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Case Report

A MULTIDISCIPLINARY APPROACH FOR THE RESTORATION OF A CROWN-ROOT FRACTURE WITH THE INVOLVEMENT OF SUPRACRESTAL ATTACHED TISSUES A CASE REPORT WITH A 7-YEAR FOLLOW-UP

ABSTRACT

Restoration of crown-root fractures with the involvement of supracrestal attached tissues represents difficulties for clinicians, as these types of fractures require a multidisciplinary approach for adequate treatment and successful prognosis. Depending on the location of the fracture, different treatment approaches, such as periodontal crown lengthening procedures, rapid orthodontic or surgical root extrusion or tooth extraction followed by fragment reattachment, direct composite restorations, veneers, and crown restorations, have been indicated.

This case report describes the management and long-term follow-up of the reattachment of a crown-root fracture using unidirectional fiber reinforcement after periodontal crown lengthening. Clinical and radiographic examinations of the reattached tooth after 7 years revealed favourable functional, physiological, and aesthetic outcomes and healthy surrounding periodontal structures, showing the success of the multidisciplinary treatment approach.

Keywords: Dental trauma, complicated crown-root fracture, reattachment.

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INTRODUCTION

Dentoalveolar traumas are mainly caused by falling, fighting, sports, and car accidents and usually affect maxillary anterior teeth.[1,2] Crown fractures have been documented to account for up to 92% of all traumatic injuries in permanent dentition[3]; however, the incidence of crown-root fractures is reported to be approximately 5%.[4] Restorative treatment of crown-root fractures is difficult due to inaccessible subgingival fracture margins and the complex nature of the injury.[5] The fracture line level, the length of the remaining root segment, and the presence and condition of the tooth fragment determine the type of treatment.[7] Therefore, depending on the location of the fracture, different treatment approaches, such as periodontal crown lengthening procedures, rapid orthodontic or surgical root extrusion or tooth extraction followed by fragment reattachment, direct composite restorations, veneers, and crown restoration, have been indicated. Among these treatment approaches, priority should always be given to the reattachment procedure when the crown fragment after trauma is relatively intact and adapts well to the remaining tooth structure.[8,9] Reattachment is the most conservative treatment option for various restorative techniques and also offers colour, morphology and translucency matches, surface texture, and wear of the incisal edge at the same rate as the adjacent teeth. Moreover, it results in a positive psychological response in the patient and offers a reduction in the treatment costs.[7,9] Clinical success has been reported for the reattachment of tooth fragments using resin composites or cements with/without fiber reinforcement.[10,11]

With the development of adhesive systems and resin-based materials, during the treatment of crown fractures, the support of a post system placed into the root canal is not always mandatory. However, when the fracture involves more than two-thirds of the crown or when the patient exhibits a large overjet and/or parafunctional habits, post-placement should be considered.[9,12,13] Fiber-reinforced composites have been introduced at the beginning of the '90s and offer several advantages, such as aesthetics, reliable bonding to enamel and dentin, and a modulus of elasticity similar to that of dentin. Materials that have an elastic modulus similar to dentin (18.6 GPa) may enhance the clinical longevity of restorations[14], as they reveal a more balanced stress distribution under functional forces.[15]

The present case describes the successful multidisciplinary treatment of a complicated crown-root fracture of a maxillary central incisor with the involvement of supracrestal attached tissues over a 7-year follow-up period.

CASE REPORT

A 30-year-old female was referred to the Department of Restorative Dentistry with a fractured maxillary right incisor that was splinted after a car accident one week previously (Figure 1).

Figure 1: Initial situation of the crown-root fracture.

Clinical and radiographic examinations revealed that the tooth had a complicated crown-root fracture extending subgingivally at the buccal side and a loose palatal splint with inflammatory periodontal tissues due to heavy plaque accumulation (Figure 2).

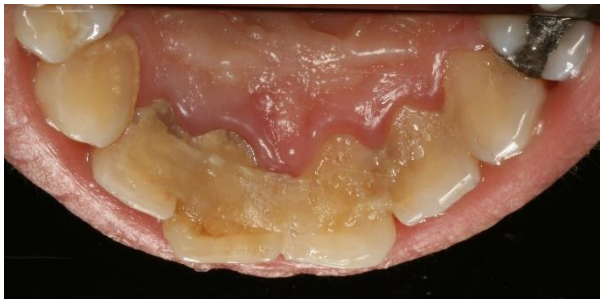

Figure 2: Palatal view revealed a loose splint with inflammatory periodontal tissues due to heavy plaque accumulation.

