Original Article

Evaluation of Root Debridement Skill in Periodontology Module

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Abstract

Objective: To evaluate the root debridement skill in periodontology pre-clinical module among dental students and to estimate the effectiveness of conducting periodontology pre-clinical module before entering clinical module.

Materials and Method: : A total of 47 pre-clinical dental students (Year 2) were included in this study. Single rooted extracted teeth were collected, mounted on acrylic resin and set into the level of 1/3 of the root length. Each of them were instructed to prepare a mounted teeth and to perform root debridement procedure on the labial surface of the tooth only within 10 minutes using Gracey curette #5/6. The similar samples were distributed back to the same students (which were already in clinical year (year 4) to repeat the same procedure on the lingual surface of the same tooth. Root surface roughness was evaluated by using scanning electron microscope (SEM) and profilometer for both labial and lingual surfaces. Statistical analysis was done using Mann-Whitney U test and T-test. Significance level of $p \leq 0.05$ was assumed for all analysis.

Results: SEM photomicrographs of root surfaces with magnifications of 100x and 800x revealed that there were incomplete removal of the dental calculus in both surfaces and significant roughness root surfaces noted.

Conclusion: : No significant differences noted between the students' root debridement skill in the pre-clinical and also clinical year. Objectives of the current module were fulfilled but in order to meet the highest standard, current module need to be improved in the future.

Keywords*:* : Pre-clinical module, root debridement skill, roughness, root surfaces

Introduction

Chronic periodontitis is an inflammatory disease of the soft and hard tissues which support the tooth root induced by bacteria. It is caused by an accumulation of dental plaque, organized as a biofilm on the surface of the tooth crown and root, which lead to the destruction of periodontal connective tissue and alveolar bone; without treatment, consequently will result in tooth loss (Jones *et al.*, 2014; Michaud *et al.*, 2017). Numerous studies have been conducted over the years about the microbiologic etiology of periodontal disease (Harvey, 2017; Chapple *et al.*, 2018). The role of microbiota in the initiation and progression of periodontal disease is conclusive (Teles *et al.*, 2013; Harvey, 2017). Periodontal treatment hence focuses on the thorough removal of dental plaque, dental calculus, and other predisposing factors that can retain the

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plaque. Nonsurgical periodontal treatment (NSPT), which includes mechanical plaque control, scaling and root debridement is the first recommended step and is an fundamental phase of periodontal therapy (Heitz-Mayfield and Lang, 2013; Delatola, Adonogianaki and Ioannidou, 2014). Supragingival plaque control can improve clinical gingival symptoms, but to produce substantial improvement, it is necessary to perform subgingival plaque control (Doherty, 2016; Gomez *et al.*, 2017). Subgingival plaque in biofilm can evade the defense mechanisms of the host and reduce the effect of chemotherapeutic agents (Haririan *et al.*, 2014). Dental biofilms cannot be eradicated just by routine oral hygiene methods. Thus, mechanical debridement, including scaling and root debridement, is required for successful periodontal treatment. Scaling and root debridement clinically contributes to a reduction in periodontal pocket depth, a decrease in the number of gingival sites with bleeding on probing, attachment level gain, and a shift from a predominantly gram-negative to gram-positive subgingival organisms (Graetz *et al.*, 2017). Besides scaling & root debridement, NSPT consists of 1) oral hygiene instruction & motivation (OHI & motivation), 2) periodontal review and 3) supportive periodontal therapy (SPT). Non-surgical periodontal treatments (NSPTs) aims to eliminate bacterial deposits and create a smooth root surface in order to accelerate the cell adhesion and proliferation (Heitz-Mayfield and Lang, 2013). Since the removal of subgingival calculus embedded in the root surface demands highly clinical skill, it takes years of experience and a desire for perfection for clinicians to become highly competent (Kumar *et al.*, 2015). Hand instrumentation has been considered as the most effective and convenient method of subgingival dental biofilm removal, with some limitations in its ability to completely remove calculus, causing recurrence of the periodontal problem. In order to achieve great results the essential key elements (other than oral hygiene) are: (1) good scaling skills, well maintained instruments and time. Less experienced operators might not be successful enough in removing subgingival plaque or calculus when using hand instruments, plus inducing damages on the root surfaces with these instruments.

