in primary dentition is 0.8% and in permanent dentition it is 2.1%. The prevalence of supernumerary teeth in Caucasians is between 1% to 3%, out of which 76% to 86% of cases represent only single tooth hyperdontia, with 2 supernumerary teeth noted in 2%-20% and three or more extra teeth in only 1% of the cases<sup>[2]</sup>. Most cases are found in association with syndromes including apert, Cleidocranial dysplasia, Crouzon, curtius, Gardners, Nance -Horan, Laband, Klippel-Trenaunay- weber, Fucosidosis and cleft lip and palate. The frequency of supernumerary teeth with unilateral cleft lip and palate is 22.2%<sup>[3]</sup>. Gardner's syndrome is associated with a single gene pleiotropism autosomal dominant in nature. 45% of the patients with multiple supernumerary teeth have premalignant intestinal polyposis and 27% out of which may present with intestinal carcinoma associated with this syndrome<sup>[2]</sup>. It has been reported that the prevalence for non syndrome associated multiple supernumerary teeth is less than

1%, So there is always a high suspicion for syndrome association in patients with multiple supernumeraries. The male to female ratio has been reported as 9:2 by Yusof.<sup>[2]</sup>

The exact aetiology of supernumerary teeth is still obscure although many theories have been proposed. Two popularly accepted theories are: the dichotomy theory of tooth germs states that the tooth bud splits into two equal or different sized parts, resulting in two teeth of equal size or one normal and one dimorphic tooth respectively. Localized and independent hyperactivity of dental lamina is the other accepted theory, which suggests supernumerary teeth are formed as a result of local, independent, conditioned hyperactivity of dental lamina. Supernumerary teeth can be classified into Mesiodens - present in the incisor region, Paramolars - present beside a molar, Disto-molars - present distal to the last molar, Parapremolars - present beside a premolar which can be Conical, Tuberculate, supplemental or Odontome<sup>[4],[5]</sup>. Supernumeraries may cause failure of eruption of tooth-The presence of a supernumerary tooth is the most common cause for the failure of eruption of a maxillary central incisor. Displacement The presence of a

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supernumerary tooth may cause displacement of a permanent tooth. The degree of displacement may vary from a mild rotation to complete displacement. Crowding Erupted supplemental teeth most often causes crowding. A supplemental lateral incisor may cause crowding in the upper anterior region. Pathology Dentigerous cyst formation is another problem that may be associated with supernumerary teeth. Primosch reported an enlarged follicular sac in 30% of cases, but histological evidence of cyst formation was found in only 4 to 9% of cases<sup>[5]</sup>.

### Case Report

A 25 years old male came in the Department of Periodontology at HP Govt. dental college, Shimla (HP) with chief complaint of Bleeding gums and

diffuse pain in the upper jaw and spontaneous eruption of teeth below the tongue. On extraoral examination no significant facial asymmetry was noticed. Intraoral examination revealed that the patient had 5 extra teeth, 1 small erupted conical tooth in the palatal aspect of 15 and 16, 2 small tuberculate in the lingual aspect of 34 and 35 and 2 similar small tuberculate in the lingual aspect of 44 and 45. No supernumerary teeth were present in the second quadrant of the mouth. All 5 extra teeth were partially erupted in the oral cavity with rudimentary roots whereas crowns were well calcified. None of the permanent tooth was found to be missing as the patient did not show any abnormal systemic manifestations, all the syndromes were ruled out.**Fig-1,2**

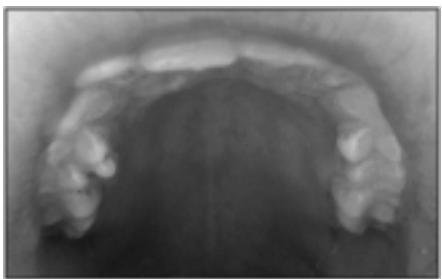


Figure 1

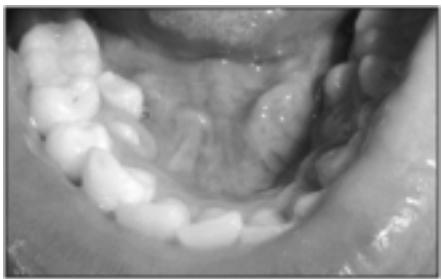


Figure 2

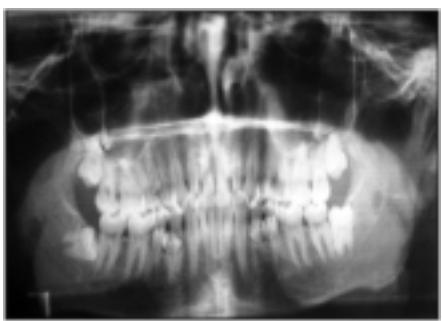


Figure 3

### Investigations

Orthopantomogram was taken to rule out any other supernumerary teeth present in the arches And to rule out tooth fusion or germination of the supernumerary tooth with the permanent tooth .Diagnostic casts were made in order to plan the surgical procedure and to evaluate the need of bone removal and bone graft placement at the time of surgery.**Fig-3**

### Periodontal Treatment

Comprehensive periodontal treatment was instituted. Complete oral prophylaxis including supragingival and subgingival scaling and subgingival curettage was performed. Frequent subgingival irrigations were done with chlorhexidine gluconate(0.12%) , deep periodontal pockets were impregnated with metronidazol gel (25%) and patient was kept on antihypersensitivity mouth wash (potassium nitrate 4%) to be used twice daily half an hour after brushing and antihypersensitivity tooth paste(stannous fluoride) to be used twice daily after meals. Patient responded the oral therapy and soon got relieved of all the symptoms.

### Surgical Treatment

All surgical procedure was planned under LA. A careful mucoperiosteal flap was raised with effect from the mesial aspect of 13 to the distal aspect of 15. Careful removal of the surrounding bone was performed with the help of slow moving micromotor bur with continuous saline irrigation and the supernumerary tooth was taken out and nanocrystalline CaSO<sub>4</sub> hemihydrate bone graft was grafted in the bone defect to aid in healing and to maintain the natural bone contours and sutures were placed. Similarly inferior alveolar and lingual nerve blocks were given on the same side of the mouth, mucoperiosteal flap was raised and after judicious bone removal careful tooth extraction was done for both the extra teeth. Bone graft was grafted and sutures were placed. Similar procedure was performed on the right side of the jaw after 10 days of prior surgery. Sutures were removed on the 7th day post operatively and IOPA radiographs were taken to evaluate the bone morphology.  
**Fig-4,5,6,7**

### Discussion

Multiple supernumerary teeth not associated with syndromes are a rare anomaly. Yusof in 1990 [6] reported that



Figure 4



Figure 5



Figure 6



Figure 7

the premolar region in the lower arch is the most common place for supernumerary teeth followed by the molar region. Hegde and Munshi, Mason et al reported displacements, rotations, ectopic eruption, and malocclusion in their studies, similar alterations were noted in this clinical case. It is difficult to establish an ideal treatment for cases of multiple supernumeraries. The clinical and radiographic exam is of vital importance to carry out a good treatment plan which can vary from simple extractions or extractions followed by orthodontic treatment to obtain a correct occlusion. In this case it was decided to extract the erupted and retained supernumerary teeth followed by orthodontic treatment in order to establish a correct occlusion<sup>[8]</sup>. We emphasize the importance of a good clinical history when a patient with multiple supernumerary teeth comes for consultation, since most of them are associated with other syndromes and their presence can be diagnosed by a routine dental professional, for example a patient of Gardner's syndrome may manifest multiple osteomas of bone including skull and jaw bones and may also have multiple sebaceous or desmoids cysts on the scalp. In later life patient may manifest multiple polyposis intestine or carcinoma. Similarly a patient with cleidocranial dysplasia may manifest Delayed closure (ossification) of the bones of the skull (fontanelles), Premature closing of the coronal suture, Protruding jaw (mandible) and protruding brow bone (frontal bossing) and wide nasal bridge due to increased space between the eyes (hypertelorism). Removal of supernumeraries should be evaluated for the possible benefits and for the treatment outcomes<sup>[9]</sup>. Treatment depends on the type and position of the supernumerary tooth and on its effect or potential effect on adjacent teeth. The management of a supernumerary tooth should form part of a comprehensive treatment plan and should not be considered in isolation. Removal of the supernumerary tooth is recommended where: central incisor eruption has been delayed or inhibited; there is associated pathology; its presence would compromise secondary alveolar bone grafting in cleft lip and palate patients; the tooth is present in bone designated for implant placement and when the spontaneous eruption of the supernumerary has occurred.

Extraction is not always the treatment of choice for supernumerary teeth. They may be monitored without removal where: satisfactory eruption of related teeth has occurred; there is no associated pathology; removal would prejudice the vitality of the related teeth.

Removal of a supernumerary tooth preventing permanent tooth eruption usually results in the eruption of the tooth, provided adequate space is available in the arch to accommodate it.<sup>[18]</sup> Di Biase found 75% of incisors erupted spontaneously after removal of the supernumerary. Eruption occurred on average within 18 months, provided that the incisor was not too far displaced and that sufficient space was available. Although the majority of authors recommend exposure of the unerupted tooth when the supernumerary is removed, Di Biase advocates conservative management without exposure<sup>[5]</sup>.

### Conclusions

Supernumeraries may be a result of biologic, genetic and environmental factors<sup>[10]</sup>. Non syndrome associated supernumeraries is a rare entity and should be looked with a high suspicion of hidden syndrome and patient should be warned for future complications he may manifest. Supernumeraries that seem to be hazardous to the dentition should be removed carefully with proper maintenance of physiologic jaw contours. Impacted supernumerary teeth that are asymptomatic and do not affect the dentition should be followed rather than removed.

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### Esthetic Management Of Turner's Hypoplasia

#### Abstract

Diminished enamel is found in turner's hypoplasia case report of 18 year old female who met with trauma in childhood presented with hypoplasia of right upper lateral incisor which was treated with composite restoration.

#### Key Words

Turner's hypoplasia, hypoplasia, lateral incisor

#### Introduction

Turner's hypoplasia usually manifests as a portion of missing or diminished enamel on permanent teeth. Unlike other abnormalities which affect the large number of teeth, Turner's hypoplasia affects only tooth in the oral cavity and it is referred to as a Turner's tooth. If involves single tooth, most likely cause is traumatic injuries leading to primary tooth being pushed into the developing tooth underneath it, infection from fractured deciduous tooth, iatrogenic from inelegant deciduous tooth extraction, bruising from local facial trauma consequently affects the formation of enamel. The affect to trauma is more pronounced if it occurs prior to 3rd year of life<sup>2</sup>. Injuries occurring after this time are less likely to cause enamel defects since enamel is already calcified. Because of the topographic relationship of the primary teeth to the permanent tooth germ, the most likely affected area on the permanent tooth is the facial surface (the site closer to lips and cheek).<sup>[1]</sup>

In considering treatment options (extractions, dentin bonding, composite restoration, cast metal restorations) a number of factors need to be considered including:

- Number of teeth affected
- Location of defects (crown tip, mid crown)
- Importance of teeth affected
- Severity of defects (coronal and root)
- Patient's expectation and resources

- Operator's knowledge, skills and resources

#### Case Report

An 18 year old patient reported to department of Conservative Dentistry and Endodontics with chief complaint of malformed right upper front tooth since childhood. (Fig - 1) Patient gave history of loss of primary incisors due to trauma at the age of 2 years. Clinical examination showed the presence of moderate to severe yellowish brown discoloration with hypoplastic enamel of right lateral incisor. Right lateral incisor exhibited no mobility with vitality test positive. Patient wanted immediate esthetic restoration of malformed tooth due to her personal reasons. So treatment using adhesive resin was preferred as it could be done in single sitting and gave immediate esthetic results. Composite veneering was done on labial surface of right lateral incisor.(Fig - 2)

After anesthesia was administered, rubber dam isolation was accomplished. Labial reduction was done upto 1mm depth. .the total etch technique was utilized due to its ability to minimize the potential of microleakage and enhance bond strength .The tooth surface was etched for 15 sec with phosphoric acid, rinsed for 5 sec, gently dried for 5 sec, and lightly air thinned to avoid desiccation. The surface was remoistened with water and a hydrophilic adhesive agent (Prime and Bond NT, Dentsply /Caulk, Milford,

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Fig 1 :Turner' Tooth



Fig 2 : Composite veneering

DE) was applied with a disposable brush. Using continuous motion ,the excess adhesive was removed with a dry micro brush applicator and light cured for 20 sec. Composite resin was applied in increments on the labial surface and each increment was cured for 40 sec. Once the composite was polymerized, a long needle shaped finishing bur was used to finish the labial surface according to the proper anatomic contours of the facial aspect of anterior tooth. Initial finishing was achieved with a 12 fluted, needle shaped bur to replicate natural form and texture. A smooth surface was achieved by following a sequential increase in number of flutes. The facial surface was subsequently polished to a high luster using aluminium oxide discs, prepolish and high shine silicon rubber points(Indentoflex Kerr /Sybron,Orange CA:Astropol,Invoclar Vivadent, Amherst, NY).To impart a high luster and reflectivity on the tooth, The final polishing was accomplished with composite polishing paste and goat hair brushes applied at conventional speed. After polishing procedure was completed ,a final 2 min post curing was performed to improve the degree of conversion and ensure surface hardness.

## Discussion

In the present case report it was seen that traumatic injuries to primary predecessors had lead to developmental disturbances in their successor. The permanent tooth which erupted crown defect like defective enamel formation. In the case of amelogenesis, it is not different cells doing different jobs, but the same cells at different stages of maturation doing the different jobs. First they lay down the organic matrix and then they lay down the hydroxyapatite crystals within this matrix and finally they become quiescent and vestigial.<sup>[3]</sup> Once the cells have matured from one phase and moved to the next, they cannot go back and fix any defects. Anything that disrupts the delicate ameloblasts during enamel production will result in defective enamel which may be very porous and weak. This defective enamel is often present at eruption but will soon be lost to abrasive forces. This leaves an area of exposed dentin and rough margins to the surrounding enamel. In some instances the enamel does not form at all and so is missing as soon as the tooth erupts.



Fig 3 : Improved esthetics

Brownish discoloration occurs due to disturbance in ameloblastic layer leading to defective matrix formation caused by traumatic injuries but the stretched inner enamel epithelium continue to induce the differentiation of new odontoblast . Under the defective or missing enamel is dentin, which eventually makes up the bulk of the tooth. It is about as hard as bone but much softer than enamel. It is pale yellow in color, compared to the stark white of normal enamel. In the present case tooth was unaffected by carious lesion ,so it was possible to save the tooth with turner's hypoplasia with minimum intervention and at six months recall visit the patient was asymptomatic ,had maintained esthetics and stability.(**Fig -3**)

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## Diode Laser Assisted Tooth Bleaching - A Case Report

### Abstract

Laser-assisted tooth bleaching is fast becoming a preferred treatment modality. The article explores the use of diode laser in laser assisted tooth bleaching. Diode laser with a hydrogen peroxide based bleaching gel was used to treat generalized discolouration on teeth. The laser was found to be highly effective with no reports of sensitivity or irritation.

### Key Words

Laser-assisted tooth bleaching, KTP-L, JWhite Power Bleaching gel, diode laser (Fotona XD-2)

### Introduction

Modern dentistry is evolving at a rapid rate with the advent of new materials and technologies. One such technique which has undergone explosive amelioration is the use of lasers in dental practice. After their introduction in the 1960s, lasers have had diverse applicability in clinical dentistry.<sup>[1]</sup> Amongst their many uses is laser-assisted tooth bleaching.

Tooth bleaching is becoming an increasing sought after treatment modality as patients are exceedingly concerned about aesthetics. Tooth discolouration may influence an individual to have a compromised self image and thus, bleaching treatments provide both aesthetic as well as psychological benefits.<sup>[2]</sup>

It was only in 1996 that laser-assisted bleaching was officially started with the approval of Ion Laser Technology's argon and carbon dioxide lasers by the FDA.<sup>[3]</sup>

Power bleaching using lasers was introduced in order to accelerate and enhance the bleaching process.<sup>[4]</sup> Laser bleaching is considered to be more efficacious as one can obtain controlled temperature elevation of the bleaching agent, and by photochemical activation provide a higher overall yield of intrinsic radicals causing better absorption into the dental hard tissues. This collectively minimises adverse pulpal reactions by reduced thermal

activation of the bleaching agents.

Now-a-days KTP-L (potassium titanyl phosphate laser), argon and diode lasers are commonly used for in-office power bleaching. The versatility of the diode laser is one of its most distinguishing characteristics. They have a multitude of applicability which includes soft tissue surgery, periodontal therapy, implantology, endodontics and esthetic dentistry.<sup>[5]</sup> Being a "soft" or "cold laser" it has also been employed for use in Low Level Laser Therapies (LLLT). The diode laser when used in bleaching procedures has been found to cause a temperature increase in pulp chamber below the critical temperature of 5.5°C, regarded as the threshold to prevent irreversible pulpal change.<sup>[6]</sup> A preclinical investigation using diode laser bleaching has concluded that it is a valuable energy source, and is simple as well as effective.<sup>[7]</sup>

The following case report describes the clinical application of the diode laser for vital tooth bleaching.

### Case Report

A 26-year old female patient visited our dental clinic with the chief complaint of generalized discolouration of teeth and wanted her teeth bleached to make them cosmetically desirable. She had noted this discolouration since the last 3 years during which she had undergone

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orthodontic treatment. On clinical examination we observed that all the teeth had a yellowish discolouration. (Fig. 1)

After explaining the various treatment options and the procedure to be undertaken, informed consent was taken from the patient.



Fig. 1. Pre-operative photograph showing generalised discolouration of teeth



Fig. 2. Photograph showing application of bleaching gel on teeth and resin barrier protection on adjacent gingiva.



Fig. 3. Post-operative photograph after diode laser assisted tooth bleaching showing improvement in the teeth shades.

The first step was to carry out shade matching of the teeth in order to set a bench mark for later comparison. This was followed by polishing the teeth using a pumice paste in order to remove plaque. Cotton wool isolation was used to maintain a dry field and a cheek tractor was used for better accessibility. The patient was made to wear protective eye wear all through the procedure. Vitamin E was kept available along with cotton tip applicators as this cures any irritation in cases where the bleaching gel comes in touch with soft tissues.

No local anaesthesia or pre-emptive analgesics were administered during treatment. Gingival protection was provided using a resin barrier (OpalDam, Ultradent) which was extended onto the cervical margin of the teeth by approximately 1mm.

The bleaching gel (JWhite Power Bleaching Gel, Heydent) was then prepared as per the manufacturer's instructions and applied onto the teeth using an applicator tip. The gel was first applied on the maxillary anterior teeth and gradually advanced towards the premolars bilaterally. The gel was then applied on the mandibular teeth in the same sequence. (Fig. 2)

A diode laser (Fotona XD-2) with a special bleaching hand piece (R24-B) was used for irradiation. Each tooth was

exposed to the laser for 30 seconds in the same sequence as that of gel application. The laser tip was used in non-contact mode and was constantly rotated in order to prevent prolonged focal application. The average power setting of the laser was maintained at 4 Watts.

After all the teeth had been irradiated the bleaching gel was aspirated and any remaining gel was removed using cotton pellets. The patient was then made to rinse and the teeth were dried. Thereafter the tooth colour was compared to the original recording. A second exposure was then done in order to achieve the desirable result. (Fig. 3)

The patient was requested to come to the clinic after a period of 10 days to check for any reversal in the tooth colour. The patient was also asked to report to the clinic in case of any discomfort.

The patient reported back to the clinic without any history of sensitivity or irritation. On clinical examination no setback in the tooth colour was noted.

### Discussion

The etiology of tooth discolouration is multivariable. Stains on teeth can be classified as either extrinsic or intrinsic. Extrinsic stains are usually seen in inaccessible areas and may result from plaque, beverages, dietary precipitates, medications or iron supplements. Some of the causes for intrinsic staining include trauma, diseases (like erythroblastosis fetalis, porphyria, amelogenesis imperfecta), medications (e.g. tetracycline), aging, etc.

Numerous techniques for teeth bleaching have been introduced in dentistry and continually reformed. Diverse numbers of oxidizing agents have been employed in tooth whitening and found to cause adverse effects on dental hard tissues and are advised to be used with caution.<sup>[8],[9]</sup> On the other hand, laser tooth bleaching causes less change in microhardness of enamel and does not result in much temperature elevation.<sup>[10]</sup> Another factor in favour of laser bleaching is the amount of time required to achieve desirable results. In today's society, where time is of essence, laser bleaching would be preferred over other techniques as 60-90 minutes would produce a favourable outcome.

The diode laser we used is provided with a specialized handpiece for laser tooth bleaching. This allows a laser spot-size of 6mm and the appropriate wattage, preventing any thermal insult on the pulp. The laser is easy to manipulate and extremely versatile.

The resin barrier protection (OpalDam, Ultradent) we used is a light-reflective, passively adhesive, light cure resin. It is a methacrylate based resin which maintains adequate strength where needed and at the same time can be removed easily from embrasures and undercuts.

We utilized JWhite Power Bleaching gel which is prepared by mixing hydrogen peroxide with JWhite powder as per the manufacturer's instructions. Use of 38% hydrogen peroxide activated by diode laser has been found to result in improved enamel luminosity using digital photometry.<sup>[11]</sup> Also, unlike other bleaching agents peroxide gels have a basic pH and this prevents any surface alterations or demineralization of the tooth surface.

The diode laser provides quick and effective results when used to activate the bleaching gel. An in vitro study concluded that diode laser activation of bleaching agent presented significantly better results as compared to the agent being used alone or when combined with LED source.<sup>[12]</sup> An added advantage is the reduced contact time of the bleaching agent with the teeth and this minimizes the chances of sensitivity or irritation.

### Conclusion

In conclusion, we would like to state that diode laser tooth bleaching is a viable treatment option, as it provides fast and effective bleaching without causing any thermal damage. The reduced time frame when utilizing power tooth bleaching will result in better patient compliance and satisfaction. Further investigation to prove the efficacy of laser tooth bleaching should be undertaken.

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## Ankyloglossia In Deciduous Dentition

### Abstract

Ankyloglossia is also known as tongue-tie. It is a relatively common finding in pediatric surgical outpatient clinics. It is a congenital condition that results when the inferior lingual frenulum is too short and attached to the tip of the tongue, limiting its normal movements.

Ankyloglossia limits the tongue movements upto varying degrees and thus can lead to a range of problems, such as difficulties in breastfeeding in infants, speech impediments, being embarrassed by peers during childhood and adolescence, and poor oral hygiene. Treatment of ankyloglossia can range from frenotomy to frenectomy to electrocautery to monopolar diathermy. The treatment choice varies from case to case.

The present article describes the surgical management of a patient having ankyloglossia associated with restricted movement of tongue. The treatment involved surgical removal of the lingual frenum, which healed uneventfully and the patient showed improved movements of tongue when viewed 1 month postoperatively.

### Key Words

Ankyloglossia, tongue-tie, Lingual frenum, Frenectomy

### Introduction:

Ankyloglossia originates from the Greek words "agkilos" (curved) and "glossa" (tongue).<sup>[1]</sup> Ankyloglossia, commonly known as tongue tie, is a congenital oral anomaly which may decrease the mobility of the tongue tip and is caused by an unusually short, thick lingual frenulum which is a membrane connecting the underside of the tongue to the floor of the mouth. The first use of the term ankyloglossia in the medical literature dates back to the 1960s, when Wallace defined tongue-tie as "a condition in which the tip of the tongue cannot be protruded beyond the lower incisor teeth because of a short frenulum linguae, often containing scar tissue."<sup>[2]</sup>

Ankyloglossia varies in degree of severity from mild cases, characterized by mucous membrane bands to complete ankyloglossia whereby the tongue is tethered to the floor of the mouth. Ankyloglossia, or tongue-tie, can be observed in neonates, children, or adults.<sup>[3]</sup>

### Classification

Several classifications have been proposed, but none have been universally accepted. (**Table Classification**)

### Case Report:

A six year old boy's parents reported to our clinic after noticing some

abnormalities during speech and mastication of food. The chief complaint of the pt was difficulty in speaking and mastication.

Clinical examination revealed a thick fibrous lingual frenulum attachment causing restriction in tongue movement. [Fig.1] Provocation test showed restriction of protrusive and lateral movements of tongue. Patient showed inability to touch tip of the tongue over the palatal region.

Haematological investigations were performed which showed no positive findings. Treatment plan was discussed with patient's parents and after taking consent of the parents frenectomy was planned. Under infiltration anesthesia, a horizontal incision through the frenum was made, the tongue being held upwards so that the frenum is stretched. The wound margins are gently undermined with curved scissors and the wound is transformed into a vertical one by suturing it from left to right. [Fig.2]

### Discussion:

Ankyloglossia is a congenital anomaly characterized by an abnormally short lingual frenulum. The condition is the result of a failure in cellular degeneration leading to a much longer anchor between the floor of the mouth and the tongue.<sup>[8]</sup> Newborns with tongue tie are often

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Figure 1 : Preoperative intraoral view

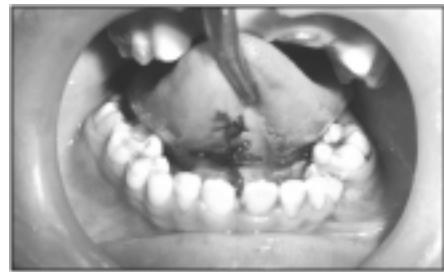


Figure 2 : Showing Placement of sutures

Classification Table

Investigators	Type Of Study	N	Method Of Assessment	Classification
Horton et al, 1969 <sup>4</sup>	Expert opinion And case series	102	Inspection	Mild : mucous membrane band  Moderate: frenum and the genioglossus muscle are markedly fibrosed  Complete: tongue fused to the floor of the mouth
Kotlow, 1999 <sup>5</sup>	Case series	322	Measured length of the free tongue (length of tongue from the insertion of the lingual frenum into the base of the tongue to the tip of tongue)	Normal: > 16 mm  Mild (class 1): 12 to 16 mm  Moderate(class 2): 8 to 11 mm  Severe (class 3): 3 to 7 mm  Complete (class 4): <3 mm
Garcia Polo et al, 2002 <sup>6</sup>	Case series	N1- 962 (group A) N2-730 (group B)	Group A :Measured distance between the cuspsids of an upper canine tooth and a lower homolateral canine tooth, in maximum opening ( $M_{max}$ ) and when the tip of the tongue is touching the palatal papilla ( $M_{pal}$ )  Group B : Measured distance between the incisal margin of the upper central and lower homolateral incisor in $M_{max}$ and $M_{pal}$ L(%) = $M_{pal}/M_{max}$	II: Lingual mobility 51% to 100%  III: Lingual mobility 31% to 50%  IV: Lingual mobility <30%
Ruffoli et al, 2005 <sup>7</sup>	Case series	200	Measurements in maximal possible opening, when the tip of the tongue is touching the palatal papilla  Method A (direct): length of frenulum  Method B (indirect): distance between the incisal margin of the upper central and lower homolateral incisor	Method A:  Normal :≥ 2 cm  Mild : 1.6 to 1.9 cm  Moderate: 0.8 to 1.5 cm  Severe : ≤0.7 cm  Method B:  Normal: 3.23 cm  Mild: 1.7 to 2.2 cm  Moderate: 0.4 to 1.6 cm  Severe: ≤0.3 cm

diagnosed and treated by paediatricians<sup>[9],[10]</sup>

Congenital oral adhesions may pose both esthetic and functional disturbing ailments to children. Most of them are benign, easily cured and may be treated as soon as possible in the dental office.<sup>[11]</sup>

The pathogenesis of ankyloglossia is not known. Ankyloglossia can be a part of certain rare syndromes such as X-linked cleft palate and van der Woude syndrome. Most often ankyloglossia is seen as an isolated finding in an otherwise normal child. Maternal cocaine use is reported to increase the risk of ankyloglossia three times.<sup>[12]</sup>

A significant association between frenal involvement and gingival recession has been reported in the literature.<sup>[13]</sup>

For many years, the subject of ankyloglossia has been controversial with practitioners of many specialties having widely different views regarding its significance and management. In many individuals, ankyloglossia is asymptomatic; the condition may resolve

spontaneously or affected individuals may learn to compensate adequately for their decreased lingual mobility. Some individuals, however, benefit from surgical intervention for their tongue-tie.<sup>[14],[15]</sup>

Surgical techniques for the therapy of tongue-ties can be through three procedures. 1) Frenotomy is a simple cutting of the frenulum (of neonates). 2) Frenectomy is defined as complete excision, i.e., removal of the whole frenulum (at or after 6 months of age). 3) Frenuloplasty involves various methods to release the tongue-tie and correct the anatomic situation. Along with surgical intervention, revision of the frenum by LASER<sup>[16]</sup> and revision by electrocautery<sup>[17]</sup> using a local anesthetic have also been described in literature.

The case presented in this paper was treated with frenectomy and postoperatively significant improvement was noticed during speech and mastication. [Fig.3]

## Conclusion



Figure 3 : Postoperative View

After surgery, the tongue could make wide range of movements including tip-elevation, grooving, and protrusion. Speech and masticatory functions of the patient were also improved after frenectomy.

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## A Newly Simplified Indirect Bonding Technique

### Abstract

Despite the accuracy and clinical time salvage, 90% of orthodontists do not use indirect bonding. Many reasons exist for this choice: materials expense, required laboratory technique, training of personnel, difficulty in achieving consistent and predictable bracket adhesion to the teeth and others. Many clinicians feel that insufficient pressure causes the failure of brackets to bond to teeth with the indirect method. Polyvinylsiloxane and vacuum transfer trays often have excessive flexibility that prevents tight contact between brackets and teeth. Some orthodontists continue to feel that the hot glue transfer tray, does not place sufficient pressure against individual teeth. The indirect bonding system described in this article has the advantage of accuracy and low cost. The technique described is a modification of a method reported by Dr Rajgopal. In this article we have also assessed the accuracy of indirect bonding versus direct bonding technique.

### Key Words

Indirect Bonding , Direct Bonding , Bracket

### Introduction:

In the past, the best clinical results were achieved by Orthodontists who had the best wire bending skills. However, "The best results in the present and in future will be achieved by those orthodontists who are best at accurate bracket positioning".

Because of the increased difficulty in accurate bracket placement in private practise, accurate bracket placement is of the utmost importance and is greatly facilitated by an indirect bonding technique.

The technique was introduced by Silverman and Cohen in the early 1970s,<sup>[1],[2],[3]</sup> but many variations have been developed, using conventional dental composites,<sup>[4]</sup> commercial adhesives,<sup>[5]</sup> or unconventional adhesives<sup>[6],[7]</sup> to attach the bracket to the working cast. In most of the indirect bonding technique the adhesives must be removed from the bracket mesh with running water, an ultrasonic cleaner and acetone, or a tooth brush before the bonding resin is applied and the bracket are bonded to the teeth.<sup>[8],[9],[10],[11],[12],[13]</sup>

The technique described is a modification of a method reported by Dr Rajgopal<sup>[14]</sup>. In this article we have also accessed the accuracy of indirect bonding versus direct bonding technique.

The method illustrated here uses readily available materials and leaves an adhesive free mesh prior to bonding. The

patient shown had a class I bimaxillary protraction with anterior spacing. Brackets were .022" PEA (MBT PRESCRIPTION). The right quadrant U/L were selected for indirect bonding and left side for direct bonding procedure.

