
UNIT 35 CLASSIFICATION

Structure

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- 35.3 Classification of Tooth Fracture
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35.0 OBJECTIVES

After reading this unit, you should be able to:

- discuss the etiology of dental traumatic injuries;
- discuss the incidence of dental traumatic injuries;
- classify dental traumatic injuries; and
- outline the methods to diagnose dental traumatic injuries.

35.1 INTRODUCTION

In the previous units, the basics about endodontics have been covered. Treatment of traumatized teeth is one of the emergencies in dentistry. It requires good skill, knowledge, experience and presence of mind on the part of the clinician to treat these cases properly. It is important to treat trauma patients on a priority basis to maintain pulp vitality if possible and to timely perform endodontics in pulpally compromised teeth. Timely management is the key to good prognosis in these cases.

Trauma to the teeth may result in either injury of the pulp, with or without damage to the crown and root, or its displacement from its socket. When the crown or root is fractured, the pulp may recover and survive the injury or it may undergo progressive degeneration and ultimately die.

A traumatic dental injury (TDI) results in damage to many dental and periradicular structures. Thus, the management and consequences of these injuries are multifactorial and knowledge of interrelated healing patterns of these tissues is essential.

Traumatic dental injuries have been classified depending on many factors such as etiology, anatomy, pathology, therapeutic considerations and degree of severity. The purpose of classifying dental injuries is to provide a description of specific conditions, allowing the recognition and treatment using recommended remedies.

In this unit you will learn the etiology and classification of the traumatic dental injuries.

35.2 ETIOLOGY AND INCIDENCE OF TOOTH FRACTURES

Sport activities can lead to dental injuries and have been shown to be common in high school students specially who do not use mouth guards.

Dental injuries can also result from child abuse or “battered child syndrome” and the dentist may be the first health care provider to observe these types of injuries. About 50% of abused children undergo orofacial trauma, intraoral injuries such as tooth and jaw fractures.

Sudden impact to face or head result in trauma to teeth and supporting tissues. Most common causes are falling, traffic accidents, fights, sports. About 20-60% of all traffic accidents produce some injury to facial region.

Most dental injuries occur during first two decades of life, mostly occurring during 8-12 years.

Incidence is higher in boys than girls with the ratio varying from 2:1 to 3:1.

Maxillary central incisors are mostly involved followed by maxillary lateral incisors and mandibular incisors.

The most common dental trauma involves fracture of enamel and dentin, without pulp involvement.

Andreason reports etiological factors as follows :

- a) **Human Behaviour**
 - 1) Risk taking
 - 2) Peer relationship problems
 - 3) Hyperactivity
 - 4) Stress behaviour
- b) **Environmental Factors**
 - 1) Deprivation
 - 2) Over crowding
- c) **Unintentional Injuries**
 - 1) Falls and collisions
 - 2) Physical leisure activities (sports)
 - 3) Traffic accidents
 - 4) Inappropriate use of teeth
 - 5) Biting hard items
 - 6) Presence of illness, physical limitations or learning difficulties.

Check Your Progress 1

- 1) Enumerate the various risk factors associated with traumatic dental injuries.

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- 2) Write about incidence of dental injuries.

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35.3 CLASSIFICATION OF TOOTH FRACTURE

In understanding tooth fracture, it is important to categorize them. There are many classifications given by various authors. For us to learn, Ellis etal and WHO classification are imperative to know as they are taught and practiced clinically. To complete the exposure of classifications, we will review few other classifications.

The classification of dental injuries allows data collection worldwide to monitor many aspects of dental traumatology: etiology, incidence and treatment outcome. The dental traumatic injuries can be classified by various methods.

35.3.1 Ellis and Davey Classification

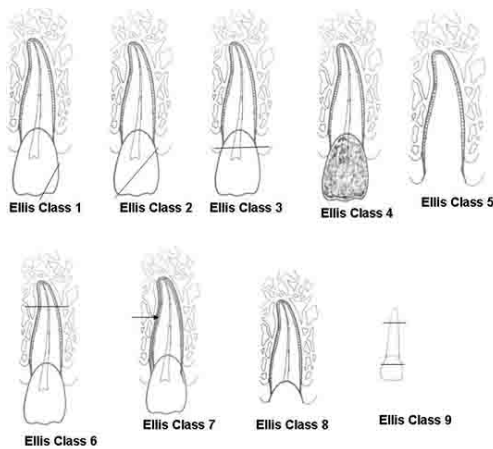


Fig. 35.1: Diagram to depict Ellis classification

Traumatic Injuries

The classification of Ellis and Davey (1970) for dental traumas is as follows:

- **Class 1:** Simple fracture of crown, involving little or no dentin. (Fig.35.2).



