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MANAGEMENT OF ROOT FRACTURES

It is defined as fractures involving dentin, cementum and pulp, they are relatively uncommon. The mechanism of root fractures is usually a frontal impact, which creates compression zones labially and lingually. The resulting shearing stress zone then dictates the plane of fracture.

Notes:

1) Root fracture of primary teeth is relatively uncommon because the more pliable alveolar bone allows for displacement of the tooth. When root fracture does occur, it should be treated in the same manner as recommended for permanent teeth; however, the prognosis is less favorable.

2) The pulp in a permanent tooth with a fractured root has a better chance to recover, since the fracture allows immediate decompression and circulation is more likely to be maintained.

3) The prognosis is poor for any tooth with a fracture that extends below the gingival margin and involves the pulp in an immature tooth.

4) Root fractures occur in the apical half of the tooth are more likely to undergo repair. Fractures in the apical third are often repaired without treatment. In fact, many apparently are undetected until evidence of a calcified repair is seen radiographically sometime after the injury.

Clinical Features

1) Root fractures involving the permanent dentition predominantly affect the maxillary central incisor region.
2) Coronal fragments are displaced lingually or slightly extruded.
3) Temporary loss of sensitivity.

Radiographic Features

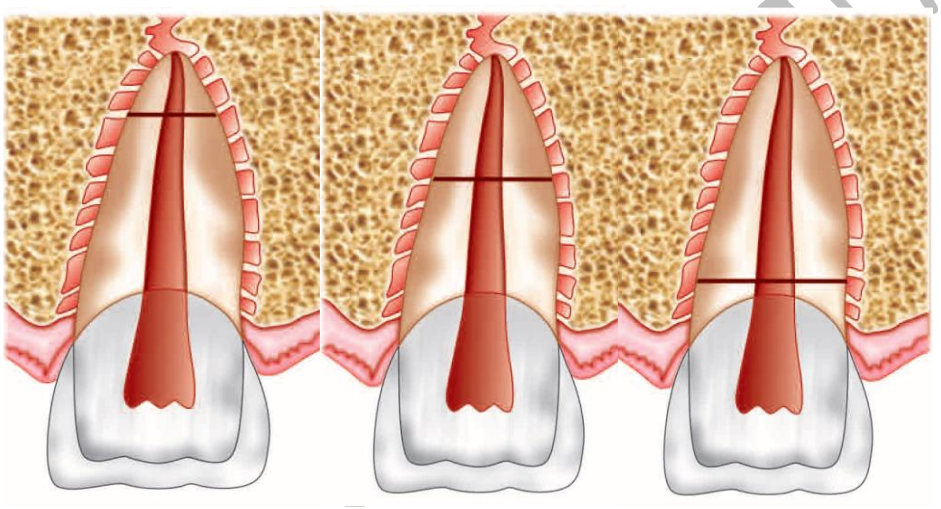
Radiographic demonstration of root fractures is facilitated by the fact that the fracture line is most often oblique and at an optimal angle for radiographic disclosure. In this context it should be remembered that a root fracture would normally be visible only if the central beam is directed within a maximum range of 15 to 20° of fracture plane.

Classification of Root Fractures

- *Based on direction of fracture line with long axis of tooth:*
  - – Horizontal (transverse root fracture, intralveolar root fractures): Fracture perpendicular to long axis of tooth.
  - – Oblique: Fracture is at an angle to long axis.
  - – Vertical: Fracture parallel to long axis.

- *Based on location:*

– Cervical third.
– Middle third.
– Apical third.



Apical third Middle third Cervical third

The position of the fracture line is an important factor in determining the treatment outcome.

Fractures, which occur in the apical third of the root, have an excellent prognosis if the coronal and apical segments **can be maintained in close proximity**. A tooth with a middle third fracture has fair prognosis for repair and requires endodontic therapy. If the root fracture is in the coronal third, approximation and stabilization of fractured segments is almost impossible. The tooth has to be extracted.

Tissue reactions after root fracture:

Four types of tissue reactions had been described after root fracture:

(1) Healing with calcified tissue, which is characterized by a uniting callus of hard tissue that may consist of dentin, osteodentin, or cementum.

(2) Healing with interposition of connective tissue, in which the fractured root surfaces are covered by cementum with connective tissue fibers joining the two fragments.

(3) Healing with interposition of bone and connective tissue, in which a bony bridge and connective tissue are positioned between the fragments.

(4) Interposition of granulation tissue. It is the least favorable form of attempted repair, and the fracture will not heal spontaneously. The teeth usually present unfavorable symptoms that may be accompanied by fistulas resulting from necrosis of the coronal portion and also sometimes the apical portion of the pulp. These teeth require follow-up endodontic treatment or extraction. Gross separation of the root fragments invariably causes inflammation in the area and subsequent resorption of the approximating fractured surfaces. For repair to take place, the fragments must be maintained in apposition. Therefore splinting is usually necessary, particularly if the coronal fragment is mobile.

