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EFFECTS OF SMOKING ON ALVEOLAR BONE LOSS OF DENTAL UNDERGRADUATES STUDENTS IN UNIVERSITY OF MALAYA

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Abstract:

Purpose of the study: This study is undertaken to investigate the prevalence of smoking among dental undergraduates students in the University of Malaya, and to study the effects of smoking on the interproximal bone heights. Materials and method: A smoking habits questionnaire was distributed to the 299 Dental Undergraduate students of Year 2 to Year 5. Students were divided into groups of smokers (history of smoking for at least 1 year), former smokers (history of smoking and stopped more than 1 year) and non smokers (no smoking history). Two bitewing radiographs (left and right) were taken from 14 smokers and 5 former smokers. In addition, 14 students were randomly picked as control group, and their previously taken bitewing radiographs were collected. Interproximal bone loss defined as the distance (mm) from CEJ to the alveolar crest (AC) was measured using caliper, magnifier and metal ruler. Results: The prevalence of smokers and former smokers among dental students was 5.57% and 1.99%, respectively. Mean ± SEM of the CEJ-AC distance for smokers and non smokers was 1.063 ± 0.066 mm and 0.849 ± 0.050 mm, respectively. The difference was statistically significant between the smokers and non smokers ($p<0.05$). Mean ± SEM of bone loss among the smoker was 0.204 ± 0.066 mm. There was no statistically significant difference between former smokers and non smokers ($p>0.05$). Premolar is the most affected tooth in smokers, with a mean ± SEM of the CEJ-AC distance of 1.350 ± 0.102 mm. Conclusions: Smoking prevalence among dental undergraduate students was very low. Smokers have more bone destruction than the non-smokers.

Key words: smoking; alveolar bone; dental students

Introduction

Smoking has been a global concern as an increasing number of teenagers, mainly from the developing world, are getting addicted to smoking. WHO has reported that 1.3 billion people are smoking worldwide (WHO World Health Report, 2003). In Malaysia, the general increase of number of smokers in the population has taken to be an issue of concern by the Ministry of Health. Many campaigns have been planned and carried out to make the public aware of the hazardous impact of smoking. Unfortunately, campaign such as 'Tak Nak' seems to be in need of reorientation as it fails to meet the objectives. The anti-smoking campaigns that have run over the years have primarily targeted smokers urging them to reduce or give it up entirely. However a new crop of smokers are springing up as more youths and women take up the habit. Alveolar bone loss is one of the indicators of periodontal destruction. Studies on smoking effects to our

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general health as well as oral health had shown the hazardous impact of smoking that may subsequently alter the normal function of our body system. In dentistry, smoking has long been a known culprit to damage of oral tissue such as the periodontium.[1] Several studies have demonstrated the association of smoking and alveolar bone loss.[2,3] Observations from studies suggest that smoking is associated with increased levels of prevalence as well as severity of vertical bone loss.[4] Alveolar bone loss may subsequently lead to tooth loss. Cigarette smoke inhalation may affect the tooth-supporting bone as early as two months after the initial exposure.[5]

Studies on subjects of good oral hygiene status have shown reduction of alveolar bone height and acceleration of alveolar bone loss over time in smokers when compared to non-smokers.[2,6] Increasing reduction of alveolar bone height with increased exposure to cigarette smoking indicates the influence of smoking to alveolar bone reduction is actually dose-dependent. Loss of alveolar bone height is less pronounced in former smokers than current smokers.[2] Ramli and Taiyeb (1999) quote an analysis of smoking and periodontal disease that found after adjusting for potential confounding variables such as age, oral hygiene, gender and socioeconomic status, smoking remained a major risk indicator for periodontal disease.[7] There are a few studies discussing the association between cigarette smoking and periodontal bone loss in subjects with high standard of oral hygiene, such as professional musicians (members of Stockholm philharmonic orchestras, Sweden), dental hygienists and regular dental attendees.

The aim of these studies was to compare smokers and non-smokers with reference to the height of proximal alveolar bone.[2,6] The studies were based on bitewing radiographs, where the loss of interproximal bone height was measured as the distance from cemento-enamel junction (CEJ) to the periodontal bone crest. According to the results the alveolar bone height was significantly reduced in smokers as compared to non-smokers. These studies have the advantage that smokers and non-smokers were of equal standard on oral hygiene and dental care habits.[2, 6] The results show an association between cigarette smoking and reduction of alveolar bone height, suggesting that smoking itself exerts a detrimental effect on the bony component of the periodontal supporting tissues.[7, 8] The aim of the present study is to assess the effects of smoking on alveolar bone loss of dental undergraduate students in Faculty of Dentistry, University of Malaya. The authors expected low prevalence of smokers among the dental undergraduate students.

