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To study and compare the apical sealing ability and fracture resistance to root canal dentine with Endosequence bioceramic, MTA and AH plus sealers –an ex- vivo study

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ABSTRACT: Main objective of obturation in endodontics is total obliteration of root canal system and development of fluid tight seal at the apical foramen,which provides a biological environment for healing of periapical tissue[1]. The method most frequently used to fill the root canal employs a semi solid,solid or a rigid core material cemented in the canal with a root canal sealer. Inadequate sealing with an endodontic sealer can have detrimentral effect such as prolongation of inflammation and infection[2]. The aim of this study was to compare analysis of apical seal by bioceramic sealer, MTA, AH plus and their effect on the fracture resistance of root canal dentin-An Ex-vivo study. Eighty single rooted extracted mandibular premolars were decoronated to a length of 11 mm. The divide two groups of 40 teeth are respectively used for sealing ability and for fracture resistance. Each group was obturated with lateral condensation technique by using the following sealers. For sealing ability 40 teeth, they were randomly divided into 4 groups 10 of each groups: group-I: roots were obturation by bioceramic sealer, group-II: roots were obturated with bioceramic sealer, group III: roots were obturated with AH Plus. & group-IV:roots were positive control (obturation done without sealer). The specimen were immersed in 2% methylene blue dye for 7 days in a close container and the specimen were check for microleakage under stereomicroscope. The fracture resistance were check under UTM and the result were analysis was using ANOVA and POST HOC test. The sealing ability of group–I (bioceramic) shows the least microleakage than group II & Group III. The highest fracture resistance is seen in group I Bioceremic followed by Group 3 (AH Plus) and the lowest fracture resistance is group 4 (positive control). We concluded that Endosequence BC shows the highest sealing ability and highest fracture resistance increased in root-filled single-rooted premolar teeth.

Keywords: Endosequence BC, AH Plus, MTA Fillapex, Root canal sealer, Obturation

I. INTRODUCTION

An endodontically treated tooth is weaker and more prone to fracture than vital teeth.[1] 11%– 13% of extracted teeth with endodontic treatment are associated with vertical root fractures rendering it the second most frequent identifiable reason for loss of root-filled teeth.[2,3] There are several factors that affect the strength of endodontically treated tooth including loss of tooth structure because of caries or trauma, access cavity preparation, dehydration of dentin, overzealous instrumentation and irrigation of the root canal, excess pressure during root obturation, and preparation of intra-radicular post space.[4,5] These factors interact cumulatively to influence tooth loading and distribution of stresses, ultimately increasing the possibility of catastrophic failure.
Sealers can be a cause of root canal failure due to microleakage at sealer-dentin or sealer-core material interface.[6,7] Bonding of sealer to the root canal dentin walls and formation of monoblock can eliminate this drawback.

An ideal endodontic sealer should fulfill all ideal requisites. A tight seal at the apex can enhance, sealer bond chemically to the dentinal wall of the root canal,and mild expansion of sealer improves its adaptation to the canal wall. It should be anti bacterial and resistant to the solution. One of such sealer is bioceramic sealer.[8]
Growing interest in reinforcing the root canal system has led to the development of adhesive root canal sealers. It is thought that adhesion and mechanical interlocking between the material and root canal dentin will strengthen the remaining tooth structure, and thus reduce fracture risk.[9]

A new Bio Ceramic sealer Endosequence BC sealer (Brasseler, USA), has recently been introduced to the market. It is a premixed bioceramic endodontic sealer According to the manufacturer's description, it is a convenient, ready-to-use injectable white hydraulic cement paste developed for permanent root canal filling and

sealing applications. Also, it is an insoluble, radiopaque, and aluminium-free material which requires the presence of water to set andharden.[10]