The tooth fragment was still attached by a soft tissue junction around the buccal aspect. The treatment alternatives were discussed with the patient, and upon agreeing on the reattachment of the crown fragment to the remnant tooth, informed consent was obtained from the patient.

Following local anaesthesia with 2% lidocaine and 1:80,000 epinephrine, the crown-root fragment (Figures 3, 4) was removed with minimal force from its soft tissue attachment and was stored in a physiological saline solution until the reattachment procedure.

Figure 3: Buccal view of the detached crown-root fragment.

Figure 4: Palatal view of the detached crown-root fragment

As the fracture was subgingivally located and extended apically to the bone crest, open flap surgery with osseous resection was performed. For the open flap procedure, an internal bevel incision was made at the buccal and palatal aspects of the involved tooth, and the incision was extended horizontally on each side. Then, a sulcular incision was made for gingival tissue removal. Following the reflection of the full-thickness mucoperiosteal flap, the distance between the fracture line and the alveolar bone crest was measured to be approximately 1 mm, violating the supracrestal attached tissues (Figure 5).

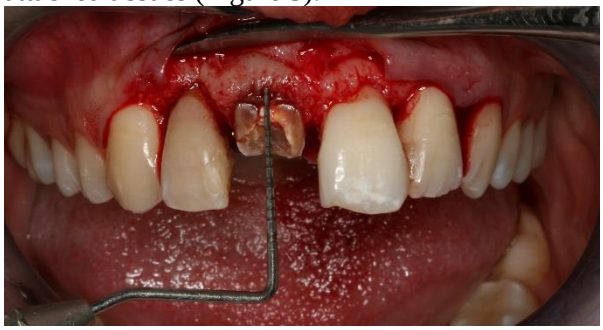

Figure 5: The distance between the fracture line and the alveolar bone is approximately 1 mm, violating the supracrestal attached tissues.

After osseous resection with a low-speed handpiece using copious amounts of saline irrigation was performed to remove and recontour the bone until a 3-mm distance between the bone crest and the fracture line (Figure 6), the base material in the pulp chamber was carefully removed with a high-speed air turbine.

Figure 6: Recontouring of the bone until there was a 3-mm distance between the bone crest and the fracture line.

Meanwhile, the tooth fragment was cleaned from all residual soft tissue and base material and was checked for its close adaptation to the tooth structure for reattachment. As freehand fragment alignment could be problematic, a thermoplastic stent was attached to the fragment during the checking and reattachment procedures (Figures 7, 8).

Figure 7: Attachment of a thermoplastic stent to the crown-root fragment for checking and reattachment procedures.

Figure 8: Removal all residual soft tissue and base material to expose enamel and dentin.

Then, a haemostatic agent (ViscoStat; Ultradent) was applied around the remnant root, which was followed by a self-etching primer application (Clearfil SE Bond Primer; Kuraray) for 20 seconds on the dentin surfaces. The enamel margins of the crown fragment were etched with phosphoric acid (K etchant; Kuraray, Japan) for 30 seconds, rinsed thoroughly with water and dried, whereas the self-etching primer (Clearfil SE Bond; Kuraray, Japan) was applied for 20 seconds on dentin and air-dried. Then, Clearfil SE Bond adhesive (Clearfil SE Bond Adhesive; Kuraray, Japan) was applied on both the enamel and dentin surfaces of the crown fragment and on the dentin of the remnant root and polymerized for 10 seconds using an LED light-curing unit with an intensity of 650 mW/cm2 (Bluephase; Ivoclar Vivadent, Schaan, Liechtenstein). A thin layer of a flowable composite (Clearfil Majesty Flow; Kuraray, Japan) was applied to the remnant root canal without polymerization, and a unidirectional preimpregnated fiber (EverStick C&B; GC) was pressed into the unpolymerized flowable composite (Figure 9).

Figure 9: Application of a unidirectional preimpregnated fiber into the unpolymerized flowable composite on the root fragment.

A micro-hybrid composite (G-aenial anterior; GC) was applied to the crown fragment, and then the fragment was placed on the fracture site and carefully aligned. After checking the smoothness of the margins, the composite was polymerized through the attached tooth for 60 seconds from both the facial and palatal sites (Figure 10).

