Harshinee Chandrasekhar et al /J. Pharm. Sci. & Res. Vol. 8(11), 2016, 1308-1311

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Efficient Agents for Pulp Protection: A Review

Harshinee Chandrasekhar*, Dr. Subash Sharma**
**Student II BDS, Saveetha Dental College*
***Department Of Endodontics, Saveetha Dental College*

Abstract:

Aim

To review on various pulp protecting agents in endodontics and analyse the uses, purposes, standard and recent advancement of each.

Objective

The objective of this review deals with the applications,advantages,disadvantages and various recent advancement of various pulp protecting agents.

Background

Pulp protection is very important in endodontic treatment and pulp protecting agents are used to protect pulp from external irritants. There are various pulp protecting agents like calcium hydroxide, glass ionimer cement, zinc phosphate cement, zinc polycarboxylate cement. Some of the advantages of these agents are they prevent the penetration of corrosion products, neutralizes the acids that migrate towards pulp, and to protect pulp against thermal injury, galvanic shock and chemical irritation. If the pulp protecting agents are not used it leads to further damage to the pulp and results in death of the pulp tissue.

Reason

If pulp protecting agents are not used it leads to various problems in the tooth so usage of pulp protecting agents is necessary in the treatment.

INTRODUCTION

Pulp capping is a treatment in which a protective agent is applied on the pulp when it is exposed by traumatic injuries, mechanical factors or dental caries, in order to allow pulp healing and to maintain the vitality of the pulp and its functions[1].

Dental cements are also used as protecting materials to protect the pulp after the cavity preparation against further trauma, like thermal and chemical insulating bases under metallic restorations[2, 3].

There are some ideal properties for pulp protecting materials like,

•It should Stimulate reparative dentin formation
•It should Maintain the pulp vitality
•It should Release fluoride to prevent secondary caries
•It should beBactericidal or bacteriostatic
•It should Adhere to restorative material
•It should Resist forces during restoration placement and during the life of restoration.
•It should be Sterile
•It should be Radiopaque
•Provide bacterial [4].

In this review the applications, advantages, disadvantages and uses of some pulp protecting agents are discussed.

CALCIUM HYDROXIDE

Calcium Hydroxide is considered as the "gold standard" of direct pulp capping materials for several decades and it was introduced in the year 1921. There are a many advantages of calcium hydroxide that have caused it to receive this recognition. Calcium hydroxide has an excellent antibacterial properties. Most importantly, calcium hydroxide has a longterm track record of clinical success as a direct pulp capping agent in periods of up to 10 years. Because of its biological and therapeutic potential this cement has been the material of choice for all pulp conservative treatment.

Calcium hydroxide is indicated in direct and indirect pulp capping, apexogenesis, apexification and in the treatment of root resorption, iatrogenic root perforations, root fractures, replanted teeth and in the interappointment intracanal dressing.

The mechanism of pulp repair using CH as a direct pulp capping agent is still not well understood. However, it has been reported that the high alkaline pH of CH solutions can solubilize and release some proteins and growth factors from dentin. These events may be responsible for the pulp repair and hard tissue barrier formation.[5 - 9]

Classical microscopic studies have shown that CH produces a superficial pulp necrosis and forms calcium carbonate, whose globules act, in a first moment, as dystrophic calcification nucleous, in the margin and in the interior of the dense reticular fiber deposition, immediately beneath the granular zone43, where odontoblast-like cells differentiate and organize to produce dentin. The cauterization effect of CH is essential for the repair of exposed pulp[7]

GLASS IONOMER CEMENT

Glass-ionomer cement has been defined as the ''cement that consists of a basic glass and an acidic polymer which sets by an acidbase reaction between these components'' by McLean, Nicholson and Wilson. This cement possesses advantages of both silicate cement and polycarboxylate cement.

These cements are available in powder and liquid system.. Powder contains silica, alumina, fluorides like calcium fluoride, aluminium fluoride, and sodium aluminium fluoride.The liquid mainly contains poly acrylic acid with copolymers, and also contains tartaric acid and water.[10]

GIC does not mature completely until 24–72 h after placement but when fully set shows better resistance to dissolution. It has been suggested that small amounts of

cement must be placed in the crown to prevent the build-up of hydrostatic pressure due to excess cement.

