

How to Cite:

Gunjal, P., Chauhan, R. S., Tirupathi, S., Patil, V., Suvarna, A., & Shah, S. (2022). Comparative evaluation of caries removal efficacy using enzymatic gel BRIX 3000® and polymer burs in primary molars: In vivo study. *International Journal of Health Sciences*, 6(S8), 3957–3965. <https://doi.org/10.53730/ijhs.v6nS8.13023>

Comparative evaluation of caries removal efficacy using enzymatic gel BRIX 3000® and polymer burs in primary molars: In vivo study

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Abstract---Aim: The study compares and evaluates enzymatic gel Brix 3000® and Polymer bur (SS White) for caries excavation in primary molars in terms of two parameters such as pain reaction and the time taken for caries excavation. Method: 60 children aged 7-9 years who require caries removal were recruited for the study and were randomly allocated into two groups: Group-A: Enzymatic gel (Brix 3000)®,

Group-B: Smart burs (SS White polymer burs). The objectives evaluated were, observed pain reaction of the child (SEM scale) during the procedure and the total time taken for caries excavation. Results: The results suggest a significant difference between among the groups Brix 3000[®] showed superior results compared to group B (Smart burs) i.e., use of Brix 3000[®] for caries excavation took less time and showed minimal pain reaction. Conclusion: We can conclude that the newer enzymatic gel Brix 3000 is a viable alternative to other minimally invasive procedures. Clinical Significance: Method practiced to minimise the treatment time and discomfort, especially in pediatric age group it becomes important factor to obtain child cooperation. With use of that can make clinician to invest less time & cause less pain to the child will save time for both the child and the clinician along with providing efficient care.

Keywords---Brix 3000[®], caries excavation, chemomechanical agent, enzymatic gel, minimal invasive dentistry, primary teeth, polymer bur, pain, duration.

Introduction

The management of dental caries has evolved over the last few decades with a change of concepts from 'extension for prevention' to 'prevention of extension'.¹ Minimal invasive dentistry (MID) is the modern medical approach to the management of caries.² With advances in adhesive dentistry, minimally invasive procedures have gained prominence.³ Caries removal by traditional methods using rotary equipment & sharp instruments has certain drawbacks such as difficulty in removing the exact amount of infected dentin, pain, discomfort, generation of heat, vibration & noise.² Various minimally invasive techniques have been documented such as air abrasion, atraumatic restorative technique, sonoabrasion, laser and chemomechanical caries removal (CMCR).⁴⁻⁸ Among all these techniques, CMCR is the most accepted technique in paediatric dentistry as an alternative to traditional drill and fill technique.⁹

CMCR is a minimally invasive technique that removes infected dentin through a chemical agent and preserves healthy tooth structure. It eliminates the fear of the drill and sound produced by the drill thus reducing fear and thereby increasing the patient's comfort.² Compared to conventional treatment process, the chemomechanical method for removing caries is known to be less painful.⁹ Many materials are used for CMCR. These include Carisolv, Caridex, GK-101, Papacarie, Carie-care.^{7,10-12} The latest product introduced in the CMCR system is enzymatic gel-based product Brix 3000[®].^{1,13} Brix Medical Science, Argentina, introduced it in 2012 as a patented papain-based gel formulation. The high concentration of papain (3000 U/mg) and Encapsulating buffer emulsion (EBE) technology, which provides the gel with the optimal pH to immobilise the enzyme at the moment of exerting proteolysis in collagen, thus increasing its activity and specificity, are unique features of this product. ¹

Conventional burs can effortlessly remove the decayed tooth structure; however, they readily wont differentiate between normal and carious dentin, and thus have a less conservative approach, and this excess removal of dentin occurs as conventional burs have a greater Knoop hardness of (7,000 KHN) which also increased risk of pulp exposure in the deep carious lesion.¹⁴ traditional burs normally have a negative rake angle, resulting in excessive dentin removal.¹⁵ Also, other drawbacks such as as high-pitched noise, increase in the friction induced heat at the surface, which can cause thermal injury is experienced with use of conventional burs. However, use of conventional burs have advantages of being less time-consuming and have decreased residual microorganisms present at the site after removal of caries. Thus, use of such bur that have more conventional approach and will prevent removal of affected dentin along with convenience for use in pediatric age group is required.¹⁶

