Correlation of Bone Defect Dimensions with Healing outcome six months after apical Surgery with IRM, Silver Amalgam & MTA As Root End Filling Materials

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Abstrac

Objectives : The objective of this prospective clinical study is to assess the ideal retrograde filling material with regard to healing outcome clinically as well as radiographically, six months after apical surgery by using silver amalgam, IRM & MTA as root end filling materials.

Patients & Method: Forty five patients between the ages of 17 to 45 years old treated with periradicular pathology were enrolled in this study. After apicoectomy, root end cavity preparation was performed & silver amalgam, IRM, MTA were used randomly as the root end filling material.

Results : Healing assessment was based on clinical & radiographic criteria after six months follow-up. Scores for pain and clinical manifestation were given for each tooth treated and the percentage of osseous regeneration (R) was calculated with the formula $R = 100 - (S^{recall} \times 100/S^{post\ op})$. Here 'S' represents the size of periradicular radiolucency. Size 'S' calculated with formula:

$$S=\pi \times \frac{A}{2} \times \frac{B}{2}$$

(A = Length & B = Width of radiographic appearance of the lesion)
Statistical data indicates that mean percentage of osseous healing is best in MTA (85%) then IRM (74.57%) and silver amalgam (72.68%) onwards. Pain & clinical score are also lesser in MTA as compare to IRM & Silver Amalgam.

Conclusion: In this study the use of M.T.A. as a root end filling material has led to a high success rate with conventional technique. Between IRM and silver Amalgam, IRM has been found comparatively better.

Introduction: Periradicular surgery includes surgical debridement of pathological periradicular tissue, root- end resection, root-end preparation and the placement of a root-end filling to seal the root canal. An ideal root-end filling material would adhere and adapt to the walls of the root-end preparation, prevent leakage of microorganisms and their toxins into the periradicular tissues, be biocompatible, be insoluble in tissue fluids and dimensionally stable, and remain unaffected by the presence of moisture. For practical purpose it should be easy to use, radiopaque and recognized on the radiograph.[1]

A number of materials have been evaluated for use as root-end fillings. They include amalgam, gutta-percha, zinc oxide-eugenol cement, composite resins, glass ionomers, polycarboxylate cement, ethoxybenzoic acid (EBA) cement, and mineral trioxide aggregate (MTA).[2]

Methodology

Patient Selection: This prospective study was conducted at the Dept. of Conservative and Endodontics, Government Dental College Jaipur Rajasthan. It included 45 patients between the ages of 17 to 45 years who had to undergo a surgical periapical endodontic procedure under local anesthesia. The tooth to be treated demonstrated a periradicular lesion of strictly endodontic origin caused by trauma with or without clinical signs or symptoms. Twenty-three patients were female and twenty-two were male. Total number of teeth was 84 out of which 50 were maxillary and 34 mandibular.

All patients were seen in a diagnostic clinic where a full history, examination, and periapical radiological examination and sensitivity testing were undertaken. Written informed consent was obtained, and verbal preoperative instructions were given before the appointment for surgery. This included the use of a 0.2% chlorhexidine mouthwash, the day before and the day of the operation and the ingestion of non-steroidal anti-inflammatory drugs (ibuprofen) 600 mg the night before and 600 mg 2 hours before the operation, if there were no contraindications.

Surgical procedure: All procedures were performed under local anaesthesia. Infiltration buccally over the apices of the tooth to be treated and the adjacent teeth was given using 1.8 ml of 2% lignocaine with 1:100,000 epinephrine (Lignocain; Hindustan Pharmaceutical Barauni, India) followed by infiltration buccally and palatally\ lingually with 3 ml of 2% lignocaine containing 1:100,000 epinephrine (Lidocaine) to involve all the surgical site.

A full-thickness flap was retracted following an intramuscular incision using a 15 no scalpel blade. A vertical incision was performed with a 15-scalpel blade to create rectangular flap. The tissues exposed by the reflection of the flap were kept moistened with sterile saline throughout the surgery to avoid the bone or the soft-tissue flap from drying out. A thin bony plate over the apex was removed gently with curettes; otherwise, the bone was removed with an ISO size 18 sterile steel bur (Dentsply Maillefer, Ballaigues, Switzerland) in a straight hand-piece with copious sterile saline coolant using light brush strokes.

