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## Comparative Evaluation of Root Canal Filling Quality Using Various obturation Techniques and Different Sealers: An In vitro CBCT Study

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### ABSTRACT

A three dimensional well fitted root canal prevents percolation and micro leakage of periapical exudates into the root canal space, prevents reinfection, and creates a favorable biological environment for healing to occur. Voids created between the sealer and root canal wall possess difficulties in bonding and leads to endodontic failure. This study aimed to evaluate the root canal filling quality using different obturation techniques with different root canal sealers using CBCT. Sixty single rooted premolars were collected and standardized to a length of 12mm, instrumented and grouped into 2 groups based on obturation techniques employed as Group I- Single cone obturation, Group II- Lateral condensation technique and are further divided into 3 subgroups in each based on various sealers employed- AH plus, MTA Fillapex and i Root SP and quality of obturation (voids determination) was performed under CBCT. Among the tested groups single cone technique iRoot SP showed least number of voids and highest number of voids are seen in lateral compaction technique AH Plus. In LC technique least number of voids are seen with respect to i Root SP and highest for AH Plus sealer. In single cone technique least number of voids are seen with respect to iRoot SP and highest number of voids are seen in AH Plus sealer group.

**Keywords:** AH plus sealer, MTA Fillapex, i Root SP, Cone Beam Computed Tomography

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## INTRODUCTION

Successful endodontic therapy requisites early diagnosis, In-vitro removal of microbes, Disinfection and 3-Dimensional anatomical obturation of root space. Thorough chemo-mechanical debridement helps in elimination of aerobic and anaerobic bacteria which boosts prognostic factor for apical periodontitis. Rapid flow towards 3D obturation techniques is to fulfill criteria of filling the canals in all dimensions, creating a fluid-tight seal, which hampers the healing of periapical tissues.<sup>1</sup>

Gutta-percha, being a solid core material doesn't bind to the root canal dentin thus necessitating the endodontic sealer and core filling material in order to prevent apical leakage which contributes to endodontic failure. Sealers works by filling in any residual spaces, and bonding to dentine. The optimal outcome in obturation is to improve the volume of the core material and minimize the amount of sealer between the inert core and the canalwall.<sup>2,3</sup>

An ideal root canal filling material must possess antimicrobial activity, biocompatibility, marginal sealing quality, dimensional stability and the ability to regenerate bone repair. The concept of Monoblock have popularized Sealers such as Resin based sealers, MTA based sealers and BioCeramic based sealers in recent era due to their various physiochemical and bonding ability.<sup>4</sup>

AH Plus, a resin based sealer, often regarded as the gold standard material for its excellent adhesion and physical properties. It is a 2-component epoxy resin- based sealer with low solubility and high radiopacity that provides an effective apical seal based on a polymerization reaction of epoxy resin amines and chemically bonds to canal wall.<sup>5</sup> Despite this, if the sealer is inadvertently extruded beyond the apical foramen, induces cytotoxic effects tend to be higher before the sealer sets AH Plus and also possess difficulty in re-treatment cases

Mineral trioxide aggregate (MTA) is a mixture of Tricalcium silicate, dicalcium silicate, tricalcium aluminate, tetra calcium aluminoferrite, bismuth oxide, iron oxide, calcium carbonate, magnesium oxide, crystalline silica, used in endodontics for various clinical applications such as root-end filling, apexification, repair of root resorption, coronal barrier, and even as a canal filling material, but possess longer setting time and causes tooth staining.<sup>6</sup>

Bioceramics are ceramic based materials implied for inducing various tissue regenerations in endodontics. They include alumina, zirconia, bioactive / glass, glass ceramics, hydroxyapatite, and calcium phosphates. Glass and calcium phosphate have bioactive properties, thus interact with the periapical tissue to enhance the growth of more durable tissues. Bioinert materials, such as zirconia and alumina doesn't possess any biological or physiological effect.<sup>7</sup>

i Root SP which is a calcium silicate based sealer, composed of Zirconium oxide, calcium silicates, calcium phosphate, calcium hydroxide, has excellent physical properties and antimicrobial activity making it an innovative and novel endodontic sealers. But there is a literature evaluating the root canal filling quality of i Root SP, MTA and AH plus sealers<sup>8</sup>

