Journal of Dental Herald
www.dherald.in

Journal of Dental Herald

(Jan 2016) Issue:1, Vol.:3
E ISSN No. : 2348 – 1331
P ISSN No. : 2348 – 134X

A Review

Recent Advancement In Root Canal Treatment: A Review

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Abstract

Endodontics is evergrowing branch in dentistry. It forms the pillar for clinical practice. Advancement in Endodontics are taking place every day leading it towards betterment. Advancement are taking place in every aspect of endodontics like materials, equipments, procedure etc. With these advancements Endodontic has become a much more easier and efficient than what it used be in the past. Modern Endodontic practice has changed the outlook of not only the clinician but also of the patient due to reduce fatigue, pain and predicatble results along with increased success rate . Though it is not possible to warranty the life long success of treatment but its success is definitely more preditcable and better than past. Now it's the era of quality dentistry.

Key Words

Endodontics, RCT, Root Canal Treatment

Introduction

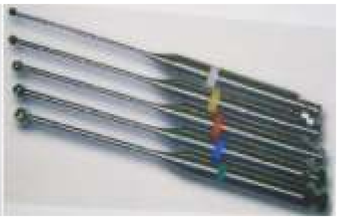
"Necessity is a mother of invention" and quest for improvement is advancement. Today's era is a "ERA OF ADVANCEMENT". There is advancement in every field of life and Endodontics is no exception to it. In Endodontics also this revolution is brought about by advances in endodontic instruments apart from other things. Various combination and permutations in designs, materials and technologies have led to these newer instruments.

These advances in instruments and their most efficient use, minimizing the chances of failure, saves time and most important enhance the quality of treatment. This seminar presents the advancements in Endodontic instruments over the conventional Endodontic instruments.

Advances In Acccess Opening Instruments

(I) FISSURE BURS

Fissure burs such as the # 558 produce less chatter when penetrating intact enamel or dentin compared to round carbide burs. In contrast, round carbide burs such as the # 6 or # 8 seem to be more controllable during the removal of carious dentin.



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(II) MUELLER BURS

Mueller burs are long-shaft, carbide-tipped burs used in a low –speed latch handpiece.

They appear similar to Gates Glidden burs, but have a round carbide tip instead of the noncutting tip of the gates Glidden bur. The long shaft is useful for working deep in the radicular portion of the tooth. In addition, it displaces the handpiece away from the occlusal surface, allowing the clinician to see the cutting tip in action. Mueller burs leave a clean, shiny surface when used on intact dentin unlike ultrasonics that leave a ragged, rough, dusty, debris-filled cut. Mueller burs are used after the gross coronal access has been achieved and a reasonable but unsuccessful search for the pulp chamber or canals has been completed.

The access preparation is thoroughly dried and an appropriately sized Mueller bur is selected. The clinician uses the bur in a brushing motion to search for white dots or white lines representing the calcified canal. While the clinician cuts, the endodontic assistance uses short, light blasts of air to blow out the dentin dust, which is then evacuated by high –volume suction. Water is not used during the process. The biggest disadvantage with these burs is that they do not endure sterilization cycles well and become dull quickly. A few uses are all that cab be reasonably expected before they become dull.

(III) ORIFICE SHAPERS

These are instruments used in orifice flaring. They are 19mm long in length and proceed from #20/ 0.05 taper to # 80/ 0.08 taper.

Ultrasonic In Endodontics

One of the most important advancements in endodontics has been the use of the surgical operating microscope, which in turn necessitated the evolution of a number of microendodontic instruments. Among these, ultrasonic instruments have improved the most. Ultrasonic technology has been available for a long time ; the only thing needed to make a modern-day ultrasonic instrument was incorporation of a contra-angle bend and parallel working ends. The contra-angle design allowed for dramatic improvement in procedural access for both anterior and posterior teeth, in addition to an unobtrusive view under the microscope.

