Comparative Evaluation of Chemomechanical Caries Removal System with Smart Burs a Clinical and Microbiological Assessment

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Abstract: _Background_: _Conventional methods of caries removal are commonly associated with pain, fear and discomfort. Newer alternatives like chemomechanical caries removal system (CMCR) and smart burs came into existence. CMCR is an excellent method for minimally invasive caries excavation, where gel is a recently developed material that comprised papain based gel whereas Smart Burs are polymer burs with self - limiting capability._ _Aim_: _To compare and evaluate the clinical and microbial efficacy of two minimally invasive methods in the removal of infected carious dentin._ _Methodology_: _20 subjects with class 1 carious lesions were selected and equally divided into two groups: CMCR group and Smart Burs group. Caries excavation was performed in accordance with manufacturer's instructions in each group. Efficacy of caries removal was assessed by caries detector dyes and microbial evaluation was done by measuring CFU._ _Statistical Analysis_: _Data was analysed by Student - t and Two way ANOVA test._ _Results_: _Smart Burs showed higher efficacy in caries removal and also greater reduction in bacterial count._

Keywords: Chemomechanical caries removal, Brix3000, Smart Burs, microbial, efficacy

1. Introduction

Traditional cavity preparations involving the use of carbide or diamond burs and extending into sound dentin are coupled routinely with local anaesthesia to prevent painful stimuli. This results in over - cutting of enamel and dentin. Minimally Invasive Dentistry depends on adhesive - style cavity design and would be greatly aided by an instrument whose cutting is limited to caries - affected dentin.

The idea of sound tissue preservation serves as the central focus of contemporary operational dental techniques. The conventional 'extension for prevention' made way for current 'prevention of extension. '

CMCR involves the use of solutions or gels that selectively removes the softened, infected dentin, which aids in enhancing the ease of manual caries excavation. This technique provides a patient - friendly removal of caries, which otherwise can be a windfall for anxious, or medically compromised patients and children.4 It has other significance that child's behaviour, less chair time, inherent disadvantages of high speed rotary instruments that causes sound, heat, pain, pulp damage and pulp exposures.

BRIX3000 is an innocuous papain - based gel formulation, introduced in 2012 by Brix Medical science, Argentina. The high papain content in this product (3, 000 U/mg) and bio encapsulation (EBE) technology, which provides the gel with the ideal pH to encapsulate the enzyme at the time it is exerting proteolysis in collagen, increase its activity, are its distinctive qualities.4

Another approach is by using Smart Burs, which are paddled shaped polymer burs, made up of polyether - ketone - ketone. Smart Bur can cut the diseased dentin while keeping healthy dentin intact since it has a harder surface than infected dentin (15–20KHN) and softer healthy dentin (68KHN). After coming in contact with sound tooth structure, smart bur vibrates and stops cutting tooth tissue.1

This study was designed to assess and compare the clinical and microbial efficacy of two minimally invasive methods in the removal of infected carious dentin.

2. Materials and Methodology

20 subjects were recruited in the study between the age group of 6 to 9 years. Criteria included were subjects in the age group of 6 - 9 years showing occlusal caries involving enamel, dentin (1 - 1.5mm depth) and not exposing pulp as confirmed by using bitewing radiograph.

Teeth showing proximal caries, developmental anomalies, mobility, restored or fractured teeth, subjects with systemic complications and under antibiotic therapy were excluded from the study.

Informed consent was obtained from the subjects with thorough explanation protocol. Institutional ethical clearance was obtained. Randomization was done through the chit system. Recruits were distributed equally into two groups:
1) Group I –CMCR gel (BRIX3000)
2) Group II - Smart Burs (SS white)

3. Procedure

Tooth was anesthetised and isolated with rubber dam. The outermost layer of carious dentin was removed with a sterile spoon excavator and discarded to avoid surface contamination. Baseline values were performed by obtaining, the carious dentin that was scooped from the base of the cavity with the sharp, sterile spoon excavator was transferred to a sterile screw vials and subjected to microbial study. The procedure was repeated for all the remaining teeth. Microbial analysis was done by culturing the sample on blood agar plates and incubated for about 48 hours under room temperature then total viable count was measured.

