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Successful Management of Complicated Crown Root and Crown Fractures by Tooth Fragment Reattachment - A Case Series

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ABSTRACT: Dental trauma can frequently resultin coronal fracture of the anterior teeth. One of the options for managing coronal tooth fractures, simple or complex, when the tooth fragment is available and there is no or minimal violation of the biological width is the reattachment of the dental fragment. Reattachment of fractured tooth fragments provides good and long-lasting esthetics because the tooth's original anatomic form, colour, and surface textures are maintained. With the advent of adhesive dentistry simple fractures can be managed with long term success by reattachment using composites, whereas complex fractures by root canal treatment followed by reattachment of the fractured segment with or without fiber post reinforcement is a feasible option. The present case series describes three clinical cases of reattachment using three different treatment procedures, depending on the severity of fracture. The success of these treatment procedures was evaluated over a period of 6 months. All the three treatment procedures have shown a successful clinical outcome. Besides being a conservative treatment modality, reattachment also provides an immediate positive psychological response from the patient.

Keywords: Case report, Fiber post, Fracture fragment, Fragment reattachment.

I. INTRODUCTION

Dental trauma is any injury to the teeth, gingiva, jawbone or soft tissues of the mouth. Traumatic dental injuries (TDIs) of permanent teeth occur frequently in children and young adults.[1]Crown fractures are the most frequent outcome of traumatic injuries, which primarily affect the anterior permanent teeth. It is estimated that 25% of people worldwide, before the age of 18, suffers at least one coronal fracture of an anterior tooth.[2]More than 75% of the tooth fractures are in the maxillary arch, and greater than half of these involve central incisors, followed by lateral incisors and canines. The most common causes of these fractures are automobile accidents, sports injuries and physical violence.[3] The majority of TDIs cause damage to the enamel and dentin. Crown-root fractures account for 0.3% to 5% of the injuries, necessitating a complex, interdisciplinary treatment plan.[2]

Several factors influence the management of coronal tooth fractures, which includes extent of fracture (biological width violation, endodontic involvement, alveolar bone fracture), pattern of fracture and the restorability of the fractured tooth (associated root fracture), presence/absence of the fractured tooth fragment and its condition for use (fit between fragment and the remaining tooth structure), secondary trauma injuries (status of soft tissue), occlusion, esthetics, and prognosis. Cooperation of patient and understanding the limitations of the treatment is of utmost importance for good prognosis. Coronal fractures of anterior teeth must be approached in a systematic way for achieving a successful treatment outcome.[4]

Choosing an appropriate esthetic restorative procedure for the damaged anterior teeth continues to be the main challenge for the dentist. Diverse range of treatment options are available including full or partial coverage ceramic restorations, composite resin restoration, and fragment reattachment. With the rise of newer adhesive systems, the best course of treatment for managing a coronal tooth fracture is tooth fragment reattachment, which was earlier times considered as an interim restoration, and has now evolved as an established treatment modality.[5]

The concept of fragment reattachment was documented by Chosack and Eidelman[6] in 1964 where they utilized a custom-made cast post and conventional cement for reattaching a crown segment in a 12-yr old boy. The acid etch technique for reattachment which was first advocated by Tannery[7] was later supported by Starkey and

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Simonsen.[8,9] It is a simple and conservative treatment option, restoring the morphological, functional, and esthetic aspects of the dentition while maintaining the shape, contour, texture, colour, and alignment of the natural teeth.[10]

This article describes a case series on the successful adhesive reattachment of tooth fragment to the fractured tooth in three different clinical scenarios.

II. CASE REPORTS

CASE1

A 17-year-old male patient reported to Conservative Dentistry and Endodontics Department, Govt Dental College, Trivandrum with the chief complaint of broken tooth in the lower anterior region. Patient gave a history of trauma 2 days before reporting to the clinic. Clinical examination revealed Ellis Class II fracture of Mandibular Right Central Incisor #41 (Fig1A). The fractured fragment (Fig 1B) brought by the patient was cleaned with 2% chlorhexidine solution and stored in isotonic saline solution. The intraoral periapical radiograph indicated complete root formation and a closed apex with no periapical radiolucency (Fig1C). Baseline pulp sensibility test was assessed and the tooth was vital. After getting a written consent, it was decided to initiate immediate dentin sealing of #41 followed by simple reattachment of the fractured segment.