Materials and Methods

Study Population

The study population consists of 299 dental undergraduate students of University of Malaya in Year 2, 3, 4 and 5. There were 220 and 79 females and males respectively, with age ranging from 19 to 25. Questionnaires about smoking habits, duration and number of cigarettes per day were distributed to all students. Selection of sample was made after the questionnaires were collected, and then divided into smokers, former smokers and non smokers. Out of 299 students, only 251 responded to the questionnaire. There were 14 smokers, 5 former smokers and 232 non smokers. All smokers and former smokers were included in the present study, and only 14 non smokers were randomly picked as a control group. In total, 33 subjects were selected for measurement of alveolar bone.

Questionnaire

The distributed questionnaire on smoking habits requested age and gender. The smoking status of the sample was used to divide the sample into smokers (history of smoking for at least 1 year), former smokers (history of smoking and stopped more than 1 year), and non smokers (no smoking history). The smoking exposure was expressed in terms of cigarette consumption (i.e. the number of cigarettes consumed per day), duration of smoking (i.e. number of years of smoking) and lifetime smoking exposure (i.e. the accumulated exposure as the product of consumption and duration) of tobacco smoking among the smokers. Of the former smokers the duration of smoking in the past was asked in the questionnaire. The duration of cessation of smoking represents the smoke-free time among the former smokers.

Radiographic Examination

Bitewing radiographs of current smokers were taken for the assessment of the alveolar bone. Consent forms and patient information sheet forms were provided before the radiographic procedures. The bitewing radiographs were taken by one examiner using standard film holder and Kodak Insight Dental Film size 1, 3 x 4 cm. Exposure time was adjusted to 0.25 s and the films were developed

manually. As for the non smokers, previous bitewing radiographs taken not more than a year before were used as a control sample.

The interproximal bone loss is defined as the change of distance in millimeters from the cemento-enamel junction (CEJ) to the alveolar crest (AC). The crest of alveolar bone was defined as the most coronal level where the periodontal membrane retained its normal width.[9] Normal distance of CEJ and AC in young adults varies between 0.75 and 1.49 mm [10], but in this study, 0.849 mm distance (mean CEJ-AC distance of the control group) was taken to assess the amount of interproximal bone loss. The amount of bone loss was interpreted as the measured CEJ-AC distance subtracted by 0.849 mm. Bitewing radiographs including molars and premolars were taken both left and right side.

The amount of bone loss was measured on the mesial and distal sites of each posterior tooth from 14 to 17, 24 to 27, 34 to 37 and 44 to 47. Thus, a maximum of 24 sites representing 6 maxillary and 6 mandibular periodontal bone septa were available for measurement in each subject. Mesial surface of all first premolars, distal surfaces of all second molars, and all third molars were omitted. Measurement of CEJ and AC distance was made by using a viewing box, caliper with sharp point tip, a metal ruler and a magnifying glass. There was one examiner involved in measuring the radiographs.

Statistical Analysis

Data are presented as means and standard deviations (SD) or standard errors of the mean (SEM). All data were analyzed by using the Statistical Package for Social Science (SPSS) Version 11.0. Statistical significance of differences between means was tested with the Student T-Test. Significance was accepted at the probability level $P < 0.05$.

Results

1. Smoking Prevalence:

The prevalence of dental students who smoke was 5.57% and only 1.99% had been previously smoking at least one year ago, while 92.4% had no history of smoking. The present study group by year of study and smoking status is presented in Figure 1, Figure 2 and Table 1.

