Original Researh Article

Malaligned Teeth and Periodontal Health in the Anterior Segment among a Sample of Sudanese Patients

Amal H. Abuaffan[1]* Samir A. Salih[2]

[1]Department of Orthodontic, Pedodontic and preventive Dentistry. Faculty of Dentistry, Khartoum University, Sudan
[2] University of Medical Sciences and Technology, Khartoum, Sudan

Background: Many adult patients with periodontal disease demonstrate the positioning of the teeth that comprise their ability for proper mechanical tooth cleaning of the proximal tooth surfaces. With adequate combined periodontal-orthodontic treatment, it is possible to re-establish a healthy and well-functioning dentition.

Aim: To evaluate the impact of various types of malocclusion on the periodontal health status in the anterior teeth.

Materials and Methods: Crosses sectional study for 315 Sudanese patient's age 15- 46 years old attending the periodontal clinic at the University of Medical Sciences and Technology. The Community Periodontal Index scores were evaluated together with types of malocclusion in either maxillary or mandibular arch for each individual.

Results: Markedly healthier periodontal conditions were found in women (45%) than men, equally in both the mandible and the maxilla. A strong association was found between age and Community Periodontal Index (P-value= 0.000), and malocclusions with corresponding periodontal health status (P-value= 0.001).

Conclusion: Maligned teeth appear to have a negative effect in regards to periodontal health status among the Sudanese patients.

Key words: Periodontal health, malocclusion, maxilla, mandible.

INTRODUCTION

Normal occlusion was considered anatomically and functionally essential for the development and maintenance of a healthy dentition.1   Correct tooth position is an significant factor for proper function, aesthetics, and overall preservation / restoration of dental health. Deviations in tooth morphology (malocclusion) and position have intense effects on the attachment apparatus because occlusal prematurity, food impaction and other consequence will occur. [2]

Malocclusion is defined in the glossary of Prosthodontic terms as "any deviation from a physiologically acceptable contact between the opposing dental arches."[3] Malocclusion is one of the several pathologies that affect the oral cavity and it is the third most important problem in the world population. [4] Malocclusion alone does not result in periodontal disease as most individuals with deficient oral hygiene and consequent accumulation of bacterial plaque, which may cause, in some cases, gingival inflammation, the most common periodontal problem. Whereas, other shows no periodontal changes. [5]

Nearly all types of tooth malposition; diastema, crowding, rotation, incisor proclination and molar tipping, may possibly result in early tooth loss as a result of periodontal pocket formation on either mesial or distal surface of the involved tooth, as the bone crest tends to follow the cement-enamel junction.[6] In misaligned dentition, plaque with harmful bacteria can attached to the tooth surface down to the bottom of the pocket. Plaque can be problematic to remove from crowded areas since difficultly in brush and floss.[7] Periodontal disease is widespread in most human population's results in significant morbidity with premature tooth loss in severely affected individuals. Gingivitis is defined as inflammation of the marginal gingival tissues due to accumulation of dental plaque which characterized clinically by redness, swelling and bleeding of the tissues. However, periodontitis is invariably associated with gingival inflammation and gingivitis appears to be a prerequisite for the development of periodontitis, although it's difficult to prove directly. [2]

Loe et al in 1965 experimentally proved that, gingivitis could be formed in any healthy individual by allowing microbial plaque to gather, which resolved when oral hygiene measures were enhanced.[8] Diagnostic evaluation by periodontics and orthodontics should be a usual practice in dental clinics, particularly among specialists. Early diagnoses of any type of abnormal tooth position provide information to direct treatment and, therefore, prevent periodontal diseases. Orthodontics acts in the tooth repositioning and presents a close relationship with the periodontal tissues, both because its execution manner as

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Corresponding Author: amalabuaffan@yahoo.com

for the results achieved, reducing the possibility of tooth loss and gingival infections resulting from irregularities of the teeth. [5]

Enormous numbers of researches have been carried out among different populations worldwide to investigate the possible relationship between malocclusion and irregularity of teeth to periodontal health among gender and different age groups. [1, 9-18] Recently there has been an increase in the number of Sudanese adults seeking orthodontic treatment; special attention should be given to periodontal status of adult orthodontic patients. Therefore, the present study had been designed to assess the relationship of malaligned teeth in the anterior segment and periodontal health among patients attending periodontics clinic at the faculty of dentistry, University Medical Science and Technology, Khartoum, Sudan.

