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Multidisciplinary approach of complicated crown fractures of both superior central incisors: a case report

CASE REPORT

Anca Silvia Vâlceanu[1], Stefan-Ioan Stratul[2]

[1]Department of Conservative and Restorative Dentistry; [2]Department of Periodontology, Faculty of Dental Medicine, 'Victor Babes' University of Medicine and Pharmacy, Timisoara, Romania

Correspondence to: Vâlceanu Anca Silvia, Str. Vuk St. Karadjic Nr.18 E, Timisoara 300368, Romania
Tel.: +40-722-248-966
e-mail: asvalceanu@yahoo.com

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Abstract – Anterior crown fractures are a common form of traumatic dental injuries that mainly affect the maxillary central incisors, in children and teenagers. Since the development of the adhesive dentistry, many case reports of crown fractures restored using adhesive reattachment techniques were published. Complex cases, in which more than one tooth are involved, with fractures differing from each other, require specific treatment of each fracture, taking different advantages of the different remaining tooth structures. This case report describes a patient with dissimilar crown fractures of both superior central incisors. After the endodontic treatment, the patient was treated using the combination of several techniques: periodontal surgery (crown lengthening with apically repositioned flap and osseous resective surgery), adhesive technique and cast restoration plus esthetic crown. The periodontal procedure re-created the biologic width and proved to be a reliable adjunctive procedure to the adhesive and the prosthetic techniques used.

The most common injuries in the permanent dentition are due to falls, followed by traffic injuries, acts of violence and sports (1). Superior central incisors are the teeth with the greatest visibility during common functions and are the most susceptible to fractures by direct trauma, especially in children and teenagers, because of their size and position (2). Dental trauma requires adequate treatment, specific to each fracture in order to preserve the remaining tooth (3). The conventional approaches for the restoration of the fractured anterior teeth include composite restorations and post-and-core-supported prosthetic restorations (4, 5). Recent developments of restorative materials, placement techniques, preparation designs and adhesive protocols allow clinicians to predictably restore fractured teeth (6). Thus, it has become possible to preserve the original structure of the hard tissues of the tooth by using the reattachment technique (7). This technique can be applied to fractured crowns resulting in simple enamel-dentin fragments, and to more complex situations in which pulp (8) and periodontium are involved (9). It provides a very important advantage: the exact restoration of the primary, secondary and tertiary crown morphology, using a material that re-creates identical optical characteristics (10).

There are situations requiring a multidisciplinary approach involving different dental specialties in order to effectively treat dental traumas (11). The present case report describes the involvement of both maxillary central incisors in a traumatic injury that required endodontic treatment, the combination of two different techniques of restoration, a periodontal surgery and a prosthetic treatment.

The case report

The patient Cosmin Aracuboaie aged 18, is a healthy male teenager, with no significant medical history. In May 2006, two days before his first visit, he suffered an aggression, resulting in the loss of the right central superior incisor. The patient was referred to the dental emergency service. Upon removal of the blood clot, the remaining root of 1.1 was found in place. A vital pulpectomy of the root of 1.1 was performed (Fig. 1).

Clinical examination revealed the following:

- the absence of any apparent trauma of the soft tissues;
- chronic gingivitis, more pronounced in the frontal teeth, with bleeding on probing and plaque retention;
- the absence of the left lateral incisor – tooth 2.2;
- complete crown fractures of the two central superior incisors as follows: 1.1 – a cervical horizontal fracture extending slightly subgingivally, with loss of the coronal fragment; 2.1 – an oblique fracture involving the enamel–cement junction and extending from the palatal to the buccal aspect deep subgingivally, with the coronal fragment still in place (crown-root fracture). The fragment of 2.1 was found mobile, the patient accusing slight pains at every attempt to touch the crown. The pulp exposure could be observed during the mobilization of the crown towards facial (Fig. 2).

Fig. 1. Initial situation.

The clinical and radiographic maxillofacial examination revealed that there was no fracture of the maxilla or mandible or other facial bones. The intraoral radiographic examination confirmed the clinical findings related to the trauma: the remaining root of 1.1 and the image of 2.1 displaying a clear fracture line (Fig. 3).

