INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 6)
Available online at: www.ijariit.com

Changing concepts in mechanical methods of cavity preparation

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ABSTRACT

With advances in the field of dentistry, the G. V. Black's concepts of extension for prevention are being replaced by the concept of minimally invasive dentistry. The present article reviews a few such techniques which help in preserving healthy tooth structure and at the same time help in efficient removal of diseased tooth structure.

Keywords— *Minimally invasive tooth cutting, Fissurotomy, Tunnel preparation, Polymer burs, Air abrasion, Box preparation*

1. INTRODUCTION

Dental Caries is considered one of the most ubiquitous noncommunicable diseases with a worldwide prevalence of 35% for all ages combined, contributing to the global burden of diseases. It is a multifactorial, infectious disease having demineralisation and remineralisation cycles. These cycles lead to the dissolution of the tooth structure leading to cavity formation.

Though the current trend in the management of dental caries is identifying the high caries risk population and instituting preventive strategies in them, there is still a considerable amount of population with restorative needs. Management of cavitated lesions which was earlier based on the G. V. Black's concept of 'extension for prevention' has now shifted to 'minimal intervention'. Hence the conventional methods of cavity preparation which caused a considerable amount of tooth destruction are being replaced by techniques and armamentarium which have minimal tooth removal as their advantage.

This article reviews a few such techniques which are being integrated into the conservative approach of caries removal.

Minimally invasive methods of cavity preparations

1. Fissurotomy
2. Use of Polymer burs
3. Air abrasion

Minimally invasive cavity preparations:

1. Tunnel preparation
2. Box only/ slot preparation

2. MINIMALLY INVASIVE METHODS OF CAVITY PREPARATIONS

2.1 Fissurotomy

Fissurotomy bur is a new approach to ultraconservative dental treatment. There are three carbide burs with a unique shape and size. 'Fissurotomy Original' [Fig. 1] bur is used for the conservative exploration of adult molars. Whereas the 'Fissurotomy Micro NTF' [Fig. 2] is used for ultraconservative pit/fissure exploration of adult molars and 'Fissurotomy Micro STF' [Fig. 3] are used in primary teeth, adult premolars and enameloplasty. Because of the smaller dimensions of these burs, they are helpful in preparing conservative preparations. The head length of 2.5 mm allows the dentist to limit the preparation at the dentinoenamel junction and not preparing further much into dentine. Similar to the Fissurotomy Micro STF used for primary molars, premolars and enameloplasty. The taper of the burs allows the cutting tip to encounter very few dentinal tubules at any given point of contact to tooth structure.

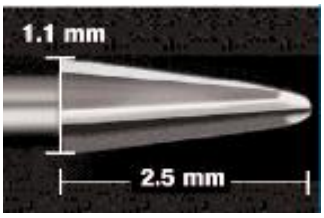

Fig. 1: Fissurotomy Original

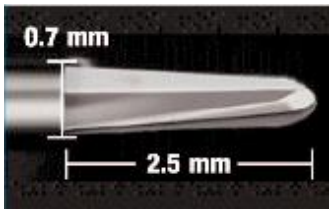

Fig. 2: Fissurotomy Micro NTF (Narrow taper fissure)

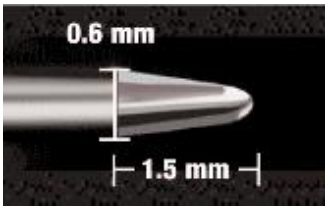

Fig. 3 Fissurotomy Micro STF (Shallow taper fissure)

2.2 Polymer burs

These are a special type of burs and as claimed by the manufacturer ['SmartPrep II', SS White, Lakewood, NJ, USA] can distinguish between the non-mineralizable and mineralizable dentine and selectively remove the non-mineralizable part. Thus, they have an advantage of preservation of healthy tooth by minimally invasive and self-limiting procedure, and fewer pain sensations being triggered. Though they look like conventional burs at a first glance, they are manufactured from a special medical grade glass reinforced polymer material, not from metal and have cutting edges similar to a shovel. The polymer material has a Knoop hardness number of 50, that is harder than softened carious dentin having Knoop hardness number ranging 0 – 30 but softer than that of healthy dentine, which is 70 – 90. Hence, the bur wears off when it comes in contact with harder materials like healthy dentine. Thus, these burs are meant for single use only.

These burs are available in ISO sizes 010, 014 & 018 and are used like conventional burs on a slow speed handpiece at 500 – 800 up to 4000 rpm by application of light pressure. The excavation of lesion is done from the centre of the lesion to the periphery to avoid contact with enamel so that they do not wear off before the intended use. This is indifference from the conventional cavity preparation, where, the excavation starts at the periphery of the lesion.

Fig. 4: Polymer burs

The limitations of these burs are that being single-use, they can be expensive. If there is no open cavitation, access to the carious lesion has to be obtained by other methods of cutting. Some amount of carious dentine may be left behind, and the removal has to be confirmed using caries detecting dyes.

Another commercially available polymer bur is 'PolyBur' [Komet Dental, Brasseler, Germany].

2.3 Air abrasion

This is a fairly non-invasive, 'drill-less technique' introduced by Dr Robert Black in the 1940s. He described a device which delivered an abrasive material under high pressure, and which would cut through enamel and dentine. It was marketed as the Airdent by SS White. Though having various advantages like being painless, no noise, comfortable to the patient, it did not gain popularity because it could not give defined cavity margins, which was necessary for the restorative materials available at that time, i.e. amalgam, restorative gold etc. Secondly, evacuation of the powder particles was difficult because of unavailability of high-velocity suction apparatus. Later Dr J Tim Rainey from Refugio Texas, USA, student and friend of Dr Robert Black, reintroduced the concept. The air abrasion technique started gaining popularity after advances in bonding technology and micromechanically bonding restorative materials.

