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Pulp Therapy Related Materials

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Abstract:. **P**ulp therapy include protective liner, indirect pulp treatment, direct pulp capping, and pulpotomy. Non-vital pulp treatment for primary teeth with irreversible pulpitis or necrotic pulp include pulpectomy. Vital-pulp therapy for immature permanent teeth include protective liners, apexogenesis, indirect pulp treatment, direct pulp capping, partial pulpotomy, and complete pulpotomy. Non-vital pulp treatment for permanent teeth includes conventional root canal treatment, apexification, and regenerative endodontics.

Keywords: Pulp therpay, open apex, pulp caping, endodontic sealers, MTA.

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a- Pulpotomy Dressing Agent

Pulpotomy is a vital pulp therapy indicated for deciduous teeth with exposed pulp and reversible pulpitis. ***MTA*** is believed to preserve pulp vitality by disinfecting, sealing and inducing the formation of a calcific barrier over the radicular pulp tissue due to its high pH. This is in contrast with the superficial fixation (*i.e.* in the histological sense) of healthy radicular tissue with ***formocresol*** in conventional pulpotomy. Clinical studies over 24–42 months have indicated a high success rate for pulpotomy using MTA (67–98.5%), comparable with formocresol (77–83%) and ferric sulfate (73%), but not with ***calcium hydroxide*** (46%). The apparent contradiction here may be due to the relatively rapid dissolution of the latter while the high pH over, and thus cytological activity of, MTA is maintained.

The incidence of ***post-operative internal root resorption*** was lowest for MTA. In contrast to MTA, and in addition to concerns arising from the toxicity and genotoxicity of formocresol, both formocresol and ferric sulfate were found to irritate and cause comparatively substantial inflammatory responses of the pulp in animal studies. Although MTA can induce initial inflammation of rat dental pulp cells *via* its effect on the nuclear factor-kappa B signaling system, a subsequent anti-inflammatory effect due to down-regulation of the expression of certain inflammatory mediators is also observed.

b- Pulp-capping agent

Combined histological and immune-histochemical analyses in human and animal studies have demonstrated reparative dentin formation by odontoblast-like cells. These have originated from the differentiation of progenitors which proliferated and pooled at the site of the capping agent. These materials appear to work to preserve exposed pulp vitality in permanent teeth by promoting the formation of dentin bridges. ***MTA*** induced reparative dentinogenesis was found to be more consistent and prominent compared with direct pulp-capping with $Ca(OH)_2$. [(1)]

MTA can provoke the formation of reparative dentin by odontoblast-like cells originating from the differentiation of progenitors which proliferated and pooled at the site of MTA capping. "Ion dissolution" (Al, Ca, K, Na) from MTA has been said to 'solubilize' the extracellular matrix components of dentin, including non-collagenous protein, glycosaminoglycans, transforming growth factor (TGF-β1) and adrenomedullin, that may mediate cellular activity in dentinogenesis. However, none of these components, especially not Al, could have that property, which is more likely due to hydrolysis arising from the high surface pH produced by the excess Ca (OH) $_2$, that is, the process is one of base-catalysed hydrolysis. Even so, enzyme-linked immunosorbent assay (ELISA) has evidently demonstrated the stimulatory effect of MTA on the production of bone morphogenetic protein (BMP-2) and TGF- β1 by fibroblasts of human periodontium. Similarly, MTA provoked mineralization of rat dental pulp cells, accompanied by a remarkable increase in the production of BMP-2. However, beyond the observations themselves, no mechanism for these effects was identified, and especially it is not clear whether these are direct effects of the MTA or indirect *via* hydrolysis products. [1]

c- Open-Apex Sealing Materials

Sealing of necrotic immature permanent teeth with open apices using ***MTA*** is considered to be a viable treatment alternative to the conventional use of both ***$Ca(OH)_2$***-assisted apexification and resin-, zinc oxide-, glass ionomer- or amalgam-based root-end endodontic surgical retrograde filling of open apical foramina, accompanied by canal obturation with gutta percha. This is the case whether the MTA is used in orthograde filling over sterile radicular blood clot (revascularization) or residual vital apical radicular tissue (apexogenesis); in the direct formation of a plug as an artificial apical barrier (apexification) or complete orthograde obturation; or even in simple retrograde root-end filling. [1]

d- Endodontic sealers

The sealers are responsible for the principal functions of the final root filling: sealing off of the root canal system, entombment of remaining bacteria and the filling of irregularities in the prepared canal. A variety of sealing materials with different specifications is currently available, such as, calcium hydoroxide-, zinx-oxide-eugenole-, glass ionomer-, and resin-based. [2]

The extrusion of sealing agents over the apical constriction is, however, a phenomenon, frequently observed in clinical routine. Although the area of contact is small, there is always concern about untoward reactions by the tissue to the filling material. Biologically unfavorable materials, while not necessarily causing overt clinical symptoms, may affect the healing processes in the periapical tissues and delay or prevent resolution of lesions. Materials used for root canal Sealing materials should not exert an irritating effect on the peri-radicular tissue and complications relating to persistence of sealing agents in the peri-apical tissue could result in endodontic failure. The knowledge of the inflammatory response pattern to the employed material is crucial in order to assess the clinical consequence of a potential material over extrusion. [2]

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