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Recent Advances in Endodontics – A Perspective Review

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ABSTRACT

Contemporary endodontics has seen an unprecedented advance in technology and materials. This article aimed to review some of the challenges and advances in the following sections: (1) Magnification, (2) LASER, (3) NiTi files, (4) Irrigation activation systems, and (5) CAD CAM. Jointly, these advances are aimed at improving the state of the art and science of root canal treatment and restoring the tooth back to function in the oral cavity.

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As science is constantly evolving, there are many innovative instruments and materials at the disposal of a dentist. Over the past few decades development in endodontics and restorative dentistry took a leap with the advent of mainly 5 things which almost altered the way in which dentistry was practiced earlier. This includes magnification devices like Microscope, Lasers in dentistry, NiTi Files, various irrigation activation systems and Computer Aided Designing and Computer Aided Milling otherwise commonly known as CAD-CAM. The scope of the current review is to give a perspective of a dentist who is new to these technologies.

Magnification

Magnification devices were mainly invented to bridge the gap between the vision of the naked eye and a microscope and it includes magnifying glasses, loupes, Dental Operating Microscope (DOM) [1]. Endodontist work with minuscule of anatomy and the use of magnification cannot be over emphasized when working in such constricted areas [2]. It has been shown through many studies with the aid of magnification variation in anatomy like second Mesiobuccal canal (MB2) and Middle Mesial Canals are found with ease [3]. Retrieval of separated instrument is much more predictable with the regular use of DOM. Earlier it was not attempted due to the fear of creating more iatrogenic errors like ledging or perforating the root canal system [4]. DOM gives a superior ergonomics for the dentist allowing them to work for longer hours without any musculoskeletal issues. Magnification can be varied in a DOM depending on the type of case to low (3x-8x), medium (8x-16x) and high (16x-30x) [5]. Endodontic microsurgeries can be performed with high precision and less trauma to the adjacent anatomical structure which in turn will improve the number of patients being referred to the clinic. The only drawback of DOM is the initial investment and the learning curve that follows for its use in everyday practice [6].

Lasers

Laser is an acronym for Light Amplification by the Stimulated Emission of Radiationand its first use dates back to 1960 by Miaman [7]. Lasers in dentistry can be broadly classified into hard and soft tissue lasers. Hard tissue lasers can be used in soft tissue also but has its limitation of being expensive and inflicting potential thermal damage to the dental pulp [8]. Carbon dioxide (CO2), Neodymium Yttrium Aluminum Garnet (Nd:YAG) and Er:YAG fall under the category of hard tissue laser and diode lasers are classified as soft tissue lasers. Clinically laser can be used for wound healing with low level laser stimulation therapy, aphthous ulcer, photoactivated dye disinfection, aesthetic gingival contouring and crown lengthening, frenectomies, removal of inflamed or hypertropic tissues [9]. Laser fluorescence is used for detection of caries. Hard tissue laser can be employed for caries removal and cavity disinfection. Use of lasers should be done with necessary precautions such as protective eyewear for everyone in the operating room and proper disinfection protocols in place [10].

Niti Files

Before the introduction of Nickel Titanium (NiTi) in endodonics by Walia, simple endo files were made of carbon steel or a stainless steel. Stainless steel instrument have inherent stiffness which increases as the size of the instrument increases. This led to a lot of transportation of the canal, zip perforations to occur [11]. NiTi instruments on the other hand have shape memory and super elasticity which made them more flexible thereby respecting the curved and complexing root canal anatomy. From 1990 to now NiTi instruments have undergone revolutionary changes in terms of their construction to their physical characteristics [13]. The objective was to preserves as much dentin as possible after shaping the canal and negotiated thin curved canals without the separation of the instrument [12]. There are 5 generation of NiTi files system and latest being the use of single file system for shaping the canal.

They can either be rotary or reciprocating based on their motion. Examples of single file system include XP endo shaper, Hyflex EDM which has the perfect combination of flexibility and fracture resistance. This makes it possible to reduce the number of files being used during a root canal treatment there by increasing the speed of completion. For a brief period the was us of self-adjusting file in the market which used scraping motion for cleaning and has a hollow body throughout the file. This however did not last in the market since they had to be used with a separate set of engine system [13-15].

