

Comparison of the Time Required for Removal of Bioceramic Sealer and Gutta-Percha with Different Techniques

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Abstract: ***Aim:** The aim of this study is to compare the time required for the removal of root filling material (gutta-percha and MTA Fillapex) with three different retreatment techniques – hand files, ProTaper Retreatment files and ultrasound files. **Materials and methods:** Sixty-six anterior single rooted teeth were used in the study. They were randomly assigned into 6 experimental groups - eleven specimens each (n=11). Root canals were enlarged and filled using single-cone technique with gutta-percha and bioceramic sealer and cold lateral condensation technique. Removal of gutta-percha and sealer was performed with the following devices and techniques: hand files, ProTaper Retreatment files and ultrasound files. The time needed for reaching full working length was recorded. The effectiveness of the retreatment procedure was evaluated using X-ray, computed tomography and stereomicroscope at x16 magnification. Statistical analysis was performed using ANOVA. **Results:** No statistically significant difference was observed when comparing the time needed for the retreatment with the different techniques (p=0.732). When comparing the time needed for the retreatment of the canals filled with single cone technique and lateral condensation it was found that it took longer time to retreat canals filled with lateral condensation. The differences were statistically significant when ultrasonic files were used (p=0.016).*

Keywords: gutta-percha, MTA Fillapex, ProTaper Retreatment files, retreatment

1. Introduction

Failure of endodontic treatment is attributed to a variety of reasons, such as inadequate filling of the root canal, complications with respect to instrumentation, coronal leakage, over extensions of obturating materials and complicated root canal anatomy. In these cases conservative retreatment is the first method of choice [1].

The main goal of endodontic retreatment is the complete removal of the filling material and disinfection of the root canal system, thus providing an adequate space for the new root canal filling material [2,3]. Different techniques can be applied for the removal of the filling material - stainless steel hand files, burs, solvents, heated instruments, ultrasonic files, nickel-titanium rotary and reciprocating systems [4,5].

The type of the applied endodontic sealer is also important for the final result of the retreatment procedure. The clinician should be able to remove it completely, cause on one side it is already infected and on the other it might cover bacteria and necrotic tissue that may cause periapical inflammation or pain afterwards [6].

Calcium silicate phosphate-based bioceramic materials have recently been introduced on the market. They are biocompatible, contain calcium phosphate, have good bonding ability to root dentine and are known to be hard upon setting [7,8]. The last two characteristics, although being searched for and recommended for a sealer to be effective, might make the retreatment procedure for canals filled with them difficult. The ability to reestablish patency,

regain full working length and remove all remnants of calcium-silicate sealer is still being studied [4, 9,10].

Different techniques may be applied in order to achieve sufficient removal of the filling material – hand files, heated pluggers, ultrasonic instruments, chemical solvents, lasers, machine instruments (Gates Glidden drills). All methods are time consuming and there is a risk of iatrogenic damages. Nickel titanium rotary retreatment systems, used with torque-controlled electric motors were introduced in the dental practice in order to reduce the fatigue and the working time for the dentist. The data concerning the effectiveness of these systems is controversial [11,12,13]

The aim of the study is to compare the time required for the removal of root filling material (gutta-percha and MTA Fillapex), using three different retreatment methods – hand files, ProTaper Retreatment files and ultrasound files.

2. Materials and Methods

Sixty-six extracted single rooted human teeth with straight roots and completely formed apices were used in the study. The coronal part of the teeth was sectioned at the level of cement-enamel junction and the root length was standardized at 15 mm. Roots with size of the apical foramen above 20 were excluded. A K-file size 15 was used to determine working length (one mm shorter than the length till the apical foramen. Canals were prepared with ProTaper Universal system till F2, according to the manufacturer's instructions. The irrigation during the enlargement was performed with 2ml 5.25% NaOCl. Another 2ml 5.25% NaOCl were applied after the enlargement was finished,

then the canals were rinsed with saline and dried with paper points (#25 Dentsply Maillefer, Bellaigues, Switzerland). Samples were divided in two groups (n=33) – the first one was filled with matched-taper single cone technique (#F2 25/0.08, Dentsply Maillefer, Bellaigues, Switzerland) and bioceramic based sealer (MTA Fillapex, Angelus, Londrina, PR, Brazil) and the second one – with cold lateral compaction technique (master cone#25) and MTA Fillapex. The coronal access cavities of the specimens were sealed with temporary filling material (MD-Temp, Meta Biomed Co Ltd, South Korea). The quality of the root fillings was checked using postoperative radiographs. Specimens were stored in 100% humidity for 3 weeks to allow complete setting of the sealer.

