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Original Article

Chemomechanical caries removal method versus mechanical caries removal methods in clinical and community-based setting: A comparative *in vivo* study

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ABSTRACT

Objective: To compare the effectiveness of various caries removal techniques in mandibular primary molars using Smart Burs, atraumatic restorative technique (ART) (mechanical caries removal) and Carie-care (chemomechanical caries removal [CMCR]) among primary school children in clinical and community-based settings. **Materials and Methods:** A total of 80 carious primary mandibular molars were selected for the study from the dental clinic and community. They were equally assigned to four groups according to caries removal technique and also by the operating site. In Group 1, caries was removed using Carie-care in the dental clinic and in Group 2, with Smart Burs in the dental clinic. In Group 3, caries was removed using Carie-care in the field and in Group 4, with the ART in the field. The time taken for caries removal, the efficacy of caries removal and patient acceptance were evaluated with different caries removal techniques. **Statistical Analysis:** The obtained data were subjected to statistical analysis by ANOVA test. **Results:** In clinical settings, Carie-care was time-consuming but was more efficient with increased acceptance than Smart Burs and the result was found to be significant statistically ($P < 0.05$). In community-based settings, Carie-care was more efficient, less time consuming, and showed an increased acceptance when compared to atraumatic restorative treatment and the result was found to be significant statistically ($P < 0.05$). **Conclusions:** The CMCR technique was superior to the mechanical caries removal technique in primary teeth among school children in terms of time, efficacy, and acceptance in both clinical- and community-based settings.

Key words: Atraumatic restorative technique, Carie-care, caries removal, patient acceptance, Smart Burs

INTRODUCTION

The majority of rural populations in India do not have access due to geographical isolation, poor education, and low-income, making them unaware of the consequences of poor oral hygiene. Poor oral hygiene increases the probability of dental caries, so basic interventions in form of minimally invasive approaches such as atraumatic restorative technique (ART), chemomechanical caries removal (CMCR) can be performed in rural areas atraumatically, with less cost and fewer instruments.[1]

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ART uses manual excavation of dental caries without the use of local anesthesia and restores cavity with glass ionomer cement – an adhesive restorative material that bonds to tooth structure chemically and releases fluoride which helps in remineralization.[2] Carie-care (CMCR) and Smart Burs (mechanical caries removal) were minimally invasive treatment approaches which selectively remove caries-infected tissue while leaving intact caries-affected tissue-conserving tooth structure.[3]

Carie-care has a main active ingredient from papaya extract – an endo protein, chloramines, and dyes and additionally contains specific amounts of essential oils from plant sources which acts by chlorination of partially degraded collagen.[4,5] Smart Burs are made of a polyamide resin having polymer shaft and blades in three different sizes – 004, 006, 008 used in slow speed rotary handpiece at 500–800 rpm which can easily remove soft carious dentin but when they come in contact with hard dentin they blunt out.[6,7]

The purpose of the study is to compare the effectiveness of different caries removal techniques in primary teeth using the Carie-Care system, ART, and Smart Burs in removing dentinal caries among school children in the clinical setup and as well as in community-based settings. The time taken for caries removal, the efficacy of caries removal and patient acceptance were evaluated for clinical success with different caries removal techniques.

MATERIALS AND METHODS

A total of 80 carious primary mandibular molar teeth of 36 male and 44 female children between the age group of 5–10 years were selected for the study from the outpatient Department of Pedodontics and Preventive Dentistry, St. Joseph Dental College and as well as from community after taking written consent from parents/guardians/teachers. The study was approved by the Ethical Committee of the Institution.

Inclusion criteria

- Healthy children of both sexes from 5 to 10 years of age who are willing to participate in the study
- Patients with asymptomatic carious lesions with distinct dentin involvement, which was verified by radiograph in relation to mandibular primary molars
- Carious lesions without any pulpal involvement.

Exclusion criteria

- Uncooperative
- Grossly decayed teeth
- Deep carious lesions with pulpal involvement.

The selected subjects were assigned to four groups according to the caries removal technique and also by the operating site. Each group comprised of 20 carious primary mandibular molars. Isolation was done by rubber dam or cotton rolls based on operating site. After caries removal, the cavity was restored with ketac molar® glass ionomer cement.

- Group 1 - caries removal using Carie-care in the dental clinic
- Group 2 - caries removal with Smart Burs in the dental clinic
- Group 3 - caries removal using Carie-care in the field
- Group 4 - caries removal with the ART in the field.