The community periodontal index (CPI) was developed by WHO / FDI in 1982 has been widely used in epidemiological studies to assess the degree of periodontal disease. [19] Pugaca J et al examined the relationship between the severity of malposition of the frontal teeth and periodontal health in an age group of 15-21 and 35-44 in Latvian population. Statistically significant interrelation has been found between the upper arch crowding and incisor overbite and CPI scores, severity only in the age 15-21 years old. In contrast, higher degree of the crowding and overbite severity with percent of subjects with bleeding, calculus and periodontal pockets greater percents of measurements were observed in the older group. [17] The association between malposition teeth and periodontal health had been studied by Estela Santos et al. A significant associations were found between gingival recession and the variables buccally tipped tooth and excessive proclination of maxillary incisors, as well between chronic periodontitis and mesially tipped molar, crowding, excessive proclination of the maxillary and mandibular incisors, and diastema (P<0.05). [5]

Silness and Roynstrand carried out a study to examine whether any combination of vertical overbite (OB) and horizontal over jet (OJ) may be more favorable than others to dental health in anterior segments. The result showed that participants with a relatively high OB/OJ ratio (OB/OJ greater than or equal to 1.21) had a more favorable periodontal condition than participants with lower ratios. [12] Jukka Ainamo conducted a study to determine the occurrence and degree of malalignment teeth and periodontal disease. In the maxillary anterior segment, the extent of periodontal disease was worse around the malaligned than aligned teeth. The results indicated that malalignment of the teeth, as such, does not enhance periodontal breakdown, although it decreases the effect of average oral hygiene measures. [20] Iffat Batool et al analyzed the correlation between lower anterior teeth crowding and the periodontal status among cadets of the Armed Forces Institute of Dentistry. The 30 subjects 19-24 years old each represented the experimental and the control sample. A significant relation was observed between periodontal indices and lower anterior crowding (P – value < 0.001). [2] Kikelomo Adebanke et al carried out a study to determine the relationship between malocclusion and gingival health among school children. Results of correlation tests between Dental Aesthetics Index (DAI) scores and the periodontal Indices were low and not statistically significant, while that of the littles' Irregularity Index (LII) score and periodontal indices were also low but statistically significant (p < 0.05). A small correlation exists between malocclusion and periodontal indices used. [21]

Ashley et al, concluded that there is no evidence of a relationship between incisor overlaps and the amount of plaque present; on the other hand they reported a correlation between overlapping of incisor teeth and gingivitis among 201 children aged 11-14 years. [15] Ngom et al, reported weak but significant correlations between inter-arch and intra-arch relationship and some indices of periodontal condition, and stated that "providing orthodontic treatment on the ground of the deleterious effect of malocclusion and malposition teeth on periodontal condition is justified". [16]

Materials and Methods

A cross-sectional clinical based study carried out in the Academy Charity Teaching Hospital, University of Medical Sciences and Technology, Faculty of Dentistry, Periodontal clinic, Khartoum. The sample size is taken into account the number of patients attending the periodontal clinic within the period from January to March 2014; this shows that the desirable sample size was to be 315 patients.

The Permission and approval first and foremost from the University of Medical Science and Technology Ethical Committee as well as the Medical Science and Technology, Dental Hospital Administration had been received in addition to verbal and signed informed consent from all patients' contribution in the study before taking part in this study, all participants were given a brief explanation about the aim of the study and the methods that will be carried out. Patients who didn't approve of the procedures were not included in the study.

Each patient had the right to voluntarily participation without any coercion, payment, or force. The personal information and identity of each patient was remained private and confidential throughout the study.

