Management of Non-Vital Immature Permanent teeth Secondary to Trauma

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Aerial View Of KGMC, Lucknow
Photo By: Arun Khanna
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Long Essays-
Classify ATT. Discuss the management of Ellis Class IV fracture wrt tooth no 21 in a 9 year old boy with the h/o trauma last year.

OR

A 10 year old boy reports with a chief complaint of fractured & discoloured tooth no. 11. History reveals fall from the cycle approx. 2 years back. Classify the trauma & discuss the management options with their merits & demerits.

OR

Essay on- critically evaluate the management options of non-vital immature permanent teeth

Short Essays-
CH Vs MTA apexification
Histology of the bridge formed following CH apexification
**Trauma** - Any physical injury of sudden onset and severity which requires immediate medical attention.

**Classification by Ellis and Davey (1970)**

- Based on numeric system.
- One of the most widely accepted classification.

- **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 and exposing the dental pulp.

**Class IV** - The traumatized teeth that become non-vital with (or) without 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 crown structure.
- **Class VII** - Displacement of a tooth without fracture of crown (or) root.

- **Class VIII** - Fracture of crown en masse and its replacement.
- **Class IX** - Injuries to primary dentition.
# Modified Ellis & Davey Classification

<table>
<thead>
<tr>
<th>Type</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No trauma</td>
</tr>
<tr>
<td>I</td>
<td>Simple fracture of crown, involving little or no dentin</td>
</tr>
<tr>
<td>II</td>
<td>Extensive fracture of crown, involving considerable dentin, not the pulp</td>
</tr>
<tr>
<td>III</td>
<td>Extensive fracture of crown, involving considerable dentin, exposing pulp</td>
</tr>
</tbody>
</table>

**IV** Non-vital tooth with out the loss of crown structure

<table>
<thead>
<tr>
<th>V</th>
<th>Total tooth loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Displacement of tooth, without fracture of crown or root</td>
</tr>
<tr>
<td>VII</td>
<td>Fracture of the entire crown and its replacement</td>
</tr>
</tbody>
</table>

FACTS & FIGURES…..

1. Area of the oral region – 1% of the body
2. Injury to the oral region – 5% of the body
3. Boy : girls – 1.4:1
4. ‘Fall’ - the most common cause of injury
5. Single tooth trauma - most common
6. Most common age group for injury - 11 years
7. Central incisors - most commonly affected

Andersson et al. Epidemiology of traumatic dental injuries. JOE 2013
## Permanent Maxillary Central Incisor

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Structure</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; evidence of calcification</td>
<td>3-4 months</td>
<td>Crown length</td>
<td>10.5 mm</td>
</tr>
<tr>
<td>Enamel completion</td>
<td>4-5 years</td>
<td>Root length</td>
<td>13.0 mm</td>
</tr>
<tr>
<td>Eruption time</td>
<td>7-8 years</td>
<td>Mesio-distal width</td>
<td>8.5 mm</td>
</tr>
<tr>
<td>Root completion</td>
<td>10 years</td>
<td>Labio-lingual width</td>
<td>7.0 mm</td>
</tr>
</tbody>
</table>
Young (Immature) Permanent tooth?
A tooth which is not fully formed, particularly the root apex. A vital pulp is necessary for the development and maturation of the tooth root.

- After eruption, a tooth takes three more years for the root development to complete (Fouad 2009).
- At the time of eruption, enamel calcification is also incomplete & takes 2-3 years to complete.

trauma before root completion $\rightarrow$ chances of pulp necrosis

non-vital tooth

-British Society of Pediatric dentistry
Diagnosis -

1. **History** - time of injury, interventions, medication, how injury occurred

2. **C/F** - fracture, discolouration, no bleeding/ pus discharge, sinus +/-

3. **Tests** - IOPA, pulp tests
Why a non-vital tooth gets discoloured?

- Injury → rupture of blood vessels
- Extravasation of hemoglobin → dissociation
- \( \text{Fe} + \text{O}_2 \rightarrow \text{FeO} \) → Discolouration

False Positive response in non-vital tooth?

- An anxious patient → anticipating unpleasant sensation
- Necrotic pulp may conduct electric current to the viable adjacent areas.
- Improper placement of probe → touching gingiva
- Failure to isolate/dry the tooth

V Gopikrishna et al IJPD 2008

R Gopakumar. IJCPD 2011
Why a tooth becomes non-vital?

**pulp necrosis**

The aetiology of pulp necrosis in immature permanent teeth include caries, trauma or the presence of the dental anomalies, dens invaginatus and dens evaginatus.

Flanagan TA. What can cause the pulps of immature, permanent teeth with open apices to become necrotic and what treatment options are available for these teeth. Australian Endodontic Journal. 2014 Dec;40(3):95-100.
Dental Trauma....

Trauma (TDI)

Crushing/displacement injury to apical area

Complete/partial obstruction in blood supply

If not restored

Necrosis
Which type of trauma causes pulp necrosis?