Obturation of irregularly-shaped and aberrant canals is more difficult than canals with straight and round profiles and smooth taper. Various obturation techniques have been evaluated, the conventional Lateral condensation does not reliably result in complete obturation of instrumented recesses and intricate areas of the canal system on other side, single cone technique was boosted as it decreases the working time and improves operator efficiency<sup>9</sup>

CBCT is a 3-Dimensional imaging modality which has various endodontic applications including assessment of root canal anatomy, diagnosis of periapical pathosis or trauma, treatment planning and outcome of root canal treatment. CBCT systems provides small field of view images at low dose with sufficient spatial resolution which can be considered as a supplemental tool in radiography<sup>1</sup>

**Aim** To evaluate the root canal filing quality using various obturation techniques and different sealers under Cone Beam Computed Tomography (CBCT).

## MATERIALS AND METHOD

### Sample Selection

This is an in vitro study, where sample size was calculated by considering 95% power and 0.05% alpha value and ethical clearance was obtained from the institutional ethical committee. Sixty single rooted premolar teeth were collected which were extracted for periodontal and orthodontic reasons.

Inclusion criteria was single rooted premolar teeth, which were free of Caries, cracks, with single canal confirmed radiographically. Teeth with Calcified canals, signs of internal or external resorption, Carious and Fractured teeth, Root filled teeth, Multiple rooted teeth and teeth with multiple canals were excluded. Samples were placed in 5.25% sodium hypochlorite for 2h for surface disinfection, and then stored in distilled water until testing was performed.

### Tooth Preparation

All teeth were decoronated at the cemento-enamel junction and standardized to 12mm in length using rotating diamond disc under water coolant. Patency of each tooth was confirmed with a 10k file and working length was determined using visual method by inserting a size 15k file into the canals until it was visible at the apical foramen.

All the specimens were instrumented with Protaper Universal files to a size 25/06 using a crown-down technique with copious irrigation using 2mL 5.25% NaOCl between each instrument and 2mL of 17% EDTA was used to remove smear layer for 5 minutes. A final rinse with 2mL 5.25% NaOCl, 2mL 17% EDTA for 1 min, and 10mL distilled water was performed; the canals were dried with paper points.

### **Root Canal Filling**

All the teeth were randomly divided into two groups based on the obturation technique performed. In group 1(n=30) all the teeth are obturated with single cone technique. The root canals of each tooth in group 2 (n=30) are obturated with lateral condensation technique. Based on the sealer used each group was subdivided into 3 subgroups.

Ia (10 Teeth) Resin based sealer (AH PLUS Sealer)

Ib (10 Teeth) MTA based sealer (MTA FILLAPEX)

Ic (10 Teeth) Ceramic based sealer (i ROOT SP)

Ila (10 Teeth) Resin based sealer (AH PLUS Sealer)

Ilb (10 Teeth) MTA based sealer (MTA FILLAPEX)

