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Radiographic and clinical evaluation of various retrograde filling materials in endodontic surgery

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Abstract
This study compared clinical and radiographic outcome of endodontic surgery with different retrograde filling materials such as ENDOCEM ZR and MTA ANGELUS..
Method*: Flap elevation and peri apical curettage was done. Root-end preparation was done and filled with materials such as Mineral Trioxide Aggregate Angelus. After whole procedure patients were recalled to assess the clinical and radiographic signs of post operative healing.*
Result*: MTA Angelus showed better results than Endocem Zr.*
Keywords: *MTA Angelus, Endocem Zr, Periapical surgery, Retrograde filling,*
ClinicalSignificance:*MTAAngelushadthefasterhealingrateascomparedtoEndocemZr*

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In cases where non-surgical endodontic treatment proves unsuccessful or are contraindicated, surgical endodontic therapy is needed to save the tooth. Root-end resection is the most common surgical procedure followed in periradicular surgery. The main goal of endodontic treatment is the correct diagnosis, optimal mechanical and chemical preparation of the root canal space and creating a hermetic seal that prevents all pathways of communication between the canal space and periradicular tissues. Although endodontic treatment has a high success rate, failures do occur. This can be attributed to various factors such as variations in the anatomy of the teeth, persistence of bacteria (both intracanal and extracanal), inadequate filling of the canals, overextensions of the root filling materials, improper coronal seal, untreated canals (both major and accessory), iatrogenic procedural errors like poor access cavity design, and complications that occurs during instrumentation such as ledges, perforations or separated instruments.

The periapical surgery procedure involves access to the affected area, root-end resection, root-end preparation, periradicular curettage and placement of a suitable root-end filling material.The root-end filling is necessary to provide adequate apical seal, preventing the egress of micro-organisms from the root canal system into the periradicular tissues.. Amongst those proposed are: amalgam, gutta percha, Cavit (3M ESPE, St Paul, Minnesota, USA), glass ionomer cement, IRM (Dentsply/Maillefer, Ballaigues, Switzerland), Super EBA, (Harry J Bosworth Co. Skokie, Illinois, USA), composite resin, compomer, gold foil, Diaket (3M/ESPE, Seefeld, Germany), polycarboxylate cement, Mineral trioxide Aggregate (MTA), casteroil polymer, Ceramicrete, Endosequence, etc.,

I. Materials and Methods

Patients irrespective of age & sex were reported.

Surgical procedure

A preoperative radiograph and Cone Beam Computed Tomography was taken to measure the lesion prior to surgery. Patient was adviced to take medications to prevent systematic disease and also to prevent postoperative infection.After patient was anesthetized with 2% Lignocaine with 1:80,000 adrenaline,a sulcular and mucogingival incision was made with B.P. Blade(SM-64 and SM-67 BLUDENT INDIA LTD.).Flap elevation was done using Elevator(PAPILA ELEVATOR PH26M)

Osteotomy was performed by using no-4 and 6 round carbide bur(S.S WHITE) with Impact Micro-motor handpiece and curette(DISK SHAPED CURETTE-1.5mm from BLUDENT INDIA LTD.) were used for periradicular curettage. At first a 3mm root tip with 0 to10-degree bevel was sectioned by Taper fissure-170L(S.S WHITE) under copious water spray.

Root-end preparation was done extending 3mm into canal space using ultrasonic tip. Root end cavities were prepared on all teeth to a depth of 3mm and width of 1mm using ultrasonic ***BLUEDENT Retrotips***in an PIEZONMASTER 400-EMS; NYON, SWITZERLAND.The ultrasonic retrotip was used with light pressure in a brushing motion. The root end cavity were checked with help of micromirror.

Prepared root end cavity was dried with irrigator/drierand filled with material such as**MTA Angeus** and **Endocemzr** based upon the acceptability for restoration.Then bone graft was placed. The wound site was closed & sutured and post-operative radiographs were taken. The patients were instructed regarding the postoperative care, the sutures were removed after 7 days postoperatively, and healing progress was checked according to Rud, Andreasen and Molven and recorded properly.

