SHORT COMMUNICATION

Comparative Evaluation of Two Commercially Available Polymer Burs for their Efficacy on Dentinal Caries Removal –Split tooth study using Polarized Light Microscopy

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ABSTRACT: *Background:* Ultra conservative caries removal now has become an integral part of Minimal Invasive Dentistry. The main objective of deep caries removal is to conserve the tooth structure as well to maintain the integrity of the health of the pulp. Recently burs made of polymers have been proposed as alternatives for metallic burs to selectively remove caries in dentin. *Aims:* This in vitro, split-tooth, comparative study evaluated the efficacy of two commercially available Polymer burs, namely Poly bur- 1 (Komet) and Smart prep bur (SS White) for their efficacy in removing deep dentinal carious lesions. The time taken for caries removal was also assessed. *Methodology:* 10 extracted carious mandibular molars were split into buccal and lingual halves. Caries in one half (n=10) was removed by Poly bur-1 (Komet) and in the other half (n=10) by Smart prep bur (SS white). They were then sectioned in the hard tissue microtome, subsequently manually thinned out and were mounted for evaluation under Polarized Light Microscopy. *Results:* The qualitative evaluation of the micrographs revealed that both the polymer burs were equally effective in removing the deep dentinal caries. However the time taken by Poly bur - 1 was lesser than the Smart prep bur.

Key words: caries, dentinal, residual caries, polymer bur, step-wise excavation method, polarized light microscopy

Deep dentinal carious lesion is histologically classified as follows:

1. Zone of destruction
2. Zone of bacterial invasion
3. Zone of demineralization
4. Zone of sclerosis

Clinically, the zone of destruction and bacterial invasion is classified as infected dentin and the zone of demineralization and sclerosis is classified as affected dentin^[1]. The affected dentin is usually retained to avoid iatrogenic pulp exposure and preserve the health of the pulp by preventive endodontics, than by root canal treatment.

Removal of deep carious lesions is done by two methods. They are

1. Conventional methods
2. Ultra-conservative methods^[2]

The conventional methods include caries removal with spoon excavator, stainless steel round bur and tungsten

carbide bur in slow speed. The disadvantage of these method is that they aggressively remove both infected and the affected dentin.

On the contrary, the main objective of the ultra-conservative methods is to selectively remove the infected dentin, leaving the affected dentin intact for remineralization. These methods are as follows:

1. Chemo mechanical removal
2. Air abrasion
3. Lasers
4. Polymer burs

Polymer burs are burs that are made of polyamide resin. Their hardness is less than the healthy dentin and greater than the carious dentin. The hardness of the bur is 50 KHN compared to healthy dentin which has 70-90 KHN and the carious dentin which has 0-30 KHN. Thus these burs can easily remove the soft carious dentin, but when they come in contact with the hard dentin, they blunt out, so that unnecessary cutting does not occur^[3].

Commercially two burs are available; namely, Smart Bur (SS White, Lakewood, NJ, USA) and Polybur-1 (Komet, Mediteam, Sweden) (Fig-1). Smart bur is available in

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three different sizes 004, 006, 008 and the recommended speed to use is 500-800 rpm. Poybur-1 is also available in three different sizes of 014, 018, 023 and are used at a speed higher than the smart bur, at around 2000- 8000 rpm. Both the burs are round shaped with spade like cutting edges

On review of literature, it was found out that there were varied results reported when smart bur was compared with conventional method. One study showed that significantly less sound dentine was found to be removed with the Smartprep burs when compared to a stainless-steel round bur ^[4]. No difference was found between Smart prep burs and conventional tungsten carbide burs in the time taken for caries removal. Contradictory results have been reported as far as residual caries is concerned ^[5,3]. It was also observed that no studies were reported on Poly bur-1.

Thus this study was planned to comparatively evaluate polymer burs, Smart bur, (SS white) and Poly bur-1, (Komet) for their efficacy in removing infected caries by using split-tooth model method and histological evaluation using polarized light microscopy. The other aim of this study was to assess the average time taken to remove the lesion

Fig 1: Polymer burs. Smart prep and Poly bur 1

METHODOLOGY

10 deep carious molars were collected and stored in distilled water at room temperature. All teeth were split at the center of the lesion as buccal and lingual half and stored in water as pairs. Caries in the one half of the tooth was removed with the smart prep bur and in the other half of the same tooth with the polybur-1 (Fig-2). This split tooth study model was used to standardize the nature of the lesion ^[6].

