

A single visit, multidisciplinary approach to the management of traumatic tooth crown fracture

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An immediate restorative technique resolving the acute problem of traumatic tooth fracture with pulpal and periodontal involvement, in which the fragment(s) are re-alignable. Repositioning facilitated by a custom stent, using dentine/enamel bonding. A challenging, conservative and economically viable procedure within the compass of a single visit.

Crown fractures have been documented to account for up to 92% of all traumatic injuries to the permanent dentition.¹ Some fractures are minor, others are severe enough to result in the untimely loss of the tooth involved.

The number and extent of the tissues involved in the traumatic injury determine the management needs. Damage restricted to the dental hard tissues is simpler to deal with than that associated with the inclusion of pulpal and/or periodontal tissue trauma.

This case report outlines the management of one such case using previously accepted techniques^{2-9,13} and introducing a means of relocating and positioning tooth tissue fragments during reattachment.

In brief

- A single visit multidisciplinary approach to the management of traumatic tooth crown fracture.
- A conservative, economic and well accepted technique provides the clinician with the ability to restore some catastrophic tooth trauma.
- Currently this is a well recognised technique with a 'variation on a theme' to assist in tooth fragment positioning.

Case report

A 54-year-old male presented complaining of a 'loose tooth' following biting on a peanut.

Initial examination revealed an unrestored upper right lateral incisor exhibiting class II mobility (Fig. 1). Light periodontal probing indicated no apparent periodontal pocketing. A fracture line was seen at the palatal cervical margin — the fracture was not evident labially. Adjacent teeth showed incisal wear faceting and chipping. Occlusal wear was also noted on the posterior segments. The patient admitted to a nocturnal bruxing habit.

Radiographic examination revealed a horizontal tooth fracture at the cervical level (Fig. 2).

Further periodontal assessment showed the coronal tooth fragment to be still attached, though by a fragile soft tissue junction around the labial aspect. The crown remained in its correct anatomical



Fig. 2 A radiographic view as a computer digital image

position with regard to aesthetics and the occlusion (centric occlusion).

The patient was informed of the horizontal fracture and treatment options outlined.

The initial treatment required a decision with regard to the fractured retained root, either:

- To retain the root portion of the tooth and restore, or
- To extract the root and prosthetic replacement.



Fig. 1 A pre-operative view with the coronal tooth attached

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Fig. 3 The coronal tissue removed

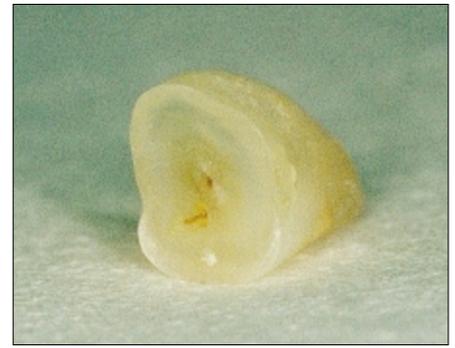


Fig. 4 The fracture site shows no caries, and no restorations



Fig. 6 A completed root treatment — note the lateral canal



Fig. 5 A slit rubber dam for root canal treatment of the subgingival root

In considering maintaining the retained tooth portion, the periodontal condition was deemed healthy enough to allow for reasonable longevity. The retained root portion was also of adequate length and sound structure to allow for restoration— had this not been so, extraction would have been considered a better option.

As the patient was keen to retain the root, and it appeared sound in structure, a treatment plan was devised whereby the fractured tooth would be reattached to it. This would use conventional post retention and adjunctional bonding of abutting surfaces.

Lignocaine (1:80,000 adrenaline) buccal and palatal infiltrations were administered. An alginate impression of the maxillary dentition was taken and then poured in stone.

