Surgical extrusion: A reliable alternative for saving fractured anterior teeth

Ibtissem Grira1,2, Boutheina Mahjoubi1,2, Raouaa Belkacem Chebil1,2, Adel Amor1,2 and Nabiha Douki1,2

Abstract
Crown-lengthening procedures are necessary to rehabilitate supracrestal insertion tissue and to guarantee a suitable dental restoration. The objective of this article was to report a surgical extrusion procedure as a treatment option for a fractured anterior tooth. A 24-year-old male patient presented to our department to rehabilitate his maxillary right lateral incisor. The tooth was fractured due to a trauma and presented a healthy periodontium. Endodontic treatment was performed before the surgical extrusion. A fixed crown was cemented after complete reduction of tooth mobility after 6 months. No complication was observed at 6 months post-operatively. A minimally traumatic surgical extrusion technique provided highly successful results in both functional and esthetic aspects, especially in the anterior region, where the latter is of great interest.

Keywords
Surgical extrusion, crown lengthening, biologic width, crown prosthesis

Date received: 3 April 2021; accepted: 15 July 2021

Introduction
Anterior teeth fractures represent the most common type of dental trauma.1 Crown–root fractures (CRFs) are frequently encountered in the dentist’s daily practice. It is defined as the fracture involving the enamel, dentin and cementum.2 Referring on the level of pulpal involvement, CRFs are classified into uncomplicated and complicated ones.3 The rate of these fractures is 5%, including all the injuries affecting permanent teeth.4,5

The subgingival location of the fracture margin in CRF often represents a restorative challenge.5 In fact, it violates the biological width and causes gingival inflammation, bleeding, pocket formation, gingival recession and periodontitis, including alveolar bone resorption.6–8

Several modalities for the management of CRF are available: gingivectomy, apically positioned flap surgery, surgical extrusion, orthodontic extrusion and extraction when the fracture include more than a third of the root.4,9,10 However, all these treatment modalities have some limitations especially when the esthetic zones are involved.

Surgical extrusion—also known as intra-alveolar transplantation, intentional implantation or intra-alveolar repositioning—was described 24 years ago as crown lengthening technique for CRF. The aim of this report was to describe a minimally traumatic surgical extrusion technique performed to save a severely compromised tooth in the anterior region.

Case description
It is about a 24-year-old male patient suffering a dental trauma at the level of the anterior upper teeth. The patient presented with fractured upper central teeth and a mobility of the coronal fragment of tooth 12 due to the trauma.

In this article, we focused on the maxillary right lateral incisor, with respect to the patient consent. Inspection revealed the presence of a healthy periodontium with pulpal exposure. The retro alveolar radiograph showed a long root

1Department of Dental Medicine, Sahloul Hospital, Sousse, Tunisia
2Faculty of Dental Medicine, Laboratory of Research in Oral Health and Maxillo Facial Rehabilitation (LR12ES11), University of Monastir, Monastir, Tunisia

Corresponding Author:
Ibtissem Grira, Department of Dental Medicine, Sahloul Hospital, Faculty of Dental Medicine, Laboratory of Research in Oral Health and Maxillo Facial Rehabilitation (LR12ES11), University of Monastir, Monastir, 5000, Tunisia.
Email: griraibtissem4@gmail.com
of the tooth with no fracture and no apical radiolucency (Figures 1 and 2). After removing the coronal fragment, we noticed a lack of supragingival tooth structure required to guarantee a reliable long-lasting restoration. The next steps consisted in evaluating the radicular length, the absence of an apical curvature, and the width of the remaining radicular and coronal walls to discuss the feasible treatment options for saving the tooth.

