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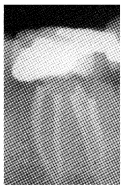

CASE REPORT

Preserving pulpal health of a geminated maxillary lateral incisor through multidisciplinary care

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Abstract

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Aim To report the multidisciplinary care of an unaesthetic geminated maxillary lateral incisor tooth, which allowed its preservation in the mouth.

Summary Preoperative examination of an unsightly geminated maxillary lateral incisor (tooth 22) demonstrated two pulp chambers and open apices, with normal pulp sensitivity responses. At surgery, a periodontal mucoperiosteal flap was reflected and the distal part of the geminated tooth was removed. The exposed root canal of the preserved tooth was sealed with mineral trioxide aggregate (MTA). The extraction socket and osseous defect was grafted with decalcified freeze-dried bone allograft (DFDBA) before flap closure. During follow-up, distal caries in tooth 22 and a diastema between tooth 22 and 23 were managed with composite resin restorations. Forty-two months postoperatively, normal thermal and electrical pulp sensitivity tests confirmed pulp health. Convincing apexogenesis and dentinogenesis of the developing root was confirmed by radiographic examination. Acceptable periodontal health including 3–4 mm clinical probing depths was achieved. Optimizing aesthetics and occlusion was accomplished without orthodontic treatment.

Key learning points:

- Adequate preoperative examination and proper interdisciplinary coordination may be required to successfully treat a geminated tooth.
- Mineral trioxide aggregate may effectively seal an exposed pulp chamber and preserve pulp vitality.
- MTA and decalcified freeze-dried bone allograft may support the healing of periodontal tissues.

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Introduction

Gemination is the attempted formation of two teeth from a single enamel organ (Kelly 1978, Regezi & Sciubba 1993); it has an incidence of 0.47% without sex predilection (Clayton 1956, Kim & Jou 2000). By contrast, fusion is the union of two or more individual teeth by cementum, dentine and/or enamel. The pulps of involved teeth may either join in the fused area or be entirely separate (Gorlin *et al.* 1972). If division of a geminated or fused tooth is required for aesthetic or functional reasons, the preservation of pulp health and regeneration of periodontal tissues may be challenging.

Decalcified freeze-dried bone allograft (DFDBA) has enjoyed considerable success in the treatment of infrabony defects, in supporting new bone formation in alveolar ridges and in general regeneration of periodontal tissues (Committee on Research, Science and Therapy of the American Academy of Periodontology 2001).

Mineral trioxide aggregate (MTA) is utilized in perforation repair and root-end surgery because of its ability to afford a biocompatible surface for the adhesion or attachment of bone and cementum. MTA is composed of tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide; it sets by hydration in the presence of moisture and solidifies to a hard structure with a pH of 12.5 in 4 h (Torabinejad *et al.* 1993, 1997, Bates *et al.* 1996, Torabinejad & Chivian 1999). As a root-end filling material, MTA shows less microleakage than amalgam and is equal to or better than Super-EBA (Torabinejad *et al.* 1993, Torabinejad *et al.* 1995, Bates *et al.* 1996). MTA displays lower cytotoxicity (Osorio *et al.* 1998), and causes less inflammation than other endodontic materials in contact with tissues (Aeinehchi *et al.* 2003). In addition, direct bone deposition, induction of cementogenesis and a promotion of dentinogenesis by MTA have been observed (Torabinejad *et al.* 1995, Torabinejad & Chivian 1999, Moretton *et al.* 2000, Zhu *et al.* 2000, Aeinehchi *et al.* 2003). MTA is considered as an effective pulp-capping material, able to stimulate reparative dentine formation by the stereotypic defensive mechanism of early pulp wound healing (Pitt Ford *et al.* 1996, Torabinejad & Chivian 1999, Aeinehchi *et al.* 2003).

Treating a geminating tooth often poses significant challenges to achieve a satisfactory clinical result. This report documents the treatment of a tooth by a multidisciplinary approach, resulting in the preservation of a periodontally sound, aesthetic tooth with a healthy pulp.

