SONIC, ULTRASONIC AND MANUAL INSTRUMENTS IN THE CONTROL OF PERIODONTAL DISEASE: AN IN VITRO EVALUATION

ABSTRACT

The purpose of this study was evaluating the damage caused by root planning through different types of instrumentation. To perform it, 30 artificial teeth were selected from Prodens trademark, and their roots were divided in longitudinal sense and later included partly in blocks type IV plaster. Next they were submitted to three different types of root instrumentation: manual, sonic and ultrasonic. In each group 15 strokes apex coronary was carried out. After the analysis of root structures, they were evaluated through a stereoscope with 8x magnification; the images were scanned and the damage caused to the dentin surface was measured in total area with software “Image J”. The measures noted were statistical analyzed trough the tests ANOVA/Tukey, comparing the different types of instrumentation. After instrumentation, statistical difference was found (p <0.001) among the three groups. A lower wear of the root structure was obtained with manual instrument with an average of 0.62mm², followed by the sonic tool wear of 1.07mm², but a greater wear was found with the ultrasonic instrument: 1.56mm². In this study was possible conclude that the instrumentation with sonic and ultrasonic methods may provoke more damage in the root structures.

KEYWORDS

Dental calculus. Dental scaling. Instrumentation.
INTRODUCTION

According to Santos et al. (2009)\(^1\), Dentistry today is towards the prevention of buccal diseases and, for this, the surgeon dentist needs to be trained to act with the patient in a wide context, providing favorable dental conditions for a good relationship socially and in the family.

For Teles and Teles (2009)\(^2\), the buccal health is an integral and essential part of the general health, and it is a relevant factor for the quality of life. Dental caries and periodontal diseases are grievances to the buccal health, and they are evaluated as the main public health problems, because they impacts prominently on the individual and on the community. They are highly prevalent and they may be prevented and controlled by joint action among community, surgeon dentist and the patient.

Periodontics means a study about the patient; in other words, this field of dentistry studies the periodontal diseases, which are a pathological process that affects periodontal structures of protection and/or sustentation\(^3\).

Periodontal disease is considered a great problem encountered in several patients’ mouth; in different studies, it is one of the main causes of premature loss of healthy teeth\(^4\).

Ota-Tsuzuki et al. (2009)\(^5\) reported that the relationship between the origin of periodontal diseases and oral hygiene was described for the first time by Pierre Fauchard in 1728. From this period the necessity to use steel instruments to remove calculus was determined.

Periodontal therapy is based on the removal of dental plaque, calculus and toxic products from bacterial origin. The elimination of these deposits is achieved by therapy of the scaling and root planning\(^4\).

Ota-Tsuzuki et al. (2009)\(^5\) consider as fundamental the means to prevent the progression of periodontal disease: regular mechanical removal of the bacterial plaque from all the dental surfaces, the patient’s motivation and cooperation with the appropriate and sustainable individual oral hygiene, beyond periodical dentist consultation to control the disease.

There are several kinds of instrument used during the periodontal treatment, among the manual, sonic and ultrasonic scalers, alternate movement and laser instruments\(^6\).

The main instruments used as manual scalers are: curettes, files, hoes and sickles. Hand instruments are composed by three parts: Shank, the active part (blade) and the handle. In order to obtain the adequate balance of the instrument, the cutting edge of the blade is centered along the axis of the handle\(^4\).

The electric instruments are divided in two: sonic and ultrasonic. Sonic apparatus are similar to the hand piece and they work with
compressed air of high and low speed units of dental equipment. The frequency generated produce vibrations which are conducted to the instrument tip that oscillates in a movement almost circular. This standard circular stroke allows that the instrument tip adapt itself to all the surfaces of teeth.\(^6\)

Ultrasonic devices were introduced in 80s in the dental office. They use high frequency probes to fracture and displace deposits from the teeth. It is necessary monitoring the water through the vibratory tip to wash effectively the pocket. The instrument tip vibrates about 25,000 to 50,000 cycles by second with the water jet creating a fine mist round the tip. The frequency is defined as the number of times by second that the active instrument tip oscillates during one standard cycle of movement; it determinates the area of the instrument tip that is considered active.\(^3\)

In this way, the perform of this study is justified to understand better the benefits and damage caused, due to the use of different types of instrumentation in the control of periodontal disease, evaluating the slots caused by ultrasonic, sonic and manual scrapers in order to identify what kind of scraper evaluated provides less slots.

