A COMPARISON OF SEALING CAPABILITIES OF AMALGUM, GIC AND ZINC OXIDE EUGENOL CEMENT WHEN USED AS RETRO GRADE FILLING MATERIALS (IN VITRO STUDY)

Shuja Riaz Ansari, Zahur Qayyum, Umar Khitab

Department of Oral & Maxillofacial Surgery, Khyber College of Dentistry, Peshawar, Pakistan.

Background: The objective of this study was to compare sealing capabilities of different filling materials when used as retrograde filling materials following apiceotomy (to check their sealing abilities as retro filling). In this study apical seal obtained following reverse retrograde root filling with amalgam, was compared with those obtained with, Glassinomer (GIC) and Zinc oxide eugonal (ZnO_2E) cement. **Methods:** The root canals of 50 extracted single rooted upper anterior human teeth were used in this study. The root canals were instrumented and obturated with laterally condensed, gutta-percha and zinc oxide sealer. Each tooth was apically resected at 90 degrees to its long axis and the root surface isolated with two coats of nail polish. Teeth were divided into 4 groups, the 1st group received amalgam retrograde filling, the 2nd and 3rd group was retro filled with GIC and ZnO_2E cement respectively and the 4th control group received no retrograde root filling. All these teeth were suspended in 1% methylene blue dye at room temperature for 72 hours, the roots were sectioned and dye penetration measured by using (stereomicroscope) microscope. The sealing abilities of these materials were determined by their ability to inhibit dye penetration. **Results:** The result of this study has shown that GIC is just as effective as amalgam but ZnO_2E cement showed poor sealing abilities. **Conclusion:** GIC is just as effective as Amalgam as a retro-sealer and on some instance, better then it, but a long term in vivo study is required to prove it.

Key words: Retrograde filling, Apiceotomy, Endodontic surgery.

INTRODUCTION

Apiceotomy followed by retrograde root filling is a well-established procedure to treat teeth with persistent peri apical infections or where conventional root canal treatment has failed.[1] Inefficient retrograde sealing of root canal following apiceotomy is a major factor in surgical endodontic failure and search for such a material that seals the root canal foramen is still required. The success depends largely on the skill of operator and the suitable material.[2]

When considering the role of materials in endodontic surgery, it is necessary to first look at the function the seal provides. The retrograde filling is intended to occlude the tooth apex, thus providing a barrier to tissue fluids and toxins, and indeed bacteria, preventing them either passing in or out of the canal.[3]

It is generally agreed that the primary cause of failure of conventional endodontic treatment is inadequate obturation. Peri apical inflammation that results from this inadequate apical seal can be corrected by placement of a retro filling.[4]

In dental literature a variety of dental materials have been used for retro filling, these include amalgam, biobond, EBE cement, heat sealed gutta-percha, cold burnished gutta-percha, ZnO_2 cement, gold foil pellets, Glassionomer cement, Ketac- silver and MTA.[5] It is worth noting that Rowe in 1968 commented that there was no other hollow cavity in the body, which has been filled, with so many materials.[6]

The ideal root end filling material should be easily introduced in to the tooth apex, plastic in use (but when in position, should set hard, preferably with some degree of expansion), adherent to dentine, dimensionally stable, non absorbable and not effected by the presence of moisture, bacterio static, non-irritant, non-toxic that is well tolerated by peri apical tissues and promote healing, radio opaque, inexpensive with a long shelf life and easily removed if necessary.[4] Every material has its own advantages and disadvantages and still a search for an ideal material is continued.

Amalgam has been the most commonly used material for retro grade filling, as it is easy to manipulate, available in all dental offices, radio-opaque, well tolerated by peri apical tissues, seals with acceptability due slight expansion on complete setting and non-resorbable. Its disadvantages include, it shows an initial leakage due to contraction at the time of primary setting[7,8], non sterile, slow setting, amalgam 'cloud', amalgam 'tattooing', reaction of mercury to tissues and corrosion. Different amalgams (including Zn free or high Copper amalgams) are available but vary in properties regarding corrosion and cytotoxicity.[9]

Gutta-percha is malleable to a certain degree and thus adaptable to irregular cavity walls and also inert, inexpensive, does not corrode but heat sealed gutta-percha has showed significant marginal defects, pull-aways, and heat blistering.[10]

The preliminary studies of the bio-compatibility of glass ionomer cement suggested its suitability as retrograde root canal filling[11,12] and Wu *et al*., showed that it leaked less than amalgam.[13]

Zinc oxide eugenol provides bactericidal seal in carious cavities prepared for endodontic reasons but when used as a retrograde filling material initially showed failure. But when used as reinforced cement showed contender results.[9] Therefore it may be considered as retrograde filling material but there are conflicting results regarding its suitability in different studies.[14-16]

The Ketac silver, a silver-cermet ionomer is shown to be as effective as high copper amalgam alloy as a retro filling material. Also MTA, a mineral trioxide aggregate cement based on a mixture of sterile water shown to leak less than amalgam by providing hermetic seal in vitro study but its clinical application is still questioned.[1,15]

MATERIAL AND METHODS

This study was carried out with an objective to compare the microleakage of amalgam, glass ionomer and ZnO_2E cement when used as root end filling material. It was conducted at department of oral surgery, Khyber college of Dentistry, Peshawar.

