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Review Article

TESTS WITH PASSIVE ULTRASONIC IRRIGATION: A REVIEW

Isak Correia Haber[1]., Ana Carolina Souza Barboza.[3].,Idiberto José Zotarelli Filho[2]., Elias NaimKassis[1,2] and Fábio Pereira Linhares de Castro[1,2]

[1]University Center North Paulista (Unorp) - São José do Rio Preto – SP, Brazil
[2]Continuing Education (Unipos), Street Ipiranga, 3460, São José do Rio Preto SP, Brazil 15020-040
[3]Dentistry – Foa - Unesp, Araçatuba-SP, Brazil

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ABSTRACT

Background: The endodontic treatment enables cleaning and shaping the root canal to then obtain a three-dimensional shutter, thus preventing reinfection by microorganisms. Thus, irrigation-aspiration complement the mechanical instrumentation facilitating the removal of microorganisms, debris and necrotic debris, especially the areas where instruments do not reach for the preparation of root canals, as isthmus, accessory canals and flattening. **Objective:** The aim of this study was to evaluate, through a literature review, the importance of passive ultrasonic irrigation in the sanitization of root canals, thus increasing the chances of success of endodontic treatment. Literature **Review:** Based on the literature, the use of passive ultrasonic irrigation complements the mechanical instrumentation facilitating the removal of microorganisms, debris and necrotic debris, especially the areas where instruments do not reach for the preparation of root canals, as isthmus, accessory canals and flattening. **Discussion:** The Ca (OH) 2 is used as an intracanal medication, in order to supply the instrumentation which, together with the use of auxiliary chemicals and agents of the root canal irrigants, failed to meet during the chemical-mechanical preparation. However, after his drug action, Ca (OH) 2 should be completely removed from the root canal, since there is a correlation between the presence of Ca (OH) 2 remaining and marginal leakage, resulting in the failure of endodontic treatment. **Conclusion:** It was concluded that the passive ultrasonic irrigation is more effective than the conventional ultrasonic irrigation and irrigation in the removal of debris and smear layer from root canals.

INTRODUCTION

The endodontic treatment enables cleaning and shaping the root canal to then obtain a three-dimensional shutter, thus preventing reinfection by microorganisms [1]. The chemical-mechanical preparation for its action along the walls of the root canal dentin release zest, who join the pulp and microorganisms remains, forming the smear layer. Thus, irrigation-aspiration complement the mechanical instrumentation facilitating the removal of microorganisms, debris and necrotic debris, especially the areas where instruments do not reach for the preparation of root canals, as isthmus, accessory canals and flattening [1,2] .

Thus, many irrigating agents can be used for disinfection of the root canal, however, the most widespread one is NaOCl, for its low surface tension, deodorization ability to dissolve organic fabrics and antimicrobial potential [3,4]. The association between NaOCl and EDTA was more effective in removing the smear layer and microorganisms from root canals than use of NaOCl alone, however these substances need to be in direct contact with the dentin surface to be effective [3,4, 5].

Moreover, this process must be combined with an adequate supply to complete the cleaning process. Thus, the passive ultrasonic irrigation (PUI) has been used as an efficient method for removal of dirt and debris dentinal [5,6]. Still, the literature has documented its use as the removal of intracanal medications Ca-based (OH). However, these studies do not establish a suitable protocol can completely remove the Ca (OH) 2 in the interior of the root canal system. The intracanal medication must be removed from the root canal prior to filling, to promote an airtight seal around the root canal. Added to this, the PUI combined with the conventional technique proved to be more efficient in removing dressing used Ca-based (OH) 2 than the association of Irrigation Manual with the conventional technique [7,8].

Corresponding author: **Isak Correia Haber*
University Center North Paulista (Unorp) - São José do Rio Preto – SP, Brazil

Furthermore, because of the small diameter of the root canal and its branches becomes difficult irrigant fills the apical side channels and thus the use of PUI to assist the arrival areas of irrigants such [9.10]. Still, the PUI enhances the action of the chemical agent, for its ability to cavitation and movement, which eventually result in the displacement of these debris [11,12].