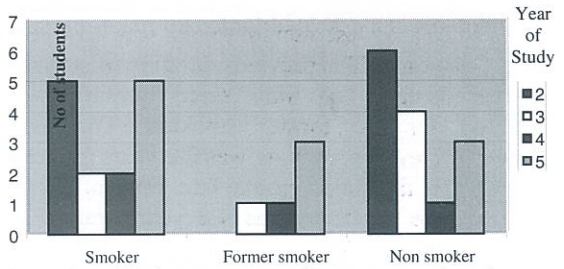

Figure 1: Study group according to year of study and smoking status

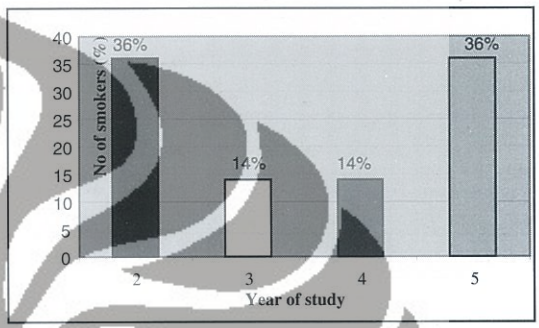

Figure 2: Distribution of smokers according to year of study

Table 1: Study group according to year of studies and smoking status

			Year of study				Tota
			2	3	4	5	
Smoking Status	Smoker	Count	5	2	2	5	14
		% within year of study	45.5%	28.6%	50.0%	45.5%	42.4%
	Former smoker	Count		1	1	3	5
		% within year of study		14.3%	25.0%	27.3%	15.2%
	Non smoker	Count	6	4	1	3	14
		% within year of study	54.5%	57.1%	25.0%	27.3%	42.4%
Total		Count	11	7	4	11	33
		% within year of study	100.0%	100.0%	100.0%	100.0%	100.0%

2. Smoking Exposure

Data regarding the exposure to cigarettes were collected through questionnaires. The frequency distributions of current smokers by cigarette consumption per day and duration of smoking in years appear in Table 2 and Table 3 respectively. About 79% of the smokers consumed ≤10 cigarettes per day. The mean consumption of smokers was 6.43 cigarettes per day (range 1-20 cigarettes per day), and the mean duration of smoking of current smokers was 5.57 years (range 1-20 years). About 71.4% of smokers smoke daily while the other 28.6 % smoke less than 4 days per week. Smoking exposure was calculated as the accumulated yearly exposure as the product of consumption per day and days of smoking in a year. Smoking exposure among the smokers showed the average of 2172 cigarettes per year as shown in Table 4. Half of the smokers had never tried to quit from smoking. The remaining half of the smokers had attempted to quit smoking, and the average time

elapsed since their last attempt to quit was 2.14 years (range 1- 4 years). The previous duration of smoking and the duration of time since quitting were accounted for the former smokers. The mean duration of previous smoking was 2.2 years (range 1-4 years) and the mean smoke-free time of former smokers since cessation was 4.8 years (range 2-7 years) as shown in Table 5.

Table 2: Frequency distribution of smokers according to number of cigarettes consumed per day.

	Consumption per day				
	≤ 10 n (%)	11-15 n (%)	>15 n (%)	Total n (%)	Mean
Current smokers	11 (78.6)	2 (14.3)	1 (7.1)	14 (100)	6.4

Table 3: Frequency distribution of smokers according to smoking duration.

	Years of smoking				
	1-4 n (%)	5-9 n (%)	≥ 10 n (%)	Total n (%)	Mean duration
Current smokers	5 (35.7)	6 (42.9)	3 (21.4)	14 (100)	5.6
Former smokers	5 (100)	0	0	5 (100)	2.2

Table 4: Frequency distribution of smokers according to smoking exposure

Exposure (cigarette-years)	<1000 n (%)	1000-2000 n (%)	>2000 n (%)	Total n (%)	Mean exposure
Current smokers	5 (35.7)	3 (21.4)	6 (42.9)	14 (100)	2172.9

Table 5: Duration of smoking in the past and smoke free time for former smokers

	Duration of past smoking (years)	Smoke free time (years)
n	5	5
Mean	2.20	4.80
SEM	0.583	0.860

3. Alveolar Bone Loss

Overall results for smokers, former smokers and non-smokers.

Assessment of the alveolar bone height was done by measuring the distance from cementoenamel junction (CEJ) to the alveolar crest (AC). The mean ± SEM of the CEJ-AC distance is shown in Table 6. Smokers have greater CEJ-AC distance than former smokers or non-smokers. The difference between smokers and non-smokers was statistically significant ($t = 2.575$, $p < 0.05$) .

