

ORTHODONTICALLY INDUCED FORCED ERUPTION FOR THE TREATMENT OF SUB-GINGIVAL DENTAL FRACTURES: LITERATURE REVIEW AND CASE REPORT

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ABSTRACT:

Crown-root fractures often present periodontal and restorative challenges. Treatment alternatives, in cases of subgingival fractures that facilitate the best prognosis and esthetics of the definite restoration, are:

- orthodontically induced forced eruption of the root,
- periodontal surgical crown lengthening,
- extraction followed by implant placement.

The position, direction and extent of the fracture, the periodontal status, and the prospective crown to root ratio of the definite restoration, are of considerable importance. The aim of this presentation is to outline the indications, the contraindications and the biologic considerations for the various treatment approaches, that may be applied to subgingivally fractured teeth. One characteristic case will be presented, where the application of the indicated multidisciplinary treatment protocol resulted in the optimum esthetics and best overall prognosis of the definite restoration.

Key Words: Root fracture, sub-gingival fracture, forced orthodontic eruption.



INTRODUCTION:

Prosthetic restoration of remained and submerged roots in the dental arch is an interesting challenge for the dentist and the patient. With successful orthodontic approaches, preparation of the adjacent teeth is avoided and the volume of the alveolar crest is maintained since the root remains in the oral cavity ^[1]. In such cases the goals for a successful prosthetic restoration are the maintenance of the

biologic width, the ferrule effect and esthetics. Orthodontic movement of dental roots helps the prementioned goals to be achieved in cases that the dental structures are destroyed up to or below the level of the alveolar crest. A case of orthodontic movement of a premolar root is presented in order to achieve a successful prosthetic restoration of the dental arch ^[1,2].

Oblique crown fractures involving enamel, dentine and pulp that extend below both the gingival margin and the alveolar bone are difficult to restore. Attempts to expose the fracture line by alveolar re-contouring alone may compromise the functional root length. In addition, poor aesthetics may result from any attempt to re-contour the labial tissues with simple or complex periodontal techniques^[1,3].

It is generally accepted that coronal restorations in the anterior region require a residual root length at least equivalent to that of the clinical crown for long-term stability. Extrusion planning should take this into account.

Orthodontic extrusion of roots was described more than 20 years ago by Heithersay¹ Ingber^[2,3] and Simon^[4] Cook reported that ideal rapid extrusion of a single root requires forces of the magnitude of 0.7 N to 1.5 N^[5] Movements of between 4–6mm over 6–8 weeks can be achieved using these light forces. Excessive forces can lead to pain, failure of the tooth to move, root damage, tilting of the abutment teeth and subsequent impaction of the root being extruded. Rapid extrusion is necessary to prevent movement of the gingival collar and alveolar bone with the root.^[1,2,5]

Practically there is always some movement of these tissues but considerably less than if the extrusion was completed with lesser forces at a slower rate.

The most frequently described technique follows root canal obturation and uses a

post made from orthodontic wire with a j-hook at its coronal end. The straight part of the post is ridged with a diamond bur in an air rotor to aid retention and cemented into the canal with a firm temporary cement (IRM). Traction down the long axis of the root is provided by stretching an elastic band from the j-hook over a wire cemented to the incisal edges of the abutment teeth and then back to the j-hook. The wire attached to the abutment teeth should ideally be bent so that traction is through the long axis of the root and not labially. A fibrotomy, prior to starting treatment and also following treatment has been advocated.^[6]

Re-organisation of the periodontal fibres requires around four weeks,^[6] and retention of the root in its new position is advisable for at least this period prior to Restoratio.^[2,5] It is generally accepted that there will be relapse of around 1 mm.

In the case of a fractured anterior tooth, especially one with previous endodontic therapy, it is not uncommon for a dentist to recommend sacrificing the tooth and placing an implant^[2,4,5] Unfortunately, traumatic injuries to the alveolus or extractions can cause a loss of buccal alveolar bone. In many cases, dentistry still lacks the ability to recreate normal periodontal architecture, despite improved technologies and biomaterials, soft- and hard-tissue grafting, and implantology^[6,7]

This article reviews the infrequently utilized treatment method of forced eruption (orthodontic extrusion) as an alternative to the sacrifice of the natural

root system. When used in the correct situation, forced eruption can preserve the natural root system and its associated periodontal architecture, resulting in years of additional service for the patient; it also maintains adjacent supporting tooth structure while retaining the option for implant reconstruction.^[6,7,8] This article presents a forced eruption case in the anterior maxilla in which a removable device is utilized instead of the more frequently used fixed device design. An overview of forced eruption also is provided that describes the clinical indications and contraindications for use of the technique.

CASE DETAIL:

A 21-year-old healthy female had traumatic fracture of left maxillary central incisor for 1 day. Clinical examination showed a cervical fracture with pulp exposure. For the tooth fracture, only the labial part was 1 mm above the gingival margin; all the other parts, including mesial, distal and lingual parts, were 3-5 mm subgingival. Patient presented class I occlusion relations and good oral hygiene. Gingiva was slightly swollen and no gingival laceration was present. Further periapical radiography showed that the root canal was vacant, the fracture line was oblique, the periodontal membrane was normal and the remaining root length was about 14 mm, with no additional root fracture image on the remaining part of the root. After full discussion with the patient about the advantages and disadvantages of the alternative treatment approaches,

including immediate implant and tooth-extraction followed by fixed or removable partial denture replacement, the patient chose to preserve the remaining root and perform a multidisciplinary treatment **Figure 1**. Then the treatment plan was divided into four phases as follow:

