



## RETREATMENT OF TEETH FILLED WITH LATERAL COMPACTION TECHNIQUE AND BIOCERAMIC-BASED SEALER – COMPARISON OF TIME NEEDED AND EFFECTIVENESS OF DIFFERENT RETREATMENT TECHNIQUES

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### ABSTRACT

**Purpose:** The aim of the presented study is to evaluate and compare the time needed and the effectiveness of three different retreatment techniques in the removal of root canal filling material from teeth filled with lateral compaction technique and bioceramic-based sealer.

**Material and methods:** Thirty-three extracted single rooted human teeth were used. Roots were enlarged using ProTaper Universal files up to size F2. Teeth were randomly assigned into three groups (n=11), according to the retreatment method: Gr1 – retreated using ProTaper Universal Retreatment files; Gr2 – hand instruments (H files); Gr3 – ultrasonic tips. For determining the effectiveness of the removal of the filling material specimens scanned with CT and then observed under a microscope under 16x magnification.

**Results:** The residual material found in most of the cases was a sealer. Best removal of root canal filling in the coronal and apical part was achieved using the ultrasonic tips and the hand instruments, the difference between the two methods being statistically insignificant. There was no significant difference, concerning the middle part.

**Conclusions:** Complete removal of filling material was not achieved in any part of the root canal. The tested techniques were comparably effective in removal of laterally compacted gutta-percha and bioceramic-based sealer.

**Key words:** bioceramic based sealer, cold lateral compaction technique, retreatment

### INTRODUCTION

Nonsurgical endodontic retreatment is generally the first treatment choice in cases with periradicular inflammatory lesions [1]. The goal of the retreatment procedure is to remove all existing filling material and regain the access to the apical foramen. This is obligatory because,

having in mind that in most cases the disease is due either to persisting or to reintroduced microorganisms, it can be expected that it's already infected [2, 3]. Moreover, the residual filling material might cover necrotic tissue and bacteria, which might be responsible for reinfection of the root canal system [4]. Thus its removal allows the complete disinfection of the root canal system and ensures the achievement of the needed conditions for the healing of the periradicular tissues [3]. Studies have also proved that establishing patency and reaching working length significantly improves the healing of periapical lesions [5].

Gutta-percha is the most commonly used core filling material. It's plastic, easy to manipulate, radio opaque, minimally toxic and it's easily removed with solvents or heat. Lack of adhesion and shrinkage on cooling are its major disadvantages [6]. That's why the use of a sealer in conjunction with the gutta-percha is recommended. It should bond to the core material and root dentine, seal voids, accessory canals and foramina, fill the space between the gutta-percha points when lateral compaction technique is used [7]. A wide variety of sealers is presented on the market. There are zinc oxide and eugenol, calcium hydroxide, glass-ionomer, resin, silicone and bioceramic based sealers, according to their chemical composition [8]. Major advantages of the bioceramic sealers are their biocompatibility [9] and improved sealing ability to root dentin [7, 10]. Unfortunately, the good sealing ability leads to a difficult removal in cases when retreatment is needed [11]. Besides these materials become very hard upon setting. [12] The data in the literature concerning their removability from the root canal system, the ability to regain patency and the time needed for regaining working length while retreating canals filled with these new sealers is quite controversial [13, 14, 15, 16].

The aim of the presented study is to evaluate and compare the time needed and the effectiveness of three different retreatment techniques in the removal of root ca-

nal filling material from teeth filled with lateral compaction technique and bioceramic based sealer

## MATERIALS AND METHODS

Thirty-three extracted single rooted human teeth with straight roots, and completely formed apices were used in the presented study. After cleaning they were stored in 0.5% NaOCl solution. Teeth were examined with an operative microscope (Leica M320, Germany) for the presence of micro cracks under x16 magnification. The crowns were removed with a diamond disk. Fifteen millimeters root segments were obtained. The size of the apical foramen was checked, and teeth with size above 20 were excluded. A K-file size 15 was used to determine the working length (1 mm shorter than the length till the apical foramen). Roots were enlarged using ProTaper Universal files (Dentsply Maillefer, Bellaigues, Switzerland) up to size F2. Irrigation during root canal enlargement was performed with 3 ml 5.25% NaOCl. Roots were dried with paper points (Dentsply Maillefer, Bellaigues, Switzerland). All samples (n=33) were filled with cold lateral compaction technique (master cone#25) and bioceramic based sealer (MTA Fillapex, Angelus, Londrine, PR, Brazil). Access cavities were sealed with a temporary filling material (MD-Temp, Meta Biomed Co Ltd, South Korea). The quality of the fillings was checked with postoperative radiographs. Teeth were stored in 100% humidity for 3 weeks in order to achieve complete setting of the sealer.

