CASE REPORT

Fractured Fragment Reattachment Using Individually Formable E-glass Fiber Posts: A Case Series

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ABSTRACT

The study aimed to ultraconservatively manage two cases of complicated crown fractures by reattaching the fractured fragments using individually formable E-glass fiber post.

Traumatic dental injuries must be managed with a multidisciplinary approach to maximize healing while maintaining function and esthetics. Complicated crown fractures have an incidence of up to 20% of all traumatic dental injuries. The most common injuries are in the maxillary anterior region, which can have a physical and psychological impact on the patient. The present case series includes two similar cases of complicated crown fracture of the maxillary right central incisor with the segment partially attached to the palatal mucosa at the level of gingival margin. Following initial stabilization using canal projector technique, non-surgical endodontic treatment was carried out. The post spaces were prepared minimally to accommodate a soft and flexible, individually formable resin-impregnated E-glass fiber post (everStick Post™, GC Corporation, Tokyo, Japan). This customizable anatomic post was used to retain the fragment in both cases. Its modulus of elasticity is comparable to that of dentin, and thus facilitates even distribution of forces. Dental composites were used to mask the fracture lines from the labial aspect, and the restorations were finished and polished. Reattachment of the fragment, previously a provisional restoration, is now the permanent treatment of choice, made possible by advances in adhesive technology. The procedure of reattachment in this case series using individually formable glass fiber post, neither required removal of the fractured fragment nor drilling of the coronal fragment and therefore is an ideal, ultraconservative approach to preserve the fragment intraorally. Long-term follow-up is necessary to evaluate the stabilization of the fragment and the overall functional and esthetic outcome of this treatment protocol.

Keywords: Canal projector technique, Case series, Complicated crown fractures, E-glass fiber post, everStick post, Fractured fragment, Reattachment.

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BACKGROUND

Traumatic injuries to the oral and maxillofacial structures warrant inter-disciplinary management to stabilize the injured hard and soft tissues and restore them back to function.[1] Complicated crown fractures (involving the enamel, dentin, and pulp), especially in the maxillary anterior region, are relatively common and can have physical and psychological impacts on the patient.[2]

In cases where the fractured fragment is available, its condition and fit with the remaining tooth structure need to be evaluated. In the present case series, both the patients had the fractured tooth fragment which was in place due to the palatal attachment to the gingiva. The fracture line was at the level of the gingival margin, with no violation of the biological width, and thus no extrusion or gingivectomy was conducted.

Advancements in polymer chemistry and resin bonded materials have revolutionized adhesive dentistry.[3] Due to their unique physical, chemical, and handling properties, a flexible individually formable resin impregnated E-glass fiber post with a modulus of elasticity, and flexural strength close to that of dentin was used to retain the coronal fragment with a resin cement.[4]

Due to the close approximation of the fractured fragments in the following 2 cases, a novel technique without any drilling of the coronal fragment and with minimal post space preparation was done to accommodate an anatomic post and provide a permanent reinforcement to the fractured fragment.

In the present case, a soft, flexible, adaptable individually formable polymer, and resinimpregnated unpolymerized Eglass fiber post (everStick Post™, GC Corporation, Tokyo, Japan) with patented interpenetrating polymer network, high flexural strength on light curing, and a modulus of elasticity close to that of

dentin, facilitating even distribution of occlusal stresses, were used to reinforce the fractured fragment and stabilize the traumatized tooth.

CASE REPORTS

Case 1

A female patient aged 55 years reported to the department complaining of the broken upper front tooth and associated pain due to a fall from the stairs on the previous night. The patient also reported to have pain and swelling of the lower lip. On extraoral examination, temporomandibular joint clicking and deviation associated with dislocation on excessive mouth opening were present. On clinical examination, complicated crown fracture of maxillary right central incisor was noted, with fractured segment partially attached to the palatal mucosa. On probing palatally, the fracture line was seen to be at the gingival level. Thus, a conservative approach of management without gingivectomy was decided. The tooth was tender to vertical percussion and responded negatively to electrical and thermal sensitivity tests. Radiographically, widening of periodontal ligament space was seen, and no evident fracture lines were noted in the radicular area. Based on these findings, fragment reattachment and reinforcement with an anatomic post (everStick Post™, GC Corporation, Tokyo, Japan) using dual-cure resin luting cement were planned.

