

## Original Research Article

# Evaluation of the effectiveness of manual and rotary techniques in the desobturation and reinstrumentation of root canal

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## Abstract

**Introduction and Objective:** This study aimed to evaluate the ability of desobturation and reinstrumentation of root canal with manual and rotary techniques. **Material and methods:** Sixty single-rooted incisors were selected, prepared with ProTaper<sup>®</sup> rotary system and obturated with gutta-percha and AH Plus<sup>®</sup>, using the lateral condensation technique. The teeth were restored with Cimpat<sup>®</sup> and were kept for 90 days at 37°C and 100% humidity. After this period, the teeth were divided into three groups according to the technique of desobturation and reinstrumentation. In group A, D1, D2 and D3 instruments of ProTaper<sup>®</sup> system for desobturation were used associated with F4 instrument of the same system for reinstrumentation. In group B, K type manual instruments were employed in the desobturation and reinstrumentation. The teeth of group C (control) were not treated. After the desobturation and reinstrumentation steps of groups A and B, the teeth were radiographed at mesiodistal and labial-lingual incidences. The images were evaluated by three examiners previously trained and calibrated. **Results and Conclusion:** The data were statistically analyzed and showed no significant differences in the amount of the remaining filling material tested by both techniques, except from the medium

third, at mesiodistal direction, in which the rotary technique was more effective. There was no difference in the cleaning of the canal walls after the desobturation and reinstrumentation. The apical third showed the largest amount of remaining material, regardless of the technique used.

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## Introduction

The success rate of the endodontic retreatment still shows a great variability [26, 28]. According to Paik *et al.* [21], the success rate of the retreatment has been related in the literature between 40 and 100%.

This variation in treatment success, on the other hand, is related to several factors, such as: periapical condition [15], quality of coronal restoration [20] and ability of removing all endodontic filling material [7].

Currently, a variety of techniques and devices is employed and studied for the desobturation of root canals: use of hand endodontic instruments, heat instruments, sonic and ultrasonic devices, laser and rotary instruments [2, 4, 5, 8, 10, 16]. Notwithstanding, to date, none of these resources is totally efficient in removing the filling material [1, 9, 13, 19].

Schwerz *et al.* [25] compared the effectiveness of NiTi rotary system, Gates-Glidden burs and the use of hand instruments in the desobturation of root canals. The authors concluded that the ProTaper® retreatment system was faster and more effective in the gutta-percha removal than hand technique with Flexofile instruments and Gates-Glidden burs.

On the other hand, Queiróz *et al.* [22] analyzed the ProTaper® rotary system and K type hand instruments in the endodontic desobturation and they could verify through diaphanization that there were no differences between the two techniques for the removal of the filling material.

In 2013, Klalilak *et al.* [17] evaluated the efficacy of the ProTaper® rotary system and H-File® hand instrument in the desobturation of root canals. They observed that the use of the rotary system was more efficient and faster in removing the filling material.

Thus, the aim of this study was to evaluate through radiographs the ability of desobturation and reinstrumentation of the root canal by using hand and rotary techniques.

## Material and methods

This study was approved by the Ethical Committee in Research in Human Beings and Animals of the Lutheran University of Brazil (under protocol number #2007 427H).

Sixty single-rooted mandibular incisors were used. After the surgical access, the working length was determined and standardized at 1 mm short of the foramen opening.

Next, the roots were individually immersed into blocks of chemically-activated acrylic resin (Clássico, Brazil), aiming to standardize the radiographic shots, so that the teeth were kept at the same position.

Root canal preparation was executed through the rotary technique at crown-down technique with the ProTaper® system (Dentsply/Maillefer, Ballaigues, Switzerland). The instruments were motor driven (Endo Pro Torque - VK Driller Equipamentos Elétricos, Brasil) at a speed of 250 rpm and torque of 2 N/cm<sup>2</sup>. The memory instrument was standardized at size 3 Finishing File (F3).

At each instrument change, the root canals were irrigated with 2 ml of 1% sodium hypochlorite (Farmácia Escola da Ulbra - Campus Canoas/RS, Brazil). In the ending of the preparation the canals were irrigated with 17% EDTA (Iodontosul - Industrial Odontológica do Sul Ltda., Porto Alegre, Brazil) for 3 minutes, followed by 1% sodium hypochlorite.

Next, the root canals were dried with size F3 paper points (Dentsply/Maillefer, Ballaigues, Switzerland), and the gutta-percha master cone was determined by size F3 instrument (Dentsply/Maillefer, Ballaigues, Switzerland).