Local anaesthesia was administered (1.0 cc of lidocaine 2% with 1: 80,000 epinephrine). Under rubber dam isolation, immediate dentin sealing was done on exposed dentin of #41 with dentin bonding agent (3M Single Bond Universal) (Fig1D). Circumferential enamel bevelling and slight internal dentinal grooving was done on fracture fragment. All the enamel area was etched for 60 seconds with 37% phosphoric acid (3M ESPE). The bonding agent was applied to the fragment and the fractured tooth. For immediate dentin sealing, 5min decoupling with time was provided for the fractured segment of the tooth. This was followed by light curing of both segments. A flowable composite resin (3M Filtek supreme flowable) was placed in a thin layer across the fractured surface of the tooth and into the internal dentinal groove of the fragment, the excess material oozing from the fracture line was removed. To closely adapt the coronal fragment to the tooth, firm and stable finger pressure was applied while visible light curing. The restorations were given a final finish and polish, labially, lingually and proximally, using finishing diamonds, soflex discs (3M) and EVE Diacomp polishing kit(Fig1E).The final post operative radiograph taken was also satisfactory. (Fig1F)The occlusion was carefully checked and adjusted, and the patient was dismissed after giving instructions to avoid exerting heavy function on the tooth and to follow regular home care procedures related to oral hygiene.The patient was kept on periodic review (1, 3 and 6 months) and it was observed that restorative treatments remained clinically acceptable through each visit.(Fig1G)

Figs 1A to G: (A) Preoperative intraoral view; (B) Fractured tooth segment with circumferential enamelbevel and slight internal dentin groove placed (C) Preoperative intraoral periapical radiograph (D)Isolation done for selective enamel etching and immediate dentine sealing (E) fragment reattachment with flowable composite (F) Intraoral periapical radiograph after reattachment(G) Postoperative intraoral view

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CASE 2

An 18-year-old female patient was referred to the Department of Conservative Dentistry and Endodontics, with a chief complaint of broken upper front tooth. A thorough history from the patient revealed accidental trauma to the upper jaw1 day back, resulting in fractured maxillary left central incisor #21(Fig 2A). The fractured fragment was also brought by the patient. (Fig 2B). Intraoral examination revealed fracture of the too thin a labiopalatal direction. Fractured tooth stump had bleeding point revealing pulp exposure. An intraoral periapical radiograph revealed no associated root fracture. The periapical tissues and the alveolar bone appeared normal. A complicated crown fracture (involving the pulp) – Ellis Class III was diagnosed in relation to maxillary left central incisor. (fig 2 C). As the fracture was a complicated one, a decision of single-visit endodontic treatment was advised. Since the fractured fragment was intact, reattachment of the same fragment was planned

After administration of local anaesthesia, access was gained through the fractured region. (fig 2 D) The coronal pulp tissuewas removed and the chamber was irrigated with 5.25% sodium hypochlorite (NaOCl) and normal saline. Initial root canal negotiation was performed with a no. 10 Kfile anda working length radiograph was taken. The root canal was cleaned with 17% ethylene diaminete traacetic acid (EDTA) and 5.25% sodium hypochlorite and shaped with Hanudent rotary file till 30 size 6 percent. The root canal was dried with absorbent paper points obturated with 2% gutta percha points and zinc oxide eugenol sealer by lateral condensation technique. Post-obturation IOPA radiograph was takenand the root canal filling was found to be satisfactory. (Fig 2 E)The internal dentine groove and slight enamel bevelling were done for fractured tooth surface and the fragment. Then they were subjected to acid etching with 37% orthophosphoric acid (3M ESPE) for15 seconds, then rinsed thoroughly with water and air dried. (Fig 2 F) Next, an adhesive (3M Single BondUniversal) was applied on to the etched surfaces and the resin cement (RelyX U200 Automix; 3M/Espe) was applied to the repositioned fragment and tooth surface.