A Periotome used with minimal force separated the coronal segment from its soft tissue attachment. Both root and crown surfaces were inspected under magnification (Fig. 3). A clean fracture — horizontal mesial to distal — angulated cervically from palatal to labial (type A fracture³) was evi-



Fig. 7 Fabrication of the Ellman thermoplastic stent



Fig. 8 Modification of the stent, sufficient for tooth location, and for positioning of the fractured portion



Fig. 9 Periodontal surgery showing the full thickness flap raised



Fig. 12 Tooth crown with labial venting cavity



Fig. 10 The repositioned rubber dam: the butterfly clamp retracts the flaps and exposes the circumferential margin of the root



Fig. 13 The fit surface of the crown dimpled for improved retention



Fig. 11 The stent tried for clearance of the clamp, and for stability



Fig. 14 Cementation of the coronal portion with the luting composite positioned in stent

dent. No caries or resorption defects were detected (Fig. 4). In order to prevent dehydration, the coronal tooth fragment was stored in distilled water.

Root canal treatment was carried out under a slit rubber dam which extended across adjacent teeth (Fig. 5). Warm vertical and thermo-mechanical compaction of gutta percha with Roth's cement sealed the root canal. Post operative root treatment assessment showed obturation to the apical constriction and also revealed a lateral canal (Fig. 6).

A thermoplastic stent or matrix (Ellman) was fabricated over the stone model made earlier (Fig. 7). This was further modified so that the lateral tooth pattern and adjacent incisal edges remained so as to locate the fractured portion in its correct position (Fig. 8).

Full thickness buccal and palatal flaps were raised showing the extent of the subgingival tooth fracture (Fig. 9). In the areas where the crestal bone was above the fracture line alveoplasty was performed using small round burs and hand chisels. Haemorrhage was reduced by the application of local anaesthetic (with 1:80,000 adrenaline) soaked gauze and pressure.

With the flap still raised, the rubber dam was again applied, a butterfly clamp



Fig. 15 The flaps were replaced and sutured



Fig. 17 1-week post-operative — note the good colour



Fig. 18 Occlusal view — note the post position and even contacts marked on adjacent teeth

was used on the exposed root (Fig. 10). This assisted in isolation, as well as retracting the soft tissue flap. Isolation was complicated by a haemorrhage; a slit rubber dam provided partial barrier control, this was aided by the use of lignocaine (1:80,000 adrenaline) pressure packs.

The stent was tried for stability and access (Fig. 11). A venting cavity was cut palatally into the coronal tooth fragment (Fig. 12) through the pulp chamber, after ensuring all pulpal tissue remnants had been removed. The root canal was then prepared with a Parapost drill (No. 4.5) to within about 5 mm of the apical constrict-



Fig. 16 A radiographic view of the completed tooth showing the post, and tooth tissue reattached

tion. A corresponding titanium Parapost was cut to size—allowing 3–4 mm for coronal fixation.

The surfaces to be bonded (root surface and the crown surface) were pitted with dimples (Fig. 13) using a 1/2 round bur, washed, etched with 37% phosphoric acid and a dentine bonding agent applied—Prime and bond 2.1. Dual cement (Dual cement—Ivoclar-Vivadent) was spun into the root canal and the titanium post seated. Simultaneously, the coronal tooth fragment was placed into the stent, its bonding surface and pulp cavity loaded with dual cure cement. This was placed into position and held until the cement was light cured set (Fig. 14).

Rubber dam was removed, the cement lute flash removed and the flaps positioned and sutured (Fig. 15). A check radiograph was then taken to confirm apposition of the two tooth portions and highlight areas of cement flash (Fig. 16). The occlusion was checked and adjusted, and the patient was dismissed.

Healing after 1 week was uneventful; the sutures were removed (Fig. 17).



Fig. 19. 6 weeks post-operative showing complete healing

A 2-monthly review showed the tooth fragment to be firmly attached, no periodontal or endodontic problems were noted and the occlusion was checked (Figs 18, 19).

Subsequent follow up involved fabrication of an occlusal splint for night time wear, and occlusal adjustment to minimise excursive movement forces.

The 18-month review shows good colour and position; the tooth is still firmly attached (Figs 20, 21).

Discussion

Traumatic injuries involving tooth fracture can now be treated by reattachment of the tissue fragments using an adhesive system (acting as a 'dental super glue') to provide what is considered to be the most conservative of restorations.⁴ Newer dentine bonding systems work with such efficiency that they easily allow for normal masticatory forces.⁵ Survival rates for such restorations have been shown to be good, with failure often only resulting from subsequent trauma.⁶

Factors influencing the extent and feasibility of such repairs include the site of fracture, size of fractured remnants, periodontal status, pulpal involvement, maturity of root formation, biological width invasion, occlusion, time and resources of the patient.⁸

Economical considerations when a reattachment technique is employed often negate the use of expensive cast restorations.