Previously, a longer stabilization period (3 months) seemed necessary to encourage a more favorable type of healing of calcified tissue; however, it had been found no significant difference in the frequency of healing when short periods (under 60 days) and long periods (60 to 90 days) of splinting were compared.

It had been found that hard-tissue healing also took place in teeth that were not even splinted. A comparison between nonsplinted and splinted teeth showed no difference in frequency of healing. So that optimal positioning of dislocated fragments significantly increases the frequency of healing, particularly in mature teeth. However, in immature teeth, healing took place even after suboptimal repositioning of dislocated coronal fragments and persistent distance between the fragments after splinting. Teeth with no or slight loosening of the fragment may not require splinting. In addition, there is general agreement that splints for root fractures should be more rigid than the splints used for stabilization after other types of displacement injuries. Application of a more rigid splint is also believed to enhance the opportunity for calcified tissue repair. Therefore, the use of heavier wires is recommended (0.032 to 0.036 inch) when one is stabilizing teeth with fractured roots.

The occlusion should be adjusted so that the injured tooth is not further traumatized during normal masticatory function. Follow-up radiographs should be obtained and pulp tests performed at frequent intervals during the first 6 months after the injury.

Treatment

- ♣ The principle of treatment of permanent teeth is reduction of displaced coronal fragments and firm immobilization.
- ♣ Immobilization of teeth with root fractures is achieved with rigid fixation with an acid etch splint.
- ♣ Following treatment modalities are recommended based on the fracture line:

Coronal 3rd fractures of the root (cervical fracture):

1) If the remaining root is long enough, coronal portion can be removed, endodontic treatment completed on the apical fragment and restored with post and core. Then cement it and take an impression overall to make acrylic crown.

2) If the remaining root is short, do extraction.

Notes:

If the fracture line located subgingivally, removal of the coronal fragment supplemented by gingivectomy and/or osteotomy, in order to convert the subgingival fracture surface to supragingival in situations where esthetics permit, thereafter, restoration (e.g. with a post-retained crown).

Fracture of middle third

1) If there is slight mobility: This fracture is treated by performing root canal treatment involving both the coronal and the apical fragments in which obturation with silver cone (that also acts as a splint) is done and later on, callus formation will occur. Sometime mostly the apical part, the tooth stay vital so inject Ca $(OH)_2$ to interrupt the fracture line. New calcific body will be formed by Ca $(OH)_2$ in fracture line.

2) If there is high mobility: The tooth should be extracted.

Fracture of apical third

High apical fractures usually require no treatment. The prognosis will depend on height of fracture – the more apical the better the prognosis. Calcific repair will be formed without treatment. Just observe the child in future and do devitalization of the pulp. Sometimes the fracture part become reattached with the root. X -Ray is important.

Notes:

If there is Vertical Root Fracture

• It is also called as cracked tooth syndrome.
• It runs lengthwise from crown towards the apex.
• It is mostly found in posterior teeth and its etiology is mostly iatrogenic like insertion of screws, after pulp therapy or due to traumatic occlusion.

• Clinical Features:

- Persistent dull pain of long-standing origin.
- Pain is elicited by applying pressure.

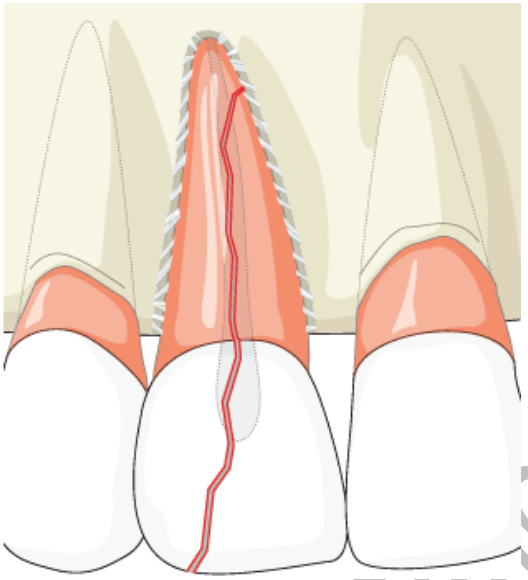
• **Radiographic features:**

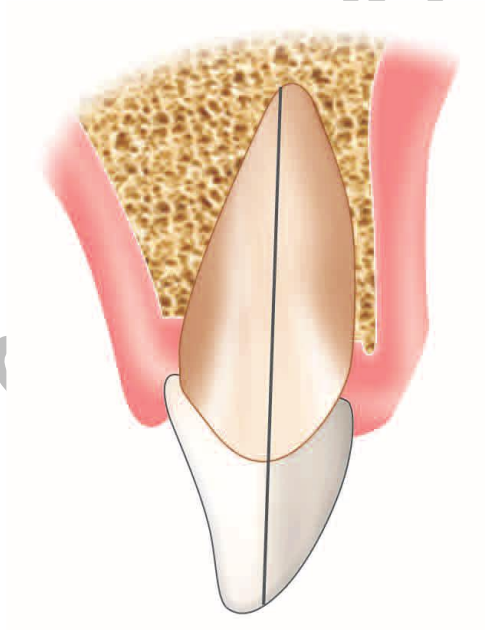
- If the central beam lies in the line of fracture it is visible as radiolucent line.
- Thickening of PDL is also seen.