Epoxyresin-based dental materials (AH Plus) have been proposed to be excellent agents to reinforce an endodontically treated tooth through the use of adhesive sealers in the root canal system.[11] However, despite several advantages exhibited by bonding agents and resins studied to date, they had problems in working properties (hydrophobic nature), radio-opacity and lack of re-treatability when used for endodontic purposes.[12,13] MTA Fillapex is the first MTA based salicylate resin sealer. It is a bioceramic type of sealer that can readily set in presence of moisture and is able to cause cementogenesis and thus helps in repair of apical tissue.[14] As it is known that MTA does not bond to dentin, the presence of resins in Fillapex sealer increases the flow properties, and the presence of MTA would cause interfacial deposition of hydroxyapatite, which would increase the frictional resistance of the obturating material.[15] However, MTA has certain drawbacks like difficulty in handling, degradation of type 1 collagen and alteration of micro hardness of dentin.[8] Many root canal obturating systems are available to clinicians, yet no consensus exists regarding the superiority of any one in root canal obturation.

Hence, the present study was undertaken with the objectives to evaluate sealing ability and fracture resistance of four root canal sealers namely like Endosequence BC sealer (Brasseler USA), MTA based-MTA Fillapex (Angelus) and Epoxy Resin-based sealer AH plus (DENTSPLY).

II. MATERIAL & METHODS

Eighty freshly extracted human single canal mandibular premolar with a root length of at least 12 mm were collected from the Oral and Maxillofacial Surgery Jaipur Dental College and Hospital, Jaipur and stored in physiological saline. Soft tissue remnants and calculus in the teeth were removed. They were confirmed by digital radiograph (RVG, Gendex) from buccal, lingual and proximal views to ensure that they had single canals. Teeth with immature apices, those that had undergone root canal treatment, or those that had root caries or restorations, two root canals, fractures, resorption and calcified canals were excluded from the study.

TOOTH PREPARATION:

All the teeth specimens were decoronated using a double sided diamond coated disc, to adjust the remaining root length to a standardized length of 11 mm. In all the1 specimens, access openings were prepared using #4 round bur and working length was determined by placing a No 10 K file (Mani) in to the root canal, until it was just visible at the apical foramen.

The recapitulation was done with master apical file before using next larger instrument. Copious root canal irrigation using 5ml of 3 % sodium hypochlorite solution using a syringe and 27 gauge needle was performed after each instrumentation. Final flush with 5ml of 17% EDTA was done in order to remove the smear layer for 1-2 minutes. This was followed by a final irrigation with 5ml of 0.9% Normal saline. Each of the root canal specimens were dried with sterile paperpoints.

All the eighty instrumented roots were divided into two groups of 40 teeth each which are again subdivided into 4 groups of ten teeth each. The divided two groups of 40 teeth are respectively used for sealing ability and for fracture resistance. Each group was obturated with lateral condensation technique by using the following sealers.

For sealing ability 40 teeth: The teeth were randomly divided into 4 groups 10 of each group:
Group-I : roots were obturated by bioceramic sealer
Group-II : roots were obturated with bioceramic MTA.
Group-III : roots were obtutarted with AP Plus.
Group-IV : positive control group (obturation done without sealer).

PREPARATION TO CHECK THE SEALING ABILITY:

DYE PENETRATION:

After removal from the incubator,the roots were dried amd given two coats of nail varnish. The specimen were immersed in 2% methylene blue dye for seven days in a close container. After removal from dye the roots were rinsed in tap water and the nail varnish was removed with the help of acetone (Loba Chemie Pvt Ltd).

PREPARATION OF THE SPECIMEN FOR MICROLEAKAGE EVALUATION:

The varnish layers were scrapped off and the roots were split longitudinally parallel to the long axis with the diamond disc using a water coolant.

STEREO MICROSCOPE OBSERVATION:

Level of linear dye leakage was measured in cleared roots to the maximum points of penetration using a stereo microscope X 10 magnification(Nissho Optical Co.Ltd ,Japan) with a built in millimeter scale to the nearest 0.1mm. The data collected was compiled,tabulated and put to statistical analysis.