Teeth were randomly assigned into six groups (n=11) according to the filling technique and using retreatment files. Group 1 (n=11) – single cone technique, retreatment with ProTaper Retreatment system (PTR) (Dentsply Maillefer, Bellaigues, Switzerland); Group 2 (n=11) – cold lateral compaction technique, retreatment with PTR system; Group 3 (n=11) - single cone technique, retreatment with hand K-files (Dentsply Maillefer, Bellaigues, Switzerland); Group 4 (n=11) - cold lateral compaction technique, retreatment with hand K-files (Dentsply Maillefer, Bellaigues, Switzerland); Group 5 (n=11) - single cone technique, retreatment with ultrasonic K-type cleaning files (EMS Dental, Switzerland); Group 6 (n=11) - cold lateral compaction technique, retreatment with ultrasonic K-type cleaning files

Gates Glidden #3 was used to remove the gutta-percha in the coronal 2 mm. Then solvent (orange oil) was applied.

The fillings in group one and two were removed with PTR system, following the manufacturer's instructions – sequent use of D1, D2 and D3 in crown down manner, until full working length was reached, the walls were felt smooth and no filling material was seen on the file. The patency of the root canal and the working length were checked with a K-file. The fillings in groups three and four were removed with K-files #25 with circumferential half-turn and brushing motions until working length was reached, the walls were felt smooth and no filling material was seen on the file. K-type ultrasonic files #25 were used for groups five and six. Vertical, circumferential and swiping motions were used for the removal of the filling material. The working length and the smoothness of the walls were checked with K-file #25. Patency and working length were reestablished in all the teeth.

Three milliliters of 5.25% NaOCl were used for irrigation during the removal of the filling material and two milliliters for a final flush. The canal was dried with paper points.

Retreatment time was measured with a chronometer. The time for the final irrigation was not included.

Radiographic examination and CT were made in order to check the efficacy of the retreatment procedure. Then teeth were sectioned longitudinally and observed under microscope (16x magnification). Images were taken and the amount of residual material in the different portions (apical, coronal, middle) of the canal was compared (fig 1).

The data was analyzed using the SPSS software (Version19). Quantitative variables were presented as mean (\bar{X}) and standard deviation (SD) whilst qualitative ones as numbers. The differences among the groups were determined using analysis of variance (ANOVA). For multiple comparisons Bonferroni method was applied.

3. Results

No statistically significant difference in the time needed for the retreatment with the three applied techniques was observed (p=0.732) (fig. 1).

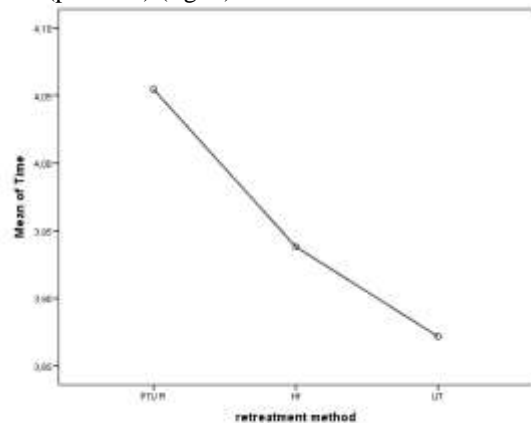


Figure 1: Distribution of time according to the retreatment method

Table 1: Comparative analysis of the studied groups and retreatment methods during retreatment

Groups	n	\bar{X}	SD	P	\bar{X}	SD	P
1	11	3.94	0.46	0.369	4.06	0.56	0.732
2	11	4.17	0.66				
3	11	3.77	0.81	0.330	3.94	0.79	
4	11	4.11	0.78				
5	11	3.35	0.76	0.004	3.87	0.92	
6	11	4.40	0.77				

Table 2: Comparative analysis of the filling techniques during retreatment

Groups	n	\bar{X}	SD	P
1	11	3.69	0.72	0.004
3	11			
5	11			
2	11	4.22	0.73	
4	11			
6	11			

When comparing the filling method, it was found that single cone technique required less time (mean 3,6864) for the retreatment than the cold lateral compaction (mean 4,2233) (fig.2). When comparing both the filling and the retreatment method, a significant difference was observed between Group 5 (mean 3.3464) and Group 6 (mean 4.3973), p = 0.016 (fig.3).