Inclusion criteria

Healthy patients more than 15 years old, Sudanese nationality, with malocclusion in anterior segment from both genders, non-smoker. All the patients attending the periodontal clinic were examined for maligned teeth in anterior segment and those fulfilling the inclusion criteria and agreed to participate were clinically examined in the periodontal clinic using sterile mouth mirrors periodontal probes and cotton rolls.

The malalignment teeth were assessed as:
- Maxillary incisor proclination
- Mandibular incisor proclination
- Crowding
- Spacing
- Diastema
- Rotated teeth

The periodontal conditions were assessed according to the WHO/FDI Community Periodontal Index (CPI) using the periodontal probe; scores are analyzed for the anterior sextant for both maxillary and mandibular arches. [19]

Score 0: health periodontal conditions
Score 1: gingival bleedings
Score 2: calculus and bleeding
Score 3: shallow periodontal pockets (4 to 5 millimeters)
Score 4: deep periodontal pockets (6 millimeters or more)

Data analysis

Data was collected, cleaned and entered into the Statistical Package for Social Sciences (SPSS) Version 17.0 and Microsoft Excel program. The differences in the distribution of malocclusion and CPI index between age groups were tested using the Pearson chi-squared test. Data were grouped and analyzed using frequencies and percentages.

Results

The total number of participants in the present study were 315 (152 males, 163 females). The age of the examined individuals were ranged from 15 ->46 among the study sample. From this, 143 individuals were examined in the maxillary arch and 172 in the mandibular arch.

The majority of the study sample (60.3%) were in the age group of 15-30 (Table 1).

Table 1: Distribution of the study sample according to Gender and age

Age group	Male	Female	Total
15-30 years	82 (26.0%)	108 (34.3%)	190 (60.3%)
31-45 years	35 (11.1%)	38(12.1%)	73 (23.2%)
>46 years	35 (11.1%)	17 (5.4%)	52 (16.5%)
Total	152 (48.3%)	163 (51.7%)	315 (100.0%)

Figure 1: Distribution of the study sample according to the different types of malocclusion
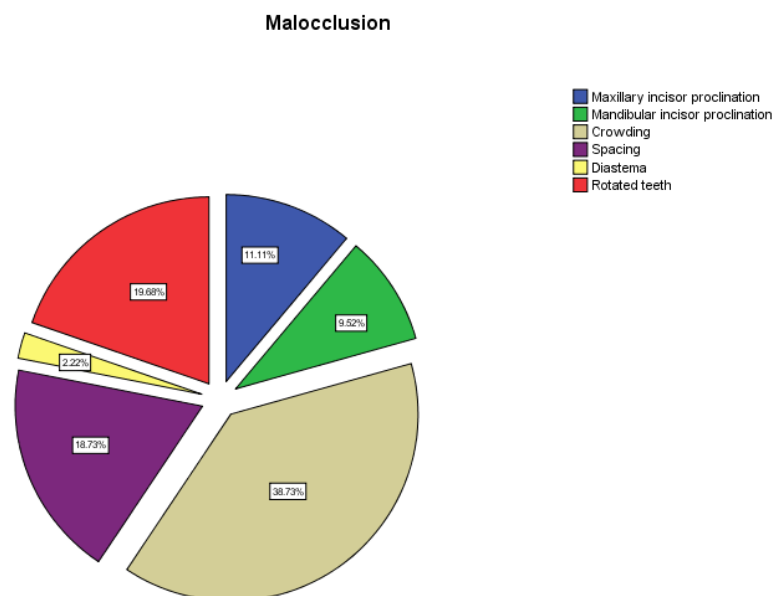
Figure 1 shows that the majority of malocclusions found in the sample was crowding 38%, and the minority found being diastema at 2%

Figure 2: Distribution of the study sample according to CPI index

CPI

Legend:
- Healthy
- Gingival bleeding
- Gingival bleeding + calculus
- Pockets 4-5 mm
- pockets >6 mm