Polymer burs are a unique rotary instrument made of specially designed polymer material (medical grade glass bead reinforced polymer) that according to the manufacturer selectively removes decayed dentin without cutting the healthy dentin as it is a self-limiting instrument.^{2,17} Polymer burs are used with a low-speed handpiece and without water coolant, which reduces the sound produced by arotor and gag which may occur due to accumulation of water while using arotor.² Smart Burs are paddled-shaped polymer burs, made up of polyether-ketone-ketone. The hardness of Smart Bur (50KHN) is higher than infected dentin (15-20KHN) and less than healthy dentin (68KHN), which allows it to selectively cut the infected dentin, leaving behind affected dentin intact.¹⁴ While using polymer bur for caries excavation, after removal of desired infected dentine the Smart bur dulls and vibrates when in repeated contact with healthy calcified tooth structure (enamel, dentin) or restorations (amalgam, composite) and this helps to know when to stop the excavation of caries.^{2,14}

A quick, comfortable, and precise restorative procedure is the ultimate goal in the pediatric age group, which in turn will make children accept the procedure without fear and tears. There is a paucity of literature, regarding the use of Brix 3000[®] and polymer burs in primary teeth. Thus, this in-vivo study is planned to evaluate and compare caries removal efficacy using enzymatic gel Brix 3000[®] and SS white polymer burs in primary molars by checking the mean time required to complete the caries excavation and pain reaction of children.

Material and Methods

60 children aged 7-9 years who were attending the OPD Department of Pedodontics and Preventive dentistry, Dr. D. Y. Patil Dental College and Hospital, Pimpri, Pune. These were divided in 2 groups Group I and Group II using simple random sampling (chit method). The objective of this current study was to assess and compare the efficacy of caries excavation using enzymatic caries removal gel Brix 3000[®] (Group-I) and polymer burs (SS white polymer bur) (Group-II) in primary molars with respect to mean time required to complete caries excavation and pain reaction. Patients included in this study were those with presence of occlusal carious lesion in primary molars in maxillary / mandibular arch, radiographic examination will be done to detect extent of Carious lesion with involvement of dentin, apparently healthy children, kids displaying Frankl's

behavioral rating positive and definitely positive during clinical examination. Patient were not included in study if presence of proximal caries, clinical and/or radiographic pulp involvement and periapical pathosis, patient with chief complaint of pain. Patient requiring local anesthesia will be excluded from the study, highly uncooperative child, medically compromised or intellectually disable.

Caries removal in Group I was carried out following isolating teeth using saliva ejector and cotton rolls. Application of material was done and left for 2 minutes before initiation of caries excavation following the manufacturer's recommendation. Decayed dentin that gets soft was scraped away with blunt spoon excavator without pressure. If required , the procedure was repeated to get healthy dentin. Complete removal of Caries was confirmed using caries detecting dye. *Figure-1 and Figure-2*



Figure-1: Armamentarium and material used in group I



Figure-2: Caries excavation with Brix 3000

In Group II Selection of polymer bur size (RA4, RA6, RA8) was done according to size of carious lesion. *Figure-3* Bur was attached to low-speed handpiece without water coolant and caries excavation was done with circular motion starting from centre of lesion to periphery as recommended by manufacturer. Excavation was stopped when instruments become macroscopically abraded and blunt and was no longer able to remove tissue. Complete removal of Caries was confirmed using caries detecting dye. *Figure-4* The mean time was calculated from beginning of caries excavation till confirmation of caries removal with caries detector dye using stopwatch. The pain reaction of the patient was evaluated using sound, eye,

motor (SEM) scale by a blinded observer. *Table-1* An independent observer measured the time required for excavation of caries.



