Sri Aurobindo College of Dentistry

Indore, Madhya Pradesh

INDIA

MODULE PLAN

- TOPIC : Traumatic injuries In Children
- SUBJECT: PEDODONTICS
- TARGET GROUP: UNDERGRADUATE DENTISTRY
- MODE: POWERPOINT – WEBINAR
- PLATFORM: INSTITUTIONAL LMS
- PRESENTER: DR. ABHILASHA MANKER

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- Incidence and prevalence
- Types of traumatic dental injuries
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- Infarction
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- Enamel dentin fracture
- Enamel dentin pulp fracture
- Crown root fractures without pulp exposure
- Crown root fractures with pulp exposures
- Root fractures
- Luxation injuries
- Soft tissue injuries
- Summary and conclusion
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Introduction

- **Trauma** (from Greek τραῦμα, "wound" also known as injury) is a physiological wound caused by an external source.
- Sixth leading cause of death worldwide, accounting for 10% of all mortalities, and is therefore a serious public health problem with significant social and economic costs.

- Trauma to teeth involves the dental pulp either directly or indirectly.
- Age is an important factor in trauma to teeth.
- The significance of age is good news/ bad news nature.

- Traumatic injuries are typically **quick, sudden, and unexpected.**
- The management and consequences of these injuries are **multifactorial**, and knowledge of interrelated healing patterns of these tissues is essential.
- Timely care is as important as the care itself because most adverse posttraumatic sequelae are a consequence of inefficient or inappropriate treatment.

ETIOLOGY

- Traumatic Dental Injuries (TDIs) are caused by collision that can generate enough mechanical energy to produce the injury.
- Any object, animate or inanimate, in motion has energy that depends in its mass and speed.
- Increase in mass or speed increases energy.
- Thus, is the cause of TDIs.

- Oral factors (over-jet)
- Environmental factors (material deprivation)
- Human behavior (risk taking, hyperactive children)

Glendor U. **Aetiology and risk factors related to traumatic dental injuries--a review of the literature.** Dent Traumatol. 2009 Feb;25(1):19-31.

- Unintentional TDIs
  - Falls and Collisions
  - Physical leisure activities
  - Traffic accidents
  - Biting hard objects
  - Presence of illness, physical limitations or learning difficulties.
- Intentional TDIs
  - Physical abuse
  - Iatrogenic procedures

PREDISPOSING FACTORS

- Increased overjet
- Protrusion of upper incisor
- Inadequate lip closure.

INCIDENCE

Sex and age distribution

- Boys > Girls (2:1)
- First two decades of life (8-12 yrs)