Phase I: Endodontic RCT and periodontal basal therapy

Root canal therapy was performed for left maxillary central incisor and the periapical radiography after RCT was satisfied. Full mouth periodontal prophylaxis cleaning and initial periodontal therapy were done before orthodontic extrusion. **Figure 2-3**

Phase II: Orthodontic extrusion

A 0.8 mm Stainless Steel (SS) wire was cemented into the root canal space for the retention of orthodontic arch wire. The standard edge wise brackets were bonded on maxillary teeth and 0.018 × 0.025 inch Nickel-Titanium (NiTi) full arch wire was engaged into maxillary brackets. A 0.2-0.3 N levelling and alignment extrusion force was applied, readjusted every 2 weeks. After 9 weeks engagement, 2 mm tooth structure was occlusally elevated with the simultaneous elevation of the surrounding periodontal bone tissue. **Figure 4**

Phase III: Periodontal crown lengthening surgery

After 4-month retention to prevent relapse, the crown lengthening surgery including gingival flap operation, alveoloplasty and gingivoplasty were performed to create an optimal relation

between the gingival and margin of restoration **Figure 5 α - β** . During the operation, the necessary clinical crown and suitable gingiva anatomy were reserved

Phase IV: Prosthodontic restoration and follow-up

Two month after the periodontal crown lengthening surgery for the proper wound healing process, prosthodontic restoration was performed. After fibre post and resin core had been built up an accurately fitting provisional crown was fabricated and cemented. Tooth preparation and silicon rubber impression were made, and all-ceramic crown was fabricated by LAVA was satisfied with the result of prosthodontic restoration Colour-selection was performed using a new Crystaleye Spectrophotometer. After transferring the colour-selection picture to computer, dentist discussed the shape and shade of final restoration with the patient and finally decided to reproduce the colour by simulating the right maxillary central incisor. Final restoration was cemented with RelyX Unicem resin cement.

One year follow-up evaluation indicated the restoration and gingival profile were healthy and stable without relapse. Figure 6-7

DISCUSSION:

Restoration of subgingival crown root fracture teeth is always a clinical challenge for the restorative dentist. Prosthodontic treatment alone or when combined with crown lengthening procedure will have

the potential problems such as discontinuous gingival margin, gingival irritation and crown root ratio imbalance, etc., thus compromising the periodontal health and cosmetic profiles, especially at anterior aesthetic zone. Orthodontic extrusion is recommended when existing clinical crown height cannot permit the placement of a crown ferrule^[7,8]. It has been demonstrated in experimental and clinical studies that levels of gingival attachment and bone will follow the extrusive movement for single teeth. So, we combined orthodontic extrusion with crown lengthening surgery to obtain an optimal gingival margin of restoration between the fractured tooth and adjacent teeth.^[7,8,9,10]

The planning for the replacement of hopeless tooth often starts even before the tooth is extracted. For the final prosthetic restoration to be esthetic and functional, the implant needs to be placed in the perfect 3-dimensional position. This necessitates the presence of adequate quantity and quality of bone and soft tissue. It has been shown that the height of peri-implant papillae in single-tooth gaps is independent of the proximal bone level next to the implant, but mainly depends on the interproximal bone height at adjacent teeth.[3] Therefore, interproximal height of bone and height and thickness of facial wall are crucial for the predictability of the esthetic result. Henceforth clinical situations with reduced interproximal bone height at adjacent teeth are very challenging and cannot be controlled by the surgeon, since

surgical techniques are still not available to predictably regain this lost bone.^[9,10]

Orthodontic extrusion procedure to elevate cervical fractured tooth for restoration was introduced by Heithersay in 1973. Only light forces are permissible when considering orthodontic extrusive movements ^[1,3,6]. If the level of fracture does not invade the biological width and the residual tooth structure allows an adequate ferrule, it is possible to reconstruct the tooth and to prepare a viable prosthesis while maintaining an equilibrium between dental and periodontal structures ^[11,12,13]. If the apical extent of the line of fracture involves the biologic width, no matter it is above or below the ridge, restorative therapy will not be feasible unless the remaining tooth structure has been exposed beyond the gingival margins. This exposure allows the tooth to be restored, provided that the health and stability of the gingival margin have been re-established with a proper biologic width ^[14,15].

Crystaleye Spectrophotometer was employed for colour selection procedure. As we know, colour selection is one of the most difficult parts in single anterior tooth restoration to achieve harmony to adjacent teeth. This new computer-based

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spectrophotometer provides two advantages. First, it could avoid subjective interference and acquire optimal objective cosmetic effect. Second, it could record and reproduce the tooth colour accurately, which made it possible for the dentist to communicate with the patient on the computer and decide the colour of different parts of the tooth, including the cervical part, middle part and incisal part of the tooth.^[15,16,17] The combination of endodontic, orthodontic, periodontal and prosthodontic disciplines is a satisfied and promising way to restore the crown-root-fractured tooth and the computer-based spectrophotometer plays an important role in the colour-selection procedure.^[1,8,9,11,13,17]

CONCLUSION:

Orthodontic forced eruption is a useful technique to regenerate bone and soft tissue in challenging esthetic cases. As of today, it is the technique of choice to regenerate interproximal height of bone between adjacent teeth. The key to success is careful and meticulous multidisciplinary treatment planning.

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FIGURES:



Figure 1: Subgingivally fractured left maxillary central incisor



Figure 4: Orthodontic extrusion finished



Figure 2: Pre-treatment periapical radiography



Figure 5a: Crown lengthening surgery (in operation)



Figure 3: Periapical radiography after root canal treatment completed



Figure 5b: Crown lengthening surgery (post operation)



Figure 6: Fibre post and core



Figure 7: Final all ceramic crown restoration