A-Comparative evaluation of root surface roughness after the use of gracey curettes and piezo-surgery-driven root planning tip on root surface: An in-vitro study

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Abstract

Introduction and Objective: The ideal instrument for initial periodontal therapy should enable the removal of all extraneous substances from the root surfaces without any iatrogenic effects. Because of that the objective of this study is to analyses and to compare the root surface roughness after using Gracey curettes, and a piezosurgery driven root planning tip, using SEM scanning electron microscopy.

Aim: The aim of this study was to compare root surface characteristics following root planing with hand- instrument and piezo surgery driven root planning tip instruments.

Material and Methods: A2 mm, 2 mm interproximal root area of 20 teeth (n = 40 surfaces) was evaluated by scanning electron microscopy (·50 to ·1000 magnification). Teeth were randomly assigned to the following two groups: Gracey curettes with 20 vertical strokes; and a piezosurgery ultrasonic scaler in mode ROOT with a power of two. In each case the evaluation for root surface roughness before and after root planing and surface roughness using the Index 't' test 'p' value was measured.

Result: SEM microscopy reviled, the mean preoperative surface roughness was 3.587 with a standard deviation of 0. 466. The samples were root planed by curettes (Gracey) and the mean post-operative surface roughness was 2.364 with a standard deviation of 0.345. The results show that there was average surface roughness reduction in group A, following root planing by curette instrument, with 't' value of 6.670 and 'p' value of =0.0000129. The 'p' value was more than 0 .01.

Conclusions: Out of the two instruments, namely Gracey curette, and piezosurgery driven root planning tip, were effective in mechanical debridement of the root surface. The results favored the use of piezo surgery root planning tip to achieve a smooth, clean root surface; however, the use of piezo surgery instrument tip was more time consuming, which might limit its use in clinical practice. Further clinical studies are needed.

Keywords: Gracey curette, Periodontal disease, Root planning, scaling; Piezo root planning tips.

Introduction

The main goal of periodontal therapy is to eliminate infection and achieve health by the mechanical removal of bacterial deposits of plaque, calculus and their supragingival and subgingival endotoxins.[1–3] It is important for the clinician to achieve an uncontaminated and smooth tooth surface to permit optimal oral hygiene control by patients. Instruction in oral hygiene technique, together with mechanical scaling and root planing, is the initial therapy carried out by the clinician to achieve this goal. Scaling and root planing can be performed with a variety of instruments.

Bacteria and endotoxins can penetrate both cementum and dentin, although there isnoconsensus regarding the depth of penetration. In vitro studies[4,5] have shown that gingival fibroblasts do not adhere to tooth surfaces contaminated by bacteria. Therefore, the objective of scaling and root planning is to provide a biologically acceptable surface for periodontal healing; however, it the amount of hard tissue thatneeds to be removed is contested.[6,7] Nyman et al.[8] specified that their study did not answer the question of whether endotoxins are in fact present within or on the surface of the exposed cementum. The reason for this may be that endotoxins adhering to the surface are removed together with the bacteria by polishing or possibly that endotoxins within the cementum are neutralized by the inflammatory response of the host organism.[8] Coldiron et al[9] noted that the depth of root surface removal necessary to reach a healthy, disease-free area is unknown. The most recent recommendation is to remove as little tooth structure as possible in achieving a clean, smooth surface.[10] The roughness of the residual root surface, as the result of instrumentation, is another important consideration in periodontal therapy.[4,11,12]

Although root roughness in vivo has been shown to have a minimal effect on healing of the periodontal attachment apparatus, it may facilitate further bacterial accumulation and subsequent deposition of calculus;[13] therefore, a smoothest root surface should be one goal of a successful scaling and root planing treatment. Root instrumentation with manual curettes is technically more difficult than other techniques; it is time consuming and causes fatigue to the clinician.[14] In addition to curettes, however, there are other instruments for the mechanical preparation of the root surface, such as sonic, ultrasonic and rotary instruments.[10]

Studies by Breininger et al.,[15] Copulos et al[16] and Drisko[17] have shown that ultrasonic instruments are superior to hand curettes. These studies concluded that

ultrasonic instruments provided a surface biocompatibility,and they are more effective in removing endotoxin from periodontally affected root surfaces. However, Santos et al.[18] investigated 35 single-rooted teeth that were assigned to two experimental groups: group 1; hand instrumentation gracey curettes group 2, piezosurgery driven root planning tip.

