Case Report

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THE ART AND SCIENCE OF TREATMENT PLANNING ON ORTHODONTIC EXTRUSION

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ABSTRACT:

Traumatized anterior teeth with sub gingival fractures of crown are a challenge to treat. This paper reports the management of sub gingival fractures of crown of the maxillary central incisor in a 29 year old female. The technique described here involves the use of fixed appliance, post and core with a loop fabricated on it for retention of fixed appliance.

Keywords: Fracture, Tooth, Root Extrusion, Crown Fracture.

INTRODUCTION:

When an anterior tooth is fractured at the level of the osseous crest due to severe dental caries or trauma, a clinician can be confronted with a dilemma in choosing the best treatment among the various options with respect to prognosis and esthetics. In such cases, surgical extraction followed by an implant restoration or fixed prostheses can be considered. On the other hand, the advantages of saving the fractured tooth include a simpler procedure, a conservative approach, achievement of the desired esthetic outcome by preservation of the alveolar bone, and a reduction in time-related cost.[1,2]

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. The use of root extrusion, in conjunction with periodontal crown lengthening, has saved many good teeth from extraction. This case report details a multidisciplinary management of such subgingivally fractured incisor teeth.[2,3]

The ferrule effect over sound dentin for the fractured tooth can be achieved in several ways, including surgical extrusion, crown lengthening, and orthodontic extrusion. Among these treatment options, orthodontic extrusion is the most common treatment because of its simplicity, non-invasiveness, low incidence of relapse, better prognosis, and good esthetic outcome.[4]

Extrusion is a tooth movement that occurs in the direction of the normal eruptive process; forced orthodontic extrusion is movement of vertical translation (in a

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coronal direction) obtained through the application of light continuous forces.[4]

The indications and contraindications for orthodontic extrusion were discussed by Bach et al (2001). Indications for the treatment include – subgingival or infraosseous lesion of the tooth between the cemento-enamel junction and the coronal third of the root; restoration impinging on the biological width; reduction of angular bone defects and isolated periodontal pockets; to maintain the integrity of an alveolar ridge for implant placement, tooth extrusion is done prior to extraction to grow alveolar bone in the extraction socket for future implant placement; for treatment of trauma or impacted teeth.[4,5]

The contraindications are - ankylosis, hypercementosis, vertical root fracture, root proximity, short roots, insufficient prosthetic space and exposure of the furcation. Extrusion is not recommended in case where it will not be possible to achieve a 1:1 crown root ratio after final restoration.[1,3,4,6,7]

Changes the placement of a fractured/diseased tooth to a supra-crestal position, preventing a planned restoration from impinging on the biologic width. The Criteria are[4,7,8,9,10]

1. Root length

-Must end up with 1:1 crown:root ratio

-Must allow adequate biologic width (~1mm connective tissue attachment, ~1mm gingival attachment, ~1mm sulcular depth)

- Generally you need ~2.5 mm from planned restoration to crestal bone level plus at least 1.5mm of tooth structure for resistance form (ferrule effect)

2. Root form

-External—preferably broad, non-tapering root form,Thin and tapered roots have poor emergence form because the new CEJ is lower and thinner than the contralateral tooth

-Internal—width of root canal must have enough internal pulpal wall

Canal space must be at least 1/3 the width of the tooth (measure 4mm below the margin because you need to extrude to ~4mm)

3. Level of Fracture

-Important for ease of orthodontic traction (difficult to work subgingival)

4. Importance of Tooth

-How old is the patient? How long does the tooth need to last? Does the restoration need to be more esthetic or more functional? Are the adjacent teeth restored? What is the longterm prognosis of the planned restoration? Does the patient understand the total cost of saving the tooth in question (orthodontics + periodontics + restorative)?

5. Esthetics

-Evaluate the patients lip level on resting and smiling. Saving natural tooth structure is of more value in high lip line patients

because pontics generally are less esthetic.

