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Research Paper

A Review of Root End Filling Materials

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ABSTRACT : *The main objective of all endodontic procedures is to obtain a hermetic seal between the periodontium and root canal foramina. When this is not possible by an orthograde approach, root end filling technique is used. Numerous materials have been suggested for root-end filling. This article reviews on the suitability of various root end filling materials from past to present.*
KEYWORDS: *Root-end filling materials, hermetic seal, biocompatibility, microleakage.*

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I INTRODUCTION

Endodontic surgery is an important adjunct to conservative root canal treatment and is sometimes the only option for some endodontic conditions. Resection of the root end during periradicular surgery results in an exposed apical dentine surface bounded by cementum with a root canal at its centre. Following the apical preparation, a retrograde filling material is usually used to seal the root-end cavity.

The ideal root-end filling material seals the contents of the root canal system within the canal, preventing egress of any bacteria, bacterial byproducts, or toxic material into the surrounding periradicular tissues. The material should be nonresorbable, biocompatible, and dimensionally stable over time. It should be able to induce regeneration of the PDL complex, specifically cementogenesis over the root-end filling itself. Finally, the handling properties and working time should be such that the endodontic surgeon can place a root-end filling with sufficient ease. A good quality apical root canal filling is essential to ensure successful endodontic surgical outcome.

II COMONLY USED ROOT END FILLING MATERIALS

2.1 Amalgam

It is the most extensively used retro-filling material from past seven decades, but one of the first reports of placing it as a root-end filling subsequent to resection is attributed to Farrar (1884). Later Rhein (1897), Faulhaber & Neumann (1912), Hippels (1914) and Garvin (1919) extolled the use of root-end amalgam fillings. Amalgam is easy to manipulate and has good radio opacity. It is non-soluble in tissue fluids and marginal adaptation as well as sealing improves as amalgam ages due to formation of corrosion products. High copper zinc free amalgam is preferred. Use of Amalgambond, a 4-META bonding agent with amalgam significantly reduces the microleakage of amalgam retrofillings[1]. Compatibility studies have demonstrated that freshly mixed conventional silver amalgams are very cytotoxic due to unreacted mercury[2], with cytotoxicity decreasing rapidly as the material hardens.

Amalgam has few limitations which include initial marginal leakage, corrosion, tin and mercury contamination of periapical tissues, moisture sensitivity of some alloys, need for retentive undercut preparation, staining of hard and soft tissues and technique sensitivity[3].The tissue response to amalgam root-end fillings has been shown to be unfavourable and associated with inflammation in short-term studies. These studies have ranged from 2 weeks to 5 months following placement [4,5]. Tronstad *et al.* [6] concluded that freshly mixed conventional silver amalgams were very cytotoxic due to unreacted mercury, with cytotoxicity decreasing rapidly as the materials hardened. Maher *et al.* [7] determined that chronic inflammation occurs in the periapical tissues of ferrets within 10 to 15 weeks of the application of amalgam as a retrograde material. However, the research found that amalgam root-end fillings become surrounded

by fibrous connective tissue over the next 15 weeks.Concern has also been expressed regarding the stability of amalgam and the migration of metallic particles into the tissues [8]. These amalgam particles have been associated with inflammation. Some larger particles of amalgam have been encapsulated by collagen and persist almost unchanged. Intracellular amalgam particles and aggregates of fine particles, resulting from their degradation, have been seen within lymph node macrophages [8]. Overall, studies show that the biocompatibility of amalgam is poor in the early period with improvement over the long term.

2.2 Zinc Oxide Eugenol Cements (IRM And Super EBA)

The use of ZOE as a root-end sealing agent in periradicular surgery has had limited documentation. Newer modifications of ZOE compounds, such as IRM and Super EBA provide a better apical seal.