An assessment was made of any bony defect at the apex of the tooth and soft-tissue debris was removed after root-end resection. A 3 mm root-end resection was carried out almost perpendicular to the long axis of the root by means of a fissure bur in a low-speed hand-piece with copious irrigation using sterile saline and root-canal prepared in a box-type manner with a No 33.5 inverted cone bur.

The water was allowed to run passively in the root-end cavity for 2 minutes to allow maximum opportunity for cleaning of the root canal wall. In cases where the crypt was large, sterile ribbon gauze was packed into the defect while the root-end filling was placed.

The root end was dried with a low-pressure compressed air source and IRM (L D Caulk Division, Densply International, Millford, Del), MTA (Proroot MTA White; Densply, Johnson City, TN) and silver amalgam (Megalloy, Densply, York Pa) were mixed according to manufacturer's instructions and randomly filled in the cavities.

MTA was placed with a flat plastic instrument or a carrier and plugged into place with microplugger. Mineral trioxide aggregate (MTA) was mixed to a consistency that allowed the material to maintain its shape on and attachment to the plastic instrument. When the root-end cavity was filled, the packing in the bony crypt was removed and the surface of the cut root end was cleaned with a cotton wall pledget dampened with sterile saline. The tissues at the surgical site were rinsed with sterile normal saline solution, avoiding washing the MTA from the root end.

The soft tissue was then approximated using either 3-0 black Mersilk sutures. Firm pressure was applied to the tissues with a gauze swab dampened with sterile saline for 5 to 10 minutes to ensure close adaptation of the soft tissue to the bone and assess cavity is filled with glass ionomer cement at the same sitting.

Postoperative Management : Verbal postoperative instructions were given to the patients. Systemic oral Antibiotics (Ofloxacine 500 mg and Ornidazole 200 mg two times a day), NSAIDs (Ibuprofen 600 mg three times a day for 5 days) and multivitamins (once in a day) were prescribed. Patients were instructed to rinse mouth with a 0.2 % chlorhexidine solution two times a day for 1 week. Sutures were removed after 1 week.

Follow-up : A radiographic examination was performed prior to surgery, 1 week after surgery, with the simultaneous removal of the sutures and at 6 months after surgery. Radiographs were taken using the long-cone paralleling technique.

Clinical signs of healing were a lack of symptoms including pain and absence of signs, including tenderness to percussion of the tooth, tenderness to palpation of the soft tissues buccally, swelling, presence of a fistula, and excess tooth mobility. Radiologic signs of healing were healing, or absence, of periradicular radiolucency and the formation of a periodontal ligament space of normal width.

Percentage of osseous regeneration (R) was calculated with the formula

$$R=100-(S^{recall} X\ 100/S^{postop})$$

with S representing the size of the periradicular radiolucency. This size (S) was approximated with the formula

$$S=\pi \times \frac{A}{2} \times \frac{B}{2}$$

(A=length and B= height of the radiographic appearance of the lesion) von Arx & Kurt (1999).[10]

Results : Out of 45 patients, three patients (dropout rate of 6.66%) did not turn up for the recall examination. The postoperative healing course was uneventful for 42 patients. At the six months follow-up examination (Table 1), 36 patients (85.71%) showed no adverse clinical manifestations (clinical score=0) and six (14.28%) patients complained for tenderness to vestibular palpation (clinical score=1). Excellent results were also noted for the patients' pain assessment (Table 2), with 36 patients (85.71%) exhibiting no painful symptoms (pain score=0) and 6 (14.28%) patients complained for mild transient pain (clinical score=1).

After, six months the mean percentage of the radiographically assessed osseous regeneration was 72.68 % (range, 55.23 % to 100%) for silver amalgam, 74.57% (range, 65.35% to 88.32%) for IRM and 85.84% (range, 66.78% to 100%) for MTA.

Two patients radiographically presented with complete osseous healing (regeneration=100%), out of these two patients one patient from Silver Amalgam (7.14%) and one patient from MTA (7.14%) presented with complete osseous healing. Three additional patients (21.42%) exhibited nearly complete osseous healing from MTA, (regeneration >90%). (Table 3)

Taking into account the healing definition, five patients (11.90%) were categorized as successful (complete healing); 37 patients (88.09%) with an osseous regeneration percentage between 50% and 90% were classified as improved (partial healing) (Table 4).

