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Management of transverse root fracture by dowel – inlay: A case report

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Abstract:

Tooth trauma has been and continues to be a common occurrence that every dental professional must be prepared to assess and treat when necessary. Tooth trauma and its management loom as a major challenge to the dental practitioner. Transverse root fractures occur most commonly in the maxillary teeth. This case report describes a new technique for the management of transverse root fractures in zone 2 with Dowel inlay. That enables the utilization of fractured fragment crown for stabilizing a transverse root fracture in zone 2 is quite 1. Simple, Economical, Minimal Invasive and can save considerable time over other alternative treatment options available in the treatment of a trauma zone 2 fractures. Both clinical and radiographic follow-up showed a stable condition without any probing defect, ongoing root resorption, or periapical pathosis.

Keywords: Transverse root fracture, Post endodontic, Restorations, Cast Post, Dowel Inlay.

Introduction

Tooth trauma has been and continues to be a common occurrence that every dental professional must be prepared to assess and treat when necessary. Tooth trauma and its management loom as a major challenge to the dental practitioner. Root fractures of permanent teeth are a relatively rare form of injury, they account for approximately 6% of all dental trauma. Coronal third type of fracture account for 0.5-0.7% of all traumatic injuries of teeth(1).

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Transverse root fractures occur most commonly in the maxillary teeth and are usually caused by an injury received in a fight or sporting event or by an inanimate object striking the teeth(2,3). Transverse root fractures are fractures that involve the dentin, cementum, pulp, and periodontal ligament. While not a common type of dental injury, they account for approximately 6% of all dental trauma,(1) and occur principally in the adult patient where the root is solidly supported in bone and periodontal membrane(2). In the younger patient the tooth is more likely to be avulsed(2).

Important in the diagnosis of transverse root fractures is the fact that root fractures and luxations and fractures of the alveolar process appear exactly the same clinically(4). Differential diagnosis is therefore entirely dependent on a reliable radiographic technique, as is the later evaluation of healing of these fractures. Based on prognostic studies,(5) the general factors predicting the type of healing that occurs after transverse root fracture are the same as those associated with luxation injuries, and therefore it can be said that a transverse root fractures is actually a luxation of the coronal segment only(4).

The goal of endodontics and restorative dentistry is to retain the natural teeth with maximal function and pleasing esthetics (6).It is generally agreed that the successful treatment of a badly broken tooth with pulpal disease depends not only on good endodontic therapy, but also on good prosthetic reconstruction of the tooth after the endodontic therapy is complete (7). The primary purpose of a post is to retain a core in a tooth that has last its coronal structure extensively.

During the treatment procedure, a structurally compromised tooth can give rise to complications such as root fracture, loss of restorative seal, dislodgement of core, and periodontal injury due to biological width invasion during margin preparation(6). There are many techniques of restoring a transverse root fractured incisor tooth after successful endodontic treatment, which should be complemented by a sound coronal restoration. This should ideally meet the requirements of function and aesthetics. It is easier to make cast metal restorations with the aid of dowel/post, Dowel-Inlay for retention and lasting service.

A Dowel inlay is a combination of dowel and inlay where in the inlay is locked to the dowel, which helps in improving the retention of the restoration as well as resistance to laterally directed forces(1). If a dowel with an attached inlay is utilized. The inlay is locked to the dowel, and some retention is imparted to the restoration, as well as resistance to laterally directed forces. Because this restoration is a combination of a dowel and an inlay, consistent nomenclature would suggest the use of dowel – inlay to describe it(5).

In this article, one case have been elaborated where minimal invasive, non surgical management of transverse root fracture by Dowel-Inlay.

Case reort:

A 55 year old male patient presented to the Department of Conservative Dentistry & Endodontics, College of Dental Sciences, Davangere, Karnataka in Jan, 2001 with a primary compliant of mobility of Maxillary left central incisor with History of Biting on a peanut 2 days back. On Examination it was found that an unrestored Maxillary left central incisor exhibiting Grade II mobility. (Fig-1)

However, tooth was asymptomatic and the clinical crown was intact, the fracture was not evident labially adjacent teeth showed incisor wear faceting and chipping, occlusal wear was also noted on the posterior segments. Light periodontal probing indicated apparent periodontal pockets further periodontal assessment showed the coronal tooth fragment to be still attached through a fragile soft tissue junction around the labial aspect. The crown remained in its anatomical position with regard to aesthetics and the occlusion. The radiographic examination of tooth no.21 revealed with clear radiolucent line at alveolar bone crest to 3mm below suggestive of transverse root fracture zone 2(1,8). No periapical changes were noted in relation to tooth no. 21.(Fig-2)

A Diagnosis of a chronic generalized periodontitis associated with transverse root

fracture zone 2 was made and the root canal treatment was performed. The following points were reviewed before proceeding further

A Gates Glidden drill no.2 (Dentsply Maillefer, Ballaigues Switzerland) was used to remove the gutta percha post space was prepared with peeso reamer in relation to tooth no.21.(Fig-3) Care was taken to ensure that the length of the post was 2/3 the length of the canal, ½ the bone supported the length of the root or in other words, length of the clinical crown(9).