STATISTICAL ANALYSIS:

The results were analysed by one way ANOVA and multiple post hoc procedures. Statistical significance were defined in advance as $p< 0.05$ using the SPSS9.0 for windows (SPSS Inc, Chicago, IL,USA) statistical package.

III. RESULT

Our study showed that the Group 1(bioceramic) shows the least microleakage and Group 4(positive control) shows the greatest microleakage. It was seen that there was a statistically significant difference in mean microleakage between the groups (p=<0.001) (table 1).

Table 1: Shows the distribution of dye penetration scores in all the group.

	Micro-leakage							
	Number	**Mean**	**Std. Deviation**	**Std. Error**	**Minimum**	**Maximum**	**F-value**	**p-value**
Group 1 (Bioceramic)	**10**	**0.38**	**0.42**	**0.13**	**0.00**	**1.20**	**39.732**	**<0.001***
Group 2 (MTA)	**10**	**0.94**	**0.30**	**0.09**	**0.40**	**1.40**		
Group 3 (AH-plus)	**10**	**1.42**	**0.27**	**0.09**	**1.00**	**1.80**		
Group 4 (Positive control)	**10**	**1.92**	**0.32**	**0.10**	**1.40**	**2.40**		

The inter-group comparison of mean Micro-leakage was done using the Post-hoc bonferroni test. The mean Micro-leakage was significantly more among group 4 than group 3 which was significantly more than group 2 which was significantly more than group 1 (table 2).

Table 2: Inter-group comparison of mean Micro-leakage

		Micro-leakage	
Groups	Groups	Mean Difference	p-value
Group 1 (Bioceramic)	Group 2 (MTA)	-0.56	0.003*
	Group 3 (AH-plus)	-1.04	<0.001*
	Group 4 (Positive control)	-1.54	<0.001*
Group 2 (MTA)	Group 3 (AH-plus)	-0.48	0.015*
	Group 4 (Positive control)	-0.98	<0.001*
Group 3 (AH-plus)	Group 4 (Positive control)	-0.50	0.010*

The highest fracture resistance is seen in group1 bioceramic followed by group 3 (AH plus) then group (2 MTA) and the lowest fracture resistance is group 4(positive control). It was that there was satistically significant difference in mean fracture resistance within the groups (p=0.002) (graph 1). The mean fracture resistance was significantly more among group 1(Bioceramic) in comparison to group 2(MTA) and group 3(AH Plus) was significantly more than group 4(Positive Control) (table 3).

