CLEANING OF THE ISTMO REGION WITH ULTRASOUND ACTIVATION IN LOWER MOLARS - COMPARATIVE ANALYSIS "EX VIVO"

LIMPIEZA DE LA REGIÓN DE ISTMO CON ACTIVACIÓN ULTRASÓNICA EN MOLARES INFERIORES - ANÁLISIS COMPARATIVO "EX VIVO"

LIMPEZA DA REGIÃO DE ISTMO COM ATIVAÇÃO ULTRASSÔNICA EM MOLARES INFERIORES - ANÁLISE COMPARATIVA "EX VIVO"

Marcus Victor Vaz Soares Castro1, Brunna da Silva Firmino2, Humbelina Alves da Silva3, Lara Lysle Silva dos Santos4, Maria Ângela Arêa Leão Ferraz5, Rodrigo Barcelos Barbosa6, Rebeca Maria Vieira Pereira7, Wanderson Carvalho de Almeida8, Carlos Alberto Monteiro Falcão9

1 – Universidade Estadual do Piauí – UESPI, Undergraduate Student in Dentistry. E-mail: m_vvaz@hotmail.com
2 – Universidade Estadual do Piauí – UESPI, Undergraduate Student in Dentistry. E-mail: bfirminno@gmail.com
3 – Universidade Estadual do Piauí – UESPI, Undergraduate Student in Dentistry. E-mail: humbelinaalves@gmail.com
4 – Universidade Estadual do Piauí – UESPI, Dentist. E-mail: lara_lysle@hotmail.com
5 – Universidade Estadual do Piauí – UESPI, PhD in Endodentistry. E-mail: angela.endo@hotmail.com
6 – Universidade Estadual do Piauí – UESPI, Undergraduate Student in Dentistry. E-mail: rodrigo_bbb@hotmail.com
7 – Universidade Estadual do Piauí – UESPI, Undergraduate Student in Dentistry. E-mail: rebecamaryya@hotmail.com
8 – Universidade Estadual do Piauí – UESPI, Undergraduate Student in Dentistry. E-mail: wandstron@gmail.com
9 – Universidade Estadual do Piauí – UESPI, PhD in Dental Clinics. E-mail: falcaoendo@hotmail.com

Marcus Victor Vaz Soares Castro (Corresponding author)
Undergraduate in Dentistry, Undergraduate Student at Universidade Estadual do Piauí – UESPI, m_vvaz@hotmail.com
Abstract

Objective: To observe the degree of penetration of the obturator cement in the isthmus region of mesial roots of lower molars after ultrasound use.

Materials and Methods: 30 extracted human lower molars were used. The teeth were instrumented and randomly divided into three groups which used different smear layer removal techniques. The results were submitted to statistical analysis by the Mann-Whitney test.

Results: It was observed that the use of ultrasound with specific insert for isthmus cleaning did not influence the degree of penetration of endodontic cementum in the cervical and middle thirds of the root canals.

Conclusion: The use of ultrasound in the final toilet of root canals influenced root canal cleansing when compared to manual technique.

Keywords: Endodontics; Ultrasonics; Root Canal Obturation.

Introduction

Success in endodontic therapy is based on the degree of knowledge of the morphology and anatomical complications of root canals, such as accessory canals, apical deltas and the presence of isthmuses. These are defined as a flat space that can promote partial or total communication between the channels of the same root.(1)
The instrumentation of this root canal system generates a waste layer composed of an amorphous, irregular and granular substrate with tissue remains, organic matter, inorganic matter and microorganisms adhered to the canal walls, obstructing the dentinal tubules and creating an interface between the material obturator and dentin. This reduces the root permeability, requiring the use of auxiliary chemical substances that act on organic and inorganic matter.\(^2\)

The applicability of irrigation in endodontic treatment is to promote the removal of pulp tissue, microorganisms, when present, remove dentine residues, as well as neutralize bacterial toxic products and lubricate the walls of the conduits.\(^3\)

The anatomical variations are an important factor to be considered, since the cleaning of curved, narrow and flattened ducts is not always easily performed. The agitation that the ultrasound promotes, provides that the irrigantes circulate in areas of anatomical complexity.\(^4\text{-}5\)

