

## Comparative Evaluation of Mechanical and Chemo-mechanical Methods of Caries Excavation: An *In Vivo* Study

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### Abstract:

**Background:** The study was aimed to compare the efficacy of caries removal, time taken, pain threshold experienced by the patient and anxiety experienced during various caries removal methods.

**Materials and Methods:** 80 primary molars of 40 children between the age groups of 3-7 years were selected randomly and divided into two groups of 40 teeth each: Group I treated by the mechanical method and Group II with Carie care method. The efficacy, time taken, and the pain threshold were evaluated during the caries removal by Ericson D *et al.* scale, visual analog scale, and modified child dental anxiety scale, respectively.

**Results:** Highly significant co-relation was observed when the intergroup comparison was made using one-way analysis of variance.

**Conclusion:** It was concluded that Carie care gel was efficient in caries removal and can be used as an alternative for the airtor in the management of dental caries especially in children.

**Key Words:** Anxiety experienced, Carie care, caries removal, efficacy, pain assessment

### Introduction

The principal behind restorative treatment for dental caries is complete removal of carious tissues with maximum preservation of sound tooth structure and maintenance of pulp vitality. The word "Caries" is derived from a Latin word meaning "Rot" and in Greek (Ker), it means "death." According to the WHO, caries is defined as localized posteruptive, the pathological process of external origin involving softening of hard tooth tissue and proceeding to the formation of a cavity. It is characterized by penetration of micro-organism into the dentin due to cavitation of the enamel.<sup>1</sup>

There are a number of techniques available for removal of caries. The most primitive approach to the treatment of caries

was by hand instrument, which was a painful, effective, and tedious method for caries removal. Due to the shortcomings of the drill, alternative techniques such as air abrasion, sono-abrasion, lasers and chemo-mechanical methods of caries removal were developed. These methods have the disadvantage such as they are costly and tooth sensitive and, therefore, less frequently used. In addition, they cause deleterious thermal and pressure effects on pulp and contribute to pain and anxiety especially in children. Therefore, the chemo-mechanical approach is documented alternative to traditional drilling.<sup>2</sup> Recently introduced is the Carie care gel, and it is an enzyme based gel which helps in non-traumatic removal of dental caries. It has endo protein as its main ingredient which has bactericidal and disinfectant properties. The presence of natural anti-inflammatory (papain gel) and clove oil (analgesic agent) compound provides an added advantage in chemo-mechanical caries removal over Carisolv and Papacarie.<sup>1</sup>

### Materials and Methods

Following the approval from the ethical committee of the institution, 40 children of both sexes between the age group of 3-8 years were selected from the Department of Pedodontics and Preventive Dentistry who met inclusion and exclusion criteria after intraoral examination and radiographic evaluation.

### Inclusion criteria for selection of the subject in the study

- Healthy co-operative children aged 3-8 years who are willing to participate in the study with consent form signed by parents
- Both girls and boys were included
- Children having bilateral occlusal carious lesion on mandibular primary second molar without pulpal involvement
- Carious lesion involving only dentin clinically and radiographically.

### Exclusion criteria for rejection of the subject in the study

- Medically compromised, mentally challenged children were not included in the study
- Deep carious lesion with pulpal involvement
- Patients with developmental defects of teeth
- Teeth which have already been restored or fractured.

All the selected teeth were isolated using rubber dam and caries detecting dye (caries detector) containing 1% acid red in propylene glycol was applied using an applicator tip for 10 s.

After washing with water, the carious lesion appeared bright red whereas sound dentin was light pink.

**Group I (40 teeth): Caries removed by airtor**

Class I cavity outline was prepared with round bur depending on the extent of caries and following the principles of cavity preparation.

**Group II (40 teeth): Caries removal by Carie care**

Carie care caries removal gel was applied directly to the carious lesion directly by the dispensing syringe for 60 s after which the cavity was washed and gentle excavation done using hand instruments. On application, the gel was clear but became opaque and cloudy with the debris in the lesion. The procedure was repeated until the gel was no longer contaminated with the debris and when the surface of the cavity was felt hard.

The time taken for the caries removal was noted from the start of the procedure until the complete caries removal was achieved by stopwatch. Efficacy, pain threshold, and anxiety were evaluated during the caries removal by Ericson D *et al.* scale (Table 1), visual analog scale (VAS) (Figure 1), and modified child dental anxiety scale (MCDAS) (Figure 2), respectively.

After the carious dentin was removed, the cavity was restored with glass ionomer cement (GIC GC-Fuji 1X, Tokyo, Japan).