Teeth were randomly assigned to three groups (n=11), according to the retreatment method: Gr1 – retreated using ProTaper Universal Retreatment files (Dentsply Maillefer, Bellaigues, Switzerland) (PTUR); Gr2 – hand instruments (H files (Dentsply Maillefer, Bellaigues, Switzerland) (HF); Gr3 – ultrasonic tips (EMS, Switzerland # 20] (UST). 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 and drying afterwards was not included.

Gates Glidden #3 was used to remove the gutta-percha in the coronal 2 mm. Then solvent (orange oil) was applied. For Gr1 ProTaper Universal Retreatment files were used consequently – D1, D2, D3 – in a crown down manner. The patency of the canal was checked with a K file #25. Hand H-files (Dentsply Maillefer, Bellaigues, Switzerland) were used with clockwise half-turn and brush-

ing motions until root canal patency was reestablished in Gr2. Ultrasonic tips (EMS Dental, Switzerland) # 20 were used for the retreatment of the third group.

Working length and smoothness of all root canals were checked at the end with a K file #25 (Dentsply Maillefer, Bellaigues, Switzerland). Retreatment was accepted as fulfilled when no filling material was observed on the last instrument that went to full working length.

Specimens were numbered and scanned with CT (100 kW-250mA, thick speed 0.625, rotation time-1, and scan type – 1.0 sec).

The following scale was used to determine the residual filling material: score 0 – no presence of residual filling material; score 1 – less than 1/3 of the wall is covered with filling material; score 2 – 1/3 to 2/3 of the wall is covered with filling material; score 3 – more than 2/3 is covered; score 4 –residual filling material was present along the whole wall.

Teeth were sectioned longitudinally and observed under a microscope (Leica M320, Germany) under 16x magnification. Images were taken, and the amount of residual material in the different portions (apical, coronal, middle) of the canal was evaluated according to the above-mentioned scale.

SPSS software (Version 17) was used to analyse the data. Kruskal-Wallis test for comparison of more than 2 groups and Mann-Whitney for comparison of 2 groups were used for the evaluation of the remaining root filling material.

## RESULTS

Complete removal of filling material was not achieved in any part of the root canal. In most of the samples, the material that was found was a sealer. In 36.36% of the samples, residual gutta-percha was found. When checking its presence in the different parts of the root canal it was found in 24.24% of the samples in the coronal part, no remnants of gutta-percha were found in the middle part and in 9% - in the apical part.

Complete removal of the filling material in the coronal part of the root was achieved in 57.57% (n=19) of the samples (table 1). When comparing the different retreatment techniques least cases with complete removal of the filling material were observed when NiTi rotary instruments were used (18.2% - n=4). The results achieved with hand instruments and ultrasonic tips were comparable (31.8% and 36.4% respectively).

**Table 1.** Samples with different scores in the different regions of the root canal

Presence of the residual filling material		PTUR		HF		UST	
		n	%	n	%	n	%
M coronal	Absence of residual filling material	4	18,2	7	31,8	8	36,4
	Residual filling material covering less than 1/3 of the wall	10	45,5	9	40,9	8	36,4
	Residual filling material covering 1/3 to 2/3 of the wall	7	31,8	4	18,2	3	13,6
	Residual filling material covering more than 2/3 of the wall	1	4,5	2	9,1	3	13,6
	Whole wall covered with residual filling material	0	0,0	0	0,0	0	0,0
M middle	Absence of residual filling material	10	45,5	10	45,5	10	45,5
	Residual filling material covering less than 1/3 of the wall	10	45,5	11	50,0	8	36,4
	Residual filling material covering 1/3 to 2/3 of the wall	2	9,1	1	4,5	4	18,2
	Residual filling material covering more than 2/3 of the wall	0	0,0	0	0,0	0	0,0
	Whole wall covered with residual filling material	0	0,0	0	0,0	0	0,0
M apical	Absence of residual filling material	5	22,7	11	50,0	15	68,2
	Residual filling material covering less than 1/3 of the wall	11	50,0	9	40,9	3	13,6
	Residual filling material covering 1/3 to 2/3 of the wall	4	18,2	1	4,5	1	4,5
	Residual filling material covering more than 2/3 of the wall	2	9,1	1	4,5	3	13,6
	Whole wall covered with residual filling material	0	0,0	0	0,0	0	0,0