### Procedure

1. Mark vertical and horizontal lines on the working cast for bracket placement. (**Fig 1**)
2. Spread out a 10mm strip of micropore adhesive tape on a glass plate with the adhesive side up. Place the brackets on the tape. Cut out the tape around each bracket. (**Fig 2**)
3. Apply a drop of cyanoacrylate glue to the non adhesive side of each piece of micropore tape. (**Fig 3**)
4. Affix the brackets to the cast in the prescribed position (**Fig 4**). Gelatin Jigs prepared over brackets for additional retention and to prevent inadvertent debonding during bonding procedure
5. Place the casts in vacuum forming machine and fabricate a transfer tray using 2mm thickness of bioplast. (**Fig 5**)
6. Remove the tray from the cast. The micropore tape will adhere to the cast because of the strong bond of the glue. The bracket with the adhesive free mesh will be embedded in the transfer tray material. (**Fig 6a, 6b**)

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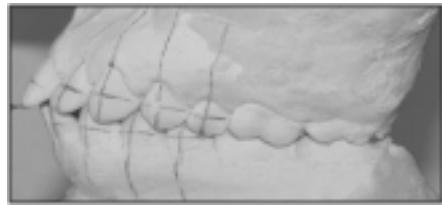


Fig 1: long axes and bracket slot heights scribed on working cast.

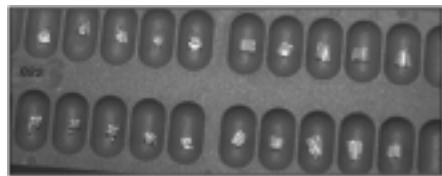


Fig 2: Bracket affixed to adhesive side of tape to right side quadrant and left side without adhesive tape for direct bonding



Fig 3: Bracket affixed with cyanoacrylate glue on the nonadhesive side of tape for bonding

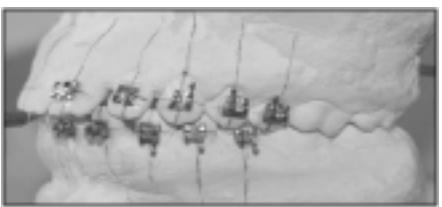


Fig 4: Bracket placed on cast



Fig 5: Gelatin Jigs prepared over brackets for additional retention and to prevent inadvertent debonding during tray removal procedure



Fig 12: Initial Lateral Ceph



Fig 6 & 6a: brackets free mesh embedded in tray material

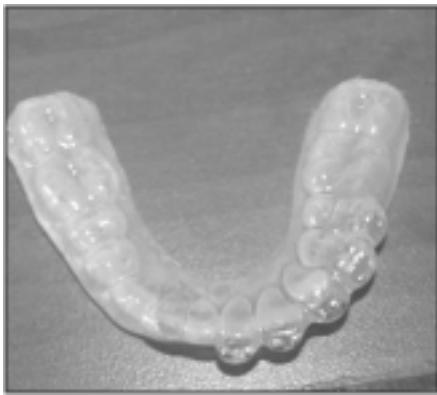


Fig 7 & 7a: tray positioned in mouth



Fig 13: Lateral Ceph After Debonding



Fig 8: Patient after indirect bonding and direct bonding procedure

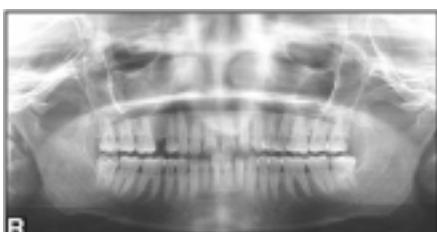


Fig 10: Initial OPG



Fig 9: Patient after debonding procedure



Fig 11: After Debonding OPG

7. Etch the patient teeth with 37%phosphoric acid for 15 seconds.
8. Apply primer over the etched tooth surface and cure it with light cure for 10 seconds (3M transbond primers)
9. Now apply adhesive paste to bracket base and position the transfer trays in the mouth and cure each bracket for 40 seconds(10 seconds on each side) .(fig 7a, 7b)
10. For easy removal ask patient to gargle with warm water and then give cuts in the interdental area of the transfer tray using scissor and peel the tray from the lingual and chech the bracket positions.

The (Fig 8) shows patient after indirect bonding and direct bonding procedures and (Fig 9) after debonding procedure. The initial OPG and Lateral Ceph are shown in (Fig 10a,10b) and after

debonding OPG and Lateral Ceph are shown in (Fig 11a, 11b).

#### Discussion:

Comparision of direct with the indirect bonding:

In this study we have done indirect bonding in right quadrants and direct in left quadrants. The treatment results suggest that there is no difference between direct and indirect bonding. In vitro shear bond strength comparison between direct and indirect-bonded attachments showed no significant difference between the two groups<sup>[16]</sup>. Bond strength obtained with Thomas indirect bonding technique was comparable with direct bonding technique. Also the time consuming for indirect bonding is less comparable to direct , with increased patient comfort and good technical and clinical advantages<sup>[15]</sup> . Especially during the first 4 months after brackets placement, this indirect bonding protocol allowed for significant reduction in plaque accumulation around the braces and reduced onset of white spots during the orthodontic treatment<sup>[17]</sup>. Comparisons of the microleakage scores between the direct and the indirect bonding groups at the enamel-composite and composite-bracket interfaces indicated no statistically significant microleakage differences at the gingival and occlusal margins ( $P > 0.05$ ). The type of bonding method (direct versus indirect) did not significantly affect the amount of microleakage at the enamel-composite-bracket complex<sup>[18]</sup>.

#### The advantages of this technique with the technique of those described by Dr Rajgopal

- 1) Indivial jigs prepared for each tooth which offers better strength and stability during bonding procedure
- 2) Less chance of debonding during tray removal
- 3) Jigs can later used to rebonding in case of bracket debonding.
- 4) Easy to prepare jigs and cost effective procedure
- 5) Less time consuming
- 6) This procedure can also be used in lingual orthodontic bonding

procedure

#### The discrepancy introduced by the thickness of the micropore tape

First order discrepancy introduced by the thickness of the micropore and a small drop of low - viscosity cyanoacrylate glue would be minimal and , in any event, would be the same thickness and is well adapted to the cast, it will not alter the torque value of the brackets<sup>[14]</sup>. Furthermore, the adhesive of the Micropore tape does not clog the bracket mesh and therefore does not require a time-consuming cleaning procedure.

#### Conclusion:

Indirect bonding is considered to be a useful and efficient approach that improves the results of the treatment. Success with the technique requires attention to detail, but does not require excessive complexity. Thus the above mentioned technique is as simple accurate and cost effective indirect bonding procedure. Continuous improvement in clinical results can be accomplished by assessing finished treatment and by using that knowledge for the benefit of future patients.

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### Cemental Tear: An Un-usual Case Report

#### Abstract

A 32 year old male patient visited to the endodontics department with the complaint of swelling after the extraction in relation to left maxillary premolars. On examination no caries were seen on the occlusal surface of first premolar whereas second premolar was covered with a crown. Radiographic examination revealed a thin radiolucent defect below Cemento- dentinal junction on distal aspect sub-gingivally. On thorough history taking patient presented the extracted fragment which was sent for histopathological examination. Root canal was carried out and the defect was curettage and closed with MTA followed by Glass Ionomer Cement. Histo-path revealed the fragment to be a cemental tear. Cemental tear case reports are associated generally with old age, trauma and traumatic occlusion. Clinicians should be aware of this rare entity as a differential diagnosis in non-carious odontogenic pain.

#### Key Words

Cemtal tear, trauma, diagnosis, MTA

#### Introduction

Swelling in the gingival or alveolar mucosal region is frequently encountered in dental practice. It is most commonly associated with periodontal or root canal infection, apart from them some other root structure abnormalities, such as palatoradicular groove, root fracture and cemental tears can be associated with it.<sup>[2]</sup> Vertical root fractures (VRF) are diagnostic challenge to clinicians because of their varied presentation.<sup>[1,5]</sup> VRF is typically associated with previous non-surgical root canal treatment and accompanied by periodontal defect.<sup>[1,3]</sup> Cemental or cementodentinal tear are specific type of root fracture which are described as 'Complete separation along the cementodental border or a partial split within the cemental tissues along an incremental line'.<sup>[1,1]</sup> From the limited number of case reported earlier central incisors and premolars seems to be the major affected teeth.<sup>[5]</sup> The most frequent suggested causes are occlusal trauma and aging.<sup>[9], [6]</sup> The prevalence of cemental tears is still not known; this is possibly owing to difficult diagnoses of cemental tears leading to limited case reported in the literature.<sup>[1]</sup>

The purpose of this article is to bring forward a case of cemental tear misdiagnosis and further consequences of it in relation to a maxillary left first premolar.

#### Case report

A 32 year old male patient has experienced pain in the left upper back region jaw for past 5 days. Three days back he visited to a local dentist for the same. Periapical radiography was performed (**Fig 1**), and a foreign body was removed from the interdental area of first and second premolar. The removed fragment was handed over to the patient and medication was prescribed. The next morning that is 4 days back the patient reported to the same dentist with pain and intra oral swelling leading to the obliteration of buccal vestibule in relation to the two premolars. The patient was then referred to the Department of conservative Dentistry and Endodontics, Himachal Institute of Dental Sciences, Paonta Sahib for further treatment. The patient visited the department along with the removed fragment which he had taken from the dentist wrapped in cotton. On clinical examination the vestibule presented with a fluctuant, palpebral, soft and edematous buccal swelling in relation to the two premolars. On clinical probing no sign of caries was observed on the first premolar and probing around the tooth was within the normal limits (<3 mm), vitality tests were performed on the first premolar and positive results were obtained for the first premolar. There was also presence of two porcelain-fused-to-metal crowns in the second premolar and maxillary 1st molar. Periapical

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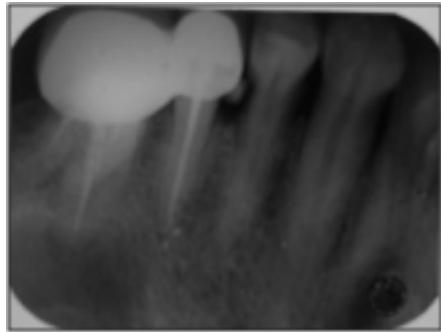


Fig. 1- Radiograph with detach fragment (pre-operative)

radiography was carried out to assess the two crowned teeth (**Fig 2**). Root canal obturation with an acceptable quality was found from the periapical radiograph. Careful examination of the periapical radiograph detected a radiolucent concavity in the distal aspect of 1st premolar. Based on the findings from the current radiograph and the radiograph before segment removal, a tentative diagnosis of a cemental tear was made. A non- surgical endodontic treatment approach was planned for the patient and root can treatment was carried out. No

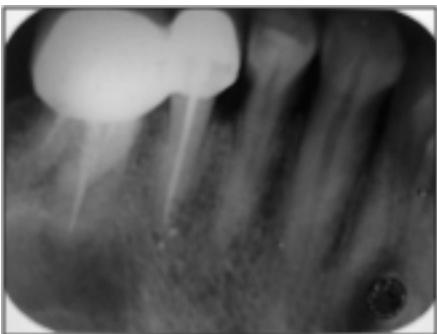


Fig. 2- Radiograph after fragment was removed

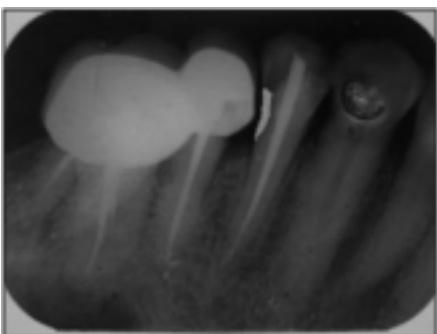


Fig. 3- post operative radiograph

discharge was seen through the canals during the cleaning and shaping procedure so a decision of single visit endodontics was made and the canal were obturated using AH Plus Sealer and gutta percha cones. The patient was sent back and recalled after two days for further evaluation. At the same time the fragment which patient has brought was sent for histo-pathological examination.

After two days the patient reported asymptomatic to us. On clinical examination the buccal vestibular swelling was not present and tooth was not tender. by now the histo-pathological report has confirmed the fragment to be a cemental tear so exploratory surgery and closure of defect was planned. Under local anesthesia, an envelope flap was lifted and distal aspect of the first premolar was exposed. Curettage was performed and after the removal of granulation tissue the defect was closed with MTA which was then covered with GIC on top of MTA. Radiographic cross checking was performed (**Fig.3**), Flap was closed sutures were placed. After one week patient follow up was done, patient was asymptomatic and healing was satisfactory so the sutures were removed.

## Discussion

The present case of cemental tear is unusual in nature owing to the fact that it is occurring in young male and at the level of cervical third of the root, which is contradictory to the fact that they occur commonly in the patients older than 60 years (72%) and in the middle third of root (45.3%), and 41.5% over the apical region.<sup>[8]</sup> The probing depth being within the normal limits can be attributed to the fact that the fragment was removed two days back and healing of the area was satisfactory. Other findings before the surgery like positive vitality testing,<sup>[7]</sup> and during the surgery like presence of granulation tissue at the fracture site are in accordance with the published data.<sup>[8]</sup>

Age related changes, heavy occlusal forces and increased thickness, mineralization and brittleness of cementum are suggested to be the major etiologic factors of cemental tears.<sup>[12]</sup> The average age of patients with cemental tear is between 50 to 79 years,<sup>[3]</sup> but cemental tear can occur in young adult also.<sup>[14]</sup> As the patient was young individual, thus the reduction in fatigue strength of dentine was ruled as a possible cause for the tear. In the present case sudden occlusal trauma or occlusal overloading can be considered as a potential etiologic cause for the cemental tear which is one of the etiologic factors for cemental tear.<sup>[10]</sup>

**D i a g n o s i s o f c e m e n t a l a n d c e m e n t o d e n t i n a l t e a r** is difficult based on history taking and clinical examination. Radiographic examination can be helpful in some cases when displacement of the detach root fragment is evident as seen in this case. Therefore when a suspected fracture line is detected in radiograph, and when the swelling or sinus tract is present along with it, additional radiographs have to be taken to check for real root fracture or cemental tears.

The long term prognosis of teeth with cemental or cementodentinal tear is not predictable.<sup>[17]</sup> Previous studies have shown that teeth treated for cemental tear with many different approaches are finally extracted.<sup>[14]</sup> However with the availability of newer and better materials like MTA the treatment prognosis can be improved. In the present case the defect was curettage and clean and restored with MTA<sup>[16]</sup> and followed by application of GIC.<sup>[4]</sup>

Cemental tears may present a diagnostic challenge, although rare cemental tear may be considered in differential diagnosis when there is persistent pain on lateral percussion accompanied by presence of swelling with no known cause from the occlusal surface.

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### Horizontally Impacted Maxillary Central Incisor - A Case Report

#### Abstract

The following report illustrates the successful treatment for horizontally impacted maxillary central incisor with the help of orthodontic tooth movement. The case was diagnosed and started in early mixed dentition period and the impacted incisor was successfully orthodontically repositioned in the arch.

#### Key Words

horizontal impaction, impacted incisor, closed eruption.

#### Introduction

Occurrence of Impaction of teeth in maxilla is third molar, canine, first and second premolars.<sup>[1],[2]</sup> Impaction of maxillary central incisor is not one of the commonest occurrences<sup>[3]</sup>. Though rare, treatment for them is one of the most challenging. As max central incisor is the most visible tooth in the oral cavity, management of this demands high aesthetic standards with utmost care to retain the vitality of the tooth.

Size and shape of central incisor does not allow it to be extracted and camouflaged with lateral incisor. The cervical incisal length, faciolingual curvature distal curvature on the cervical third of facial surface does not allow it to mimic central incisor<sup>[4]</sup>.

If the impacted central incisor is extracted and replaced by an implant, the drawbacks being; a good healthy tooth is lost, treatment has to be delayed as after 18 years of age, if done earlier shortening of implant tooth is common.

So the best treatment possible is to orthodontically move the impacted tooth into good occlusion and alignment so a very conservative approach but with best result<sup>[5]</sup>. Though vitality of tooth has to be watched carefully, and dilacerations may appear<sup>[6],[7]</sup>.

Impacted tooth sometimes may erupt spontaneously if the causative factor such as supernumerary tooth, retained deciduous is removed or space is made

available for the eruption of the impeding tooth. But the time taken for the eruption is very long and the tooth neither may or may nor erupt on its own depending on its site and angulations of impaction<sup>[8]</sup>. There are very few records available of successfully treated impacted central incisors.

Surgical repositioning has been the treatment of choice. This may lead to devitalisation of the tooth involved or resorption of tooth after a period of time.

#### Case Study

A healthy 9 year old male patient referred by a general dentist in a private hospital reported to the clinic. The boy had a non erupted maxillary left central incisor, with no other relevant medical history / trauma. Parents were concerned with non eruption of the tooth and compromised aesthetics.

#### Clinical Examination

Oral examination revealed non erupted left maxillary central incisor, on palpation incisal edge of the incisor could be palpated high up in the labial vestibule. Maxillary right central incisor and maxillary lateral incisors were already erupted; slightly obliterating the space for central incisor. There was deficiency of space for the eruption of impacted central incisor due to drifting of adjacent teeth into the non erupted tooth space. No other abnormal feature was found.

#### Radiographic Examination

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Panoramic radiograph (**Fig. 1**) revealed an un erupted maxillary left central incisor, lying horizontally high up in the alveolar ridge with facial surface towards nasal floor, right maxillary central and left lateral incisor erupted with 2/3<sup>rd</sup> root formed. Right lateral incisor in the process of eruption with half of the root formed. Right central incisor and left lateral incisor tilted into the space for left central incisor partially occupying the right central incisor space, left and right maxillary deciduous canine were present.

#### Treatment

Deciduous canines were extracted, flap over the maxillary left central incisor was raised and bracket bonded to the impacted maxillary incisor, flap resutured and wire attached to the bracket left coming out of the flap. Fixed treatment started in upper arch with niti palatal expander given its arms extending up to left lateral incisor. The wire from max left incisor was tied to the bridge of niti palatal expander (**Fig 2**). Patient was asked to put mild pressure on his upper lip above the 21 crown 4-5 times daily.

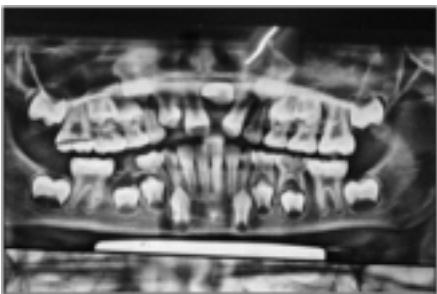


Fig. 1. Showing horizontally impacted maxillary left central incisor



Fig. 5. Fully erupted left central incisor



Fig. 2. Palatal expander in place with ligature wire from left central incisor tied to its bridge.



Fig. 3. Central incisor in vertical position



Fig. 6. Impacted incisor brought into alignment, canine about to erupt

The treatment plan consisted of using closed eruption, as this is cited to be the best choice in such cases than excisional gingevectomy and apically positioned flap technique on account of better aesthetic results<sup>[9]</sup>.

Full thickness flap was raised, there was no bony tissue overlying the crown. A Begg's bracket was bonded on to the facial surface of the tooth and a stainless steel ligature wire was tied to the vertical slot and left extended outside the flap. Flap was resutured and closed eruption technique followed so as not to irritate the labial mucosa, Begg's bracket was chosen for its small size and vertical slot



Fig. 4. Impacted maxillary incisor emerging in the oral cavity

allowed ligature wire to be tied without it being dislodged during the treatment duration.

The extending wire was lightly tied to the bridge of niti palatal expander. The lateral arms of the expander rested on the lateral and right central incisor and contacted their proximal surface to assist the opening up of the 21 space<sup>[5]</sup>. The deciduous canines were also extracted to create space for the 21. Begg's bracket was also bonded on the 11 and 22 so as to engage a wire on them on a later stage. As of now we did not want to disturb the eruption of canines.

Patient was asked to regularly put mild pressure on the labial surface (palpable) of 21, as to help guide the incisor towards occlusion.

The ligature wire tied to the 21 was regularly tightened slightly. 21 oriented itself in a vertical direction within six months, though still did not emerge into the oral cavity. By now the Begg's bracket could be felt in a vertical direction above the alveolar ridge. This can be seen on radiographic examination (Fig 3). No dilacerations or resorption can be seen.

The tooth started erupting within 10th month of treatment (Fig 4).

Whole of the crown was now visible in the oral cavity with good aesthetic results. (Fig. 5).

Further treatment was discontinued after six months of retention as canines were still to erupt. Patient had class I molar relationship. Parents did not want further treatment and were satisfied with the result. 21 was vital and did not show any dilacerations (Fig. 6).

## Discussion

There are not many reported cases in the literature of treatment of horizontally impacted maxillary central incisor by orthodontic repositioning.

In the present case as the patient was diagnosed quite early in mixed dentition stage, the treatment of choice was to retain the incisor and bring it into a right occlusion and alignment with the orthodontic treatment.<sup>[6]</sup>

The choice of treatment was with closed eruption. This helped to reduce infection,

irritation of labial mucosa by bracket placed<sup>[9]</sup>.

Begg's bracket was chosen because of its small size<sup>[10]</sup> and vertical slot which helped to secure the ligature wire.

The bracket was bonded to the facial surface because of better bonding in this area as compared to lingual anatomy; also the wire from the facial position did not impinge directly on the palatal mucosa.

The use of ligature wire was for controlled amount of force which we did not want to exceed. And also elastics and e-chain were impinging on palatal mucosa and would collect more of plaque.

Slight amount of regular pressure by the patient as regular exercise achieved the desired result of up righting the central incisor.

The niti palatal expander with activated arms gained the desired space for eruption of 21.

Similarly the deciduous canine extraction gave us enough space for eruption of 21.

Further treatment after eruption and alignment of 21 was discontinued as canines were still to erupt and patient did not have any other malocclusion. Parents were satisfied with the result and did not want full fixed treatment at this stage.

Low magnitude of force was applied to

the tooth. The force was merely used to align the tooth in natural position and the erupting pressure of the tooth brought the tooth into occlusion.

### Conclusion

In the present case it can be well concluded that the age of patient plays a vital role in the treatment of impacted maxillary incisor.

Horizontally Impacted maxillary incisor if diagnosed in early mixed dentition period with no dilacerations of root present, treatment of choice should be to orthodontically reposition the tooth, and with closed eruption technique followed

The amount of force applied should be minimal in nature and eruptive forces of the developing root of the tooth should be used to the maximum

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## Ridge-Splitting Technique In Mandible With Simultaneous Implant Placement - A Case Report

### Abstract

Atrophy of the alveolar ridge following tooth extraction may present an anatomic limitation to the conventional placement of dental implants. Loss of bone width necessitates augmentation procedures such as autogenous bone block grafting with or without the use barrier membranes. This however requires a second surgery for implant placement at a later date thus lengthening the treatment time and the cost. Augmentation can also be achieved by the ridge split technique for bone expansion that also allows for simultaneous implant placement. This case report describes the technique for ridge splitting and gradual expansion in the mandible and immediate implant placement within the split ridge. Six months later, the implants were uncovered followed by impression and final restoration with implant-supported porcelain-fused-to-metal crowns.

### Key Words

Ridge splitting, ridge expansion, osteotomy, atrophic ridge

### Introduction

The resorption process of the alveolar ridge after tooth loss is routinely encountered in patients requiring dental implant treatment. Several methods have been described to augment the alveolar crest before or after implant placement to establish at least 1 mm bony wall around screw type implant. Various surgical widening techniques have been described, including lateral augmentation with or without guided bone regeneration (GBR) and horizontal distraction osteogenesis. Expansion of the existing residual ridge is another method and is referred as ridge splitting, bone spreading, ridge expansion, split-crest<sup>[1]</sup> or the osteotome technique. This approach creates a sagittal osteotomy of the edentulous ridge using instruments such as chisels between the two cortical plates to expand the ridge width and consequently allow for the placement of implants.

Ridge splitting for root-form implant placement was developed in the 1970s by Dr. Hilt Tatum. Tatum developed specific instruments including tapered channel formers and D-shaped osteotomes to expand the resorbed residual ridge<sup>[2]</sup>. Summers later revived the interest in this technique; he developed round implant

osteotomes suitable for use with commercially available cylinder root-form implant systems<sup>[3]</sup>.

The ridge splitting technique is used to expand the edentulous ridge for implant placement or insertion of an interpositional bone graft<sup>[4]</sup>. This technique is only suitable for enhancing ridge width. There must be adequate available bone height for implant placement, and no vertical bone defect should be present. A minimum of 3 mm of bone width, including at least 1 mm of cancellous bone is desired to insert a bone chisel between cortical plates and consequently expand the cortical bones.

A pyramidal form ridge with a wider base is the ideal indication for this technique because it will prevent the risk of buccal plate fracture. The risk of fracture of the osteotomized segment is higher in the mandible because of its lesser flexibility due to the thicker cortical plates<sup>[5]</sup>. If this occurs, bone fixation screws need to be used to stabilize the buccal plate. Ridge splitting is more applicable to the maxilla than the mandible. The thinner cortical plates and softer medullary bone make the maxillary ridge easier to expand. Favourable conditions for the posterior mandible include a long edentulous span

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(missing molar and premolar teeth), abundant bone height superior to the mandibular canal (>12 mm), and the presence of some cancellous bone between the dense outer cortical plates. If these conditions are not present, the clinician may prefer onlay augmentation.

One advantage of ridge splitting over other ridge augmentation techniques such as bone grafting is that implants may be placed simultaneously, considerably shortening the treatment time. Unlike guided bone regeneration, which relies on bone forming over the exposed implant surface, ridge splitting repositions the cortical plates around the implant. Bone then regenerates within the space between the expanded cortical plates<sup>[6]</sup>. Other advantages include lesser overall cost, no need of barrier membranes or bone graft materials and no morbidity related to second donor site.

## Clinical report

A 55-year-old male reported to the prosthetic department for treatment of fractured mandibular right first premolar, missing mandibular right second premolar and bilaterally missing mandibular molars (**Fig. 1**). The patient was advised replacement of missing teeth with implant supported fixed prosthesis. Since the mandibular right first premolar was fractured below the gum line, it was decided to extract the tooth atraumatically followed by immediate implant placement. It was decided not to replace missing mandibular right second molar as its antagonist was also missing.

The panoramic radiograph and computerized tomography (CT) scan evaluation revealed adequate bone height for implant placement, but a narrow ridge crest of 3 mm in the mandibular left molar region. Bone width and height were adequate in the right mandibular second premolar & molar regions. Palpation of the bone and ridge mapping were also done to assess the soft tissue in the areas of proposed implant placement.

At the time of the surgery, following bilateral block local anaesthesia, an incision was made buccal to the ridge crest on the left side to provide more attached tissue along the facial aspect of the implant. Minimal mucoperiosteal flap reflection was performed to expose only the ridge crest. The periosteum along the lateral cortices was left intact to ensure blood supply to the underlying bone. A scalpel with a No. 15 BP blade was used to begin the osteotomy. The osteotomy bisected the ridge crest to separate the cortical plates. A mallet was used to advance the scalpel blade through the bone. After the scalpel blade was tapped to depth, it was gently removed with a back and forth motion, parallel to the cut, to prevent breakage of the instrument. The length of the osteotomy along the edentulous span was extended well beyond the planned implant sites to allow the plates to expand or bow during preparation of the osteotomy and implant insertion. Chisels of increasing width and a mallet were used to further enlarge the osteotomy to a point 4-5 mm shorter than the final length of the implants to be placed (**Fig. 2**). As the bone was found to be less dense, it was decided to use osteotome for completing the osteotomy at implant sites. The no. 15 BP blade was used with the help of mallet at proposed



Fig. 1: Pre operative photograph right side (a) and left side (b)



Fig. 2: Initial ridge splitting with BP blade, chisels & mallet



Fig. 3: D-expander being used for implant site preparation



Fig. 4: Initial osteotomy (a) and final osteotomy (b) achieved with D-expanders & round osteotomes

implant location to expand the osteotomy till final depth of implant. Subsequently, D-expanders (**Fig. 3**) and round osteotomes were tapped into implant sites alternatively in increasing order of size till the desired diameter for the planned implants was achieved (**Fig. 4**). Tapered implants (Alpha-Bio Tec, SPI- 3.75mm × 13mm, Petach Tikva, Israel) were inserted slowly as they demand less expansion at the base of the osteotomy and allow more gradual bone expansion during implant advancement. The cover screws were placed and tissue was approximated with 3-0 silk sutures (**Fig. 5**).

On the right side, the mucoperiosteal flap was reflected using a crestal incision. The mandibular right first premolar was extracted atraumatically with use of a periotome but the socket exhibited dehiscence of the buccal plate. Implant placement was therefore delayed in this region; extraction socket was curetted and filled with a mix of autogenous & allogenic bone graft. Implant fixtures (Alpha-Bio Tec, SPI- 4.2mm × 13mm) were placed in the mandibular second premolar & first molar regions following conventional osteotomy (**Fig. 6**).

After 6 months, second stage surgery was performed for implant uncovering on both the sides and single stage immediate loading implant (Hi-Tec, TRX OP- 3.3 mm × 13 mm, Herzlia, Israel) was placed in mandibular right first premolar region followed by placement of healing abutments on all earlier placed implants (**Fig. 7**). Following a healing period of 5 weeks, impressions were made and splinted metal-ceramic crowns were fabricated for all the implant fixtures (**Fig. 8**).

## Discussion

Clinical experience has shown that the ridge splitting technique can be a useful method for managing the narrow residual ridge. It allows placement of implants in a narrow crestal ridge in a single procedure. Chiapasco et al evaluated the success of different surgical techniques for ridge reconstruction and success rates of implants placed in the augmented areas. The surgical success and the implant survival rates were as high as the guided bone regeneration and onlay graft procedure<sup>[7]</sup>, with the advantage of a shorter treatment time. Careful preparation of the bone and maintenance



Fig. 5: Implant fixtures in expanded ridge



Fig. 6: Placement of implants on right side & bone graft in extraction socket of first premolar



Fig. 7: Healing abutments in place with immediate implant placement in right mandibular first premolar



Fig. 8: Splinted metal-ceramic crowns in place

of an attached periosteum are critical to the formation of new bone around the interproximal surfaces of the implants. Wound healing in these cases is similar to the fracture repair of bone. The gap fills with a blood clot that organizes and is replaced with woven bone that later matures into load-bearing lamellar bone at the implant interface<sup>[8]</sup>. In cases of buccal plate fracture, the mobile plate may be retained with bone fixation screws.

Generally, mandibular bone has higher density compared with maxillary bone, requiring sometimes a different approach in ridge splitting. In some cases it is advised to place several holes in buccal cortex with a round bur vertically beyond the proposed implant sites and to join them with horizontal row of holes. During expansion, this will cause green-stick fracture of buccal plate but it will remain attached in its position.

### Conclusion

This article describes implant placement in atrophic mandibular alveolar crests using the ridge-splitting technique. The correct indication associated with careful clinical manoeuvre of the ridge-splitting technique allows predictable placement of implants even in narrow alveolar ridges. A significant advantage of this technique is that it allows simultaneous implant placement. Proper patient evaluation and case selection is essential to achieving a successful surgical and prosthetic outcome.

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## Custom Impression Trays In Prosthodontics - Clinical Guidelines

### Abstract

Prosthodontist always desire to make accurate impression for successful prosthesis. To achieve accurate impressions dentist need to access the tissue to be recorded, selection of accurate stock tray, technique for making accurate and well-adapted custom impression tray, ideal impression materials and techniques for making accurate impression.

A dentist usually uses stock tray for making primary impression as well as final impression due to lack of knowledge like, optimum material for making custom impression tray, adequate extension, required thickness and designs of spacer, tissue stops, escape holes, tray handles and polymerization time regarding custom impression trays in prosthodontics.

This article will encourage the dentists to use accurate design of custom impression trays in clinical practice. This will help in reducing chair side time and will give good adaptation of final prosthesis; hence, dentist will receive patient appreciation in practice.

### Key Words

Conventional Custom Impression Tray, Sectional Custom Impression Tray, Types Of Spacers, Selective Pressure Principle.

