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Reattachment of a fractured permanent molar cusp: a 12-month follow-up

Canoglu H, Cehreli ZC. Reattachment of a fractured permanent molar cusp: a 12-month follow-up. © Blackwell Munksgaard, 2006.

Abstract – A posterior crown fracture due to acute trauma is an uncommon type of dental injury. This case report presents combined endodontic-bioadhesive treatment of a complicated crown fracture of a permanent molar due to a horse riding accident. Endodontic therapy was initiated following surgical removal of the fractured mesiolingual cusp, which was stored frozen until bonding procedures could be carried out. Subgingival and proximal contours of the missing cusp were maintained by an interim glass–ionomer restoration during endodontic therapy. Following root-canal obturation, the fractured cusp was reattached using a total-etch adhesive and composite resin system. The patient was recalled at 1, 3, 6 and 12 months, demonstrating excellent clinical and radiographic findings.

Harun Canoglu, Zafer C. Cehreli

Department of Pediatric Dentistry, Faculty of Dentistry, Hacettepe University, Ankara, Turkey

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Zafer C. Cehreli DDS, PhD, Gazi M. Kemal Bulvari 61/11, 06570 Maltepe, Ankara, Turkey
Tel.: +90 535 3197969
Fax: +90 312 3243190
e-mail: zcehreli@yahoo.com

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Injury to anterior teeth is a common occurance among children and teenagers, and coronal fractures are the most frequent form of dental injury that affects children, particularly between 8 and 11 years (1–3). Whenever possible, reattachment of fractured fragments can offer several advantages (i.e. improved esthetics and function, potential durability in terms of surface anatomy and wear, conservation of sound remaining tooth tissue) over conventional methods of treating and restoring fractured teeth (3–5). Significant advances in recent years have led to the development of dentin bonding systems with relatively high bond strengths to enamel and dentin. Although laboratory studies have shown that reattached teeth may demonstrate 20–60% less fracture resistance than that of intact teeth (1, 2, 6–8), bioadhesive reattachment of fractured fragments should not be regarded as a long-term provisional solution because of acceptable clinical retention rates, when proper adhesive and restorative techniques are used (9). In children and young patients, reattachment of fractured teeth may also help to preserve vital tooth tissues during dental and craniofacial development, without complicating any possible future restorative approach (6, 9).

Unlike anterior tooth fractures, coronal fractures of posterior teeth due to acute exogenous trauma are uncommon. Those generally observed in the posterior teeth arise from chronic masticatory trauma, affecting teeth with extensive loss of dental hard tissues because of caries or with large non-adhesive restorations [i.e. mesial-occlusal-distal (MOD) amalgam] (10, 11). Luebke (12) termed such fractures as 'complete tooth fracture', where there is a visible separation at the interface of segments along the line of fracture or the segments can be easily separated. Conversely, 'incomplete tooth fracture' is a fracture plane of unknown depth and direction passing through the tooth structure that, if not already involving, may progress to communicate with the pulp and/or periodontal ligament (10).

Despite a multitude of published case reports on the reattachment of fractured anterior teeth, a search of the literature fails to demonstrate the use of this treatment option in the posterior region. This paper reports on reattachment and 12-month follow-up of a fractured molar cusp due to acute exogenous trauma.

Case report

A 9-year-old boy presented with a fractured mandibular right first molar, 48 h after a horse riding accident. The post-traumatic neurologic and orthopedic status of the patient was non-contributory. Clinical examination revealed the presence of a mesiolingual cusp fracture, extending slightly below the cemento-enamel junction on the lingual and mesial aspects of the first molar (Fig. 1). Although the fragment was mobile, it was still in place. The patient reported little discomfort except for sensitivity to air. Pulpal exposure was revealed by clinical and radiographic examinations (Fig. 2), confirming the necessity of endodontic treatment. The neighboring primary second molar had also been affected by acute trauma, showing an oblique uncomplicated crown fracture on the mesial aspect of the crown which did not extend subgingivally (Fig. 1). However, the fractured fragment was absent. There were no other injuries to either the hard or soft tissues as confirmed radiographically.