Intermediate restorative material (IRM) consists of a powder containing greater than 75% zinc oxide and approximately 20% polymethacrylate mixed in equal parts with a liquid that contains greater than 99% eugenol and less than 1% acetic acid. IRM seals better than amalgam and is not affected by the liquid/powder ratio or root-end conditioning agents.[9,10] IRM appears to be tolerated in the periradicular tissue, but it has no dental hard-tissue regenerative capacity. The response is similar to that seen with other ZOE-based materials.

SuperEBA consists of a powder containing 60% zinc oxide, 34% aluminum oxide, and 6% natural resins. It is mixed in equal parts with a liquid that contains 37.5% eugenol and 62.5% *o*-ethoxybenzoic acid. SuperEBA is available in two forms, fast set and regular set. Other than the setting time, the properties of the two forms appear to be the same. SuperEBA has radiopacity and sealing effects similar to those of IRM and is less leaky than amalgam. The leakage pattern of SuperEBA does not appear to be affected by root-end conditioning or finishing techniques. When SuperEBA and IRM were finished with a carbide finishing bur in a high-speed handpiece, marginal adaptation was better than with ball burnishing, which was equal to burnishing with a moistened cotton pellet. The environment of the periradicular wound may affect the long-term stability of SuperEBA, which has been shown to disintegrate over time in an acid pH environment.

Biologically, SuperEBA is well tolerated in the periradicular tissues when used as a root-end filling, but it has no capacity to regenerate cementum. Bone healing has been demonstrated at 12 weeks, with some fibrous tissue persisting. SuperEBA root-end fillings show a basophilic-stained line adjacent to the filling material, which may indicate hard-tissue formation.[11,12]

2.3 Glass Ionomer Cement (GIC)

Glass ionomer cement (GIC) consists of aqueous polymeric acids, such as polyacrylic acid, plus basic glass powders, such as calcium aluminosilicate. GIC sets by a neutralization reaction of aluminosilicate, which is chelated with carboxylate groups to cross-link the polyacids; a substantial amount of the glass remains unreacted and acts as reinforcing filler. Glass ionomer cements can be either light or chemically cured. Silver has been incorporated into GIC to improve the physical properties, including compressive and tensile strength and creep resistance. Both forms of GIC have been suggested as an alternative root-end filling material.[13,14]

Light cure, resin reinforced GIC was used as a retrograde filling material by Chong et al28. It showed least microleakage due to less moisture sensitivity, less curing shrinkage and deeper penetration of polymer into dentin surface. Glass ionomer cements are susceptible to attack by moisture during the initial setting period, resulting in increased solubility and decreased bond strength. Contamination with moisture and blood adversely affected the outcome when GIC was used as a root-end filling material; this occurred significantly more often in unsuccessful cases. The cytotoxicity of chemical- and light-cured GIC does not differ significantly from that of SuperEBA or amalgam. The tissue response to GIC is considerably more favorable than to amalgam and similar to that with ZOE-based materials.[15,16]

2.4 Diaket

Diaket (ESPE GmbH, Seefeld, Germany) a polyvinyl resin initially intended for use as a root canal sealer, has been advocated for use as a root-end filling material. It is a powder consisting of approximately 98% zinc oxide and 2% bismuth phosphate mixed with a liquid consisting of 2.2-dihydroxy-5.5 dichlorodiphenyl methane, propionylacetophenone, triethanolamine, caproic acid copolymers of vinyl acetate, and vinyl chloride vinyl isobutyl ether. Leakage studies comparing Diaket to other commonly used root-end filling materials have shown it to have superior sealing ability,[17,18] but its sealing ability has not been directly compared to that of MTA. When Diaket was used as a root canal sealer, biocompatibility studies showed that it was cytotoxic in cell culture and generated long-term chronic inflammation in osseous and subcutaneous tissues. However, when mixed at the thicker consistency advocated for use as a root-end filling material, Diaket has shown good biocompatibility with osseous tissues.[19,20]

2.5 Composite Resins and Resin-Ionomer Hybrids

Composite resins due to their cytotoxic or irritating effects on pulp tissue have received minimal attention as root-end filling materials. The cytotoxic effects are a function of the evaluative methods employed, and, when the agents are properly used, the cytotoxic effects were substantially decreased or eliminated30. McDonald and Dumsha compared composite with a dentin bonding agent, composite alone, cavit, amalgam, hot burnished gutta percha,

and cold burnished gutta percha and found that composite with dentin bonding agent showed least amount of leakage followed by composite alone when both of these were placed directly on resected root surface31. These findings suggest that the preparation of a root-end cavity may be obviated.

