REACTIO N OF THE PULP TO VARIOUS CAPPING MATERIAL

Zinc oxide Eugenol
Before Ca(OH)2 came into common use ,zinc oxide eugenol had been used as a direct pulp capping material . But it is no longer recommended.

Calcium Hydroxide
Because of high alkalinity ( PH of 12) , it is caustic when placed in contact with vital pulp tissue ,the reaction produce superficial necrosis of the pulp, the irritant qualities seem to be related to its ability to stimulate development of calcified barrier. The necrotic area demarcated from the healthy pulp tissue below by a new, deeply staining zone comprising basophilic elements of the Ca(OH)2 dressing . The original proteinate zone is still present against this zone .is a new area of coarse of fibrous tissue likened to a primitive type of bone . On the periphery of the new fibrous tissue , cells resembling odonoblast appear to be lining up . One month after the capping procedure , a calcified bridge is evident radiographically. This bridge continue to increase in thickness during the next 12 months period . The pulp tissue beneath the calcified bridge remain vital and is essentially free of inflammatory cells.

Preparation containing formalin:-
The clinical success in treatment of primary pulp with these materials is possibly related to the drug germicidal action and fixation qualities rather than to its ability to pulpotomy promote healing . Some studies have indicated that the formocresol technique may be applied to permanent teeth, but its use in a permanent teeth remain interim procedure to be followed by conventional endodontic therapy.

Ferric sulfate
Ferric sulfate use to treat the surface of the remaining pulp tissue after pulpotomy of primary teeth . Ferric sulfate agglutinates blood proteins and controls hemorrhage in the process without clot formation. Currently it appears that ferric sulfate could be a better choice for treating primary teeth needing pulpotomy (results equal to those achieved with diluted formocresol but with less toxicity). Ferric sulfate is available in a 15.5% solution under the trade name of Astringedent .

PRO ROOT M.T.A (mineral trioxide aggregate):
MTA is emerging as a popular product for pulpotomies secondary to a variety of factors.

Originally developed as a root-end filling material, its main components are
1- Tricalcium Silicate
2- Tricalcium aluminate
3- Tricalcium oxide
4- Silicate oxide
The positive properties of MTA are:-
- Biocompatibility
- Good sealing properties
- Antimicrobial activity
- The ability to set in the presence of moisture and blood.

The negative attributes include
- Difficulty of handling and the exceptional cost.
- In addition, along with formocresol and ferric sulfate, MTA can cause pulp canal obliteration. Despite this, it seems to come closest to the goal of formation of a natural dentinal bridge across the exposed pulpal tissue.

Physical properties
1. pH
   10.2 Immediately after mixing. It rises to 12.5 after 3 hours. There after it remain constant.
2. Mixing and setting
   MTA + sterile water or other sterile liquids in 3 : 1 (powder/liquid) ratio to obtain a putty consistency or a thick grainy paste. If the paste is too dry it will fall when one try to pick it up.
   MTA can set in a surgical environment where complete removal of moisture is not always possible. The presence of some moisture during placement of the material is advantageous in aiding adaptation of it.
   The powder consists of fine particles, hydration of the powder results in a colloidal gel which solidifies to hard structure in 2 hours and 45 minutes.

MODE OF ACTION
MTA offers a biologically active substrate for bone cells.
MTA allow a good adherence of the cells to the material.
It has ability to stimulate osteoblast cells to produce high amount of osteocalcin, alkaline phosphotase, and cytokin which is believed to be involved in coordinating bone metabolism and stimulating bone formation.