### Introduction:

The need to make accurate impression is fundamental to the practice of Prosthodontics. This necessitates the dental clinicians to make careful assessment of the tissues to be recorded in the impression, type of impression trays, impression material and the techniques to be used. After many informal discussions with academicians, practitioners and lab technicians, we felt that stock metal trays are the most commonly used impression trays. Few among them know about the modification of stock trays to make them more precise. Very few clinicians use custom impression trays for making impression in partially edentulous arches. Conventional practice in removable prosthodontics is to use stock trays for making primary and final impression. The selected stock tray must cover all denture bearing area in over-extended manner. A primary cast with good coverage of proposed denture bearing area gives freedom of using any spacer design with tissue stops within the custom impression tray, thus dictating impression technique and allowing better final impressions. Though, custom impression trays are used for making final impression in complete denture, there is an inadequate knowledge of custom impression tray design among

clinicians and most of the clinicians depend upon lab technicians for their designing. Custom impression tray is used to carry, control and confine the required impression material. Many lab technicians also felt the need to modify the primary cast prior to construction of custom impression trays which may be because of inadequacy of many primary impressions to record the desired area of mouth.

In microstomia patient the mouth opening is reduced to 20-30 mm, thus making final impression for partially edentulous situation or completely edentulous situation is very difficult or impossible<sup>1</sup>. In that situation dentist usually make final impression by the help of sectional custom impression tray, which can be easily inserted intraorally in sections and can be easily reassembled intraorally and extra orally<sup>2</sup>. The final impressions made by sectional custom impression trays are as accurate as conventional custom impression tray<sup>3</sup>. This article enumerate design specifications of conventional and sectional custom impression trays for completely and partially edentulous situation.

**Custom impression trays should be used in partially edentulous situation**

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### Quick Response Code



### under following conditions :

1. When stock trays do not cover the proposed denture bearing area.
2. When the stock trays are poorly fitting on the arches leading to sub-optimum thickness of impression material, thus producing the potential for inaccuracy.
3. When there is impingement of tray borders on the tissues.
4. When there is an unusual distribution of missing teeth.
5. When the last tooth in the arch is to be included in the impression. In these circumstances it is common to produce 'drag' in the impression when using stock trays.
6. When mobile teeth are to be recorded with low viscosity impression material, which is most difficult to be confined within the stock tray .

## Recommend Specifications

### A - Custom Impression Trays For Completely Edentulous And Partially Edentulous Arches:

#### 1. Material used for making custom impression trays:

a) **Pikka-tray material**, Type II chemical cure poly-methyl methacrylate contains more filler-particles, which reduces polymerization shrinkage and improves linear dimensional accuracy. Thus, clinicians should encourage the use of this material for custom impression trays to obtain accurate master casts for fixed partial denture instead of conventional chemical cure PMMA resin<sup>4</sup>.

b) **Visible light cure (VLC) dimethacrylate resins** for completely edentulous and partially edentulous situations offer superior mechanical properties to the currently available alternatives.

Although the material is relatively expensive, it requires special light-curing unit for processing and is difficult to trim when cured. Custom impression trays made from this material has sufficient rigidity to be used in fairly thin section and has excellent dimensional stability<sup>5</sup>. This custom impression tray material can also be used in patients who are allergic to PMMA resins, because of no residual polymer is left in polymerized material.

#### 2. Adequate extension of custom impression trays:

The periphery of the tray should incorporate all denture bearing area without distorting the tissue of the vestibules through over extension. Marking primary cast with pencil 2mm short of the vestibule, guides the lab technician to make optimum extensions of custom impression trays which saves clinician's time on adjusting the tray. In partially edentulous situations, the custom impression trays should be kept 3 to 5 mm away from the gingival margin

and about 3 mm beyond the most distal tooth.

**3. Types of spacer design and the required thickness:** Thickness of wax spacer for complete and partially edentulous situations is 1 mm and 2-3 mm respectively. Wax spacer thickness may vary according to load bearing capacity of the tissue and attachment of soft tissue with periosteum. Presence of flabby and mobile tissue over the ridges demands for extra thickness of spacer to allow their undistorted recording in the impressions. The design of custom impression trays for complete dentures depends upon choice of impression material and technique to be used. Impression principle such as muco compressive, minimal pressure, selective-pressure demands for specific spacer design.

The spacer design for the selective pressure is directly governed by the knowledge of the stress bearing and relief areas. The stress bearing areas in the maxillary arch are the horizontal plates of the palatine bone and the relieving areas are mid-palatine raphae and the incisive papilla. For mandible, the primary stress bearing area is buccal-shelf area and relieving area is sharp mylohyoid ridge and crest of alveolar ridge. But views of different authors on how to achieve selective pressure impression are different.

#### Selective Pressure Impression Technique<sup>6</sup>-

Considering the views given by different authors it has been established that no wax spacer placed in primary stress bearing areas allows positive contact of custom impression trays with these areas. This permits selective placement of more pressure in primary stress bearing



Fig - 1 Sharry's design for spacer.

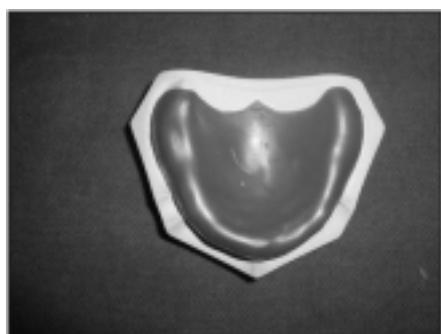


Fig - 2 Boucher's spacer design for Maxillary arch.



Fig - 3 Boucher's spacer design for Mandibular arch.



Fig - 4 Morrow, Rudd, Rhoads spacer design for maxillary arch.

areas and spacer design reduces pressure in relieved areas, thus it is called selective pressure principle.

**5) Tissue Stops:** Strategically placed tissue stops provide even thickness of impression material in custom impression trays. Placement of four tissue stops of 2mm width in cuspid and

Table-1 Design For Spacer And Tissue Stops For Selective Pressure Theory

Author	Spacer	Tissue stops
Roy Mac Gregor	Metal foil spacer in incisive papilla and mid palatine raphae	
Neill	0.9mm casting wax full spacer/relief except PPS.	
Sharry	1mm of Base plate wax spacer all area including PPS (Fig - 1)	4 tissue stops, 2 mm wide in molar and cuspid region, extended from palatal aspect to mucobuccal fold.
Bouchers	1mm base plate wax spacer except PPS in maxilla. (Fig - 2) In mandible 1mm base plate wax spacer except buccal shelf area and retro molar pad (Fig - 3).	
Morrow, Rudd, Rhoads	Full wax spacer 2mm short of borders (Fig - 4).	3 tissue stops, 4x4mm equidistance from each other
Barnard Levin	1 layer of pink base plate wax about 2mm thick all over the ridges except PPS and buccal shelf area.	

molar regions which extends from palatal aspect of ridge to the muco buccal fold are usually recommended in completely edentulous cases<sup>6</sup> (**Table 1**). In partially edentulous situations, tissue stops are placed on widely separated three or four non-functional cusps of teeth, (buccal cusp of maxillary and lingual cusp of mandibular). If all teeth are involved a large soft tissue stop can be placed on the crest of the alveolar ridge or in the centre of the hard palate. Tissue stops are made by removing wax at an angle of 45° to the occlusal surface on, that have a tripod or quadrangular arrangement in the arch. This provides stability to the tray and the 45° angulated stops will help centre the tray during insertion.

**6) Escape holes:** After removing wax spacer from inside of the tray, a series of holes are prepared, about 12.5 mm apart in the center of alveolar groove and in the retro molar fossa with no. 6 round bur. The relief holes provide escape way for the final wash impression material and relieve pressure over crest of the residual ridge and in the retro molar pads when the final impression is made<sup>7</sup>. For good adhesion between impression material and custom impression trays, use of tray adhesives and escape holes both should be encouraged because this provides a chemical - mechanical type of adhesion.

**7) Tray handles:** Tray handles are useful in loading, orienting and placing custom impression trays in the patient mouth. Tray handles if not properly made can cause potential inaccuracy in complete denture as they distort the lip form and hence functional sulcus is recorded in overextended manner. The handle should be 25 mm long from the edge of the labial border of tray and 12 mm wide. The handle is positioned in the approximate position of the upper anterior teeth so that it doesn't distort the upper lip when the tray is in position. A handle made this way enables the clinician to securely grasp the tray without any interference with the tongue and lips. Two additional handles one on each side are placed in the first molar region. These handles are centered over the crest of the residual ridge at its lowest point and are approximately 19 mm in height. The posterior handles are used as finger rests to complete the placement of the tray on the residual ridges and to stabilize the tray on the correct position with minimal distortion of soft tissue while the final

impression material sets . One anterior handle and one or two posterior handles are required for partially edentulous situation with unilateral and bilateral distal extension bases respectively.

**8) Polymerization time:** Polymerization time is the time interval between fabrication of custom impression trays and using it for making final impression. This is characterized by polymerization of residual monomer resulting into polymerization shrinkage which exerts significant effect upon the linear dimensional accuracy of master cast 8. All acrylic custom impression tray materials show linear dimensional changes up to 9 hours, but maximum shrinkage occurs up to 30 minutes after tray fabrication. Thus acrylic custom impression trays should be used after 9 hr of fabrication<sup>9</sup>. If clinical situation demand early use, than custom impression tray seated over the casts should be placed in boiling water for 5 minutes and then cooled to room temperature. Custom impression tray made by visible light cure dimethacrylate resin can be used immediately after completion of polymerization , because complete polymerization takes place and there is no residual monomer is left .

### B - Sectional Custom Impression Tray

Making final impression and fabrication of removable or fixed prosthesis is often cumbersome for microstomia patient , because in microstomia patient the mouth opening is reduce to less than 30 mm and dentist cannot place the smallest stock tray in the patient's mouth<sup>1</sup>. Thus dentist usually fabricate sectional custom impression trays and sectional prosthesis in microstomia patient.

Limited mouth opening (Microstomia ), which itself is not a disease but manifest as a consequence of certain conditions namely, cleft lip, trauma and burns, Plumber Vinson syndrome , scleroderma, trismus, temporo mandibular joint syndrome, rheumatism, oral sub mucous fibrosis, any damage to masticatory muscle and surgical treatment of orofacial carcinomas .

Sectional custom impression tray are made in various designs like pins<sup>10</sup>, bolts and LEGO plastic building blocks<sup>10,11</sup>, cross-pins slots<sup>12</sup>, Tungsten carbide bur divided into three parts<sup>3</sup> , slide locks

system1, 4 parallel metal pins and an acrylic resin block<sup>10</sup> (**Fig -5,6**) nail head and latch back locking mechanism<sup>10</sup> , all these designs are added to re approximate the sectional custom impression tray<sup>2</sup>.

Sectional custom impression trays are usually designed with two or three sections that could be detached and then joined together intra orally or extra orally in the correct original position after making final impressions. Sectional custom impression trays allows dentist to do accurate border molding , and making of final impression in microstomia patients, thus final prosthesis either removable or fixed partial dentures can be made accurately with the help of sectional custom impression trays<sup>3</sup>.

### C-Digital Impressions -

The misfit of the prostheses is never due to impression material, because manufacturer has made all these impression material accurate and stable. Digital impressions will not solve the problems related to soft tissue management, which is very frequently neglected by dentist while making impression by conventional technique using custom impression tray or stock tray.



Fig - 5 Mandibular sectional custom impression tray with 4 metal pins and acrylic block.



Fig - 6 Maxillary sectional custom impression tray with 4 metal pins and acrylic block.

Many digital impression software are available in dental market , which uses CAD / CAM technology , soon more clinically efficient and cost effective software will be available . The current digital impression devices which are availa Lava 3M , ESPE , CEREC -1,2, and the latest CEREC -3( Sirona Dental Systems GmbH , Bensheim,Germany) , all these system allow scanning and milling of the prosthesis in office , so final prosthesis can be placed in single sitting .The other soft ware available are i Tero ( Cadent, Carlstadt N.J ), ED4 system ( D4D Technology, Richardson ,Texas) , in these system scanning is done and data is send to lab where milling of prosthesis is done , so final prosthesis can be placed in two visit appointments .

The CEREC -3 Sirona dental implant system was first to use digital impression and CAD / CAM technology and even today it is the most reliable in office chair side system for making in lays , on lays , laminates , single unit P F M crown , all ceramic crown up to 14 units and implant supported fixed partial dentures up to 6 units<sup>13</sup>.

It is obvious to clinical dentist experienced in the digital impression technique that digital impression require more definitive pre impression isolation of tooth preparation margin than do conventional impression. A digital camera cannot record tooth preparation margin if they are not visible to the naked human eye, and the computer cannot “fake” a margin any better than a human laboratory technician can. To provide an adequate digital image of tooth preparations, the dentist must isolate the margins of all the tooth preparation and ensure that they are visible to the eye before making a digital impression<sup>14</sup>.

Digital impression appear to be practical and perfect , but it is very costly in respect to indian scenario. Digital impression technology have some limitation like technology cannot be used in making complete dentures and Keneddy class 1 & 2 situations , where functional imprints are needed . Further research is needed in digital impression so that they can be made cost effective in respect to Indian scenario.

## Conclusion

Making impression using conventional

custom impression tray is common and economic in dental practice . The misfit of the prostheses is never due to impression material , because manufacturer has made all these impression material accurate and stable ,failure of the prosthesis is always multifactor like improper selection of stock tray , pouring and handling of impression materials and improper technique used for making impressions and casting . If dentist take care of all the steps properly than accurate master cast and final prosthesis can be made using conventional impression technique , which is cost effective too.

Picca tray material or Visible light cure ( VLC ) di methacrylate resin material should be used for making custom impression tray . Custom impression tray should be made with optimum extension , specific spacer design, tissue stops, escape holes, tray handles with recommended polymerization time for making removable or fixed prosthesis, because this result into accurate reproduction of impression detail made from different impression techniques . For microstomia patients, sectional custom impression tray is used for accurate border molding and final impressions . Through this article, dental clinicians must be encouraged to make valuable changes in their daily practice by using optimal design of custom impression tray. As a result they may begin to leap the reward of reduced chair side time and good adaptation of final prosthesis and receiving patient's appreciation .

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## "Seeing Is Believing" - Endoscopy In The Clinical Practice Of Dentistry: A Review Of Literature

### Abstract

Seeing is believing! There has always been a quest by clinicians to actually observe and visualize the clinical procedures being carried out by them so they can co-relate with their respective theoretical concepts. As the field of dentistry involves minute and intricate anatomical structures, the naked eye vision provides limited field of observation. This lead to the advent of advancements in the sphere of magnification and illumination. The Endoscope remains as one of the pioneering and most promising tool to achieve this objective. The literature has demonstrated dearth in the number of publications with respect to the applications of endoscopy but recently in the previous decade there has been a steady rise in the publications. One of the reasons responsible has been attributed due to the increased interest demonstrated by the dental professionals.

The Dental endoscope not only acts as a diagnostic, but also as a therapeutic adjunct to the various disciplines of dentistry including restorative dentistry, endodontics, periodontics, implantology, caries detection and a whole lot more. This communication throws light over some of the afore mentioned fields of applications, especially on their advent, usage and indications.

### Key Words

Endoscopy, restorative dentistry, Endodontics, periodontics.

### Introduction:

"Your vision will become clear only when you look into your heart. Who looks outside, dreams. Who looks inside, awakens."

This maxim as quoted by **Carl Jung** not only holds true with respect to human behaviour but also concurs with the field of dentistry. This is achieved by techniques that utilize greater magnification and illumination for the purpose of diagnosis and treatment of a wide spectrum of clinical situations.

Quite understandably, the development of the endoscopy of the oral cavity was somewhat delayed because the oral cavity can be well observed by a naked eye. However, it was not long before high-frequency currents found application in surgery in the form of light and heat.<sup>[1]</sup>

The term endoscopy is derived from the Greek language and is literally translated as *endon* (within) and *skopion* (to see), hence the meaning, "to see within."<sup>[2]</sup>

The definition as mentioned by the National Library of Medicine (MeSH) defines and entails the domain of endoscopy stating that "Endoscopy involves passing an optical instrument through a small incision in the; or through a natural orifice and along natural body pathways; and/or through an incision in the wall of a tubular structure or organ to examine or perform surgery on the interior parts of the body."<sup>[3]</sup>

Dental literature represented certain paucity on the applications of endoscopy but recently in the last decade due to the ascent of interest by dental professionals there has been a steady rise in the publications with regard to this diagnostic modality. Endoscopy now finds a host of applications encompassing the domain from detection of caries to endodontics and from periodontics to implantology.

The paper is based to present a focus of dental endoscopy as a diagnostic and therapeutic adjunct to the restorative dentist, endodontist, periodontist, oral implantologist, oral surgeon and with

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### Quick Response Code



regard to caries detection.

### Historical Perspective: - A Changing Paradigm

Early endoscopists such as Hippocrates in 377 BC used primitive tube-like instruments for endoscopy. Arabs in 900 AD utilized mirrors to illuminate body cavities, and Nitze in the 1870s incorporated lenses with an incandescent platinum wire loop for illumination. But all of these were restricted by the inability to transfer sufficient light distally into the body cavity, as well as the limited field of vision offered by the tube opening (bore).<sup>[4]</sup>

A breakthrough in optical quality was achieved in 1960 by Hopkins, who

created a rod lens series that led to important advancements in the field of view, magnification, and focal length of the endoscope, resulting in a clearer image. During this time period, the convergence of image bundle fibers also advanced reducing to smaller bore devices of 2, 3, and 5 mm.<sup>[5]</sup> The addition of video systems has been attributed to Mouret in 1980s. These provided an enhanced image signal. By the late 1980s and early 1990s, flexible endoscopes that used fiber-optic bundles to transmit light and images were important instruments in the field of medicine.<sup>[6]</sup>

The field of endoscopy has recently expanded further with the introduction of the dental endoscope. This endoscope, with its uniquely small bore size of less than 1 mm, is ideal for use during minimally invasive dental surgical applications<sup>[7]</sup>

At the very end of the 20th century, endoscopy involves using the Orascope TM, a modified medical endoscope which utilizes fiber optics and made it portable. The advent of endodontic microscopy began in late 1990s and only a few clinicians demonstrated any interest in it.<sup>[1]</sup> Endodontic endoscopy utilized a fiber-optic probe to explore internal and external components of the root canal. Images taken via the probe are projected on a video monitor for evaluation purposes.

Perioscopy was developed in 1999, with an irrigation system to view the periodontal sulcus after root scaling. A disadvantage of this method was that due to its small dimension of fiberscope, it had limited image quality and hence it could not be utilized in the other dental disciplines.<sup>[8],[9]</sup>

Literature has reported a technique to intraoperatively examine a prepared implant site using immersion endoscopy. In 2006, a Microendoscope (Visio Scope, Ulm, Germany) was introduced for multidisciplinary use in dentistry.<sup>[10]</sup>

#### Caries Detection:

The Laser supported dental endoscope (LSDE) is a combination of a customary intraoral camera with a laser as an illumination source and has been described in the literature. In particular, the monochromatism of the laser beam in combination with its high spectral

density enables it to depict visual differences between sound and carious tooth enamel. It supports evidence of lesions which remain undiscovered during routine dental inspections.<sup>[11]</sup>

A laser beam of 530 nm is used to illuminate the tooth enamel. On this wavelength, the tooth enamel mainly scatters the incident light. Damaged areas are prominent either as dark or bright areas on the tooth surface. The phenomenon of dark areas has been widely described in the literature.<sup>[12]</sup> The LSDE can additionally be operated with a Ultra violet laser beam in order to test the adequacy of autofluorescence to depict carious areas of tooth enamel. Incipient lesions are described as the partial demineralizing of the tooth enamel, which is characterized by reduced surface hardness and interprismatic mineral deficiency<sup>[13]</sup>. The surface appears to be microscopically intact, as it is remineralized from "within" at the cost of the mineral content of the enamel on a deeper level. Demineralized areas, invisible to the naked eye, are characterized as incipient carious areas.<sup>[14]</sup> The development of clinically visible incipient caries either as a white opaque spot, the so-called "white spot", or as a brown enamel area, the so-called "brown spot", is graded as advanced incipient lesions.<sup>[15]</sup> The conversion of the carious area to sound enamel was easily recognizable in the reduction of brightness.

#### Restorative Dentistry:

The dental endoscopic viewing system enhances the visualization of a new carious lesion, recurrent caries, inadequate restorations in proximal boxes or class V restorations, intrafurcal fractures, anatomic aberrations, (eg, a palatal groove on maxillary lateral incisors), residual crown and bridge cement, oral pathologic lesions, and root fractures/perforations.<sup>[16]</sup> Once the etiology is determined with the endoscope, then the practitioner can use the enhanced visualization and, with curettes, files, scalers, and explorers, treat the problem with either a surgical or nonsurgical approach.

The margins of a casting or restorations can be better evaluated for a precise fit by means of a dental endoscopy system. This provides in depth visualization as the naked eye inspection was limited to

the supragingival areas. It was also used to visualize the abutment teeth and proximal areas with subgingival restorations.<sup>[17]</sup>

The endoscope can also provide diagnostic confirmation of a tooth with a suspected fracture by enhancing the visualization of the root surface.

#### Endodontics:

The very beginning of the 21<sup>st</sup> century brought a revolution to endodontics.<sup>[18]</sup> As practitioners began to see and understand endodontic etiology, it enabled endodontists to provide treatment based on visual confirmation rather than radiographic estimates. Historically loupes on eyeglasses allowed a magnification of 3- 4 power, but then in early 1990s, the Dental operating microscope was introduced providing a magnification ranging from 4 to 25X. Dentists today use endoscopy to instrument, irrigate, and obturate while viewing the root canal system in real time.

#### Equipment Development<sup>[11]</sup>

The endoscopes in endodontics permit the working diameters from 0.15mm, up to about 1 mm. But these provide only about 3000 pixels of resolution for the image guide due to space requirements; however, the applications demand higher resolutions with more than at least 10,000 pixels (e.g., 20,000, 30,000, 50,000).

Currently, there are five types of magnification devices and systems to be used in dentistry:

- Loupes
- DOM(Dental Operating Microscope)
- Orascopes modular
- E n d o s c o p e s y s t e m (microendoscopes).
- A Miniature endoscope

The range of magnification of the dental loupes varies from x2 to x6. The DOMs provide magnification from 4X to 25X. While DOM is different, orascope and endoscope have some similarities.

#### Modular Endoscope System-

The Modular endoscope system (Sialotechnology Ltd., Ashkelon, Israel) is designed and manufactured based on the experienced gained from other surgical fields of small channels, especially from salivary ductal system. A rapid development in endoscopic digital

and illumination miniaturization led to compact system that fits in a dental operatory. It consists of a camera, a video, a monitor, a light source, and an archive system. The endoscope is flexible due to special nitinol coating. The optical part which is 0.9 mm of diameter, is a piece of equipment that enables the practitioner a magnification of up to 20 with clear picture with wide angle. This type of endoscope have a 3 channel instrument for endodontic instruments, suction and a channel for the telescope. The central channel contains the endoscope (0.9 mm endoscope 10,000 pixels 120° lens).

#### A Miniature endoscope-

It includes a handpiece which further consists of three segments, mainly:

- A semi-flexible examination probe
- Flexible optical fiber connections for light transmission and image transmission
- Rigid eyepiece with a cold light source connection and coupler for a high-quality CCD camera.

For illumination, a bundle of randomly arranged optical fibres is employed, which transmits the light from the external cold light source to the distal tip of the endoscope.

#### *Working options<sup>[1]</sup>*

The procedure is to be performed using standard root canal equipment, which includes endodontic hand and rotary files, irrigating and the video endoscopy equipment. The optical cavity in endodontic endoscopy is created with a negative pressure. The suction removes condensation, fluids and particles from the surgical field, resulting in a clear picture.

#### *Other applications of endodontic endoscopes*

Transillumination- As a fiberoptic light source, it is an excellent tool for fracture detection as light may refract along fracture line.<sup>[19],[20]</sup>

Apical surgery- The surgical procedure is performed under the inspection of the endoscope with intermittent irrigation. The curvature of the hand-piece enables the practitioner to visualize the hidden parts of the cavity preparation, and to inspect for cracks and root fractures in the apical retrograde preparation.<sup>[21],[22]</sup>

#### *Endodontic Observations:*

Lateral canals and microscopic root cracks are usually detected with high accuracy, providing better intraoperative judgment and facilitating adequate treatment.<sup>[23]</sup> Another observation during treatment might be a color change in the canal. The apical one third of the root appears red, probably because of the presence of the vascularized tissue (periodontal ligament) and the transillumination effect.<sup>[24]</sup>

#### **Periodontics:**

Orthogonal polarization spectral imaging (OPS), capillaroscopy and intravital microscopy are the three methods that can produce an image of microcirculation.<sup>[25]</sup> Literature has described a variation of calliroscopic system that allows direct imaging of gingival sulcus and periodontal pocket microcirculation.

The periodontal endoscope allows for subgingival visualization of the root surface at magnifications of 24X to 48X. This is accomplished through a .99 mm fiber optic bundle that is a combination of a 10,000-pixel capture bundle surrounded by multiple illumination fibers. This fiber is delivered to the gingival margin coupled into an instrument called an "explorer."<sup>[26]</sup>

#### **Equipment:**

Imagefiber, has a core system with coherent fiber optics. A fiber of diameter of 950um gives an image circle diameter of 790um with 30,000 pixel picture elements. The fiber can be used as a flat tipped fiber(FTF), used without lenses. The resolution power of imagefiber is theoretically limited to 0.5 line pairs per fiber diameter (4.3um) and the picture quality is relatively poor.<sup>[25]</sup>

The combination of capillaroscopy with endoscopy has been demonstrated too provide an image of periodontal microvasculature in gingival crevice and periodontal pocket and should prove useful in the further study of pathological processes in the region

#### **Implantology<sup>[10]</sup>**

The main goal of the endoscopic-assisted dental implantation is to increase the longevity of oral implants by securing proper implant placement into bone of sufficient density.

#### The Modular Dental Implant Endoscope

can perform several tasks including the planning of surgery. The bone conditions can be accurately evaluated without causing any pressure necrosis of the bone. In complementary procedures, the endoscope can assist in sinus lifting intervention, and during the operation, endoscopic observation can further assess bone density and implant stability.

Until now, the number of reports on the application of endoscopy in dental implantology has been minimal.<sup>[27],[28]</sup> At the same time, these publications have reported that endoscopic assistance resulted in minimal invasive surgery, low intraoperative trauma, good implant stability upon placement, few postoperative symptoms, and high success rates after years of loading.

#### **Future Developments:**

In the 21st century, as long as basic principles of endodontic therapy are followed, the equipment and tools available to clinicians increase the chances for a higher success rate. New materials, techniques and instruments are entering the marketplace to assist dentists in providing patients with more predictable and reliable treatment.

The introduction of microsurgical principles in endodontics involving techniques used for canal treatment has tremendously improved visualization of the operating field. At the same time, the advent of microsurgical instruments and dental operating microscope has brought about advantages in root canal instrumentation and the application of root canal filling materials.

#### **Conclusion**

In the end it can be concluded that, "the clinical scenarios are more the rule than the exception. With the use of the endoscope, generally inaccessible anatomic considerations can be observed, diagnosis can be enhanced, and treatment planning can be improved."

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## Socioeconomic Status And Oral Health In India - A Critical Review

### Abstract

Relationship between socioeconomic status of individual and health, including oral health, is well established in literature. The conventional measures of socioeconomic status such as social class and household income, have a number of weaknesses so that alternatives, in the form of area-based measures of deprivation, are increasingly being used. The aim of this review was to locate, appraise evidence from scientific studies in order to provide informative empirical answers regarding association of socioeconomic status and oral health.

### Key Words

Socioeconomic Status, Oral Health

### Introduction

Oral health is an important part of general health and may be defined as the 'standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being' (Department of Health, 1994).<sup>[1]</sup> Over the last few decades there have been improvements in oral health in India. However, inequalities in oral health exist throughout the region. Poor health precedes socioeconomic position in the causal pathway, and then there would be little point in addressing socioeconomic factors to reduce socioeconomic inequalities in health. However Selection or reverse causation plays only a minor role and most evidence shows that socioeconomic conditions precede health outcomes<sup>[2],[3]</sup>. In 1998, the World Health Organization in Europe, listed the social gradient first among ten factors identified as the key social determinants of health and a major contributor to unequal health outcomes in populations<sup>[2],[3],[4]</sup>. Individuals in the upper social class have a longer life expectancy, less mortality and a better health and nutritional status than those of lower class. A growing body of recent research suggests that communities with high levels of social capital, the norms and networks that enable people to act collectively<sup>[5]</sup>, have better general health and lower levels of mortality and morbidity. In UK, the Acheson Review highlighted the importance of the socioeconomic determinants of health inequalities and

identified a range of social and welfare policies to promote the health and well-being of the population<sup>[5]</sup>. In USA, the Institute of Medicine has reviewed the evidence base for public health interventions and has recommended a change in approach. The report stresses the importance of focusing on the social determinants of disease, injury and disability, and of adopting a complementary range of different interventions to promote health. The World Health Organization global strategy for the prevention and control of non-communicable diseases also places emphasis on developing interventions which address the environmental, economic, social and behavioral determinants of chronic disease.<sup>[5]</sup> A major problem facing dental policy makers is the persistent and universal nature of oral disease and how to tackle oral health inequalities. A substantial body of scientific literature from many countries has shown that the oral health of lower socioeconomic status groups is worse than their higher socio economic status counter parts. Despite significant overall improvements in oral health in recent decades across the developed world, social inequalities in oral health have remained even in countries with well-developed dental health care system.<sup>[7]</sup> There are large numbers of studies linking social class to incidence of disease. Income, occupation and education these are the major components of most measures of social class and are positively correlated with health status.<sup>[7]</sup>

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### Quick Response Code



In dental health, the socioeconomic status has been recognized for years as a main factor for inequalities.<sup>8</sup> In different areas in the Western world, oral diseases has been shown to be more frequent in the lower socioeconomic groups, with the more affluent having lower experience of oral diseases.<sup>[7],[8],[9]</sup> there is no comprehensive review of studies of socioeconomic status and oral health in IndiaHence this review mainly concentrates on the studies done to assess the relationship between socioeconomic status and oral health in India .

### Measuring Socioeconomic status

Measures of Socioeconomic status vary considerably, in terms of both the variables used as indicative of socioeconomic status and the level at which they have been constructed. They can be relatively simple single-item asset-based measures such as income, occupation, car and house ownership to more complex measures incorporating from four to 40 variables.<sup>[10]</sup> These measures have been used at the individual, household and area level.

