Vital Pulp Therapy in Children
Study Objectives

• Define, understand, and describe all the principles involved in vital pulpotomy techniques.
• Discuss indications, contraindications, clinical procedures, and reasons for failures of vital pulp treatment in children.
Vital Pulp Therapy

The treatment objectives for *vital pulp therapy* include:

- Eradication of infection.
- Capitalization of reparative ability of the pulp.
Vital Pulpotomy

A procedure in which the non vital coronal pulp (or part of it) is amputated and a medicament is placed over the radicular pulp to help maintain its vitality.
Indications

- Mechanical or carious exposure of pulp
- Inflammation limited to coronal pulp
- Absence of spontaneous pain
- Absence of swelling or alveolar abscess formation
Contraindications

• Tooth with gross coronal breakdown that makes retention of restoration difficult
• Tooth close to natural exfoliation.
• Tooth with excessive tooth mobility.
Contraindications (2)

• Tooth with advance pathological root resorption, pulp calcifications and profuse haemorrhage from the pulp chamber.
• Tooth with sagittal fracture.
Vital Pulpotomy Procedure

• Prepare instrument and materials.
• Isolate the tooth using rubber dam.
• Prepare the cavity to provide easy access to the pulp chamber using a No. 330 bur to create your cavity outline.
Vital Pulpotomy Procedure - 2

- It is important to extend the occlusal part of the cavity across the entire occlusal surface. Extend across the oblique ridges on the occlusal surfaces of the mandibular first molars and maxillary second molars.
• Excavate deep caries with large excavators.
• Remove roof of the pulp chamber using sterile fissure bur.
• Remove the coronal pulp with a large excavator or slowly rotating round bur.
• Irrigate the pulp chamber with sterile water or saline using a disposable syringe with a sterile needle.
• Dry and control bleeding with sterile cotton wool pledgets.
• Apply pulp medicament. If formocresol, dip a cotton pledget into formocresol solution, remove excess by dapping on a cotton wool, then
Vital Pulpotomy Procedure - 6

- Place pledget on the pulp chamber covering the radicular pulp stumps for 4 – 5 minutes. Do not allow solution to leak unto the gingival.
• Apply antiseptic dressing: prepare an antiseptic paste by mixing equal parts of eugenol and formocresol with ZnO cement.
• Remove the pledget containing formocresol and place just enough paste to cover the radicular pulp stump.
Prior to placement, dab the paste lightly into a moist cotton pledget to remove excess liquid. The antiseptic dressing is used to combat any residual infection. Pressure on the radicular stumps should be avoided.
Vital Pulpotomy procedure - 9

- Place quick setting cement base before restoring with amalgam.
- Restore with stainless steel crown. SSC is the deal restoration because the a tooth treated by pulpotomy becomes brittle with time and may fracture.
Vital Pulpotomy Medicaments

Pharmacologic agents:
- Formocresol
- Calcium hydroxide (not used for primary teeth)
- Glutaraldehyde
- Ferric sulphate
- Mineral trioxide aggregate
Non pharmacologic agents:
• Laser
• Electrosurgery
The ideal pulpotomy material should:

- Be bacteriocidal
- Be harmless to the pulp and surrounding tissues
- Promote healing of the radicular pulp
- Not interfere with physiologic root resorption
- Preserve the radicular pulp without any clinical or radiographic symptoms.
Formocresol

- Formocresol has been the ‘gold standard' for vital pulpotomy for many decades
- It was introduced by Buckley 1904.
- Clinically emphasized by Sweet in 1930
- Contains 19% formalin in 15% aqueous glycerin, 35% cresol
• Prepared as Buckley or Sultan formocresol.
• Sultan formocresol contains antiseptics.
• Buckley formocresol is used at a 20% concentration achieved by 1:5 dilution. This is done by adding 3 parts of glycerin to 1 part of distilled water. Then 1 part of formocresol to 4 parts of diluent.
Reported success rates of pulpotomy done using formocresol ranges from 70% to 97%. Despite its efficacy, there are doubts about its safety.
Formocresol - 4

- It diffuses very fast through the pulp tissue, and to other parts of the body. There is evidence of systemic distribution to the liver and kidney.
- There is also the potential for toxicity, allergenicity, carcinogenicity and mutagenicity.
The primary concern regarding the use of formocresol is related to its toxicity and possible blood-borne spread to distant sites.

A study of Rhesus monkeys found that a 5 minutes exposure of pulpal tissue to formocresol resulted in systemic absorption of approximately 1% of the dose.
In 2004, The International Association of Cancer Research classified formaldehyde as carcinogenic to humans.

There are strong but not sufficient evidences to suggest leukemia and cancer of the paranasal sinuses associated with the use of formocresol.
These findings have led to a search for a suitable alternative to replace formocresol which is equally effective but without the side effects of formocresol.
Some of these materials include MTA, Glutaraldehyde, ferric sulfate, BMP, Osteogenic protein, bioactive glass. Also, non-pharmacologic haemostatic techniques such as laser and electro surgery are considered for vital pulpotomy.
Glutaraldehyde

- Superior fixation by cross linkage of 2 aldehyde rings
- Diffusibility is limited because it has larger molecules than formaldehyde.
- Causes less necrosis of pulp tissue due to less diffusibility.
Gluteraldehyde - 2

- Excellent antimicrobial agent.
- Causes less dystrophic calcificant in pulp canals.
- Does not stimulate significant immune response.
- 15 – 20 times less toxic than formocresol
• Minimal systemic distribution because of larger molecular size and less chance of penetrating the apical foramen
• 90% of the drug is metabolized within 3 days.
Clinical success of glutaraldehyde is as high as 96.5%.