• Occlusal pressure test: When asked to bite/chew on a cotton applicator or a rubber polishing wheel patient gets sharp pain.

• **Treatment:**

- Single rooted teeth—extraction
- Multi rooted teeth—hemisection and the remaining tooth is endodontically treated and resorted with crown.





OTHER DISPLACEMENT INJURIES OF TEETH REQUIRING STABILIZATION

Teeth subjected to less severe luxation injuries may also benefit from stabilization with a bonded resin and wire splint during the recovery period. The severity of the injury will help determine the length of time the splint should remain in place. Splinting times may vary from:

- ♣ 1 to 2 weeks, for teeth that have been discernibly loosened (subluxation),
- ♣ 4 to 6 weeks, for teeth that have been laterally displaced, fracturing the alveolar process.

As with all tooth injuries, frequent periodic evaluation is required for at least the first 6 months to afford the dentist the opportunity for early intervention if adverse sequelae develop; after this, evaluation at regular recall appointments should continue.

Displaced teeth with closed apices and many with open apices will require follow up endodontic therapy. As with many of the other injuries, calcium hydroxide paste is the

currently recommended material for initial canal filling, and the canal should be recleaned and refilled with calcium hydroxide periodically if signs or symptoms warrant retreatment. Placement of a permanent gutta-percha filling should be delayed for at least 1 year (arbitrarily determined), and the calcium hydroxide should be replaced at least once (again, arbitrarily determined) during this time. If the injured tooth had an open apex when endodontic therapy was initiated, the calcium hydroxide filling material should be used until the apexification process is complete or at least 1 year has elapsed, whichever is longer.

Note:

Types of fracture

By Ellis and Davey (1960):
Class I: Enamel fracture;
Class II: Enamel and dentin fracture;
Class III: Enamel and dentin fracture exposing dental pulp;
Class IV: The traumatized tooth that becomes non vital;
Class V: Avulsion;
Class VI: Fracture of the root;
Class VII: Displacement of tooth;
Class VIII: Fracture of crown en masse;
Class IX: Traumatic injuries of primary teeth.

In a summary:

(1)Concussion: an injury to the tooth-supporting structures without abnormal loosening or displacement but with marked reaction to percussion.

(2) Subluxation (loosening): an injury to the tooth-supporting structures with abnormal loosening but without clinically or radiographically demonstrable displacement of the tooth.

(3) Extrusive luxation (peripheral displacement, partial avulsion): partial displacement of the tooth following the axis of the tooth out of its socket but without leaving the socket. Radiographic examination always reveals an increased width of the periodontal ligament space.

(4) Lateral luxation: eccentric displacement (other than axial) of the tooth. This is accompanied by comminution or fracture of the alveolar socket. Depending on the angulation of the central beam, radiographic examination may or may not demonstrate an increased width of the periodontal ligament space.

(5) Intrusive luxation (central dislocation): displacement of the tooth deeper into the alveolar bone. This injury is accompanied by comminution or fracture of the alveolar socket. The direction of dislocation follows the axis of the tooth. Radiographic examination reveals dislocation of the tooth and sometimes a missing or diminished periodontal space. In the adult dentition, an apical shift of the cemento-enamel junction of the involved tooth can be seen.

The most important clinical difference between intrusive and extrusive luxation is that in the latter the apex is displaced out of its socket and not through the alveolar bone socket as in intrusive luxation. Moreover, extrusive luxation can imply complete rupture or stretching/tearing of the neurovascular supply to the pulp at the apical foramen, and the periodontal ligament fibers are to a great extent severed, whereas the supporting bone is not affected.

The factors that determine the type of luxation injury appear to be the force and direction of impact.

In both the primary and permanent dentitions, tooth luxations primarily involve the maxillary central incisor region and are seldom seen in the mandible. With increasing age, the frequency and pattern of injury change.

In the primary dentition, intrusions and lateral luxations comprise the majority of all injuries, a finding which is possibly related to the high resilience of the alveolar bone at this age. In contrast, in the permanent dentition the number of intrusive luxation injuries is considerably reduced and usually seen in younger individuals. Most frequently, two or more teeth are luxated simultaneously and a number of luxations show concomitant crown or root fractures.

	Type of luxation injury				
	Concussion	**Subluxation**	**Extrusion**	**Lateral luxation**	**Intrusion**
Abnormal mobility	–	+	+	–(+)*	–(+)
Tenderness to percussion	+	+(–)	+(–)	–	–
Percussion sound	Normal†	Dull	Dull	Metallic	Metallic
Positive response to sensibility testing	+/–	+/–	–(+)	–(+)	–
Radiographic dislocation	–	–	+	+	+

* A sign in parentheses indicates a finding of rare occurrence.
† Teeth with incomplete root formation and teeth with marginal or periapical inflammatory lesions will elicit a dull percussion sound.