Ideal goal of performing successful root debridement is to effectively remove dental biofilm and calculus without causing root surface damage (Ciantar, 2014; Graetz *et al.*, 2017). The smoother the root surface, the better the results will be. Studies in animals concluded that surface roughness resulting from subgingival instrumentation had a significant influence on subgingival microbial colonization (Heitz-Mayfield and Lang, 2013). Again, smooth root surface is the main objective for successful root debridement.

Students are exposed to the periodontology module during their preclinical year, which is in Year 2 in University Technology MARA, Dental Faculty (UiTM). They were trained to give motivation and OHI to the periodontitis, scaling and root debridement on extracted teeth and on Frasaco^{Ò} models with artificial calculus and sharpening of the periodontal instruments like Gracey curettes in order to become competent for the clinical years. Students will be evaluated for their effectiveness in root debridement skill during pre-clinical module and during competency test in clinical year. To our knowledge not many research evaluating root debridement skill carried out in South East Asia. Hence, in this study, we would like to observe if there's any improvement on root debridement skill

by evaluating and measuring the root surface roughness after they have undergone preclinical training. Furthermore, it is a call to evaluate the current pre-clinical periodontology module, and any short out coming will be assessed.

Materials and Methods

Participants

A total of 49 undergraduate pre-clinical dental students (Year 2) of UiTM Dental Faculty had participated in this study. In the beginning, they had little knowledge about the root debridement procedure, which later were equipped with series of lectures, hands on demonstration on the procedure. Demonstrations of root debridement using Frasaco$^{\dot{O}}$ dental model and extracted teeth were conducted for the students. The number of students have been reduced to 47. One student had dropped out of the course meanwhile the second student deceased in the same year. Out of 47 students, only 12 of them male students. Three students were left-handed while the remaining students have dominant hands.

Preparation of teeth

Single rooted extracted teeth were collected for this study. Inclusion criteria of the selected teeth were as follows; (1) intact root surface, (2) absence of caries (sound), (3) consisted deposits of supragingival and subgingival dental calculus. Wax box was prepared; the selected tooth was mounted on an acrylic resin to the level of apical 1/3 of the root length as shown in Figure 1. All these procedures were prepared when they were in pre-clinical year (Year 2).

Instrumentation procedure

Each of 49 pre-clinical dental students (Year 2) were instructed to perform root debridement on the prepared teeth only on the labial surface. Instrumentation was performed using Gracey curette no. #5/6 (Figure 2) . The students were allocated only 10 minutes to perform the root debridement. Following that, the sample were collected in individual envelopes and labelled with student number, name, and the date. The similar samples were distributed back to the same student when they are already in clinical year (Year 4) to repeat the root debridement procedure on the lingual surface of the same tooth. The instrumentation and the allocated time were fixed as previous.

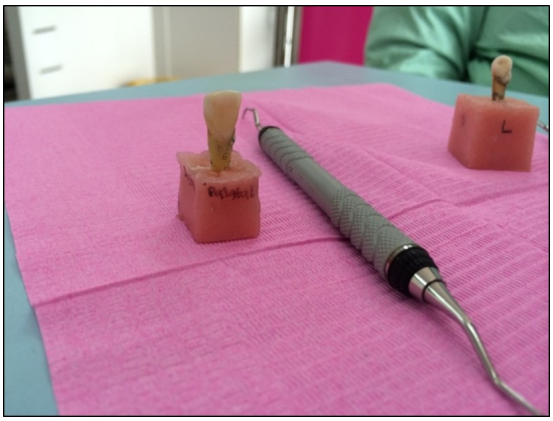


Fig 1: (i) showing mounted extracted single rooted tooth (ii) Gracey Curette no #5/6