6. Endodontic and Periodontic prognosis

-Vertical fractures have poor prognoses

-Teeth with multiple-wall periodontal defects have poorer prognoses

The purpose of this report is to describe a modified appliance for orthodontic extrusion of a fractured tooth in cases where a conventional orthodontic extrusion appliance application is not possible due to ceramic restorations of the adjacent teeth. This modified design should be developed so that it does not interrupt oral function and so that it concurrently satisfies the esthetic desires during the forced eruption period.

CASE DETAIL:

A 29 -year-old woman presented to the restorative dentist on emergency after a traumatic incidence, which resulted in the fracture of tooth No. 11. Immediate root canal therapy was commenced on both teeth Nos. 12and11 as endodontic symptoms were apparent for both teeth, and it was the patient's desire to try to save both teeth if possible. An electrosurgical unit was used along with a hemostatic agent to create a dry field so that a post and core could be placed . An acrylic temporary was cemented and the patient proceeded to the periodontist's office the same day for evaluation of these teeth and treatment planning discussions The clinical examination at the periodontist's office revealed a healthy periodontium with no active periodontal disease. A thin, scalloped gingival biotype was noted with a diastema between teeth Nos. 11and 21. Clinical and radiographic examination revealed a subgingival root fracture on the palatal aspect of tooth No. 11to the level of the osseous crest. A root proximity was noted between teeth Nos. 12 and 11 which would make implant placement to replace one or both teeth a potential esthetic problem because of limited space availability. The root length of tooth No. 11was deemed adequate for forced eruption even with the anticipated 5 mm to 7 mm of eruption. The prognosis of both teeth Nos. 12 and 11 were deemed guarded and the following treatment options and concerns were reviewed with the patient.**Figure 1-2**

Extraction of tooth No. 11 with socket preservation with delayed implant placement or immediate implant placement based on the periodontist's intrasurgical assessment. Future extraction and immediate implant/socket preservation could not be ruled out for tooth No. 12 as well if symptomatic problems continued for this tooth. A vertical root fracture could not be ruled out for either tooth since the patient was in such a state of discomfort at presentation. With the experience of adjacent implants in the esthetic zone and anticipated lack of interproximal papillae formation between the final implant restorations, a discussion of future replacement of the final crown of tooth No. 11with a cantilever bridge and an ovate pontic to replace tooth No. 12would be the best esthetic result if tooth No.12 was lost in the future **Figure 3a-b**

The prognosis of tooth No. 12 could not be formulated presently and a provisional would be recommended for 3 months to reevaluate this tooth's overall healing and its ability to function as an abutment or the need to incorporate tooth No. 13in the final restoration. The soft tissues would require reevaluation at 3 months for soft/hard tissue reconstruction before the final restoration based on the amount of postextraction recession seen with the extraction defect associated with tooth No. 11.

Forced eruption (orthodontic extrusion) by the periodontist to be completed over three to six visits spread out over weekly intervals until clinical, radiographic, and patient symptoms could be better evaluated. If the fracture line could not be fully exposed after completion of forced eruption and flap entry, then continued eruption until extraction (orthodontic extraction) would follow with immediate implant placement. This approach would further extrude both the hard and soft tissues coronally, which would allow the periodontist more leeway to provide an esthetic final result. The surgical adjustment of both the hard and soft tissues would then become a "subtraction" procedure (ostectomy/gingivectomy), which is clinically more predictable than an "addition" procedure (hard tissue and/or soft tissue reconstruction). Thus, the periodontist would be able to sculpt the tissues at the surgical implant placement visit to create gingival symmetry. It is the authors' clinical experience to avoid cases in which previous apical endodontic surgery was performed because the buccal plate fenestration and/or dehiscence will be present at the time of extraction resulting in a needed guided bone regeneration procedure anyways. **Figure 4**

