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Comparative Evaluation of Efficacy of Caries Removal And Reduction In S. Mutans Count During Proximal Caries Removal In Primary Teeth Using Ultrasonic System And Tungsten Carbide Bur In Children Aged 6-9 Years – A Clinical And A Microbiological Study

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Abstract

Background and Objectives: Carbide burs are indiscriminate in removal of carious tissue, with over extension into underlying sound dentin. Henceforth, restorative dentistry has moved away from a "drill and fill" philosophy to a minimally invasive approach. Very few literature is available on techniques like the ultrasonic devices, hence the study was aimed to compare ultrasonic system with conventional carbide bur for proximal caries removal and S mutans count in pediatric patients aged 6-9 years.

Methods: 60 primary molars were selected from 30 healthy children with proximal carious lesions without pulpal involvement and divided into 2 groups in which caries excavation was done with the help of (1) ultrasonic system (2) conventional method. Efficacy of caries excavation was assessed using caries detector dye and graded according to Ericson D et al scale for assessment of caries. Dentin samples were collected before and after caries excavation for microbiological analysis with the help of sterile sharp spoon excavator. Samples were inoculated on mitis salivarius agar and incubated at 37°C for 24 hours. After bacterial cultivation, the bacterial count of Streptococcus mutans was obtained.

Results: It was also equally efficient in caries removal in comparison to the conventional method. There was a decrease in colony count of Streptococcus mutans before and after caries excavation and was significant in both the groups.

Interpretation and Conclusion: Ultrasonic system is efficient in proximal caries removal and in reduction of S mutans count.

Keywords: Ultrasonic system, Conventional method, proximal caries, Caries detector dye; Streptococcus mutans.

Introduction

The word “caries” is derived from the Latin word meaning “rot” and Greek word “ker” meaning death. According to WHO, caries is defined as “localized post eruptive, pathological process of external origin involving softening of hard tooth tissue and proceeding to the formation of a cavity.”1 The most primitive approach for caries removal was by the hand instruments, which was a painful, ineffective and tedious method leading to evolution of rotary instruments like high speed airotor (conventional method).2 However these often resulted in inadvertent removal of healthy sound dental tissue especially during proximal cavity preparation. Of the adjacent surfaces, 80% were found affected, 37.5% showed marked severe damage. It also causes deleterious thermal and pressure effects on the pulp which is unpleasant and painful for many patients often requiring local anaesthesia to control pain.3 Current cavity preparation procedures due to the advent of adhesive restorations demand a more cautious approach with conservative removal of the carious tissue. This approach to the treatment is known as Minimally Invasive Dentistry.4 Alternative techniques which are minimal in dental tissue removal are air abrasion, ultrasonic instrumentation, lasers, chemo mechanical caries removal, polymer burs. Out of these, in air abrasion technique the depth of penetration during cavity preparation cannot be controlled and splattering of the powder particles within the oral cavity and around the dental operatory happens, hence its less frequently used.4 Chemo mechanical method required lot of time to excavate, lot of material volume, and cumbersome armamentarium hence its usage was limited.5 Usage of lasers still pose problems regarding thermal irritation to the pulp, the control of the procedure and destruction of the adjacent sound tissue. These factors coupled with the expense and size of the equipment reduced their usage for cavity preparation.[6]

Polymer burs on the other hand required preparation of enamel with high-speed airotor and burs whenever there is no direct access to the carious dentine and required more than one bur to prepare moderate sized cavities.7 Ultrasonic systems have better minimally invasive potential than conventional handpieces since the removal of carious tissues and preparation of sound tissues are selective and well controlled.8 There is a single case reported in literature so far with use of ultrasonic in proximal cavity preparation and was found to be effective in treating pediatric patients .9 But there is no evidence concerning to microbial reduction in proximal cavity preparation using this system. Hence the aim of our study was to evaluate and compare the S mutans reduction in children aged 6-9 years during proximal caries removal using ultrasonic system and conventional technique (airotor and tungsten carbide bur).

Materials and Methods

This randomized, crossover, split-mouth, clinical study was conducted in the Department of Pediatric and Preventive Dentistry, M.R Ambedkar Dental College and Hospital, after obtaining approval from the institutional review board and ethics committee (IRB number – MRADC/ECIRB/2017-18) and written informed consent from the parents and verbal assent form from children involved in the study. The sample size is estimated using GPOWER 3.1.9.2 Software. Assuming 80% power, 8% margin of the error, the required sample size is 52. In our study, we are considering a sample size of 60 teeth. Samples were selected based on Inclusion criteria.

- Bilateral proximal carious lesions in vital primary mandibular molars confirmed using bitewing radiographs.
- Softened carious lesions involving dentin.

- Patients whose parents have given written consent.