Methodology

Group 1 procedure

The involved tooth was isolated with rubber dam, and Carie-care gel was applied to the carious lesion. After 60 s, the area treated with Carie-care gel showed a cloudy appearance. Later on, the gel was removed with a moistened cotton pellet and softened carious dentin was scrapped off using spoon excavator. Caries removal was verified by probing with explorer. The drill was used to adjust the periphery, and the tooth was restored with ketac molar® glass ionomer cement [Figure 1].

Group 2 procedure

The tooth involved was isolated with a rubber dam. Caries was excavated with Smart Burs in slow speed handpiece with circular movements starting from the periphery to the center of the lesion. Caries removal was verified by probing with explorer and then the tooth was restored with ketac molar® glass ionomer cement [Figure 2].

Group 3 procedure

The involved tooth was isolated with cotton pellets, and the Carie-care gel was applied to the carious lesion. After 60 s, the carious lesion treated with Carie-care gel showed a cloudy appearance. Later on, the gel was removed with a moistened cotton pellet and softened carious dentin was scrapped off using spoon excavator. Caries removal was verified by probing with explorer, and the tooth was restored with ketac molar® glass ionomer cement [Figure 3].

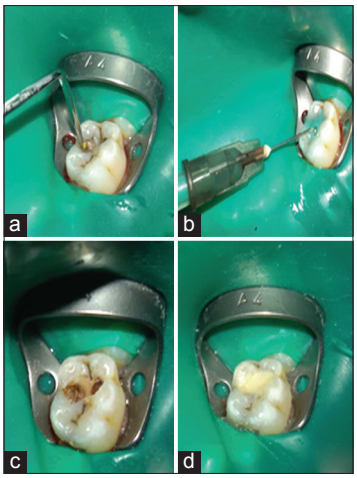

Figure 1: (a) Carious 75, (b) Carie-care gel application, (c) after Caries excavation, (d) after GIC restoration

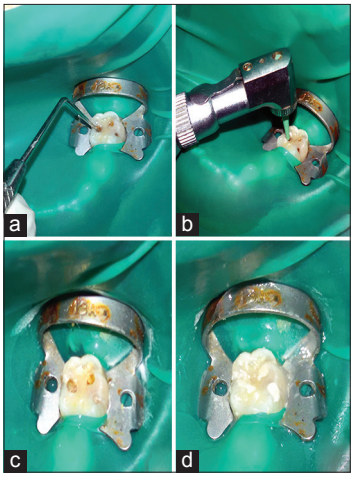

Figure 2: (a) Carious 75, (b) Caries excavation with Smart Burs, (c) after Caries excavation, (d) after GIC restoration

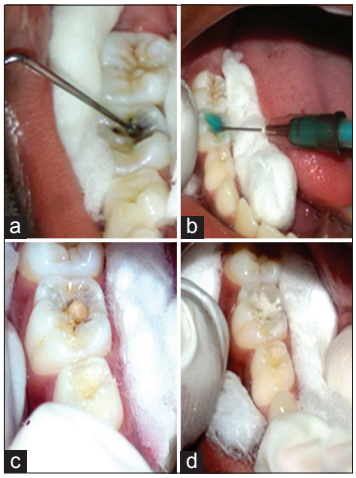

Figure 3: (a) Carious 85, (b) Carie-care gel application, (c) after Caries excavation, (d) after GIC restoration

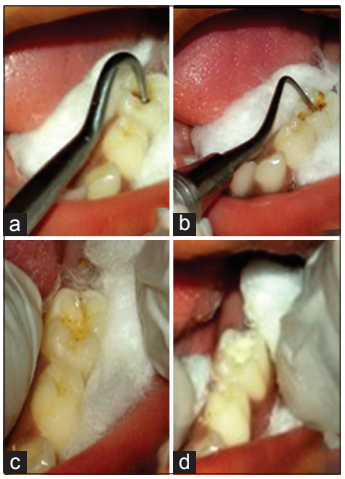

Figure 4: (a) Carious 75, (b) Caries excavation with spoon excavator, (c) after Caries excavation, (d) after GIC restoration

Group 4 procedure

The involved tooth was isolated with cotton pellets, the entrance of the lesion was widened by enamel hatchet to remove unsupported enamel rods and then caries was removed by spoon excavator. Caries removal was verified by probing with an explorer followed by ketac molar® glass ionomer cement restoration [Figure 4].

