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Case Report

Forced eruption after crown/root fracture with a simple and aesthetic method using the fractured crown

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Abstract – Forced eruption offers a method of treatment of teeth fractured close to the alveolar crest. We introduce a modification of this common technique. The fractured fragment of a patient's crown is bonded to the adjacent teeth and used as anchorage, permiting the root extrusion while offering acceptable aesthetics. The bonded crown does not impede the eruption of the root so that the frequent occlusal adjustment of other methods is not required. The final result is acceptable and a low cost alternative to common techniques.

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Restoration of a tooth fractured in the coronal third of the root is a difficult procedure. Preservation of the gingival biologic width is critical for the long-term success of the treatment (1). Restorative, functional and aesthetic needs should be balanced with the demands of healthy periodontium. Aesthetic considerations of tooth restoration very often demand the placement of the subgingival margin. Care must be taken to involve the sulcus as little as possible in the process. Placing the margin of the restoration in the biologic width frequently leads to chronic gingivitis, the loss of clinical attachment, bony pockets and gingival recessions (1–5). Four treatment possibilities exist: tooth removal, surgical crown lengthening, surgical intra-alveolar transplantation or orthodontic extrusion. Extraction seems to be the easiest choice, yet it requires prosthetic treatment or implant therapy. Surgical crown lengthening can be successfully used in the posterior region, where the aesthetics is not a major concern (6–8). The surgical approach requires osseous and gingival contouring which also affects adjacent teeth. It usually lowers gingival papillas, exposes the cemento-enamel junction, causes hypersensitivity and produces compromized aesthetics (3, 8, 9). In a 1988 report, Kahnberg (10), described a simple surgical technique involving intra-alveolar transplantation. A carefully extruded root, stabilized by interdental suturing and surgical dressing, required endodontic therapy and a porcelain crown. A highly satisfactory alternative to the surgical approach is the controlled orthodontic extrusion of the fractured root. The method is also called forced eruption, orthodontic eruption, vertical extrusion or assisted eruption (3). First reported by Heithersay (7) and Ingber (8), controlled orthodontic extrusion is considered the easiest orthodontic tooth movement that can produce excellent results with a good prognosis and a low risk of relapse. Although highly advantageous, the technique is rarely used; the possible reasons may include the fear of first time approach, a false belief that the procedure is inherently complex, little knowledge in this field and some emphasis on specialist orthodontic aspects involved. The vertical tooth movement can be obtained with removable or fixed orthodontic appliances, the former using mostly elastic bands or magnets (6, 11–15), and fixed appliances and

many modifications thereof referred to when the tooth is extruded mostly applying a fabricated resin-based crown with a bonded orthodontic bracket (2, 3, 7–9, 12, 13, 16–21). There are also some reports on non-aesthetic solutions, such as a hook cemented in the root canal and connected with the interdental bar or orthodontic wire (2, 3, 12, 18, 22). The lingual orthodontic technique was also proposed for exposing sound tooth structures with excellent aesthetic results (9). Apart from treatment of non-restorable teeth, Ingber et al. suggested the use of forced eruption for isolated osseous defects. When the root is extruded restoratively, however, a fiberotomy or periodontal surgical procedure must follow to allow a better access when preparing the margins. Forced eruption is also indicated for transverse root fractures, external or internal resorptions, and iatrogenic perforations, when they are located even up to 4 mm below the alveolar bone crest (21). This technique can also be used to slowly extract a tooth in cases where the routine extraction is contraindicated because of radiation therapy (20). This article describes our modification of the common procedure using a new simple orthodontic and restorative design. It allows for an aesthetic provision during the extrusion period, produces predictable results and makes the treatment cost-effective. It also requires the minimum of specialized materials and orthodontic skills.

Case report

A patient A.R., aged 22, presented to the Department of Paediatric Dentistry with a deep, subgingival fracture in the aesthetic region of the maxillary left central incisor (Fig. 1). The clinical and radiological evaluation revealed inadequate root canal treatment. Under local anaesthesia the entire crown was removed and endodontic retreatment therapy was completed. The canal was filled with gutta-percha using Obtura II gun. The fragment of a fractured crown was bonded to the adjacent teeth, which produced good aesthetics (Fig. 2). During the next visit 4 days later, the patient's own 'temporary' crown was removed and a standard post – Radix Anchor was temporarily cemented in the root canal. An elastic loop was attached to the head of the post with dental floss and the fragment of a fractured crown was now used again. It was attached to the adjacent teeth with acid-etch composite resin, which created a passive end for the elastics. The elastic loop was then activated by being stretched and moved from the palatal side of the temporary crown, via the incisal edge, to the labial side of the very same crown (Fig. 3). Finally, the activated elastic loop was bonded to the acid-etched labial side of the crown with flowable composite. The patient was sent home with an aesthetically acceptable,

Fig. 1. Preoperative view.

Fig. 2. Fragment of a fractured crown bonded to the adjacent teeth, presenting good aesthetics.

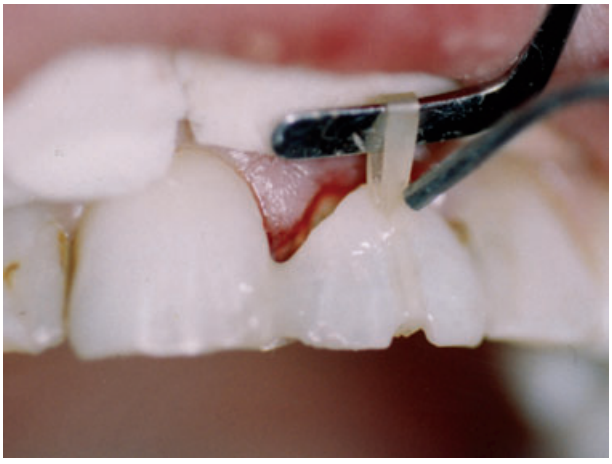

Fig. 3. Elastic loop bonded to the acid-etched labial side of the crown with the flowable composite.

