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Comparison of pain and efficacy of caries removal using tungsten carbide bur versus chemomechanical agent (Brix Gel): A randomized controlled trial.

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ABSTRACT… Objective: To compare the pain response and efficacy of caries removal using tungsten carbide burs with that of using Brix Gel as a chemomechanical caries removal agent. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Operative Dentistry, PIMS, Islamabad. **Period:** November 2023 to April 2024. **Methods:** Conducted on 40 participants were selected using a non-probability technique. Participants aged 12 to 65 years with open occlusal carious lesions involving dentin were included. Patients with symptoms of pulpitis, caries affecting maxillary or mandibular anterior teeth, severe systemic illnesses, allergies, sensitivities, or pregnancy/lactation were excluded. Caries removal methods were randomly assigned. Pain levels were assessed using a Visual Analog Scale (VAS), and caries removal efficacy was evaluated. Statistical analysis was done using chi-square and independent samples t test. **Results:** Among the 40 participants, 47.50% were female, and the mean age was 36.30±15.57 years. Mandibular molars were the most commonly affected teeth (n=24, 60%). No significant difference in age or gender distribution was observed between the two groups. The chemomechanical method resulted in significantly lower pain scores compared to carbide bur (2.59 ± 1.34 vs. 4.44 ± 1.61, $p < 0.001$). Pain severity also differed significantly between groups, with more mild pain reported in the chemomechanical group (80.00% vs. 5.00%, $p < 0.001$). However, caries removal efficacy did not significantly differ between the two methods ($p = 0.48$). **Conclusion:** Chemomechanical caries removal using Brix Gel demonstrated superior pain management compared to carbide bur. While both methods showed similar efficacy in caries removal, the chemomechanical approach may offer better patient comfort during the procedure.

Key words: Carbide Bur, Chemomechanical Method, Caries Removal, Efficacy, Pain.

INTRODUCTION

Dental caries, also known as tooth decay or cavities, is a widespread and chronic oral health issue affecting people of all ages globally.[1,2] It is a complex disease that involves the breakdown of tooth enamel and the subsequent damage to the underlying layers of the tooth, such as dentin and pulp tissue.[3,4] The process begins when oral bacteria, primarily Streptococcus mutans and Lactobacillus species, interact with dietary carbohydrates to produce acids. These acids erode the tooth structure, leading to the demineralization of the enamel. Over time, this can result in small holes or cavities in the tooth surface.[5]

Poor oral hygiene practices, such as irregular brushing and flossing, allow plaque a sticky film containing bacteria to accumulate on the teeth and contribute to the decay process.[6] Other risk factors for developing dental caries include a diet high in sugary and acidic foods and drinks, limited access to fluoride, dry mouth, and certain medical conditions or medications.[7] Preventative measures for dental caries include maintaining a regular oral hygiene routine, such as brushing twice daily with fluoride toothpaste and flossing, using fluoride treatments, and limiting the intake of sugary foods and drinks. Regular dental check-ups and professional cleanings can help detect and address early signs of tooth decay before they worsen.[8]

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The removal of caries can be achieved through several techniques, primarily mechanical removal using carbide burs and chemical methods. Mechanical removal involves using rotary instruments like carbide burs to cut away decayed tooth structure, effectively arresting the progression of the disease while preserving healthy tooth tissue. This method is precise and allows for the restoration of the tooth's structural and functional integrity.[9] Chemical methods, such as silver diamine fluoride (SDF), can also be employed to halt the decay process by hardening and stabilizing the affected area, though it may leave a dark stain on treated teeth. The choice of method for removing caries depends on various factors, including the severity and location of the decay, the patient's age and overall health, and the dentist's clinical judgment. Pediatric patients, for instance, may benefit from less invasive approaches to minimize discomfort and anxiety. Once the caries has been removed, the tooth is typically restored using materials such as composite resin, amalgam, or glass ionomer to ensure the tooth's functionality and aesthetics are maintained.[10,11]

