Materials used for vital pulpotomy
Outline

• Properties of ideal material for vital pulpotomy
• Formocresol
• Ferric Sulphate
• Gultaraldehyde
• Mineral trioxide Aggregate
• LASER
• Electrocutery
Properties of materials

Ideal pulpotomy material should be:

• Bacteriocidal
• Harmless to the pulp and surrounding tissues
• Promote healing of the radicular pulp
• Should not interfere with physiologic root resorption
• Should preserve the radicular pulp without any clinical or radiographic symptoms.
Formocresol

- Formocresol has been the ‘gold standard' material for vital pulpotomy many decades
- Introduced by Buckley 1904.
- Clinically emphasized by Sweet in 1930
- Contains 19% formaldehyde, 35% cresol, 15% water and glycerin
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- Contains 19% formaldehyde, 35% cresol, 15% water and glycerin.
• Buckley formocresol comes as a 20% concentrated solution.
• Should be diluted as a 1:5 dilution before use.
• 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.
• Success rate ranges from 70-97%.
Despite its efficacy, there are doubts about its safety. Suspected to be mutagenic, cytotoxic, carcinogenic thus posing threat to humans. IACR 2004 classified formaldehyde as carcinogenic to humans. Strong but not sufficient evidence of formocresol causing leukemia and cancer of the paranasal sinuses (Zarzar 2003).
• Suitable material replacement for formocresol include MTA, glutaraldehyde, ferric sulfate, BMP, osteogenic protein, bioactive glass.
• Non-pharmacologic haemostatic techniques e.g Laser and electro surgery.
• These replacement are equally effective without the side effects of formocresol.
Formocresol Pulpotomy Procedure

• Give Local anaesthesia.
• Isolate tooth with rubber dam.
• Use No 330 bur to create your cavity outline.
• Remove all carious dentine and the roof of the pulp chamber with a slow speed round bur.
• Amputate the coronal pulp with a slow speed round bur or a spoon excavator.
• Irrigate coronal pulp chamber with normal saline.
Formocresol Pulpotomy Procedure

• Place a moisten cotton pellet on the orifice of the canals to achieve haemostasis for between 3-5 minutes.

• Place cotton pellet moistened with formocresol on pulp stump for 5 minutes.

• The pulp stump should appear blackish brown.

• If there is bleeding after use of formocresol, check for residual pulp tissue otherwise indicative of irreversible pulpitis.
Formocresol Pulpotomy Procedure

- Remove the formocresol moistened cotton pellet.
- Cover the radicular root stump with medicament containing a drop of formocresol, a drop of eugenol mixed with eugenol powder.
- Fill the pulp chamber with zinc oxide eugenol.
- Restore with stainless steel crown
- Recall patient for follow-up.
Ferric sulfate

- An astringent
- Forms a ferric ion protein complex that mechanically occludes capillaries when applied.
- 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; bacteriostatic in nature
- It is not toxic.
Ferric sulfate - 3
When using ferric sulphate for vital pulpotomy, follow same procedure as formocresol but place moistened cotton pellet on radicular root stump for 15 seconds only.

Ibricevic and Aljame (2000) reported 100% clinical success and 97.2% radiographic success for Formocresol and Ferric sulphate.

Good alternative for formocresol.
Advantages over formocresol

• Has larger molecules than formaldehyde, and as a result diffusion through the tissues is reduced. Hence there is less chance of causing pulp necrosis.
• Superior fixation by cross linkage of 2 aldehyde rings
• 15 – 20 times less toxic than formocresol (Jeng 1987).
Glutaraldehyde - 2

- Does not stimulate significant immune response.
- Minimal systemic distribution because of larger molecular size and less chance of penetrating the apical foramen.
- It is readily metabolized: 90% of the drug is metabolized within 3 days.
• Adenubi and Shumayrikh (1999) studied 61 primary teeth. Clinical success of glutaraldehyde was 96.5% and 89.2% for calcium hydroxide. The radiographic success rate was 75.5% glutaraldehyde for & 71.4% for calcium hydroxide.