An H file was used circumferentially to smoothen the preparation of the post space. The mouth of the canal must be extended enough to remove any under cuts particularly towards the facial wall of the preparation. Smooth internal walls are also important to the fit of the inlay component of the restoration. Begin the widening of the orifice of the canal with a round –end tapered diamond. Flare out the incisal 2-3mm of orifices to form the inlay portion of the preparation. Use a no. 170 bur to plane the walls smooth. To achieve the best possible marginal adaptation of the final restoration, place a wall defined wide bevel (1.0mm or greater) around the entire surface of the mouth of the canal(10).

The gingival portion of the bevel will be at approximately a 90º angle to the path of insertion of the dowel(4,5). Finishing touches are added to the bevel with a white polishing stone. Because the lingual surface of the crown closely approximates the path of insertion of the dowel. The finish for the incisor segment of the bevel may not be as well defined(10).

The direct wax pattern technique is the only choice for the indirect fabrication of a Dowel-Inlay in this transverse root fractured central incisor.

Orange wood stick (Post) was selected and trimmed and shaped conically to fit passively to full length in to the prepared post space of the root canal. The orange wood stick was coated with type I inlay Patten wax and placed in to the prepared post space in the canal. The wax pattern had one Dowel attached with concave lingual surface of the inlay component.

The casting procedure was carried out and the final casting comprised of dowel inlay. After casting remove the sprue with a carborundum separating disc. Trim off the excess contour where the sprue was attached, producing a slight concavity in the lingual surface of the inlay(5,10). There should be a v-shaped cement escape vent on the side of the dowel, but it should end about 2.0 mm from the inlay margin to avoid the possibility of a marginal defect(10).

The dowel-inlay is seen before cementation. Notice the concave lingual surface of the inlay component. (Fig-4)

The type I Glass Ionomer Luting cement (Fuji I) used for the final cementation of the Dowel-Inlay. Cement was applied to the dowel preparation with a periodontal probe or Lentulo spiral cement filler. The walls of the canal were coated all the way to the apical end of the dowel preparation(10).

The dowel –inlay was inserted into the cement-filled orifice of the canal, pushing it in with finger pressure. A condenser was used to seat the dowel-inlay completely to place. After evaluating the margins with an explorer, pressure was applied on the dowel-inlay with the instrument until the cement was set. The dowel-inlay was cemented in the canal, providing a closure of the endodontic access and reinforcement of the root and coronal tooth structure under the crown. Carborundum stone was used to adjust the contour of the dowel-inlay to blend in with that of the adjacent lingual surface. Initial steps were taken in margin finishing, orienting the stone so that it revolves from inlay to surrounding crown. After completing the margin finishing, a white polishing stone was used moving the stone from inlay to crown. A large, coarse, red rubber point was used to smooth the surface of the inlay to eliminate scratches produced by the abrasive stones. A final polish was performed by using a large, fine, green rubber point. The completed dowel-inlay is seen cemented to the natural crown. (Fig 5 and Fig 6).

Fig 1: The clinical crown is intact and fracture was not evident labially

Fig 2: Radiograph of tooth no. 21 shows no periapical changes

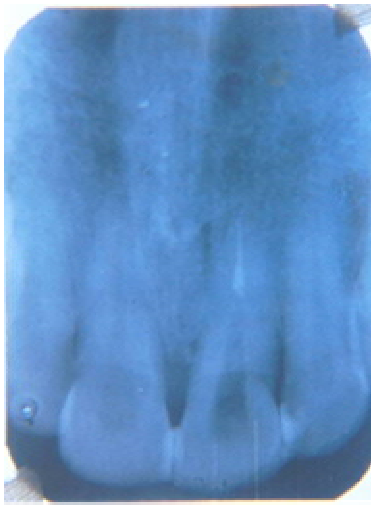

Fig 3: Radiograph shows Post space preparation

Fig 4: The dowel inlay is ready for cementation with slight concavity in the lingual surface of the inlay

