

# Materials used for direct pulp capping- an overview

## Direct pulp capping- a review

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**ABSTRACT:** Direct pulp capping is a technique for treating exposed vital pulp with dental materials or cements to facilitate the formation of reparative dentin and to maintain the pulpal vitality. Calcium hydroxide and mineral trioxide aggregate (MTA) are two most commonly used materials for pulp capping in clinics, adhesive resin and resin modified glass ionomer has been considered a promising pulp capping material. This paper is a review of various material used for pulp capping and will be discussing about the composition, working mechanism and it's clinical outcome.

**Keywords:** Pulp capping, vital pulp, calcium hydroxide, MTA, reparative dentin.

### 1. INTRODUCTION

Direct pulp capping is defined as treatment of exposed vital pulp by sealing the wound with dental material to facilitate the formation of reparative dentin and to maintain the vitality of pulp.<sup>[1-3]</sup> Pulpal exposure mainly caused by three factors: caries, mechanical sources and trauma. If the pulp is exposed even before the complete removal caries is considered as pulp exposure due to caries. If the pulp exposure occurred during cavity or crown preparation it is called as mechanical pulpal exposure. Traumatic exposure of pulp mostly occurs in athlete. Indirect pulp capping is defined as “a procedure in which a material is placed on a thin partition of remaining carious dentin that, if removed, might expose the pulp in immature permanent teeth.<sup>[1,4,5]</sup> Pulpotomy differs from pulp capping, in which the part of coronal

pulpis removed and then pulp capping agent is placed over the remaining pulp to maintain the vitality and to facilitate root completion. Clinical pulp conditions associated to patient symptoms are to be considered before placing direct pulp-capping material placement. For assessing clinical pulp conditions, the most important test is pulp vitality. If the pulp vitality test is negative, pulp necrosis has happened. If the pulp vitality test is positive, then we call it as vital pulp. Pulp capping could be done on tooth with normal pulp or reversible pulpitis. Irreversible pulpitis usually has spontaneous and/or lingering pain and it could also have referred pain and it could be treated by pulpectomy. Direct pulp capping is indicated only when the exposure site is 1mm or less than that and pulpal hemostasis should be achieved before placing capping material.

## MATERIALS USED IN PULP CAPPING CURRENTLY

### *CALCIUM HYDROXIDE*

Calcium hydroxide has been considered as the gold standard for pulp capping. The effect of calcium hydroxide is observed as the result of the chemical injury caused by the hydroxyl ions. The primary effect of calcium hydroxide placed over the exposed pulp is the development of a superficial necrosis. Steady necrosis leads to mild irritation and stimulates the pulp to defend and repair to form a reparative dentin bridge through cellular differentiation, extracellular matrix secretion and subsequent mineralization.<sup>[6]</sup> Formation of dentinal bridge is believed to be clinical success of calcium hydroxide.

### *Calcium hydroxide powder*

Calcium hydroxide powder was applied directly to the exposed pulpal surface in the past and when it comes in contact with pulpal fluid and forms a paste<sup>[7,8]</sup>, this technique is not widely followed nowadays. Aqueous calcium hydroxide paste is used for pulp capping<sup>[9]</sup>, this aqueous paste is prepared by mixing calcium hydroxide powder with saline or water while performing the pulp capping at clinic.<sup>[10]</sup> Though aqueous calcium hydroxide has been accepted clinically it has some drawbacks, including a poor setting characteristics and gradual resorption of material after placement. Additional disadvantage is porosities in the reparative dentin, known as tunnel defects, which can result in micro-leakage and lead to the loss of tooth vitality and calcification.<sup>[11]</sup>

### *Calcium hydroxide based cement*

To overcome the disadvantages of aqueous calcium hydroxide, a cement type calcium hydroxide with improved setting characteristics was developed and has been widely used in clinics from 1960s. Commercially it is marketed in name of DYCAL, it is a two-paste system consisting of base and catalyst. Base paste consists of 1, 3-butyleneglycol disalicylate, zinc oxide, calcium phosphate and calcium tungstate and catalyst paste consists of calcium hydroxide, N-ethyl-o-phenylenesulfonamide, zinc oxide, titanium dioxide and zinc stearate. Another product which is available commercially is Life, setting reaction of which is similar to that of dycal but composition of base and catalyst differs.

## MINERAL TRIOXIDE AGGREGATE

MTA was introduced into the field of dentistry by Lee et al. in the early 1990s.<sup>[12]</sup> This bioactive silicate cement was originally composed of tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide, and other mineral oxides.<sup>[13]</sup> The product is currently marketed under different names, composition of MTA has been changed since its

introduction substitution of dicalcium silicate for tricalcium silicate and the addition of tetracalciumaluminoferrite, calciumsulfate dehydrate, and bismuth oxide; the latter was added to impart radiopacity.<sup>[14]</sup> White MTA was introduced due to aesthetic reasons. MTA exhibits favourable characteristic, which makes it superior material for pulp capping and for partial pulpotomy. Mechanism of action of MTA is comparable to that of Calcium hydroxide. The hydration of MTA cause leaching out of ions and causes superficial necrosis pulp, when in contact and irritation will stimulate reparative dentin formation. Major advantages of MTA are supposed to be its sealing ability, biocompatibility, bioactivity and its capacity to promote mineralized tissue formation.<sup>[15-18]</sup> Also, MTA is proposed to be higher to calcium hydroxide due to its uniform and thicker dentin bridge formation, less inflammatory response and less necrosis of pulpaltissue. The significant outcomes for direct pulp capping with MTA are attributable to its distinct properties inherent to the material. The sustained alkaline pH of the set cement is bactericidal and most likely contributes with NaOCl to the eradication of many left over microorganisms at the dentin-pulpal interface. MTA sets in the presence of moisture, so direct contact with tissue fluids is not going to affect the setting characteristics of the material.

### **ADHESIVE RESINS**

Japanese researchers was first one to introduce adhesive cements for pulp in the early 1980s.<sup>[19-21]</sup> primary research was carried out on a primate tooth models following ISO standards. Resins are placed directly over the exposed pulp and evaluated histologically for pulpal reaction, microbial presence, and the establishment of reparative dentin showed favourable biocompatibility but it's not same in human subjects.<sup>[22-25]</sup> Two clinical studies has been conducted on human subjects comparing direct pulp capping with either resin-modified glassIonomer cement with a hydrophilic resin.<sup>[26,27]</sup> Histological sections of subjected tooth resulted primarily with a moderate to intense inflammatory response and did not stimulate formation reparative dentin.<sup>[28]</sup> Murray et al. conducted a study, in which the hierarchy of repair was measured against microbial contamination, 18.6% of resin-based composite, 22.2% of resin-modified glass ionomer, and 47.0% of Ca(OH)<sub>2</sub> specimens displayed bacterial contamination of the reparative dentin bridge.<sup>[29]</sup> It's indication that these pulp capping materials do not permit for predictable pulpal healing, nor do they deliver a favourable environment for reparative dentin formation and the elimination of microorganisms.<sup>[30-31]</sup>

### **2. CONCLUSION**

Success rate of pulpectomy is superior to that of direct pulp capping. Currently available materials for pulp capping lack efficacy due to improper sealing of dentin and pulpal capping material interface. The well-Sealed restoration will prevent leakage and improve success rate of pulp capping. The dental adhesive systems may put forth a potential damage on the pulp tissue, which leads us not to recommend the use of these materials in the direct pulpcapping therapies. Recent developments and technologies may overcome the disadvantages of pulp capping materials used in the past and provide better results.

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