



Journal Homepage: - [www.journalijar.com](http://www.journalijar.com)  
**INTERNATIONAL JOURNAL OF  
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/7468  
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/7468>



### RESEARCH ARTICLE

#### ADAPTABILITY OF DIFFERENT ROOT END FILLING MATERIALS.

Sherif El Shershaby<sup>1</sup>, Ehab Hassanien<sup>2</sup>, Shehab El Din Saber<sup>2</sup> and Mohamed Zaazou<sup>3</sup>.

1. Assistant researcher, National Research Centre, Egypt.
2. Professor of Endodontics, Faculty of Dentistry, Ain Shams University, Egypt.
3. Researcher Professor of restorative Dentistry, National Research Centre, Egypt.

#### Manuscript Info

##### Manuscript History

Received: 23 May 2018  
 Final Accepted: 25 June 2018  
 Published: July 2018

##### Keywords:-

Adaptability, endodontic surgery, root end filling materials.

#### Abstract

**Introduction:** The purpose of this study was to evaluate and compare the adaptability of TotalFill, Mineral trioxide aggregate (MTA) and Intermediate restorative material (IRM) on human extracted teeth. **Methods:** Thirty single rooted freshly extracted human teeth with mature apices were selected. Clinical crowns were sectioned at the cement-enamel junction to create a standardized length of about 16 mm. The root canals were instrumented in a crown down technique by using Protaper rotary nickel titanium files. Root canals were obturated with Gutta-percha and resin based sealer. The root-ends were then resected perpendicular to the long axes of the teeth and ultrasonically prepared to receive a retrofilling. Under scanning electron microscopy, the gaps between the material and dentinal wall were measured. **Results:** The maximum mean gap measurements were found in IRM, whereas the minimum mean gap measurements were found in TotalFill. **Conclusion:** None of the tested materials had a perfect marginal adaptation to the walls of the prepared retro cavity.

Copy Right, IJAR, 2018,. All rights reserved.

#### Introduction:-

Endodontic surgery is a valid procedure for the treatment of teeth with persistent periradicular lesions that failed to respond to primary or secondary root canal treatment. Endodontic surgery includes four main steps in elimination of persistent endodontic pathogens: 1. surgical removal of the pathological tissues of the periapical area. 2. Resection of the root tip 3. Apical root canal preparation. 4. Retrograde filling of the root canal <sup>(1)</sup>.

The role of the retrograde filling is to seal the canal in order to prevent passage of bacteria or their toxins from the canal space into the periradicular tissues. In contrast to orthograde root canal filling materials, root-end filling materials are placed in direct contact with vital periapical tissues. Hence, the tissue response to these materials is very important as it may affect the prognosis of the surgical endodontic treatment.

An ideal root end filling material should be biocompatible, nontoxic, dimensionally stable, insoluble in tissue fluids, radiopaque, easily manipulated and able to seal the root canal system <sup>(2, 3)</sup>. Many materials have been used as root-end filling materials. These include amalgam, guttapercha, zinc-oxide eugenol cements (ZOE), Mineral trioxide aggregate (MTA), glass ionomer cements, composite resins, compomers, bioceramics.

**Corresponding Author:- Sherif El Shershaby.**

Address:- Assistant researcher, National Research Centre, Egypt.

Zinc-oxide eugenol cement was known to have good handling properties as well as postoperative results. Nevertheless, the original ZOE cements were weak and more likely to be absorbed over a period of time.<sup>(4-6)</sup> Therefore it was unsuitable for long term use. Accordingly, modified forms of ZOE cements were recommended as intermediate restorative material (IRM)<sup>(7,8)</sup>.

MTA is considered as a suitable root end filling material with high clinical success rate and tissue regenerative properties.<sup>(9)</sup>

In attempt to find materials with similar properties to MTA and improved handling characteristics, new bioceramic materials have been recently introduced such as TotalFill.

## **Materials and Methods:-**

### **Specimen selection:-**

Thirty single rooted freshly extracted human teeth with mature apices, without any root caries, root fracture or resorption were selected. Teeth were carefully cleaned with curettes to remove any soft tissue remnants, placed in 2.5 % sodium hypochlorite for one hour to allow for surface disinfection and then stored in saline solution until instrumentation.