The amount of bone loss among smokers was calculated by subtracting the mean ± SEM CEJ-AC distance of non-smokers (0.849 ± 0.050 mm) from the mean CEJ-AC distance of the smokers. The resulting mean alveolar bone loss of smokers was 0.204 ± 0.066 mm. Site specific measurement analyses of alveolar bone height for current smokers, former smokers and non-smoker are presented in Table 7. The overall mean ± SEM of the CEJ-AC distance based on all sites shows that current smoker had greater CEJ-AC distance than former smokers and non-smokers. Site specific measurement of CEJ-AC distance based on tooth region shows that loss of bone height was more pronounced in premolars than molars as showed in Table 7. Maxillary region also appeared to have more alveolar bone loss than mandibular region in current smokers, non-smokers and former smokers (Table 8).

Table 6: Total mean (± SEM) CEJ-AC distance of control group, smokers and former smokers

	CEJ-AC distance(mm) Mean (± SEM)
Smokers	1.063 (0.0660) *
Former smokers	0.862 (0.1213)
Non-smokers	0.849 (0.0501)

*Statistically significant

Table 7: Number of site-specific measurements of bone height included in case mean (Mean and SEM for smokers, non-smokers and former smokers.)

CEJ-AC distance (mm) (Mean and SEM for smokers, non-smokers and former smokers.)

Sites	Smoker (n = 14) Mean (± SEM)	Former smoker (n=5) Mean (± SEM)	Non-smoker (n=14) Mean (± SEM)
Total	1.063 (0.0660)*	0.862 (0.1213)	0.849 (0.0501)
Total			
→ maxilla	1.213 (0.087)	0.902 (0.133)	1.025 (0.088)
→ mandible	0.912 (0.071)	0.823 (0.132)	0.673 (0.053)
All premolars	1.118 (0.074)	0.902 (0.091)	0.938 (0.059)
All molars	1.007 (0.071)	0.823 (0.164)	0.760 (0.062)
Maxillary			
Molar	1.156 (0.098)	0.830 (0.198)	0.900 (0.106)
Premolar	1.270 (0.097)	0.973 (0.086)	1.150 (0.089)
Mandibular			
Molar	0.859 (0.065)	0.817 (0.151)	0.620 (0.055)
premolar	0.966 (0.099)	0.830 (0.119)	0.726 (0.074)

* Statistically significant

Table 8: Mean ± SEM (mm) of CEJ-AC distance between maxilla and mandibular region in smokers, former smokers and non-smokers

	Maxilla Mean (± SEM)	Mandible Mean (± SEM)
Current smoker (n=14)	1.213 (0.087)*	0.912 (0.071)
Former smokers (n=5)	0.902 (0.133)	0.823 (0.132)
Non-smokers (n=14)	1.025 (0.088)	0.673 (0.053)

* Statistically significant

Alveolar Bone Assessment for Smokers

The overall results of the radiographic assessment of the alveolar bone loss of smokers on right and left side are presented in Table 9. As for the smokers, the mean ± SEM of CEJ-AC distance for the maxillary region (1.213 ± 0.087 mm) was greater than that of the mandibular region (0.912 ± 0.071 mm) and the differences were statistically significant ($t = 2.680$, $p < 0.05$), as shown in Table 8. Comparison between the right and left bitewing images of maxilla showed that the right maxillary premolars had the highest CEJ-AC distance (1.350 ± 0.102 mm). The mean CEJ-AC distance of the maxillary right premolars was higher than that of the maxillary left premolars. In contrast, the maxillary left molars had more mean bone loss than the

maxillary right molars. For the mandibular region, the right premolars showed an increased mean CEJ-AC distance when compared to the left premolars. For the mandibular molars the mean CEJ-AC distance was higher on the left than on the right side.

Table 9: Mean CEJ-AC distance in smokers (S), former smokers (FS) and non-smokers (NS).

Sites	CEJ-AC distance (mm) Mean (± SEM)					
	RIGHT			LEFT		
	S	FS	NS	S	FS	NS
Maxillary (premolar+molar)	1.207 (0.011)	0.953 (0.168)	0.980 (0.105)	1.219 (0.081)	0.85 (0.109)	1.070 (0.100)
Mandibular (premolar+molar)	0.937 (0.099)	0.823 (0.113)	0.670 (0.070)	0.887 (0.070)	0.823 (0.176)	0.676 (0.056)
Maxillary Premolar	1.350 (0.102)	0.920 (0.142)	1.124 (0.118)	1.191 (0.108)	1.027 (0.088)	1.176 (0.102)
Mandibular Premolar	1.052 (0.139)	0.807 (0.119)	1.052 (0.139)	0.879 (0.090)	0.853 (0.170)	0.879 (0.091)
Maxillary Molar	1.064 (0.133)	0.987 (0.216)	0.836 (0.112)	1.248 (0.095)	0.673 (0.192)	0.964 (0.120)
Mandibular Molar	0.822 (0.090)	0.840 (0.144)	0.822 (0.089)	0.895 (0.077)	0.793 (0.183)	0.895 (0.077)

