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College Of Dentistry

Effect of endoactivator on radicular system disinfection

A project Submitted to the Council of the Collage of Dentistry at the University of Misan, Department of Conservative in Partial Fulfillment of the Requirement for B.D.S degree

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DEDICATION

To my parents

Those who encouraged me and gave me all love and confidence until I reached here.

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1.1 INTRODUCTION

The success of root canal treatment mainly depends on the instrumentation of the root canal system followed by thorough disinfection. Root canal irrigants play an important role by mechanical, chemical, and biological action. Mechanical action can be achieved by cleaning the root canal to remove the necrotic or the vital pulp tissue. This process leads to the formation of the smear layer, which contains the infected microorganisms from the dentinal tubules, root canal isthmus, and anastomosis, that needs to be removed by the chemical action of the root canal irrigants. Therefore the ideal requirement of root canal irrigant include debridement, removal of the necrotic tissue, antimicrobial activity, ability to inactivate the endotoxins. Chemomechanical preparation is the main responsible for the bacterial load reduction in the root canal system (RCS) to prevent the development or promote conditions for the healing of a perirradicular disease. It is primarily based on the associated use of endodontic instruments (mechanical cleaning) and auxiliary chemical solutions (chemical cleaning), further complemented by the physical cleaning performed by injection followed by aspiration of the irrigating solutions into the RCS. The metallurgical revolution occurred in the last years has positively impacted endodontic science, stemming from the development and improvement of instruments with different designs, objectives, kinematics, characteristics, and properties However, the difficulties imposed by the anatomical complexity and the infection of the RCS continue to be the pillars of endodontic failure, thus encouraging the study of alternatives to enhance the chemical and disinfection processes.

1.2 LITERATURE REVIEW

1.2.1 DISINFECTION OF THE ROOT CANAL SYSTEM

Hydrodynamics of Irrigation

Irrigation dynamics refers to how irrigants flow, penetrate,and readily exchange within the root canal system as well as The forces they produce. A better understanding of the fluid dynamics of different modes of irrigation will contribute to achieving predictable disinfection of the root canal system

Hence, in endodontic disinfection, the process of delivery Is as important as the antibacterial characteristics of the Irrigants

Irrigation is defined as "to wash out a body cavity or wound with water or a medicated fluid" and aspiration as *the process Of removing fluids or gases from the body with a suction Device." Disinfectant, meanwhile, is defined as "an agent that Destroys or inhibits the activity of microorganisms that cause Disease.

Figure 1

This graphic shows residual tissue following shaping, while the inset image depicts a file generating debris, resulting in a blocked lateral canal

The objectives of irrigation in endodontics are mechanical Chemical, and biologic. The mechanical and chemical objectives are as follows: (1) flush out debris, (2) lubricate the canal(3) dissolve organic and inorganic tissue, and (4) prevent the Formation of a smear layer during instrumentation or dissolve It once it has formed.' The mechanical effectiveness will Depend on the ability of irrigation to generate optimum streaming forces within the entire root-canal system. The chemical effectiveness will depend on the concentration of the antimicrobial irrigant, the area of contact, and the duration of interaction between irrigant and infected material.The final Efficiency of endodontic disinfection will depend on its chemical and mechanical effectiveness .

The biologic function of irrigants is related to their antimicrobial effects. In principle, irrigants should (1) have a high efficacy against anaerobic and facultative microorganisms In their planktonic state and in biofilms, (2) inactivate endotoxin, and (3) be nontoxic when they come in contact with vital tissue and (4) not cause an anaphylactic

Efficiency of root canal irrigation in terms of debris removal and eradication of bacteria depends on several factors: penetration depth of the needle, diameter of the root canal, inner and outer diameter of the needle, irrigation pressure, viscosity of the irrigant, velocity of the irrigant at the needle tip, and type and orientation of the needle bevel.

1.2.2 Types of irrigants solutions

Chemically Non-active Solution

• Water

• Saline

• Local anesthetic.

Chemically Active Materials

• Alkalis: Sodium hypochlorite 0.5 to 5.25 percent.