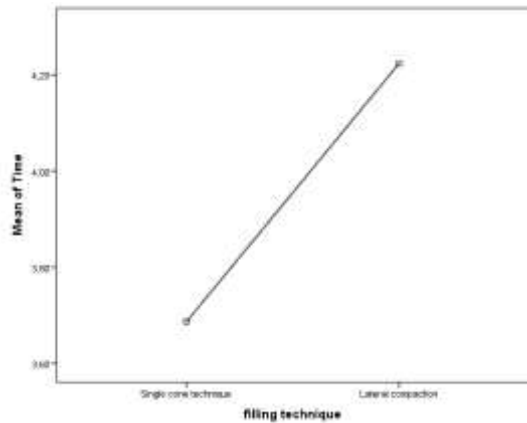


Figure 2: Distribution of time depend on used filling technique

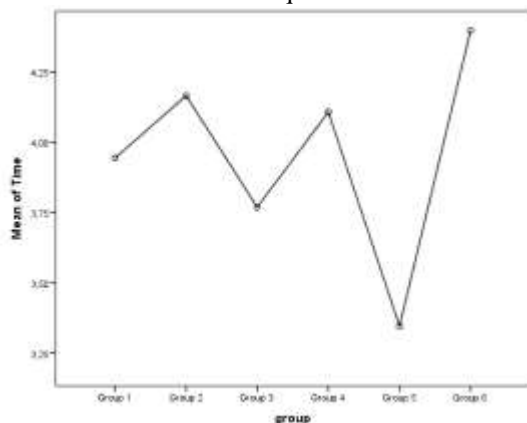


Figure 3: Distribution of time depends on using retreatment instruments and used filling technique

4. Discussion

The presented study was conducted on single rooted teeth with straight canals because they usually present with less complex anatomy, and the standardization of the samples is expected to be better. Nevertheless it should be kept in mind that the shape of the root canal system is impossible to be standardized. Tooth crowns were removed in order to achieve similar working length for all canals. Thus the effect of factors such as crown anatomy, working length and curvatures was reduced as much as possible.

We have used two filling techniques – single cone and lateral cold compaction. We have found that the retreatment of root canals filled with single cone technique requires less time than lateral cold compaction (mean 3.68 and 4.22 respectively). This corresponds with the results of other authors [3]. This might be explained with the fact that with the single cone technique the gutta-percha is a solid mass that gets softened by the solvent and is easily removed, while in the lateral compaction there is sealer between the gutta-percha points, that interferes their softening and fast removal. Besides obturation with lateral compaction leads to a better condensation of the filling material, which also might result in a more difficult and time-consuming removal afterwards [14].

It is generally accepted that the removal of root canal filling material with hand files is a hard and time-consuming procedure [15]. That's why soon after NiTi rotary and

reciprocating systems started being widely spread and applied in the dental practices, NiTi retreatment systems were created. There are several studies that confirm the fact [5, 11, 12, 16, 17]. But those systems still can't remove all filling material, from all parts of the root canal [3], so some authors recommend they to be used in combination with hand files [18]. It was also found that they generate more heat on the root surface [11] cause greater extrusion of debris [13, 19], have higher incidence of separation and are more likely to alter root canal anatomy [15]. No significant difference in the time needed for the retreatment with hand and rotary instruments for both filling techniques was found in our study. When comparing the average results, the time for the machine retreatment was even a little higher than that of the hand files (4.05 min. and 3.93 min. respectively). This might be due to the fact that in most of the studies the time needed for the change of the NiTi retreatment instruments was not included, while in ours we have included it too.

The retreatment time with the ultrasonic instruments was done for the shortest time (mean 3.86). This correlates with the results of other authors [17]. This might be contributed to the frictional heat produced by the ultrasonic tip, that leads to plasticization of the gutta-percha on one side and to the vibrations of the tip that lead to de-bonding of the sealer and displacement of the filling material in coronal direction on the other [17].

In the presented study we have used orange oil as solvent. It is generally accepted that the use of a solvent facilitates the removal of sealer and gutta-percha from root canal walls by degrading and softening the gutta-percha cones [17, 20]. There are some studies that reveal that although they might lead to faster removal of the root filling material under scanning electron microscope more gutta-percha and sealer remnants on root canal walls and inside dentinal tubules are observed [21]. Other studies show no significant difference in the retreatment time and effectiveness with and without solvents [22].

5. Conclusions

The results show that none of the tested retreatment methods succeeded to remove completely the filling material. There was no significant difference in the time needed for the retreatment with the three applied techniques. The retreatment of the canals filled with lateral compaction took more time than the single cone technique.

References

- [1] Eleman RF, Pretti I: Comparison of the success rate of endodontic treatment and implant treatment. ISNR Dent 2011 2011:640509. doi: 10.5402/2011/640509
- [2] Moreira C., F. Martinho, M. Coelho, L. Coutinho Junior, E. da Silva, C. Torres, A. Gomes. Cone-beam Computed Tomographic Analysis: Comparison of the Efficacy of Two Rotary Retreatment Systems for removal of Filling Material from Primary Teeth obturated with Contemporary Endodontic sealers. World Journal of Dentistry, 2015, 6(3): 129-137
- [3] Uzunoglu E., Z. Yilmaz, D. Sungur, E. Altundasar. Retreatability of root canals obturated using Gutta-

