



RECENT TRENDS IN ENDODONTICS- A REVIEW

Dental Science

**Dr. Abdullatif
Almusharraf**

Dentist, AlAflaj General Hospital, Riyadh, KSA

**Dr. Jaber al
Shahrani***

Dentist, MOH, Riyadh, KSA *Corresponding Author

**Dr. Adel
Alshahrani**

Dentist, Riyadh specialized dental center, KSA

ABSTRACT

Contemporary endodontics has witnessed an unprecedented, rapid and extensive advances in technological evolutions in dentistry in the past couple of decades. The current clinical practice of endodontics includes the utilization of a variety of these new technological advances and materials. This article aims to review the recent trends and advances in the field of endodontics in the following sections: (1) diagnosis & imaging, (2) root canal preparation or instrumentation, (3) root canal irrigation & disinfection, (4) root canal obturation, (5) regenerative endodontic procedures (REPs) and (6) endodontic surgery. All these advances are aimed at improving the state of the art and science of root canal treatment.

KEYWORDS

Endodontics, Recent trends, Diagnosis, Instrumentation, Disinfection, Obturation, Surgery, Regeneration.

INTRODUCTION

Until the early 1990s, endodontic practise was restricted to use of conventional techniques. To mention few of them: visualisation with mouth mirror only due to lack of magnification, reliability on conventional 2-dimesional radiographs due to lack of automated radiographic techniques and use of manual and tiring hand files only. The past couple of decades have witnessed and embraced rapid and extensive technological advancements in dentistry, with remarkable developments in field of endodontics.² This article aims to concisely review and spread some light on the advances and recent trends pertinent to endodontic treatment. The recent trends will be discussed under following sections: (1) diagnosis & imaging, (2) root canal preparation or instrumentation, (3) root canal irrigation & disinfection, (4) root canal obturation, (5) endodontic surgery and (6) regenerative endodontic procedures (REPs).

1. Diagnosis & Imaging:

Diagnosis of Pulpal pathosis is done by tests such as biting, chewing, percussion, apical palpation, thermal, and electric pulp testing. Likewise, dental radiographs also have fundamental role in diagnosing pulpal and periapical diseases. Radiographic imaging is also used to determine the caries, restoration defects, multiple canals, presence of multiple roots, resorptive defects, root fractures, the extent of root maturation etc.; essential to know prior to endodontic treatment. Bender and Seltzer in their review article discussed the drawbacks of conventional radiography and imaging, that lesions in cancellous bone or early stages of bone disease cannot be detected.³

In recent years in addition to Analog or conventional radiography, digital imaging modalities are available for use in endodontic diagnosis. Amongst the most recent and advanced ones three imaging technologies in endodontics are presented in this section: cone-beam computerized tomography (CBCT) and optical coherence tomography (OCT). CBCT is frequently cited in dental literature, and is a necessary radiographic adjunct for diagnosis of some endodontic cases. According to various studies CBCT has role in determining periapical lesion's size pre and post-endodontic treatment, diagnosis of vertical root fractures, determine the number of roots, root canals, root morphology and the presence of any separated instrument in the canal. The American Association of Endodontists (AAE) recommends the use of CBCT for endodontics; it falls under the principle of ALARA, which stands for as low as reasonably achievable.⁴ OCT or Optical Coherence tomography is high resolution optical ultrasound, an optical signal acquisition and processing method like coloured doppler. It captures micrometre resolution and three-dimensional images from within optical scattering media. OCT is another diagnostic tool that can be employed in endodontics to monitor the bone or periapical healing. This way of using ultrasound is easy, with good success rate and also it gives less radiation. OCT is an emerging

technology in dentistry, but well proved in ophthalmology. Future applications in dentistry may include caries detection, endodontic treatment, periodontal probing, digital impression taking and cancer screening.⁵

2. Root canal preparation or instrumentation:

Root canal preparation includes effective removal of necrotic and infected intracanal as well as periapical tissue, followed by instrumental shaping and coronal flaring of canal adequate to receive irrigation and final obturation. None of the technique or materials available today falls under ideal category. Rotary instruments used with engine-driven endodontic motors with apex locators are recently under trend over the conventional stainless-steel hand files. The main focus of availability and improvisations of materials or instruments available in market today is towards: Nickle-Titanium (NiTi) rotary instruments which have two crystal configurations, other flexible materials tough enough to resist fracture, motors allowing different torque settings and allow reciprocal motion, instruments allowing adequate coronal preparation or flaring and periapical cleaning.⁶

NiTi instruments though flexible have high tendency to fracture. Manufactures have turned up with unique ideas to prevent file separation like twisting rather than milling, electropolishing, thermal nitridation, or use of M-wire. But at the same time considering its limitations, research is ongoing to replace NiTi with other metals. Also, 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). A non-instrumental canal disinfection system, based on ultrasonic activation, is being researched in vitro to get a more radical change.⁷

