Influence of sealer placement technique on the filling of mandibular incisors

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ABSTRACT

Introduction: The aim of the present study was to compare three techniques of sealer insertion in flat canals. The conventional technique where the sealer is inserted with the master cone was compared to 2 experimental groups, Irrisonic tip and Easyclean file in reciprocal movement. **Methods:** Forty-five mandibular incisors with flat anatomy of root canal (RC) were selected for this study. The RC were enlarged up to the R40 Reciproc file size. Next, the samples were divided into 3 groups (n = 15) in accordance with the insertion sealer techniques. For obturation, in all groups, the Touch'n Heat was used. The sections at 2 and 4mm from foramen were obtained and they were examined in a stereoscopic with a 40-times magnification. In the sequence, images were taken with a digital camera and the total area of the RC, as well as the voids and areas filled with gutta-percha and sealer were measured with the Axion Vision LE software. **Results:** At the levels 2mm (p=0,131) and 4mm (p>0,05) there was no difference among the groups in relation to the void areas. The void areas were compared also between the levels 2mm and 4mm and there was no difference present in any tested group. (EasyClean File p=0,309, Master Cone: p=0,164; Irrisonic: p=0,867). **Conclusions:** The Irrisonic ultrasonic tip and Easyclean files could not provide a better filling result than the conventional technique.

Keywords: Endodontics. Root Canal Obturation. Root Canal Filling Materials.

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Introduction

The success of endodontic treatment depends on an adequate disinfection of the root canal (RC). However, due to the anatomical complexity inside the RC in all dental groups, the complete filling is required to avoid new growths of microorganisms and consequently reinfection of the RC.[1]

The main material used for the filling is the gutta-percha and it must always be associated with an endodontic sealer. The gutta-percha is a solid material and the sealer has the capacity of filling irregular and oval areas of any RC. Besides that, the sealer provides the bond between the gutta-percha and dentinal walls.[2]

In the past, the need for a larger amount of gutta-percha and the minimum quantity of sealer to fill the RC was the main target of many studies. The choice of obturation techniques that provide more gutta-percha inside the RC than sealer was explained by the poor physicochemical properties inherent to the sealers, such as solubility and contraction. Nowadays, the endodontic sealers, mainly those epoxy resin based, have showed an improvement in those properties mentioned above.[3,4] This way, the majority of sealers can be used for filling larger and irregular areas that are always presents in the most RC.[5]

During the mechanical preparation of the RC to improve debridement and disruption of the smear layer and biofilm, some devices are used to activate the endodontic irrigants. Among these devices, the stainless steel ultrasonic tip Irrisonic E1 (Helse, Ind.& Com., Santa Rosa de Viterbo-SP, Brazil) and the rotatory/reciprocation Easyclean file (Easy equipamentos, Belo Horizonte, MG, Brazil) are used for that irrigant activation.[6,7]

There are many techniques available to modify the gutta-percha and this way provide a better filling of the RC. Likewise, new techniques have been suggested to put the sealer inside the RC. The main idea of such new techniques is to activate the endodontic sealer by the same devices used for activate endodontic solutions. Thus, the sealer could reach and fill flat and oval areas of the RC.[8] However, there are few investigations on the use of those devices for sealer insertion into the RC.

The aim of the present study was to compare three techniques of sealer insertion in flat canals. The hypothesis tested was whether the Irrisonic and Easy Clean devices could provide a better filling than the conventional technique in which the placement of a sealer is performed by the master gutta-percha cone.

Materials and methods

the approval for this study was granted by the Ethics Committee of the Federal University of Mato Grosso do Sul, Campo Grande, MS, Brazil (CAAE 51274715.3.0000.0021). Forty five mandibular incisors extracted with complete root formation and single root canals were selected for this study. The cone bean tomography (Icat Kavo Kerr, CA, USA) was used in order to standardize only specimens with flat anatomy in the apical third of the RC.

Biomechanical preparation

All crowns were removed and the working length was determined to be at the apical foramen. A biomechanical preparation was performed using the Reciproc System (VDW, Munich, Germany) powered by an electric motor in reciprocal movement. The root canals were enlarged up to the R40 file size. The irrigant used was 5,25% sodium hypochlorite of approximately 20 mL per RC.

