ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 4, Issue – 6, December - 2021, Page No. : 307 - 313

Comparison of apical microleakage in different root canal obturation techniques: An in-vitro study

[1]Dr. Monika Rawat, Post Graduate student, Department of Conservative Dentistry and Endodontics, Inderprastha dental college and hospital, Sahibabad 201010.

[2]Dr. Dakshita Joy Sinha, Professor and Head, Department of Conservative Dentistry and Endodontics, Inderprastha dental college and hospital, Sahibabad 201010.

[3]Dr. Sarita Singh, Professor, Department of Conservative Dentistry and Endodontics, Inderprastha dental college and hospital, Sahibabad 201010.

[4]Dr. Beenish Parvez, Post Graduate student, Department of Conservative Dentistry and Endodontics, Inderprastha dental college and hospital, Sahibabad 201010.

[5]Dr. Pranshu, Post Graduate student, Department of Conservative Dentistry and Endodontics, Inderprastha dental college and hospital, Sahibabad 201010.

[6]Dr. Isha Singh, Post Graduate student, Department of Conservative Dentistry and Endodontics, Inderprastha dental college and hospital, Sahibabad 201010.

Corresponding Author: Dr. Dakshita Joy Sinha, Professor and Head, Department of Conservative Dentistry and Endodontics, Inderprastha dental college and hospital, Sahibabad 201010.

Citation of this Article: Dr. Monika Rawat, Dr. Dakshita Joy Sinha, Dr. Sarita Singh, Dr. Beenish Parvez, Dr. Pranshu, Dr. Isha Singh, "Comparison of apical microleakage in different root canal obturation techniques: An in-vitro study", IJDSIR- December - 2021, Vol. – 4, Issue - 6, P. No. 307 – 313.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: To comparatively evaluate the apical sealing ability of three different obturation techniques.

Materials and Method: 60 extracted mandibular single rooted human permanent premolars were access opened and working length was determined using 15 K file. ProTaper Rotary System was used for root canal preparation. Teeth were obturated using 3 obturation methods and were divided into 4 groups (n=15): control group, lateral condensation group, single cone group and thermoplastic zed group. Teeth were sectioned along the long axis of the tooth vertically in a buccolingual direction and the split segments were examined under stereomicroscope at 10X magnification. The data collected was then evaluated using statistical analysis.

Conclusion: Thermoplastic zed technique is better than Lateral condensation and Single cone obturation methods as it exhibited least amount of apical microleakage amongst the three groups.

Key words: Apical microleakage, Lateral condensation, Dye penetration, Single cone obturation, Thermoplastic zed obturation.

Introduction

3-D obturation of the endodontic spaces is the ultimate objective of root canal treatment after cleaning and shaping of root canals. Complete sealing of the main root canals and all "portals of exit" to restrict any future communication between the periodontium and endodontium is the main purpose of obturation. In order to prevent any empty spaces, the filling must entirely fill the root canal. Many endodontic failures are reported that are related to incomplete root canal obturation.[1]

Necrotic pulp remnants along with the accumulating exudate, can contribute to their viability. Entrapment without nutritional sources and with reduced possibility of proliferation of the microorganism occurs when the root canal system is completely obturated in all three dimensions.[2]

Fluid- impervious seal is mostly provided by obturation techniques using a sealer and a core material. Till date, researchers have not found any obturation technique providing a complete seal.[3] Dow and Ingle[4] reported approx. 60% of endodontic failure related to incompletely filled canals. Many changes have been made in the techniques of biomechanical preparation and root canal obturation based on the results of the apical microleakage studies.