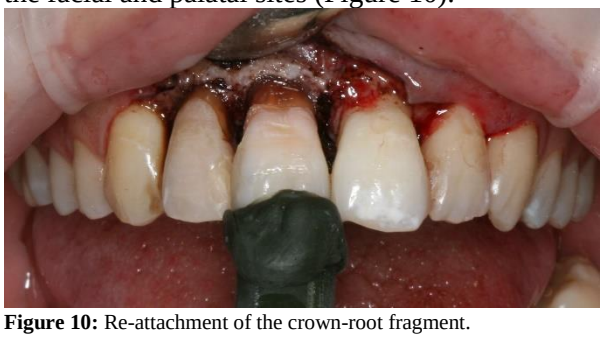

Figure 10: Re-attachment of the crown-root fragment.

The surgical flaps were then closed with simple interrupted sutures (Figure 11).

Figure 11: Closure of the surgical flaps with simple interrupted sutures.

Thereafter, the occlusion was checked and finishing and polishing procedures were accomplished using fine burs (Acurata G+K Manhardt Dental 544#018) and polishing rubber (Enhance/PoGo, Dentsply).

Postoperatively, the patient was instructed to follow a soft diet and avoid brushing or biting in the operated area for 1 week. An antibiotic (amoxicillin-clavulanate, 1000 mg, twice a day for 5 days), analgesic (naproxen sodium, 550 mg, every 8 hours, as necessary) and mouth rinse (chlorhexidine gluconate 0.2%, twice a day for 4 weeks) were prescribed to prevent infection and pain. Sutures were removed after 1 week, and the patient was recalled every week for 1 month. A soft toothbrush was suggested with a roll technique. The clinical situation of the reattached tooth was confirmed by clinical assessments at 1 (Figures 12, 13), 2 (Figures 14, 15), 5 (Figures 16, 17) and 7 years (Figures 18, 19, 20, 21).

Figures 12 and 13: Clinical situation of the reattached tooth at 1 year.








Figures 14 and 15; Figures 16 and 17; Figures 18, 19, 20, and 21: The clinical situation of the reattached crown-root fragment at 1 year, 2 years, 5 years and 7 years, respectively.

DISCUSSION

For the treatment of traumatized teeth, several factors, such as the extent and pattern of fracture, pulpal involvement, stage of root development, alveolar bone fracture, involvement of supracrestal attached tissues, soft tissue injuries, fractured tooth fragment, occlusion and aesthetic properties, should be considered.[1,16,17] Regarding complicated crown-root fractures, there are several proposed treatment options, including periodontal crown lengthening surgery with open flap and osseous resection and orthodontic or surgical extrusion, which are followed by reattachment of the fractured tooth fragment, direct composite restorations, veneers, or crown restorations.[18,19]

Surgical crown lengthening and orthodontic or surgical extrusion of the remaining root are the most preferred methods for the re-establishment of supracrestal attached tissues. However, all of the described techniques have both advantages and disadvantages. Orthodontic or surgical extrusion will shorten the root length[20], while crown lengthening may create aesthetic problems.[21,22] In the present case, the fracture line was above the alveolar bone crest but extended subgingivally on the buccal aspect. Additionally, as the patient had

limited time and an almost 1:1 width to length ratio in her maxillary teeth, open flap surgery with osseous resection was preferred. The first treatment option for the rehabilitation of a crown fracture should be reattachment when the crown fragment is retrieved following the trauma, is relatively intact, and adapts well to the remaining tooth structures.[7,8,9] Reattachment is the most conservative treatment option for various restorative techniques, as it offers colour, morphology and translucency matches, surface texture, and wear of the incisal edge at the same rate as the adjacent teeth. Reattachment of fractured incisal fragments using new-generation adhesive systems is considered to be effective against shear stresses, comparable with intact teeth.[23,24,25] Moreover, it results in a positive psychological response in the patient and offers a reduction in the treatment costs.[7,9] The limitation of this technique is principally due to the involvement of supracrestal attached tissue, which is defined as the sum of the epithelial and connective tissue attachment lengths.[26] Whenever this occurs, flap surgery with minimal osteotomy and osteoplasty was suggested to convert the subgingival fracture surface to supragingival[7] and to create a space for supracrestal attached tissues. It has been shown that adhesive fragment reattachment in periodontally healthy teeth had no detrimental impact on periodontal health over a time course of 2 years.[27] However, the potential threat to tooth survival following crown-root fracture and subsequent restoration with a post-core-supported crown is higher due to the subsequent fractures emanating from the root canal.[28]

