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Pulp Capping Agents-A Review

Karthikeson P.S
I year BDS Student,
Saveetha Dental College and Hospitals,
No.162.P.H.Road,Chennai-600077.

Jayalakshmi S
Conservative Dentistry,
Saveetha Dental College and Hospitals,
No.162.P.H.Road,Chennai-600077.

Abstract::

Aim and Objective:
This review focuses on describing the various dentin bridge forming direct pulp capping agent .

Background:
Pulp capping agents are used in dental restorations to prevent the dental pulp from dying, after being exposed, or nearly exposed due to a mechanical exposure. Some commonly used pulp capping agents include Calcium Hydroxide,
Zinc Oxide Eugenol (ZOE) Cement,Corticosteroids and Antibiotics,Collagen,Polycarboxylate cement,Calcium phosphate etc.

Reason:
The success of the pulp capping procedure greatly depends upon the circumstances under which it is performed and the prognosis depends upon the age, type, site and size of pulp exposure. In addition to this the pulp capping material should have the following ideal properties like
* Stimulate reparative dentin formation
* Maintain pulpal vitality
* Release fluoride to prevent secondary caries
* Bactericidal or bacteriostatic
* Adhere to dentin
This review helps to know the various pulp capping agents which can form dentin bridge .

Keywords: dentin bridge, dental caries, pulp capping , pulpitis

INTRODUCTION:

Historically, the first pulp capping procedure was performed in 1756, by the Phillip pfaff, who packed a small piece of gold over an exposed vital pulp to promote healing. However, the success of the pulp capping procedure greatly depends upon the circumstances under which it is performed and the prognosis depends upon the age, type, site and size of pulp exposure.[1]
The consequences of pulp exposure from caries, trauma or tooth preparation misadventure can be severe, with pain and infection the result. The morbidity associated with treating pulp exposures is consequential, often requiring either extraction or root canal therapy.[2]Both the loss of the tooth and its replacement, or endodontic treatment and tooth restoration, involve multiple appointments and considerable expense. An alternative procedure to extraction or endodontic therapy is pulp capping, in which a medicament is placed directly over the exposed pulp (direct pulp cap), or a cavity liner or sealer is placed over residual caries (indirect pulp cap) in an attempt to maintain pulp vitality and avoid the more extensive treatment dictated by extraction or endodontic therapy.[3]

DIRECT PULP CAPPING:

The pulp of a tooth can be exposed due to several causes: caries, trauma or mechanical reasons, the latter typically due to a misadventure during tooth preparation. [4]The direct pulp cap, in which a material is placed directly over the exposed pulp tissue, has been suggested as a way to promote pulp healing and generate reparative dentin. [5]If this becomes successful, this procedure suggests the need for more invasive, more extensive and more expensive treatment.A number of factors have been shown to have an impact on direct pulp cap success.A number of materials have been suggested for use in direct pulp capping. [6]
Some of the pulp capping materials form dentin bridge and some materials don't form dentin bridge.
In this review, pulp capping agents forming dentin bridge is discussed briefly.

Significance of pulp capping agents forming dentin bridge:

Dentin bridge is defined as a deposit of reparative dentin or other calcific substances that forms across and resells exposed tooth pulp tissue. [7] Dentin is formed usually after 30 days of pulp capping. Direct pulp capping agents like calcium hydroxide and MTA help in thick dentin bridge formation. [8]These materials are well known for its antimicrobial properties. Indirect pulp capping agents don't form think dentin bridge.
Hence for most of the patients, dentin bridge forming pulp capping agents is used.Some of the pulp capping agents forming dentin bridge is discussed below.

Dentin bridge forming pulp capping agents:

1.Calcium Hydroxide $Ca(OH)_2$
2.Mineral Trioxide Aggregate MTA
3.Calcium phosphate
4.Hydroxyapatite
5.Biodentine

1.Calcium Hydroxide $Ca(OH)_2$:

Calcium hydroxide is a gold standard of direct pulp material discovered in 1929.

One study found a 100% reduction in microorganisms associated with pulp infections after one-hour contact with calcium hydroxide. [9] Most importantly, calcium hydroxide has a long term track record of clinical success as a direct pulp-capping agent in periods of up to 10 years.