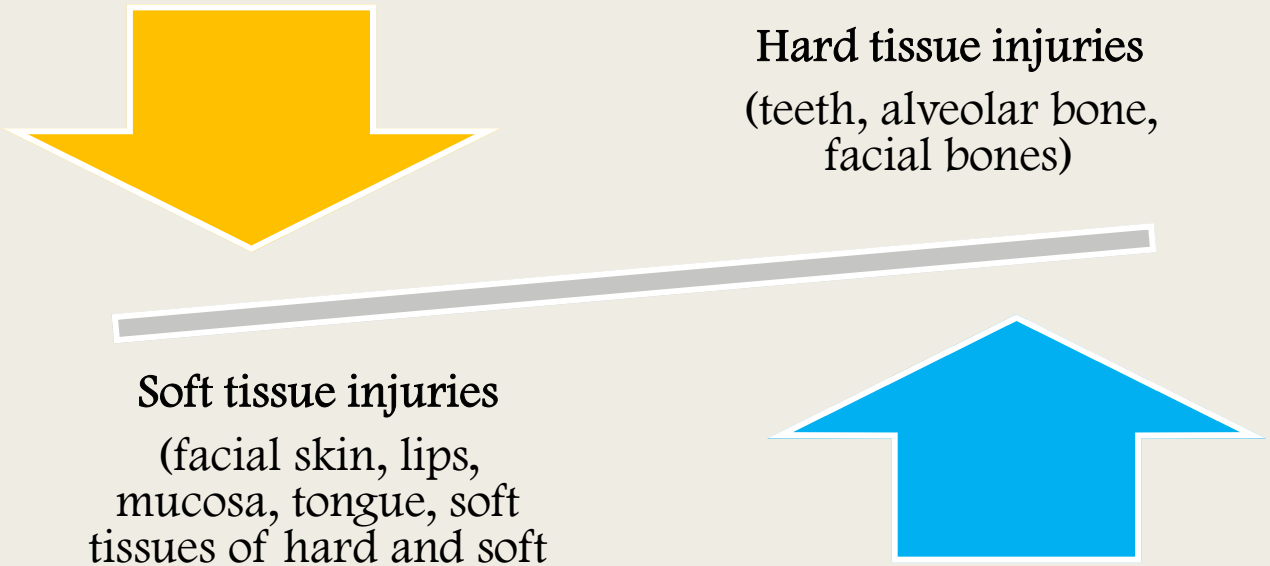
Susceptible tooth

- Maxillary central incisor (80%)
- Maxillary lateral incisor
- Mandibular central and lateral incisors

- In Davangere, South India.
- The overall prevalence rate of traumatic dental injuries (TDI) to permanent incisor teeth was 15.1%.
- The prevalence of TDI was higher in boys compared to girls.
- The major cause of TDI was falling followed by collision.
- The maxillary incisors were commonly injured, involving mainly enamel fracture.
- Children with excessive overjet and inadequate lip coverage were more likely to have injuries

Ravishankar TL, Kumar MA, Ramesh N, Chaitra TR. Prevalence of traumatic dental injuries to permanent incisors among 12-year-old school children in Davangere, South India. Chin J Dent Res. 2010;13(1):57-60.

TYPES OF TRAUMATIC DENTAL INJURIES



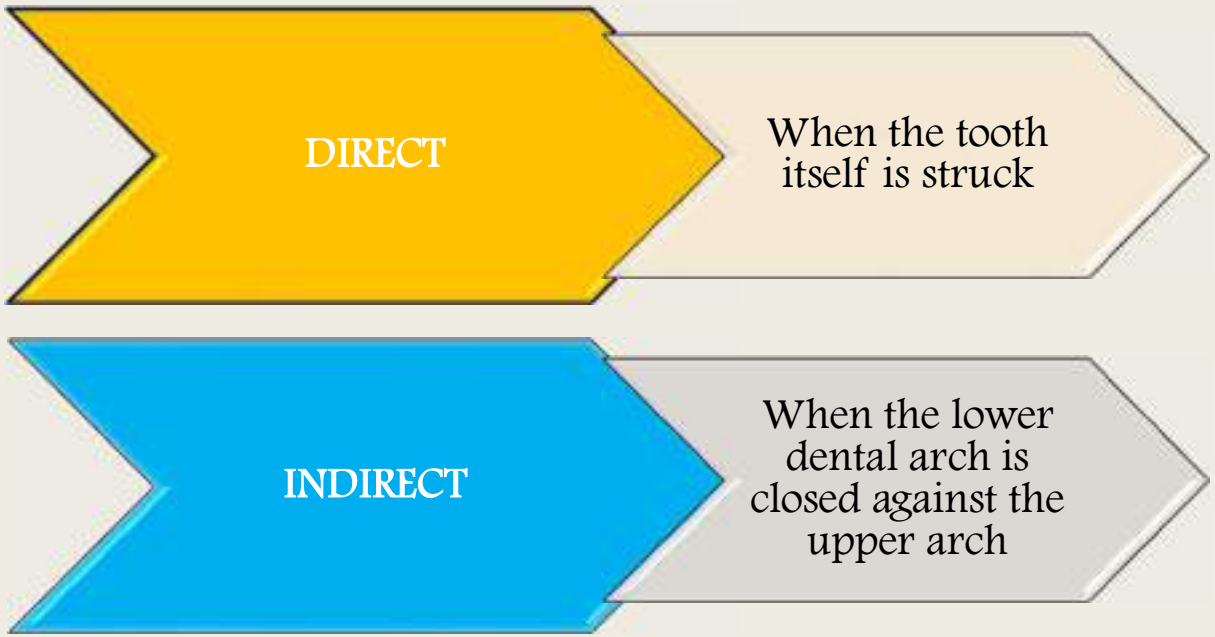
Hard tissue injuries

(teeth, alveolar bone, facial bones)

Soft tissue injuries

(facial skin, lips, mucosa, tongue, soft tissues of hard and soft palate)

MECHANISM OF TDIS



Factors characterizing an impact to the teeth

- Energy of the impact
- Resilience of the impacting object
- Shape of the impacting object
- Direction of the impacting force

Various terminologies

- Trauma- trauma refers to injury, damage, impairment, external violence producing injury or degeneration
- Fracture- defined as a sudden violent breach of continuity of bone, which may be complete or incomplete in character
- Infraction - An incomplete fracture (crack) of the enamel without loss of tooth structure.

