Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 873-879
Received 25 April 2021; Accepted 08 May 2021.

Comparison of the apical sealing ability of gutta-percha by three different obturation techniques: Lateral Condensation technique, Single cone root canal obturation technique and Injectable thermoplasticized gutta-percha technique (System B)

Dr. Ankur Chauhan[1], Dr. Sameer Makkar[2], Dr. Nisha Garg[3], Dr. Abhijeet Khade[4], Dr. Saurabh Bhagat[5], Dr. Ritika Agarwal[6]

[1]PG 3RD YEAR, Dept of Conservative Dentistry and Endodontics, Bhojia Dental College And Hospital, Baddi, HP.

[2]Professor and head, Dept of Conservative Dentistry and Endodontics, Bhojia Dental College And Hospital, Baddi, HP.

[3]Professor , Dept of Conservative Dentistry and Endodontics, Bhojia Dental College And Hospital, Baddi, HP.

[4]Senior lecturer , Dept of Conservative Dentistry and Endodontics, DR H S R S M DENTAL COLLEGE AND HOSPITAL, HINGOLI.

[5]Senior lecturer, Dept of Conservative Dentistry and Endodontics, Baba Jaswant Singh Dental College and Hospital, Ludhiana.

[6]MDS, Senior Resident, Oral Medicine and Radiology, Dept of Dentistry, Patna Medical College and Hospital, Patna.

Corresponding Author: Dr Ankur Chauhan, PG 3RD YEAR, Dept of Conservative Dentistry and Endodontics, Bhojia Dental College And Hospital, Baddi, HP.

ABSTRACT:

Aims & objectives: Comparing the apical sealing ability of gutta-percha by three different obturation techniques: Lateral Condensation technique, Single cone root canal obturation technique and Injectable thermoplasticized gutta-percha technique (System B).

Materials & methods:75 freshly extracted single rooted teeth were collected from the department of Oral and Maxillofacial Surgery, Bhojia Dental College and Hospital, Baddi, and cleaned under running tap water, disinfected using 5.25% NaOCl and stored in normal saline before use. All the specimens were randomly divided into three groups and access cavities were prepared using diamond burs with air rotor handpiece. After pulp tissue removal from pulp chamber, # 15 K- file were introduced into canal until it was seen at the tip of apical foramen. The size and flaring of the coronal preparation was dictated by the diameter of injection needle of System B system. The Zinc Oxide Eugenol sealer was used in this study. Instrumented single rooted teeth were randomly assigned one of the three groups. These three groups include: Group A – 25 single rooted teeth were obturated with Lateral condensation, Group B – 25 single rooted teeth were obturated with Single cone technique, and Group C – 25 single rooted teeth were obturated with System B technique. The teeth remained submerged in the dye for additional 48 hrs at room temperature under atmospheric pressure. The extent of dye penetration in the specimens for each group will be tabulated and a Statistical analysis was performed.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 873-879
Received 25 April 2021; Accepted 08 May 2021.

Results: Mean microleakage among specimens of group 1, group 2 and group 3 was 0.26 mm, 0.29 mm and 0.33 mm respectively. While comparing the mean microleakage in between the three study groups, non-significant results were obtained.
Conclusion: Lateral condensation obturation technique, Single cone obturation technique and Injectable thermoplasticized gutta- percha obturation technique (System B) are equally effective as root canal obturation materials for preventing apical microleakage. Nevertheless, further clinical studies are necessary to confirm these results and evaluate their relevance to the treatment outcome.
Keywords: Apical microleakage, lateral condensation, obturation technique.

INTRODUCTION

Dental caries is a biofilm-mediated, sugar-driven, multifactorial, dynamic disease that results in the phasic demineralization and remineralization of dental hard tissues. A key to successful endodontics and a major goal of contemporary nonsurgical root canal treatment is to seal completely both the apical and coronal avenues of potential leakage and maintain the disinfected status reached by the chemical and mechanical cleaning to prevent reinfection and percolation of bacterial substrates, allowing the periodontium to maintain its integrity and to achieve healing. Ingle found that nearly 60% of endodontic failures were due to the incomplete obturation of the root canal system. Cold lateral condensation, after being successfully tested and used, has set the golden standard in endodontics. However, it has been found that cold gutta-percha (GP) techniques rely heavily on a root canal sealer to address the problem of the accessory anatomy, as the core filling material does not move out of the main canal. Only voids and spreader tracts are reported.[1- 3]