• Chelating agents: Ethylene diamine tetra acetic acid (EDTA)

• Oxidizing agents: Hydrogen peroxide, carbamide peroxide

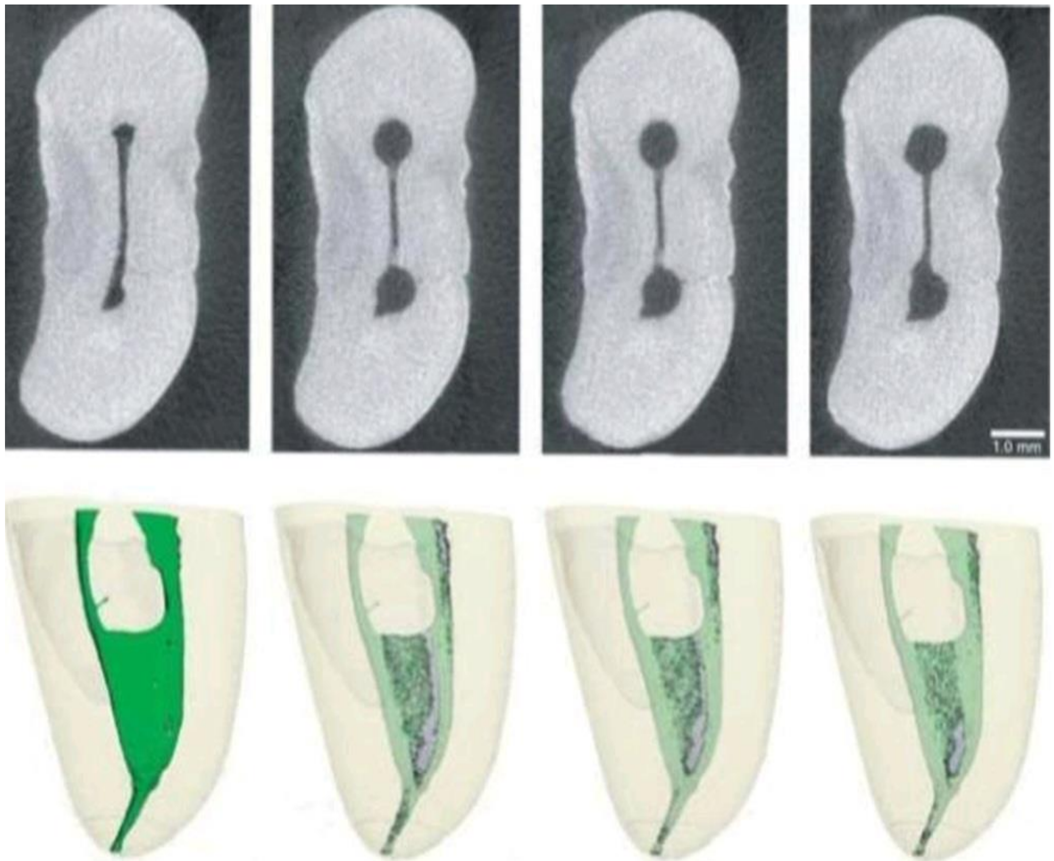
• Antibacterial agents: Chlorhexidine, Bisdequalinium acetate

