Case Report

Biological Approach in the Treatment of Uncomplicated and Complicated Crown Fractures in Permanent Maxillary Central Incisors: A Case Report

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Abstract

Traumatic injuries of teeth also involve varying degrees of damage to the supporting soft tissues or hard tissues. A very common injury to the permanent dentition affecting children and adolescents during their growing years is the anterior crown fracture. Recent advances in restorative materials, placement techniques, preparation designs, and dental adhesive protocol allow clinicians to predictably restore fractured teeth. With the advent of adhesive dentistry, the process of fragment reattachment has become simplified and more reliable. Among the various treatment options, reattachment of a crown fragment is a conservative treatment that should be considered for crown fractures of anterior teeth. Fracture reattachment treatment provides immediate function, esthetics, and psychological well-being with a more biological approach of reattaching the same fractured tooth fragment to its intact tooth. This case series presents different treatment techniques for fractured teeth reattachment depending on the complexity of the fractured crown in permanent maxillary central incisor teeth.

Keywords: Complicated fracture, Crown fracture, Internal dentinal groove, Intra-enamel bevel, Reattachment, Uncomplicated fracture.

Introduction

Coronal fractures of the anterior teeth are a common form of dental traumatic injuries affecting both the deciduous and permanent teeth. It has a severe impact on the social and psychological well-being of a patient.[1] The majority of dental injuries involve the anterior teeth, especially the maxillary incisors (because of its position in the dental arch), whereas the mandibular central incisors and the maxillary lateral incisors comparatively are less frequently involved.[2] Approximately one in six adolescents and one in four adults suffer a traumatic dental injury in their lifetime and most dental injuries involve just one tooth. After maxillary central incisors, traumatic injuries occur most frequently in upper and lower lateral incisors and the upper canines.[3] Divakar *et al*. 2007 reported that crown fractures have been documented to account for up to 92% of all traumatic dental injuries to the permanent dentition. Coronal fractures of permanent incisors represent 18–22% of all trauma to dental hard tissues, 28–44% being uncomplicated fractures involving enamel, dentin, and 11–15% complicated fractures involving enamel, dentin, and pulp.[4] Uncomplicated crown fractures are a frequent form of dental injuries, as they present without any pulpal exposure. Whereas complicated crown fractures are present with pulpal exposures, often requiring immediate management in dental clinics. A variety of factors influence the success of the treatment and these include the extent, pattern of fracture, and more importantly the restorability of the traumatized tooth. Other factors such as secondary trauma, and the availability of the fractured tooth fragment determine the prognosis of the condition.[5] To determine the treatment, the position of the fracture line is an important factor, especially when the supporting gingival tissue is compromised.[6,7] Management of the fractured tooth by reattaching the fractured fragment to the intact tooth using adhesive restorative materials offers advantages such as; immediate reestablishment of esthetics, function, shape, texture, shade, and original alignment of the fractured teeth involved.[2]

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This case series presents the management of: (1) Uncomplicated crown fracture of a maxillary central incisor tooth involving enamel, and dentin. (2) Complicated crown fracture of a maxillary central incisor tooth involving dental pulp, treated with fractured tooth reattachment technique using flowable dental composites.

Case Report 1

A 32-year-old male patient reported to the Department of Conservative Dentistry and Endodontics in Triveni Institute of Dental Sciences, Hospital and Research Centre, Bilaspur, Chhattisgarh, with the chief complaint of fractured maxillary left central incisor tooth after a fall. The patient had collected the fractured tooth fragment from the site of injury and had placed it in a wet cloth and reported immediately to our department within 30 min. On intraoral clinical examination, crown fracture involving enamel and dentin, Ellis Class-II fracture with fracture line extending obliquely at incisal one-third of the crown involving both the labial and palatal aspect was seen in permanent maxillary left central incisor tooth (tooth no. 21) (Figure 1). However, there was no soft-tissue injury seen.

The fractured tooth fragment was then immediately placed in 0.9% normal saline to prevent its dehydration. Radiographic examination of tooth no. 21 confirmed uncomplicated oblique crown fracture with no periapical pathology, roots were completely matured (or) formed, no bone loss was noticed, no root fracture, and no injury to any adjacent teeth. After confirming, that the involved tooth (21) is vital with a cold test using Roeko Endo-Frost spray (Coltene Endo, Coltene/Whaledent, Germany) and Electric pulp tester (Waldent Electric Pulp Tester, Gurugram, India), reattachment of fractured tooth fragment was planned to tooth no. 21 using flowable dental composite resin.