For the promotion of complete sealing of root canal space, many obturation techniques based on heated or preheated heated gutta-percha have been introduced. These include- Cold lateral condensation Schilder's technique, Single cone, Thermafil technique and Thermoplastic zed gutta percha. An endodontic sealer, with all these techniques is recommended.[5]

Evaluation of the apical sealing ability of root canal fillings have been carried out using various methods such as- Dye penetration method, Bacterial penetration measurement electrochemical techniques, Fluid filtration techniques Glucose leakage test and Radioisotope techniques. Still there is a constant effort in searching for the ideal obturation technique and the best method for evaluating apical microleakage in obturated teeth.[6]

Materials and Method

60 extracted single rooted mandibular premolars for this study were collected from the Department of Oral Surgery of Inderprastha Dental College and Hospital, Sahibabad. Teeth with more than one root, root caries, cracked teeth, immature or open root apices, calcified canals, pulp stones, excessive curvatures (Type 1 Schneider's classification), internal or external resorption were excluded from the study.

Teeth were collected and stored in 0.9% isotonic saline. Before initiation of the study, organic debris was removed by placing the teeth in 5.25% sodium hypochlorite (Chemdent, Vensons India) for 8 hours. Endo access bur (Dentsply, Maillefer, Switzerland) was used for access opening. Patency of root canals and glide path was established using 10 K (Dentsply, Maillefer, Switzerland) file. The working length determination was done by Apex locator (Woodpex III Gold, Woodpecker, Dent mark) using the 15 K file and was confirmed through radiograph.

ProTaper universal rotary system (Dentsply, Maillefer, Switzerland) was used with the following the recommended sequence (S1, S2, F1, F2, F3 and F4) in a crown down manner for root canal preparation. To remove the smear layer and inorganic debris, 17% Ethylene Diammine Tetra Acetic Acid (Avue prep) was used as a lubricant. 5.25 % Sodium Hypochlorite and saline were used as irrigants. 2ml of 5.25% NaOCl was used for irrigation of canals in between each file. After preparing all teeth, they were divided into 4 groups. Each group consisted of 15 specimens.

Group 1: Control

Group 2: Cold lateral condensation

Group 3: Single cone

Group 4: Thermoplastic zed gutta percha

Group 1: After access cavity and biomechanical preparation was done, teeth were obturated with single cone technique but prior to the commencement of dye leakage test, the entire root apex of the tooth was covered with nail varnish.

Group 2: The gutta percha point (Meta-Biomed, USA) having a tug back fitted to 0.5mm short of predefined working length was chosen as master cone in lateral condensation technique. Seal apex (Sybron Endo, Kerr Dental) was coated around the master gutta percha point as sealer and placed in the root canal. For lateral compaction accessory cones were placed into the canal space. Excess gutta percha was removed and endodontic pluggers were used in vertical motion for compaction of the gutta percha.

Group 3: F3 ProTaper gutta percha cone (Dia-Pro T, Diadent, USA) coated with freshly prepared Seal apex sealer was used for obturating the canals. The gutta percha cone was inserted firmly to 0.5mm short of the pre-defined working length with tug back method.

Group 4: Seal apex was coated onto the canal walls upto 0.5mm short of the pre-defined working length. The temperature of Calamus unit was set at 200°C, and thermosoftened gutta percha was dispensed into the most apical part of canal with the help of Calamus Flow handpiece in 2 to 3 mm segment. For compaction of warm gutta percha into the canal, plugger was used. Continuous filling of gutta percha into the canal was done using backfilling technique until the canal was completely reversed filled.

Obturation was done and the access cavities were sealed using Cavit. In order to allow complete setting of the sealer and were then stored in 100% humidity for 24 hrs. They were stored in an incubator (Yorco, York Scientific Industries Pvt Ltd) at 37°C for 7 days. Nail varnish covered entire root except the apical 2mm. Aqueous solution of 2% methylene blue dye at 37°C was used to immerse the teeth, in a vacuum machine (Renfert) for 30 minutes. All the teeth were rinsed in running tap water in order to remove the dye. Water cooled diamond disc (Syndent) of 0.2mm diameter was used for sectioning of the teeth. The split segments were examined under the stereomicroscope at 10X magnification to assess the dye penetration. This distance from apex to the most coronal part of the root was measured in millimetres on digital images of sectioned specimens which had been captured using stereomicroscope. The data collected was then statistically evaluated.

