European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 10, 2020

An overview of materials used in periapical surgery

Ravindranath Megha, M.D.S., Alagarsamy Venkatesh, M.D.S., Rathakrishnan Mensudar, M.D.S, Dhakshinamoorthy Malarvizhi, M.D.S

Department of Conservative Dentistry and Endodontics,

Sree Balaji Dental College and Hospital,

Bharath Institute of Higher Education and Research,

Narayanapuram, Pallikaranai, Chennai-600 100.

Email id : mmegs12@gmail.com

ABSTRACT

The main objective of an endodontic surgery is to maintain the function of the tooth that has a periapical lesion which couldn't be resolved by conventional endodontic (re-)treatment . It is a critical procedure requiring knowledge and skill. This review gives a gist of the materials used for periapical surgery.

Key words: Endodontics, Periapical, Surgery, Root end materials, Retrograde filling

INTRODUCTION:

A case indicated for periapical surgery must always be considered first for the possibility of conventional root canal treatment by carefully evaluating all the clinical and radiographic features. However, Kim and Kratchman stated that a surgical approach is more conservative than orthograde approach in certain cases.(1) A frequently encountered example is a tooth with acceptable apical and coronal seal or a new post and crown restoration, but having a persistent or enlarging periapical lesion. The indications for endodontic surgery given by Grossman et al are presence of large and intruding periapical lesions, overfilled canals and incomplete apical root formation.(2)The indications given by European Society of Endodontology are radiographic signs of apical periodontitis and/or symptoms associated with an obstructed or obliterated canal, extruded material with clinical or radiological findings of apical periodontitis and/or symptoms continuing over a long period of time, persisting or enlarging lesion following root canal treatment when root canal re-treatment is not possible or inappropriate and perforation of the root or the floor of the pulp chamber and where it is impossible to treat from within the pulp cavity.(3) The contraindications for periapical surgery are: if the tooth has no function (no antagonist or no strategic importance serving as a pillar for a fixed prosthesis), cannot be restored, has inadequate periodontal support or if the tooth has a vertical root fracture.(4) Additional contraindications may be an uncooperative or medically compromised patient where oral surgical intervention is not suitable.

INSTRUMENTS

The micro surgical instruments include:

1. Examination instruments
2. Incision and elevation instruments
3. Tissue retraction instruments
4. Osteotomy instruments
5. Curettage instruments
6. Inspection instruments

7. Retro-filling carrier and plugging instruments
8. Suturing instruments and
9. Miscellaneous instruments.

The instruments included in each type are briefed in Table 1

The micromirrors are stainless steel surfaced, available in round and rectangular shapes.The sapphire surfaced have diameter of 3mm.These micromirrors are positioned at 45° angle to the resected root to reflect the entire root surface. The micro-explorer is useful for looking for the exact site of a leak on the resected root surface and identifying a fracture line. The retro-filling carrier instruments are of flat surfaced and ball ended types.The micro pluggers are available with diameter of 0.2-0.5mm.Tip angle is of 90 degrees for universal use and 65 degrees for lingual apex.The length of the tip is 3mm.

MATERIALS

Hemostatic agents

They include mechanical agents like bone wax, cotton pellet and chemical agents which include epinephrine pellets and ferric sulphate solution. The absorbable haemostatic agents are gelfoam, absorbable collagen (microfibrillar collagen hemostasis) which are intrinsic whereas surgicel is extrinsic. Surgical Calcium sulphate is a hemostatic agent which works by mechanical action.

