Journal of Advances in Medicine and Medical Research

32(17): 35-40, 2020; Article no.JAMMR.61478
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Comparative Evaluation of Influence of Three Different Obturation Techniques on Removal of Filling Material during Retreatment: An *in vitro* Study

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript. Author DC designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author DC managed the analyses of the study and managed the literature searches.

Article Information

DOI: 10.9734/JAMMR/2020/v32i1730638
Editor(s):
(1) Dr. Ashish Anand, G.V. Montgomery Veteran Affairs Medical Center, University of Mississippi Medical Center and William Carey School of Osteopathic Medicine, USA.
Reviewers:
(1) Lígia Maria Lima Andreatta Ferreira, University of Sao Paulo, Brazil.
(2) Maurício da Rocha Costa, Universitário Tabosa de Almeida (ASCES UNITA), Brazil.
Complete Peer review History: http://www.sdiarticle4.com/review-history/61478

Original Research Article

Received 14 July 2020
Accepted 18 September 2020
Published 25 September 2020

ABSTRACT

Aim: To evaluate the influence of various obturating techniques on retreatment teeth.
Place and Duration of Study: Department of Conservative Dentistry and Endodontics, Institute of Dental Sciences, Jammu and Kashmir, India between December 2019 and February 2020.
Methodology: Sixty extracted mandibular premolars were randomly divided into three groups (n=20) based on the obturation technique adopted which endodontic treatment i.e., cold lateral compaction, thermoplasticized and GuttaFlow techniques. The samples were evaluated using micro-computed tomography for the volume before and after the retreatment to assess the remaining amount of filling material in the canals, and also the time taken for the removal of filling material during the retreatment. Data were analyzed using ANOVA followed by Post hoc test at $P < 0.05$.
Results: The percentage of remaining filling material was between 17%-27%. The highest percentage of remaining filling material was seen in samples obturated with GuttaFlow ($P < 0.05$). The time required for retreatment was highly significant in thermoplasticized technique ($P < 0.05$).
Conclusion: The type of obturating technique influenced the amount of filling material remained in the canal after retreatment and also the time taken during this removal.

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Keywords: Thermoplasticized technique; gutta flow; obturation; Micro-computed tomography.

1. INTRODUCTION

The root canal treatment is done with a view to remove all harmful microbes within the canal of the tooth. In order to achieve this goal, cleaning and biomechanical shaping are the key requirements. Sometimes due to various limitations during root canal therapy like anatomic variations, preparation techniques and irrigation techniques, the endodontic therapy fails. The success rate of endodontic therapy is approximately 75% [1].

When initial endodontic therapy fails, retreatment procedure is the most conservative option to retain the tooth in the mouth. The retreatment procedure aims at a better root canal debridement and placement of a unfailing root canal material [2]. Improper cleaning and failure to remove the residual root filling material, leads to low success rate of the retreatment done [3,4]. Thus, the key factor for a successful treatment is the removal of original filling material from the root canals. Sometimes filling materials like gutta-percha and sealers are very difficult to remove due to uneven passage of root canal system which might entrap the material in small area. Ingle et al. have found that nearly 60% of endodontic failures arise due to incomplete obturation of the canals [5].

Cold lateral compaction, has been widely used method for obturation. It has set the golden standard in endodontics. The problem with this kind of techniques is that it mainly rely on a root canal sealer to achieve a fluid-tight seal in the root canal [6]. The major disadvantages which have been reported are voids, spreader tracts, incomplete adaptation of materials to walls [7].

Another obturating technique which utilizes heated gutta-percha was Obtura II. It is an injectable, thermoplasticized technique that has been found to be better than lateral condensation. It shows a three-dimensional adaptation to the root canal walls [8]. A new root canal obturating material, GuttaFlow (Coltene / Whaledent, Raiffeinsentra, Germany) is considered a good obturating material. It has better properties like good flowability, superior sealing, adaptability and also the material expands on setting [9-11]. This is a modification of RoekoSeal Automix sealer.

It is challenging and requires time and efforts to remove obturating materials during retreatment cases. The objective of this study is to evaluate the influence of three obturating techniques on the removal of root filling materials during retreatment using micro-computed tomography.