During the obturation process, AH Plus® endodontic cement (Dentsply/Maillefer, Ballaigues, Switzerland) was used together with size B7 accessory gutta-percha points (Tanari®, Manaus, Amazonas, Brazil), following the manufacturer's instructions. The accessory points were also involved into endodontic cement and inserted into

the open spaces. This was repeated until the size B spacer (Dentsply/Maillefer, Ballaigues, Switzerland) could not be inserted anymore. The obturation technique used was lateral condensation and vertical adaptation with the aid of size 3 Paiva condenser (SSWhite, Rio de Janeiro, Brazil).

After the ending of the endodontic treatment, the teeth were sealed with temporary restorative material (Cimpat® -Septodont Brasil Ltda., São Paulo, Brazil).

Following, the teeth were kept into flasks with distilled water (Iodontosul - Industrial Odontológica do Sul Ltda., Porto Alegre, Brazil) taken into an incubator (Fabbe-Primar Equipamentos e Serviços Ltda., São Paulo, Brazil) at 37°C, with 100% humidity, for 90 days.

Elapsed this time, the teeth were randomly divided into three experimental groups (table I), to be submitted to the procedures of desobturation and reinstrumentation.

**Table I** - Experimental groups

Group	Number of teeth	Technique of desobturation and reinstrumentation
A	20	Desobturation = ProTaper® system (sizes D1, D2, D3) Reinstrumentation = ProTaper® system (size F4)
B	20	Desobturation = K type hand instrumentation Reinstrumentation = K type hand instrumentation
C	20	None

In group A, the desobturation of the root canal was executed with ProTaper® reinstrumentation system coupled with a contra-angle handpiece (Dabi Atlante, Ribeirão Preto, São Paulo, Brazil) and motor driven (Endo Pro Torque®), at a constant speed of 300 rpm and torque of 2 N/cm<sup>2</sup> [6].

The enlargement movements with constant rotation were performed in the following sequence: size D1, D2 and D3 instruments onto the cervical, medium and apical thirds, respectively. During the reinstrumentation, the size File 4 (F4) instrument of ProTaper® Finishing system was used at the working length.

In group B, root canal desobturation was executed with K type hand instruments. The procedure was completed when the size 30 K file reached the working length and no material remnants were seen. Next, the canals were re-instrumented with sizes 35 and 40 endodontic instruments through sharpening movements, at the working length.

Both in groups A and B, at every instrument change, root canal was irrigated with 2 ml of 1% sodium hypochlorite. Eucalyptol (Iodontosul - Industrial Odontológica do Sul Ltda., Porto Alegre, Brazil) was used as solvent agent during the desobturation procedures. During all procedures, both hand and rotary instruments were used at most five times and then discarded [24].

All study steps were executed by a single operator who was Specialist in Endodontics.

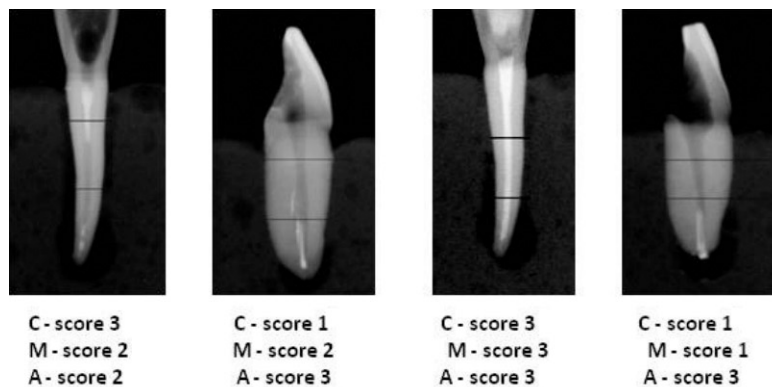
To assess the condition of the root canal walls regarding to the presence or absence of filling material remnants, a digital radiographic shot was executed after the desobturation and reinstrumentation procedures at two incidences: mesiodistal and labial-lingual, enabling the assessment of the labial and proximal views of each sample.

The specimens were placed into a radiographic platform and the Charge-Coupled Device (CCD) sensor (Cygnus Ray - Progeny Dental, Buffalo Grove, Illinois USA) was positioned parallelly to the specimens (labial and mesial surface), at vertical position. The cylinder of TimeX device (70 kV, 7 mA, Gnatus, Ribeirão Preto, SP, Brazil) was positioned in order to enable that the central ray perpendicularly reached the CCD sensor, with focal distance of 28 cm and 1.5 second of exposure.

The radiographic images obtained were divided into three thirds (cervical, medium and apical) and assessed by three examiners, specialists in Endodontics, which were previously trained and calibrated.

The examiners scored the images regarding to the amount of remaining material, as follows (figure 1):

- Score 1 = lack of filling material;
- Score 2 = presence of up to 50% of filling material;
- Score 3 = presence of more than 50% of filling material.



