

order to prevent dehydration and discoloration of the tooth fragment. The fit of the fragment was checked. Tooth was isolated using split dam technique. Working length of 12 mm was established with the help of radiograph followed by the biomechanical preparation using step back technique, with the apical master file being 60 k-file. 2.5% sodium hypochlorite and saline solution were used during the preparation alternately for irrigation. The root canal was dried with paper points and obturation was performed with guttapercha and AH Plus sealer (Dentsply, Maillefer, Germany) using lateral condensation and was terminated 3mm below the fracture lines. Fractured segment and root dentin was cleaned with an ultrasonic tip. Internal dentinal groove of 1mm deep and wide was made on the segment and the remaining tooth by # 2 round carbide bur with a high speed hand piece. Retraction cord was placed around 12 to obtain isolation during cementation of the fragment with resin cements. Both fractured segment and root dentin were treated with 37% phosphoric acid for 15 seconds, thoroughly washed and gently air dried. Prime and Bond NT bonding agent was applied along with self cure activator over the segment and the tooth. Resin cement Calibra (DENTSPLY Caulk) was mixed and was injected to the canal and also over the fragment, reattachment was done. Approximation of the fragment was carried out and excess cement was removed. Angulation of the reattached tooth was checked followed by light curing.

Case Report 02

A 30 year old female patient reported to the Department of Conservative Dentistry and Endodontics, Bharati Vidyapeeth Dental College and Hospital Navi Mumbai, with a chief complaint of fractured left upper anterior tooth. Medical history was non contributory. Patient gave history of trauma two days back and no treatment had been performed. Clinically subgingival complicated fracture with 22 was noted. Oblique fracture exposing the pulp chamber was revealed. Ellis Class VI Fracture line below the gingival margin was present and the fracture was not evident labially or palatally. Tooth fragment was attached to the tooth with the support of soft tissue. Crown was in correct alignment with regard to esthetics and the occlusion. On radiograph, fracture line below CEJ was noted. Further periodontal assessment showed the coronal tooth fragment to be still attached, though by a fragile soft tissue junction around the labial and palatal aspect. Grade II mobility and tenderness on percussion was positive.

Following Treatment options was explained. 1) To retain the root portion of the tooth and restore, or 2) To extract the root and prosthetic replacement. As the patient preferred to save the tooth, reattachment of the fractured crown was planned using a fiber reinforced post and dual cure resin cement. In the case described above, restoration of the teeth would necessarily involve the use of a post system, primarily because of the lack of tooth structure coronal to the gingival margin to support the restoration fragment. Fiber reinforced post was used as it has the potential for increased retention, with more flexibility and a modulus of elasticity approximately same as dentin, and when bonded with resin cement it distributes forces evenly along the root, preventing root fracture during occlusal loading which is the inherent disadvantage of a cemented cast post. Routine haematological investigations showed all values within normal range.

Procedure: Operation site was scrubbed with Povidone Iodine solution. Local anaesthesia 2% Lignocaine with Adrenaline (1:100000) was injected. A full-thickness mucoperiosteal flap was raised. Intrасulcular incision & crevicular incision was given and triangular flap was raised on buccal site to expose the

fracture line. Fracture fragment was detached by separating the gingival attachment with no.15 BP blade.

Fragment was cleaned of debris and soaked in normal saline to prevented dehydration. After removal of the fractured segment, the fit of the fragment was checked. It measured about 3mm below CEJ. Root canal was performed on the tooth using single visit protocol. Working length was 11mm using apex locator. Cleaning and shaping was done using step back technique, with the apical master file being 50 k-file. Irrigants used was 5.25% sodium hypochlorite and saline solution. Sectional obturation was done with gutta percha (Dentsply Maillefer, Switzerland) and AH plus sealer (Dentsply, Maillefer, Germany). Post space was prepared with the help of peeso reamers to size 3. The fiberpost No 1 (ReforPost, Angelus) was tried in the canal and adjusted to the desired length. Both fractured segment and root dentin were treated with 37% phosphoric acid for 15 seconds, thoroughly washed and gently air dried. Prime and Bond NT bonding agent was applied along with self cure activator over the segment, the tooth and the fiber post. Resin cement Calibra (DENTSPLY Caulk) was mixed and was injected to the canal and also over the fragment. Fiber post was placed in the canal. Approximation of the fragment was carried out and excess cement was removed. Angulation of the reattached tooth was checked and light curing was carried out from palatal, labial, and incisal surfaces for 40 second. Radiograph was taken to confirm correct placement of the fiber post. The surgical flap was secured in place with the help of sutures which were removed after one week. Occlusion was checked and post-operative instructions were given

Case Report 03

A 26 year old female reported to the Department of Conservative Dentistry and Endodontics of the BVDU Dental College and Hospital, Navi Mumbai, India with a chief complaint of broken left upper anterior tooth following trauma 2 days back No relevant medical history was reported. The trauma had occurred 2 days back due to fall while working in the farm and that no treatment had been performed.