### **Specimen preparation:-**

The teeth were decoronated to create root sample with standardized length of 16 mm using a safe sided diamond disk mounted in a low speed handpiece under water coolant. The working length was measured by subtracting 1mm from the length recorded when the tip of a # 15 K-file was visible at the apical foramina. The root canals were prepared using Protaper rotary system to an apical preparation size F5.

Irrigation of the canals with 1 ml of 2.5% NaOCL was done between each instrument. After completion of the instrumentation, the smear layer was removed with 3ml of 17% EDTA for 3 minutes followed by 3 ml 5.25% NaOCl. Finally the canal was flushed with 3 ml distilled water then dried with paper points. Then the root canals were dried with paper points and obturated with gutta-percha and Ad seal root canal sealer. The teeth were then stored at 100 % humidity.

### **Root end preparation:-**

The root-ends were then resected perpendicular to the long axes of the teeth using a high speed hand piece and air water spray with a tapered fissure bur 3 mm from the anatomic apex. Three millimeter deep root end cavities were prepared with retrotip attached to an ultrasonic unit.

### **Root end filling:-**

The materials were mixed according to the instructions proposed by the manufacturer and to a consistency that promoted the material to preserve its shape and attachment to the plastic instrument and plugged with a microplugger. After filling the root end cavity, a cotton wall pledget dampened with sterile saline was used to clean the surface of the cut root end.

Specimens were divided into 3 groups, ten sample each, according to tested material.

Group I: Root end cavities filled with TotalFill.

Group II: Root end cavities filled with MTA.

Group III: Root end cavities filled with IRM.

### **SEM Preparation:-**

All samples were air dried, then mounted on aluminum stubs and gold sputtered for scanning electron microscope.

### **SEM evaluation:-**

Postoperative scanning electron photomicrographs were made of each specimen to compare the interface between the retrofilling material and the prepared root surface. Photomicrographs of specimens were viewed at 200x, because this magnification appeared to reveal the most detail while maintaining the entire retrofilling/tooth interface.

**Measurement of Gap:-**

The total area of the root-end cavity ( $\Delta R$ ) and the area occupied by the root-end filling material ( $\Delta M$ ) were measured in  $\mu\text{m}$ . The difference between the values ( $\Delta R - \Delta M$ ) was considered as the measurement of the projection of the gap area.

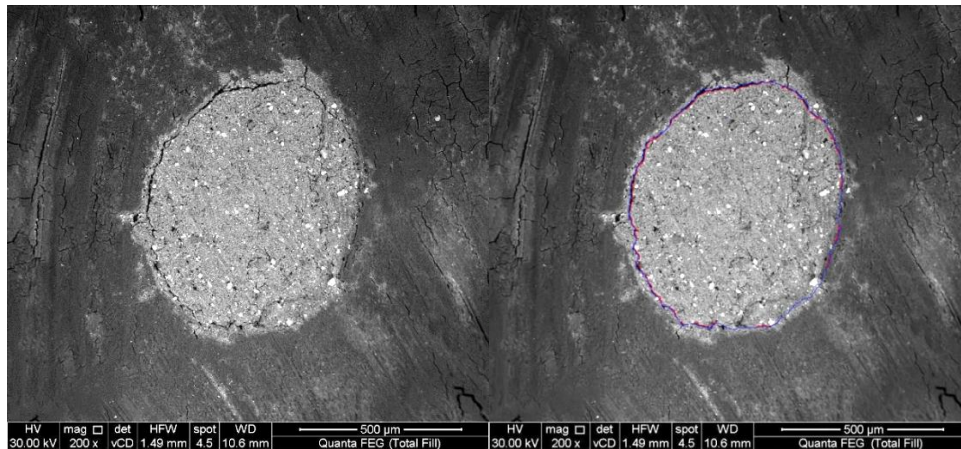
**Statistical analysis:-**

Analysis of data was performed using SPSS 18 (Statistical Package for Scientific Studies) for Windows. Description of quantitative variables was in the form of mean and standard deviation (SD). Comparison between groups for a quantitative variable was carried out after data were explored for normality using Shapiro-Wilk test of normality. Data were found to be normally distributed and comparison was done using One Way ANOVA. Tukey's Post hoc multiple comparisons test was done to determine the group(s) responsible for the significance.