Gross removal of caries at the entrance and till the dentino-enamel junction was removed with high speed diamond rotary instrument, leaving only the dentinal caries. Dentinal lesion was removed in brushing sweeping-out motion from soft center of the lesion to periphery (Fig-3a,b,c). A straight probe was used to

verify if the removal is complete. Hardness and color were the parameters that were used to check the caries removal. Time taken till this stage, starting from the use of the polymer bur was recorded.

The teeth were mounted in resin blocks and were sectioned in hard tissue microtome to 1 mm thickness (Fig-4). The sections were further ground manually. They were then mounted on to the slides and were observed under the Polarized Light Microscope (Fig-5). Images were obtained in the computer monitor. A binary parameter of caries 'present' or 'absent' was used.

RESULTS

The mean time take for removal of caries with Smart prep bur was 3.997 minutes and for Poly bur-1 was 3.13 minutes. 8 out of 10 teeth sections (80%) in both the groups showed complete removal of caries from dentin, when viewed under PLM (Fig-6 a & b and Fig-7 a & b).

DISCUSSION

The affected dentin is characterized by intact collagen frame work but with loss of minerals. This layer has the capacity to remineralize and retaining such a dentin during pulp capping procedures provides an opportunity to heal and repair a stressed pulp without invasive procedures like root canal treatment ^[7].

In addition to other clinical parameters, such as discoloration and hardness on probing, caries detector dyes were also used to differentiate the infected and affected dentin. Among all, tactile sensation became the most reliable clinical criteria to detect if all the soft lesions have been removed. However a histo-pathologic section is the ideal method of visualizing the carious changes in the dentin ^[3].

This study used the tactile sensation as the clinical parameter to confirm caries removal and subsequently used the Polarized Light microscopy to study the sectioned specimens for the presence of caries.

In this study it was observed that the Poly bur-1 and the Smart prep burs performed equally well in removing caries. 80% of samples showed no caries in the sections under polarised light microscopy, for both the groups. However the time taken for Polybur-1 (3.1min) was shorter than the Smart prep bur (3.99 min). This can be attributed to the recommended speed for Poly bur-1. While it is 2000 rpm for Poly bur-1, the recommended speed for Smart prep bur is 800 rpm. However, both the

Fig 2: Carious tooth split into two halves

Fig 3A: Gross caries removal with diamond point Fig 3B: Caries removal with Smart prep Fig 3C: Caries removal with Polybur 1

Fig 4: Tactile check with probe

Fig 5: Sectioned and mounted in slide

Fig 6 A: Dentinal caries removed with smart prep bur

Fig 6 B: Dentinal caries removed with Polybur-1

Fig 7 A: Infected dentin remaining with Smart prep bur

Fig 7 B: Infected dentin remaining with Polybur-1

burs blunted during use, indicating that they are self-limiting, single use burs. The 20% of sections that showed evidence of caries remaining in both the groups, though does not pose a statistical problem, may pose a clinical challenge of prospective damage to pulp from

the residual infected dentin. But when weighing the disadvantage of indiscriminate removal of tooth structure and the disadvantage of leaving residual caries behind, one can conclude that it is better to err on the more conservative side.

Soft residual caries left behind has been proven to be well handled by the step-wise excavation method^[8]. In this method, the deep caries that is being left out for fear of pulp exposure, can be capped with a pulp capping agent in the first sitting. In the second sitting, the cavity can be re-entered to assess if the soft lesion has hardened with remineralization. Any residual soft caries that is still detected can be safely removed at this stage without the risk of pulp damage, as most of the dentin would have remineralized. A recent systematic review of the literature concluded that that stepwise excavation is effective for pulp preservation in extremely deep caries that do not show clinical symptoms of irreversible pulpitis^[9].

CONCLUSION

This pilot study comparing two commercially available polymer burs for their caries removal efficacy and time taken to remove caries concludes that the polymer burs can be used as an effective ultraconservative caries removal tool.

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