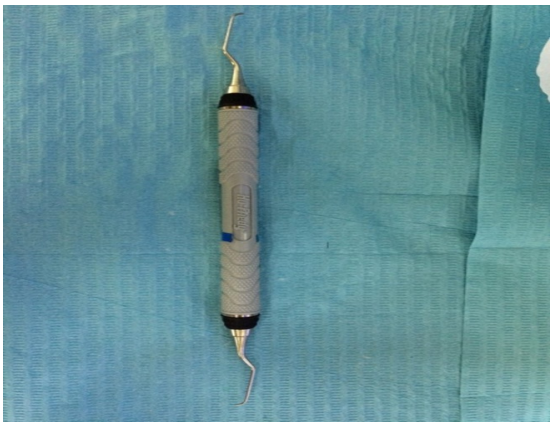


Fig 2 : Gracey curette no. #5/6 by Hu-Friedy^{TM}

Determination of root surface roughness

Root debridement skill was evaluated based on the surface roughness of the teeth that the students performed during

pre-clinical and clinical module. In order to evaluate the surface roughness, scanning electron microscope (SEM) and profilometer were used for both labial and lingual surfaces. Forty-seven teeth were subjected to SEM examination. A total of 94 surfaces (47 buccal and 47 lingual) were evaluated by SEM.

Two micrographs were obtained per surface at 100x magnification and 800x below the cemento-enamel junction for each tooth surface. However, in this study, we looked into surface cleanliness, remaining calculus and structure loss and damage. Three indices were used to evaluate the performance of the students; 1) degree of cleanliness (Folwaczny *et al.*, 2004; Ribeiro *et al.*, 2006), 2) remaining calculus index (RCI) and 3) roughness and loss of tooth substance index (RLTSI) by (Ribeiro *et al.*, 2006).

For degree of cleanliness, the grading is as follows:

Grade 1: Absence of visible debris and plaque with good exposure of dentinal tubules and no evidence of remaining smear layer.

Grade 2: No visible debris, no exposure of the dentinal tubules, and presence of a smear layer.

Grade 3: Presence of visible debris and plaque all over the scanned area, no visible tubuli and smear layer present on the entire surface.

Remaining calculus index (RCI) is used to estimate remaining calculus is graded as follows:

0 – No calculus remaining on the root surface

1 – Small patches remaining on the root surface

2 – Definite patches of calculus confined to smaller areas

3– Considerable amounts of remaining calculus appearing as one or a few voluminous patches or as several smaller patches scattered on the treated surface.

Roughness and loss of tooth substance index (RLTSI) is used to evaluate roughness and loss of tooth substance which has the following criteria:

0 – Smooth and even root surface without marks of instrumentation and with no loss of tooth substance

1 – Slightly roughened or corrugated local areas where the cementum may be completely removed, although most of the cementum is still present

2 – Definite corrugated local areas where the cementum may be completely removed, although most cementum is still present

3 – Considerable loss of tooth substance with instrumentation marks into dentin. The cementum is completely removed in large areas or it has a considerable number of lesions from the instrumentation.

After scanning electron microscope analysis, all 94 surfaces (47 buccal and 47 lingual) were used for roughness evaluation. The roughness of the root surface was measured in micrometres (μm) using a profilometer. For this purpose, centre of instrumented root surface 1-4 mm below the gingival groove was considered the instrumented area. Before starting the measurement, instrument was calibrated against a standard object. Profilometer light was focused on area of interest which covered the entire instrumented area and measurements were obtained as interference pattern (fringes) given by profilometer. Surface profile was determined as average roughness (Ra), defined as the mean between peaks and valleys of the surface profile is the most general and commonly used parameter.

Statistical analysis

The statistical analysis of the measurements was performed with statistical software (SPSS Statistics 20,

IBM, Chicago, IL, USA). For SEM, normal distribution of the data was controlled using Shapiro-Wilk test and Kolmogorov-Smirnov test. Hoc tests were performed using Mann -Whitney test. All tests were two-sided; statistical significance was assumed if p≤0.05. For profilometer, normal distribution of the data was controlled by Shapiro-Wilk test and Kolmogorov-Smirnov test as well. Hoc tests were performed using T-test. All tests were two-sided, statistical significance was assumed if p≤0.05.

Results

This study included a total of 47 students (37 females and 10 females) undergraduate dental students. There were 47 teeth included for evaluation in this study with 94 root surfaces were analysed. They were labelled ***A*** for preclinical year and ***B*** for clinical year.

