

# An Evaluation of Different Caries Removal Techniques in Primary Teeth: A Comparative Clinical Study

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**Objective:** To compare the efficacy of caries removal, time taken and to evaluate the pain threshold experienced by the patient during various caries removal methods. **Study Design:** Eighty patients between the age groups of 5-9 years were selected and caries removal was done by Hand instruments, Airotor, Carisolv and Papacarie. The efficacy, time taken and the pain threshold was evaluated during the caries removal by Ericson D et al scale, visual analogue scale respectively. **Results:** Highly significant relation ( $<0.05$ ) was observed when intergroup comparison was made using one way analysis of variance (ANOVA). **Conclusion:** It was concluded that chemomechanical removal of caries with Papacarie and Carisolv were found to be effective measures of caries removal and could be considered as viable alternatives to painful procedures like Airotor in management of dental caries especially in children.

**Keywords:** caries removal, efficacy, time taken, pain threshold

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## INTRODUCTION

The word “caries” is derived from the Latin word meaning “rot” and Greek word “ker” meaning death.<sup>1</sup> According to WHO, caries is defined as “localized post eruptive, pathological process of external origin involving softening of hard tooth tissue and proceeding to the formation of a cavity.”<sup>2</sup>

There are a number of techniques available for removal of caries. The most primitive approach to the treatment of caries was by the hand instruments, which was a painful, ineffective and tedious method for caries removal.<sup>3</sup> Due to the shortcomings of the drill, alternative techniques like air abrasion, ultrasonic instrumentation, lasers and chemomechanical approach to caries removal were developed. Out of these, air abrasion, sonoabrasion, ultrasonic instrumentation, lasers are costly and tooth-sensitive methods and therefore

less frequently used.<sup>4</sup> In addition, these cause deleterious thermal and pressure effects on the pulp and contribute to pain and anxiety especially in children.<sup>5</sup> Therefore, chemomechanical approach is most documented alternative to traditional drilling.<sup>3</sup> Recently, in 2003, Papacarie a material composed of papain, chloramine and toluidine blue was launched to be used as chemomechanical caries removal method. The carious dentin collagen is chlorinated by the solution, which helps in chemical and mechanical caries removal.<sup>6</sup>

## METHOD

Following the approval from the ethical committee of the institution eighty patients between the age groups of 5-9 years were selected, who on intraoral examination were found to have single or multiple carious primary teeth. A total of 120 carious teeth patients screened were selected for the study group. The carious teeth were called “samples” and were randomly divided into four groups (Table 1).

**Table 1.** Division of samples

Group I (n=30)	Group II(n=30)	Group III (n=30)	Group IV (n=30)
Caries removal by hand instruments	Caries removal by Airotor.	Caries removal by chemomechanical method- Carisolv gel	Caries removal by chemomechanical method- Papacarie

## ISOLATION AND APPLICATION OF CARIES DETECTING DYE

All the selected teeth were isolated using rubber dam and caries detecting dye (Caries Detector) containing 1% acid

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red in propylene glycol was applied using an applicator tip for 10 seconds. After washing with water, carious lesion appeared bright red whereas sound dentin was light pink.

**Group I:** Caries removal by hand instruments: Carious tooth structure was removed using spoon excavators (Hufriedy) by making circular scooping movements around the long axis of the instrument till sound dentin appeared. Complete caries removal was finally judged by applying caries detecting dyes again.

**Group II:** Caries removal by Airotor (NSK. PANA AIR-Σ): Class I and class II cavity outline form was prepared depending on the extent of caries and Dr. G.V. Black's principles of cavity preparation.

**Group III:** Caries removal by Carisolv (Mediteam, Sweden): The Carisolv gel was mixed using multimix syringe dispenser according to manufacturer's instructions and applied on to the dentinal carious lesion using the hand instrument. After 60 seconds, the cavity was gently scraped using specialized hand instrument to remove the softened carious tissue. On application the gel was clear, but became opaque/ cloudy with debris from the lesion. When the gel was heavily contaminated with debris, it was removed with gentle suction or with a cotton pellet, and fresh gel was applied. The procedure was repeated until the gel was no longer contaminated with the debris and the surface of the cavity was felt hard.

**Group IV:** Caries removal by Papacarie (F&A Laboratorio Farmaceutico Ltd.): Following prophylaxis access to the lesion was gained. Papacarie was applied using disposable tip attached to the syringe. The carious lesion was then covered with the gel for 30seconds in acute lesions and for 40-60 seconds in chronic lesions. Initially Papacarie was clear which after sometime became blurred. These signs indicated that the removal process could be started. The cavity was gently scraped with hand instruments to remove the softened decayed dentin. The gel was re-applied as many times as necessary, till darkish colour appeared indicating the decomposition of decayed tissue. The procedure was repeated until the gel was no longer contaminated with the debris and the surface of the cavity was felt hard.