Report

A 10-year-old Asian boy was referred for evaluation and treatment of tooth 22, which appeared to be geminated or fused and associated with gingival bleeding and swelling (Fig. 1). Retention of plaque and gingivitis was noted. Periodontal examination showed 3–4 mm probing depths around the tooth. Positive pulp vitality was confirmed by electronic sensitivity testing. Radiographs revealed that this dental abnormity contained two maxillary lateral incisors with two pulp chambers and open apices. It was uncertain whether the two pulp chambers communicated with each other or not at the preoperative stage (Fig. 2). According to the clinical and radiographic examination, a diagnosis of germination was made. Following consultation with the patient and his parents, surgical

Figure 1 Gingivitis with plaque accumulation was found in the geminated tooth 22.

Figure 2 The preoperative radiograph showed that there were two pulp chambers in tooth 22; however, it was unclear whether they were connected or not.

intervention was planned for aesthetic reasons and to avoid damage to the developing tooth 23.

Plaque control and oral hygiene instruction was performed and informed consent was signed. Prior to administering local anaesthesia, the patient rinsed for 1 min with 0.12% chlorhexidine mouthrinse (Scodyl, Beauteeth Company Ltd, Taipei, Taiwan). Local anaesthetic (Xylestesin-S with 1 : 50 000 Epinephrine, 3M ESPE AG, Seefeld, Germany) was administered buccally and palatally to tooth 22. An intrasulcular incision was made from the mesial surface of tooth 21 to the mesial surface of tooth 23 buccally. Vertical releasing incisions were placed on tooth 21 mesio-buccally and tooth 23 disto-buccally. A full-thickness mucoperiosteal flap was reflected buccally. A hemisection was performed, splitting the tooth by chisel on its incisal notch, with removal of the distal part of the geminated tooth. Following degranulation and root planing with ultrasonic and hand

instruments, a root canal exposure of the preserved tooth (Fig. 3a) and a 3-wall (mesial, palatal and distal walls) osseous defect were noted. MTA (ProRoot, Dentsply Tulsa Dental, Tulsa, OK, USA) was mixed with sterile water and used to seal the exposed pulp canal. A pulp exposure of approximately $1.0 \times 6.0 \times 1.0$ mm^3 was filled by a firm MTA mixture after copious irrigation with sterile saline solution (Fig. 3b). Decalcified freeze-dried bone allograft (DFDBA, Pacific Coast Tissue Bank, Los Angeles, CA, USA) was placed into the bony defect to cover the MTA and filling the osseous lesion to avoid collapse of the extraction socket. The flap was repositioned and sutured with interrupted 5-0 chromic gut sutures. Amoxicillin 250 mg, q.i.d. for 5 days was prescribed postoperatively to prevent further infection. A regimen of 0.12% chlorhexidine rinse b.i.d. was utilized for 3 weeks following the surgery. Following suture removal at 10 days, the patient received periodontal maintenance recall at 3-month intervals.

Follow-up to 42 months showed good evidence of tissue healing (Fig. 4). When tooth 23 erupted, a 2–3 mm space was noted between the remaining teeth 22 and 23. Distal caries was also noted in tooth 22. A composite resin restoration (SingleBond and Z100 Restorative; 3M ESPE, St Paul, MN, USA) was applied to restore the defect, close the diastema, and improve aesthetics (Fig. 5). Forty-two months postoperatively, the remaining tooth remained asymptomatic. There was no evidence of pulp necrosis on electronic and thermal pulp testing. A distinct periodontal ligament space had formed around the tooth and a closing apex revealed successful apexogenesis (Fig. 4). Clinically, there was 2–3 mm of gingival recession on the distal surface of tooth 22 and the probing depth was approximately 3 mm all around the tooth. Some mild gingival inflammation and bleeding on probing were present during the treatment and follow-up period, as a consequence of poor oral hygiene measures (Fig. 5). Physiological tooth mobility was observed.