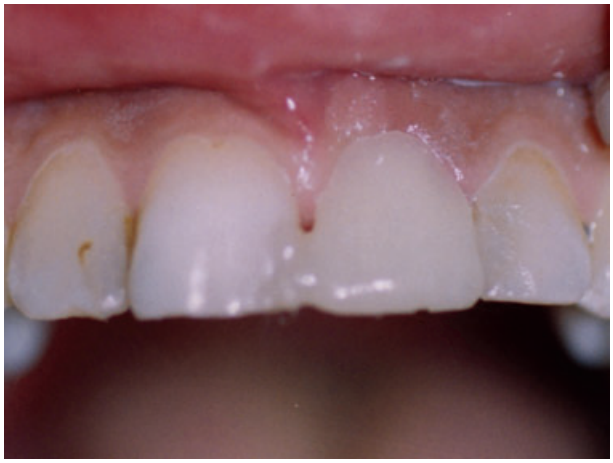

Fig. 4. Composite crown as a retainer.

Fig. 5. Final restoration.

Fig. 6. Status 4 months later.

Fig. 7. One year follow-up visit.

temporary and active appliance and scheduled for follow-up visits every 4 days. Elastic loops were changed regularly and sulcular incisions and radiological assessments were made. After 25 days of controlled extrusion, some 3.5 mm of the root were exposed with an average speed of 1 mm week^{-1}. The extruded root was retained for 5 weeks. A composite crown was fabricated and used as a retainer (Fig. 4). Following a 5-week stabilization period, the temporary crown was removed and the extrusion post unscrewed with a haemostat. The tooth mobility was normal. The final restoration, a porcelain-fused-to-metal crown was finished 1 week later (Fig. 5).

Four months afterwards, the function and aesthetics were still good, and the patient was asymptomatic. Clinical evaluation revealed some minor tooth intrusion of about 0.5 mm. (Fig. 6). Two months later, the tooth appeared stabilized with no further intrusion observed. Radiological assessment showed the lack of root resorption. The function and aesthetics remained good. During the follow-up visit 1 year later, good aesthetics, the stable crown position and the proper function were observed (Fig. 7). Radiological evaluation showed no pathological response in the root area.

Discussion

The paper presents some modification of a common procedure. The simple and aesthetic technique presented here seemed to be effective in treating non-restorable teeth. It also guaranteed a stable final result that could be reproduced in every dental office without a need for specialty care. It has been reported that with single extrusion techniques, the alveolar bone and gingiva extrude with the tooth (2, 3, 8, 16, 14, 23), resulting in the need for steps to treat this isolated periodontal pocket (12, 18, 23). To avoid the bone and soft tissue movement, others have suggested a sulcular incision performed at every follow-up visit. This procedure should be carried out while the tooth is

being extruded, or just before the stabilization period (2, 11).

The use of fractured crown of the patient, as the one used in the presented case, offers several advantages. It is an aesthetically excellent temporary restoration that appears very useful in the extrusion and retention period. It is also an important part of the biomechanical construction that allows the retaining tooth to keep its original position. A temporary crown also prevents tipping of adjacent teeth during extrusion (13).

The extrusion rate used in this case was similar to that recommended by other authors (3, 8, 16, 23). After 25 days of controlled extrusion, 3.5 mm of the root were exposed with an average speed of 1 mm week^{-1}. If the extrusion speed is too high, temporary stabilization is needed. According to recent studies, the force of 30–60 g is required to extrude the tooth (3, 11, 12, 14, 16). While other authors reported that forces of 70–150 g were necessary (12), in our case the initial force of 60 g did not move the traumatized incisor. The extrusion was possible at 120 g. The application of a large force has been reported to possibly cause pulp inflammation, root resorption, or a bone and periodontal loss, which did not occur in this case. The elastic loop located on the palatal side of the provisional crown secures the correct direction of the root vertical movement.

When the forced eruption is completed, the tooth should be stabilized. As a retainer in the case presented here, two adjacent teeth on both sides were used. A fabricated crown was used to bond the head of the post to the anchor unit. As the reported studies indicate the stabilization period of 7–14 weeks is adequate (2, 7–9, 14, 16, 18, 20). The removal of the retainer too early may result in retrusion of the root, but the tendency toward relapse is weaker than with other orthodontic movements. Lemon (24) recommended 1 month of stabilization per 1 mm of extrusion, while Simon et al. (25) suggested 7 weeks claiming that the remodelling of periodontal ligament was then complete. Andreasen (17) observed that 1 week was sufficient for splinting to create an adequate support to maintain the avulsed tooth in position. In our case, a rigid composite splint was used. The stabilization period of 5 weeks was too short. During the follow-up visit 4 months later, a minor 0.5 mm intrusion was noticed, which could have been the consequence of short retention time. One year follow-up period did not show any further tendency towards intrusion.

Conclusions

In the case presented here, forced eruption was the treatment of choice. The fractured fragment of patient's crown-when bonded to the adjacent teeth, permiting the root extrusion while at the same time offering acceptable aesthetics. Simplicity of this orthodontic procedure and the use of common dental materials do guarantee correct stability, predictable results and low costs. Also as the aesthetic unit does not move with the extruded root, pretreatment adjustment of occlusion was avoided.

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