The following observations were noted:

1. The time taken was recorded from the start of caries removal procedure till the placement of ketac molar® glass ionomer cement restoration by a stopwatch
2. Efficacy of caries removal was evaluated by assessing the amount of remaining caries left by following scores given by Ericson *et al*.[8]
   0 - Caries removed completely
   1 - Caries present in base of the cavity
   2 - Caries present in base and/or wall
   3 - Caries present in base and/or two walls
   4 - Caries present in base and/or >2 walls
   5 - Caries present in base, walls, and margins of cavity.
3. To know the patient acceptance of the respective procedure after caries removal, pain rating was assessed with the help of Wong–Baker Faces pain rating scale.[9]
   0 - No hurt
   2 - Hurts little bit
   4 - Hurts little more
   6 - Hurts even more
   8 - Hurts whole lot
   10 - Hurts worst.

The obtained data from the study was subjected to statistical analysis by GraphPad Prism statistical software (6.0 version) (www.graphpad.com/scientific-

software/prism/). Analysis was done with one-way ANOVA for:

1. Comparison of time taken for caries removal, the efficacy of caries removal, and patient acceptance with all four groups
2. Comparison between Carie-care in clinical settings (Group 1) versus Smart Burs in clinical settings (Group 2)
3. Comparison between Carie-care in community-based settings (Group 3) versus ART in community-based settings (Group 4).

RESULTS

Table 1 shows intergroup comparison between all four groups:

The average time taken by Carie-care (Group 1) was 420.0 s, and Smart Burs (Group 2) was 351.0 s in clinical settings and Carie-care (Group 3) was 400.5 s and by ART (Group 4) was 499.5 s in community-based settings. In clinical settings, the mean value of efficacy of caries removal by Carie-care was 1.05 and by Smart Burs was 1.9. In community-based settings, the mean value of efficacy of caries removal by Carie-care was 0.9 and by ART was 1.6.

There was a statistically significant difference ($P < 0.0001$) in the time taken, efficacy, and acceptance when the comparison was made between all the four groups and the correlation factor (F) was 235.1. Almost all the patients affirmed that chemomechanical approach was more acceptable.

The results determined that CMCR technique was superior to the mechanical caries removal technique in primary teeth among school children in terms of time, efficacy, and patient acceptance in both clinical- and community-based settings.

Table 2 shows intergroup Comparison between Carie-care in clinical settings (Group 1) versus Smart Burs in clinical settings (Group 2).

Intergroup comparison of the time taken for caries removal, the efficacy of caries removal, and patient acceptance between Carie-care in clinical settings (Group 1) and Smart Burs in clinical settings (Group 2) was made to ascertain the better modality of treatment among chemomechanical and mechanical methods for caries excavation. The results showed a statistically significant difference between ($P < 0.0001$) these groups with 136.0 correlation factor (F).

In clinical settings, though time-consuming Carie-care was more efficient in caries removal with increased patient acceptance than Smart Burs.

Table 3 shows intergroup comparison between Carie-care in community-based settings (Group 3) versus ART in community-based settings (Group 4).

Intergroup comparison of time taken for caries removal, the efficacy of caries removal and patient acceptance by Carie-care in community settings (Group 3) and ART in community settings (Group 4) was made to find out better method of treatment among chemomechanical and mechanical methods of caries excavation. The results showed a statistically significant difference between ($P < 0.0001$) these groups with 574.2 correlation factor (F).

In community-based settings, Carie-care was more efficient, less time consuming and showed an increased acceptance when compared to ART.

DISCUSSION

Clinically, removal of caries is performed by two methods namely conventional and ultra-conservative. Caries removal by conventional procedures is

Table 1: Comparison of time taken for caries removal, the efficacy of caries removal and patient acceptance with all 4 groups

Groups	Sample size	Mean time taken (s)	Mean efficacy	Mean patient acceptance	*F*	*P*
1	20	420.0	1.05	1.9	235.1	<0.0001
2	20	351.0	1.90	3.4		
3	20	400.2	0.90	2.0		
4	20	499.2	1.60	2.3		

Table 2: Carie-care in clinical settings (Group 1) versus Smart Burs in clinical settings (Group 2)