Discussion

Tooth fusion of unknown aetiology is characterized by a union of cementum, dentine and/or enamel of two or more separate developing teeth, whereas gemination is the incomplete attempt of one tooth bud to divide into two (Kelly 1978). In this case, the

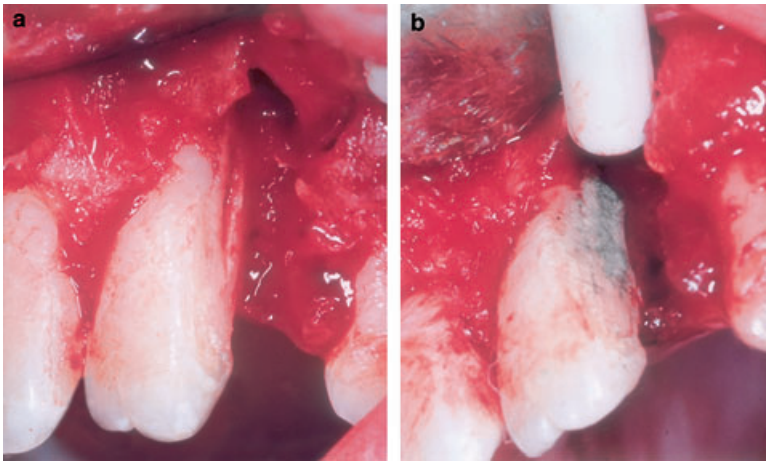

Figure 3 (a) A three wall (mesial-palatal-distal) osseous defect and a $1 \times 6 \times 1$ mm^3 pulp exposure of tooth 22 were noted after hemisection. (b) A mixture of mineral trioxide aggregate was applied to seal the exposure and isolate the pulp chamber of tooth 22.

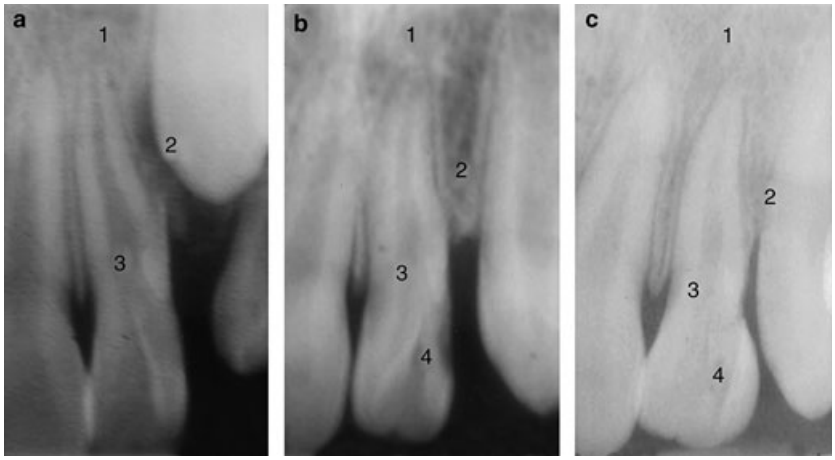

Figure 4 Six-month (a), 30-month (b), and 42-month (c) postoperative radiographs of tooth 22 showed the successful apexogenesis (1), osteogenesis and cementogenesis with a distinct periodontal ligament space formation (2), dentinogenesis and persistent mineral trioxide aggregate were noted (3). Distal caries was found (b-4) and restored with composite resin (c-4).

Figure 5 Composite resin was used to restore the caries, close the space and recreate the aesthetic appearance for tooth 22.

normal number of teeth, and the symmetrical appearance of the tooth components involved provided sufficient evidence of germination. This view was reinforced during the operation after hemisection, when the root canal was exposed. Nevertheless, an exact differentiation between fusion and gemination may not be so relevant in terms of clinical management (Kim & Jou 2000, Braun *et al.* 2003); of more concern is the overall health, functional and aesthetic implications.