• Acids: 30 percent hydrochloric acid

• Enzymes: Streptokinase, papain, trypsin

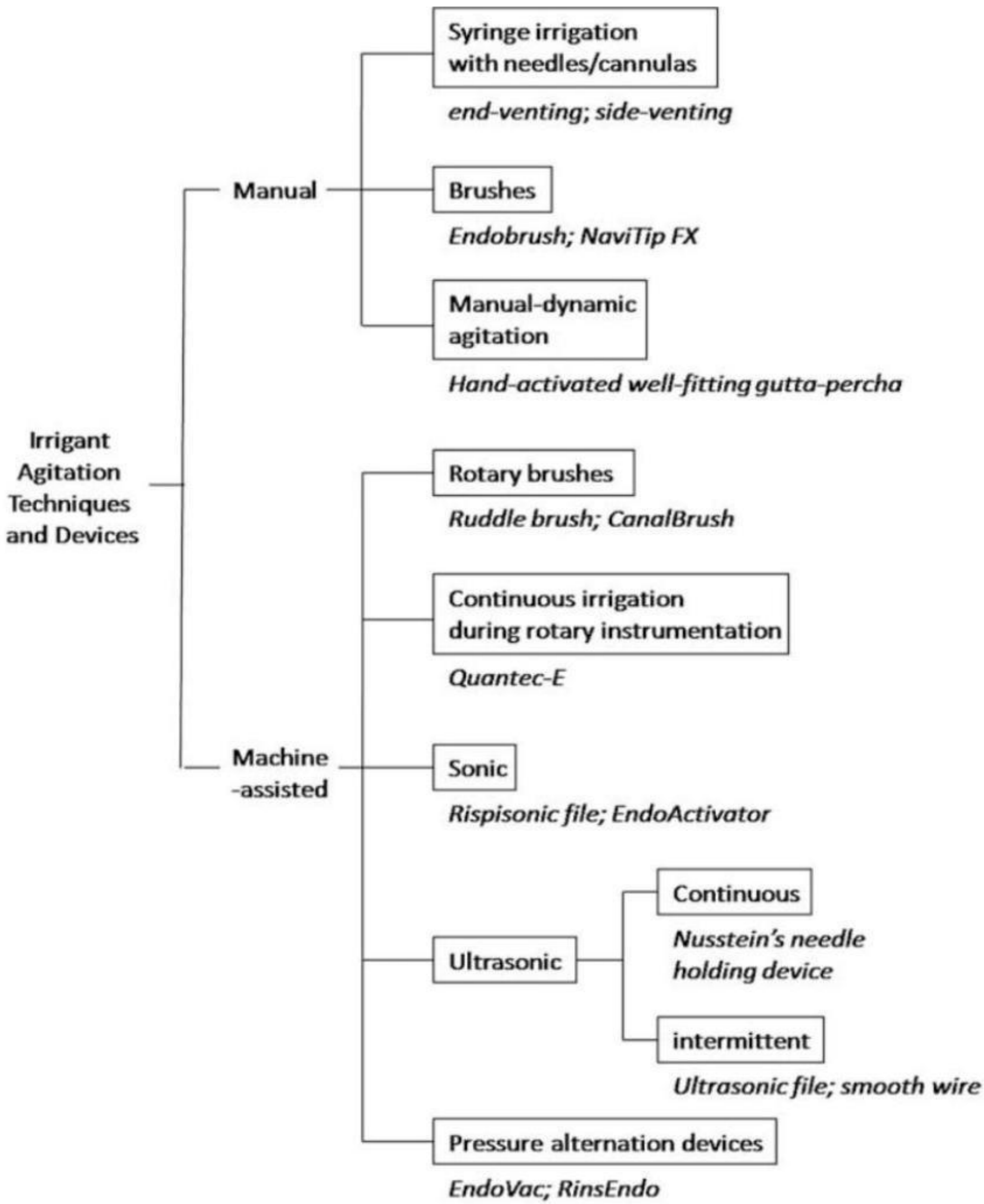
• Detergents: Sodium laruyl sulphate

Figure 2



Debris accumulation in accessory anatomy following instrumentation, Individual MCT slices from the apical third of a typical specimen before and after root canal preparation and irrigation with NaOCl, subsequent irrigation with EDTA, and final passive ultrasonic irrigation using NaOCl (a, from left to right). The corresponding three-dimensional reconstructions of the whole canal system are depicted in (b).

1.2.3 Disinfection Devices and Techniques



1.2.3.1 Syringe Delivery

Application of an irrigant into a canal by means of a syringe And needle allows exact placement, replenishing of existing Fluid, rinsing out of larger debris particles, as well as allowing Direct contact to microorganisms in areas close to the needle Tip. In passive syringe irrigation, the actual exchange of irrigant Is restricted to 1 to 1.5 mm apical to the needle tip, with fluid dynamics taking place near the needle outlet. Volume and Speed of fluid flow are proportional to the cleansing efficiency Inside a root canal.Therefore, both the diameter and position of the needle outlet determine successful chemomechanical Debridement; placement close to working length is required to Guarantee fluid exchange at the apical portion of the canal, but Close control is required to avoid extrusion. Therefore. The choice of an appropriate irrigating needle is important Although larger-gauge needles allows a quicker and larger Amount of fluid exchange, the wider diameter does not allow Cleaning of the apical and narrower areas of the root canal System. Excess pressure or binding of needles into canals During irrigation with no possibility of backflow of the irrigant Should be avoided under all circumstances to prevent extrusion into periapical spaces. In immature teeth with wide apical foramina or when the apical constriction no longer exists special care must be taken to prevent irrigation extrusion and Potential accidents.