- Extrusive luxation- A partial axial displacement of the tooth from its socket.
- Intrusive luxation- An axial displacement of the tooth into the alveolus often accompanied by comminuted apical fracture of the alveolar socket.
- Avulsion (Exarticulation) - The complete separation of a tooth from its alveolus by traumatic injury.

- **Concussion**- A traumatic tooth injury characterized by tenderness to percussion and no mobility or displacement.
- **Subluxation**- Injury to supporting tissues resulting in abnormal loosening of a tooth or teeth without displacement.
- **Luxation**- Displacement of a tooth from its original position in the alveolus, without total avulsion, resulting from acute trauma.
- **Lateral luxation**- A displacement of the tooth in a direction other than axially, usually accompanied by fracture of the alveolar socket.

- Contusion- injury produced by blunt trauma that results in edema and hematoma formation in the subcutaneous tissues.
- Abrasion- injury that results from friction along a surface, removing or peeling off, of the superficial layers of the skin, that results in a raw, exposed or bleeding surface.
- Lacerations- Injury that causes a discontinuity in the skin or mucosal surface. Lacerations may be simple, stellate, jagged beveled or flap like

CLASSIFICATION

1. Ellis' Classification
2. Ellis And Davey's Classification (1960)
3. Andreasen's Classification (1981)
4. Heithersay And Morile (1982)
5. Modification Of Ellis Classification By Mcdonald, Avery And Lynch (1983)
6. Classification By Ulfohn (1985)

7. Spinas And Altrantas Classification (2002)

8. Based On The World Health Organization Classification Of Diseases And Modified By Andreasen And Andreasen.

9. WHO Classification(1978)

10. Classification by World Health Organization in its application of International Diseases of Dentistry and Stomatology (1994)

ELLIS' CLASSIFICATION (TRAUMATIZED ANTERIOR TEETH)

1. Enamel fracture.
2. Dentine fracture without pulp exposure.
3. Crown fracture with pulp exposure.
4. Root fracture.
5. Tooth luxation.
6. Tooth intrusion.

Endodontic Practice 11th edition, Grossman. Cross reference- Ellis RG. The classification and treatment of injuries to the teeth of children. 4th edition. Chicago yearbook, 1961, pg 19

ELLIS AND DAVEY'S CLASSIFICATION (1960)

Class I	Simple fracture of the crown involving little or no dentin.
Class II	Extensive fracture of the crown involving considerable amount of dentin involved without pulpal exposure.
Class III	Extensive fracture of the crown involving considerable amount of dentin involved with pulpal exposure.
Class IV	Traumatized teeth become non-vital with or without a loss of crown structure.
Class V	Teeth lost as a result of trauma
Class VI	Fracture of the root with or without a loss of the crown structure.
Class VII	Displacement of a tooth without crown or root fracture.
Class VIII	Fracture of crown en mass.
Class IX	Traumatic injuries to deciduous teeth.

Textbook of Pediatric Dentistry. Prof. SG Damle. 3rd edition. 2006

ANDREASEN'S CLASSIFICATION (1981)

Class I	Enamel infraction
Class II	Enamel fracture (crown fracture not complicated)
Class III	Enamel and dentin fracture (crown fracture not complicated)
Class IV	Complicated crown fracture
Class V	Crown-root fracture, not complicated
Class VI	Complicated crown-root fracture
Class VII	Root fracture

Textbook of Pediatric Dentistry. Prof. SG Damle. 3rd edition. 2006

HEITHERSAY AND MORILE (1982)

Classification of subgingival fractures based on the level of tooth fracture in various horizontal planes.

1. Fracture line does not extend below the level of attached gingiva.
2. Fracture line below the level of attached gingiva, but above level of alveolar crest.
3. Fracture line below the level of alveolar crest.
4. Fracture line below the level of alveolar crest, but within the coronal third of the root.

