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Recent advancements in Endodontic Treatment: A Review

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***Abstract**: The past couple of decades have witnessed one of the most rapid and extensive technological evolutions in dentistry.This paper aims to review the recent advances in the field of endodontics with respect to endodontic imaging, root canal preparation, disinfection and obturation.* ***Keywords:** Endodontics, advances, dental treatment*

INTRODUCTION-

Before the early 1990s, cold lateral gutta-percha compaction and stainless-steel hand files were used for canal preparation and obturation, respectively, in conventional endodontic treatment. In addition, the two dimensions of a typical wet tank processed dental radiograph and the absence of magnification (dental loupes) made it challenging to see during the entire dental procedure treatment in order to ascertain the proper working length of a root canal system [1]. Since then, the field of endodontics has embraced advances in technology and shifts in the way that different schools of thought have approached root canal therapy. Modern developments in instrumentation, obturation, visualization, and surgical methods have helped dentists to better predict the long-term health of their patients' teeth after endodontic therapy [The field of dentistry has developed extremely quickly and extensively in the last few decades; this article sheds some light on the developments in endodontic imaging, root canal preparation, root canal disinfection, and root filling. Digital imaging—dosage reduction, improved images, and no wet processing—is a part of endodontic imaging. More flexible alloys, such as nickel titanium, can be used in root canal preparation. It may also be possible to use fewer instruments per patient and less coronal flaring is required. Improved fluid dynamics during root canal irrigation and the creation of novel antimicrobials are two aspects of root canal disinfection. A sealer based on calcium silicate cement and nano-metric bioactive glass particles are used.

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Endodontic imaging/radiography

CBCT has long been employed in the field of Endodontics, whereby numerous studies have demonstrated and reported its role in the diagnosis of periapical and endodontic lesions. Several studies proposed by Estrela et al. .Lofthag - Hansen et al[5, 6], Patel et al have proposed a CBCT-based periapical index to determine and establish periapical lesion size pre and post-endodontic treatment as well as comparisons with periapical radiographs in the detection of periapical lesions on individual roots[7]. Moreover, CBCT cannot only aid in the diagnosis of vertical root fractures in the Bucco-lingual or mesio-distal directions but determine the number of roots, root canals, root morphology and the prescence of any separated instrument in the canal .Another key diagnostic tool in the field of endodontics that has demonstrated superior results in comparison to the conventional radiographs is the high-resolution ultrasound and colour power Doppler that is employed to monitor the healing of periapical lesions as well as bone healing[8, 9]. The advantage of this tool resides in the fact that it is easy to perform, has demonstrated an excellent success rate and is a radiation free system, which can reduce the patient's exposure to radiation [8, 9]. Studies have also confirmed that only ultrasound combined with Doppler helps in differentiating venous from arterial flow, quantify the amount of flow and identify the anatomy of feeding vessels and well as the presence, exact size, shape, content and vascular supply of endodontic lesions in the bone [9]. However, the only drawback of this system resides in the fact that ultrasound is blocked by bone and is therefore useful only for assessing the extent of periapical lesions where there is little or no overlying cortical bone.

Root canal preparation

Antimicrobial effectiveness is the basic step for any endodontic procedure to be carried out in root canal preparations [10]. Removal of intracanal tissue and necrotic material is served by root canal preparation [11]. Large number of materials are available in marketplace, including the following techniques:

1. More flexible alloys which extends fatigue life.
2. Practice of reciprocation motion.
3. Use of instrument designed to instrument large area of the canal.
4. Nickle-titanium rotary instruments.

The two types of crystal configurations, known as austensitic and martensitic, have distinct characteristics. As opposed to Martentite, which can be dead-soft, and autinite, which permits 7% recoverable elastic deformation [13]. The majority of practitioners who use rotatory instruments powered by electric motors are also in the development stage. Infected root canal systems may benefit from instrumentation through mechanical force to increase irrigation efficiency. Clinical observations indicate that healing of apical periodontitis and prolonged mechanical function of teeth are important endodontic outcomes. Since shaping of teeth that have had endodontic treatment increases the risk of fracture, strategies are being used during shaping, as this makes teeth that have had endodontic treatment more susceptible to fratucre. Limiting coronal flaring and the maximum fluted diameter (MFD) is how this tactic operates [14–16]. To achieve a more drastic change, in vitro research is being done on a non-instrumental canal disinfection system that is based on ultrasonic activation [17–19]. Adequate irrigation strategies will continue to be used in conjunction with canal preparation, as shaping alone will not be sufficient to reduce microbial loads.