1.2.3.2 Sonically Activated Irrigation

The EndoActivator System uses safe, noncutting polymer tips in an easy-to-use subsonic handpiece to quickly and vigorously agitate irrigant solutions during endodontic therapy In one study، the safety of various intracanal irrigation systems was analyzed by measuring the apical extrusion of Irrigant. EndoActivator had a Minimal statistically insignificant amount of irrigant extruded Out of the apex in comparison with manual, ultrasonic and Rinsendo (Dürr Dental, Bietigheim-Bissingen, Germany)Groups. When cleanliness of the root canal walls was analyzed,Investigators suggested that both passive sonic or ultrasonic Irrigation rendered root canals significantly cleaner than manual preparation in comparison with manual syringe irrigation.

Movements: sonic devices range between 1500 Hz and 6000 Hz, and If sonic devices are left in the canal for Longer periods of time, better cleaning effects can be found Sonic or ultrasonic irrigation may be carried out with activated Smooth wires or plastic inserts,endodontic instruments, or Activated irrigation needles. Examples include EndoSonor (Dentsply Maillefer) and EndoSoft ESI

(EMS Electro Medical Systems, Nyon, Switzerland) inserts, IrriSafe (Acteon Satelec).,

The EndoActivator System (Dentsply Tulsa Dental Specialties).And the Vibringe sonic syringe (Vibringe B.V., Amsterdam.Netherlands). Inadvertent cavitation of root canal walls has not been observed with sonic activation of instruments.

The EndoActivator system consists of a sonic-powered activation device that agitates irrigants within the root canal system. This agitation helps in the mechanical debridement of the canal walls and improves the penetration of irrigants into intricate canal spaces, enhancing disinfection efficacy.This sonically driven system has been engineered to safely and more effective method to disinfect a root canal system is able to remove the smear layer, debride into the uninstrumentable portions of the root canal system, and dislodge biofilms within long, narrow, and highly curved canals of molar teeth.

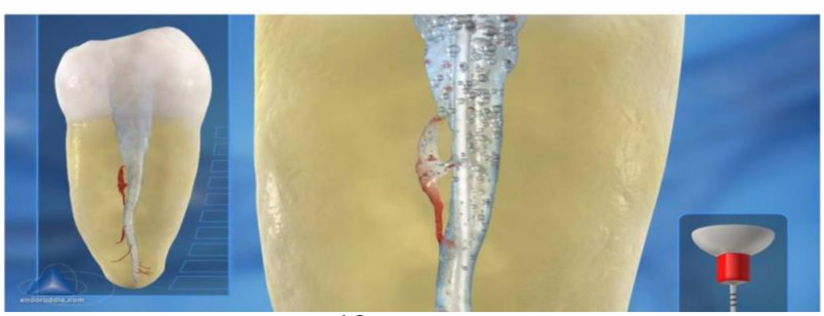
• **SONIC HANDPIECE**

The sonic handpiece has been designed to be cordless,

Contra-angled, and ergonomic, and is used to mechanically Drive strong and flexible polymer EndoActivator tips. When The handpiece is activated, the power defaults to 10,000 Cpm, which research has shown significantly promotes all aspects of 3D disinfection.4,6-7 Depending on use, a new, single lithium battery is periodically replaced to ensure optimal Performance. For infection control, custom protective barrier Sleeves have been designed to easily slide over the entire Handpiece. After use, it is important to not autoclave or submerge The handpiece in cleaning solutions; rather, remove the barrier Sleeve and simply wipe down the handpiece with a mild detergent.