Endodontic Practice 11th edition, Grossman.
Cross reference – Heithersay GS, Morile AJ. Aust Dent J. 1982;27:368

Modification of Ellis Classification by McDonald, Avery and Lynch (1983)

Class I	Simple fracture of the crown involving little or no dentin.
Class II	Extensive fracture of the crown involving considerable dentin, but not the dental pulp.
Class III	Extensive fracture of the crown involving considerable dentin with an exposure of the dental pulp.
Class IV	Loss of the entire crown

Textbook of Pediatric Dentistry. Prof. SG Damle. 3rd edition. 2006

Classification by Ulfohn (1985)

- Classification is evolved from clinical endodontic point of view.
- Ulfohn classified crown fractures into three very simple cases:
  a. *Fracture of enamel.*
  b. *Fracture of crown with indirect pulp exposure through the dentin*
  c. *Fracture of the crown with direct pulp exposure.*

Textbook of Pediatric Dentistry. Prof. SG Damle. 3rd edition. 2006

Spinas And Altrantas Classification (2002)

A class	Simple enamel lesion involving one proximal angle or only incisal edge
B class	enamel-dentin lesions involving one proximal angle or only an incisal edge
Sub class B1	With pulp exposure
C class	enamel-dentin lesion involving the incisal edge and least 1/3rd of crown
Subclass C1	with pulp exposure
D Class	enamel- dentin lesion involving mesial or distal angle and incisal/palatal surface
Subclass D1	with pulp exposure

Spinas E, Altana M. A new classification for crown fractures of teeth. J Clin Pediatr Dent. 2002 Spring;26(3):225-31

Based On The World Health Organization Classification Of Diseases And Modified By Andreasen And Andreasen

SOFT TISSUES

- Lacerations
- Contusions
- Abrasions

TOOTH FRACTURES

- Enamel fractures
- Uncomplicated crown fractures
- Complicated crown fractures
- Crown root fractures
- Root fractures

LUXATION INJURIES

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

FACIAL SKELETAL INJURIES

- Alveolar process
- Body of maxillary/mandibular bone
- Temporomandibular joint

World Health Organization (WHO) (19

Number	Description
873.60	Enamel fracture
873.61	Crown fracture involving enamel and dentin without pulpal exposure
873.62	Crown fracture with pulp exposure
873.63	Root fracture
873.64	Crown root fracture
873.66	Luxation
873.67	Intrusion or Extrusion
873.68	Avulsion
873.69	Other injuries such as soft tissue lacerations

Classification by World Health Organization in its application of International Diseases of Dentistry and Stomatology (1994)

- Based on anatomical, therapeutic and prognostic considerations.
- Can be applied to both primary and permanent teeth.

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HISTORY AND CLINICAL EXAMINATION

History And Clinical Examination

CHIEF COMPLAINT:

- Includes several subjective symptoms.
- Listed in order of importance to the patient.
- Note the duration of each symptom.

Andreasen JO, Andreasen FM, Andreasen L. Textbook and Color Atlas of Traumatic Injuries to the Teeth. 4th edition.2008.

HISTORY OF PRESENT ILLNESS:

- **When did the injury occur?**
  - Implies a time factor, influences the choice of treatment- critical in the case of avulsed or displaced teeth.
- **Where did the injury occur?**
  - ➢possibility of contamination of wounds.
- **How did the injury occur?**
  - ➢ location of possible injury zones

- **Treatment elsewhere**
  - Previous treatment such as immobilization reduction or replantation of teeth, should be considered before further treatment is instituted

History of previous dental injuries

Repeated injuries- influence pulpal sensibility

- **General health**
  - Did the trauma cause amnesia, unconciousness, drowsiness, vomiting or headache?
  - Is there spontaneous pain from teeth?
  - Do the teeth react to thermal changes, sweet or sour foods?
  - Are the teeth tender to touch or during eating?

MEDICAL CONSIDERATIONS

- Allergic reaction to any medication.
- Disorders such as bleeding problems diabetes and epilepsy.
- Current medication
- Tetanus immunization status.
- Usually a thorough evaluation is made by a physician; however, the clinician should be aware of the general medical issues that may affect emergency dental care.

THE CLINICAL EXAMINATION

1. Recording of extraoral wounds and palpation of facial skeleton.

2. Injuries to oral mucosa or gingiva

3.Examination of crowns of teeth for the presence and extent of fractures, pulp exposures or change in color.