Some of the advantages of Glass ionomer cements is it has a Good Chemical bonding, Sustained fluoride release and ability to absorb fluoride from the oral environment (fluoride recharge) and makes it the cement of choice in patients with high caries rate ,the Coefficient of thermal expansion is similar to tooth,cement is Translucent,and can be used with porcelain crowns,it has an Adequate resistance to acid dissolution,it also have a Low film thickness and maintains constant viscosity for a short time after mixing, so better seating of restorations and some of the disadvantages are Initial slow setting and sensitivity to early moisture contamination and desiccation, Modulus of elasticity lower than zinc phosphate, so potential of elastic deformation in areas of high masticatory stress, Initial low setting pH was assumed to be associated with post cementation sensitivity. However, there is a report presenting that there is no any significant difference in the postoperative sensitivity of both the zinc phosphate and GIC cements[10,11,12]

GICs and cell response GIC were developed by Wilson and Kent, in 1971, and introduced in the market in the early 1970s. Their popularity is due to the fact that these materials present several important properties such as fluoride release, coefficient of thermal expansion and modulus of elasticity similar to dentin, bonding to both enamel and dentin and biocompatibility. Despite these advantages, conventional GICs possess limitations as restorative materials, which are related to their susceptibility to dehydration and poor physical properties, such as high solubility and slow setting rate. Developments in the field of GICs have led to the introduction of light activated hybrid GIC versions creating the resin-modified GICs. The incorporation of polymerizable water-compatible monomers such as HEMA to the formulation of conventional GICs resulted in enhanced flexural strength, diametral tensile strength, elastic modulus and wear resistance,although they may not be as biocompatible as conventional GICs.[11,12]

MINERAL TRIOXIDE AGGREGATE

Mineral trioxide aggregate (MTA), was first proposed for pulp capping in 1996. MTA is primarily composed of calcium oxide in the form of tricalcium silicate, dicalcium silicate and tricalcium aluminate. When MTA reacts with water it forms calcium hydroxide,and so it is actually the formation of calcium hydroxide that provides MTA's biocompatibility. It helps in the formation of a thicker dentinal bridge, with low inflammatory response, hyperemia and pulpal necrosis compared to calcium hydroxide cement.

Thus the advantages of MTA are similar to calcium hydroxide, including its antibacterial and biocompatibility properties, high pH, radiopacity and its ability to aid in the release of bioactive dentin matrix proteins.

Some of the disadvantages of MTA are it has high solubility in water, The presence of iron in the grey MTA formulation may darken the tooth, prolonged setting time and It is very expensive. One gram of MTA powder costs approximately the same as 24 grams of calcium hydroxide base/catalyst paste.

Some of the uses of MTA are it helps in Root-end Filling after Apicoectomy, Internal & external root resorption & obturation, in Lateral or furcation perforation, It is used as a Root canal sealer, used in Apexification and Apexogenesis and also used for Pulp capping.[13]

BIODENTINE

Biodentine, is also known as 'dentine in a capsule', 'biocompatible and bioactive dentine substitute' which overcomes the draw backs of Calcium hydroxide and Mineral trioxide.

Biodentine is composed of powder and liquid system.

Powder consists of
Tri-calcium silicate- This is the main core material.
Di-calcium silicate- this is the second core material
Calcium carbonate & oxide- it acts as a filler.
Iron oxide-it acts as a colouring agent.
Zirconium oxide- it acts as a radioopacifier.

Liquid consists of
Calcium chloride- it acts as an accelerator.
Hydrosoluble polymer- it is a water reducing agent.

The Properties of Biodentine are Tissue Regeneration & Early Mineralisation , it has
Short setting time - sets in 12 mins, it has an Anti bacterial property, good Biocompatibility and Good material handling.

Some of the advantages are it is Biocompatible,it has Good anti microbial activity, it Stimulates tertiary dentin, it is less soluble and produces tighter seals compared to Ca(OH)2, and it has less setting time and the disadvantage is More long-term clinical studies are needed for a definitive evaluation of Biodentine.[14_ 18]

CASTOR OIL BEAN

The castor oil bean (COB) (Ricinus communis) is polyester formed by an amino radical, which confers bactericidal effect and has biocompatibility with living tissues3. COB facilitates tissue healing, it has excellent structural properties, low cost and does elicit toxic effects. COB cement has absence of late inflammatory reaction and no signs of systemic toxic effects than calcium hydroxide.