Suture materials

Sutures are silt, gut and ethibond. Silk sutures are natural, non-absorbable, multi filamentous and braided. One advantage is its ease of manipulation. The movement of fluids between the fibres called the 'wicking action' caused due to the high capillary action of the suture results in severe oral tissue reactions.(5) It tends to support bacterial growth.(5) Due to the severe tissue reaction to silk, it is not the suture material of choice for endodontic surgery today.Gut sutures are natural and absorbable. They are plain or chromic. In terms of biocompatibility, plain gut is preferred over chromic gut for oral soft tissues.(5) They are not routinely used for periapical surgery because sutures may weaken or dissolve too soon or remain in incision area for longer than desired. Ethibond is synthetic, nonabsorbable and braided suture composed of polyethylene terephthalate. It has a smooth teflon or polybutilate coating which is well suited for periradicular surgery. It is easy to handle and does not promote bacterial growth. Tissue adhesives such as cyanoacrylates and fibrin glues may hold promise for wound closure after periradicular surgery.(6) Suturing needles are half round or 3/4th round and a needle with reverse cutting edge is preferred.

Root end conditioning

For root end conditioning citric acid, tetracycline and EDTA are used. 1- 2 minutes of application of 50% citric acid (pH-1) results in demineralised root ends and promotes faster healing.(7) Extended application discourages alveolar bone growth.(8) Tetracycline removes smear layer, leaving clean, open tubules in 30 seconds.(9) EDTA has neutral pH and is more favourable for human PDL cell attachment.(10)

Root End Filling materials:

Amalgam

Amalgam was the most extensively used retro-filling material and was first reported by Farrar in 1884.(11) It is easy to manipulate and has good radio opacity. It is non-soluble in tissue fluids. The marginal adaptation improves as amalgam ages due to formation of corrosion products.(11) The disadvantages of amalgam include initial marginal leakage, corrosion, contamination of periapical tissues by tin and mercury, moisture sensitivity of some alloys, need for retentive undercut preparation, staining of hard and soft tissues and technique sensitivity.

Use of Amalgambond, a 4-META bonding agent with amalgam significantly reduces the microleakage of amalgam retrofillings.(12)

Guttapercha

The use of gutta percha as a root-end filling material was not advocated until the development of thermoplasticized gutta-percha. It is reported in a study that a better seal can be obtained with thermoplasticized gutta-percha than amalgam with and without varnish.(13) Due to its innate porosity, it expands by absorbing the moisture from surrounding periapical tissue followed by contraction at a later stage. This may result in poor marginal adaptation and increased microleakage.(14)

Zinc oxide eugenol (ZOE)

Its use as a root-end sealing agent in periradicular surgery has had limited documentation. Newer modifications of ZOE compounds, such as Intermediate Restorative Material (IRM) and Super Ethoxy Benzoic acid(EBA) provide a better apical seal. IRM is zinc oxide eugenol cement with addition of 20% polymethacylate by weight to the powder. Super EBA is zinc oxide eugenol cement modified with ethoxybenzoic acid to change the setting time and enhance the mechanical properties of the mixture. Super EBA has high compressive strength, high tensile strength, neutral pH and low solubility. Super EBA shows good adherence to tooth structure even in presence of moisture. Super EBA adheres well to itself unlike IRM. Hence it can be added in increments as necessary. Reports showed a good healing response to super EBA with minimal chronic inflammation at the root apex.(15) Super EBA and IRM showed less microleakage as compared to silver amalgam.(16)

Cavit

Cavit is a zinc oxide based filling material frequently used as provisional restoration. Cavit is soft initially when placed in the tooth but gradually undergoes a hygroscopic setting after permeating with water or periapical fluids. This was the reason for its use as a root-end filling material. It is found to be soluble and quickly disintegrates in tissue fluids.It exhibits greater leakage than IRM.(17) Biocompatibility studies with Cavit are in conflict, showing it to be both toxic(18) and nontoxic.(19)

Gold

Schuster in 1913 and Lyons in 1920 first reported the use of gold foil as a root-end material. It shows ideal marginal adaptability, surface smoothness and biocompatibility. Gold Foil was found to be the best apical sealing material as far as the improvement in biting force is concerned.(20) But its routine use as a root-end filling material is not practical because it requires a moisture free environment, careful placement and finishing. However it can be used in cases where perfect isolation is achieved.