3. Root Canal Irrigation & Disinfection:

As root canal shaping alone is not sufficient to reduce microbial loads, adequate irrigation and disinfection strategies are second prime requisite to complement canal preparation. Choice of irrigation solution remains the most controversial and subjective till date. Topical antimicrobial such as sodium hypochlorite, EDTA, hydrogen peroxide, normal saline is commonly used in root canal treatment to combat microbial biofilms. These antimicrobials somehow sometimes fail to eliminate microorganisms in complex anatomies or uninstrumented areas of root canal, also sometimes syringe based delivery of these irrigants is unsuccessful in achieving bacteria free canal space. The recent trends and advances in root canal irrigation and disinfection are focused towards delivery of antimicrobials and delivery system of irrigants. **Improving the fluid dynamics during root canal irrigation:** Lasers are recently used in endodontics by Photon-induced photoacoustic streaming (PIPS) technology, based on the direct shock wave generated by a erbium:YAG (Er:YAG) laser in a

liquid irrigant. On activation of laser with irrigant the fluid dynamics is enhanced by bubble formation. Light Activated Disinfection or Photodynamic antimicrobial therapy uses a photosensitizer in the form of a dye (methylene blue or toluidine blue) loaded with nanoparticles PGLA (poly-glycolic-lactic-acid) introduced into the canal are activated with light source, leads to antimicrobial chemotherapy and light activated disinfection. EndoActivator is recently in trend for agitation of irrigants, making irrigation more meaningful. EndoVac is also another recent device which uses negative pressure to eliminate complete apical debris of canal system.⁸

Developing newer potent and efficacious antimicrobials:

Recently antimicrobial nanoparticles which are in the range of 1-100 nm, are developed to have a broad spectrum of antimicrobial activity. The positively charged nanoparticles interact with the negatively charged bacterial cell membrane and lead to efficient entry of antimicrobials. These nanoparticles are incorporated with sealers, which shows a superior ability to diffuse the antibacterial component deep in the dentin. Their role is seen more as an intracanal medicament than an irrigant. Disinfection of root canals with nanoparticles has recently gained interest owing to its broad-spectrum antibacterial activity. Studies have demonstrated that nanoparticles such as zinc oxide, chitosan and silver can disrupt the cell wall of *Enterococcus faecalis* as well as disintegrate the biofilm of oral microflora present within the canal. 0.02% silver nanoparticles have been able to kill and disrupt *Enterococcus faecalis* biofilm. Furthermore, Bioglass (SiO₂-Na₂O-CaO-P₂O₅) works efficiently in alkaline environment over a period of time. Another advancement is Antimicrobial photodynamic therapy (APDT) includes the application of photosensitizer and light illumination of the sensitized tissue which would lead to microbial killing by generation of toxic photochemistry on the target cell. 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.⁹

4. Root Canal Obturation:

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. 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. 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 not. In many cases, gutta-percha is also used as a core material, which shrinks on cooling. Recently, bioactive materials like polycaprolactone have been embedded in the matrix of the root filling material. It diminishes the use of a separate core material but it is not successful as it is biodegradable. Moreover, current regenerative approaches exist that could replace conventional root canal treatment, by regenerating the infected pulp rather than removing it.¹⁰

5. Regenerative Endodontic Procedures (REPs):

Most recent in terms of research topics in endodontics happens to be Regenerative endodontics that allow stem cell-mediated regeneration and repair of the damaged pulp-dentin complex. The Regenerative endodontics emerged in early 2000s, for the treatment of immature teeth with pulpal necrosis as a result of trauma or necrosis. The REPs are based on the triad of tissue engineering that are likely to involve the direct clinical manipulation of scaffolds, growth factors, and stem cells. Stem cells are derived from inducing the bleeding in apical area of tooth or sometimes using patients' own blood PRF (platelet rich fibrin). Growth factors are naturally present in the patients' blood. Scaffold are mostly external like MTA (mineral tri-oxide aggregate) or Collagen plug. According to various publications it results in: Resolution of apical periodontitis and signs and symptoms of pulpal inflammation; Radiographic evidence of continued root development both vertically and horizontally and apical closure; and Restoration of vitality responses. This procedure necessitates long term follow up more research is required to confirm the outcomes.¹¹

6. Endodontic Surgery:

Conventional endodontic apical surgery or apicoectomy being a blind procedure poses a risk of leaving the infectious cyst lining or damaging the vital structures. Computed tomography (CT) guided endodontic

surgery introduced by Dr Buchanan in 2010 is more precise to perform osteotomy or apicoectomy procedures. Further to this Pinsky et al introduced CAD/CAM designed presurgical guides to be used with CT guided endodontic surgeries, apicoectomies or osteotomies in close proximity to nerves.¹²

Summary

this article presents the recent trend in field of endodontics which are recently introduced into the dentistry as well as others which are still under research or trials. Newer inventions make s endodontic treatment more efficient and easier both for clinicians and patients. Hence, there is need of constant and ongoing research in this field.

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