Mineral trioxide aggregate revisited: a cement for all seasons

By Gary Glassman, DDS, FRCD

Pulpal and periapical tissue injuries, especially when the dental pulp and periapical tissues become exposed to microorganisms. In experimental, germ-free conditions, pulpal and periapical tissues fail to show the development of pathosis and associated lesions when exposed to bacteria. 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 periapical 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. Furthermore, the presence of moisture should not affect its sealing ability; it should be easy to use and heat radiopaque for recognition on radiographs.

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. Conversely, it has been used for pulp capping, pulpotomy, apexogenesis, apical barrier formation in teeth with open apices, repair of root perforations and most recently in regenerative endodontic cases.

MTA has a similar mechanism of action to calcium hydroxide in that the main component of the material, calcium oxide, when in contact with a humid environment, is converted into calcium hydroxide. This results in a high pH of 12.5, making its surrounding insipicuous for bacterial growth and producing an antibacterial effect for a long period of time. 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 materials. It is also packaged in air-tight bottles, allowing the practitioner to use only what is clinically needed, without introducing undue moisture into the remainder and without waste.

Endodontic revascularization

Treatment of the immature, non-vital tooth with apical pathologies 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.

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 irrigated to initiate bleeding into the canal to produce a blood clot at 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.

Microorganisms are the main irritants of the dental pulp and periodontium, significantly reducing bacterial leakage. MTA has been shown to seal 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. Furthermore, the presence of moisture should not affect its sealing ability; it should be easy to use and heat radiopaque for recognition on radiographs. 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. Conversely, it has been used for pulp capping, pulpotomy, apexogenesis, apical barrier formation in teeth with open apices, repair of root perforations and most recently in regenerative endodontic cases. MTA has a similar mechanism of action to calcium hydroxide in that the main component of the material, calcium oxide, when in contact with a humid environment, is converted into calcium hydroxide. This results in a high pH of 12.5, making its surrounding insipicuous for bacterial growth and producing an antibacterial effect for a long period of time. 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.

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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, it was felt that an attempt to achieve regeneration of the pulp should be made by a technique similar to that described by Bule and Winter and Iwaya et al.

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 mas-

Fig. 1 MTA Angelus (Angelus, Londrina, Brazil) available in available vials. (Photo Provided by Gary Glassan, DDS, FRCD(C)).

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

Macro Carmina

Micro Carmina

Master Delivery Tip

Comparative size of above

Fig. 3 EndoVac apical negative pressure delivery system (Axis/SybronEndo, Coppell, Texas)
After the triple antibiotic paste was inserted into the canal, a temporary restoration was placed (Fig. 4).

The patient returned three weeks later and was asymptomatic. The access was opened and the canal again flushed with 20 ml of 2.5% 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 $50 K-file was introduced into the canal until vital tissue was felt at a depth of 10 mm into the canal. 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 50 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 setting, a bonded composite was placed and the patient was scheduled for follow-up in three months. Unfortunately, the MTA was placed further apically than 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 whenever possible and wherever practical.

References

4. Dentsply Tulsa Dental. ProRootM TA Root canal re-RootTM MTA Root canal re-RootTM MTA Root canal re-RootTM MTA Root canal re-

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 radiographs reveal that definitive endodontics had been completed by the patient’s new dentist.

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