Fig. 35.2: Crown fracture (uncomplicated Ellis Class 1/WHO N502.50)

- **Class 2:** Extensive fracture of crown, involving considerable dentin, but no dental pulp (Fig. 35.3).



Fig. 35.3: Crown fracture (uncomplicated Ellis Class 2/WHO N502.51)

- **Class 3:** Extensive fracture of crown, involving considerable dentin and exposing pulp (Fig. 35.4).



Fig. 35.4: Crown fracture (Complicated Ellis Class 3/WHO N502.52)

- **Class 4:** The traumatized tooth becomes non vital with or without loss of crown structure (Fig. 35.5).



Fig. 35.5: Discolored traumatized tooth (Ellis Class 4)

- **Class 5:** Tooth lost as a result of trauma.
- **Class 6:** Fracture of root with or without fracture of crown (Fig. 35.6).

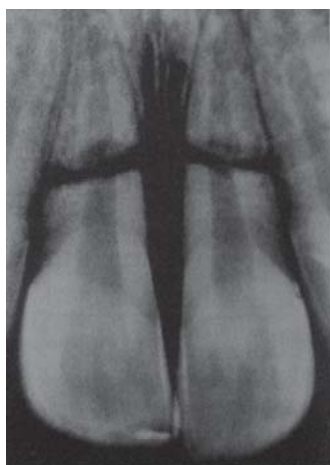


Fig. 35.6: Radiograph showing horizontal root fracture (Ellis Class 6/WHO N502.53)

- **Class 7:** Displacement of tooth without fracture of crown or root.
- **Class 8:** Fracture of crown enmasse.
- **Class 9:** Traumatic injury to deciduous tooth (Fig. 35.7).

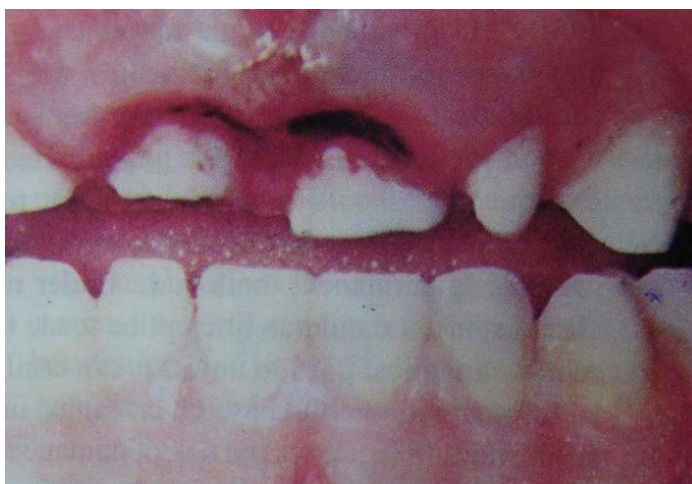


Fig. 35.7: Traumatic injury to deciduous tooth (Ellis Class 9)

35.3.2 WHO Classification of Traumatic Injuries

WHO has classified the traumatic injuries according to the following categories:

- 1) Injuries to hard tissues or pulp
- 2) Injuries to periodontal tissues

Injuries to Hard Tissues/Pulp

Code	Injury	Criteria
N 502.50	Enamel Infraction	An incomplete fracture (crack) of enamel without loss of tooth substance.
N 502.50	Enamel Fracture (uncomplicated crown fracture) (Fig.35. 2)	Fracture with loss of tooth structure confined to enamel
N 502.51	Enamel dentin fracture (uncomplicated crown fracture) (Fig.35. 3)	Fracture with loss of substance confined to enamel and dentin not involving the pulp.
N 502.52	Complicated crown fracture (Fig. 35.4)	Fracture involving enamel, dentin and also exposing the pulp.
N 502.54	Uncomplicated crown root fracture.	A fracture involving enamel dentine and cementum, but not pulp.
N 502.54	Complicated root-crown fracture	Fracture involving enamel, dentine and cementum but not involving the pulp.
N 502.53	Root fracture (Fig 35.6)	A fracture involving dentin, involving cementum and pulp.