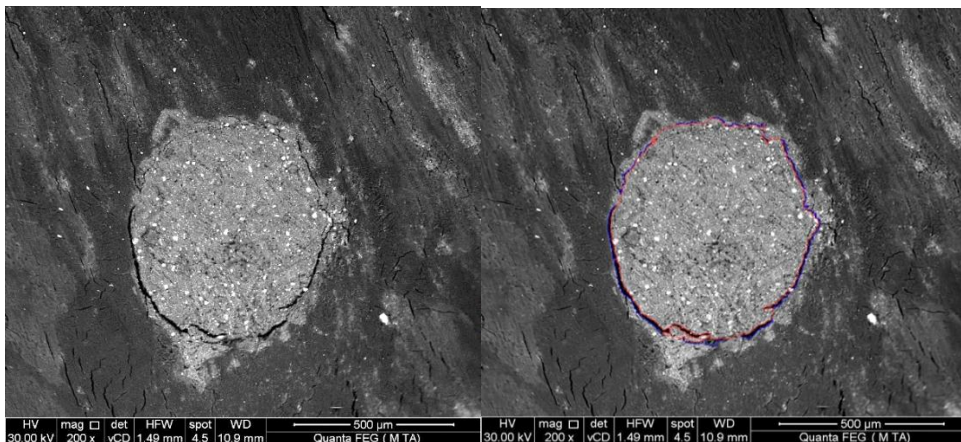
**Results:-**

Scanning electron microscopic photographs of Totalfill, MTA, IRM are shown in Figure (1, 2, 3). The mean values of the marginal gap of Totalfill, MTA, IRM are shown in Table (1), Figure (4). IRM showed the highest mean value of the marginal gap ( $48.1\mu\text{m} \pm 10.26$ ) followed by MTA ( $8.9\mu\text{m} \pm 5.57$ ) while TotalFill recorded the lowest mean value of the marginal gap ( $6\mu\text{m} \pm 3.8$ ). The difference in mean value of the marginal gap between all groups was statistically significant as revealed by ANOVA test ( $p < 0.05$ ).

Tukey's Post hoc multiple comparisons test revealed that IRM recorded a significantly ( $p < 0.05$ ) higher mean value of the marginal gap than TotalFill and MTA. TotalFill was statistically non significantly ( $p > 0.05$ ) lower than MTA.



**Figure (1):-** Photograph showing measurement of gap TotalFill.



**Figure (2):-** Photograph showing measurement of gap MTA

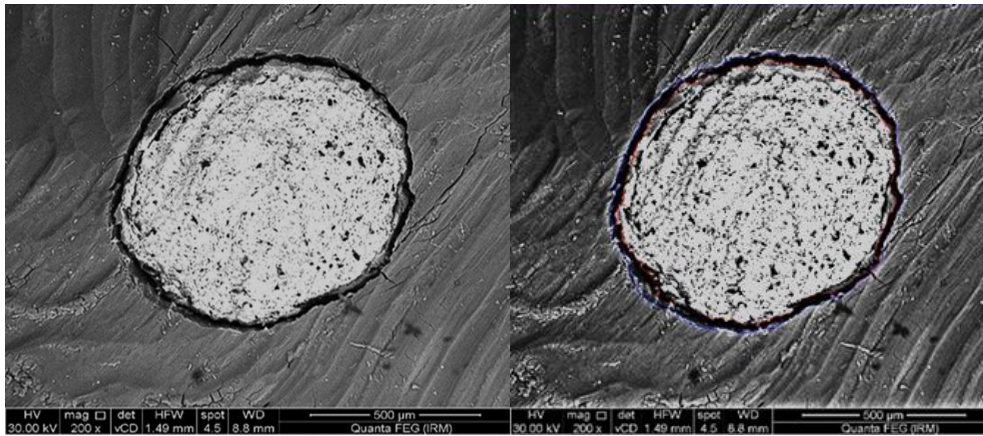


Figure (3):- Photograph showing measurement of gap IRM

Table 1:- The mean value of the marginal gap of Totalfill, MTA, IRM

	TotalFill	MTA	IRM	p-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Gap	6 ± 3.8 <sup>b</sup>	8.9 ± 5.57 <sup>b</sup>	48.1 ± 10.26 <sup>a</sup>	< 0.001*

\* Statistically significant p-value < 0.05.  
<sup>a,b</sup> Different small letters indicate significant differences between groups.