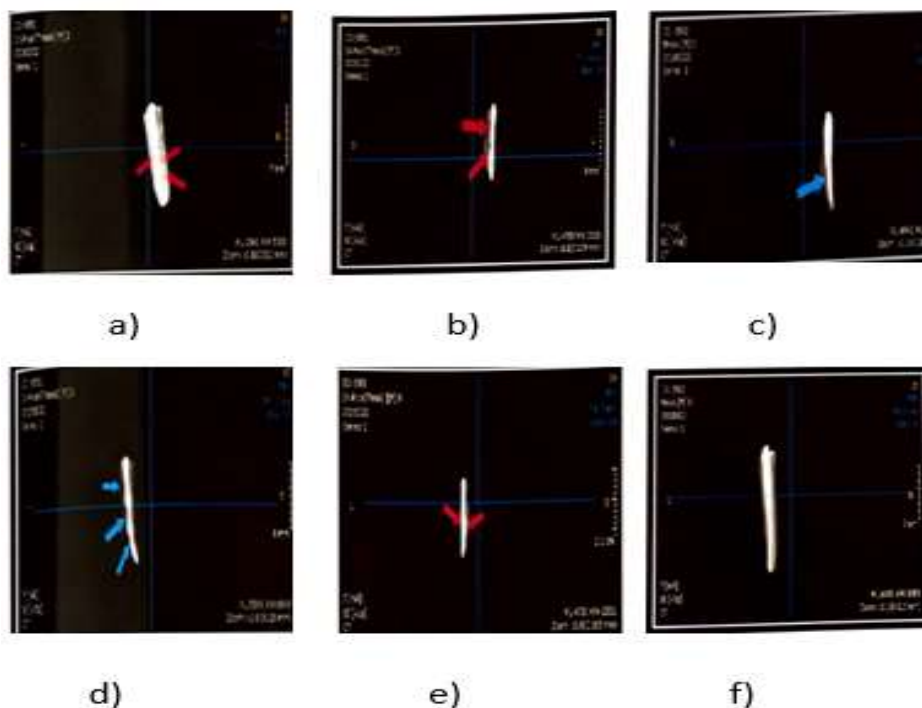
Ilc (10 Teeth) Ceramic based sealer ( i ROOT SP)

According to the groups divided all the samples are filled with 3 different sealers respectively using lentulospirals. The sealers were mixed according to the manufacturer's instructions. Followed by obturation of the root canals using single cone in group I and lateral condensation group II. Accessory cones were condensed with spreaders and placed until no space was left in group II. Excess gutta percha were removed. All specimens are then stored at 37° in 100% humidity for 1 week to allow complete setting of sealer.

### **CBCT Evaluation**

Teeth are positioned in wax occlusal rims to simulate soft tissue. Pre- operative CBCT images were acquired with the HDX WILL CORP CBCT model PXD-140CT with power input 200-240v~ , 50/60 Hz, 8A. The tube voltage of 110kVp, 10mA. Exposure time was 24 s.

The presence of voids was assessed in 2D slices for all the samples by a blinded observer. The mean percentages of the root filling volume (sum of the volume of the gutta-percha and the endodontic sealer) and total number of voids were calculated. (Figure a-f)



**Figure a) Single root obturation with AH Plus sealer, b) Single root obturation with MTA Fillapex c) Single root obturation with i Root SP d) lateral condensation technique with AH plus sealer, e) lateral condensation technique with MTA Fillapex f) lateral condensation technique with iRoot SP sealer**

## RESULTS AND DISCUSSION

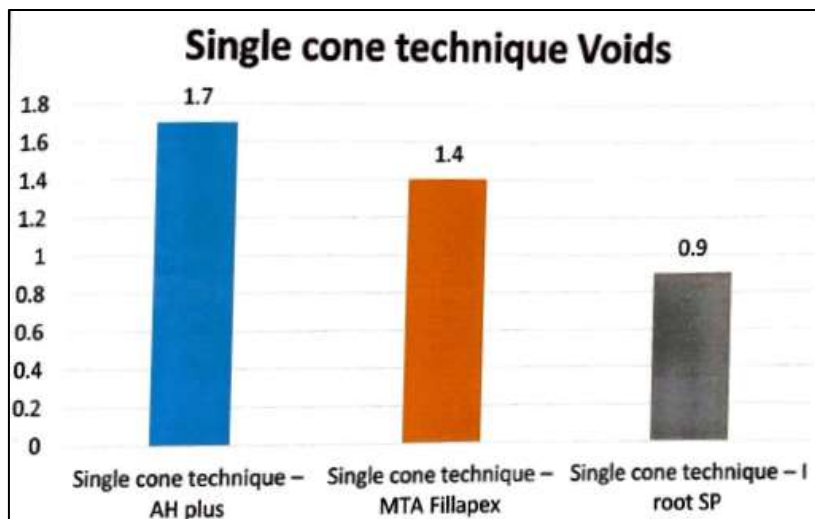
Based on observation of CBCT images evaluation was done for voids in each tooth sample and volume was recorded and subjected to statistical analysis. Statistical analysis was performed using One way ANOVA and Tukeys multiple posthoc procedures ( $p < 0.05$ ). Statistical analysis showed no significant difference between all the groups.

