

Ultrasonic Excavator

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Abstract

Aim: The aim of this study is to prove the effectiveness of device that have been developing. The ultrasonic excavator will be easily used to penetrate in caries and defective dentine which will decrease traumatic injury and reduce the feeling of pain for the patient through connecting ultrasonic wave into excavator tip (Figure).



Figure

Material: In this study we used two molars extracted teeth one of them is decayed tooth and the other another one sound tooth. (Before make excavations, I prepared the class 1 cavity the sound molar by using a high speed air driven with round bur). And I used ultrasonic excavator to excavate the dental caries and defective dentine at frequency 30 KHz.

Keywords: *Ultrasonic Excavator; Caries; Dentine*

Introduction

Since the beginning of using of high and low speed air driven the operative treatment of caries lesions has often resulted in considerable removal of tooth structure and minimal cavity design. The start of ultrasonic devices was in the 1950 [2,3] (The ultrasonic devices it's using in periodontal therapy (scaling), endodontics therapy, micro surgery, multiple uses). I have come up with this idea after I have experienced problems excavating with removing caries by using manual excavators, which they require a high force to penetrate in caries and defective to dentine, especially with deep caries.

Objective

Remove the caries and defective dentine with less trauma, and laceration to the pulp tissue, also, reduce the feeling of pain for the patient by reduce heat generation, vibration and noise that come from high speed and low speed air driven by using ultrasonic excavator in the solution for all problems that are mentioned above.

Methodology

I have used the ultrasonic excavator tip to make excavation for a caries, defective dentin and intact dentin in decayed tooth and sound tooth. The reason is to evaluate the possibility of ultrasonic excavator to remove the caries and dentin at frequency 30 KHz even providing less trauma laceration and heat generation to the pulp tissue. And I have used the same angels and tip for manual excavator to be more easy, control it, visibility and more comfortable for dentist.

According to the study of effect of ultrasonic and high speed air-driving devises on pulp-dentine reaction in animal study [they evaluated the pulp by reaction changing after make perforation by ultrasonic device in eighteen upper incisors from nine dog and compared by high speed including the cavity surface appearance, the odontoblast response, the dislodgment of dentine chips into pulp and the hemorrhage in the pulp tissue all of this to evaluate state of the pulp if changing to (total or partial necrosis or nothing)] [1]. And according to [4] the ideal cutting instrument should fulfill certain factors to satisfy both operator and patient these factors might include: comfort and ease of use in the clinical environment, the ability to discriminate and remove diseased tissue only, being (painless, silent, requiring only minimal pressure for optimal use), not generating vibration or heat during periods of operation, and being affordable and easy to maintain. And according to [5] the ultrasonic technique is the only one able to remove carious dentine without formation of a smear layer and the consequent obstruction of dentinal tubules.

Result

The ultrasonic excavator is more comfortable for dentist then manual excavator because the ultrasonic wave can easily penetrate to caries and defective dentine, furthermore, it will cause less trauma, heat generation and laceration, and we can remove a deep carious more biologically and conservatively for tooth.

According to study of the showed (effect of ultrasonic and high speed air-driving devices on pulp-dentine reaction in animal study) that if we make perforation by ultrasonic device is better than making it by high and low speed air driven because: The bleeding level in eighteen upper incisors from nine dog if we make perforation by ultrasonic device between none to mild bleeding. but by high speed air driven the bleeding level is varying between (none, mild, moderate and sever bleeding) depend an exposure [1]. The test by histological examination after perforate nine old dog teeth by ultrasonic device (immediate exposure) it was appeared as a smooth wound surface and mild reaction of pulp-dentine and the alignments of odontoblast. No dentine chips displacement was found and hemorrhage level in pulp tissue was mild to moderate (Figure 1) [1].



Figure 1

And by making perforation by high speed air drive, it was appeared a moderately smooth wound surface. The reaction under dentinal tubules in the pulp was severe reaction, dentine chips displacement and level of hemorrhage in the pulp tissue is [1].

In the same study after two week of perforation in eighteen upper incisors from nine dog teeth by ultrasonic showed no pulp necrosis (Figure 2) and on the opposite side the high speed air driven make a partial necrosis in the pulp (Figure 3). In SEM (scanning electronic microscopy) investigation after ultrasonic device perforation showed smooth pulp tissue without any obvious trauma inside the perforated place (Figure 4,5), and in the opposite side the high speed air driven the tissue is lacerated in the perforated place (Figure 6,7) [1]. According to [6] with the use of ultrasound a patients pain perception is reduced as this system eliminates the production of noise, vibration, heat and pressure. And according to [7] it is possible to use ultrasound without the resource of local analgesia. And according to [5] his used ultrasonic technique to make cavity preparation for 2 years old patient without the need of local analgesia.

