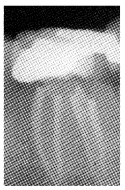
doi:10.1111/j.1365-2591.2007.01274.x



CASE REPORT

Mineral trioxide aggregate pulpotomy of a primary second molar in a patient with agenesis of the permanent successor

A. B. S. Moretti[1], T. M. Oliveira[1], V. T. Sakai[1], C. F. Santos[2], M. A. A. M. Machado[1] & R. C. C. Abdo[1]

[1]Department of Pediatric Dentistry, Orthodontics and Public Health; and [2]Department of Biological Sciences, Bauru School of Dentistry, University of São Paulo, Bauru, SP, Brazil

Abstract

Moretti ABS, Oliveira TM, Sakai VT, Santos CF, Machado MAAM, Abdo RCC. Mineral trioxide aggregate pulpotomy of a primary second molar in a patient with agenesis of the permanent successor. *International Endodontic Journal*, **40**, 738–745, 2007.

Aim To describe a pulpotomy with mineral trioxide aggregate in a primary second molar with no permanent successor.

Summary Coronal pulpotomy was performed on a carious primary molar with no permanent successor in a 7-year-old child. Follow-up examinations 24 months later revealed that the treatment was successful in preserving the tooth and the vitality of its pulp.

Key learning point Mineral trioxide aggregate might be considered as an alternative wound dressing for pulpotomy in primary molars, preserving pulp vitality and prolonging the useful life of the tooth.

Keywords: agenesis, hypodontia, mineral trioxide aggregate, primary teeth, pulpotomy.

Received 16 October 2006; accepted 28 February 2007

Introduction

Hypodontia, which may be synonymous with partial anodontia, congenital absence, oligodontia or agenesia, occurs when one or more tooth buds fail to develop (Caldo-Teixeira & Puppin-Rontani 2003). Agenesis of permanent teeth has direct clinical implications, and the diagnosis of hypodontia must be made as early as possible, to allow careful planning of functional and aesthetic needs by a multidisciplinary team

Correspondence: Dr Carlos Ferreira Santos, Bauru School of Dentistry, University of São Paulo, Alameda Dr Octávio Pinheiro Brisolla, 9-75, Discipline of Pharmacology, Bauru, SP 17012-901, Brazil (Tel.: 55 14 32358276; fax: 55 14 32234679; e-mail: cebola@usp.br).

(Hobkirk *et al.* 1995). In some cases, the retention of primary molars is an acceptable semipermanent solution (Ith-Hansen & Kjaer 2000).

A primary goal of all restorative treatment is to maintain pulp vitality whenever it is possible. If pulpal exposure occurs in a primary molar, a pulpotomy may be indicated for tooth preservation. Medicaments applied to radicular pulp tissue after pulpotomy have included formocresol (Fuks 2002), ferric sulphate (Fuks 2002) and calcium hydroxide (Witherspoon *et al.* 2006). Recently, mineral trioxide aggregate (MTA) has demonstrated the ability to induce hard tissue formation in pulpal tissue (Torabinejad *et al.* 1993, Torabinejad & Chivian 1999, Camilleri & Pitt Ford 2006). MTA is a mineral powder that consists of hydrophilic particles, whose principal components are tricalcium silicate, tricalcium aluminate, tricalcium oxide and other mineral oxides (Torabinejad & Chivian 1999). It has a pH of 12.5, and sets in the presence of moisture in approximately 4 h (Torabinejad *et al.* 1993, Torabinejad & Pitt Ford 1996, Schwartz *et al.* 1999, Torabinejad & Chivian 1999). Studies have shown that MTA is apparently equal or superior to other materials with respect to dye and bacterial leakage (Torabinejad *et al.* 1995, Schwartz *et al.* 1999, Torabinejad & Chivian 1999, McCabe 2003). It presents acceptable sealing ability (Torabinejad & Pitt Ford 1996, Torabinejad & Chivian 1999, Keiser *et al.* 2000, McCabe 2003), biocompatibility (Torabinejad & Pitt Ford 1996, Schwartz *et al.* 1999, Torabinejad & Chivian 1999, Witherspoon *et al.* 2006), low cytotoxicity (Torabinejad & Pitt Ford 1996, Torabinejad & Chivian 1999, Keiser *et al.* 2000) and induces odontoblasts to form hard tissue barriers (Torabinejad & Pitt Ford 1996, Shabahang *et al.* 1999, Torabinejad & Chivian 1999, Witherspoon *et al.* 2006).