Result

Table 1 shows the distribution of mean ± S.d. apical dye penetration (mm.) among the groups. The mean of apical dye penetration (mm.) (2.1180) in Cold Lateral Condensation group is significantly lower than Single cone group while significantly higher than Control and Thermo plasticized Gutta Percha group. The means of apical dye penetration (mm.) (3.8240) in Single cone group is significantly higher than other groups. The mean of apical dye penetration (mm.) (1.3607) in Thermo plasticized Gutta-percha group was significantly lower than Cold Lateral Condensation & Single Cone groups while higher than control group (Fig.1).

Table1: Distribution of mean and S.d. of Apical dye penetration (mm) among the groups.

	N	Mean Std. ±Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Control	15	.1880±.08385	.02165	.1416	.2344	.08	.34
Cold Lateral Condensation	15	2.1180±.39611	.10228	1.8986	2.3374	1.45	2.81
Single Cone	15	3.8240±.61151	.15789	3.4854	4.1626	2.86	4.76
Thermo plasticized Gutta Percha	15	1.3607±.47115	.12165	1.0998	1.6216	.69	2.21

Fig1: Apical dye penetration (mm).

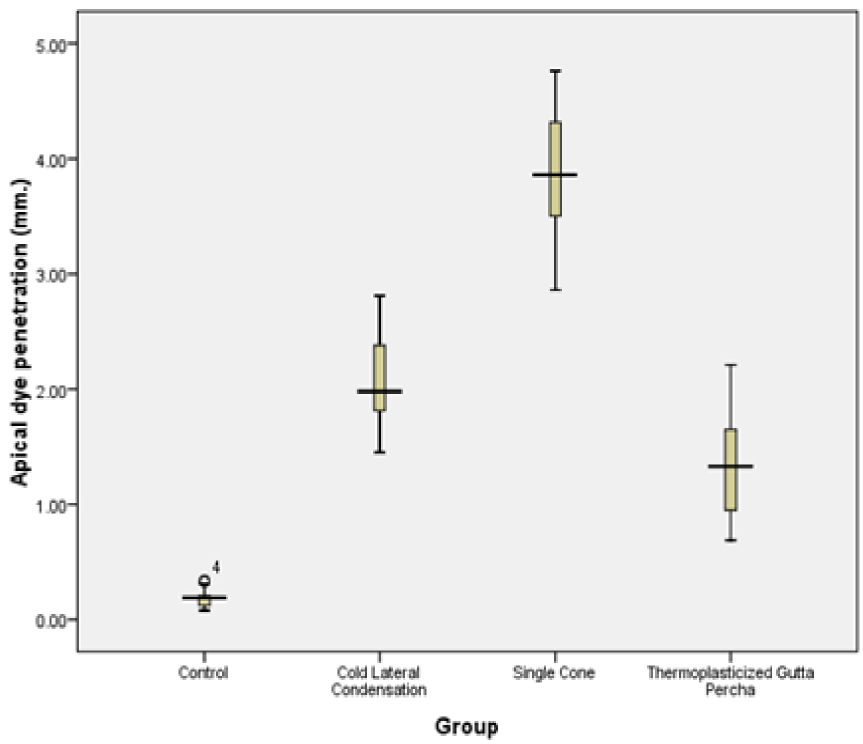

Table 2 shows multiple comparison of means of apical dye penetration (mm.) between groups by Tukey HSD test, the difference mean ±S.E.M. of apical dye penetration between Control & Cold Lateral Condensation (-1.93000±.15915), Control & Single Cone (-3.63600±.15915), Control & Thermo plasticized Gutta Percha(-1.17267±.15915), Cold Lateral Condensation & Single Cone (-1.70600±.15915), Cold Lateral Condensation & Thermo plasticized Gutta Percha (.75733±.15915), Single Cone & Thermo plasticized Gutta Percha(2.46333±.15915) are highly significant, p<0.001. Therefore mean of apical dye penetration (mm.) (.1880) in control groups is significantly lower than

Single Cone, Lateral Condensation, and Thermo plasticized Gutta Percha groups.

Table 2: Intergroup comparison of mean apical dye penetration (mm).