Extrusion orthodontiucs of a fractured tooth technique is ; **Figure 5a-d**

1. Use heavy traction for fastest eruption possible

-Goal: maximum stretch of PDL principal fibers, bone below erupting tooth will regenerate over time.Fast eruption prevents immediate formation of bone around new CEJ (crestal fibers stretched)

- You must do a supracrestal fiberotomy and/or crown lengthening to prevent the formation of bone near new CEJ (need ~4mm of tooth above bone level)

2. Cement a hook of 0.036" SS wire in endodontically-treated root fragments to provide a centered attachment

3. If brackets are used, you must provide anchorage support for the extrusion—a minimum of one tooth on either side of a single-rooted tooth (2 anchors) or two teeth on either side of a multi-rooted tooth (4 anchors). Use a heavy square or rectangular NiTi wire to minimize tipping.

4. Evaluate occlusion to be sure extruded teeth do not cause traumatic occlusion. You may need to open the bite during the extrusion or trim the extruded tooth.

5. Be sure you assess the need for a supracrestal fiberotomy (cutting the periodontal ligament fibers near the

crown of the tooth) and/or crown lengthening after your extrusion. If you have pulled the tooth out of the bone, you will need to perform or refer this minor surgery.

6. Once the extrusion has been completed, stabilize the tooth and hold for 4-6 months before restoring for optimal esthetics and stability. Remember the tooth may potentially relapse in an apical direction. Bonded retainers are the best way to ensure long-term retention

The major advantage of forced eruption is the maintenance of esthetics and symmetry of contralateral gingival margins by converting a three-tooth osseous crown lengthening procedure to a one-tooth osseous procedure. The final decision to restore the tooth or to continue eruption until extraction with immediate implant placement was made by the restorative dentist. Because he felt that the tooth was presently restorable, he reprovisionalized and it was stabilized passively with a larger diameter wire (0.018 round nickel titanium) for retention by the periodontist while tooth No. 22was derotated for a favorable final prosthetic-esthetic result. Common tying of teeth Nos. 13,12 , and 11 with 0.010 dead soft wire was then done for anchorage followed by stripping of the contact between teeth Nos. 11and 21 A chain elastic was used to orthodontically move tooth No. 21mesially to provide additional prosthetic room to bring tooth No.22 back into a more ideal arch position This was completed in three additional visits. Upon completion of derotating tooth No. 22, fiber resection was completed to avoid relapse of this tooth. Three months of healing was recommended after orthodontic eruption of tooth No. 11. The derotation of tooth No. 22 took place during this time frame. The decision was made to go ahead with the final crown on tooth No. 11 because tooth No. 12 had been asymptomatic for months. The esthetic makeover of the maxillary anterior sextant and diastema space closure was then commenced with the patient again being informed of the continued guarded prognosis of both teeth long-term.

From the time of the initial accident to the final stages of restorative therapy, patients often experience heightened emotions. Traumatic accidents can leave patients unprepared for the treatment decisions they need to make. This patient was happy with the esthetics of her teeth before the accident and never considered the shapes, sizes, color, or position of her teeth. After following the long path from extrusion to surgical correction and postsurgical healing of the tissues, this patient had a difficult time deciding if she wanted her previous diastama between teeth Nos. 11and 21 closed. Dentists often feel compromised when they are not able to create smiles that are perfect from their prospective. It is important that we provide patients the smiles that they want. Careful dialogue, wax-ups, esthetic imaging, and realistic temporaries help to show our patients the end result. The patient finally decided on space closure between teeth Nos. 11 and 21 and slight rotation of tooth No.22(like her

presentation smile). She wanted a minimal rotation of tooth No. 22 with small irregularities in her teeth. Meeting the patient's esthetic expectations is paramount for a successful case. **Figure 6,7a-b**