These differences arise because there is no commonly accepted definition of socioeconomic status and no theoretical framework to guide the selection of appropriate indicators<sup>[11]</sup>. In a lengthy review of the use of SES in epidemiology, Liberatoset al.<sup>[12]</sup> stated that most of the socioeconomic status measures are based upon three related dimensions: occupation, education and income. A ranking of occupational classes is often employed because occupation is considered to be a reliable indicator of relative standing in industrial societies. It is not surprising, then, that many scales and indices for assessing SES, such as that described by Pineo et al.,<sup>[13]</sup> rely on the social prestige of subjects' occupation as a major indicator. For studies in which detailed personal questionnaires are not available for all subjects, the accurate measurement of SES is problematic. Educational level and income are particularly difficult to ascertain in administrative or medical data sets, since such data are rarely collected. For population or administrative data in which occupation, education and income are unknown, census surveys are sometimes used, estimating the income and education of individuals on the basis of their neighbourhood average. The existence of a variety of occupational scales and other proxy measures is an indication of the extent of this problem.<sup>[14]</sup> Socioeconomic status scale most widely used for urban population in India is the one proposed by kuppuswamy<sup>[15]</sup> in 1976. It is based on education, occupation and income of the head of family. Main disadvantages of the Kuppuswamy scale, it primary measures the socioeconomic status of urban population. Emphasis is on professional education and occupation of the head of the family may not have the same relevance today. Thus an educated, unskilled member of the family business is likely to be in the upper low category, even though he has good standard of living and can afford good health care. It therefore does not necessarily reflect the standard of living or other human development indicators such as sanitation and health. Prasad's classification<sup>[16]</sup>is based on per capita income of family. Pareek's scale<sup>[17]</sup>is used for rural population. It is based upon nine items which include Caste, Occupation of head of family, Education of head of family, Level of social participation of the head of the family, Land holding, Housing, Farm power (draught animals

like bullock, prestige animals like camel, elephant, horse and mechanical power), Material possessions, Family (type of family, family size and distinctive features of family in respect of persons other than the head of family). Apart from these individual indices, Human development index (HDI) is extensively used to measure the standard of living of a country. HDI is calculated based on three indices; life expectancy to measure longevity, educational attainment to represent knowledge and real gross domestic product (GDP) to represent income. Other indices most frequently employed in research onvariations in health in the other countries are the Townsend Index<sup>[18]</sup>, the Carstairs Index<sup>[19]</sup> and the Jarman Underprivileged Areas Index (UAI)<sup>[20]</sup>. Townsend<sup>[18]</sup> used four indicators to assess material deprivation, namely: percentage of economically active persons who are unemployed, percentage of households with no car, percentage of households not owner-occupied and percentage of households overcrowded. Carstairs& Morris<sup>[19]</sup> used a similar array of variables: overcrowding, no car, male unemployment and percentage of all persons in households where the head is in a semiskilledor unskilled occupation. The Jarman UAI<sup>[20]</sup> is a more complex measure, consisting of a summation of eight weighted variables, which attempts not only to measure deprivation but also to assess levels of need for primary care and general medical practitioner workloads.

## Discussion

The central question of this review is whether socioeconomic status was related to oral health. Since by definition a risk factor must clearly establish that the conditions were established that make outcome likely, longitudinal or cohort studies were necessary to demonstrate risk factors. A condition associated with an outcome in a cross sectional study can only be viewed as risk indicator. Mascernhas A K<sup>[21]</sup>, Prakash P etal<sup>[22]</sup> reportedthat parent's education levels used as socioeconomic status indicators were associated with prevalence and severity of caries. Occurrence of caries was higher in children of low socioeconomic status and uneducated mothers. Other similar studies in Moradabad<sup>[23]</sup> and Dawangere<sup>[24]</sup> reported significant differences in mothers' caries activity, high level of S. mutans,

educational level, socioeconomic status, frequency of maternal sugar consumption, and their child's caries experience. Acharya S<sup>[25]</sup> results demonstrated the relationship between Locus of Control and oral health, and the role of socioeconomic status having a strong bearing on this relationship.

VV Doifode et.al<sup>[26]</sup> in Nagpur India observed that dental caries was less common in lower socioeconomic strata but at the same time other disorders viz. periodontal disease, oral mucosal lesions and opacities and enamel disorders were more common in lower socioeconomic strata. Duraiswamy P et.al<sup>[27]</sup> in marble mine workers in Rajasthan observed that substantial unmet treatment needs, chiefly for caries. Sogi GM et al<sup>[28]</sup> in Davangere India reported that dental caries experience and oral hygiene status of children were strongly correlated to socio-economic status. Jose B<sup>[29]</sup>, KuriakoseS et.al<sup>[30]</sup> in Kerala preschool children reported that groups at high risk from dental caries lesions werethose belonging to a lower socioeconomic class. RetnakumariN<sup>[31]</sup> in primary school children reported socio-economic level was negatively associated withcaries status. Studies point to one thing that social class or socioeconomic status may affect caries risk in Indian population. This can be explained on the basis of factors such as lowincome. Low income can affect the degree of education, health, values, life styles and access to health care information, thereby increasing susceptibility to caries. Major drawback of these studies isthat there was no universally accepted definition of socioeconomic status. This may be because socioeconomic status has very broad categorization. It has various components which may differ in different geographic areas. Second major drawback of these studies was all of them were crosssectional surveys. As cross sectional survey have some inherent disadvantages. Burt<sup>[32]</sup> reported that cross-sectional surveys under estimate the real condition due to imperfect clinical examinations. Moreover, the examiners disease detection ability is never perfect. Considering that a number of tooth sites are constantly exposed to demineralization, even the most meticulous method might give different results at different moments of the day. Studies have reported that higher frequency of periodontal diseases is not limited to subjects at the bottom of the

social hierarchy, but manifests itself as a gradient at every level of the social hierarchy. thus a direct relationship between the relative socioeconomic position of the subjects and the occurrence of periodontal diseases was observed.<sup>[33]-[34]</sup>

Kumar Set al.<sup>[35]</sup> in Kesariyaji Rajasthan reported prevalence of periodontal disease to be 98.2% in mine workers of Rajasthan. Mine workers who migrated from other states were of lowest of the socioeconomic status. Bleeding on probing and calculus was widespread in this population. Gundala R<sup>[36]</sup> a significant decrease in periodontitis was observed as the income and education level increased.

Prabhu N et al.<sup>[37]</sup> in Udupi Karnataka reported correlation between different socioeconomic parameters and partial edentulism. As income increases, the incidence of partial edentulism decreases. They also reported that partial edentulism is less in the employed compared to unemployed group.

Shah N et al<sup>[38]</sup> level of edentulousness was found to be high, more so in rural than in urban people and more so in advancing age. The denture needs of the rural elderly were higher than those of the urban elderly. Shigli K et al<sup>[39]</sup> in Belgaum Karnataka India reported that majority of the patients gave economic reasons for not replacing teeth. Cost was the main barrier for obtaining dentures.

Socioeconomic status is related to periodontal conditions and loss of teeth. Explanation of these findings is rooted in the treatment preferences of different socioeconomic status. A preference of more radical dental treatment in terms of tooth extractions could explain that missing teeth was more prevalent in disadvantaged social groups, because this was a low-cost dental treatment. In addition, the choice of radical dental treatment might also rely on past dental treatment traditions where tooth extraction was the acknowledged dental treatment procedure in case of pain or symptoms.

In India, dental visiting is still not considered a preventive dental behavior; at present it only depends on treatment needs. Thus people from lower income group fail to make prophylactic visit to a dentist thus giving them poorer dental health behavior.

ThankappanK et al.<sup>[40]</sup> find significance of social status and tobacco use and oral cancer in Kerala India. They suggested

that since tobacco use has been reported to be higher among the poor and less educated people.

Hashibe Met.al.<sup>[41]</sup> reported subjects with high SES index had protective odds ratio for oral premalignant lesions, Higher education and income levels were also associated with decreased risk of all four oral premalignant lesions.

ChandershekharBR<sup>[42]</sup>, Ahmad M S et al.<sup>[43]</sup> reported inverse relationship between oral health status and SES. The overall treatment need was more in the lower class people than in the upper class. Ramanathan<sup>[44]</sup> also found most of the oral submucous fibrosis cases from India were also of low socioeconomic groups.

Socioeconomic status is suspected to be related to oral cancer risk, but the results from studies have been mixed. Though the mechanism for the association is not clear, SES may be associated with oral premalignant lesions because of access to medical care, health related behaviors, living environment or psychosocial factors.

Socioeconomic characteristics of the individual will be more crucial in determining visits for preventive services than visits for treatment of a strong perceived need such as a toothache. The discretionary characteristic of dental care among low socioeconomic status people or low-income persons may reflect the prioritization of needs rather than an unwillingness to seek dental care. In the presence of limited resources, dental needs have to compete with other health and survival needs. Dental care does not have a high priority in India because the consequences of delaying it usually are less severe and less expensive than the consequences of delaying most medical treatments. However, a low prioritization of dental care does not mean that there is no perception of need for dental care

## Conclusion

The review showed that while many studies have looked at the relationship of socioeconomic status with oral health almost all of studies were cross sectional, which is not the ideal study design. It is well established fact that the socioeconomic position of individuals, groups, and places are defining characteristics for the levels of systematic health and disease. The effect of socioeconomic position on the occurrence and severity of ill health is not restricted to individuals and groups

characterized by absolute deprivation or poverty but shows at every level of social hierarchy generating what is known as social gradient in health.

Action to reduce oral health inequalities in India remains a major dental public health challenge. Evidence has shown that poorer oral health of lower SES groups compared with their higher social status counterparts. Recent research has highlighted a social gradient across the social hierarchy for a variety of oral health outcomes. Effective action to tackle oral health inequalities can only be developed when the underlying causes of the problem are identified and understood.

Emerging evidence is beginning to map out the social determinants of oral health inequalities. A range of complementary public health actions can be implemented at local, national or international levels to promote sustainable oral health improvements. A radical change in approach is needed. More of the same is no longer an option.

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## Orthodontist's Forensic Vision

### Abstract

The responsibility of orthodontists in the practice of their profession and the richness of information found in orthodontic records, forensic case of an individual whose remains were incinerated can easily assessed using information from a panoramic radiograph and intraoral photographs taken during orthodontic treatment. The orthodontist can easily recognize and assess bite marks. Indexing and identification of bite marks has high evidentiary value in forensic odontology.

### Key Words

Bite Marks, Rugoscopy, Cheiloscopy

### Introduction

Forensic Odontology (Dentistry) is that specialty of dentistry which deals with the application of the knowledge of dental sciences to the furtherance of law and justice. It involves the recognition, correct handling, collection, recording, preservation, archiving, and presentation of dental records as evidence in a court of law or to other law enforcing agencies. Its primary scope is concerned with person identification, age estimation, dento-maxillo-facial disability estimation, domestic violence and child abuse, dental malpractice, fraud, or negligence claims, and occupational hazards in dentistry.

Though a relatively young branch of dentistry, especially so in India, forensic odontology plays a pivotal role in the identification of victims of mass disasters, crimes, terrorism, road traffic accidents and unidentified bodies.

The use of teeth as evidence is not recent. There are historical reports of identification by recognizing specific dental features. However, Forensic Odontology, as a science, did not appear before 1897 when Dr. Oscar Amoedo wrote his doctoral thesis entitled "L'Art Dentaire en Medecine Legale" describing the utility of dentistry in forensic medicine with particular emphasis on identification.<sup>1</sup> Dental identifications are based on two main processes. The first involves a comparative technique where ante mortem dental records are accessed, assessed and compared with the postmortem dental recordings of the deceased. The identification by this technique is only possible if dental

records are available in fairly satisfactory condition. In situations where ante mortem records are unavailable, the forensic odontologist is called upon to do a dental profiling which might help in narrowing the zone of search and make identification easier. Identification of the deceased is most commonly achieved visually by a relative or a friend who knew the person during life. This is performed by looking at characteristics of the face, various body features and/or personal belongings. However, this method becomes undesirable and unreliable when the body features are lost due to post- and peri-mortem changes (such as decomposition or incineration). Visual identification in those circumstances is subject to error. Methods of human identification that are acknowledged as scientific are fingerprint, DNA, dental and medical characteristics.<sup>2</sup>

The markers of dental records most commonly relied on by a forensic odontologist for dental comparison and relatively accurate identification are - recording the decayed, missing and filled teeth (DMFT), crown and root morphology, periodontal health, alveolar bone morphology, details on maxillary sinus, condylar and coronoid process and the TM joint. The diversity of dental characteristics is wide, making each dentition unique.<sup>3</sup> The dental enamel is the hardest tissue in the body and hence withstands post-mortem changes and to some extent so would dental materials adjoined to teeth.

Dental aging is based on the chronology of formation and eruption of teeth. This

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helps in determining the age for persons up to 15 years-old in a fairly accurate manner. After 15 years of age, dental aging relies on modifications that take place during life, such as attrition, cementum formation and root transparency.<sup>4</sup> The forensic dental profiling in the absence of ante mortem records would be able to provide inputs on age, sex, ancestry, race, socio economic status and dietary habits. Essentially it is quite clear that the key to accuracy in forensic odontology lies in

### Record Keepings

Orthodontics is the specialization whose purpose is the prevention, supervision and guidance of the development of the masticatory system, the correction of dentofacial structures, including the conditions that require tooth movement for their treatment, and the establishment of esthetic harmony of the maxillary and mandibular structures of the face. Because of the complexity of cases and the considerable time spent working with orthodontic patients, orthodontists produce several dental records,

fundamental for the planning and performance of this type of treatment. These records usually include dental charts, which may be defined as the comprehensive document that contains all data about patient identification and history, answers to a health questionnaire, findings of general physical examinations and extra- and intraoral exams, treatment plan chosen and authorized by the patient and treatment outcomes. Patient records are also used as a file to store complementary tests required by the orthodontic treatment, such as radiographs, plaster impressions, photographs, tracings, and other specific documents. The storage of dental records enables the orthodontist to follow the clinical development of treatments under way and those already completed at any time. In Forensic Dentistry, the importance of these stored materials is associated with both issues of professional defense, in cases of law suits against dentists, and the identification of skeletonized, putrefied or incinerated cadavers. Considering the responsibility of orthodontists in the practice of their profession and the richness of information found in orthodontic records, forensic case of an individual whose remains were incinerated can easily assessed using information from a panoramic radiograph and intraoral photographs taken during orthodontic treatment.

The orthodontist can easily recognize and assess bite marks. Indexing and identification of bite marks has high evidentiary value in forensic odontology. The limitations being only the relatively small percentage of individuals seeking orthodontic treatment from amongst the general population, particularly in India.

The various methods employed in forensic odontology include bite marks, rugoscopy, cheiloscopy, tooth prints, radiographs, and photographs. Though the shortcomings with these various methods are few, the discrepancies associated with them are to be weighed cautiously to make forensic odontology a more accurate, reliable, and reproducible investigatory science.

### Bite marks

#### **History: Role of bite marks in FO (Forensic Odontology)**

The first case solved by bite mark identification was the famous "Salem Witch Trials" in 1692 in United States. During the trial, the bite marks were

compared to the marks present on the body of the victims by a forensic odontologist.

"Ted Bundy" killed numerous people between 1973 and 1978 but was finally tried for the murder of Lisa Levy in Florida State University, through the bite marks that he inflicted on her body. He was later convicted by accurate identification matching of his bite marks with those found on the victim's body. Mac Donald defined a bite mark as a mark made by the teeth either alone or in combination with other mouth parts<sup>5</sup>. Bite marks are found on human body or food or on materials such as wooden cabinet, bottle cap, cigar and cigarette holders, pipes and musical instrument mouth pieces<sup>6,7</sup>. Usually bites are the result of sexual or physical assault by an adult on a child, rape or attempted rape, quarrels and fights among men<sup>7</sup>. Not all human bites are associated with homicides, sexual assaults or child abuse cases. They may be produced due to self-defense when defending against aggressive animal or self inflicted as tongue bite in epileptic fits or fall from heights<sup>8</sup>. Mac Donald's etiological classification<sup>5</sup> of bite marks is as follows:

- a) Tooth pressure marks caused by incisal edge of anterior teeth
- b) Tongue pressure marks seen as impression of the palatal surface
- c) Tooth scrapes mark may be scratches and abrasions that can indicate irregularities in the teeth such as incisal fractures, restorations or attrition
- d) Complex marks are a combination of all the above, occasionally complicated by multiple bites.

#### **Gustafson's clinical classification<sup>9</sup> of bite marks is as follows:**

- a) Sadistic or sexual bite is usually made slowly and is therefore well defined.
- b) Aggressive bite is made quickly with force and is caused by scribing across the tissue.
- c) Most aggressive bite results in tissue being bitten off usually and involves ears, nose, and nipples.

The American Society of Forensic Odontology (ASFO) & American Board of Forensic Odontology (ABFO) have given various guidelines for assessing similarities and discrepancies between the Ante-mortem and Post-Mortem dental features. According to the ABFO

guidelines, the bite marks are classified on the basis of:- (1) the relationship of the jaws, (2) the form and size of arches, (3) missing teeth, (4) spacing between teeth, (5) presence of supernumerary teeth, (6) observed rotations of teeth, (7) the width of teeth, and (8) presence of special features such as fractures and ridges.

**Anatomical location** The anatomical location of a bitemark is also crucial in determining its potential to be analysed. If one considers that the breast is by far the most commonly bitten location, this presents a considerable problem. Breast tissue is highly mobile and easily deformed and therefore it can be difficult to determine the position of the breast during biting or the effect of the bite force on the deformity of the tissue and hence the injury.<sup>10,11</sup>

Bitemarks on the arm and leg can be similarly affected, depending on their position at the time of biting.<sup>10,11</sup>

### **Presentation of bitemark injuries**

Bitemarks will typically present as a semi-circular injury which comprises two separate arcs (one from the upper teeth, the other from the lower) with either a central area absent of injury, or with a diffuse bruise present.<sup>12</sup> It is not unusual to see only one arch of teeth on an injury and, if this is the case, it is most often the lower teeth that are present which relates to the mechanics of biting, i.e. the maxilla remains stable while the mandible moves until the teeth meet.<sup>12</sup> There are three main factors that influence the severity of a bitemark injury:

1. The force by which the original injury was inflicted
2. The anatomical location bitten
3. The time elapsed between infliction

The American Board of Forensic Odontology provide a range of conclusions to describe whether or not an injury is a bitemark. These are:

**Exclusion** - The injury is not a bitemark.  
**Possible bitemark** - An injury showing a pattern that may or may not be caused by teeth, could be caused by other factors but biting cannot be ruled out.

**Probable bitemark** - The pattern strongly suggests or supports origin from teeth but could conceivably be caused by something else.

**Definite bitemark** - There is no reasonable doubt that teeth created the pattern.

The first stage of any analysis is to

determine if the injury is a bitemark, and then to provide a statement on the forensic significance. If one or more suspect's dental casts are available, and the bitemark is suitable for analysis, then an overlay comparison can be conducted.

### Bite marks-indexing

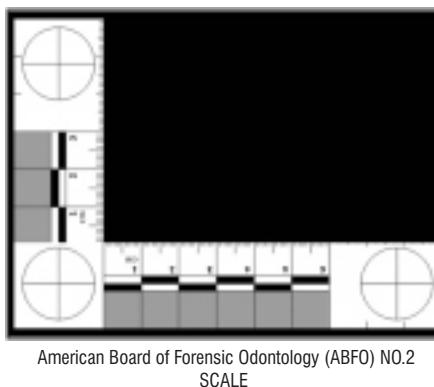
Bite marks can be best reproduced with the help of impression materials like hydrocolloids and light-body vinyl polysiloxane (VPS). Polyether has been also found to have excellent accuracy, long term stability, good elastic recovery and excellent tear resistance. Its excellent hydrophilicity ensures impressions with superior detail reproduction in wet surfaces, including areas difficult to access. The impressions can then be duplicated in die stone and used for assessment with ante mortem records.

Injuries of bite marks may be abrasions, bruises or lacerations. Teeth crush the superficial epithelium and leave its imprint, which can be photographed appropriately. It is imperative to take an early photograph as a bite bruise usually disappears in twenty minutes. However, infrared photographs can show deep-seated bleeding<sup>13</sup>. Lacerations having ragged edges are mostly found in cases of animal bite. Human bite mark is almost circular or oval, whereas animal bite mark is narrowing U-shaped<sup>14</sup>. Not all teeth are involved in a bite and usually consist of three or four upper teeth and one or more lower opposing teeth<sup>15</sup>. Bite marks investigation starts with the examination of wound and if identified as bite mark, to identify the teeth involved, notify any peculiarity of size, shape, position to detail the individual tooth features seen in marks and those seen in tooth of the accused, followed by photography<sup>16</sup>.

Further analysis of bite marks is done by superimposition of marked transparency of inked edges of the plaster model of teeth over the bite mark<sup>17-20</sup>. Presently, scanning electron microscope and computerized axial tomography (CAT) technique is also used to develop precise registration of incisal edge for comparison of bite mark<sup>21</sup>.

Identification of the bite mark can also be done with the help of accurate and high precision photography. The bite mark is photographed keeping the **ABFO No. 2 scale** adjacent to it. It is then digitized by scanning and accessing the images for comparison using a software program like ADOBE Photoshop 8.0. New

research is underway to allow digital comparison of teeth and bitemarks at a 3-dimensional level.<sup>22</sup> This novel technique is aimed to overcome perspective distortion, a significant morbid factor in bitemark analysis that results from reducing 3-dimensional objects to 2-dimensional images.



### Bite marks- UV photography-

Reflective ultraviolet photography (RUPV) is the latest advancement in the bite mark photography. This technique deals with the accurate visualization of bite marks which are impossible to be viewed even with the help of high definition photographs taken from different angles. RUPV records the reflection and absorption of long-wave UV light by the subject matter excluding exposure of the film by all visible light. Long-wave UV light penetrates deeper into the skin than does visible light, therefore, by placing a specially designed filter over the camera lens, one which will only allow a specific wave-length of UV light (less than 400 nanometers) reflective UV photographs can be taken. Since UV light penetrates deeper into the skin, the film will pick up the image of a bruise or bite mark, which has been absorbed too deep into the skin to be able to be seen using visible light.

### Study of palatal rugae (Rugoscopy)

Palatal rugae comprises about three to seven ridges radiating out tangentially from the incisive papilla. These ridges can be classified as curved, straight, wavy, and branched. The pattern of these rugae is considered unique to an individual. In instances where postmortem dental identification is not possible, as in edentulous mouths, palatal rugae can be used as supplement. Postmortem identification is not possible without the antemortem records. Complex rugae patterns that cannot be classified under

one particular group can cause intra or interobserver errors. Kapaliet al.<sup>23</sup> have observed that denture wear, tooth malposition, and palatal pathology can cause alterations in rugae patterns

### Examination of lip prints (Cheiloscopy)

The external surface of the lip has numerous elevations and depressions that form a characteristic pattern, referred to as lip prints. Using lip prints for personal identification in forensic odontology is an accepted method in the criminal justice system worldwide. Impressions are made from the middle portion of the lower lip, an area always visible in any trace made, and the characteristic patterns are studied. Various factors can alter lip print recording. Lip prints have to be obtained within 24 hours of the time of death to prevent erroneous data that would result from postmortem alterations of lip<sup>24</sup>

### Examination of tooth prints (Ameloglyphics)

Ameloblasts lay down the enamel rods in an undulating and intertwining path. This is reflected on the outer surface of the enamel as patterns of the ends of a series of adjacent enamel rods. This study of the enamel rod end patterns is termed as ameloglyphics by Manjunath et al<sup>25</sup> and could aid as an identification tool in decomposed or burned bodies as enamel can resist decomposition

### Radiographs

Dental features do change over time and for this very reason, dental based identification is considered less reliable compared to other biometric methods like finger prints. But in victims where there is complete decomposition, radiographs may be the only available biometric method. Various morphological and pathological alterations can be studied from the radiographs. In morphology based studies, root morphology comparatively aids better identification than crown morphology.<sup>26</sup>

### Photographs

Photographs are valuable substitutes for written records and can overcome language barriers. However, photographs have considerable inherent limitations and stringent requirements are needed for accurate reproduction. The basic difficulty arises when three-dimensional

objects are replicated as two-dimensional photographs, which can create distortion, and color change.

The landmark case of an orthodontist serving as an Forensic Odontologist was in the early months of 1994 in which numerous human remains were exhumed in connection with what came to be known as the 'Cromwell Street murders' or the 'Frederick and Rosemary West' case. In the case, a young female was murdered and some of her teeth were missing, potentially presenting difficulties for comparison with information available at the time of her death. Orthodontist at the Forensic Dental Laboratories at Cardiff used high resolution photographs of the skull and superimposed over the females face. Moreover, they also replaced a labially tipped upper lateral incisor and finally proved the skull to be the same as that of the missing girl.

## Conclusion

It would not be unjustified to state that the orthodontist by virtue of his training and the stringent demands of his profession is adept at record keeping. Routine pre treatment diagnostic record assimilation is ingrained in the orthodontist from the very days of the post graduate training. Detailed case history recording by an orthodontist comprises of medical history, previous dental history alongside intraoral and extra oral examination. The orthodontist is quick at assessing and recording details of cephalic and facial index which provides vital inputs into anthropometric parameters. His unmatched knowledge about the various aspects of the teeth which include the position and angulations of various teeth, inter canine and inter molar width and various aspects regarding implication of 2D & 3D radiographs, gives him in edge in the field of forensic odontology.

In cases where it is impossible to identify the body of a person on the basis of soft tissue examination only, it becomes important to assess the hard tissues i.e. the maxilla and the mandible in various planes for a correct match. Cases where the body of the individual is severely burnt or is impossible to identify on the basis of various soft tissue appearances, would require a more complex assessment of the relatively unchanging hard tissues, which are the maxilla, mandible, the dentition, & cranial base. The process of tracing maxilla, mandible and cranial base, in various planes and

assessing them with respect to various analysis present to identify the deviation from normal, can readily help the forensic odontologist to match with the post-mortem records of the individual.

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## Issues Of Biocompatibility Associated With Commonly Used Endodontic Irrigants: A Review

### Abstract

The root canal anatomy always presents itself with surprises. It is highly variable and full of complexities and for successful outcome it needs to be respected in each and every step of treatment. The step of biomechanical preparation involves cleaning and shaping of the root canal, thereby emphasising that even with best of instruments and techniques there remain areas which cannot be prepared mechanically and have to be only cleaned using irrigants. Since these irrigants often come in contact with living tissues their biocompatibility is of utmost concern. This article presents an elaborated review of biological effects of irrigants routinely used in endodontics.

### Key Words

irrigants, cytotoxicity and biocompatibility.

### Introduction

The use of Endodontic materials goes around saving the pulp vitality, disinfecting the pulp and then finally filling the root canal three dimensionally (solid materials and sealers) to prevent re-infection. The concern while using wide variety of materials in endodontics is their biological effects. Biocompatibility is defined as the ability of a material to function in a specific application in the presence of an appropriate host response (Williams 1987). This definition implies the interaction between a host, a material and an expected function of a material.

Adverse reactions to various materials are assessed in terms of genotoxicity, mutagenicity, carcinogenicity, cytotoxicity, histocompatibility or microbial effects, thus making it impossible to say a material safe on basis of one single test. Autian (1970) was the first to propose a structured approach as a concept consisting of three levels:

1. Nonspecific toxicity (cell cultures or small laboratory animals); do not reflect the application of a material clinical situation.
2. Specific toxicity (usage tests, e.g. in subhuman primates).
3. Clinical testing in humans.

Permanent cell lines, e.g. HeLa, 3T3 or

L929 cells and primary/diploid human cells, are used for cell culture tests. Primary cells are considered to be more relevant for biocompatibility studies than permanent cultures<sup>(1,2)</sup>. They are assessed for growth inhibition, determination of the elective dose 50 (ED50), membrane integrity, DNA, RNA or protein synthesis and/or the determination of alterations of cellular morphology by light or electron microscopy<sup>(1,2,3,4,5)</sup>.

Since the microorganisms may persist even after the successful endodontic treatment, it would be best if an endodontic material has biocompatible as well as antibacterial properties. Antimicrobial activity of materials to endodontic pathogens is normally measured using simple tests, e.g. agar diffusion and agar dilution tests. Endodontic materials with strong antibacterial activity have frequently been found to induce strong adverse effects during and after treatment and were also found to be cytotoxic and even mutagenic<sup>(6)</sup>.

In vivo nonspecific tissue reactions caused by endodontic materials are normally investigated by histological studies following the implantation of the test material into various tissues of animals either directly injected or implanted within Teflon, silicone or polyethylene tubes into various tissues,

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such as the subcutaneous connective tissue, muscle or bone of rats, rabbits, guinea pigs, hamsters and ferrets<sup>(7,8,9,10,11,12,13)</sup>.

Specific in vivo toxicity tests involve the use of the test material for root-canal therapy in animals, predominantly dogs<sup>(14,15,16,17)</sup> or monkeys. Due to ethical considerations these tests are rarely performed in humans<sup>(18)</sup>.

Although in vivo tests are helpful in understanding the complex interactions between the host and host tissue, the use of animals faces ethical problems and is under public discussion.

One of the goals of root canal treatment is to eliminate bacteria, bacterial products and debris from the root canal system. Most bacteria found in the canal space may be removed by the mechanical action of endodontic instruments. However, in several situations, due to the

complex anatomy of the root canal system, organic residues and bacteria lodged deep inside the dentinal tubules cannot be reached even after careful mechanical instrumentation. In these cases, the use of irrigating solutions is essential to ensure bacterial minimization and elimination of organic tissue remnants. Numerous products are currently used as endodontic irrigants, such as sodium hypochlorite (NaOCl), chlorhexidine gluconate, calcium hydroxide and saline. It is highly desirable that the chemical agents selected as endodontic irrigants possess favorable properties, such as antimicrobial activity and dissolution of organic tissues, assist in root canal system debridement and induce a favorable reaction in the periapical tissues.

Because root canal irrigants and medications can come in contact with periradicular tissues, in addition to having good antibacterial ability, they also should be biocompatible. The following is the detail account of biocompatibility issues of routinely used endodontic irrigants.

### Sodium Hypochlorite

Sodium hypochlorite is an effective and most commonly used irrigation fluid in endodontics with anti-microbial effects<sup>(19)</sup> and some tissue-dissolving properties<sup>(20,21)</sup>. The antimicrobial efficacy of the solution is due to its ability to oxidize and hydrolyze cell proteins and, to some extent, osmotically draw fluids out of cells due to its hyper tonicity<sup>(22)</sup>.

Sodium hypochlorite has a pH of approximately 11-12 and when hypochlorite contacts tissue proteins, nitrogen, formaldehyde and acetaldehyde are formed within a short time and peptide links are broken resulting in dissolution of the proteins. During the process, hydrogen in the amino groups (-HN) is replaced by chlorine (NCl) thereby forming chloramine, which plays an important role in antimicrobial effectiveness. Necrotic tissue and pus are thus dissolved and the antimicrobial agent can reach and clean the infected areas better. An increase in temperature of the solution significantly improves the antimicrobial and tissue-dissolving effects of sodium hypochlorite.

It has been found to be highly toxic when used in higher concentrations. In a study demonstrating the cytotoxicity of NaOCl using three independent biological models, it was found that a concentration as low as 1:1000 NaOCl in saline caused complete haemolysis of red blood cells in vitro<sup>(22)</sup>. Undiluted and 1 : 10 dilutions produced moderate to severe irritation of rabbit eyes whilst intradermal injections of undiluted, 1 : 2, 1 : 4 and 1 : 10 (v/v) dilutions of NaOCl caused skin ulcers. It has been proved that Dakin's solution is detrimental to neutrophil chemotaxis and toxic to fibroblasts and endothelial cells<sup>(23)</sup>. A study examined wound healing relative to irrigation and bactericidal properties of NaOCl in in-vitro and in vivo models. It was concluded that 0.025% NaOCl was the safest concentration to use because it was bactericidal but not tissue-toxic<sup>(24)</sup>. Different concentrations of NaOCl (e.g. 0.5, 1, 2.5 or 5.25%) are currently used as root-canal irrigants.

Clinical tests showed that sodium hypochlorite at 0.5 or 5% concentration has similar clinical efficiency in supporting mechanical debridement of the root canal<sup>(25,26)</sup>. As the proteolytic effect is dependent on the amount of free available chlorine that is used up during the process by reacting with inorganic reducing substances, frequent irrigation with a lower concentration may achieve as much of a proteolytic effect as the use of a higher concentration. Therefore, an adequate concentration of NaOCl to be used for endodontic irrigation may be 0.5-1.0% with the pH close to neutral, as it has optimal antimicrobial effectiveness with minimal tissue irritating effect<sup>(27)</sup>.