A scanning electron microscopy study[19] showed that scaling and root planing with conventional hand curettes and piezo surgery driven root planning tip. Knowing that the ideal instrument should enable the removal of all extraneous substances from the root surfaces without any iatrogenic effects, the present study aimed to evaluate root surface topography after in vitro scaling and root planing with different instruments and to provide new and relevant data for its subsequent application at the clinical level.

Material and Methods

A total of 20 extracted human teeth with 40 interproximal root surfaces, mesial and distal, were included in the study. Multi radicular teeth, teeth with root surface resorption and teeth with restorations on the root surface were not included caries or external.

Study design

This is a comparative, in vitro, blind study comparing Gracey curettes (Hu-Friedy, Chicago, IL, USA), & piezo surgery ultrasonic scaler (Mectron, Carasco, GE, Italy). All teeth were free of calculus and were conserved in sodium chloride isotonic (0.9%) solutions (B. Braun Medical SA, Rubı´, Barcelona, Spain). During the study, the solution was changed every 5 d. The teeth were numbered 1–20 for identification and were catalogued.

The 40 interproximal root surfaces were randomly assigned and divided into four groups of 10 surfaces each. In order to be consistent and precise, an area of 2 mm·2 mm was drawn on the coronal third of each root surface, and a mark was made in the upper right corner of the box (area 2 mm · 2 mm) with a thin cylindrical bur (Komet, Lemgo, Germany) to produce a defined reference point when using the light microscope for analysis. This mark defined the control and test areas.

In group 1, Gracey curettes were used to make 20 vertical strokes with gentle movements from the most apical point to the most coronal root surface point. In group 2, the piezosurgery ultrasonic scaler set on function On/Mode Periodontics (ROOT), with the insert PS1, was applied at a medium power of two for 20 s using the same movements as with the piezo-ceramic ultrasonic scaler.

Scanning electron microscopy

As the scaling and root planning were performed only on the coronal third of each interproximal root surface, to evaluate the sample for the scanning electron microscope, a mark with a cutting dental disc (Komet) was made on the middle of the root to delineate two areas; the inferior part corresponded to the control (untreated tooth surface) and the superior part to the test (treated tooth surface with scaling and root planning).

The control and test measurements for the scanning electron microscopy were made after completing all the examinations with confocal microscopy, because different sample preparations are needed for each of the microscopes (Fig. 1). The specimens were first dried completely and gold sputtered. After that, the surfaces were examined at magnifications ranging from ·50 to ·100X.

Statistical analysis

The means and standard deviations were calculated, and statistical analysis between means was performed with factorial analysis of variance. The statistical analysis was done with an available statistics computer program on a Macintosh computer. The level of significance was determined at 1%.The primary outcome variable was surface roughness average .this variables were tested for two different instrument for scaling and root planning. The change in surface roughness for each instrument after treatment was also considered. Note that the statistical analysis was performed with the surface roughness value obtained through the scanning electron microscope microscopy. The reductions of roughness average values amongst the groups and within the groups were tested before and after instrumentation.

Results

Tooth root debridement procedure is of vitally important component of non- surgical and surgical pocket reduction of periodontal pocket therapy. It is the key factor that influences the success of most of the periodontal procedures aimed at gaining periodontal attachment on previously infected root surfaces.

Power-driven scalers, (Sonic and ultrasonic) have been adopted by many clinicians over manual scalers for most the mechanical instrumentation performed during initial therapy and supportive periodontal therapy (SPT). This paradigm shift occurred after the innovative ultrasonic tip modification first introduced by “Holbrook and Low” more than a decade ago. Since then, many new designs in sonic and ultra-sonic-powdered scaling tips have been developed that offer easier access to periodontal pockets and improved the efficiency in root debridement procedure.

In piezoelectric device, the vibrations can easily allow the segmentation of interfaces from solid to solid by means of distinct vibration, and solid-liquid by means of cavitation. These two concepts are the basis of piezoelectric technology used now days in the dental field. As Per the literature, in 1950 Pohlman was the first to apply ultrasound to human tissues for the treatment of Myalgias and neuropathic pain. The same

year Maintz revealed the positive effect on regeneration and healing of the bone.

