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Comparison of clinical performance of newer chemo-mechanical caries removal system and conventional cavity preparation technique in children

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Abstract---Objective: The study was aimed to compare the clinical performance of newer chemo-mechanical caries removal system and conventional cavity preparation technique in children. Study Design: Forty primary molars or first permanent molars of twenty children

between the age groups of seven to ten years were selected randomly and divided into two groups of twenty teeth each: Group I was treated by the mechanical method and Group II with Brix 3000 gel method. The efficacy, time taken, and the pain threshold were evaluated during the caries removal by Ericson D et al. scale, stopwatch and modified visual analog scale, respectively. The preferred choice of treatment was assessed using a questionnaire. Results: The comparison between the time taken by the two methods showed a significant difference ($P < 0.05$). The caries removal efficacy indicated a significant difference as well ($P < 0.05$). The pain rating results indicated a notable difference in the mean Visual Analogue Scale score ($P = 0.001$). The comparison between the two choices of treatment indicated a significant difference at $p \leq 0.05$. Conclusion: It was concluded that airotor was efficient in caries removal and while Brix 300 had lower pain rating and better patient acceptance.

Keywords---chemical removal of caries, Brix 3000, caries removal, efficacy, pain assessment.

Introduction

According to a systemic review and meta-analysis by Mohsen Kazeminia et al., the prevalence of dental caries in primary teeth in children in the world was 46.2%, whereas the prevalence of dental caries in permanent teeth in children in the world w was 53.8%. The World Health Organization (WHO) has represented early childhood caries as a global problem with a prevalence of between 60 and 90%. According to the current statistics of the European countries, 61% of children aged 6 to 12 years have at least one decayed tooth.[1] It is very important for every pediatric physician to know about the signs and symptoms of dental caries, its sequelae if untreated, and its impact on general health. Sometimes an unexplained fever in a child may be related to an abscess associated with the carious tooth with the infection spreading into the jawbone. An otherwise asymptomatic, untreated carious lesion can lead to the spread of infection into the bone via the root resulting in submandibular or deep cervical lymphadenopathy.[2]

Thus, it becomes important to excavate caries at the earliest. In the beginning, there was the wheel, and later, the wheel was replaced by air-driven handpieces, which, over time, became faster, currently revolving at up to several hundred thousand times per minute. Nevertheless, the fundamental drawbacks of the drilling approach, being inherent to the technique, remained: unpleasantness to the patient, the necessity of local anesthesia, and potential adverse effects on the pulp due to heat and pressure.[3] It was at this point that the chemomechanical approach came in. It was claimed to be a non-invasive alternative for the removal of carious dentine. In essence, the technique involved applying a solution onto the decayed dentinal tissue, allowing it to soften the tissue, and, finally, scraping it off with blunt hand instruments. Alleged advantages included removal of infected carious tissue only, absence of pain (therefore elimination of local anesthesia),

and absence of potentially deleterious effects to the dental pulp due to heat and pressure.

Chemo mechanical caries removal has been developed as an alternative to the conventional methods. Compliance by some children in dental care can be poor, even with good behavior management. In order to overcome these problems of removal, several conservative caries removal methods have been developed. The objective of chemomechanical substances is to remove the most external portion (infected layer), leaving the affected demineralized dentin that is capable of being remineralized and repaired. Chemo mechanical methods are said to remove only the infected dentin where collagen is degraded, maintaining the demineralized portion.[4] The aim of this study is to evaluate and compare the clinical efficacy of the chemomechanical caries removal technique used with the chemical agent, Brix 3000, with conventional caries removal technique.

Materials and Methods

With the approval from the ethical committee of the institution, 20 children of both sexes between the age group of 7-8 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

- Healthy children of both sexes from the age group of 7-10 years
- No previous dental history
- The teeth selected are permanent first molars or second primary molars
- The patient should have at least two deep dentinal carious lesions on occlusal and/or proximal surfaces without the involvement of pulp, as verified by a radiograph.

Exclusion criteria

- Teeth indicated for definitive endodontic treatment.
- Teeth with grade II/ grade III mobility
- Patients with systemic disorder.
- Patients who are mentally compromised.
- The children were selected from the Department of Pediatric and Preventive Dentistry according to the inclusion criteria mentioned. Consents of parent and child assent form were filled and taken. The sites for conventional cavity preparation and for cavity preparation by Brix 3000 were decided by coin test. All the selected teeth were isolated using rubber dam.

Group I (20 teeth): Caries removal by airotor

Caries were excavated, and cavity was prepared with round bur depending on the extent of caries and following the principles of cavity preparation. The caries removal was checked by a second examiner and also using caries detection dye.