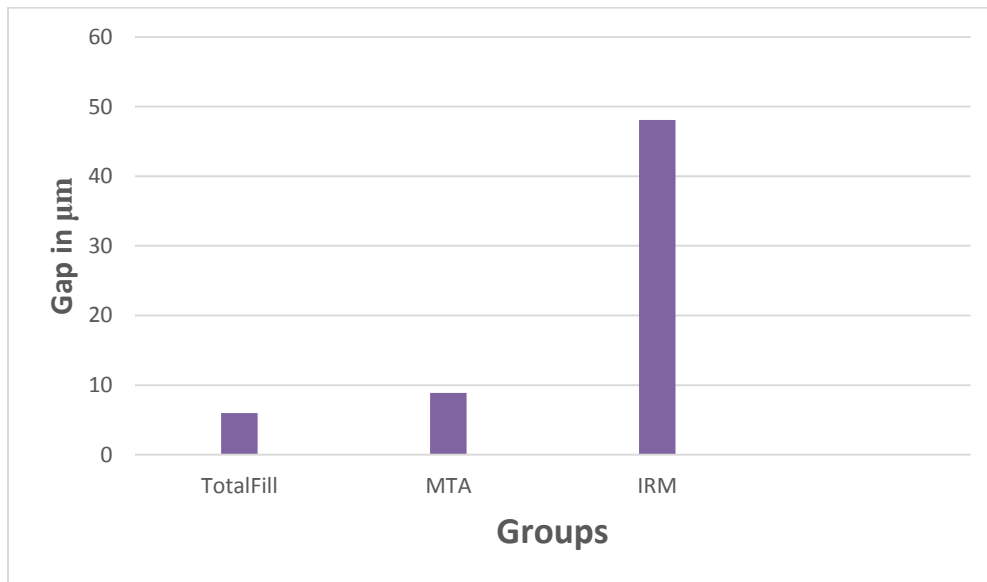


Figure 4:- A column chart of the mean value of the marginal gap of Totalfill, MTA and IRM.

**Discussion:-**

Marginal adaptation indirectly reflects the sealing capacity of a root end filling material; therefore, it has been considered as an important factor<sup>(10)</sup>. Evaluation of marginal adaptation of root end filling materials by means of scanning electron microscopy (SEM) can provide information concerning their sealing capacity<sup>(10, 11)</sup>. SEM has been used in this study because it was proven to be a reliable method of examining features such as surface topography<sup>(12)</sup>, measuring the marginal gaps at the interface and the percentage in gap formation under higher image magnifications<sup>(13)</sup>.

Torabinejad et al 1995<sup>(14)</sup> claimed that the longitudinal type of sectioning might create false gaps in the interface between dentin and root end filling material thereby affecting the evaluation of marginal adaptation. However,

Transverse sections promote the visualization of the restoration-dentin interface throughout the circumference. Hence, we sectioned the samples transversely and examined the interface directly under SEM.

Orosco et al 2010<sup>(15)</sup> asserted that for evaluation of marginal adaptation of the retrofilling material, the samples can be directly viewed under SEM after gold sputtering with no need for creation of resin replicas, as direct SEM evaluation of the samples did not cause artificial gap formation. Hence, we viewed the samples without resin replica and examined the interface directly under SEM.

TotalFill has an excellent adaptation and this may be attributed to its ability to form hydroxyapatite as well as a bond between dentin and filling material<sup>(16)</sup>. Partial reaction of phosphate with calcium silicate hydrogel and calcium hydroxide, produced through the reaction of calcium silicates in the presence of the dentin's moisture, resulting in the formation of hydroxyapatite along the mineral infiltration zone<sup>(17)</sup>.

The good adaptation of MTA to cavity margins might be intrinsically attributed to the properties of the material. MTA powder is made up of fine hydrophilic particles that absorb water during hydration. Thus, the material expands during solidification, which explains its superior adaptation to cavity margins<sup>(18)</sup>. The superior adaptation of MTA has been mentioned in previous reports as well<sup>(13, 19, 20)</sup>

IRM, is a zinc oxide-eugenol reinforced cement which requires mixing of its separate powder and liquid components before use. Studies have shown that variations in volume resulting from contraction of the material and the inhomogeneous mixing process could partially explain the poor adaptation of this material<sup>(21)</sup>.