Suggested indications for the use of MTA include root-end filling (Torabinejad & Pitt Ford 1996, Torabinejad & Chivian 1999), pulp capping (Queiroz *et al.* 2005), repair of furcal perforations (Main *et al.* 2004, De-Deus *et al.* 2006, Oliveira *et al.* in press a), apical filling of teeth with open apices and apexification therapy (Shabahang *et al.* 1999, Torabinejad & Chivian 1999, Oliveira *et al.* in press b). MTA has been proposed as a potential medicament for pulpotomy, and evaluation in dogs teeth has produced favourable pulp responses (Shabahang *et al.* 1999, Main *et al.* 2004). Compared with other materials used for pulpotomy in primary teeth, MTA is the most biocompatible (Shabahang *et al.* 1999, Eidelman *et al.* 2001, Holland *et al.* 2001, Agamy *et al.* 2004, Holan *et al.* 2005, Queiroz *et al.* 2005, Yildirim *et al.* 2005). This case report describes clinical and radiographic outcomes of an MTA pulpotomy in a primary second molar with agenesis of the permanent successor.

Case report

A 7-year-old boy attended the Paediatric Dentistry Clinic of Bauru School of Dentistry with a request for dental care because of the presence of carious lesions. The medical and dental history were reviewed before commencing treatment. The mother reported that he had experienced pain in the decayed tooth when eating. Extra-oral examination revealed nothing of note.

The clinical and radiographic examinations revealed an extensive secondary carious lesion in the mandibular left second primary molar with no evidence of ankylosis or infra-occlusion, and absence of the successional premolar (Figs 1 and 2). According to the mother, there were no other known cases of tooth agenesis in the family.

After thorough examination, the initial treatment plan included the maintenance of the decayed tooth until it exfoliated normally in an attempt to avoid the establishment of a malocclusion in the future. It was therefore decided to attempt restoration of the carious molar. Initially, the patient received a regional anaesthetic block of the buccal, lingual and inferior alveolar nerves, and rubber dam isolation was achieved. Access to the carious

Figure 1 Clinical examination revealed extensive secondary caries in the left second mandibular primary molar.

Figure 2 Initial periapical radiograph revealed extensive secondary caries in the left second mandibular primary molar and absence of the premolar successor.

lesion and the removal of restorative material were completed using a diamond spherical bur in a high-speed handpiece with water spray. Dentinal caries removal was accomplished manually with an excavator. During this procedure, the pulp was exposed and a pulpotomy was indicated. The pulp chamber was opened with a carbide spherical bur, followed by irrigation with saline solution. After removal of the entire coronal pulp with hand instruments, haemostasis was achieved by irrigating copiously with saline solution and drying the pulp chamber with a sterilized cotton pellet. White MTA (Ñngelus®, Londrina, Brazil) was then mixed with sterile water to a paste consistency, and an approximately 2-mm-thick layer of this material was applied into the pulp chamber with an amalgam carrier. The tooth was then restored with glass ionomer cement (Figs 3–5).

Follow-up examinations were carried out 12 and 24 months after treatment (Figs 6–8). Each checkup involved clinical and radiographic examinations of the tooth and periradicular area. All follow-up examinations, including pulp sensitivity tests, revealed that the treatment was successful in preserving pulpal vitality of the primary tooth. The patient will be monitored quarterly in order to follow the eruption of all permanent teeth.

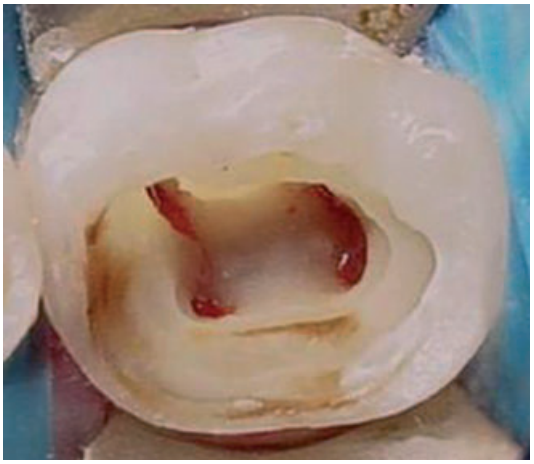


Figure 3 Opening of the pulp chamber and control of bleeding of the remaining pulp tissue.

Figure 4 Mineral trioxide aggregate applied into the pulp chamber.

Figure 5 Tooth restored with glass ionomer cement.