Ultrasonic instruments play an ever-increasing role in several aspects of endodontic treatment. Teeth with root canal obstructions are no longer automatically treatment planned for surgical endodontics; endodontic retreatment has become the procedure of choice. In addition, root canal obstructions are being removed in a more conservative manner that does not unnecessarily destroy the root structure. The identification of missed and hidden canals has become a predictable outcome rather than a serendipitous discovery. Access cavities are being cut and refined with greater precision, opening up gateways to better endodontics. Above all. these procedures are no longer being performed blindly: instead the clinician is now able to maintain visual contact with the operating field at all times during ultrasonic procedures.(1) So the most frequent applications of ultrasonic in Endodontics can be summarized as follow (2) -

1. Access refinement, finding calcified canals, and removal of attached pulp stones.
2. Removal of intracanal obstructions (separated instruments, root canal posts, silver points, and fractured metallic posts).
3. Increased action of irrigating solutions
4. Ultrasonics condensations of gutta- percha
5. Placement of mineral trioxide aggregate (MTA)
6. Surgical endodontics: Root-end cavity preparation and refinement and placement of root-end obturation material.
7. Root canal preparation.

The ultrasonic technique is essentially a nonrotary method of cutting dental hard tissue and restorative materials using piezo-electric oscillations. Cutting dentine structure with ultrasonic tips is analogous to cutting dentine with the thinnest bur imaginable. Because the operating field is so restricted, the use of high magnification and proper illumination is essential during the use of these instruments. The combination of ultrasonic instruments with the magnification and illumination provided by surgical operating microscope has been termed microultrasonics.

Today, ultrasonic tips are being made and coated with different materials. The Enac ultrasonic endodontic system (Osada Electric Co. Tokyo, Japan) uses stainless steel tips that are effective and very economical. To improve efficiency, ultrasonic instruments also have been manufactured with a coating of zirconium nitride (ProUltra ultrasonic instruments; Dentsply, Tulsa. Oklahoma). These tips are designed to function dry. CPR ultrasonic instruments (Spartan CPR instruments, Fenton. Missouri) are similar in design to the ProUltra instruments, except that they are diamond coated and have built-in water ports. These instruments are designed primarily to function on Spartan Piezo-Electric units (Obtura/Spartan, Fenton, Missouri). Diamond-coated tips purport¬edly last longer and are associated with greater efficiency when compared to uncoated or zirconium nitride-coated tips. Both the CPR and ProUltra systems also are accompanied by a set of slender and long tips made from titanium alloys Titanium alloy provides flexibility and greater vibratory motion to the tips. These tips are end cutting and are employed for cutting deep inside the root canals. Recently, a set of BUC.access refinement tips (Spartan instruments) have been introduced to the market. The BUC tips also are diamond coated and have built-in waters ports that constantly bath the activated tips. The "4" series (Sybron Endo, West Collins Orange, California) is another popular system that is geared for troughing around posts and opening calcified canals.

Breakage of ultrasonic tips is a common phenomenon. Once broken, these tips usually jump out of the canal or can be retrieved easily. However, some of these tips are quite expensive and must be used properly to avoid unnecessary breakage. The most common reason that tips break is because they are not operated at their recommended frequencies. Therefore, it is important to follow the manufacturer's recommendations with regard to the ultrasonic intensity at which a particular tip must be used.. However, the slender and longer tips with small cross-sectional diameters (ie. CPR 6-8) will fracture easily when used at high intensity. On the other hand, short and sturdy tips used for vibrating posts out of root canals are operated at medium-high intensity. Similarly, tips that are used for bulk removal of dentine or restorative materials (eg, CPR 2) also need to be used at moderate to high intensities. The troughing tips (eg, CPR 3D 5D, BUG 3, and CPR b~ 8) should be used at low intensity. In general, thick and short tips are operated at higher intensities, whereas long and slender tips are operated at lower intensities.

Each instrument system usually comes with its own ultrasonic engine, which is capable of generating ultrasonic frequencies in the range 20 kHz to 30 kHz. These frequencies generate comparable patterns of oscillation at the tip of the instruments. The components of the different ultrasonic systems have been broadly classified as follows: (1) access refinement tips, (2) vibratory tips, (3) bulk removal tips, and (4) troughing tips.