2. MATERIALS AND METHODS

The present study was conducted at Department of Conservative Dentistry and Endodontics, Institute Of Dental Sciences, Jammu and Kashmir, India for a period of three months from December 2019 to February 2020.

Sixty extracted, non-carious human mandibular single-rooted premolars teeth, were collected. The premolars which were extracted for orthodontic purpose were used. External surface of teeth were cleaned to remove any kind of debris and were stored in normal saline till used. The teeth were examined radiographically and all the teeth with calcified canals were discarded.

Standardized access opening was performed for all the samples, followed by working length determination from 15K-file (Mani, Japan) under a radiograph. Cleaning and shaping was performed using ProTaper files (Dentsply Maillefer, Ballagues, Switzerland) upto size F3/0.09. The canals were thoroughly irrigated with 2ml of 5% sodium hypochlorite in between the preparation and the final rinse was done with normal saline. The canals were dried with paper points by corresponding size of F3 (Dentsply Maillefer, Ballaigues, Switzerland).

Samples were divided into three groups depending upon the technique of obturation (20 samples in each group).

Group I: Cold Lateral condensation

Group II: Thermoplasticized Gutta-Percha (Obtura II)

Group III: Flowable Gutta-Percha (GuttaFlow)

The groups were obturated according to manufacturer's instructions. The samples were sealed with temporary restorative material Cavit and stored at 37^{o}C and 100% humidity for 7 days. In order to quantify the root-filled area micro-computed tomography (X-radia Versa 500, Ziess, Germany) was used. The three-dimensional images of the root canal filling materials were visualized by surface-CT-Vol (SkyScan). All the samples were prepared by single operator in order to reduce the discrepancies during the preparation.

2.1 Root Canal Retreatment

Gutta-percha was removed from the cemento-enamel junction with the help of Gutta-percha dissolving solution Endosolv (Septodont, France). Retreatment instrument ProTaper R (Dentsply Maillefer, Baillagues, Switzerland) was used to remove the filling material in all the samples obturated by different techniques. ProTaper R files (D1, D2 and D3) were used in a crown-down pattern. File D3 was used till working length. Time taken by the retreatment file to reach the working length (T1) and time taken to remove filling material from the canal (T2), were recorded using a digital stopwatch. The canal were irrigated and when no gutta-percha residue was seen on the file, the procedure was considered complete.

The amount of remaining obturating material of all the specimen were observed under micro-computed tomography. The residual amount of filling material was calculated.

Residual filling material= Remaining filling material/ Total space of each canal $\times$ 100

2.2 Statistical Analysis

Descriptive and comparative statistics were performed using IBM SPSS v21. Differences among the groups were analysed by Analysis of variance (ANOVA) tests. P value <0.05 was considered statistically significant for all tests. Variables were expressed as means ± standard deviation. Tukey's multiple post hoc test was used for comparisons among the three groups.

3. RESULTS

The results of the present study depicted that residual filling material was seen in all types of obturating techniques [Table 1]. The samples obturated with cold lateral compaction technique exhibited less remaining filling material as compared to thermoplasticized Gutta-percha techniques and those filled with GuttaFlow (P < 0.05). There was no statistical significant difference in samples obturated with GuttaFlow and thermoplasticized Gutta-percha (P > 0.05) [Table 2].

On calculating the time required by for retreatment of the teeth samples, it was noted that maximum time for removal was taken for thermoplasticized Gutta-percha samples [Table 3]. Cold lateral compaction technique revealed significantly less time for retreatment of the samples (P < 0.05) as compared to other two sample groups [Table 4].

Table 1. Mean value percentage of remaining filling material and on-way analysis of variance

Group	*n*	Mean	Standard Deviation	*P*
Group I Cold lateral compaction	20	17.43	6.15	0.0001<0.05 (Significant)
Group II Thermoplasticized Gutta-percha	20	25.19	6.48	
Group III GuttaFlow	20	27.08	8.16	

Table 2. Post hoc Tukey's tests for multiple comparisons

Groups	Mean difference	Significant	95% CI	
			Lower bound	Upper bound
Group I vs Group II	7.7600	0.0025*	2.4441	13.0759
Group II vs Group III	1.8900	0.6702	3.4259	7.2059
Group III vs Group I	9.6500	0.0002*	4.3341	14.9659