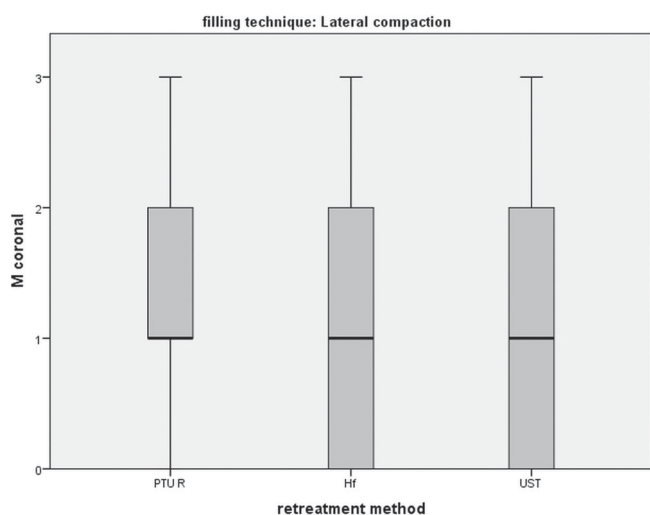
As a whole best removal of root canal filling in the coronal part was achieved using the ultrasonic tips and the hand instruments, the difference between the two methods being statistically insignificant (table 2, fig 1).

The distribution of the samples with different scores for the effectiveness of the removal of filling material is presented on fig. 1.

**Table 2.** Difference in the effectiveness of cleaning of teeth filled with lateral compaction technique in the different parts of the root canal

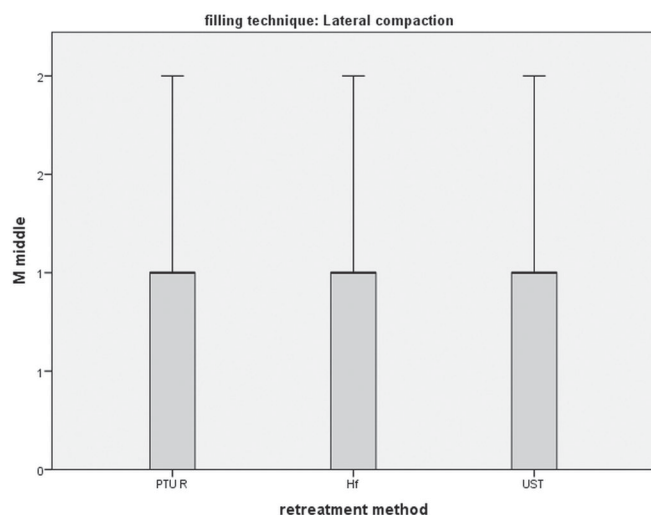
Part of the root canal	<i>p</i> overall	<i>p</i> machine/ hand	<i>p</i> machine/ ultrasonic tips	<i>p</i> hand/ ultrasonic tips
Coronal	.591	.397	.360	.901
Middle	.893	.875	.758	.642
Apical	.033	.040	.021	.455

**Fig. 1.** Plots of the residual filling material in the coronal part



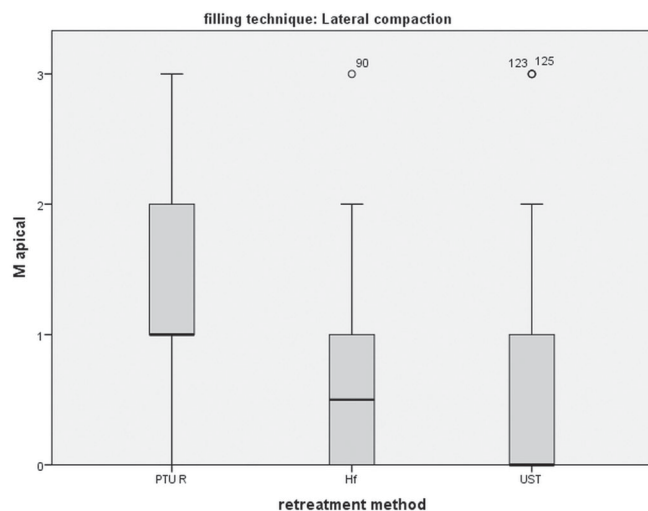
Concerning the middle part of the root canal, complete removal of the filling material was achieved in 45.5%. The hand instruments showed best results in this part (95.5% of the samples were with residual material, covering less than 1/3 of the wall, 45% of which were without any at all), while the NiTi and ultrasonic instruments presented worse (81.9% and 90.5% respectively) (fig 2). There was no statistically significant difference in the amount of the remaining root canal filling material in the coronal and middle third of the canal between the different techniques (table 2), although we could recommend the use of hand and ultrasonic files, because more cases with complete removal of filling material were observed with them, compared with the ProTaper Universal Retreatment system.

