

A Comparative Clinical Evaluation Of A Bioceramic Root Canal Sealer With MTA Based Sealer, Resin Based Sealer And Zinc Oxide Based Sealer - *An In Vivo Study*

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Abstract: Three- dimensional obturation of the radicular space is essential to long- term success of root canal system. The sealer plays an important role in the root canal filling. This study compared and evaluated the clinical success and biocompatibility of Bioceramic root canal sealer with MTA based sealer, Resin based sealer and Zinc oxide based sealer as an obturating material.

Key words: Bioceramic sealer, Root canal obturation, Smartpaste bio.

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I. Introduction

The ultimate goal of endodontic therapy should be to return the involved teeth to a state of health and function without surgical intervention. [1] All inflammatory periapical lesions should be initially treated with conservative nonsurgical procedures. [2] Conservative approach of treatment of any lesion is always preferable over surgery as most periapical lesions are the result of an inflammatory response to bacterial infection within the root canal, i.e., intracanal infection. Nonsurgical root canal treatment involves cleaning and disinfecting the root canal system, thereby reducing the bacterial load and creating an environment in which periapical healing can occur. [3]

According to Grossman (1958), the endodontic sealers, regardless of type, should exhibit some requirements, as follows: biocompatibility, easy insertion into and removal from root canal, viscosity while handling, good adhesion to root canal's walls, satisfactory handling time, promotion of a tridimensional sealing, dimensional stability, good flowing, good radiopacity, lack of color change, insolubility to tissue fluids and saliva, solubility to common solvents when necessary, impermeability, and antimicrobial activity.[4] Different types of endodontic sealers based on their main constituent like zinc oxide, calcium hydroxide, glass ionomer, epoxy resin, silicone and methacrylate have been introduced to endodontics.[5,6] "The good news in the arena of endodontic material science is that it is continuing to evolve and, in fact, the game has changed. The game changer is the increased use of bioceramic technology; more specifically in endodontic obturation.[7] Recently, bioceramic root canal sealers have been developed. Bioceramics include alumina, zirconia, bioactive glass, glass ceramics, calcium silicates, coatings and composites, hydroxyapatite and resorbable calcium phosphates and radiotherapy glasses.[8.9.10] A further advantage of the material itself is its ability (during the setting process) to form hydroxyapatite and ultimately establish a chemical bond between dentin and the appropriate filling. Some of the other advantages are: enhanced biocompatibility, the fact that it does not shrink, it does not resorb (which is critical for a one-cone technique), its high pH (12.8) during the initial 24 hours of the setting process (which is strongly anti-bacterial), its excellent sealing ability, the fact that it sets quickly (3 to 4 hours) and its ease of use (particle size is so small it can be used in a syringe) materials.[7]

Due to the presence of several advantages of these sealers this study was undertaken to compare and evaluate the clinical success of Bioceramic root canal sealer with MTA based sealer, Resin based sealer and Zinc oxide based sealer and to check the clinical applicability and biocompatibility of the Bioceramic sealer as an obturating material.

II. Subjects & methods

A total of fifty two maxillary anterior teeth from forty patients who reported to the Department of Conservative Dentistry & Endodontics, School of Dental Sciences, Sharda University requiring root canal treatment were selected. The mean age of the participants (19 females and 21 males) was 31 years and ranged

from 15 to 47 years. The inclusion criteria were carious/traumatic lesion involving pulpal tissue with - Apical periodontitis, Small periapical lesion, Root resorption. Approval from Ethical Committee Board and the written informed consent was obtained from all the patients.

After clinical and radiological examination, diagnosis was confirmed and the root canal treatment was initiated. The standard protocol was followed for all the selected patients. Endodontic access was prepared using Access preparation kit. Canals were instrumented & intermittently irrigated with 2 ml of 2.5% NaOCl & 2.0 mL of sterile saline followed by 10ml 17% EDTA. The instrumented teeth were randomly divided according to the obturating material used into four groups. In Group 1, Bioceramic sealer [Smartpaste bio]. In Group 2, MTA based sealer [ProRoot MTA]. In Group 3, Resin based sealer [AH Plus]. In Group 4, Zinc oxide eugenol sealer (Septodont).

The efficacy of the root canal sealers was assessed on the basis of clinical (Pain, Tender on percussion, Sinus tract, Swelling and Mobility) and radiographic parameters (Superior-inferior and transverse axis) at baseline and an interval of 1, 3 and 6 months after obturation.