Obturation of the root canals

Before the obturation, PUI (passive ultrasonic irrigation) was performed. The solution was shaken by a specific ultrasonic tip - irrisonic (Helse, Ind.& Com., Santa Rosa de Viterbo-SP, Brazil) coupled to a Jet Sonic ultrasonic device (Gnatus, Ribeirão Preto-SP, Brazil) in the following sequence: irrigation with 5,25% sodium hypochlorite and ultrasonic 20-second activation, flooding with EDTA Trisodium (Biodinâmica,Ibiporã.-PR, Brazil), a 20-second activation and an irrigation with 5,25% sodium hypochlorite and ultrasonic 20-second activation, totaling a 1-minute activation of the irrigating solution. In the sequence, the RC were thoroughly irrigated with 10 ml of a saline solution. Then, the RC were dried with absorbent paper points, and the AH Plus sealer (Dentsply, York, PA) was manipulated according to the manufacturer's instructions. In sequence, the samples were divided into 3 groups (n = 15) in accordance with the insertion sealer techniques: Irrisonic (I), Easyclean file (EC) and Conventional technique with master cone (MC).

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In all groups, the Touch'n Heat (Sybron, EUA) was used. Before obturation, the plugger (0.08) was fitted and the apical binding point was determined to be 5 mm shorter than the working length. Each gutta-percha cone was seared at the orifice. The Touch'n Heat was set to 10 potency and the tip of the plugger was placed into the canal orifice and it was advanced through the gutta-percha until it reached the apical binding point. Then, the heat of the plugger was inactivated and the apical pressure was maintained on the plugger in this position for 5 seconds to avoid any shrinkage because of the cooling gutta-percha. After 5 seconds, the heat was activated and the plugger was quickly removed from the canal.

Group I – Conventional technique with a Master Cone (MC)

The master cone #40 of medium size (Odous, Brazil) was fitted to the working length and coated with a sealer Ah Plus (Dentsply, Switzerland). During the introduction of the master cone in the canal, helical movements were applied, in order to touch all walls of the RC. When the master cone reached the working length some input and output movements with 2-3 millimeters of amplitude were performed as well. Coming next, the obturation technique with the Touch'n Heat was made as previously described.

Group 2 – Ultrasonic tip Irrisonic (I)

The Irrisonic tip was coated with the AH Plus sealer and introduced up to 1mm before the working length. Helical movements were applied as well. The ultrasonic device (Gnatus, Ribeirão Preto, Brazil) was activated at 10% potency and the Irrisonic tip remained inside the RC for 20 seconds. After that, the master cone was inserted in the canal the same way as in group 1. Next, the obturation technique with the Touch'n Heat was performed.

Group 3 – Easyclean File (EC)

The Easyclean file was coated with the AH Plus sealer and introduced up to 1mm before the working length. Helical movements were applied as group 1 and 2. Then it was activated using the Reciproc System (VDW, Munich, Germany) powered by an electric motor (VDW) in reciprocal movement. The duration of that procedure was 20 seconds and in the sequence, the master cone was inserted into the RC the same way as in group 1 and 2. The obturation technique with the Touch'n Heat followed the procedures applied.

After the obturation the roots were measured with a digital caliper (Black Bull, USA) and they were marked at 2mm and 4mm from the apical foramen.[9] The sections were made with a double face diamond disk # 7020, diameter 0.10mm (KGSorensen, Cotia-SP, Brazil), powered by a handpiece at 10,000 RPM. The procedure was performed under constant cooling conditions derived from the handpiece and an additional water Jet was directed towards the section area. The sections were fixed on the microscope slides (Carvalhaes, Gravata.-RS, Brazil) with Blu Tac (Bostik, UK). Then the sections were examined in a Stereoscopic (Coleman, Santo André, Brasil) with a 40-times magnification and the images were taken with a digital camera (Cyber-Shot DSC-WX10, Sony, Japan).

The images of the total area of the RC, as well as the voids and areas filled with gutta-percha and sealer were measured with the Axion Vision LE software (Carl Zeiss, Thornwood-NY, USA) (Figure 1 and 2). The measures were taken at a 1:1 scale on the inserted images and the pixels were calculated automatically. Those measures were transformed into percentages of the void areas so as the sealer and gutta-percha filled areas.

The comparison in relation to the void areas in the levels of the RC 2mm and 4mm was performed by the ANOVA one via test and the Student-Newman-Keuls post-test. The comparison between the levels (2 e 4 mm) was also made and a t-student paired test was applied. The statistical analysis was made by SigmaPlot software and a significance level of 5% (α = 0,05) was established for that.