The patient was explained with the treatment plan of the involved tooth; fractured tooth reattachment technique, which included intra-enamel bevel preparation in the intact tooth and in the fractured tooth fragment and internal dentinal groove preparation in the fractured tooth fragment, both bonded together with flowable dental composites and the long-term monitoring needed with this treatment option. The patient was also briefed about the restriction on aggressive biting activities on the involved tooth. On understanding the benefits and limitations of our treatment plan, the patient showed positive intention for reattachment of his fractured tooth fragment with the intact tooth to maintain the integrity of the natural tooth in its original form. Written informed consent was obtained from the patient.

Under rubber dam isolation of the involved tooth, an intra-enamel circumferential bevel (0.5 mm in dimension) was prepared using 8862 diamond bur (Komet's, USA) both on the fracture line of the intact tooth and also on the fractured tooth fragment. An internal dentinal groove (dimension of 1 mm depth and 1 mm width) was prepared on the palatal aspect over the fracture line of the fractured tooth fragment using 8,862 diamond bur.

The fracture line on both the intact tooth structure and the fractured tooth fragment was then acid etched using 37% phosphoric acid (Actino gel, Prevest, DenPro, Jammu, India) for 15 s and thoroughly rinsed off with water and gently air dried. Adper Single bond 2 (3M ESPE St Paul MN, USA) dental adhesive was then applied to both the pre-etched tooth surfaces and light cured for 15 s each. Flowable dental composite resin (Filtek Z-350, 3M ESPE, USA) was placed using the composite filling instrument (Hu-Friedy, Chicago, USA) in the inter-fragmentary space between the intact tooth and the fractured tooth fragment and the fit was both clinically and radiographically verified, so that the tooth fragment reattached is in perfect alignment with the intact tooth. The excess composite resin was then removed and light cured using dental composite curing light (Saab, China) from both the buccal and palatal surfaces. Finishing and polishing were done using Soflex discs (3M ESPE, Dental products, St Paul, USA) with polishing paste (Shofu Inc. Kyoto Japan) (Figure 2). The patient was recalled after 1 month and a pulp vitality test was done and the tooth was found to be vital. Periodically, once in every 3 months for the next 2 years, the patient was recalled to check the integrity of the fractured tooth reattachment.

Figure 1: Pre-operative clinical photograph of maxillary left central incisor tooth with Ellis Class-II fracture

Figure 2: Post-operative: Reattachment of fractured tooth fragment using flowable composite resin in the maxillary left central incisor

Case Report 2

A 37-year-old male patient reported to the Department of Conservative Dentistry and Endodontics in Triveni Institute of Dental Sciences, Hospital and Research Centre, Bilaspur, Chhattisgarh, with a chief complaint of fractured right maxillary central incisor tooth after accidentally hitting a metal rod. The patient had collected the fractured tooth fragment from the site of injury and placed it in a small plastic box containing normal water and reached our department with an elapsed time of 20 min.

Intraoral clinical examination showed a complicated crown fracture, with a fracture line extending obliquely at incisal one-third of the crown involving enamel, dentin, and with exposure of pulp tissue, Ellis Class-III fracture with pulpal bleeding seen on the labial aspect of the permanent maxillary right central incisor (tooth no. 11) (Figure 3). However, there was no soft-tissue injury seen and the tooth was immobile.

The fractured tooth fragment was then immediately placed in 0.9% normal saline to prevent its dehydration. A radiographic examination of the tooth involved confirmed a complicated oblique crown fracture involving pulp in tooth no.11, with no periapical pathology, roots were completely matured, no periodontal bone loss seen, no root fracture, and no injury to any adjacent teeth.

The patient was explained the treatment plan of the involved tooth; single visit root canal treatment followed by reattachment of the fractured tooth fragment to the intact tooth using adhesive composite resin and the long-term monitoring needed with this treatment option. The patient was also briefed about the restriction on aggressive biting activities on the involved tooth. On understanding the benefits and limitations of our treatment plan, the patient showed positive intention for root canal treatment followed by reattachment of the fractured tooth fragment with the intact tooth to maintain the integrity of the natural tooth in its original form. Written informed consent was obtained from the patient. Local anesthesia was administered with a 2% lignocaine hydrochloride solution (Xicaine, ICPA Health Products Ltd, Gujarat, India).

