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roots

the international C.E. magazine of endodontics

4 2013

_C.E. article

Mineral trioxide aggregate revisited: A cement for all seasons

_technique

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How's your armamentarium?

Fred Weinstein, DMD, MRCD(C), FICD, FACD

One thing I find exciting about the specialty is the ever-expanding universe of tools and equipment available to practitioners. When it comes to beefing up one's armamentarium, there's no better place to go than a major dental meeting. From the latest files to the most innovative irrigation systems and beyond, it seems there is always plenty to see and learn about at events such as the AAE and ADA annual sessions or the Greater New York Dental Meeting.

Perhaps you picked up this copy of *roots* at one of these meetings.

That's good, because in this issue you can read about how many of these specialized tools can be used in clinical endodontic practice. Dr. Gary Glassman reports on the use of mineral trioxide aggregate (MTA), which he says can "seal the pathway of communication" between the root canal system and the surrounding tissues. Dr. L. Stephen Buchanan explains why his trusted electronic apex locator is the "most indispensible" device he uses. Dr. John J. Stropko writes about his invention, the Stropko Irrigator, which he designed to help make procedures easier by maintaining a clean field of vision.

Every issue of *roots* also contains a C.E. component. By reading the article by Dr. Glassman, then taking a short online quiz about this article at *www.DTStudyClub.com*, you will gain one ADA CERP-certified C.E. credit. Keep in mind that because *roots* is a quarterly magazine, you can actually chisel four C.E. credits per year out of your already busy life without the lost revenue and time away from your practice.

To learn more about how you can take advantage of this C.E. opportunity, visit *www.DTStudyClub.com*. You need only register at the Dental Tribune Study Club website to access these C.E. materials free of charge. You may take the C.E. quiz after registering on the DT Study Club website.

I know that taking time away from your practice to pursue C.E. credits is costly in terms of lost revenue and time, and that is another reason *roots* is such a valuable publication. I hope you will enjoy this issue and that you will take advantage of the C.E. opportunity.

For those of you attending the fall meetings in New Orleans and New York City, be sure to say hello to me in person. As always, I welcome your comments and feedback.

Sincerely,

Fred Weinstein, DMD, MRCD(C), FICD, FACD
Editor in Chief

page 06

page 10

page 15

C.E. article

06 Mineral trioxide aggregate revisited: A cement for all seasons
_Gary Glassman, DDS, FRCD(C)

technique

10 The rationale and use of electronic apex locators
_L. Stephen Buchanan, DDS, FICD, FACD

education

15 New endo program is established at University of Tennessee

industry

16 X-Runner all-tissue ablative laser scanner

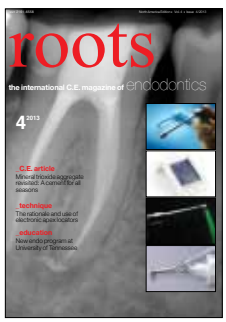
17 PIPS Laser Endo harnesses the power of the Lightwalker

18 Stropko Irrigator removes debris, making many procedures easier
_John J. Stropko, DDS

20 Wykle Research expands its Calasept Endo line

about the publisher

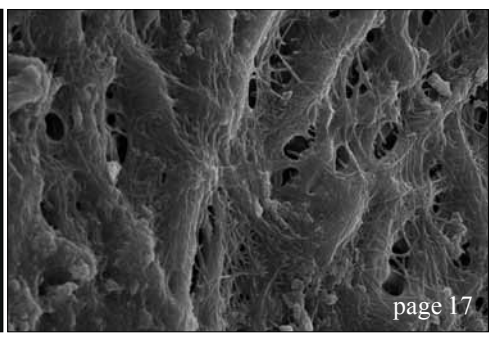
21 _submissions
22 _imprint



on the cover

From top: Stropko Irrigator, RootZX-mini electronic apex locator, X-Runner all-tissue ablative laser scanner, EndoVac irrigation device Master Delivery Tip. Clinical image provided by Richard Mounce, DDS.

page 16


page 17

page 18

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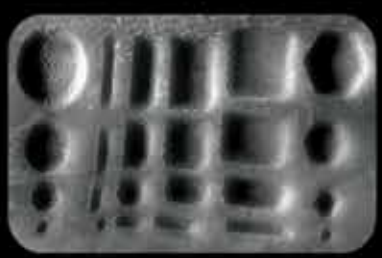