GROUP 1 comparison between three root canal sealers using single cone technique (voids). The mean voids percentage present with respect to different sealers and obturation by Single cone gutta percha is highest for AH plus group (1.70), followed by MTA fillapex (1.40) and least for I Root SP (0.90), with no significant difference. (Table 1), (Graph 1)

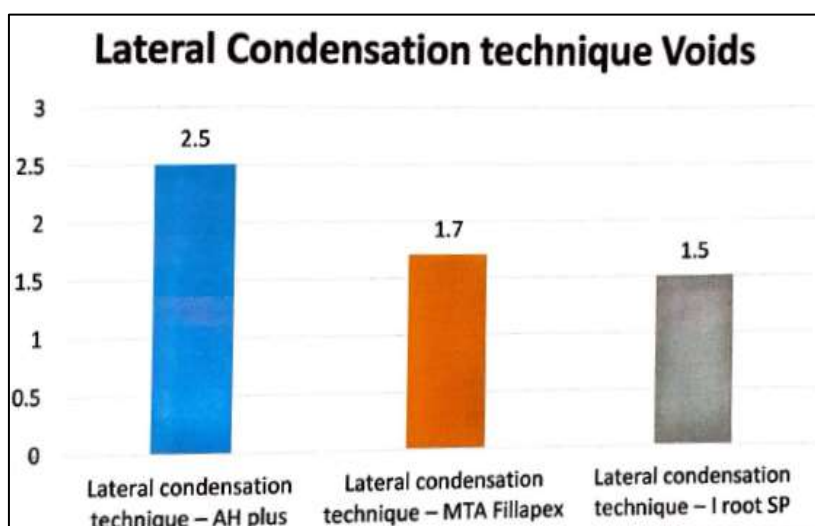
GROUP 2 demonstrates the comparison between three root canal sealers using lateral condensation technique (voids). The mean voids percentage present with respect to different sealers and obturation by lateral condensation technique is highest for AH plus group (2.50), followed by MTA fillapex (1.70) and least for I Root SP (1.50). (Table 2), (Graph 2)

**Table 1: Intragroup comparison of canal voids of Single cone obturation technique with different root canal sealers**

Group I	N	Mean	SD	F value	P value
Single cone technique AH plus	10	1.70	1.15	1.404	0.263
Single cone technique MTA Fillapex	10	1.40	1.17		
Single cone technique - root SP	10	0.90	0.87		