**Fig. 2.** Plots of the residual filling material in the middle part



The ultrasonic tips performed best in the apical part, although the difference with the hand instrumentation was not statistically significant (table 2), the median was lower compared to the one for the hand instruments (fig 3).

**Fig. 3.** Plots of the residual filling material in the apical part



The average retreatment time was 4,2233 min. The slowest removal of the filling material was achieved with the ultrasonic files (average 4.39 min), The time for the hand instrumentation and the machine was the same (average 4.16 and 4.1 respectively).

## DISCUSSION

We have used single rooted human teeth with straight root canals in the presented study. There are authors who have used palatal [17] or mesiobuccal [15] roots of upper teeth for similar studies, but we have preferred single rooted ones because they usually present with less

complex anatomy and better standardization of the samples could be achieved. Canals larger than size twenty were excluded because canals were enlarged till F2 file, which has a tip #25 and we couldn't have achieved good apical stop otherwise. Tooth crowns were removed. Thus similar working length was achieved, and factors like crown anatomy and curvatures were reduced as much as possible. Nevertheless, it should be kept in mind that the shape of the root canal system is impossible to be standardized.

Orange oil was used as a solvent in the presented study. The strongest solvents of gutta-percha are xylol and chloroform [18], but they also are considered potentially carcinogenic and neurotoxic to the periapical tissues [19]. According to some studies, the effect of orange oil is statistically similar to that of chloroform [20] and xylol [21] although there are also studies with opposite results [22]. We have preferred to use orange oil because it's accepted as safe, biocompatible and non-carcinogenic [20].

Complete removal of filling material was not achieved with any of the studied techniques, which corresponds with the results of other authors [16, 17, 23]. The coronal part of the canals was best cleaned with the ultrasonic and hand files. ProTaper Universal Retreatment system did not present that well. When comparing them with the hand instruments, this might be explained with the fact that NiTi rotary instruments do not fit that well to the root canal walls, especially in cases with oval shaped canals. When comparing them with the ultrasonic instruments, this might be attributed to the vibrations of the tip that lead to de-bonding of the sealer on one side and the heat, generated by the friction of the tip, that leads to plasticization of the gutta-percha on the other [24]. Worst cleaning for all studied techniques was achieved in the coronal part. Other authors have presented similar results [16, 23, 25], although there are also studies with controversial results [17, 26].

All retreatment techniques presented best in the middle part or the root canal. In this region the anatomy of the root canal system is not that complex as in the apical, or at the level of the orifice, the walls are smooth, and the sealer is easier to be removed.

In the apical one-third, the achieved results were closer to that from the coronal part, although a little bit better. Again we attribute this to the specific anatomy in this region and the difficult instrumentation. Worst results were achieved with the machine instruments. This could be explained with the fact that the tip of D3 file is #20, while F2 (the file till which we have enlarged) file's tip is #25. So the tip of D3 does not correspond exactly to the diameter of the canal, and more remnants might be expected. Some authors do not recommend the separate use of machine rotary instruments and support their combining with hand instruments for ensuring better results [26]. This was the region where the biggest amount of residual gutta-percha (9% of the cases) was observed. A possible explanation of this fact might be that we have placed gutta-percha solvent only in the coronal part of the root, so in this region, its plasticization and removal was harder.



## CONCLUSIONS:

Complete removal of filling material was not achieved in any part of the root canal. A significant difference was observed only in the cleaning in the coronal part of the root canal between the PTUR files and the ultrasonic files. No statistically significant difference was observed between different retreatment techniques concerning both their effectiveness and the time needed for the procedure in the other regions of the root canal system.

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