Figure 3: Ellis Class-III fracture of the maxillary right central incisor

Rubber dam isolation was done to tooth no. 11. Endodontic access cavity preparation was done through the fractured labial aspect of the tooth at the site of pulpal exposure with bleeding using round diamond bur no. 4 (Mani, Japan) attached to high-speed conta-angled airoter handpiece (NSK, Japan), canal orifice was located, and pulp tissue was extirpated using barbed broaches (Dentsply Maillefer, Switzerland). The root canal was negotiated up to the apical constriction using hand file size no. 15K (Kerr) (Mani, Japan). Working length was determined using an electronic apex locator (E-pex, Orikam Health cares, Delhi, India), and final confirmatory working length determination Intra-Oral PeriApical radiograph was taken using RadioVisioGraphy (BlueX Imaging Srl, Italy).

Chemomechanical preparation was done using ProTaper Next Rotary file system (Dentsply Maillefer, Switzerland) attached to CanalPro Cl2 Cordless Endomotor handpiece (ColteneWhaledent Pvt. Ltd, Altstatten, Switzerland) up to X4 file size following manufacturer's instructions. During root canal instrumentation, 3% sodium hypochlorite solution (Neelkanth Health Care Pvt Ltd, Jodhpur, India), 17% ethylene diamine tetraacetic acid (Prime Dental Products Pvt Ltd, Thane, India) and 2% chlorhexidine gluconate solution (Nivy Remedies Pvt. Ltd., West Bengal, India) were used as root canal irrigants. The root canal was then dried with sterile paper points (DiaDent, Group International, Korea). Root canal walls were uniformly coated with AH-Plus Resin-based sealer (Dentsply, Maillefer, Switzerland) and obturated with X4-Gutta-percha point (Dentsply, Maillefer, Switzerland) in single cone technique, and a radiograph was taken. Post-endodontic restoration was done with Filtek Z350 XT Dental composite resin (3M ESPE, St Paul MN, USA) following the self-etch technique.

Under rubber dam isolation of the involved tooth, an intra-enamel circumferential bevel (0.5 mm in dimension) was prepared using 8862 diamond bur (Komet's, USA) both on the fracture line of the intact tooth and also on the fractured tooth fragment. An internal dentinal groove (Dimension of 1 mm depth and 1 mm width) was prepared on the palatal aspect over the fracture line of the fractured tooth fragment using 8862 diamond bur.

The fracture line on both the intact tooth and the fractured tooth fragment was then acid-etched using 37% phosphoric acid (Actino gel, Prevest, DenPro, Jammu, India) for 15 s and thoroughly rinsed off with water and gently air-dried. Adper Single bond 2 (3M ESPE St Paul MN, USA) dental adhesive was then applied to both the pre-etched tooth surfaces and light cured for 15 s each. Flowable dental composite resin (Filtek Z-350, 3M ESPE) was placed using a composite filling instrument (Hu-Friedy, Chicago, USA) in the interfragmentary space between the intact tooth and the fractured tooth fragment and the fit was both clinically and radiographically verified, so that the tooth fragment reattached is in perfect alignment with the intact tooth. The excess composite resin was then removed and light cured using dental composite curing light from

both the buccal and palatal surfaces. Finishing and polishing were done using Soflex discs (3M ESPE, Dental products, St Paul, USA) with Polishing paste (Shofu Inc. Kyoto Japan) (Figure 4). Periodically, once in every 3 months for the next 1 year, the patient was recalled to check the integrity of the fractured tooth reattachment.

Discussion

Chosack and Eidelman[8] in 1964 pioneered the procedure of using a patient's own fractured crown fragment reattached to his intact tooth. The use of flowable dental composite resins and dental adhesives enables the clinician to reattach the patient's own fractured tooth fragment to the intact tooth structure. Acid-etch technique in fragment tooth reattachment was first used by Tennery[9] in 1988. Various techniques are currently been used for the fractured tooth fragment reattachment; intra-enamel circumferential bevel, chamfer, over-contour, lingual bevel, simple reattachment, and internal dentin groove preparations on enamel tooth surface.[10]