Concussion – 3%,
Enamel–dentin fracture – 12%,
Extrusion – 26%,
Lateral luxation – 58%,
Avulsion – 92%,
Intrusion – 94%

Borum MK, Andreasen JO, Therapeutic and economic implications of traumatic dental injuries in Denmark; an estimate based on 7549 patients treated as a major trauma centre. Int J Paediat Dent 2001, 11;249-58
Surprisingly…

30% - injuries in permanent teeth

Occur…………

before the completion of roots  ???
Treatment Options
Non-vital immature permanent teeth

Creating apical stop
(Apexification)
- Gradual
- Immediate
- Traditional
- Apical Barrier Technique

Creating root end closure
(Regenerative Endodontics)
- Revascularization
- Tissue engineering technology
- Cell homing
- Cell transplantation

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Apexification—method of inducing apical closure by the formation of osteo-cementum or a similar hard tissue or continued apical development of the root of an incompletely formed tooth in which the pulp is no longer vital.

- AAE

Materials used:
- Calcium Hydroxide
- Mineral Trioxide Aggregate (tricalcium silicate, tricalcium aluminate, tricalcium oxide & silicate oxide)
- Bioceramics (zirconium oxide, calcium silicates, calcium phosphate monobasic, calcium hydroxide, filler, and thickening agents)
- Biodentine (tricalcium silicate, dicalcium silicate, calcium carbonate, calcium oxide, calcium hydroxide & zirconium oxide)
Mechanism of action-

CH or MTA in the apical III

Stimulation

release of growth factors & bioactive molecules form alveolar bone matrix

signal

stem cells in PDL & alveolar bone marrow

differentiation into odontoblast like cells

hard tissue barrier (cementoid or osteoid)
**Traditional Apexification**

- Calcium Hydroxide powder/ paste
- Use of Ca(OH)$_2$ in apexification was first reported by Kaiser
  - multi-appointment procedure
  - Fastest bridge formation- CH+Iodoform

Kaiser JH. Management of wide-open canals with calcium hydroxide. 1968

First Appointment

i. Isolation

ii. Access – Straight line

iii. Instrumentation – Working length – 2-3 mm short
   ○ Circumferential filing
   ○ 120-140 number Files 90, 100, 110, 120, 130, 140

iv. Irrigation – NaOCl + Saline

v. Seal the access
Second Appointment

vi. Dry the canal – Blunt end of paper point

vii. Material placement – Metapex / Pulpdent or thick paste of Ca(OH)$_2$ + BaSO$_4$ + CMCP (with amalgam carrier or Syringe)

viii. Fill till CEJ

ix. A layer of Ca(OH)$_2$ powder

x. Access sealed
Case 1 CH Apexification

Pre-op

Canal cleaned, shaped & filled with calcium hydroxide.

Post-op
Apical 1/2 obturated with GP & rest with composite (1.6 years follow up)

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Case 2 CH Apexification

Pre-op

Canal cleaned & filled with CH.

6 months Post-op GP obturation

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Case 3 CH Apexification

Pre-Op

Canal cleaned & filled with Metapex

Post-Operative
Case 4 CH Apexification

Pre-Operative

Metapex filling after canal cleaning

Obturation
Types of Apical Closure

Periodic recall-

- Normal time 6-24 months
- 3 months recall… see evidence
Apical Barrier Technique

k/a One/two Step apexification
Material used-

MTA (Grey & White) ...... FeO & MgO in Grey

• Powder: Liquid = 3: 1, Mixed with water
• Setting time – 2.6 hrs
• pH 10.2 during mixing & 12.5 when set

Material is packed in apical III

Quick ... apical barrier technique allows Immediate obturation
Technique:

1. Canal cleaned & medicated with CH
2. After 1 week – Irrigate with 1 - 1.5 % NaOCl
3. Dry the canal, pack 3 – 4 mm of MTA at apical third
4. Wait for 3 hours.....allow to set
5. Obtrurate
Fast Setting MTA

Sets in 4 minutes

Good sealing capabilities

Strong antibacterial properties

Minimal discoloration & calcification

Other uses – Retrograde fillings, DPC,

Perforation repair
Case 5 MTA Apexification

Pre-Op  Working length  MTA placement  Post obturation
Case 6 MTA Apexification

Pre Op

Working length

MTA plug

Post Obturation
Outcome-

In either of the approaches…..

- Tooth remains non-vital
- Short roots & prone for fracture
- Thin dentinal walls
- Apical barrier is weak & porous (CH Apexification)
- Altered Crown Root ratio
- Need for full coverage restoration

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### CH Vs MTA Apexification

#### Calcium Hydroxide

1. Multi visit procedure
2. Apical stop – 6-24 months
3. Bridge formation - irregular
   - Cheesy consistency
   - Minute communication
     (vascular inclusions)
4. Need for refilling
5. Cost effective
6. Weaken dentin - if placed for more than 5 months

#### Mineral Trioxide Aggregate

1. One or two visit procedure
2. Apical stop – immediate
3. Apical stop - thicker
   - Harder
   - Non-porous
4. No need
5. Not cost effective
6. No effect on dentin
Reinforcement of Thin Dentinal Walls Following Apexification

- Apical III- GP obturation (CH) or MTA
- Cervical & middle III reinforced
- 4 approaches-
  a. Use of adhesive sealers
  b. GIC
  c. Intra canal composite with clear posts
  d. Glass fiber posts (biomechanical properties & modulus of elasticity similar to dentin)

Suggested Reading


- Pulp therapy for primary and immature permanent teeth. The reference manual of pediatric dentistry 2014.

Thank You

Any Questions?

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