Therefore, it is possible determinate the more effective method to control periodontal disease.

**MATERIAL AND METHODS**

In order to perform this study, 30 artificial teeth were selected from prodens brand; their roots were divided in the longitudinal sense to separate the vestibule face from the lingual one. Artificial teeth were selected instead of natural ones due to the standardization in prepare of teeth. Posteriorly they were included in gypsum blocks type IV with the cutting edge upwards, then the mesial and distal faces could be photographed to visualize the damages caused by instrumentation.

At that time, they were submitted to three different kinds of root instrumentation (groups I, II and III), performed by the same calibrated operator using similar force during the scraping in the different groups:

- **Group I** – Manual scraping performed by Gracey curettes number 5/6 in 15 apical coronary movements. Each five instrumented teeth the curette was sharpened with Arkansas stone.

- **Group II** – Scraping performed with sonic equipment (SonicBorden 2000 Kavo, Brazil), coupling tips referent to the Gracey curettes 5/6 in 15 apical coronary movements.

- **Group III** – Scraping carried out by ultrasonic equipment (ALT- Altsoni Jet Ceramic II with peristaltic pump), coupling blunt tips in 15 apical coronary movements in medium power.

After the instrumentation of roots, the analysis of root structures was performed and they were evaluated though a stereoscope (Carl Zeiss, Goettingen – Germany) with 8x magnifying; the images were digitalized and the damages caused to the dentin surface were measured in their total area (Fig.1) with the software “Image J” © (Research Services Branch, National Institute of...
Mental Health, Bethesda, Maryland, USA). A single observer was responsible by measurements, without know what group was evaluated. The measures were reported and statistically analyzed through the ANOVA and Tukey test to compare the different types of instrumentation in relation to the damage caused in the root surface (p= 0.05)

RESULTS

In this study, the damages caused by root scaling and planning were evaluated in 30 plastic teeth of prodens trademark through different kinds of periodontal instrumentation: manual, sonic and ultrasonic. It was analyzed the damage caused to the root surface measured in the total area with the software “Image J” © (Research Services Branch, National Institute of Mental Health, Bethesda, Maryland, USA), in order to evaluate what instrument provided less slots on the root surface and next identifying the more effective scraper.

The differences on the root wear among the groups before the instrumentation were not significant. Therefore, all the specimens showed similar planning on the root surface before the instrumentation, due to the standardization of preparation of teeth which were used to perform this study.

After the root instrumentation, statistically significant differences were observed among the three groups studied. The slots made by the Gracey 5/6 curette were shallower and the surface was also more regular 0.624mm², and in the other instrumented groups the slots were deeper and the surface more irregular; with the sonic instrument the wear was 1.07mm² and with ultrasonic was 1.56 mm². The results found may be analyzed by the table 1 and the figures 1, 2, 3, and 4.

Table 1 – Results found in relation to the wear area in millimeters with different instruments. Statistical comparisons among groups with Tukey test.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>media ±</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>Manual</td>
<td>20</td>
<td>0.62 ± 0.40</td>
<td></td>
</tr>
<tr>
<td>Sonic</td>
<td>20</td>
<td>1.07±0.40</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Ultrasonic</td>
<td>20</td>
<td>1.56±0.40</td>
<td></td>
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Figure 1 – Tooth 20 after scrape with sonic instrument with 8x magnifying evaluated on stereoscope (Carl Zeiss, Goettingen – Germany).
Figure 2 – Tooth 20 after scrape with sonic instrument with 8x magnifying evaluated on stereoscope (Carl Zeiss, Goettingen – Germany).

Figure 3 – Tooth 4 after scrape with manual instrumentation with 8x magnifying evaluated on stereoscope (Carl Zeiss, Goettingen – Germany).
DISCUSSION

Root scaling and planning are the procedures more used in the treatment of periodontal disease, and the authors have determined that the aims of these procedures were the removal of biofilm and calculus.\textsuperscript{7-9}

According to the literature, although the study methodology complicates the comparison of calculus removal among
manual, sonic and ultrasonic instruments, it has been investigated by several authors with contradictory opinions.

In this study was possible observe that results obtained with manual instruments are deeply dependent on the force applied and the curette sharpening.