Despite the PUI have shown good results, we still need to improve their technique, because other studies did not show statistically significant results between manual techniques and ultrasound. As a corollary, the study by Rangel (2009) [16] evaluated the in vitro efficacy of ultrasound use passively during the final irrigation canals flattened in dye removal adhered to dentin walls. The author concluded that none of the techniques has been able to remove all of the dye of the root canal walls, there was also no significant difference between the two groups.

As a corollary, Hellstein and Johnson (2003) [31] conducted a study to determine if the sonic or ultrasonic passive irrigation were able to reduce the amount of debris in the root canal molar instrumented after they have been manually. For this, 100 molars were selected, which were divided into 5 groups: 1 control group that received no treatment, only final irrigation with NaOCl 5.25%; group 2 received SI for 30 sec and group 3 for 60 sec. Groups 4 and 5 received PUI, 30 and 60 sec, respectively. The authors concluded that passive ultrasonic activation is more effective than conventional irrigation and the sonic activation in the removal of dentinal debris from root canals, and about the time used, there was no significant difference.

In addition, Spoleti, Siragusa and Spoleti (2003) [30] evaluated the influence of PUI in disinfecting root canals. They used 60 teeth (incisors and canines, and distobuccal root molar), contaminated with 3 different types of microorganisms. Each group received a different system of irrigation: Group 1 received saline solution as well as group 2, but this was ultrasonically activated. The PUI was made with files 20 for 10 sec. Then, the specimens were sectioned and analyzed by culture medium, and the surviving colonies counted. Surviving colonies were found in all teeth of the sample, but the number of these colonies was higher in cases where the PUI was not performed.

The aim of this study was to evaluate, through a literature review, the importance of passive ultrasonic irrigation in the sanitization of root canals, thus increasing the chances of success of endodontic treatment.

LITERATURE REVIEW

Based on the literature, the use of passive ultrasonic irrigation complements the mechanical instrumentation facilitating the removal of microorganisms, debris and necrotic debris, especially the areas where instruments do not reach for the preparation of root canals, as isthmus, accessory canals and flattening. As findings, the working Munley and Goodell (2007) [27] conducted a study that analyzed the PUI using digital spacers would be more effective than held with K type files for removal of dentinal debris after the instrumentation of root canals. The authors concluded that the K files when activated by 3 min, were more effective in removing debris.

Added to this, the authors Van Der Sluis *et al*. (2007) [25] conducted a study evaluating the influence of PUI in the shutter seal. The authors concluded that, in the teeth where the ultrasound was used, there was a significantly better seal than the other group. To support, Tasdemir *et al*. (2008) [26] determined the influence of PUI in the apical extrusion of irrigating solution. The authors concluded that the experimental group had significantly less extrusion of irrigating solution than the control group.

Still, al-Jadaan said authors *et al*. (2009) [7] conducted a study comparing different activations ultrasonic, sonic and conventional irrigation using 2.5% NaOCl for cleaning curved canals. After the analysis, the authors concluded that there was no statistical difference between the three groups (PUI), but the sonic device and conventional irrigation removed significantly less necrotic tissue.

Moreover, the authors Goel and Tewari (2009) [24] evaluated and compared the effect of the PUI intermittently or continuously, and the use of needles NavitipFx in the smear layer removal. There was no significant difference among the other experimental groups and the control group. The authors concluded that both the use of NaviTipsFx needles as the use of intermittent PUI methods are effective in removing the smear layer.

Another study by Townsend and Maki (2009) [23] examined whether the conventional irrigation, EndoVac®, EndoActivator®, F-File® and sonic agitation are as effective as ultrasonic activation to remove Enterococcus faecalis simulated channels with 30 of curvature. The authors concluded that the PUI removed significantly more bacteria than the other tested methods. Additionally, Van Der Sluis, Wu and Wesselink (2009) [22] conducted a study with five groups in order to determine the effect of the irrigation time in removing debris from dentin root canal PUI comparing two activation methods. It was no statistical difference among the five groups, and when the irrigating solution was activated there was greater removal of debris. Thus, the authors concluded that one minute intermittent PUI was as effective as 3 min with the same streaming.