Irrigation Activation Systems

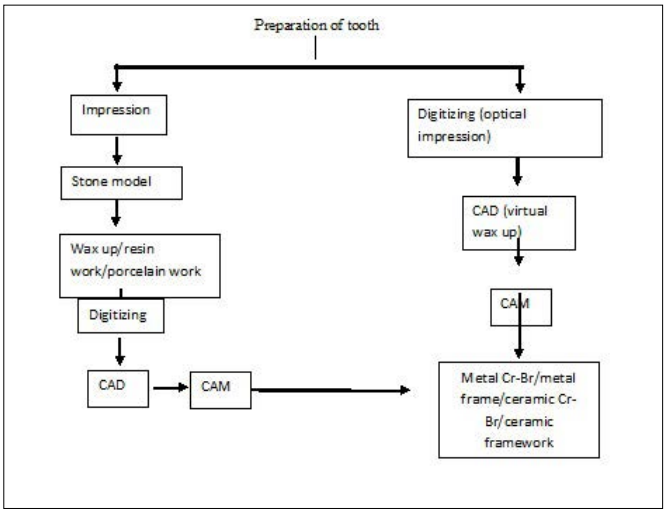
As we have become aware that endodontic infection is not just by planktonic bacteria but by the biofilms to which they are associated, it is imperative to destroy the biofilm in the process of chemomechanical preparation. The shaping part of the root canal system is taken care by advanced file systems whereas the disinfection is mainly attributed to the irrigant employed. The efficacy of the irrigant can be improved with adjunctive activation systems. Various studies have shown reduction in the bacterial load after activating the irrigant with ultrasonics. Newer activation devices like Endovac (Discus Dental, Culver City, CA), Photo Activated Disinfection, Photon induced photoacoustic streaming (PIPS), and SWEEPS have been introduced in the market. Of which endovac is an apical negative pressure irrigation system with 3 basic components: A Master Delivery Tip (MDT), the Macrocannula and the Microcannula. During irrigation, the MDT delivers irrigant into the pulp chamber and siphons off the excess irrigant to prevent overflow. The cannula in the canal simultaneously exerts negative pressure that pulls the irrigant from its fresh supply in the chamber by MDT, down the canal to the tip of the cannula and out through the suction hose. This ensures a constant flow of fresh irrigant being delivered by negative pressure to working length [16].

PIPS uses low energy (50mJ, 10-15Hz) short pulses of Er:YAG for 50 microseconds. They create profound shock waves than cavitation which is seen in ultrasonics. Studies have shown that 17% EDTA and PIPS for 40 seconds can remove smear layer completely in the apical third simultaneously maintaining hydroxyapatite and collagen structure in the middle third indicating no thermal damage brought. PIPS along with 6% NaOCl shows complete removal of biofilm. Regular utilization of these techniques can enhance the clinical outcome of a root canal treatment [17].

Cad-Cam

In dentistry the major development for CAD CAM took place in 1980. Dr. Duret was the first to work on developing this system way back in 1971 which led to the development of sopra system [18]. The second is Dr. Moermann, the developer of the CEREC® system. He attempted to use new technology in a dental office clinically at the chairside of patients. He directly measured the prepared cavity with an intra-oral camera, which was followed by the design and carving of an inlay from a ceramic block using a compact machine set at chair-side. The emergence of this system was really innovative because it allowed same-day ceramic restorations. When this system was announced, it rapidly spread the term CAD/CAM to the dental profession [19]. The third was Dr Anderson the developer of procure system. This system later developed as a processing center networked with satellite digitizers around the world for the fabrication of all-ceramic frameworks [20].

Workflow with a Cad Cam Set Up [21].



Conclusion

Gone are the days when endodontics was practice with just reamers and patient being uncomfortable in a dental chair. The advent of new technologies in dentistry has not only made the work flow easy for the operator but also makes the dental treatment much more comfortable for the patients. Endodontics in the present era is practiced with much more predictable outcome than it was done two or three decades ago. The future looks promising as already researches are underway to clean the root canal system without the need for shaping. It may take more time to come into every day practice. What is already present must be utilized to its fullest benefit.

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