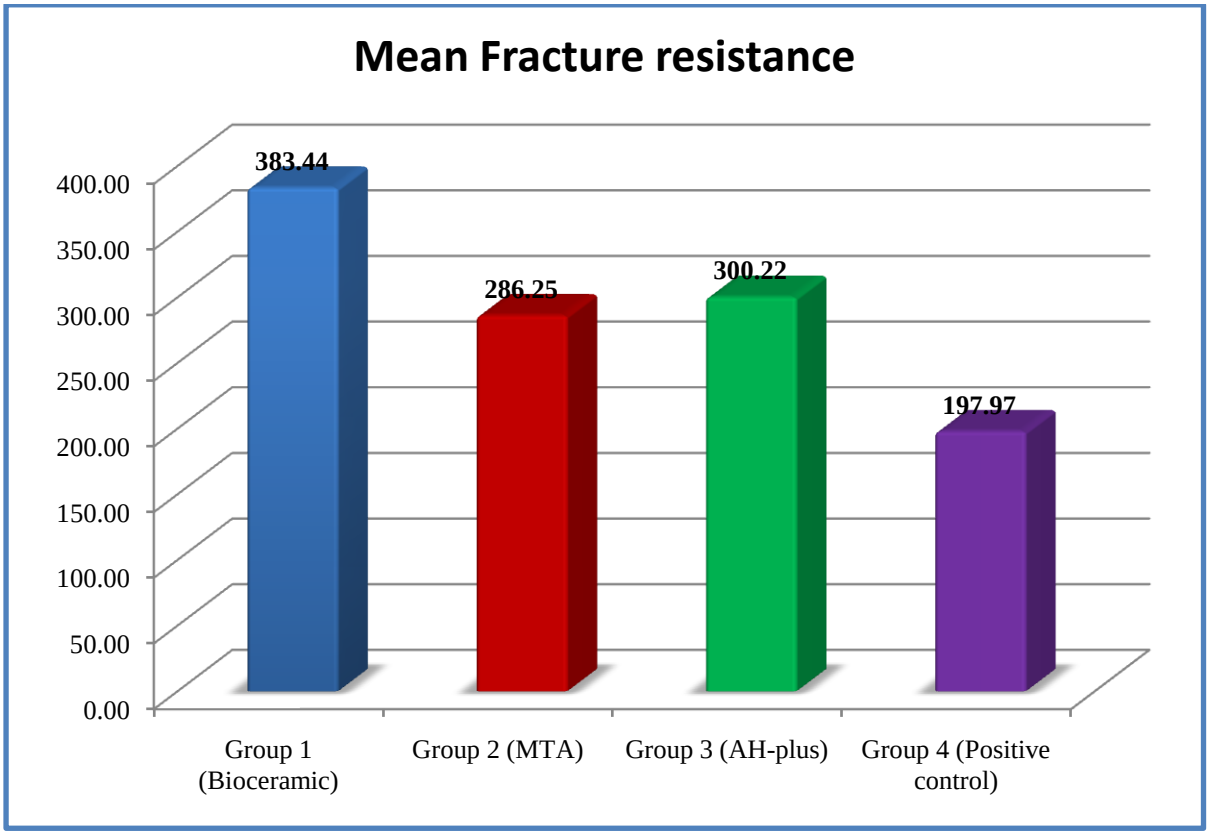

Table 3: The inter group comparison of mean fracture resistance

		Fracture resistance	
Groups	Groups	Mean Difference	p-value
Group 1 (Bioceramic)	Group 2 (MTA)	97.19	0.004*
	Group 3 (AH-plus)	83.22	0.015*
	Group 4 (Positive control)	185.47	0.001*
Group 2 (MTA)	Group 3 (AH-plus)	-13.97	0.353
	Group 4 (Positive control)	88.28	0.017*
Group 3 (AH-plus)	Group 4 (Positive control)	102.25	0.007*

POST hoc test *** Significant difference**

IV. DISCUSSION

Leakage into the root canal system can occur via four possible roots: (a) through the apical foramen can root filling material and the root canal wail,(b) through the apical foramen by infusion into the material,(c) from outside the tooth through expose dentin, accessory canals etc and (d) through the coronal access cavity.[16]

In the present in vitro study, results revealed that the bioceramic group (group1) has the highest sealing ability values (0.38) and the highest fracture resistance (383.44N). Positive control group (group 4), has the lowest sealing ability (1.92) and the lowest fracture resistance (69.38 N).

The mean fracture resistance of endosequence BC in the current study was higher (383.44 N) than the mean fracture resistance of AH plus (300.22 N), as reported by **Topcuoglu et al**[17], AH Plus (248.36 N) as reported by **Khan S et al**[18] and MTA Fillapex (286.25 N),as reported by **Mandava et al**.[15] Therefore the mean fracture resistance with Endosequence BC in our study was favourable and higher compared to mean fracture resistance of various other sealants.

Hatibovic and **Kofman et al** [19] assessed the fracture resistance of root dentine in open apex cases for longer duration and they demonstrated an increase in fracture resistance; however in closed apex cases MTA showed a reduction in fracture resistance[20] which was similar to our study. Various Studies have showed that fracture resistance of teeth obturated with MTA Fill apex was low probably due to lack of bonding of MTA to the dentin.[21] These results are similar to our study result with MTA Fillapex.