Polycarboxylate Cement

It was introduced by Smith in 1968. It is available as powder and liquid. The powder is modified zinc oxide with fillers and liquid comprises of aqueous solution of polyacrylic acid. When the powder and liquid are mixed and hardened, it forms a cement of zinc oxide particles dispersed in a cross linked structureless matrix of zinc polycarboxylate. The initial pH of the cement is 1.7, which increases as the cement sets. The use of polycarboxylate as root-end filling material is controversial because of their poor sealing ability and uncertain periradicular tissue response. Further evaluation is needed.

Glass Ionomer Cements

These cements show initial cytotoxicity which decreases as setting occurs. It is easy to handle and does not cause any adverse histological reaction in the periapical tissue.(21) The prior use of acid conditioners and varnishes enhances the marginal adaptation and adhesion of these cements. Light cured, resin reinforced GIC was used as a retrograde filling material. Its sensitivity to moisture is less and hence it showed less microleakage. Glass ionomer cements containing glass-metal powder have been reported to have less microleakage and showed no pathologic signs. Their use as root-end filling materials needs further investigations.

Composites

Composite resins have cytotoxic and irritating effects on pulp tissue due to which they have not been recommended as root-end filling materials. The newly evolving dentin bonding agents and composite resins may play a significant role in enhancing the final root-end filling. Further research is required regarding their use.

Mineral trioxide Aggregate (MTA)

The powder contains tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide and other mineral oxides which sets in presence of water. Its initial setting time is four hours during which the colloidal gel formed solidifies to a hard structure. The pH is 10.2 initially which increases to 12.5 three hours after mixing. MTA provides superior seal when compared with Amalgam, IRM and Super EBA.[22] Studies have shown that osteoblasts have favorable response to MTA as compared to IRM and amalgam.[23] In a two year follow-up study, MTA as root-end filling material resulted in a high success rate.[24] Such studies support further development of MTA in reducing the long setting time and difficulty in manipulation.

Calcium Phosphate Cement (CPC)

It is also known as hydroxyapatite cement. It is composed of tetracalcium phosphate and dicalcium phosphate reactants. They react isothermally with water forming a solid of carbonated hydroxyapatite. It is as radio opaque as bone. It forms hydroxyapatite by reacting with moisture or even blood present in periapical tissues. It has excellent biocompatibility eliciting no inflammatory response or toxic reaction. It has compressive strength greater than 60 Mpa maintaining its shape and volume over time. It is resorbed slowly and is replaced by bone in an approximate 1:1 ratio in an osteoconductive manner. CPC is a promising material for retrograde filling.

CONCLUSION

An endodontic surgeon should consider using materials, which have been biologically and clinically evaluated and which have given evidence of long term success.

SOURCE OF FUNDING : Nil

ETHICAL CLEARANCE : Not required for a review manuscript

CONFLICT OF INTEREST : Nil

REFERENCES:

1. Kim S, Kratchman S. Modern endodontic surgery concepts and practice: a review. Journal of endodontics. 2006 Jul 1;32(7):601-23.
2. Grossman L, Oliet S, Del Rio C. Endodontic practice. 11th ed. Philadelphia: Lea & Febiger; 1988.
3. European Society of Endodontology. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. International Endodontic Journal. 2006 Dec;39(12):921-30.
4. Von Arx T. Apical surgery: A review of current techniques and outcome. The Saudi Dental Journal. 2011 Jan 1;23(1):9-15.
5. Lilly GE, Cutcher JL, Jones JC, Armstrong JH. Reaction of oral tissues to suture materials. IV. Oral Surgery, Oral Medicine, Oral Pathology. 1972 Jan 1;33(1):152-7.
6. Coulthard P, Worthington H, Esposito M, Van Der Elst M, van Waes O. Tissue adhesives for closure of surgical incisions. Clinical Otolaryngology. 2006 Dec;31(6).