Fifty freshly extracted human single rooted (upper central, lateral and canine) teeth were included in our study. All stored in saline. The clinical crowns of these teeth were removed using taper fissure bur in high-speed hand piece. A K-File was introduced into the canal and 1mm was subtracted from the length at which K-File appeared at apical foramen for determining the working length. The apical portion of the canal was prepared up to No. 30 file and rest of the canal was prepared with step back technique up to No. 60 file. Sodium hypo chloride was used as an irrigant. The clean and prepared canal dried with air by triple syringe and paper points and obturated with gutta-percha using lateral condensation technique and zinc oxide eugenol was used as a sealer. The access opening was sealed with Cavit (UK). Apical root resection was done at all roots by removing 3 mm of each apex at 90 degree to the long axis of the tooth by using the fissure bur in high speed hand piece with water coolant. A 3 mm deep root end cavity was prepared by round diamond bur in high-speed hand piece. Two coats of nail polish were applied on the whole surface of the root except the tip where root end filling have to be applied.

The teeth where divided in to 4 groups:

1. **Retro filled with amalgam (15 roots)**
2. Retro filled with GIC (15 roots)
3. Retro filled with ZnO_2E cement (15 roots)
4. Not Retro filled (5 roots), control group.

Each root was suspended in the middle of its own jar by a 3/0 silk suture attached to its coronal aspect, 1% methylene blue was added to the jars to cover the apical third of the root and remained suspended for 72 hours to check the apical seal.

After removal of the teeth from 1% methylene blue jar, were washed under running tap water and dried. Each root was sectioned to the long-axis of root, in labio lingual direction by using a taper fissure bur, in a high-speed hand piece (NSK Japan). The depth of dye penetration was evaluated by ×10 (Zeiss SV, Oberkochem, Germany). The roots were evaluated and scored either acceptable (no leakage or leakage that does not extended beyond the retro filling) or non acceptable (leakage beyond the retro seal). Statistical analysis of the results was performed using the χ^2 test.

The linear penetration of the dye was also measured, in the three groups.

RESULTS

When the dye leakage between amalgam, GIC and ZnO_2E cement was compared after a period of 72 hours the following observations were obtained (Table 1 and 2).

Table-1: Summary of the experiment

Material	Total	No Leakage	Leakage	Leakage beyond Retro Seal	Dye Penetration	
					Minimum (mm)	Maximum (mm)
GIC	15	2	13	3	2.12	5.37
Amalgam	15	1	14	5	1.48	4.57
ZnO_2 Cement	15	0	15	11	2.08	7.86
Control	5	0	5	Dye penetration throughout entire length		

1. In the group retro filled with GIC 13 roots out of 15, showed leakage. Three out of these 13 roots exhibited dye penetration beyond the retro filling. In two teeth there was no dye penetration. The minimum dye penetration was 2.12 mm and maximum dye penetration was 5.37 mm (Fig-1)

2. In the group retro filled with amalgam 14 roots out of 15 showed leakage. Five out of these 14 roots exhibited dye penetration beyond the retro filling. In one tooth there was no penetration of dye. The minimal dye penetration was 1.48 mm while maximum was 4.57 mm.
3. In the group retro filled with ZnO_2E cement all the all roots showed leakage.11 roots exhibited dye penetration beyond the depth of apical cavity preparation. The minimum dye penetration was 2.08 mm and maximum was 7.86 mm.
4. The five control samples with no retrograde filling showed dye penetration through out entire length of root canal.

The data collected from the three groups was statistically analyzed by applying chi-square test. The difference between GIC and amalgam was not statistically significant ($p>0.05$) where as the difference between GIC and ZnO_2E cement ($p<0.001$) and amalgam and ZnO_2E cement ($p<0.01$) was statistically significant.

Table-2: Leakage of retro filling materials 72 hours

MATERIALS	OBSERVATIONS	ACCEPTABLE	UN ACCEPTABLE
GIC*	15	12	3
Amalgum**	15	10	5
ZnO_2E Cement***	15	4	11

(*p>0.05, ** p<0.001 and ***p<0.01)

Fig-1: Bar chart showing linear dye inhibition retro filling materials used in in-vitro study

DISCUSSION

Research into the role of materials proposed for retro fillings in surgical endodontics has been wide spread. Vogues for different materials have been evident, as first encouraging, and then discouraging results have been reported. The survey of initial studies seems to consider the theoretical aspects of material, without any statistics. Any specific clinical data obtained has been quite limited. Most of the materials are transferred from restorative dentistry, may be well satisfactory where they are used, but may not be suitable for endodontic surgery.