• Reports on the mutagenicity of glutaraldehyde remains unconfirmed.
Mineral Trioxide Aggregate

- Developed by Torabinejad in 1995 Loma Linda University.
- Composed of Tricalcium silicate (CaO)$_3$.SiO$_2$, Dicalcium silicate (CaO)$_2$.SiO$_2$, Tricalcium aluminate (CaO)$_3$.Al$_2$O$_3$, Tetracalcium aluminoferrite (CaO)$_4$.Al$_2$O$_3$.Fe$_2$O$_3$, Gypsum CaSO$_4$·2 H$_2$O, and Bismuth oxide Bi$_2$O$_3$
Mineral Trioxide Aggregate - 2
Mineral Trioxide Aggregate - 3

• Comes as gray and White material
• Similar to Portland cement
• Very alkaline pH 12.5
• Biocompatible with oral tissue and non-toxic
• Minimal or no marginal leakage associated with use.
• Promotes regeneration of tissues
• Long setting time of 1-2 hours
Mechanisms of Action

• Stimulates synthesis of cytokines and interleukin products from bone cells.
• This allows the attachment of osteoblast
• Stimulates hard tissue formation - release calcium in form of calcium hydroxide.
• Stimulates the formation of “dentinal bridge” and preserve the vitality of the remaining pulp tissue.
The commercial products with MTA are:

- ProRoot MTA (Dentsply Tulsa Dental, Tulsa, OK USA)
- White ProRoot MTA (Dentsply Tulsa Dental)
- MTA-Angelus (Solucoes Odontologicas, Londrina, Brazil)
- MTA-Angelus Blanco (Solucoes Odontologicas)
- MTA Bio (Solucoes Odontologicas).
Disadvantages

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

• Follow procedure as outlined with formocresol pulpotomy.
• Cover radicular pulp stump with MTA paste prepared by mixing MTA powder with sterile saline using 3:1 powder/saline ratio.
• Wait for 24 hours before restoration of the tooth to achieve optimal solidity and compressive strength.
• Could place GIC on partially hardened MTA in one-visit procedure. This way allows undisturbed hardening of MTA below the restorative material.
MTA vs Formocresol

- Eldeman reported on use of MTA and formocresol for 33 children with 62 teeth and follow-up for between 4 and 74 months.
- The success rate of pulpotomy was 97% for MTA and 83% for formocresol.
Farsi et treated 74 primary molars with formocresol and MTA and followed up for 24 months.

The success rate of MTA was 100% while that of formocresol was 92.7%.
Olatosi, Sote and Orenuga treated 50 primary molars and followed up for 9 months follow-up.

Clinical success rate for MTA was 100% and 81% for formocresol. The radiographic success rate for MTA was 96% and 81 percent for formocresol.
Bone Morphogenic Protein

- BMPs initiate endochondral bone formation.
- BMP stimulates undifferentiated pluripotent cells to differentiate into cartilage and bone forming cells.
- BMP’s are abundant in bone and dentine and they help promote osteogenesis and reparative dentin formation.
LASER is the acronym for Light Amplification by the Stimulated Emission of Radiation.

The machine 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 (1964).
• It resulted in a reduction in permeability to acid demineralization of enamel.
• Causes coagulation necrosis and degeneration of the odontoblastic layer without damage to the radicular portion of the pulp.
• Er:YAG laser radiation (wavelength, 2.94 μm) can be delivered to the canal orifices with a special handpiece with parameters set at 2 Hz and 180 mJ/pulse

• The pulp’s microcirculation after irradiation with the Er:YAG laser, shows an instant, reversible decrease of blood flow for 3 to 6 min but with no signs of hyperemic reaction that might be caused by heat.
Electrosurgery

- Electrocoagulation is a non-pharmacological hemostatic method and has been suggested to give favorable results in pulpotomy procedures.
- Electrocoagulation is generally termed as electrosurgery, which includes 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; it involves the removal of the coronal pulp tissue.

- Large sterile cotton pellets placed in contact with the pulp, and pressure is applied to obtain haemostasis.
Electrosurgery - 3

• Dental electrode is used to deliver the high frequency electrical current applied to the pulpal stump for 1 second, followed by a cool-down period of 5 seconds.

• Heat and electrical transfer are minimized by keeping the electrode as far away from the pulp stump and tooth structure as possible.
• When the procedure is properly performed, the pulp stumps appear dry and completely blackened.
• The chamber is filled with ZOE placed directly against the pulpal stumps.
Advantages of Electrosurgery

- Electrosurgery is fast.
- It has no undesirable local or systemic effects.
Properties of ferric sulphate:
• Causes more inflammation than formocresol
• It is a fixative
• Bacteriocidal in nature
• It is not toxic.
Properties of glutaraldehyde:
• Has smaller molecules than formaldehyde
• Diffuses through the tissues more readily than formaldehyde
• Superior fixation
• 15 – 20 times more toxic than formocresol
Mineral trioxide aggregate:

- Need to wait for 24 hours before restoration
- Could restore with GIC on partially hardened MTA
- It is very expensive
- It is hydrophobic
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