Scanning electron microscope evaluation

Assessment using scanning electron microscope (SEM)(*model HITACHI Tabletop SEM: TM-3000*) was done using two different magnifications, which are 100x and 800x qualitatively. Three parameters (index) were included. The degree of cleanliness, remaining calculus index (RCI) and roughness and loss of tooth substance index (RLTSI) were analyzed for each sample which included buccal surface and lingual surface. Each surface of the individual samples was graded according to the respective index. Later, the mean for each index was obtained and Mann-Whitney U test was run for this assessment because data are not normally distributed. The first microscopic examination (Figure 3) revealed that the surface is unclean with the presence of visible plaque and calculus. This image scored grade 3; presence of visible debris and plaque all over the scanned area, no evidence of remaining smear layer.

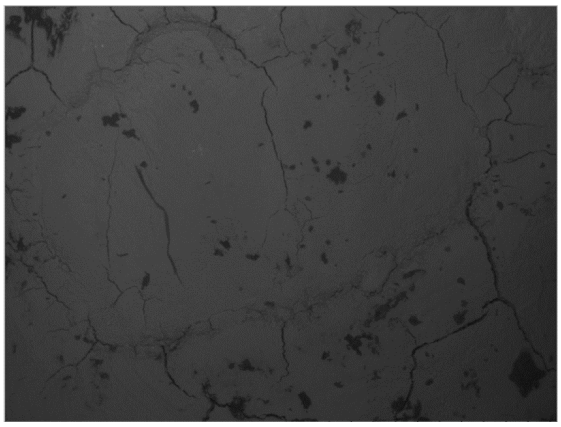


Figure 3: Morphology of the root surface debrided with curette in relation to degree of cleanliness (scanning electron microscope photograph, x100).

The second photomicrograph (Figure 4) showed that the surface was relatively clean with score of 1; absence of visible debris and plaque with good exposure of dentinal tubules and no evidence of remaining smear layer.

Figure 4: Morphology of the root surface debrided with curette in relation to degree of cleanliness (scanning electron microscope photograph, x100)

For Remaining Calculus Index, the mean score for ***A*** (preclinical) (buccal surface) and ***B*** (clinical) (lingual surface) were 1.851 and 1.553 respectively with the *p*-value 0.171. The difference of mean revealed that the calculus still remains in lingual surface but relatively less compared to

buccal surface. Samples showed variation of state of remaining calculus; at some areas, some appeared as small patch. Where else, on some areas, some appeared as definite patches on smaller area and also smaller patches scattered on treated surface. The photomicrograph (Figure 5) showed the example of surface scored 3; which means considerable amounts of calculus appearing as one or a few voluminous patches or as a several smaller particles scattered on the treated surface. Meanwhile, the photomicrograph on the (Figure 6) revealed that definite patches of calculus confined to smaller areas (grade 2)

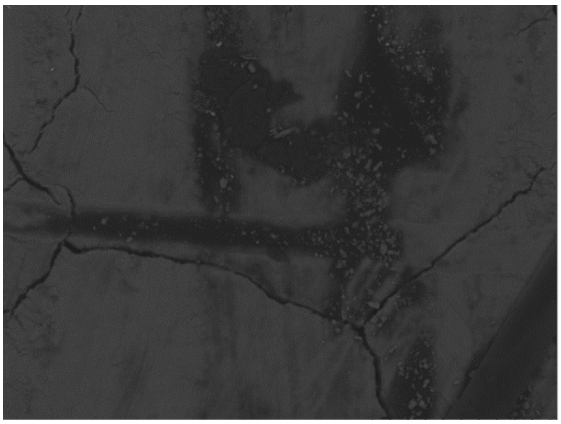


Figure 5: Morphology of the root surface debrided with curette in relation to the remaining calculus index (scanning electron microscope photograph, x800)

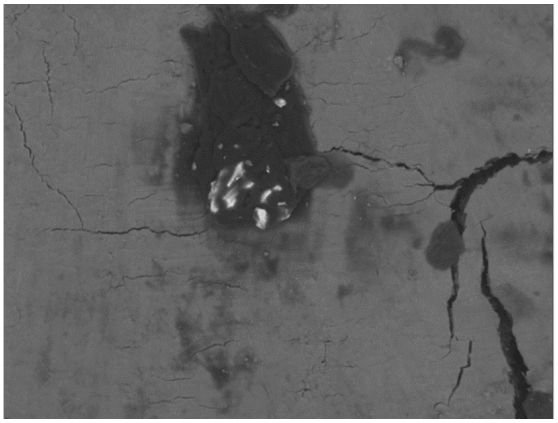


Figure 6: Morphology of the root surface debrided with curette in relation to the remaining calculus index (scanning electron microscope photograph, x800)