Injuries to Periodontal Tissues

Code	Injury	Criteria
N 503.20	Concussion	Injury to tooth supporting structure without abnormal loosening or displacement of tooth, but with marked reaction to percussion.
N 503.20	Subluxation (Loosening)	Injury to tooth supporting structure with abnormal loosening but without displacement of tooth.
N 503.20	Extrusive luxation (Peripheral Dislocation, Partial Avulsion)	Partial displacement of a tooth out of its socket.
N 503.20	Lateral luxation	Displacement of tooth in a direction other than axially accompanied by communication or fracture of alveolar socket.
N 503.21	Intrusive luxation (Central Dislocation)	Displacement of tooth into the alveolar bone accompanied by communication or fracture of alveolar socket.
N 503.22	Avulsion (Exarticulation)	Complete displacement of a tooth out its socket.

35.3.3 Epidemiological Classification of WHO

Traumatic dental injuries according to epidemiology have also been classified by WHO as international classification of disease.

Code	Injury	Criteria
Code 0	No injury	No evidence of treated or untreated dental injury.
Code 1	Treated dental injury	Composite restoration, bonding of tooth fragment, crown, denture or bridge Pontic replacing missing teeth due to TDI, restoration located on the palatal/lingual area of crown suggesting endodontic treatment, but no evidence of decay.
Code 2	Enamel fracture only	Loss of small portion of crown, including only enamel.
Code 3	Enamel dentin fracture	Loss of portion of crown, including enamel and dentin without pulp exposure.
Code 4	Pulp injury	Signs/symptoms of pulp involvement due to dental injury, includes fracture with pulp exposures, dislocation of tooth, presence of sinus tract, swelling in labial/lingual vestibule without evidence of caries and discoloration of crown.
Code 5	Missing tooth due to trauma	Absence of tooth due to complete avulsion.
Code 9	Excluded tooth	Signs of traumatic injuries cannot be assessed that is presence of appliances on all permanent incisors, missing due to caries.

35.3.4 WHO Classification of Dentofacial Injuries

WHO has given a classification which does not pertain to tooth only but also the soft tissue injuries and facial skeletal injuries. It is discussed as following

a) Soft Tissues

- 1) Lacerations
- 2) Contusions
- 3) Abrasions

b) Tooth Fractures

- 1) Enamel Fractures
- 2) Crown fractures – uncomplicated (no pulp exposure)
- 3) Crown fractures – complicated (with pulp exposure)
- 4) Crown root fractures
- 5) Root fractures.

Traumatic Injuries

c) Luxation Injuries

- 1) Tooth concussion
- 2) Subluxation
- 3) Extrusive luxation
- 4) Lateral luxation
- 5) Intrusive luxation
- 6) Avulsion.

d) Facial Skeletal Injuries

- 1) Alveolar Process – maxilla/mandible
- 2) Body of maxillary/mandibular bone
- 3) Temporomandibular joint

Now you know about the WHO classification and realise that it is an extensive layout of dento-facial injuries. Let us now go through the final points of tooth fractures and luxation injuries.

TOOTH FRACTURES

- **Crown Fracture (Uncomplicated; No pulp exposure)**



Fig. 35.8: Crown fracture involving enamel & dentine (uncomplicated)



Fig. 35.9: Crown fracture involving enamel & dentine

Crown fracture involving enamel and dentine without pulp exposure are called uncomplicated crown fracture by Andreasen and Class 2 fracture by Ellis. These may include incisal-proximal corners, incisor edges or lingual chisel type fracture in anterior teeth and cusps in posterior teeth.

Incidence

It is very common and accounts for 1/3rd of all dental injury.

Biological Consequences

This Occurs Only

- If only enamel is involved – minimum consequences and complication.
- If dentine is exposed – a direct pathway exists for noxious stimuli to pass through dentinal tubule to the pulp. Pulp may remain normal or chronic pulpal inflammation may occur. It depends on factors like proximity of fracture to the pulp, surface area of exposed dentine, length of time between trauma and treatment and any injuries to the pulpal blood supply.