Still, the authors Bhuva *et al*. (2010) [8] conducted a study to compare the effectiveness of PUI or conventional irrigation with NaOCl 1%, the removal of Enterococcus faecalis biofilm of root canals. The study showed that both experimental groups were effective in removing bacterial biofilm. Still, Boff (2010) [9] histologically evaluated the passive use of ultrasound in cleaning the apical portion of flattened root canals. After analyzing the author concluded that the passive use of ultrasound was able to remove larger quantity of debris than the conventional technique.

Added to this, De Moor *et al* (2010) [19] compared the effectiveness of laser activation with erbium (Er) and erbium-chromium (ERCR) with the PUI. To this, 100 with straight roots upper canines were selected, and their roots separated longitudinally for making a patterned groove. The authors observed that there was a statistical difference between the control group and the other groups, and concluded that both techniques with erbium laser for 20 sec, are as efficient as the PUI for 60 sec.

Also, according to Jiang *et al*. (2010) [20], multiple activations of irrigant through ultrasonic pulses must increase the removal of debris dentinal repeated acceleration caused by the same. The authors found significant differences only between groups 1 and 3, and activation in the most effective irrigating solution when the pulse interval is 50% than in the group without the use of the wrist.

Furthermore, Rodig *et al*. (2010) [18] conducted a study with the purpose of comparing the efficacy of conventional irrigation, irrigation RinsEndo® and PUI in removing debris dentinal irregularities simulated apical root canals with different diameters. 45 single-rooted premolars were selected. After analysis with scanning electron microscopy, the authors concluded that PUI is more effective than the other two methods used in the removal of dentinal debris, and the apical diameter is not a deciding factor.

Also, Gonçalves (2011) [13] conducted a study to assess qualitatively, by scanning electron microscopy cleaning the apical third of curved root after conventional final irrigation, sonic and ultrasonic passive. The author concluded that the PUI and SI no significant differences as regards the removal of smear layer.

Added to this, Paque, Boessler and Zehnder (2011) [14] conducted a study in order to investigate the impact of irrigation result in debris accumulated in root canals after instrumentation. Irrigation sequence had a significant impact in reducing debris, and the use of EDTA with the PUI were the most responsible for reducing the amount of debris.

In addition, Wiseman *et al*. (2011) [15], evaluated through the use of computed microtomography, the efficacy of sonic or ultrasonic irrigation in the removal of Ca (OH) 2 of root canals. They used 46 human molars with complete summits and bends between 20th and 30th. The authors concluded that none of the methods can completely remove calcium hydroxide root canal, yet the use of more PUI instrumentation for 3 cycles of 20 sec each, significantly removed a greater percentage of Ca (OH) 2 that sonic irrigation.

Extending the results, Al-Ali authors, Sathorn and Parashos (2012) [6] conducted a study in order to compare the removal capacity of smear layer and debris from four different irrigation protocols. They used 107 mesial roots of upper molars 20 and divided into 4 groups receiving 15% EDTA and 1% NaOCl. The authors concluded that the CanalBrush ™ are as effective as PUI in removing debris and smear layer.

Still, the authors Case *et al*. (2012) [10] conducted a study that examined the effects of ozone gas taken by saline in root roots infected with Enterococcus faecalis, with and without the use of PUI. Seventy single-rooted teeth were selected. The analysis revealed that 1% NaOCl was the best disinfecting agent, followed by combination of the PUI with ozone gas, ozone gas alone and finally PUI alone.