The prognosis of the reattached tooth depends on the fitness, contour, and surface finish of the subgingival restoration, which may increase plaque retention.[8,29] Moreover, patient cooperation and maintenance of oral hygiene also affect the long-term prognosis of the restored tooth.[30] In the present case, the patient did not strictly follow the oral hygiene instructions, especially around the reattached tooth, and as a result, mild gingival inflammation was still evident even after the 1-year follow-up (Figure 12, 13). During the follow-up period, even though full-mouth plaque control was optimal, substantial plaque accumulation was also observed around the treated tooth due to the patient's fear of dislocation of the restored tooth. However, there were no unfavourable soft tissue reactions other than mild gingival inflammation throughout the follow-up period (Figures 12, 14, 16).

Based on the results of in vitro studies, the internal dentin groove technique generated the highest bond strength recovery in the reattached teeth; however, this value did not exceed 60% of an intact tooth's strength.[31] Conversely, removal of the pulp dentin from the fragment before bonding showed a greater increase in fracture strength.[32,33] It has been stated that there was no significant difference between the retention of a flexible fiber-bundle post system and a rigid prefabricated fiber post system.[34] However, glass fiber posts that are shorter than the clinical crown length demonstrated root fracture under a significantly lower loading force.[15] Therefore, in this case, a prefabricated fiber post was avoided, and an individual fiber-bundle structure was inserted into the pulp chamber to enhance fragment attachment and to create an intermediate structure between the dentin and the luting composite that resists functional forces. The physical properties of fiber-reinforced composites are dependent on the type of matrix, the type of fiber, the fiber distribution, the fiber/matrix ratio and the diameter and length of the fibers.[35] EverStick C&B, with an elastic modulus of 27 GPa, is composed of unidirectional continuous Bis-GMA- and PMMA-impregnated glass fiber, that are 1.5 mm in diameter and have 4000 individual glass fibers.[36] Unidirectional preimpregnated fiber was preferred to increase retention of the crown fragment to the remnant tooth and to distribute homogeneous stress along the root. This approach has been reported in the literature and provides a conservative and aesthetic treatment strategy.[37] However, randomized controlled clinical trials with long-term follow-up periods are necessary to substantiate the efficacy of the treatment.

CONCLUSIONS

The present case represents the management and long-term success of a reattached crown-root fragment along with unidirectional fiber reinforcement after surgical crown lengthening.

Clinical and radiographic examinations of the reattached tooth after 7 years revealed favourable functional, physiological, and aesthetic outcomes and healthy surrounding periodontal structures, showing the success of the multidisciplinary treatment approach. However, randomized controlled clinical trials with long-term follow-up periods are necessary to substantiate the efficacy of this type of treatment.

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None

CONFLICT OF INTEREST STATEMENT

The authors deny any conflicts of interest related to this study.

ÖZ

Suprakrestal bağ dokusunu içine alan kuron-kök kırıkları doğru tedavi ve başarılı bir prognoz için multidisipliner tedavi yaklaşımı gerektirdiğinden klinisyenleri oldukça zorlamaktadır. Bu tip komplike kuron kırıklarının tedavi alternatifleri kırığın lokalizasyonuna göre: periodontal kuron boyu uzatma, ortodontik olarak kök boyunun uzatılması veya dişin kırık parçasının çekimini takiben fragman reataşmanı, direkt kompozit restorasyonları, vener restorasyonları veya kuron restorasyonlarıdır. Bu olgu sunumu, komplike kuron-kök kırığının periodontal kuron boyu uzatma işlemi sonrasında fiberle güçlendirilmiş kompozitle reataşmanını ve bu tedavinin uzun dönem takibini anlatmaktadır. Reataşman yapılan dişin 1, 2, 5 ve 7 yıllık klinik ve radyografik takibi, dişin sağlıklı periodontal dokular ile birlikte fonksiyonel, fizyolojik ve estetik olduğunu ve multidisipliner tedavi yaklaşımının başarılı olduğunu göstermektedir. ***Anahtar kelimeler:*** *Travma, komplike kuron-kök kırığı, reataşman.*

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