- Percha with bioceramic, MTA and resin-Based Sealers. Iranian Endodontic Journal, 2015, 10(2):93-98
- [4] Obeid M F , AAEIgendy. Efficacy of three Ni–Ti rotary systems for removal of filling materials from root canal system of extracted teeth. Tanta Dental Journal, 2015, 12, (4): 259-264
- [5] Donnermeyer D, Bunne C, Schäfer E, Dammaschke T. Retreatability of three calcium silicate-containing sealers and one epoxy resin-based root canal sealer with four different root canal instruments. Clin Oral Investig. 2017 Jun 22. doi: 10.1007/s00784-017-2156-5.
- [6] Tomer A., A. Miglani, S. Sahni, V. Goud, S. Vaidya, A. Kumari. Comparison of Efficacy of Three Ni-Ti Instruments in removal of Gutta-Percha from root canal during Retreatment – an In Vitro Study. Journal of Dental and Medical Sciences, 2017, 16(4): 32-37
- [7] Camilleri J, Gandolfi MG, Siboni F, Prati C: Dynamic sealing ability of MTA root canal sealer. IntEndod J 2011 44(1): 9-20
- [8] Jafari F, S Jafari. Composition and physicochemical properties of calcium silicate based sealers: A review article. J ClinExp Dent 2017 9(10): e1249-1255
- [9] Hess D., E. Solomon, R. Spears, J. He. Retreatability of a Bioceramic Root Canal Sealing material. JOE, 2011
- [10] Al Haddad A, ZA CheAb Aziz. Bioceramic-Based Root Canal Sealers: A Review. Int J Biomaterials 2016;2016:9753210. doi: 10.1155/2016/9753210
- [11] Bramante CM, NS Fidelis, TS Assumpção, N Bernardineli, RB Garcia, AS Bramante, IG de Moraes. Heat release, time required and cleaning ability of Mtwo R and ProTaper Universal retreatment systems in the removal of filling material. J Endod 2010 36(11): 1870-1873
- [12] Hammad M, Qualtrough A, Silikas N. Three-dimensional evaluation of effectiveness of hand and rotary instrumentation for retreatment of canals filled with different materials. J Endod. 2008 34(11):1370-1373
- [13] Somma F, G Cammarota, G Plotino, NM Grande, CH Pameijer. The effectiveness of manual and mechanical instrumentation for the retreatment of three different root canal filling materials. J Endod. 2008 34(4): 466-9.
- [14] Johnson WT, JC Kulild. Obturation of the cleaned and shaped root canal system in Cohen's pathways of the pulp, KM Hargreaves, S Cohen and LH Berman, Eds, p.349-388; Mosby, St Louis, Mo, USA, Tenth edition, 2011
- [15] Schirrmeister JF, KM Meyer, P Hermans, MJ AltenburgerKTWrba. Effectiveness of hand and rotary instrumentation for removing a new synthetic polymer-based root canal obturation material (Epiphany) during retreatment. IntEndod J 2006 39(2): 150-156
- [16] Garg A, A Nagpal, S Shetty, S Kumar, KK Singh, A Garg. Comparison of time required by D-RaCe, R-Endo and Mtwo instruments for retreatment: An in vitro study. J ClinDiag Res 2015 Feb, Vol-9(2): ZC47-ZC49doi: 10.7860/JCDR/2015/11100.5596
- [17] Rached-Junior F., M. Sousa-Neto, J. Bruniera, M. Duarte, Y. Silva-Sousa. Confocal microscopy assessment of filling material remaining on root canal walls after retreatment. International Endodontic Journal, 2014, 47, 264-270
- [18] Siotia J, SR Acharya, SK Gupta. Efficacy of ProTaper Retreatment system in root canals obturated with gutta-percha using two different sealers and GuttaFlow. Int J Dent 2011 doi: 10.1155/2011/676128
- [19] Giuliani V, R Cocchetti, G Pagavino. Efficacy of ProTaper Universal retreatment files in removing filling materials during root canal retreatment. J Endod 2008 34: 1381-1384
- [20] Oltra E., T. Cox, M. LaCourse, J. Johnson, A. Paranjpe. Retreatability of two endodontic sealers, EndoSequence BC Sealer and AH Plus: a microcomputed tomographic comparison. Restorative Dentistry and Endodontics, 2016, 1-8
- [21] Horvath SD, MJ Altenburger, M Naumann, M Wolkewitz, JF Schirrmeister. Cleanliness of dentinal tubules following gutta-percha removal with and without solvents: a scanning electron microscopic study. IntEndod J. 2009 Nov; 42(11):1032-8.
- [22] Bhagavaldas MS, A Diwan, S Kusumvally, S Pasha, M Devele, DC Chava. Efficacy of two rotary retreatment systems in removing Gutta-percha and sealer during endodontic retreatment with or without solvent: A comparative in vitro study. J Conserv Dent 2017 20(1): 12–16.

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