Mineral trioxide aggregate revisited: a cement for all seasons

By Gary Glassman, DDS, FRCD

Pulpal and periapical diseases are treated when the dental pulp and periapical tissues become exposed to microorganisms. In experimentation, 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 have radiopaque for recognition on radiographs.

Because existing restorative materials used in endodontics did not possess these “ideal” characteristics, 4 mineral trioxide aggregate was developed and recommended initially as a root-end filling material. MTA has been used for pulp capping, pulpotomy, apexification, apical barrier formation in teeth with open apices, repair of root perforations and, most recently, in necrotic cases. MTA has been recognized as a bioactive material.

MTA has been shown to seal the pathways of communication between the root canal system and surrounding tissues, significantly reducing bacterial migration. 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 aluminium, tetracalcium aluminoferrite, calcium sulphate dihydrate (gypsum) and bismuth oxide, which provides it with radiopacity.

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 nonstructurally grout. It is used as a basic ingredient of cement in general use around the world, common type of cement in the world, its presence of moisture should significantly reduce bacterial migration. It is imperative if bacterial leakage is to be prevented.

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 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 surroundings inhospitable for bacterial growth and producing an antibacterial effect for a long period of time. Unlike calcium hydroxide products, such as Decalcalend (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 products.

It is also packaged in air-tight bottles, allowing the practitioner to use only what is needed, without introducing undue moisture into the remainder and without waste.

Endodontic revascularization

Treatment of the immature, non-vital tooth with apical patency 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 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 new tissue to grow, and an effective coronal seal appears to have the ability to produce an environment necessary for new tissue to grow. 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 Decalcalend, MTA is available in resealable vials. (Photos/Provided by Gary Glassman, DDS, FRCD(C)).

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 microavascular and necrosis of the pulp. The tooth had an open apex associated with a large radiolucency (Fig. 2).

Periodontal proprosings were within normal limits for all teeth in the lower left region. Diagnosis was negative for cold and electric pulp testing, with mild sensitivity to 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 hemmorhagic 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-
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 Cosmocore (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 $50 K-file was introduced into the canal until vital tissue was felt at a depth of 10 mm into the 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.

References

8. Dentply Tulsa Dental. Pro-RootTM MTA Root canal repair material; Material safety data sheet (MSDS).