The irrigators most commonly used in endodontic treatment are sodium hypochlorite (NaOCl) and chlorhexidine, due to their antimicrobial activities, but because of their inability to effectively remove the smear layer, the use of ethylenediaminetetraacetic acid (EDTA) is necessary. allows the removal of the smear layer, however, it has been observed that none of these solutions completely removes the dentin mud, especially when it is not associated with a type of activation.\(^6\)

Considering the small diameter of the canal, its ramifications and anatomical irregularities, the irrigant may find it difficult to cover the entire region of the canal. Several studies have proposed the use of the ultrasonic activation of the irrigant to improve its action, being of great relevance for cleaning regions of complex anatomy.\(^7\)

The apical cleaning of flat root canals instrumented through manual and rotational techniques associated with ultrasonic irrigation using 6% sodium hypochlorite presents satisfactory results in cleaning root canal walls and isthmus. The use of an irrigation needle coupled to the ultrasound as a guarantee of the constant renewal of the irrigating solution during the ultrasonic activation favors the cleaning.\(^8\)

In order to evaluate the effect of EDTA 17% with and without the passive use of ultrasound in the ability to remove the smear layer, the researchers established a final irrigation protocol, after biomechanical preparation, for the four groups in which EDTA was used 17% as follows: the first group was irrigated with 17% EDTA for 3 minutes, the second group underwent ultrasonic irrigation with 17% EDTA for 3 minutes. In the other two groups the time of EDTA use was only reduced from 17% from 3 minutes to 1 minute. With the aid of M.E.V, the authors evaluated the removal of the smear layer from the specimens and concluded that the groups that used passive ultrasonic irrigation had a significant difference in the removal of these debris in relation to the groups that the ultrasound was not used. It was also observed that 1 minute of ultrasonic irrigation with EDTA 17% is enough for the removal of the dentin mud in the apical third of the root canal.\(^9\)

In a study evaluating the effectiveness of saline solutions, NaOCl 2.5% and Chlorhexidine 2% with and without passive ultrasonic irrigation for the removal of debris from simulated irregularities in the apical third of the root canals, bovine lateral incisors were included in muffle with silicone and the channels prepared with oscillatory system up to a diameter of 80, irrigated during preparation with 2.5% NaOCl (groups 1 and 2) and with 2% chlorhexidine (group 3). After the preparation, the roots were sectioned longitudinally. The post-experiment images were obtained
by scanning electron microscopy with 20x magnification. The authors verified that, regardless of the irrigation solution used, passive ultrasonic irrigation makes the removal of debris from the apical third more effective, however, it did not obtain complete cleaning in any sample.\(^{(10)}\)

In an in vitro comparison on the incidence and type of isthmus, in the first molars, 72 teeth with intact roots and not endodontically treated were used. With their crowns removed the specimens were included in silicone mold and wrapped in epoxy resin and then sectioned perpendicular to their long axis, the sections produced were stained and analyzed under microscopy for the presence and type of isthmus based on the classification of Hsu & Kim. The observed results point to a higher prevalence of this anatomical structure in more cervical levels, having in the lower molars a percentage of 100% incidence in the two most coronal cuts, and being in the great majority of the type that has the union between two separated ducts carried out by the isthmus.\(^{(1)}\)

The present study evaluated the degree of penetration of the obturator cement in the isthmus regions of the root canal after using ultrasound with specific inserts, in comparison with other techniques that do not use it.

**Material and Method**

This is a study with a quantitative and experimental approach, and its development in the Preclinical laboratory of the School of Dentistry of the State University of Piauí - UESPI, Campus Alexandre Alves de Oliveira, and the results evaluated in the Institutions dependencies.

Thirty human teeth (lower molars) were selected with intact roots and fully formed apices obtained from the teeth bank of the State University of Piauí -OSPI, submitted to sterilization in autoclave and preserved in saline solution at room temperature until the moment of the experiment.

Soon after the start of the sectioning and elimination of the dental crowns with double-faced diamond disc (KG Sorensen®, Cotia, São Paulo, Brazil) mounted in low rotation with the purpose of facilitating the instrumentation of the channels.

Odontometry was performed with a K-file file (Dentsply® Maillefer, Petrópolis, Rio de Janeiro, Brazil) #15 until reaching the apical foramen and retreating 1mm in order to obtain the working length.