Clinical examination showed the subgingival complicated fracture of permanent left lateral incisor. The fracture was in horizontal direction exposing the pulp chamber (Ellis Class VI). A fracture line was seen extending below the gingival margin — the fracture was not evident labially or palatally. The tooth fragment had grade 2 mobility with positive response to vertical percussion and the surrounding structures showed no damage.

Radiographic examination revealed a sub gingival horizontal tooth fracture below cervical level. Electrical pulp testing displayed a positive pulp response. Further periodontal assessment showed the coronal tooth fragment was attached to fragile soft tissues, at the junction around the labial and palatal aspect.

As the patient was keen to save the tooth, a treatment plan was devised to reattach the fractured fragment with the aid of a fiber post.

Routine haematological investigations showed all values within normal range.

Preparation of the operation site was done as in case 2 and profound anaesthesia was achieved by administering 2% Lignocaine with Adrenaline (1:100000).

A full-thickness mucoperiosteal flap was raised to expose the fracture line and the fractured fragment was detached as in case 2.

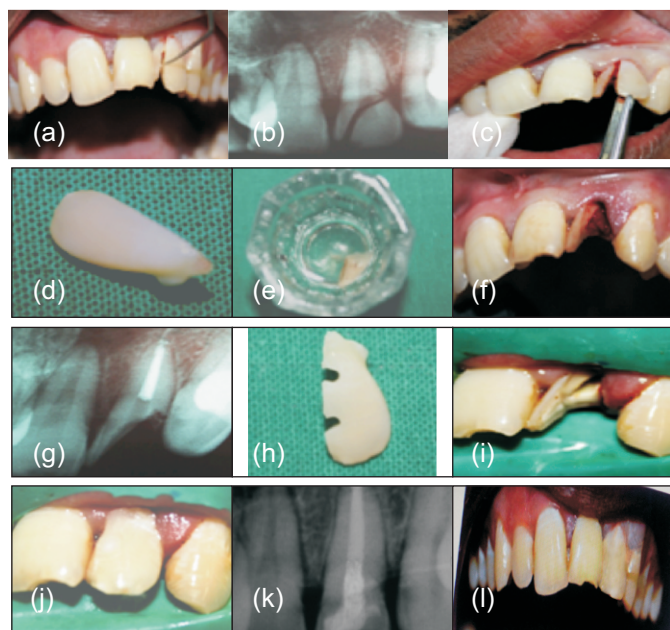
Endodontic treatment of the fractured tooth was planned as for the single visit protocol. Cleaning and shaping was done

using step back technique, with the apical master file being 60 k-file. Sectional obturation was done with gutta percha (Dentply Maillefer, Ballaigues, Switzerland) and AH Plus sealer (Maillefer, Dentply, Konstanz, Germany). After completion of the endodontic treatment, post space was prepared with the help of Peeso reamers. The fiber post No. 1 (ReforPost, Angelus) was tried in the canal and adjusted to the desired length. Remnants of pulp tissue from the fractured fragment were removed during this step. Care was taken not to remove excess dentin as it can alter the final aesthetic appearance of the tooth. Once the desired fit was confirmed, it was again stored in distilled water. It was decided that crown fragment and fibre post would be cemented separately *ex vivo* before attaching them to the root fragments. The lengths of fiber posts needed were measured using a periodontal probe. A hole was drilled in the centre of the original crown fragments using a diamond abrasive point with water cooling to attach the fibre post.

The crown fragments were etched with 37% phosphoric acid gel (Scotchbond Etchant, 3M ESPE, St. Paul, MN) for 20 seconds, rinsed for 20 seconds and dried with a gentle stream of air. The bonding agent (Adper Single Bond, 3M ESPE), a dual curing luting system (Calibra® Esthetic Resin Cement (Caulk/Dentsply) and fibre posts were sequentially applied according to the manufacturer's instructions using a light-emitting diode device (Bluephase 2, Ivoclar Vivadent).

Root canal space was etched with 37% phosphoric acid, bonding agent (Prime and Bond NT) was applied, coronal tooth fragment with cemented fiber post was placed on prepared surface and light curing was done for 40 sec. A radiograph was taken to confirm correct placement of the fiber post. The surgical flap was secured in place with the help of interrupted sutures which were removed after one week. Occlusion was checked and post-operative instructions were given to the patient and the patient was recalled after 7 days for evaluation. On further follow-ups of 2, 6 & 12 months, the tooth was asymptomatic, confirmed the satisfactory aesthetic and functional outcome of the treatment with no associated endodontic or periodontal problem.