Efficacy, time taken and pain threshold were evaluated during the caries removal by Ericson D et al scale<sup>7</sup> (Table 2), time scale, visual analogue scale (Fig.1) and verbal scale (Table 3) respectively.

After the carious dentin was removed, the cavity was restored with Glass Ionomer Cement (GIC Fuji II cement). Data was collected and statistically analyzed using one way analysis of variance (ANOVA) test ad Scheffe Post Hoc Test.

**RESULTS**

**1. Efficacy of caries removal:** Table 4 (Fig.2) shows the comparison of mean values of remaining caries (Ericson D et al scale<sup>7</sup>) of different caries removal methods. There was a highly significant difference (p<0.05) in efficacy of caries removal when intergroup comparison were made. Non significant results were observed for efficacy

of caries removal when Group IV (Papacarie) was compared with group II (Airotor) and group III (Carisolv). All other intergroup comparisons showed significant results.

**Table 2.** Ericson D et al (1999) scale<sup>7</sup> for assessment of caries

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 walls
4	Caries present in base and / or more than 2 walls
5	Caries present in base, walls and margins of cavity



**Figure 1.** Visual Analogue Scale..

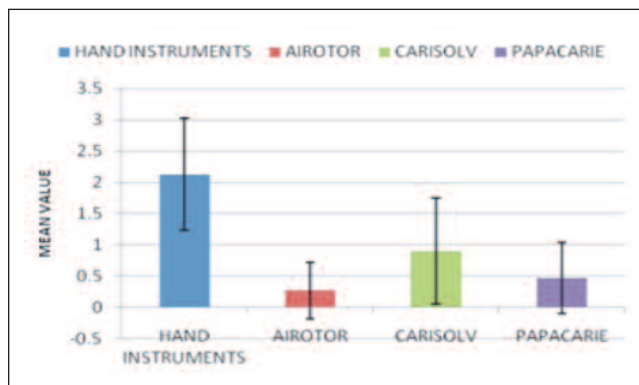
**Table 3.** Verbal pain scale

0	No Pain
1	Mild pain (Pain recognizable but no discomfort)
2	Moderate pain ( Pain discomforting but bearable)
3	Severe pain (Pain that causes considerable discomfort and is difficult to bear)
4	Very severe

**Table 4.** Quantification of mean values of remaining caries (Ericson D et al scale<sup>7</sup>) for assessment of efficacy of caries removal

Name of the method	N	Mean	S.D.	S.E.
<b>Hand instrument</b>	30	2.13	0.900	0.164
<b>Airotor</b>	30	0.27	0.450	0.082
<b>Carisolv</b>	30	0.90	0.845	0.154
<b>Papacarie</b>	30	0.47	0.571	0.104

S.D - standard deviation S.E. - standard



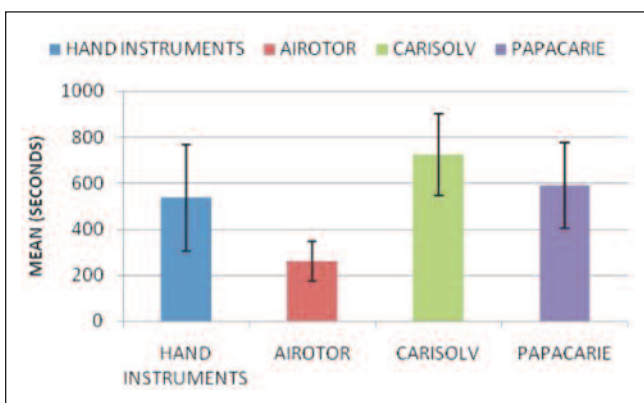
**Figure 2.** Diagram showing remaining caries following caries removal using different methods

2. **Time taken:** Table 5 (Fig.3) shows the mean value of time taken for caries removal by different groups. Intergroup comparisons exhibited a highly significant relation ( $P < 0.05$ ). Non significant results were obtained when Group I & IV (Hand instruments and Papacarie) were compared, whereas all the other groups showed significant results.