Fig. 1. Fractured mandibular first right molar and second primary molar. Note absence of fractured primary tooth fragment.

Immediate treatment plan comprised surgical removal of the fractured cusp and initiation of endodontic therapy as well as restoration of the fractured second primary molar. As there was no visible loss of sound tooth tissue between the fractured cusp and the permanent first molar and as the fracture did not seem to extend down to the alveolar crest, the cusp was scheduled for reattachment. The patient's parent accepted the treatment plan after being fully informed about the limitations and risks as well as benefits of the tooth fragment reattachment technique.

The tooth was anesthetized, antisepsis was performed and the fractured mesiolingual cusp was removed with a periost elevator (Aesculap, Tuttlingen, Germany) (Fig. 3). The fragment was cleansed of plaque and debris, and was further stored in sterile saline solution at 4°C until bonding procedures could be carried out (13). Removal of the fractured cusp clearly revealed a pulp exposure of about 2 mm diameter on the mesiolingual aspect of the tooth crown. Despite the visibility of the pulp, a conventional access cavity had to be prepared to reach the distal root canals. Following endodontic procedures, a temporary restoration was placed using high-viscosity glass–ionomer cement (Ketac Molar ART; 3M-ESPE, Seefeld, Germany). Subgingival and proximal contours of the missing cusp could thus be maintained until reattachment. Slight subgingival contours of the fracture base were clearly visible and did not necessitate raising of a mucoperiosteal flap to expose limits of the fracture. In the same appointment, the fractured second primary molar was restored with a poly acid-modified resin composite (Prime & Bond NT and

Fig. 2. Initial periapical radiograph, revealing the extent of fractures on the mandibular first right molar and second primary molar.

Fig. 3. Internal (pulpal) view of the fractured cusp. Contours and size of the pulp space (in the middle of dentinal surface) confirm the severity of pulp exposure.

Dyract AP; Dentsply, Konstanz, Germany) following minimal cavity preparation to enhance macroretention (14).

Final obturation of the root canals with gutta-percha and AH Plus Sealer (DeTrey/Dentsply) was accomplished after 2 weeks. The pulp chamber was restored with high-viscosity glass–ionomer cement and the remaining temporary glass–ionomer restoration was removed with sharp excavators in order not to damage the original fracture line (Fig. 4a). The gingival tissues were retracted using epinephrine-impregnated retraction cords before bonding procedures (Roeko Inc., Langenau/Ulm, Germany). The fractured mesiolingual cusp, previously thawed at room temperature for 24 h, was reattached using a total etch adhesive system (Prime & Bond NT) and a flowable resin composite (Filtek Flow; 3M-ESPE) under magnification (Fig. 4b). Before photopolymerization, the fractured margins were checked for accurate fit as well as complete removal of excess resin. The endodontic access cavity was then restored with a resin composite (Spectrum TPH; DeTrey/Dentsply). The occlusal registration of the reattached cusp with opposing maxillary molar did not reveal any premature contact (Fig. 5). Oral hygiene motivation included daily use of dental floss.

Clinical and radiographic examinations at 1, 3, 6 and 12 months revealed a stable reattachment of the fragment, good esthetics and periodontal health (Figs 6 and 7). The patient is still attending regular visits biannually.

Discussion

Although the biomechanical properties of endodontically treated teeth are similar to that of their vital counterparts (15), the conventional belief that such teeth are weaker or more brittle (16) and are more

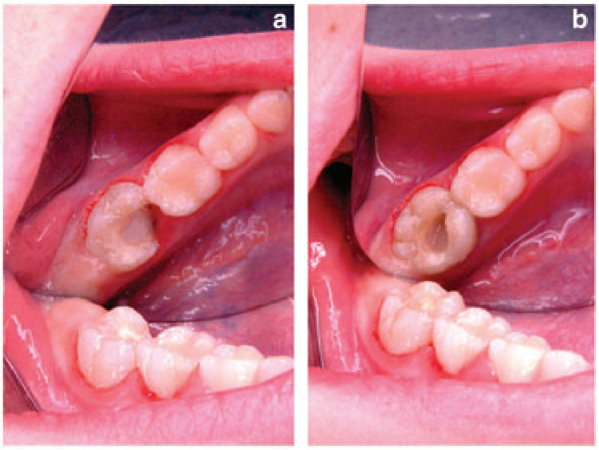

Fig. 4. (a) Clinical view of the tooth before reattachment. (b) Fractured cusp reattached. The access cavity was, thereafter, restored with resin composite.

