

Raising the bar for endodontic success: Where we were, where we are and where we are going

By Dr Gary Glassman, Canada

■ Vince Lombardi so eloquently stated, "Practice does not make perfect. Only perfect practice makes perfect." In other words, we can perform a procedure repeatedly over and over again and not obtain the expected outcome for success. We must continually advance in all disciplines of dentistry in order to provide our patients with the most predictable treatment regimens possible, understanding the greatest variable that stands in our way is the human variable. Elevating the standards of endodontic care is inexorably tied to an important dynamic in our armamentaria.^{48,50}



• Dr Gary Glassman

The objective of endodontic treatment has continue to be a constant since root canal treatment was first performed; the prevention or treatment of apical periodontitis such that there is complete healing and an absence of infection,¹ while the overall long-term goal is the placement of a definitive, clinically successful restoration and preservation of the tooth. After all, the main objective in dentistry is to retain what nature has created!

From about 1985 to 1995 there was more change in clinical endodontics than in perhaps the previous 100 years combined. In these 10 years, clinical endodontics changed forever with the emergence and development of four very important technologies: the dental operating microscope (DOM), ultrasonics, nickel-titanium rotary file systems and mineral trioxide aggregate (MTA).^{2,3,50}

Where We Were

The Dental Operating Microscope

Superior vision became attainable with the integration of the dental operating microscope (DOM). Diagnostically, the operating microscope is an indispensable aid in locating cracks and tracking vertically fractured teeth.^{2,4} It allows a more detailed view of root canal intricacies, enabling the operator to more efficiently examine, clean and shape complex anatomy.⁵ It provides superior resolution, thereby aiding the removal or bypassing of separated canals.⁶ A microscope provides an improved surgical technique allowing for smaller osteotomies, shallower bevels and the location of isthmi and other canal irregularities,⁷ thereby allowing unprecedented success rates of up to 96.8 per cent.⁸ A DOM has sig-

nificantly shown to improve the probability of locating a second mesial buccal canal in maxillary molars. Baldassari-Cruz et al.⁹ showed that the MB-2 canal was located in 90 per cent of maxillary molars with the operating microscope but only 52 per cent with unaided vision.⁵⁰

Sonics

Piezoelectric ultrasonic energy, in conjunction with the DOM, drove microsonic (sonic and ultrasonic) instrumentation techniques that are minimally invasive, efficient and precise.² Refinement of access openings in a controlled and predictable manner, locating calcified canals with a reduced risk of perforation, removal of attached pulp stones, removal of intracanal obstructions (separated instruments, root canal posts, silver points and posts) and removal of the smear layer, biofilm and remaining debris are just some of the many uses that microsonics are capable of doing.^{2,10,11}

In surgical endodontics, specially designed retro tips are used ultrasonically for superior root-end cavity preparation. This allows minimal removal of root structure down the long access of the root canal without the creation of a bevel for surgical access. This subsequently reduces the number of exposed dentinal tubules and minimizes apical leakage.^{10,50}

Nickel Titanium Instruments

Canal preparation procedures became more predictably successful



• The operating microscope has become an indispensable aid in the field.

with the emergence of nickel titanium files (NiTi) files.² This super-elastic alloy has shape memory, allowing for better maintenance of the original canal anatomy. These files produce less extrusion of debris, allow greater cutting efficiency and reduce the time for canal shaping compared to stainless-steel files. They are biocompatible, anticorrosive and do not weaken following sterilization.^{12,13} Although full rotary has been the mainstay for nickel-titanium systems for years, reciprocating motors have taken the market by storm by allowing less debris extrusion and quicker negotiation to the apices and less file fatigue.

Mineral Trioxide Aggregate

This decade of extraordinary change concluded with the introduction of mineral trioxide aggregate (MTA).² This remarkable and biocompatible restorative material has become the standard for pulp capping and has salvaged countless teeth that previously had been considered hopeless.² In vital pulp therapy, when MTA is used as a direct pulp cap to maintain pulp vitality, studies have shown that these areas were free of inflammation and all of them had calcified bridge formation after five months.⁴⁹

MTA has proved to be the ideal pulpotomy agent in terms of dentin bridge formation and preserving normal pulpal architecture.⁴⁹ MTA produces favourable results when it is used as a root-end filling material in terms of lack of inflammation, presence of cementum and hard-tissue formation.⁴⁹ It is used to repair both furcal and lateral perforations with a relatively high degree of success and to seal both internal and external resorptive defects from an orthograde and retrograde approach.⁴⁹

The treatment of teeth with open apices and necrotic pulps has always been a challenge for the dental practitioner. MTA can effectively be used as an apical barrier in teeth with necrotic pulps and open apices.^{49, 50}