Diagnosis

- Clinical examination with a mirror and explorer.
- Determination of status of pulp and periradicular tissues by the routine examination procedures.
- **Crown Fracture (Complicated; with pulp exposure)**



Fig. 35.10: Crown fracture involving enamel dentine and pulp

Crown fracture involving enamel, dentine and pulp are classified as complicated crown fracture by Andreasen and Class 3 fracture by Ellis and Davey.

Incidence: Incidence compared with all types of dental injuries is about 2-3%.

Biological Consequences: A complicated crown fracture if left untreated will always result in pulp necrosis. Bacterial contamination of pulp prevents healing and repair unless exposure is covered. Initial reaction is hemorrhage at the site of pulp wound. Followed by a superficial inflammatory response resulting in either a destructive or proliferate reaction.

Diagnosis: It can be made by clinical observation. It is important to evaluate the condition of the pulp.

- **Crown Root Fractures**

In these fractures enamel, dentine and cementum are involved; pulp may or may not be involved.

Incidence: Andreasen reported a 5% incidence of total dental injuries. If crack tooth syndrome and vertical fracture of endodontically treated teeth are also included the total incidence will be higher.

Biological Considerations: These are same as complicated or uncomplicated fractures. In addition, periodontal complication are present because fracture may encroach attachment apparatus.

Diagnosis: These fractures results in complains of pain on manipulation. Fragments are easy to move and bleeding from periodontal ligament or pulp fills the fracture lines. Direct light and transillumination is an effective way of diagnosing these fractures.

- **Root Fractures**

Root fractures involve the roots only, that is cementum, dentine and pulp

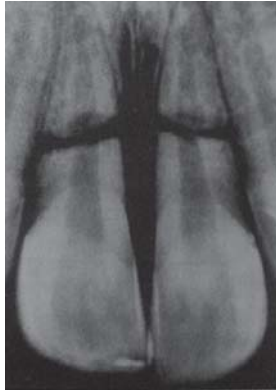


Fig. 35.11: Root fracture 11,21

Incidence: These accounts for less than 3 % of all dental trauma.

Diagnosis: As these fractures are mostly diagonal in angulation they are often missed radiographically. One additional film angulation of 45 degrees when combined with standard 90 degree reveals most of the traumatic fractures.

LUXATION INJURIES

These include impact trauma ranging from minor crushing of periodontal ligament and neurovascular supply to the pulp to more major trauma such as total displacement of teeth.

Incidence: Tooth luxation (extruding avulsion) is comprising the largest group of injuries in classification of dental trauma ranging from 30-40%.

There are 5 kinds of luxation injuries:

- **Concussion:** There is no displacement or mobility. It is characterized by sensitivity to percussion only.
- **Subluxation:** There is no displacement but there is increased mobility and sensitivity to percussion.
- **Lateral Luxation:** Injury may result in displacement of tooth labially, lingually, distally or mesially. This condition is often very painful particularly when tooth is moved into premature occlusion due to trauma.
- **Extrusive Luxation:** Displacement of a tooth axially in coronal direction results in partial avulsions. Tooth is highly mobile and continuously traumatized by contact with opposing teeth.
- **Intrusive Luxation:** A tooth may be pushed into its socket resulting in a very firm almost ankylosed tooth.

Check Your Progress 2

1) Write the various methods of classifying dental injuries.

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2) Discuss the WHO classification of dentofacial injuries.

Diagnosis and Management

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35.4 ROOT FRACTURES AND CRACKS

Root Fractures

It is unfortunate to come across root fracture as you are here to save a tooth and if the root of tooth is broken the prognosis is poor. You do come across them in various positions and depths. Following is figure to give you an idea of root fracture classification as given by Hithersay & Morlie.

