A new approach to endodontic treatment and operative procedure in nonendodontically treated posterior crown root fractures

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We report a case of nonendodontically treated first upper premolar crown root fracture in which the palatal cusp fracture extended below the cementoenamel junction. Reattachment of the palatal cusp in its original position by acid-etch and flowable composite allowed the creation of a standard access opening as in an intact tooth, avoiding apex location errors and contamination of the root canal. During crown-lengthening surgery, the palatal cusp fragment was hollowed out and used as a natural individual matrix for placement of the core material. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108:e106-e110)**

Vertical root fractures are a challenging complication and often lead to extraction of the tooth. They are usually characterized by a longitudinal or oblique fracture line that extends vertically toward the apex and can reach different root levels. A crown root fracture is defined by an oblique fracture line that extends below the cementoenamel junction. These fractures have most typically been reported in endodontically treated teeth, with or without post insertion.[1] However, they are increasingly found in nonendodontically treated teeth (40% of cases),[2] where they are often cusp fractures that extend deep into the root with the coronal fragment usually still in place.[3] Vertical root fractures in nonendodontically treated teeth tend to occur in older patients (mean 51-55 years),[2] most of the patients have intact dentition (<4 missing teeth), and the incidence is twofold higher in men than in women.[4]

Restoration of a tooth with crown root fracture is a difficult procedure. The fracture line frequently exposes the pulp, or endodontic treatment is required to facilitate subsequent restoration. Absence of the palatal cusp hinders a correct isolation. Salivary microleakage during endodontic therapy is considered to be a major cause of treatment failure owing to bacterial and endotoxin penetration into the root canal.[5,6]

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Received for publication Jun 10, 2009; accepted for publication Jun 19, 2009.
1079-2104/$ - see front matter

doi:10.1016/j.tripleo.2009.06.014

The objective of the present paper was to report a multidisciplinary approach to the treatment of premolar crown root fracture, in which adhesive reattachment of the fractured palatal cusp in its original position favored a successful outcome of endodontic therapy by achieving a dry operative field and facilitating subsequent restorative procedures.

CASE REPORT

A 45-year-old male patient was referred to the Dental School of Granada University for mild pain on touching the left maxillary first premolar, which hindered mastication. The patient reported that the fracture occurred when he was biting into hard food. Examination of the tooth revealed no signs of caries, but there was intense pain on percussion of the palatal cusp. When thoroughly dried, the occlusal surface showed a fracture line along the entire central groove. When the palatal cusp was gently pushed backwards, it was slightly displaced toward the palate, revealing a fissure of the whole central occlusal groove that extended down the root. The crown fragment was mobile but still in place, and the diagnosis was a diagonal crown root fracture (Fig. 1). X-Ray images did not reveal the fracture line or its end point, and there was no apical radiolucency or widening of the periodontal space. The patient had no medical history of interest.

Clinical examination under local anesthesia revealed the presence of a palatal cusp fracture extending slightly below the cementoenamel junction on the palatal aspect of the upper first premolar. Pulp exposure could be observed during palatal mobilization of the crown. The palatal cusp was removed to explore the depth of the fracture line (Fig. 2). The line extended below palatal gingival margins to infrabone level, exposing root pulp (Fig. 3) and confirming the need for endodontic treatment. This situation was addressed by firmly inserting the palatal cusp into its original position, thereby achieving gingival hemostasis, followed by bonding of the occlusal enamel with acid-etch and flowable composite (Tetric Flow; Ivoclar Vivadent, Schaan, Liechtenstein), en-

Fig. 1. Diagonal crown root fracture; the fracture line occupies the entire central occlusal groove and extends down to the root.

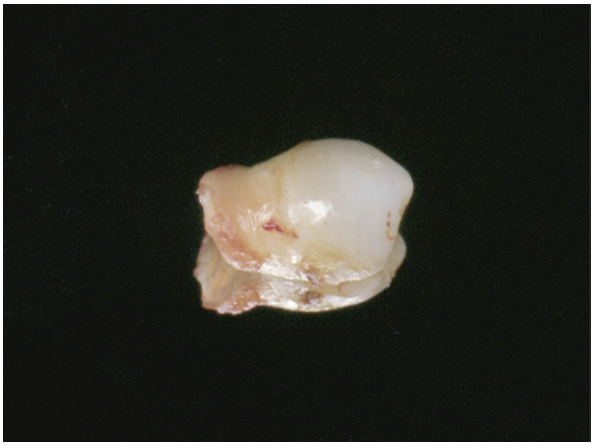

Fig. 2. The fractured palatal cusp after removal.