After whole procedure patients were recalled in every 3 months for 9 months to assess the Radiographic and Clinical signs of healing.

CLINICAL RADIOGRAPHIC AND CONE BEAM COMPUTED TOMOGRAPHY EVALUATION.

Clinical Evaluation

- After surgical procedure and suture patients were instructed and recalled after 7 days for suture removal. Thereafter the patient were recalled every one month till 3 months and then after 6 month and 9 month for follow-up. On every recall visit post-operative instructions was done every 3 months till 9 months thereafter to assess Radiographic and Clinical signs of healing. On every recall visit, routine examination procedures were followed to identify and evaluate any signs and/or symptoms like pain, swelling, mobility, sinus tract formation, or periodontal pocket formation-European Society of Endodontology-1994(25).

- **Radiovisiography Evaluation**

Digital radiovisiographic images were taken at 3months, 6 months and 9 months and calliberated into the Sirona Sidexis XG software program developed for analysis of monitor-displayed digital images. The radiographs were displayed on a 48 cm monitor situated in a room with subdued lighting. Then assessed and measured the bone defects on the digital radiographs. The maximum vertical distance(supero-inferior) was measured from the resection surface at the central point of the root filling to the most apical part of the defect.The horizontal distance(transverse) was measured at its maximal width perpendicular to the vertical measurement line, which was displayed by the program

- **Cone Beam Computed Tomography Evaluation**

CBCT images were taken at preoperative and post operative at 9 month.It has been suggested that CBCT imaging may be more accurate in diagnosing cavitated lesions that would require surgical excision based on a positive or negative gray scale value.

TABLE 1 INTRAGROUP COMPARIONS OF PERCENTAGE REDUCTION ON THE HORIZONTAL DIMENSION

	3 month	6 month	9 month	P value
Group I (Endocem Zr)	24.36±1.00	37.00±1.00	43.98±1.00	0.001 (Sig)
Group II (MTA Angelus)	25±1.00	43.00±1.00	60±1.00	0.001 (Sig)

Graph No. 1

TABLE 2 INTRAGROUP COMPARIONS OF PERCENTAGE REDUCTION ON THE VERTICAL DIMENSION

	3 month	6 month	9 month	P value
Group I (Endocem Zr)	14.68±1.00	27.27±1.00	44.72±1.00	0.001 (Sig)
Group II (MTA Angelus)	20±1.00	33.12±1.00	60±1.00	0.001 (Sig)

Graph No. 2

RADIOGRAPHICALY

- The values of endodontic lesion selected for the study were evaluated preoperatively by using cone beam computed tomography in which horizontal and vertical parameters of the lesion were recorded followed by a follow up at 3months,6months which were evaluated by radiovisiographic examination and a 9 month follow up was taken again using cone beam computed tomography.

- However,**Group1 and Group 2 showed a statistically significant difference at different time intervals**i.e 3months-6months-9months for vertical and horizontal parameters of the lesion i.e P>0.05
- Therefore, **Group 2 revealed a significant reduction at 3months,6months,9 months in the measurement of lesions horizontally and vertically as compared to group 1 respectively which shows group 2 has a faster healing rate**.

The objective of periapical surgery is to surgically maintain a tooth that has an endodontic lesion which cannot be resolved by conventional endodontic treatment. This goal is achieved by root-end resection, root-end cavity preparation and a bacteria-tight closure of the root canal system at the cut root-end with a retrograde filling. Most endodontic failures occurs as a result of leakage of irritants & microbes from the infected root canals. The success of periradicular surgery is directly dependent on the good apical seal, using a well adapted root-end filling material. These material are intended to prevent the leakage of potential irritants from the root canal system into the periradiculartissues.So, an ideal retrograde filling material must have good adhesion to the canal wall providing an adequate apical seal. It should also be biocompatible and able to possess osteoinductive or osteoconductive qualities which will accelerate the healing process at the periapical area and reduce the incidence of failures.

