RECENT ADVANCES IN ENDODONTICS

Abstract

Advances in dentistry can help to improve the quality of care. Contemporary endodontics has seen an unprecedented advancement in technology and materials aspect. Several developments in endodontics have allowed for further simplification of endodontic practice. The present chapter discusses the various advancements in the field of endodontics and their potential for daily use.

Keywords: Advances, Dentistry, Endodontics, Technology.

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Non-surgical endodontics primarily aims to eliminate the infected pulp and associated periradicular pathology, and ensure stability to prevent recurrence. Endodontics is undoubtedly an ever evolving and expanding branch of dentistry.[1] Recent developments in the endodontic field has led to the fruition of significantly proficient as well as safe instrumentation systems. This has given rise to significant outcomes in the recent era with the introduction of heat-treated NiTi alloys that enhance instrument flexibility as well as resistance.[2] In general, root canal/endodontic treatment is usually considered as one of the most challenging procedures in dental practice. However, recent technological advancements have resulted in a more predictable endodontic treatment with successful outcomes in challenging cases.

I. ARTIFICIAL INTELLIGENCE IN ENDODONTICS

John McCarthy holds the credit of coining the term "artificial intelligence"(AI) at one conference in the United States in the year 1956. Subdivisions of AI incorporate machine learning, neural networks, and deep learning (DL). Artificial neurons resembling neurons of an individual are used in neural networks (NNs), which use a numerical model to imitate the human mind. NNs have the ability to recreate rational abilities like critical thinking and human skills to reason, which incorporates both learning and decision making.[3] NNs essentially consist of three layers: input layer (wherein data enters the framework), hidden layer (wherein information is handled), and output layer (wherein the framework chooses what is to be done).[4] The most utilized sorts of NNs are artificial neural networks (ANN), convolutional neural networks (CNN), & recurrent neural networks. DL constitutes one portion of NNs where the processor is capable of learning by itself as to how to deal with the information.[5]

AI can prove to be valuable in recognizing periradicular pathologies as well as cracks/fractures, assessment of canal configuration, stem cell sustainability, canal length estimations, in addition to foreseeing outcome of endodontic retreatment.[6] One study published in 2020 utilized DL for ascertaining periradicular lesions with the aid of cone-beam computed tomographic (CBCT) scans and successfully detected them in 93% of cases.[7] AI has additionally demonstrated to be extremely productive in contrast with periapical radiographs in diagnosing vertical root fractures on CBCT scans.[8]

II. GUIDED ENDODONTICS

Endodontics can frequently prove to be an arduous task when instances of pulp canal obliteration (PCO) are experienced in clinical practice. PCO alludes to accumulation of calcified and hard mass inside canal space. It can occur as a result of injury, following orthodontic treatment, as a response towards pulpal injury, tooth decay, restorations or else abfractions and in older patients.[9] As of late, guided endodontics (GE) is a procedure wherein computer-planned guides exist aimed at preparing access cavities to accomplish unsurprising and safe outcomes.[10]

There are various sorts of GE namely static GE (SGE), as well as dynamic GE (DGE). In SGE, CBCT of whichever arch (contingent upon which tooth has to be treated) is procured. Arch of the patient is registered simultaneously using intra-oral camera or else taking an impression to be glanced at afterwards. Superimposition of acquired pictures is

done with a programming application. This helps in planning of a guide taking into account the tooth to be worked upon (alongside a few contiguous teeth). Drill opening is then planned in this guide with a particular suitable dimensions as well as angulation for permitting uninterrupted admittance towards the canal that is calcified.[11] DGE depends on utilizing CBCT pictures having orientation points located inside the patient's oral cavity opposite to the area to be worked (prior to taking CBCT). Drill trajectory leading to both pulp chamber as well as canal stays synchronized through assistance of stereo camera linked alongside a dynamic navigation system (DNS). Operator will then be able to monitor everything they do and make any necessary adjustments to the instruments' angulation.[12]

It may very well be reasoned that guided endodontics utilizing static or dynamic navigation gives off an impression of being a safe and insignificantly obtrusive strategy for recognizing calcified root canals.