Table. 1 Definition Of Pain Scores

0	Score
1	Mild pain (temporary)
2	Mild pain (permanent)
3	Severe pain

Table. 2 Definition of Clinical Scores

Score	Definition
0	No clinical manifestations
1	Apical area tender to palpation
2	Apical swelling or tooth tender to percussion
3	Sinus tract or abscess

Table. 3 Definitions for Healing Classification

Class	Definition
Success	Complete healing: Osseous regeneration >90% and Pain & clinical scores=0
Improvement	Partial healing: Osseous regeneration 50-90% and Pain and clinical scores=0
Failure	Uncertain/no healing: Osseous regeneration <50% or Pain or clinical score >1

Table. 4 Assessment of Healing at the Six Months Follow Up (n=42)

Class	No. of teeth	Percentage
Success	5	11.90
Improvement	37	88.10
Failure	0	0

Table. 5 Distribution of Variables for The Patients in the Study

Total number of patients eligible to be recruited to study	45
Number of patients not available for recall	3
Teeth included in analysis	84

Patient age distribution

Age range	17-45
Mean age	31
Sex	
Females	21
Males	21
Follow-up time in months (mean)	6

Color Plate, 5 Caste No. 2

Fig. 9 : Non Vital upper central incisor with periapical pathology : Preoperative view

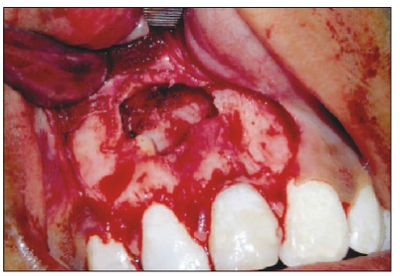


Fig. 10 Full thickness reactangular mucoperiosteal flap raised with curettage of lesion obuturation and retropreparation

Color Plate 6

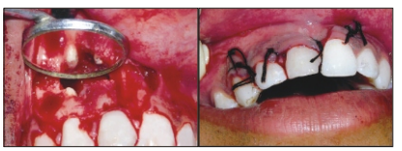


Fig. 11 MTA used as Root end filling material

Fig. 12. Postoperative view with sutures placed

Color Plate 16

MTA used as retro filling material

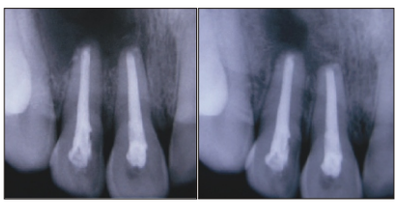


Fig. 30 : Seven days post operative radiograph

Fig. 31 : Six months post operative radiograph

Color Plate 17

IRM used as retro filling material

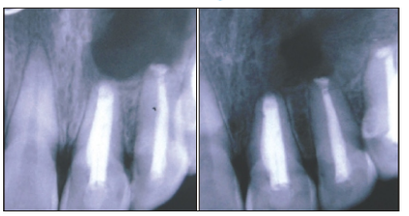


Fig. 32 : Seven days post operative radiograph

Fig. 33 : Six months post operative radiograph

Color Plate 12

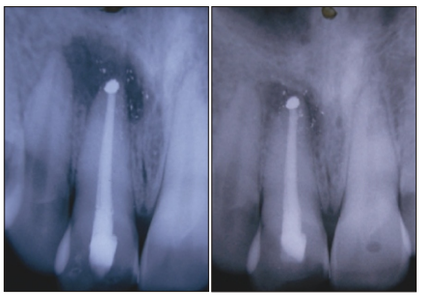


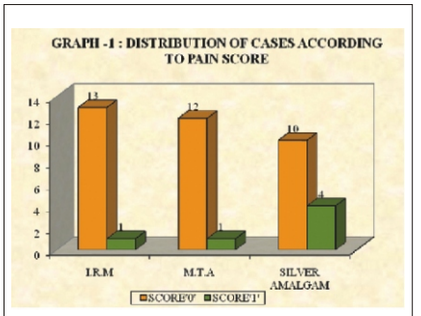
Fig. 22 : Seven days post operative radiograph

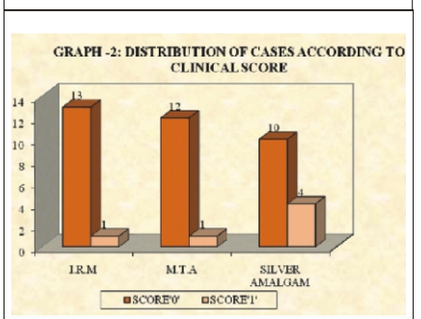
Fig. 23 : Six months post operative radiograph