All the patients were evaluated by the following CLINICAL PARAMETERS:

1. **Pain:** Recorded using Visual Analogue Scale. (1 to 10)

1= minimum, 10= maximum

2. **Sinus tract:** Recorded as

Present = 1

Absent = 0

Root canal Obturation was only done after the healing of the sinus tract.

3. **Swelling**

Recorded as : Present = 1, Absent = 0

4. **Mobility**

Recorded according to Miller's Mobility Classification :

Grade 1 = More than normal

Grade 2 = Upto 1 mm in any direction.

Grade 3 = more than 1mm in any direction and vertical depression

II.i. Radiographic Parameters

Radiovisiography (Kodak Dental Software) was used to record radiographs at baseline, and an interval of one, three and six months (after obturation) using a Rinn XCP system (Dentsply) for standardization. The periapical lesion was measured by using the Radiovisiography measurement scale/tool in greatest superior-inferior and transverse dimensions.

II.ii. Assessment Of Time Intervals:

The efficacy of the root canal sealers was assessed on the basis of clinical and radiographic parameters at baseline, and an interval of 1, 3 and 6 months after obturation. All clinical and radiographic parameter values, so obtained, were entered in the standard proforma drawn for the study and subjected to statistical analysis.

III. Statistical Analysis:

The arithmetic mean & standard deviations were calculated at definitive time intervals for intra & inter group comparisons. All the values of different clinical and radiographical parameters at different time intervals were expressed in terms of Mean \pm S.D. respectively. The one way ANOVA -F TEST was applied to find the significant difference among the different time intervals i.e. (at base line, one month, 3 months & 6 months) for four sealer groups (Group 1 Bioceramic, Group 2 MTA, Group 3 AH Plus and Group 4 Zinc Oxide Eugenol) at 5% level of significance (i.e $P < .05$). The Two-Way ANOVA test was used to compare all the clinical and radiographical parameters among different time intervals & different groups. Also the percentage improvement for each group at successive time intervals and the percentage difference of Group 2 MTA, Group 3 AH Plus and Group 4 Zinc Oxide Eugenol at each time period w.r.t. Group 1 Bioceramic sealer group for all the parameters was calculated.

IV. Result

The one way ANOVA -F TEST which revealed that a significant difference was present in pain score, tender on percussion, sinus tract, swelling & mobility(all clinical parameters) for all groups at .05 level of significance. (i.e. $p < .05$)for radiographical parameters revealed that a significant difference was only present in superior-inferior axis in Group 1 (Bioceramic sealer) (i.e. $p < .05$). Rest in all the groups no significant difference was present in both the axis. Further the percentage improvement was observed at successive time points 0-1 month, 1-3 month and 3-6 month respectively, which revealed that the maximum improvement was observed for

all the clinical parameters from 1-3 month except for pain which showed maximum improvement in 1-3 month in all the four groups. (Table No.1)

Likewise the percentage improvement was observed at successive time points 0-1 month, 1-3 month and 3-6 month respectively, for both the radiographical parameters which revealed that the maximum improvement was observed for both parameters from 3-6 month in all the four groups.(Table No.2)

V. Discussion

Root canal therapy comprises two principal phases. The first is the microbial control phase, in which the root canal is prepared to ensure that the remaining bacteria in the root canal are at a minimum. The second phase-or filling phase-consists of sealing the space created in the first phase, and includes both the root filling and the crown filling.[11] For endodontic filling and sealing materials to fulfill the ideal requirements, they should be bacteriostatic, seal apically and laterally, be nonirritating to periapical tissues, resist moisture, and provide radiopacity. Also, the material should be sterile, nonshrinking, nonstaining, and easily placed and removed from the root canal system. [12]

Bioceramic sealer is exceedingly biocompatible, non-toxic, do not shrink, and are chemically stable within the biological environment. Secondly, bioceramics will produce little, if any, inflammatory response if an over fill occurs during the obturation process or in a root repair. A further advantage of the material itself is its ability (during the setting process) to form hydroxyapatite and ultimately a bond between dentin and filling materials. In addition to its excellent physical properties, the purpose of BC Sealer is to improve the convenience and delivery method of an excellent root canal sealer while simultaneously taking advantage of its bioactive characteristics. [13]

In this study, **SmartpasteBio bioceramic sealer** was used. The percentage improvement was observed for the clinical parameters at successive time points in all the four groups at different time intervals. But the momentous decline was seen in Group 1 (i.e Bioceramic sealer). This could be due to its anti-bacterial effect. According to the manufacturer, **SmartpasteBio** kills all bacteria within the canal with 2 minutes of contact. It has a setting time of 10 hours during which it gives out calcium hydroxide and hydroxyapatite, which leads to the formation of new bone matrix. [14]

Radiographic evaluation is the most widely used method for the detection of periapical lesions. Caliskan[15] observed healing within 2 years of treatment in approximately 70% of patients with periapical lesions. In the present study, we observed the initiation of periapical healing at 3 month after treatment and continued till 6 month.