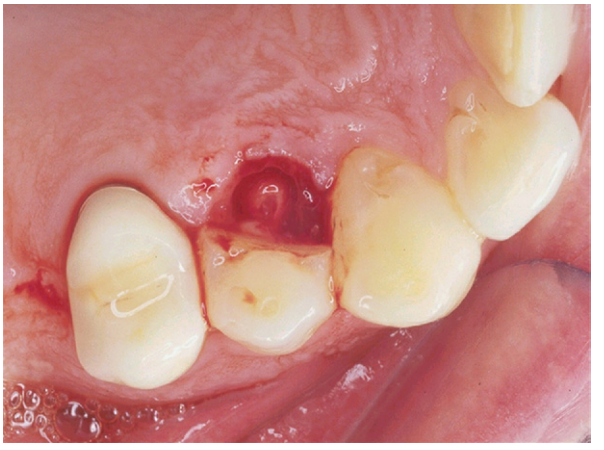

Fig. 3. Fractured lines reached beyond palatal gingival margins to below bone level, exposing root pulp.

Fig. 4. The palatal cusp was bonded with acid-etch and flowable composite in its original position. A standard access opening was then created. The rubber dam is removed to reveal the gingival hemostasis achieved by placing a Hygenic no. 2 clamp.

suring a good fit of the fragment at subgingival level. A no. 2 Hygenic clamp (Coltène/Whaledent, Altstätten, Switzerland) was placed to apply pressure to the gingiva and maintain the hemostasis, and a standard access opening was then prepared (Fig. 4).

After placement of a rubber dam, the endodontic therapy was carried out in a single session using manual instrumentation (K-Flex Files; Sybron-Endo, Glendora, CA) and a combination of lateral condensation technique and sealer (AH Plus; Dentsply De Trey, Konstanz, Germany). When the endodontic treatment was completed, the palatal fragment was detached with an LM 611-621 excess remover (LM Instruments, Parainen, Finland), and Fermit-N temporary cement (Ivoclar Vivadent) was placed. The fragment was stored in sterile saline solution at 4°C until the next appointment, when it was used in the restorative procedure after surgical crown lengthening.

One week later, the surgery was performed under local anesthesia. A scalloped incision was made with a no. 15 scalpel at 2 mm from the gingival margin from the mesial of the upper canine to the distal of the upper second premolar, making an incision to the center of the palate to obtain a partial-thickness flap. The aim was to thin the flap or palatal tissues at the dentogingival junction to reduce the thickness of the osteoctomy required to obtain the posterior fit of the flap. Two small mesial and distal release incisions were made in the flap to facilitate its detachment. After an intrasulcular incision, the secondary flap was removed with a periodontal curette. After raising the flap to achieve a good hemostasis, suture with no. 3 silk was used to keep it separated and allow easy access to the operative field (Fig. 5). Sharp bony structures over the fracture line were removed by using burs with a low-speed handpiece under saline irrigation until the entire fracture line was 2 mm above the bone.

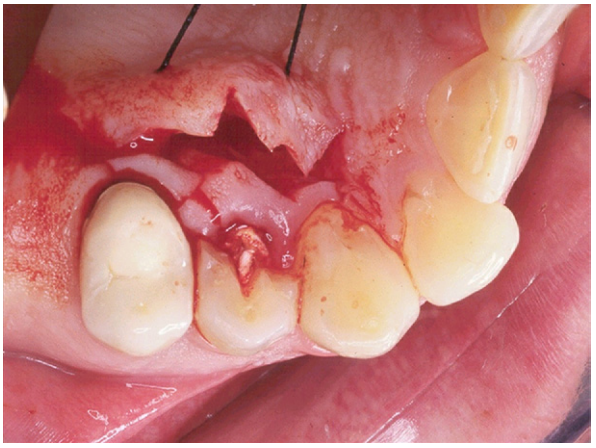

Fig. 5. A partial-thickness flap was raised with 2 small mesial and distal release incisions to facilitate its detachment.