For roughness and loss of tooth substance index (RLTSI), the mean score for ***A*** (pre-clinical) (buccal surface) and ***B*** (clinical) (lingual surface) were 2.277 and 2.596 respectively with the *p*-value of 0.055. The high mean value in 2013 suggested that, more tooth substance was removed by curette, which resulted in a roughened tooth surface. The significant difference in term of mean may be due to the students gradually lost their fundamental skills in root debridement such as single stroke motions and gentle pressure. Most of the samples showed linear instrumentation marks into the dentin surface produced by the curette which is evidence in the Figure 7.

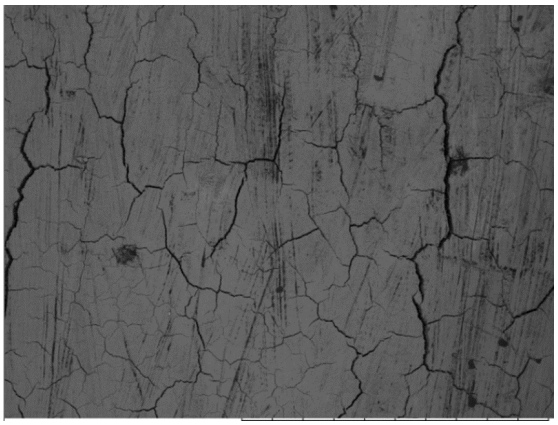


Figure 7: Morphology of the root surface debrided with curette in relation to the roughness and loss of tooth substance index (scanning electron microscope photograph, x100)

As we increased into higher magnification, the linear instrumentation marks was clear as shown by the Figure 8). When vertical and horizontal strokes were combined, haphazard, irregular pattern will be produced by the curettes.

Degree of cleanliness

The mean score for the ***A*** (pre-clinical) (buccal surface) and ***B*** (clinical) (lingual surface) were 3.000 and 2.936 respectively as shown in graph 1. The *p*-value was

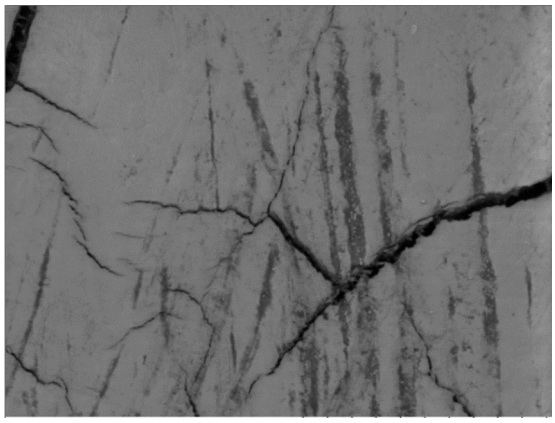
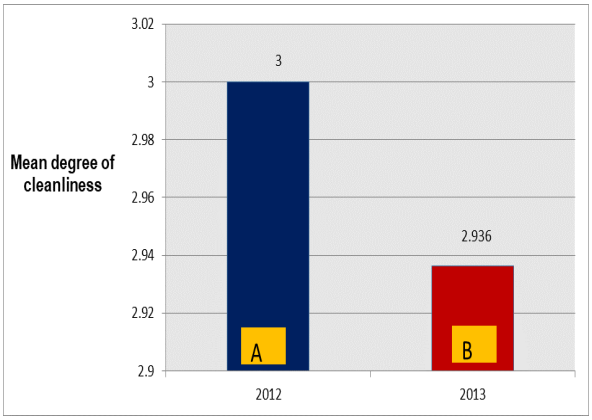


Figure 8: Morphology of the root surface debrided with curette in relation to the roughness and loss of tooth substance index (scanning electron microscope photograph, x800)