Groups	Mean Difference Std. ±Error	P value	95% Confidence Interval	
			Lower Bound	Upper Bound
Control vs Cold Lateral Condensation	-1.93000±.15915	<0.001**	-2.3514	-1.5086
Control vs Single Cone	-3.63600±.15915	<0.001**	-4.0574	-3.2146
Control vs Thermoplastic zed Gutta Percha	-1.17267±.15915	<0.001**	-1.5941	-.7513
Cold Lateral Condensation vs Single Cone	-1.70600±.15915	<0.001**	-2.1274	-1.2846
Cold Lateral Condensation vs Thermoplastic zed Gutta Percha	.75733±.15915	<0.001**	.3359	1.1787
Single Cone vs Thermoplastic zed Gutta Percha	2.46333±.15915	<0.001**	2.0419	2.8847

Discussion

Passage of bacteria, fluids, ions or molecules between restorative material and tooth which is clinically undetectable is defined as microleakage in endodontics. Failure in endodontics have been mostly associated with coronal or apical microleakage. Leakage of tissue fluids into the canal space and entry of micro-organisms account for apical microleakage.[7] According to Ingle and Backland (1996)[8], incomplete sealing of the root canal have been linked to 60% of endodontic failure. Thus, emphasizing on the importance of three-dimensional obturation.

A confounding factor with a thermoplastic zed injectable gutta-percha technique is the size of apical preparation of the root canal. Insertion of the injection needle maybe prohibited by narrow or curved canals. Though this was not a problem in the present study as the premolar teeth taken had wide straight canals. To minimize bias, canals were prepared upto the same apical size (i.e. F4 preparation). In order to reduce bias, a single operator carried out all the procedures. Clinical success rates might get influenced by the under extensions or overextensions of gutta-percha.[9]

Thermoplasticised obturation has become popular as the compaction of α-gutta percha creates a homogenous root canal filling with lesser voids that would otherwise be created because of spreader use and the inherent non-adhesive nature of β-gutta percha points used in lateral condensation.[10]

The teeth were placed at 37 °C in 100% humid environment for 7 days, for complete setting of sealer for mimicking the oral cavity in in-vitro setup.[11] By using chemically active, adhesive root canal sealers, apical leakage is minimized.[12] In the present study, 17% EDTA was used to remove smear layer and 5.25% NaOCI was used as irrigant to increase the surface contact between the intracanal walls and the filling material.

Seal apex, a calcium hydroxide-based sealer used in the present study, stimulates the periapical tissues for better healing and has good sealing ability. It induces hard tissue formation and provides antibacterial and tissue repair abilities. According to Ashwini K.S *et al* [13] Seal apex sealer exhibited more resistance to leakage than zinc oxide eugenol-based sealer which was in accordance with the study by Sleder FS et al.[14]

Various methods have been used to detect the apical seal obtained by root canal obturation. E.g. dye penetration, bacterial leakage, radioisotope penetration, fluid filtration, fluorometric and electrochemical means, gas chromatography and scanning electron.[15] In this study, dye penetration method was used to compare apical microleakage in obturated root canals. Quantitative measurement of the extent of dye penetration can be done using methylene blue dye.

82% of leakage studies conducted in endodontics, apical microleakage has been evaluated using dye penetration or radioisotope.[16] Dye penetration tests are preferred as they are easy to perform and cost effective with reduced armamentarium. The methylene blue dye is detectable in the concentration of 2.0% under visible light. It is water soluble and easily diffusible with no uptake by the dentine matrix.[17] The molecular weight of methylene blue dye is comparable to a few bacterial by-products, e.g. butyric acid, that were reported to leak from the infected root canal space into the periapex.[18]

Gencoglu et al.[19] reported that Soft Core, Thermafil, Quick-Fill and system B techniques showed reduced leakage than cold lateral condensation. According to Manal Faria et al [20] cold lateral condensation exhibited significantly more apical microleakage than system B technique. These studies showed results in conjunction with our study.