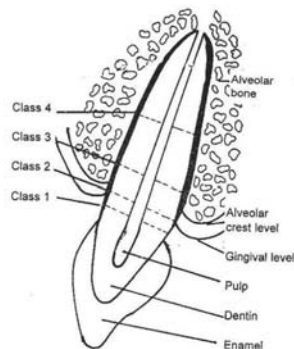


Fig. 35.12: Hithersay & Morlie's Classification of subgingival fracture

The literal meaning of crack is “breach in continuity”. Following trauma, cracks can be observed in tooth. The cracks can be classified as:

- a) Craze lines
 - b) Fractures
 - c) Split roots
- **Craze lines** are merely cracks in enamel, not extending into the dentin. They may occur naturally or secondary to trauma. They are more common in adult teeth and in posterior region. On transillumination these show up as fine lines in the enamel with light being able to transmit through them. They are mostly asymptomatic and no treatment is necessary unless they do not create a cosmetic problem.

Fractures (cracks) (Fig. 35.13) extend deeper into the dentin primarily extending mesially to distally involving the marginal ridges. Dyes and transillumination help in visualizing potential root fractures.

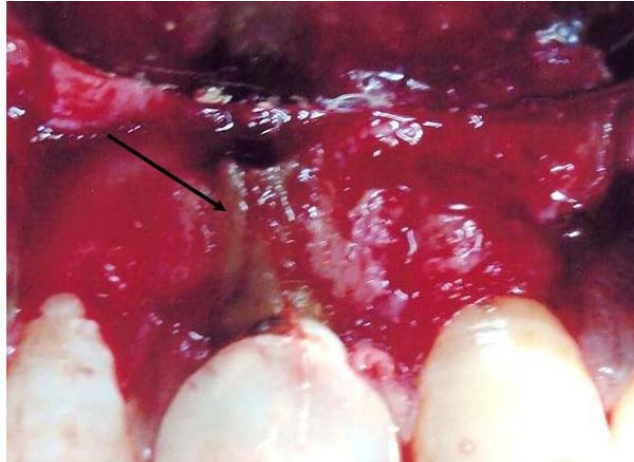


Fig. 35.13: Crack line on the root

- **Split roots** – Occur when fracture extends from one surface of the teeth to another surface of the tooth, with the teeth separating into two segments. If the split is oblique, it is possible that smaller fragment may be removed and other saved. But if the split extends below the osseous level, the tooth may not be restorable and endodontic treatment may not result in a favourable prognosis.

35.5 VERTICAL ROOT FRACTURES

It is a severe crack in the tooth that extends longitudinally down the long axis of the root often extending through the pulp into the periodontium.

Etiology of Vertical Root Fracture

- a) They may arise from physical traumatic injuries.
- b) Occlusal prematurities.
- c) Excessive parafunctional habit.
- d) Resorption induced pathologic root fractures.
- e) Most common cause is iatrogenic dental treatment like placement of posts and pins or placing a tightly fitting post or intracoronal restoration. Most common dental procedure leading to vertical root fracture is endodontic treatment.

Diagnosis

History of facial trauma – patients with seizure disorders may be prone to dental trauma history of ice chewing or parafunctional habits or complaint of pain only on biting. A well performed endodontic procedure may suggest a vertical fracture if the tooth does not heal after retreatment or apical surgery.

Transillumination and Dyes

Methylene blue dyes when painted on tooth surface with cotton tip penetrates into cracks and helps in its location. Directing a high intensity light directly on the exterior surface of the tooth a CEJ (cementoenamel junction) indicates the extent of fracture. Teeth with fractures block transilluminated light.

Radiographic Evaluation

Diagnosis and Management

Mostly, the fracture is in a plane that is not perceptible from a periapical radiograph. Using a CT scan has shown to be superior to dental radiography in detection of a vertical fracture.

35.6 CRACKED TOOTH SYNDROME

Cracked tooth syndrome accounts for many diagnostic problems. These are incomplete fractures through the body of the tooth. The patient complains of pain ranging from mild to excruciating at the initiation or release of the biting pressure when patient bites on a cotton applicator or rubber wheel, fracture segments may separate and pain is reproduced at the initiation or release of biting pressure. This enamel crack may be better visualized using a dye or by transilluminating the tooth with a fiber optic light. Sometimes removal of an intracoronal restoration in the suspected teeth may reveal a crack in the enamel running into the dentin.



Fig. 35.14: Crack line on the root

The pulp in these teeth may become necrotic or sometimes these teeth fracture completely. If the fracture is incomplete only in enamel and dentin a full crown restoration immobilizing the fragments may be helpful.