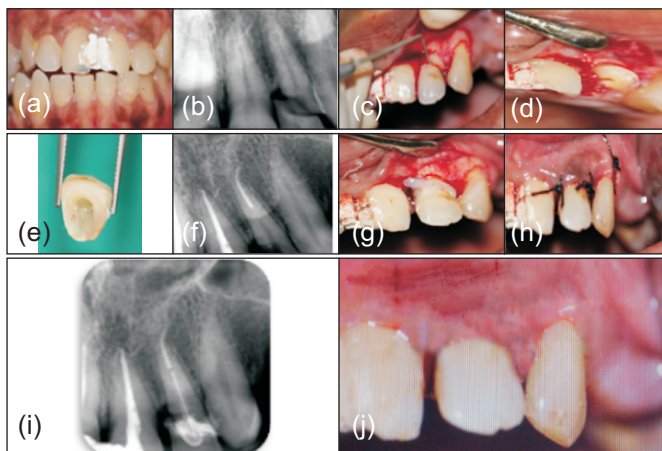
Case 1



Case 1: a) preoperative clinical view, b) pre operative

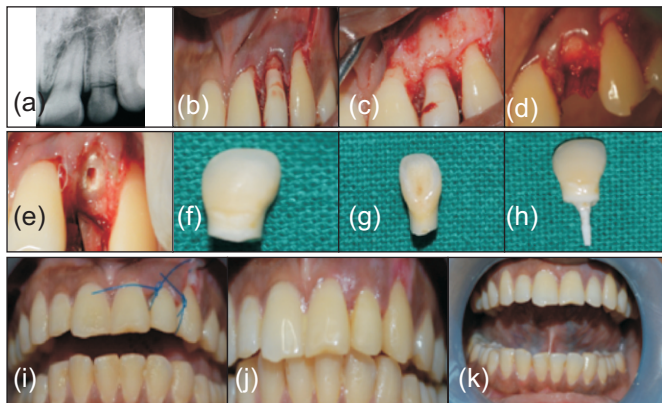
radiograph c) removal of the mobile fragment, d) fractured fragment, e) fragment stored in saline, f) after removal of fractured fragment, g) post obturation radiograph, h & i) internal dentinal groove on the fragment and the tooth, j) fragment reattached with resin cement, k) post operative radiograph, l) follow up after 12 months.

Case 2

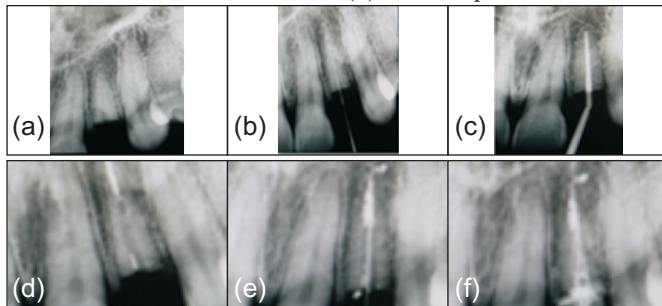


Case report 2: a) pre operative clinically, b) pre operative radiograph, c) incision and flap raising to check the fracture line, d & e) removal of the fracture segment, f) post obturation radiograph with sectional obturation in 22, g) cementation of the fractured segment with use of fibre post cemented using resin cement, h) suture placed after flap approximation, i & j) post-operative radiograph and follow up after re-attachment

Case 3



(a) Preoperative IOPA (b,c) Flap raised to check the fractured fragment (d,e) Fractured fragment detached from the main tooth structure (f,g) Labial & palatal view of fractured fragment (h) Fiber post attach to the fractured crown fragments (i) Reposition of fractured fragment and flap sutured (j) Removal of sutures after 1 week (k) Follow up after 12 months



a) Immediate IOPA after removing fragment (b) Working length X-ray (c) Master cone X-ray (d) Sectional Obturation (e) Fiber post trial (f) Post operative IOPA after re-attachment showing fiber post cemented with resin cement

Discussion

Anterior teeth are commonly traumatized in orofacial injuries associated with automobile accidents¹, sports injuries, violence or fall. Among traumatic injuries, uncomplicated crown fracture accounts to more than 50% cases whereas complicated crown fractures accounts to 2 to 13% of all dental injuries⁷. Trauma with associated fracture of anterior tooth poses immense distress to the young patient. Reattachment of fractured fragment and preservation of natural tooth form provokes a positive emotional and social response from the patient¹⁴. Various treatment options can be considered for the management of fractured teeth. Early techniques include stainless steel crowns, basket crowns, orthodontic bands, pin-retained resin, porcelain bonded crown, and composite resin with acid etch adhesive techniques and jacket crown but techniques that restores aesthetics and improve long term success rates are of potential value and should be considered.

