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## To compare the efficiency, efficacy, and pain perception with ceramic bur, diamond bur and hand excavation

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### Abstract

**Background:** By employing an airtor eradicates caries easily and rapidly, but it also has the potential to remove the affected dentin and sound bone. Caries excavation employing the typical method is often linked with pain and discomfort for patients.

**Aim:** The aim is to assess pain perception and compare the effectiveness and efficiency of caries removal methods using ceramic bur, conventional bur (diamond point), and hand excavation in children between 4-9 years.

**Methodology:** Evaluation of time (Efficiency): Evaluation of time (Efficiency): From the start of cavity preparation until the infected dentin excavation was finished, an assistant kept track of the amount of time needed to remove caries using a stopwatch. The efficacy of caries removal in the prepared cavity was examined for any residual carious dentin using caries detecting dye. The patient's pain response during the caries removal procedure was assessed by Wong baker faces pain scale.

**Results:** Caries removal efficacy was efficient with respect to ceramic bur. The amount of time needed to eliminate caries by ceramic bur was the least in contrast to conventional bur and hand excavation. Regarding the pain response that the patients felt during caries excavation, there was no difference found with respect to ceramic and conventional burs and also hand excavation.

**Conclusion:** Diamond burs would be suitable for excavating cavities in children since they demonstrated greater efficiency and less time consuming.

**Keywords:** Caries excavation burs, clinical trial, efficacy, efficiency

### Introduction

In pediatric dentistry, dental caries is a significant issue. The disease is multifactorial, meaning that host, behavioral, and environmental factors interact to cause it. It causes the organic portion of the tooth structure to disintegrate and the inorganic part to demineralize <sup>[1]</sup>. There are two layers in dental caries. Bacterial infected outermost layer of dentin, known as the superficial layer. This causes damage to the collagen matrix and destroys the dentin's mineralized tissue, making remineralization impossible. Caries excavation requires the entire removal of this layer. But bacteria infiltrate the inner layer (affected dentin), dissolving the mineralized tissue while leaving the collagen matrix's cross-banded ultrastructure intact. The inner layer of dentin caries can remineralize if these bacteria and the products of their metabolism, which are the primary cause of caries, are eliminated <sup>[2]</sup>. Pediatric dentistry faces challenges with the traditional use of rotary devices to treat tooth cavities. Among its many drawbacks are the patients' perceived discomfort, the need for local anaesthetic, and the removal of both diseased and healthy dentin, which needlessly weakens the integrity of the tooth. In addition, it may cause iatrogenic pulp exposure and has harmful thermal effects on pulpal tissue. Even with local anaesthesia, the patient may still experience discomfort from the caries extraction process due to their dread of needles, noise, and vibration from the mechanical preparation <sup>[3]</sup>.

The paradigm for managing dental caries has changed over the past few decades from "extension for prevention to prevention of extension", as a result of substantial research in the material sciences and cariology. The latest medical method to managing dental caries is called minimally invasive dentistry (MID), which emphasizes early disease prevention and interception while using caries-risk assessment [4]. Because of the non-selective caries removal, conventional caries removal burs like diamond and tungsten carbide bursts often remove a large amount of damaged and diseased dentin. In addition, if the cavity is adequately sealed to keep out oral debris complete excision of all existing caries may not be required to manage the lesion's growth [5].

Boston has unveiled a novel polymer bur to replace traditional burs. For the purpose of selectively removing carious dentin, Smart Burs™ (SS White, Lakewood, NJ, USA) is composed of a polymer with strengthened blades. Only infected dentin is removed by these burs; healthy dentin has a KHN of 70-90, whereas soft, infected dentin has a KHN of 0-30 and polymer material has a KHN of 50 [6]. Because only the carious portion of the tooth is removed with this bur, there is less possibility that the odontoblasts will be exposed, which can lessen discomfort and sensitivity during cavity preparation or the healing process.