It is believed that the pulp reaction can vary with the use of different available products, depending on their biocompatibility, which could cause severe damage to this tissue12. For this reason, there is an interest to increase the knowledge of the biocompatibility of COB because this material can be a candidate for direct pulp capping[19]

Some of the Advantages of COB is it has Good antibacterial property ,It showed less inflammatory response, Facilitates tissue healing , Better sealing ability than MTA&GIC , Goodmechanical properties, and low cost[19].

The Disadvantages are it is Bio inert rather than bioactive and Further clinical trials are required.[19]

THERACAL

Theracal is a new light-cured resin-modified calcium silicate-filled base/ liner. Theracal is composed of 45% wt mineral material (type III Portland cement), 10% wt radiopaque component, 5% wt hydrophilic thickening agent (fumed silica) and approximately 45% resin. The resin consists of a hydrophobic component such as urethane dimethacrylate (UDMA), bisphenol A-glycidyl methacrylate (BisGMA), triethylene glycol dimethacrylate (TriEDMA or TEGDMA) and a hydrophilic component such as hydroxyethyl methacrylate (HEMA) and polyethylene glycol dimethacrylate (PEGDMA). It also have a good sealing capabilities.

Some of the advantages of Theracal are it acts as protectant of the dental pulpal complex Bond to deep moist dentin,Used as a replacement for Ca(OH)2, glass ionomer,RMGI, IRM/ZOE and other restorative materials, Have strong physical properties,no solubility, high radiopacity ,It also displayed higher calcium releasing ability and lower solubility than either ProRoot MTA or Dycal and the disadvantage is It is opaque and“whitish” in color, it should be kept thin so as not to show through composite materials that are very translucent affecting final restoration shading.[20]

PROPOLIS

Propolis (Russian penicillin) is a natural product collected from trees and shrubs by honeybees and the color varies from yellow-brown to darkbrown.Propolis has shown to possess potent antimicrobial and anti-inflammatory properties.18,19. The chemical composition of Propolis are Flavonoids, phenolics and other various aromatic compounds. Flavonoids has antioxidant, antibacterial, antifungal, antiviral and anti-inflammatory proprieties. Propolis as an anti-inflammatory agent inhibits the synthesis of prostaglandins. Additionally, it contains elements such as iron and zinc which are important for the synthesis of collagen.20,21

Propolis forms the hard tissue bridge by stimulating various enzyme systems, cell metabolism, circulation and collagen formation. It also breaks down bacterial cell wall, cytoplasm and prevents bacterial cell division.25

Some of the advantages of propolis is it has Antioxidant, antibacterial, antifungal, antiviral and anti-inflammatory properties, Forms dental pulp, collagen reduces both pulp inflammation and degeneration and Stimulate reparative dentin formation.

Some of the disadvantages are Show mild moderate inflammation with partial dentinal bridge formation.[20]

CONCLUSION

Restorative dentistry has been going through numerous changes as an outcome of clinical applications and development of new materials.

To achieve clinical success, the advantages, disadvantages and the qualities of each type of pulp capping agent in a must.

Based on the literature review it can be concluded that

- the best choice for the conservative treatment are the calcium hydroxide products, which is due to their biological potential and stimulating property of formation of reparative dentin
- GIC's which contains unpolymerized monomers should not be directly applied to the pulp.
- The aggregates of mineral trioxide are suitable and favorable materials for cervical pulpotomy.

