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Comparative evaluation of Root Roughness after Instrumentation with Curettes, Ultrasonic, Diamond Tip Sonic Scaler with control group: A in Vitro study

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Abstract

Objective: The purpose of this study was to evaluate the roughness on the surface of root after instrumentation with sonic, ultrasonic tips and gracey curettes.

Materials and Methods: Sixty root surfaces of human teeth were randomly assigned to four treatment groups: curette instrumentation, ultrasonic instrumentation with universal tip and sonic instrumentation with diamond-coated tip and control group (without instrumentation). Each sample was instrumented with fifteen strokes. Before and after the instrumentation, surface roughness was measured. In addition, the root surface topography was examined after treatment with the scanning electron microscope.

Results: Significant statistical differences ($p<0.05$) were observed when comparing the control group (0.585±0.075mm) to the treated groups (hand 1.236±0.269mm , ultrasonic 1.469±0.176mm and sonic instrumentation1.586±0.21mm). The highest roughness was produced by diamond-coated sonic tip and by ultrasonic universal tip ($p>0.05$).

Conclusion: The sonic and ultrasonic scaler instrumentation produces similar root surface roughness which is higher than curette instrumentation.

Keywords: Instrumentation; scaling; root planning; Scanning electron microscope.

Introduction

Since 1950s, ultrasonic and sonic scalers are used in periodontal therapy. These ultrasonic and sonic scalers have many advantages like reduced instrumentation time spent per tooth[1] and better accessibility in furcation defects.[2] Recently, to provide better access and instrumentation[3], many tip designs for sonic and ultrasonic scalers have been modified. Diamond-coated sonic inserts reduces the average treatment time[4] and improves access to furcations. Many studies have shown that sonic tip inserts removed more of the tooth structure than conventional sonic scaler inserts.[5] Diamond-coated sonic scaler tips can damage the root surface if improperly handled.[5] The ideal goal of periodontal instrumentation is to effectively remove plaque and calculus without causing root surface damage. The aim of this *in vitro* study was to evaluate the root roughness caused by sonic, ultrasonic tips instrument tips and gracey curettes.

Material and Methods

Collection of Experimental Sample

Sixty mandibular and maxillary premolars extracted for orthodontics reasons were selected for this study. All the teeth were extracted after written informed consent of the patients. Extracted teeth were rinsed with water for approximately 60 seconds and then placed in 10% formalin.

Selection Criteria

All teeth should fulfill criteria like intact root surface, caries free, negative history of periodontal involvement, clean and free of gross soft and hard debris and unaltered by extraction procedure. By using stereomicroscope, the final selection was made at 4x magnification. Teeth with excessive root concavities or convexities were excluded from the study.

Mounting Procedure

The crown portion of the teeth were removed and each root was mounted in a 2cm high plastic tube filled with acrylic resin with one root face exposed. Roots were polished to reach a similar roughness prior to the instrumentation for all the samples. The mounted teeth were numbered from 1 to 60 and randomly assigned to one of the four study groups. A 3x3mm area in each root was delimitated as the reading area to avoid reading location errors.

Pre instrumentation roughness reading

Surface roughness measuring instrument to check for roughness with a Surf-Corder SE 1200 Kosaka Laboratory Limited at 0.1mm/sec reading speed by following the ANSI (American National Standards Institute) standard. Each root surface received 6 roughness readings (3 parallel and 3 perpendicular to the scaling) to determine a mean roughness for each tooth.

Scaling and root planning

The root surfaces were treated by the same operator by using one of the following instruments: Gracey hand curettes 5/6 (Gracey curette 5/6, Hu Friedy, Chicago, USA), ultrasonic scaler and sonic scaler. The control group has not received any type of instrumentation or treatment. Groups treated with curettes received a total of 15 apical to coronal strokes, parallel to the axis of the tooth. The curette was resharpened with a sharpening stone (Arkansas stone No.6A, Hu-Friedy, Leimen, Germany) after each ten strokes. The groups treated with ultrasonic and sonic scalers received 15 apical to coronal strokes with an inclination of zero degree of the tip.[6]

Post instrumentation roughness evaluations

A roughness reading (Surf-Corder SE 1200 Kosaka Laboratory Limited.) was performed again on all treated roots to determine a mean roughness for each treated root surface.