Emergency Phase

Access opening was done under local anesthesia by approximating the fragment to the intact tooth structure under digital pressure, and the canal orifice was located. The coronal third was negotiated using a #15 K-file coated with EDTA (Glyde) and was enlarged using the orifice shaper Sx (ProTaper Gold). To achieve stabilization of the coronal fragment, a 6% gutta-percha with a tight fit to the orifice was coated with a very thin layer of petroleum jelly was placed through the access cavity into the canal. This technique has previously been suggested by Gerald N Glickmann and Roberta Pileggi for maintaining canal patency.[5] The fragment was then reflected palatally, and the intact tooth surface and fragment surfaces were etched with 37% phosphoric acid for 15 s, rinsed, bonded using Scotchbond Universal Adhesive (3M ESPE) and light cured for 40 s. A low viscosity flowable composite Tetric N-Flow (Ivoclar Vivadent) was injected into the space between the partially detached fragment and intact tooth structure. The fragment was then approximated, held under digital pressure for about 30 s, light cured for 40 s and excess cement was removed. Thus, the fragment was stabilized for further treatment.

Definitive Phase

i. Biomechanical preparation and Obturation: After glide path was achieved and working length was determined, the canals were enlarged using ProTaper Gold system to finishing file F3 along with irrigation using saline and 3% sodium hypochlorite. After a final rinse with 17% EDTA, the canal was dried with absorbent paper points, gutta-percha cone (#30; 6%) was placed and checked for tug back. Master cone radiograph was taken and ensuring that a 5 mm apical seal was present, sectional obturation was done using AH plus sealer. Excess sealer was removed from the canal walls using paper points.
ii. Post space preparation and customization of anatomic post: Post space was prepared minimally using peeso reamer to size #2, to preserve tooth structure, thereby ensuring the fracture resistance of the traumatized tooth. Using a BP blade, the anatomic post was trimmed to adapt to the canal space. The wide space in the coronal third was filled with additional everStick posts with bonding agent coated between the strips of the post, and laterally condensed using a hand spreader; similar to conventional lateral condensation of gutta-percha with sealer in between. Once the fit was confirmed, a short initial cure/tack cure of 10 s was done to bond the posts together and achieve better handling.
iii. Reinforcement of fractured fragment using post: Scotchbond Universal Etchant was used to etch the canal for 15 s. The etchant was completely washed away using distilled water, and the canal space was dried using paper points. Prime and Bond NT Adhesive and self-cure activator (Dentsply Sirona) were used as the adhesive. 2 drops of each were placed and mixed in a mixing well and coated on the canal wall using applicator tip. 10 s light cure activation was done. The post was also coated with the same adhesive system and light cured for 10 s according to manufacturer's instructions. Calibra esthetic resin cement base and catalyst paste (Dentsply) were mixed on a mixing pad and coated liberally in the canal using a spreader. The light cured post was placed in the canal, held under digital pressure, light cured for 40 s, and the excess post was trimmed to the orifice level. Fluorocore2+, which is a dual-cure core build-up and fast endodontic post cement, was used for the core restoration.
iv. Esthetic rehabilitation: The tooth was prepared on the labial surface at the fracture line, to a depth of

Figure 1: (a and b) Pre-operative clinical and radiographic images, (c) gutta-percha cone as canal projector, (d) initial stabilization with composite, (e) sectional obturation and post space preparation, (f) customization of everStick post, (g) radiographic image after post placement, (h) preparation for composite restoration, (i) post-operative clinical photograph, and (j) 1 year follow-up clinical photograph

about 2–2.5 mm, to receive a composite restoration to mask the fracture line. The shade selection was done (A3). Following the etching and bonding procedure, as described earlier, Filtek Z350 XT Universal composite (3M ESPE) was incrementally placed and light cured. Sof-Lex discs were used to contour and polish the restoration. The patient was not concerned about the diastema and insisted not to close it. 1 year follow-up revealed a completely stabilized tooth with no symptoms [Figure 1].

Case 2

A male patient aged 42 years reported to the department complaining of the broken upper front tooth and associated pain due to a fall 1 week back. The patient also reported to have injured the forehead and upper lip. Clinical examination revealed crown fracture of maxillary right central incisor with segment partially attached to the palatal mucosa at the level of gingival margin, similar to that in the first case. No radicular involvement was seen either radiographically or clinically. Based on the findings, treatment plan was to reattach the fractured fragment followed by reinforcement with a glass fiber post.

The clinical steps were similar to that in the first case, which included the emergency fragment stabilization by canal projector technique using flowable composite followed by biomechanical preparation, sectional obturation, minimal post space preparation, customization, and placement of everStick glass fiber. The core was built up using Multi-Core Flow (Ivoclar Vivadent) and light cured for 40 s. The fracture line was masked using universal composite and polished [Figure 2].