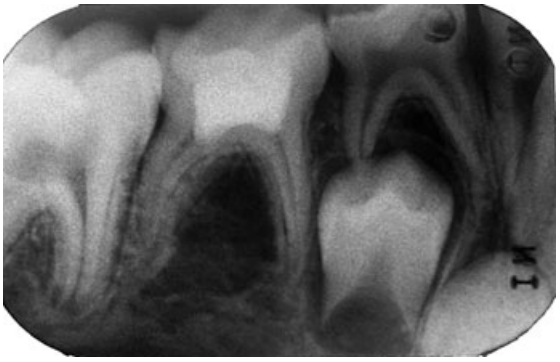


Figure 6 Immediate postoperative radiograph of the tooth treated with mineral trioxide aggregate.

Figure 7 Twelve-month follow-up periapical radiograph.

Figure 8 Twenty-four-month follow-up radiograph showing the success of treatment.

Discussion

Tooth agenesis is an anomaly that may result in dental malpositioning, periodontal damage, lack of development of maxillary and mandibular alveolar bone height and may have significant psychological, aesthetic and functional consequences. Knowledge of the condition may contribute to the development of more effective therapies (Silva Meza 2003, Kirzioglu *et al.* 2005).

Management of hypodontia can pose a significant clinical challenge (Cuoghi *et al.* 1998, Rao & Sarkar 1999). Primary teeth that have no permanent successors may be ankylosed or infra-occluded. Besides, root resorption of these teeth may be less pronounced than those with permanent successors (Haselden *et al.* 2001). Before embarking on treatment, the practitioner must decide whether to extract the retained primary teeth and maintain the space until prosthetic rehabilitation, or maintain those teeth until their root resorption becomes more severe. In cases with crowding, the missing premolar may be used as an extraction space. The mandibular second primary molar can be extracted, and the space used to relieve crowding, retract anterior teeth or both. On the other hand, when the early removal of the second primary molar occurs, a series of changes in the dental arches can be observed, such as reduction in arch length, inclination of adjacent teeth, alveolar bone resorption and extrusion of the antagonist tooth. In such cases, if the decision is to keep the primary molar, a malocclusion may be avoided in the future (Bjerklin & Bennett 2000, Ith-Hansen & Kjaer 2000).

In young children, pulp exposures due to extensive carious lesions may be treated by pulpotomy, and several materials have been used as wound dressings (Fuks 2002). Formocresol has been the most popular pulp dressing material for pulpotomized primary molars for many years, but due to potentially hazardous effects, its use has decreased considerably worldwide (Eidelman *et al.* 2001, Holan *et al.* 2005). Ferric sulphate has been proposed as a substitute to formocresol (Fuks 2002). For other authors (Witherspoon *et al.* 2006) the material of choice is calcium hydroxide. MTA is now available as an alternative for use in pulpotomy (Torabinejad *et al.* 1997, Torabinejad 2004, Witherspoon *et al.* 2006). It is a biocompatible material with numerous clinical applications in endodontic procedures. Several laboratory and *in vivo* studies have shown that it prevents microleakage and promotes regeneration of the original tissues when it is placed in contact with the dental pulp or periradicular tissues (Torabinejad *et al.* 1997, Torabinejad 2004, Witherspoon *et al.* 2006). According to histological evidence from animal experiments, MTA both maintains pulp vitality and induces a tubular hard tissue bridge (Bernabe *et al.* 2005), and therefore, may be ideal for several endodontic procedures (Schwartz *et al.* 1999, Torabinejad 2004).

On the basis of recent studies, MTA may prevent microleakage and promote regeneration of the original tissues when it is placed in contact with the dental pulp or periradicular tissues (Shabahang *et al.* 1999, Torabinejad & Chivian 1999, Holland *et al.* 2001, Main *et al.* 2004, Yildirim *et al.* 2005, Camilleri & Pitt Ford 2006, De-Deus *et al.* 2006). There are reports of complete dentine bridge formation when MTA was used as a pulp capping agent (Schwartz *et al.* 1999, Queiroz *et al.* 2005). It showed a higher long-term clinical and radiographic success than formocresol in primary teeth (Eidelman *et al.* 2001, Agamy *et al.* 2004, Holan *et al.* 2005). MTA can be recommended because its replacement, unlike formocresol, does not induce undesirable responses (Eidelman *et al.* 2001, Holan *et al.* 2005). Despite its high cost, MTA may be considered as an alternative option for pulpotomy in primary teeth in an attempt to prolong their longevity.