Figs 2A to H: (A) Preoperative intraoral view (B) Fracture tooth fragment C) Preoperative intraoral periapical radiograph; (D) After access opening for root canal treatment #21; (E) Perioperative intraoral periapical radiograph after RCT (F) split dam isolation and etchant applied for reattachment (G) Postoperative intraoral view (H) Postoperative intraoral periapical radiograph

Prior to light curing, the fragment's adaptation to the tooth surface was verified. Light curing was done for 20 seconds on both sides, labially and palatally. After light curing 1-mmdeep chamfer was prepared along the fracture line on the labial surface with round bur (BR31 bur, Mani, India). Following surface etching and bonding protocol, a layer of micro hybrid composite (Filtek Z250™ 3M ESPE) was applied to the chamfer surface and subjected to visible light curing for 40 seconds per increment. The restored surface was finished and polished using Sof-Lex™ disks (3M ESPE). Final evaluation for occlusion and esthetics was also done. (Fig 2E). The final post operative radiograph was also satisfactory. (Fig 2 H). Postoperative instruction regarding preventing loading of the anterior teeth was given to the patient and was scheduled for recall visits 1 month,3 months and 6 months. Postoperative period was uneventful.

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CASE 3

A 27-year-old male injured in a fall injury, referred to the Department of Conservative Dentistry and Endodontics for emergency management of fractured tooth #11. The fractured line was labiopalatal, running obliquely upwards and was held in place by the gingival attachment(Fig 3 A). Radiographice xamination showed a complicated oblique crown fracture on #11 that extended sub gingivallybeyond the junctional epithelium. Periapical radiographs revealed no root fracture or any other periapical changes. (Fig 3B)

Figs 3A to I: A) Intraoral preoperative view with subgingival fractured tooth segment(B) Preoperative intraoral periapical radiograph(C)Stabilised fracture segment (D)RCT completion(E) Post space preparation done and fiber post tried (F) Extracted fracture fragment (G) surgical flap elevated (H)Fragment together with post held in position before curing (I) Immediate post operative view after suturing (J) Immediate Postoperative intraoral periapical radiograph; (K) Postoperative intraoral view after healing

A single visit root canal treatment (RCT) was planned on #11 as an emergency management, followed by reattachment with fiber post reinforcement as an elective procedure on the next day. Local anaesthesia was administered (1.0 cc of lidocaine 2% with 1: 80,000 epinephrine) and the fractured segment in relation to #11 was stabilized with Interlig splint (Angelus) in relation to #12 #11 and #21(Figure 3 C). RCT was completed on #11(Fig 3D) and post space was prepared using Peeso reamers. Esthetic post of diameter 1.1mm (Angelus, REFORPOST) was selected. Access for the post was temporarily closed with an interim restoration (Orafil G, Prevest).Patient was recalled for surgical reattachment of the fractured segment on the next day. Fracture segment was carefully removed after the splint removal. (Fig 3E, F) It was then cleaned with 2% chlorhexidine solution and stored in isotonic saline solution. To gain access to the gingival extent of the fracture line and to better evaluate its relation to the bone crest, buccal and palatal full thickness mucoperiosteal flaps were elevated using number 15 B-P blade. (Fig 3G) Haemostasis was achieved with tranexamic acid (TRANCIS 500MG /5ML) and nonwoven sterile sponges (Oro, India).

Assessment of post along with fractured segment was done after adjusting the post length. The prepared post space and fractured segment were etched for 15 seconds using 37% phosphoric acid (3M ESPE).It was then rinsed thoroughly with sterile water and excess water was removed with a cotton pellet. After that the bonding agent (3M Single Bond Universal) was applied on the etched surface as well as the post. The adhesive was air thinned and light cured for 10 seconds. The post was then luted with resin cement (RelyX U200 Automix; 3M/ESPE) (Figure 3H).The

mucoperiosteal flaps were sutured and periapical radiograph was taken to ensure the proper cementation of post as well as fragment (Figure 3I, J). The occlusion was checked and postoperative instructions were given to the patient. The patient was kept on periodic review and it was observed that both endodontic and restorative treatments remained clinically acceptable. (Fig 3.K)

III. DISCUSSION:

Reattachment of fractured tooth fragment can provide good and long- lasting esthetics because the tooth's original anatomic form, colour, and surface texture are maintained. It not only restores function but also provides a positive psychological response, and is a relatively simple procedure. Reattachment of fragments involving enamel and dentin has been found to be satisfactory after 1 year.[11] Incisal fractures of anterior teeth have been successfully treated by reattachment.[12] Complicated fractures involving pulp have been treated by reattachment with post and core.[13]The present case series presents three cases of effective anterior tooth fracture reattachment with a 6-month follow-up.