DISCUSSION

The procedure of reattaching the fractured tooth fragment and reinforcing it with a prefabricated fiber post is a minimally invasive technique as it requires atraumatic removal of the coronal fragment and preparation of a channel on its inner surface to fit the head of the post during rebonding.[6] This removal of the fragment might result in a subgingival fracture which requires either gingivectomy or raising a palatal flap for predictable bonding. The retention and resistance offered by the fiber post mainly depend on how well the post adapts to the root canal wall.[7]

The closer the adaptation, the better will be the retention and stress distribution.[8] However, the main drawback with the prefabricated fiber posts is that they are rigid and customization to the available canal diameter is even difficult. Hence, reattachment without removal of the fractured fragment using a customized anatomic fiber post would be an ideal method of reattachment in complicated crown fractures.

The reattachment technique described in our case report is simple and ultraconservative without removal of the fragment and reinforced with a well adapting customized anatomic everStick™ fiber post. As the patient resented with a completed access preparation through the fractured fragment, instead of removal and

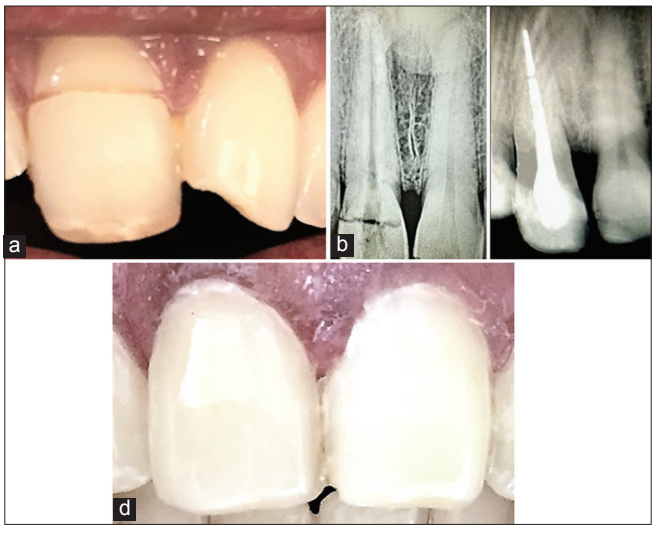

Figure 2: (a and b) Pre-operative clinical and radiographic images, (c) post operative radiographic image, and (d) post-operative clinical photograph

re-bonding, the canal projection technique was selected for pre-endodontic stabilization. A greater taper, gutta-percha canal projector was used, which is readily available and is an economical alternative to projector - Endodontic Instrument Guidance System as described by Tanikonda.[9]

The main benefit of using projectors in complicated fractures is that the fragment can be bonded with the composite resin, thus stabilizing the fragment, and preventing further propagation of the fracture line. When the canal is projected, the orifice will be relocated 3–4 mm coronally on to the occlusal surface, thus elongating the canal. This elongated canal provides an additional surface area for bonding during internal reinforcement with fiber post. The other additional advantages are the projectors prevent blockage of the canal lumen by the entry of resin composite, the elongated chamber acts as a reservoir for the irrigant and also facilitates hydraulic condensation of gutta-percha during warm vertical compaction by acting as a "hydraulic chamber" Glickman and Pettiette 2006.[5]

Reinforcement with anatomic everStick™ E-glass fiber post creates a classic primary monoblock, with a single interface between root dentin and the resin luting cement. The anatomic post is fabricated by adding additional everStick™ posts to the main post. The bond between two everStick™ posts is by the free radical polymerization between the polymethyl methacrylate (PMMA) molecules present on their outer surfaces thus uniting the posts into a single, coherent unit that exactly replicates the canal morphology. The resin in the luting agent diffuses into the PMMA-enriched outer surface of the everStick™ post and gets interlocked into the interpenetrating polymer resin network after polymerization by interdiffusion bonding.[10] Completely extending the everStick fiber posts into the elongated chamber provides maximum support to the coronal fragment by minimizing the occlusal stresses over it.

Sapna *et al.* reported three cases of successful reattachment of a fractured segment of maxillary anterior teeth with a 12-month follow-up period. They also concluded that tooth-colored fiber post may be the best option with several important advantages such as esthetics, good bonding between post and cement, lower chair time, and minimal tissue removal.[11] It appears that the use of a fiber post with fractured teeth minimizes the stress on the reattached tooth fragment as it interlocks the two fragments. Likewise, our innovative procedure of attaching the fiber post without drilling the crown helps to further reduce stress on the fragment.

CONCLUSION

Fractured fragment reattachment using individually formable glass fiber post did not require removal of the fractured fragment, drilling of the coronal fragment, extensive post space preparation, or any gingival intervention procedures. Thus, the fracture resistance of the traumatized tooth was not compromised, and the adhesive bond achieved between the resin post and dentin additionally reinforced the tooth. With such a minimalistic adhesive treatment protocol, this procedure can be considered as an ideal, ultraconservative approach to attain a monobloc effect and preserve the fragment intraorally.

However, long-term follow-up is necessary to evaluate the stabilization of the fragment and overall functional and esthetic outcome of this treatment protocol.

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