The treatment of agenesis often involves a combined orthodontic-surgical-restorative approach. The orthodontic treatment may contribute to the overall management of hypodontia by closing or redistributing spaces (Zarrinnia & Bassiouny 2003, Fekonja 2005). Prosthodontic methods for replacing congenitally missing teeth include traditional fixed prostheses, resin-bonded fixed partial dentures, removable partial dentures or osseointegrated implants to support an independent anatomically contoured crown (Zhu *et al.* 1996). In the present case, an implant may be indicated in future. It is worth mentioning that the osseointegration technique is not recommended for young children because osseointegrated implants are not displaced during growth like normal teeth (Zuccati 1993).

Coronal leakage and tooth fracture are real issues for the longevity of endodontically treated primary molars. In this case, a simple glass ionomer cement restoration was rapidly placed, rather than a stainless steel crown. This material has good sealing properties and is easy to handle. It is, however, accepted that this approach may represent a compromise, and the use for a stainless steel crown cannot be ruled out in future.

Conclusion

This case revealed that MTA was an effective alternative for primary molar pulpotomy, at least in the short term. Full-scale clinical trials to evaluate the effectiveness of MTA are warranted.

Disclaimer

Whilst this article has been subjected to Editorial review, the opinions expressed, unless specifically indicated, are those of the author. The views expressed do not necessarily represent best practice, or the views of the IEJ Editorial Board, or of its affiliated Specialist Societies.

References

Agamy HA, Barkry NS, Mounir MM, Avery DR (2004) Comparison of mineral trioxide aggregate and formocresol as pulp-capping agents in pulpotomized primary teeth. *Pediatric Dentistry* **26**, 302–9.

Bernabe PF, Holland R, Morandi R et al. (2005) Comparative study of MTA and other materials in retrofilling of pulpless dogs' teeth. *Brazilian Dental Journal* **16**, 149–55.

Bjerklin K, Bennett J (2000) The long-term survival of lower second primary molars in subjects with agenesis of the premolars. *European Journal of Orthodontics* **22**, 245–55.

Caldo-Teixeira AS, Puppin-Rontani RM (2003) Management of severe partial hypodontia: case report. *Journal of Clinical Pediatric Dentistry* **27**, 133–6.

Camilleri J, Pitt Ford TR (2006) Mineral trioxide aggregate: a review of the constituents and biological properties of the material. *International Endododontic Journal* **39**, 747–54.

Cuoghi OA, Bertoz FA, de Mendonça MR, Santos EC (1998) Loss of space and dental arch length after the loss of the lower first primary molar: a longitudinal study. *Journal of Clinical Pediatric Dentistry* **22**, 117–20.

De-Deus G, Petruccelli V, Gurgel-Filho E, Coutinho-Filho T (2006) MTA versus Portland cement as repair material for furcal perforations: a laboratory study using a polymicrobial leakage model. *International Endodontic Journal* **39**, 293–8.

Eidelman E, Holan G, Fuks AB (2001) Mineral trioxide aggregate vs. formocresol in pulpotomized primary molars: a preliminary report. *Pediatric Dentistry* **23**, 15–8.

Fekonja A (2005) Hypodontia in orthodontically treated children. *European Journal of Orthodontics* **27**, 457–60.

Fuks AB (2002) Current concepts in vital primary pulp therapy. *European Journal of Paediatric Dentistry* **3**, 115–20.

Haselden K, Hobkirk JA, Goodman JR, Jones SP, Hemmings KW (2001) Root resorption in retained deciduous canine and molar teeth without permanent successors in patients with severe hypodontia. *International Journal of Paediatric Dentistry* **11**, 171–8.

Hobkirk JA, King PA, Goodman JR, Jones SP (1995) Hypodontia: 2. The management of severe hypodontia. *Dental Update* **22**, 8–11.

Holan G, Eidelman E, Fuks AB (2005) Long-term evaluation of pulpotomy in primary molars using mineral trioxide aggregate or formocresol. *Pediatric Dentistry* **27**, 129–36.

Holland R, de Souza V, Nery MJ, Faraco Junior IM, Bernabe PF, Otoboni Filho JA et al. (2001) Reaction of rat connective tissue to implanted dentin tube filled with mineral trioxide aggregate, Portland cement or calcium hydroxide. *Brazilian Dental Journal* **12**, 3–8.