Most complications of the use of sodium hypochlorite appear to be the result of its accidental injection beyond the root apex which can cause violent tissue reactions characterized by pain, swelling, haemorrhage, and in some cases the development of secondary infection and paraesthesia<sup>(28,29)</sup>.

Hypersensitivity reactions to sodium hypochlorite have also been reported<sup>(30,31,32)</sup>. A great deal of care should therefore be exercised when using sodium hypochlorite during endodontic irrigation. **Ehrich et al. (1993)<sup>19</sup>** suggested that a clinician should check, both clinically and radiographically, for immature apices, root resorption, apical

perforations or any other conditions that may result in larger than normal volumes of irrigant to be extruded from the root-canal system into the surrounding tissue. Irrigation should be performed slowly with gentle movement of the needle to ensure that it is not binding in the canal.

### Ethylene Diamine Tetra-acetic Acid

The disodium salt of ethylene diamine tetra-acetic acid (EDTA) is generally used as the most effective chelating agent to enhance the chemo-mechanical enlargement of canals, to remove smear layer<sup>(33)</sup> and to clean and aid in disinfecting the dentinal walls<sup>(34)</sup>.

In a study which evaluated the cytotoxic effects of different concentrations of neutral and alkaline EDTA and sodium hypochlorite solutions using an established mouse skin fibroblast cell line: L929, it was found that both neutral and alkaline EDTA showed moderate-to-severe cytotoxicity in a concentration dependent manner<sup>(35)</sup>. In addition, EDTA has been shown to inhibit the substrate adherence capacity of macrophages as well as the binding of vasoactive peptide to macrophage membranes in vitro<sup>(36,37)</sup>. These results suggest that leakage of EDTA to periapical tissues during root-canal preparation may inhibit macrophage function, and thus alter the inflammatory response in periapical lesions. EDTA has been shown to have weak antibacterial and antifungal properties<sup>(34,38,39,40)</sup>.

### Chlorhexidine

Chlorhexidine is a broad-spectrum antimicrobial agent that has been shown to be active against vegetative bacteria and mycobacteria. It has moderate activity against fungi and viruses, and inhibits spore germination. It has been shown to be most effective against gram-positive cocci, while less active against gram-positive and gram-negative rods. The antibacterial efficacy of chlorhexidine is comparable with that of NaOCl and it is effective against strains of bacteria resistant to calcium hydroxide, such as gram-positive *Enterococcus faecalis*. The concentration often used in endodontic therapy is 2% chlorhexidine.

In several studies, chlorhexidine as an irrigant has been shown to lower the number of post irrigation positive bacterial cultures, as well as the number

of colony-forming units remaining in positive cultures. Because of its cationic properties, chlorhexidine can bind to surfaces covered with acidic proteins, such as the hydroxyapatite component of dentin, and be released at therapeutic levels, a phenomenon known as substantivity. This can occur in 48 hours to 72 hours after instrumentation.

One of the often cited reasons for using chlorhexidine as a canal irrigant is its perceived minimal toxicity to host tissues. While chlorhexidine does not appear to cause any long-term damage to host tissues, it still may cause an inflammatory response in these tissues if expressed beyond the root canal. In a study 0.12% chlorhexidine was injected into the subcutaneous tissues of the backs of guinea pigs to help assess short-term toxic effects. After histologic examination, they found a mild inflammatory response after 2 hours, moderate inflammatory response after 2 days, and foreign body granuloma formation at 2 weeks, which resolved over time. However, this study was performed using a lower concentration of chlorhexidine than is often used in endodontic therapy. To help evaluate the inflammatory response of 2% chlorhexidine, in a separate study 0.5% NaOCl, 2% chlorhexidine digluconate, and phosphate-buffered saline were injected into the peritoneal cavity of mice. This study found that the number of inflammatory cells resulting from 2% chlorhexidine injection was similar to the phosphate-buffered saline control at all times tested, while the 0.5% NaOCl injection resulted in a significantly larger number of inflammatory cells. The researchers concluded that 2% chlorhexidine was biocompatible. It was also reported that, chlorhexidine in concentrations of 0.5% and 1% induced large foci of coagulative necrosis associated with an inflammatory infiltrate mainly composed of neutrophils and mononuclear cells, along with interstitial dermal and subcutaneous edema. The concentration of 0.25% chlorhexidine caused only small foci of tissue necrosis, while 0.125% chlorhexidine appeared to cause no necrosis. This study also examined the effect of chlorhexidine on tissue healing by testing different concentrations of chlorhexidine on cultured L929 fibroblasts. They found that at lower concentrations, chlorhexidine induced

apoptosis of the fibroblasts and, at higher concentrations, induced necrosis and increased expression of heat-shock protein 70, an indicator of cellular stress. These findings seem to indicate that a 2% concentration of chlorhexidine, as commonly used in endodontic therapy, may have toxic effects on host tissues if expressed beyond the confines of the root canal and may impair healing<sup>(41)</sup>.

Another toxicity concern with the use of chlorhexidine is the formation of para-chloranaline (PCA), which is an aromatic amine. When studied in rats, rabbits, and cats, the primary toxic effect was methemoglobin formation. In humans, accidental occupational exposure to PCA produced symptoms of increased methemoglobin and sulfhaemoglobin levels, cyanosis, the development of anemia, and systemic changes from anoxia. While chlorhexidine may spontaneously hydrolyze to PCA over time, it undergoes a chemical reaction when combined with NaOCl and forms a precipitate that contains PCA. Water or alcohol can be used as an irrigant to flush NaOCl from the canal before chlorhexidine is used, thus minimizing PCA formation. Ethylenedia minetetraacetic acid (EDTA) may also be an appropriate substance to flush the remaining NaOCl out of a canal, as the combination of chlorhexidine and EDTA does not result in a chemical reaction. The white precipitate that is formed from the combination of EDTA and chlorhexidine has been shown to be a salt containing no PCA.

It is important to note that various symptoms of immediate hypersensitivity, including anaphylactic reactions, have been reported after topical treatment with chlorhexidine<sup>(42, 43)</sup>. The toxic potency of chlorhexidine is dependent on the length of exposure and the composition of the exposure medium. It has been found that chlorhexidine rapidly disrupts the cell membrane of both crevicular and peripheral blood neutrophils at concentrations above 0.005% within 5 min, indicating that its inhibitory effect on neutrophil function is mostly due to its lytic properties<sup>(44)</sup>.

#### MTAD

It is an endodontic irrigant, which represents an innovative approach in simultaneous removal of endodontic smear layer and complete disinfection of

root canals. It has been shown to be clinically effective and biocompatible, with potential antibacterial substantivity. It is available as powder-Liquid system. Part A is liquid and is supplied in syringes (5ml, 20ml-single, multiple doses). It contains 4.25% citric acid and 0.5% polysorbate 80 detergent (Tween 80). Its low pH 2.15 contributes to its role as a calcium chelator, thereby causing root surface demineralization and thus helps in the removal of smear layer.

Tween 80 (polyoxyethylene sorbitan monooleate), is a detergent present in MTAD and is a non-ionic surfactant, it helps in reducing the surface tension of distilled water, NaOCl and EDTA, thereby enhancing the flow and penetration of irrigating solutions like MTAD deeper into the dentinal tubules. It has a pH of 7.0 and is a biologically acceptable material.

**Part B** is powder supplied in bottles (single, multiple doses-150mgs, 600mgs). It contains Doxycycline hydralate which is a broad spectrum antibiotic effective against a wide range of microorganisms. It is bacteriostatic and shows the property of substantivity and anticollagenase activity.

There was a study which evaluated eugenol, 3% hydrogen peroxide, 5.25% NaOCl, REDTA Aqueous Irrigant, Peridex, Pulpdent paste, and MTAD for their cytotoxicity. Four concentrations of NaOCl (5.25%, 2.63%, 1.31% and 0.66%) were evaluated for cytotoxicity. Each experiment was conducted using six cultures for each group. L929 fibroblasts were grown on cell culture plates and were placed in contact with various concentrations of test irrigants and medications. The cytotoxicity of these materials was evaluated 24 hours after incubation using MTT assay<sup>(45)</sup>.

Consequently, the MTT method is considered a sensitive index to evaluate the cytotoxicity of dental materials. The advantage of this method is simplicity, rapidity, and repeatability, and it does not require radioisotopes. MTT is a water-soluble, tetrazolium salt yielding a yellowish solution when prepared in media or salt solution. Dissolved MTT is converted to an insoluble purple formazan by cleavage of the tetrazolium ring by dehydrogenase enzymes in living cells. The test results reflect not only the

cell number but also the cell metabolic level.

Based on the test results, it seems that MTAD is less cytotoxic than eugenol, 3% H<sub>2</sub>O<sub>2</sub>, Ca(OH)<sub>2</sub> paste, 5.25% NaOCl, Peridex, and EDTA. The results show MTAD is more cytotoxic than 2.63%, 1.31%, and 0.66% NaOCl. Eugenol is almost 100 times more toxic than 5.25% NaOCl. It also is more cytotoxic than MTAD, and 3% H<sub>2</sub>O<sub>2</sub> is almost 50 times more toxic than MTAD.

Clinical studies are in progress to determine the safety and efficacy of MTAD as a final irrigant to remove the smear layer and disinfect root canals.

### Conclusion

The question of whether results from in vitro experiments can be applied to the clinical situation remains to be investigated. There is evidence that in vitro methods adequately measure cytotoxicity and therefore could reasonably be used as a screening tool to evaluate biocompatibility of test materials.

Research shows that intracanal drugs and irrigation can have deleterious effects on vital tissue. Although these substances are meant to only contact nonvital dentine during use, they often come into contact with the periapical tissues. It is thus important to consider biocompatibility when choosing an endodontic irrigant or intracanal medicament.

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## Advances In Clinical Diagnosis In Periodontics

### Abstract

A proper & true periodontal diagnosis is essential for treatment & preventive strategy & to identify sites as risk in periodontitis patients. Traditional clinical criteria are inadequate for determining the sites showing active tissue destruction & monitoring the response to therapy, as well as to measure susceptibility to future periodontal breakdown. So, newer techniques are being invented for the diagnostic purposes. This article reviews the recent advances in clinical diagnosis in periodontics.

### Key Words

Probe, Generation, Periodontal Disease, Conventional

Diagnosis may be defined as identifying disease from an evaluation of the history, signs and symptoms, laboratory tests, and procedures. It is primarily derived from information obtained from the patient's medical and dental histories combined with findings from thorough oral examination. The entire constellation of signs and symptoms associated with disease is taken into consideration before arriving at a diagnosis. In some instances additional information provided by laboratory tests is useful in the over all decision making process.

Traditional periodontal diagnostic parameters used clinically include probing depths, mobility assessment, bleeding on probing, clinical attachment levels, plaque index, and radiographs assessing alveolar bone level. For the most part, findings from traditional diagnostic procedures (e.g., signs of inflammation, deep probing depths, and clinical attachment loss) are related to pathologic processes associated with periodontal infections. Finally, the absence of conventional signs of periodontal disease is strongly related to the presence of a stable, healthy periodontium.

### Limitations of traditional periodontal diagnostic techniques:

- Clinical or radiological measurements of attachment loss are not precisely accurate and if not carried out very carefully can be misleading.

- Full mouth recording is necessary because of the site specific and episodic nature of periodontal disease progression.
- Individual susceptibility to periodontitis varies both genetically and over time because of other conditions which may affect susceptibility. Such conditions need to be determined and taken into account.
- All clinical diagnostic techniques provide only retrospective information about past disease activity and are unable to diagnose present disease activity.
- If regular serial periodontal chartings are to be compared to monitor periodontal progression or if these measurements are required for clinical research purposes then much more accurate diagnostic techniques are necessary.

Commonly used diagnostic procedures have these significant weaknesses. There exists a critical need for objective diagnostic methods to enable clinicians to identify sites in the periodontium having active disease. A great deal of current periodontal research has therefore been directed towards improving this situation. This has been both aimed at improving the accuracy of traditional clinical diagnostic methods and developing alternative methods capable of detecting periodontal disease

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### Quick Response Code



activity clinically. This article aims to review the advances in diagnostic aids in periodontics.

### Periodontal Probes

The word probe is derived from the Latin word Probo, which means "to test." Periodontal probes are used primarily to detect and measure periodontal pockets and clinical attachment loss<sup>[1]</sup>. In addition, they are used to locate calculus; measure gingival recession, width of attached gingiva, and size of intraoral lesions; identify tooth and soft-tissue anomalies; locate and measure furcation involvements; and determine mucogingival relationships and bleeding tendencies.

### First-Generation (Conventional) Probes

Conventional or manual probes(Fig. 1) do not control for probing pressure and are not suited for automatic data collection.<sup>[6]</sup> These probes most commonly are used by general dental

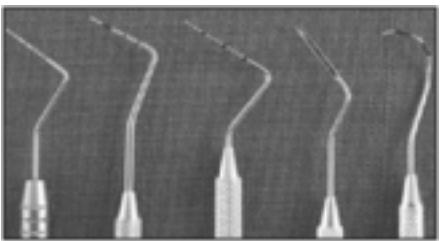


Fig. 1

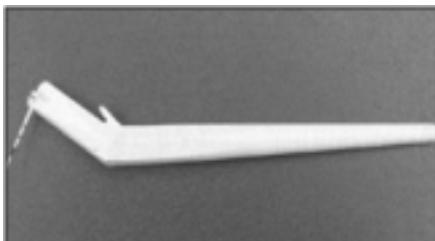


Fig. 2

practitioners as well as periodontists. Invented in 1936 by periodontist Charles H.M. Williams, the Williams' periodontal probe is the prototype or benchmark for all first-generation probes. These probes have a thin stainless steel tip of 13 mm in length and a blunt tip end with a diameter of 1 mm. The graduations on these probes are 1 mm, 2 mm, 3 mm, 5 mm, 7 mm, 8 mm, 9 mm, and 10 mm. (The 4-mm and 6-mm markings are absent to improve visibility and avoid confusion in reading the markings.) The probe tips and handles are enclosed at 130°.

The Community Periodontal Index of Treatment Need (CPITN) was designed by Professors George S. Beagrie and Jukka Ainamo in 1978. CPITN probes are recommended for use when screening and monitoring patients with the CPITN index. The index and its probes were first described in World Health Organization's (WHO) Epidemiology, etiology, and prevention of periodontal diseases. Report of a WHO Scientific Group.<sup>[9]</sup> The FDI World Dental Federation/WHO Joint Working Group 1 has advised the manufacturers of CPITN probes to identify the instruments as CPITN-E (epidemiologic), which have 3.5-mm and 5.5-mm markings, and CPITN-C (clinical), which have 3.5-mm, 5.5-mm, 8.5-mm, and 11.5-mm markings. CPITN probes have thin handles and are lightweight (5 gm). The probes have a ball tip of 0.5 mm, with a black band between 3.5 mm and 5.5 mm, as well as black rings at 8.5 mm and 11.5 mm.

University of North Carolina-15 (UNC-15) probes are color-coded at every millimeter demarcation. They are the preferred probe in clinical research if conventional probes are required.

The Naber's probe is used to detect and measure the involvement of furcation areas by the periodontal disease process in multirooted teeth. Naber's probe also is used in the assessment of more complex

clinical cases, including those with a restorative treatment. These probes can be color-coded or without demarcation.

### Second-Generation (Constant Pressure) Probes

The second-generation instruments are pressure sensitive, allowing for improved standardization of probing pressure. Scientific literature that demonstrated probing pressure should be standardized and not exceed 0.2 N/mm<sup>2</sup> led to the development of these probes. Second-generation probes can be used in general dental practices, as well as periodontal practices, and do not require computerization in the operatory<sup>[1]</sup>.

The True Pressure Sensitive (TPS) (Fig. 2) probe is the prototype for second-generation probes. Introduced by Hunter in 1994, these probes have a disposable probing head and a hemispheric probe tip with a diameter of 0.5 mm. A controlled probing pressure of 20 gm is usually applied. These probes have a visual guide and a sliding scale where two indicator lines meet at a specified pressure.

In 1977, Armitage designed a pressure-sensitive probe holder to standardize the insertion pressure and determine how accurate probing pressure of 25 pounds affected the connective-tissue attachment. In 1978, van der Velden devised a pressure-sensitive probe with a cylinder and piston connected to an air-pressure system. Subsequently, it was modified with a displacement transducer for electronic pocket-depth reading.

The electronic pressure-sensitive probe, allowing for control of insertion pressure, was introduced by Polson in 1980. This probe has a handpiece and a control base that allows the examiner to control the probing pressure. The pressure is increased until an audio signal indicates that the preset pressure has been reached. Polson's original design was modified by its initial users: that probe is known as the

Yeaple probe, which is used in studies of dentinal hypersensitivity.

### Third-Generation (Automated) Probes

In spite of the advances in second-generation probes, other sources of errors, such as in reading the probe, recording data, and calculating attachment level, still needed to be addressed. Third-generation probes were developed to help minimize these mistakes by using not only standardized pressure, but also digital readouts of the probes' readings and computer storage of data. This generation includes computer-assisted direct data capture to reduce examiner bias and allows for greater probe precision. These probes require computerization of the dental operatory and can be used by periodontists and academic institutions for research.

The Foster-Miller probe (Foster-Miller, Inc, Waltham, MA) is the prototype of third-generation probes. Devised by Jeffcoat et al in 1986, this probe has controlled probing pressure and automated detection of the cementoenamel junction (CEJ)<sup>[6]</sup>. The components of the probe are: a pneumatic cylinder, a linear variable differential transducer (LVDT), a force transducer, an accelerator, and a probe tip.

The main mechanism of action of the Foster-Miller probe is by detection of the CEJ. The ball tip moves or glides over the root surface at a controlled speed and preset pressure. Abrupt changes in the acceleration of the probe movement (recorded on a graph) indicate when it meets the CEJ and when it is stopped at the base of the pocket. Under controlled pressure, the probe tip is extended into the pocket and refracted automatically when the base of the pocket is reached. Position and acceleration-time histories are analyzed to determine attachment level and pocket depth. As with all devices, the Foster-Miller probe has advantages and disadvantages. The main advantage is the automatic detection of the CEJ, which is a better landmark than gingival margin, because the position of the gingival margin may change depending on inflammation or recession. The main disadvantage is that it can deem root roughness or root surface irregularities as the CEJ.

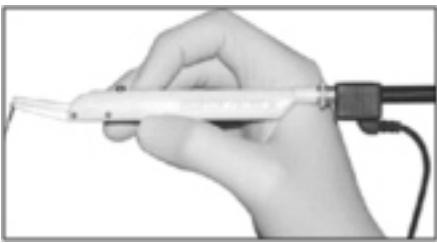


Fig. 3

The Florida Probe® (Florida Probe Corp, Gainesville, FL) (Fig. 3) was devised by Gibbs et al in 1988. The probe consists of a probe handpiece and sleeve; a displacement transducer; a foot switch; and a computer interface/personal computer. The hemispheric probe tip has a diameter of 0.45 mm, and the sleeve has a diameter of 0.97 mm. Constant probing pressure of 15 gm is provided by coil springs inside the handpiece. The edge of the sleeve is the reference from which measurements are made, and the probe has Williams' markings; however, actual measurement of the pocket depth is made electronically and transferred automatically to the computer when the foot switch is pressed.

These probes provide a constant probing pressure of 15 gm, which can be overridden when necessary, for accuracy and patient comfort. Each measurement is recorded with potentially 0.2-mm accuracy. Comparison to previous data can be made more quickly and accurately. (The system shows black arrows for changes between 1 mm and 2 mm, and red arrows are used for changes > 2 mm.) Also, there is a chart showing diseased sites, which can be used in patient education. The Florida Probe does have some disadvantages, which include underestimating deep probing depths, a lack of tactile sensitivity. Also, clinicians need to be trained to operate these probes.

The Toronto Automated probe, devised by McCulloch and Birek in 1991 at University of Toronto, used the occlusoincisal surface to measure relative clinical attachment levels. The sulcus is probed with a 0.5-mm nickel-titanium wire that is extended under air pressure. It controls angular discrepancies by means of a mercury tilt sensor that limits angulation within  $\pm 30^\circ$ . This probe has the advantage of an incorporated electronic guidance system to improve precision in probe angulation.

It also estimates the biophysical integrity of the dentogingival junction by measuring intrapocket probing velocity. The disadvantages are associated with positioning: it is difficult to measure second and third molars, and patients have to position their heads in the same place to reproduce readings.

The InterProbe™ (The Dental Probe Inc, Glen Allen, VA), also known as the Perio Probe, is a third-generation probe with a flexible probe tip, which curves with the tooth as the probes enter the pocket area. Stainless steel probes push the gingiva away from the tooth, causing pain, whereas the InterProbe gently slides in. This probe produces accurate readings of periodontal pockets with its standardized 15 gm of pressure. The probe's optical encoder handpieces uses constant probing pressure, which provides repeatable measurement of pocket depth and attachment loss.

#### Fourth-Generation

Fourth-generation refers to three-dimensional (3D) probes. Currently under development, these probes are aimed at recording sequential probe positions along the gingival sulcus. They are an attempt to extend linear probing in a serial manner to take into account the continuous and 3D pocket being examined.

#### Fifth-Generation

Despite all the advances in earlier generation probes, they remain invasive and, at times, their use can be painful to patients. Plus, with these earlier generation probes, the probe tip usually crosses the junctional epithelium. Fifth-generation probes are being devised to eliminate these disadvantages. Probes are being designed to be 3D and noninvasive: an ultrasound or other device is added to a fourth-generation probe<sup>[5]</sup>. Fifth-generation probes aim to identify the attachment level without penetrating it.

The only fifth-generation probe available, the UltraSonographic (US) probe (Visual Programs, Inc, Glen Allen, VA) (Fig. 4), uses ultrasound waves to detect, image, and map the upper boundary of the periodontal ligament and



Fig. 4

its variation over time as an indicator of the presence of periodontal disease. The US probe was devised by Hinders and Companion at the NASA Langley Research Center.<sup>[24]</sup> This small intraoral probe has an ultrasound beam projection area close enough in size to the width of the periodontal ligament space to give the optimal coupling and small enough to inspect the area between the teeth, while still delivering sufficient signal strength and depth of penetration to image the periodontal ligament space. To probe these structures ultrasonically, a narrow beam of ultrasonic energy is projected down between the tooth and bone from a transducer, which is scanned manually along the gingival margin.

The transducer is mounted at the base of a dual-taper, convergent-divergent coupler to provide an acoustically tapered interface with a throat area on the order of 0.5 mm. This constitutes an active area reduction from the transducer element to the aperture of 20:1. Such a reduction is mandated by the geometry and the very small window afforded by the gingival margin. An added virtue of attaining this small a tip size is the ability of the ultrasonic probe to help the clinician examine the area between the teeth, which is where periodontal disease is most likely to occur.

The ultrasound transducer is mounted in the probe-tip shell, which also incorporates a slight flow of water to ensure good coupling of the ultrasonic energy to the tissues. The couplet water can come either from a suspended intravenous-type sterile bag or plumbed from the dental-unit water source. The focused ultrasonic beam is transmitted into the pocket in the same orientation as the insertion of a manual probe. Then, the probe is moved along the gingival margin, so the two-dimensional graphical output corresponds to the results a clinician gets from "walking the sulcus" with a manual probe. However, ultrasound gives more information because secondary echoes are recorded from tissue features at various depths. It appears likely that the technique also will be able to provide information on the condition of the gingival tissue and the quality and extent of the epithelial attachment to the tooth surface. This may supply valuable data to aid the clinician in the diagnosis and treatment charting of these diseases.



Fig. 5

### Nonperiodontal Probes

#### Calculus Detection

Calculus detection probes detect subgingival calculus by means of audio readings and are reported to increase chances of subgingival calculus detection<sup>[7]</sup>. Currently, the DetecTar probe (DENTPLY Professional, Des Moines, IL) (**Fig. 5**) is the only calculus detection probe on the market. This device has a lightweight, well-balanced handpiece, which can be autoclaved, and it produces an audible beep to signify calculus detection (beep function can be disengaged). This probe may augment standard methods of calculus detection; however, it is expensive and the handpiece is bulkier than a standard periodontal probe. The probe has a short waterline hookup, which may prevent ergonomic placement of the unit, and it does not have a published waterline treatment protocol. As with many automated probes, there is potential for false positives and false negatives; therefore, further research is required.

#### Temperature Sensitive Probe

The Periotemp® Probe (Abiodent Inc, Danvers, MA) (**Fig. 6**) is a temperature-sensitive probe, which reportedly detects early inflammatory changes in the gingival tissues by measuring temperature variations in these tissues<sup>[4]</sup>. The Periotemp Probe detects pocket temperature differences of 0.1°C from a referenced subgingival temperature. This probe has two light indicating diodes: red-emitting diode, which indicates higher temperature, denoting risk is twice as likely for future attachment loss; and green-emitting diode, which indicates a lower temperature, indicating lower risk. This probe can detect initial inflammatory changes; therefore, treatment can be initiated at an early stage. However, the presence of surface cooling caused by breath airflow may



Fig. 6



Fig. 7



Fig. 8



Fig. 9

further complicate the determination of even a normal temperature distribution.

#### Hallimeter

Halitosis or Oral malodor is most often caused by Gram -ve anaerobic bacteria which degrades the proteins and produce volatile sulphur compounds<sup>[7]</sup>. These sulphur compounds can be detected by gas chromatography or the recently Hallimeter (Interscan) (**Fig. 7**) by Rosenberg et al in 1991. The Hallimeter is compact, easy to use and allows chairside testing. Its performance lacks specificity in the analysis of the different components of mouth air in comparison to the gold standard gas chromatography with flame photometric detection. (Tonzetich et al 1995).

#### Diamond Probe

This is a recently developed commercially available instrument developed by the Diamond General Development Corporation, Ann Arbor USA (**Fig. 8**). It has been designed so that it combines the features of a periodontal probe with the detection of volatile sulphur compounds in the periodontal pocket.

#### Periotest

Tooth mobility is a clinical expression of periodontitis. The Periotest (**Fig. 9**) is one of the current systems to assess tooth mobility. It utilizes dynamic forces of short duration of low millisecond range. It evaluates the damping characteristics of the tooth, the device consists of a hand piece that is connected to a unit via a cable. Inside the hand piece a metal rod is accelerated until it reaches its nominal speed and contacts the tooth. The tooth is slightly deflected and the rod is decelerated. Using the measured contact times in milliseconds the Periotest values are calculated<sup>[7]</sup>.

The following ranges are recorded.

-8 to +9-clinically firm tooth

10-19-Palpable mobility

20-29-Visible mobility

30-50-Mobility in response to lip and tongue movements.

Errors may occur due to variation in duration, point of application, mode of application, manner and duration and time of forces, or due to instability, variation, slippage of device etc.

#### Conclusion:

Although there are many potential

clinical diagnostic methods for assessing periodontal disease activity and progression, still numerous features hamper the ability to use them as diagnostic methods of proven utility.

There is still a lack of a proven gold standard of disease progression. After all these years of intensive research we look forward for the betterment of the diagnostic aids to measure present disease activity.

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## Implants in Orthodontics: Applications and Complications

### Abstract

Wide range of endosseous implants for orthodontic and orthopedic anchorage have lead to great degree of success. This article will review the biomaterials used for dental implants; mechanism of osseointegration; various orthodontic implants; placement procedure and their clinical applications.

### Key Words

Anchorage, Implants, Orthodontics, Osseointegration.

### Introduction:

Implantation is a term used to "designate the operation of introducing either a natural or artificial tooth into an artificial socket cut into the alveolar process" (Congdon in 1915). According to Boucher, Implants are alloplastic devices which are surgically inserted into or onto jaw bone. Newton's Third Law states that there is a reaction for every action, control of which is difficult to achieve intraorally. Earlier, orthodontists used extraoral traction to reinforce intraoral anchorage. Nevertheless, patients seldom used headgears 24 hours a day -7 days a week, hence this source of anchorage was often compromised. Clinicians continue to need anchorage that displays a high resistance to displacement.

The ideal intra oral anchorage would not displace, and would require a source devoid of periodontal membrane, which tends to respond to tension and pressure allowing movement through bone. The development of small diameter titanium microimplants with specially designed heads that accept ligatures, coil springs and elastomers have helped to solve the main objections to previous implants and screws.

**Biomaterials Used For Dental Implants :**  
Over the past several decades various biomaterials have been used for surgical implant.

**Materials Mainly Used For Implant Designs Are:-<sup>[1],[2]</sup>**

1) Metals And Alloys :-

- a) Titanium and titanium -6 Aluminum-4 vanadium (Ti-6Al-4V)
  - b) Cobalt-Chromium-Molybdenum -Based Alloys
  - c) Iron-Chromium-Nickel-Based Alloys.
- 2) Ceramics:
    - a) Aluminum, Titanium and Zirconium Oxides
    - b) Aluminum oxides
    - c) Hydroxyapatite
  - 3) Carbon and carbon silicon components
  - 4) Polymers and composites:
    - a) Polymers.
    - b) Composites
  - 5) Porous and Featured coating
    - a) Titanium plasma sprayed.

### Osseointegration:

Osseointegration is the most important stability. The term "Osseointegration" is made of two Latin words.

- Osseo meaning bone
- Integration meaning the state of being combined into a complete whole.

According to Branemark "Osseointegration is the direct structural and functional connection between ordered living bone and the surface of load carrying implant".<sup>[3]</sup>

### Implants In Orthodontics

Their classification can be based on the implant morphology:

1. Implant Disc :
  - a. Onplants
2. Screw design
  - a. Orthosystem Implant System<sup>[4]</sup>

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- b. Spider Screw<sup>[5]</sup>
  - c. OMAS system<sup>[6]</sup>
  - d. Mini Implants<sup>[7]</sup>
  - e. Micro Implants
3. Plate Design
    - a. Skeletal Anchorage system<sup>[8]</sup>
    - b. Zygoma Anchorage System<sup>[9]</sup>
  4. Resorbable Implants / Biodegradable Implants<sup>[10],[11]</sup>

### Placement Procedure :<sup>[12]</sup>

This procedure is performed under local anesthesia.

Maxillary micro-implant sites need a 30°-40° angulation to the long axis of the tooth, either buccally or lingually. Thicker mandibular cortical bone generally requires 10°-20° angulations.

When placing micro-implant in palate, the greater palatine artery and nerve must always be avoided. If micro-implant is inserted through movable soft tissue rather than attached gingival, it is preferred to use a screw without a button head, placing it completely beneath the

gingival with an emerging ligature wire hook for elastic engagement. This reduces the risk of inflammation and infection. The micro-implant depends upon mechanical retention within the bone, thus requires a tight fit. A low speed contra angle with a drill 0.2-0.3 mm narrower than microscrew is used for initial entry into the bone.

It is safer to use a manual screwdriver so the clinician can feel resistance from roots and make adjustments to avoid them. Whenever resistance is encountered, withdraw the implant and redrill the bone with the pilot drill before reinserting the micro-implant. When the micro-implant fits tightly, orthodontic forces can be applied immediately.

