

Original Article

Comparative Evaluation of Efficacy of Chemomechanical and Conventional Methods of Caries Excavation in Young Permanent Molar Teeth: *In vivo* Study

Abstract

Aim: To evaluate and compare the efficacy of chemomechanical method using Carie-Care (Eco Works Pvt. Ltd.) and conventional method (airotor and hand instruments) during excavation of caries in young permanent molar teeth. **Methodology:** Twelve children in the age group of 6–9 years having moderate occlusal caries in any two first permanent molars according to the ICDAS-3 or 4 category were selected. Caries excavation in Group I was carried out by the conventional method using airotor and hand instruments. In Group II, it was carried out using Carie-Care gel. The findings recorded in the study included pain response during caries excavation using the Wong-Baker Faces Pain Scale (WBFPS), time taken for caries excavation using a stopwatch (Taksun TS-1809), and the need felt for administration of local anesthesia in children for both the methods. **Results:** Data obtained were subjected to statistical analysis. Intergroup comparison for WBFPS scores and time needed for caries excavation was done using unpaired *t*-test and the results obtained were statistically highly significant ($P < 0.01$). **Conclusion:** It was concluded from the present study that the use of Carie-Care resulted in reduced pain response from the children during caries excavation. Thus, it can be used as an alternative to the conventional method in children with dental phobia to achieve better cooperation and maintain a positive dental attitude for future treatment.

Keywords: Carie-Care, caries removal, chemomechanical caries removal, children, pain assessment

Introduction

The permanent first molar is the most susceptible tooth to attack by dental caries because it is usually the first tooth of the permanent dentition to erupt.^[1] Pain during treatment of dentinal caries in these teeth often induces discomfort and anxiety in children.^[2] Insufficient pain management for children in the age group of 6–9 years could result in a negative dental experience causing dental fear and anxiety and eventually avoidance of any dental treatment in the future.^[3,4] With advances in materials and techniques, the management of such teeth has evolved considerably.

Ideally, caries excavation techniques should incorporate certain criteria to ensure operator and patient satisfaction which includes ease and comfort of its use in the clinical setup, its ability to differentiate and eliminate infected tissue only, should not induce pain, should require least amount of pressure without generating vibration or heat while conducting

the procedure, and be affordable and easy to maintain. However, none of the currently available techniques fulfill all these criteria.^[5]

Caries removal has been conducted by traditional means using rotary equipment and sharp-ended hand instruments. These techniques have certain inherent drawbacks such as difficulty in establishing the exact amount of dentin to be removed, along with pain, discomfort, generation of heat, vibration, and noise.^[6]

Chemomechanical method for caries removal helps overcome these drawbacks. It reduces pain associated with the removal of carious dentine, thereby reducing discomfort and providing a gentle introduction of dental treatment in children.^[7] The main objective of this method is to remove minimal tooth structure and eliminate the carious portion by proteolytic action on the carious necrotic tissue.^[8,9]

When compared with the conventional methods of using a rotary or hand instrument, this method can serve as a way to win over fearful patients, enabling

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good behavior management, diminishing discomfort, and minimizing the need for anesthesia.^[10] The newly introduced Carie-Care gel (Eco Works Pvt. Ltd, Bengaluru, India) is a papain-based gel which helps in nontraumatic removal of dental caries by the chemomechanical method [Figure 1].

There is limited evidence of literature reporting the *in vivo* experience of chemomechanical caries removal in children using papain-based agents. Hence, the purpose of this study was to evaluate and compare the efficacy of chemomechanical and conventional methods of caries excavation in young permanent first molar teeth using Carie-Care (Eco Works Pvt. Ltd) as the chemomechanical agent.

Thus, the aim of the present study was to evaluate and compare the efficacy of conventional method (using airtor and hand instruments) and chemomechanical method using Carie-Care (Eco Works Pvt. Ltd.) for excavation of caries in young permanent molar teeth. This was done on the basis of the pain response of the child during excavation of caries in young permanent molar tooth, time taken for the same, and need felt for anesthesia by children during this procedure, using both methods.

Methodology

This *in vivo* study was conducted to evaluate and compare the efficacy of chemomechanical method: Carie-Care (Eco Works Pvt. Ltd.) and conventional method (airtor and hand instruments) during excavation of caries in the first permanent molar teeth. Approval to conduct the study was obtained from the institutional scientific review board and the institutional ethical review board. The risks and benefits of the procedure were evaluated, and the patient information sheet, assent form for the child, and written informed consent forms were formulated in English and the local language (Marathi). These forms were validated before the commencement of the study.