Treatment options include extracting the tooth with prosthetic replacement, surgically separating and endodontically treating the fusion/gemination followed by orthodontic alignment (Kohavi & Shapira 1990, Braun *et al.* 2003), or surgically removing the redundant part of the tooth only (David *et al.* 1997). Some reports have demonstrated that if the pulp chambers are connected, the need for endodontic treatment for the remaining part of the tooth becomes evident after resecting the tooth (Hülsmann *et al.* 1997, Braun *et al.* 2003). In the present case, the exposed pulp was sealed with MTA in an effort to preserve pulp vitality and promote apexogenesis. Two similar cases have been reported (David *et al.* 1997). The distal crown of a fused maxillary lateral incisor in one case and a mesial crown

of a geminated maxillary central incisor in the other case were resected, and full-thickness flaps were used to cover the two exposed pulps without root canal treatment. No evidence of pulp necrosis was noted at 12- and 4-year-case follow-ups after operation and orthodontic treatment (David *et al.* 1997). However, the interaction between intracanal tissues and periodontal tissues is uncertain in such situations. If the critical area was infected or an unfavourable inflammatory sequence developed, possible complications such as pulpitis, root resorption, open root apex, ankylosis, gingival recession and root canal exposure by recession might cause troublesome sequelae. After reviewing the candidate dental materials, a decision to separate the periodontal surroundings from the pulp environment by MTA was made for this case.

Decalcified freeze-dried bone, an allograft material, is widely used to treat infrabony defects in periodontal therapy and preserve bone volume after extraction. The potential osseo-conductive and osseo-inductive properties from bone morphogenetic proteins (BMP) contained in DFDBA were demonstrated on osteoblasts and new attachment apparatus formation has been described (Urist 1965, Urist & Iwata 1973, Bowers *et al.* 1989a,b). A latent regenerative effect of DFDBA was expected to benefit the extraction socket and bony defect after hemisection in this treatment. In addition to promoting periodontal regeneration, grafting with DFDBA was undertaken to avoid MTA exposure in the oral cavity with the risks of washout or long term dissolution. Moreover, the allograft was expected to function as a space-maintainer to preclude excessive alveolar ridge collapse. The exact relationship amongst DFDBA, MTA, pulp, cementum, periodontal ligament and alveolar bone cannot be recognized without a histological examination. However, an encouraging clinical outcome has been observed for more than 42 months. A review of the postoperative radiographs revealed an increasing radiopacity at the osseous defect, which suggested bone formation in the resection area and extraction socket. An intensifying radiopacity beside the MTA repair and inside the root canal denotes a valuable dentinogenesis confirming earlier findings (Pitt Ford *et al.* 1996, Torabinejad & Chivian 1999, Aeinehchi *et al.* 2003). Furthermore, successful apexogenesis was demonstrated and a positive electric pulp test implied that pulp vitality was not compromised by the surgical procedure or MTA. Minimal use of rotary instruments during surgery may also avoid the impaction of infected material into the pulp. In contrast to earlier concerns about MTA wash-out (Kim & Jou 2000), the material appears radiographically to have remained in place in this case. Proper haemostasis during surgery without pulpectomy minimized the risk of wash-out from both inside and outside the root canal. Despite mild gingival inflammation due to inadequate oral hygiene, acceptable probing depths and the absence of severe inflammatory signs or attachment loss were noted.

Besides pulp exposure and treatment, other complications can accompany the treatment of fused and geminated teeth, including caries, periodontal diseases, gingival recession and diastema formation. Caries forms readily after aproximal dentine exposure and was encountered in this case. Periodontal full-thickness flap operations may elicit some attachment loss (Wilderman 1964), and osseous defects, extraction sockets and infection may be the further factors. Whilst these effects could be diminished by guided tissue regeneration (GTR), the limited financial budget restricted such techniques in this case. Recession of 2–3 mm and probing depths of 3–4 mm without pathological tooth mobility still presented an acceptable outcome for this case.

Conclusions

This case report with 42-month follow-up documents a practical treatment including multidisciplinary approaches to help a patient with a geminated maxillary lateral incisor.

A favourable outcome following hemisection without a root canal treatment, applying MTA to seal the exposed pulp, filling the extraction socket with DFDBA and restoring coronal caries with composite resin shows that contemporary methods may maintain gingival health, preserve occlusal function, retain pulp health and recreate aesthetics for a geminated tooth.

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