Clinical applications of MTA
1. Pulp capping
2. Root resorption
3. Apexification
4. Furcal repair
5. Perforation repair
6. Root ending filling

Other experimental capping materials alternative to formocresol
- Beech wood creosote
- Bone morphogenic protein
- Calcium hydroxide
- Dentin chips
- Electro surgery
- Biodentin.
VITAL PULP THERAPY
DIRECT PULP CAPPING
MTA is suitable as a pulp capping because MTA stimulates dental bridge formation and the bridge formed adjacent to MTA was thick and continuous with regional dentin.
When MTA was used no bacteria were observed on the cavity wall, due to sealing ability, biocompatibility, alkalinity, and ability of MTA to stimulate dentin bridge formation.

Pulpotomy of immature permanent teeth
The pulp responds favorably to the protection provided by an MTA layer, and the reparative dentin is consistently more uniform and thicker under MTA compared with Ca(oH)2.

Pulpotomy of primary teeth
Eidelman et al. in 2001 compared the effect of MTA to that of formocresol as a pulp-dressing agent in forty-five primary molars of twenty-six children who were treated by conventional pulpotomy technique. They evaluated them after 6-30 months, clinically and radiographically. The results showed that none of the MTA-treated teeth showed any clinical or radiographic pathology and only one failure in molar treated with formocresol. MTA seems a suitable replacement for T.C.F.

FAILURES AFTER VITAL PULP THERAPY
Failure in the formation of a calcified bridge across the vital pulp has often been related to:
The age of the patient.
Degree of surgical trauma.
Sealing pressure.
Improper choice of capping material.
Low threshold of host resistance.
Presence of microorganisms with subsequent infection.

Internal resorption
Radiographic evidence of internal resorption occur within the pulp canal several months after the pulpotomy procedure is the most frequently seen evidence of an abnormal response in primary teeth.
Internal resorption is a destructive process generally believed to be caused by osteoclastic activity, and it may progress slowly or rapidly. Occasionally, secondary repair of the resorbed dentinal area occurs with a true carious exposure of the pulp. There will be a inflammatory process of some degree. The inflammation may be limited to the exposure site, or it may diffuse throughout the coronal portion of the pulp. Amputation of all the pulp that shows the inflammatory change may be difficult or impossible, and abnormal pulp tissue is allowed to remain. If the inflammation extends to the entrance of the pulp canal, osteoclast may have been attracted to the area. Inflammatory cells attracted to the area as a result of placement of an irritating capping material might attract the osteoclastic cells and initiate internal resorption. This may explain the occurrence of internal resorption even though the pulp is normal at the time of treatment. Because the roots of primary teeth are undergoing normal
physiological resorption, vascularity of the apical region is increased. There is osteoclastic activity in the area. This may predispose the tooth to internal resorption when an irritant in the form of a pulp – capping material is placed on the pulp.

**ALVEOLAR ABSCESS**
An alveolar abscess occasionally develops some months after pulp therapy has been completed. The tooth usually remains asymptomatic, and the child is unaware of the infection, which may be present in the bone surrounding the root apices or in the area of the root bifurcation.

A fistulous opening may be present, which indicates the chronic condition of the infection. Primary teeth that show evidence of an alveolar abscess should be removed. Permanent teeth that have previously been treated by pulp capping or by pulpotomy and later show evidence of pulpal necrosis and apical infection may be considered for endodontic treatment.

**EARLY EXFOLIATION OR OVER RETENTION OF PRIMARY TEETH WITH PULP TREATMENT**
A pulpally treated tooth previously believed to be successfully managed will loosen and exfoliate (or required extraction) prematurely for no apparent reason. Such a condition results from low grade, chronic, asymptomatic, localized infection. Usually abnormal and incomplete root resorption pattern of the affected teeth are also observed. When this occurs, space management must be considered.

Another sequela requiring close observation is the tendency for primary teeth having successful pulpotomies or pulpectomies to be over retained. This situation may have untoward result of interfering with the normal eruption of permanent teeth and adversely affecting the developing occlusion.

This phenomenon occurs when normal physiologic exfoliation is delayed by the bulky amount of cement contained in the pulp chamber even though the material is resorbable, its resorption is slowed significantly when large quantities are present.