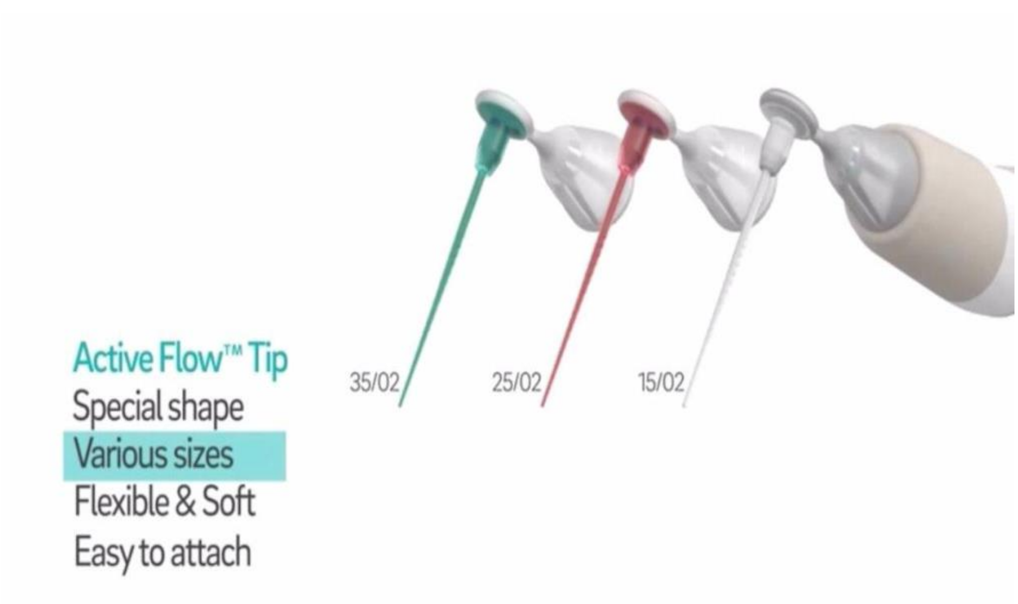
• ENDOACTIVATOR TIPS

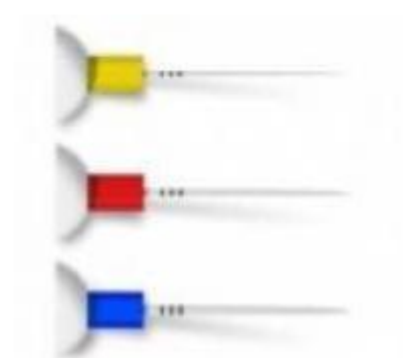
The EndoActivator tips have an easy snap-on/snap-off design and are color-coded yellow, red, and blue to approximately Correspond to file sizes 20/02, 25/04, and 30/06, respectively. The tips are made from a noncutting, medical-grade polymer, Are strong and flexible, and are 22 mm long with orientational depth gauge rings positioned at 18, 19, and 20 mm. The EndoActivator tips are disposable, single-use devices that Should not be autoclaved. Autoclaving an EndoActivator tip Reduces the elasticity of the tip, which decreases its back-And-forth movement and performance. The EndoActivator Tip selected is placed over the barrier-protected driver and is Simply snapped on to secure its connection to the handpiece



Tip Selection

In well-prepared canals, it is easy to select a tip that fits loosely to within 2 mm of working length.1,11 When a tip is too big for any given prepared canal, its back-and-forth movement will be restricted or dampened, limiting its ability to agitate a Solution. Research has shown that vibrating the tip, in combination with moving the tip up and down in short 2-3 m Vertical strokes, synergistically produces a powerful hydrdynamic phenomenon. This specific technology optimizes debridement, eliminates the smear layer, and disrupts biofilms





