COMPENDIUM OF DENTAL SCIENCES RESEARCH

EDITORS:

AZLINI ISMAIL | KHAIRANI IDAH MOKHTAR | BASMA EZZAT MUSTAFA | MOHD HAFIZ ARZMI

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Editors:

Azlini Ismail
BBiotech(Hons), PhD (Pharmacology)
Department of Fundamental Dental and Medical Sciences
Kulliyyah of Dentistry
International Islamic University Malaysia

Khairani Idah Mokhtar
BSc, MSc (Med. Science), PhD (Dev. Biology).
Department of Fundamental Dental and Medical Sciences
Kulliyyah of Dentistry
International Islamic University Malaysia

Basma Ezzat Mustafa
BSc Pharmacy, MSc Clinical Laboratory Sciences,PhD Clinical Pharmacology
Department of Fundamental Dental and Medical Sciences
Kulliyyah of Dentistry
International Islamic University Malaysia

Mohd Hafiz Arzmi
BSc (Microbiology) Hons., MDSc (Microbiology), PhD (Microbiology & Immunology), PGDip (Islamic Studies), PTech
Department of Fundamental Dental and Medical Sciences
Kulliyyah of Dentistry
International Islamic University Malaysia

Kulliyyah of Dentistry
International Islamic University Malaysia

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TABLE OF CONTENTS

PREFACE

Welcome,

"Compendium of Dental Sciences Research" is a collection of research reports prepared by our own academicians and researchers from Kulliyyah of Dentistry, International Islamic University Malaysia. The research topic highlighted in the current publication encompassed multidisciplinary areas related to oral health and dental sciences with the overall aim to provide knowledge and share the outcome of the research with a wider community.

The publication of the research book was to assist our lecturers to share and showcase their research output to a wider audience. It is also to acknowledge the work that has been carried out by our undergraduate students. This book will surely complement other references book especially when one would like to find the appropriate methodology and analysis to be applied particularly for those who will be doing similar oral health and dental sciences research. It is hoped that this book will create a continuous link between basic and clinical sciences, supporting and encouraging the expansion of knowledge for the advancement of dental sciences.

Editors,
"Compendium of Dental Sciences Research"

MESSAGE FROM DEAN

All praises be to Allah, the Creator of the Universe, The One and Only. Peace be upon our Prophet, Muhammad s.a.w, the Messenger to all mankind. It is my great pleasure to congratulate all lecturers that have contributed to the publication of our research book entitled "Compendium of Dental Sciences Research".

Research and publication are parts and parcels of an academicians; as such, one will not be able to exclude himself/herself from involving in research and later publish their findings to the relevant communities. Hence, the publication of "Compendium of Dental Sciences Research" will become one of the available platforms to our academics to highlight their research findings.

I thanked all the authors who have contributed significantly to ensuring the content of the book achieved its objectives and I would also like to convey my sincere thanks to all the editors for making this research book project a success.

Prof. Dr. Zainul Ahmad Rajion
Dean
Kulliyyah of Dentistry
International Islamic University Malaysia (IIUM)

CHAPTER 1

STUDY OF THE RELATIONSHIP BETWEEN DENTAL CARIES AND BODY MASS INDEX (BMI) IN CHILDREN ATTENDING PEDIATRIC CLINIC, KULLIYYAH OF DENTISTRY IIUM

Ghasak Ghazi Faisal[1]*, Nur Zety Mohd Noh[2], Farahin Ibrahim[3], Yunita Dewi Ardini[4]

[1] Department of Fundamental Dental and Medical Sciences, Kulliyyah of Dentistry, International Islamic University Malaysia
[2] Department of Restorative Dentistry, Kulliyyah of Dentistry, International Islamic University Malaysia
[3] Ministry of Health, Malaysia
[4] Department of Paediatric Dentistry and Dental Public Health, Kulliyyah of Dentistry, International Islamic University Malaysia

*Corresponding author email: drghasak@iium.edu.my

SUMMARY

Obesity is an alarming worldwide health concern as both adults and children can be affected. Cardiovascular diseases and diabetes mellitus are among the most commonly associated systemic problems with obesity. In addition, obesity in children has very harmful effects on the growth and development. Genetic factors can contribute to obesity, however, in most of the cases, it is caused by poor dietary habits, high sugar and fat intake and reduced physical activity. On the other hand, the other effect of ingestion of unhealthy food is manifested on the oral health, such as development of dental caries. Tooth decay is associated with poor oral hygiene and the consumption of high sugar foods will lead to a prolonged drop in intraoral pH and subsequently produce dental caries. The objectives of this study were to investigate the relationship 1) between body mass index (BMI) and dental caries, and 2) between age group, daily sugar intake, daily oral self-care and dental caries among pediatric patients attending Polyclinic of Kulliyyah of Dentistry, International Islamic University Malaysia (IIUM). A total of 120 patients attending pediatric clinic aged between three to twelve years old were involved in this study. A questionnaire about the daily sugar intake and oral care of the children was given and answered by the parents. Body weight and height of the children were measured. The children were grouped according to BMI categories: underweight, normal, overweight, and obese. Dental charting was done, and the children were categorized based on the caries risk assessment: low, medium, and high. Out of 120 patients, 20.8% patients were underweight, 65% were normal, 5% were overweight, and 9.2% were obese. Meanwhile, 16.7% of the children had low caries risk, 20.8% had medium caries risk and 62.5% had high caries risk. Even though both underweight and overweight children showed higher caries risk than normal weight children, however, there was no statistically significant association between BMI category and dental caries (p>0.0.5). Children in the age group three to six scored highest in high caries risk