Results

The results of gutta-percha, sealer and void areas percentages in the levels 2mm and 4mm are showed in Table 1. The percentages of the void areas are illustrated in Figure 3.

At the levels 2mm (p=0,131) and 4mm (p>0,05) there was no difference among the groups in relation to the void area percentages.

The void area percentages were compared between the levels 2mm and 4mm and there was no difference present in any tested group. (EasyClean File p=0,309, Master Cone: p=0,164; Irrisonic: p=0,867).

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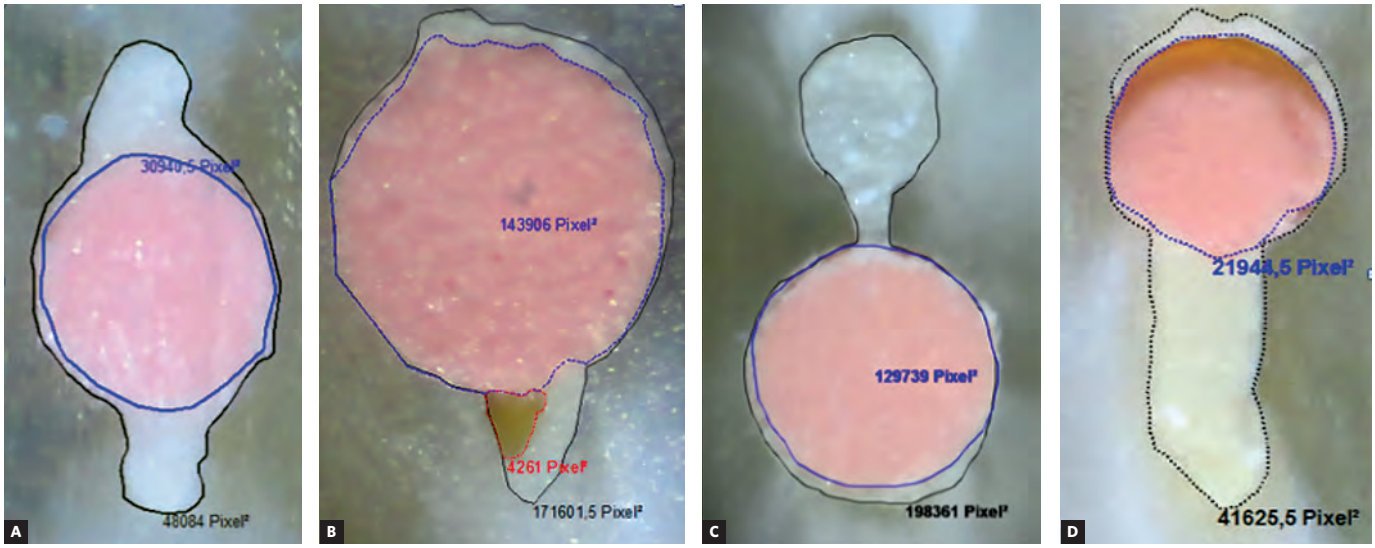

Figure 1. Void area contoured by the red line; the blue line shows the limit of gutta-percha and the black line shows the total area of RC. The endodontic sealer was calculated based on the remaining area. (Sealer area = [Total area - (gutta-percha + void area]. In cases of 100% filling (Sealer area = [Total area - gutta-percha)]. **A** and **B** group 1, **C** group 2, **D** group 3, level of 4mm. The measurements were made in pixels.