Removal of 3-4mm of root-end is common during periradicular surgery and is usually required to eliminate anatomical irregularities and contaminated (biofilms, bacteria & endotoxins) radicular hard tissues. Root-end resection was carried out with a high-speed rotating bur &coolant, minimizing heat generation and prevents the development of root fractures.Root-end resection can be done at different planes ie. 30^0, 45^0 and 90^0 to the long axis of the tooth. Among these the most accepted is 90^0, as it least affects the adaptability of root-end material and minimizes the leakage that might occur through the cut dentinal tubules whereas 30^0& 45^0 resection angles have a disadvantages of leading to open dentinal tubules, more mechanical stresses, loss of dentine-cementum bone which results in compromised healing after periapical surgery.In 1944, Carr introduced retrotips specifically designed for root-end cavity preparation which can be used during periapical surgery. The ultrasonic retrotips are made up of stainless steel or stainless steel with diamond coating or zirconium coating. In a study done by H.Ishikawa et al in 2003, they evaluated the root-end cavity prepared using ultrasonic retrotips, the authors concluded that use of ultrasonic retrotips with diamond or zirconium coating takes less time for preparing retrograde cavities and the retro cavities prepared were more accurate & these tips have more efficient cutting abilities than compared to rotary burs.

A variant of MTA named **MTA Angelus** (Angelus, Londrina, Brazil) was launched in 2001 and was approved by food and drug administration (FDA), USA in 2011. It possesses the same desirable properties as traditional MTA with the difference of reduced setting time, and is sold in containers that permit more controlled dispensing of the material.Many researchers have attempted to develop fastsetting MTA or its derivatives.However, most of these trials have focused on the addition of chemical setting accelerators, some of which proved to have detrimental physical and biologic effects.Endocem, a fast-setting MTA-derived pozzolan type of cement, was recently developed. Choi et al. demonstrated that Endocem had a much shorter setting time and more washout resistance under the presence of fetal bovine serum compared to ProRoot. They also suggested that the decreased setting time might be associated with the increase in the early strength of Endocem. Bismuth oxide, which is used as a radiopacifier in MTA cement, interacts with the collagen in dentin, so could be the cause of tooth discoloration. Therefore, the radiopacifier was replaced with zirconium oxide in the **Endocem Zr** formulation. The major component of Endocem Zr is zirconium oxide, which substitutes for bismuth oxide to reduce tooth discoloration. Zirconium oxide is a radiopacifier with the characteristics of biocompatibility and radiopacity and an ability to accelerate hydration.However, a decreased amount of calcium silicate in cement indicates possible shortcomings in terms of calcium ion release. Calcium ion release from Portland cement has been reported to decrease on addition of a radiopacifying agent. This could be a reason for the lower extracellular calcium ion concentration and calcific barrier formation found with Endocem Zr. Sealing ability is another reason for the less favorable histologic result achieved using Endocem Zr. It appears that angelus MTA provides good sealing ability and marginal adaptation. It has been reported that Endocem, the earlier pozzolan-based MTA material, has sealing ability comparable with that of ProRoot MTA. In contrast, Endocem Zr was found to have less favorable sealing ability than other MTA-based materials in a dye penetration study. However, the results of dye penetration studies do not necessarily reflect bacterial invasion and there are no reports on the mechanical properties of Endocem Zr. Thus, further studies are needed to evaluate the physicochemical properties of Endocem Zr.

II. Conclusion

In this study MTA Angelus showed better results than EndocemZr.Within the limitations of this study, after analyzing the results and obtaining a complete follow up of 09 months radiographically and by using CBCT, it can be concluded that **MtaAngelus had the faster healing rate as compared to Endocem Zr**

However, further clinical trials are needed to explore thoroughly its clinical behaviour on long term basis and to compare the material to other well documented materials.

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