In recent years more attention is directed towards the dye leakage studies of the materials, the extent to which they inhibit dye penetration, to screen out a suitable retro filling material. When such a material does not allow penetration of small molecules, it has the potential to prevent leakage of larger substances such as bacteria and it's by products.[1]

In our study no significant difference was found between GIC and amalgam when dye penetrations beyond retro fillings were considered. The GIC leaked less than amalgam and this was agreeable with other studies.[16,17] The amalgam showed more leakage than GIC in our study and is agreeable to Gerhard and Wagner[18] and Chong *et al*[17].

Initially it seems that GIC is just as effective as amalgam or better than it and so, can be considered as an alternative retro filling material because of disadvantages of amalgam. But this is in vitro study and its clinical and practical application is questionable. A long-term clinical study is required to confirm it.

When linear dye penetration was compared among these materials, amalgam leaked less distance than GIC and this could be due to setting properties of amalgam, which shows an initial shrinkage at primary setting allowing fluids to flow in, but there is slight expansion on final setting, which can be considered as an advantage, and preventing further leakage. Though GIC has showed good dentinal wall adherence in operative dentistry but the material is technique sensitive. Freshly mixed GIC shows difficulty in handling and also sensitive to moisture and in a wet environment like endodontic surgery may show more shrinkage on setting and thus voids and microleakage, and a continuous penetration of fluids. Increasing the size of sample and duration of experiment different results may be obtained.

CONCLUSION

Though in our *in vitro* study GIC is just as effective as amalgam as a retro sealer and on some instances seems better than it, it cannot be considered superior to amalgam unless it is proved by a long term *in vivo* study. A search for a suitable material must be continued.

RECOMMENDATION

The materials such as Ketac silver and MTA, which in other studies[1,8,19] are claimed to have better sealing capability must also be investigated both by *in vitro* and *in vivo* studies.

REFERENCES

1. Aqrabawi J. Sealing ability of amalgam, super EBA cement, and MTA when used as retrograde filling materials. Br Dent J 2002;188:266-8.
2. Rud, Andreasen. Operative procedure in periapical surgery by radiographic histologic and stereomicroscopic methods. Int J Oral Surg1972;85-9.
3. High AS, Rusell JL. Retrograte root filling using antibiotic-containing radioopaque bone cement. J Dent 1989;17:241-5.
4. Gartner AH, Dorn SO. Advances in endodontic surgery. Dent Clin North Am 1992;36:357-60.
5. Arens DF, Adams WR, Castro D (eds). Endodontic surgery. Philadelphia: Harbor & Row,1981. 154-7.
6. Row. Endodontics in relation to restorative dentistry. Dent Mag Oral Top 1969;137.
7. Boyer DB, Torny DL. Microleakage of high copper amalgam. J Dent Research 1979;58:12-3.
8. Zetterqvist L, Anneroth G, Danin J, Roding K. Micro leakage of retrograde fillings. A comparative study between amalgam and glassionomer cement in vitro. Int Endod J 1988;21:1-8.
9. Onynick J, Onynick T. A study of new material for retrograde fillings. J Endod 1978;4:203-6.
10. Kaplan SD, Tanzilli JP, Raphael D, Moodnik RM. A comparison of the marginal leakage of retrograde techniques. Oral Surg 1982;54:583-5.
11. Jonck LM, Grobbelear CJ, Starting H. The biocompatibility of glassionomer cement in joint replacement, Bulk-testing. Clin Materials1989;4:85-107.
12. Risto L. Tissue reaction of glassionomer cement in rat, a possible material for apiceotomy using retrograde filling. Int J Oral Surg 1985;14;105–8.
13. Beltes P, Zervas P, Lambrianidis T, Moylvdas I. In vitro study of the sealing ability of four retrograde filling materials. Endod Dent Traumatol 1988;4:82-4.
14. Bondra DL, Hartwell GR, Macpherson MG, Portell FR. Leakage in vitro with IRM, high copper amalgam and EBA cements as retrofilling materials. J Endond 1989;15:157-60.
15. Torabinejad M, Watson TP, Pit Ford TR. Sealing ability of mineral trioxide aggregate when used as a root end filling materials. J Endond 1993;19:591-5.
16. Wu MK, Kontakiotis EG, Wesselink PR. Long term seal provided by some root end filling materials. J Endond 1998;24:557-60.
17. Chong BS, Pitt Ford TR, Watson TF. The adaptation and sealing ability of light cure glassionomer retrograde filling. Int Endod J 1991;24:223-32.
18. Gerhard F, Wagner W. Sealing ability of five different retrograde filling materials. J Endod 1996;22:463-6.
19. Schwartz SA, Alexander JB. A comparison of leakage between silver glassionomer cement and amalgam retro fillings. J Endod 1988;8:385-91.

Address for correspondence:
Dr. Shuja Ansari, Department of Oral and Maxillofacial Surgery, Khyber College of Dentistry, Peshawar.
Email: zahurqayyum@yahoo.com