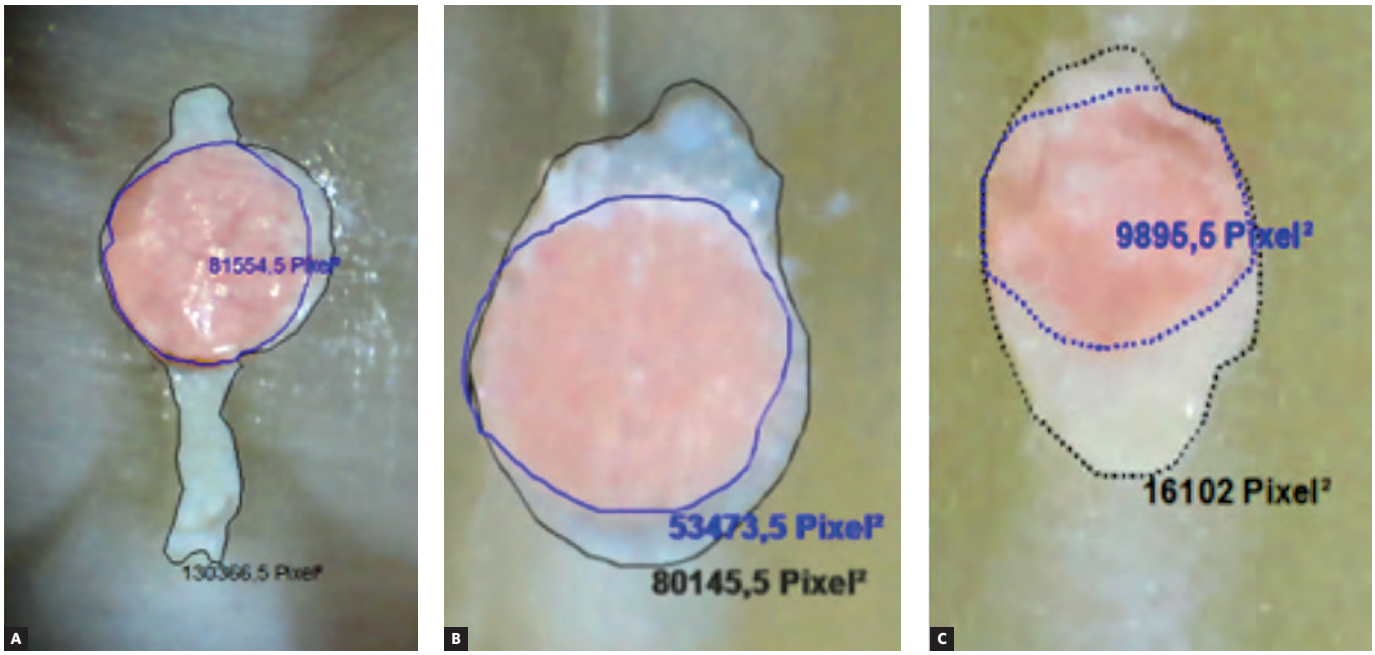

Figure 2. The blue line shows the limit of gutta-percha and the black line shows the total area of RC. The endodontic sealer was calculated based on the remaining area (Sealer area = [Total area - gutta-percha)]. **A** group 1, **B** group 2, **C** group 3, level of 2mm. The measurements were made in pixels.

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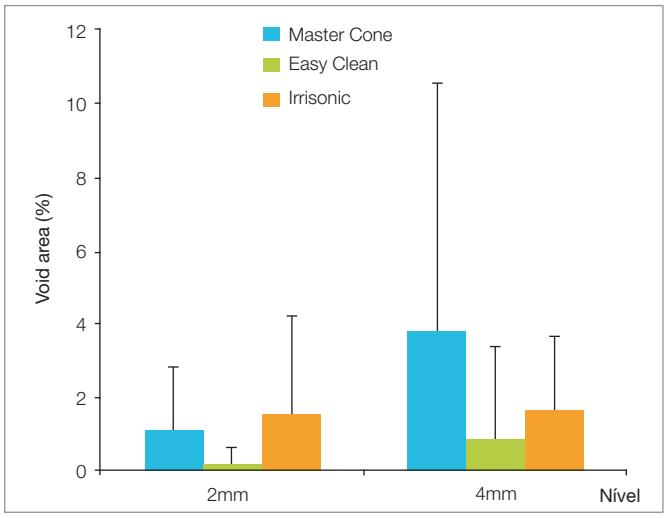
Table 1. The results in relation to gutta-percha, sealer and void area percentages at 2 and 4mm levels.

Group	Level		*p*
	2mm	4mm	
Gutta-Percha			
Master Cone	73.88 ± 12.37	76.44 ± 12.91[a]	0.562
Easyclean	73.69 ± 12.27	58.74 ± 17.64[b]	0.044
Irrisonic	75.51 ± 11.19	77.31 ± 9.57[a]	0.693
p	0.900	<0.001	
Sealer			
Master Cone	25.03 ± 11.55	19.81 ± 13.17[b]	0.246
Easyclean	26.19 ± 12.20	40.43 ± 17.27[a]	0.054
Irrisonic	22.99 ± 10.43	21.08 ± 8.91[b]	0.663
p	0.741	<0.001	
Void Area			
Master Cone	1.09 ± 1.68	3.75 ± 6.79	0.164
Easyclean	0.13 ± 0.49	0.83 ± 2.50	0.309
Irrisonic	1.50 ± 2.71	1.61 ± 2.00	0.867
p	0.131	0.175	

The results are showed in mean, standard deviation of the mean. Value of p in the t-student paired test (comparison between the levels) or in the ANOVA test of one via (comparison between tested methods). Different letters in the columns indicate differences between filling materials. (post-test Student-Newman-Keuls, p<0,05).



