Comparative evaluation of microleakage of three different sealers using vertical compaction technique under stereomicroscope: An in vitro study

Manoj Chandak1, Chanchal Rathi2, Madhulika Chandak3, Saurabh Rathi4, Samrudhi Khatod5, Anuja Ikhar6

1Professor, Conservative Dentistry and Endodontics, Sharad Pawar Dental College and hospital, Datta meghe institute of medical and dental sciences deemed to be university (DU) Sawangi, India; Email: drmanojchandak@yahoo.com
2Post graduate student, Conservative Dentistry and Endodontics, Sharad Pawar Dental College and hospital, Datta meghe institute of medical and dental sciences, deemed to be university (DU) Sawangi, India; Email: chanchalrathidr@gmail.com
3Post graduate student, Conservative Dentistry and Endodontics, Sharad Pawar Dental College and hospital, deemed to be university (DU) sawangi, India; Email: chandakmadhulika40@gmail.com
4Post graduate student, Conservative Dentistry and Endodontics, Sharad Pawar Dental College and hospital, deemed to be university (DU) sawangi, India; Email: saurorathi@gmail.com
5Post graduate student, Conservative Dentistry and Endodontics, Sharad Pawar Dental College and hospital, deemed to be university (DU) sawangi, India; Email: khatod.samrudhi@gmail.com
6Associated professor, Conservative Dentistry and Endodontics, Sharad Pawar Dental College and hospital, deemed to be university (DU) sawangi, India; Email: anujaikhar@gmail.com

Corresponding author
Professor, Conservative Dentistry and Endodontics, Sharad Pawar Dental College and hospital, Datta meghe institute of medical and dental sciences deemed to be university (DU) Sawangi, India; Email: drmanojchandak@yahoo.com

Article History
Received: 02 April 2020
Reviewed: 03/April/2020 to 19/May/2020
Accepted: 20 May 2020
E-publication: 27 May 2020
P-Publication: July - August 2020

Citation
ABSTRACT

Introduction: Complete fluid tight seal is important for successful endodontic treatment. It will be achieved by use of gutta percha with sealer during obturation. Aim: Compare and evaluate microleakage of Sealapex, MTA Fillapex and Adseal using stereomicroscope. Materials and Methods: Thirty single canaled human teeth were collected. Samples were separated into three groups (n=10). Group I- Sealapex, Group II-MTA Fillapex, Group III- Adseal. Samples were examined under stereomicroscope for sealing ability. Data obtained were statistically checked using One-way ANOVA test. Results and conclusion: Least microleakage was found with Sealapex followed by Adseal followed by MTA Fillapex sealer. MTA Fillapex shows highest amount of leakage.

Keywords: Root canal sealer, Microleakage, stereomicroscope.

1. INTRODUCTION

The endodontic treatment includes the removal of microbial load in the root canals. It is followed by filling of the pulp canal completely. Accordingly, complete root canal sealing is utmost importance to prevent colonization of oral microflora which cause periapical infection. This will be achieved by thorough cleaning and shaping. Gutta percha material does not adhere to pulpal canal walls. So Sealer fills the gap between gutta percha and root dentin (Ballullaya et al., 2017). Therefore gutta-percha along with sealer should provide complete seal. This hermetic seal is very important. Because slight amount of microleakage cause complete failure of endodontic treatment. So sealers should satisfy some properties like biocompatibility, dimensional stability. It also should be insoluble in oral fluids, radiopaque. It should be easy for application, antibacterial in nature. It should adapt well to canal walls and capable to supply a hermetic seal (Limkangwalmongkol et al.,1992). Newy there has been enhancement in root canal sealers chemically. The conventional zinc oxide eugenol sealers have been replaced with calcium hydroxide based sealer. Also newer sealers are present in the market like resin-based sealer. Then MTA based sealer and bioceramic sealer (Hasnain, 2017).

Calcium hydroxide based sealers have been introduced which shows excellent antimicrobial activity (Ballullaya et al., 2017). It also helps to stimulate sterile apical area. But one property of this sealer is, it sets rapidly when it come in contact with moisture. It results in poor adherence to canal walls. It never sets in dry condition (Ballullaya et al., 2017). Calcium silicate based sealer like MTA based has been introduced newly in the market. It is comprises of synthetic Portland cement. It is available in gray nodular particles. According to the manufacturer’s instruction this sealer exhibit higher radiopacity. This sealer is sets gradually. It shows adequate working time. Excellent flow helps to fill the canals completely. It also shows lesser solubility. Easy to remove without any efforts, Easy to handle (Singh et al.,2016).

