

ENDODONTICS-FORCED ORTHODONTIC EXTRUSION AND PROSTHETIC REHABILITATION : MULTI-DISCIPLINARY APPROACH FOR MANAGING SUB-GINGIVAL FRACTURE.

Dr. Arun Choudhary*, **Dr. Avik Mohanty****, **Prof. Dr. Manoj Chowdhury*****,
Prof. Dr. Ritesh Gourav****, **Prof. Dr. Pratheek Shetty*******

Abstract

Traumatized anterior teeth with sub-gingival crown fractures are a challenge to treat. The management of patients with traumatic injuries to their dentition poses a serious challenge in everyday general dental practice. For the rehabilitation of the complicated subgingival crown fracture of anterior teeth, multidisciplinary approach is often indicated. A combination of endodontic, orthodontic, periodontal and prosthodontic approach may be required. Orthodontic or periodontal intervention becomes an integral part for the exposure of the sound tooth structure of fractured anterior teeth with fracture line extending subgingivally.

The aim of this paper is to discuss the immediate endodontic management followed by orthodontic extrusion of traumatized upper anterior teeth with fracture at the subgingival level. In order to expose the sound tooth structure for prosthodontic intervention, orthodontic extrusion was performed after endodontic treatment. To avoid extraction of the involved teeth, the multidisciplinary approach was adopted and finally the teeth were restored prosthodontically. The final result was aesthetically pleasant, cost-effective and periodontically sound.

Key Words Forced-Orthodontic extrusion, Subgingival root fracture, Forced eruption, Post and core, Full Porcelain crown.

INTRODUCTION

Traumatic injuries to the teeth especially in the esthetic region pose a great challenge to a dentist to be able to restore the tooth to proper health and function. Nothing can replace the natural but the natural. Such dental trauma can lead to fracture of the tooth, particularly in the anterior region of the mouth. At times, when the fracture line is below the level of gingiva, the prognosis of such fractured tooth is considered questionable or hopeless. With the recent trend and attitude towards dental implants, extraction remains the common treatment modality. This, however, should be considered as the last option, and every attempt should be made to preserve and restore the natural tooth structure. Such treatment modalities involve a multi-disciplinary approach including endodontics, periodontal crown lengthening and/or orthodontic extrusion followed by prosthetic rehabilitation. The major problem with sub-gingival fracture is absence of adequate coronal ferrule and a compromised biological width. This usually complicates the application of the rubber dam during endodontic treatment. Periodontal crown

ABOUT THE AUTHORS

*PG student, Dept. of Prosthodontics, ** PG student, Dept. of Endodontics, ***H.O.D. Dept. of Endodontics
****Prof. Dept. of Prosthodontics, *****H.O.D. Dept. of Prosthodontics
Awadh Dental College and Hospital, Jamshedpur, Jharkhand, India.

lengthening involves the removal of supporting crestal alveolar bone while orthodontic intervention forcibly extrudes the tooth. Both are attempts to expose sufficient coronal tooth structure for proper prosthetic restoration. Crown lengthening procedures may expose excess of root and, in turn, may compromise esthetic results that can be avoided by the use of orthodontic extrusion.¹⁻⁶ The prime objective of tooth extrusion or forced eruption is to provide both a sound tissue margin for ultimate restoration and to create a periodontal environment (biological width) that will be easy for the patient to maintain.

Indications of orthodontic extrusion

- Treatment of a sub-gingival or infraosseous lesion of the tooth between the cemento-enamel junction and the coronal third of the root (e.g., caries, oblique or horizontal fractures, perforations caused by a pin or post, internal or external root resorption), especially when there are esthetic considerations
- Treatment of a restoration impinging on the biological width
- Reduction of angular bone defects and isolated periodontal pocket⁷
- Pre-implant extraction to maintain or re-establish the integrity of an alveolar ridge
- Orthodontic extraction where surgical extraction is contraindicated (e.g., in patients receiving chemotherapy-bisphosphonates or radiotherapy)⁸
- Treatment of trauma^{9,10} or impacted teeth¹¹ (canines)
- To facilitate the endodontic treatment.
- Contraindications to orthodontic extrusion
- Ankylosis or hypercementosis (the extra load would cause intrusion of the anchor teeth)¹²
- Vertical root fracture
- Root proximity and premature closure of embrasures
- Short roots, which do not allow for adequate support of the restoration (that is, when the crown-root ratio is less than 1:1)¹³
- Insufficient prosthetic space
- Exposure of the furcation.¹⁴

Advantages of orthodontic extrusion

- Conservative
- Allows retention of tooth without need of fixed bridge
- Avoids mutilation of adjacent teeth
- No loss of bone or periodontal support as seen in

surgical crown lengthening

- More favorable crown-root ratio
- Simple and relatively easier movement
- Cost-effective.