Graph 3. Graph shows the percentages of void areas in the techniques at 2 and 4mm levels. Each column represents the mean value and the bar the standard deviation of mean.

Discussion

Even after an excellent mechanical preparation of the RC the success may be compromised if the filling phase is not properly carried out.[10] It has been a long time that the principal materials for filling the RC are defined as gutta-percha and sealer.[11] The ideal filling is reached when those materials are well suited to the walls and irregular areas of the RC.[12]

The obturation quality reached by the filling materials have widely been surveyed in extracted teeth. The choice of mandibular incisors in this investigation was because that kind of tooth usually presents an oval-flat anatomy of the RC[13]. This anatomy allows the achievement of better tests for filling efficiency of materials and techniques than round root canals.[14]

Based on the results that PUI can improve the delivery of irrigant at irregular areas of the RC, Guimarães et al.[8] investigated the quality of filling of 4 epoxy resin sealers. Among them, the AH Plus which was activated into the RC by ultrasonic activation. Those authors confirmed that the ultrasonic activation promoted a large penetration of the sealers in dentine. A few void areas were identified in such study at the apical region when it was compared to groups that did not receive the ultrasonic activation.

The results from the present work based on the methodology applied may be considered efficient in all groups evaluated. The Irrisonic group did not show a filling improvement when compared to group that the sealer was inserted in the RC with the Master Cone. The results can be explained due to obturation technique performed. Techniques that plasticize the

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gutta-percha, case of Touch'n Heat, obtain a homogeneous mass of obturation and a large quantity of gutta-percha at the apical third of the RC.[15,16] Once that plasticized gutta-percha enters into areas that solid gutta-percha cones do not achieve it can suggest that the sealer was pushed by plasticized gutta-percha towards the oval-flat areas of the RC. Based on these information the MC group may have been benefited by the obturation technique used in the present investigation.

Although many researchers recommend the lateral condensation technique (CL) for this kind of investigation, we did not use CL because it does not promote an effective filling of the RC. This technique leaves many void areas and does not guarantee a homogeneous distribution of filling materials inside the RC[15,17,18,19]. Therefore it could interfere in the study. Besides that, nowadays the CL is very little used in the endodontic treatment.

So far, there is no investigations in the scientific literature revealing the use of the Easyclean for insertion of sealers. According to Kato et al[7] the EC is composed of a 25/.04 plastic instrument designed to mechanically activate the irrigant and combines reciprocating motion with an "aircraft wing" design. Due to the plastic constitution of EC the walls of the RC are not deformed and this instrument is considered highly safe. Although the EC had showed a convenient performance when used to insert the sealer inside the RC, there was no statistical difference among the groups. However, such indication for the EC seems to be useful, mainly in cases where there is a need of filling large and irregular areas of the RC.

The activation time proposed to I and EC was of 20 seconds. This time was standardized because we could notice that the AH Plus sealer in the ultrasonic group became darker and its appearance looked thicker in times of activation longer than 20 seconds. According to Viapiana et al.[20], the physical and chemical properties of AH plus were negatively affected by the changes in temperatures. Knowing that ultrasonic activation generates the increase in temperature on the ultrasonic tips and consequently inside the RC[21]. This way, the time of activation of 20 seconds was defined for this work.

Void areas were little found and there were no statistical differences among the insertion sealer techniques in all levels (2 and 4mm). The obturation of the RC reached percentages above 95% of filling. These results agree with the previous studies that evaluated obturation techniques with Ah plus sealer.[9,11] The quality of the filling obtained in the present survey is adequate in order to prevent microbial recolonization through communication between the periapical environment and the RC[22].

The results of this study have shown that there were no advantages in inserting sealer by EC and I (ultrasonic). However, future studies are strongly recommended with other brands of endodontic sealers and dental groups that have a more complex anatomy of the RC in relation to mandibular incisors.

Conclusion

The Irrisonic ultrasonic tip and Easyclean files could not provide a better filling result than the conventional technique where the placement of a sealer was performed by the master gutta-percha cone.

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