Data were collected and statistically analyzed using one-way analysis of variance (ANOVA) test.

**Results**

Table 2 and Graph 1 show the caries removal score using mechanical and chemo-mechanical before and after the procedure which was compared using one-way ANOVA. The result indicates no significant difference in the mean caries removal score using two techniques before the procedure (F-stat = 0.415, P > 0.05). However, average caries removal score after procedure indicates a significant difference in the mean caries removal score (F-stat = 40.114, P < 0.001). Table 3

**Table 1: Ericson D *et al.* (1999) scale for assessment of caries.**<sup>3</sup>

|   |  |
|---|--|
| 0 | Caries removed completely                            |
| 1 | Caries present in base of cavity                     |
| 2 | Caries present in base and/or one wall               |
| 3 | Caries present in base and/or 2 wall                 |
| 4 | Caries present in base and/or more than 2 walls      |
| 5 | Caries present in base, walls, and margins of cavity |

**Table 2: Mean efficacy of caries removal score (Ericson D).**

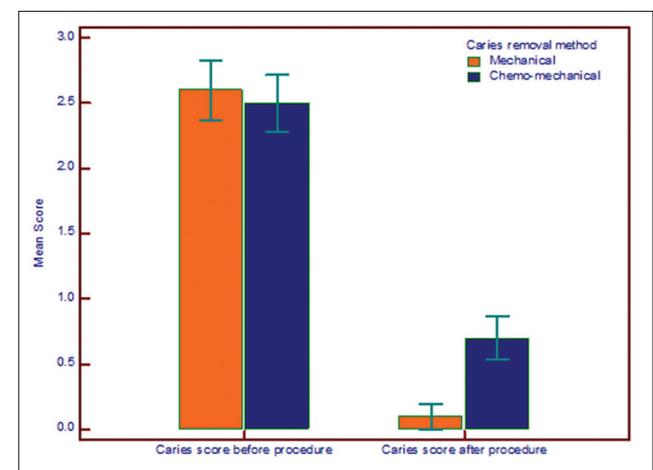
| Name of the method | N  | Mean±SD          |                 |
|--------------------|----|------------------|-----------------|
|                    |    | Before procedure | After procedure |
| Mechanical         | 40 | 2.60±0.71        | 0.10±0.30       |
| Chemo-mechanical   | 40 | 2.50±0.68        | 0.70±0.52       |
| One-way ANOVA      | F' | 0.415            | 40.114          |
|                    | p' | 0.521            | <0.001          |

ANOVA: Analysis of variance, SD: Standard deviation

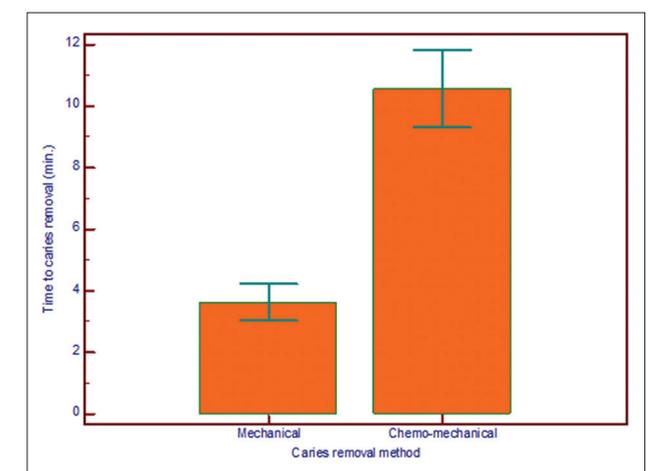
**Table 3: Mean time for caries removal (min).**

| Name of the method | N  | Before procedure |
|--------------------|----|------------------|
|                    |    | Mean±SD          |
| Mechanical         | 40 | 3.63±1.86        |
| Chemo-mechanical   | 40 | 10.56±3.94       |
| One-way ANOVA      | F' | 101.359          |
|                    | p' | <0.0001          |

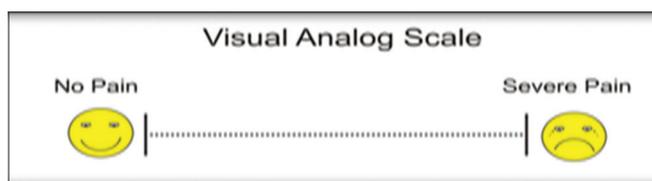
ANOVA: Analysis of variance, SD: Standard deviation