Fig 5: The completed dowel - inlay is seen cemented to the natural crown

Fig-6 Post operative view of 21 after dowel inlay cementation

Fig 7: Radiograph of 21 shows dowel - inlay after cementation

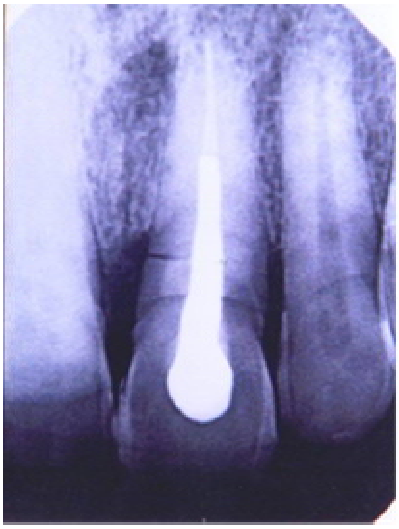

Fig 8: Radiograph showing post-operative view of dowel inlay after 6months

The completed dowel-inlay was cemented in the endodontic access opening in the lingual surface of the Transverse root fractured (zone 2) central incisor anatomical crown. The occlusion was then checked on all follow up examination after 15 days (Fig 7), One month, Two months, Six months(Fig 8). Satisfactory healing was evident both clinically and radiographically.

Discussion:

The presence of a transverse root fracture usually is clearly evident on radiographic examination(1); although the fracture line can be missed if radiography is performed immediately after the injury because at that stage the fracture line may be barely discernible. Just as other research as demonstrated the need for multiple radiographic exposures in the diagnosis of the dental trauma, the same is true for the discloser of the transverse root fractures (2,3,7).

The angulations of the vertical beam is important because it can alter the fracture line, causing the fracture to disappear completely and making differentiation of hard and soft tissue extremely difficult(1). To accurately diagnosis a transverse root fracture, a steep occlusal exposure as well as two conventional periapical bisecting-angle exposures is recommended (2,4).

In some zone 2 fractures, the base of the gingival crevice is very close to the transverse root fracture. It merely takes some mild inflammation to start apical migration of the base of the gingival crevice. Eventually, communication with the fracture line is a certainly (one-sided arrow). Once this communication exists, the coronal segment must be lost.

An occlusal radiographic view is ideal for disclosing fractures in the apical one third of the root; periapical radiographic views are better for visualizing coronally located root fractures (7). The direction of the fracture line changes from an oblique angle in the apical and middle third of the root to a more horizontal fracture line in the cervical one third. Thus an occlusal view shows apical and middle third fractures while a periapical view shows the more coronal fractures. Failure to expose both of these radiographs could easily result in misdiagnosis (6).

The most common clinical finding is a tooth that is slightly extruded with a lingually displaced crown – the coronal segment is laterally luxated. When a tooth suffers an impact that fractures the root of the tooth the single tooth becomes two teeth. As long as it is undisturbed, the apical segment remains vital in 99% of cases and usually is not a problem(6). The coronal segment may or may not be vital and may or may not be mobile depending on the state of the tooth at the

time of fracture and on the extent of the fracture and the location of the fracture line.

Transverse root fracture can be classified into 3 zones (1,8)

Zone: 1 Extends from the incisal edge to the alveolar bone crest

Zone: 2 Ranges from the alveolar bone crest to 5mm below

Zone: 3 Extends from 5mm below the alveolar bone crest to the apex of the root.

The nature of the fracture line:

Correct management of the tooth with a transverse root fracture depends on a complete understanding of what is occurring between the segments of the fractured tooth. Transverse root fracture healing can involve union of segments with hard tissue, interposition of connective tissue (periodontal ligament), or nonunion with associated interposition of granulation tissue. According to the experimental data and literature on this subject (1-6), true union across the fracture line is a relatively uncommon occurrence; the 'healing' that apparently occurs is the result of consolidation of the surrounding and supporting tissues (7).

Andreasen and Hjorting –Hansen (4) were the first to describe the four categories into which the transversely root fractured tooth may be classified. The coronal and apical segments may have union by hard tissue, union by fibrous tissue, union by bony ingrowth across the fracture line, or ingrowth of chronic granulation tissue. Union of the coronal and apical segments by hard tissue is the most desirable outcome but occurs relatively infrequently. The coronal and apical segments of the fractured tooth are brought together and remain without mobility. The chances of healing by hard tissue across the fractured segments normally is increased if only a small amount of luxation of the coronal segment occurs (concussion is far better than extrusion), if the segments have only a small amount of separation, if the "fracture foramen" of the coronal segment is large, or if the patient is young rather than elderly.

Timing is significant with hard tissue union across the fracture line (7). When a tooth is splinted immediately after trauma, a greater chance exists of hard tissue union than if the tooth is treated the next day when granulation tissue is already in place. If hard – tissue union occurs, the root may show a stage of "tunneling resorption" which does not affect the prognosis of the tooth but can appear quite dramatic on a radiograph.