Exclusion criteria

- Medically compromised children and children with special health care needs.
- Primary teeth with deep dentinal caries which are symptomatic.
- Tooth with occlusal caries.
- Tooth already restored or fractured
- Lesions not extending more than two-third into dentin (radiographically).
- Systemic/topical antibiotics or antiseptics The selected samples were divided by simple random sampling method among two groups based on the caries excavation method opted i.e Group A: Ultrasonic system using Dentsply start-x #1 – caries excavation was carried out using ultrasonic system. Group B: Conventional method – caries excavation was carried out using carbide bur until the sample size of 60 teeth with 30 teeth in each group is achieved.

The sample in both the groups from one patient were treated in one appointment. All the treatment procedures were carried out by one pediatric dentist. 15 children from total sample were treated with ultrasonic system in the first and with carbide bur next, while the remaining 15 were treated first with carbide bur and next with ultrasonic system. Infected dentin sample were then collected from the tooth, using a standard, sharp, sterile spoon excavator10 into a sterile test tube containing brain heart infusion broth [Fig 1]. Carious dentin was removed using Dentsply start-x #1 which is connected to ultrasonic device with specifications (EMS, minipiezon) in one tooth [Fig 2] and using airotor and tungsten carbide bur in another [Fig 3] and tooth cavity was prepared [Fig 4, Fig5]. Cavity was assessed by visual, tactile method and by using caries detector dye (Diagnose, 1% acid red in propylene glycol). Dye was applied and left for 10-15 sec and then washed off and were graded according to the scoring criteria of evaluation of caries removal by Ericson. Dentin sample was collected after cavity preparation, using standard, sharp, sterile spoon excavator and collected into a sterile test tube containing brain heart infusion broth. Collected samples of dentin before and after caries removal was sent for microbiological assessment. These samples collected were transferred to 5ml of brain heart infusion broth and incubated at 37°c for 24 hours in CO2 incubator. 1ml of 24 hours incubated brain heart infusion broth was serially diluted with distilled water and was spread plated onto the Mitis Salivarius Bacitracin Agar using a heated spreader [Fig 6]. The plates were incubated in carbon-dioxide CO2 incubator at 37°c for 24 hours. The colonies were identified using gram staining were counted manually. Thus colony forming units (CFU's) were given for each sample collected [Fig 7 & Fig 8].

The data obtained was subjected to appropriate statistical analysis. Wilcoxon Signed Rank test was used to compare the mean CFUs between pre & post treatment samples in ultrasonic and conventional method. Mcnemar's Test was used to compare the caries removal assessment using dye scores between ultrasonic and conventional method and were performed using the SPSS statistical software package version 22.0.

Results

There was staining seen in 33.3% (6.7% on proximal wall and base, 13.3% on proximal wall, 13.3% at the base) of the cavities prepared using ultrasonic method. There was no staining seen in the cavities prepared using conventional method [Fig 8]. This indicated that demineralised dentin was left behind in ultrasonic method as the dye has potential to stain the demineralised dentin owing to the minimal invasive potential of ultrasonic

method. The P value for the comparison of caries detector dye scores in ultrasonic and conventional method was 0.01 and it was statistically significant. There was reduction in number of CFU's in both the groups post treatment. The mean pre and post treatment CFU's for ultrasonic method was 43.23, 9.70 respectively and for conventional method was 44.23, 7.20 respectively [Fig 9]. The P value for the comparison of mean CFU's pre and after treatment in ultrasonic and conventional method were 0.22, 0.18 which was not statistically significant.

Discussion

Ultrasonic system is less invasive procedure as the removal carious tissue is well controlled. The mechanism of action of the ultrasonic is that the kinetic energy of water molecules is transferred to the tooth surface through the high speed oscillations of the cutting tip. The tip creates a continuous spectrum of bubbling activity within water and results in shock waves that break the biological tissue coming in contact with it.6 Age of the pediatric patient is one of the factors impacting dental anxiety in them. In our study patients aged 6–9 years were selected because the children in this age group have good cognitive skills.

The difficulty in accurately and reliably detecting what is remineralizable and what is not remineralizable dentin is usually a clinical judgment. In this study completeness of caries removal were verified using tactile examination, visual examination and caries detector dye which was graded using Ericson et al scale for assessment of caries removal. This scale has been used in various other studies for assessment of caries removal.11,12 In the present study complete caries removal using the conventional method was achieved in all the lesions examined, whereas it was accomplished in 66.7% of the lesions treated using the ultrasonic tip. This difference can be attributed to the detector dyes which stain the demineralized organic matrix13 rather than the bacteria14. Hence the affected remineralizable dentin which is left behind during ultrasonic preparation also gets stained.