Calcium hydroxide is believed to effect pulp repair by one or more of several mechanisms of action. It has believed that hydroxide's high pH causes irritation of the pulp tissue, which stimulates repair via some unknown mechanism .[10]

In recent years, this "unknown mechanism" may have been explained by the release of bioactive molecules. [11] It is known that a variety of proteins are incorporated into the dentin matrix during dentinogenesis. Of particular importance to the topic of pulp capping is that at least two of these proteins, Bone Morphogenic Protein (BMP) and Transforming Growth Factor-Beta One (TBF-β1), have demonstrated the ability to stimulate pulp repair. [12]

The advantages of calcium hydroxide are,it has excellent antibacterial properties to eliminate bacterial penetration to the pulp.Induction of mineralization is seen in calcium hydroxide.[13] Cytotoxicity is low in calcium hydroxide.[14]

However it has some disadvantages also.It is highly soluble in highly soluble in oral fluids.It lacks adhesion.[15] Due to high extensive dentin formation property,it obliterates the pulp chamber.It easily degrades after acid etching.Calcium hydroxide is lost due to dissolution over time.[16],[17] Risk of pulp inflammation is more in calcium hydroxide Tunnel defect is more common in calcium hydroxide where tunnels are formed in reparative dentin however the quality of reparative dentin improves as the bridge gets thicker.[15]

2.Mineral Trioxide Aggregate MTA:

Mineral Trioxide Aggregate (MTA) has been emerging as a good direct pulp capping agent in recent years.[18]

Unset MTA is primarily calcium oxide in the form of tricalcium silicate, dicalcium silicate and tricalcium aluminate.[19]Bismuth oxide is added for radiopacity.Basically calcium hydroxide is the combination of water and Mineral Trioxide Aggregate (MTA).[20],[21]

However MTA is used more common next to calcium hydroxide due to its good compatibility,less pulpal inflammation,radiopacity and antibacterial property [22]

Moreover it releases bioactive dentin matrix proteins.It has more predictable hard tissue barrier formation compared to calcium hydroxide.It has high solubility like calcium hydroxide which is a disadvantage.[23]

Most of the dentists don't prefer to buy MTA since it is highly expensive.[24]Also some disadvantages are its poor handling characteristics,setting time is long.There are two versions of MTA-grey and blue.[25],[26] Grey MTA is due to addition of iron.Grey MTA causes tooth discolouration.[26],[27]

Apical barrier formation with MTA can be achieved in one visit unlike in calcium hydroxide apexification which takes around 6 to 9 months for the apical barrier to form.

3.Calcium phosphate:

Calcium phosphate is another pulp capping agent which came into practice in the year 1900's.[28]

Its advantages are ,it helps in forming dentin bridge without any tissue necrosis.It has good physical properties.Also the absence of pulp inflammation is seen compared to calcium hydroxide $Ca(OH)_2$.[28]

Release of calcium ions is the key factor for a successful pulp capping because of action of calcium on differentiation,proliferation and mineralisation of pulp cells.

But calcium phosphate is not commonly used till now.Because more clinical trials are necessary to evaluate the material.

4.Hydroxyapatite:

It is the most thermo dynamically stable of the synthetic calcium phosphate ceramics.

Hydroxyapatite is a ceramic biomaterial, biocompatible, osteoconductor and classified as a ceramic composed of calcium phosphate crystals that are similar to the mineral portion of the bone tissue. It acts as a frame for bone tissue growth and has been indicated for filling bone cavities.[29]

Hydroxyapatite is not indicated for pulp protection of human teeth because the formation of a dentine bridge has not been observed.However, its combination with other biomaterials is being amply used.

The association of collagen and hydroxyapatite has been indicated as a collagenic biocompatible biomaterial. [30]

It has been evaluated in laboratory animals and in humans and indicated for pulp coverage, filling of surgical cavities in bone defects,guided tissue regeneration and as a fixing agent for ceramic particles.[30]

It has good biocompatibility with neutral pH -7.0. It can be used as scaffolding for the newly formed mineralised tissue However there is mild inflammation with necrosis of pulp.

5.Biodentine:

Biodentine is a new tricalcium silicate(Ca_3Si0_5) based inorganic restorative commercial cement and advertised as bioactive dentin substitute.[31]

It possess good physical and biological properties compared to MTA and bioaggregate.In powder form,its composition will be tricalcium silicate,dicalcium silicate,calcium carbonate,zirconium oxide and iron oxide.Its nature can be easily explained as it causes early mineralization by release of TGF- β1 from pulpal cells to encourage pulp healing and by odentoblastic stimulation for dentin bridge formation to protect the pulp.

Mineralisation occurs in the form of osteodentine that forms the reparative dentine.Remineralisation of dentine,pulp healing,preserving pulp vitality,better handling characteristics,reduced setting time are the advantages of biodentine.

However there are some disadvantages.

More long term and clinical studies alike calcium phosphate are needed for a definitive evaluation of Biodentin.[31]

CONCLUSION:

When you hear the word "endondontics," you probably think of a root canal. But endodontic treatment entails treating any disease of the tooth's pulp, and endodontists practice several techniques to save teeth.[32] One such example is pulp capping, which is used to keep tooth decay from attacking the tooth's pulp chamber.

Pulp capping agent provide a well-sealed restoration immediately after pulp capping. This will provide protection against ongoing leakage and bacterial contamination that can compromise the success of the pulp cap.This review provides evidence-based recommendations to guide clinicians in their decision-making process when they encounter a situation requiring pulp capping.This review mainly describes about she dentin bridge forming pulp capping agents.[33]

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