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CASE STUDY

A SIMPLE COUSTOMIZED STAINLESS STEEL WIRE FRAMEWORK FOR FORCED ORTHODONTIC EXTRUSION

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ABSTRACT

The management of traumatic injuries to patient's dentition is an integral part of the general dental practice. One of the most important challenges for dentists is the recovery of extensive destroyed teeth. A multi-disciplinary approach is required in Treatment of crown fractures. However, crown-root fractures with fracture line below the gingival attachment or alveolar bone crest present restorative difficulties. In this case report we have presented a 22-year-old male who reported with fractured upper right central incisor following trauma. On clinical examination, it was observed that the upper right lateral incisor had a horizontal fracture at the junction of middle and cervical one-third level. The traumatized teeth treated endodontically, and then referred to our department to increase the crown height by orthodontic extrusion before permanent restoration. A long term follow up revealed that a multidisciplinary approach including: endodontic therapy, surgical crown lengthening or/and orthodontic extrusion followed by rehabilitation prosthesis could lead to long survival rate even for "hopeless" teeth. These procedures have the aim to expose a good amount of healthy tooth tissues that is fundamental to obtain a ferrule effect for the subsequent prosthetic restoration. Forced orthodontic extrusion is a technique in which difficult endodontic cases can be handled by the clinicians. In order to achieve desired results patients cooperation is necessary in spite of this being an easy technique.

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INTRODUCTION

The recovery of traumatic teeth represents one of the most important challenges for dentists especially in the esthetic region. Nowadays, due to the frequent use of dental implants extraction remains the common treatment modality (Moghaddam *et al.,* 2014; Giannobile and Lang, 2016). Conservative procedures should be preferred whenever possible over implant therapies because of the absence of periodontal ligament in implants when compared to natural teeth. In case of failure of conservative therapies implant placement can be considered as a treatment option (Setzer and Kim, 2014). The periodontal ligament acts as a shock absorber and absorbs the occlusal loads produced during function and distributes the forces at the root interface level. In order to obtain long-term success in this type of treatments prosthetic and periodontal factors should be taken into account. For a correct restoration of the "biologic width", different kinds of therapies may be performed such as: surgical crown lengthening combined, or not, with orthodontic extrusion (Zenóbio *et al.,* 2015). The expected results from these procedures is a sufficient amount of circumferential healthy tooth tissues. In fact, an amount of 1.5-2.0 mm in height and 1.0 mm in width is mandatory in order to obtain the "ferrule effect" which strongly reduces the chances of vertical fractures (Zenóbio *et al.,* 2015; Mamoun, 2014). The micro esthetics of the smile and the maintenance of the delicate gingival contour is of prime importance. Such treatment modalities involve a multi-disciplinary approach. orthodontic intervention involves forcibly extrusion of the tooth while Periodontal crown lengthening involves the removal of supporting crestal alveolar bone. Both are attempts to expose sufficient coronal tooth structure for proper prosthetic restoration. Crown lengthening procedures causes exposure of excess of root and also change in gingival zenith when compared to the adjacent tooth and in turn, may compromise esthetic results that can be avoided by intervening forced orthodontic extrusion (Delivanis *et al.,* 1978; Johnson, 1990; Ivey *et al.,* 1980; Fournier, 1981). Different methods of orthodontic extrusion in cases of fractured teeth have been reported in literature which basically by using brackets on buccal or lingual surfaces and wires as part of fixed mechanotherapy and another one is by extending a customized rigid wire across the teeth adjacent to the fractured tooth and applying traction forces to the fractured tooth through this attachment. Orthodontic tooth extrusion is a less invasive approach but requires a better patient compliance (Brindis and Block, 2009).