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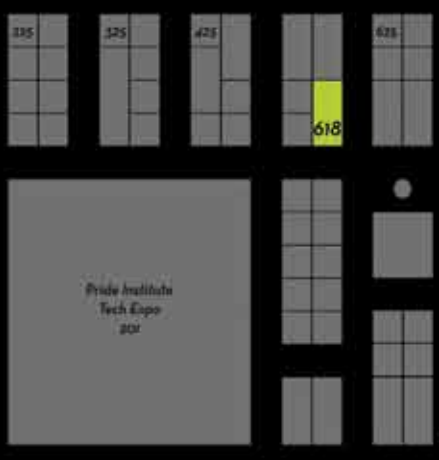

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Mineral trioxide aggregate revisited: A cement for all seasons

Author_Gary Glassman, DDS, FRCD(C)

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_Pulpal and periradicular pathology develop when the dental pulp and periradicular tissues become exposed to microorganisms. In experimental, germ-free conditions, pulpal and periradicular tissues fail to show the development of pathosis and associated lesions when exposed to bacteria.[1,2] The conclusion: Microorganisms are the main irritants of the dental pulp and periodontium, and sealing the pathways of communication between the root canal system and the periradicular tissues is imperative if bacterial leakage is to be prevented.

An ideal orthograde or retrograde filling material that seals the pathways of communication between the root canal system and its surrounding tissues should be non-toxic, non-carcinogenic, biocompatible, insoluble in tissue fluids and dimensionally stable.[3,4] Furthermore, the presence of moisture should not affect its sealing ability; it should be easy to use and be radiopaque for recognition on radiographs.[4]

Because existing restorative materials used in endodontics did not possess these "ideal" characteristics,[4] mineral trioxide aggregate (MTA) was developed and recommended initially as a root-end filling material and subsequently has been used for pulp capping, pulpotomy, apexogenesis, apical barrier formation in teeth with open apices, repair of root perforations and, most recently, in revascularization cases. MTA has been recognized as a bioactive material.[5,6]

MTA has been shown to seal off the pathways of communication between the root canal system and surrounding tissues, significantly reducing bacterial migration.[7] It is made up of fine hydrophilic particles that set in the presence of water, and it is composed of tricalcium silicate, dicalcium silicate, tricalcium aluminate, tetracalcium aluminoferrite, calcium sulfate dihydrate (gypsum) and bismuth oxide, which provides it with radiopacity.[8]

Fig. 1_MTA Angelus (Angelus, Londrina, Brazil) available in resealable vials. (Photos/Provided by Gary Glassman, DDS, FRCD(C))

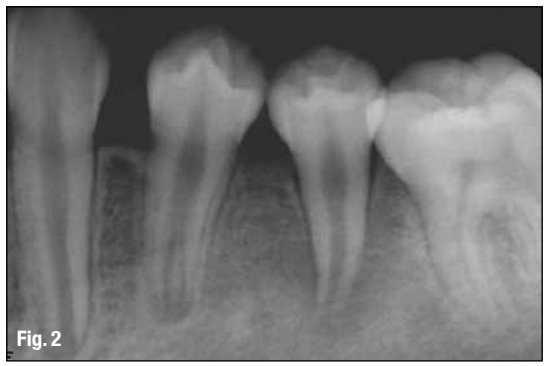

Fig. 2_Radiograph of a necrotic lower left second premolar with large periradicular radiolucency with an incompletely formed root, both longitudinally and laterally.