Group I: BRIX 3000 (Brix Srl Argentina) was applied with a blunt spoon excavator according to manufacturer's instructions and allowed to stand for 3 minutes, once the applied gel turned turbid, it was removed by using spoon excavator. This procedure was repeated until the healthy dentin was encountered, then the contents of the cavity were collected into a sterile screw vial and subjected to microbial analysis. Dye was applied onto the cavity and checked for the efficacy of caries removal by observing the colour change. The procedure was repeated for remaining samples. Then cavities were cleaned, dried and restored with Type lX GIC (GC Fuji Gold).
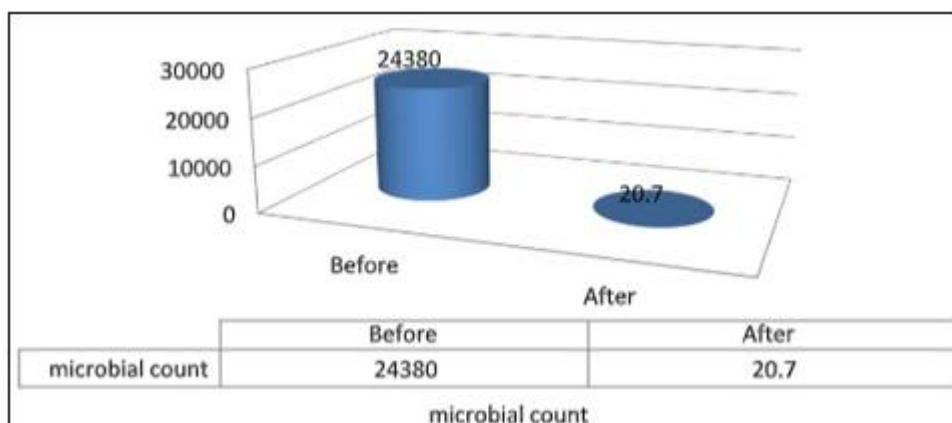
Group II: Using a slow speed hand piece (500 - 800 rpm), caries removal was carried out using Smart Burs (SS White Burs, Inc., Lakewood, NJ, USA) in circular motions beginning at the centre and moving outwards. When a Smart Bur was clearly abraded and rendered useless, it was replaced, and the contents of the cavity were collected into a sterile screw vial and transported for testing and cavity was visually inspected for the thorough caries removal and efficacy was checked with the help of caries detector dyes (Seek) by observing the colour change. If there was a colour change after application of dye, the procedure is again repeated until the dye showed no change in colour. The procedure was repeated for remaining samples. Then cavities were cleaned, dried and restored with Type lX GIC (GC Fuji Gold).

Statistical analysis
Data analysis was performed using IBM SPSS, Version 21.0 (IBM Corp. Armonk, NY). The difference in CFU counts before and after caries excavation in each group was analysed using a Student t - test. In contrast, the difference between the two groups for CFU was analysed using two - way ANOVA test. The level of significance remained at P < 0.05.

4. Results

Table 1 Graph 1: In Group l, the baseline bacterial count was 2.4 x 104 CFU and after CMCR gel application the mean value was 0.2x102 CFU, with standard deviations of 3618.7, 2.10 respectively with the p value <0.001 which is statistically significant.

Table 2 Graph 2:: In Group ll, the baseline bacterial count was 2.8 x 104 CFU and after using smart burs, the mean value was 0.2x102 CFU, with standard deviations of 2746.56, 1.37 respectively with a p value <0.001 which is statistically significant.

Table 3 Graph 3: Compares the reduction in mean bacterial count between Group l and Group ll, highest reduction was found in Group II with a mean of 2.8 x 104 CFU than group I i. e., 2.4 x 104 CFU with a statistically significant p value (0.01).

Tables

Table 1: Evaluation of reduction in mean microbial count within Group l

Time interval	Mean	SD	Mean diff	tvalue	pvalue
Before	24380.70	3618.7	24360	21.298	<0.001*
After	20.70	2.10			

Paired t test, p<0.05* significant

Table 2: Evaluation of reduction in mean microbial count within Group ll

| Time interval	Mean	SD	Mean diff	t value	P value
Before	28689.40	2746.56	28667.7	33.02	<0.001*
After	21.67	1.37			

Paired t test, p<0.05* significant

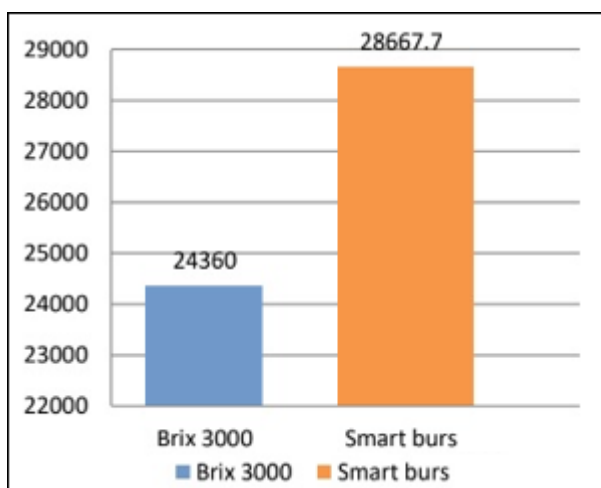**Table 3:** Comparison of reduction in mean microbial count after caries excavation between Group I and Group II