Hard-tissue union does not occur in teeth with restorations or marginal periodontal disease (7).Union of the coronal and apical segments by way of fibrous tissue is the more common event after transverse root fracture and occurs where slight mobility exists during the healing process. Union of the coronal and apical segments by bony ingrowth across the fracture line occurs principally during growth spurts of the child. The coronal segment of the fractured tooth moves with the growing bone and leaves a bony interface between the two fractured segments (2). Healing takes place by interposition of bone and connective tissue (due to a growth component) (7). Therefore, these latter two categories are the same. The chance of healing with connective tissue is significantly increased by an increased age of the patient at the time of fracture, the presence of restoration in the tooth, and orthodontic band splinting of the tooth.

Attempted union of the coronal and apical segments by ingrowth of granulation tissue occurs if infection exists in one of the segments (usually the coronal segments). Granulation tissue also forms if the fracture line communicates with the oral cavity (7). Interposition of granulation tissue between the two fractured segments is caused by increased luxation of the two segments (extrusion is greater than concussion), increased loosening of the coronal segment, decreased diameter of the "fracture foramen" in the coronal segment, administration of antibiotics at the time of injury, and orthodontic band splinting. No teeth with interposition of granulation tissue had wide open apicies (7).

From a management point of view, the transversely fractured tooth segments can be considered as separate entities in virtually all cases. On a practical level, all treatment regimens are

directed at management of the coronal segment only (1-3,8).

Radiographic and histologic observations in humans have shown that the healing events after root fracture can be divided into four types (3)

1. Healing with calcified tissue
2. Interposition of connective tissue
3. Interposition of bone and connective tissue
4. Interposition of Granulation tissue.

Traumatic injuries involving tooth root fracture can now be treated by dowel-inlay to provide what is considered to be most conservative of restorations.
Factors influencing the extent and feasibility of such repairs include: (1-3,8)

- The position of the tooth after it has been fractured
- The mobility of the coronal segment
- The status of the pulp
- The position of the fracture line
- The status of the periodontium
- The occlusion
- The time and resources of patient

The general approach to management of transverse root fractures is summarized in table.1

Table -1: summary of management of transverse root fractures

Vitality	Mobility	Endodontic Therapy Required	Splinting Required
+	_	No	No
+	+	No	Yes
_	_	Yes	No
_	+	Yes	Yes

The presence of vitality or mobility is indicated by a +, and the absence of vitality or mobility is indicated by a -.

If the tooth is endodontically involved, a cast dowel core that passes through the crown and in to the root can solve the retention problem and obviate prefabrication of the crown. This is the same technique that shilling burg describes as the dowel inlay crown repair(11). Shilling burg et al (12) uses this technique in a case with out a loss crown to restore the endodontic access opening at the same time the tooth is strengthen. This technique for stabilizing a loss crown with a post & core that passes through the crown is quite simple and can save considerable time and expenses over remaking the crown. Also this technique utilizes the standard materials and method used to produce dowel inlay castings He used in a case without a loose crown to restore the endodontic access opening at the same time to strengthen the tooth .If endodontic therapy must be done on a tooth after it has received a crown, the access opening will diminish crown retention by 61% , therefore they described the placement of dowel-inlay for stabilizing of crown(10,11). David E. Snyder (1986) suggested that use of Dowel-Inlay in repair of loose crown of an endodontically involved tooth (11). Dowel-inlay can be used for stabilizing crown that are over tapered or short crown preparations (4).

This technique can save considerable time and expense over remaking the crown (4).

Other treatment options available in the treatment of transverse root fracture in Zone.2 includes (1,8,9)

- Periodontal adjustment
- Orthodontic extrusion
- Intra-alveolar transplantation of the fractured tooth
- Root extraction and prosthetic replacement
- Root burial & prosthetic replacement
- Surgical extrusion involving extraction then reimplantation and restoration

However many of the above techniques have associated with limitations. These may include cost, stabilization, and be less conservative in nature when compared with this case report.

Conclusion:

In general, if the tooth can be repositioned, stabilized, and occlusally adjusted, the prognosis of a transversely root-fractured tooth is quite favorable. However, if the fracture occurs in zone two, a complicated and extended treatment

regimen may be necessary and sometimes the prognosis may be poor.

No two dental fractures are similar so we should not use cook-book method. Each one has to be treated as a separate new case; each injury projects its own pattern and has to be treated differently. The clinician must judge every situation on its individual merits and select a procedure that fulfills the needs of the case while maximizing stability and minimizing mobility. The availability of newer treatment options with fiber posts hold great promise and benefits because their elastic modulus is similar to dentin, fiber posts tend to absorb and dissipate stress (masticatory and traumatic) like natural dentin, thereby protecting the root from fracture and in case of failure of the post/core, fiber posts allow for further treatment. This article presents the new techniques to stabilize and restore transverse root fractured central incisor in zone 2 and restore that to function and esthetics is quite simple and save considerable time and expense.

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