Numerous investigations have been conducted in order to assess the effectiveness and efficiency of conventional caries elimination techniques against other minimally invasive caries removal treatment methods. Studies contrasting conventional and minimally invasive techniques along with pain perception are scarce, nevertheless. Thus, this study aimed to compare the effectiveness, pain perception, and efficiency of ceramic bur, diamond bur, and hand excavation.

**Materials and Methods**

Before the study was carried out, the institutional ethical committee reviewed and approved the research protocol. After gaining the parents' signed informed consent, study participants were chosen from the outpatient Pediatric and Preventive Dentistry department.

- **Group I:** Smart bur
- **Group II:** Diamond bur
- **Group III:** Hand excavation

This study used the lottery method for randomization, which resulted in a 1:1:1 allocation ratio for the randomized clinical trial. Two blinded examiners participated in order to prevent bias; one person assigned participants to groups, while the other evaluated cavities and made sure the prepared teeth were free of caries.

**Inclusion criteria**

1. Healthy, willing participants between the ages of 4 and 9 were chosen for the study.
2. Children with positive or definitely positive behaviour according to Frankel's behaviour rating scale.
3. Class I and V caries in primary teeth.
4. Caries limiting to dentin.
5. ASA Class I & II.

**Exclusion criteria**

1. Noncooperative child.
2. Caries extending beyond dentin.
3. ASA Class III, IV, V.

**Clinical Procedure**

**Group I:** Smart Bur group [N=20] The polymer bur (SmartPrep, SS White Burs, Inc., Lakewood, NJ, USA) was used to remove carious dentine. Without using water spray the bur was mounted on a low speed handpiece (500-800 revolutions per minute), as recommended by the manufacturer. After repeatedly coming into touch with healthy dentin, caries clearance was carried out until the polymer bur became dull. The quantity of burs required for every carious lesion has no upper limit. Unless the patient specifically requested it, caries was removed with only partial isolation and no local anaesthesia.

**Group II:** Diamond bur group (N=20) In order to prevent pulp damage, carious dentine was removed using a diamond point bur in generated heat under water irrigation. The procedure involved using a slow-speed contra-angle handpiece (API) and light, independent strokes aimed outward from the middle of the lesion. Cutting continued until no more softened dentin flakes emerged, at which point the bur was stopped from advancing into the healthy dentin. Caries were removed with just partial isolation and without the use of local anaesthetic, unless the patient requested it.

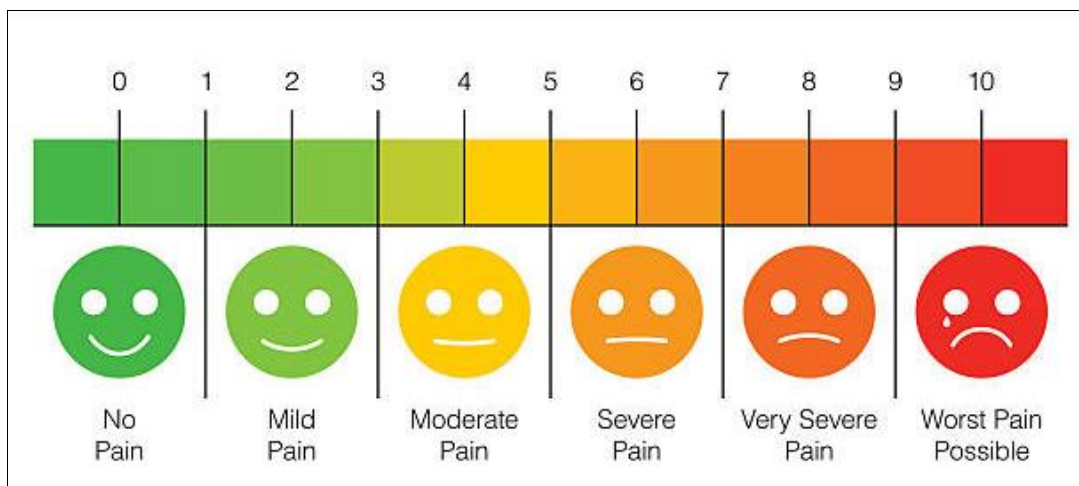
**Group III:** Hand excavation group (N=20) A spoon excavator was used to remove the carious dentine until hard dentine was seen.