#### Clinical Applications:

##### 1. Closure of extraction space :

The mini screw can be placed between the roots of the first molar and the second bicuspid roots. (Figure 2)

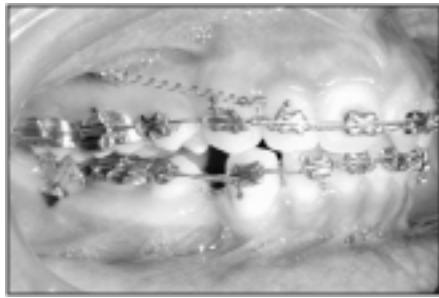


Figure 2

##### 2. Symmetric intrusion of the incisors:

To intrude the upper incisor, the best placement of miniscrew is between the upper lateral incisors and the canines. The placement of the miniscrew should be done after alignment and leveling. (Figure 3)

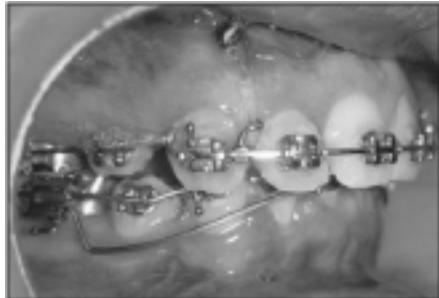


Figure 3

##### 3. Correction of Occlusal plane and dental midline :

The miniscrews are placed between the upper laterals and the canines or in between the upper canines and the bicuspids for the maxillary arch and in between the laterals and canines for mandibular arch on opposite side for midline correction. (Figure 4)

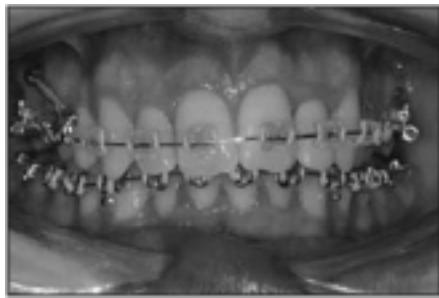


Figure 4

##### 4. Molar intrusion :<sup>[13]</sup>

Molar intrusion can be done in the cases where simple molar intrusion is required. Miniscrews can be placed between the roots of the first and second molars. (Figure 5)



Figure 5

##### 5. Molar distalization:

The ideal implant site in palate is between the roots of the first and second premolars.

#### Risks and Complications of Miniscrews

Complications can arise during miniscrew placement and after orthodontic loading in regard to stability and patient safety.

#### Complications During Insertion

Trauma to the periodontal ligament or the dental root

Potential complications of root injury include loss of tooth vitality, osteosclerosis, and dentoalveolar ankylosis.<sup>[14],[15]</sup> Interradicular placement requires proper radiographic planning, including surgical guide with panoramic and periapical radiographs to determine the safest site for miniscrew placement.<sup>[16],[17],[18],[19]</sup>

#### Microscrew Slippage

Placement of miniscrews less than 30° from the occlusal plane can increase the risk of slippage. To avoid this, the clinician can initially engage bone with the miniscrew at a more obtuse angle before reducing the angle of insertion after the second or third turn.

#### Nerve Involvement

Most minor nerve injuries not involving complete tears are transient, with full correction in 6 months.<sup>[20]</sup> Long-standing sensory aberrations might require pharmacotherapy (corticosteroids), microneurosurgery, grafting, or laser therapy.

#### Miniscrew bending, fracture, and torsional stress

Increased torsional stress during placement can lead to implant bending or fracture, or produce small cracks in the peri-implant bone, that affect miniscrew stability.<sup>[21],[22],[23]</sup> Self-drilling miniscrews should be inserted slowly, with minimal pressure, to assure maximum miniscrew-bone contact.

#### Complications Under Orthodontic Loading

##### Stationary anchorage failure

According to the literature, the rates of stationary anchorage failure of miniscrews under orthodontic loading vary between 11% and 30%.<sup>[24],[25],[26],[27]</sup>

The key determinant for stationary anchorage is bone density.<sup>[28],[29],[30]</sup>

Stationary anchorage failure is often a result of low bone density due to inadequate cortical thickness. Bone density is classified into 4 groups (D1, D2, D3, and D4) based on Hounsfield units (HU)-an x-ray attenuation unit used in computed tomography scan interpretation to characterize the density of a substance.<sup>[31]</sup> D1 (>1250 HU) is dense

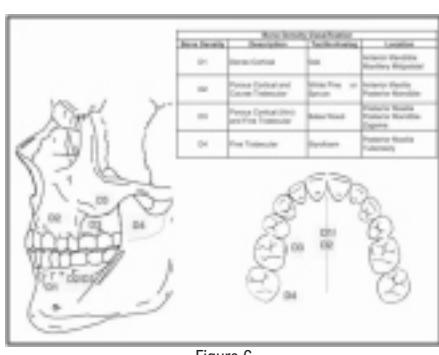


Figure 6

cortical bone primarily found in the anterior mandible and the maxillary midpalatal area.[32] D2 (850-1250 HU) is thick (2 mm), porous cortical bone with coarse trabeculae primarily found in the anterior maxilla and the posterior mandible. D3 (350-850 HU) is thin (1 mm), porous cortical bone with fine trabeculae primarily found in the posterior maxilla with some in the posterior mandible. D4 (150-350 HU) is fine trabecular bone primarily found in the posterior maxilla and the tuberosity region. (**Figure 6**)

Sevimay et al<sup>[33]</sup> reported that osseointegrated dental implants placed in D1 and D2 bone showed lower stresses at the implant-bone interface. Placement of miniscrews in D1 and D2 bone might provide greater stationary anchorage under orthodontic loading. Placement of miniscrews in D4 bone is not recommended due to the reported high failure rate.<sup>[34],[35],[36]</sup>

### **Miniscrew Migration**

Orthodontic miniscrews can remain clinically stable but not absolutely stationary under orthodontic loading. To account for potential migration, the clinician should allow a 2mm safety clearance between the miniscrew and any anatomical structures.<sup>[37]</sup>

### **Soft-Tissue Complications**

#### **Aphthous ulceration**

Minor aphthous ulcerations are self-limiting and resolve within 7 to 10 days without scarring.<sup>[38]</sup>

#### **Soft tissue inflammation, infection, and periimplantitis**

Healthy peri-implant tissue plays an important role as a biologic barrier to bacteria.<sup>[39]</sup> Tissue inflammation, minor infection, and peri-implantitis can occur after miniscrew placement.<sup>[40]</sup>

### **Complications During Removal**

#### **Miniscrew fracture**

The miniscrew head could fracture from the neck of the shaft during removal. The proper placement technique can minimize the risk of miniscrew fracture during its removal.

#### **Partial osseointegration**

Although orthodontic miniscrews achieve stationary anchorage primarily through mechanical retention, they can achieve partial osseointegration after 3

weeks, increasing the difficulty of their removal. The miniscrew typically can be removed without complications a few days after the first attempt of removal.<sup>[41]</sup>

### **Conclusion :**

The success of this type of absolute anchorage has widened the horizons of the orthodontist, which should be explored to the best possible advantage for treating cases. This should help in providing the aesthetically conscious adult patient orthodontic care which has once compromised or denied altogether due to lack of posterior teeth which serve as anchors during orthodontic treatment.

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## Clinical Aspects Of Adhesion Of All Ceramics: An Update

### Abstract

The clinical success of resin bonding procedures for ceramic restorations depends on the quality and durability of the bond between ceramic and the resin. The quality of this bond depends upon the bonding mechanisms that involve surface treatments that promotes micromechanical and chemical bond to the substrate. With the great diversity of the available materials, there is a need for establishing general concepts for bonding all-ceramic restorations. Ceramics differ in nature of their composition of glass-to-crystalline ratio which affects their properties and hence usage for restorations. Also, the cementing techniques and design of the restoration have great influence on the adhesion mechanisms. Thus, there is a need for establishing general concepts for bonding all-ceramic restorations and there are many clinical aspects that are important for success with all-ceramic materials. Recent studies have focused on various new techniques, that involve different bonding strategies to different ceramics, which is essential to achieve a strong and durable bond.

### Key Words

ceramic restorations, bonding, adhesion to dentin, inlays and onlays

### Introduction

Over the last decade, it has been observed that there is an increasing interest in the ceramic materials in dentistry. Even though the combination of strength and reasonable esthetics has continued to make traditional metal ceramic restorations popular,<sup>[1]</sup> patient demand for improved esthetics has driven the development of ceramics for use with inlays, onlays, crowns, FPDs and implant supported restorations.<sup>[2]</sup> Esthetically these materials are preferred alternatives to the traditional materials. The use of conservative ceramic inlay preparations, veneering porcelains is increasing, along with all-ceramic complete crown preparations.<sup>[3]</sup> It has been observed that typical survival rates for all ceramic restorations range from 88 to 100% after 2-5 years in service.<sup>[4],[5],[6]</sup> and 84- 97 % after 5-14 years of service.<sup>[7],[8]</sup>

### Bonding is Pre-requisite for clinical success

Achieving strong and reliable bond to all-ceramic restorations is a pre-requisite for long term clinical success of the restoration. It is observed that establishing a good bond to all-ceramic restorations improves their retention, reduces micro-leakages, and enhances the fracture resistance. Various studies have shown that the strength of an all ceramic restoration is dependent on the ceramic material used, core veneer bond strength, design of the restoration, and

the bonding techniques.<sup>[10]</sup> However, the clinical success of resin bonding procedures for ceramic restorations depends on the quality and durability of the bond between ceramic and the resin and, the quality of this bond depends upon the bonding mechanisms that are controlled in part by the surface treatment that promotes micromechanical and chemical bond to the substrate.<sup>[11]</sup> For a successful bond the surfaces of parts to be bonded should be thoroughly conditioned to obtain a tight junction between the molecules of the bond and the work-pieces. This link must be strong enough to withstand stresses in the bonding agents generated due to polymerization shrinkage. Thus, this review evaluates the factors that influence adhesion of ceramics and thus, lead to clinical success of the restoration.

### Challenges in adhesion to dentin

Adhesion to dentin is not as reliable as adhesion to enamel, because of the morphologic, histologic, and compositional differences between the two substrates i.e enamel and dentin. To overcome the challenges in dentin bonding, various advancements have been made in the field of adhesive dentistry.<sup>[29],[30]</sup> Dentin not only has a more complex histologic structure than enamel, but and composition occur not only with differences in depth, but also from region to region of the tooth. The permeability of occlusal dentin is higher

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over the pulp horns than at the center of the occlusal surface, proximal dentin is more permeable than occlusal dentin, and coronal dentin is more permeable than root dentin.<sup>[31],[32]</sup> The mean diameter of dentinal tubules ranges from 2.37 μm at the pulpal side to 0.63 μm at the periphery. Likewise the number of tubules decreases from about 45,000/mm<sup>2</sup> near the pulp to about 20,000/mm<sup>2</sup> near the surface with the average of 30,000 tubules/mm<sup>2</sup> in the middle part of the cut human dentin.<sup>[33]</sup> Also, the relative area of dentin occupied by tubules decreases towards the DEJ, from about 22-28% of the cross-sectional area near the pulp to only 1-4% near the enamel.<sup>[34]</sup> Also, the smear layer poses a problem while bonding to dentin. It consists of debris (such as ground enamel and dentin) that is burnished against, and bound to, the dentin surface during instrumentation. Depending on factors such as the type of cutting instrument used, the smear layer is typically just 0.5-5.0μm thick, but occludes the orifices of the dentinal tubules. Although the smear layer acts as a diffusion barrier that

decreases dentinal permeability, it also can be considered an obstruction that prevents resin from reaching the underlying dentin substrate.<sup>[35]</sup> For the above reasons, it is necessary to differentiate between the kind of restoration whether in enamel or dentin, while choosing resin or conventional cements for adhesion of all ceramic restorations.

### Nature of ceramic material and restoration

Ceramics can be classified by their microstructure (amount crystalline phase and glass composition) and processing techniques (powder liquid, pressed or machined).<sup>[13]</sup> At microstructural level, ceramics are defined by the nature of their composition of glass-to-crystalline ratio.

- Composition Category 1 - Glass based systems (mainly silica)
- Composition Category 2 - Glass based systems (mainly silica) with fillers, usually crystalline (typically leucite or, more recently, lithium disilicate)
- Composition Category 3 - Crystalline-based systems with glass fillers (mainly alumina)
- Composition Category 4 - Polycrystalline solids (alumina and zirconia)

On the basis of processing techniques ceramics are classified as:

(1) Powder/liquid, glass based systems; (2) Machinable or pressable blocks of glass-based systems; and (3) CAD/CAM or slurry, die-processed, systems. Out of these, the strongest ceramics are aluminum oxide and zirconium oxide ceramics. They are 100% crystalline but also very opaque. Spinel Ceramics can be very translucent to very opaque.

### Fabrication of inlays/onlays

Glass-infiltrated, partially sintered alumina was introduced in 1988, and marketed under the name In-Ceram. The system was developed as an alternative to conventional metal-ceramics, and has met with great clinical success.<sup>[14],[15],[16]</sup>

The crystalline phase consists of alumina, alumina/zirconia, or an alumina/magnesia mixture appropriately named "spinell" that is fabricated by a process called slip casting, or it can be milled from a pre-sintered block of either material. The alumina or spinell framework is then infiltrated with a low-viscosity lanthanum glass at high

temperature. Extremely high flexural strengths have been reported for this new class of dental ceramic, three to four times greater than any other class of dental ceramic.<sup>[17],[18],[19]</sup> Several clinical studies have shown that, In-Ceram alumina had the same survival as that of PFM up to the first molar, with a slightly higher failure rate on the second molar.<sup>[20]</sup> The alumina/zirconia material should only be used on molars because of its very high opacity, which is not ideal for anterior esthetics. For anterior teeth, the alumina/magnesia version of In-Ceram (called spinell) is ideal because of its higher translucency. More recently, powder-liquid versions were made for the specific veneering of alumina-based core systems, eg, In-Ceram® (Vita Zahnfabrik, distributed by Vident, Brea, CA). These materials have been developed into very fine-grain machinable blocks, such as Vitablocs Mark II (Vident) for use with the CEREC® CAD/CAM system (Sirona Dental Systems, Charlotte, NC). This material is the most clinically successfully documented machinable glass for the fabrication of inlays and onlays, with all studies showing a < 1% per year failure rate, which compares favorably with metal-ceramic survival data, CEREC, and metal-ceramic references.<sup>[21]</sup>

### Fabrication of veneers

Low-to-moderate leucite-containing feldspathic glass are called "feldspathic porcelains" by default. These materials are typical powder-liquid materials that are used to veneer core systems and are also the ideal materials for porcelain veneers. The original materials had a fairly random size and distribution of leucite crystals, with the average particle size being around 20 µm. This random distribution and large particle size contribute to the material's low fracture resistance and abrasive properties relative to enamel. Newer generations of materials (VM 13, Vita) have been developed with much finer leucite crystals and very even particle distribution throughout the glass and are less abrasive and have much higher flexural strengths.<sup>[22],[23]</sup>

### Adhesion for restoration with margins located in the enamel(inlays, partial crowns, veneers).

It is absolutely advisable to use resin cements for bonding when restoration margins are located in the enamel and

perfect moisture control with rubber dam is possible. Bonding with enamel results in a compound system with stabilization of the ceramic. That is the reason for high success rate of a veneers and inlays.<sup>[36]</sup>

### Fabrication of anterior crowns

High leucite containing (approximately 50%)glass. The most widely used version is the original IPS Empress®(Ivoclar Vivadent, Amherst, NY) but there are several other products in this category. This material is called a glass ceramic, which has had the crystalline phase grown within the glass matrix by a process called "controlled crystallization of glass." Conventional porcelain has the crystalline leucite added to the glass matrix. Pressable and machinable versions designed for both the CEREC and E4D(D4D Technologies, LLC, Richardson, TX) of high-leucite ceramics have performed excellently clinically. Vitabloc Mark II for the CEREC and pressable and machinable versions of IPS Empress ideally suited for inlay and onlay restorations, anterior crowns and veneers.<sup>[24],[25],[26]</sup>

### Fabrication of full contour restorations

Lithium-di-silicate glass ceramic is a new type of glass ceramic introduced by Ivoclar as IPS Empress® II (now called IPS e.max®), where the aluminosilicate glass has lithium oxide added. This material can be very translucent even with the high crystalline content which is due to the relatively low refractive index of the lithium-di-silicate crystals. Because of its higher strength and fracture toughness, E max has the potential to be used for any type of single restoration anywhere in the mouth. According to the manufacturer, E.max can be conventionally cemented, but because of the glass matrix it can also be etched and bonded.<sup>[27]</sup>

### Fabrication of three-unit bridges

Zirconia has unique physical characteristics that make it twice as strong and twice as tough as alumina-based ceramics.<sup>[28]</sup> Reported values for flexural strength for this new material range from over 900 MPa to 1,100 MPa. Zirconia materials are supplied by virtually all dental ceramic manufacturers; the most recognizable names are Lava™ (3M ESPE, St. Paul, MN), Vita YZ (Vident/Vita), and Cercon® (DENTSPLY, York, PA). These materials were designed as a PFM alternative for single crowns and three-unit bridges anywhere in the mouth.

### **Adhesion for restoration with margins located in the dentin (full crowns and bridges)**

In many cases full crowns are made two or three times when the margins of the replaced restorations are located subgingivally and in the dentin: leading to clinical handling problems. Furthermore, sulcus fluid and saliva negatively affect the quality of the bonding surface after pre-conditioning. If the perfect bond between ceramic, dentin and the luting is not guaranteed, there is no guarantee of obtaining a compound system. In case the restorative margin is in dentin, it makes no sense of using a resin cement, because the polymerization shrinkage of composite will lead to gap formation, with its negative consequences of the bacterial invasion.<sup>[37],[38]</sup>

### **Selections of cements for adhesion<sup>[39]</sup>**

The cements used for bonding all ceramic restorations fall under three types of resin cements-adhesive, esthetic, and self-adhesive resin cements.

#### **Esthetic Resin Cements**

- Self-etch or total-etch bonding agent is needed for bonding to tooth substrates.
- Silane or ceramic primer is needed for all-ceramic restorations.
- Curing mode options can be light or dual-cured.
- Light-cured cement is available for veneers.
- Stronger mechanical properties than self-adhesive resin cement.
- Multiple shades available.
- Most esthetic resin cements provide water soluble try-in pastes.

#### **Adhesive Resin Cements**

- Primer is needed for bonding to tooth substrates.
- Silane coupling agent is needed for silica-based ceramics.
- Can bond directly to zirconia without primer.
- Curing mode options-can be light-, dual-, or self-cured.
- Several shades available.
- May release fluoride.

#### **Self-adhesive Resin Cements**

- Self-etching-no phosphoric acid or special primer needed for bonding to tooth substrates.
- Can bond directly to zirconia without primer.
- Curing mode options-can be light, dual, or self-cured.

- May release fluoride.
- Usually available in universal, translucent and opaque shades.

### **Bonding/cementing techniques for ceramics based on their microstructure**

**Feldspathic Porcelains:** These require resin cement bonded to both tooth structure and ceramic. Dual-cured esthetic resin cement with a dual-cured total-etch (etch-and-rinse) bonding agent should be used for thicker or more opaque veneers. Etching of the porcelain should be done with hydrofluoric acid etchant. For bonding to the porcelain, silanating agent or appropriate ceramic primer should be used. Silica-based ceramics (feldspathic porcelain, leucite-reinforced ceramic, lithium disilicate ceramic) should be bonded with adhesive or esthetic resin cements using appropriate bonding agents and primers.

**Leucite-reinforced Ceramics:** These require resin cement bonded to both tooth structure and ceramic. Dual-cured esthetic resin cement with a dual-cured total-etch (etch-and-rinse) bonding agent can be used for thicker or more opaque veneers. For the tooth, an adhesive resin cement or a dual-cured esthetic resin cement should be used.

**Lithium Di-silicate Ceramics:** These should be bonded with an esthetic resin or an adhesive resin cement for best retention and esthetics. A dual-cured esthetic resin cement with a dual-cured total-etch (etch-and-rinse) bonding agent should be used for thicker or more opaque veneers. For bonding to tooth structure, use an adhesive resin cement or a dual-cured esthetic resin cement. Lithium di silicate ceramics can be cemented with traditional crown and bridge cements when retention is adequate.

**Zirconia-based Ceramics:** Zirconia (zirconium oxide)-based ceramics are a rapidly growing type of esthetic restoration. Due to their high strength, they have more indications than other all-ceramic restorative choices. In addition, because of their high strength, zirconia-based ceramic restorations can be cemented with traditional cements or bonded with adhesive resin cements. Self-adhesive resin cements offer less technique sensitivity than traditional cements, making them excellent choices for the cementation of appropriate zirconia based ceramic restorations. When additional retention is required,

zirconia-based restorations can be bonded with adhesive resin or dual-cured esthetic resin cements using tooth and ceramic primers. Zirconia-based ceramics with ideal retention can be cemented with traditional crown and bridge cements or bonded with resin cements. Zirconia-based ceramics with less than ideal retention require a resin cement bonded to both tooth structure and ceramic. Use adhesive resin cement, dual-cured esthetic resin cement, or self-adhesive resin cement when bonding is required. Sandblast (Micro Etcher IIA, Danville Materials) the intaglio surface of zirconia using 50 um alumina at 30 psi for increased bond strength. Use zirconia primer on the intaglio surface of zirconia when increased bonding is required. Silanating agents are not compatible with zirconia. Hydrofluoric acid is not compatible with zirconia. manufacturers' instructions for proper bonding of the restoration to tooth structure.

### **Design of the restoration**

The design of the restoration also influences selection of resin cement. When the tooth preparation has adequate cervical-occlusal height: height > 3 mm and adequate taper i.e 2-5 degrees, then cementation with self-adhesive resin is preferred. For teeth with short clinical crown: height < 3 mm and an over-tapered preparation i.e > 5 degrees bonding with adhesive resin cement or esthetic resin cement is recommended.

### **Conclusion**

Adhesive bonding techniques and modern all ceramic systems offer a wide range of highly esthetic treatment option. Ceramics differ in nature of their composition of glass-to-crystalline ratio which affects their properties and hence usage for restorations. Also, the cementing techniques and design of the restoration have great influence on the adhesion mechanisms. With the great diversity of the available materials, there is a need for establishing general concepts for bonding all-ceramic restorations and there are many clinical aspects that are important for success with all-ceramic materials. Thus, we should have significant knowledge and training in these areas for success with all-ceramic materials.

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## Oral Health Related Quality Of Life And It's Impact On Elderly People

### Abstract

Quality of life is a holistic approach that not only emphasizes on individuals' physical, psychological and spiritual functioning but also their connections with their environments and opportunities for maintaining and enhancing skills. Oral health-related quality of life can be stated as a "self-report specifically pertaining to oral health, capturing both the functional, social and psychological impacts of oral disease. Evaluation of oral health-related quality of life is made by subjective indicators, complementary to those clinical and brings together the dimension of social impact and clinical indicators. It measures the extent to which health status disrupts normal functionality and social roles and produces major changes of behavior.

Aging is a highly variable process, affected by numerous factors including genetic predisposition, environmental factors and diseases. The elderly represent a special category in the population, not only because of the consequences of specific diseases and conditions but also because they often have restricted access to medical care, including dental care. The prevalence of oral health problems increases with age, highlighting the importance of oral health related quality of life (OHRQoL). This is a concept that reflects aspects of human life generally affected by oral health or dental care which affect the daily lives of older adults. OHRQoL is patient oriented and will enhance our understanding of relationship between general and oral health and demonstrate that improving the level of patient's well being goes beyond simply treating dental related problems in the elderly segment of the population

### Key Words

Health Related Quality of Life, Oral Health Related Quality of Life, Ageing, Elderly,

### Introduction

Health has evolved over the centuries as a concept from an individual concern to a world-wide social goal and encompasses the whole quality of life. The widely accepted definition of health given by the World Health Organization (WHO) rejects the notion that health is merely just the absence of physical disease but places the person's experience of his health in context of physical, psychological and social well-being<sup>[1]</sup>. According to the policy of the WHO program, oral health is integral and essential to general health; it is a determinant factor for quality of life. Oral and general health is related and proper oral care reduces premature mortality<sup>[2]</sup>.

Quality of life is a holistic approach that not only emphasizes on individuals' physical, psychological, and spiritual functioning but also their connections with their environments; and opportunities for maintaining and enhancing skills<sup>3</sup>. Oral health-related quality of life is defined as "a multifaceted concept that attempts to

simultaneously assess how long and how well people live". This concept portrays health as a part of everyday living, an essential dimension of the quality of our lives, a resource which gives people the ability to manage and even to change their surroundings<sup>[4]</sup>. Oral health-related quality of life is also defined as a "self-report specifically pertaining to oral health - capturing both the functional, social and psychological impacts of oral disease<sup>[5]</sup>. Evaluation of oral health-related quality of life is made by subjective indicators, complementary to those clinical and brings together the dimension of social impact and clinical indicators, measures the extent to which health status disrupts normal functionality and social roles and produces major changes of behavior<sup>[6]</sup>.

The elderly represent a special category in the population, not only because of the consequences of specific disease and conditions but also because they often have restricted access to medical care, including dental care<sup>[7]</sup>. As a result of

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living longer and retaining more of their natural teeth, more oral problems arise and lead to restrictions that modify their life styles and social interactions, thus affecting their oral health related quality of life<sup>[8]</sup>.

The relationship between oral health and general health is complex and multifaceted, especially among the elderly. Some unfavorable general health conditions that are more prevalent among this age group can act as predisposing factors for oral health impairment, such as diabetes, which can induce xerostomia and reduction of the saliva flow<sup>[9]</sup>. Oral conditions that are more prevalent among the elderly, such as tooth loss and periodontal disease, may act as predisposing factors for malnutrition and restrictions on the intake of certain foods. In this sense, it is important to focus on the relation between oral health self-perception among the elderly and their

general health condition.<sup>[10]</sup>

The prevalence of oral health problems increases with age, highlighting the importance of oral health-related quality of life (OHRQoL). This is a concept that reflects aspects of human life generally affected by oral health or dental care which affect the daily lives of older adults<sup>[11]</sup>. Perception of oral well-being, or lack thereof, can affect social and physical oral functioning which in turn, can have a substantial influence on individuals' overall QoL and affect their daily activities, including mobility<sup>[12], [13], [14]</sup>.

Oral health is a component of general health that is essential for well-being<sup>[15]</sup> and it is directly related to socioeconomic conditions and access to information and health services. Exclusive use of clinical indicators to assess oral health conditions is a limitation for dental studies. These fail to take into consideration an important instrument for the planning of health services when they do not recognize the need to evaluate the self-perception of oral health and the impact of oral health on quality of life<sup>[16]</sup>.

### **Concept Of Health Related Quality Of Life**

The concept of health has undergone a shift during recent years. The medical model of health, founded at the beginning of 20<sup>th</sup> century has greatly expanded by incorporating aspects of psychological health. The previous understanding of health as a state of absence of organic disease or pathological process is now interpreted as a state of complete physical, mental and social well being and not merely absence of disease or infirmity<sup>[17], [18]</sup>.

It is increasingly recognized that when assessing health status and treatment outcomes, impact of Quality of Life (QoL) of disease, its treatment and its consequences should be taken into account. Only clinical indicators are not sufficient to describe the health condition of an individual and it is not necessary that a person with chronic, disabling disorders or poor health will have a poor Quality of Life as compared to a normal person<sup>[19], [20]</sup>. Personal characteristics and the capacity to adapt, influence the patient's response and perception to a particular disease. This can in turn lead to counterintuitive reports as stated by a

German study where people with less than 9 teeth reported to have more effect on Quality of Life than having cancer, hypertension or allergy. Therefore clinical indicators alone are not sufficient to describe health status<sup>[21]</sup>.

WHO has defined QoL as individual's perception of their position in life in context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a wide concept affected by the person's physical health, level of independence, social relations, psychological state, personal beliefs and their relation to the environment<sup>[22]</sup>. Quality of life is an expression with many meanings and it creates positive associations for most people<sup>[23]</sup>. However, quality of life and the factors most important for each individual vary depending on age, gender, and cultural situation, among other things<sup>[24]</sup>. Quality of life is therefore not a directly measurable variable, but a construction of several independent factors based on the perception of the individual<sup>[25]</sup>.

The quality of life of elderly people has become relevant. It is seen that concepts and concerns related to QoL in older ages are different from general population. When taking all other influences as constant, ageing does not influence QoL in a negative manner, rather a long period of good quality of life is possible. Therefore improving and maintaining QoL should be included among goals of clinical management<sup>[26]</sup>.

In an effort to focus on the assessment of health and quality of life issues, the term "health-related quality of life" is now widely used. Regarding the relationship of health and disease to quality of life, there appears to be a relation between these domains which is not clearly defined. Locker suggested that health problems may affect quality of life but such a consequence is not inevitable<sup>[27]</sup>. The implication of this is that people with chronic disabling disorders often perceive their quality of life as better than healthy individuals, i.e., poor health or presence of disease does not inevitably mean poor quality of life. To further explain this phenomena, Allison et al suggested that quality of life was a "dynamic construct", and thus likely to be subject to change over time<sup>[28]</sup>.

Quality of life (QoL), or individuals' "perceptions of their position in life in the context of culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns", is now recognized as a valid parameter in patient assessment in nearly every area of physical and mental healthcare, including oral health<sup>[22]</sup>. Changes in population structure will have several implications on health, economy, security, family life, well-being and Quality of Life of people. All the aspects of "Health status", "Lifestyle", "Life satisfaction", "MentalHealth" and "Well-being" together reflects the multidimensional nature of Quality of Life in an individual<sup>[29]</sup>.

### **Oral Health Related Quality Of Life**

Oral diseases such as dental caries or periodontal diseases are highly prevalent and their consequences are not only physical but are economic, social and psychological<sup>[30]</sup>. They seriously impair quality of life in a large number of individuals and can affect various aspects of life including oral function, appearance, alimentary function, social development and interpersonal relationships, thus indicating a need for oral rehabilitation in aging society<sup>[26]</sup>.

Measurement of oral health-related quality of life (OHRQoL) is an essential component of oral health surveys and clinical treatment evaluating the outcomes of preventive and therapeutic effect<sup>[31]</sup>. The importance of assessing both patients' perceptions of health and presence or absence of disease lies in the need to have appropriate data to promote health, disease prevention programs, and for allocation of health resources<sup>[32], [33]</sup>. Furthermore, as patients' assessment of their health related quality of life is often markedly different to the opinion of health care professionals, patient assessment of health care interventions is warranted<sup>[34]</sup>. A patient based assessment of health status is, therefore, essential to the measurement of health.

Oral health status contributes significantly to the quality of life of older people and affects them not only physically (as in eating), but also psychologically and socially<sup>[35], [36]</sup>. In a study conducted in 1979 in England, 30% of people 65 yr of age and older reported difficulty chewing, while 41% took a long time to complete their meal, and

13% felt embarrassment during social contacts<sup>[37]</sup>. In a national survey of community-dwelling older people in Great Britain<sup>[38]</sup> 17% of the edentate subjects and 14% of the dentate subjects reported that their mouth affected their pattern of daily living on a regular basis. Those in manual occupations reporting twice as high a prevalence of oral impacts on quality of life than those in non-manual occupations<sup>[38]</sup>. In addition to this, oral impacts were significantly related to different clinical measures of oral health status among both dentate and edentate older British people<sup>[39]</sup>. The association of malnutrition risk in the elderly and its association with OHRQoL has also been documented<sup>[40]</sup>.

Since Cohen and Jago (1976)<sup>[41]</sup> first advocated the development of socio-dental indicators, efforts have been invested in developing instruments to measure OHRQoL<sup>[42],[43],[44]</sup>.

Researchers began to postulate how oral health is related to health-related quality of life (HRQoL) and to understand the inter-relationships between and among typical clinical variables, data from clinical examinations, and person-centered, self-reported health experience<sup>[45]</sup>. The subjective evaluation of OHRQoL "reflects people's comfort when eating, sleeping and engaging in social interaction; their self esteem; and their satisfaction with respect to their oral health"<sup>[46]</sup>. It is the result of an interaction between and among oral health conditions, social and contextual factors, and the rest of the body<sup>[47],[48]</sup>.

In a report of United States Surgeon General on oral health OHRQOL was defined as "a multidimensional construct that reflects (among other things) people's comfort when eating, sleeping, and engaging in social interaction; their self-esteem; and their satisfaction with respect to their oral health"<sup>[46]</sup>.