The healing response of the periradicular tissues to composite resins in general appears to be very diverse, ranging from poor to good[21,22]; this may depend on the type of material used. Two composite resin–based materials, Retroplast (Retroplast Trading, Rørvig, Denmark) and Geristore, (Den-Mat, Santa Maria, CA) have been advocated for use as root-end filling materials.

2.5.1 Retroplast

Retroplast is a dentin-bonding composite resin system developed in 1984 specifically for use as a root-end filling material. The formulation was changed in 1990, when the silver was replaced with ytterbium trifluoride and ferric oxide. Retroplast is a two-paste system that forms a dual-cure composite resin when mixed. Paste A is composed of bis-GMA/TEGDMA 1:1, benzoyl peroxide *N*,*N*-di-(2-hydroxyethyl)-*p*-toluidine, and BHT. This is mixed in equal parts with paste B, which is composed of resin ytterbium trifluoride aerosil ferric oxide. A Gluma-based dentin bonding agent is used to adhere the material to the root-end surface. The working time is 11 2 to 2

minutes, and the radiopacity (due to the ytterbium trifluoride content) is equivalent to 6 mm of aluminum.

2.5.2 Resin-Ionomer Suspension (Geristore) and Compomer (Dyract)

The resin-ionomer suspension and compomer group of materials attempts to combine the various properties of composite resins and glass ionomers. Geristore and Dyract (DENTSPLY, Tulsa, OK) have been investigated for use as root-end filling materials, although the available published literature on both is limited. These two materials require light activation and resin-dentin bonding agents to attach to the tooth. Geristore has been recommended both as a root-end filling material and for use in restoring subgingival surface defects such as root surface caries, external root resorption lesions, iatrogenic root perforations, and subgingival oblique fractured roots. Clinical evaluation of Geristore as a restorative material for root caries and cervical erosions showed it to be an acceptable material.[23,24]

2.6 Mineral Trioxide Aggregate

It was developed at Loma Linda University, CA, U.S.A in 1993. This cement contains tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide and other mineral oxides forming a hydrophilic powder which sets in presence of water. The resultant colloidal gel solidifies to a hard structure within 4 hours. Initially the pH is 10.2 which rises to 12.5 three hours after mixing. It is found to be more opaque than EBA and IRM. MTA provides superior seal when compared with Amalgam, IRM and Super EBA[25]. Adamo et al[26] compared MTA, Super-EBA, Composite and amalgam and found statistically no significant difference in the rate of microleakage but studies of Torabinejad et al and Fischer et al proved MTA to be superior as compared to Super EBA and IRM[27]. The marginal adaptation of MTA was better with or without finishing when compared to IRM and Super EBA[28]. MTA, when used as a root-end filling material, showed evidence of healing of the surrounding tissues. Most characteristic tissue reaction of MTA was the presence of connective tissue after the first postoperative week. Studies have shown that osteoblasts have favorable response to MTA as compared to IRM and amalgam. With longer duration, new cementum was found on the surface of the material[29]. In a two year follow-up study with MTA as root-end filling material resulted in a high success rate[30]. Such studies support further development of MTA to reduce the long setting time and difficulty in manipulation for use as a root-end filling material.