Figure 2 shows that the majority of the sample had a healthy CPI index by 36%, and gingival bleeding was found to be 19.6%, the minority having pockets greater than 6mm depth 8.2%

Table 2: The Community Periodontal Index in relation with age and gender (%)

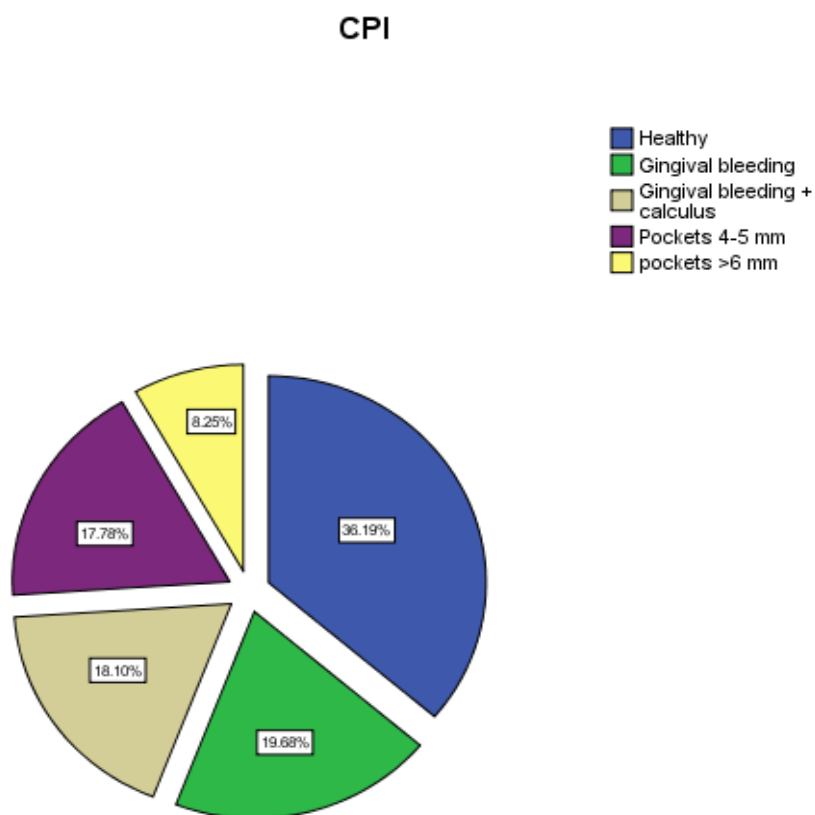| Gender			Community Periodontal Index						P-value
			Healthy	Gingival bleeding	Gingival bleeding +calculus	Pockets 4-5 mm	pockets >6 mm	Total	
Male		15-30	32(21.1)	25(16.4)	10 (6.6)	11 (7.2)	4 (2.6)	82 (53.9)	
	Age	31-45	3 (2.0)	5 (3.3)	13 (8.6)	11(7.2)	3 (2.0)	35 (23.0)	
		>46	5 (3.3)	5 (3.3)	12 (7.9)	6 (3.9)	7 (4.6)	35 (23.0)	0.000*
Female	Total		40(26.3)	35(23.0)	35 (23.0)	28(18.4)	14 (9.2)	152(100.0)	
		15-30	66(40.5)	23(14.1)	9 (5.5)	8 (4.9)	2 (1.2)	108 (66.3)	
	Age	31-45	2 (1.2)	3 (1.8)	9 (5.5)	18(11.0)	6 (3.7)	38 (23.3)	0.000*
		>46	6 (3.7%)	1 (0.6%)	4 (2.5)	2 (1.2)	4 (2.5)	17 (10.4)	
	Total		74(45.4)	27(16.6)	22 (13.5)	28(17.2)	12 (7.4)	163(100.0)	

Statistically significant if P-Value < 0.05

Table 2 showed that age has a strong significance in relation to the CPI score within both genders (P-value=0.000), thus showing no gender predilection.