Diagnosis: The tooth slooth is a very useful device for differentially diagnosing various stages of incomplete crown fractures. Its design permits selective application of chewing force on one cusp at a time allowing the clinician to evaluate weakness in a define areas of the tooth. It is specially effective when cotton rolls or wooden sticks are not helpful

Check Your Progress 3

- 1) Define vertical root fracture? Describe its etiology and diagnosis.

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2) What is Cracked Tooth Syndrome?

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3) Classify the various types of crack lines in teeth.

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35.7 LET US SUM UP

Traumatic dental injuries generally occur in people of younger age group. These injuries not only affect the function and mastication but also affect the social and psychological behaviour of the patient. Proper classification and diagnosis of the type of injury is a must to reach a proper care of treatment. It is essential to have knowledge of interrelated healing patterns of various tissues as trauma to the tooth also affects the periodontal tissues and the alveolar bone.

35.8 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) Various risk factors associated with traumatic dental injuries are:
- Sport activities
 - Dental injuries can also result from child abuse or “battered child syndrome”.
 - Sudden impact to face or head result in trauma to teeth and supporting tissues. Most common causes are falling, traffic accidents, fights, sports.

- Most dental injuries occur during first two decades of life, mostly occurring during 8-12 years.
 - Andreason reports etiological factors as follows :
 - a) **Human Behaviour**
 - Risk taking
 - Peer relationship problems
 - Hyperactivity
 - Stress behaviour
 - b) **Environmental Factors**
 - Deprivation
 - Over crowding
 - c) **Unintentional Injuries**
 - Falls and collisions
 - Physical leisure activities (sports)
 - Traffic accidents
 - Inappropriate use of teeth
 - Biting hard items
- 2) Most dental injuries occur during first two decades of life, mostly occurring during 8-12 years. Incidence is higher in boys than girls with the ratios varying from 2:1 to 3:1. Maxillary central incisors are mostly involved followed by maxillary lateral incisors and mandibular incisors. The most common dental trauma involves fracture of enamel and dentin, without pulp involvement.

Check Your Progress 2

- 1) Various dental injuries can be classified as follows:
 - a) Ellis and Davey classification.
 - b) WHO classification of injuries to hard tissues and pulp.
 - c) WHO classification of injuries to periodontal tissues.
 - d) Epidemiological classification of traumatic dental injuries.
 - e) WHO classification of dentofacial injuries.
 - f) Heithersay and Morlie
 - g) Dean's classification.
- 2) WHO Classification of dentofacial injuries can be summarized as follows:
 - a) **Soft Tissues**
 - Lacerations
 - Contusions
 - Abrasions

Traumatic Injuries

b) **Tooth Fractures**

- Enamel Fractures
- Crown fractures – uncomplicated (no pulp exposure)
- Crown fractures – complicated (with pulp exposure)
- Crown root fractures
- Root fractures.

c) **Luxation Injuries**

- Tooth concussion
- Subluxation
- Extrusive luxation
- Lateral luxation
- Intrusive luxation
- Avulsion.

d) **Facial Skeletal Injuries**

- Alveolar Process – maxilla/mandible
- Body of maxillary/mandibular bone
- Temporomandibular joint

Check Your Progress 3

- 1) It is a severe crack in the tooth that extends longitudinally down the long axis of the root often extending through the pulp into the periodontium.

Etiology of Vertical Root Fracture

- They may arise from physical traumatic injuries.
- Occlusal prematurities.
- Excessive parafunctional habit.
- Resorption induced pathologic root fractures.
- Most common cause is iatrogenic dental treatment like placement of posts and pins or placing a tightly fitting post or intracoronal restoration. Most common dental procedure leading to vertical root fracture is endodontic treatment.

Diagnosis

- History of facial trauma
- Transillumination and Dyes
- Radiographic evaluation

- 2) These are incomplete fractures through the body of the tooth. The patient complains of pain ranging from mild to excruciating at the initiation or release of the biting pressure. This enamel crack may be better visualized using a dye or by transilluminating the tooth with a fiber optic light. Sometimes removal of an intracoronal restoration in the suspected teeth may reveal a crack in the enamel running into the dentin.
- 3) Crack in teeth can be classified as:
 - a) Craze lines
 - b) Fractures
 - c) Split roots

35.9 FURTHER READINGS

Endodontics fourth edition John I. Ingle Leif K Bakland