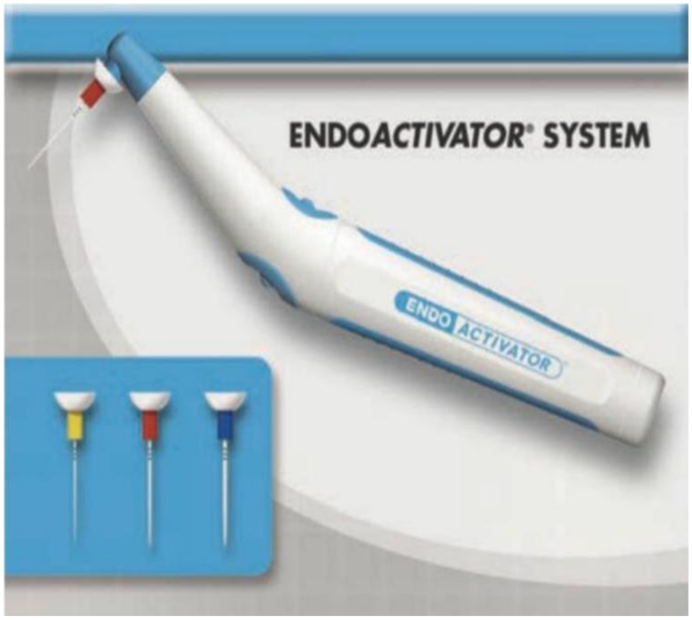


Figure 6 The EndoActivator System is designed to safely and vigorously exchange intracanal reagents into all aspects of the root canal system.

•CLINICAL PROTOCOL

Following shaping procedures, re-irrigate and flush the root Canal space with a 6% solution of NaOCl, then suction to remove this reagent. Next, flood the pulp chamber with a 17% Solution of EDTA and use the EndoActivator to agitate this Intracanal solution for 60 seconds. This process should be Repeated for each canal or until the fluid in the pulp chamber.

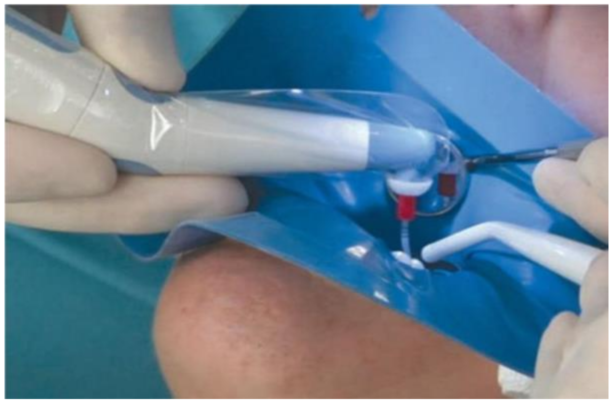


Figure 7 A pre-selected EndoActivator tip is placed over a protective barrier and snapped onto the handpiece for clinical use.

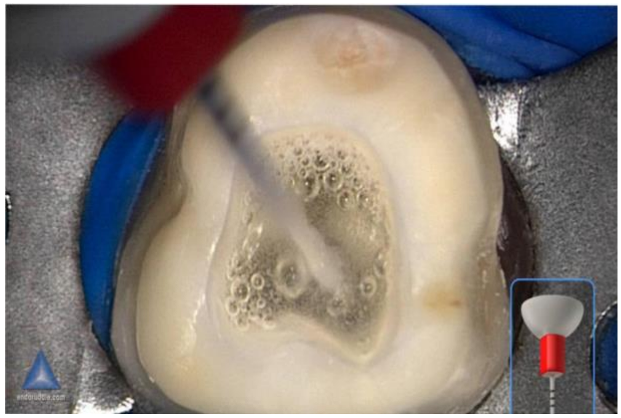


Figure 8 This clinical image shows the EndoActivator in use. Note the powerful activation of fluid and appreciate the suborifice potential for 3D cleaning

Figure 9 This image depicts a simulated root canal system. The Activator tip is used with a gentle pumping motion to enhance the exchange of irrigant.

The sonic advantage

The EndoActivator is a sonic technology that has been shown to be superior to ultrasonic technology utilized for 3D disinfection.