1. Access refinement tips

Access cavity preparation is the most important phase of endodontic therapy. A properly designed access cavity that provides direct line access to all the root canals is key to endodontic success. A properly designed access cavity should allow for placement of endodontic instruments in the root canals in the same manner as flowers are placed in a vase. Traditionally, access cavities have been refined with burs that were designed primarily for operative preparations. Recently, a combination of access refinement ultrasonic tips and magnification has revolutionized the basic concept of access cavity preparation.

There are many advantages to using ultrasonic tips rather than burs to refine the access cavity to locate the underlying anatomy. There is no handpiece head to obscure vision and, therefore, the progressive cutting action can be observed directly and continuously under the microscope. The size of ultrasonic tips is smaller than the smallest burs; therefore, the dentine can be brushed off in smaller increments and with greater control. The process allows for exposure of any missed or hidden canals or recesses containing necrotic pulp tissue without cutting down the tooth structure. The process is similar to archeologists unearthing artifacts at excavation sites. The dentine must be brushed off in smaller increments until the road map on the floor of the pulp chamber is uncovered completely. The usual term used for this procedure is "unroofing" the pulp chamber; however, this term is valid only when dealing with young and large pulp chambers. For pulp chambers that have receded with calcification, the term "uncovering" the floor of the pulp chamber is more appropriate.

Another advantage of ultrasonic instruments over burs is the production of cavitation within the cooling water that flows over the tip of the ultrasonic instrument (4). Cavitation may be described simply as bubble activity in a liquid, which is capable of generating enough shock waves to cause disruption of remnants of necrotic pulp tissue and any calcific deposits. Therefore, it is no wonder that access cavities prepared with ultrasonic instruments have a thoroughly washed out and clean appearance. A number of tips are available to refine the access cavity. The uncovering of the floor of the pulp chamber can be accomplished with the help of the CPR 2D or BUC -1 tips. If the dark, colored floor of the pulp chamber is not visible, it usually is obscured by pulp stones or tertiary dentine deposits The pulp stones sometimes can be vibrated or teased out by the CPR 2D or BUC 1 tips at other times, they can be planed with the help of a BUC 2 tip—a process similar to planning the root surface. The tip of this instrument is designed with a planed surface and it can grind the floor until the dark-colored dentine becomes visible. The unveiling of the dark-colored floor of the pulp chamber is of critical importance because it dictates and guides the extension of access cavity.

The second mesiobuccal canal (MB2) is reported to occur in more than 90% of maxillary molars (5). On average, it is located 1.8 mm away from the mesiobuccal canal in a palatomesial direction. A protocol involving deepening of the bucco-lingual groove overlying the mesiobuccal root is essential for locating the MB2. The groove should not be extended toward the palatal canal but rather in a direction slightly mesial to it. so as to follow the bucco-lingual orientation of the mesiobuccal root. The refining tips can accomplish this task in a much-controlled manner by deepening the groove while at the same time restricting its mesiodistal dimension so as to not perforate the furcal or mesial aspect of the tooth.

The refining tips also are used for moving the mesial marginal ridges mesially to have a direct line access to the MB2 canal . In addition, the tips also can be used for delineating the outlines of the root canal orifices so that the overhanging dentine deposits are removed and the orifices are exposed. This step sometimes can reveal the presence of two canals in a single orifice and helps to guide the instruments easily in and out of the canals. The ultrasonic tips can be used to dig and follow the sclerosed canals until patency is achieved. However, this procedure must be accomplished by a number of radiographic checks and restricted to the coronal aspect of theroot trunk only. To check progress, an ultrasonic tip is used to dig a test hole at the most probable site of the sclerosed canal. The test site is filled with thermoplastisized gutta-percha and an orientation radiograph is exposed. If the test site is found centered in the root and pointing correctly, then cutting is continued to enter the canal; otherwise, the direction of the cutting is modified according to information gathered from the radiograph. Radiographs are two dimensional in nature, however, and do not provide any information regarding the bucco-lingual depth of the tooth structure.