The teeth were randomly divided into 3 groups with 10 specimens each, where all were submitted to the same biomechanical preparation using instruments of the Reciproc R25 Non-Reciprocal Oscillatory System (VDW, Germany), with the aid of a 1% sodium hypochlorite solution (Biodinâmica®, Ibiporá, Paraná, Brazil), aspiration and drying by means of a metal vacuum cannula (Endo Points®, Rio de Janeiro, Rio de Janeiro, Brazil) and cones of absorbent paper Reciproc R25 (VDW, Germany).

Always irrigate with 1% sodium hypochlorite. After instrumentation and drying of the channel, the final toilet stage was performed, followed by obturation according to the following approaches as expressed in Table 1:

**Table 1** - Distribution of the groups according to the channel system cleaning method.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Amount of specimens</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>10</td>
<td>Instrumentation, EDTA sludge removal activated with</td>
</tr>
</tbody>
</table>
memory instrument for 5 minutes, single cone technique

| Group 2 | 10 | Instrumentation, removal of dentin sludge with EDTA activated with ultrasound for 30 seconds, single cone technique.
| Group 3 | 10 | Instrumentation, isthmus cleaning with ultrasonic activation, removal of the dentin sludge with EDTA activated with ultrasound for 30 seconds, single cone technique.
| Total   | 30 | -

Ultrasonic activation was performed using the E18 Istmo and E1 (Irrisonic) Helse inserts coupled to the CV Dentus Ultrasound device, at a power of 10% as indicated by the manufacturer.

After the final toilet and drying of the conduits, the canals were sealed by the single cone technique, in which Sealer 26 cement (Dentsply®, Petrópolis, Rio de Janeiro, Brazil) was fed to the canal through a lentulo # 01 drill bit (Dentsply®, Petrópolis, Rio de Janeiro, Brazil), followed by the placement of the gutta-percha cone of the Reciproc System, R 25 (VDW, Germany). Excesses were removed with heated condenser (Dentsply, Petrópolis, Rio de Janeiro, Brazil), followed by cold vertical condensation. The entrance of the channels was sealed with TPH Spectrum photopolymerizable composite resin (Dentsply®, Petrópolis, Rio de Janeiro, Brazil) and the roots radiographed.

After 72 hours, the teeth were sectioned using a diamond disk (KG Sorensen®, Cotia, São Paulo, Brazil) in two transversal planes (one in the cervical third and the other in the middle third) and made a wear of this thickness of 1mm to visualize (KG Sorensen®, Cotia, São Paulo, Brazil), medium grain size.

For the evaluation of cross-sectional plans, an Operative microscope (DF Vasconcellos®, Valença, Spain) was used. The results were classified in four modalities, regarding the penetration level of the obturator material in the isthmus region, these being: Degree 0 - there was no filling of the isthmus region. Grade 1 - when there was penetration up to 1/3 of the isthmus region. Grade 2 - when penetration covered the middle third of the isthmus. Degree 3 - Full isthmus penetration.

The research was approved by the Research Ethics Committee of FACIME/UESPI, under number 1,801,895.

Results

SPSS, in its version 21, was used to perform comparative analyzes between groups with small samples. For that, Kruskal-Wallis ANOVA was calculated, followed by Mann-Whitney tests.
Table 2 - Distribution of the samples according to the degree of penetration of the cement observed at 03 mm from the apex.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Grade 0 (without penetration)</th>
<th>Grade 1 (penetration up to 2/4 of the isthmus region)</th>
<th>Grade 2 (penetration close to 4/5 of the isthmus region)</th>
<th>Grade 3 (total penetration of the isthmus region)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Direct Search

From the sample, Kruskal-Wallis ANOVA test was performed of one factor in the three groups analyzed at 3 mm from the apex. It was observed that there was no statistical difference between the means of the groups. However, it can be observed that group II had the highest mean and group I had the lowest mean. From the results, $\chi^2$ (chi-square) of 5.22 was observed, with an associated probability of 0.07. Thus, the difference was close to being statistically significant as compared to the other groups.

It was also sought to complement these results by performing, through the Mann-Whitney test, the comparison between the groups, according to Table 3, demonstrating the statistically significant difference between G1 x G2; marginally between G2 x G3 and non-statistically significant G1 x G3.

Table 3 - Comparisons between the groups at 3 mm from the apex (from the Mann-Whitney test).