Comparison of the CEJ-AC distance (mm) between the premolars and molars of smokers on both left and right side is illustrated in Table 10. The alveolar bone of premolars was more affected than in the molars. The total mean (± SEM) of CEJ-AC distance of all premolars and molars was 1.118 (± 0.074) mm and 1.007 (± 0.071) mm, respectively. The overall differences between the premolars and molars were not statistically significant ($t = 1.083$, $p>0.05$). The maxillary right premolars had the greatest mean CEJ-AC distance of 1.350 (± 0.102) mm. In short, both left and right premolars of the maxillary region showed greater CEJ-AC distance than the molars. As for the mandibular teeth, comparison between mandibular right premolars and molars revealed that the premolars (1.052 ± 0.139 mm) had greater CEJ-AC distance than the molars (0.822 ± 0.090 mm). However, there were no large differences in the CEJ-AC distance of mandibular left premolars and molars.

Table 10. Comparison of the CEJ-AC distance (mm) between the premolars and molars of smokers on both left and right side

	CURRENT SMOKER Mean (± SEM)
All premolars	1.118 (0.074)
Vs	
All molars	1.007 (0.071)
Maxillary right premolars	1.350 (0.102)
Vs	
Maxillary right molars	1.064 (0.133)
Maxillary left premolars	91 (0.108)
Vs	
Maxillary left molars	1.248 (0.133)
Mandibular right premolars	1.052 (0.139)
Vs	
Mandibular right molars	0.822 (0.090)
Mandibular left premolars	0.879 (0.090)
Vs	
Mandibular left molars	0.895 (0.077)

Alveolar Bone Loss and Smoking Exposure

The relationship between the alveolar bone loss and smoking exposure is illustrated in Figure 3 and Figure 4. Figure 3 shows that the alveolar bone loss was greatest (0.285 mm) in current smokers who had been smoking for 5 to 9 years, followed by smokers with smoking duration less than 5 years (0.258 mm), and then by smokers with long duration of smoking (0.12 mm).

Figure 4 shows that the bone loss was greater in the group with high consumption of cigarettes (≥15 cigarettes per day) than in the group with low consumption (< 15 cigarettes per day).

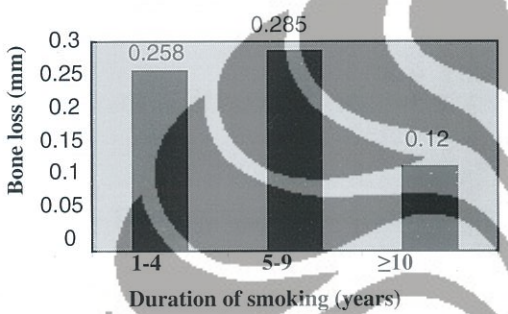

Figure 3: Relationship between the total bone loss and duration of smoking

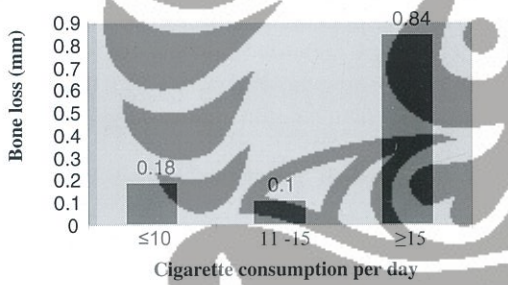

Figure 4: Relationship of alveolar bone loss and cigarette consumption.

Discussion

In the present study, only 5.6% of 299 dental students are smokers. The limited percentage of smokers may not represent the population of all dental students. Overall; the low prevalence of smokers was expected and supported the authors' hypothesis suggesting reduced number of smokers among the dental undergraduate students. Knowledge and awareness on the hazardous effects of smoking to general and oral health may contribute to the low prevalence of smoking. The results from the radiographic measurements have shown more alveolar bone loss in smokers than in non-smokers. The observations are in agreement with some earlier studies.[2, 6] However, the reduction of alveolar bone height was generally limited as can be expected in subjects with above average standard of oral hygiene. The proximal bone loss observed in smokers was more pronounced than that of non-smokers.