Even though it has recently emerged over the past few decades, oral health-related quality of life (OHRQoL) has important implications for the clinical practice of dentistry and dental research. OHRQoL is a multidimensional construct that includes a subjective evaluation of the individual's oral health, functional well-being, emotional wellbeing, expectations and satisfaction with care, and sense of

self. It has wide-reaching applications in survey and clinical research<sup>[49]</sup>. In fact, it is recognized by the World Health Organization (WHO) as an important segment of the Global Oral Health Program (2003).

Even though OHRQoL is a construct applicable for the entire age range, differences have been found between children and adults since oral health is also strongly age-dependent<sup>[51]</sup>. And most instruments developed in older adults, may therefore not be generalizable to the entire adult population.

### **Old Age And Oral Conditions**

Aging is a normal, biological and universal phenomenon. United Nations considered 60 years to be dividing line between 'old age' and 'middle and younger age group'<sup>[51]</sup>. In most of the gerontological literature, people above 60 years of age are considered as 'old' and constituting the 'elderly' segment of the population<sup>[2],[52],[53]</sup>. Aging is defined as the process of deterioration in functional capacity of an individual in consequence of structural, physiological changes, and ongoing accumulation of the chronic pathological processes. The overall effect of these alterations is an increase in the probability of dying, which is evident from the rise in the age-specific death rates in the older population. This should be regarded as normal inevitable biological phenomenon<sup>[54]</sup>. Aging is a highly variable process, affected by numerous factors including genetic predisposition, environmental factors and disease. With advancing age, the prevalence of diseases and infections increases at the population level<sup>[55]</sup>, and affects the quality of life and functional ability in older age<sup>[56],[57],[58]</sup>.

Aging population basically means a decline in the proportion of children and young people, and an increase in the proportion of elderly people 60 years and above. It is speculated that, in the next half of a century, there will be a total of about 2 billion elderly people with 80% of them living in the developing countries. This situation has been ascribed to a decrease in fertility rates and increasing longevity despite setbacks in life expectancy in the developing countries<sup>[52]</sup>.

Oral health has been defined as a comfortable and functional dentition

which allows individuals to continue in their desired social role<sup>[59]</sup>. It means being free of chronic oral-facial pain conditions, oral and throat cancers, oral soft tissue lesions, birth defects such as cleft lip and palate, and scores of other diseases and disorders that affect the oral, dental, and craniofacial tissues, collectively known as the craniofacial complex. Apart from oro-pharyngeal cancers and HIV/AIDS related diseases, oral diseases such as dental caries, periodontal disease, tooth loss, oral mucosal lesions and oro-dental trauma, though not life threatening, constitute major public health problems worldwide<sup>[2],[60]</sup>.

Vast improvements in oral conditions of populations has been seen in many countries but despite this, the underprivileged in both developed and underdeveloped areas still show presence of problems<sup>[15]</sup>. General characteristics of the individual and the environment affect the stomatognathic system, which makes an understanding of these interactions extremely important to the diagnosis of the needs and priorities of elderly patients<sup>[61]</sup>.

Oral health and status are affected by similar factors, and they are the accumulation of a person's life experiences with caries, periodontal disease and iatrogenic disease as well as with dental care<sup>[62],[63],[64]</sup>.

Geriatric dentistry includes, but is not limited to, the diagnosis, treatment and prevention of caries and periodontal disease, as well as oral mucosal diseases, head and neck pain, salivary dysfunction and impaired chewing, tasting and swallowing<sup>[64]</sup>. In dentistry, a functional definition of an elderly adult is based on his or her ability to travel to seek services. This definition is more appropriate than a chronological one<sup>[65]</sup>.

The ageing population can be broadly categorized into 3 groups<sup>[65]</sup>:

- Functionally independent older adults
- Frail older adults
- Functionally dependent older adults

Older people are likely to develop several chronic diseases (for example, arthritis, diabetes, cardiovascular disease), which occur at increasing rates with increasing age and can be treated with an ever-expanding variety of medications<sup>[66]</sup>.

These chronic diseases can affect a person's quality of life, especially the ability to eat, speak, taste and swallow; in addition, they can cause significant pain and discomfort. Many systemic drugs prescribed for these chronic diseases can cause adverse effects to the oral mucosa, the most common being hyposalivation. Patients also may experience xerostomia, bleeding disorders of the tissues, lichenoid reactions, tissue overgrowth and/or hypersensitivity reactions, the most common being xerostomia, or dry mouth<sup>[67],[68]</sup>.

In the past elderly people received dental care very infrequently and that to when the problem could no longer be ignored or had turned severe. Dental care was basically seen with provision of dentures for this age group. With time, the rate of edentulism has fallen and care must now include complex restorative procedures as well as esthetic dentistry and implants<sup>[69],[70],[71]</sup>. The percentage of teeth with decayed or filled root surfaces increases with each decade of adulthood, affecting more than one-half of all remaining teeth by age 75 years<sup>[72]</sup>. As people live longer and retain more natural teeth, the complexity of their treatment increases<sup>[73]</sup>.

### Conclusion

In short, applied science is translational and QoL assessments may be at the hub of evidence based clinical care. Assessments of health perceptions from patients and community dwellers can increase our understanding of health care access, expectations and treatment effectiveness

OHRQoL has a number of substantive applications for the field of dentistry, healthcare and dental research. OHRQoL is patient oriented and will enhance our understanding of relationship between general and oral health and demonstrate that improving the level of patient's well being goes beyond simply treating dental related problems in the elderly segment of the population

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## Stem Cell Applications In Dentistry And Medicine

### Abstract

While the regeneration of a lost tissue is known to mankind for several years, it is only in the recent past that research on regenerative medicine/dentistry has gained momentum. Initial existence from pioneering studies has documented the likely breakthrough that stem cells offer for various life threatening diseases that have so far defeated modern medicine care. This review takes you on a sojourn of origin of stem cells, their properties, characteristics, current research and their potential applications.

### Key Words

Stem cells, Multipotent, Embryonic stem cells

### Introduction

Stem cells are unspecialized cells with an extraordinary ability to self-renew, capable of differentiating into one or more specialized cell type playing a crucial role in hemostasis and tissue repair. When called into action following injury.

Stem cells

(Cells division)

Stem cell + progenitor cells (intermediate cell type)

Differentiating cells

### Types Of Stem Cells

1. Embryonic stem cells (ESCs)
  - Derived from embryos that are 2-11 days old called blastocysts.
  - Are totipotent cells
  - Have the highest potential to regenerate and repair<sup>[1]</sup>

ESCs are not so far used therapeutically as owing to the belief that the process of extraction of stem cells from an embryo destroys the embryo itself and some view this as taking life so, raising ethical and moral concerns. It is difficult to control the growth and differentiation of embryonic stem cell posing risk of tumourogenicity and teratoma formation.

### 2. Advent Stem Cells

- Are multipotent

- Are found in most adventitious.

### They are of two types:

- i. Hemopoietic Stem Cells (HSCs) - are obtained either from cord blood or peripheral blood.
- ii. Mesenchymal Stem Cells (MSCs) - are obtained from mesodermal layer of fetus and in adult from bone marrow, dermal stem cells, etc.

### Characteristics of Stem Cells

1. Totipotency: generate all types of cells including germ cells (ESCs)
2. Pluripotency: generate all types of cells except cells of the embryonic membrane.
3. Multipotency: differentiate into more than one mature cell (MSC)
4. Self-renewal: divide without differentiation and create everlasting supply.
5. Plasticity: MSCs have plasticity and can undergo differentiation. The trigger for plasticity is stressing of tissue injury which upregulates the stem cells and releases chemoattractants and growth factors.

### Source Of Stem Cells

1. Bone Marrow Stem Cells- The most commonly known procedure involving stem cells is the bone marrow transplant. Bone marrow transplants are used for the treatment of diabetes, crohn's disease, bone defects or cartilage injury.<sup>[2]</sup>
2. Cord Blood Stem Cells- Obtained

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### Quick Response Code



from umbilical cord blood. Used to treat blood relates diseases. In treatment of leukemia, myocardial infarction, diabetes mellitus and neurological disorders.<sup>[3]</sup>

3. Adipose Tissue Stem Cells- MSCs can be isolated from adipose tissue obtained from liposuction aspirates or abdominoplasty procedures and are being studied for repairing tissue defects resulting from traumatic injury, tumor resection and congenital defects, calvarial defects following severe head injury and in dentistry for repair of jaw bone.<sup>[4],[5]</sup>
4. Embryonic Stem Cells- In 1998 scientists derived cells from frozen human embryos to generate human embryonic stem cells for the first time.<sup>[6]</sup>
5. Dental Stem Cells- A new source of readily available MSCs-teeth-was discovered in 2000 by scientists at the NIH stem cells can be collected from
  - Deciduous teeth when they naturally exfoliate between 6-11 years.
  - From teeth that are surgically

- removed such as premolars for orthodontic.
- Extraction of 3<sup>rd</sup> molars.

### Niches Of Dental Stem Cells

Dental stem cells reside in multiple niches of deciduous and permanent teeth.

- From dental follicle of unerupted 3<sup>rd</sup> molar (DFCs).
- Stem cells from human exfoliated deciduous teeth (SHED).
- Periodontal ligament stem cells (PDSC)
- Stem cells from apical papilla (SCAP)

### Clinical Applications For Dental Stem Cells

Alveolar bone regeneration: Defects of at least 1.5 cm in the alveolar ridge of 17 humans were filled with a construct of stem cells collected from third molars and seeded onto a collagen matrix. One year later in many cases, the gap was filled with bone<sup>[7]</sup>.

Periodontal ligament: Due to the complex structure of the periodontium. Its complete regeneration has always remained a challenge. All the current regenerative techniques such as autologous bone grafts, allografts or alloplastic materials have limitations and cannot be used in all clinical situations. Therefore, a cell mediated bone regeneration technique will be a viable therapeutic alternative. Periodontal ligament cells cultured in vitro were successfully reimplanted into periodontal defects in order to promote periodontal regeneration by Hasegaura et al<sup>[8]</sup>.

Regeneration of damaged coronal dentin and pulp- To this date, no restorative material has been able to mimic all physical and mechanical properties of tooth tissue. Furthermore, we have not been successful in providing an ideal solution to certain situations such as an immature tooth with extensive coronal destruction and reversible pulpitis. If the regeneration of tooth tissue is possible in these situations, it facilitates physiological dentin deposition that forms an integral part of the tooth thereby restoring structural integrity, minimizing interfacial failure, microleakage, and other consequent complications. Similarly, young permanent teeth that require apexogenesis or apexification are prefect candidates for regeneration of

pulp as they allow completion of both vertical and lateral root development, improving the long term prognosis. However, pulp regeneration in fully formed teeth may not be of great benefit, although there is sufficient evidence to say that a restored vital tooth serves longer than a root canal treated one.

Pulp tissue regeneration involves either delivery of autologous/allogenic stem cells into the root canals or implantation of pulp that is grown in the lab, using stem cells. Both these techniques will have certain advantage and limitations that need further research<sup>[9],[10],[11]</sup>.

### Third Dentition (Bioengineered Teeth)

A method has been developed to regenerate tooth buds in a single procedure by combining dental pulp and bone marrow on a scaffold and implanting this into surgically created defects. After a number of months, the construct led to organized dentin, enamel, pulp, cementum and periodontal ligament surrounded by regenerated alveolar bone, suggesting a method that could translate directly to humans<sup>[12]</sup>.

### Application In Medicine:

- CORNEA-** Based upon similarities of human dental stem cells with limbal cells in the eye, human dental stem cells were used to successfully treat an animal model for cornea damage by chemical burn<sup>[13]</sup>.
- LIVER DISEASE-** Stem cells from third molars were differentiated into hepatocytes in cell culture and in an animal. Model of liver disease, they prevented liver fibrosis and increased levels of albumin and bilirubin<sup>[14]</sup>.
- MYOCARDIAL INFARCTION (HEART ATTACK) -** Human dental stem cells injected intramyocardially into a rat model of acute myocardial infarction showed an increase in angiogenesis, improvement in cardiac function, and a reduction in infarct size<sup>[15]</sup>.
- MUSCULAR DYSTROPHY -** Animal studies have been done on the golden retriever for treating muscular dystrophy.
- DIABETES -** Dental stem cells have been shown to produce insulin<sup>[16]</sup> and to modulate the immune system by suppressing T-cells response in laboratory and animal testing<sup>[17],[18]</sup>.
- STROKE -** Neuronal stem cells from human third molars were used to treat a rat model of middle cerebral artery exclusion<sup>[19]</sup>.

- SPINAL CORD INJURY AND OTHER NEUROLOGICAL DISEASES/DISORDERS -** Neurons have been generated from dental stem cells<sup>[20]</sup>, including from PDSC<sup>[21]</sup>, DPSC<sup>[22]</sup>, DFSC<sup>[23]</sup>, and SHED<sup>[24]</sup>.

### Summary:

Research has shown that teeth are a source of high quality stem cells that may be used for the treatment of medical and dental diseases. The discovery that odontogenic tissues are a source of adult stem cells has opened up a new role for dentist in the field of medicine. Dentists are positioned to become one of the key providers of stem cells, and as a result, their linkage with the medical field will become very intimate.

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## Endodontic Perforations : A Review

### Abstract

**Context (Background)** : Artificial communication between the root canal system and supporting tissues of the tooth or oral cavity lowers the prognosis of endodontic treatment, and often leads to extraction of the tooth. It has been found that the second most common reason for failure associated with endodontic treatment is perforation.

**Aims** : This review aims the accurate causes diagnosis, management, prevention and prognosis of different types of perforations and elaboration of different perforation repair materials used with nonsurgical and surgical techniques.

**Methods** : A review of the literature was performed by using electronic and hand-searching methods for the diagnosis, management, prevention and prognosis of different types of perforations and elaboration of different perforation repair materials used with nonsurgical and surgical techniques from 1972 to 2009.

**Conclusions** : Perforation defects may be repaired by nonsurgical or surgical techniques, diagnosis, prognosis, and management of perforations provides information for avoiding, detecting, and treating of such defects.

### Key Words

MTA, Root Perforation, Barrier Material

### Introduction

An endodontic perforation may be defined as an artificial opening in a tooth or its root, created by boring, piercing, cutting or pathologic resorption, which results in a communication between the pulp space and the periodontal tissues.<sup>[1]</sup> Iatrogenic root occur in approximately 2 to 12 % of endodontically treated teeth.<sup>[2]</sup> Consequences such as gingival down growth of epithelium into the perforation area inflammation, bone resorption and/or necrosis can result because of perforation. Repair of a perforation without periradicular inflammation may take place provided infection is avoided and asepsis maintained during treatment. Except for resorption and caries, root perforations are iatrogenic and are the main cause for endodontic failures.

### Materials used to repair perforations:

**Hemostatics** : Various materials have been used to control the bleeding at perforation side.

**Calcium hydroxide** : Calcium hydroxide is passively syringed into the canal, hydraulically moved to place and allowed to remain in the canal and defect or 4 to 5 minutes or longer. The calcium hydroxide is then flushed from the field using sodium hypochlorite. 2 or 3 applications of placing and then

removing calcium hydroxide usually begins to control the bleeding. When hemostasis is obtained calcium hydroxide can be left in canal until a future appointment.<sup>[3]</sup>

Other materials like amalgam, cavit, glass ionomer calcium hydroxide calcium sulphate, freeze-dried bone, collagen and MTA are also used to achieve hemostasis.<sup>[4],[5],[6]</sup>

**Barrier Materials**: Barrier materials produce a dry field and also provide an internal matrix or back stop to condense restorative material against. The restorative materials used dictates the selection of barrier materials. There are divided into  
a) Resorbable  
b) Non-resorbable

**Resorbable Barriers** : Resorbable material should be placed in the bone not left within tooth structure. The barrier should conform to the anatomy of the furcation or root surface involved. Collagen and calcium sulfate materials are best used because of ease of handling, research and observed clinical results.

**Collagen Materials** : Collacote exhibit excellent working properties that provide complete hemostasis.<sup>[7]</sup> Collacote is

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biocompatible, supportive of new tissue growth, resorbable in 10 to 14 days left in situ. Hemostasis is typically achieved in 2 to 5 minutes. Collagen barriers have been widely used in conjunction with amalgam, super EBA and other non-bonded restoratives.<sup>[8]</sup> Collacote is contraindicated as a barrier if adhesive dentistry is contemplated because it absorbs moisture and will contaminate the restorative.

**Calcium Sulfate** : Capset can be used as both a barrier and hemostatic material in perforation management.<sup>[9]</sup> Calcium sulphate creates a tamponade effect, mechanically plugging the vascular channels once it sets. Capset is remarkably biocompatible, does not promote inflammation and is bioresorbable in 2 to 4 weeks.

This material is syringed through the tooth and into the osseous defect using a microtube delivery system. UFI are coated for sanding, scaled to work deep within the root canal space and their port

technologies dispense irrigant precisely into the field of action.<sup>[10]</sup>

#### Non-resorbable Materials (barriers):

MTA: MTA is an excellent biocompatible material that can be used both as a non-resorbable barrier and restorative material.<sup>[11]</sup> It has many clinical. The setting time for the cement is 48 hrs. The compressive strength of MTA at 21 days is 70 MPa, which is comparable with that of IRM and super-EBA, but significantly less than amalgam (311 MPa).<sup>[12]</sup>

In vitro and in vivo experiments have compared the sealing ability and biocompatibility of MTA with those of amalgam, Super EBA and IRM. The sealing ability of MTA has been shown in dye and bacterial leakage studies to be superior to that of Amalgam and to be equal or better than super EBA. In animal study where MTA was implanted to bone it was found that the specimen were free of inflammation and direct bone opposition was found. MTA has an inductive effect on cementoblasts in dogs and monkey.<sup>[13]</sup>

MTA has been used as a capping material in mechanically exposed pulps, for root end induction, repair of root perforation and as a barrier during internal bleaching of endodontically treated teeth.<sup>[14]</sup>

#### Access Cavity Perforations<sup>[15]</sup>

Accidents such as excess removal of tooth structure or perforation may occur during attempts to locate canals. Perforation of crown can occur peripherally through sides either of the crown or through the floor of the chamber into the furcation.

Furcation perforations are 2 types:

- 1) Direct
- 2) Stripping

Each type is created and managed differentially and prognosis varies.

- 1) Direct perforation occurs during search of canal orifice. It is more of a punched out defect into the furcation with a bur therefore, it is accessible and may be small and have walls.
- 2) Stripping perforation involving the furcation side of the coronal root surface results from excessive flaring with files or drills. The sequela is inflammation followed by development of pockets.

#### Causes:

- 1) Lack of attention to the degree of axial inclination of a tooth in relation

to adjacent teeth or to alveolar bone may result in either gouging or perforation of the crown or the root at various levels.

- 2) Failure to direct the bur parallel to the long axis of a tooth will cause gouging or perforation.
- 3) Failure to check the orientation of the access opening during preparation may also result in perforation.
- 4) Searching for pulp chamber or orifices of canal through unprepared access cavity.
- 5) Failure to recognize when the bur passes through a small or flattened pulp chamber in a multirooted tooth result in gouging or perforation of the furcation.
- 6) Directing the bur along the misaligned casting may result in coronal or radicular perforation.

#### Recognition:

Signs of Perforations:

- 1) Sudden pain during the working length determination when local anesthesia was adequate during access preparation.
- 2) Sudden appearance of hemorrhage when crown is perforated into the periodontal ligament.
- 3) Burning pain or a bad taste during irrigation with sodium hypochlorite when access cavity perforation is above the periodontal attachment.
- 4) Radiographically malpositioned file.
- 5) Apex locator that is far short of the working length on an initial file entry.<sup>[16]</sup>
- 6) Unusually severe postoperative pain may result from cleaning and shaping procedure performed through an undetected perforation. At a subsequent appointment, the perforation site will be hemorrhagic due to inflammation of the surrounding tissue.

#### Correction or Treatment:

- 1) Perforations above the alveolar crest: This is repaired intracoronal without need for surgical intervention. Cavit can be used to seal the perforations during endodontic treatment.
- 2) Perforations into PL laterally or furcation should be done as soon as possible to minimize the injury to the supporting tissue of tooth.

The 2 types of furcation perforation are treated differently and the prognosis

vary:

- a) Punched out defect should be repaired immediately with MTA or if proper conditions exist (dryness), GIC or composite can be used.
- b) Stripping perforation are inaccessible and require more elaborate approach. It is treated either surgically or non-surgically.

#### i. Non-surgical treatment

If feasible non-surgical treatment is preferred to surgical treatment. Traditionally various materials such as amalgam, gutta-percha, zinc oxide eugenol, cavit calcium hydroxide, freeze dried bone, indium foil has been used clinically and experimentally to seal these defects. The repair should be sealed immediately but the patency of the canal must be protected. Repair is difficult because of potential problems visibility hemorrhage control and management and sealing ability of the repair material. Immediate repair of perforation with MTA offers the best results.

The introduction of the optical microscopes into practice has provided dentists with the ability to explore the root canal anatomy in greater details. Hatems A Alhadainy et al. have done in vitro study to repair furcal perforation using artificial floor technique in which calcium sulfate and hydroxyapatite were used as artificial floor and found less die penetration in their group compared to control group.

#### GTR (guided tissue regeneration)

Formally introduced by Nyman et al. offers a treatment for regenerating the attachment apparatus and membrane barrier to support the gingival tissues and the apical migration of sulcular epithelium into the perforation site. The membrane isolates and protects the blood clot, so that it can organize. Healing occurs primarily from formative cells of the PL that deposits new cementum and produce ligamental fibers.

#### ii. Surgical Treatment

Surgery requires more complex restorative procedures and more demanding oral hygiene from the patient. Surgical alternatives are hemisection, bicuspidization, root amputation and intentional replantation.

#### Root Perforations:

Roots may be perforated at different levels during cleaning and shaping. To

radicular perforations can be identified as cervical, middle and apical perforations. Perforations in all locations are caused by 2 main errors:-

- 1) Creating a ledge in the canal wall during initial instrumentation and perforating through the side of the root at the point of canal obstruction or root curvature.
- 2) Using too large or too long an instrument and either perforating directly through the apical foramen or wearing a hole in the lateral surface of the root by overinstrumentation (canal stripping).

#### **Repair of root perforations:**

Root perforations can occur during root canal therapy or post space preparation. In an in vitro study, Lee and associates compared the sealing ability of MTA with that of amalgam or IRM for repair of experimentally induced root perforations in extracted teeth. The result showed that MTA had significantly less leakage than IRM or amalgam and it showed the least overfilling tendency whereas IRM had the least underfilling tendency.<sup>[17]</sup> In a recent study Nakata and associates compared the effectiveness of MTA and amalgam in repairing furcal perforations using a dual-chambered, anaerobic bacterial leakage model and reported that MTA was superior to amalgam in preventing leakage of fusobacterium nucleatum past furcal perforation repairs.<sup>[18]</sup>

Ford and co-workers examined the histological response of intentional perforations in the furcation of mandibular premolars of dogs repaired with MTA or amalgam. An delayed group, all the amalgam samples were associated with inflammation, in contrast only 4 of 7 filled with MTA were inflamed. Based on the results of these studies, it seems MTA is a suitable material for perforation repair.<sup>[19]</sup>

#### **Considerations influencing perforation repair<sup>[20]</sup>:**

- 1) The four dimensions of a perforation:
  - a) Level: - Perforations occur in the coronal, middle and apical one thirds of roots. Coronal/ furcation perforations threaten the sulcular attachment and pose different treatment challenges than more apically occurring perforations.
  - b) Locations: - Perforations occur circumferentially on the buccal, lingual, mesial and distal aspects of

roots. The location of the perforation is not so important when non-surgical treatment is selected. Its position is critical and may preclude surgical access if this approach is considered.

- c) Size: - Perforation size greatly affects the clinician's ability to establish a hermetic seal. The area of a circular shaped perforation can be mathematically described as  $r^2$ . Therefore doubling the perforation size with any bur or instrument increases the surface area to seal four-fold.

- d) Time: - Regardless of the cause, a perforation should be repaired as soon as possible to discourage further loss of attachment and prevent sulcular breakdown. Chronic perforations exhibiting a loss of sulcular attachment pose treatment challenges that potentially escalate to surgical correction and effort directed toward guided tissue regeneration procedures.<sup>[21]</sup>

Microscopes, paper points, electronic apex locators such as Root ZX and diagnostic radiopaque contrast solution such as the middle solution are used in determining the level, location and extent of a perforation and the potential for successful management.

- 2) **Periodontal Conditions :** Periodontal involvement is another cause of failure of endodontic treatment. Example the granulomatous tissue formed in the furcation regions of posterior teeth may eventually involve the periapical tissue.

Teeth that have been perforated must be thoroughly examined periodontally with a probe.<sup>[22]-[23]</sup>

- 3) **Esthetics :** Patients that exhibit a high lip line can be esthetically compromised by soft tissue defects such as cleft, reossious or discrepancies in the incisogingival dimensions of a crown when compared with the adjacent teeth.

- 4) **Vision :** Magnification glasses, headlamp and trans-illuminating devices facilitate vision and are important adjuncts in addressing perforation.

- 6) **Restoratives:** Restoratives should be,
  - Nonresorbable
  - Biocompatible

- Esthetically pleasing
- Provide complete seal

The choice of the restorative repair material is based on the technical access to the defect, the ability to control moisture of the esthetic consideration. Various materials are used like amalgam, super EBA resin cement, composite bonded restoratives, calcium phosphate cement and MTA.<sup>[17]</sup>

#### **Prognosis:**

The prognosis of perforation depends on,

- 1) Perforation size
- 2) Location of the perforation
- 3) Length of time the perforation is open to contamination
- 4) Ability to seal the perforation
- 5) Accessibility to the main canal
- 6) Existing periodontal condition

#### **Prevention:**

- 1) Thorough examination of diagnostic pre-operative radiographs is the paramount step to avoid this mishap.
- 2) Checking the long axis of the tooth and aligning the long axis of the access bur with the long axis of the tooth can prevent unfortunate perforations of a tipped tooth.
- 3) The presence, location and degree of calcification of the pulp chamber noted on the preoperative radiograph are also important information to use in planning the access preparation.
- 4) Perforations can be avoided by preparing adequate access.
- 5) Perforations can be prevented by close attention to the principles of access cavity preparation, adequate size and location, both permitting direct access to the root canals.
- 6) A thorough knowledge of tooth anatomy, specifically pulp anatomy is essential for prevention of perforation.

#### **Cervical Canal Perforations:**

The cervical portion of the canal is most often perforated during the process of locating and widening the canal orifice or inappropriate use of Gates-Glidden burs.

#### **Recognition**

- a) Recognized by the sudden appearance of blood,
- b) Magnification with either loupes, endoscope or a microscope.
- c) If the perforation is not visible directly a small file can be kept in the area that has been exposed and radiograph taken.

- d) The electronic apex locators can also be used to locate the perforations.<sup>[16]</sup>

### Correction

Perforation on lateral aspects of root are ovoid by nature of occurrence. If the perforation is mechanical and has just occurred. It is probably clean. In this situation and if hemostasis is present the defect can be immediately repaired. If the perforation is chronic and exhibits microleakage it needs to be clean and prepared before receiving the restoration material. Ultrasonic finishing instruments are ideal for preparing perforation site because of their geometries coating and post technologies.

Perforation repair may include both internal and external repair. A small area of perforation may be sealed from inside the tooth. If the perforations is large it may be necessary to seal first from the inside and then surgically repose the internal aspect of the tooth and repair the damaged tooth structure.

Once the defect has been properly prepared, an appropriate barrier material and restorative are then selected based on the following esthetic considerations.

- In a coronal one third perforation where esthetics is a concern, a calcium sulfate barrier in conjunction with adhesion dentistry is generally used.
- Historically amalgam and more recently, super EBA have been used to repair coronal one-third perforation when esthetics was not an issue. Presently MTA is rapidly become the barrier and restorative of choice for repairing non-esthetic coronal one-third defects because of its many desirable attributes.

After perforation repair, the care can be 3-D cleaned, shaped and packed if this has not already been accomplished.

**Prognosis :** Prognosis is considered to be reduced in this type of perforations and surgical correction is necessary if a lesion or symptoms develop.

**Prevention :** Reviewing each tooth's morphology prior to entering its pulp space. Additionally, radiographically verifying one's position in the tooth can turn one back on tract before it is too late.

**Mid Root Perforations :** Lateral perforations at mid root level tend to occur mostly in curved canal either as a

result of perforating when a ledge has formed during initial instrumentation or stripping which is most common

### Recognition

- 1) Sudden appearance of hemorrhage in a previously dry canal.
- 2) Sudden complaint by the patient.
- 3) Paper points placed in canal can confirm presence of location of perforation.
- 4) Apex locators.
- 5) Optical microscopes can be used for visualization.

### Correction

When managing deeper defects that are positioned on lateral walls of canals, vision is enhanced when direct access exists or can be safely created. Generally perforations that occur secondary to overzealous canal instrumentation are sterile and do not require modification using microinstrumentation procedure.

In middle one-third perforations with a small defect, if the bleeding can be arrested and the canal dried, the perforation can then be sealed and repaired during 3-D obturation. However if the defect is large and there is nuisance moisture or if the canal cannot be definitely dried, the perforations must first be repaired before 3-D obturation. Repair of strip perforation has been attempted both surgically and non-surgically. Access to mid-root perforation is most often difficult and repair is not predictable. Various materials has been used. Calcium hydroxide has been used to stimulate a biologic barrier against which to pack filling material, but usually filling material ends up into the perforation area. A majority of techniques propose a two-step method wherein the root canal are first obturated and then the defect is repaired surgically. Removal of the excess GP using a hot spatula and cold burnishing the perforation site was reported by Allam.<sup>[24]</sup> Use of amalgam, GP and calcium hydroxide was reported by Biggs et al.<sup>[50]</sup>, and the GIC were reported by Lundergan.<sup>[25]</sup> All have reported limited success.

MTA is the material of choice in cases where moisture control is difficult. MTA is mixed and carried into the field and managed in accordance with the technique as discussed earlier. Upon reappointment, MTA will invariably be hard and the clinician can proceed with the required treatment.<sup>[13],[18],[25]</sup>

### Prognosis:

Stripping and direct lateral perforation of root has reduced prognosis. Loss of tooth structure and integrity of the root wall can lead to subsequent fractures or microleakage owing to inability to properly seal the perforation.

### Prevention:

To overcome the problem of stripping caused by students, university of South California developed a technique termed as anticurvature filing,<sup>[26]</sup> stressing the importance of maintaining mesial pressure on the enlarging instruments to avoid the delicate danger zone of the distal wall. A similar technique was advocated at Ohio State University.

### Apical Perforations:

Perforation in the apical segment may be the result of file not negotiating a curved canal or not establishing accurate working length and instrumenting beyond the apical confines. Perforation of a curved root is the result of "ledging" "apical transportation" or apical zipping.

### Recognition:

- 1) Sudden complain of pain during treatment
- 2) Canal becomes flooded with hemorrhage'
- 3) Lose of tactile resistance of the confines of the canal space
- 4) Apex locators can be used.
- 5) A paper point inserted to the apex will confirm a suspected perforation.
- 6) Extension of the largest file beyond the radiographic apex is also a sign.

### Corrections:

Various treatment options are considered based on the location and width of the perforation.