Although tug-back is necessary to obturate the root canal, in some cases there are possibility of errors to fit the gutta-percha master cone into the 1 to 3 mm end of the root canal. These include; (i) in apexification cases that have large diameter at the end of the canal (Blunder Buss); (ii) in recently completed tooth apex (young teeth) the shape of canal in transverse plan is oval, so the fitting of gutta-percha master cone in the apical portion of the canal is only on two planes: (iii) despite canal preparation, there are some irregularities in the inner surface of the root. The gutta-percha master cone cannot fit in to these irregularities.[4- 6]

Newer contemporary methods of obturation that involve thermal softening include injectable thermoplasticized gutta percha systems (Obtura II), heat condensers and recently, the use single cone obturation is introduced. Newer methods using warm gutta-percha have been introduced using high or low temperature thermoplasticized injectable gutta-percha.[7] Hence; under the light of above mentioned data, the present study was undertaken for evaluating and comparing the apical sealing ability of gutta-percha by three different obturation techniques: Lateral Condensation technique, Single cone root canal obturation technique and Injectable thermoplasticized gutta-percha technique (System B).

MATERIALS & METHODS

This in vitro study was conducted in the Department of Conservative Dentistry & Endodontics, Bhojia Dental College and Hospital, Baddi. The aim of present study was to evaluate and compare the apical microleakage in root canals filled with three different obturating techniques.

1. Group-A Cold lateral condensation obturation technique
2. Group-B Single cone obturation technique
3. Group-C Injectable thermoplasticized gutta- percha obturation technique. (System B)

In this study, 75 freshly extracted single rooted teeth were collected from the department of Oral and Maxillofacial Surgery, Bhojia Dental College and Hospital, Baddi, and cleaned

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 873-879
Received 25 April 2021; Accepted 08 May 2021.

under running tap water, disinfected using 5.25% NaOCl and stored in normal saline before use.
Selected teeth were carefully examined under stereomicroscope to rule out pre- existing fractures and radiographed to check for internal resorption, obliterated root canal space or any other anatomical variation. All debris on the extracted teeth was removed with an ultrasonic scaler. The teeth was then be placed into 5.25% NaOCL for 8 hours to remove any organic debris after cleaning, teeth were rinsed and stored in saline.
To eliminate variables in access preparation and to facilitate instrumentation and obturation and to aid in precise length control, root standardization of 14 mm was done with slow speed micro motor hand-piece under a constant water flow. The specimens were stored in sterile water until the procedure was performed.

ACCESS PREPARATION:
All the specimens were randomly divided into three groups and access cavities were prepared using diamond burs with air rotor handpiece.

CANAL INSTRUMENTATION:
After pulp tissue removal from pulp chamber, # 15 K- file were introduced into canal until it was seen at the tip of apical foramen. This length subtracted by 1 mm established the working length of each canal. Hyflex CM rotary files were used to clean and shape the canals using 17% EDTA as a canal lubricant. Maximum apical preparation size of the teeth was # 40.
The size and flaring of the coronal preparation was dictated by the diameter of injection needle of System B system. For the sake of uniformity, all preparations were made to standard dimensions regardless of filling technique. After every file size, all canals were irrigated with 2 ml of 5.25% NaOCL followed by normal saline. Each of the root canal was dried using paper points.

Sealer standardization:
The Zinc Oxide Eugenol sealer was used in this study. It was mixed to a creamy homogenous texture as per manufacturer's instructions and was used to coat the canal walls of selected teeth.

CANAL OBTURATION:
Instrumented single rooted teeth were randomly assigned one of the three groups. These three groups include
Group A – 25 single rooted teeth were obturated with Lateral condensation.
Group B – 25 single rooted teeth were obturated with Single cone technique.
Group C – 25 single rooted teeth were obturated with System B technique.
The patency of individual canal were checked with a# 10 K-file, after which the apical stop was checked with Hyflex CM no 40 file. Each canal was then be irrigated with 2 ml of 5.25% NaOCl followed by normal saline and dried with absorbent paper points. All canal preparations and obturations were performed by the operator under aseptic environment throughout this study.
Just prior to obturation, canal was coated with thin layer of sealer with the help of lentulo-spiral by rotating counter-clock wise and then up and down motion twice throughout the length of the canal.
Lateral Condensation Technique (Group A):n=25
Single cone Obturation Technique (Group B):n=25
Thermoplasticized injectable gutta-percha technique (Group-C):n=25
All the teeth were coated except the apical 3 mm with two layers of nail varnish, allowing