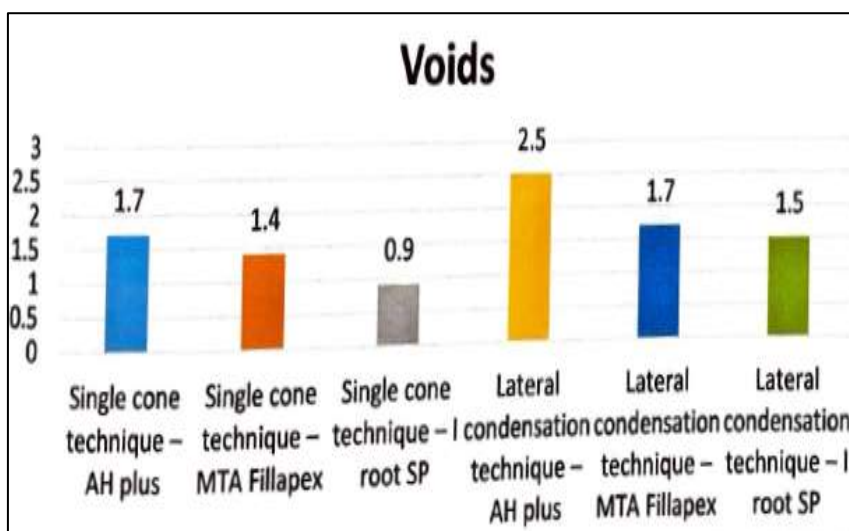
**Graph 1: Intragroup comparison of canal voids of Single cone obturation technique with different root canal sealers****Table 2: Intragroup comparison of canal voids of lateral condensation obturation technique with different root canal sealers**

Group II	N	Mean	SD	F value	P value
Lateral condensation technique - AH plus	10	2.50	0.97	3,273	0.053
Lateral condensation technique - MTA Fillapex	10	1.70	0.82		
Lateral condensation technique - I root SP	10	1.50	0.97		

**Graph 2: Intragroup comparison of canal voids of lateral condensation obturation technique with different root canal sealers**

**Table 3: Intergroup comparison of canal voids of various obturation techniques with different root canal sealers**

Group	N	Mean	SD	F value	P value
Single cone technique AH plus	10	10	1.70	2.712	0.029*
Single cone technique MTA Fillapex	10	10	1.40		
Single cone technique - root SP	10	10	0.90		
Lateral condensation technique - AH plus	10	2.50	0.97		
Lateral condensation technique - MTA Fillapex	10	1.70	0.82		
Lateral condensation technique - I root SP	10	1.50	0.97		

**Graph 3: Intergroup comparison of canal voids of various obturation techniques with different root canal sealers**

## DISCUSSION

A three dimensional well fitted root canal prevents percolation and micro leakage of periapical exudates into the root canal space, prevents reinfection, and creates a favorable biological environment for healing to occur. Removal of bacteria from the root canal system is not always achieved by instruments and irrigants alone, because of anatomical complexity and limitations in accessing the entire endodontic space.<sup>10</sup>

Voids inside filling materials (internal voids) could be considered less clinically relevant because bacteria, if present, are confined in an unfavourable environment<sup>11</sup>. Voids along the canal walls (external and combined voids) are caused by the presence of a gap between the filling material and the dentinal walls and may jeopardize the outcome, because they are in contact with potentially infected canal walls; furthermore, they represent a gap that may promote the failure of the sealer and lead to leakage.<sup>10</sup>

A high frequency of technically inadequate root filings have been shown in several population studies based on radiography and the technical quality of the root filing has been identified as a significant parameter associated with the presence of apical periodontitis (AP).

On the basis of the previous studies, it may be concluded that the task to perform high quality root fillings is of core importance.<sup>1</sup>

Voids in root fillings can, theoretically, compromise the outcome of root canal treatment. Clinically, voids in root fillings are difficult to detect. The post-treatment radiograph is the benchmark for the quality of the root filling and is the only way to determine the density of the filling and the presence of voids. It is unclear to what extent void size, imaging technique and position in the root canal influence the detectability of voids in root fillings.<sup>12</sup> Hence this study aimed to evaluate the presence of voids using different root canal sealers by various obturation techniques under cone beam computed tomography.