A conservative treatment was taken into consideration: post-and-core-supported prosthetic restorations for the tooth 1.1 and the adhesive reattachment of the coronal fragment to the remaining tooth structure for the tooth 2.1.

Under local anesthesia, the gentle removal of the coronal fractured fragment of tooth 2.1 was performed, exposing the vital pulp. The complete endodontic therapy was carried out in both upper central incisors in a single session using rotary NiTi instruments (ProTaper; Dentsply-Maillefer, Ballaigues, Switzerland) and a combination of lateral and vertical condensation technique, with large taper and accessory cones (Dentsply-Maillefer), sealer (AH Plus; Dentsply De Trey GmbH, Konstanz, Germany) and warm gutta-percha (Q&A; Meta Biomed Co.Ltd., Mochoong-Dong, Korea) (Fig. 4).

The remaining pulp tissue was removed from the detached fragment and the crown was immediately cleaned and preserved in saline solution, to avoid dehydration and discoloration (9, 12). For the right incisor, a cast post-and-core, made of a gold alloy was initially fabricated and cemented into the prepared root canal (Fig. 5). An integral Artglass (Heraeus Kultzer) crown was planned as a provisional coronal restoration until the gingival contour reaches its final stable position.

Fig. 2. The exposed pulp of tooth 2.1 can be observed on slight mobilization of the crown towards the buccal (mirror image).

Fig. 3. Initial radiographic examination.

Fig. 4. Image after the removal of the remaining fragment and root canal therapy of both central upper incisors.

The noticeable subgingival and infra-alveolar extension of the fracture line in the vestibular area of the left incisor necessitated a periodontal surgical procedure. In this case, a split-thickness conventional flap was elevated to provide visibility and access to the bone and the fractured root surface. During the elevation, the flap became partially dissected and necessitated internal sutures. Taking into account that, on one hand, the vestibular margin of the fracture surface was situated slightly below the alveolar crestal bone and, on the other hand, that the adhesive reattachment technique requires clean and dry surfaces, a resective osseous procedure was necessary to reshape the alveolar margin (Fig. 4). The reshaping process was basically an attempt to modify the

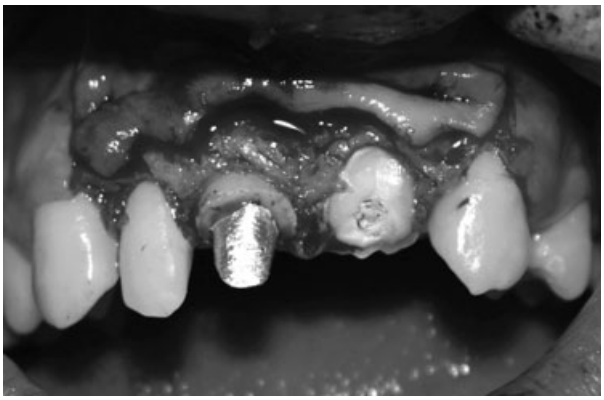

Fig. 5. The fractures exposed after the elevation of a split-thickness flap.

Fig. 7. Checking the adaptation of the resin fiber post into the root canal of tooth 2.1.

bone in order to allow the soft tissues both to follow the contour of the bone (13) and to restore the biologic width (14). To obtain symmetry and harmonization of the gingival contours in the frontal area (15), a similar alveolar outline recontouring was performed on the other central incisor – tooth 1.1 (Fig. 6).

Once the resective osseous surgery was completed and a good hemostasis was achieved, the flap was displaced apically and maintained in place with gauze rolls in contact with the bone, in order to avoid the flap's dehydration during the reattachment procedures.

To improve the tooth resistance and expand the bonding areas involved in the adhesive reattachment technique, a translucent glass fiber post (FRC Postec Plus nr.3; Ivoclar Vivadent) was fitted and applied (Fig. 7); the post was bonded in both radicular and coronal cavities of tooth 2.1, at the same time. The root canal space was prepared and a suitable space was created in the middle part of the crown fragment. The tooth and fiber post surfaces involved in adhesion were etched using 35% phosphoric acid (etching gel; 3M ESPE, St. Paul, MN, USA), washed, dried and the adhesive resin (Adper Single Bond 2; 3M ESPE) was applied and photopolimerized. The bonding of the fiber post and the reattachment of the tooth's fragment were performed simultaneously, with dual resin cement of a proper shade (RelyX ARC; 3M ESPE); the fragments were closely maintained in their original position during the photo-polymerization (60 s altogether vestibular and oral).