2. Vibratory tips

Removal of intraradicular posts has always been a challenge when performing endodontic retreatment. This procedure also has been fraught with unwanted consequences, such as root fracture or perforation. The implementation of ultrasonic energy has provided the clinician with an important adjunctive method for removal of posts. A number of studies (6-8) have shown conclusively that the use of ultrasonic vibration significantly reduces the amount of tensile force required to dislodge both the cast and prefabricated posts. The VT (Sybron Endo), OsadaEnac ST09, and CPR 1 are examples of such instrument tips. The tips of these instruments are spherical or flat and are placed against the post to transmit vibration. They are activated at the maximum intensity and moved circumferentially until the post loosens or dislodges. If this method does not loosen and free the post then alternate methods must be used. The manufacturer cautions against placing these tips directly on ceramics because it may cause severe damage to the prosthesis.

The inability to remove posts by vibration alone is dependent on many factors such as the type of luting agent, the length and type of the post, and the type of core buildup. The core buildup around the post should be removed before applying the vibratory tip. In some cases, the troughing tip should be used around the post and then vibratory tips should be reapplied to obtain the maximum benefit. Posts luted with zinc phosphate cement can be dislodged readily by ultrasonics because of microcrack formation in the cement (7). However, posts luted with resin cements such as Panavia fail to dislodge by ultrasonic vibration, probably due to the lack of the micro-fracture propagation in these materials

3. Bulk removal tips

Bulk removal tips are extremely sharp and sturdy tips that are operated at moderate or maximum intensity of the ultrasonic unit. BUC 1 and CPR 2D are examples of tips that fall into this category. Both of these tips are diamond coated and have an added advantage of a water port placed near the cutting surface of the tip for increased washing and cooling of the operative site.

These tips are designed primarily to remove dentine and core material quickly and expeditiously before subjecting the root canal obstruction to vibratory or troughing procedures. In retreating cast post and cores, the core portion is reduced and sculpted until it becomes an extension of the post itself . This gives the clinician a purchase point to apply extraction devices when normal vibratory motions fail to dislodge the post completely. The controlled and incremental cutting with ultrasonic instruments under magnification provides a clear contrast between the core materials - for example, between composites and the underlying dentinal structure. Therefore, the chances of inadvertently perforating the crown of a tooth are reduced greatly.

4. Troughing tips

Troughing tips are used to create a sufficiently deep trough around posts to maximize the benefits of subsequently applied vibratory or extraction forces. In the past, troughing around the root canal obstruction was performed with trephine drills. This process was extremely destructive and fre-quently led to the gutting down and perforation of root trunks. Now with the help of ultrasonic tips, troughing around root canal obstructions can be performed in a predictable and controlled manner.Initially, the troughing is performed with instruments such as CPR 3D, 4D, and 5D, which are 15. 20. and 25 mm in length, respectively. These instruments are used in the coronal, middle, and apical one third of root canals and their selection depends on the depth at which they need to be operated. These instruments are diamond coated and aggressively cut dentin along their lateral sides. The BLJC 3 (Obtura/Spartan, Fenton, Ohio) or CT 4 tip (Sybron Endo) which also is available with a diamond coating, can be used for this purpose. The instruments not only remove cement that may be present around the post, but also remove a thin shelf of dentine around the perimeter of an obstruction.

If the obstruction is located in the deeper part of a straight canal, then titanium CPR tips 6 (red). 7 (blue), and 8 (green) are used, which are 20. 24, and 27 mm long, respectively. These instruments are quite slender, long, and parallel sided to cut deep into the root without taking away too much dentine, and at the same time provide maximum visibility under the microscope. These instruments are especially useful when removing long and thick prefabricated post systems. The fact that these instruments are made of titanium alloys and have thin cross-sectional diameters makes them extremely flexible and vibrant, but, at the same time, subject to breakage. The instruments should be used with a light touch; that is, with the same amount of pressure used to avoid breaking the lead tip of a pencil. These tips most commonly fracture when inadvertently brought into contact with metallic objects such as posts. Therefore, extreme caution needs to be taken when using these instruments. The instruments must be used at low intensities and always under the magnification provided by the microscope so as to not inadvertently contact any metallic obstruction.