Group II (20 teeth): Caries removal by BRIX 3000

BRIX3000 gel was applied directly to the carious lesion by applicator tip for 2 minutes, after which the cavity was washed, and gentle excavation was done using hand instruments. On application, the gel was initially clear but became opaque and cloudy with the debris in the lesion. The caries removal was checked by a second examiner and also using caries detection dye. The procedure was repeated till the tooth was no longer contaminated with the debris. 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 patient acceptance were evaluated during the caries removal by Ericson D et al. scale, a modified version of the visual analog scale and patient acceptance forms (in 3 local languages), respectively. After the carious dentin was removed, the cavity was restored with glass ionomer cement type 2 and composite resin.

Results

- Assessment of Time Taken For Caries Removal
  Table 1 shows that the mean time taken for caries removal by Brix 3000 is around 9 minutes while airotor requires a mean time of 5.8 mins. The comparison between the two was done using independent t-test. The result indicates a significant difference in the mean caries removal time using two techniques before the procedure ($P < 0.05$).
- Assessment of Efficacy Of Caries Removal [5]
  Table 2 shows the caries removal score using mechanical and chemomechanical before and after the procedure, which was compared using a one-way Mann-Whitney U test. The result indicates a significant difference in the mean caries removal score using two techniques before the procedure ($P < 0.05$).
- Assessment of Pain Rating:[6]
  From Table 3 it can be seen that more pain was endured when airotor was used. The results indicate a significant difference in the mean VAS score ($P < 0.001$).
- Patient Preference
  Table 4 indicates the patient's choice of treatment based on the questionnaire. The comparison between the two choices of treatment is done using Chi-square goodness of fit test; * indicates a significant difference at $p \leq 0.05$. We can successfully reject the null hypothesis and conclude that there are statistically significant differences in the preference of the type of method, with fewer people preferring the "Airotor" ($N = 2$) compared to the "BRIX" ($N = 18$)

Discussion

Dental caries is one of the most common childhood diseases. It is one of the primary causes of oral pain, tooth loss, and other complications. However, dental caries can be arrested and potentially reversed in its early stages, but it is often not self-limiting, and without proper care, caries can progress until the tooth is destroyed. There are various techniques for the removal of caries. The oldest approach to the treatment of caries was by hand instrument, which was a

painful, effective, and tedious method for caries removal. However, because of the shortcomings of the drill, alternative techniques such as air abrasion, sono-abrasion, lasers, and chemomechanical methods of caries removal were developed. These methods have disadvantages, 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. [2]

Therefore, the chemomechanical approach is documented alternative to traditional drilling. Chemomechanical caries removal (CMCR) has been introduced as an alternative method of caries removal. CMCR is a method of caries removal based on dissolution. Instead of drilling and using sharp excavators, this method uses a chemical agent assisted by an atraumatic mechanical force to remove soft carious tooth structure. Recently introduced, BRIX 3000 is a chemomechanical caries removal method. This gel is a dental product for non-traumatic caries treatment involving an enzymatic activity (3.000 U/mg*) in which the papain is bio-encapsulated by using EBE Technology (Encapsulating Buffer Emulsion) exclusive technology that immobilizes and confers stability, which increases the enzymatic activity of the final product exponentially with respect to current technology. Thus, the following is achieved: higher proteolysis effectiveness to remove collagen tissue in decayed tissue, less dissolution of active principle by oral fluids, greater resistance to storage even in unfavorable conditions, without requiring cold-chain preservation, and greater antibacterial and antifungal potency with an increase in antiseptic effect on tissue.[7]

Assessment of time taken for caries removal

According to Hegde RJ et al., Airotor removed caries in minimum time, followed by Carie care.[8] This was in accordance with a study conducted by Nalwade HS et al[9]. In the study, the time needed for caries excavation was observed to be higher with the use of Carie-Care compared to the conventional method. A statistically significant difference ($P < 0.01$) was seen with the conventional group requiring lesser time for caries excavation. This could be attributed to the multiple applications of the gel required for its enzymatic action to occur over the carious lesion and the use of hand instruments when compared to the airotor. According to Jawa D et al.[10], the mean time for complete caries excavation with Papacarie was 328.5 seconds. This was significantly much longer compared with the conventional method, wherein the mean time was 124.6 seconds, thus proving chemomechanical caries removal takes a longer time.

Assessment of efficacy of caries removal

The results indicated that the efficacy of caries removal was higher with Airotor than with BRIX 3000. The results were in accordance with the study by Banerjee et al[11]., which showed that the efficacy of caries removal was best with Airotor. A study by Kocchar et al.[12] also concluded that the efficacy of airotor was higher than that of Carie Care and Carisolv. The results also agreed with the results of a study by Hedge RJ,[8] which stated that the efficacy of airotor was better than that of Carie Care. The studies done by Ericsson et al., Watson et al., had also

concluded that no significant difference was seen between the Carisolv and bur in removing infected dentin.