Two years later in 1952, an ultrasonic unit was used in dentistry for preparation of tooth cavities; finally, in 1988 the ultrasonic phenomenon was applied in the field of oral surgery. But in the due course of time, dental and oral surgical techniques have been changed and developed significantly during the last 20 years. In current devices, the ultrasonic frequency is modulated by the surgeon from 10, 30 and 60 cycles/s (Hz) even up to 35 kHz. The low frequency enables cutting of mineralized structures, but not soft tissue.

However, the piezo-surgery driven scaler tips are driven at10, 30, & 60 Hz, per seconds, and can be controlled up to 29Hz which enables scraping of hard calcified surface of tooth root, the power of piezo surgery unit can be adjusted from 2.8 W to 16 W. The strokes applied through this sonic instruments does not need any intentional pressure to be applied on the root surface thereby preventing any undue root surface roughening and gouging of cemental surface. The unit provides extreme precision and safety as well as micrometric cutting, thus allowing one to selectively section the mineralized bone structures. Moreover, the device causes less trauma during and after the procedure and the healing duration is also shorter. Hence this study was planned to compare and evaluate the root surface roughness which will prove the efficacy of this peizo surgery root planing tip for root planing procedure.

An in vitro study was carried out on extracted teeth with a total of 20 teeth as samples taken into consideration. These 20 study samples were divided randomly into Group A and Group B with each group containing 10 samples. The coronal portions of tooth samples were sheared off with carborundum discs, and the radicular portions were subjected to SEM study for evaluation of surface roughness. The readings of Group A and Group B were noted pre-operatively for surface roughness.

Group A- subjected to root planning procedure by area specific Gracey curettes number 1 and 2.

Group B- subjected to root planning procedure by piezosurgery root planing tip number SKU:

Z305113.virosurg.The study samples from both the groups were again subjected to SEM evaluation for the surface roughness, caused by both the instruments after the root planning procedure, the results were then arranged in a master chart and were sent for statistical analysis. The inter group statistical analysis was carried out applying un-paired 't'-test and intra group analysis was carried out by paired t-test. As studies, like the one carried out with this piezosurgery root planning tip instrument has not been carried out, we have endeavored to compare the results of our study with studies evaluating other similar sonic and ultrasonic instruments used for root planning as compared to curettes.

Fig. 1: Surface roughness average value. Sample prepared for observation with the scanning electron microscope

Table 1: Mean changes in the value of surface roughness average

	Preoperative		Postoperative		t' Value	P' Value
	Mean	SD	Mean	SD		
Surface roughness(Ra)	3.587	0.466	2.364	0.345	t'= 6.670	p'=0.0000129

Mean change in roughness average (0.lm)

The mean preoperative surface roughness was 3.587 with a standard deviation of 0. 466. The samples were root planed by curettes (Gracey) and the mean post-operative surface roughness was 2.364 with a standard deviation of 0.345. The results show that there was average surface roughness reduction in group A, following root planning by curette instrument, with 't' value of 6.670 and 'p' value of =0.0000129. The 'p' value was more than 0 .01.

Table2: Comparison between preoperative and postoperative surface roughness (Ra) in Group B (Piezo surgery root planing tip)

	Preoperative		Postoperative		t' Value	P' Value
	Mean	SD	Mean	SD		
Surface roughness(Ra)	3.319	0.4325	1.472	0.1968	t'= 12.2919	p'<0.00001

Paired 't' Test p=.03, p=.01 statistically significant.

The mean preoperative surface roughness was 3.319 with a standard deviation of 0. 4325.The sample were root planed by using piezo surgery root planning tip and post-operative the mean of the surface

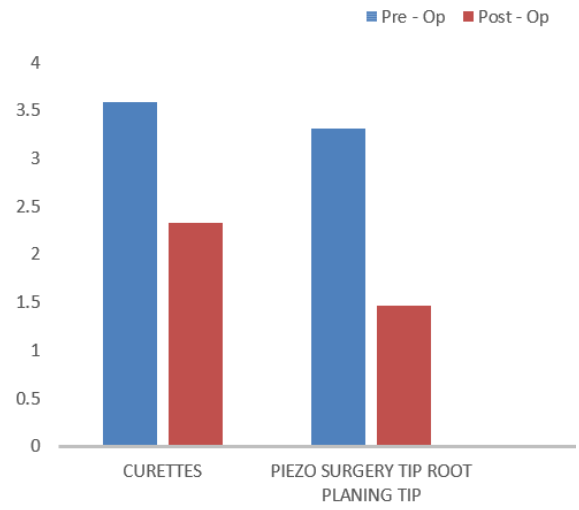
roughness was 1.472 with a standard deviation of 0.1968. The results show that there was reduction in surface roughness in group B following root planning by piezo surgery root planning tip instrument, with 't' value of 12.2919 and 'p' value of <0.00001. The 'p value was less than 0.01, which indicates that the reduction in average surface roughness was statistically significant.

