Current concepts in the management of dental trauma

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Introduction

- Around one in ten children had sustained dental trauma to their incisors (12% at age 12 and 10% at age 15 - Child Dental Health Survey 2013)
- Boys at 12 are twice as likely to suffer from dental trauma
- Minimal information with regard to adult population
- In General:
  - Uncomplicated crown fracture most common in permanent teeth (50%)
  - About 5% pulp exposure
  - Luxation injuries less common

Predisposing factors for dental trauma

- Overjet, 3 – 6 mm OJ double incident of Dental Trauma than 0 – 3 mm, > 6mm OJ threefold.
- Lip competency
- Age peak 2-4 years, 8-10years

Management of the vital pulp in permanent teeth

Treatment need for crown fracture

- Subacute (within 24 hours)
- Delayed (> the first 24 hours)
  - ✓ *Andreasen JO et al. Effect of treatment delay upon pulp and periodontal healing of traumatic dental injuries -- a review article.Dent Traumatol. 2002 Jun;18(3):116-28.*
  - ✓ *Viduskalne I, Care R. Analysis of the crown fractures and factors affecting pulp survival due to dental trauma*
  - Good seal – improve outcomes

Direct Pulp Cap

- Small exposure
- Recent, within 24 hours
- Tight seal against bacteria

- The reported prognosis for direct pulp capping is in the range of 80% when performed under ideal conditions.

✓*Fuks AB, Bielak S, Chosak A. Clinical and radiographic assessment of direct pulp capping and pulpotomy in young permanent teeth. Pediatr Dent 1982: 4: 240– 244.*

✓*Ravn JJ. Follow-up study of permanent incisors with complicated crown fractures after acute trauma. Scand J Dent Res 1982: 90: 363–372.*

Pulpotomy

Removal of exposed vital pulp to preserve the radicular vitality

Any exposure size

Delayed presentation (> 24 hours)

- ✓ *Cvek M. A clinical report on partial pulpotomy and capping with calcium hydroxide in permanent incisors with complicated crown fractures. J Endod 1978;4:232–7.*
- ✓ *Fuks et al . Partial pulpotomy as a treatment alternative for exposed pulps in crown-fractured permanent incisors . Endod Dent Traumatol. 1987 Jun;3(3):100-2*
- ✓ *Bimstein & Rotstien. Cvek pulpotomy: revisited. Dent Trauma 2016; 32: 438-442*

Mineral trioxide aggregate (MTA)

- First introduced in 1993
- tricalcium silicate, tricalcium oxide and silicate oxide
- pH 12.5
- Hydrophilic
- Biocompatible
- Direct bone apposition
- Inductive effect on cementoblasts
- Actively promotes hard tissue formation
- Facilitates the regeneration of PDL
- Marginal seal

MTA and the vital pulp

- Pulp capping
- Pulpotomy
- Advantages
  - Superior long-term sealing ability
  - Stimulates a higher quality and greater amount of reparative dentin
- Disadvantages
  - Discolouration
  - Cost

Evidence / Pulp capping

Prospective studies comparing MTA to Ca[OH]2:

Initial healing is better with MTA; subsequent healing similar in MTA and Ca(OH)2

- ✓ *Nair et al. Int Endod J. 2008 Feb;41(2):128-50* RCT (no long term outcome)
- ✓ *Sawicki et al. Am J Dent. 2008 Aug;21(4):262-6*

Observational study:

- ✓ *Bogen et al. J Am Dent Assoc. 2008 Mar;139(3):305-15* . 97.6% of the sample showed favourable outcomes; all immature teeth showed subsequent complete root formation (Caries)

Evidence/Pulpotomy

- RCT
- Prospective studies comparing MTA to Ca(OH)2
  - *El-Meligy and Avery. Pediatr Dent. 2006 Sep-Oct;28(5):399-404.* Similar clinical and radiographic outcomes

Biodentine

Bioactive Dentine Substitute

September 2011

Calcium-silicate based formulation

mechanical properties similar to the sound dentine.

Tight seal

Limited Evidence

Crown – Root Fracture

Immediate management

Reattach fracture fragment with composite resin.

Definitive treatment options (usually within two weeks from the initial injury):

1. Remove fracture fragment only (pulpotomy if exposed pulp)
2. Remove fragment and gingivectomy
3. Orthodontic extrusion
4. Root burial
5. Extraction

Follow up

Clinical and radiographic control 6- 8 weeks and 1 year

Root Fracture

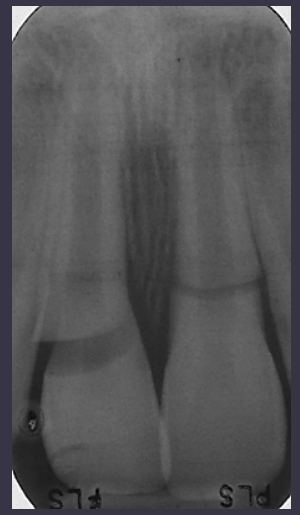
Classification:

A- Direction of fracture line

- Vertical
- Horizontal

B- Position of the Fracture Line:

- Apical
- Middle
- Cervical:
  - Poorer prognosis
  - May require extraction of tooth
  - May require extraction of coronal fragment and extrusion of root
  - Splinting up to 4 months



Immediate Management

- Immediate repositioning if displaced
- Splint up to 4 weeks or until stable if mobile
- Soft diet and CHX
- Review vitality of coronal fragment
- Treat complications

Alveolar fracture

Management:

- Reposition
- Splint for 4 weeks

Follow up:

- clinical and radiographic control after 6-8 weeks, 4 months, 6 months, 1 year and yearly for 5 years