In all the three groups the efficiency was assessed by the time taken to remove infected dentin and was recorded using a stop clock from the start of caries excavation until the entire infected dentin was removed. The efficacy was assessed using caries detector dye. Cavity was assessed by application of dye over the tooth surface Following ten seconds, the dye was removed with water, and a coinvestigator, who was not aware of the assignment, scored the sample numerically using the Munshi *et al.* standard scale.

Score	Criteria
0	Caries completely removed
1	Caries present in the base of the cavity preparation
2	Caries present in the base and/or in one wall of the cavity preparation
3	Caries present in the base and/or two walls of the cavity preparation
4	Caries present in the base and/or more than two walls of the cavity preparation
5	Caries present in the base, walls, and margins of the cavity preparation

After complete removal conventional restoration was done with glass ionomer cement for all the three groups. Patient's pain response during the caries removal procedure was assessed using Wong baker faces pain scale. The examiner

provided a printed copy this scale for every patient and asked to score the patient themselves how they felt throughout the procedure.



The collected data underwent statistical analysis following the clinical trial's conclusion. Numbers, percentages, means, and standard deviations were used to express the data. The one-way ANOVA (Post hoc) is used to determine the statistical significance between the groups, and it is followed by the Sheaffe t test. At a 95% confidence interval, a p value of less than 0.05 is deemed statistically significant.

**Results**

Comparison of mean efficiency between smart bur, diamond bur and hand excavation showed that hand excavation has required more time with least time for diamond bur. When intergroup comparison did not show any statistically

significant difference was seen. [Table 1]. Analysis of mean efficacy between smart bur, diamond bur and hand excavation showed that hand excavation had highest efficacy with least efficacy for smart bur. When intergroup comparison did not show any statistically significant difference was seen. [Table 2]. Analysis of mean pain perception between smart bur, diamond bur and hand excavation had smart bur had more pain perception with least pain perception for diamond bur group. When intergroup comparison was seen statistically significant difference was with diamond bur and hand excavation. [Table 3].

**Table 1:** Comparison of mean time taken between the three groups

Groups	Time taken (min) (MEAN±SD)	Comparison between the groups	P-Value
Group-I	1.50±0.38	I with II	0.625
		I with III	0.323
Group-II	0.85±0.23	II with I	0.625
		II with III	0.067
Group-III	2.54±1.94	III with I	0.323
		III with II	0.067

p>0.05 no significant difference compared between the groups

**Table 2:** Comparison of mean efficiency between the three groups

Groups	Efficiency (MEAN±SD)	Comparison between the groups	P-Value
Group-I	1.00±0.89	I with II	0.741
		I with III	0.182
Group-II	0.67±0.81	II with I	0.741
		II with III	0.517
Group-III	0.17±0.40	III with I	0.182
		III with II	0.517

p>0.05 no significant difference compared between the groups

**Table 3:** Comparison of mean pain perception between the three groups

Groups	Pain perception (MEAN±SD)	Comparison between the groups	P-Value
Group-I	2.33±1.50	I with II	0.019
		I with III	0.884
Group-II	0.16±0.40*	II with I	0.019
		II with III	0.048
Group-III	2.00±1.26*	III with I	0.884
		III with II	0.048