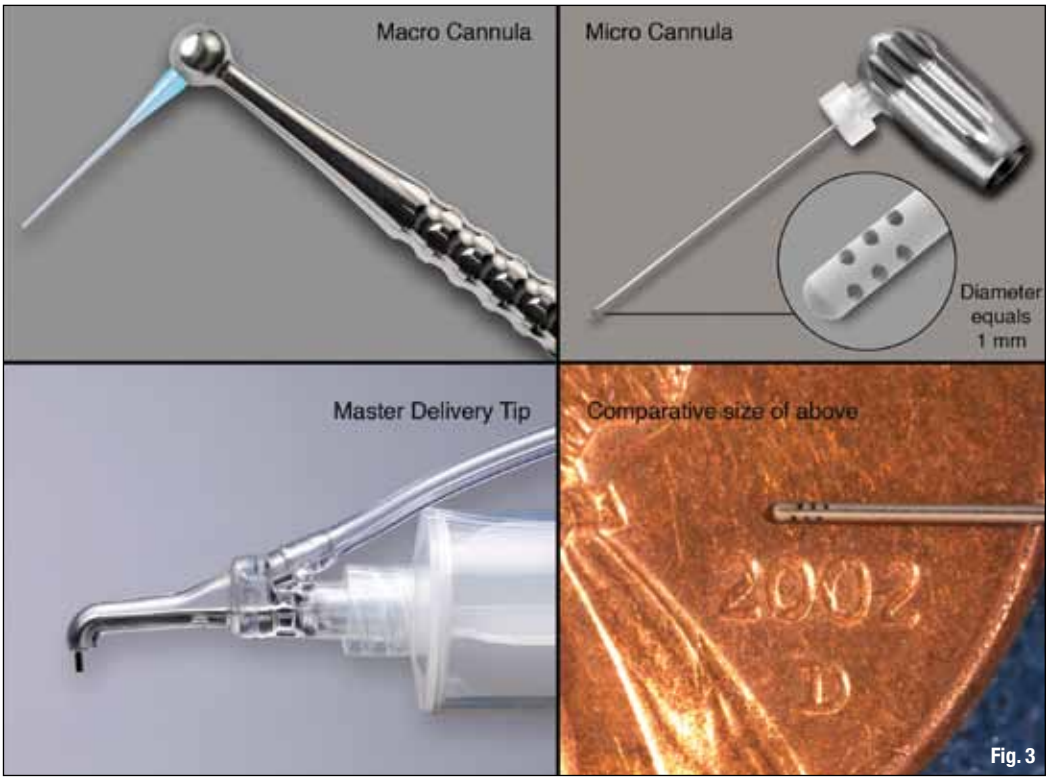

Fig. 3_EndoVac apical negative pressure delivery system (Axis/SybronEndo, Coppel, Texas).

Portland cement is the most common type of cement in general use around the world, used as a basic ingredient of concrete, mortar, stucco and most non-specialty grout. It usually originates from limestone. MTA is available as gray MTA and white MTA. The crystalline structure and chemical composition of gray and white MTA are similar, except for the presence of iron in gray MTA.

Both contain bismuth oxide and calcium silicate oxide. Portland cement is composed mainly of calcium silicate oxide and does not contain bismuth oxide but does contain potassium. Calcium oxide is added in both Angelus white and gray MTA (Angelus, Londrina, Brazil) to reduce the setting time, which is too long in MTA cements of other brands (Fig. 1).

MTA has a similar mechanism of action to calcium hydroxide[9] in that the main component of the material, calcium oxide, when in contact with a humid environment, is converted into calcium hydroxide.[10] This results in a high pH of 12.5, making its surroundings inhospitable for bacterial growth and producing an antibacterial effect for a long period of time. But unlike calcium hydroxide products, such as Dycal® (DENTSPLY, York, Pa.) and MTA Angelus (Angelus, Londrina, Brazil), it has very low solubility, so it maintains a hard, excellent marginal seal.

Finally, unlike most dental materials, MTA actually needs moisture to set, so it thrives in a moist environment. Of the commercially available MTA products, MTA Angelus is well suited for most of the indicated endodontic procedures due to its setting time of 10 minutes, compared with the four-hour setting time of the other commercially available MTA. It is also packaged in air-tight bottles, allowing the practitioner to use only what is exactly needed, without introducing undue moisture into the remainder and without waste.[11]

_Endodontic revascularization

Treatment of the immature, non-vital tooth with apical pathology presents several challenges. The mechanical cleaning and shaping of such a tooth with a blunderbuss canal is difficult, if not impossible, to achieve predictably. The thin, fragile lateral dentinal walls can fracture during mechanical filing, and the large volume of necrotic debris contained in a wide root canal is difficult to completely disinfect.[12]

A new technique is presented to revascularize immature permanent teeth with apical periodontitis. The canal is disinfected with copious irrigation and a combination of three antibiotics. After the disinfection protocol is complete, the apex is mechanically irritated to initiate bleeding into the canal to produce a blood clot to the level of the cementoenamel junction.

A double seal of the coronal access is then made, first with MTA over the blood clot and then a bonded composite. The combination of a disinfected canal, a matrix into which new tissue could grow, and an effective coronal seal appears to have the ability to produce an environment necessary for successful revascularization.[13] The development of normal, sterile granulation tissue within the root canal is

Fig. 4_After the triple antibiotic paste was inserted into the canal, a temporary restoration was placed.

Fig. 5_Blood clot was induced and MTA Angelus (Angelus, Londrina, Brazil) was placed over top, and then the tooth was restored with bonded composite.

Fig. 6_Three-month recall reveals excellent longitudinal apical and lateral dentin development.

Fig. 7_One-year recall radiograph reveals that definitive endodontics had been completed by the patient's new dentist.