AMPLITUDE AND FREQUENCY

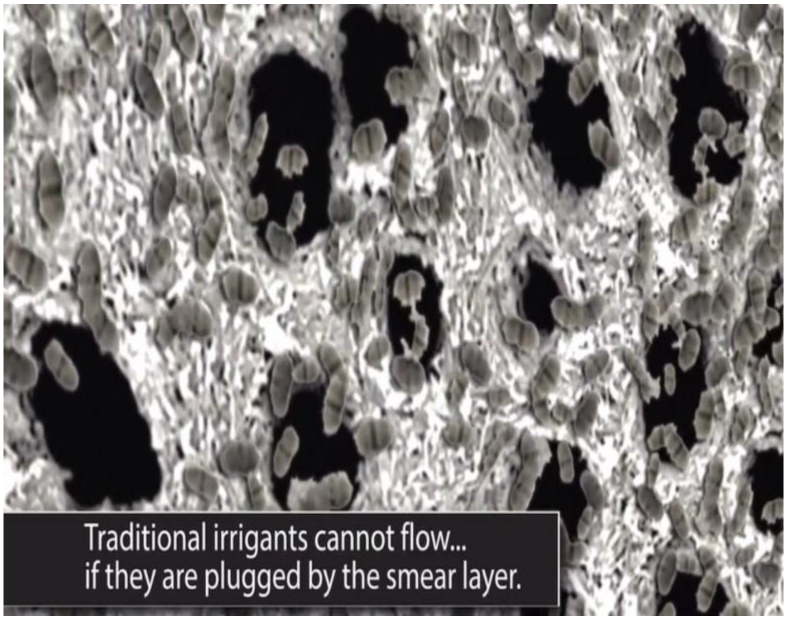
Amplitude is the maximum value of back and forth displacement of a vibrating tip. Frequency is the interval of time it takes a vibrating tip to move through one complete back-and-forth displacement In general, the higher the frequency, the lower the amplitude. Certain distributors market activating metal insert tips at high ultrasonic frequencies for endodontic 3D disinfection. However, an ultra high frequency requires an ultra low amplitude to mitigate tip breakage. To clarify, when ultrasonic energy is used for 3D disinfection, high frequency sinusoidal waves are produced with low amplitude, meaning less useful energy. On the contrary, sonic technology produces a high tip amplitude about 60 times greater than ultrasonic technology . Research shows this amplitude maximizes hydrodynamics and 3D disinfection.

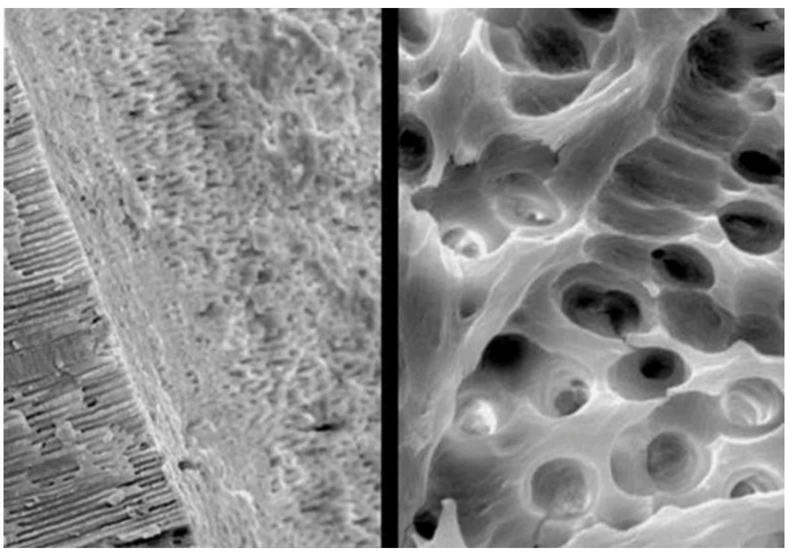
NONCUTTING Sonic technology drives highly flexible, noncutting, polymer tips that absolutely maintain the anatomical integrity of the final preparation. On the contrary, all ultrasonically driven instruments are manufactured from metal alloys. Appreciate that ultrasonically driven instruments are either active and have cutting edges, or are nonactive in that their cutting edges have been reduced or eliminated. Regardless, any active or nonactive metal-driven ultrasonic insert tip that contacts dentin will cut dentin and generate its own smear layer. Of greatest concern, vibrating any metal tip, even precurved, around a canal curvature invites ledges, apical transportations, lateral perforations, or broken instruments

CONTINUOUS MOVEMENT It should be understood that any vibrating tip will almost certainly contact dentin because of the various dimensions and curvatures of any given final preparation. Research has shown that, when a sonically driven polymer tip is constrained against a dentinal wall, the tip advantageously continues to display a large displacement amplitude.To validate this phenomenon, simply turn on the endoactivator handpiece, purposefully constrain, at any level, the moving tip, and note that the tip will continue to vigorously move! On the contrary, constrain a vibrating ultrasonic insert tip and note the tip movement will be sharply reduced or the tip will not move at all.It is appreciated that a loss of tip movement will compromise the exchange of irrigant.