At the cementation stage, the temporaries were sectioned and removed. The teeth were cleaned with a pumice-water slurry in a rubber cup. The restorations were tried in individually to check marginal integrity and then together for evaluation of interproximal contacts. The restorations were then reinserted with RelyX try-in paste to check color and to gain patient approval. A split dam technique was used for isolation during the technique-sensitive process of inserting the restorations. The restorations were re-etched and salinated. The teeth were etched three at a time using 37% phosphoric acid and rinsed well. Gluma desensitizer was applied for 30 seconds followed by OptiBond F for 20 seconds and air-dried. All of the restorations were then seated together with RelyX translucent resin cement. The restorations were held in place and the excess cement was removed from the buccal aspect. A 2-mm Demitron Optilux tacking tip was used for 5 seconds on each restoration to hold them in position. The cement on each tooth was then meticulously removed.

DISCUSSION:

Orthodontic extrusion is one of the best conservative treatment options for compromised biologic width cases. This approach typically uses wires and orthodontic devices attached to the adjacent teeth. In the present case, a conventional orthodontic device could not be bonded because of the adjacent zirconia-ceramic prostheses, which were at risk of chipping and fracture, and which had low bonding strength to sustain traction force. [7,8,9]

Delivanis et al. detailed a case report where the fracture of the crown of the tooth extended below the alveolar crest and the tooth was saved through an endodontic-orthodontic approach. Following pulpotomy, orthodontic attachments were directly bonded to the two teeth on either side of the fractured tooth. The fractured crown received a direct bonded button placed as high gingivally as possible. A sectional archwire was fitted to the adjacent teeth and an elastic force was used to extrude the ractured tooth[3,10]

Modifications of the extrusion appliance for compromised teeth with inadequate biologic width include removable appliances, such as the flipper type and the partial anterior occlusal splint using elastic threads for drawing the cast metal post and core with two supporting retentive rods, and fixed appliances including the clasp and rest types. These appliances do not need bonding to adjacent teeth, but may cause damage to adjacent teeth in the form of chipping or fracture, and do not satisfy esthetic needs. Another method is the use of a fiber-reinforced composite with bonding. This method is simple, esthetically pleasing and time-saving. But it needs

adjacent natural teeth for bonding. Each of these reported modifications had limitations in its application to the present case with respect to esthetics, technique and cost.[11,12,13,14]

Stern and Becker discussed orthodontic extrusion as an esthetic alternative to surgical crown lengthening and lowering of the alveolar crest 2-3 mm. They indicated that with an extrusive force, there was additional bone deposition lining the socket. Unlike other orthodontic procedures, in extrusion, bone resorption does not occur. Bundle bone is replaced by lamellar bone. If excessive forces are used, however, significant pulpal changes or necrosis may easily result. They also indicated that Begg brackets and a multistranded wire allowed for three times the interbracket length whilst allowing a decrease in eruptive force of 27 times, thereby reducing concerns over necrosis and resorption.[5,6,15,16,17]

Simon et al. indicated that the orthodontic extrusion should become a routine procedure in dentistry. They also stressed that the orthodontically extruded tooth must be stabilized for 8-12 weeks prior to fabrication of a permanent post and core. We have also found that 8-12 weeks of stabilization of orthodontically extruded teeth has better prognoses.[7,8,9,10,14,15]

Biggerstaff et al. found that using 20-30 g of eruptive force resulted in eruption with alveolar crestal new bone, which coupled with a biologic width realignment procedure, afforded superior esthetic to crown lengthening procedures only. Similarly, periodontal implications of orthodontic tooth movements were studied by Polson et al. by creating intrabony periodontal angular pockets on the mesial and distal areas of incisors in rhesus monkeys. The teeth were moved through these defects, ultimately eliminating the angular defects.[11,12,13,16,17]