Root canal disinfection:

The key challenges for effective disinfection in endodontics are complexities of the root canal and the structure of dentin. Sodium hypochlorite, a topical antimicrobial is used in root canal treatments to combat microbial biofilms. The flow of irrigants, their penetration, and exchange within the root canal space and the forces produced by them occur under irrigation dynamics. The widely used syringe-based irrigants displays a passive flow at the apical region, 1-3 mm beyond the exit of the needle. It also fails to generate optimum level of shear stresses on the canal wall, which is significant for disinfecting root canal films. thus current advances in endodontic disinfection include:

1. Improving fluid dynamics during root canal irrigation
2. Developing newer antimicrobials

Antimicrobial nanoparticles are microparticles in the range of 1-100 nm, which are found to have a broad spectrum of antimicrobial activity [20]. The positively charged nanoparticles interact with the negatively charged cell membrane and lead to loss of membrane permeability. When sealers are loaded with nanoparticles, they display a superior ability to diffuse the antibacterial component deep in the dentin. Their role is seen more as an intracanal medicament than an irrigiant (20) .Antimicrobial photodynamic therapy (APDT)[21] is a two-step procedure involving the first step, namely, application of photosensitizer and the second step includes light illumination of the sensitized tissue which would lead to microbial killing by generation of toxic photochemistry on the target cell. Antimicrobial photodynamic therapy is considered as a possible supplement to the existing protocols for root canal disinfection[21-25].Gentlewave (GW) (Sonendo, Laguna Hills, CA, USA) has been developed for root canal irrigation which delivers sodium hypochlorite into the root canal under pressure through a specialized handpiece, activated by acoustic waves. Suction removes the outflowing fluid at the same time through the specialized handpiece [20]. Disinfection of root canals with nanoparticles has recently gained interest owing to its broad spectrum antibacterial activity [26]. Studies have demonstrated that nanoparticles such as zinc oxide, chitosan and silver can disrupt the cell wall of *Enterococcus fecalis*as well as disintegrate the biofilm of oral microflora present within the canal, whereas 0.02% silver nanoparticles has been able to kill and disrupt *Enterococcus faecalis b*iofilm. Furthermore, Bioglass (SiO_2-Na_2O-CaO-P_2O_5) [26] possesses a characteristics to work in alkaline environment over a period of time.

Advances in root filling

The root canal system has traditionally been treated with synthetic materials, but pulp-like tissue may one day be able to be filled into canals that have been cleaned and shaped [27]. The need to enhance root canal fillers will never go away because tissue engineering is still not widely used in clinics. The main characteristic of root-filling materials that sets them apart from many other materials currently in use is their hermetic seal against microorganisms [27]. Particularly for root-filling materials, dimensional changes should be minimized. In contrast, the majority of sealers used today have core materials that are not dimensionally stable, but are based on silicone or epoxy resin. Gutta-percha is also frequently used as a core material which shrinks on cooling. Two newer concepts have evolved over the recent years which may improve and simplify root-filling procedures. The first one is, calcium silicate cement-based sealer [28]. The advantage it has is that it mimics nature by forming a calcium phosphate interface between the sealer and the root canal. Gutta-percha also needs to be added as the core material which does not make it useful.

Recently, bioactive materials like polycaprolactone have been embedded in the matrix of the root filling material [28]. It diminishes the use of a separate core material but it is not successful as it is biodegradable ..Some of the challenges in current root-filling are complex application schemes and uncontrolled thermal shrinkage. Promise for the future has been shown by newer nanomaterial-based approaches . .Moreover, current regenerative approaches exist that could replace conventional root canal treatment, by regenerating the infected pulp rather than removing it. In their study, Fioretti et al. reported the first use of nanostructured and functionalized multilayered films and demonstrated that a-MSH (melanocortin peptides) was able to promote the proliferation of pulpal fibroblasts [29-31].

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