4. Recording displacement of teeth

5. Disturbance in occlusion

6. Abnormal mobility of teeth or alveolar fragments

7. Palpation of alveolar process

8. Tenderness of teeth to percussion and change in percussion tone

9. Reaction of teeth to pulpal sensibility testing

EXAMINATION OF SOFT TISSUE WOUNDS:

- The penetrating nature of the wounds
- possible presence of foreign bodies embedded within these wounds.

- Lips, cheeks, and tongue adjacent to any fractured teeth should be carefully examined and palpated.

- It is not unusual for tooth fragments to be buried in the lips.

EXAMINATION OF HARD DENTAL TISSUES:

TEETH:

- ✓Presence of infractions and cracks
- ✓Pulp exposure
- ✓Symmetry

■ ALVEOLAR BONE

VISUAL OBSERVATION

GENTLE PALPATION

Pain, malocclusion, mobility, fractured segments

Mobility testing:

- To determine the extent of loosening, especially in the axial direction of individual teeth (an indication of a severed vascular supply).
  - Observed by objectively moving the tooth
    - with the back ends of two mirrors
    - with a mirror and a finger
  - Tooth moved in all directions
  - Mobility of groups of teeth (an indication of fracture of the alveolar process).

Increased mobility: Subluxation

Lateral luxation

Alveolar bone fracture

Root fracture

Decreased mobility: Intrusive luxation

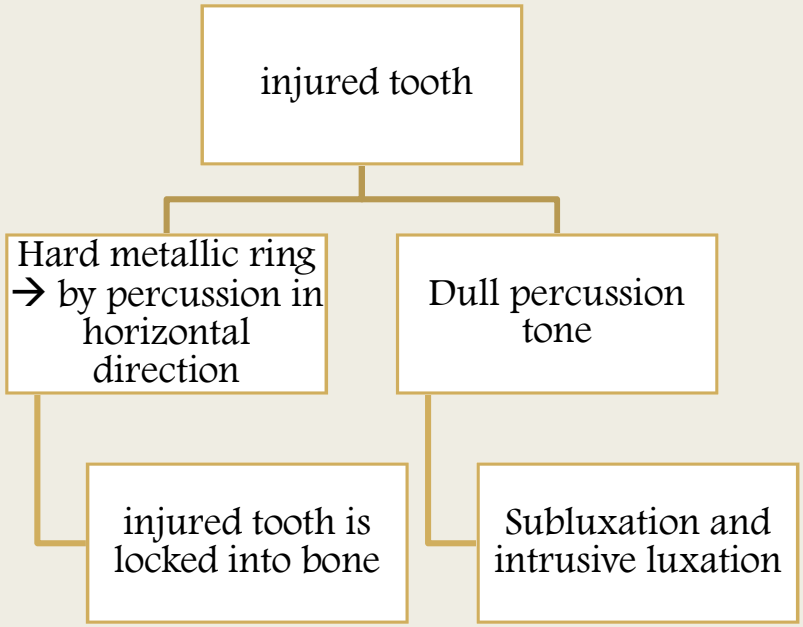
Ankylosis

Injury To Periodontal Ligament:

- Evaluated by tooth percussion.
- Include all teeth suspected of having been injured and several adjacent and opposing ones.
- Results may be recorded as “normal response,” “slightly sensitive,” or “very sensitive” to percussion.
- Back of mirror handle is used.
- In cases of extensive apical periodontal damage, it is advisable to use no more than a fingertip for percussion.

Percussion testing:

with a finger in small children or the handle of a metal instrument,



PULPAL TRAUMA:

- Condition of the dental pulp → evaluated both initially and at various times.
- Response of the pulp to trauma largely determines the treatment of and prognosis for injured teeth.
- Often the initial treatment may be no treatment but rather monitoring of the pulp response.
- Pulps may deteriorate and become necrotic months or years after the original trauma, so periodic re-evaluation is important in the management of dental injuries.

The electric pulp test (EPT):

- The EPT should be used, and the **results recorded**, at the initial visit and at subsequent recall visits.
- The most reliable response is obtained when the electrode is placed upon the incisal edge or the most incisal aspect of enamel in the case of crown fractures.
- It should be noted that young teeth with incomplete root formation do not respond consistently to sensibility testing.
- Finally, sensibility testing in the primary dentition may yield inconclusive information due to lack of patient cooperation.