**Graph 1: Mean caries removal score (Ericson D).**



**Graph 2: Mean time for caries removal (min).**



**Figure 1: Visual analog scale.**<sup>3</sup>



**Figure 2: Modified child dental anxiety scale.**<sup>4</sup>

and Graph 2 results indicate that the average time for caries removal using mechanical method was significantly less as compared to chemo-mechanical method (F-stat = 101.359,  $P < 0.0001$ ). Table 4 and Graph 3 results indicate no significant difference in the mean VAS score (0-100) using two techniques before the procedure (F-stat = 1.039,  $P > 0.05$ ). But after the procedures, results indicate a significant difference in the mean VAS score (F-stat = 68.196,  $P < 0.001$ ). Table 5 and Graph 4 results indicate no significant difference in the mean MCDAS score using two techniques before the procedure (F-stat = 1.918,  $P > 0.05$ ). But after the procedure, the results indicated a significant difference in the mean MCDAS score (F-stat = 33.950,  $P < 0.001$ ).

**Discussion**

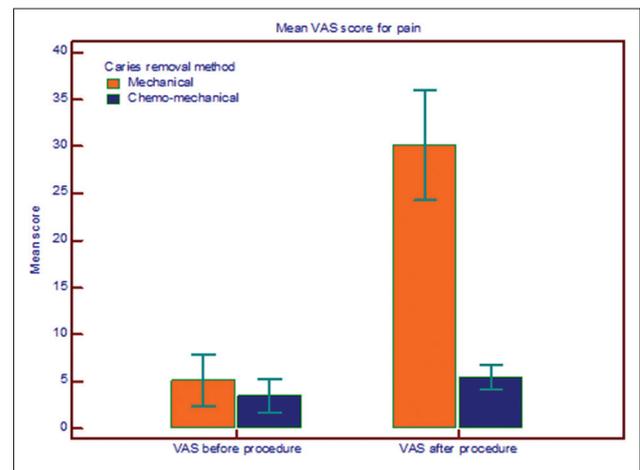
Conventional drilling is the most common clinical procedure for caries removal, but it generates pain, fear, discomfort, and anxiety in children. Chemo-mechanical caries removing method is desirable in pediatric dentistry as it allows a minimal invasive technique. This system eliminates the use of anesthesia, painful symptoms, and unnecessary removal of the sound tooth structure as only the carious dentin is removed and the painful removal of sound dentin is avoided.<sup>1</sup> So, this study was undertaken to know the efficacy of the newly introduced Carie care gel with that of the conventional drilling and hand excavation.

**Efficacy**

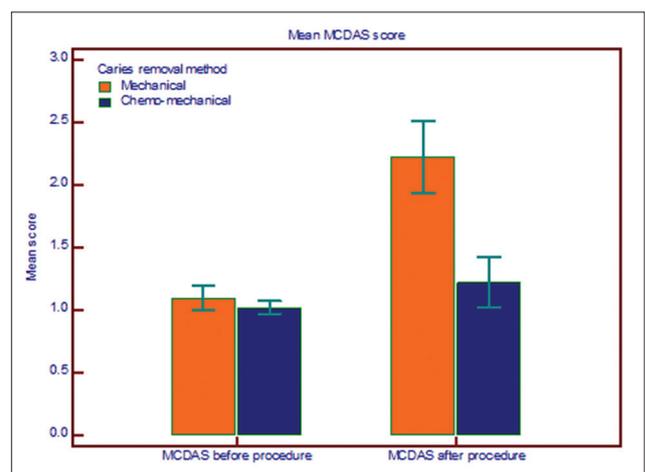
The results indicated that the efficacy of caries removal was highest with airtor followed by Carie care. The results were in accordance, with the study by Banerjee *et al.*,<sup>5</sup> which showed that effectiveness of caries removal was the highest with airtor. The studies done by Ericson *et al.*<sup>6</sup> had also concluded that the Carisolv was as effective as bur in removing infected dentin. Similar studies were conducted by Maragakis *et al.*,<sup>7</sup> who reported that efficacy of caries removal by chemo-mechanical method was only 62.5% showing that it did not remove caries efficiently, and therefore, cannot replace rotary instruments. Yazici *et al.*<sup>8</sup> showed success rate in only 36% cases treated with Carisolv.

**Time taken**

Airtor removed caries in minimum time, followed by Carie care. This was in accordance with a study conducted by Banerjee *et al.*,<sup>5</sup> who evaluated five alternative methods of carious dentin excavation and found that airtor was the quickest method and Carisolv excavation was the slowest out of the five methods. According to the study done by Kakaboura *et al.*,<sup>9</sup> the reason for increased time taken by Carisolv might be because of multiple applications required for caries removal. Bergmann *et al.*<sup>10</sup> reported that the time spent for caries removal with chemo-mechanical method was significantly higher than handpiece. However, the operative time with chemo-mechanical method did not adversely affect the cooperation of children.