New epoxy resin sealer has been introduced. It is comprises of a mixture of epoxy resins, amines. It also contains calcium phosphate zirconium oxide. It also constitutes ethylene glycol salicylate, bismuth sub-carbonate (Ballullaya et al., 2017). It exhibit good adhesion to the dental structure. It has long working time. It is easy to manipulate. Also it has excellent sealing ability make it popular (Song et al., 2016). Different methods were used to measure the apical sealing of sealers, such as radioisotopes and gas chromatography. Also include dye penetration tests and CBCT and fluid infiltration test (AlHabdann, 2017). The most widely used technique for assessing sealing ability is dye penetration technique. It is rooted on the linear measurement of the dye penetration. Dye get penetrated between gutta percha and sealers (Ballullaya et al., 2017). Purpose of the study is to evaluate and compare microleakage of three different sealers using stereomicroscope.

2. MATERIALS AND METHODS

Step I – Collection of sample
Study was carried out in Sharad Pawar Dental College in Department of Conservative Dentistry and Endodontics. Thirty single rooted freshly extracted teeth were collected and stored as per OSHA guideline. Coronal third of all the teeth were sectioned upto cement-
enamel junction. Samples which are sectioned were shown in fig 1. After they were stored in normal saline until they were used. Negotiation of canal was carried out with #10 k file (Mani). Working length was established by inserting #15 file into the root canal. By keeping 1mm short of actual working length, all the samples were prepared upto F3 protaper rotary file system using 17% EDTA (Prime dental). In between biomechanical preparation, canals were irrigated using 3% NaOCl and normal saline. And final flush with 2% chlorohexidine were done.

Inclusion criteria:
1] Intact tooth
2] Unrestored

Exclusion criteria:
1] With resorption
2] Tooth with fracture
3] Endodontically treated teeth.

Figure 1 Sectioning of samples at cemento-enamel junction

Step II - Grouping of the samples
All the 30 samples were arbitrarily separated into three groups. Each group comprise of ten samples. Group I- Sealapex (Sybron Endo USA), Group II- MTA Fillapex (Angelus, Londrina Brazil), Group III- Adseal (Meta Biomed).

Step –III Obturation of root canals
As per manufacturer instructions, sealer was mixed. Sealers were applied to the canal walls with use of lentulospiral and endoactivator. Master cone were placed and obturation was done using vertical compaction technique. Cavities were sealed by Tempfill.

Step – IV: Preparation of specimens for stereomicroscopic analysis
Samples allow drying for 5min. Then two layer of nail varnish applied on samples except 2mm of apical area. It helps to allow dye penetration at apical area. After that samples were deep into 1% methylene blue dye for 3 days. Then after 72 hours, roots were sectioned off and microleakage analyses were done at 15X magnification using Wuzhou New Found Instrument Co.Ltd. China model.

Step V: Scoring criteria
Scored were given by scoring scale which was given by Pontes D G in 2002
Score1: 1-3mm of dye penetration
Score 2: 3-5mm of dye penetration
Score 3: > 5mm of dye penetration
Step VI: Statistical analysis
Analyses were done using one way ANOVA with Tukey’s test.
3. RESULTS

Score of the samples according to scoring criteria is shown in table 1. Mean and standard deviation of samples were shown in the table 2. Table 3 shows higher mean dye penetration with calcium silicate based sealer. Minimal dye penetration was seen with group II. Also there was no statistical significant differences were found between group I and group III. While statistically significant difference were found between group I and group II. Table 4 shows Tukey’s multiple comparison between all the groups. Figure 2 Shows graph of microleakage of three sealers. Figure 3 shows stereomicroscopic images of dye penetration of samples.

Table 1 Dye penetration score of samples.

<table>
<thead>
<tr>
<th>Score</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2 Mean and standard deviation of all the three groups

<table>
<thead>
<tr>
<th>Sealers</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Upper Bound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sealapex</td>
<td>10</td>
<td>1.40</td>
<td>0.51</td>
<td>0.16</td>
<td>1.03</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td>MTA Fillapex</td>
<td>10</td>
<td>2.50</td>
<td>0.52</td>
<td>0.16</td>
<td>2.12</td>
<td>2.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Meta Adseal</td>
<td>10</td>
<td>1.50</td>
<td>0.70</td>
<td>0.22</td>
<td>0.99</td>
<td>1.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Table 3 Multiple Comparisons: Tukey’s Test

<table>
<thead>
<tr>
<th>Sealer</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>p-value</th>
<th>95% Confidence Interval</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealapex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTA Fillapex</td>
<td>-1.10</td>
<td>0.26</td>
<td>0.001, S</td>
<td></td>
<td>-1.75</td>
<td>-0.44</td>
</tr>
<tr>
<td>Meta Adseal</td>
<td>-0.10</td>
<td>0.26</td>
<td>0.924, NS</td>
<td></td>
<td>-0.75</td>
<td>0.55</td>
</tr>
<tr>
<td>MTA Fillapex</td>
<td>1.00</td>
<td>0.26</td>
<td>0.002, S</td>
<td></td>
<td>0.34</td>
<td>1.65</td>
</tr>
</tbody>
</table>

Figure 2 Graph shows mean microleakage of three sealers. Mean microleakage in Sealapex was 1.40±0.51, in MTA Fillapex it was 2.50±0.52 and in Meta Adseal it was 1.50±0.70.

