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REVIEW ARTICLE

RECENT ADVANCEMENTS IN ENDODONTICS: A COMPREHENSIVE REVIEW

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ABSTRACT:
Past few decades have seen tremendous advancement in technology and materials in the field of endodontics. Analog and digital imaging modalities are available for use in diagnostic endodontic imaging. In the present paper, we tend to summarize the recent advancements in the imaging, irrigation, regeneration and various other aspects in the endodontic therapy.
Key words: Advancements, Endodontics

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INTRODUCTION

Over the past few decades, the specialty discipline of Endodontics has progressed through many changes. Most of these have been related to the technical aspects of root canal treatment with much emphasis on new designs for files and new devices for root canal fillings. Clinicians probably feel that they are technologically more advanced in what they are doing – but is this really the case and are we providing better treatment outcomes for our patients? Or, are we just using different instruments, devices, and perhaps materials that can achieve similar results? How do we know the answer to these questions? It is timely that the profession reviews these aspects and considers whether the current approaches are appropriate and the best for our patients.[1]

Looking back over the last two decades from 1990 – 2010, there are 3 main areas of change in root canal treatment - in a broad sense, 2 are technological, and 1 is biological. The 2 technical areas are the increasing use of nickel-titanium rotary files and the use of magnification. The biological aspect centers around the use - or rather the non-use - of intracanal medicaments and the number of treatment visits. Many practitioners may have adopted all 3 of these changes into their practice, and therefore, it is impossible for researchers, let alone clinicians, to know what effect each individual aspect has on treatment outcome.[2,3]

REGENERATIVE ENDODONTIC

Regenerative endodontic strategies are continuously being updated and improved to benefit dentistry in every possible way. American Association of Endodontists Foundation has recently awarded a grant of $1.7 million to evaluate the effectiveness of two regenerative approaches (REGENDO and REVASC) compared with the conventional MTA apexification. The trial will be carried out in collaboration with Loma Linda University, University of Texas Health Science Center at San Antonio and the University of Maryland School Of Dentistry and is estimated to complete in December 2019. Iohara et al. aims to use pulp stem cells with granulocyte-colony stimulating factor (G-CSF) for pulp/dentin regeneration to fully restore the tooth instead of filling, capping or extracting it. Misako Nakashima (Japan) said that a clinical trial of pulp regeneration has already been initiated with the permission of the Japanese Ministry of Health, Labor and Welfare. Recently, PRF box has been announced to produce homogenously thickened hydrated exudate rich in platelets, vitronectin, leukocytes, and fibronectin expressed from the fibrin clots that have improved the issues regarding the handling of the platelet-rich fibrin (PRF) clot. It is likely that the next advance in regenerative dentistry is the availability of regenerative dental kits, which will enable the dentists the ability to deliver regenerative therapies locally as part of routine dental practice.[4, 5]

Regenerative endodontic strategies have tremendous potential to be an effective, safe, and biological mode to save teeth which have compromised structural integrity provided the above discussed problems are dealt with. Considerable research and development efforts are required to advance the regenerative therapeutics to next level. With new discoveries, innovative ideas, and high-quality research, in the future, the scope of regenerative endodontics might increase to include the replacement of periapical tissues, gingiva, and even whole teeth.[6, 7]

ROOT CANAL IRRIGANTS

The most widely used endodontic irrigant is 0.5% to 6.0% sodium hypochlorite (NaOCl), because of its bactericidal activity and ability to dissolve vital and necrotic organic tissue. However, NaOCl solutions exert no effects on inorganic components of smear layer. Chelant and acid solutions have been recommended for removing the smear layer from instrumented root canals, including ethylene diaminetetraacetic acid (EDTA), citric acid, and phosphoric acid. There has been much controversy over the concentration of hypochlorite solutions to be used in endodontics. The antibacterial

effectiveness and tissue dissolution capacity of aqueous hypochlorite is a function of its concentration, and so is its toxicity. It appears that the majority of American practitioners use "full strength" 5.25% sodium hypochlorite as it is sold in the form of household bleach leading to several adverse reactions like irritation and decrease in flexural strength of dentin. Also decrease in microbiota was also not significantly altered with this high concentration. It must be realized that during irrigation, fresh hypochlorite consistently reaches the canal system, and concentration of the solution may thus not play a decisive role. Unclean areas may be a result of the inability of solutions to physically reach these areas rather than their concentration. Hence, based on the currently available evidence, there is no rationale for using hypochlorite solutions at concentrations over 1% wt/vol.[8- 10]