It is important highlight that Ribeiro et al. (2006)\textsuperscript{9} performed a study to evaluate with scanning electron microscopy the roughness root obtained after instrumentation with diamond tip sonic device, Gracey 5/6 curette and ultrasound, beyond a control group. Statistically significant differences were observed when compared the control group to the others (curette, ultrasound and Diamond tip sonic device). Higher roughness was produced by sonic and ultrasonic instruments; the slots found were deep and all the surfaces were irregular with grooves due to the vibration of these instruments. With this study it is possible observe that diamond tips provide a root roughness similar to the ultrasound instrumentation, and this roughness is higher than that presented by manual instrumentation, because the slots observed were in the same direction.

Likewise, in the study performed by Kishida et al. (2004)\textsuperscript{10}, rotatory instruments were compared to the manual ones (Gracey curette Hu-Friedy). In this work, the time necessary to the root planning was measured and the roughness of root surface, the surface texture and the cells adhered to the root surface were verified through scanning electron microscopy. The results obtained showed that the time used to the root planning and scaling is significantly higher with manual instruments.

About the surface texture, significant difference was found among the groups in which the scaling was performed with rotatory instruments; they were more roughness when compared to the manual instruments, and in relation to the surface roughness there were no statistically significant differences found in the results.

It is interesting highlight that Walmsley et al. (2008)\textsuperscript{11}, with their study, reported that ultrasonic instrumentation causes a rough aspect with several grooves, slots and burn on the root surface, and the fast oscillatory movements on the root wear more substances, what leads to form defects on the surface.

Another relevant factor and that influenced in the performance of this study is that sonic and ultrasonic instruments with inadequate pressure or non-uniform velocity of movements produce clefts and roughness on the surface.

On the other hand, in an evaluation of defects on the root surface with scanning electron microscopy produced by manual
curettes and ultrasonic instruments with different potencies, Casarin et al. (2009)\textsuperscript{12} observed that for the area of contact of instrument with surface, the results were significantly higher for manual instruments when compared to the ultrasonic ones, no matter the potency used. About the values of defect depth, the results showed numerically, but not statistically, differences between manual and ultrasonic instruments. In this way, the results only demonstrated that manual instrumentation produced defects with similar depth to those obtained with ultrasonic instruments.

It is important remember that Lea et al. (2009)\textsuperscript{13} determinate technical advances and the new design of sonic and ultrasonic instruments have revolutionized the role played by these oscillatory instruments in the periodontal therapy; wherefore several studies have been carried out to prove their effectiveness and observation of damage caused to the root dentin.

In this study was also observed that, besides the potency of ultrasound apparatus, the design of the tip used also has influence in the dental surface wear. The higher the active part, the higher will be the wear, no matter the potency of ultrasound apparatus.

Therefore, in this research was verified that manual instruments include a large contact area than that observed with electric instruments; it results in a less rough surface and, consequently with less slots. Tactile sensation of instrument tip is virtually lost when the unity is activated, and may occur removal of more dental structure than with manual instruments; in this way, for the dentist surgeon who does not show much ability, it is recommended using manual instruments because despite they demand more time and exhausting from the operator, it will cause less damage to the patient’s dental structure.

In the study performed by Chapper et al. (2005)\textsuperscript{14}, the following parameters were reported: probing depth, clinical insert level and bleeding on probing, analyzed four groups (manual, manual associated with irrigation, ultrasonic, ultrasonic preciously to manual).

The results revealed the treatments produced significant changes in clinical parameters without statistically significant differences among the four groups. Reduction of bleeding on probing on proximal faces, in probing depth, and in the clinical insert level was observed for all the groups, both for free faces and proximal ones. It was possible conclude that the four therapeutic modalities of subgingival instrumentation were equally effective in the improvement of clinical parameters studied. It is important remember that whether these parameters were studied in the execution of this work, the results should reveal that the treatments achieved their
objectives without statistically significant differences among the groups.

CONCLUSION

After the analysis of results, it was possible conclude with this research: the slots found with manual instruments were shallower and also the surface was more regular; with ultrasonic and sonic instruments the slots were deeper and the surface more irregular. A less wear on root structure was obtained with manual instrument, followed by the sonic instrument, and the higher wear was found with ultrasonic instrument. Hence, instrumentation with sonic and ultrasonic equipment should be used with caution, in order to avoid damage to the root structures.

REFERENCES