**Graph 3:** Mean visual analog scale score.



**Graph 4:** Mean modified child dental anxiety scale score.

| Table 4: Mean VAS score (0-100). |    |                  |                 |
|----------------------------------|----|------------------|-----------------|
| Name of the method               | N  | Mean±SD          |                 |
|                                  |    | Before procedure | After procedure |
| Mechanical                       | 40 | 5.15±0.48        | 30.18±18.43     |
| Chemo-mechanical                 | 40 | 3.50±0.33        | 5.50±4.16       |
| One-way ANOVA                    | F' | 1.039            | 68.196          |
|                                  | p' | 0.311            | <0.001          |

VAS: Visual analog scale, ANOVA: Analysis of variance, SD: Standard deviation

| Table 5: Mean MCDAS score. |    |                  |                 |
|----------------------------|----|------------------|-----------------|
| Name of the method         | N  | Mean±SD          |                 |
|                            |    | Before procedure | After procedure |
| Mechanical                 | 40 | 1.10±0.30        | 2.25±0.89       |
| Chemo-mechanical           | 40 | 1.03±0.16        | 1.23±0.62       |
| One-Way ANOVA              | F' | 1.918            | 33.950          |
|                            | p' | 0.170            | <0.001          |

MCDAS: Modified child dental anxiety scale, ANOVA: Analysis of variance, SD: Standard deviation

**Pain assessment**

**VAS**

The pain experienced was found to be maximum with airtor followed by chemo-mechanical. Anusavice and Kincheloe<sup>11</sup> demonstrated that cutting or removing carious dentin generally

elicits little or no sensation while cutting sound dentin often results in some level of pain and sensitivity. Similar data have been presented in the studies Rafique *et al.*,<sup>12</sup> in his study concluded that chemo-mechanical caries removal agents for caries removal were well-accepted by patients in comparison to airotor. The reason for pain and discomfort associated with airotor could be because of sensitivity of vital dentin, pressure on the tooth surface, development of high temperature at the cutting surface and high pitch noise of air turbine of airotor Balciuniene *et al.*,<sup>13</sup> considered Carisolv gel as a less painful method of caries removal because the hand instruments have been specially designed for safe scrapping action, that has 90 degree edge with not a sharp cutting profile.

### Anxiety assessment

#### MCDAS

Dental anxiety in the practice of dentistry is crucial that the practitioner is able to detect and assess the severity of anxiety among children with a valid method of measurement.<sup>14</sup> In the present study, while comparing MCDAS for evaluation of anxiety experienced for caries removal method, it was observed that maximum anxiety was associated with mechanical group and minimum with chemo-mechanical group. The results were in accordance with study conducted by Wang *et al.*,<sup>15</sup> who conducted a study on the effects of three caries removal method on children's dental fear evaluated by physiological measure, they concluded that the degree of dental fear in traditional drilling group was significantly higher than that in chemo-mechanical group and ART group; thus, chemo-mechanical group and ART may decrease children's dental fear and anxiety. Similar results were found in the study conducted by Anegundi *et al.*,<sup>16</sup> and they also found deterioration of the behavior from positive to negative during the treatment with the conventional method and after the treatment improvement was seen in the behavior. However in the chemo-mechanical group, there was no change in the behavior of children during and after the treatment. However, a study conducted by Topaloglu *et al.*,<sup>17</sup> to evaluate the perceived dental anxiety among school children treated through three caries removal approaches concluded 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. The results of this study were not inconsistent with the present study conducted.

Thus, based on the results of the present study, it is recommended that mechanical and chemo-mechanical are suitable alternatives for caries removal and it can be widely used in pediatric restorative dentistry.

### Conclusion

Caries was removed effectively by all the methods; however,

- The efficacy of caries removal score was more in mechanical method as compared to chemo-mechanical method
- The time taken for caries removal was more in chemo-mechanical method as compared to mechanical method

- The pain perception measured by VAS score was significantly higher in mechanical method as compared to chemo-mechanical method
- The anxiety levels measured with modified child dental anxiety significantly higher in the mechanical method as compared to chemo-mechanical method.

Thus, the chemo-mechanical removal of caries with Carie care was found to be effective measure and could be considered as viable alternatives to painful conventional procedures such as airotor in the management of dental caries especially in children.

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