The advantages of this technique are no sound, vibration, heat or pressure, factors which are very patient-friendly, hence no need for anaesthesia especially when shallow preparations are anticipated. Because there is no application of pressure and vibration, the formation of microfractures and chipping of the tooth structure is avoided. The technique also leaves the working area relatively dry.

The method of tooth preparation involves directing a stream of aluminium oxide particles, to the tooth structure under compressed air or from bottled carbon dioxide gas or nitrogen gas. The nozzle is held at a distance of 0.5 to 2 mm from the surface to be prepared. The size of the particles ranges from 27µm to 50 µm and the smaller particles are preferred over the larger particles in most of the cavity preparations. The larger particle sizes help in preparing the cavity faster but tend to give larger preparations. The air abrasive particles remove a small amount of tooth structure because of their high velocity. The other parameters that determine the amount of tooth structure removal are air pressure, particle size, a number of particles passing through the nozzle, the diameter of the nozzle, angulation of the nozzle with respect to the tooth structure, distance from the tooth, and the time of exposure. The pressure range is from 40 – 160 psi, around 100 psi for cutting and 80 psi for etching of the surface.

The limitations are, it does not effectively remove gross caries, because it does not cut through soft substances and the hand excavating instruments have to be used for this purpose. It gives rounded margins, hence is not suitable for restorative materials like conventional amalgam, inlays/onlays etc. which require a specific cavity form. Rubber dam isolation and protective eyewear

is a must to prevent accidents with the air-abrasive powder. The powder particles can also cause damage to the lenses of loupes and operating microscopes. The depth of penetration cannot be controlled and can cause sensitivity in some patients. Air abrasion cannot be used to remove existing large amalgam restorations because of the mercury hazard concern.

3. MINIMALLY INVASIVE CAVITY PREPARATIONS

3.1 Tunnel preparation

The tunnel preparation was first described by Jinks for the restoration of deciduous second molars. The carious lesion was removed by taking an approach to the lesion from the occlusal aspect and leaving the marginal ridge intact. It was then restored with a fluoride leachable silicate cement. This technique was later reintroduced by Hunt & Knight in the 1980s. They advocated it to be a more conservative procedure than a conventional class II preparation. The technique for caries removal was similar to that described by Jinks. But, the restorative material of choice was Glass Ionomer Cement introduced by Wilson and Kent in the 1970s.

There is a confusion regarding the terminology related to tunnel preparations. One is the *internal tunnel preparation* in which the approximal enamel is retained and the preparation is actually similar to a Class I cavity. In this type it is thought that there is no macroscopic cavitation form, hence the approximal enamel can be left intact. But according to the newer concepts, if there is no cavitation, remineralisation of the lesion should be attempted by use of improved oral hygiene techniques and use of remineralising agents. The second is the *partial tunnel preparation*, which extends in the proximal surface in macroscopically observable cavitation. In such areas, the enamel has disintegrated due to the carious process. The remaining enamel is smoothened and some of it is left behind which remains adjacent to the restorative material. Whereas in the *total tunnel preparation* the demineralised enamel is removed completely.

The technique of tunnel preparation involves confirming the presence of a cavitated lesion. This is done by the use of orthodontic separators placed near the concerned tooth for a period of 7 days. After this slow separation, the teeth can be assessed by gently moving the probe parallel to the tooth surface. If there is a need of restoring the tooth, the further procedure of tunnel preparation and restoration with Glass ionomer cement is done. After local anaesthesia and rubber dam isolation, the access to the lesion is gained by a tungsten carbide bur. The entry point of the bur is in the occlusal fossa, about 2 mm away from the marginal ridge. An ovoid cavity is made in the enamel by angling the bur axially, and once dentine is reached the bur is angled towards the carious lesion. The removal of the remaining caries is done with a slow speed round burs. The cavity is considered to be complete when on probing hard dentine is felt. Matrix retainer, band and wedge are appropriately positioned, conditioning of the tooth is done and Glass ionomer cement restoration is done following the manufacturer's instructions of mixing and placing the cement. After maturation, finishing and polishing of the restoration are done. The occlusal preparation is later replaced by a composite restoration by reducing the Glass ionomer cement restoration. A clinical and radiographic evaluation of the restoration is done at regular intervals.

3.2 Box/Slot preparation

Box preparation– This type of preparation is advocated when caries involves the proximal surface only and the occlusal surface is healthy. Using a round or inverted cone diamond bur held parallel to the long axis of the tooth, the proximal lesion is approached by cutting through the marginal ridge. The axial depth is maintained at 0.2 mm inside the DEJ and the gingival extent of the cavity is dependent on the gingival extent of the carious lesion. The preparation is completed to give a box form to the lesion with the help of the inverted cone bur.

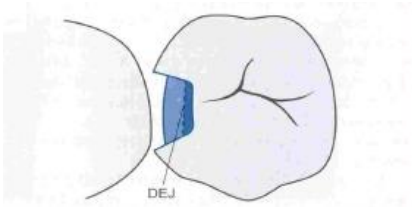

Fig. 5: Box preparation

Slot preparation – done in cases where there is a proximal lesion without the involvement of the occlusal surface. With a small round bur access is gained to the proximal lesion from the lingual or the buccal side and caries excavation is done, the cavosurface margins are kept at 90º or more. The facial and lingual sides are preserved as much as possible.

Fig. 6: Slot preparation

4. CONCLUSION

The above-mentioned methods and techniques have been studied and reviewed by various authors and are proving to be efficient in caries removal while at the same time preserving healthy tooth structure. They can be incorporated into the daily practice to achieve a high level of patient care and satisfaction.

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