\*p<0.05 significant difference between the groups

**Discussion**

Conventional burs are made to effectively eliminate decalcified enamel and dentine, but because of their less cautious approach, they are deemed unsatisfactory because they are unable to distinguish between carious and normal

dentine.<sup>7</sup> The polymer bur is a special type of rotary tool that removes damaged dentine only, leaving good dentine intact. It is made of medical-grade polyether-ketone-ketone. This characteristic stems from the fact that the instrument's hardness is less than that of healthy dentine. Furthermore,

compared to employing traditional burs, this minimally invasive excavation has the benefit of cutting less dentin tubules, which in turn triggers fewer pain feelings.<sup>8</sup> Dental professionals and researchers are now very interested in the idea of self-limiting, painless caries eradication, particularly in pediatric dentistry. Because of this, the polymer bur has become a relatively recent type bur on the dentistry market, promising to be the best bur for selective caries eradication. Therefore, a clinical trial regarding the comparative evaluation efficiency, efficacy and pain perception among smart bur, diamond bur and hand excavation was required. This study used the criteria of efficiency, efficacy and pain response among there method of caries excavation was seen.

In this study, it has been proved that better tactile control was seen with polymer bur but lesser caries removal efficiency was when compared to diamond bur which are traditionally used. Pain perception with polymer bur was less in comparison to hand excavation but higher than diamond bur. The time taken was longer with smart bur which one of the major criteria to be considered in pediatric dentistry making the use of this method to be questionable.

The polymer bur quickly wears down and loses its cutting effectiveness when it comes into contact with dentin, which is why the smart bur takes longer to finish caries excavation. A fresh bur is then attached to the handpiece. With diamond bur, this kind of abrasion does not happen. Consequently, it was necessary to repeatedly change the bur until all caries was removed. The findings of the present investigation align with those of Wahba *et al.*<sup>[10]</sup> and Shakya *et al.*<sup>[11]</sup> who conducted a comparative analysis between the polymer bur (SmartPrep) and conventional burs (diamond points), coming to the conclusion that the former worked better than the latter.

According to our findings, diamond bur is typically a quick and non-conservative way to remove dental cavities, which is consistent with Banerjee *et al.*'s<sup>[9]</sup> findings. Our results confirmed that this technique is susceptible to being influenced by the operator's criteria due to its speed and mode of operation, which may make it less sensitive and harder to manage.

Compared to bur, hand excavation would produce a more regulated, tactile controlled caries removal technique. Nevertheless, access to the regions directly beneath enamel was not always possible. Due to which for cavity preparation, the extra use of diamond burs is nearly always required to remove the remaining caries left after hand excavation<sup>[12]</sup>.

Since the visual and tactile criteria is the majorly used criteria to assess full caries eradication, it was chosen in the current investigation. It is commonly known that tactile and visual examinations alone are not always sufficient to consistently and precisely identify diseased carious dentin. Fortunately, carious dentin removal was being supervised by stains appearing with caries detection dyes, which is how the cavity preparations in the current study were examined for accuracy of caries removal<sup>[13]</sup>.

Since pain is a challenging to measure subjective parameter, the "Wong-Baker Faces Pain Rating Scale," which is understandable also appropriate for the children's belonging to the particular age was group chosen for this assessment, was used to evaluate patient pain response of the treatment procedure. The hand-excavation group reported far low pain response in contrast to polymer bur group. It seems that the hand excavator group experienced significant initial psychological alleviation as a head start on the treatment when the drill was not used. While vibration, noise, overheating, and excessive pressure were the main causes of

the severe pain and discomfort in the polymer bur group, the unpleasant sensation of scraping the decay was likely the reason of the pain response in the hand excavation group. Similar findings from investigations carried out by Pandit *et al.*<sup>[14]</sup> and Kochhar *et al.*<sup>[15]</sup> further support these conclusions.

## Conclusion

**In summary from the study's limitations, the following conclusions can be drawn**

- When compared to traditional hand excavators and diamond bur, the use of polymer burs did not increase the effectiveness in primary molar dentine caries removal.
- Using polymer bursts in place of traditional hand excavators did not reduce children's perception of pain.
- Until today, diamond bur of carious lesions is still the "gold standard" for dentin caries removal.

As far as we are aware, no reported research has been done to compare polymer bur, diamond bur and hand excavators for dentin cutting; hence, additional research is required to validate our findings.

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