Conventional method on the other hand which is used at high speed tends to over prepare the cavities and remove reversibly affected dentin leaving minimally discolored, hard, glossy dentinal surface.[15]

Several investigations have shown that often a lower number of residual microorganisms (101– 102 CFU) remain behind in clinically sound dentin, inspite of a significant reduction in bacterial count after caries excavation which is considered to be clinically acceptable.[16]

The efficacy of caries excavation methods can be assessed based on the reduction in microbial flora from the tooth cavity. S. mutans is the primary pathogen in the etiology of dental caries in children and adults. Hence reduction of S. mutans count was evaluated in our study.

The decrease in bacterial count was highest in group B followed closely by group A and the difference in reduction of microbial count between groups was not statistically significant indicating ultrasonic system is equally efficient in reducing microbial load. This result was in accordance with the study done by Hassan et al.10

The reasons for highest percentage reduction of bacterial count after cavity preparation in carbide bur could be due to negative rake angle design and less control over the instrument producing nonconservative cavity preparation.[10]

Inspite of the significant advantages of ultrasonic cavity preparation, some disadvantages have been noted, such as slowness of action and limited availability of instruments tips.

In general ultrasonic tips have resulted in significant improvement in cavity preparation and is on par with the conventional method for reduction in S mutans count.

This system also promises lesser pain during cavity preparation and hence can lead to more comfort to the patient. Thus requiring further studies evaluating operative pain while using ultrasonic instruments.

Conclusion

It can be concluded from the following study that ultrasonic system is equally effective in caries removal and reduction in S mutans count in comparison to conventional method. This system is conservative in removing tooth structure.

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Legends Figures

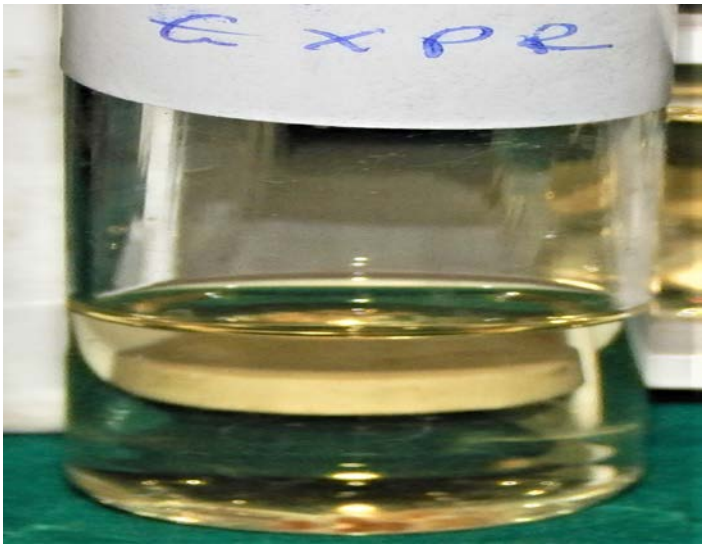

Fig. 1: Infected dentin sample collected in sterile test tube containing brain heart infusion broth.

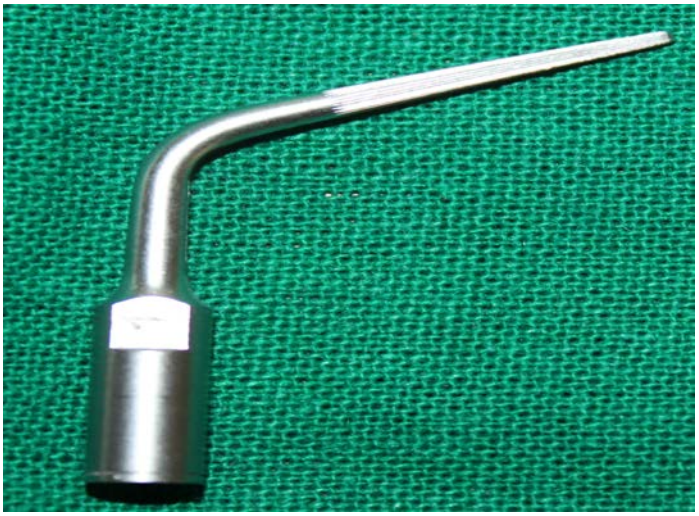

Fig.2: Start x #1Dentsply ultrasonic tip.

Fig.3: Tungsten carbide bur.

Fig. 4: Cavity prepared using ultrasonic system.

Fig. 5: Cavity prepared using airotor and tungsten carbide bur.