One study comparing the effectiveness of sonic activation (EndoActivator) and conventional needle irrigation in reducing the bacterial load did not report statistically significant differences. However, the two methods are not interchangeable. Although EndoActivator is considered less performant than ultrasonic activation, due to the production of only one node along the length of the instrument, the similar efficacy of irrigants registered in Huffaker et al. through the needle irrigation method is not related to physical action, but it is likely attributable to the irrigant antimicrobial properties. Moreover, conventional needle irrigation may fail to deliver irrigants in the apical third, where entrapped gas particles may produce a vapor lock effect, although this effect could be prevented when the root canal is enlarged adequately and the needle is placed close to working length . Besides, conventional needle irrigation generates a positive pressure at the end of the needle forcing the irrigating solutions and microbial debris into the periapical tissue. Combining NaOCl and chelating agents such as HEDP can potentially reduce debris accumulation in the apical parts, but it can force irrigants into periapical, if positive pressure is applied. Finally, depending on the needle tip, the extent of irrigation delivery beyond the needle tip may change: for open-ended needles, the jet is intense and extends apically to the needle tip along the root canal, while for closes-ended needles, the jet is formed near the apex of the outlet and it is directed apically with a slight divergence

EndoActivator applies a negative pressure to irrigate and remove debris from the apex without forcing the irrigant into the periapical tissues, so resulting in more effective than conventional needle irrigation in the clinical context because it reduces the risk of overirrigation.





SEM images .provide evidence that the endoactivator System can clean root canal systems

1.3 DISCUSSTION

The success of endodontic treatment depends on the removal of debris, smear layer, and vital and necrotic tissue from the root canal system. The role of root canal instrumentation is to mechanically disrupt the biofilms formed on the root canal walls and facilitate the flow of irrigants inside the root canal.5 Anatomical complexities such as isthmus, fins, accessory, and lateral canals create an environment favorable to the survival of microorganisms by creating niches where irrigants cannot reach, in addition to the presence of tissue remnants that serve as a nutritional source for the microbiota. Interestingly, at least 35% of the root canal walls have been reported to be untouched by rotary instruments.6 The apical 4 mm of the root canal remain untouched in 17.6% of cases and 34.6% of the necrotic teeth remain untouched by the reciprocating systems as demonstrated These untouched portions of the root canal contain bacterial cells, debris, and tissue remnants which make it difficult to clean these areas using the traditional syringe method of irrigation.7 One of the major challenges is the inability of the irrigants to penetrate into the apical portions in order to overcome the above- mentioned lacunae. There is a development of newer methods of irrigation devices which can help to exchange the irrigants within the root canal systems, and hence enhances the success of endodontic treatment.

1.4 RESULTS

present as main results that the combined use of mechanical instrumentation and irrigation reduces but doesn't completely eliminate bacteria. Until now there is no ideal irrigant. Some new techniques capable of fighting the present difficulties and increasing the potential of irrigation have been developed, each of them presenting their own advantages and disadvantages. From the results obtained, that the endoactivator System the best regarding biosafety and the passive ultrasonic irrigation system the best regarding disinfection and cleansing.

1.5 CONCLUSION

A specific sequence of combined irrigants is apparently necessary to achieve success in Endodontic therapy, as well choosing an adequate technique. The most recent techniques, such as manual dynamic activation, passive ultrasonic irrigation, sonic activation and systems with negative apical pressure show better results when used with adequate irrigants such as sodium hypochlorite, EDTA, citric acid, chlorhexidine and ethanol. However, it was concluded that further research is necessary to increase the success rates of non-cirurgical endodontic treatment,also concluded that the use of a mechanical activation device along with the irrigant will help in better removal of the smear layer and debris from the root canal system, improving the cleanliness and helping achieve more successful endodontic treatment.

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