Figure-3: SS white Polymer Bur Bur size (RA4, RA6, RA 8)



Figure-4: Caries excavation with SS white Polymer Bur

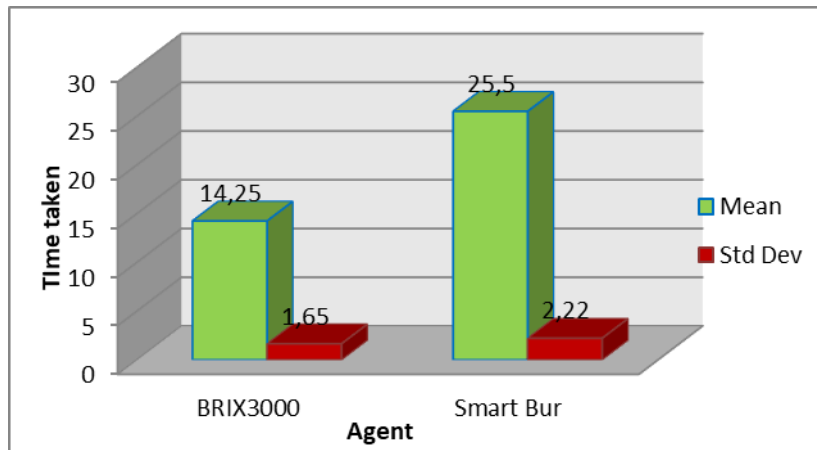
Results

In the current in-vivo study total number of 60 primary molar with occlusal caries were selected from 60 patients aged 7-9 years. The patients were divided into group I and group II using simple random sampling method. *Caries excavation mean time* : The mean time required for caries excavation in Group I was less (13.24 minutes) when compared to Group II (21.50 minutes). A significant difference was observed between time taken for excavation of caries with Brix 3000 and polymer bur ($P = <0.0001^*$). Group I took less time as compared to Group II. (*Table-1*) and (*Graph 1*)

Table-1: Data representing the mean time taken for caries excavation.

Group	No	Minimum	Maximum	Mean	Std. Deviation	Difference	t-value	Significance
Group I	30	10.00	16.50	13.24	1.65	7.91	7.52	<0.0001*
Group II	30	18.00	28.50	21.15	2.22			

*Significance at $p < 0.05$. A significant difference is observed between time taken for excavation of caries with Group I and Group II. Group I took less time as compared to Group II.

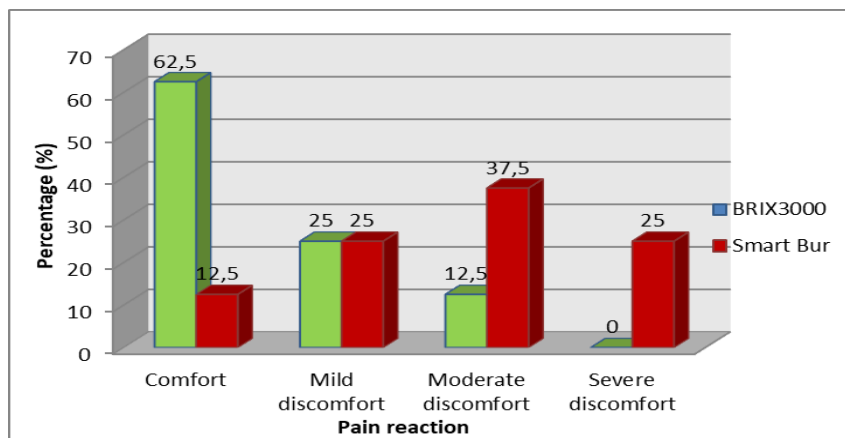


Graph no.1- Bar diagram representing mean time taken in BRIX3000 (Group I) and Smart Bur group (Group II).