Unlike CPR tips 3D, 4D, and 5D, which are diamond coated and active along the sides of their tips. CPR tips 6, 7, and 8 are end cutting and only active at their tips. Therefore, before troughing with these tips a collar of dentine must be exposed around obstructions that are embedded in root canals. The collar or shelf of dentine can be prepared around the obstructions with the help of LightSpeed instruments (LightSpeed, Inc., San Antonio, Texas). The tips of these instruments are flattened with the help of a grinding stone,which allows them to cut dentine as close to the obstruction as possible. The instruments are used sequentially to the coronal extent of the obstruction until the canal is enlarged sufficiently, and a shelf of dentine is prepared around the obstruction. Gates Glidden (GG) drills also can be used for this purpose: however. GG drills can be used only in the straight portions of the canal and are unable to

negotiate any curvatures in the root canals . Nevertheless, retreatment becomes difficult when the coronal end of the instrument lies apical to the elbow of the curvature and cannot be seen with the help of the surgical operating microscope. Once the shelf of dentine is prepared, CPR tips 6. 7, and 8 can be used to create a trough around the instrument The tips are moved counterclockwise around the fractured instrument to disengage it from the surrounding dentine . Once loosened, the instrument usually moves coronally and "jumps out" from the root canal Inother instances, the exposed part of the separated instrument can be grabbed and pulled out with one of the currently available extraction devices.

The use of NiTi rotary instruments has increased the incidence of file separation in endodontics. The NiTi files mainly break by either torsional fracture or flexural fatigue (8). In the former case, the instrument usually gets forced into the root canal and, once jammed, fractures at its weakest point. This type of failure is associated most often with an unwinding of flutes that can be recognized under the operating microscope. The fractured instruments usually are engaged into dentine along their whole lengths and at times may be difficult to remove. On the other hand, fatigue failure causes the instrument to fracture at the point of its maximum flexure. These instruments do not exhibit any unwinding of flutes when observed under the operating microscope. Even though these instruments are not tightly bound in dentine, they may be difficult to access because their coronal ends usually are located apical to the elbow of root curvature.

In addition to trephining around posts and removal of broken instruments and other intracanal obstructions, ultrasonic instrumentation also can be used for eliminating brick-hard paste-type materials .The procedure can be accomplished with CPR 3D, 4D. and 5D; BUG 3; or ST21 Enac tips under the microscope so that the paste can be differentiated easily from the surrounding root canal dentine. Under the microscope, the paste - depending on its color - appears as a white or pinkish dot. The CPR tips are used to eliminate it by following the dot to its apical extent. However, no attempt should be made to remove paste materials around curves, because the ultrasonic files are unable to negotiate curvatures and may lead to perforation of the root surface. Ultrasonic tips also can be used to help MTA flow precisely into place. This is done by depositing mineral trioxide aggregate (MTA) at a site (ie. perforation) and then vibrating it with an activated ultrasonic tip until it flows evenly into the defect.

Increased Action Of Irrigating Solutions

The effectiveness of irrigation relies on both the mechanical flushing action and the chemical ability of irrigants to dissolve tissue. Furthermore, the flushing action of irrigants helps to remove organic and dentinal debris and microorganisms from the canal. The flushing action from the syringe irrigation is relatively weak and dependent not only on the anatomy of the root canal but also on the depth placement and the diameter of the needle. It has been shown that irrigants can only progress 1mm beyond the tip of the needle. Ultrasonic is a useful adjunct in cleaning these difficult anatomical features. It has been demonstrated that an irrigant in conjunction with ultrasonic vibration, which generates a continuous movement of the irrigant, is directly associated with the effectiveness of the cleaning of the root canal space. The flushing action of irrigants may be enhanced by using Ultrasonic. This seems to improve the efficacy of irrigation solutions in removing organic and inorganic debris from root canal walls. A possible explanation for the improved action is that a much higher velocity and volume of irrigant flow is created in the canal during ultrasonic irrigation.

Ultrasonics can also improve disinfection of root canals probably because organic tissues entering the streaming field that is generated are disrupted, as proposed by Walmsely. Ahmad confirmed that ultrasonically activated files produced streaming patterns close to the file, continuously moving irrigants around, thereby producing shear stress, which can damage biological cells, as stated by Williams.

