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Newer Trends 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*

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I. Introduction

Prior to the early 1990s, conventional endodontic treatment involved the use of stainless-steel hand files and cold lateral gutta-percha compaction for canal preparation and obturation respectively[1]. Moreover, visualization during the entire dental procedure treatment was difficult owing to the lack of magnification (i.e., dental loupes), and the two dimensions of a standard wet tank processed dental radiograph while attempting to determine the correct working length of a root canal system[1]. Since that timeframe, the field of endodontics has embraced technological advancements and changes in various thought processes in regards to root canal therapy. Recent advances in instrumentation, obturation, visualization, and surgical techniques have assisted dentists in order to provide superior long-term prognosis for their patient’s tooth or teeth post endodontic treatment[2-4]. In past few decades there has been a very rapid and extensive development in the field of dentistry, this article spreads some light on the advances related to endodontic imaging, root canal preparation, root canal disinfection and root filling. Endodontic Imaging includes Digital Imaging- dose reduction, enhanced images, no wet processing. Root canal preparation includes more flexible alloys like Nickel Titanium; potential reduction of number of instruments per patient, decrease the need of coronal flaring. Root canal disinfection includes improved fluid dynamics during root canal irrigation; development of newer antimicrobials. Root filling includes use of calcium silicate cement based sealer; Nano-metric bioactive glass particle.

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1.1Endodontic 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 color 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.

1.3 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.

Due to some metallurgic properties, Nickle-titanium alloys can be used[12]. Austinetic and Martensitic are the two crystal configurations which have different properties. As autinite allowing 7% recoverable elastic deformation and Martentite which can be dead-soft[13].Most practitioners using electric motor to power rotatory instruments are also going under development. Irrigation efficiency in infected root canal systems may be facilitated by instrumention via mechanical force.An important endodontic outcome, as suggested by clinical observations is healing of apical periodontitis as well as extended mechanical function of teeth. Strategies are being developed to retain the dentin at the coronal root third during shaping as this increases fracture susceptibility in endodontically treated teeth. This strategy works by limiting coronal flaring and the maximum fluted diameter (MFD)[14-16]. A non-instrumental canal disinfection system, based on ultrasonic activation, is being researched in vitro to get a more radical change[17-19]. As shaping alone is not sufficient to reduce microbial loads, adequate irrigation strategies will continue to complement canal preparation.

1.4 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 irrigant 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 irrigant[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*biofilm. Furthermore, Bioglass (SiO_2-Na_2O-CaO-P_2O_5) [26] possesses a characteristics to work in analkaline environment over a period of time.

1.5Advances in root filling

Conventionally, synthetic materials have been used to fill the root canal system for its treatment and there may be a possibility in the future where pulp-like tissue can be filled into cleaned and shaped canals[27]. Since tissue engineering hasn't reached everyday clinics, the issue to improve root canal fillers will always remain.The hermetic seal against microorganisms is the primary most quality to be achieved by root-filling materials, which cannot be found in many currently used materials[27]. For root-filling materials in particular, dimensional changes should be kept minimal and whereas, for most current sealers, epoxy resin or silicone based are dimensionally stable, but the core material is no[27]t. In many cases, gutta-percha is also 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 thefirst 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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