A new standard of contemporary endodontics has been created with the advent of CBCT. For several years, RCF quality was evaluated in clinical practice according to a 2D image of 3D structures.<sup>13</sup> CBCT is a 3D imaging method that provides the possibility of viewing a specific tooth or teeth in any view that intraoral, panoramic, and cephalometric images cannot. CBCT is a complementary modality for specific applications rather than a replacement for 2D imaging modalities.<sup>14</sup>

In the present study the entire root canal filling quality is evaluated using various obturation techniques and different sealers and found no statistically significant difference between root filling quality. The observers did not distinguish between small or larger voids in the filling and unprepared areas of the root canal. However, since the roots were randomly allocated to the two root obturation techniques after preparation of the canals, the distribution of canals with unprepared areas would presumably be even in the two groups and consequently this should not affect the comparison of the obturation techniques.<sup>1</sup>

Single-cone technique with matched-taper gutta-percha cones is popular after root canal preparation with rotary instruments. Because it allows better adaptation in 3-dimensional preparation, and it reduces the time spent on the lateral compaction technique<sup>1</sup>. Gordan reported similar percent gutta-percha-filled area when they filled curved canals using .06 tapered instruments with the single-cone and lateral condensation techniques. However, they also found that the single-cone technique was faster than the lateral condensation method<sup>15</sup>. Horsted-Bindslev and others reported that the lateral condensation technique did not differ from the single-cone technique with respect to the radiographic quality of the root filling.<sup>9, 15</sup> The results of the study of Holland et al Showed that the single cone technique exhibited a better sealing than the lateral condensation technique<sup>9</sup>.

The most common and recognized root filling technique is cold lateral compaction. A gutta-percha (GP) master point fitted to correspond to the prepared canal is inserted and laterally compacted. The remaining canal lumen is then filled with accessory points. This technique

allows the operator to achieve a thin layer of sealer despite irregularities in the canal wall, hence minimize the risk of voids between canal wall and filling. Furthermore, the cold lateral compaction technique minimizes the risk of apical overfilling of the root canal.<sup>1</sup>

Lateral compaction was achieved with .02 taper gutta-percha cones, and .06 taper cones were used for the single-cone technique. The quality of the root fillings was assessed microscopically on thin cross-sectional sections as percentage of gutta-percha sealer and voids to total canal area. No significant difference was found between the two methods, but the single-cone technique is significantly faster to obturate<sup>1,16</sup>.

The results of the present study show the mean voids is highest in Single cone technique AH plus group, followed by single cone technique MTA fillapex, and least in Single cone technique iRoot SP and no significant difference is found between the groups. The mean voids is highest in Lateral condensation technique AH plus group, followed by Lateral condensation technique MTA fillapex and least in Lateral condensation technique i Root SP group and no significant difference is found between the groups.

Adriana Simionatto Guinesi, et al. stated that when LC was performed, no significant difference in the percentages of filling material and voids could be observed, despite different sealer placement methods being applied. Thus, the quality of the filling was similar, whatever the method by which the endodontic sealer was placed in the canal. The LC results are similar to those reported in previous studies in which only LC filling technique was used.<sup>17</sup>

In the present study when comparison was made between the sealers i Root SP showed least number of voids followed by MTA fillapex and the highest number of voids was seen in AH Plus sealer. The presence of voids can be attributed to the fact that resin-based sealers undergo a polymerization shrinkage, which might lead to gap and void formation. Then, the greatest thickness of the sealer in the LC group would explain the greatest amount of voids<sup>18</sup>.

When intergroup comparison was made the mean number of voids observed in Lateral condensation technique AH plus group is highest followed by the Single cone technique AH plus group then, Lateral condensation technique MTA Fillapex, Lateral condensation technique i Root SP, Single cone technique MTA Fillapex and least in Single cone technique iRoot SP. A statistically significant difference is observed between Lateral condensation technique AH plus group and Single cone technique i Root SP group ( $p=0.01$ ) (Table 3), (Graph 3)

Our results are in accordance with the study done by the study done by Gandolfi et al. They investigated the voids with AH Plus and MTA Flow sealers using Thermofill filling and separated the teeth into three parts apical, middle, and coronal thirds in assessing voids. They indicated that MTA Flow had fewer voids in the apical third than AH Plus, whereas similar

voids were seen in the middle and coronal thirds after 7 days of storage. Demiriz et al. stated that AH Plus and Gutta-percha showed higher gap formation when compared with MTA Fillapex and Gutta-percha showed similar gap formation in the root sections<sup>19</sup>.