- Traumatic injuries to teeth present problems with respect to vitality.
- Teeth that temporarily or permanently lose their sensory function will not respond to EPT and are described as ‘concussed’. These teeth, however, may have intact vasculature.
- Bhaskar & Rappaport (1973) described 25 traumatized anterior teeth and EPT in all cases gave a negative response. But they were all vital.
- Animal studies have investigated this aspect of EPT to determine the time period taken for injured teeth to return a baseline response (Pileggi et al. 1996).

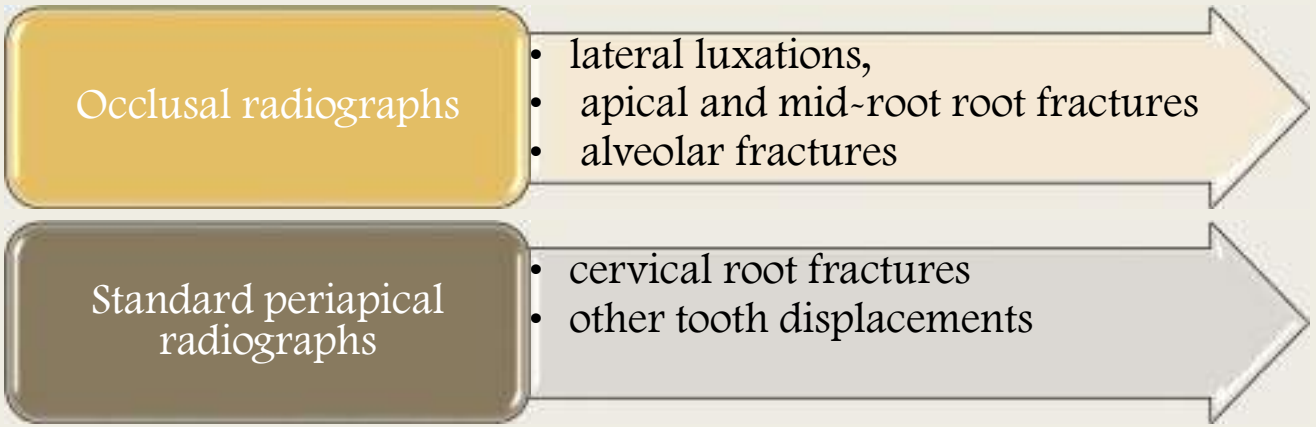
- **Cold stimulus**
  1. Used extensively for pulp testing and is quite reliable.
  2. Response not easily quantified.
  3. Pain occurring when ice is applied to a normal tooth subsides when ice is removed.

Newer approaches: Laser Doppler Flowmetry, Pulse oximetry

- **Thermal stimulus**
  1. More reliable in testing primary incisors in young children than electric pulp testing.
  2. Failure Response – pulp necrosis.
  3. Response of tooth to lower degree of heat – indication of inflammation.
- **Discoloration**
  1. Grayish hue, involving permanent teeth is indicative of pulp necrosis.
  2. Yellowish hue means that extensive calcification has occurred but not necessarily associated with irreversible pulpitis or pulp necrosis.

THE RADIOGRAPHIC EXAMINATION:

- The clinical examination should now have determined the area of injury that is the area to be examined radiographically.