The flap was sutured to the periosteum in an apically displaced position using 000 sutures (Fig. 8). A groove was carried across the palatal fracture line (situated supragingivally), into the enamel thickness, using a flame-shaped diamond finishing bur. This was to reinforce the bonding and cover the line between the glued surfaces (16); the groove was filled with a body shade of high-viscosity composite resin (Filtek Supreme XT Universal Restorative Composite; 3M ESPE).

Radiological examination immediately after the end of treatment showed a good fit between the bonded fragments (Fig. 9). Ten days later, the sutures were removed and the provisional crown of 1.1 was cemented (Fig. 10). The patient was scheduled for recall visits at 1, 3 and at each following six months. He was advised to use chlorhexidine 0.2% rinses (Dentaton; Ghimas s.p.a., Casalecchio di Reno, Bologna, Italy) during the first two weeks after the removal of the sutures and to avoid further trauma of both hard and soft tissues. Tooth brushing with a soft toothbrush, predominantly in a coronal direction (to enhance the re-creation of the attached gingiva) after the removal of the sutures, and

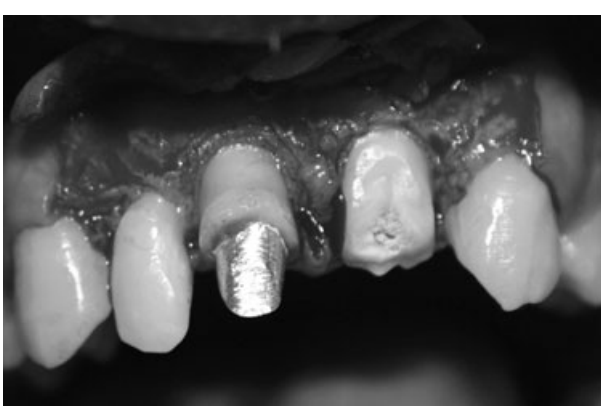

Fig. 6. The buccal alveolar bone symmetrical re-conturing.

Fig. 8. The apically repositioned flap and sutures to the periosteum.

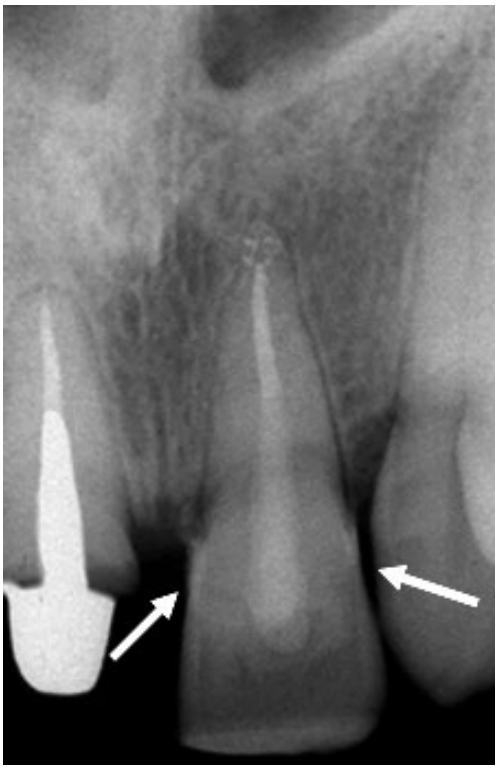

Fig. 9. Radiographic examination immediately after reattachment shows a good adaptation of the fragment.

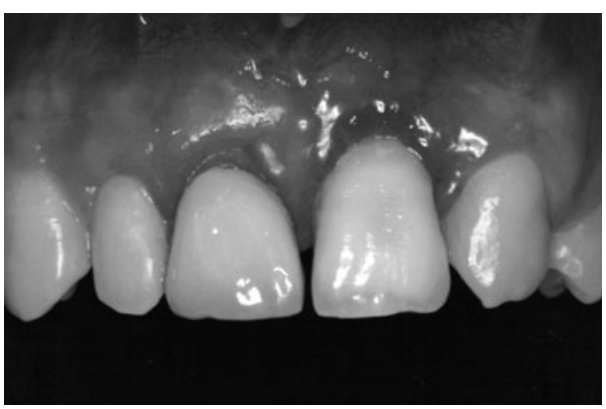

Fig. 10. Three months postoperatively: 1.1 restored with a provisional crown and 2.1 restored by reattachment. The esthetic appearance of the keratinized gingiva of the region was maintained.

maintenance of a good hygiene of the operated area, were also advised.