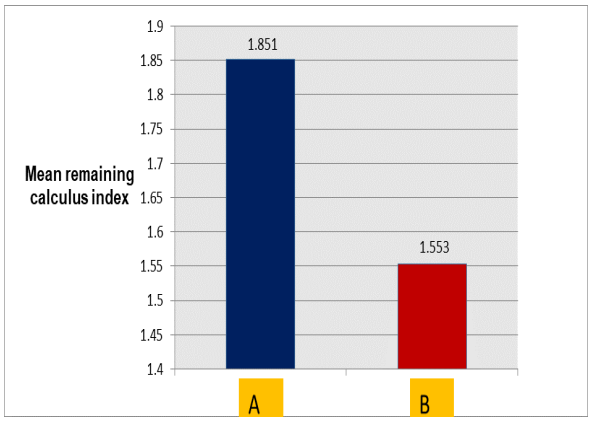
0.317, which was greater than 0.05. The test statistics showed that there was no difference between buccal surface and lingual surface in terms of degree of cleanliness.



Graph 1: Histogram of year vs mean degree of cleanliness in *A* and *B*

Remaining calculus index (RCI)

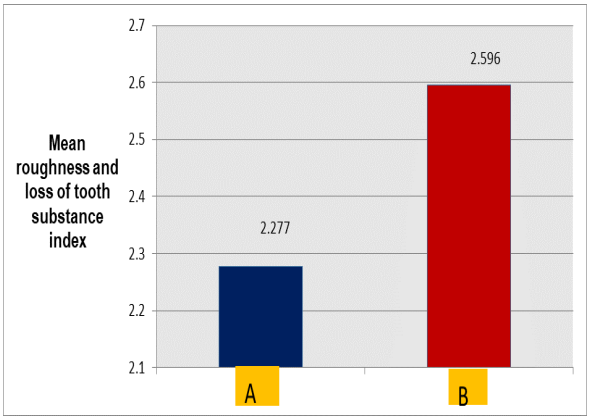
The mean score for the ***A*** (buccal surface) and ***B*** (lingual surface) were 1.851 and 1.553 respectively as shown in graph 2. The *p*-value was 0.171, which was greater than 0.05. Based on the test statistics, there were no difference between buccal surface and lingual surface in terms of remaining calculus index.



Graph 2: Histogram of year vs mean remaining calculus index in *A* and *B*

Roughness and loss of tooth substance index

The mean score for the ***A*** (buccal surface) and ***B*** (lingual surface) were 2.277 and 2.596 respectively as shown in graph 3. The *p*-value was 0.055, which was greater than 0.05. Based on the test statistics, there were no difference between buccal surface and lingual surface in terms of roughness and loss of tooth substance index.



Graph 3: Histogram of year vs mean roughness and loss of tooth substance index in *A* and *B*)

Comparison of mean of each parameter and their significance is tabulated in the table 1 below.

Groups	No.of specimen	Total no.of score	Mean	Differences between groups	
				Group compared	Significance
Group I	47	141	3.000	I vs IV	P>0.05, NS*
Group II	47	87	1.851	II vs V	P>0.05, NS
Group III	47	107	2.277	III vs VI	P>0.05, NS
Group IV	47	138	2.936		
Group V	47	73	1.553		
Group VI	47	122	2.596		

Group I – Degree of cleanliness (Buccal surface, ***A***); Group II – Remaining calculus index (Buccal surface, ***B***); Group III – Roughness and loss of tooth substance index (Buccal, ***A***), Group IV – Degree of cleanliness (Lingual surface, ***B***), Group V – Remaining calculus index (Lingual surface, ***B***), Group VI – Roughness and loss of tooth substance index (Lingual surface, ***B***) *NS – not significant

Table 1: Comparison of mean of each parameter and their significance (Mann-Whitney U test)

Profilometric evaluation

Measurement of roughness surface was done by a contact profilometer (*Ambios Technology XP-1 High Resolution Surface Profiler*). Mean surface roughness for ***A*** (buccal surface) was 0.384 meanwhile for ***B*** (lingual surface) was 0.395. The *P*-value was 0.755, which is greater than 0.05, thus there is no significant difference between buccal surface and lingual surface. Comparison of mean of between ***A*** and ***B*** and its significance were tabulated in the Table 2 below.