(74.2%). Additionally, children with low sugary intake showed the highest percentage of low caries risk (50%). This study also found that the children who did not brush their teeth showed the highest caries risk (76.9%). There was a statistically significant association between daily sugar intake and dental caries (p=0.045), sugar intake and BMI (p=0.03) and age group and caries risk (p=0.000). Dental caries is a multifactorial disease which is caused by various factors like age, diet, and oral self-care. Therefore, BMI can be attributed to play only a partial role in determining caries status in children. Hence, proper oral health education and dietary advice since early childhood should be emphasized to achieve a good oral health.

Keywords: *BMI, caries risk, children, dental caries, oral self-care, sugar intake*

INTRODUCTION

Obesity can be defined as an increase in distribution of body lipid in relation of normal range of age and sex of the patient [1]. One of the methods that can be used to determine obesity is by measuring body mass index (BMI). BMI is calculated by dividing weight in kilograms by height in meters square [2]. According to Obesity Statistic by Malaysian National Health and Morbidity Survey 2017, it is concluded that 43% of adults and 38% of children in Malaysian population were obese or overweight, [3]. Obesity can be caused by genetic predisposition, lack of exercise, sedentary lifestyle, and unhealthy dietary intake such as fast food and high sugar diet [4].

Dental caries is occurring at high prevalence. It affects around 60-90% of children worldwide and can cause significant impact on their lives [5]. It is a multifactorial process involving interaction between oral bacteria, carbohydrates and sugars in food and the tooth. Recently, time has also been added as a factor for caries formation where there is a higher chance of development of caries with prolonged interaction. [6] *Streptococcus mutans* (*S. mutans*) primarily has links with dental caries initiation, and *Lactobacilli* has links with the progression of dental caries. The substrates for these bacteria are fermentable carbohydrates and the bacterial-generated carbohydrate reserve in the biofilm [7].

The interrelationship between host, diet, and bacteria together with time will lead to development of dental caries. Oral microorganisms will catabolize carbohydrate in food into acid. Subsequently, pH in oral cavity will fall below 5.5. Saliva buffering action will counter act the pH reduction to prevent dental caries from developing. However, long term repeated fall in pH will cause demineralization of susceptible tooth surface and caries develops [6]. The most common cause of dental caries is due to high sugar intake.

Children are more prone to have dental caries as their dietary habit is more towards sugary food [8]. It is also well known that high sugar diet may contribute to weight gain or obesity [9]. This fact shows that there might be a relationship between body weight, sugar intake, oral self-care, and dental caries. The aims of this study were 1)

to find the relationship between BMI and dental caries, and 2) to identify the effect of age group, daily sugar intake, daily oral self-care, and dental caries.

METHODOLOGY

Study design

This study was a cross-sectional study conducted at the Pediatrics clinic, Kulliyyah of Dentistry (KOD), International Islamic University Malaysia (IIUM). Children aged 3-12-year-old attending the clinic were included in this study. Prior to conducting the study, ethical approval was obtained from the IIUM Research Ethics Committee.

Sample size calculation

Epi info Statistical calculator from Center of Disease Control, USA [10] was used to compute the sample size from an estimated 1,800 pediatric patients expected to visit the pediatric clinic during the period of the study. 95% confidence level was selected. The sample size was calculated to be 120 children aged between 3 to 12-year-old.

Data collection

The inclusion criteria for this study were healthy children, children aged between three to twelve years old with informed consent by the parents. While the exclusion criteria include children with systemic illness, mentally and physically handicap children and children on medication that can cause caries.

A total of 120 pediatric patients, aged 3 to 12 years old attending Pediatrics clinic, KOD, IIUM were enrolled in this study. Ethical approval was obtained prior to conducting the study. Parental written consent was received before the data was collected, together with questionnaires regarding the child's sugar intake and oral self-care. Sugar intake was estimated based on the number of servings of sugar containing foods, the child averagely consumed per day, and it was categorized into Low (≤4 portions daily), Medium (5-6 portions daily) and High (≥6 portions daily).

Oral self-care was assessed according to the frequency of tooth brushing per day and categorized into never, once daily, twice daily and three times daily. Body weight was measured by using electronic measuring scale in kilograms and height was measured by using measuring tape in meters. The data was recorded, and BMI was calculated by using the formula of body weight in kilograms divided by height in meters square. BMI value was categorized into underweight, normal, overweight, and obese by using a range that has been standardized by World Health Organization (WHO) [11]. Dental charting was done by using dental probe and mirror. Caries status is categorized by dft and DMFT index. New caries lesions and restoration with secondary caries are considered as carious lesions. Teeth with present restoration even without secondary caries are also considered in this index to assess the caries status of the children.