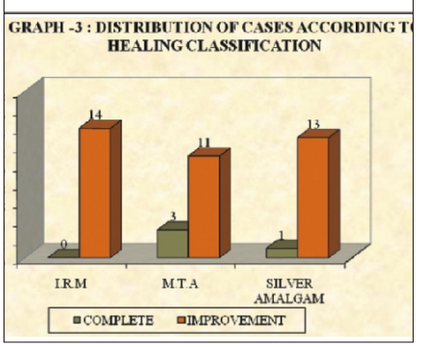
Table No. 6 : Mean percent Healing in Different Treatment Groups

Material Used	N	Mean	STD. Dev.	'P' Value*	Result
Silver Amalgam	14	0.7268	0.1247		
I.R.M.	14	0.7457	0.06263	P < 0.01	HS
M.T.A.	14	0.8584	0.1078		

* ONE WAY ANOVA TEST







Discussion

The purpose of inserting a root-end filling material is to provide an apical seal that inhibits the leakage of irritants from the root canal system into the periradicular tissues.[11-12]

A number of materials have been evaluated for use as root-end filling. They include amalgam, gutta-percha; zinc oxide-eugenol cements, composite resins, glass ionomers, polycarboxylate cements, ethoxybenzoic acid (EBA) cements and mineral trioxide aggregate (MTA).[2]

Newer modifications of ZOE compounds, such as IRM and Super EBA provide a better apical seal. IRM is zinc oxide-eugenol cement reinforced by addition of 20% polymethylmethcrylate by weight to the powder. Studies reveal that IRM seals better than non zinc amalgam but it also has potential disadvantages including moisture sensitivity, irritation to vital tissues, solubility, and difficult in handling.

MTA was developed at Loma Linda University, California, 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.[4] Adamo et al [9] compared MTA, Super-EBA, composite and amalgam and found statistically no significant difference in the rate of microleakage but studies of Fischer et al[8] proved MTA to be superior as compared to super EBA and IRM .The marginal adaptation of MTA was better with or without finishing when compared to IRM and Super EBA.[14]

MTA when used as a root-end filling material, showed evidence of healing of the surrounding tissues.[2,6,7] Most characteristic tissue reaction of MTA was the presence of connective tissue after the first postoperative week.[13] 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.[11] In a two year follow-up study with MTA as root-end filling material resulted in a high success rate. [15] 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.

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In the present prospective randomized study a comparison was carried out evaluating the outcome of periradicular study with 3 different root-end fillings in single-rooted teeth using Silver Amalgam, IRM and MTA

Radiographically, the size of the periradicular bone defect (S) was approximated by using the formula:
(A = Length & B = Width of radiographic appearance of the lesion)

By comparing the 6 months radiograph with the postoperative radiograph, the percentage of osseous regeneration ® was calculated using the formula:

$$S = \pi \times \frac{A}{2} \times \frac{B}{2}$$

$$R = 100 - (S^{recall} \times 100 / S^{postop}) \ldots 10$$

Overall statistical data indicates that mean percentage of osseous healing in different treatment groups shows that 6 months after surgery silver amalgam showed 72.68 % healing, IRM showed 74.57 % healing and MTA showed 85.00 % healing in different age and sex group.

Although not a single case showed complete healing, IRM treated patients had minimum STD deviation i.e. 0.06263 (range, 65.35% to 88.32% healing,) and only one patient showed pain and clinical score 1 which made it superior to Silver Amalgam.

Silver Amalgam treated cases have shown minimum healing percentage that is 72.68 % with maximum STD deviation (0.1247). Four patients had complained of pain and tenderness, so it is likely to be inferior among all three.

Recently, many authors have questioned the suitability of Amalgam as a retro seal. Moodnik et al. [16] in a scanning electron microscopic study demonstrated gaps between the Amalgam and the root canal wall. Oynick and Oynick[17] expressed concern about the effect of free mercury in the periapical tissues. Poor results in leakage studies[18] as well as concern about corrosion products[19] and electrochemical reactions[20] have led), many researchers to look for alternative materials.

Data indicate that more than ten percent difference of healing was seen with MTA material as compared to IRM and silver amalgam. If we put a vision on six months analysis of the result it is clearly seen that MTA is likely to be better than other two substances. Seven patients showed clinical and pain score one, in spite of that we cannot declare them as failures because they had osseous regeneration more than 60 % within six months and cases will be followed for one year. In the present study complete healing was noted in one patient and >90% healing in three cases after 3 months, this is testament to the regenerative ability of tissues in contact with the MTA.