Fig. 4

Fig. 5

Fig. 6

Fig. 7

thought to aid in revascularization and stimulation of cementoblasts or the undifferentiated mesenchymal cells at the periapex, leading to the deposition of a calcific material at the apex as well as on the lateral dentinal walls.[12]

_A case of mistaken identity

A 15-year-old girl of Asian descent was referred to the author's private endodontic clinic for evaluation on the lower left second premolar. The healthy young patient with an unremarkable medical history presented with a history of buccal swelling of the left mandibular area and discomfort to direct pressure on the tooth. On clinical examination, the patient was asymptomatic, and the tooth appeared intact, without caries. The presence of an enamel pearl on tooth #45 suggested that one may have been present on this tooth, which was fractured during function, resulting in a microexposure and necrosis of the pulp. The tooth had an open apex associated with a large radiolucency (Fig. 2).

Periodontal probings were within normal limits for all teeth in the lower left region. Diagnostic testing was negative to cold and electric pulp testing, with mild sensitivity on percussion and palpation. Because of the presence of a wider than 4 mm open apex and thin dentinal walls prone to possible future fracture,[14] it was felt that an attempt to achieve regeneration of the pulp should be made by a technique similar to that described by Rule and Winter[15] and Iwaya et al.[16]

An access cavity was made, purulent hemorrhagic drainage obtained, and the necrotic nature of the pulp confirmed. The root canal was slowly flushed with 20 ml of 5.25 percent NaOCl for 15 minutes. It was delivered with the master delivery tip and the macro canulae of the EndoVac apical negative pressure delivery system (Axis/SybronEndo, Coppel, Texas) (Fig. 3).

The canal was dried with paper points, and a mixture of ciprofloxacin, metronidazole and minocycline paste as described by Hoshino et al.[17] was prepared into a creamy consistency and spun down the canal with a lentulo spiral instrument to a depth of 8 mm into the canal. The access cavity was closed with a sterile cotton pellet placed in the chamber and blue Cosmecore (Cosmedent, Chicago). (Fig. 4).

The patient returned three weeks later and was asymptomatic. The access was opened and the canal again flushed with 20 ml of 5.25 percent NaOCl for 15 minutes. It was delivered in the same manner as in the first visit with the master delivery tip and the macro canulae of the EndoVac apical negative pressure delivery system.

The canal appeared clean and dry, with no signs of inflammatory exudate. A #30 K-file was introduced into the canal until vital tissue was felt at a depth of 10 mm into the canal space. It was used to irritate the tissue gently to create some bleeding into the canal. The bleeding was stopped at a level of 5 mm below the level of the CEJ and left for 30 minutes, so that the blood would clot at that level.

After 30 minutes, the presence of the blood

clot to approximately 5 mm apical of the CEJ was confirmed. White mineral trioxide aggregate, MTA Angelus was carefully placed over the blood clot and allowed to set for 20 minutes. After confirmation was achieved of its set, a bonded composite was placed and the patient was scheduled for follow-up in three months. Unfortunately, the MTA was placed further apically then would have been preferred (Fig. 5).

At the three-month follow-up appointment, the patient was totally asymptomatic, and the radiograph showed complete resolution of the radiolucency, with closure of the apex and thickening of the dentinal walls. Pulp testing was inconclusive (Fig. 6).

At the one-year follow-up appointment, the radiograph revealed that treatment had been performed on this tooth by another dentist, different from her original dentist who made the initial referral. The new dentist, not familiar with revascularization treatment performed, had entered the root canal space, cleaned it out and obturated it with gutta-percha and sealer. Fortunately, the treatment was successful (Fig. 7).

_Conclusion

The future of endodontics is bright as we continue to develop new techniques and technologies that will allow us to perform treatment painlessly and predictably and continue to satisfy one of the main objectives in dentistry – being to retain the natural dentition wherever possible and wherever practical._

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_about the author

roots

Gary Glassman, DDS, FRCD(C), graduated from the University of Toronto, Faculty of Dentistry in 1984; and graduated from the endodontology program at Temple University in 1987, where he received the Louis I. Grossman Study Club Award for academic and clinical proficiency in endodontics. The author of numerous publications, Glassman lectures globally on endodontics, is on staff at the University of Toronto, Faculty of Dentistry, in the graduate department of endodontics, and is adjunct professor of dentistry and director of endodontic programming for the University of Technology, Jamaica. He is a fellow of the Royal College of Dentists of Canada and the endodontic editor for Oral Health dental journal. He maintains a private practice, Endodontic Specialists, in Toronto, Ontario, Canada. He can be reached through his website, *www.rootcanals.ca*.