Missing teeth could not be included in this research as the children are in mixed dentition (primary teeth are gradually replaced by permanent teeth).

Caries risk assessment was divided into three groups which were high, moderate, and low caries risk group. The criteria were based on American Association of Paediatric Dentistry (AAPD) guidelines [12]. Factors to determine caries risk assessment were based on sugar intake, fluoride intake, patient has dental home care and caries lesions from the clinical findings. All the information were collected from the questionnaires that was disseminated during the clinical examination.

Statistical analysis

SPSS 21.0 was used for analyzing the data. The analysis of the variables such as age group, gender, BMI category, caries risk group, oral self-care was presented in numbers and percentages. ANOVA test and Chi square test were used to determine the association of BMI on dental caries risk and the effect of sugar intake, age, and oral self-care on dental caries respectively. A *p*-value of less than 0.05 was considered statistically significant.

RESULTS

In this study, 66 (55.0%) children were aged between three to six, 38 (31.7%) were seven to nine years old and the remaining 16 children (13.3%) aged between ten to twelve years old. The gender was nearly equally distributed in number, with 61 males and 59 females. The majority of the children, which was 65% from the total participants were in the normal BMI category. Meanwhile, there were 25 (20.8%) underweight children and 17 (14.2%) of overweight/obese children. Most of the children consumed medium daily sugar intake (66.7%). Most of the children, 52 of them (43.3%) practiced oral self-care once daily. However, about 10.8% of children did not practice daily self-oral care (Table 1).

Most of the children in this study were in the high caries risk group, 75 (62.5%). Meanwhile, there were nearly similar numbers of children in low and medium caries risk groups with 20 (16.7%) and 25 (20.8) respectively (Table 2).

When comparing the mean score of the dft index with the BMI categories, we found that the highest caries risk was in the underweight and overweight children, 8.56±3.720 and 7.50±2.881 respectively. Similarly, the highest caries risk fell into the same categories, with 8.46±3.310 and 7.01±3.081 in underweight and overweight children respectively. However, there were no statistically significant difference between dft & DMFT (p=0.071 & p=0.088) in the caries risk with BMI categories using ANOVA test, indicating no association of BMI categories with caries risk (Table 3 & 4).

Table 1. Distribution of age, BMI category, daily sugar intake and oral self-care of participants

	Number of subjects	Percentage
Age		
3-6	66	55.0
7-9	38	31.7
10-12	16	13.3
Gender		
Male	61	50.8
Female	59	49.2
BMI category		
Underweight	25	20.8
Normal	78	65.0
Overweight	6	5.0
Obese	11	9.2
Daily sugar intake		
Low	36	30
Medium	80	66.7
High	4	3.3
Daily oral selfcare		
Never	13	10.8
Once a day	52	43.3
Twice a day	42	35.0
Three times a day	13	10.8

Table 2. Caries risk status

Caries Risk	No of subjects	Percentage (%)
Low	20	16.7
Medium	25	20.8
High	75	62.5
Total	**120**	**100**

Table 3. Association of BMI categories with caries risk (dft)

BMI category	Caries risk (mean dft ±SD)		*p*-value
Underweight	8.56	3.720	
Normal	6.51	5.242	**0.071**
Overweight	7.50	2.881	
Obese	4.18	3.459	

Table 4. Association of BMI categories with caries risk (DMFT)

BMI category	Caries risk (mean DMFT±SD)		*p*-value
Underweight	8.46	3.310	
Normal	5.92	5.042	**0.088**
Overweight	7.01	3.081	
Obese	3.98	3.359	

Meanwhile, there was a statistically significant difference between BMI category and daily sugar intake (*p*=0.03*)*, indicating an association between BMI category and daily sugar intake. From the results, it was found that majority of the children in each BMI category had a medium level of daily sugar intake (Table 5).

Table 5. Association between BMI category and daily sugar intake

BMI category	Daily Sugar Intake			*p*-value
	Low	**Medium**	**High**	
Underweight	5 (20.0%)	19 (76.0%)	1 (4.0%)	
Normal	25 (32.1%)	52 (66.7%)	1 (1.3%)	0.03*
Overweight	4 (66.7%)	2 (33.3%)	O (0.0%)	
Obese	2 (18.2%)	7 (63.6%)	2 (18.2%)	

*p <0.05 ANOVA test

In this study, we found a significant association (*p*=0.045*)* between daily sugar intake and caries risk group, with children with a medium and high caries risk had more medium daily sugar intake than low sugar intake (Table 6).

There was a strong association between caries risk and age group (*p*=0.000). 49 (74.2%) children in the age group 3-6 years and 21(55.3%) children in the age 7-9 years were having high caries risk. Meanwhile, there was an equal distribution of older children aged 10-12 years old in all caries risk groups (Table 7).