In the present case series, three different treatment protocols were carried out for reattachment of fractured tooth segment. In case report1, reattachment was carried out by placing a circumferential enamel bevel. In the second case report, reattachment was carried out using placement of an internal dentinal groove. Whereas, in the third case report, the fractured tooth fragment was a traumatically removed and then reattached using fiber reinforced post. All the three cases had shown a successful treatment outcome in a span of 6 months.

Fragment Reattachment may offer the following advantages:
1. Most rapid and conservative management
2. Better esthetics as shade match and translucency will be perfect.
3. Incisal edge will wear at a rate similar to that of the adjacent teeth.
4. A positive emotional and social response for the patient

There are also perceived disadvantages:
1. Colour changes of the bonded fragment
2. Reduced esthetic result if the tooth fragment is dehydrated
3. Unknown longevity
4. Need of continuous monitoring[14]

The remarkable advancement in adhesive systems and resin composites has made reattachment of tooth fragments a procedure that is no longer a provisional restoration but rather a restorative treatment offering a favourable prognosis. However, this technique can be used only when intact tooth fragment is available and close repositioning between fragments is possible.[15]Another important consideration for successful outcomes is the rehydration of the fractured fragment. Hydration of the tooth fragment can help in maintaining the original aesthetic appearance and prevents the desiccation of the collagen fibrils and network. A dehydrated fragment will tend to exhibit decreased bond strength, fracture resistance and poor translucency. A rehydrated fragment ensures better penetrability of the bonding agent, improving the bonding outcome by mechanical interlocking.[16]

Amir et al in 1986 have shown that the coronal pulp chamber can be used as reinforcement; thereby avoiding excess tooth preparation in cases where endodontic therapy is indicated and further stated that the direction of fracture line is an important aspect in re-restorability and has a direct bearing on the prognosis of teeth.[17]

Extensive damage of the anterior tooth structure warrants reinforcement using fiber posts. Tooth colored fiber posts have several advantages like improved esthetics, ability to bond to tooth tissue, having a modulus of elasticity similar to that of dentin and being more fracture resistant. An additional use of fiber posts is that it helps to distribute the stress to remaining radicular dentin.[18]

Luting the fiber posts with resin cement not only reinforces the tooth but also helps toachieve higher bond strengths of the fractured segments. It can also minimize the inclusion of air voids .[19,20]

If the fracture line is supragingival, the procedure for reattachment will be more predictable However, if the fracture site is subgingival or intraosseous, orthodontic extrusion of the tooth may be necessary. Alternative methods which include surgical techniques such as electro surgery, elevation of tissue flap, clinical crown lengthening surgery with removal of alveolar bone, and removal of gingival overgrowth for access to the fractured site may be needed, for bonding of the fractured component to the tooth. It has been suggested that whenever the fracture site invades the biologic width, surgery should be performed with minimum osteotomy and osteoplasty.[20]

Long-term follow-up should include clinical evaluation of fragment retention, tooth

color and form, and periodontal health, as well as radiographic monitoring (periapical radiographs) to visualize small changes in the periodontal ligament. Periodic sensitivity tests are also required. Medium and long-term follow-up examinations are imperative to assess the pulp condition of the traumatized tooth.

IV. CONCLUSION:

With the adhesive materials available today, in conjunction with an appropriate technique, esthetic results can be achieved with predictable outcomes for fracture reattachments. Thus, tooth fragment reattachment is a viable technique which can restore function and esthetics with a very conservative approach, and it should be considered when treating patients, especially young patients with coronal fractures of the anterior teeth.

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