Along with advantages, rapid extrusion is accompanied with some problems; higher forces exerted on tooth may lead to pulpal necrosis and root resorption. However, pulpal death is not a concern for endodontically-treated tooth, and studies have indicated that root resorption after extrusion is rare.¹⁵ Thus it is considered as a choice of treatment.

The purpose of this paper is to review this multi-disciplinary treatment approach and to present a case of traumatized maxillary central incisor tooth with sub-gingival fracture and its management maintaining the healthy periodontal tissue and alveolar bone.

CASE REPORT

A 23-years-old male patient was referred to Awadh Dental College of Dental College and Hospital, Jamshepur with his injured front tooth in a road accident leading to its fracture a day before. Clinical examination showed horizontal coronal fracture of upper right lateral incisor (#12) with exposed pulp tissue [Figure 1a]. The fractured line extended sub-gingival on the palatal side making the prosthetic rehabilitation difficult. Around 2 mm of the buccal tooth structure was intact without any mobility. Radiographic examination revealed a fully-formed apex without any peri-apical lesion or any sign of additional root fracture [Figure 1b]. The separated coronal tooth fragment could not be located; so, the option of re-attachment was ruled out. Patient was given the option of extraction or multi-disciplinary treatment, and thankfully patient opted for the latter.

With patient's consent, root canal therapy was carried out immediately on the same appointment, and orthodontic extrusion was planned subsequently. Achieving working length followed by biomechanical preparation and proper irrigation of the canal obturation is done after confirming with tug-back and radiograph. After the tooth was asymptomatic for a week, rapid orthodontic extrusion was carried out [Figure 1f]. Extrusion was done using a round 0.014 NiTi wire stabilizing wire bonded to adjacent teeth (right second premolar to left second premolar teeth) with straight wire (MBT) technique.. Based on the depth of the palatal fracture line, it was planned to extrude the tooth to about 2-3 mm. After 6 week, the tooth had extruded around 2.5 mm and about 1 mm of palatal tooth structure was exposed, sufficient enough to provide a ferrule of 1 mm. Tooth extrusion at this point was considered



Fig. 1a: Pre-operative photograph

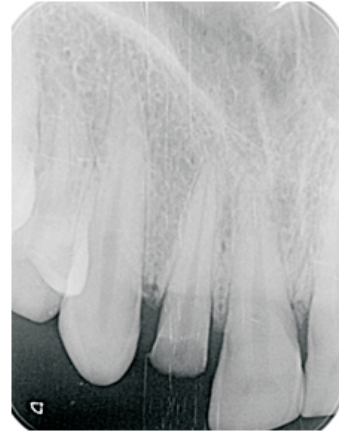


Fig.1b: Pre-operative I.O.P.A. radiograph



Fig.1c: Working length determination

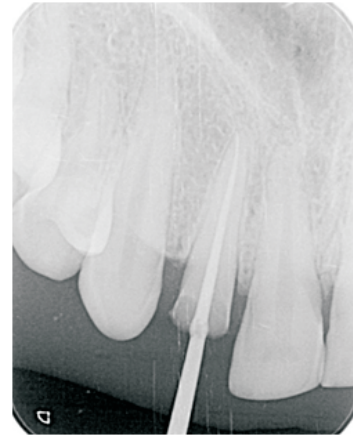


Fig.1d: Pre-obturation master cone



Fig.1e: post obturation



Fig.1f: forced orthodontic extrusion

adequate, and the extruded tooth was stabilized by splinting to the original wire with direct composite for a period of about 8 weeks. After the stabilization period, screwed post was fixed and coronal core build-up is done using type IX glass ionomer cement. Minor gingival re-contouring was carried out in order to have a symmetrical gingival margin to the left lateral incisor.

Tooth preparation was done, and a full-coverage

porcelain crown was given [Figure 2b]. The amount of the extrusion of #12 did not affect the crown-root ration. Patient was reviewed for a year, and the treatment outcome was stable and symptomless.

DISCUSSION

Placing restorative margins within the biologic width frequently leads to gingival inflammation, clinical attachment loss, and bone loss. This is

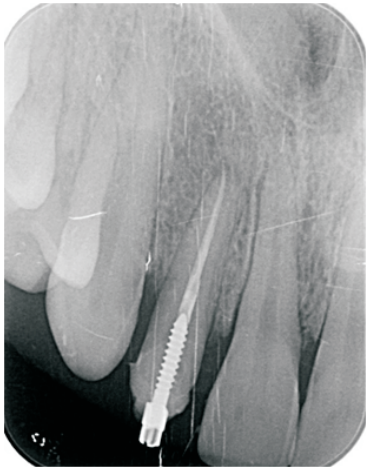


Fig. 2a: post and core



Fig.2b: definitive full coverage all ceramic prosthesis



Fig.2c: Pre-operative



Fig.2d: Post-operative

thought to be due to the destructive inflammatory response to microbial plaque located at such depths. Thus, it is important to maintain health of periodontium during restoration in sub-gingival areas. Ingber et al. suggested that a minimum distance of 3 mm is required from the restorative margin to the alveolar crest to permit adequate healing and restoration of the tooth that is biologically acceptable.¹⁶ 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.¹⁴ Extrusion is easiest of all orthodontic movements because it closely resembles natural tooth eruption.¹⁷