From Table 8, it was observed that high caries risk reduces with increased frequency of oral self-care. However, there was no significant difference between oral self-care and caries risk (*p*=0.09).

Table 6. Association between caries risk and daily sugar intake

Daily sugar Intake	Caries risk group			*p-value*
	Low	**Medium**	**High**	
Low	10 (50.0%)	6 (24.0%)	20 (26.7%)	0.045*
Medium	8 (40.0%)	19 (76.0%)	53 (70.7%)	
High	2 (10.0%)	0 (0%)	2 (2.7%)	

*p<0.05 Chi square test

Table 7. Association between caries risk and age group

Age group	Caries risk			*p-value*
	Low	**Medium**	**High**	
3-6	12	5	49	
	18.2%	7.6%	74.2%	
7-9	3	14	21	0.000
	7.9%	36.8%	55.3%	
10-12	5	6	5	
	31.2%	37.5%	31.2%	

*p<0.05 Chi square test

Table 8. Association between oral self-care and caries risk.

Oral self-care	Caries risk			*p-value*
	Low	**Medium**	**High**	
Never	0	3	10	
	0.0%	23.1%	76.9%	
Once daily	6	11	35	
	11.5%	21.2%	67.3%	0.09
Twice daily	12	6	24	
	28.6%	14.3%	57.1%	
Three times daily	2	5	6	
	15.4%	38.5%	46.2%	
Total	20	25	75	
	16.7%	20.8%	62.5%	

DISCUSSION

Childhood obesity is on the rise due to the changes in lifestyle where children become less active due to their interest in computer games and consumption of unhealthy foods such as fast food, sugar loaded sweets and reduced physical exercise. As reported by a previous study, overweight children are associated with high carbohydrate consumption [13]. In this study, most of the children were of normal BMI (65.5%) while 20.8% were underweight. Underweight children lack essential nutrients that are crucial for growth and development. However, these underweight children showed a higher mean score of dft and DMFT than normal weight children.

Consequently, they are more likely to suffer from caries than children of normal weight. This finding corroborates with the finding by another study conducted in Turkey, which found that underweight children are more prone to dental caries [14].

Although there was no statistically significant relationship between BMI and caries risk group in this present study, both underweight and overweight children showed a higher mean score for dft. This reflects the importance of proper nutrition on dental health. This finding is consistent and corroborates with findings from another study conducted among a large group of children in India where there was no association between BMI categories and caries risk. [15] In addition, another study conducted among children five- to eight-year-old in the Netherlands reported similar result, in which there was no association between BMI and dental caries in these children [16]. A large systemic review done in 2018 also did not find a solid association between BMI and dental caries [17].

This can be explained through the mechanism of development of dental caries which is multifactorial in nature. Caries development does not depend on one individual factor but on several factors such as, sugar intake, bacteria, tooth structure together with time [18]. Despite the multifactorial factors of caries development, high sugar intake will increase caries risk and body weight, which consequently will affect the BMI value. Therefore, in order to control BMI value and caries risk, daily sugar intake also needs to be controlled.

Overconsumption of carbohydrates and refined sugars has been linked to an increased incidence of dental caries in children [19]. This was evident in our study as most children consumed a medium amount of daily sugar intake and most children (62.5%) were at high caries risk regardless of their BMI. The World Health Organization strongly recommends the reduction in the consumption of free sugars to less than 10% of the daily calorie intake as the consumption of these sugars is directly related to the development of dental caries and obesity [20].

In regard to oral self-care, only 42 (35%) of the participants practiced twice daily self-care and some did not brush their teeth at all 13 (10.8%) (Table 1). Research has shown that it is important to maintain regular twice-a-day-tooth brushing to reduce the risk of dental caries.[21] This finding may contribute to the high percentage of children having high caries risk in our study (Table 2).

Another factor that seems to affect the development of dental caries is the age of the child. In our study, most of the children in the age group 3 to 6 years (74.2%) had high caries risk, while older children aged 10 to 12 years had nearly equal rates of being in any of the caries risk group (Table 7). This can be explained by the fact that younger children are unable to perform effective brushing without the assistance from the parents. As a result, there was a high prevalence of caries among this age group.[21] This emphasized the role of parents in ensuring a good oral health of younger children.

CONCLUSION

Younger aged children, 12-year-old and below are prone to a high caries risk status. As dental caries is a multifactorial disease, various factors play a role in its development. Daily sugar intake and age is strongly associated with high caries risk. BMI can also be attributed to play only a partial role in determining caries status in children.