In contrast to our study, Celikten et al[22] and Jainaen et al[23] demonstrated low fracture resistance for teeth obturated with Endosequence BC sealer, and AH Plus sealer respectively. According to Celikten et al,[22] the reduced fracture resistance offered by Endosequence BC sealer could be due to the reduced moisture in the dentinal tubule required for the setting of sealer. Jainaen et al[23] stated that reduced fracture resistance of AH Plus was due to the reduced compressive and tensile strength of AH Plus in comparison with dentine.

Researchers have analysed and concluded that single circular canals have lower and more uniform stress distribution than oval canals in which greater stresses are present at the labial and lingual canal extensions and at the cervical and middle thirds.[24]In all of the premolar samples used in the present study, had a circular cross- section, which would have resulted in uniform distribution of load and also simulated the clinical situation where chewing forces are maximum.

Some studies have suggested that lateral condensation creates stresses in the root during obturation, which could lead to subsequent fracture. Single cone Obturation technique is a simple and time efficient technique which has become popular after the advent of NiTi rotary instruments. **Ersev et al** [25] reported that the group in which AH Plus was used with the matched taper single-cone technique showed significantly higher fracture resistance than the instrumented but not obturated roots. The major advantage of using single cone obturation technique is that it forms a uniform mass in combination with endodontic sealers thereby preventing failures observed among multiple cones as in cold lateral condensation technique[26]. In the present study, as lateral condensation obturation technique was used because it excluded both the excessive dentin removal required to facilitate the plugger"s insertion during vertical compaction and the wedging forces of the spreaders during lateral compaction. In the present study aluminium foil and acrylic resin blocks were used to simulate the periodontal ligament and alveolar bone and a single load to fracture was applied vertically as in many other studies that evaluated the effect of root canal sealers on the fracture resistance of root filled teeth.

In summarized that the present invitro study shows Endosequence –BC sealer have improved the fracture resistance of endodontic ally treated teeth. Further invivo studies will throw light into the clinical application of this promising material in future endodontics.

V. CONCLUSION

The present study concluded that Endosequence provides the best sealing ability and best fracture resistance. Further research is necessary to take advantage of the excellent biological properties of this cement under clinical applications. Additional invitro, ex vivo, and invivo research must be conducted to evaluate the performance of this new material and to confirm its use in endodontic therapy and the possibility of retreatment.

REFERENCES

[1]. Bender IB, Freedland JB. Adult root fracture. J Am Dent Assoc. 1983 Sep;107(3):413–9.
[2]. Fuss Z, Lustig J, Tamse A. Prevalence of vertical root fractures in extracted endodontically treated teeth. Int Endod J. 1999Aug;32(4):283–6.
[3]. Caplan DJ, Weintraub JA. Factors related to loss of root canal filled teeth. J Public Health Dent.1997;57(1):31–9.
[4]. Tang W, Wu Y, Smales RJ. Identifying and reducing risks for potential fractures in endodontically treated teeth. J Endod. 2010 Apr; 36(4):609–17.
[5]. Sedgley CM, Messer HH. Are endodontically treated teeth more brittle? J Endod. 1992Jul;18(7):332–5.
[6]. Nair U,Ghattas S,Saber M, Natera M,Walker C,Pillegi R. A comparative ability of 2 root-end filling materials: An in vitro leakage study using intrococcus fecaelis. Oral Surg Oral Med Oral Pathol Oral Rdiod Endod2011;112:E74-7.
[7]. Liviu S.Comparision of interface dentin-endodontic sealers using two SEM magnifications. Rev Odonto Cienc 2010;25:296-9.
[8]. Ingle JI,Bakland LK, Baumgartner JC, Ingle's Endodontics 6th ed Hamilton : BC Decker Inc; 2008; p.1053-87.
[9]. Johnson ME, Stewart GP, Nielsen CJ, Hatton JF. Evaluation of root reinforcement of endodontically treated teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2000Sep;90(3):360–4.
[10]. Zhang W, Li Z, Peng B. Assessment of a new root canal sealer's apical sealing ability. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009 Jun;107(6):e79-82.
[11]. Mehrvarzfar P, Saghiri MA, Karamifar K, Khalilak Z, Maalek N. A comparative study between resilon and gutta-percha as a secondary root canal filling materials: an in vitro study. Iran Endod J.2010;5(3):117–20.
[12]. Zidan O, ElDeeb ME. The use of a dentinal bonding agent as a root canal sealer. J Endod. 1985Apr;11(4):176–8.
[13]. Leonard JE, Gutmann JL, Guo IY. Apical and coronal seal of roots obturated with a dentine bonding