**Table 5.** Comparison of mean values of the time taken for caries removal by different methods

Name of the method	N	Mean	S.D.	S.E.
<b>Hand instrument</b>	30	535.83	232.137	42.382
<b>Airotor</b>	30	261.70	86.06	15.712
<b>Carisolv</b>	30	723.73	179.476	32.768
<b>Papacarie</b>	30	590.80	187.004	343.142

S.D - standard deviation S.E. - standard

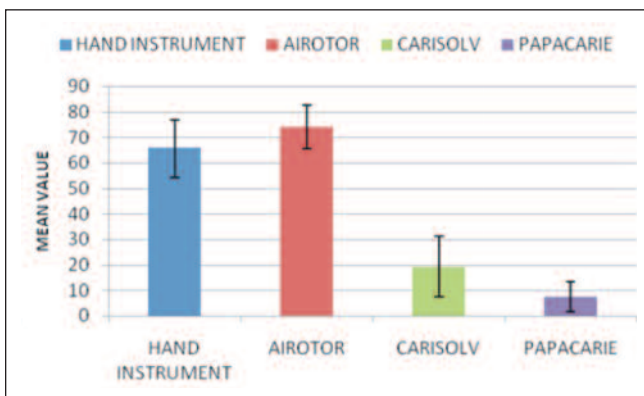


**Figure 3.** Diagram showing time taken for caries removal using different methods

**Table 6.** Comparison of mean values of pain using Visual analogue scale (VAS) score for caries removal by different methods

Name of the method	N	Mean	S.D.	S.E.
<b>Hand instrument</b>	30	65.67	11.351	2.7072
<b>Airotor</b>	30	74.00	8.550	1.561
<b>Carisolv</b>	30	19.33	11.725	2.141
<b>Papacarie</b>	30	7.33	5.833	1.065

S.D - standard deviation S.E. - standard



**Figure 4.** Diagram showing visual analogue scale for pain using different methods of caries removal.

3A) **Pain assessment using visual analogue scale:**

Table 6 (Fig.4) shows mean values for pain using Visual Analogue Scale (VAS) during different methods. Highly significant relation ( $P < 0.05$ ) were observed when intergroup comparisons were made. All the intergroup comparisons showed highly significant differences.

3B) **Pain assessment using verbal pain scale:**

Table 7 (Fig.5) shows verbal pain score reported by different methods. Highly significant relation ( $P < 0.05$ ) were observed when intergroup comparisons were made. Non significant results were obtained when group I and II (hand instruments and Airotor) were compared. All other groups showed significant results when intergroup comparisons were made.

**DISCUSSION**

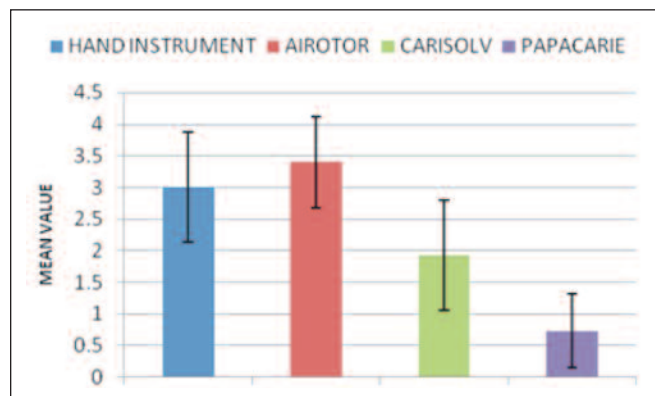
**EFFICACY:** The results indicated that the efficacy of caries removal was highest with Airotor followed by almost comparable Papacarie method followed by Carisolv and least by the Hand instrument.

The results were in accordance to the study by Banerjee *et al*<sup>5</sup> which showed that effectiveness of caries removal was the highest with Airotor. The studies done by Ericsson *et al*,<sup>8</sup> Watson *et al*,<sup>9</sup> had also concluded that the Carisolv was as effective as bur in removing infected dentin. However, Yazici AR *et al* 2003<sup>10</sup> showed success rate in only 36% of cases treated with Carisolv. Whereas, Maragakis *et al*<sup>1</sup> reported that the efficacy of caries removal by Carisolv was only 62.5% showing that it did not remove the caries

**Table 7.** Comparison of mean values of pain using verbal scale for all experimental groups

Name of the method	N	Mean	S.D.	S.E.
<b>Hand instrument</b>	30	3.00	.871	.159
<b>Airotor</b>	30	3.40	.724	.132
<b>Carisolv</b>	30	1.93	.868	.159
<b>Papacarie</b>	30	.73	.583	.106

S.D - standard deviation S.E. - standard



**Figure 5.** Diagram showing verbal pain using different methods of caries removal.

efficiently and therefore cannot replace the rotary instruments. Peters *et al*<sup>11</sup> concluded that chemomechanical caries removal had lower efficacy and efficiency when treating dentinal depth occlusal lesions with minimal opening.