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CHAPTER 2

EVALUATION OF BLOOD PRESSURE AND PULSE RATE DURING TOOTH EXTRACTION IN PATIENTS ATTENDING POLYCLINIC KULLIYYAH OF DENTISTRY IIUM KUANTAN

Nazih Shaban Mustafa[1], Muayad Salim Rahma Al-Zerje[2], Nurliyana Shabudin[3], Zaiton Zakaria[3], Basma Ezzat Mustafa Alahmad[4]*

[1] Oral Maxillofacial Surgery and Oral Diagnosis, Kulliyyah of Dentistry, International Islamic University Malaysia, Malaysia
[2] Halery Street Medical Centre, England
[3] Oral Maxillofacial Surgery Department, Hospital Tengku Ampuan Afzan Pahang, Malaysia
[4] Department of Fundamental Dental and Medical Sciences, Kulliyyah of Dentistry, International Islamic University Malaysia, Malaysia

* Corresponding author email: drbasma@iium.edu.my

SUMMARY

Tooth extraction is one of the common dental treatments and it is one of the most fearful treatments undergone by patients in dental clinics. During a tooth extraction procedure, a normal person will be overwhelmed by psychological stress. Upon the stress, the body systems will respond in two pathways, which are the sympathetic nervous system and hypothalamus pituitary adrenocortical axis. Through the sympathetic pathways, Sinoatrial (SA) nodes in the heart will increase firing thus will increase heart rate. Increasing heart rate will finally increase blood pressure. On the other hand, the hypothalamus pituitary adrenocortical axis reacts by releasing stress hormones such as adrenocorticotropic hormones (ACTH) that stimulate the secretion of cortisol. Cortisol will give the effect of protein breakdown and gluconeogenesis in the liver. It is known that stress emotionally and psychologically affects the blood pressure level and pulse rate. The release of stress hormones such as catecholamines (epinephrine and norepinephrine) will narrow the blood vessels and the heart will beat faster and give rise to blood pressure levels. This study aimed to measure and compare the blood pressure and pulse rate variabilities of patients before injection, after injection, and after extractions. Based on this research, it has been demonstrated that stress and anxiety do not significantly cause changes in blood pressure and pulse rate measurement before and after tooth extraction.

Keywords: *blood pressure, Kulliyyah of Dentistry, polyclinic, pulse rate, tooth extraction*

INTRODUCTION

One of the most fearful dental treatments experienced by patient is tooth extraction. During tooth extraction procedure, a normal person will be overwhelmed by psychological stress; in which, the body systems will response in two pathways, which are sympathetic nervous system and hypothalamus pituitary adrenocortical axis [1]. SA nodes in the heart will increase firing thus will increase heart rate. Increasing heart rate will finally increase the blood pressure. Alternatively, the hypothalamus pituitary adrenocortical axis react by releasing stress hormones such as adrenocorticotrophin hormones (ACTH) that stimulates the secretion of cortisol [2]. Cortisol will give the effect of protein breakdown and gluconeogenesis in the liver [3].

Managing the variability of blood pressure and heart rate has been proposed as a treatment modality. It is known that stress emotionally and psychologically affects the blood pressure level and pulse rate. Stress hormones such as catecholamines (epinephrine and norepinephrine) will be released resulting in narrowing of the blood vessels and an increase in heart rate; and subsequently, an increase of blood pressure [4].

In Malaysia, the prevalence of hypertension is high, but levels of awareness, treatment, and control are low. There is an urgent need for a comprehensive integrated population-based intervention program to ameliorate the growing problem of hypertension among Malaysians [5].

Therefore, the purpose of this study was to measure and compare the blood pressure and pulse rate variabilities of patients before local anaesthesia injection, after injection, and after extraction to avoid any cardiovascular complications. Several studies have been conducted on blood pressure and pulse rate variability before and after the extraction [6,7].

Dental surgery

Tooth or dental extraction is the permanent removal of a tooth from its socket in the jawbone. During the tooth extraction procedure, a normal person will be overwhelmed by psychological stress [1]. There are two categories of extraction which are routine simple extraction and surgical extraction. Routine simple extraction is a procedure in which a visible tooth is grasped with forceps easily. A simple extraction takes place under local anaesthesia by a general dentist. Surgical tooth extraction is required when the tooth is impacted or in case of difficult extraction when a tooth is ankylosed or has abnormal roots such as curved or dilacerated roots. Routine general tooth extraction is one of the common dental treatments done in clinic [8].

Physiology of blood pressure

Blood pressure is created when the heart pumps and therefore pressure is exerted on the walls of the heart and blood vessels. It can also be defined as force per unit area exerted by the blood against the inner walls of blood vessels [9]. It is affected by heart rate, blood volume, and peripheral resistance. For example, an increase in heart rate,

blood volume, and peripheral resistance will increase the blood pressure. Arterial blood pressure (BP) is calculated by multiplying cardiac output (CO) by vascular resistance (VR).

$$BP = CO \times VR$$

While cardiac output is the rate of blood flow produced by the heart, vascular resistance describes resistance in blood vessels to the blood flow, which is affected by both the blood volume and blood vessel size.

Systolic pressure is highest when the blood is being pumped out of the left ventricle into the aorta during ventricular systole. The average systole is 120 mm Hg. Diastolic blood pressure lowers steadily to 80 mm Hg during ventricular diastole. Furthermore, the regulation of blood pressure is also regulated by neural and renal mechanisms [9].