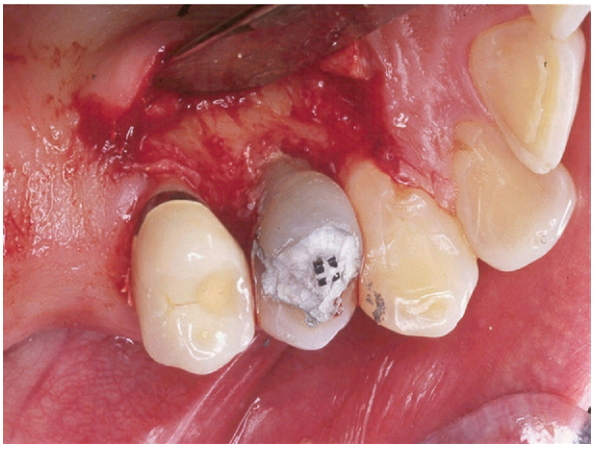

Fig. 6. The palatal cusp was hollowed out with a round diamond bur and reattached, acting as an individual matrix. An amalgam core was made. This technique avoids contamination of the operative field with amalgam.

Fig. 7. Tooth preparations were completed with a slightly subgingival circumferential shoulder, and a porcelain-fused-to-metal crown was made for the final restoration.

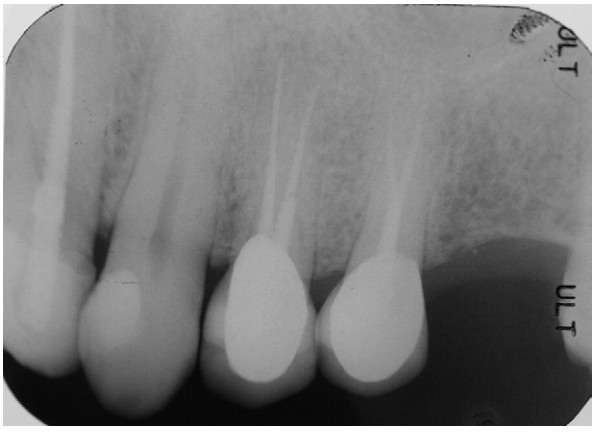

Fig. 8. At 7 years, the function and esthetics remained satisfactory and periodontal health was good. There were no radiologic signs of pathologic response in the root area.

After the resective bone surgery was completed, the palatal cusp fragment was hollowed out with a high-speed round diamond bur under water spray to the approximate thickness of the enamel, taking care to avoid any contact with the areas of fit with the remnant tooth. The fragment was then inserted until the fracture lines met, leaving no gaps, and was again bonded at occlusal level and stabilized in this position by using a metal matrix kept taut with a Tofflemire matrix retainer. The flap was repositioned and held in place with gauze wetted in physiologic serum to avoid its dehydration during restorative procedures.

A space for a Unimetric post was prepared in the palatal root after removal of gutta-percha to the cervical third, using a standard set of drills under copious irrigation. A post was inserted and cemented into the root canal with resin based cement (Panavia; J. Morita, Tustin, CA,) according to the manufacturer's instructions. After the cement was cured, a core was built with amalgam and, when this hardened, the matrix band was taken off and the palatal fragment readily removed (Fig. 6). The flap was then repositioned and sutured. The patient was instructed to use 0.2% chlorhexidine rinses daily during the first week after suture removal.

At 6 weeks after the surgery, when the periodontal tissues had healed, a slightly subgingival circumferential shoulder was built and a porcelain-fused-to-metal crown was made (Fig. 7). At the first try-in, complete seating, marginal adaptation, esthetic appearance of crown, and occlusion were assessed, and the ceramic restorations were cemented with ionomer cement luting. At 7 years, the esthetic and functional outcomes remained satisfactory and the state of periodontal health was good, with no radiologic signs of a pathologic response in the root area (Fig. 8).

DISCUSSION

Crown root fractures are frequently encountered in dental practice, and various clinical approaches to their treatment have been proposed. The fractures can be longitudinal or diagonal, and conservative treatment is only possible when the fracture extends no further than just below the cementoenamel junction. Andreasen et al.[7] defined a crown root fracture as a fracture involving enamel, dentin, and cementum, which can be classified as complicated or uncomplicated according to the pulp involvement. However, it could be argued that all of these fractures are complicated and require a multidisciplinary approach.