The study comprised 12 healthy children reporting to the Department of Pedodontics and Preventive Dentistry for

dental treatment with no past dental experience, based on the following the inclusion and exclusion criteria:

Inclusion criteria

1. Children in the age group of 6–9 years
2. Children showing Frankl Behavioral Rating Scale^[11] score of 3 or 4 indicating positive and definitely positive type of behavior as observed during oral examination at their first dental visit by the operator
3. Children with 2 or more carious first permanent molar teeth belonging to the ICDAS-3 to ICDAS-4 category on occlusal surfaces according to the ADA Caries Classification System^[12,13] which included moderate caries extending up to the dentin.

Exclusion criteria

1. Physically and mentally disabled children
2. Parents declining consent or child declining assent for the treatment procedure or for inclusion in the study
3. First permanent molars having deep occlusal caries with pulpal or periapical involvement.

The procedure was explained to the parent and the child in detail. Risks and benefits of using both the procedures were explained to their satisfaction. Written informed consent was taken from the parents or guardian of the subjects, and assent was obtained from the child. Confidentiality of the records obtained during the study was maintained, and they were used for research purpose only.

On the first dental visit of the child, a thorough clinical examination was done followed by a radiographic examination for the participants of the study as a part of routine oral examination to determine the extent of caries.

On the second dental visit of the child, two contralateral carious first permanent molar teeth were selected as samples from each patient and allocated in two groups randomly for caries excavation on the same day. The sequence of caries excavation method was alternately used for the twelve participants of the study.

The Wong-Baker Faces Pain Scale (WBFPS)^[14] was shown to the child by the blinded observer before the treatment, and the ratings were explained. Higher end of the scale indicated maximum pain response given by the child denoted by 5, while lower-end indicated no pain response by the child denoted by 0 [Figure 2].

Group I

For this group comprising 12 first permanent molar teeth caries, excavation was done by the conventional method using airtor and hand instruments. Isolation was achieved with the use of sterile cotton rolls and saliva ejector. Access to the occlusal carious lesion was gained with the help of an airtor using a round bur of 1 mm diameter (BR41: Mani) to eliminate the undermined enamel [Figure 3].



Figure 1: Carie-Care (Eco Dental Works) used as chemomechanical caries removal agent in the study

Remaining caries excavation was carried out using small and large spoon excavators (EXC131/2 and EXC31W: GDC). The cavity was checked for complete removal of caries by absence of any discoloration, a catch, or a tug back position on smooth passage of a blunt probe or curved end of an explorer.^[15]

Group II

For this group comprising 12 first permanent molar teeth, caries excavation was done by the chemomechanical method using Carie-Care (Eco Dental Works). The Carie-Care (Eco Dental Works) syringe was removed from the refrigerator 30–40 min before the treatment as per the manufacturer's instructions.

The tooth was isolated using sterile cotton rolls and saliva ejector. The gel was applied into the cavity and left for about 30–40 s [Figure 4]. The softened carious tissue was removed with spoon excavator in a pressureless manner. The cavity was not rinsed or washed between applications. Remaining gel was wiped away using a sterile cotton pellet. This was repeated until the gel showed no turbidity or any change in color from blue. It appeared clean and without any debris.^[16] The cavity was checked for complete removal of caries by the absence of any discoloration, a catch, or a tug back position on smooth passage of a blunt probe or curved end of an explorer.^[15]

For both the groups, pain response from the child was recorded at the end of caries excavation by the blinded observer who remained constant throughout the study. The child was asked to raise the hand if the pain on caries excavation became unbearable. The observer assessed the child's physical response and facial expressions to intervene for the need for anesthesia during the procedure for each tooth.

Time taken for excavation of the caries was recorded by the observer using a stopwatch (Taksun TS-1809) and noted at the end of caries excavation with each sample tooth.

As per the manufacturer's instructions, the sample teeth were then restored using composite resin material (3M™ ESPE Filtek, USA). However, in samples 1 and 2 of the study, the subject teeth were restored as per the manufacturer's instructions using type IX GIC (GC Gold Label, Japan) as they presented with molar incisor hypomineralization.

The readings from Group I and Group II were then tabulated, evaluated, compared, and statistically analyzed using SPSS v 21.0, IBM Corporation, 2009.

Results

For both Group I and Group II, the child's pain response was recorded, using the WBFPs^[14] by asking the child to point out how he/she felt during the treatment. The numerical value, correlated to the face as shown on the pain scale, was recorded by the observer as pointed out by the child. Accordingly, the scores varied from 0 to 5, where 0 = no hurt, 1 = hurts little bit, 2 = hurts little more, 3 = hurts even more, 4 = hurts whole lot, and 5 = hurts

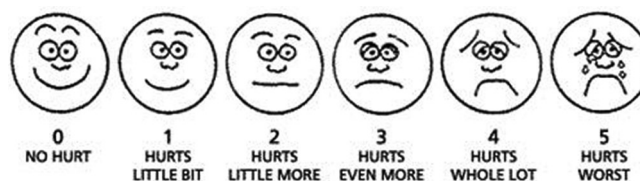


Figure 2: The Wong-Baker Faces Pain Scale



Figure 3: Group I showing caries excavation using conventional method



Figure 4: Group II showing caries excavation using Carie-Care (Eco Dental Works)

worst [Figure 2]. The scores for pain response for each tooth in both groups are recorded as shown in Table 1.