**Figure 1** - Radiographic images, at the two radiographic incidences, regarding to the score of each root third  
C = cervical third; M = medium third; A = apical third

The results were submitted to statistical analysis through Mann-Whitney and Friedman non-parametric tests followed by the test of multiple comparisons with level of significance of 5%.

## Results

By applying Kendall coefficient of concordance, it was observed a good inter-examiner agreement whose index was of 0.860 for the apical third, 0.825 for the medium third, and 0.883 for cervical third.

Because in group C (control) the teeth were not desobtured and reprepared, the radiographic examination showed 100% of filling material presence. Due to that reason, there was no need to execute the comparative statistical analysis with the two other groups.

Aiming to compare the desobturation of the canal between the experimental groups, Mann-Whitney non parametric test was used and showed that there were no statistical significant differences between groups, except for the medium third where the rotary system exhibited the lowest scores (table II).

**Table II** - Desobturation of root canals between the experimental groups and at the two radiographic incidences

Incidence	Score	Root thirds					
		Cervical		Medium		Apical	
		Rotary	Hand	Rotary	Hand	Rotary	Hand
M-D	1	7	4	2	0	0	0
	2	13	15	15	6	3	1
	3	0	1	3	14	17	19
	Total	20	20	20	20	20	20
	p	<b>0.327</b>		<b>0.001</b>		<b>0.602</b>	
V-L	1	9	4	2	1	0	0
	2	10	13	9	4	2	1
	3	1	3	9	15	18	19
	Total	20	20	20	20	20	20
	p	<b>0.114</b>		<b>0.108</b>		<b>0.799</b>	

p = minimum level of significance of Mann-Whitney non-parametric test

By comparing the rotary group after the desobturation and reinstrumentation procedure, no significant differences were found after Mann-Whitney non-parametric test (table III).

**Table III** - Desobturation and reinstrumentation with the rotary system at the root thirds and at the two radiographic incidences

Incidence	Score	Root thirds					
		Cervical		Medium		Apical	
		Desobturation	Reinstru- mentation	Desobturation	Reinstru- mentation	Desobturation	Reinstru- mentation
M-D	1	7	8	2	3	0	0
	2	13	12	15	14	3	3
	3	0	0	3	3	17	17
	Total	20	20	20	20	20	20
	p	<b>0.799</b>		<b>0.820</b>		<b>1.000</b>	
V-L	1	9	9	2	4	0	0
	2	10	9	9	9	2	3
	3	1	2	9	7	18	17
	Total	20	20	20	20	20	20
	p	<b>0.883</b>		<b>0.445</b>		<b>0.799</b>	

p = minimum level of significance of Mann-Whitney non-parametric test

In the comparison of hand group between desobturation and reinstrumentation there were no statistical significant differences after Mann-Whitney non-parametric test (table IV).

**Table IV** - Desobturation and reinstrumentation with the rotary system at the root thirds and at the two radiographic incidences

Incidence	Score	Root thirds					
		Cervical		Medium		Apical	
		Desobturation	Reinstru- mentation	Desobturation	Reinstru- mentation	Desobturation	Reinstru- mentation
M-D	1	4	7	0	0	0	0
	2	15	12	6	11	1	1
	3	1	1	14	9	19	19
	Total	20	20	20	20	20	20
	p	<b>0.445</b>		<b>0.183</b>		<b>1.000</b>	
V-L	1	4	7	1	0	0	0
	2	13	9	4	6	1	1
	3	3	4	15	14	19	19
	Total	20	20	20	20	20	20
	p	<b>0.640</b>		<b>0.862</b>		<b>1.000</b>	

p = minimum level of significance of Mann-Whitney non-parametric test

When the comparison among the three root canal thirds was performed through Friedman non-parametric test, followed by the Test of multiple comparisons with level of significance of 5%, it was verified that at the mesiodistal direction in the rotary groups (desobturation and reinstrumentation) at the apical third, the scores attributed were significantly higher than those of the other thirds. In the hand groups (desobturation and reinstrumentation) the scores attributed to the apical thirds were significantly higher than those attributed to the cervical third, but without significant differences from those of the medium third (table V).

**Table V** - Comparison among groups at the three root thirds, at the mesiodistal radiographic incidence

Group	Score	Root thirds		
		Cervical	Medium	Apical
Rotary (desobturation)	1	7	2	0
	2	13	15	3
	3	0	3	17
	Total	20	20	20
	medium Rank	1.35 <sup>B</sup>	1.825 <sup>B</sup>	2.825 <sup>A</sup>
Hand (desobturation)	1	4	0	0
	2	15	6	1
	3	1	14	19
	Total	20	20	20
	medium Rank	1.15 <sup>B</sup>	2.28 <sup>A</sup>	2.58 <sup>A</sup>
Rotary (reinstrumentation)	1	8	3	0
	2	12	14	3
	3	0	3	17
	Total	20	20	20
	medium Rank	1.38 <sup>B</sup>	1.80 <sup>B</sup>	2.83 <sup>A</sup>
Hand (reinstrumentation)	1	7	0	0
	2	12	11	1
	3	1	9	19
	Total	20	20	20
	medium Rank	1.23 <sup>B</sup>	2.08 <sup>A</sup>	2.70 <sup>A</sup>