Ith-Hansen K, Kjaer I (2000) Persistence of deciduous molars in subjects with agenesis of the second premolars. *European Journal of Orthodontics* **22**, 239–43.

Keiser K, Johnson C, Tipton DA (2000) Cytotoxicity of mineral trioxide aggregate using human periodontal ligament fibroblasts. *Journal of Endodontics* **26**, 288–91.

Kirzioglu Z, Koseler Sentut T, Ozay Erturk MS, Karayilmaz H (2005) Clinical features of hypodontia and associated dental anomalies: a retrospective study. *Oral Disease* **11**, 399–404.

Main C, Mirzaryan N, Shabahang S, Torabinejad M (2004) Repair of root perforations using mineral trioxide aggregate: a long-term study. *Journal of Endodontics* **30**, 80–3.

McCabe PS (2003) The clinical applications of mineral trioxide aggregate. *Journal of the Irish Dental Association* **49**, 123–31.

Oliveira TM, Sakai VT, Santos CF, Silva TC, Machado MAAM, Abdo RCC (in press a) Repair of furcal perforation treated with MTA in a primary molar tooth: 20-month follow-up. *Journal of Dentistry for Children*, in press.

Oliveira TM, Sakai VT, Silva TC, Santos CF, Abdo RCC, Machado MAAM (in press b) Mineral trioxide aggregate (MTA) as an alternative treatment for intruded permanent teeth with root resorption and incomplete apex formation. *Dental Traumatology*, in press.

Queiroz AM, Assed S, Leonardo MR, Nelson Filho P, Silva LAB (2005) MTA and calcium hydroxide for pulp capping. *Journal of Applied Oral Sciences* **13**, 126–30.

Rao AK, Sarkar S (1999) Changes in the arch length following premature loss of deciduous molars. *Journal of Indian Society of Pedodontics & Preventive Dentistry* **17**, 29–32.

Schwartz RS, Mauger M, Clement DJ, Walker WA (1999) Mineral trioxide aggregate: a new material for endodontics. *The Journal of the American Dental Association* **130**, 967–75.

Shabahang S, Torabinejad M, Boyne PP, Abedi H, McMillan P (1999) A comparative study of root-end induction using osteogenic protein-1, calcium hydroxide and mineral trioxide aggregate in dogs. *Journal of Endodontics* **25**, 1–5.

Silva Meza R (2003) Radiographic assessment of congenitally missing teeth in orthodontic patients. *International Journal of Paediatric Dentistry* **13**, 112–6.

Torabinejad M (2004) Clinical applications of mineral trioxide aggregate. *Alpha Omegan* **97**, 23–31.

Torabinejad M, Chivian N (1999) Clinical applications of mineral trioxide aggregate. *Journal of Endodontics* **25**, 197–205.

Torabinejad M, Pitt Ford TR (1996) Root-end filing materials: a review. *Endodontic & Dental Traumatology* **12**, 161–78.

Torabinejad M, Watson TF, Pitt Ford TR (1993) Sealing ability of a mineral trioxide aggregate when used as a root end filling material. *Journal of Endodontics* **19**, 591–5.

Torabinejad M, Rastegar AF, Kettering JD, Pitt Ford TR (1995) Bacterial leakage of mineral trioxide aggregate as a root-end filling material. *Journal of Endodontics* **21**, 109–12.

Torabinejad M, Pitt Ford TR, McKendry DJ, Abedi HR, Miller DA, Kariyawasam SP (1997) Histologic assessment of mineral trioxide aggregate as a root-end filling in monkeys. *Journal of Endodontics* **23**, 225–8.

Witherspoon DE, Small JC, Harris GZ (2006) Mineral trioxide aggregate pulpotomies: a case series outcomes assessment. *The Journal of the American Dental Association* **137**, 610–8.

Yildirim T, Gencoglu N, Firat I, Perk C, Guzel O (2005) Histologic study of furcation perforations treated with MTA or Super EBA in dogs' teeth. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology & Endodontology* **100**, 120–4.

Zarrinnia K, Bassiouny MA (2003) Combined aplasia of maxillary first molars and lateral incisors: a case report and management. *Journal of Clinical Pediatric Dentistry* **27**, 127–31.

Zhu JF, Marcushamer M, King DL, Henry RJ (1996) Supernumerary and congenitally absent teeth: a literature review. *Journal of Clinical Pediatric Dentistry* **20**, 87–95.

Zuccati G (1993) Implant therapy in cases of agenesis. *Journal of Clinical Orthodontics* **27**, 369–73.