**P<0.05 statistically significant; P>0.05 non-significant; CI, Confidence interval*

Table 3. Mean time in minutes taken to remove the filling material

Group	n	Mean	Standard Deviation	P
Group I	20	3.195	0.56146	0.0000<0.005 (Highly Significant)
Group II	20	6.875	0.66004	
Group III	20	6.05	0.34412	

Table 4. Post hoc test to compared the three obturation techniques according the time taken for retreatment

Groups	Mean difference	Significant	95% CI	
			Upper bound	Lower bound
Group I vs Group II	3.6800	0.0014*	3.2704	4.0896
Group II vs Group III	0.8250	0.0000*	1.2346	-0.4154
Group III vs Group I	2.8550	0.0000*	2.4454	3.2646

P<0.05 statistically significant; P>0.05 non-significant; CI, Confidence interval

4. DISCUSSION

In the present study, we compared the influence of three different obturation techniques on the removal of filling material during retreatment in in-vitro conditions. In order to maintain the consistency, all the samples were prepared by a single operator using standard techniques.

In this study, cold lateral compaction technique was used because it is widely used and studied technique. It serves as a standard to compare other obturation techniques [12,13]. Another technique Obtura II is a thermoplaticized, injectable gutta-percha was also used in this in the present study. It has a better adaptability than lateral compaction in three dimensional root canal system [7,8,14]. A canal obturating material GuttaFlow, is also used in the study. It has better flow, good adaptability, better sealing and also expands on setting [9,10,15].

The results of our study was quite similar to the study conducted which depicted that there were more fracture fragments present in samples obturated with cold lateral compaction technique when compared with other obturation techniques[16]. This may be attributed to the reason that thermoplasticized gutta-percha flows all the irregularities and adapt well to the canal walls where as lateral compaction poorly adapts, this forms gaps and voids in between the gutta-percha and the sealer [16].

Earlier in order to access the residual root-filled material volume sectioning followed by radiographic evaluation was done. Now more noninvasive technique micro-computed tomographic method is used which reduces the chances of error during experimental studies as it easily differentiates the canal wall and residual debris in the canal [17].

The result of this study are in accordance to the previous study conducted which determined that the thermoplasticized gutta-percha technique fills more area of the root canal as compared to cold lateral compaction technique [18]. The overall percentage of remaining filling- material in the samples were 17-27%, which were in close to previous studies conducted with micro-computed tomography [18,19]. More amount of remaining filling material was observed in samples obturated with GuttaFlow and thermoplasticized technique due to the reason that gutta-percha melts on heating and allow better adaptation into the root canal irregularities [18]. Also, Gutta-flow is a paste system, thus provides extended condensation and pressing into the narrow areas of root canal anatomy [20].

On comparing the time required for retreatment, it was found that cold lateral compaction took considerably less time when compared with thermoplasticized gutta-percha technique and GuttaFlow. There was significantly less difference in the thermoplasticized and GuttaFlow. This may be due to nonhomogenous obturation and less volume of filling material in lateral compaction technique, the retreatment files (ProTaper R) can easily penetrate and remove the obturation material. The result of this study are somewhat similar to other studies which evaluated that thermoplasticized gutta-percha technique took maximum time for the removal of obturation material [19,21].

Although the in vivo study are better than in vitro study as certain factors cannot be easily and quantitatively determined. To extract better results and evaluate the relevance of the treatment done with these materials, further clinical studies should be performed.

5. CONCLUSION

Within the limitations of this study, the following conclusion were drawn:

1. The percentage of residual filling material in the canals were more for samples obturated with GuttaFlow.
2. The time taken to perform retreatment in obturated samples was in following order Thermoplasticized gutta-percha > GttaFlow > Cold Lateral Compaction.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT AND ETHICAL APPROVAL