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 873-879
Received 25 April 2021; Accepted 08 May 2021.

each layer to dry between coats. The roots were immersed in a sealed bottle containing 2% Methylene blue dye upto 3 mm from the apical portion of the root leaving rest of the root portion out of dye. pH was adjusted to by mixing 2 gm of methylene blue powder with 100 ml of standard buffer solution [Potassium phosphate and Monobasic sodium hydroxide (0.05 M)]. The teeth remained submerged in the dye for additional 48 hrs at room temperature under atmospheric pressure. The roots were removed from the dye and rinsed with tap water. They were allowed to air dry for 36 hours at room temperature. The roots were sectioned longitudinally in labiolingual direction, at low speed with carborundum disc. The specimen were mounted on a glass slide and the extent of dye penetration was measured using Stereo microscope of 20x magnification. Measurements were recorded from the minor diameter of the tooth to the most coronal extent of the dye penetration. The extent of dye penetration in the specimens for each group will be tabulated and a Statistical analysis was performed.

RESULTS

Mean microleakage among specimens of group 1, group 2 and group 3 was 0.26 mm, 0.29 mm and 0.33 mm respectively. While comparing the mean microleakage in between the three study groups, non-significant results were obtained.

Table 1: Mean Microleakage among Different Study Groups

Microleakage	Group 1	Group 2	Group 3
Mean (mm)	0.26	0.29	0.33
SD	0.043	0.051	0.064

Table 2: Comparison of Microleakage among Different Study Groups

Microleakage	Group 1	Group 2	Group 3
Mean	0.23	0.25	0.31
SD	0.050	0.064	0.073
F- Value	1.027		
P- Value	0.361 (Non-Significant)		

Table 3: Individual Group Comparison of Mean Microleakage

Multiple Comparison	T-Value	P-Value
Group 1 Versus Group 2	0.018	0.918 (Non-Significant)
Group 2 Versus Group 3	1.128	0.215 (Non-Significant)
Group 1 Versus Group 3	1.335	0.324 (Non-Significant)

DISCUSSION

The obturation of root canal system needs a lot of attention. Many failures in root canal treatment in long term are related to incomplete obturation. A good filling should be perfectly dense and creates a complete seal in all three dimensions of the root canal. Root canal obturation should be ended to the apical constriction. Many obturation techniques and equipments are presented so far to enhance and improve the quality of root canal seal. These include cold lateral condensation, vertical condensation, obtura II, System B, Ultrafill, Thermafill, Sucessfill, Simplifill, thermomechanical condensation, and chloroform dip technique. Lateral condensation technique is one of the most common methods of root canal obturation. In conventional obturation methods, the tug-back in the gutta-percha master cone is recommended in order to create and maintain the apical seal.[8- 10] Hence; under the light of above mentioned data, the present study was undertaken for evaluating and comparing the apical sealing ability of gutta-percha by three different obturation techniques: Lateral

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 873-879
Received 25 April 2021; Accepted 08 May 2021.

Condensation technique, Single cone root canal obturation technique and Injectable thermoplasticized gutta-percha technique (System B).

In the present study, mean microleakage among the specimens of group 1, group 2 and group 3 was found to be 0.23 mm, 0.25 mm and 0.31 mm respectively. While comparing statistically, non-significant results were obtained. Also, while doing inter-group comparison in between individuals group, non-significant results were obtained. Our results were in concordance with the results obtained by various authors who reported similar findings in their respective studies. In a previous study conducted by Samson E et al, authors didn't observe any significant difference while comparing the apical dye penetration between lateral condensation and Obtura II.[11] Study by Rahimi et al showed no statistical significance between the lateral condensation and Obtura II techniques, whereas, on the contrary, Tsukada et al showed that the technique using melted gutta percha alone may not be favourable as compared with lateral condensation. The variations in results may be due to the fact that thermoplastic root canal filling methods like Obtura II is technique sensitive.[12- 14]