III. MAGNIFICATION IN ENDODONTICS

Magnification is chiefly driven by innovation and technology and has now radically changed how endodontic practice is currently being performed.[13] Over time, a variety of magnification instruments have been created to fill the gap between the human eye and microscope. In fact, the usage of instruments like an endoscope, magnifying lens, and intraoral cameras has been mostly superseded by more contemporary ones that appear to be more useful and convenient. The main differences between the two devices have been depicted in figure 1.[14]

	Loupe	Dental operating microscope
Cost	Cheaper	Significantly more expensive
Portability	Portable and light Allows practice in multiple locations	Floor standing microscopes are portable but take up space and are very heavy to shift While, mounted microscopes are fixed to the ceiling or wall
User adaptability	Easier	Steeper learning curve
Ergonomics	Slight head tilt may be required depending on the degree of lens declination	Perfectly neutral body posture
Level of magnification	Reasonable but fixed and limited (2.5×-8.0×)	A higher level of magnification is available which can be adjusted (3×-30×)
The line of sight and eye strain	The convergent line of sight leading to eye strain over a long duration of use[20]	A parallel line of sight allowing more relaxed eye muscles[21]

Figure 1: Differences between loupes and dental operating microscope (DOM)

The improved vision accompanied by light can simplify the following endodontic procedures:[14]

- Identifying small cracks and caries
- Preparation of conservative access cavities
- Recognizing doubtful root canal anatomy
- Handling calcified canals
- Verifying the cleanliness of the canal before obturating
- Identifying as well as eliminating pulp stones

- Dealing with perforations along with tooth resorption
- Recovering fractured files, posts and silver point
- Endodontic microsurgery: smaller osteotomies, enhanced view of the resected tooth surface, retropreparation, & retrofilling.

IV. ENDODONTIC IMAGING

The cone beam registered tomography (CBCT) approach has brought about boundless acceptance for three-D picture handling. Computed tomography significantly improves demonstrative yield in specific circumstances where two-dimensional routine radiographic examinations have restrictions. The shortest scan durations should be employed with lowest field of view and voxel size possible without compromising signal-to-noise ratio.[15]

After a thorough clinical evaluation, prescribing CBCT in specific diagnostic cases in clinical endodontics is supported by the existing literature. A portion of the expected uses of CBCT incorporate diagnoses connected with the following: preliminary examination for ambiguous signs and symptoms, tooth related anomalies, growth disturbances, anatomical variation, calcifications, broken files, root cracks/fractures, failures because of previous treatment, retreatments, specific injury cases, resorption, and dental implants.[16]

V. ROOT CANAL DISINFECTION:

Owing to the intricacy of the canal system as well as dentin structure and composition, effective disinfection in endodontics can be problematic in certain instances. If antimicrobials were unable to get rid of the biofilm bacteria in the complex anatomy and uninstrumented parts of the canal, root canal therapy would be less successful. To get the most out of the antimicrobials, it is necessary to enhance the root canal system's irrigation dynamics for the delivery of irrigant.[15]

Photodynamic therapy (PDT) is a process first involving application of photosensitizer (PS) and then illuminating the sensitized tissue with light (step 2) to produce toxic photochemistry and kill the bacteria.[17] PDT is now considered more of a possible supplement than a substitute to the current root canal disinfection regimens.[18]

Ozone therapy offers unique qualities that range from detoxicating, bioenergetic, and biosynthetic activities to antibacterial, immunostimulant, pain-relieving, and antihypnotic effects. Ozone has the potential to be employed in endodontics as an antibacterial. Ozone is effective when used in sufficient quantity, over an extended period of time, and when delivered accurately into root canals after conventional cleaning, shaping, and irrigation techniques have been successful. When ozone water and sonification were used to disinfect a root canal, the antibacterial adequacy was comparable to 2.5% NaOCl. Pathogens that cause disease, such as Enterococcus faecalis, Candida albicans, Peptostreptococcus, and Pseudomonas aeruginosa, have been discovered to be resistant to ozone. Additionally, ozone removes the specific anaerobic smell that is brought on by often contaminated teeth.[19]

VI. CONCLUSION

Technology and materials science have advanced at an unprecedented rate in modern endodontics. Together, these advancements aim to advance the science and art of endodontic treatment.

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