In 2002, a variation of the original formula of gray MTA was introduced. This material, which is a white cream color, is often called *white MTA*. The chemical composition of white MTA is very similar to that of the original. White and gray ProRoot-MTA materials differ by less than 6% in any one component. Both are fine powders with a mean particle size of approximately 10 μm (the range in particle size is approximately 0.1 to 100 μm). The radiopacity of both materials is equivalent to approximately 3.04 mm of aluminum. When white MTA was implanted in the subcutaneous connective tissue of rats, the results were similar to those reported for gray

MTA. One study compared the tissue reaction evoked by the two materials when used as root-end fillings in canines. The only statistically significant difference observed was in the presence of macrophages and/or multinucleated giant cells adjacent to the material. Gray MTA had more samples with mild to moderate infiltration of macrophages and/or multinucleated giant cells, and white MTA had more samples with no macrophages and/or multinucleated giant cells adjacent to the material. All other parameters assessed were essentially the same. [31,32,33]

III CONCLUSIONS

Many different materials have been advocated for use as rootend filling materials, and each has specific advantages and disadvantages. However, from the biologic perspective of regeneration of the periradicular tissues, MTA, followed by Retroplast, appear to have a clear advantage over the other available materials. Retroplast and other composite resin– based filling materials require meticulous hemostasis and a dry surgical field for optimum results. The most commonly cited disadvantage of MTA is its handling properties. Even when properly prepared, MTA is more difficult to place in the root end cavity than most other materials. Several devices have been modified or developed specifically for use with MTA.