Where We Are

Irrigants and Irrigant Delivery Systems

Perhaps the greatest international attention in recent years has fo-

cus on methods to improve endodontic disinfection in the root canal system.² The desired attributes of a root canal irrigant include the ability to dissolve necrotic and pulpal tissue, bacterial decontamination with a broad antimicrobial spectrum, the ability to enter deep into the dentinal tubules, biocompatibility and lack of toxicity, the ability to dissolve inorganic material and remove the smear layer, ease of use and moderate cost. The combination of sodium hypochlorite and EDTA has been used worldwide for antiseptics of root canal systems.¹⁵ Sodium hypochlorite has the unique ability to dissolve necrotic tissue and the organic components of the smear layer.¹⁶⁻¹⁸ It also kills sessile endodontic pathogens organised in a biofilm.^{19,20} There is no other root canal irrigant that can meet all these requirements, even with the use of methods such as increasing the temperature²¹⁻²⁵ or adding surfactants to increase the wetting efficacy of the irrigant.^{26,27}

Deminerizing agents such as EDTA have therefore been recommended as adjuvants in root canal therapy in combination with sodium hypochlorite^{20,28} as they dissolve inorganic dentin particles and aid in the removal of the smear layer during instrumentation.²⁹ It is very important to note that while sodium hypochlorite has unique properties that satisfy most requirements for a root canal irrigant, it also exhibits tissue toxicity that can result in damage to the adjacent tissues, including nerve damage should sodium hypochlorite incidents occur during canal irrigation.¹⁵ It is therefore very important that irrigant delivery devices are used that not only allow voluminous exchange right to the apex but also deliver them in a safe and effective manner without apical extrusion.

Root canal irrigation systems can be divided into two categories: manual agitation techniques and machine-assisted agitation techniques.¹¹ Manual irrigation includes positive pressure irrigation, which is commonly performed with a syringe and a side-vented needle. Machine-assisted irrigation techniques include sonics and ultrasonics, as well as newer systems

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“Seeking new global partnerships”

An interview with Gary W. Price, CEO and president of the Dental Trade Alliance

■ The Dental Trade Alliance (DTA) has been representing the interests of the North American dental industry since 2004, when the American Dental Trade Association merged with Dental Manufacturers of America. It is also the organiser of the US pavilion at the upcoming International Dental Show (IDS) in Cologne. *today international* had the opportunity to speak with Gary W. Price, CEO and president of the dental trade organisation, about the state of the industry and the importance of the show to US manufacturers of dental equipment.

today international: At IDS Cologne 2011, the US dental industry was the second-largest group of manufacturers from one country. Are we going to see another increase in participation this year?

Gary W. Price: The International Dental Show is a very popular venue for the majority of American and Canadian companies. We see this in the increasing number of companies exhibiting under the joint US dental industry pavilion that we organize in Hall 4.2. For the period 2011-2015, we anticipate additional growth in participating exhibitors of roughly 15 per cent.

The IDS attracts the largest number of distributors, government health-care agencies and authorised buyers of any dental meeting that US manufacturers can attend. It gives our industry the best opportunity to connect with reputable and new strategic partners.

The recession seems to have had a significant impact on dental markets in North America. What's the

current state of the industry there and what are the most prominent trends?

Sales of oral health-care products and equipment have been increasing moderately since the economic downturn. Certain segments like digital radiography, however, are growing



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rapidly. This year is shaping up to be a good one for sales owing to pent-up demand and new dentists wanting the latest technology for their practices. Retiring dentists are also increasingly upgrading their equipment to make their practices more attractive to potential buyers.

How important is the IDS for American companies with regard to sales, as well as a being a showcase for innovation?

Based on demand for exhibition space, attendee registrations and hotel rooms, IDS 2013 is poised to be one of the best meetings ever in the dental industry. While every edition showcases new technologies, the reality is that

companies and dentists from around the world covet American dental products and equipment for their reliability, versatility and cost. Innovation is important but in general the world wants American products, whether they are new cutting-edge technologies or tried-and-true products used daily by dentists everywhere.

How does the show compare to the big US shows like the Chicago Midwinter Meeting or GNYDM?

The IDS is seven times larger than all the dental meetings in New York, Chicago or any show organised by the American Dental Association. While US meetings tend to be a more traditional model of companies selling to or educating dentists, American companies typically exhibit in Cologne because they are seeking new global partnerships.

The EU has recently announced a revision of its existing medical device regulations, which could also affect manufacturers of dental materials and equipment. Do you think that this will have any impact on your industry?

The DTA is keenly aware of changing European and other international regulations. The impact of these modifications will probably be low. Many US companies export to Europe and have EU specifications. Our organization is helping to bring international accreditation to the industry so that a company's products can be accredited and inspected once and approved for sale in most countries. This is something DTA has taken the lead on.