The observations show a positive correlation between smoking and increasing CEJ-AC distance that indicates alveolar bone loss. The cut-off point of the CEJ-AC distance in this present study was 0.846 mm (mean CEJ-AC distance of non-smokers), and the data presented indicate an average reduction of 0.2 mm in smokers. The mean CEJ-AC distance of the former smokers was almost equal and not significantly different from that of non-smokers. This suggests that the cessation of smoking may lower the chances of alveolar bone loss associated with smoking.

As reported in several previous studies, the CEJ-AC distance increases with increased smoking exposure.[2,6] An increasing CEJ-AC distance with increased smoking exposure was also observed in the present study. This would indicate a dose-dependent influence of smoking-related bone loss. However, in the present results, the CEJ-AC distance was greater in smokers who had smoking duration of less than 10 years as compared to smoking duration of more than 10 years. This may be incidental due to the low number (3) of smokers with smoking duration of more than 10 years.

Site specific measurements and analysis of alveolar bone in smokers revealed that the mean CEJ-AC distance of all maxillary teeth (premolars and molars) was greater than of all mandibular teeth (premolars and molars). Some studies have reported differences in the "pattern" of periodontal destruction among smokers and non-smokers that imply a localized effect of the smoking habit in the upper anterior region and especially at the palatal sites.[7,11] However, the alveolar bone of anterior region and the palatal sites was not measured in this present study.

Greater reduction of alveolar bone on the maxillary region may indicate that smoking affects more the maxillary than the mandibular region. The difference of CEJ-AC distances in maxilla and mandible can be explained by the difference in bone density between the arches, and the direct effects of smoking on maxillary rather than mandibular teeth. The present observations of CEJ-AC distance based

on each tooth region (premolar and molar) shows that the premolars had higher mean CEJ-AC distance than the molars. Although the difference is not significant, it can be explained by the position of premolars that are nearer to the anterior region than the molars.

This is accordance with several earlier studies which demonstrated that the upper anterior teeth are more subjected to periodontal destruction due to the localized and direct effects of smoking.[7, 11, 12] With regard to the inter-arch side (left and right), there was no significant difference in the mean CEJ-AC distance (premolar and molar) between the right and left side. However, the maxillary premolars on the right side had greater mean CEJ-AC distance compared to the left side. This may be due to a directional cigarette placement leading to the alveolar bone loss at the premolar region.

References

1. American Academy of Periodontology. Tobacco use and the periodontal health. J Periodontol 1999; 70:1419-1427.
2. Bergstrom J, Eliasson S, Preber H. Cigarette smoking and periodontal bone loss. J Periodontol 1991; 62: 242-246.
3. Bolin A, Eklund G, Frithiof L, Lavsted S. The effects of changed smoking habits on marginal alveolar bone loss. Swed Dent J 1993; 17: 211-216.
4. Baljoon M, Natto S, Bergstrom J. The Association of Smoking with Vertical Periodontal Bone Loss. J Periodontol 2004; 75:844-851.
5. Cesar-Neto JB, Benatti BB, Sallum EA. The influence of cigarette smoke inhalation and its cessation on the tooth-supporting alveolar bone: a histometric study in rats.
6. Bergstrom J, Eliasson S. Cigarette smoking and alveolar bone height in subjects with a high standard of oral hygiene. J Clin Periodontol 1987; 14: 466-469.
7. Ramli J, Taiyeb Ali T.B. Association between smoking and periodontal disease. Annal Dent Univ Malaya 1999; 6: 21-26.
8. Bergstrom J, Eliasson S, Dock J. A 10-Year prospective study of tobacco smoking and periodontal health. J Periodontol 2000; 71: 1338-1347.
9. Novak M.J. Classification of diseases and conditions affecting periodontium. In: Carranza's Clinical Periodontology 9th ed. W.B Saunders Co, 2002; 64-73.
10. Carranza F.A. Bone loss and patterns of bone destruction. In: Carranza's Clinical Periodontology 9th ed. W.B Saunders Co, 2002; 354-370.
11. Schuller AA, Holst D. Testing the consistency of measurements of the distance between the cemento-enamel junction and the alveolar bone crest in the bitewing radiographs. J Clin Periodontol 1996; 23: 977-981.
12. Bergstrom J. Influence of tobacco smoking on periodontal bone height. Long term observations and a hypothesis. J Clin Periodontol 2004; 31: 260-266.