Conventional composite resin restoration may result in less than ideal contours, color match and incisal translucency. In addition, composite has poor abrasion resistance¹³ in comparison to enamel. Prosthodontic restorations in younger patients may have confounding variables such as large pulp, progressive eruption and gingival margin instability. Thus, when an intact fragment is available that fits reasonably well to the fractured tooth, fragment reattachment may provide most conservative and most esthetic treatment option available¹⁶.

The choice of treatment for complicated crown and/or root fractures which involves the pulp depends upon several factors viz the developmental stage of a tooth, time lapsed between occurrence of an accident and treatment rendered as well as concomitant periodontal injury. Success of reattachment will depend on how dehydrated the tooth fragment is, because the longer it remains dehydrated, lesser will be the fracture strength of the tooth; however fracture strength can be reinstated by hydrating the fragment.¹⁵

Reattachment of tooth fragment when violation of biological width has occurred present a different clinical situation. There are several options for the treatment of teeth fractures involving the biologic width, including tooth extrusion, crown lengthening followed by fragment reattachment, or reconstruction.⁸

Development of the adhesive material creates new perspective in reconstruction of fractured teeth, it is now possible to achieve excellent results with reattachment of dislocated tooth fragment provided that the biological factors, materials and techniques are logically assessed and managed. Reattachment should be the first choice of treatment when the fracture fragment is available.¹⁸

Resin composites produce a favourable subgingival reaction and formation of junctional epithelium and connective tissue adjacent to subgingival restorative materials occurs in humans. Reattachment techniques generally require only a thin layer of a resin composite to restore the tooth to its original form and colour. This is the biggest advantage of the technique for fractures related to the gingival margin.¹⁹

In case of complicated fractures when endodontic therapy is required, the space provided by the pulp chamber can be used as an inner reinforcement thus avoiding further preparation of

fractured tooth.²⁰ The use of post increases retention and distributes the stress along the root, with the help of the glass fiber post the fractured crown can be permanently bonded to the root.²¹ Connecting the fiber post with the resin cement increases the retention of segment and provides a monoblock effect.²²

In case report 2 & 3 it was possible because the fractured fragment was intact and we could achieve a good approximation as the crown and post were inserted as a single unit and thorough curing of the composite was achieved as it was cured extra orally. The whole process was less time consuming and since most of the work was done extraorally isolation was not an issue. Studies have proved that over a period of time chemical or dual cure resin cements change color due to the presence of the amine accelerator. In this case bonding of the post on to the fracture fragment was preferred with composite resin as they are more color stable and provides teeth with enhanced esthetics over time.^{23, 24, 25}

In case report 3, fibre post was attached to the fractured crown fragments out of the mouth, then cemented these structures to the root fragment. The advantages of this technique were ease of attachment and better fit between the fibre posts and fractured fragment of tooth, in contrast to fiber posts attached to roots and crown together or after cementing a fibre post to the root.

Studies have shown that dentin-bonded resin post-core restorations provide significantly less resistance to failure than cemented custom cast posts and cores.²⁶ In addition, the fiber reinforced posts can be used with minimal preparation because it uses the undercuts and surface irregularities to increase the surface area for bonding, thus reducing the possibility of tooth fracture during function

After 12 months of follow-up, the efficacy of this technique was confirmed by the satisfaction of the patient and the success of the restoration: reattachment, colour stability, apical pathology and periodontal health remained favourable. Although the clinical outcome seemed good, the technique involves many steps and, therefore, considerable expense. For this to become a generally accepted form of treatment for subgingival coronal fractures there would need to be evidence of adequate longevity. Thus, patients should be well informed about possible failures before the treatment. When the conditions and patient expectations meet, as in this case, the technique may be evaluated as a possible long-term solution. However, it should be noted that the success of this technique is related to the clinician's ability and the patient's care.

The clinician must always consider that a dry and clean working field and proper use of bonding protocols and bonding materials are the key to achieve success in adhesive dentistry. With all traumatic injuries, follow up is of critical importance and the patient should be followed for 3, 6, and 12 months and yearly for 5 years. Aesthetics, tooth mobility, and periodontal status should be confirmed both clinically and radiographically at these follow-up visits.

Conclusion

Even though there are an array of treatment options available in such situation, success is dictated by remaining tooth structure after endodontic therapy. Reattachment of the fractured fragment is a viable technique that restores function and esthetics with a conservative approach.

References

References are available on request at editor@healtalkht.com