## References:-

1. Harty FJ, Parkins BJ, Wengraf AM. The success rate of apicectomy. A retrospective study of 1,016 cases. *Br Dent J* 1970 Nov; 129: 407-413.
2. Torabinejad M, Pitt Ford TR. Root end filling materials: a review. *Endod Dent Traumatol* 1996 Aug; 12:161-78.
3. Ribeiro DA. Do endodontic compounds induce genetic damage? A comprehensive review. *Oral Med Oral Path Oral Radiol Endod* 2008 Feb; 105:251-6.
4. Phillips RW, Love DR. The effect of certain additive agents on the physical properties of zinc oxide-eugenol mixtures. *J Dent Res* 1961 Mar; 40:294-303.
5. Weine FS. *Endodontic Therapy*. 4th ed. St Louis: Mosby; 1982. P498-502.
6. Torabinejad M, Walton RE. *Principles and Practice of Endodontics*. 3rd ed. Philadelphia: Saunders; 2002. P 275-278.
7. Hendra LP. EBA cement. A practical system for all cementation. *J Br Endod Soc* 1970 summer; 4:28-32.
8. Oynick J, Oynick T. A study of a new material for retrograde fillings. *J Endod* 1978 Jul; 4:203-206.
9. Fernandez-Yanez Sanchez A, Leco-Berrocal MI, Martinez- Conzalez JM. Meta-analysis of filler materials in periapical surgery. *Med Oral Pathol Oral Cir Bucal* 2008 Mar; 13: E 180-5.
10. Stabholz A, Friedmans S, Abed J. Marginal adaptation of retrograde fillings and its correlation with sealability. *J Endod* 1985; 11:218-23.
11. Tanzilli JP, Raphael D, Moodink RM. A comparison of the marginal adaptation of retrograde techniques: a scanning electron microscopic study. *Oral Surg Oral Med Oral Pathol* 1980; 50:74-80.
12. Fogel HM, Peikoff MD. Microleakage of root-end filling materials. *J Endod*. 2001; 27:456-8.
13. Moodnik RM, Levey MH, Besen MA, Borden BG. Retrograde amalgam filling: A scanning electron microscopic study. *J Endod*. 1975; 1:28-31.
14. Torabinejad M, Smith PW, Kettering JD, Pitt Ford TR. Comparative investigation of marginal adaptation of mineral trioxide aggregate and other commonly used root-end filling materials. *J Endod*. 1995 Jun; 21(6):295-9.
15. Orosco FA, Bramante CM, Garcia RB, Bernardineli N, de Moraes IG. Sealing ability, marginal adaptation and their correlation using three root-end filling materials as apical plugs. *J Appl Oral Sci*. 2010 Mar-Apr; 18(2):127-34.
16. Walsh RM, Woodmansey KF, Glickman GN, He J. Evaluation of compressive strength of hydraulic silicate-based root-end filling materials. *J Endod* 2014; 40:969-72.
17. Zhang H, Shen Y, Ruse ND, Haapasalo M. Antibacterial activity of endodontic sealers by modified direct contact test against *Enterococcus faecalis*. *J Endod*. 2009 Jul; 35(7):1051-5.

18. Shipper G, Grossman ES, Botha AJ, Cleaton-Jones PE. Marginal adaptation of mineral trioxide aggregate (MTA) compared with amalgam as a root-end filling material: a low-vacuum (LV) versus high-vacuum (HV) SEM study. *Int Endod J* 2004; 37:325–36.
19. Xavier CB, Weismann R, de Oliveira MG, Demarco FF, Pozza DH. Root-end filling materials: apical microleakage and marginal adaptation. *J Endod* 2005; 31: 539–42.
20. Gondim E, Zaia AA, Gomes BP, Ferraz CC, Teixeira FB, Souza-Filho FJ. Investigation of the marginal adaptation of root-end filling materials in root-end cavities prepared with ultrasonic tips. *Int Endod J* 2003; 36:491–9.
21. Deveaux E, Hildelbert P, Neut C, Romond C. Bacterial microleakage of Cavit, IRM, TERM, and Fermit: a 21-day in vitro study. *J Endod* 1999; 25:653-9.