Table 3: Comparison of reduction in roughness of root surface between curettes (Group A) and piezo surgery root planning tip (Group B)

Mean change in roughness average (µm)			T' value	P' value
	Group A	Group B	7.4654	<0.00001
Mean	1.223	1.847		
SD	0.121	0.235		
Minimum	0.88	1,02		
Maximum	1.69	2.53		
Range	0.81	1.51		

The study shows that the mean surface roughness in group A is 1.223 and that with Group B is 1.847 with a standard deviation of 0.121 in group A and standard deviation of 0.235 in group B with a 'T' value of 7.4654 and P' value of <0.01 Thus the result indicates that there is a statistical significant decrease in surface roughness values (Ra) in group B (piezo surgery instrumentation) as compared to that of Group A (curettes), using an unpaired 't' test. The value in this incidence is statistically significant.

Graph 1: Pre-operative and post-operative Mean (Ra) comparison between Groups A & B



The results show that the mean Ra values of pre-operative in both A and B group is statistically equal whereas post -operatively mean surface roughness (Ra) was statistically more significant with that of group B. The aim of our study was to analyze and to compare the root surface roughness after using scanning electron microscopy. Scanning electron microscopy showed that Piezo-surgery root planning tip, seems to leave the smoothest surface. It is also evident from the bar diagram that there is a reduction in root surface roughness in both the groups, with the values being lower in the piezo surgery instrumentation group B which is statistically significant. Thus, we can conclude that both the instruments, i: e Piezo surgery root planning tip and Gracey curettes can reduce a substantial amount of root roughness during root planning procedure with a statistical significant difference. Hence piezo-surgery root planning tip instrument appears to be a better instrument than curettes in the root planning procedure. The result shows that the mean Ra values of pre-operative in both A and B group is statistically equal whereas post -operatively mean surface roughness (Ra) was statistically more significant with that of group B. The results obtained in our study cannot be directly compared to other studies due to lack of similar study. But on indirect comparison between other root planning instruments i:e.Piezo electrical ultrasonic scaler, it can be said that our results are similar to the observation of a study carried out by many different researchers on the tooth root surfaces treated with other three of the four instruments tested for root planning reduced surface roughness, however, most of the studies also indicate that none of the instrumentation techniques is totally effective in eliminating all bacteria and calculus from the subgingival surface of the tooth. As per the observation carried out by Busslinger et al, leknes et al., Quirynen et al. indicated that with the currently available instruments for planning or smoothening the subgingival root surface during nonsurgical or surgical periodontal therapy, the surface roughness would still be far above the threshold Ra value. Nevertheless, even if these instruments leave behind a surface that to a certain extent promotes plaque formation by its residual roughness, the clinician should still attempt to strive to obtain a surface with the lowest possible surface roughness. An ongoing research for faster and effective root planning has resulted in the invention of a new Piezo-surgery root planning tips which can be efficiently used in routine root planning procedure As per the studies done by Leknes et al., Quirynen et al.[1,3] Though curettes happen to be the instrument of choice for root planning procedure compared to other instruments, they carry some disadvantages too, of being uncomfortable to the patient and significantly more root surface gauging and root surface roughening also painful, and time consuming, and traumatic to the periodontal tissues. Also, various studies advocate cementum surface planning. Hence the usage of Piezo-surgery operated root planing tip overcomes various disadvantages of conventional hand operated instruments results of our study are similar to that of Solis Moreno. et al 2012[40] who did the study with an

objective of analyzing and comparing different instruments to evaluate root surface roughening. As a general observation from all studies in the literature, it is evident that subgingival scaling and root planing is a must have procedure, to reduce the amount of diseased cemental surface caused by bacterial plaque and calculus attached to the subgingival root surface. However, most of the studies also indicate that none of the instrumentation techniques is totally effective in eliminating all diseased cemental surfaces due to plaque and calculus from the subgingival surface of the tooth root. The results depict that the reduction in roughness of root surfaces with Piezo-surgery ultrasound scaler left a smoother surface than Gracey curettes.

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