7. Craig KR, Harrison JW. Wound healing following demineralization of resected root ends in periradicular surgery. Journal of Endodontics. 1993 Aug 1;19(7):339-47.
8. Blornlöf J, Lindskog S. Periodontal tissue-vitality after different etching modalities. Journal of clinical periodontology. 1995 Jun;22(6):464-8.
9. Madison III JG, Hokett SD. The effects of different tetracyclines on the dentin root surface of instrumented, periodontally involved human teeth: a comparative scanning electron microscope study. Journal of periodontology. 1997 Aug;68(8):739-45.
10. Zaman KU, Sugaya T, Hongo O, Kato H. A study of attached and oriented human periodontal ligament cells to periodontally diseased cementum and dentin after demineralizing with neutral and low pH etching solution. Journal of periodontology. 2000 Jul;71(7):1094-9.
11. Bhagat K, Goel M, Bhagat N. Root-End Filling Materials and Recent Advances: A Review. EC Dental Science. 2017;12:46-57.
12. Anderson RW, Pashley DH, Pantera EA. Microleakage of amalgam bond in endodontic retrofillings. J Endod. 1991;1:63-5.
13. MacPherson MG, Hartwell GR, Bondra DL, Weller RN. Leakage in vitro with high-temperature thermoplasticized gutta-percha, high copper amalgam, and warm gutta-percha when used as retrofilling materials. Journal of endodontics. 1989 May 1;15(5):212-5.
14. Woo YR, Wassell RW, Foreman PC. Evaluation of sealing properties of 70° C thermoplasticized gutta-percha used as a retrograde root filling. International endodontic journal. 1990 Mar;23(2):107-12.
15. Oynick J, Oynick T. A study of a new material for retrograde fillings. Journal of endodontics. 1978 Jul 1;4(7):203-6.
16. Higa RK, Torabinejad M, McKendry DJ, McMillan PJ. The effect of storage time on the degree of dye leakage of root-end filling materials. International endodontic journal. 1994 Sep;27(5):252-6.
17. Friedman S, Shani J, Stabholz A, Kaplawi J. Comparative sealing ability of temporary filling materials evaluated by leakage of radiosodium. International endodontic journal. 1986 Jul;19(4):187-93.
18. Wennberg A, Hasselgren G. Cytotoxicity evaluation of temporary filling materials. International endodontic journal. 1981 May;14(2):121-4.
19. Al-Nazhan S, Sapounas G, Spngberg L. In vitro study of the toxicity of a composite resin, silver amalgam, and Cavit. Journal of endodontics. 1988 Jan 1;14(5):236-8.
20. Goel BR., et al. “Clinical evaluation of gold foil as an apical sealing material for reimplantation”. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology 55.5 (1983): 514-518
21. Callis PD and Santini A. “Tissue response to retrograde root fillings in the ferret canine: A comparison of glass ionomer cement and gutta percha with sealer”. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology 64.4 (1987): 475-479.
22. Torabinejad M, Rastegar AF, Kettering JD, Ford TR. Bacterial leakage of mineral trioxide aggregate as a root-end filling material. Journal of endodontics. 1995 Mar 1;21(3):109-12.
23. Zhu Q, Haglund R, Safavi KE, Spangberg LS. Adhesion of human osteoblasts on root-end filling materials. Journal of Endodontics. 2000 Jul 1;26(7):404-6.
24. 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. International endodontic journal. 2003 Aug;36(8):520-6.

TABLE 1 – Instruments classified under each category

TYPE	INSTRUMENTS
1. Examination instruments	Mouth mirror, explorer and periodontal probe
2. Incision and elevation instruments	15c blade and handle, microsurgical scalpel and soft tissue or periosteal elevators
3. Tissue retraction instruments	Kim/Pecora (KP) 1, 2, 3 and 4 retractors and university of Minnesota retractors
4. Osteotomy instruments	H 161 Lindemann bone cutting burs and the

ISSN 2515-8260 Volume 07, Issue 10, 2020

	impact air 45 handpiece
5. Curettage instruments	Lucas curette
6. Inspection instruments	Micromirrors and microexplorers
7. Retro-filling carrier and plugging instruments	Micropluggers
8. Suturing instruments	Needle holder and microscissors
9. Miscellaneous	Minirongeur, double-ended bone file and Stropko irrigator/dryer