The Washington study of endodontic success and failure suggests apical percolation of periradicular exudates into the incompletely filled canals as the greatest cause of endodontic failures, (Ingle 1994) although apical percolation may be considered as a logical hypothesis. However, the role of the end products of microleakage in the production of periradicular inflammation is open to speculation. It would seem safe to assume that noxious products leaking from the apical foramen acts as an inflammatory irritants.[15- 17]

Estimation of sealing quality in in vitro studies is done by measuring microleakage that allows the tracer agent to penetrate the filled canal. A study concluded that, methylene blue can be used as a dye of choice, since it is inexpensive, easy to manipulate, has a high degree of staining and a molecular weight even lower than that of bacterial toxins. According to Camps and Pashley, both dye extraction method and fluid filtration method gave similar results, because both the techniques measure quantitatively the fluids passing through the interface between root and the obturating materials. The dye extraction method presents great advantage over fluid filtration method, as the time passes, the values in fluid filtration method tend to diminish as the water tends to penetrate all the irregularities before reaching a platuea.[18- 20] Hence, in the present study, methylene blue dye and linear apical microleakage method was followed.

Lateral compaction had 78.1% of overall filling, the lowest value of all the fillings. This was mainly because this technique does not produce a homogeneous mass and may leave spaces between the GP and the dentinal walls or accessory cones. The accessory and master cones are laminated and remain separate from each other. Sometimes, the sealer fills the space between the cones, often depicting a denser root fill. Sequential injection and then multiple compactions of warm GP compensate for the contraction of GP that takes place on cooling and hence creates a dense obturation.[21] Yilmaz et al compared the apical efficacy of the BeeFill 2in1, System B heating device and Obtura II systems with the single-cone and cold lateral compaction techniques at one and two weeks. There were no differences in the apical seal of the root canals filled with either of the techniques; however, they were not capable of completely blocking the fluid conductance.[10]

Various studies have employed different methods to evaluate apical and coronal microleakage like the degree of dye penetration, radioisotope penetration, bacterial penetration, electrochemical means and fluid filtration techniques. However, no concrete results are available that prove the superiority of one sealer over the others. Dye penetration method is a common technique for microleakage studies; the advantages are low cost, low toxicity, good availability and ease of storage. Torabinejad et al. has stated that if a root filling material does not allow penetration of small particles such as dye molecules, it is more likely to have the potential to prevent microleakage of bacteria and their by-products. As

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 873-879
Received 25 April 2021; Accepted 08 May 2021.

methylene blue has a low molecular weight and penetrates more deeply along the root canal filling, we used it as a leakage marker for the current study.[22- 24]

In the present study, no-significant difference was observed while comparing the microleakage among specimens of lateral condensation and single cone obturation group. These results corroborate with a previous study that reported no difference between the apical sealing efficiency of these two techniques.[9] However, when a bacterial leakage model was used, root canals obturated with single cone Protaper gutta-percha points (Dentsply Maillefer) showed significantly greater bacterial penetration than cold laterally compacted gutta-percha, laterally compacted Protaper gutta-percha, Thermafil (Dentsply Maillefer), and System B (Synbron Endo) at 30 days. Interestingly, the same study failed to show significant differences among the test groups at 60 days, indicating that the 30-day differences were only related to the reduction of the speed of bacterial penetration, and not with the sealing efficacy of the tested obturation systems, which all were levelled eventually.[25]

CONCLUSION

Lateral condensation obturation technique, Single cone obturation technique and Injectable thermoplasticized gutta- percha obturation technique (System B) are equally effective as root canal obturation materials for preventing apical microleakage. Nevertheless, further clinical studies are necessary to confirm these results and evaluate their relevance to the treatment outcome.