Time taken for excavation of the caries was recorded by the observer using a stopwatch (Taksun TS-1809) and noted at the end of caries excavation with each sample tooth, as shown in Table 2. Time taken for caries excavation ranged from 261 s to 550 s.

None of the children from either group indicated the need for local anesthesia, either by any physical response or by facial expressions.

Discussion

Teeth having similar extent of carious lesions were selected for this study^[12,13] to eliminate selection bias for the size and extent of the cavity to compare the time needed for caries excavation using both the methods.

In this study, the conventional method of caries excavation was carried out using arotor handpiece with round

Table 1: Scores obtained for pain response by Wong-Baker Faces Pain Scale

Group I	Group II
3	2
3	1
2	1
3	2
4	2
2	2
4	2
2	1
3	1
2	1
4	2
2	0

Where 0: No hurt, 1: Hurts little bit, 2: Hurts little more, 3: Hurts even more, 4: Hurts whole lot, 5: Hurts worst

Table 2: Scores obtained for time required (seconds)

Group I	Group II
402	550
266	428
338	432
402	418
339	381
272	314
261	371
362	440
314	395
422	469
316	436
270	319

bur (No. BR41: Mani) to achieve access to the cavity and eliminate the undermined enamel followed by excavation using spoon excavators.

The visual and tactile method was used to detect any residual caries. The cavity was checked for complete removal of caries by the absence of any discoloration, no catch, or a tug back position on smooth passage of a blunt probe or curved end of an explorer which was in accordance with Dali and Rao.^[15] Fusayama^[17] in 1988 reported that this method of caries detection may not be reliable and caries detector dye may aid in confirming the cavity caries free. However, Kidd *et al.*^[18] in 1993 reported satisfactory results when this method was used to assess the caries-free status of the cavity.

The chemomechanical agent Carie-Care was used in this study. It is a papain-based gel which helps in nontraumatic removal of dental caries.^[19] *In vitro* studies have shown that primary teeth are better suited to chemomechanical caries removal when compared with permanent teeth.^[20] This mode of treatment has achieved more acceptance in children and patients presenting with dental anxiety.^[21]

Children with Frankl's Behavioral Rating Scale 3 and 4 were chosen for the present study because children between 6 and 9 years since the first young permanent molar teeth were selected for the study due to higher susceptibility and faster spread of dental caries.^[22] The results would be expected to apply to populations of similar age group.

This study was performed using both the methods of caries removal in the same dental visit similar to Nagaveni *et al.*^[23] Anxiety or fear of the unknown affects the behavior of the child during the initial dental visit.^[24] Pain response by the child to the type of caries removal method being employed could be affected in the successive dental visit as the child would be sensitized to the caries removal process earlier. The sequence of caries removal method was used alternately for each child to eliminate bias toward a group in this study. Dental anxiety perceived by schoolchildren treated with three caries removal approaches showed that the treatment environment and preparatory visits may be factors determining the level of dental anxiety in children and not the method employed for caries removal.^[25]

Pain response during caries excavation was recorded using the WBFPS score at the end of caries excavation procedure since it is commonly used in clinical practice for pediatric population. It was introduced for measuring the intensity of pain or the "amount of pain" by Wong and Baker^[14] in 1988. This scale has also been used earlier to study the pain response during caries excavation by chemomechanical method in children of the age group of 5–10 years by other authors.^[15,19,26,27]

Pain perception in the age group of 6–9 years as selected in the present study is seen to be reported accurately as the children belonging to this age group undergo the stage of concrete operations in their cognitive development.^[24] Measures for self-report of severity of pain have been used commonly in children with this age group. The reliability of the data self-reported by 6-year-old children using this scale is found to be adequately reproducible over time.^[28]

As seen in Table 3, the comparison of pain scores are obtained using the WBFPS score; it was found that lower pain response was seen in children during caries excavation in Group II with the use of Carie-Care as compared to Group I which made use of the conventional method for caries excavation. The mean value for Group II (1.42 ± 0.66) was lower than Group I (2.83 ± 0.83), suggesting that the pain response was lower with the use of the Carie-Care gel for excavation of caries rendering a more comfortable mode of treatment for the children. Statistically significant difference ($P < 0.01$) was obtained after comparison of the pain scores recorded from the pain response of the children on the scale. This was in accordance with other authors who compared pain response with the use of Carie-Care with conventional method. It has an endoprotein as its main active ingredient which has bactericidal and disinfectant properties. The presence of a natural anti-inflammatory (papain gel) and