The advantages of using the original tooth fragment over all other materials may be listed to include:⁸

- Colour
- Morphology
- Translucency
- Physiochemical characteristics (including wear, thermal and hygroscopic expansion)
- Patient acceptance
- Structurally conservative
- Economical.

Some clinicians have even advocated restorations using hard dental tissue from donor teeth.¹⁰ However, acceptance is unlikely because of practical considerations such as sterilisation and patient attitudes.

Limitations of tooth tissue reattachment include those associated with dental adhesion, in particular control of operating field from contamination and force application, particularly indirect or shear forces working in directions where bonding forces are weakest.

Tooth preparation technique and extent is relative to the site and amount of the tooth fragment for reattachment. Where enamel margins are large compared with dentinal bonding area, and the size of the fractured tissue for reattachment is small, little or no preparation is desirable.¹⁷ Conversely, where little enamel remains, increasing the bonding surfaces is desirable. One such means advocated⁸ is the adjustment of abutting surfaces to



Fig. 20 Frontal view — the 18-month review



Fig. 21 Occlusal view — at 18 months

increase the surface area as well as serve to assist retention.

If the fracture involves two thirds or more of the crown a post-reattachment is more commonly used.¹⁶ Post placement is also to be considered in fractures where the patient exhibits a large overjet and/or parafunctional habits such as bruxing are seen. Post placement in addition to bonding, serves to retain the coronal portion via a friction bond, and assists in preventing dislodgement from non-axial forces.

Fragment alignment can be problematic, hence the use of a press-form matrix stent. Subgingival fractures do not usually allow direct visualisation, therefore, a matrix for repositioning segments can be of great advantage. Apart from locating well the clear stent allows the operator to see, and so check the positioning of the segments. Apposition can be affected by cement thickness as well as problems with relocation even when using a stent. These would include incorrect tooth segment placement, distortion of the plastic during seating, incorrect alignment of the stent itself. Such problems similarly occur when the apposition is 'freehand', but with the added difficulty of maintaining position in three dimensions without movement while the cement sets.

Should the fragment be reattached in an incorrect position, its function and the aesthetics would be compromised.

Removal of an incorrectly placed fragment is difficult, and subsequent reuse of the fragment is almost always impossible.¹⁶

Other treatment options available in the treatment of a fractured tooth include:⁷

- Root extraction and prosthetic replacement eg fixed, implant, removable
- Root burial — prosthetic replacement
- Retention of the apical tooth portion and conventional conservation eg periodontal correction if required, cast restoration
- Orthodontic extrusion, followed by restoration

- Surgical extrusion involving extraction then reimplantation and restoration.

However, many of the above techniques have associated limitations. These may include multi-visit appointments, cost, stabilisation (splinting), and be less conservative in nature when compared with this case report. For example, when considering the extrusion of a retained root — either orthodontically or more rapidly by surgery — follow up splinting¹⁴ is often necessary requiring many visits. Endodontic therapy may also have to be delayed until the extruded tooth is stable (some 10 weeks later).¹⁴ Also, if the fractured root margin is moved with orthodontics more coronally, it brings with it the periodontal tissues requiring subsequent periodontal surgery.

Other problems encountered are the reduction in root length for post retention (although an improved crown:root ratio may be achieved — a shorter root may well result with the post apex lying close to the alveolar crest giving undesirable stress concentrations. This can lead to root fracture).¹⁵ A reduced cross-sectional cervical diameter also produces restorative difficulties with respect to embrasures and emergence.

The single visit, multidisciplinary approach to a crown fracture tooth requires consideration of periodontal, endodontic, restorative and occlusal factors. This presents a great challenge to the dental surgeon, with regard to both clinical skills and time management.

Follow up must involve assessment of occlusion, periodontium and subsequent traumatic force reduction. This may take the form of a night guard, sports shield, or even subsequent more conventional tooth strengthening, such as the placement of a full coverage restoration or porcelain veneer¹² should the fracture line become supra-gingival and accessible.

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