<table>
<thead>
<tr>
<th>Comparative Samples (two to two)</th>
<th>Difference between averages</th>
<th>Meaningfulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 X Group 2</td>
<td>5,0</td>
<td>0.03*</td>
</tr>
<tr>
<td>Group 1 X Group 3</td>
<td>1,0</td>
<td>0.70</td>
</tr>
<tr>
<td>Group 2 X Group 3</td>
<td>4,0</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Source: Direct Search
Note: * p <0.05 (significant)

Table 4 - Distribution of the samples according to the degree of penetration of the cement observed at 06 millimeters from the apex.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Grade 0 (without penetration)</th>
<th>Grade 1 (penetration up to 2/4 of the isthmus region)</th>
<th>Grade 2 (penetration close to 4/5 of the isthmus region)</th>
<th>Grade 3 (total penetration of the isthmus region)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Direct Search

The Kruskal-Wallis ANOVA test was performed with one factor in all three groups. The projection for the mean of the stations for each of the groups can be
observed at 06 mm from the apex. The results presented a $\chi^2$ (chi-square) of 2.47 with an associated probability of 0.52.

Therefore, there was no statistically significant difference in penetration observed in each group. It was observed that in both conventional and ultrasound cleaning techniques good hygiene indices were obtained in the cervical and middle thirds, which may be justified by the amplitude of these regions. We also sought to complement these results by performing a Mann-Whitney test comparing the groups, according to Table 5, showing that there was no statistically significant difference between G1 x G2; G1 x G3; G2 x G3.

Table 5 - Comparisons between the groups at 06 mm from the apex (from the Mann-Whitney test).

<table>
<thead>
<tr>
<th>Comparative Samples (two to two)</th>
<th>Difference between averages</th>
<th>Meaningfulness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 X Group 2</td>
<td>2.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Group 1 X Group 3</td>
<td>1.50</td>
<td>0.53</td>
</tr>
<tr>
<td>Group 2 X Group 3</td>
<td>1.70</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Source: Direct Search.
Note: * p <0.05 (significant)

Discussion

The isthmus observed in the dental roots represents a complex anatomical structure. Researches that suggest that most of these structures present an obliteration in the communication between the ducts, by apposition of dentin, and therefore need sanitification that transposes this difficulty.(1)

Studies also demonstrate that the root isthmus, because of its unpredictable location and anatomically complex, makes cleaning and disinfection laborious, where conventional instrumentation does not have the capacity to reach all irregularities. Irrigating substances play an important role in the debridement of the unreached residues, however the regions of greater complexity still present resistance to the penetration of these irrigants.(11-12)

Activation with ultrasound provides the transmission of acoustic micro current energy generating a greater agitation of the irrigators, which results in the penetration of the material into areas of anatomical complexity and tubules producing a greater capacity of cleaning.(5)

Ultrasound is considered an alternative to minimize the difficulties of sanitizing the conduit system, since it is observed that the agitation promoted by its action provides that the irrigators circulate in areas of anatomical complexity resulting in greater cleaning capacity, obtaining satisfactory results in the hygiene of the root walls and isthmus.(5-8)

Passive ultrasonic irrigation presents more favorable results regarding the degree of cleaning compared to other techniques that do not use ultrasound.(8-9,13-14)

The present study used similar results when it observed a greater penetration of endodontic cement in the isthmus region when the passive ultrasonic activation was used.

The cleaning effectiveness conferred by ultrasonic irrigation was more pronounced in apical third,(10) as can be observed in the experiment, in which the significant difference was found in the evaluation of the cuts at the apex 3mm level.
The use of the special insert for the cleaning of the isthmus region did not change the result regarding the penetration of the sealant cement when compared to the techniques that did not use this feature. This result can be justified, since the recommended insert for isthmus cleaning only acts on the cervical and middle third, which are of greater amplitude, where the efficient action of conventional techniques is observed.

Despite the results obtained in the present study, it was observed that the protocol of use of the ultrasonic inserts for isthmus cleaning and removal of the smear layer used reduced time with similar or superior results to the conventional techniques, reducing the operative time.

Conclusion

It was concluded that the use of ultrasound with specific insert for isthmus cleaning did not influence degree of penetration of the endodontic cement in the isthmus region. The use of ultrasound in the final toilett of the root canals helps in the removal of the dentinal mud in the apical and middle thirds of the root canals.

References