For each group, medium ranks followed by different letters differed significantly through Friedman non parametric test, followed by the test of multiple comparisons with the level of significance of 5%

In the comparison between the experimental groups at the three root thirds, at the labial-lingual direction by applying Friedman non parametric test, followed by the test of multiple comparisons with the level of significance of 5%, it was observed that in the rotary group (desobturation) and hand group (desobturation and reinstrumentation) the scores attributed to the apical third were significantly higher than those given to the cervical third, but without statistically significant differences from those of the medium third. For the rotary group (reinstrumentation), the scores attributed to the apical third were significantly higher than those of apical and medium thirds (table VI).

**Table VI** - Comparison among groups at the three root thirds, at the labial-lingual radiographic incidence I

Group	Score	Root thirds		
		Cervical	Medium	Apical
Rotary (desobturation)	1	9	2	0
	2	10	9	2
	3	1	9	18
	Total	20	20	20
	medium Rank	1,28 <sup>B</sup>	2,05 <sup>A</sup>	2,68 <sup>A</sup>

Table VI (continued)

Group	Score	Root thirds		
		Cervical	Medium	Apical
Hand (desobturation)	1	4	1	0
	2	13	4	1
	3	3	15	19
	Total	20	20	20
	medium Rank	1,28 <sup>B</sup>	2,20 <sup>A</sup>	2,53 <sup>A</sup>
Rotary (reinstrumentation)	1	9	4	0
	2	9	9	3
	3	2	7	17
	Total	20	20	20
	medium Rank	1,38 <sup>B</sup>	1,95 <sup>B</sup>	2,68 <sup>A</sup>
Hand (reinstrumentation)	1	7	0	0
	2	9	6	1
	3	4	14	19
	Total	20	20	20
	medium Rank	1,28 <sup>B</sup>	2,23 <sup>A</sup>	2,50 <sup>A</sup>

For each group, medium ranks followed by different letters differed significantly through Friedman non parametric test, followed by the test of multiple comparisons with the level of significance of 5%

## Discussion

The removal of a preexisting filling material within root canals is of fundamental importance to obtain success in endodontic retreatment [22]. For this reason, there is a constant searching for new techniques that make easy the removal of this filling material. The rotary instruments are a reality today in Endodontics and its use during endodontic retreatment has been searched by diverse researches [5, 19, 29].

The ProTaper® system has been already studied by several authors [12-14, 23], who evidenced its good performance in the desobturation of the root canals. Notwithstanding, likely other rotary systems, this system was not capable of removing completely the filling material. Other studies [11, 22] also observed this same research.

Concerning to the efficacy of the techniques tested, the results did not show statistic differences in the amount of remaining material after the desobturation and reinstrumentation. These findings are in agreement with other studies previously conducted by Schirmeister *et al.* [24], Gergi and Sabbagh [12] and Barletta *et al.* [3].

A better cleaning of the root canal walls was obtained with the rotary technique than with the

hand technique, only at the medium third, at the mesiodistal direction. This probably occurred because of the design of the ProTaper® instruments, which exhibited a greater taper than standardized hand files, enabling a greater contact of the instrument with the root canal walls during its action.

Marques da Silva *et al.* [18] did not find statistically significant difference regarding the amount of remaining filling material after retreatment when ProTaper® retreatment system, D-Race® system and MTwo® retreatment instruments were compared, even when additional instruments had been employed for reinstrumentation.

In relation to the analysis of the removal of the filling material among the root thirds, it could be observed that the apical third was the region that showed the greatest amount of remaining filling material, regardless of the operative technique used. Other studies [22, 25, 27] also verified this same situation. Only in the study conducted by Garcia Júnior *et al.* [11] the apical third exhibited the smallest amount of remaining filling material, followed by medium and cervical third.

Based on the results of this study, further studies are necessary because an efficient and safe technique has not been found for the total removal of the filling material.

## Conclusion

According to the results obtained, it can be concluded that:

- Hand and rotary techniques were not capable of removing completely the filling material inside root canals. The rotary technique was most efficient only at the medium third, at mesiodistal direction, without statistically significant difference between the two techniques at the other thirds and directions;
- Concerning to the cleaning of the root canal walls after desobturation and reinstrumentation, there were not statistically significant differences, regardless of the technique used;
- The apical third showed the greatest amount of filling material after the desobturation and reinstrumentation of the root canals in both techniques tested.

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