REFERENCES

1. Pitts NB1, Zero DT2, Marsh PD3, Ekstrand K4, Weintraub JA5, Ramos-Gomez F et al. Dental caries. Nat Rev Dis Primers. 2017 May 25;3:17030. doi: 10.1038/nrdp.2017.30.
2. Featherstone JD. Dental caries: a dynamic disease process. Aust Dent J. 2008 Sep;53(3):286-91.
3. Peters LB, Wesselink PR, Moorer WA. The fate and the role of bacteria left in root dentinal tubules. Int Endod J. 1995;28:95–9.
4. Ingle JI, editor. Obturation of the radicular space. 5th ed. Hamilton, Canada: 2008. Endodontics; p. 571.
5. Weller RN, Kimbrough WF, Anderson RW. A comparison of thermoplastic obturation techniques: Adaptation to the canal walls. J Endod. 1997;23:703–6.
6. Tabassum S, Khan FR. Failure of endodontic treatment: The usual suspects. Eur J Dent. 2016;10(1):144–147.
7. Estrela C, Holland R, Estrela CR, Alencar AH, Sousa-Neto MD, Pécora JD. Characterization of successful root canal treatment. Braz Dent J. 2014 Jan-Feb;25(1):3-11.
8. Wong AW, Zhang S, Li SK, Zhang C, Chu CH. Clinical studies on core-carrier obturation: a systematic review and meta-analysis. BMC Oral Health. 2017;17(1):167. Published 2017 Dec 29.
9. Gordon MP, Love RM, Chandler NP. An evaluation of. 06 tapered gutta-percha cones for filling of. 06 taper prepared curved root canals. Int Endod J. 2005;38:87–96.
10. Yilmaz Z1, Deniz D, Ozcelik B, Sahin C, Cimilli H, Cehreli ZC, Kartal N. Sealing efficiency of BeeFill 2in1 and System B/Obtura II versus single-cone and cold lateral compaction techniques. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009 Dec;108(6):e51-5. doi: 10.1016/j.tripleo.2009.07.057.
11. Samson E, Kulkarni S, Sushil K C, Likhitkar M. An In-Vitro Evaluation and Comparison of Apical Sealing Ability of Three Different Obturation Technique - Lateral Condensation, Obtura II, and Thermafil. J Int Oral Health 2013; 5(2):35-43.
12. Rahimi S, Oskoee SS, Maljaei SS, Abdolrahimi M, Mokhtari H, Kazemi A. In vitro comparision of apical microleakage following canal obturation with lateral and

thermoplasticized gutta percha compaction techniques. Afr J Biotech. 2010;9:8235–40.
13. Tsukada G, Tanaka T, Torii M, Inoue K. Shear modulus and thermal properties of gutta percha for root canal filling. J Oral Rehabil. 2004;31:1139–44.
14. Kqiku L, Weiglein A, Städtler P. A comparative study of five different obturation techniques. Acta Stomatol Croat. 2006;40:3–11.
15. Ingle J, Bakland LK, editors. Endodontics. 4. Williams and Wilkins; Malvern: 1994. p. 228.
16. Anil K, Shivanna V, Thomas N, Shivamurthy GB. Comparative evaluation of the apical sealing ability and adaptation to dentine of three resin-based sealers: An in vitro study. J Conserv Dent. 2011;14(1):16–20.
17. Brosco VH, Bernardineli N, Moraes IG. In vitro" evaluation of the apical sealing of root canals obturated with different techniques. Journal of applied Oral Science. 2003;11(3):181–185
18. Beatty RG, Haddix J, Baker S, Hart F. The Efficacy of four root canal obturation techniques preventing apical dye penetration. Journal of American Dental Association. 1989;119(5):633–636
19. Camps J, Pashley D. Reliability of the dye penetration studies. J Endod. 2003;29:592–4.
20. Veríssimo DM, do Vale MS. Methodologies for assessment of apical and coronal leakage of endodontic filling materials: A critical review. J Oral Sci. 2006;48:93–8.
21. Jindal D, Sharma M, Raisingani D, Swarnkar A, Pant M, Mathur R. Volumetric analysis of root filling with cold lateral compaction, Obtura II, Thermafil, and Calamus using spiral computerized tomography: An In vitro Study. Indian J Dent Res 2017;28:175-80
22. Torabinejad M, Watson TF, Pitt Ford TR. Sealing ability of a mineral trioxide aggregate when used as a root end filling material. J Endod. 1993 Dec;19(12):591–5.
23. van der Sluis LW, Wu MK, Wesselink PR. An evaluation of the quality of root fillings in mandibular incisors and maxillary and mandibular canines using different methodologies. J Dent. 2005;33(8):683–8.
24. Sevimay S, Kalayci A. Evaluation of apical sealing ability and adaptation to dentine of two resin-based sealers. J Oral Rehabil. 2005;32(2):105–10.
25. Yucel AC, Ciftci A. Effect of different root canal obturation techniques on bacterial penetration. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102:e88-e92