REFERENCES

[1]. Anderson RW, Pashley DH, Pantera EA : Microleakage of Amalgambond in endodontic retrofillings. J Endod. 1991; 17: 198, Abstr. #51
[2]. Tronstad l, Wennberg A : *In vitro* assessment of toxicity of filling materials. Int Endod J. 1980; 13: 131-138.
[3]. Gartner AH, Doran SO. Advances in endodontic surgery. Dent. Clin. N. Amer. 1992; 36: 357-379.
[4]. Torabinejad M, Hong CU, Lee SJ, Monsef M, Pitt Ford TR. Investigation of Mineral Trioxide Aggregate for rootend filling in dogs. J Endod 1995; 21: 603–8.
[5]. Torabinejad M, Pitt Ford TR, McKendry DJ, Abedi HR, Miller DA, Kariyawasam SP. Histologic assessment of Mineral Trioxide Aggregate as a root-end filling in monkeys. J Endod 1997; 23: 225–8.
[6]. Tronstad I, Wennberg A. In vitro assessment of the toxicity of filling materials. Int Endod J 1980; 13:131–8.
[7]. Maher WP, Johnson RL, Hess J, Steiman HR. Biocompatibility of retrograde filling materials in the ferre canine, amalgam and IRM. Oral Surg Oral Med Oral Pathol 1992; 73: 738–45.
[8]. Eley BM. Tissue reactions to implanted dental amalgam, including assessment by energy dispersive x-ray microanalysis. J Pathol 1982; 138: 251–72.
[9]. Crooks WG, Anderson RW, Powell BJ, Kimbrough WF: Longitudinal evaluation of the seal of IRM root end fillings. *J Endod* 20:250, 1994.
[10]. Peters LB, Harrison JW: A comparison of leakage of filling materials in demineralized and non-demineralized resected root ends under vacuum and non-vacuum conditions. *Int Endod J* 25:273, 1992.
[11]. Pertot WJ, Stephan G, Tardieu C, Proust JP: Comparison of the intraosseous biocompatibility of Dyract and Super EBA. *J Endod* 23:315, 1997.
[12]. Pitt Ford TR, Andreasen JO, Dorn SO, Kariyawasam SP: Effect of super-EBA as a root end filling on healing after replantation. *J Endod* 21:13, 1995.
[13]. Pissiotis E, Sapounas G, Spangberg LS: Silver glass ionomer cement as a retrograde filling material: a study in vitro. *J Endod* 17:225, 1991.
[14]. Pissiotis E, Spangberg L: Reaction of bony tissue to implanted silver glass ionomer and a reinforced zinc oxideeugenol cement. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 89:623, 2000.
[15]. Chong BS, Ford TR, Kariyawasam SP: Tissue response to potential root-end filling materials in infected root canals. *Int Endod J* 30:102, 1997.
[16]. Chong BS, Pitt Ford TR, Kariyawasam SP: Short-term tissue response to potential root-end filling materials in infected root canals. *Int Endod J* 30:240, 1997.
[17]. Gerhards F, Wagner W: Sealing ability of five different retrograde filling materials. *J Endod* 22:463, 1996.
[18]. Kadohiro G: A comparative study of the sealing quality of zinc-free amalgam and Diaket when used as a retrograde filling material. *Hawaii Dent J* 15:8, 1984.
[19]. Nencka D, Walia H, Austin BP: Histological evaluation of the biocompatibility of Diaket. *J Dent Res* 74:101, 1995.
[20]. Williams SS, Gutmann JL: Periradicular healing in response to Diaket root-end filling material with and without tricalcium phosphate. *Int Endod J* 29:84, 1996.
[21]. Andreasen JO, Rud J, Munksgaard EC: [Retrograde root obturations using resin and a dentin bonding agent: a preliminary histologic study of tissue reactions in monkeys]. *Tandlaegebladet* 93:195, 1989.
[22]. Trope M, Lost C, Schmitz HJ, Friedman S: Healing of apical periodontitis in dogs after apicoectomy and retrofilling with various filling materials. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 81:221, 1996.
[23]. Galan D: Clinical application of Geristore glass-ionomer restorative in older dentitions. *J Esthet Dent* 3:221, 1991.
[24]. Nakazawa Y, Mitsui K, Hirai Y, Takahashi K, Ishikawa T: Histo-pathological study of a glass-ionomer/resin (Geristore) restoration system. *Bull Tokyo Dent Coll* 35:197,1994.
[25]. Torabinejad M, Falah R, Kettering JD, Pitt Ford TR : Bacterial leakage of mineral trioxide aggregate as a root end filling material. J Endod 1995; 21: 109-21.
[26]. Adamo HL, Buruiana R, Schertzer L, Boylan RJ : A comparison of MTA, Super-EBA, composite and amalgam as root-end filling materials using a bacterial microleakage model. Int Endod J 1999; 32: 197-203.
[27]. Mangin C, Yesilsoy C, Nissan R, Stevens R : The comparative sealing ability of Hydroxyapatite cement, Mineral Trioxide Aggregate, and Super Ethoxybenzoic Acid as root-end filling material. J Endod. 2003; 29: 261- 264.
[28]. Gondim E, Zaia A A, Gomes BPFA, Ferraz CCR, Teixeira FB, Souza-Filho FJ : Investigation of the marginal adaption of root-end filling materials in rootend cavities prepared with ultrasonic tips. Int Endod J. 2003; 36: 491-499.
[29]. Qiang Zhu, Robert Haglund, Kamran E. Safavi, Larg S. W. Spanberg : Adhesion of Human Osteoblasts on Root-End Filling Materials. J Endod 2000; 27: 404-406.

[30]. Chong BS, Pitt Ford TR, Hudson MB : A prospective clinical study of Mineral Trioxide Aggregate and IRM when used as root-end filling materials in endodontic surgery. Int Endod J. 2003; 36: 520-526.
[31]. Barnes D, Adachi E, Iwamoto C, et al: Testing of the white version of ProRoot® MTA root canal repair material. DENTSPLY Tulsa Dental, Tulsa, OK, 2002.
[32]. Holland R, Souza V, Nery MJ, Faraco Junior IM, Bernabe PF, Otoboni Filho JA, Dezan Junior E: Reaction of rat connective tissue to implanted dentin tubes filled with a white mineral trioxide aggregate. *Braz Dent J* 13:23, 2002.
[33]. Loftus D: Assessment of MTA, White MTA, Diaket, and Geristore when used as surgical root-end fillings in dogs. *In Endodontics1*. Dallas, 2003, Baylor College of Dentistry The Texas A&M University System Health Science Center.

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