In our both first and second case reports, we used intra-enamel circumferential bevel preparation both on the fractured tooth fragment and also on the intact tooth surface to obtain optimal esthetics, retention, and function. Intra-enamel bevel preparation for tooth fragment reattachment was originally put forth by Simonsen in 1979.[11] This entails a 45° bevel preparation circumferentially on the intact tooth structure at the site of the fracture line, as bevelling of enamel removes very minimal enamel and displays the appropriate end-to-end relationship between the enamel prisms of the fractured tooth fragment and the intact tooth structure for the most effective etching and bonding mechanism for the tooth fragment reattachment technique using dental composites resins.[11]

Both in our first and second case reports, internal dentinal groove preparation was done over the fracture line in the fractured tooth fragment. This groove had two objectives: (1) Creating physical space for the composite resin cement. (2) Increasing the fracture strength of the reattached tooth fragment to the intact tooth structure. Consequently, an accurate adaptation of the fractured tooth fragment is achieved with better esthetics, and functional and biological parameters are successfully maintained.[12] Rajurkar *et al*.[13] compared four distinct reattachment tooth preparation techniques and concluded that the internal dentinal groove preparation demonstrated superior bond strength equivalent to the intra-enamel bevel technique.

Figure 4: Post-operative: Reattachment of fractured tooth fragment using flowable composite resin in the maxillary right central incisor

Both in our case reports 1 and 2, we used a biological treatment approach, as the patient's own fractured crown fragment was itself reattached to the intact tooth structure using flowable composite resin, rather than restoring the entire fractured crown with dental composites. The treatment performed in both of our case reports is one of the many possible options that could be used for the treatment of the patient's teeth. Selection of the treatment plan should be made considering the advantages and disadvantages of each treatment technique available and should be within the desires and limitations of the patient.[14] Numerous factors play an important role in determining how long the reattached tooth fragment remains functional and among these factors, the media used to store the fractured tooth fragment, type and flow of composite resin used, type of tooth preparation technique followed in the reattachment procedure becomes significant.[15-17] Restoration of the fractured crown with dental composites can be considered an esthetic treatment approach, However, no synthetic tooth-colored restorative material can exactly replicate the esthetic characterization of color, shade matching, and translucency of the natural tooth structure.[18] Moreover, composite resin will be abraded more quickly than enamel by the opposing tooth.[19] Whereas, when the fractured tooth fragment is reattached, the rate of wear and abrasiveness is the same as that for the intact tooth. In addition, the fractured tooth reattachment treatment procedure is less time-consuming and cost-effective.[10] Reattachment of the patient's own fractured tooth fragment for the restoration of the tooth gives an emotional positive response to the patient.[20] The use of natural tooth structure clearly eliminates the problem of differential wear, shade mismatch, and difficulty in contour and texture reproduction associated with any dental restorative material.[13]

The minimal tooth preparation of the fractured tooth fragment and the remaining intact tooth structure actually enhances their bonding between them.[19] Reattachment without making any tooth preparation lowers the fracture strength of the reattached tooth fragment.[21] Badami *et al*.[22] showed that fractured tooth specimens prepared with chamfer preparation and bonded exhibited a fracture resistance of 40–60%, whereas, with internal dentin groove and over-contour tooth preparation, the fracture resistance reached 90%.[22] Bruke[23] used a combination of internal dentin groove preparation and circumferential beveling of enamel margins and found the result to be successful.[23] If the fracture line extends apically from labial to lingual direction, the fracture pattern is unfavorable, since it would offer low resistance to labially applied forces. Whereas, if the fracture line runs in an incisal direction from labial to lingual aspect, the fracture pattern is said to be favorable due to the amount of lingual support it

offers.[24] The flowable composite resin not only reinforces the tooth but also helps in achieving higher bond strength of the fractured tooth fragment to the intact tooth. Flowable composites minimize the inclusion of air voids and also provide strength to the tooth.[5]

Reattaching fractured tooth fragments with flowable dental composites can be used to restore crown fractures presumably with sufficient strength, but long-term follow-up is essential to predict the durability of the intact tooth-composite resin-fractured tooth fragment complex and the vitality of the tooth involved.[24]

Conclusion

Our case report presented a biological approach to the management of both uncomplicated and complicated traumatic crown fractures involving permanent maxillary anterior teeth with reattachment of the fractured crown fragment. Nonetheless, relief from pain and immediate restoration of natural dental esthetics and function accomplish the treatment goal in traumatic dental injuries.

Acknowledgment

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Conflicts of Interest

Nil.

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