Time interval	Mean	SD	Mean diff	t value	P value
Brix 3000	24360.0	3616.96	4307.72	- 2.910	0.017*
Smart burs	28667.7	2745.35			

Paired t test, p<0.05* significant

Graphs

Graph 1: Microbial count in Group I
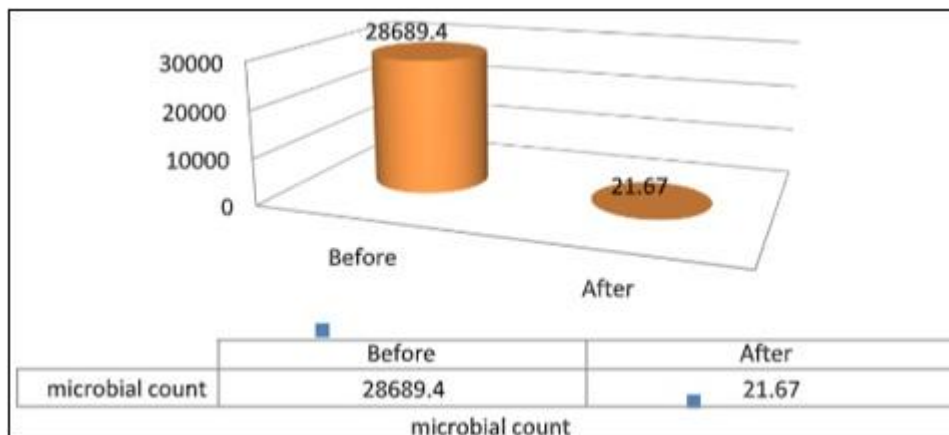
Graph 2: Microbial Count in Group II

Graph 3: Mean Reduction in Microbial Count In Both Groups I and II

5. Discussion

Introduction of CMCR since its inception has come a long way by its utilisation in the community rural health programmes and individual therapeutic strategies. Another innovation is Smart bur which have the ability to preserve sound tooth structure and its low speed is beneficial in removal of the carious lesions without exposing the pulp tissue. In this study, comparison was made between these two in terms of efficacy and bacterial count.

In this study, class I lesions were chosen for their ability to deliver CMCR gel to the carious tissue without the need of high speed handpieces to prepare the cavity.

After removal of the decay, caries detector dye was used in addition to visual and tactile method to confirm thorough removal of the deceased tissue. Caries detector dye was used for evaluation of completeness of caries excavation, which would have resulted in the potential reduction of the bacterial count.

When CMCR group was tested, there was a considerable reduction in the bacterial count and efficacy in caries removal compared to before and after the administration of CMCR, with a statistically significant difference.

When Smart burs group was evaluated, there was a considerable reduction in the bacterial count and efficacy in caries removal compared to before and after the administration of Smart burs, showing statistically significant difference.

When comparisons were made between CMCR and Smart burs group, there was statistical significant difference in the post reduction of the bacterial count as well as efficacy.

Krishna Aswathi K 2017 compared the efficacy of smart bur and Carie care clinically and microbiologically and concluded that the reduction in mean microbial count was found significantly higher in polymer bur group compared to Carie - Care group which is in accordance with the present study.

Mahenaz Salam Inamdar 2020 conducted a study to compare and evaluate the caries excavation efficacy of BRIX3000, Carie Care & Smart burs Caries excavation which was performed in accordance with manufacturer's instructions in each group and evaluation for reduction in bacterial count & mean working time was done and concluded that all the techniques reduced bacterial count potentially.

BRIX 3000 proves the most effective among three, which is in contrast to the current study. On the other hand, Smart burs showed less chair side time compared to CMCR, though this variable was not within the preview of the study, the possible explanation could be the morphology of the primary teeth which has thinner enamel and dentin compared to the permanent teeth. Therefore the time required could have been shorter.

6. Conclusion

CMCR caries removal can be used as an alternative modality especially in children. It is simple, effective and needs little training. Smart burs are best tools for the effective and selective removal of caries without exposing pulp. Latter was found to be more effective than former in terms of efficacy and bacterial count.

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