The efficacy of removing caries with Airotor was the highest because it tends to over prepare the cavities due to lack of sensitivity of tactile feedback. This resulted in gross rapid removal of tissue with reduced control over the whole process. Thus, it was not always apparent to the operator when the true clinical end point was reached. So, the excavation procedure continued in healthier dentin leading to eventual over preparation.<sup>9</sup> Carbide or diamond bur used with high speed for cavity preparation often remove reversibly affected dentin along with the odontoblastic reaction zone plugs, resulting in the exposure of the more permeable healthy dentin.<sup>22</sup>

Airotor removed the caries in minimum time, followed by Papacarie and hand instruments. Carisolv took maximum time for caries removal (Fig.3). This was in accordance with study conducted by Banerjee *et al*,<sup>5</sup> who evaluated five alternative methods of carious dentin excavation and found that Airotor was quickest method and Carisolv excavation was the slowest out of the five methods. According to the study done by Kakaboura *et al*,<sup>12</sup> the reason for increased time taken by Carisolv might be because of multiple applications required for caries removal. Carrillo CM 2008<sup>13</sup> showed work time acceptability of Papacarie in paediatric dentistry (4 to 8 min). Bergmann *et al* 2005<sup>14</sup> reported that the time spent for caries removal with chemomechanical method was significantly higher than hand piece, However, the operative time with the chemomechanical method did not adversely affect the cooperation of children.<sup>15</sup>

## PAIN ASSESSMENT

a) Visual Analogue Scale: The pain experienced was found to be maximum with Airotor followed by Hand Excavation and Carisolv and the least by Papacarie (Fig.4). Anusavice and Kinchloe<sup>16</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 of Zinck *et al*.<sup>18</sup> The unpleasant sensation of scraping the decay with hand excavation and the vibration associated with the use of Airotor during caries removal makes the treatment more traumatic than chemomechanical caries removal system.<sup>18</sup> Rotary instruments are universal method of caries removal but pain and discomfort are associated with the cavity preparation, due to sensitivity of vital pulp, pressure in the tooth (e.g. mechanical stimulus), conduction of noise and vibration to the bone, sharp noise and finally due to development of high temperatures on the surface cut due to thermal stimulation. The Carisolv gel is effective only on the denuded fibres in the demineralized dentin, thus painful removal and damage to sound dentin is avoided.<sup>19</sup> According to Braum *et al*<sup>5</sup> slight anesthetic effect from the gel has also been observed.

A study was conducted by Fiske<sup>20</sup> to investigate whether

caries removal with Carisolv gel/air abrasion is an alternative to conventional local anesthetics and drills in the treatment of patients. Visual Analogue Scale was used to assess the pain using different methods of caries removal and it was concluded that air abrasion /Carisolv treatment was a well accepted and viable alternative to conventional local anesthetics and drill for dental patients.

b) Verbal Pain Scale: Of all the methods adopted in the present investigation, Papacarie method seems to be least painful with respect to caries removal. (Fig.5).The results were similar to those as observed by Gurbuz<sup>21</sup> who concluded that chemo-mechanical method was an effective method in removal of caries causing less pain and need for local anesthesia, thus decreasing fear, anxiety and stress of children.

Papain interacts with exposed collagen by the dissolution of dentin minerals through bacteria, making the infected dentin softer, and allows its removal with non-cutting instruments without local anesthesia and burs.<sup>6</sup>

Banerjee<sup>8</sup> stated that the reason for mild pain experienced in Group-III (Carisolv) and Group IV (Papacarie) was because of the prolonged time taken to remove the caries. Pain was reported during caries removal with high speed rotary instruments.<sup>3</sup>

## CONCLUSION

All the four methods removed caries effectively; however, the efficacy of caries removal using was highest with Airotor followed by almost comparable effectiveness by Papacarie and Carisolv method and the least by the hand instruments.

The time taken to remove caries by Carisolv method was observed to be significantly higher followed by Papacarie and hand instrument method. Minimum time was taken by Airotor method.

The pain experienced by the patients during caries removal was found to be least with Papacarie method, followed by Carisolv and hand excavation. Pain was significantly higher with Airotor.

The chemomechanical removal of caries with Papacarie and Carisolv were found to be effective measures and could be considered as viable alternatives to painful conventional procedures like Airotor in management of dental caries especially in children.

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