The final coronal restoration of 1.1 was scheduled to be performed when the recovery of periodontal tissue would be complete, with the establishment of a stable band of keratinized gingiva.

Results and discussions

Several treatment options for crown-root fractures are considered in the classical dental trauma literature: the fragment removal and gingival reattachment, the fragment removal and the surgical exposure of the subgingival fracture, the fragment removal and the orthodontic extrusion, the fragment removal followed by surgical extrusion and the tooth removal. None of the aforementioned options refer to the possibility of combining the root-recovery procedures with the fragment recovery by means of adhesive techniques. Reattachment of fractured incisal fragments by using new-generation bonding agents is considered to be effective against shear stresses, comparable with the intact teeth (17).

The early root canal treatment of 1.1 and the root canal treatment of 2.1 immediately after the removal of the fractured crown prevented the pulpal infection (18). The good functional short-term outcome of our multidisciplinary approach was present after 3 months (Fig. 10). The esthetical appearance is also acceptable as the patient's lip line position during smile is low (Fig. 11).

The reattachment technique described provides several advantages which are as follows (19, 20).

- The exact initial crown shape and surface morphology can be obtained.
- The crown restorations are realized in a material that wears at the same rate as the adjacent teeth.
- The color characteristics remain unchanged.
- The method is faster and more conservative than conventional restorative approaches.
- The treatment costs are lower.
- The fiber-reinforced resin postbonded into the root canal of the incisor provides an increased retention of the crown's fractured fragment and is less subject to root fracture, due to the combination of adhesive and elastic properties.
- The conservation of the natural color reflection.
- The comfortable perception of the attachment line by the soft sensitive tissues (16) (here, the tongue).

Generally, fiber posts offer some important benefits (20):

- passivity (they do not actively engage the tooth structures);
- a modulus of elasticity close to dentin;
- teeth move and flex as a single unit.

Fig. 11. The smile appearance is very good in the low position of the lip line.

Once the coronal adhesive restoration of the left central incisor was achieved using the original tooth fragment, the restored crown was used as a morphology and color map pattern for the prospective restoration of the symmetric right incisor. The utilization of two different techniques for the coronal restoration of the two fractured superior incisors was decided by several clinical findings at the time the patient reported: the crown of the right incisor was lost during the traumatic accident and the root canal of the right incisor was treated initially in the emergency unit with an eugenolated material, thus the adhesive cementation of an esthetic post was contraindicated. The best solution seemed to be the classical cementation of a gold alloy cast post-and-core, to be eventually covered with a ceramic crown.

During the periodontal tissue healing, a provisional polymeric crown (integral Artglass) was applied in order to restore the masticatory and the esthetic functions. The cervical limit of this crown was 0.5 mm shorter, to prevent gingival irritations during the healing period (21).

Conclusions

Crown fracture restorations localized in the superior incisor area need to be evaluated from several perspectives, including the topography, tissues involved, quality and the quantity of the remaining tooth structures, adaptation of the fragment to the dental remnant and the patient's age.

The recent achievements in the adhesive dentistry allow the practitioner to use the natural separated fragment to restore the fractured teeth. The reattachment techniques using bonded fiber posts offer a conservative and effective alternative to traditional post-and-core plus artificial crown restorations. The crown lengthening procedure with apically repositioned flap and alveolar bone recontouring to restore the biologic width proved to be a reliable adjunctive procedure to the adhesive technique used.

Dental trauma cases involving teeth with factures extending subgingivally and/or infra-alveolar could benefit from multidisciplinary adhesive surgical approaches, with good results. However, such cases require a long-term follow-up. Additional long-term observations of similar cases are called to elucidate aspects as the resistance in time of the dissimilar restorations, color stability, stability of the gingival level and of the keratinized tissue.

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