All the irrigation solutions at our disposable have their share of limitations and the search for an ideal root canal irrigant continues with the development of newer materials and methods. Newer root canal irrigants in the horizon are as follows:[11- 14]

- MTAD,
- tetraclean,
- electrochemically activated solutions,
- ozonated water,
- photon-activated disinfection,
- herbal irrigants.

Presently these newer irrigants could be used as an adjunct to NaOCl, with the hunt for the elusive ideal root canal irrigant continues.[13]

ROOT CANAL PREPARATION

Due to its specific metallurgical properties, nickel-titanium (NiTi) alloy can be manufactured so that it is, for example, at body temperature, predominantly either in austenitic or martensitic crystal configuration. These two crystal configurations have distinctly different properties, with austenite being less flexible but allowing up to 7% recoverable elastic deformation range. Currently, most practitioners use electric motors to power rotary instruments. These motors are also undergoing development. The ability to set a torque limit is common to most electric motors but many models currently allow reciprocating action. While this is not entirely new, several NiTi instruments have been developed entirely for reciprocation motion with unequal angles of rotation. Reciprocation movement has been shown to be efficient and safe In particular, fatigue lifespan of a file is extended with reciprocation design. Irrigation efficiency in infected root canal systems may be facilitated by instrumentation via mechanical force and perhaps a scraping action of instruments along the canal walls. Toward this several techniques were initiated in the last few years, beginning with the so-called self-adjusting file.[14- 18]

Flexibility and resistance to fatigue of the instruments are increasing. Current and future developments of instruments and strategies are aimed to provide antibiofilm effects and remove less radicular dentin structure. As shaping alone is not sufficient to reduce microbial loads, adequate irrigation strategies will continue to complement canal preparation.[19]

LASER IN ENDODONTICS

No article on the technologic advances in endodontics is complete without the mention of lasers. A search of dental lasers in the US National Library of Medicine National Institute of Health (http://www.pubmed.gov/) resulted in more than 4000 entries dating back to 1964 on the use of lasers in dentistry.[20]

In the endodontic literature the neodymium:yttrium-aluminum-garnet (Nd:YAG), erbium:chromium:yttrium-scandium-gallium-garnet (Er:Cr:YSGG), and the erbium: yttrium-aluminum-garnet (Er:YAG) are the lasers that are most studied. The Nd:YAG laser has been shown to significantly reduce the number of bacteria, and reduced apical leakage after root canal obturation. Another study stated that there were no significant differences between laser-irradiated and nonlaser-irradiated groups. The Nd:YAG laser can soften gutta percha for retreatment and is an effective tool for the removal of root canal obturation materials. In addition, temperature rises on the root surface ranging from 17^0C to 27^0C can occur.[20- 22]

A temperature increase greater than 10^0C can be detrimental to the attachment apparatus. The Er:Cr:YSGG laser is developed and manufactured by Waterlase MD (Biolase Technology, Irvine, CA, USA). This laser is equipped with a 200-mm radially emitting laser tip. The tip diameter is equivalent to a number 20 file. It can be used to remove the smear layer and debris from the root canal and reduce bacteria. An in vitro study by Rahimi and colleagues showed that the laser could be used for an apical preparation in root end surgery. The laser preparation resulted in fewer cracks and chipping compared with ultrasonics.[22- 26]

Most endodontic studies have used the laser for cleaning, shaping, and disinfection of the root canal system. There are no published case-controlled studies that show that the laser yields a higher degree of success than current endodontic procedures.[27]

CONCLUSION

This article addresses the technologic advances in some of the aspects of endodontics. Considerable research and development efforts are required to advance the regenerative therapeutics to next level. We, therefore, recommend future studies and research for improving the prognosis of root canal therapy.

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