Prognosis:

- Pulp necrosis
- Resorption

Luxation Injuries

- Concussion
- Subluxation
- Extrusion
- Lateral Luxation
- Intrusion
- Avulsion

Management

- Diagnosis
- Repositioning
- Splinting
-Follow up
- Root canal treatment

Management of Non Vital Immature Permanent Incisor

Immature Permanent Incisors

- Open apex
- Thin dentinal walls
- Root/crown ratio

Conventional Root End Closure (apexification)

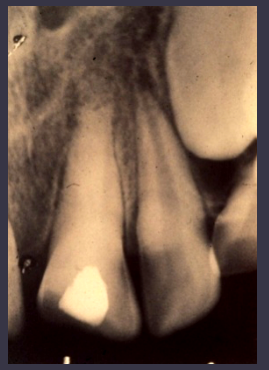
Good success rate

Straight forward technique

No known discoloration

Calcium hydroxide has an antimicrobial effect, which achieves further disinfection.

- ✓ *Mackie et al. BDJ 1988 and 1993*
- ✓ *Sheehy EC, Roberts GJ. Br Dent J. 1997 Oct 11;183(7):241-6.*



Problems with apexification

Multiple visits over several months

Barrier detection:

- ✓*Kinirons et al. 2001, 43.3 wks,*
- ✓*Mackie et al. 1988, 5.1- 6.8 months*

No qualitative increase in root dimensions

Final filling difficult due to wide root canal

Root continues to be predisposed to fracture

Problems with apexification

Risk of root fracture in immature teeth treated with apexification

✓*Cvek 1992. Endodontics and Dental Traumatology 8, 45–55.*

885 luxated, non-vital immature incisors

- Frequency of fractures dependant on the stage of root development
- Range 28-77%

✓ *Andreasen et al. 2002. Dental Traumatology 2002;18:134-7*

- Longterm calcium hydroxide as a root canal dressing may increase risk of root fracture.
- Proteolytic nature affects the circumpulpal dentine

MTA for Root End Closure

- Immediate barrier
  - One – two visits
  - Coronal seal

    ✓*Saunders & Saunders EM. Endod Dent Traumatol 1994;10:105–8.*
  - Improve compliance

Regenerative Endodontics

Biologically based procedures designed to replace damaged structures, including dentin and root structures, as well as cells of the pulp-dentin complex.

Objectives of Regenerative Endodontics

- To regenerate pulp-like tissue, ideally, the pulp-dentin complex.
- Regenerate damaged coronal dentin. E.g. following a carious exposure
- Regenerate resorbed root, cervical or apical dentin.

When did we start thinking about regenerative techniques

1952

✓*Herman BW. On the reaction of the dental pulp to vital amputation and calxyl capping. Dtsch Zahnarztl Z 1952;7:1446-7.*

Guided tissue or bone regeneration (GTR, GBR) procedures and distraction osteogenesis

The application of platelet rich plasma (PRP) for bone augmentation

Emdogain for periodontal tissue regeneration

Research into regenerative endodontic includes :

Stem cells

Growth factors

Organ-tissue culture

Tissue engineering materials

Stem Cells and Endodontics

- Dental pulp stem cells (DPSC)
- Stem cells from human-exfoliated primary teeth (SHED)
- Periodontal ligament stem cells (PDLSC).
- Stem Cells from apical papilla (SCAP)

Scaffolds

- Provide framework for cell growth differentiation and organisation at a local site
- Natural (e.g. Collagen), Synthetic (polymer hydrogel)
- Porous
- Biocompatible
- Degrade slowly and replaced by regenerative tissues

Suggested Technologies for Regenerative Endodontics

Root canal regeneration via blood clotting

Scaffold implantation – GF , AB

Injectable scaffold delivery (Hydrogel)

Stem cell implantation

Pulp implantation

Gene Therapy

Pulp regeneration via blood clot

1961

- ✓NYGAARD OSTBY, B . : The role of the blood clot in endodontic therapy. A n experimental histologic study. *Acta odont. scand.* 1961: **1 9 :** 323-353.

Considered a possibility after avulsion

Requirements

Disinfection of the canal (non- infected pulp necrosis conditions)

Provide a scaffold (blood clot)

Coronal seal

Disinfection of the root canal space

Irrigation

Dressing

- $Ca(OH)_2$
- Antibiotic paste

Triple antibiotic paste

- Ciprofloxacin 200mg, Metronidazole 500mg, Minocycline100mg
  - Ciprofloxacin: Bactericidal, Gram –ve
  - Metronidazole: selectively toxic, Broad spectrum protozoa & anaerobic bacteria, bind to DNA , disrupt helical structure leading to rapid cell death
  - Minocycline: Bacteriostatic , inhibit protein synthesis , Broad spectrum –ve & +ve.

Alternative used

- Bi- antibiotic paste
- Triple antibiotic paste Replace Minocycline with cefaclor
  - Cefaclor: 2nd generation cephalosporin antibiotic , broad spectrum
- Sealing dentinal tubules

How do we get continued root growth

Vital pulp cells remain at the apical end differentiate into odontoblasts guided by ERS of Hertwig

PDLSC

SCAP

Blood clot is considered a reservoir of growth factors

Conventional treatment vs. regenerative techniques

Reinforcement of dentinal walls by deposition of hard tissue thus strengthening the root against fracture

Further pulp disease

Different techniques

Emerging problems

Further proof of concept research and clinical trials

Traumatised teeth with poor prognosis

The Future

- Core outcomes set : IADT
- Care pathways to ensure appropriate initial management and reduce long term burden
- Transitional care
- PROMs