Four samples of each group were selected for scanning electron microscopy (SEM) (JEOL JSM-T330A, Japan) with a magnification of 100X. The images acquired were used for the descriptive analysis.

Statistical analysis

Differences in roughness means were evaluated by analysis of variance (ANOVA) and by the Tukey test (a=0.05) after instrumentation.

Results

Roughness

Before treatment, differences in root roughness among all groups were not statistically significant. So, all the specimens before instrumentation showed similar smoothness in root surfaces due to the standardized preparation. All the groups showed a significant increase in roughness ($p<0.05$) as compared to the control group (0.585±0.075mm). Significant statistical differences were found when hand instrumentation was compared (1.236±0.269mm) to ultrasonic (1.469±0.176mm) and sonic (1.586±0.21mm) treatments ($p<0.05$). The diamond-coated sonic tips created the roughest surface, so this roughness was not significantly different when compared with roughness created by the ultrasonic scaler.

Microscopy Descriptive Analysis

After instrumentation, difference can be observed in the surface topography of treated groups. All the treated surfaces showed an irregular aspect which was different from the non scaled root surfaces. Dental tissue was removed along the entire instrumentation stroke. Curette produced the smoothest surfaces among the treated groups. Grooves with curette were observed following the same direction of the scaling movements and less roughness was found when compared to ultrasonic and sonic groups. Ultrasonic group showed the presence of deeper sulcus and a rough surface. In the ultrasonic group and sonic scaler with diamond-coated tips group, irregular scratching was found in all the surfaces. Both ultrasonic group and sonic scaler produced uneven surfaces marked with scratches due to the vibrating movements of machine scalers. Sonic scaler with diamond coated tips showed a rough surface caused by scaling. The diamond coating caused an irregular surface due to the grinding action. The diamond splinters give multitude of edges which leaves a characteristic roughness.

Discussion

According to this study, the roughness reading and the SEM examinations showed that all the treated groups presented a significant increase in roughness compared with the control group and demonstrated that the diamond coated sonic tip and ultrasonic universal tip caused increased roughness when compared to hand curettes.

Group Treatment Mean

G1 (n=15) Control 0.585±0.075mm C

G2 (n=15) Curette 1.236±0.269mm B

G3 (n=15) Ultrasonic scaler/universal tip 1.469±0.176mm A

G4 (n=15) Sonic scaler/diamond-coated tip1.586±0.21mm A

The sharpness of the working edge, the length of time the instrument is in contact with the root, angulation, design of instrument tip, and the cumulative number of strokes have impact on the degree of root damage and this situation can be explained by the lack of standardization. The Roughness Loss of Tooth Substance Index (RLTSI) has been used by some studies[7] but the loss of tooth substance of a specific instrument cannot be directly correlated with its produced roughness[5] and a separate evaluation of tooth substance loss and surface roughness produced is necessary.[8] In the present study, differences in surface roughness have been found among different instruments, although it remains to be determined whether these differences are of clinical significance.

Roughness created after debridement and the success of periodontal treatment, different aspects have to be distinguished: supragingival or subgingival roughness and supragingival plaque control during healing.

Root surface should be free of plaque and calculus[9] for the healing after periodontal treatment. Mierau[10] in 1984 and Quirynen and Bollen[11] in 1995 stated that supragingival rough surfaces subsequent to the scaling and root planning can promote plaque formation which leads to the bacterial adhesion. Supragingival surface roughness and surface irregularities increases the surface area which promotes plaque formation, bacterial colonization, and so can compromise daily plaque removal.[12].

Rosenberg and Ash[13] in 1974 did not find that the different instruments had a significant effect on the histologically assessed healing. Khatiblou and Ghodossi[14] in 1983 have reported that periodontal healing following flap surgery occurs regardless of subgingival root surface is rough or smooth. These results were confirmed by Oberholzer and Rateitschak[15] in 1996, who found no difference in pocket reduction and clinical attachment gain after creating rough or smooth surfaces during a flap operation. This indicates that subgingival roughness do not interfere with healing if there is a good supragingival plaque control. Leknes, et al.[16] in 1996 stated that roughness resulting from subgingival instrumentation significantly influenced the subgingival microbial colonization.

More studies are required to clarify the influence of diamond-coated sonic tips on root surface roughness.

Conclusion

It can be concluded that ultrasonic universal tips and diamond-coated sonic tips and produce a similar roughness surface that is higher than that produced by hand curettes.

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