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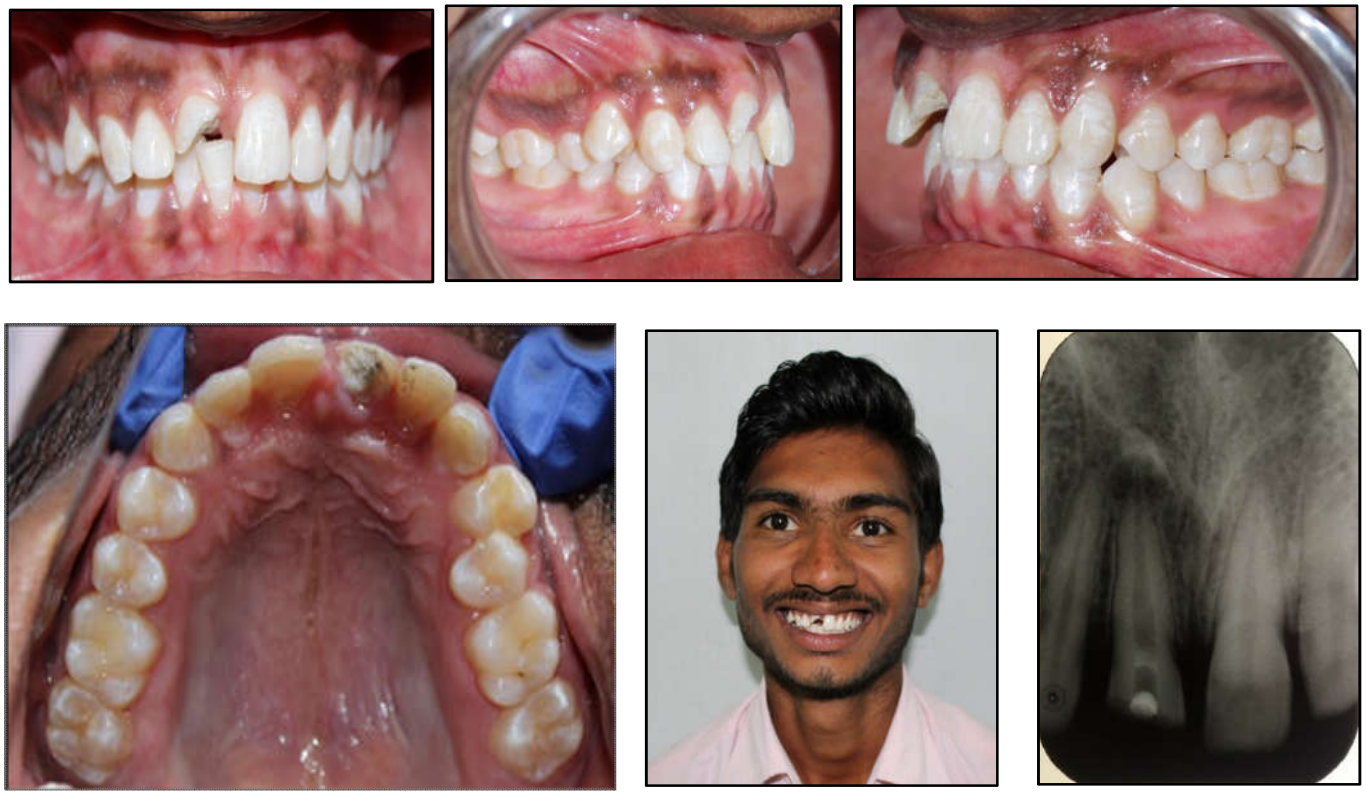

Figure 1. Preoperative condition

Tension created by gingival fibers during and after dental extrusion often leads to the migration of periodontal tissues coronally. This coronal migration can be prevented by performing a supracrestalfiberotomy. Hence, a sufficient amount of healthy tooth structure can be provided for the subsequent prosthetic restoration (Carvalho *et al.,* 2006). Another advantage is related to the quality of the regenerated tissues. These extrusive procedures lead to apposition of new "endogenous" bone which is one of the advantage related to the quality of the regenerated tissues (Berglundh *et al.,* 1991). Orthodontic extrusion could also be an alternative option in periodontal therapy aiming to reduce angular periodontal bony defects (Ingber, 1974; Fakhry, 2007). In this paper, we report a case of traumatized maxillary central incisor restored with a multidisciplinary approach which involves the use of orthodontic extrusion and Circumferential supracrestal fibrotomy.

Forces Exerted

Firstly, the force applied for extrusion must be applied along the tooth axis to prevent any undesirable tilting. Approximately 15 g of force can be applied for the lower incisor and 60 g for a molar for slow extrusion. As recommend by some authors the maximum force for a slow movement should not exceed 30 g, whereas rapid extrusions are accomplished with forces higher than 50 g (Minsk, 2000; Reitan, 1967; Bondemark *et al.,* 1997). Slow extrusion occurs at a rate of approximately 1 mm or less per week after a latency period of a few days to a few weeks, including a period of hyalinization (Minsk, 2000). The force to be used varies according to physiologic response of the patient and other factors such as root surface morphology. The forces must be altered according to the clinically verified speed of extrusion. A constant force is required for creating a tension in periodontal ligament and also for bone remodelling and movement of the periodontal attachment (Minsk, 2000; Alves *et al.,* 1997).