In many cases, a combination of mechanical and chemical methods may be used to effectively manage caries. Traditionally, the use of tungsten carbide burs, a staple in dental practice for their cutting efficiency, has been the standard for caries removal. However, this method is associated with pain and discomfort in patients, leading to dental anxiety and reluctance to seek treatment.[12] The fear of experiencing pain and the noise generated by dental drills during procedures are significant factors in dental phobia. In recent years, chemomechanical caries removal agents, such as Brix Gel, have emerged as promising alternatives to bur-based techniques.[13] Chemomechanical caries removal agents combine chemical dissolution of carious tissue with minimal mechanical intervention, offering a novel and promising alternative to traditional bur-based techniques.[14]

With a dearth of local studies addressing the comparison between traditional tungsten carbide bur and chemomechanical agent (Brix Gel) for caries removal in terms of pain and efficacy, this randomized controlled trial aims to fill this gap. By directly comparing these methods, we seek to provide evidence-based guidance to clinicians regarding the optimal approach for caries removal. Such insights are crucial for improving patient comfort and treatment outcomes. This study endeavors to offer concise and practical recommendations to enhance dental care practices and patient satisfaction.

The objective of this study was to compare the pain response and efficacy of caries removal using tungsten carbide burs with that of using Brix Gel as a chemomechanical caries removal agent.

METHODS

This randomized controlled trial was conducted at the Department of Operative Dentistry, PIMS, Islamabad, for 6 months from November 2023 to April 2024, involving 40 participants selected using a non-probability technique. Written informed consent was obtained from all participants after a detailed explanation of the aims and objectives of the study. Before commencing the study, approval was obtained from the institutional ethical committee SOD/ERB/2023/38, and all procedures adhered to institutional ethical standards. The sample size of 40 was determined using the WHO sample size calculator, with 20 participants in each group and a significance level of 5%. The power of the test was set at 80%, with an anticipated population proportion of 90% for the control group and 40% for the test group.

The study's criteria included patients aged 12 to 65 years with open occlusal carious lesions involving dentin, which needed to be accessible with a small excavator and should specifically target mandibular molars and premolars. Conversely, individuals showing symptoms of pulpitis, those with caries affecting maxillary or mandibular anterior teeth, and those with severe systemic illnesses or conditions potentially affecting pain perception were excluded from participation. Furthermore, individuals with allergies or sensitivities, along with pregnant or lactating mothers, were also ineligible for the

study.

Following the initial steps of history-taking and clinical examination, a preoperative radiograph was conducted to precisely assess the extent of the lesion. Once the diagnostic phase was complete, the dentinal caries present in the permanent maxillary and mandibular molars were purposefully selected and randomly divided into two distinct experimental groups. In one of these groups, referred to as group A, Brix 3000, manufactured by Brix S.R.L. of Argentina, was employed as a chemomechanical caries removal agent. This selection process was carried out using a randomized method to ensure impartial allocation.

The application of Brix 3000 was meticulously performed in accordance with the manufacturer's specified guidelines. A blunt spoon excavator was utilized to carefully apply the material onto the affected teeth, after which it was allowed to set for duration of 2 minutes. During this time, the chemical components of the agent worked to soften the decayed dentin, facilitating its subsequent removal. Following the application and softening process, the decayed dentin was gently scraped away using a blunt excavator. This removal was conducted with a pendulum-like motion, ensuring thorough removal without exerting undue pressure on the surrounding dental structures. The objective of this process was to ensure the elimination of all decayed tissue, leaving behind only healthy dentin. To confirm the success of the caries removal procedure, the cavity was carefully examined using both tactile sensation and visual inspection techniques.

In group B, the procedure for caries removal involved the use of a slow-speed handpiece equipped with a tungsten carbide bur, mirroring the technique employed in group A to ensure consistency in evaluating any remaining caries. Following the removal of caries, the resulting cavities were restored with light-cured composite material, aiming to preserve the structural integrity of the affected teeth.

To gauge the level of discomfort experienced by participants, pain levels were assessed using a Visual Analog Scale (VAS), allowing for a comparative analysis between the groups. Furthermore, to determine the effectiveness of each method, a caries disclosing agent was applied, revealing any remaining carious tissue for assessment. The percentage of caries removal was then evaluated by the principal operator, providing insight into the comparative efficacy of the two approaches. Additionally, the time required for caries removal was meticulously measured by the operator, offering further insight into the efficiency and practicality of each method.