Table 3: The Community Periodontal Index in relation to examined dental arch in different age groups

Community Periodontal Index							
Age	Dental Arch	Healthy	Gingival bleeding	Gingival bleeding + calculus	Pockets 4-5 mm	pockets >6 mm	Total	P-value
15-30	Maxillary arch	48 (25.3)	17 (8.9)	11 (5.8)	10 (5.3)	2 (1.1)	88 (46.3)	0.366
	Mandibular arch	50 (26.)	31(16.3)	8 (4.2)	9 (4.7)	4 (2.1)	102 (53.7)	
Total		98 (51.6)	48(25.3)	19 (10.0)	19 (10.0)	6 (3.2)	190(100.0)	
31-45	Maxillary arch	5 (6.8)	5 (6.8)	6 (8.2)	20 (27.4)	2 (2.7)	38 (52.1)	0.002*
	Mandibular arch	0 (0.0)	3 (4.1)	16 (21.9)	9 (12.3)	7 (9.6%)	35 (47.9)	
Total		5 (6.8)	8 (11.0)	22 (30.1)	29 (39.7)	9 (12.3)	73 (100.0)	
>46	Maxillary arch	4 (7.7)	2 (3.8)	3 (5.8)	4 (7.7)	4 (7.7)	17 (32.7)	0.620
	Mandibular arch	7 (13.5)	4 (7.7)	13 (25.0)	4 (7.7)	7 (13.5)	35 (67.3)	
Total		11 (21.2)	6 (11.5)	16 (30.8%)	8 (15.4)	11(21.2)	52 (100.0)	

(Statistically significant if P-Value < 0.05)

Table 3 shows the correlation of examined arch and CPI scores in different age groups. A statistical significance was observed in maxillary and mandibular arches and CPI in age group of 31-45 (p-value 0.002)

Table 4: The Community Periodontal Index in relation to examined dental arch among genders (%)

<table>
<tr><td colspan="9" align="center">Community Periodontal Index</td></tr>
<tr><td>Gender</td><td></td><td>Healthy</td><td>Gingival bleeding</td><td>Gingival bleeding+ calculus</td><td>Pockets 4-5 mm</td><td>pockets >6 mm</td><td>Total</td><td>P-value</td></tr>
<tr><td></td><td>Dental Arch</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Male</td><td>Maxilla</td><td>19 (12.5)</td><td>15 (9.9)</td><td>10 (6.6)</td><td>15 (9.9)</td><td>5 (3.3)</td><td>64(42.1)</td><td>0.302</td></tr>
<tr><td></td><td>Mandible</td><td>21 (13.8)</td><td>20 (13.2)</td><td>25(16.4)</td><td>13 (8.6)</td><td>9 (5.9)</td><td>88 (57.9)</td><td></td></tr>
<tr><td></td><td>Total</td><td>40 (26.3)</td><td>35 (23.0)</td><td>35(23.0)</td><td>28(18.4)</td><td>14 (9.2)</td><td>152(100.0)</td><td></td></tr>
<tr><td>Female</td><td>Maxilla</td><td>38 (23.3)</td><td>9 (5.5)</td><td>10 (6.1)</td><td>19(11.7)</td><td>3 (1.8)</td><td>79 (48.5)</td><td>0.047*</td></tr>
<tr><td></td><td>Mandible</td><td>36 (22.1)</td><td>18 (11.0)</td><td>12 (7.4)</td><td>9 (5.5)</td><td>9 (5.5)</td><td>84 (51.5)</td><td></td></tr>
<tr><td></td><td>Total</td><td>74 (45.4)</td><td>27 (16.6)</td><td>22(13.5)</td><td>28(17.2)</td><td>12 (7.4)</td><td>163(100.0)</td><td></td></tr>
</table>

(Statistically significant if P-Value < 0.05)

Table 4 showed that Females had a significant association (p-value=o.o47) between examined arch and CPI score, while the Males showed no association (p-value=0.302) regarding arch type and CPI scores.