Table 3: Comparison of scores obtained for pain response by Wong-Baker Faces Pain Scale

Group	n	Mean	SD	SEM	P value of t-test
Conventional (Group I)	12	2.83	0.835	0.241	0.000**
Carie-Care (Eco Works Pvt. Ltd.) (Group II)	12	1.42	0.669	0.193	

**Statistically highly significant difference ($P < 0.01$), *Statistically significant difference ($P < 0.05$), #Statistically nonsignificant difference ($P > 0.05$). SD: Standard deviation, SEM: Standard error of the mean

Table 4: Comparison of means of time needed for caries excavation

Group	n	Mean	SD	SEM	P value of t-test
Conventional (Group I)	12	330.33	57.424	16.577	0.003**
Carie-Care (Eco Works Pvt. Ltd.) (Group II)	12	412.75	64.330	18.571	

**Statistically highly significant difference ($P < 0.01$), *Statistically highly significant difference ($P < 0.01$), #Statistically nonsignificant difference ($P > 0.05$). SD: Standard deviation, SEM: Standard error of the mean

clove oil (analgesic agent) compound provides an extra advantage in the chemomechanical caries elimination over Carisolv and Papacarie.^[19] Papain has a debriding anti-inflammatory effect that does not damage the healthy tissue and enhances the cicatricle process. This is because healthy tissue contains alpha-1-antitrypsin, which is an antiprotease. Thus, the dentin which is not necrotic with a possibility of regeneration is preserved. It is recommended not to cut the dentin but to scrape it because papain only interacts with the broken down collagen. An unnecessary cutting procedure can be avoided.^[29] Unlike Papacarie and the previous chemomechanical agents, Carie-Care does not require the use of a customized instrument kit for its use.

The time needed for excavation of caries in the present study was recorded by the observer using a stopwatch (Taksun TS-1809) and noted at the end of caries excavation with each sample tooth. This method provides an objective and accurate way of recording the time scores to evaluate the time needed for caries excavation by the chemomechanical method.^[15,19,23,26,27,30-32] Time needed for caries excavation was noted and scored in seconds to achieve more accurate findings as against in minutes by other authors.^[23,32,33]

As seen in Table 4, the time needed for caries excavation was observed to be higher in Group II (mean value 412.75 ± 64.33) which involved the use of Carie-Care compared to Group I (mean value 330.33 ± 57.42) for the conventional method. A statistically significant difference ($P < 0.01$) was seen with the conventional group requiring lesser time for caries excavation. This could be attributed to the multiple applications of the gel required for its enzymatic action to occur over the carious lesion and the use of use of hand instruments when compared to the airtor.^[23,27,31]

The mean value for time needed for caries excavation in the same age group of children using Carisolv was found to be 580.26 s ,^[30] which was higher than the mean value for caries excavation in the present study using Carie-Care, suggesting this newer chemomechanical agent to have a faster action for caries removal than the earlier agents.

The observer assessed the child's physical response and facial expressions to intervene for the need for

anesthesia during the procedure for each sample tooth in this study. This was also recorded by other authors for caries excavation using Carie-Care for children belonging to similar age group.^[32,34] It was noted that none of the subjects in this study required the administration of local anesthesia during caries excavation for both the groups. The chemomechanical caries removal method significantly reduced the need for local anesthesia and the additional use of drill during caries excavation in children belonging to the age between 5–9 years as reported in studies conducted by other authors.^[16,31,35] The factors attributing to the lack of need felt for anesthesia other than the age group may be due to the selection of teeth having caries extending only up to the dentin. Inadvertent removal of sound dentin was avoided with the use of Carie-Care due to its proteolytic action exerted only on the infected tissue.

None of the participants in this study showed any signs of gingival irritation or adverse tissue reactions, complaints of foul taste or smell from the gel on application of the chemomechanical agent as reported by earlier studies.^[34,36]

Conclusion

It was concluded from the present study that the use of Carie-Care resulted in reduced pain response from the children in the age group of 6–9 years with moderate occlusal caries extending up to dentin in the first permanent molars. Although the time taken for caries excavation was longer than the conventional method, none of the methods required the need for local anesthesia. Thus, Carie-Care can be used as an alternative to the conventional method for caries excavation in children with dental phobia to achieve better cooperation and maintain a positive dental attitude for future treatment.

However, further research needs to be carried out for children with varying age groups and with different presentations of dental caries so as to obtain greater clinical evidence for regular use of Carie-Care (Eco Works Pvt. Ltd.) in pediatric restorative dentistry.

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Conflicts of interest

There are no conflicts of interest.

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