The American Association of Endodontists classified 5 specific variations of cracked teeth, from least to most severe: craze line, fractured cusp, cracked tooth, split tooth, and vertical root fracture.[8] Split tooth and vertical root fracture result from the progression of a crack, usually in a mesiodistal direction, that completely splits the tooth into 2 separate segments; therefore, the fit between fragments is generally good. The reattachment technique can be applied to crown root fractures with a single enamel-dentin fragment and to more complex situations in which pulp[9] and periodontium are involved.[10] Good medium-term esthetic and functional outcomes have been obtained with this approach, although the long-term outcome is not predictable.[11] Reattachment can be challenging in fractures that extend subgingivally, because it is difficult to keep the operative field isolated, compromising the adhesion. In the present case, however, we only bonded the fragment at occlusal level to keep it in place. A reported predisposition of some posterior teeth to vertical root fracture[12] has been related to heavier masticatory force associated with thin or flat roots,[4] and a reattached palatal cusp can be expected to easily detach in this situation. Although reattachment is not predictable in these circumstances, it is adequate to maintain the fragment in place during subsequent restorative procedures.

Endodontic treatment is always indicated, because of the high frequency of pulp necrosis after bonding of fragments in crown root fractures, owing to problems in maintaining a dry operative field.[11] Thus, it is difficult to isolate the field and prevent contamination during biomechanical preparation and shaping of the root canals, and there can be errors in the measurements given by apex locators owing to the presence of saliva or blood.

There have been numerous case reports on the reattachment of fractured anterior teeth using the natural fractured crown as a short-term provisional measure[13,14] or permanent restoration.[15,16] However, the application of this technique in posterior teeth has been less well studied. Canoglu and Cehreli[17] achieved favorable short-term outcomes reattaching the mesiolingual cusp of a first molar with a fracture that extended slightly below the cementoenamel junction on the lingual and mesial aspects. Unlike in the present case, they first performed the endodontic treatment and then applied the reattachment technique in a second session. Cusp reattachment allows the creation of a standard access opening, as in a whole tooth. Moreover, root canal measurements can be based on accurate apex locator data, contamination is avoided, and the cavity will retain irrigants during the biomechanical preparation. All of these conditions favor the long-term success of endodontic treatment.

Two conservative treatment options are available to preserve the biologic width in subgingivally fractured teeth: surgical crown lengthening and orthodontic extrusion. The crown-lengthening procedure should be reserved for the posterior region or for patients needing only palatal gingivectomy and ostectomy.[18] When applied in the anterior region, it results in a severe esthetic problem requiring osseous and gingival contouring that also affects adjacent teeth.[19] In contrast, controlled orthodontic extrusion yields excellent outcomes with a good prognosis and no risk to the esthetic appearance.[19,20] The amount of extrusion required should be the same as the "biologic width."[21] Therefore, it is generally recommended to combine conventional forced eruption with clinical crown lengthening in anterior teeth and to lengthen the clinical crown in posterior teeth by removing supporting bone to expose sound tooth structure.[22]

The usual restoration option is to perform a core and crown. However, the intrabone fracture line in crown root fractures makes it difficult to stabilize the circumferential matrix needed for the core placement. As a result, it is not easy to obtain a satisfactory seal at gingival level and prevent extravasation of restoration materials. In our procedure, the palatal cusp fragment was hollowed without disturbing the areas of fit with the tooth remnant, forming a natural individual matrix. It was then placed in its original position by adhesive bonding and stabilized by placing a taut matrix using a Tofflemire band-type matrix retainer. By this means, a post space was prepared for placement of a titanium post, and the amalgam core could be fabricated in a dry operative field. In our view, amalgam is the material of choice in these cases because of its greater resistance to contamination versus composites. The technique proposed here has some limitations. It is only indicated in shallow nonendodontically treated posterior crown root fractures resulting in enamel-dentin fragments below the cementoenamel junction that show a good fit. It is not indicated when the fit is poor or unstable, or in previously restored teeth, or when the tooth remnant

has inadequate resistance to support the subsequent restoration.

At 7 years, clinical and X-ray examinations showed satisfactory esthetic and functional outcomes and a good state of periodontal health. This technique offers benefits in the management of endodontic and restorative procedures for posterior teeth with crown root fractures.

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