agent and resin. Int Endod J. 1996Mar;29(2):76–83.
[14]. Vitti RP, Prati C, Silva EJNL, Sinhoreti MAC, Zanchi CH, de Souza e Silva MG, et al. Physical properties of MTA Fillapex sealer. J Endod. 2013 Jul;39(7):915–8.
[15]. Mandava J, Chang PC, Roopesh B, Faruddin MG, Anupreeta A, Uma C. Comparative evaluation of fracture resistance of root dentin to resin sealers and a MTA sealer: An in vitro study. J Conserv Dent. 2014Jan;17(1):53–6.
[16]. Limkangwalmongkol s, Burtscher P,Abbot P V,Sandler AB and Bishop BM: A comparative study of the apical leakage of four root canal sealers and laterally condensed gutta percha.Journal of Endodontics 1991;17 (10) :495-99.
[17]. Topçuoğlu HS, Tuncay Ö, Karataş E, Arslan H, Yeter K. In Vitro Fracture Resistance of Roots Obturated with Epoxy Resin–based, Mineral Trioxide Aggregate–based, and Bioceramic Root Canal Sealers. Journal of Endodontics. 2013 Dec1;39(12):1630–3.
[18]. Khan S, Inamdar MNK, Munaga S, Ali SA, Rawtiya M, Ahmad E. Evaluation of Fracture Resistance of Endodontically Treated Teeth Filled with Gutta-Percha and Resilon Obturating Material: An In Vitro Study. J Int Oral Health. 2015;7(Suppl2):21–5.
[19]. Hatibović-Kofman S, Raimundo L, Zheng L, Chong L, Friedman M, Andreasen JO. Fracture resistance and histological findings of immature teeth treated with mineral trioxide aggregate. Dent Traumatol. 2008 Jun;24(3):272–6.
[20]. Komath M, Varma HK. Development of a fully injectable calcium phosphate cement for orthopedic and dental applications. Bull Mater Sci. 2003 Jun 1;26(4):415–22.
[21]. Ashraf H, Momeni G, Moradi Majd N, Homayouni H. Fracture Resistance of Root Canals Obturated with Gutta-Percha versus Resilon with Two Different Techniques. Iran Endod J. 2013;8(3):136–9.
[22]. Celikten B, Uzuntas CF, Gulsahi K. Resistance to Fracture of Dental Roots Obturated with Different Materials. BioMed Research International. 2015;2015:1–5.
[23]. Jainaen A, Palamara JEA, Messer HH. The effect of resin-based sealers on fracture properties of dentine. Int Endod J. 2009Feb;42(2):136–43.
[24]. TayFR, LoushineRJ, Monticelli F,Weller RN, BreschiL, FerrariM, etal. Effectiveness of resin-coated gutta-percha cones and a dual-cured, hydrophilic methacrylate resin-based sealer in obturating root canals. J Endod. 2005 Sep;31(9):659-64.
[25]. Ersev H, Yilmaz B, Pehlivanoğlu E, Ozcan-Çalişkan E, Erişen FR. Resistance to vertical root fracture of endodontically treated teeth with MetaSEAL. J Endod. 2012May;38(5):653–6.
[26]. Prajna P, Konark P, Roseline M, Ramesh K. A fast and economical photoelastic model making of the teeth and surrounding structures. IOSR Journal of Dental and Medical Sciences. 2013Jan;3(5):28–33.

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