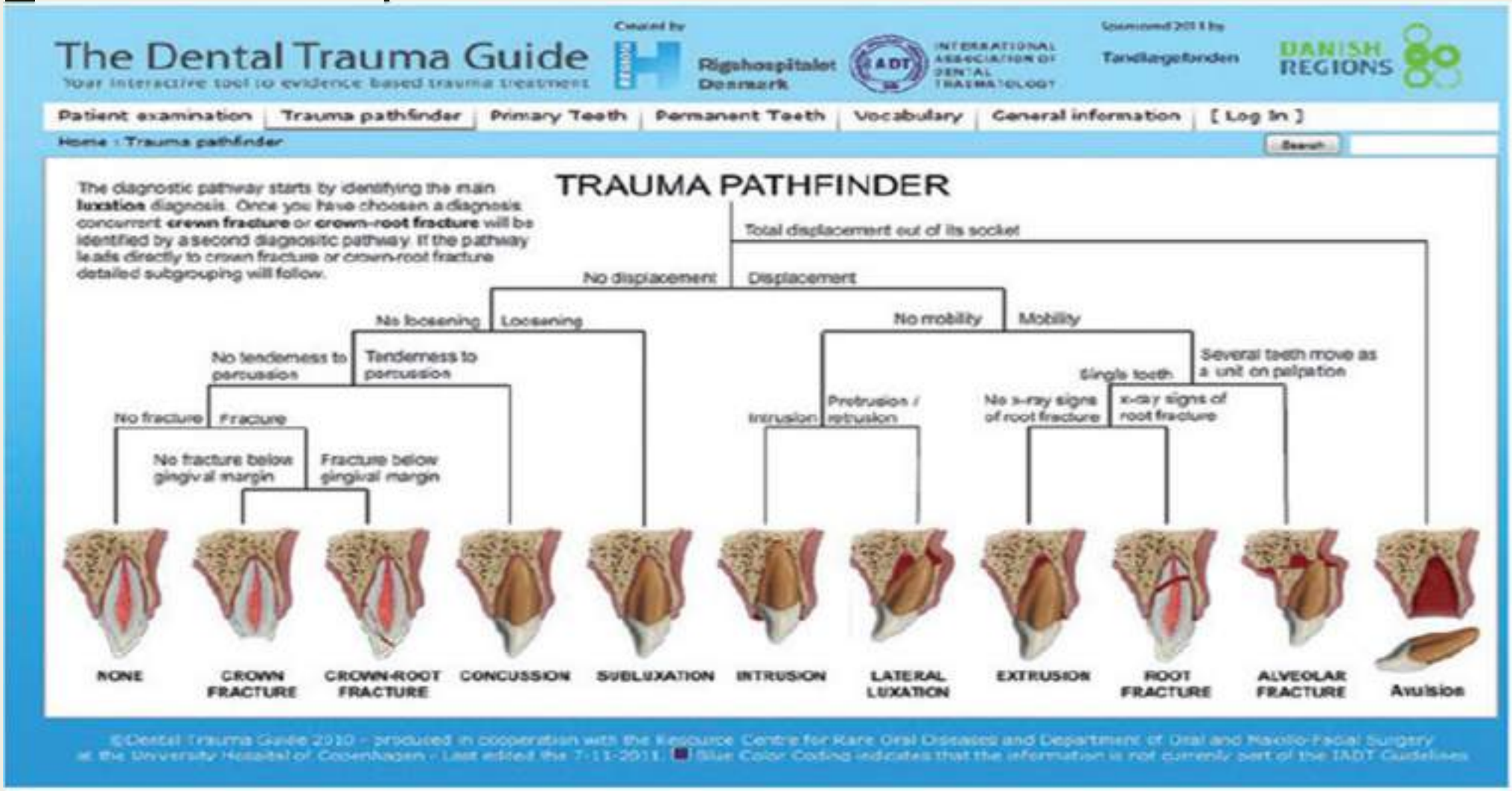


- Thus, a radiographic examination comprising 1 occlusal exposure and 3 periapical bisecting angle exposures of the traumatized region will provide maximum information in determining the extent of trauma.
- Extraoral radiography indicated in
  - jaw and condylar fractures
  - Suspected trauma to the succedaneous permanent teeth by intruded primary teeth.

- In the presence of a penetrating lip lesion a soft tissue radiograph is indicated in order to locate presence of foreign bodies.
- It should be noted that the orbicularis oris muscles close tightly around foreign bodies in the lip, making them impossible to palpate; they can only be identified radiographically.
- This is accomplished by placing a dental film between the lips and the dental arch and using 25% of the normal exposure time.

- Changes in the pulp space, both resorptive and calcific, may suggest pulp degeneration and indicate therapeutic intervention.
- Stage of root development is determined.
- Root fractures
- Coronal pulp and its proximity to the area of fracture – influence the type of restoration.

Trauma pathfinder



Crown fracture

- Permanent dentition
  - 26~76% dental injuries
- Etiologic factors
  - Injuries caused by falls
  - Contact sports
  - Automobile accidents
  - Foreign bodies striking teeth

Enamel infarction

Clinical findings

- Caused by direct impact.
- Crazings within the enamel substance which do not cross DEJ and may appear with or without loss of tooth substance.