- 1) Lateral opening is considered like a new foramen, one is now dealing with 2 foramina, one natural and other iatral. Obturation of both of these foramina and of the main body of the canal requires the vertical compacting techniques with heat-softened GP. Often surgery is necessary if a lesion is present apically.
- 2) The canal is negotiated for the physiologic terminus. The file is gently worked to negotiate the physiologic pathway, establish patency and pave the way for the successively large instrument. The next sequentially large, precurved file

- is then inserted and carried apical to the perforation but not necessarily to length. This holding file "maintains the pathway of the true canal and prevent it from being blocked during subsequent repair. Proroot (MTA) is material of choice for repairing deep perforation, especially when a dry environment and technical access are not possible.
- 3) In a perfectly straight canal if instrument used exceeds the correct working length. This destroys the resistance form of the root canal preparation at the CDJ making it difficult to control the apical extensions of the root canal filling.
  - a. The treatment includes re-establishing tooth length short of the original length and then enlarging the canal with larger instruments, to that length.
  - b. Careful adaptation of the primary filling point, often blunted is imperative.
- 4) Creating an apical barrier is another technique that can be used to prevent overextension during root canal filling. Materials used for developing such barriers include dentin chips, calcium hydroxide powder, proplast, hydroxyapatite and MTA.

#### **Prevention:**

Weine et al have recommended the use of a flared preparation to reduce the incidence of elbow formation in the apical portion of the canal. Apical transportation has been shown to be a common undesirable result from the instrumentation of curved canals. Cimis et al reported that 46% of curved canal exhibited various degree of apical transportation after instrumentation. Briseuo and Sounabend evaluated the ability of endodontic instruments to remain in the central axis of the canal.

#### **Conclusions:**

Perforation defects may be repaired by nonsurgical or surgical techniques. Diagnosis, prognosis, and management of perforations provides information for avoiding, detecting, and treating such defects.

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## Elusive Canals - "An Endodontic Enigma"

### Abstract

The anatomy of the root canal system is so uncertain that none can successfully predict the number of root and root canals in tooth. Variation in morphology is very common. A successful endodontic therapy is the one where such variations can be detected, cleaned, shaped and obturated. This article discusses various methods for detection of extra canals.

### Key Words

Root Canals, SLOB, Shamrock, Magnification, Dyes, CBCT, Loupes, DOM

### Introduction

Endodontics has been practiced as early as second or third century BC. The history of endodontics begins in 17<sup>th</sup> century and since then many advances, developments and research work has been conducted continuously. The technological advances made routinely since the early part of this decade have far exceeded the progress made since the discipline was first recognized as a specialty. The advent of nickel titanium files, rotary instrumentation, "endosonics," radiovisiography, endoscope, and the clinical microscope are but a few innovations that have changed the way in which endodontics is practiced. This progress has increased both productivity and quality of care. The public's awareness and interest in preserving their teeth are increasing, and cases that heretofore were not attempted are now being successfully managed. On the other hand, the complexity of the cases being treated by both general dentists and endodontists is increasing, with the result that new problems need to be addressed

One of the most common problem that compromise the success of endodontic therapy is Missed canals. These Elusive canals are those that are missed by dentist during endodontic procedure.

A missed canal decreases the prognosis and will most likely result in treatment failure. Locating all of the canals in a multicanal tooth is the best prevention of treatment failure. There are many methods that can be employed to prevent

this unfortunate event. This article discusses various methods for detection of these elusive missed canals.

### Role Of Radiographs: Buccal-object Rule (Cone Shift)

Radiographic examination is an essential component in all aspects of endodontic treatment, from diagnosis and treatment planning to assessing outcome. Radiographs have been conventionally used by dentists for ascertaining the number of canals and for detection of extra canals. Information gained from conventional films and digital periapical radiographs is somewhat limited. In endodontic therapy, it is imperative that the clinician should know the spatial or buccal-lingual relation of an object within the tooth or alveolus. The technique used to identify the spatial relation of an object is called the cone or tube shift technique. Other names for this procedure are the buccal object rule, Clark's rule, and the SLOB (same lingual, opposite buccal) rule.<sup>[1]</sup> (Fig 1) Proper application of the technique allows the dentist to locate additional canals or roots, to distinguish between objects that have been superimposed and between various types of resorption, to determine

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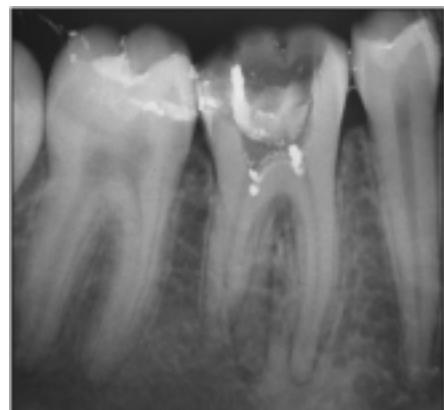


FIG 2: RADIOPHGRAPH TAKEN AT A DIFFERENT SHIFT HELPS IN DETECTION OF AN ADDITIONAL ROOT.

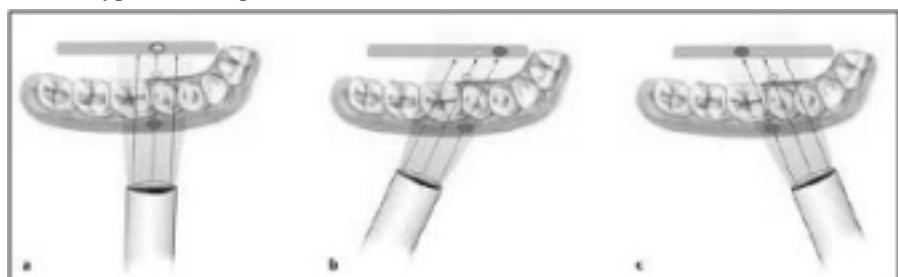


Fig. 1. Pre-operative photograph showing generalised discolouration of teeth

the buccal-lingual position of fractures and perforative defects, to locate foreign bodies, and to locate anatomic landmarks in relation to the root apex, such as the mandibular canal.<sup>[2]</sup>, (Fig 2)

### Dental Operating Microscope

The introduction of the dental operating microscope has changed both non-surgical and surgical endodontics. An important aid for location of root canal orifices is the Dental Operating Microscope (DOM). The increased magnification and coaxial illumination decreases the chances of missed canals. In non-surgical endodontics, every challenge existing in the straight portion of the root canal system, even if located in the most apical part, can be easily seen and managed competently under the microscope.<sup>[3]</sup> (Fig 3,4,5) The DOM enhances clinicians ability to remove dentin with greater precision. Many studies eliciting utility of DOMs for location and negotiation of such elusive missed canals have been conducted.

### Ultrasonics

Ultrasonics (US) in endodontics has enhanced the quality of treatment and represents an important adjunct in the treatment of difficult cases. Since its introduction, US has become increasingly more useful in applications such as gaining access to canal openings, cleaning and shaping, obturation of root canals, removal of intracanal materials and obstructions, and endodontic surgery.

One of the challenges in endodontics is to locate canals in cases in which the orifice has become occluded by secondary dentin or calcified dentin secondary to the placement of restorative materials or pulpotoxies. With every access preparation in a calcified tooth, there is the risk of perforating the root or, when incorrectly performed, of complicating each subsequent procedure. Microscopic visualization and ultrasonic instruments are a safe and effective combination to achieve optimal results<sup>[6],[7],[8]</sup>. In difficult-to-treat teeth such as molars, US has proven to be useful for access preparation, not only for finding canals, but also for reducing the time and the predictability of the treatment<sup>[4],[5]</sup>. In conventional access procedures, ultrasonic tips are useful for access refinement, location of MB2 canals in upper molars and accessory canals in

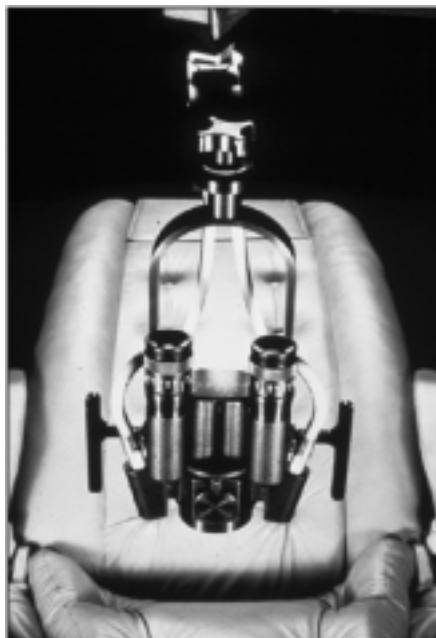


FIG 3: THE ORIGINAL DENTISCOPE

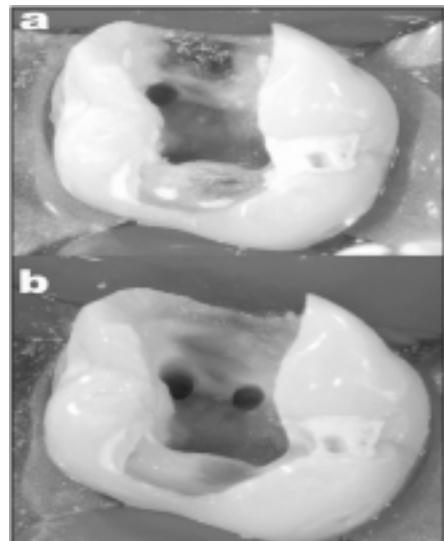


FIG 6.The orifice of the second mesiobuccal canal (MB2) in an upper firstmolar was located (a) and enlarged (b). Dentine spur at the orifice was effectively eliminated with the use of a diamond-coated ultrasonic tip, thus permitting easy location of the orifice of the canal.



FIG 4: NEWER DOM



FIG 5: MAGNIFICATION LOUPES

other teeth, location of calcified canals in any tooth, and removal of attached pulp stones<sup>[6],[7],[8]</sup>. When locating the MB2 canals in upper molars, US is an excellent means for the removal of secondary dentin on the mesial wall (Fig 6). When searching for hidden canals, one should remember that secondary dentin is

generally whitish or opaque, whereas the floor of the pulp chamber is darker and gray in appearance. US works well when breaking through the calcification that covers the canal orifice. A troughing tip is a good choice for this task (Fig 7)

### Geometric Techniques

Traditionally, access cavities have been prepared in relation to the occlusal anatomy. However, complete reliance on the occlusal anatomy is dangerous because this morphology can change as the crown can be destroyed by caries and reconstructed by various restorative materials. Complete dependence on the occlusal anatomy may explain the occurrence of procedural errors like missed canals, perforation etc. Krasner and Rankow utilized geometric techniques to formulate a set of laws to set guidelines for easier location of canal orifices.

### Krasner And Rankow Laws<sup>[9]</sup> (Fig 8)

- **Law of centrality:** The floor of the pulp chamber is always located in the center of the tooth at the level of the CEJ.
- **Law of concentricity:** The walls of the pulp chamber are always concentric to the external surface of the tooth at the level of the CEJ.
- **Law of the CEJ:** The CEJ is the most consistent, repeatable landmark for locating the position of the pulp chamber.
- **Law of Color Change:** The color of

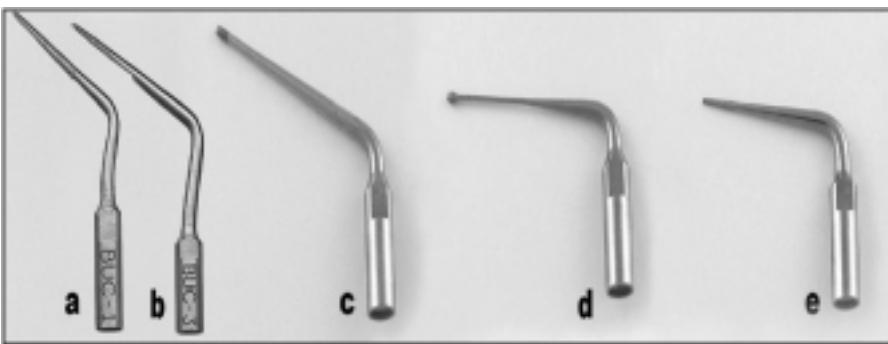


FIG 7. (a) The BUC-1 is an example of diamond-coated spreader tip of medium length that can be used for gross dentin removal, moving access line angles, cutting a groove in the mesial access wall to drop into MB2 canals, and quickly and carefully unroofing pulp chambers. (b) The BUC-3 is similar to the BUC-1 with a sharper tip and a water port for increased washing and cooling of the operative site. It is used for chasing canals or for digging around a post or carrier-based obturator with the objective to remove it. (c) This diamond-coated pear tip is used to find canals, remove coronal obstructions or restorative materials, or remove calcifications, temporary and permanent cements, and posts. It creates a smooth, clean flat troughing groove that facilitates canal location. (d) This diamond-coated ball tip provides fine cutting control when preparing a troughing groove and is less aggressive than the pear tip shown in c, yet it has the same clinical indications. (e) A classic spreader tip with a diamond coating, which offers a side- as well as an end-cutting action. This is needed to flare the walls of a troughing groove in an axial direction.

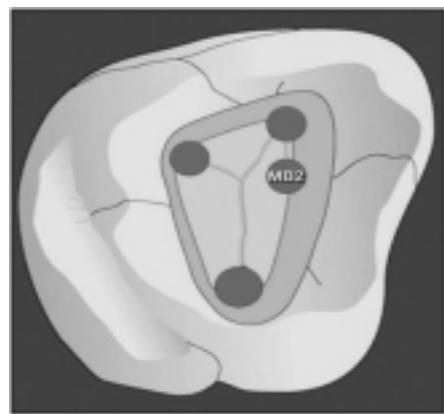


FIG 9: BEER AND BAUMAN TECHNIQUE

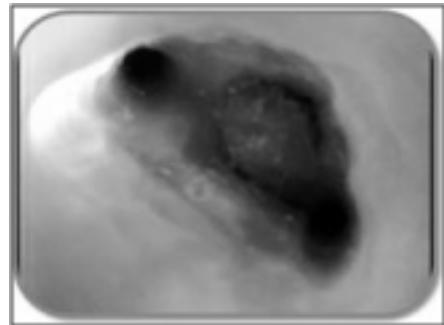


FIG 11(a): Transillumination of pulp floor

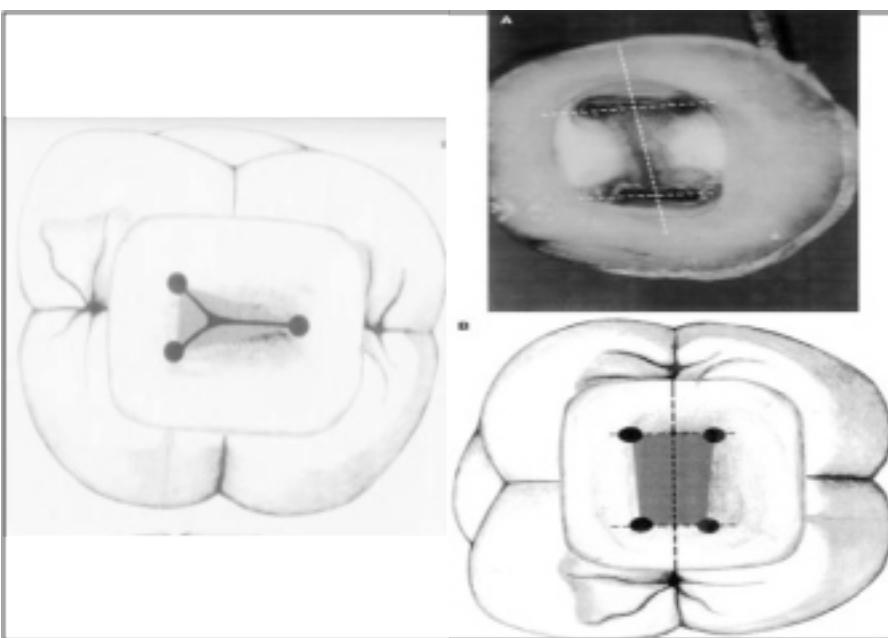


FIG 8 Law of centrality and Law of concentricity (A) Cut specimen showing the laws of symmetry 1 and 2 and orifice locations 1, 2, and 3. (B) Laws of symmetry 1 and 2 and orifice locations 1, 2, and 3.

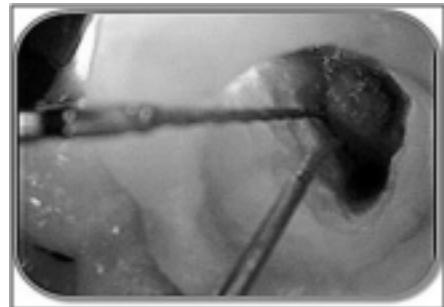


FIG 11(b): Transillumination of MB2 & MB3

the pulp-chamber floor is always darker than the walls.

- **Law of symmetry 1:** Except for maxillary molars, the orifices of the canals are equidistant from a line drawn in a mesial distal direction through the pulp-chamber floor.
- **Law of symmetry 2:** Except for the maxillary molars, the orifices of the canals lie on a line perpendicular to a line drawn in a mesial-distal direction across the center of the floor of the pulp chamber.
- **Law of orifice location 1:** The orifices of the root canals are always located at the junction of the walls and the floor.
- **Law of orifice location 2:** The orifices of the root canals are located at the angles in the floor-wall junction.
- **Law of orifice location 3:** The



FIG 10: FIBRE OPTIC LIGHT FOR TRANSILLUMINATION



FIG 12: Transillumination reveals dystrophic calcifications in the pulp chamber.

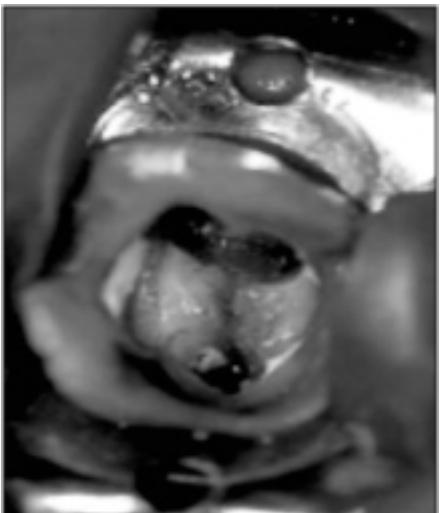


FIG 13 a: Use of dye Before Staining

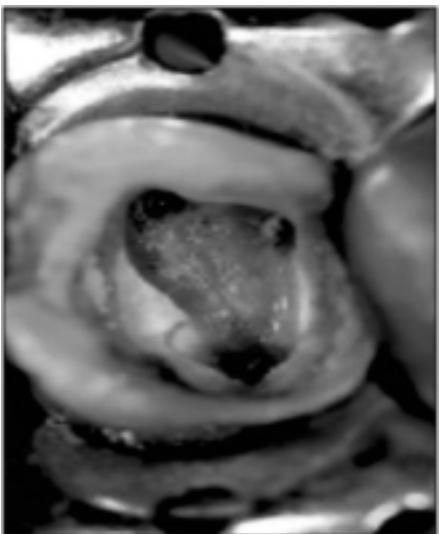


FIG 13 b: After Staining

orifices of the root canals are located at the terminus of the root developmental fusion lines.

#### Beer And Bauman Technique (Fig 9)

LINE 1: connects MB canal to Palatal canal

LINE 2: Perpendicular to Line 1, at a point one third from intercanal distance of palatal canal, such that the line passes

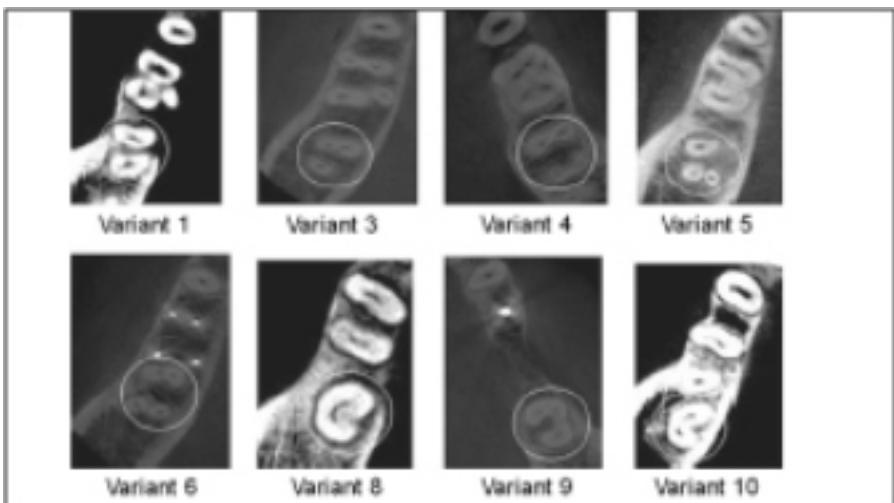


FIG 14 Cone-beam computed tomography images showing the categorisation of the eight variants in mandibular second molars found . The white circles indicate the examined tooth.  
(Courtesy: Zhang et al.2011 Chinese root canal morphology)

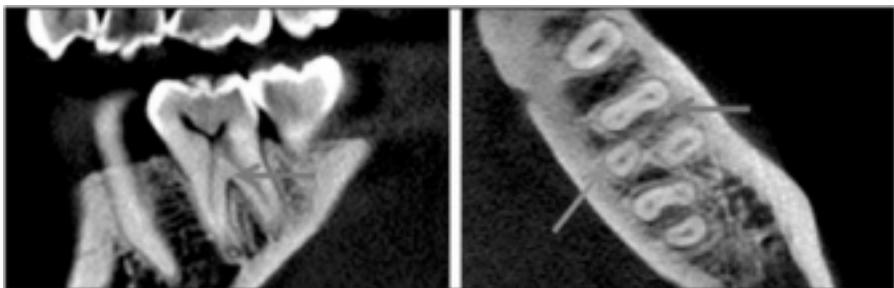


FIG 15:Cross-sectional cone-beam computed tomography image of a mandibular first molar with a clearly distinguishable distolingual root. The purple arrows denote the mandibular first molar and the orange arrows denote the distolingual root.  
(Courtesy: Zhang et al.2011 Chinese root canal morphology)

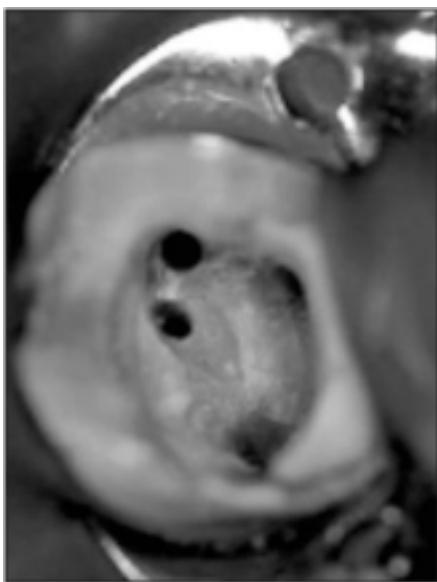


FIG 13 c: MB2 Identified

over distobuccal canal  
LINE 4: Lies on LINE 3 that deviates 10°

#### Transillumination

Apart from magnification, illumination is an important adjunct for location of canal orifices. Previous sources of illumination could not illuminate site even after reflection. Introduction of transillumination provided by fiberoptics (Fig 10) helped to increase chances of detection of additional canals. (Fig 11 a, b) More over this technique also helps in the assessment of calcifications. (Fig 12)

#### Dyes

Dyes like methylene blue , Indian ink, Basic Fushchin are also used for location of additional canals. Moreover dyes can also be used for detection of fractures and carious exposure. After use of dye the tooth can be cleaned using 70% isopropyl alcohol. (Fig 13 a, b, c). Dyes provide a road map to detect canals with greater

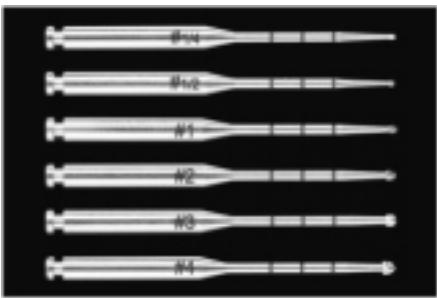


FIG 16: MUNCE DISCOVERY BURS



FIG 17: ROD LENS ENDOSCOPE AND ORASCOPE

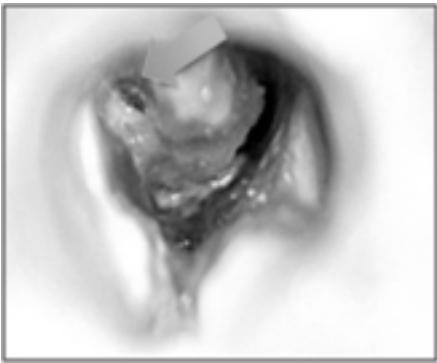


FIG 18: SODIUM HYPOCHLORITE CHAMPAGNE BUBBLE TEST

predictability.

#### Cone-Beam Computed Tomography

The radiographic interpretation of a potential endodontic pathosis is an integral part of endodontic diagnosis and prognosis assessment. Until 10 years ago, routine dental radiograph consisted of two dimensional imaging. But limitations of conventional radiography promulgated a need for three dimensional imaging, also known as cone-beam computed tomography (CBCT) and cone-beam volumetric tomography (CBVT). The use of these devices increased in dentistry since 1998. CBCT/CBVT utilise 3 D view of patients tissues in multitude of planes and assessment of

variations in root and root canal anatomy can be accurately detected.

In vivo studies with operating microscopes (Sempira & Hartwell 2000<sup>[10]</sup>) and conventional radiography (Omer et al. 2004<sup>[11]</sup>) are undertaken frequently to evaluate tooth anatomy (Fig 14). Previous studies (Tu et al. 2007<sup>[12]</sup>, Schafer et al. 2009<sup>[13]</sup>) have suggested that three-dimensional radiographic techniques, such as computed tomography (CT) scans, could offer a more accurate method for these investigations. Recently, cone-beam computed tomography (CBCT) images have been found to be useful and accurate in detecting periapical lesions and assessing root canal morphology (Fig 15) (Tsiklakis et al. 2005<sup>[14]</sup>, Nakata et al. 2006<sup>[15]</sup>, Lofthag-Hansen et al. 2007<sup>[16]</sup>, Zhang et al. 2011<sup>[17]</sup>). CBCT has also been used to estimate the inter-orifice distances of root canals in three-rooted mandibular molars in Taiwanese individuals (Tu et al. 2009<sup>[18]</sup>). As an emerging technology in endodontics, CBCT, with its lower radiation and higher resolution than traditional CT scans (Arai et al. 2000<sup>[19]</sup>, Patel 2009<sup>[20]</sup>, Patel et al. 2009<sup>[21]</sup>), has produced valid root and canal details in three dimensions for diagnosis and prognosis in the context of endodontic therapy (Cotton et al. 2007<sup>[22]</sup>, Matherne et al. 2008<sup>[23]</sup>).

#### Clinical Significance

It is difficult to detect the third roots of mandibular molars with conventional radiography because the images of the roots overlap and the roots themselves are narrow. Moreover, branching of the canals may not be obvious, especially if they are fine. An angled view (vertically and horizontally) may be helpful (Cooke & Cox 1979<sup>[24]</sup>), but achieving such a view is often difficult. If adjacent teeth, restorations or implants are present, there is even more overlap, reducing the clarity of the radiographic image. When root canal treatment is considered, special attention to the extra distolingual roots is necessary, especially when they are smaller than the other roots and are curved (Vertucci et al. 2006<sup>[25]</sup>). Clearly, the failure to locate and negotiate the narrow additional distolingual canal may result in treatment failure (Gulabivala et al. 2002<sup>[26]</sup>).

#### Other Aids

Munce discovery burs (Fig 16), Endodontic explorers, Rod lens endoscope and orascope (Fig 17), Sodium hypochlorite champagne bubble test (Fig 18), loupes etc are commonly used for detection of missed canals.

#### Conclusion

The concept that each tooth has a fixed number of root and root canals is now obsolete and it is the responsibility of dentist to look for those Elusive canals that might get missed leading to poor prognosis of treatment. In past decade or so dentistry especially the specialty of endodontics has witnessed a sea of change with the introduction of newer and improved armamentarium that has made the treatment more predictable.

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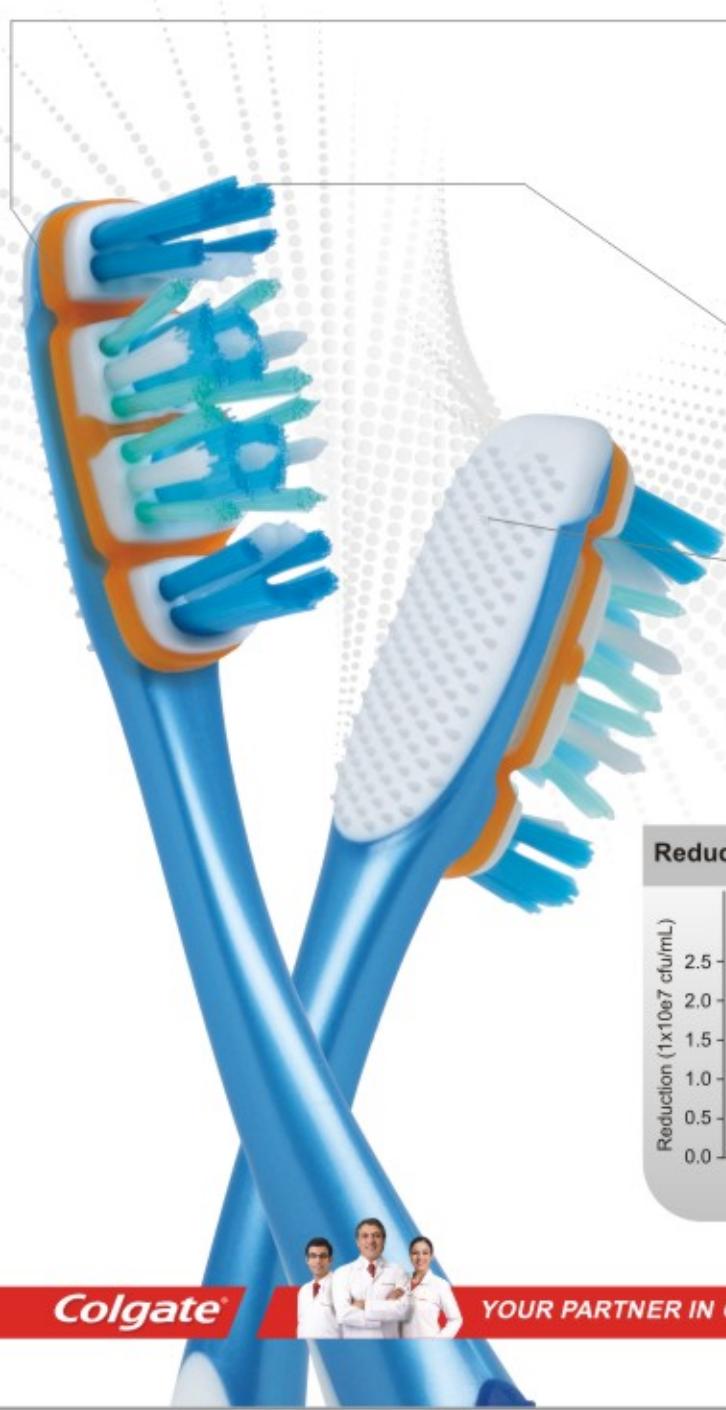
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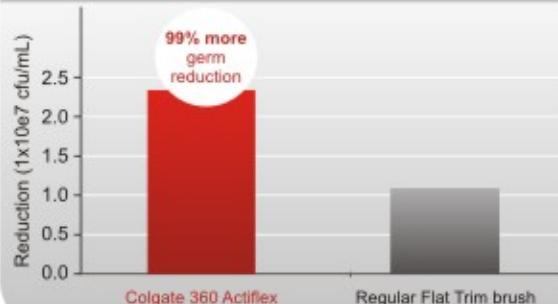
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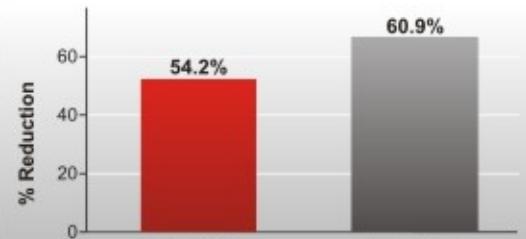
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