Table 5: Malocclusion in relation to age groups among genders (%)

Gender	Age	Maxilla proclined Incisor	Mandible proclined incisor	Crowding	Spacing	Diastema	Rotated teeth	Total	P-value
Male	15-30	6 (3.9)	6 (3.9)	38 (25.0)	13 (8.6)	1 (0.7)	18 (11.8)	82 (53.9)	
	31-45	5 (3.3)	3 (2.0)	11 (7.2)	6 (3.9)	0 (0.0)	10 (6.6)	35 (23.0)	
	>46	1 (0.7)	6 (3.9)	10 (6.6)	8 (5.3)	2 (1.3)	8 (5.3)	35 (23.0)	0.244
	Total	12 (7.9)	15 (9.9)	59(38.8)	27(17.8)	3 (2.0)	36(23.7)	152(100.)	
Female	15-30	14 (8.6)	9 (5.5)	45 (27.6)	20(12.3)	2 (1.2)	18 (11.0)	108(66.3)	
	31-45	6 (3.7)	2 (1.2)	16 (9.8)	7 (4.3)	2 (1.2)	5 (3.1)	38 (23.3)	
	>46	3 (1.8)	4 (2.5)	2 (1.2)	5 (3.1)	0 (0.0)	3 (1.8)	17 (10.4)	0.329
	Total	23 (14.1)	15 (9.2)	63 (38.7)	32(19.6)	4 (2.5)	26 (16.0)	163(100.)	

Statistically significant if P-Value < 0.05

Table 5 shows that no association has been found in regards to the types of malocclusion and age in both genders (P-value=0.244 for males, p-value=0.329 for females)

Table 6: Malocclusion in the upper and lower dental arch among gender (%)

Gender	Arch	Maxilla proclined Incisor	Mandibe proclined incisor	Crowding	Spacing	Diastema	Rotated teeth	Total	P-value
Male	Maxilla	12 (7.9)	0 (0.0)	16 (10.5)	13(8.6)	2 (1.3)	21(13.8)	64 (42.1)	0.00
	Mandible	0 (0.0)	15 (9.9)	43 (28.3)	14(9.2)	1 (0.7)	15 (9.9)	88 (57.9)	
	Total	12 (7.9)	15 (9.9)	59 (38.8)	27(17.8)	3 (2.0)	36(23.7)	152(100.)	
Female	Maxilla	23 (14.1)	0 (0.0)	19 (11.7)	18 (11.0)	4 (2.5)	15 (9.2)	79 (48.5)	0.00
	Mandible	0 (0.0)	15 (9.2)	44 (27.0)	14 (8.6)	0 (0.0)	11 (6.7)	84 (51.5)	
	Total	23 (14.1)	15 (9.2)	63 (38.7)	32 (19.6)	4 (2.5)	26(16.0)	163(100.)	

(Statistically significant if P-Value < 0.05)

Table 6 shows that there are strong associations between type of malocclusion and the arch it affects within both genders. (P-value=0.000 for Males and Females

Table 7: Correlation between the malocclusion and Community Periodontal Index (%)

Malocclusion	Community Periodontal Index						P-value
	Healthy	Gingival bleeding	Gingival bleed-ing + calculus	Pockets 4-5 mm	pockets >6 mm	Total	
Maxillary incisor proclination	19 (6.0)	4 (1.3)	4 (1.3)	8 (2.5)	0 (0.0)	35 (11.1)	
Mandibular incisor proclination	11 (3.5)	4 (1.3)	9 (2.9)	0 (.0)	6 (1.9)	30 (9.5)	
Crowding	44(14.0)	31 (9.8)	26 (8.3)	16(5.1)	5 (1.6)	122 (38.7)	0.001*
Spacing	20 (6.3)	10 (3.2)	4 (1.3)	16(5.1)	9 (2.9)	59 (18.7)	
Diastema	2 (0.6)	2 (0.6)	0 (0.0%)	3 (1.0%)	0 (.0%)	7 (2.2)	
Rotated teeth	18 (5.7)	11 (3.5)	14 (4.4%)	13(4.1%)	6 (1.9)	62 (19.7)	
Total	114(36.2)	62(19.7)	57(18.1)	56(17.8)	26(8.3)	315(100.)	