Fig. 6. Clinical view after 12 months, showing good esthetics and retention.

Fig. 5. Bite registration of reattached cusp.

Fig. 7. Final radiograph taken 12 months post-treatment.

prone to subsequent cuspal fractures has led to the philosophy encouraging aggressive reinforcement of remaining tooth structure. Contrarily, the opportunity for the restoration of non-vital teeth with resin-based composites has increased because of the development of better, more reliable dentin bonding systems, which reinforce remaining tooth structure (17). In fact, laboratory and clinical studies have already demonstrated good to excellent cuspal fracture resistance of endodontically treated posterior teeth when proper adhesive restorative techniques were used (18–21). It is thus apparent that factors including subsequent acute trauma, size of restoration (loss of dentinal support), or continued flexure of tooth structure (7, 11, 21) may be more critical to cuspal fractures of endodontically treated teeth.

In the present case, adhesive reattachment of the fractured cusp was performed using a nanofilled total-etch adhesive system (Prime & Bond NT) and a flowable resin composite (Filtek Flow). Farik et al. (22) have shown this adhesive system to yield superior fracture strength at both low and high debonding speeds, particularly when used with an unfilled resin (Heliobond, Vivadent, Liechtenstein). Indeed, use of filled adhesives in conjunction with thick unfilled or filled low-viscosity resin as an intermediate elastic layer have been shown to increase interfacial fracture toughness as well as dentinal sealing in the case of clinical bond failure (23). It should also be noted that the occlusal composite resin placed for the restoration of the endodontic access cavity has certainly provided additional inner reinforcement to the reattached fragment presented herein (5).

Andreasen et al. (2), Farik & Munksgaard (7) and Farik et al. (24) have shown a drastic drop in fracture strength between bonded and intact teeth when the velocity of applied force during testing exceeds 200 mm min^{-1}. In light of these work, it is tempting to speculate that the lack of subsequent acute trauma to the reattached fragment could be another contributory factor to the short-term clinical success achieved herein. This is in agreement with clinical observations that rebonded fractured teeth fail clinically if rapid loading or impact forces are applied, while the relatively slow loading applied during mastication does not normally induce failure (2). Clinical factors including deterioration of micromechanical adhesion because of hydrolytic degradation of resin-dentin/enamel bonds (25) and cyclic fatigue under wet conditions (26) may further be responsible for the mid-term and long-term clinical failure of reattached tooth fragments, which still merits further research.

Although resin composites have been shown to possess favorable subgingival biocompatibility (27) along with formation of junctional epithelium and connective tissue adjacent to restorations (28), unreacted monomers leached from dentin bonding agents and/or resin-based materials may delay or interfere with the healing process in human gingival tissues (29). In the present case, the marginal gingiva adjacent to the fracture site demonstrated optimal healing. The reattachment technique enabled contact of the gingival tissues with natural tooth, leaving only an extremely thin bonded fractured line to interact with the tissue (30). Also important is the good adaptation of the reattached fragment, associated with the sealing effect of the adhesive system used and the proper fit and contour of the margin, avoiding plaque retention (31). The present case fulfilled prerequisites for optimal gingival healing.

Also of interest is the uneventful healing observed in the fractured second primary molar. Despite a considerable impact leading to tooth fracture, as well as subsequent cavity preparation and adhesive restoration, the pulp appeared to remain vital with no clinical or radiological sign of pathology during visits. Periodontal breakdown, pathologic root resorption, internal resorption and intrapulpal calcifications have been reported in fractured primary molars previously (32, 33).

Short-term favorable results achieved in the present case suggest that fragment reattachment could be used as a conservative treatment option in fractured permanent molar in young patients. Further laboratory and clinical studies are required to establish technique criteria as well as the limitations.

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