Discussion

The aim of this research was to evaluate the current preclinical module practice for the management of the chronic periodontal patients including the non-surgical periodontal treatment.

The nonsurgical periodontal treatment remains the gold standard for managing the periodontal patients. It can result in reduction of inflammation, pocket depth reduction and clinical attachment gain. New knowledge determining the rational for mechanical nonsurgical pocket therapy continues to validate the importance of therapies directed at removal or disturbance of the plaque biofilm and removal of factors facilitating biofilm formation (Noor and Al-Bayaty, 2015, Noor and Ariffin, 2016;, Chapple *et al.*, 2018; Kamil *et al.*, 2018)

A large number of longitudinal studies were initiated comparing the outcome of various therapeutic modalities on non-surgical

Groups	No. of specimen	Mean	Differences between groups	
			Group compared	Significance
Group VII	47	0.384	VII vs VIII	P>0.05, NS*
Group VIII	47	0.395	VIII vs VII	

Group VII – Buccal surface, ***A*** ; Group VIII – Lingual surface, ***B*** *NS – not significant

Table 2: Comparison of mean and its significance (Independent sample t-test)

periodontal therapy (Ciantar, 2014; Bunæs *et al.*, 2015; Nibali *et al.*, 2015; Susin *et al.*, 2015). It is clear from the literature that scaling and root debridement play an important role in the elimination of causative factors of periodontal disease throughout periodontal therapy; including the non-surgical, surgical and maintenance phases. Traditional approaches to mechanical debridement of the tooth surface to remove tooth accretions continue to be an integral part of periodontal therapy and hand/ultrasonic instrumentation always be the only means for the past few years. However, controversy remains between researchers who believe that manual instrumentation may lead to excessive root surface removal (Dahiya and Kamal, 2012). Among various determining factors for the achievement of new attachment, root surface smoothness following instrumentation may affect the cell response (Dahiya and Kamal, 2012; Marda *et al.*, 2012). A rough surface produced from the root debridement will cause dental biofilm to retain thus result insignificant subgingival microbial colonization.

In order to assess the student's performances in root debridement skill, profilometer was used to assess root surface smoothness, and through quantitative and qualitative evaluation of surface ultrastructure by scanning electron microscopy (Bogle *et al.*, 2012). Evaluation of the degree of cleanliness, residual calculus index, and roughness and loss of tooth substance index (RLTSI) was based on the visual inspection of standardized photomicrograph and scored according to defined criteria (Ribeiro *et al.*, 2006).

Photomicrograph of scanning electron microscopy demonstrated that the mean degree of cleanliness slightly higher in ***A*** than in ***B*** and the mean remaining calculus index was less in ***B*** these minor differences could be due to pressure applied by the students, the number of stroke and the orientation of instrumentation. Statistical analysis did not show significant differences. Considerable time and manual dexterity are required to carry out effective root debridement with hand scalers.

Despite all the sophisticated technology of the scanning electron microscope, the most reliable instrument to study root surface roughness is by using profilometer because surface roughness can be measured quantitatively (Kumar *et al.*, 2015; Graetz *et al.*, 2017). Roots debridement of the buccal surfaces ***A*** and the lingual surfaces ***B*** with the Gracey curette showed relatively more roughness and loss of tooth substance a statistically in ***B***. Statistical analyses revealed non-significant difference, which indicated that all the students demonstrated similar performance in removal of calculus deposits.

Standardization of experimental conditions is important in studies concerned with the evaluation of root debridement invitro. Various factors like instrument sharpness, applied forces, tuning, time of instrumentation, and the physical properties of the dentin (i.e., micro hardness within different layers) can influence the results.

There are rooms for improvements of this preclinical module conducted by the Centre of Periodontology Studies, Universiti Teknologi MARA to revise the current one more time can be allocated and expose students to root debridement intensive refreshing course may be needed before handling patients. Hence, reinforcement of the periodontology pre-clinical module before entering the periodontology clinical module is needed to improve the root debridement skill.

Conclusion

From the results obtained, we can conclude that no significant differences noted between the students' root debridement skill in pre-clinical year and clinical year. Objectives of the current module were fulfilled but in order to meet the highest standard, current module need to be improved in the future.

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