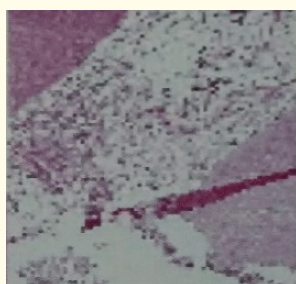


Figure 2



Figure 3

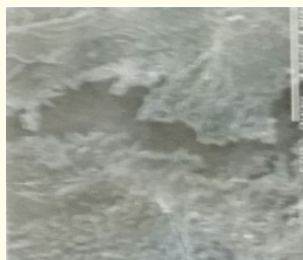


Figure 4

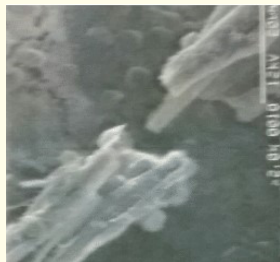


Figure 5

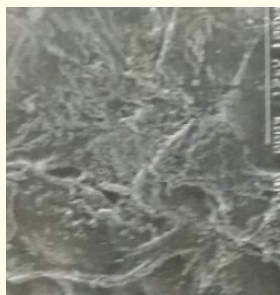


Figure 6

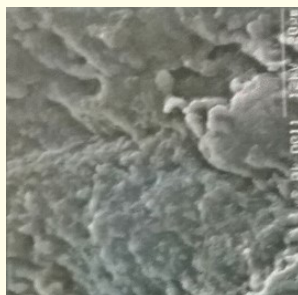


Figure 7

Discussion

In general the development of caries removal techniques in restorative dentistry is progressing towards a more biological and conservative so, the excavation process is very important process to remove caries and defective dentine conservatively because the manual excavator it's easy to control a dentists we can sense by movement and force applied it on the tooth because it has three angels, easy of accessibility and visibility a caries, there is no heat generation or vibration comes from using manual excavator and causing less traumatic injury to pulp then rotary instrument, so it's more comfortable for a patient and reduce the feeling by pain and we don't need to use local analgesia, but there is some disadvantage for a manual excavator like needs more force to remove caries (caused fatigue for dentists), some caries cannot be remove by manual excavator, difficulty to penetrate necrotic dentine.

Techniques for caries removal have been developed in an attempt to minimize excessive tissue loss [10], even though the rotary bur is in universal use, there are still problem that need to be overcome. Five factors are potentially responsible for the discomfort and pain that is associated with cavity preparation: the sensitivity of vital dentine, pressure on the tooth, bone-conducted noise and vibration, the high-pitched noise of the air-turbine handpiece and development of high temperature at the cutting surface [8,13]. The main difficulty concerning rotating instrument is that the adjacent dentition is damaged in 70% to 95% of cases prepared and finished for proximal cavities [9,12]. Using of high speed and low speed air driven can lead to undesirable removal of tooth structure. So we have disadvantage for air driven handpiece as: caused traumatic injuries to a pulp tissue, high heat generation to a pulp tissue, need to lubrication oil which could lead to cross infection and if we make perforation by rotary instrument its will caused irritation more than other instrument [1]. The operative dentistry progressing towards more conservative treatment, from all of these advantages and disadvantages for manual excavator and air driven handpiece the idea of ultrasonic excavator appeared to me.

The advantages of ultrasonic excavator is:

- Its comfort and ease of use in the clinical environment
- It's more easy in excavation process than manual excavator
- Being painless, silent, requiring only minimal pressure in excavation process
- Not generation vibration
- Less in the heat generation than air driven handpiece
- Provide to a dentist good visibility of the working
- Easy and accessible to detect caries site and remove it
- Can be control by movement and applied
- Easy to penetrate the tip of excavator into caries and defective dentine (because ultrasonic wave).

The ultrasonic minimizes or eliminates the development of noise, vibration, heat and pressure [6], and can be used without local analgesia [7]. The use of ultrasonic technique can be helpful to modified the proximal preparation procedure in order to protect adjacent teeth against iatrogenic damage caused by the use of dental bur [11], and it's possible to use ultrasound without the resource of local analgesia [7], the ultrasonic technique is the only one able to remove carious dentine without formation of a smear layer and the consequent obstruction of dentinal tubules [4].

The only disadvantages we know of for ultrasonic excavator are:

- Heat generation even though we installed a coolant system, there is still a problem with heat generation but still under more control than the high speed air driven devices.
- It takes a little bit more time than high speed air driven devices to make cavity preparation efficiently.

Conclusion

According to my experience when I used the ultrasonic excavator to excavate the caries and defective dentine for two molars extracted teeth, it proved to me the device can removed a caries and defective dentine. But the device under development and there is a trial version of it and also I have patent application from Saudi patent office, number 116380118.

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