After a global clinical examination, surgical tooth extrusion, consisting in crown lengthening technique, was performed to maintain a healthy supracrestal healthy tissue, thus offering to the patient a reliable long-term outcome. The clinical procedures involved, at first, endodontic treatment. It was conducted prior to surgical extrusion. Canal preparation was carried out using rotary instrumentation system (Revo S®, Micro Mega, France). It was accompanied by intracanal irrigation using 2.5% NaOCL and 17% EDTA as a final irrigation. At the same clinical consultation, the canal was dried with sterile paper points. The root canal was filled with gutta-percha (ProTaper Universal Gutta Percha Points, Meta Biomed, South Korea) and root canal sealer, using the lateral condensation technique. The coronal seal was provisional. After 1 week, the surgical extrusion procedure was performed.

After disinfection of the area using mouthwash of 0.12% of chlorhexidine (KLOREX fort, STODERMA, Tunisia), local anesthesia with 2% of lidocaine was administered. Syndesmotomy was performed using a syndesmotome, placed in both the buccal and palatal sides. A fine elevator was used to carry out tooth luxation. It was placed in the periodontal space and manipulated in a walking motion all around the tooth without causing surgical trauma. Minimally, traumatic luxation forces were applied just at the first 4 mm of the radicular structure to avoid periodontal ligament damage.

The tooth was carefully extruded to the desired situation using root forceps and it was placed at a level such that the fractured margin would be situated at least 3 mm from the alveolar crest, while being kept inside the socket. It is important to limit the extrusion quantity to preserve an adequate crown–root ratio that should always be inferior to 1.12 The tooth was maintained at the radicular portion, supposed to be kept in a supra-bony position after the procedure. A slight pressure was applied in a bucco-palatal direction, using a gauze, to obtain hemostasis and to keep the tooth in the right position. Simple interrupted sutures were placed to stabilize the tooth. A 0.3-mm diameter monofilament (violet braided of PGA Lac Synthetic Absorbable Suture, NEOFIL+) was used to achieve primary stabilization, thus obtaining a correct reorganization of the periodontal ligament fibers.13 After that, a semi-rigid splinting was placed using a flowable nano-hybrid composite (Reflectys Flow, ITENA, France) on the adjacent teeth. Special attention was exerted to release the interdental septum so that it would be easy for the patient to keep it clean. The patient was instructed to use a daily mouthwash with 0.12% of chlorhexidine for 1 week to thoroughly clean the area. Only analgesic was prescribed post-operatively (Figure 3). The sutures were deposed after 10 days to avoid surgical site infection. In fact, microbes adhere to the suture filament and form biofilms. The knot is the principal site of infection. Typically, they should be left in place no longer than 2 weeks.14 Splinting was removed 15 days post-operatively. In fact, the risk of ankylosis increases when the splint is kept for more than 3 weeks.15 Actually, a slight mobility during the periodontal healing period is favorable.5 Six weeks later, the extruded tooth mobility was.
clinically acceptable. In fact, the periodontal ligament
acquires its characteristics 45 days post-operatively.\textsuperscript{16}
Then, a fiber post (Fiber Post Refill Dentoclic, ITENA
Clinical Dental Post, France) was placed to ensure correct
height to the core preparation. It was cemented with a dual
core composite cement (Dentocore Body, Core Build-up,
ITENA) that was utilized as a core build-up material to
rebuild the missed coronal tooth structures (Figure 4). A
crown preparation was performed and a temporary crown
was cemented. Six months post-operatively, impressions
were taken and a final ceramic crown was placed (Figures
5 and 6). After 2-year follow-up, complete periapical bone
formation is observed with a periodontal tissue repair
(Figure 7).

**Discussion**

Crown–root and cervical root fractures are frequent in chil-
dren as well as in adults.