It is possible that moisture in the clinical surgical apical procedure reduces the sealing capability of the zinc oxide eugenol cements. MTA cements, however, has hydrophilic characteristics and moisture acts as an activator and does not pose a problem for its clinical use. A more plausible explanation is that the delay in healing is caused by the profound effects IRM has on the periapical tissues.[5,3] Marked rounding of the cells and depletion of cell numbers characterize the tissue response indicating its toxicity. [5] This influence can be explained by the eugenol leaching from the retrograde filling, thereby slowing the healing potential. Eugenol libration from IRM is high initially and decreases over a protracted time period.

MTA has shown excellent sealing[7] and hard tissue repair (cementum) has been observed directly on the surface of the material a property not observed with other current root end filling materials. Cementum formation is a sign of regeneration may seal the root end exposed dentinal tubules.

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Miracle or Reunion : A Case Report

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Abstract

Traumatic injuries of teeth are the main cause of emergency treatment in dental practice. Horizontal root fractures are more frequently observed in the maxillary anterior region and young male patients. The most common type of root fracture is in the middle third, followed by apical, and coronal part. A patient during routine examination reported injury to the maxillary central incisors 15 years back.The history prompted us to check the vitality of the teeth and also the colour change of the teeth which was all positive i.e the teeth gave a positive response with the pulp tester and cold test also was positive.Also they showed no colour change.Radiographically the fracture lines on both the central incisors was visible which was evident of revascularisation after union of the fractured segments.

Key Words : Fracture, Centralincisors, Reunion, Revascularisation.

Introduction

Traumatic injuries of teeth are the main cause of emergency treatment in dental practice.[1] It occurs most commonly in young patients, and varies in severity from enamel fractures to avulsion.[2] Root fractures of permanent teeth are fairly uncommon[3] and horizontal root fractures are more frequently observed in the maxillary anterior region in the 11-20 years age group male patients.[4] This kind of fractures usually occurs because of severe trauma, such as traffic accidents and sports injuries, and it has been reported to occur in less than 3% of all dental injuries.[1] These fractures are often complicated in fully erupted anterior teeth, whereas they occur as cusp fractures extending variably down the root in posterior teeth.[5] Treatment of fractures below the alveolar crest consists of reduction and rigid fixation as soon as possible. The splint is usually left in position for at least a month, but fractures near the cervical line may require a longer time.[6, 7] The majority of root fractures have been shown to undergo healing. It has been reported that 77% of root-fractured teeth healed, while pulp necrosis occurred in 20%.[8]

Usually, four types of healing sequelae are given:

1. Repair with calcified tissue, giving union across the fracture.
2. Healing with connective tissue.
3. Healing with calcified tissue and connective tissue.
4. Healing with granulation tissue.

The last mode of healing, with granulation tissue, is a sign of pulp necrosis and an indication that endodontic treatment of the coronal portion of the tooth is necessary.[9] Pulp capping, pulpotomy, or pulpectomy, and root canal obturation are alternative treatment strategies, depending on the maturity of the tooth, size of the exposure, and duration between injury and treatment.[7] However, there are cases of horizontal root fractures with signs of healing without any treatment.[6] Additionally, the horizontal root fracture cases showed a higher number of pulp-vitality preservation than luxation injury cases without root fracture.

Case Report

A patient aged 35 years during routine examination reported traumatic injury 15 years back but had no complaint of pain on percussion or palpation on those two maxillary central incisors.The clinical examination revealed no bony protuberance over that area, nodiscoloration, nomobility. Tested vital to electric pulp test, CO2 ice, and the heat test. Radiographically revealed the fracture lines in the midroot area but no PDL space widening or any changes in the periapicalarea.Since the patient was completely asymptomatic there was not much to be done except that the patient was adviced to take care and report back if any complaint.

Discussion

Maxillary central incisors are most vulnerable to injury sustaining approximately 80% of all dental injuries followed by maxillary laterals and mandibular incisors.

The most common type of root fracture are in middle third of the roots(57%)next is the apical portion(34%)and next is the coronal part of the root(9%).

Dental treatment may not be necessary in cases of root fracture where there is no mobility or displacement of the coronal segment and the patient is asymptomatic.

Prognosis for horizontal fracture is quite good.Healing of horizontal fracture with or without treatment is reported to occur in upto 70% to 80% cases.

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