Thank you very much for the interview. ◀◀

such as the EndoVac (SybronEndo, USA), which delivers apical negative pressure (ANP) irrigation,³⁰ the plastic rotary F File (Plastic Endo, Lincolnshire, IL),^{31,32} the Vibringe (Vibringe BV, The Netherlands),³³ the RinsEndo (Air Techniques Inc., USA),⁹ and the Endo-Activator (DENTSPLY Tulsa Dental Specialties, USA). Of all the techniques listed, only the Endo Vac has repeatedly shown to break the apical vapour lock (the column of gas that is formed at the apical 3 mm of the root canal formed by the hydrolysis of organic tissue by sodium hypochlorite), produce a current of irrigant, remove debris and deliver voluminous amounts of irrigant to the apex without the risk of apical extrusion.^{15,50}

Lasers

The integration of lasers is a viable addition to the endodontic armamentarium and has the potential to overcome some of the challenges to successful root canal therapy.⁵¹ Of particular benefit is the ability to avoid vibration pain upon access, even in “hot” teeth that are difficult to anaesthetise, and the three-dimensional ability to remove pulpal tissue, bacteria, smear layers and dentin from canal walls via laser energy and hydrophobic activity. Of particular significance is the ability of laser light to penetrate 1,000 microns into the dentinal tubules.⁵² Bacterial infiltration into dentinal tubules has been reported to be 400 microns⁵³ and chemical rinses have a penetration depth of only 100 microns.⁵⁴ This results in the possibility of bacterial entombment and microleakage. The resulting disinfection and reduction of bacteria in the dentinal tubules is significant with respect to providing unparalleled levels of endodontic success.⁵⁰

Digital Radiography

Digital radiography has significantly reduced treatment time for endodontic procedures with far less exposure compared to conventional film. High-resolution digital images are instantaneously generated and easily manipulated for enhanced diagnostic performance. Digital storage of images is simple, allowing quick transfer and communication.^{34,35,50}

Cone-Beam Computed Tomography (CBCT)

What digital radiography has provided us for imaging in the present, CBCT (cone-beam computed tomography) will carry us into the future. CBCT technology has been around since the 1980s, however, only recently has it become a viable option for the endodontic office.³⁶ Cone-beam technology uses a cone-shaped beam of radiation to acquire a volume in a single 360-degree rotation, similar to panoramic radiography.³⁶ It has advantages over conventional medical CT, including increased accuracy, higher resolution, scan-time reduction and dose reduction.³⁶ Endodontic uses include but are not limited to diagnosis of odontogenic and non-odontogenic cysts, cysts vs. granulomas,³⁷ location of untreated canals and the diagnosis of certain root fractures. The extent of internal, external and cervical resorption can be accurately mapped and the presurgical evaluation of anatomic landmarks can be precisely surveyed.^{36,50}

Regenerative Endodontics

Regenerative endodontics has become an exciting possibility, allowing stem cells found in the dental pulp to regenerate and replace diseased tissue with healthy tissue and re-

talize a tooth.³⁸ The vascularisation of necrotic teeth with immature apices can be a significant challenge to the clinician. In the past, apexification procedures have allowed root length to continue, but the walls of the roots remained thin, allowing the high risk and probability of fracture. Revascularization techniques provide such a tooth the ability to not only continue linear root growth, but also to allow increased thickness of dentin on the root canal walls, which will ultimately allow retention of the natural tooth, obviating the need for extraction and implant replacement.³⁹ The technique is uncomplicated and easy to learn. Through the use of a specialized tri-antibiotic mixture, blood clot induction and its coronal sealing with MTA, many necrotic and immaturely developed teeth that would otherwise be extracted can now be retained.^{40,50}

Endodontics vs. Implants

With the advent of implants, patients were able to maintain their occlusion and health in those functional areas that were missing teeth. Unfortunately implants are also being used to replace viable teeth.⁴¹

If a tooth is sound from both a restorative and periodontal aspect, then endodontic therapy should be the treatment of choice. However, if a tooth is compromised from a restorative or periodontal perspective, then an implant may be considered.⁴² Both root canal therapy and orthograde retreatment as a first and second line of intervention are more cost-effective compared to implant therapy. Current cost structures indicate that implants are limited to a third line of intervention.⁴³

Confidence and embracing the advances in the science and art of endodontics is imperative if we are to continue to achieve and improve the successes that we have achieved. There are numerous studies that support the excellent clinical results of endodontic treatment.⁴⁴ Kim and Iqbal conducted a review of the relative success rates of endodontic treatment and implants. The literature review found equal survival rates of single-tooth implants and endodontically restored teeth. Both therapies had overall survival rates of 94 per cent, thus providing predictable outcomes.^{45,46} However, implants have a longer mean and median time to function, and have a higher frequency of postoperative complications requiring additional treatment intervention.^{47,50}

Where We Are Going

Science and research will elevate the specialty of endodontics to its rightful pinnacle.⁴⁸ The cornerstone of our specialty's integrity and relevance must be built on a strong foundation of randomized clinical trials and evidenced-based endodontics.⁴⁸ The future of endodontics is bright as we continue to develop new techniques and technologies that will allow us to perform endodontic treatment painlessly and predictably, and continue to satisfy one of the main objectives in dentistry, that being to retain the natural dentition.^{14,50} ◀◀

A complete list of references is available from the publisher. Dr Gary Glassman maintains a private practice in Toronto, Canada, and is on staff in the graduate department of endodontics at the University of Toronto's Faculty of Dentistry. The author of numerous publications, he is a regular contributor to today's sister publication roots the international magazine of endodontics.



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