Participants assessed their pain levels for each treatment approach separately using the Visual Analog Scale (VAS). They were instructed to mark the scale from "0" representing "No Pain" to "10" representing "Worst Possible Pain." A vertical mark was made at the point on the scale that best reflected their pain level for each treatment. It was important that participants completed the scale for both approaches without comparing responses while evaluating each one.

To analyze the data collected from the randomized controlled trial, statistical methods were applied using SPSS 22. Descriptive statistics, including mean, standard deviation (SD) were computed for numerical variables such as age and pain score. The Mann-Whitney U test was employed to compare the pain score reported by participants between the two treatment groups. Chi-square tests were run to compare categorical variables, specifically pain severity (mild, moderate, and severe), time of caries removal and amount of caries removed between the experimental groups. $P<0.05$ was significant level.

RESULTS

Gender distribution among the participants (n = 40) was as follows: 19 (47.50%) were female, and 21 (52.50%) were male. The mean age of the participants was 36.30 ± 15.57 years.

Most common teeth involved in caries were mandibular molars (60%) followed maxillary molar (17.5%) and least were mandibular premolar as shown in Figure-1.

Table-I presents the distribution of age, gender, and tooth type between two groups undergoing caries removal using either chemomechanical agents or carbide bur. In both groups, the mean ages were comparable (35.7 ± 14.07 years in the chemomechanical group and 36.8 ± 17.30 years in the carbide bur group, p = 0.83). Gender distribution showed no significant difference between the two groups (>0.99). Regarding tooth distribution, while there was no significant difference overall (p = 0.095), notable variations were observed in the distribution of specific tooth types between the two groups.

Table-II presents the comparison of pain and caries removal efficacy between two methods of caries removal, chemomechanical and carbide bur, in a sample of 40 patients. The chemomechanical method demonstrated significantly lower pain scores compared to carbide bur (2.59 ± 1.34 vs. 4.44 ± 1.61, p < 0.001), indicating better pain management. Additionally, pain severity varied significantly between the two groups, with the majority of patients in the chemomechanical group experiencing mild pain (80.00%) compared to the carbide bur group, where most patients reported moderate pain (80.00%, p < 0.001). However, there was no significant difference in caries removal efficacy between the two methods (p = 0.48), suggesting similar effectiveness in removing carious lesions.

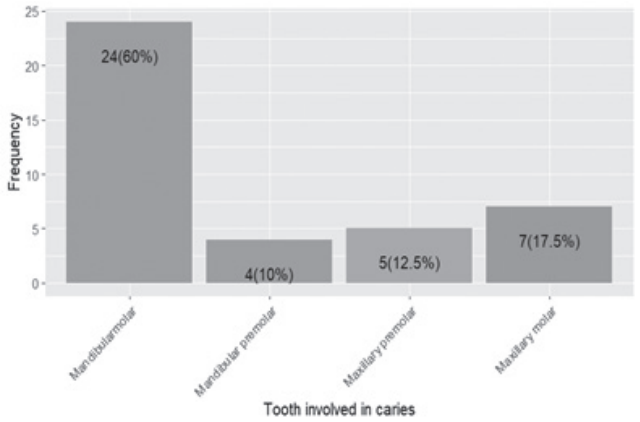

Figure-1. Distribution of posterior teeth involved in caries

Characteristic	Brix Gel, N = 20	Carbide Bur, N = 20	P-Value
Age (years)	35.7±14.07	36.8±17.30	0.83*
gender			>0.99**
female	9 (45.00)	10 (50.00)	
male	11 (55.00)	10 (50.00)	
Tooth			0.095**
mandibular molar	12 (60.00)	12 (60.00)	
mandibular premolar	3 (15.00)	1 (5.00)	
maxillary molar	4 (20.00)	1 (5.00)	
maxillary premolar	1 (5.00)	6 (30.00)	