Ultrasonic vibration can also be effective when touching the shank of a hand file inserted inside the canal. The hand file will transmit vibrations to irrigant inside the canal, but a greater risk for touching dentinal walls exists.

To prevent a dampening effect, sonic or ultrasonic files should not contact the canal walls, therefore, the use of smooth files is recommended. In contrast, ultrasonically activated stainless steel files tend to ledge and perforate canal walls because of their sharp cutting surfaces. The use of a smooth wire during ultrasonic irrigation in vitro was as effective as a K-file in debris removal. Furthermore, Ultrasonic as an adjunct with EDTA enhanced the canal wall cleanliness after post space preparation in endodontically treated teeth, especially in the apical portion of the post space.

ULTRASONIC CONDENSATION OF GUTTA-PERCHA

Ultrasonically activated spreaders have been used to thermoplasticize gutta-percha in a warm lateral condensation technique. Ultrasonic spreaders that vibrate linearly and produce heat, thus thermoplasticizing the gutta-percha, achieved a more homogenous mass with a decrease in number and size of voids and produced a more complete three-dimensional obturation of root canal system.

A number of obturation protocols have been described for ultrasonic condensation of gutta-percha:

a) Ultrasonic softening of the master cone followed by cold lateral condensation

b) One or two times of ultrasonic activation after completion of cold lateral condensation.

c) Ultrasonic activation after placement of each second accessory cone

d) Ultrasonic activation after placement of each accessory cone.

Warm lateral condensation combines the advantages of having control over the length of root fill, similar to cold lateral condensation, with the superior ability of a thermoplasticizedmaterial to replicate the three-dimensional shape of the root canal. From the practical point of view, Ultrasonic condensation of gutta- percha is quickly mastered and has several advantages over other warm lateral condensation technique. The heat generated during ultrasonic activation, and the plugger appeared to cool rapidly once activation ceased. The size of the heat carrier (ultrasonic spreader) can be chosen to match the diameter of the root canal, and the ultrasonic spreader can be curved to match the curvature of the root canal. Furthermore, guttapercha does not stick to the ultrasonic file when the ultrasonic unit is activated. Also, the low temperature produced by the unit at its lowest power setting may result in less volumetric changes of gutta-percha upon cooling.

The obturation technique recommended when using the Ultrasonic technique consists of initial placement of gutta-percha cone to the working length followed by cold lateral condensation of two or three accessory cones using a finger spreader. The Ultrasonic spreader is then placed into the center of the gutta-percha mass 1mm short of the working length and activated at intermediate power to prevent charring of root surfaces and fracture of the ultrasonic spreader. After activation, the Ultrasonic spreader is removed, and an additional accessory cone is placed, followed by energizing with the activated Ultrasonic spreader. This process is repeated until the canal is filled. During each subsequent step, the Ultrasonic spreader should be placed slightly more coronally.

The Ultrasonic spreader must be in the mass of gutta-percha for about 10 seconds to achieve thermoplasticization. Leaving it in the canal for more than 10 seconds can produce a rise in temperature that is damaging to the root surface.

In addition, it has been demonstrated that placement of sealers with an ultrasonically energized file promoted a better covering of canal walls with better filled accessory canals (evaluated by radiography) than placement of sealers with hand instruments (2). A

Placement Of Mineral Trioxide Aggregate (Mta)

Witherspoon and Ham described the use of Ultrasonic to aid in the placement of MTA. The inherent irregularities and divergent nature of some open apices may predispose the material to marginal gaps at the dentin interface. With the adjunct of Ultrasonic a significantly better seal with MTA is achieved. Placement of MTA with ultrasonic vibration and an endodontic condenser improved the flow, setting, and compaction of MTA. Furthermore, the Ultrasonically condensed MTA appeared denser radiographically, with fewer voids.

Summary

The use of ultrasonic instruments has revolutionized the art of endodontic retreatment. These instruments have multiple uses and have become an integral part of the endodontic armamentarium. However, the use of ultrasonic instruments requires specialized knowledge and de¬velopment of certain skills that may require training before use.

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Source of Support : Nill, Conflict of Interest : None declared