Definition and classification of hypertension

Persistent elevation of systolic BP of 140 mmHg or greater and/or diastolic BP of 90 mmHg or greater is described by the term hypertension. Hypertension can be classified into mild, moderate, and severe hypertension. 'Normal' blood pressure is considered with a systolic value of less than 120 mmHg and a diastolic value of less than 80 mmHg. Mild hypertension is with a systolic value of 140 mmHg to 159 mmHg and a diastolic value of 90 mmHg to 99 mmHg, moderate hypertension is with a systolic value of 160 mmHg to 179 mmHg and a diastolic value of 100 mmHg to 109 mmHg and severe hypertension is with a systolic value of more than 180 mmHg and a diastolic value of more than 110 mmHg [10].

As for controlled hypertension, it is being defined as less than 140 mmHg for systolic value and diastolic value that is less than 90 mmHg for all patients, systolic value less than 130 mmHg and diastolic value that is less than 80 mmHg for patients with either diabetes or ischaemic heart disease or cerebrovascular disease or renal impairment and systolic value less than 125 mmHg and diastolic value that is less than 75 mmHg for patients with proteinuria of less than 1 gram per day [10].

Pathophysiology of hypertension

In hypertensive patients, there are several pathological features of blood vessels that can cause complications during tooth extraction such as failure in the regulation of vascular resistance, central arterial stiffness, and loss of elasticity. Thus, all these features will raise the effect of the high blood pressure [11].

Isolated office (white-coat) hypertension

Isolated office ("white-coat") hypertension is a medical condition in patients that have consistently elevated blood pressure which takes place in the physician's clinic but stays within the normal range at other times [12]. In these patients, blood pressure in the clinic remains above 140/90 mmHg, however, when the patients are at home, their

ambulatory blood pressure reaches 125/80 mmHg or lower. Isolated office hypertension accounts for 10 – 15% of hypertensive patients [10].

Stress as a factor that influences the changes of blood pressure and pulse rate in dental surgeries

The blood pressure and pulse rate response may be influenced by many factors and one of it may be patients' anxiety about the thought of dental extraction. A comparative study was conducted to compare patients receiving non-invasive treatment and patients who had undergone tooth extraction. The results showed that extraction was perceived as a stressful procedure to the patients [13]. Psychological and physical stress induced by painful stimuli is considered to influence the changes in the blood pressure [14]. A previous study on the age of patients in correlation to blood pressure and autonomic nervous system regulation also showed significant results [15]. These studies demonstrate that the response of blood pressure is due to stress that alters the autonomic nervous system.

Other studies were conducted to assess dental anxiety effect on the level of cortisol metabolism. The results suggested that dental anxiety has a long-term effect on the cortisol metabolism of patients [16,17]. Therefore, all these suggest that stress can affect the autonomic nervous systems leading to changes in blood hormones level and causing changes in blood pressure and pulse rate.

Negligible effect of local anaesthesia on blood pressure and pulse rate changes

A previous study has been conducted mainly focused on blood pressure and pulse rate variability before and after the administration of local anaesthesia containing a vasoconstrictor. The study showed that local anaesthesia containing vasoconstrictor does not significantly alter blood pressure and the increase of systolic level is thought to be due to the patient's anxiety [18].

In another study, well controlled hypertensive patients given less than three cartridges of local anaesthesia with vasoconstrictor showed no significant hemodynamic change [7]. The study of hypertensive patients with blood pressure equivalent or smaller than 154/99 mmHg also supports both of the studies above concluding that blood pressure and pulse rate alike had no significant changes during surgical procedures indicating that one cartridge of local anaesthesia articain hydrochloride containing 0.012 mg is safe to use [6]. All these studies showed that the use of local anaesthesia containing vasoconstrictor does not bring a significant effect on the blood pressure and pulse rate of patients whether they are hypertensive or normotensive.

The objectives of this study are to determine the effect of stress on blood pressure during tooth extraction and to investigate the changes in blood pressure and pulse rate before administration of local anaesthetic, before and after tooth extraction.

METHODOLOGY

Instruments

The instruments used in this study are:

1. **Stethoscope:**
   Acoustic stethoscope obtained from Kulliyyah of Dentistry Polyclinic, IIUM Kuantan.

2. **Sphygmomanometer:**
   Conventional calibrated mercury sphygmomanometer obtained from Kulliyyah of Dentistry Polyclinic, IIUM Kuantan.

3. **Watch:**
   Manual wristwatch.

Inclusion and exclusion criteria

The inclusion criteria are:

- Age from 20-50 years old.
- Normotensive patients or controlled hypertensive patients.
- Definition of control: <140/90 mmHg for all, <130/80 mmHg for patients with diabetes/ischemic heart disease/cerebrovascular disease/renal impairment and <125/75 mmHg for patients with proteinuria of >1 gram per day. (Malaysian Hypertension CPG, 2008).

The exclusion criteria are:

- Uncontrolled hypertensive patients
- Uncontrolled diabetic patients
- Pregnant patients

Study design

The study included 33 Malay patients aged between 20-50 years old who underwent tooth extraction in the Oral Surgery Department at Kulliyyah of Dentistry Polyclinic, IIUM Kuantan, from March 2012 to October 2012.