REFERENCES

1. MLR Accorinte, AD Loguercio, A Reis E Carneiro, RHM Grande, SS Murata, R Holland ,Response of Human Dental Pulp Capped with MTA and Calcium Hydroxide Powder, Operative Dentistry, 2008, 33-5, 488-495.
2. Sita Ramaraju DV, Rama Krishna Alla, Venkata Ramaraju Alluri, Raju MAKV, A Review of Conventional and Contemporary Luting Agents Used in Dentistry 2014,No. 3, 28-35.
3. Ladha K, Verma M, Conventional and Contemporary Luting Cements: An Overview, J Indian Prosthodont Soc, 10(2), 79-88, June 2010.
4. Asma Qureshi, Soujanya E, nandakumar, Pratapkumar, Sambashivarao,Recent Advances in Pulp Capping Materials: An Overview, Journal of Clinical and Diagnostic Research. 2014 Jan, Vol-8(1): 316-321.
5. TJ Hilton, Keys to Clinical Success with Pulp Capping: A Review of the Literature, Operative Dentistry, 2009, 34-5, 615-625.
6. Thompson V, Craig R, Curro F, Green W & Ship J (2008) Treatmentofdeepcariouslesions bycompleteexcavation or partial removal Journal of the American Dental Association 139 705-712.
7. Al-Hiyasat, A, Barrieshi-Nusair K &Al-Mari M (2006) The radiographic outcomes of direct pulp-capping procedures performed by dental students Journal of the American Dental Association 137(12) 1699-1705.
8. Barthel C, Rosenkranz B, LeuenbergA& Roulette J (2000) Pulp capping of carious exposures: Treatment outcome after 5 and 10 years: A restrospective study Journal of Endodontology 26(9) 525-528.
9. Barthel C, Levin L, Reisner H & Trope M (1997) TNF-α release in monocytes after exposure to calcium hydroxide treated Escherichia coli LPS International Endodontic Journal 30 155-159.
10. Rama Krishna Alla, Dental Materials Science, Jaypee Brothers Medical Publishers Pvt Limited, New Delhi, India, 2013, 1st Edition, 91-125.
11. Ebru SÜMER, Yalçın DEĞER, Contemporary Permanent Luting Agents used in Dentistry: A Literature Review, Int Dent Res, 1(1), 26-31, 2011.
12. Upadhya NP, Kishore G, Glass Ionomer Cement – The Different Generations, Trends Biomater. Artif. Organs, 18 (2), 158-165, Jan 2005.
13. TJ Hilton, Invited Paper Keys to Clinical Success with Pulp Capping: A Review of the Literature , ©Operative Dentistry, 2009, 34-5, 615-625 .
14. About I: Bioactivity of BiodentineTM: A Ca3Si05-based Dentine Substitute. Oral session, IADR Congress, Barcelona 2010.
15. Till Dammaschke et al.THE dentist SEPTEMBER 2011;Direct pulping.
16. Saidon et al., 2003 Shayegan et al., 2010.
17. Laurent P, Camps J, About I,.Biodentine induces TGF-B1 release from human pulp cells and early dental pulp mineralisation. Int Endod.J, 45(5),2010,439-48.
18. Marjorie Zanihi, Jean Michel Sautier, Ariane Berdal, Stephane Simon.,Biodentine Induces Immortalized Murine Pulp Cell Differentiatiion into Odontoblast-like cells and Stimulates Biomineralisation. Journal of Endodontics.;38(9) Sep2012,1220-1226.
19. Subcutaneous tissue reaction to castor oil bean and calcium hydroxide in rats Samira Esteves Afonso CAMARGO1, Sigmar de Mello RODE2, Renata Falchete do PRADO3, Yasmin Rodarte CARVALHO4, Carlos Henrique Ribeiro CAMARGO

20. M. G. Gandolfi, F. Siboni & C. Prati Laboratory of Biomaterials and Oral Pathology, Department of Odontostomatological Sciences, University of Bologna, Bologna, Italy. Chemical–physical properties of TheraCal, a novel light-curable MTA-like material for pulp capping. InternationalEndodonticJournal,45,571–579,2012.
21. A Parolia,* M Kundabala,* NN Rao,SR Acharya,* P Agrawal,M Mohan,M Thomas*, . A comparative histological analysis of human pulp following direct pulp capping with Propolis, mineral trioxide aggregate and Dycal, Australian Dental Journal 2010; 55: 59–64
22. Karin Cristina da Silva MODENA,Leslie Caroll CASAS-APAYCO1, Maria Teresa ATTA2, Carlos Alberto de Souza COSTA3, Josimeri HEBLING4, Carla Renata SIPERT5, Maria Fidela de Lima NAVARRO6, Carlos Ferreira SANTOS CYTOTOXICITY AND BIOCOMPATIBILITY OF DIRECT AND INDIRECT PULP CAPPING MATERIALS ,J Appl Oral Sci. 2009;17(6):544-54.