The study has been approved by ethical committee of the institute. As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature - part 1. Effects of study characteristics on probability of success. Int Endod J. 2007;40(12):921-939.
2. Zuolo AS, Mello JE Jr, Cunha RS, Zuolo ML, Bueno CE. Efficacy of reciprocating and rotary techniques for removing filling material during root canal retreatment. Int Endod J. 2013;46(10):947-953.
3. Yürüker S, Görduysus M, Küçükkaya S, et al. Efficacy of combined use of different nickel-titanium files on removing root canal filling materials. J Endod. 2016;42(3):487-492.
4. Kfir A, Tsesis I, Yakirevich E, Matalon S, Abramovitz I. The efficacy of five techniques for removing root filling material: Microscopic versus radiographic evaluation. Int Endod J. 2012;45(1):35-41.
5. Ingle JI, Beveridge E, Glick D, Weichman J: The Washington study. In: Ingle I, Taintor JF, editors. Endodontic. Philadelphia: Lea & Febiger; 1994.
6. Sönmez IS, Oba AA, Sönmez D, Almaz ME. In vitro evaluation of apical microleakage of a new MTA-based sealer. Eur Arch Paediatr Dent 2012;13(5):252-255.
7. Weller RN, Kimbrough WF, Anderson RW. A comparison of thermoplastic obturation techniques: Adaptation to the canal walls. J Endod. 1997;23(11):703-706.
8. Budd CS, Weller RN, Kulild JC. A comparison of thermoplasticized injectable gutta-percha obturation techniques. J Endod. 1991;17(6):260-264.
9. Elayouti A, Achleithner C, Lost C, Weiger R. Homogeneity and adaptation of a new gutta-percha paste to root canal walls. J Endod. 2005;31(9):687–690.
10. Kontakiotis EG, Tzanetakis GM, Loizides AL. A 12-month longitudinal in vitro leakage study on a new silicon-based root canal filling material (GuttaFlow). Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;103(6):854–9.
11. Herbert J, Bruder M, Braunsteiner J, Altenburger MJ, Wrbas KT. Apical quality and adaptation of Resilon, EndoREZ, and Guttaflow root canal fillings in combination with a noncompaction technique. J Endod. 2009;35(2):261-264.
12. Goldberg F, Artaza LP, De Silvio A. Effectiveness of different Obturation techniques in filling of simulated lateral canals. J Endod. 2001;27(5):362-4.
13. Abarca AM, Bustos A, Navia M. A comparison of apical sealing and extrusion between Thermafil and lateral condensation techniques. J Endod. 2001;27(11):670-672.
14. Vizgirda PJ, Liewehr FR, Patton WR, McPherson JC, Buxton TB. A comparison of laterally condensed gutta-percha, thermoplasticized gutta-percha, and mineral trioxide aggregate as root canal filling materials. J Endod. 2004;30(2):103-106.
15. Herbert J, Bruder M, Braunsteiner J, Altenburger MJ, Wrbas KT. Apical Quality and Adaptation of Resilon, EndoREZ, and Guttaflow root canal fillings in combination with a noncompaction technique. J Endod. 2009;35(2):261-264.
16. Hegde J, Bashetty K, Kumar KK, Chikkamallaiah C. Comparative evaluation of the sealing ability of different obturation systems used over apically separated rotary nickel-titanium files: An in vitro study. J Conserv Dent. 2013;16(5):408-412.
17. Crozeta BM, Silva-Sousa YT, Leoni GB, et al. Micro-computed tomography study of filling material removal from oval-shaped canals by using rotary, reciprocating, and

adaptive motion systems. J Endod. 2016;42(5):793-797.
18. Athkuri S, Mandava J, Chalasani U, Ravi RC, Munagapati VK, Chennareddy AR. Effect of different obturating techniques and sealers on the removal of filling materials during endodontic retreatment. J Conserv Dent. 2019;22(6):578-82.
19. Rödig T, Wagner J, Wiegand A, Rizk M. Efficacy of the ProTaper retreatment system in removing Thermafil, GuttaCore or vertically compacted gutta-percha from curved root canals assessed by micro-CT. Int Endod J. 2018;51(7):808-815.
20. Kandaswamy D, Venkateshbabu N, Krishna RG, Hannah R, Arathi G, Roohi R. Comparison of laterally condensed, vertically compacted thermoplasticized, cold free-flow GP obturations - A volumetric analysis using spiral CT. J Conserv Dent. 2009;12(4):145-149.
21. Jorgensen B, Williamson A, Chu R, Qian F. The efficacy of the WaveOne reciprocating file system versus the ProTaper retreatment system in endodontic retreatment of two different obturating techniques. J Endod. 2017;43(6):1011-1013.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/61478