In a systematic review,\textsuperscript{5} the mean age of the treated
patients was 24 years old. Different treatment options for

\begin{figure}[h]
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\includegraphics[width=0.5\textwidth]{figure3.png}
\caption{Postoperative radiograph: the radiolucent area in
the apical region of the tooth mentioned the quantity of the
extrusion.}
\end{figure}

\begin{figure}[h]
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\includegraphics[width=0.5\textwidth]{figure4.png}
\caption{Clinical picture after build up with fiber post and
composite.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure5.png}
\caption{Final cementation of the extruded tooth with all
ceramic crown.}
\end{figure}

\begin{figure}[h]
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\includegraphics[width=0.5\textwidth]{figure6.png}
\caption{Postoperative radiograph after 6 months showing
healing of the apical area.}
\end{figure}
complicated CRFs are discussed such as gingivectomy, apically positioned flap and orthodontic extrusion. These conventional crown lengthening procedures are used to save compromised tooth.

For this reason, some anatomical and biological considerations need to be taken into account. In fact, during the restorative procedures and to avoid periodontal breakdown, 3 mm of tooth structure between the bone and the margin of the final restoration should be maintained.17 Furthermore, when dealing with the anterior region, the final esthetic outcome is the main goal for any restorative approach. Protection of the gingival margin and the interdental papillae are highly required.11 The procedure proposed in the present case report was simple. It was performed using luxation and partial tooth extraction, with no surgical exposure of the apex nor bone transplants for stabilization.16 Increased periodontal ligament space both apically and laterally is the immediate result of the procedure. Consequently, radiographically, periapical bone formation was evident as early as 2 months post-operatively. In fact, no study has objectively evaluated the quality of the newly formed bone, beneath the surgical extruded tooth.5 According to the International Association of Dental Traumatology 2020 guidelines,18 this technique is similar to an extrusive luxation. For that reason, stabilization of the tooth was achieved using a passive and flexible splint for 2 weeks.18

In addition, the endodontic treatment timing of the extruded tooth has been discussed in several clinical studies.4,5 In the present case report, endodontic treatment was performed before surgical extrusion. Isolation of the tooth from contamination by saliva and blood was accomplished using a liquid-dam.

Surgical extrusion is recommended to be used by clinicians as this procedure does not require special clinical skills. It is a one-step technique, which is simpler and less time-consuming.15 It is indicated in CRFs, subgingival caries, cervical root resorption, large radicular perforations of the coronal third of the root and incongruous prosthetic preparations violating the supracrestal insertion tissue.11,16

An atraumatic extraction system (AES), known as Benex®, was proposed for use in a clinical study of surgical extrusion as it reduces trauma to the alveolar socket. However, the AES screw needed for retention in the post space and the axial force applied during extrusion may cause microcracks to the dentin, possibly leading to vertical root fracture and may affect the outcome.19

Moreover, the vitality of the periodontal ligament cells is critical for a successful reattachment, which is more affected by the viable cells on the root surface than on the alveolar socket wall.1 Surgical extrusion has such advantages on healing, although inflammatory or replacement root resorption is frequent in any dental replantation.1 In the present case report, a follow-up appointment after 6 months revealed satisfactory outcomes with clinical and radiographic signs of healed periodontium. Statistical analysis showed an event rate of 30% of non-progressive root resorption as the most common adverse event following surgical extrusion. However, Tegsjo et al. considered it as a “healed” root resorption and a reparative event rather than a harmful one.5,20

Surgical tooth extrusion is recommended as a reliable treatment in the management of crown–root-fractured permanent anterior teeth.4 It can be successfully applied with minimal chairside procedures and it does not require special surgical skills. It often leads to good esthetics and has a low incidence of failure. Moreover, recovery is not complicated and it is easily accepted by the patient.4,11

**Conclusion**

Surgical extrusion is simple and easy to perform. It can be suggested as a suitable treatment option in the management of highly damaged anterior teeth. In the present case report, a minimally traumatic controlled surgical extrusion technique provided highly successful outcomes in both function and esthetics, especially in the anterior region where the latter is of great concern.

**Acknowledgements**

The authors thank the Dental Lab Cap Dentaire for the great work and the Laboratory of Research on Oral Health and Facial Rehabilitation (LR12ES11) for their support.