CASE REPORT

A 22-year-old male patient was referred to the Department of Orthodontics and Dentofacial Orthopaedics, Rural Dental College, Loni, with fractured upper central incisor following trauma during sports. Clinical examination showed diagonal fracture starting from cervical region mesiallyupto middle third of the crown distally with temporary restoration. [Figure 1]. Root Canal Therapy was already in process in the Department of Endodontics, Rural Dental College, Loni. One month after the completion of root canal treatment and after the tooth was asymptomatic for a week, orthodontic extrusion was carried out [Figure 2]. Extrusion was done using a customized round 19 gauge rigid stainless steel wire framework. It was planned to extrude the tooth to about 3-4 mm. A circular loop was incorporated in the wire to retain and attain a larger length of elastic thread for adequate force generation. The wire was bonded to adjacent teeth (right no. 12 to left no. 21 teeth) using the composite restorative material. A bondable lingual button was bonded on 12 and 21. An elastic was stretched between the buton and loop incorporated in the framework in order to avoid slipping of rubber elastic from the framework. A force of 35 g was applied which was measured using a dontrix gauge [Figure 3]. The elastic was changed every 1 week until the desired extrusion was obtained. The total extrusion was completed in 6 weeks [Figure 4]. After desired extrusion was obtained, Circumferentialsupracrestalfibrotomy was performed in order to cut off the streached gingival fibers and prevent chances of relapse and restore the position of coronally migrated gingival tissues.[Figure 5] The tooth then was passively tied with a 010 inches stainless steel ligature wire from the button to the framework for the stabilization. The period of stabalization was 2 months.[Figure 6] After stabalization definitive the stainless steel framework was removed and coronal restoration was planned [Figure 7]. At this point, it was judged to be adequate to retain a definitive full coverage restoration without any need for intra-radicular support.

Figure 2. Customized stainless steel framework in place

Figure 3. Application of force with red elastic

Figure 4: After extrusion

Figure 5: Circumferential supracrestalfibrotomy

Figure 6. Tooth passively tied with a .010 inches stainless steel ligature wire

Figure 7. After removal of framework

Figure 8. Periapical bone formation after 1 year followup

A cast post was prepared, and definitive prosthetic restoration was done. A followupupto one year was done in order to check the periapical bone formation and stability of the restored tooth [Figure 8].

DISCUSSION

The replacement of missing and destroyed teeth with implant represents one of the most common procedures during the clinical practice recently (Albrektsson and Donos, 2012). Implants present a high survival rate, but some patients refuse their use (Bellini *et al.,* 2008). Whenever possible it is advisable to recover strongly destroyed teeth especially young patients. Option of implant placement can be considered in cases of subsequent failure of restoration of natural teeth or missing teeth (Rosa *et al.,* 2016). Movement of a tooth by extrusion involves applying tractional forces in all regions of the periodontal ligament to stimulate marginal apposition of crestal bone. Because the gingival tissue is attached to the root by connective tissue, the gingiva follows the vertical movement of the root during the extrusion process. Similarly, the alveolus is attached to the root by the periodontal ligament and is in turn pulled along by the movement of the root (Bach *et al.,* 2004). Rapid extrusions are accomplished with forces can higher than 50 g (Bondemark *et al.,* 1997). But Some authors recommend that the maximum force for a slow movement should not exceed 30 g (Minsk, 2000; Reitan, 1967). Forces of 15 g for the fine root of a lower incisor and 60 g for a molar are sufficient for slow extrusion. It is necessary to provide a stable anchorage that acts as a support for the discharge of the forces on the element to be extruded. Modified provisional restoration, fixed orthodontic appliances or mini-implant screw are various options used for the anchorage that vary depending on the clinical situation (Fakhry, 2007; Sönmez *et al.,* 2008; Greco and Derton, 2012). Heda *et al*. also suggested a similar technique using a stainless steel wire which is bonded to adjacent tooth. However, since no vertical steps were given for the extrusion, rolling of the wire was an issue which would lead to undesired force vectors (Heda *et al.,* 2006). Fidel *et al*. described a technique for extrusion using bonded brackets on the adjacent teeth. The main drawback of bonded brackets is that, there is a necessity to align the anteriors and time will be lost as a result. Furthermore, reciprocal forces of intrusion might act on the adjacent teet (Fidel *et al.,* 2011). Murali *et al*. suggested a lingual technique using STB brackets. The same forces of intrusion are evident here (Murali *et al.,* 2011). In this case report a rigid framework of Stainless steel wire was used

incorporated with a loop for retention purpose. There was no need for aligning the anteriors since the rigid wire could be bonded directly chair side. Serrations were created with a carbide bur to roughen the bonding surface of the framework to enhance its retention. Readily available and cheap bondable lingual button were used as attachments.

Conclusion

In clinical practice a multi-disciplinary approach is often necessary for the restoration of fractured tooth. In this clinical case report, a forced eruption therapy with a customized stainless steel framework that minimizes treatment time and increases ease of use was described in depth. In spite of the relative difficulties, orthodontic extrusion remains an accessible and easy technique for general practitioners and a beneficial technique for the patient who wishes to retain a natural tooth.

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