All patients were informed of the purpose of the study, and signed consent was obtained in all cases. Before the extraction procedure, patients were given a set of questionnaires to be answered.

Blood pressure and pulse rate measurements of subjects were recorded

- Before giving local anaesthesia with adrenaline,
- After local anaesthesia with adrenaline,
- After a tooth extraction.

The blood pressures were measured indirectly using a conventional calibrated sphygmomanometer in a sitting position. The pulse rates were determined by manual palpation of the radial artery by the operator, measured in beats per minute in the

same position right after each measurement of blood pressure. The technique used for blood pressure measurement is based on Malaysian Clinical Practice Guideline Management for Hypertension 3rd edition (2008) [10].

The following techniques were used in taking the measurement of blood pressure using a sphygmomanometer (Malaysian CPG management for hypertension, 2008) [10]:

1. Patients have rested adequately whilst being seated in an upright position with their arms supported (Figure 1).

Figure 1. Patient sitting at upright relaxed position

2. The cuff and the mercury reservoir were placed at the level of the heart.
3. The initial SBP estimation was determined by palpitation. During the palpitation of the brachial/radial artery the cuff was inflated until the pulse disappears. Following this, the cuff was inflated another 20mmHg then slowly deflated. The pressure which allows the pulse to be palpable was denoted as the estimated SBP.
4. Then the bulb was inflated to 20 mmHg over the estimated SBP. The pressure was then reduced in the interval 1-2mmHg per second whilst auscultating with the stethoscope bell (Figure 2).

Figure 2. Measuring of blood pressure

5. The pulse rates were measured in beats per minute in the same position right after each measurement of blood pressures (Figure 3).

Figure 3. Measuring of heart rate

Data analysis

All data were collected from March 2012 to October 2012. The collected data were analysed using an independent paired t-test in IBM® Statistical Package for The Social Sciences (SPSS) 16.0 software.

RESULTS

Majority of the patients belong to the age group of 31 – 40 years old (Figure 4). The results showed that 33.3% of participating patients had a fear to undergo tooth extraction (Figure 5). The majority of participating patients had previously undergone dental extraction in IIUM (Figure 6). More than 35% of participants had more than 4 teeth previously extracted (Figure 7).