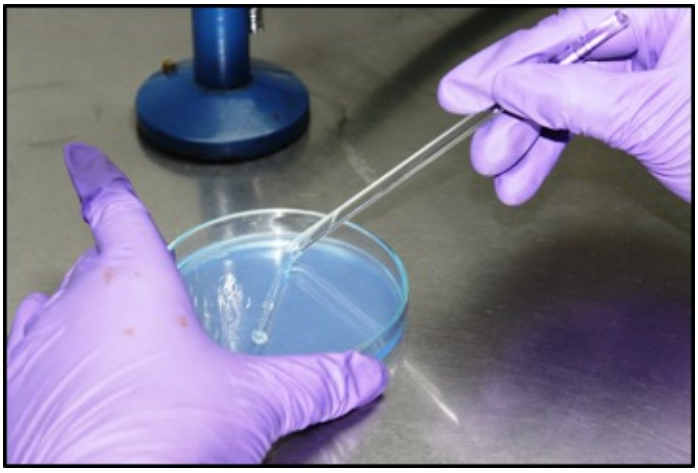

Fig. 6: Diluted sample spread plated onto the prepared media using heated spreader

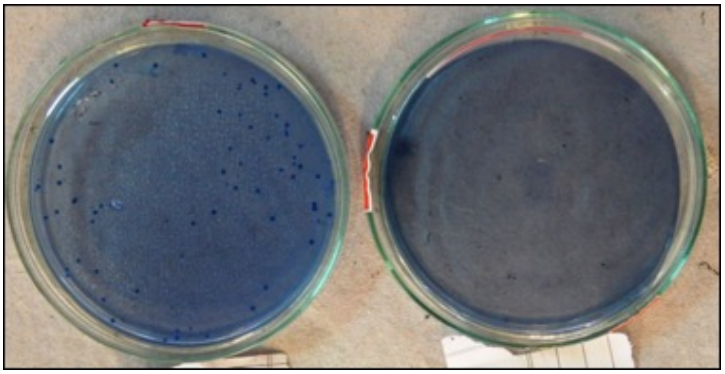

Fig. 7: Group a Ultrasonic pre and post treatment dentin samples cultured plates showing S. Mutans colonies

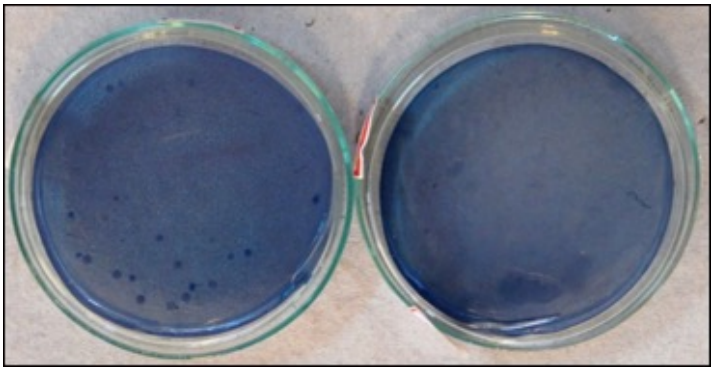

Fig 8 - Group B Conventional pre and post treatment dentin samples cultured plates showing S. mutans colonies.

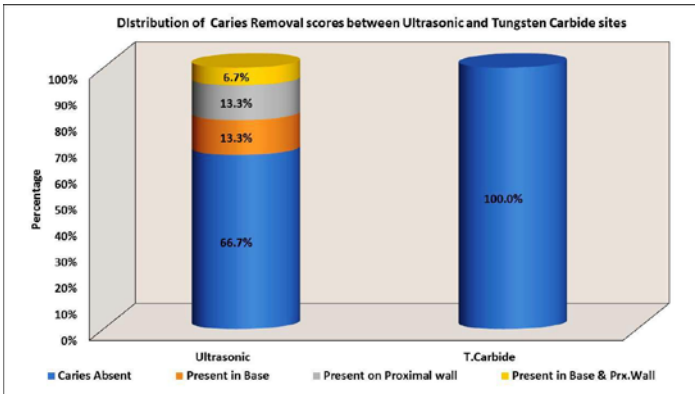

Fig 9 - Graph showing comparison of caries removal scores between ultrasonic and conventional method.

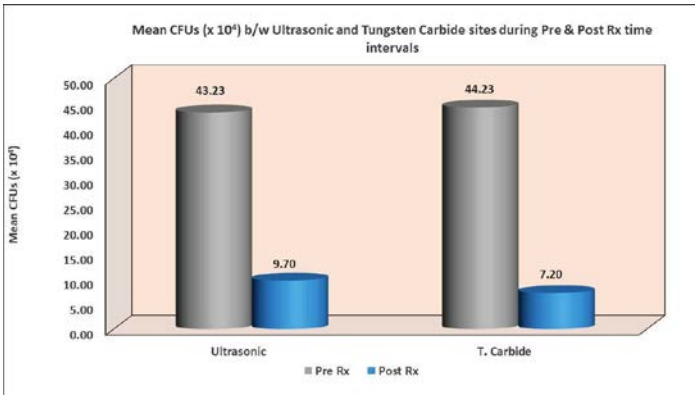

Fig 10 - Graph showing comparison of mean CFUs (x 104) during pre and post treatment dentin samples between ultrasonic and conventional method.