Epoxy resin-based root canal sealers have also shown good physicochemical properties, biological properties as well as excellent apical sealing. 33 Studies have demonstrated that resin endodontic sealers, such as AH Plus, have lasting dimensional stability and satisfactory apical sealing ability.<sup>44</sup> Hengameh et al stated that the micro leakage of AH Plus might be due to its fast setting and subsequent shrinkage<sup>1</sup>.

MTA Fillapex is a new MTA-based sealer. MTA based sealer creates integrated excellent and perfect seal, it provides high biological regeneration. MTA setting leads to hydration of inorganic oxide compounds, resulting in the production of calcium hydroxide and calcium silicate hydrate phases, which in turn lead to expansion at its margins, improving the seal and reducing micro leakage. Nikhil et al. compared the depth of penetration of MTA Fillapex and AH Plus sealers into the dentinal tubules with the use of a confocal laser microscope and reported that MTA Fillapex sealer penetrated deeper into the dentinal tubules. These results do not coincide with the results of the present study or it is better to conclude that although MTA Fillapex exhibits deeper penetration into dentinal tubules, it does not result in better apical seal.<sup>9</sup>

The iRoot SP bioceramic sealer is composed mainly of calcium silicate and calcium phosphate, which requires moisture to complete their hydration-setting reaction.<sup>29</sup> Zhang et al., stated that iRoot SP and AH plus exhibited architectures that seemed to correlate with their sealing performance. Gap-free and gap-containing regions were observed along the sealer-dentin and the cone-sealer interface with two sealers.<sup>37</sup> Farnaz jafari, et al. stated that bioceramic-based sealers exhibited more gap containing regions when compared with AH Plus<sup>20</sup>

In the present study, Among the tested groups single cone technique iRoot SP showed least number of voids and highest number of voids are seen in lateral compaction technique AH Plus. In LC technique least number of voids are seen with respect to i Root SP and highest for AH Plus sealer. In single cone technique least number of voids are seen with respect to iRoot SP and highest number of voids are seen in AH Plus sealer group.

### **Limitations**

- This study was performed on teeth with straight root canals, therefore the conclusions of this study cannot be directly extended to teeth with curved root canals.
- All the procedures are performed in a controlled environment in in vitro conditions that may not be equivalent to in vivo conditions.

## CONCLUSION

Within the limitations of the present study, the following conclusions can be drawn: In single cone technique least number of voids are seen with respect to i RootSP and highest for AH Plus. In LC technique least number of voids are seen with respect to i Root SP and highest for AH Plus sealer. Among the tested groups single cone technique i Root SP showed least number of voids and highest number of voids are seen in lateral compaction technique AH Plus. Comparatively Bioceramic based root canal sealers show promising results as root canal sealers.