Table-I. Distribution of Age, gender and tooth between both groups of caries removal
***Welch Two Sample t-test; ****Pearson's Chi-squared test**

Characteristic	Brix Gel, N = 20	Carbide Bur, N = 20	P-Value*
Pain score	2.59 ±1.34	4.44± 1.61	<0.001*
Pain Severity			<0.001**
mild	16 (80.00)	1 (5.00)	
moderate	3 (15.00)	16 (80.00)	
severe	1 (5.00)	3 (15.00)	
Caries Removal Efficacy			0.48**
100% caries removal	16 (80.00)	13 (65.00)	
80% caries removal	4 (20.00)	7 (35.00)	

Table-II. Comparison of pain and caries removal efficacy two method of caries removal (n=40)
***Welch Two Sample t-test; ****Pearson's Chi-squared test**

DISCUSSION

Our study revealed that the most commonly affected teeth by caries were mandibular molars (60%), followed by maxillary molars (17.5%), with mandibular premolars being the least affected. This finding is consistent with previous literature highlighting the higher susceptibility of molars, particularly mandibular molars, to caries due to various factors.[15] The increased susceptibility of mandibular molars to caries can be attributed to several factors.[16] Firstly, mandibular molars typically erupt earlier than other teeth in the

permanent dentition, exposing them to the oral environment for a longer duration, thus increasing their susceptibility to caries.[16,17] Additionally, anatomical features such as deep occlusal fissures and grooves make mandibular molars more prone to plaque accumulation and subsequent caries development. Furthermore, the larger crown size of mandibular molars provides more surface area for bacterial colonization, contributing to their increased caries susceptibility.[18] Another contributing factor to the high caries prevalence in mandibular molars is their posterior location in the mouth, which makes them more challenging to clean effectively, especially for individuals with inadequate oral hygiene practices. The difficulty in reaching and properly cleaning these teeth, particularly the proximal surfaces, increases the likelihood of plaque accumulation and subsequent caries formation.[19]

In our study, the chemomechanical method resulted in significantly lower pain scores and severity compared to carbide bur ($p < 0.001$). Most patients in the chemomechanical group reported mild pain, whereas the majority in the carbide bur group reported moderate pain. However, both methods showed similar effectiveness in removing carious lesions ($p = 0.48$). In Iraq, a study was conducted involving 30 children aged 8-12 years with bilateral occlusal carious permanent molars to assess anxiety levels during and after treatment, comparing chemomechanical caries removal (CMCR) using Brix 3000 with conventional rotary instruments. The findings revealed that CMCR led to lower negative behavior percentages during treatment, indicating enhanced patient comfort compared to rotary instruments.[20] Their results are consistent with our findings.

A comparative study assessed the clinical efficacy of carious tissue removal using Brix3000 versus ceramic bur, focusing on pain reaction. A split-mouth design was employed on 30 bilateral cavitated permanent molars. Results indicated a significant difference in pain reaction between the two methods, with Brix3000 resulting in less discomfort.[21] These results are also similar to our study.

A study in India aimed to compare a new chemomechanical caries removal gel (Carie-Care™) with conventional drilling in primary teeth, focusing on pain reaction. In a split-mouth trial involving 30 children, Carie-Care™ gel was compared to dental bur for caries removal. Results showed patients reported significantly greater comfort (Score 1, $p < 0.001$) with Carie-Care™ compared to drilling, indicating its effectiveness and improved patient experience.[22]

Our findings indicate that the chemomechanical caries removal method is as effective as rotary drilling. Similar results have been reported by previous studies.[22]

CONCLUSION

In conclusion, our study underscores the superiority of the chemomechanical approach over traditional carbide bur methods in terms of pain management during caries removal. While both methods demonstrated similar efficacy in eliminating carious lesions, the chemomechanical technique notably resulted in significantly lower pain scores and severity. This suggests that the chemomechanical approach offers a more comfortable experience for patients without compromising effectiveness.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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2	Sheharyar Akhtar Khokhar	Concept & Final approval.	
3	Nosheen Sarwar	Data analysis, Drafting.	