In this case, a clear appliance over the adjacent teeth was used to establish an anchor of sufficient strength. The strength was reinforced by scaffolding using the fiber-reinforced composite. To improve the esthetics during the traction or retaining period, the labial shell of the artificial tooth was attached to the inner labial side of the clear appliance. A beam made in the fiber-reinforced composite, crossing over the space of the root rest between the two adjacent teeth, acted as the main anchor to draw the fractured tooth. The clear appliance could not be delivered without occlusal interference, which was controlled by removal of the area of centric stops by making a hollow in the plastic sheet. This appliance and technique incorporated some modifications and provided adequate esthetics, function, and stability.[15,16,17]

CONCLUSION:

This multidisciplinary treatment including forced eruption is the ideal option to restore the fractured teeth especially in the anterior segment. The advantage of this approach includes preservation of the root structure in order to avoid atrophy of the surrounding bone that normally accompanies a long standing extraction

site. The enhancement of gingival level provides the restorative dentist with more favorable conditions for placement of esthetically pleasing restorations. The preservation of bone will enhance the success of eventual implant placement if becomes essential at a later stage. **Figure 8a-b,9**

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FIGURES:

Figure 1: The fractured coronal portion was removed.

Figure 3a: Lingual view of endodontic obturation on tooth No. 11. Note extension of the fracture line subgingivally.

Figure 2: Preoperative PA radiograph of teeth Nos. 12and 11.

Figure 3b: Completion of endodontics with fill of composite resin. Endodontics was then completed for tooth No. 12 (lateral incisor). Note the fracture line to osseous crest for tooth No. 11 An acrylic provisional was placed for tooth No. 11, prepared through the biologic width to gain retention, and cemented with permanent cement.

Figure 4: Presentation to the periodontist's office. After case presentation forced eruption was commenced with acid-etching of teeth Nos. 13,12,21, and 22 on the mid-facial enamel portion of the crowns.

Figure 5a: Brackets were bonded first on teeth Nos. 13,12,21 and 22 for passive bracket engagement with a 0.012 round wire (nickel titanium) followed by apically positioning the bracket for tooth No. 11 approximately 2 mm to allow wire engagement.

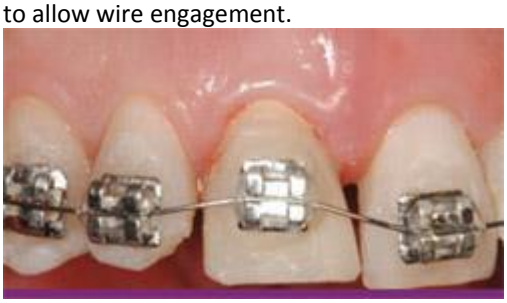

Figure 5b Engagement of the wire into tooth No. 11bracket causes an offset in the wire and its desire to erupt the tooth by its memory to straighten. The temporary crown was reduced 2 mm to 3 mm incisally to allow unimpeded coronal movement of the tooth without interference from the mandibular incisors

Figure 5c : After 2 weeks, the wire is straight and passive; acrylic is placed above the bracket to allow further eruption without replacing it.

Figure 5d: Radiograph taken the day of the surgical flap procedure. Note the amount of eruption achieved (approximately 5 mm to 6 mm).

Figure 6 Facial view of the corrected soft tissue after crown lengthening of tooth No.11

Figure 7a Tooth No. 11was prepared to place a new temporary crown approximately 3 weeks after surgery, with margins placed only to marginal tissues to allow further maturation of the biologic width and sulcular area.

Figure 7b Lingual view of prepared tooth No. 11with adequate tooth structure now available to place a conventional full-coverage porcelain crown after additional healing of 2 months and completion of orthodontics to move tooth No. 23 into a better arch position for restorative dentistry. Note the facial rotation of this tooth.

Figure 8a: Close-up smile view posttreatment. Note that the gingival symmetry was able to be maintained.

Figure 8b: Clinical view with lips retracted. Note that gingival health and interproximal papillary locations are very close to pretreatment with gingival health noted around all of the restorations.

Figure 9: Two years after completion of the case.