Statistically significant if P-Value < 0.05
Table 7 shows that there is a strong association between malocclusion and CPI score (P-value=0.001).

Discussion

This is a clinically based study aims to evaluate the impact of malocclusion on the periodontal health in the anterior segment of the Sudanese patients attending the periodontal clinic at the University of Medical Sciences and Technology (UMST), in regards to age, gender and affected arch.

In the present study, the majority of the study sample under the age group 15-30 years old and a few patients were in the range of >46 years and most of the patients had a healthy Community Periodontal Index. In the current study,

Community Periodontal Index score was found to be more severe in males than females. Moreover, it is observed that severity of periodontal disease has a direct relationship with age (p-value= 0.000). A similar statement had been reported by Craig Palmer in American population that periodontal disease is higher in men and periodontal disease prevalence increased with increase of age.[22] However, previous studies by Helm S and Petersen PE among 176 adolescents over a 20 year follow up period, showed that healthier periodontal conditions were found more frequently in women than men,

and in the maxilla were more common than in the mandible.[13] Such differences in results of correlation between CPI among gender can be attributed to the sample size in the previous literature, as well as the study method conducted can affect the outcome results.

In the current study, Community Periodontal Index score was significantly related to the dental arch within the age group of 31- 45 years (P-value= 0.002), whereas no significant association found within the younger age group. In contrast, Pugaca J et al reported a statistically significant relation between upper arch and CPI scores, severity in the younger age group than the older groups. [17] Regarding malocclusion within the present study, a statistically significant association has been found in relation to the Community Periodontal Index (P-value=0.001). Similar correlations had been reported by Iffat Batool et al, Estela Santos et al, Ashley et al, and Kikelomo Adebanke et al, where a significant association between malaligned teeth and periodontal health was recorded. [2, 5, 15, 21]

On the other hand, Jukka Ainamo conducted a study to determine the occurrence and degree of malalignment and periodontal disease for 154 Army recruits aged 19–22 years. The results indicated that malalignment of the teeth does not enhance periodontal breakdown. Moreover, Abu Alhaija ES and Al-Wahadni AM observed no association between the type of displacement teeth and plaque accumulation, gingivitis, attachment loss and alveolar bone level.[20, 18]

The reasons for such dissimilar outcomes can be due to the age differences in the previous two literatures comprising of children and young adults, whereas the current study included a wide range to include the elderly. Other reasons can be due to oral hygiene measures taken into account, as well as ethnic backgrounds of different populations. Such limitations and differences in results can be accredited to the fact that this study was conducted in a limited sample in the UMST Dental clinic, and therefore the results could have varied from other literatures in that it is not as diverse.

Conclusion

1. The most common malocclusion found amongst the Sudanese sample was crowding at 38.7%. A higher percentage of crowding was found in females when compared to males. Crowding was more evident in the younger age group.
2. The most common Community Periodontal Index score found amongst the Sudanese sample was "healthy" at 36%. A higher percentage of females were found to be healthy regarding Community Periodontal Index scores compared to males. As well as the younger population seemed to have healthier scores.
3. The most affected arch by malocclusion was the mandibular arch 54%. The most common malocclusion in the maxillary arch for males was rotation of teeth, while in the mandibular arch, it was found to be crowded. In females, the maxillary arch was found to be affected by proclined incisors, while the mandibular teeth by crowding.

Recommendations

- A larger sample size is recommended to be studied with a more diverse age range, equal distribution of

gender, and different areas in Sudan to have an overview of the general Sudanese population.

- An analysis of need of periodontal treatment should be made for each patient attending the Periodontic clinic, including undergoing basic periodontal treatment (oral hygiene instructions, scaling and root planning), and surgical intervention. In addition, patients with malocclusion should be evaluated for the need of orthodontic treatment so as to facilitate easier oral hygiene access by minimizing inaccessible areas in the oral cavity.

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