If the fracture line is positioned both below alveolar bone and gingival free margin, and, if the length of the root segment is sufficient enough to support a coronal restoration, then the root can be endodontically treated and, afterwards, orthodontically extruded to elevate the fracture plane above the gingival margin. These procedures enable more favorable prosthodontic coronal restoration by securing its good sealing and esthetics, and,

moreover, preserving a good periodontal tissue health.¹⁸ Various splints and appliances^{5,19} have been proposed for orthodontic-forced eruption. In normal course of events, bone and gingival movements are produced under low-intensity extrusive forces. When stronger traction forces are exerted, as in rapid extrusion, coronal migration of the tissues supporting the tooth is less pronounced because the rapid movement exceeds their capacity for physiologic adaptation.[20] Thus, rapid extrusion is necessary to prevent movement of the gingival collar and alveolar bone with the elevated tooth. Forces of 15 g for the fine root of a lower incisor and 60 g for a molar are sufficient for slow extrusion. Some authors recommend that the maximum force for a slow movement should not exceed 30 g,^{21,22} whereas rapid extrusions are accomplished with forces higher than 50 g.²³ Rapid orthodontic extrusion is carried out at higher forces; so, longer retention periods are required to stabilize the tooth for remodeling and adaptation of the periodontium to the newly acquired tooth position. During rapid extrusion, a pseudo-apical radiographic radiolucent lesion appears, which must be differentiated from a true lesion of endodontic origin. When one tooth has luxated or fractured, the adjacent tooth might have also suffered some injury, hence anchorage of 2-3 healthy teeth should be taken.²⁴ Orthodontic extrusion forces coronal migration of the root and

increases the bone ridge as well as the quantity of attached gingiva, in particular when weak to moderate forces are applied. The amount of attached gingiva is increased through eversion of the sulcular epithelium, appearing first as immature non-keratinized tissue (known as “red patch”) and then as keratinized tissue; the process of keratinization requires 28 to 42 days.¹⁵ After coronal movement of the periodontal attachment has occurred, minor surgical correction may be necessary.¹⁴ Moreover, when the tooth is moved to a new position, cervical periodontal fibers are stretched and may become a cause of relapse. Thus, such case might require surgical fibrotomy.^{25,26} The major limitation of this treatment is the longer duration and may impair good esthetic results as the cervical diameter of the extruded tooth is less than the adjacent tooth. The mesio-distal diameter of the root, which is naturally “strangled” at the CEJ of single-rooted teeth, is reduced with progression of the extrusion (especially in the case of conical roots), which causes expansion of interproximal gingival embrasures.

The contour of the crowns must not be exaggerated to compensate for this reduction in diameter, which could adversely affect the marginal periodontium.²⁷ For the present case, the fracture line on palatal side was below the level of gingiva. Thus, did not provide sufficient coronal tooth structure and adequate biological width for a proper coronal restoration. This left us with the option of either extraction followed by implant or retaining the root fragment with subsequent rehabilitation. All the aspects were discussed with the patient. The option of implant was out-rightly rejected considering the high cost involved and psychological taboo of extraction. The patient was given the other option of retaining the natural root by endodontic treatment followed either by periodontal treatment or forced eruption. The patient agreed for the latter as it was more physiological, no need for any surgical procedure and most importantly, cost-effective. Since the patient was a villager, his main concern was only the restoration of the lost tooth and did not wish for a comprehensive orthodontic treatment for closure of the interdental spaces. Hence, we limited our treatment towards that aspect only. A simple custom-made appliance was fabricated for this patient, and rapid extrusion concept was chosen. Since we used a round cross-section wire, vertical bends were made at the level of canine teeth to prevent any.

CONCLUSION

Multidisciplinary approach has been recognized and established as a key factor for successful outcomes in dental problems. Orthodontic extrusion is a conservative procedure that allows retention of a tooth without the disadvantages of a fixed bridge. As well, extrusion does not involve loss of bone or

periodontal support, as commonly occurs during extraction. Simple surgical crown lengthening involves additional resection of supporting bone, and such osteotomy can sometimes be avoided by use of orthodontic extrusion. Thus, this simple technique requires a relatively easy movement and helps in subsequent restoration of the tooth and can be considered as a savior for both the natural tooth and its supporting tissues.

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