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.
Ethical approval
Our institution does not require ethical approval for reporting individual cases or case series.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

Informed consent
Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

ORCID iDs
Ibtissem Grira https://orcid.org/0000-0002-7492-2185
Raouaa Belkacem Chebil https://orcid.org/0000-0002-1832-3487

References
1. Lee JH and Yoon SM. Surgical extrusion of multiple teeth with crown-root fractures: a case report with 18-months follow up. Dent Traumatol 2015; 31(2): 150–155.
2. Spinas E and Altana M. A new classification for crown fractures of teeth. J Clin Pediatr Dent 2002; 26(3): 225–231.
3. Kirzioglu Z and Karayilmaz H. Surgical extrusion of a crown-root fractured immature permanent incisor: 36 month follow-up. Dent Traumatol 2007; 23(6): 380–385.
4. Das B and Muthu MS. Surgical extrusion as a treatment option for crown-root fracture in permanent anterior teeth: a systematic review. Dent Traumatol 2013; 29(6): 423–431.
5. Elkhadem A, MICKAN S and Richards D. Adverse events of surgical extrusion in treatment for crown-root and cervical root fractures: a systematic review of case series/reports. Dent Traumatol 2014; 30(1): 1–14.
6. Padbury A Jr, Eber R and Wang HL. Interactions between the gingiva and the margin of restorations. J Clin Periodontol 2003; 30(5): 379–385.
7. Plancianas L, Puriene A and Mackeviciene G. Surgical lengthening of the clinical tooth crown. Stomatologija 2006; 8(3): 88–95.
8. Pham HT, Nguyen PA and Pham TAV. Periodontal status of anterior teeth following clinical crown lengthening by minimally traumatic controlled surgical extrusion. Dent Traumatol 2018; 34(6): 455–463.
9. Fariniiuk LF, Ferreira EL, Garcia Soresini GC, et al. Intentional replantation with 180° rotation of a crown-root fracture: a case report. Dent Traumatol 2003; 19(6): 321–325.
10. Mohan KP, Ravindra RN, Roopa D, et al. Atraumatic surgical extrusion using periosteal in esthetic zone: a case series. J Conserv Dent 2013; 16(2): 175–179.
11. Argueta J, Orellana A and Plotino G. Surgical extrusion: A reliable technique for saving compromised teeth: a 5-years follow-up case report. G Ital Endod 2018; 32(1): 25–30.
12. Kim C-S, Choi S-H, Chai J-K, et al. Surgical extrusion technique for clinical crown lengthening: report of three cases. Int J Periodontic Restorative Dent 2004; 24(5): 412–421.
13. Shillingburg HT, Jr Hobo S, Whitsett LD, et al. Fundamentals of fixed prosthodontics. 3rd ed. Chicago, IL: Quintessence, 1997.
14. Yag-Howard C. Sutures, needles, and tissue adhesives: a review for dermatologic surgery. Dermatol Surg 2014; 40(Suppl. 9): S3–S15.
15. Özer SY and Uysal Bahşi İE. Case report surgical extrusion of a complete crown fractured tooth: a case report 2011; 1(2): 70–75.
16. Becciani R, Faganello D and Fradeani M. Surgical extrusion: a simplified esthetic method of treating non-restorable teeth. Int J Esthet Dent 2018; 13(2): 240–273.
17. Bajaj P, Chordiya R, Rudagi K, et al. Multidisciplinary approach to the management of complicated crown-root fracture: a case report. J Int Oral Health 2015; 7(4): 88–91.
18. Bourguignon C, Cohenca N, Lauridsen E, et al. International association of dental traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations. Dent Traumatol 2020; 36(4): 314–330.
19. Dietrich T, Krug R, Krastl G, et al. Restoring the unrestorable! Developing coronal tooth tissue with a minimally invasive surgical extrusion technique. Br Dent J 2019(226): 789–793.
20. Tegsjo U. Intra-alveolar transplantation of teeth with cervical root fractures. Swed Dent J 1978(2): 73–82.