In addition, Castle-Baz *et al*. (2012) [11] conducted a study to compare the effect of two ultrasonic irrigation techniques penetration of NaOCl in the main channel and accessory canals of extracted teeth. The teeth were divided into three groups, with group 1 irrigation was made with positive pressure in group 2 was held PUI and group 3 was made continuous ultrasonic irrigation. The results showed that group 1 had lower NaOCl penetration rate in the lateral canals and principal than other experimental groups.

Finally, a test performed by Zart authors *et. al*. 2014 [3] evaluated the efficacy of passive ultrasonic irrigation (PUI) associated with the conventional technique in removing dressing used Ca-based (OH) 2. Thirty previous monoradicular human teeth were used. IUP group had statistically smaller percentages of Ca (OH) 2 remaining as compared to the manual irrigation group, regardless of the analyzed thirds ($P < 0.05$). The apical showed the highest amount of residual drug in both groups ($P < 0.05$). The association of PUI to the conventional technique proved to be more efficient in removing Ca intracanal medication based (OH) 2 that the combination of manual irrigation with the conventional technique.

DISCUSSION

The Ca (OH) 2 is used as an intracanal medication, in order to supply the instrumentation which, together with the use of auxiliary chemicals and agents of the root canal irrigants, failed to meet during the chemical-mechanical preparation [29]. However, after his drug action, Ca (OH) 2 should be completely removed from the root canal, since there is a correlation between the presence of Ca (OH) 2 remaining and marginal leakage, resulting in the failure of endodontic treatment. According Margelos *et al*, 1997 [32], this interaction exists, especially when the sealer of the root canal system is based on zinc oxide and eugenol.

Thus, some methods for the removal of intracanal medications based on Ca (OH) 2 has been studied. Thus, the authors Van der Sluis *et al*. (2009) [22] found that the CUI with NaOCl was more effective in removing Ca (OH) 2 than the other groups. Although methodological differences, the results of this study corroborate the findings Van der Sluis, since conventional technique associated with the PUI was more efficient in removal of paste Ca (OH) 2 ($p < 0.05$) the conventional technique associated with the final irrigation manual mode.

In a similar study, Silva *et al*. (2009) [17] evaluated the effectiveness of PUI in the removal of Ca (OH) 2 in the apical third, by scanning electron microscopy, and found that the apical third showed higher amount of remaining dressing used, suggesting that, as approaches the apical foramen, the less effective is the removal of Ca (OH) 2. According Balvedi *et al*. (2010) [21] the composition of Ca-based slurry (OH) 2, regardless of the vehicle used, no influence on the removal of the root canal walls, suggesting that the interaction between the calcium hydroxide and dentin is essentially mechanical.

As a corollary to the above, the method allowed to evaluate only the area of Ca (OH) 2 remaining, unlike other methods that can be quantified three-dimensionally waste dressing used as the computed microtomography [15]. But the microtomógrafo is an expensive and limited access equipment. According to Wiseman *et al*. (2011) [15], the crown of removal prior to irrigation of protocols eliminates a natural reservoir for irrigating solution. Furthermore, when activating the irrigating solution with ultrasound, a significant amount of solution may be lost coronally, decreasing the hydrostatic pressure at the apex.

Thus, in general, external to that the difficulty in completely removing Ca (OH) 2 was also verified by other authors, demonstrating that Ca waste (OH) 2 are recalcitrant in the root canal walls, especially in apical since to date no method was able to remove them completely [1-5]. However, even with different protocols is a consensus that the IUP technique for the removal of Ca (OH) 2 is superior to others. Accordingly, the development of new studies in order to establish an efficient protocol for full it is imperative removal intracanal medications Ca-based (OH) 2 as well as to evaluate the clinical effect of the presence of Ca (OH) 2 on success endodontic treatment [5,6,7].

CONCLUSION

It was concluded that the passive ultrasonic irrigation is more effective than the conventional ultrasonic irrigation and irrigation in the removal of debris and smear layer from root canals. Furthermore, passive ultrasonic irrigation is not able to remove completely all traces of debris from the root canal system, although the literature has shown the best statistical results of cleaning.

Competing interests

The authors declare que they have no competing interests.

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