Assessment of pain rating while excavation of caries

According to this study, the patients felt more pain when airotor was used. There was a significant difference the patient acceptability. This result was in accordance with a study done by Hegde et al., where the pain experienced by the patients was found to be maximum with airotor followed by chemomechanical. Similar data have been presented in the studies by Rafique et al.[13], which concluded that chemomechanical caries removal agents for caries removal were well-accepted by patients in comparison to airotor.

Patient preference

According to this study, the patients preferred BRIX 3000 to airotor. There was a significant difference the patient acceptability. This result was in accordance with a study done by J.H.Zinck et al.[14] in which they compared patient acceptance to CARIDEX and airotor. The patients preferred the chemomechanical caries removal system. This result also agreed with the study done by Priyanka Sontakke et al.[15], in which they compared the patient acceptance between CARIE-CARE GEL and airotor. However, the results showed a contradiction to a study done by Maragakis Gh et al.[16], where the patients showed more acceptability toward conventional caries removal than chemomechanical.

In the current situation, when the world is facing a global pandemic, dentistry has had a paradigm shift. The novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has precipitated the COVID-19 pandemic. Alongside the safety protocols, many countries suspended elective and non-urgent dental care, closing many practices with only emergency treatment provisions. Children are considered to be silent carriers of the novel coronavirus, and thus utmost safety protocols should be followed. The WHO recommended to used non-aerosol generating procedures wherever possible to reduce the contamination. With the aim of performing caries excavation without generating aerosol chemomechanical caries, removal is always a better alternative during this pandemic.

Conclusion

In conclusion, according to the results of the study, though caries removal efficacy is significantly higher with airotor, the patient acceptance is more with BRIX 3000. One can use chemomechanical caries removal to help make an anxious child comfortable in the dental setting. Nevertheless, for better efficacy, airotor should be preferred. Also, though caries removal time is lower with an airotor, the pain experienced is more with the airotor

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Table 1
Assessment of time taken for caries removal

Group	Mean (in minutes)	SD	Difference	t value	p value
BRIX	9.35	0.93	3.55	12.281	0.001*
Airotor	5.80	0.89			

Table 2
Assessment of caries removal efficacy

Group	Mean Rank	Z value	p value
BRIX	30.43	-5.483	0.001*
Airotor	10.58		

Table 3
Assessment of pain rating

Group	Mean Rank	Z value	p value
BRIX	10.50	-5.528	0.001*
Airotor	30.50		

Table 5
Assessment of patient preference
Erickson D scale for caries removal

Group	Observed N	Expected N	x^2 value	p value
BRIX	18	10	12.800	0.001*
Airotor	2	10		

Caries removal score
0 - Caries removed completely
1 - Caries present in the base of the cavity
2 - Caries present in the 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 6
Modified wong bakers pain rating scale score

DESCRIPTION	SCORE
NO HURT	1
HURTS A LITTLE	2

HURTS LITTLE MORE	3
HURTS EVEN MORE	4
HURTS A LOT	5
HURTS WORST	6

Figure 1. Caries involving enamel and dentin

Figure 2. Caries removal using airotor

Figure 3. Caries removal after using airotor

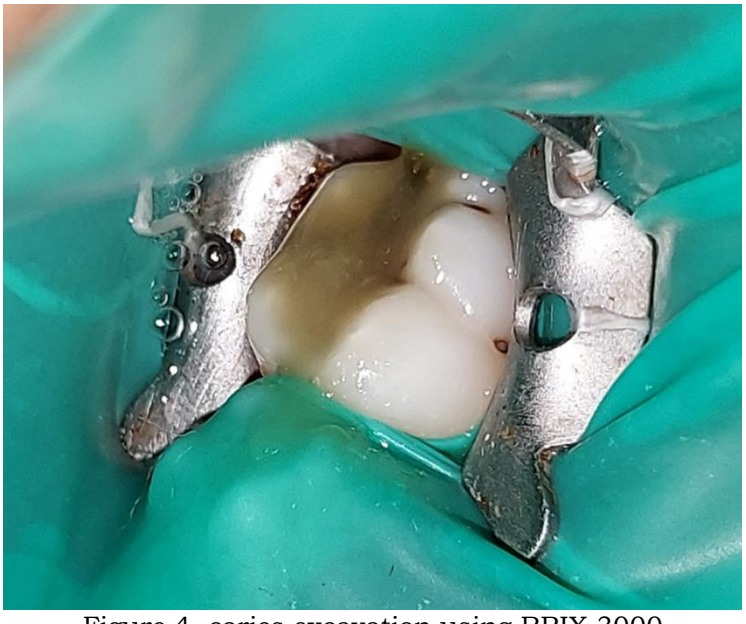

Figure 4. caries excavation using BRIX 3000

Figure 5. Caries removal after application of BRIX 3000

Figure 6. Modified Wong bakers pain rating scale