## REFERENCES

1. Moeller L, Wenzel A, Wegge -Larsen AM, Ding M, Kirkevang LL. Quality of root fillings performed with two root filling techniques. An in vitro study using micro-CT. *Acta Odontol Scand* 2013; 71:689-696.
2. Weis MV, Parashos P, Messer HH. Effect of obturation technique on sealer cement thickness and dentinal tubule penetration. *Int Endod J* 2004; 37:653-663.
3. Zahra Shourgashti, Hamid Keshvari, Hasan Torabzadeh, Mostafa Rostami, Shahin Bonakdar, Saeed Asgary. Physical Properties, Cytocompatibility and Seal ability of HealApex (a Novel Premixed Biosealer). *Iran Endod J*2018; 13(3):299-304.
4. S. Sevimay A. Kalayci. Evaluation of apical sealing ability and adaptation to dentine of two resin-based sealers. *J Oral Rehabil* 2005; 32:105-110.
5. Ines Ferreira, Stephanie Soares, Joana Sousa, Joana Barros, Cristina Braga, Maria Ascensao, Lopes, Irene Pina. New Insight into the Dissolution of Epoxy Resin-based Sealers. *J Endod* 2017;43(9):1505-1510
6. Afaf AL-Haddad, ZetiA.Che Ab Aziz. Bioceramic-Based Root Canal Sealers: A Review. *Int Journal Biomater* 2016; 4:1-10.
7. Zhang W, Li Z, Peng B. Effects of Root SP on mineralization -related genes expression in MG63 cells. *J Endod* 2010; 36:1978-1982.
8. Andrea Cardoso Pereira, Celso Kenji Nishiyama, Lidiane de Castro Pinto. Single-cone obturation technique: a literature review. *RSBO*.2012;9(4):442-447.
9. Somma F, Cretella G, Carotenuto M, Pecci R, Bedini R, De Biasi M, Angerame D. Quality of thermo plasticized and single point root fillings assessed by micro-computed tomography. *Int Endod J* 2011; 44:362-369.
10. M. G. Gandolfi, A. P. Parrilli, M. Fini, C. Prati, P. M. H. Dummer. 3D micro-CT analysis of the interface voids associated with Thermafil root fillings used with AH Plus or a flowable MTA sealer. *Int Endod J* 2013; 46:253-263.

11. B. Huybrechts, M. Bud, L. Bergmans, P. Lambrechts R. Jacobs. Void detection in root fillings using intraoral analogue, intraoral digital and cone beam CT images. *IntEndod J* 2009; 42:675-685.
12. Daniel Almeida Decurcio, Mike Reis Bueno, Ana Helena Goncalves De Alencar, Olavo Cesar Lyra Porto, Bruno Correa Azevedo, Carlos Estrela. Effect of root canal filling materials on dimensions of cone- beam computed tomography images. *J Appl Oral Sci* 2012;20(2):260-267.
13. William C.Scarfe, Martin D.Levin, David Gane, and Allan G.Farman. Use of Cone Beam Computed Tomography in Endodontics. *Int J Dent* 2009; 2009:1-20.
14. Preben Horsted-Bindslev, Mette A, Andersen, Michaela F. Jensen, Julie H.
15. Nilsson, Ann Wenzel. Quality of molar root canal filings performed by lateral compaction and single cone technique. *J Endod* 2007; 33:468-471.
16. Adriana SimionattoGuinesi, Gisele Faria, Mario Tanomaru-Filho, Idomeo Bonetti-Filho. Influence of Sealer Placement Technique on the Quality of Root Canal Filling by Lateral Compaction or Single Cone. *Braz Dent J* 2014;25(2):117-122.
17. Keles, H. Alcin, A. Kamalak, M. A. Versiani. 3D Micro-CT evaluation of root filling quality in oval-shaped canals *Int Endod J* 2014.
18. Demiriz L, Kocak MM, Kocak S, Saglam BC, Turker SA. Evaluation of the dentinal wall adaptation ability of MTA Fillapex using stereo electron microscope. *J Conserv Dent* 2016; 19:220-224.
19. Hengameh Akhavan, Farhad Zahdabadi, Peyman Mehrvari, Anahid Ahmadi Birjandi. Comparative Study on the Microleakage of Three Root Canal Sealers. *Endod J* 2011;6(1):1-5.
20. Farnaz Jafari, Ehsan Sobhani, Hossein Samadi-Kafil, Ahmad Pirzadeh, Sanaz Jafari. In vitro evaluation of the sealing ability of three newly developed root canal sealers: A bacterial microleakage study. *J Clin Exp Dent* 2016.1-5.
21. Wei Zhang, Zhi Li, Bin Perg, Wuhan. Assesment of a new root canal sealer's apical sealing ability. *Oral Surg Oral Med Oral Pathol Oral RadiolEndod* 2009; 107:79-82.

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