Reports on the mutagenicity of glutaraldehyde have given mixed results.
Ferric Sulfate

- An Astringent
- It forms a ferric ion protein complex that mechanically occludes capillaries.
- It has been used as haemostatic retraction agent for crown and bridge impression.
- Proposed as a pulpotomy agent in 1988 by Landau and Johnson.
• Causes less inflammation than formocresol when used as a pulpotomy agent.
• Ferric sulfate is not a fixative but it is bacteriostatic in nature
• It is not toxic.
Ferric sulfate - 3

• Same procedure as formocresol but should be placed on stump of amputated pulp for 15 seconds.
• 92.7% to 100% success rates reported.
• Good alternative for formocresol.
Mineral Trioxide Aggregate (MTA)

- Developed by Torabinejad of the Loma Linda University in 1995.
- Its composition include: Tricalcium silicate, dicalcium silicate, tricalcium aluminate, tetracalcium aluminoferrite, gypsum and bismuth oxide.
Mineral Trioxide Aggregate - 2
• Two types: Gray and White MTA.
• Similar to Portland cement.
• Biocompatible with human oral tissues.
• Non toxic.
• Minimal or no marginal leakage.
• Highly alkaline with a pH of 12.5
• It promotes regeneration of tissues
• Long setting time of 1-2 hours
Mechanism of Action

• Stimulates synthesis of cytokines and interleukin products from bone cells. This allows the attachment of osteoblast.
Mechanism of Action

- Stimulated hard tissue formation through release of calcium in form of calcium hydroxide.
- Stimulates the formation of “dentinal bridge” and preserve the vitality of the remaining pulp tissue.
Clinical Applications of MTA

- Pulp Capping
- Furcal Repair
- Perforation Repair
- Root-end Filling
- Root Resorption
- Apexification
Procedure:

- Prepare cavity and achieve haemostasis.
- Cover pulp stump with MTA paste prepared by mixing MTA powder with sterile saline using 3:1 powder:saline ratio.
- To achieve an optimal solidity and compressive strength, wait for 24 hours before definitive restoration of the tooth.
Procedure (2):

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Procedure (3):

- Some prefer the use of conventional GIC for the definitive restoration. This can be placed on partially hardened MTA allowing for undisturbed hardening of MTA beneath the definitive restoration. This method allows for single visit pulpotomy.
Disadvantages

• It is very expensive
• It is hydrophilic and can cause air setting when exposed to moisture. This can be prevented by placing it in an Eppendoff tube after opening.
MTA vs Formocresol

- Eldeman (2001) worked on 33 children with 62 teeth and followed them up for a period ranging between 4 and 74 months. The success rate of pulpotomy using MTA was 97% and 83% for pulpotomy using formocresol.
Farsi et al (2005) treated 74 primary molars with formocresol and MTA and followed up for 24 months. The success rate of pulpotomy using MTA was 100% while that of formocresol was 92.7%.
In Nigeria, Olatosi, Sote and Orenuga (2012) treated 50 primary molars in 37 children and followed up for 9 months. Clinical success rate for MTA pulpotomy was 100% and 81% for formocresol. Radiographic success rate was 96% for MTA and 81% for formocresol.
The use of calcium hydroxide for vital pulpotomy in the primary molar is controversial.

Calcium hydroxide is associated with internal root resorption.

Internal root resorption results from stimulation of undifferentiated mesenchymal cells to differentiate to osteoclasts. The osteoclasts cause internal root resorption.
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Some studies show that when the blood clot formed prior to placement of the calcium hydroxide is thin, the internal root resorption observed is comparable with that associated with formocresol pulpotomy.
Bone Morphogenic Protein

- BMPs initiate endochondral bone formation by stimulating undifferentiated pluripotent cells to differentiate into cartilage and bone forming cells. BMP’s are abundant in bone and dentine. They help promote osteogenesis and reparative dentine formation.
Laser

• Light Amplification by the Stimulated Emission of Radiation (LASER) transforms light of various frequencies into chromatic radiation. It is capable of mobilizing immense heat and power when focused at close range.
• First used in dentistry by Stern and Sognnaes in 1964.
• It causes a reduction in permeability to acid demineralization of enamel.
• Also causes coagulation necrosis and degeneration of the odontoblastic layer without damage to the radicular portion of the pulp.
The pulp’s microcirculation after irradiation with the Er:YAG laser, shows an instant, reversible decrease of blood flow for 3 to 6 minutes with no signs of hyperemic reaction that might be caused by heat.
Electrosurgery

• Electrocoagulation is a nonpharmacological hemostatic method and has been suggested to give favorable results in pulpotomy procedures.
• Electrocoagulation is generally termed as electrosurgery.
It involves the use of several types of electrical equipment producing a variety of electrical currents.

The steps in the electrosurgical pulpotomy technique are basically the same as those for the formocresol technique.
• Following coronal pulp amputation, dental electrode is used to deliver the high frequency electrical current to the pulpal stump for 1 second.
• This is followed by a cool-down period of 5 seconds.
• Heat and electrical transfer are minimized by keeping the electrode as far away from the pulpal stump and tooth structure as possible.
• When the procedure is properly performed, the pulpal stumps appear dry and completely blackened.
• The chamber is filled with ZOE placed directly against the pulpal stumps.
• Electrosurgery is fast.
• It has no undesirable local or systemic effects.
Quiz 1

Materials for vital pulpotomy:

• Ferrous sulphate
• Formaldehyde
• Gluteraldehyde
• Mineralised trioxide aggregate
Indications for vital pulpotomy

• Tooth with grass coronal breakdown
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Acknowledgement

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