CBCT scans preoperatively and 6 month postoperatively of a patient in Group 1(Bioceramic sealer) was done to compare its healing with a digital periapical radiograph. (Fig.1a&b,2a&b,3a&b) The CBCT scan revealed a marked decrease in the size of periapical radiolucency in all the three planes- antero-posterior, transverse and supero-inferior dimensions. This result was accordant to the values obtained on a two-dimensional digital radiograph.

VI. Conclusion

The Bioceramic Sealer was found to be of greatest efficiency followed by MTA, AH PLUS & Zinc Oxide Eugenol for all the evaluated parameters. However to determine the long term clinical success of the Bioceramic sealer, there is a future scope for a similar study spread over a greater period of time .

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| <p>Fig 1a: Preoperative(Baseline) <i>Coronal View</i> showing large periapical lesion wrt 11,12.</p> | <p>Fig 1b: Postoperative(6 months) <i>Coronal View</i> showing reduced size of periapical lesion wrt 11,12.</p> |
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| <p>Fig 2a: Preoperative(Baseline) <i>Saggital View</i> showing large periapical lesion wrt 11,12.</p> | <p>Fig 2b: Postoperative(6 months) <i>Saggital View</i> showing reduced size of periapical lesion wrt 11,12.</p> |
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| <p>Fig 3a: Preoperative(Baseline) <i>Axial View</i> showing large periapical lesion wrt 11,12.</p> | <p>Fig 3b: Postoperative(6 months) <i>Axial View</i> showing reduced periapical lesion wrt 11,12.</p> |

TABLE 1 - Percentage Improvement In Clinical Parameters (Pain, Tender On Percussion, Sinus Tract, Swelling & Mobility) By Four Sealers b/w Successive Time Periods

| | Time -Difference | % Difference / Improvements | | | |
|-----------------------------|-----------------------|-----------------------------|-------|---------|--------------------|
| | | BIO CERAMIC SEALER | MTA | AH PLUS | Zinc Oxide Eugenol |
| Pain | Base Line To 1 Month | 86.96 | 76.47 | 62.5 | 68.08 |
| | One Month To 3 Months | 100 | 91.67 | 88.88 | 80 |
| | 3 Months To 6 Months | 0 | 100 | 100 | 100 |
| Tender On Percussion | Base Line To 1 Month | 100 | 67.67 | 57.16 | 50.01 |
| | One Month To 3 Months | 0 | 0 | 100 | 100 |
| | 3 Months To 6 Months | 0 | 0 | 0 | 0 |
| Sinus Tract | Base Line To 1 Month | 100 | 100 | 100 | 100 |
| | One Month To 3 Months | 0 | 0 | 0 | 0 |
| | 3 Months To 6 Months | 0 | 0 | 0 | 0 |
| Swelling | Base Line To 1 Month | 100 | 100 | 100 | 80.02 |
| | One Month To 3 Months | 0 | 0 | 0 | 100 |
| | 3 Months To 6 Months | 0 | 0 | 0 | 0 |
| Mobility | Base Line To 1 Month | 75 | 75 | 50 | 40 |
| | One Month To 3 Months | 100 | 100 | 100 | 100 |
| | 3 Months To 6 Months | 0 | 0 | 0 | 0 |

TABLE 2 - Percentage Improvement In Radiographical Parameters (Superior Inferior And Transverse Axis) By Four Sealers B/W Successive Time Points

| | Time -Difference | % DIFFERENCE / IMPROVEMENTS | | | |
|----------------------------|-----------------------|-----------------------------|-------|---------|--------------------|
| | | BIO CERAMIC SEALER | MTA | AH PLUS | ZINC OXIDE EUGENOL |
| Superior Inferior | Base Line To 1 Month | 16.20 | 6.76 | 4.53 | 4.12 |
| | One Month To 3 Months | 14.76 | 5.83 | 4.60 | 6.31 |
| | 3 Months To 6 Months | 12.78 | 12.21 | 8.87 | 6.47 |
| Transverse Diameter | Base Line To 1 Month | 5.95 | 6.28 | 2.81 | 3.28 |
| | One Month To 3 Months | 9.95 | 11.59 | 5.99 | 4.84 |
| | 3 Months To 6 Months | 17.47 | 12.30 | 7.25 | 6.62 |

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