Caries excavation pain reaction : In Group-I 53.3% (n=16) of children appeared to be comfortable, 26% (n=8) to be mildly discomfortable and, 20% (n=6) moderately discomfortable while caries excavation. That shows a greater number of children comfortable with Group I procedure. In Group-II 13% (n=4) of children appeared to be comfortable, 25% (n=10) to be mildly discomfortable, 26.6% (n=8) moderately discomfortable and, 26.6% (n=8) severely discomfortable while caries excavation. That shows a greater number of children having moderate discomfortable with Group II procedure. The difference in the pain reaction between Group I and Group II was evaluated using Mann-Whitney U test. A significant difference (P = 0.044*) was observed between Group I and Group II with respect to pain reaction. (Table-II) and (Graph II)

Table no-2: Difference in the pain reaction between Group I and Group II

Pain reaction	Group-I		Group-II	
	Frequency (f)	Percentage	Frequency (f)	Percentage
Comfort	16	53.3	4	13
Mild Discomfort	8	26	10	25
Moderate Discomfort	6	20	8	26.6
Severe Discomfort	0	0	8	26.6
Total	30	100.0	30	100.0
Mann-Whitney U	11.00			
p-Value	0.044*			



Graph no.2-Bar diagram representing frequency distribution of pain reaction in BRIX3000 (Group I) and Smart Bur group (Group II).

Discussion

CMCR method of caries removal is minimally invasive and is a useful armamentarium, especially for caries removal in young paediatric patients. The present study was done on primary molars (both maxillary and mandibular), only occlusal carious lesions were selected due to the reason that less modifications will be required for cavity preparation which allows better evaluation of efficacy among both the modalities evaluated. We have adopted carious detection dye method to evaluate the removal of carious tissue, unlike other studies which evaluate carious tissue removal with tactile and visual methods which are less accurate.^{13,18} Caries detecting dyes stain the organic matrix of infected dentine. Caries detecting dyes are composed of two components including a dye and a solvent mostly made of propylene glycol. Solvents with low molecular weight can penetrate deeper into permeable tissues compared to those with high molecular weight. Dyes absorb specific wavelengths of light more than others; therefore, discolorations can be clearly distinguished, hence removal of carious dentin can be done precisely. Therefore, using caries detector dyes, the caries excavation in this study were tested for completeness of caries removal.¹⁹ SEM scale is an objective method of pain assessment that assesses pain experience by measuring sound, eye and motor observation components of the child's reaction to the pain stimuli.²⁰ Hence, the SEM scale was used in the present study to measure the parameters of pain reactions of the children during caries excavation in Group I and Group II. Brix 3000[®] caused less discomfort and pain compared to polymer bur. In the article by Inamdar et al 2020 compared Brix 3000 and polymer burs for caries excavation in permanent molars teeth and reported that Brix 3000[®] was more efficient.^[1] In another study by Alkhouli et al 2020 who compared Brix 3000[®], 2.5% sodium hypochloride gel and traditional bur, the efficacy of Brix 3000[®] is comparable to 2.5% sodium hypochloride gel.^[13] Brix 3000 has additional advantage of being safer in comparison to sodium hypochloride gel. Time is also an important factor in the dental treatment of the pediatric age group as children have very short attention span. Thus, short appointment makes them willing toward treatment. In present study time required for caries excavation in both groups was monitored with the help of stopwatch. In present study Group I (Mean

time - 13.24 minutes) was found to consume less amount of time than that taken by Group II (Mean time – 21.15 minutes). A method requiring less time and causing minimal pain, provides effective way for management of children in pediatric dental practice. Use of Brix 3000® can be considered in fulfilling this requirement by eliminating fear of the child towards dental treatment.

The study limits to the pain response of the child towards the treatment is measured with the SEM scale, although, the response might vary depending upon the pain threshold of particular child. Thus, further studies for measuring pain response accurately are needed. This study also includes time required for the procedure and this parameter may vary with operator skills and the child's psychology, understanding, and acceptance towards treatment.

Conclusion

From this study we can conclude that Brix 3000® can be efficiently used in pediatric dental procedures as Brix 3000® showed superior results, it showed to be a less invasive and more comforting procedure requiring minimum time for caries excavation as compared to polymer burs. Further in vivo studies are needed to confirm the efficacy of Brix 3000® when compared to polymer burs.

Clinical Significance

Method practiced to minimise the treatment time and discomfort, especially in pediatric age group it becomes important factor to obtain child cooperation. With use of that can make clinician to invest less time & cause less pain to the child will save time for both the child and the clinician along with providing efficient care.

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