- Not tender
- Can be overlooked when direct illumination is used, but are easily visualized when light beam is directly perpendicular to long axis of tooth from incisal edge.
- Fibre optic light source can also be used.
- Infarctions are often the only evidence of trauma, Thus, presence of infarction lines suggest injuries to adjacent structure.
- In ground sections it appears as dark lines running parallel to the enamel rods and terminate at DEJ

Radiographic findings

- No radiographic abnormalities
- Radiographs recommended: a periapical view. Additional radiographs are indicated if other signs or symptoms are present

Treatment

- In case of marked infractions, etching and sealing with resin to prevent discoloration of the infraction lines; otherwise, no treatment is necessary

Follow up

- No follow up is generally needed for infraction injuries unless they are associated with a luxation injury or other fracture Types

Favourable outcome

- Asymptomatic
- Positive response to pulp testing
- Continuing root development in immature teeth

Unfavourable outcome

- Symptomatic
- Negative response to pulp testing
- Signs of apical periodontitis
- No continuing root development in immature teeth
- Endodontic therapy appropriate for stage of root development is indicated

Enamel fracture

Clinical findings

- A complete fracture of the enamel
- Loss of enamel. No visible sign of exposed dentin
- Not tender. If tenderness is observed, evaluate the tooth for a possible luxation or root fracture injury.

- Normal mobility
- Sensibility pulp test usually positive
- Confined to single tooth usually max central incisor especially mesial or distal corners.
- Fractures can be horizontal extending mesio-distally.

Radiographs findings

- Enamel loss is visible
- Radiographs recommended: periapical, occlusal, and eccentric exposures. They are recommended in order to rule out the possible presence of a root fracture or a luxation injury
- Radiograph of lip or cheek to search for tooth fragments or foreign materials

Treatment

- If the tooth fragment is available, it can be bonded to the tooth.
- Contouring or restoration with composite resin depending on the extent and location of the fracture.

Follow up

- 6–8 weeks and after 1 year for clinical and radiographic examination;

Favourable outcome

- Asymptomatic
- Positive response to pulp testing
- Continuing root development in immature teeth

Unfavourable outcome

- Symptomatic
- Negative response to pulp testing
- Signs of apical periodontitis
- No continuing root development in immature teeth
- Endodontic therapy appropriate for stage of root development is indicated

Enamel dentin fracture

- A fracture confined to enamel and dentin with loss of tooth structure, but not exposing the pulp
- Percussion test: not tender. If tenderness is observed, evaluate the tooth for possible luxation or root fracture injury
- Normal mobility
- Sensibility pulp test usually positive

- $1mm^2$ Fracture exposes about 20000-45000 dentinal tubules.
- This constitute pathways for bacteria, thermal and chemical irritants which provokes pulpal inflammation.
- Lundy and Stanley found that speed of bacterial penetration about 0.03-0.06mm → 6-11 days and 0.52mm in 84 days.

■ Radiographic findings

- Enamel–dentin loss is visible
- Radiographs recommended:
  - periapical, occlusal, and eccentric exposure to rule out tooth displacement or possible presence of root fracture
- Radiograph of lip or cheek lacerations to search for tooth fragments or foreign materials

- Treatment
- If a tooth fragment is available, it can be bonded to the tooth.
- Provisional treatment → covering exposed dentin with glass Ionomer.
- Exposed dentin 0.5 mm of the pulp (pink, no bleeding) → calcium hydroxide base and glass ionomer

- The treatment of enamel dentin fracture without pulpal exposures has been dentin coverage with hard setting calcium hydroxide liner.
- However, clinical experience indicates that hard setting calcium hydroxide cement disintegrate beneath dental restoration with time.
- Cultivable and stainable bacteria have been found within calcium hydroxide liners used in both exposed and pulp capped and nonexposed control teeth and are unable to provide permanent barrier against microleakage.

- Moreover, dentin bonding agents has minimized calcium hydroxide liner and thus it maximized the bonding area and minimized the gap formation between the tooth surface and composite restoration to ensure pulpal healing.
- Provisional treatment options
  - *Glass ionomer cement bandage*
  - *Resin or celluloid crowns*

Glass ionomer cement bandage

Treatment

- If the tooth fragment is available, it can be bonded to the tooth.
- Contouring or restoration with composite resin depending on the extent and location of the fracture.

Follow up

- 6–8 weeks and after 1 year for clinical and radiographic examination;