© 2020 Discovery Publication. All Rights Reserved. www.discoveryjournals.org | OPEN ACCESS
4. DISCUSSION

Complete sealing of root canal laterally as well as apically is very important. Because of improper sealing of pulpal canal causes breakdown of endodontic treatment. For success of endodontic treatment hermetic sealing plays a vital role (Ehsani, 2014; Patni, 2016). There are different properties of endodontic sealers like antibacterial property, hermetic sealing. Also sealers show property of adhesion, radiopacity, lubrication. But for clinical success hermetic sealing and antibacterial properties plays a vital role (Altan et al., 2018). Till date none of the sealers satisfy all the ideal properties discussed above. But the sealers which are choosen in this study met the ideal requirement of sealers to some extent. There are different methods of obturation. Such as cold lateral copaction technique, warm vertical compaction technique and single cone technique etc. (Olczak & Pawlicka, 2017). In this study vertical compaction technique was used. Because, it provides excellent seal apically as well as laterally. It Also provide obturation of larger lateral as well as accessory canals (Lone & Khan, 2018).

There are various methods are invented for studying the microleakage. But stereomicroscopic analysis with dye penetration is the most commonly used method (Nikahde et al., 2019). It is because it has easy availability (Ballullaya et al., 2017). Easy to measure the microleakage score and Capture fine details. 1% methylene blue dye was used for the study. Because it shows better penetration and its molecular size is similar or microbes toxins (Ahuja et al., 2016). Present study resulted that Calcium hydroxide sealer shows least microleakage followed by resin based sealer followed by Calcium silicate based sealer shows more microleakage. When group I compared with group II mean value shows with group I was 1.4 and group II was 2.5. This means group I shows less leakage compared with group II. When group II compared with group III, mean value with group II was 2.5 and group III was 1.5. When group I and group III was compared. There was no statistical significant difference between were found between group I and group III. The result of the present study is in accordance with-

“A.Tomer et al compare the sealing ability of calcium hydroxide, MTA, and silicone based sealers”. Study resulted that sealapex shows less leakage compared with MTA Fillapex. While no significant difference were found between “Sealapex and Roekoseal” This is because Sealapex has property of volumetric expansion. It undergoes expansion in presence of water. This results in less leakage (Tomer et al., 2016).

“Cobankara FK et al. compare the sealing of four sealers with the use of fluid filtration method”. Sealapex shows lesser leakage compared to AH plus, polymeric based and ZOE based sealers (Ballullaya et al., 2017).

“H Altan et al. studied apical sealing ability of MTA fillapex, AH plus, Sealapex by fluid filtration method”. Study resulted that At 24 hour MTA Fillapex shows lesser leakage that other two sealers. While after 6 month Sealapex and AH plus shows less leakage compared to MTA Fillapex. It means Sealapex has long term effect with less microleakage (Altan et al., 2018).

“Asawaworarit et al. found that MTA Fillapex had more leakage compared to AH Plus after 7 days.” But after 4 weeks MTA Fillapex exhibit better sealing ability compared to AH Plus. MTA Fillapex constitutes salicylate resin. It causes long terms sealing ability as it has extended setting time (Asawaworarit et al., 2016).

“S.Sonmez et al studied apical microleakage of new MTA based sealer”. Study resulted that MTA Fillapex had highest microleakage compared to AH plus and MTA sealer (Sönmez et al., 2012).

“Jain V et al. evaluate the qualitative and quantitative analysis of microleakage of various endodontic sealers”. Study revealed that MTA Fillapex, sealapex shows better result with lesser microleakage as compared to other sealers (Jain et al., 2017).
“Ahuja L et al. studied sealing ability of new MTA based sealer with resin based sealer”. Study showed result that Adseal had better sealing ability than MTA Fillapex and Pro root MTA. This is because it has good flow and expansive ability. It means it expands while it sets. So it has good sealing ability and less leakage (Ahuja et al., 2016). “Singh R et al. studied the effect of irrigating solutions on the apical sealing ability of MTA Fillapex and Adseal root canal sealers”. Study resulted that “5.25% sodium hypochlorite followed by 17% EDTA and Adseal resulted in the best apical seal than MTA Fillapex” (Singh et al., 2016).

Limitations
This is an in vitro study so there is chance of error while performing the study. Also clinical scenario is different so chance that accurate result may not be produced.

5. CONCLUSION
Calcium hydroxide sealer shows least microleakage followed by resin based sealer followed by Calcium silicate based sealer shows more microleakage.

Acknowledgment
The authors are thankful to the sharad pawar dental college for providing necessary materials for this study.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCE
15. Patni PM, Chandak M, Jain P, Patni MJ, Jain S, Mishra P, Jain V. Stereomicroscopic evaluation of sealing ability of four...