Conclusion

From the results of this study, the authors concluded that apical microleakage was present in all the three groups with some differences in the microleakage values. But within the limitations of this in-vitro study, it was observed that least amount of apical microleakage was exhibited by thermoplastic zed gutta percha, followed by cold lateral condensation and single cone technique. This area requires more experimental studies to be done in future to evaluate which obturation method is best suited for the root canal treatment.

References

1. Dow PR, Ingle JI. Isotope determination of root canal failure. Oral Surg Oral Med Oral Pathol 1955; 8:1100–4.
2. Andreasen JO, Rud J. A histobacteriologic study of dental and periapical structures after endodontic surgery. Int J Oral Surg 1972; 1:272–81.
3. Leonard JE, Gutmann JL, Guo IY. Apical and coronal seal of roots obturated with a dentine bonding agent and resin. Int Endod J 1996;29(2):76–83.
4. Dow PR, Ingle JI. Isotope determination of root canal failure. Oral Surg Oral Med Oral Pathol 1955; 8: 181-5.
5. Ingle JI, Bebridge E, Glick D, Weichman J. The Washington study. In: Ingle JI, Bakland LK, eds. Endodontics. 4th Edition. Baltimore, MD: Williams & Wilkins; 1994.p.25.
6. Wu MK, Wessel ink PR. Endodontic leakage studies reconsidered. Part I. Methodology, application and relevance. Int Endod J 1993 Jan; 26(1):37-43
7. AlHabdan AA. Review of microleakage evaluation tools. J Int Oral Health 2017;9(4):141-5.
8. Ingle JI, Bebridge E, Glick D, Weichman J. The Washington study. In: Ingle JI, Bakland LK, eds. Endodontics. 4th Edition. Baltimore, MD: Williams & Wilkins; 1994.p.25.
9. Goodman A, Schilder H, Aldrich W. The thermomechanical properties of gutta-percha. II. The history and molecular chemistry of gutta-percha. Oral Surg Oral Med Oral Pathol 1974;37(6):954–61.

10. Storms JL. Factors that influence the success of endodontic treatment. J Can Dent Assoc 1969; 35:83-97.
11. Tomson R, Polycarpou N, Tomson P. Contemporary obturation of the root canal system. Br Dent J 2014;216(6):315–22.
12. Oksan T, Aktener BO, Sen BH, Tezel H. The penetration of root canal sealers into dentinal tubules. A scanning electron microscopic study. Int Endod J 1993; 26:301-5
13. Ashwini KS, Devadiga D, Hegde MN, et al. Evaluation of microleakage of four root canal sealers - a fluorescent microscope study. J Evolution Med Dent Sci 2020;9(50): 3800-3805.
14. Sleder FS, Ludlow MO, Bohacek JR. Long-term sealing ability of a calcium hydroxide sealer. J Endod 1991;17(11):541-3.
15. Dalat DM, Spångberg LS. Comparision of apical leakage in root canals obturated with various gutta percha techniques using a dye vacuum tracing method. J Endod 1994; 20:315-9.
16. WU MK, De Gee AJ, Wesselink PR, Moorer WR. Fluid transport and bacterial penetration along root canal fillings. Int Endod J 1993;26(4):203–8.
17. Limkangwalmongkol S, Burtscher P, Abbott PV, Sandler AB, Bishop BM. A comparative study of the apical leakage of four root canal sealers and laterally condensed gutta-percha. J Endod 1991;17(10):495–9.
18. Bodrumlu E, Tunga U. Apical leakage of Resilon obturation material. J Contemp Dent Pract 2006;7(4):45–52.
19. Gencoglu N, Orucoglu H, Helvacioglu D. Apical leakage of different gutta-percha techniques: Thermafil, Js Quick-Fill, Soft Core, Micro seal, System B and lateral condensation with a computerized fluid fifiltration meter. Eur J Dent 2007; 197–203.
20. Manal Farea, Sam'an Masudi, Wan Zaripah Wan Bakar. Apical microleakage evaluation of system B compared with cold lateral technique: In vitro study. Aust Endod J 2010 Aug;36(2):48-53.