Groups	Sample size	Mean time taken (min)	Mean efficacy	Mean patient acceptance	*F*	*P*
1	20	7.0	1.05	1.9	136.0	<0.0001
2	20	5.85	1.90	3.4		

Table 3: Carie-care in community-based settings (Group 3) versus atraumatic restorative technique in community-based settings (Group 4)

Groups	Sample size	Mean time taken (min)	Mean efficacy	Mean patient acceptance	*F*	*P*
3	20	6.67	0.90	2.0	574.2	<0.0001
4	20	8.32	1.60	2.3		

accomplished with high-speed rotary equipment, ART, stainless steel burs, tungsten carbide burs, and hand excavators, but have disadvantages of causing dental anxiety due to drill, pain, local anesthesia, excess removal of tooth structure, removal of both infected and affected dentin, and can lead to adverse effects to the pulp due to the heat generated at the cutting ends.[6,10]

Ultraconservative methods have gained importance by leaving affected dentin intact for remineralization, no need for local anesthesia and with a conservative approach. These methods include CMCR, air abrasion, lasers, and polymer burs. Ultraconservative methods such as CMCR and polymer burs have gained importance by leaving affected dentin intact for remineralization.[6]

In this study, the efficacy of caries removal was assessed with scoring given by Ericson *et al*.[8] The studies conducted by Pandit *et al*. and Kochhar *et al*. showed the greatest efficacy of caries removal by air-rotor followed by Carisolv™ and the least efficacy of caries removal was with hand instruments and both the studies used caries detector dyes to detect the presence of any remaining caries.[11,12] A study done by Soni *et al*. had shown greatest efficacy with air-rotor followed by almost comparable efficacy with polymer bur and then by Carisolv™ and the least effective method was by hand instrument,[13] but in our study, greatest efficacy was noticed with Carie-care when compared to polymer burs and ART in both clinical and community-based settings.

Smart Burs lead to under-preparation due to self-limiting nature of the bur that will not cut affected dentin, if a greater force is applied then it will wear away rather than cut sound dentin.[14] Carie-care is a minimally invasive method of caries removal which removes degraded collagen found in demineralized portion (infected dentin) of a carious lesion by the action of chloramines whereas unaffected collagen in affected dentin is more resistant to degradation due to their strong framework.[15]

In our study, the time taken for caries removal was recorded by a stopwatch from beginning of caries excavation till the placement of ketac molar® glass ionomer cement and it was found to be minimal for the mechanical approach (ART and Smart Burs) when compared to chemomechanical approach (Carie-care). Hegde *et al*. compared Carie-care system and conventional drill among school children and concluded that chemomechanical technique, though time-consuming it was superior to the conventional technique in pediatric dentistry.[16]

Dammaschke *et al*. measured the time required for caries excavation by Smart Burs and conventional carbide burs. The mean time taken by Smart Burs was 208.1 s and by carbide burs was 228.32 s, and results were found to be not statistically significant.[17] In the present study, time taken by Carie-care (clinical settings) was 420.0 s; Smart Burs was 351.0 s, Carie-care (community settings) was 400.5 s, ART was 499.5 s till restoration placement, and the results were statistically significant.

Kochhar *et al*. observed mean visual analog scale (VAS) scores for airotor group, spoon excavator group, Carisolv™ group, and concluded Carisolv™ was the least painful method for caries removal than drilling.[12] Soni *et al*. observed mean VAS scores for the air-rotor group, spoon excavator group, Carisolv™ group, polymer burs, and concluded that Carisolv™ group was the least painful method for caries excavation followed by polymer burs, spoon excavators, and air-rotor group.[13] Similar results were observed in this study which means pain rating scores using Wong–Baker Faces pain rating scale with Carie-care (1.9) was the least painful and the most acceptable method followed by polymer burs (3.4) and ART (2.3).

The unpleasant sensation during caries removal with the mechanical approach, ART (pulpal stimulation) and Smart Burs (heat generation), makes treatment more traumatic when compared to chemomechanical approach – Carie-care (leaving the intact affected dentin and thermal insulating function).[13]

CONCLUSIONS

From this study, it was observed that Carie-care was as effective as conventional methods in caries removal so it can be recommended as an alternative treatment modality in anxious children in both clinical and community-based settings. Carie-care CMCR agent holds excellent promise in dental practice for the preservance of the tooth structure.

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Conflicts of interest
There are no conflicts of interest.

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