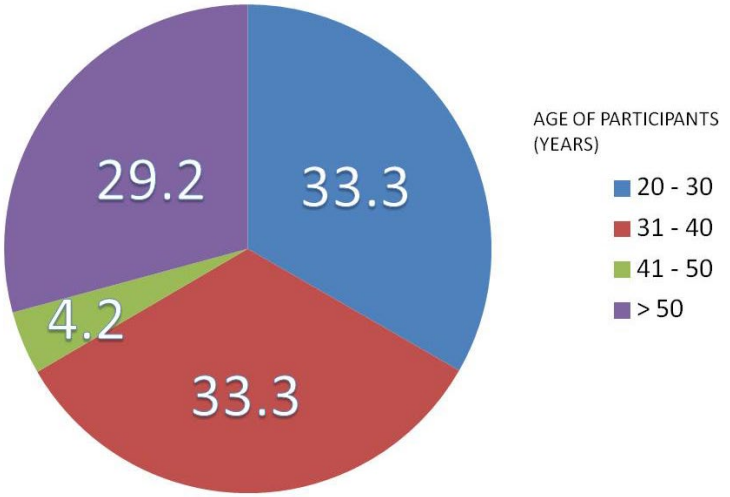

Figure 4. Age group of participants

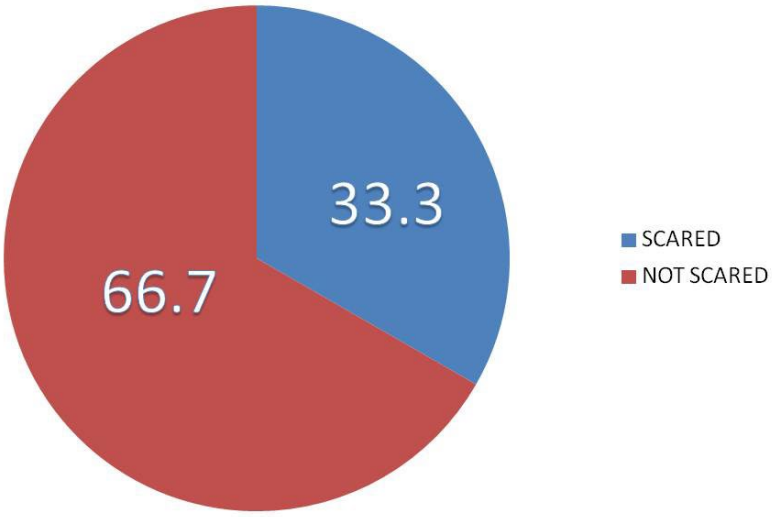

Figure 5. Percentage of patients who fear dental extraction

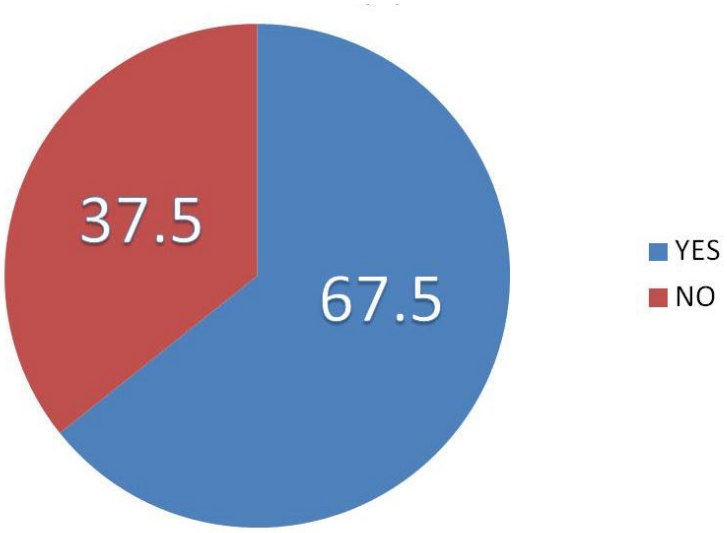

Figure 6. Percentage of patients who had tooth extraction under local anaesthesia in IIUM polyclinic

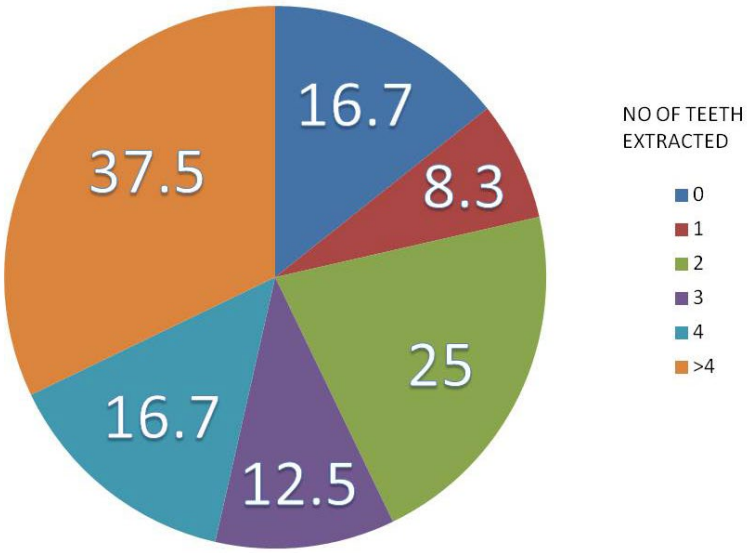

Figure 7. Number of previous extractions done for a patient

The systolic blood pressure of the patients was ranging from 98-172 (mean 129), 98-170 (mean 129), 98-190 (mean 131) mmHg before injection, after injection, and after extraction respectively (Table 1). The diastolic blood pressure of the patients was ranging from 54-106 (mean 86), 58-100 (mean 81), 56-102 (mean 80) mmHg before injection, after injection, and after extraction respectively (Table 2). The heart rate of

the patients was ranging from 40-110 (mean 73), 40-104 (mean 78), 40-102 (mean 75) beats/min before injection, after injection, and after extraction respectively (Table 3).

Table 1. The range and mean of systolic blood pressure before injection of Local Anaesthesia, after injection of Local Anaesthesia and just after tooth extraction

Time Interval	Range of Systolic Blood Pressure (mmHg)	Mean of Systolic Blood Pressure in mmHg (SD)
Before injection	98-172	129(17)
After injection	98-170	129(17)
After extraction	98-190	131(19)

Table 2. The range and mean of diastolic blood pressure before injection of Local Anaesthesia, after injection of Local Anaesthesia and just after tooth extraction

Time Interval	Range of Diastolic Blood Pressure (mmHg)	Mean of Diastolic Blood Pressure in mmHg (SD)
Before injection	54-106	86(10)
After injection	58-100	81(12)
After extraction	56-102	80(11)

Table 3. The range and mean of pulse rate before injection of Local Anaesthesia, after injection of Local Anaesthesia and just after tooth extraction

Time Interval	Range of Pulse Rate (beats/minute)	Mean of Pulse Rate in beats/minute (SD)
Before injection	40-110	73(14)
After injection	40-104	78(14)
After extraction	40-102	75(14)

DISCUSSION

Many patients who visit dental clinics have systemic diseases including hypertension, ischemic heart disease, metabolic disorders like diabetes, and renal impairment. Hypertension, however, is the most frequent among these. For the elderly patients visiting the dental clinic, there is the presence of one or more systemic diseases [19]. Additionally, cardiovascular incidents induced by hypertension were usually reported [20]. Therefore, there is great importance in the determination of blood pressure and sympathetic outflow responses during oral surgery treatment.

In this study, we hypothesized that blood pressure and pulse rate which reflects sympathetic nervous system activity would increase during oral surgery treatment, as a result of painful stimuli, psychological stress, or the epinephrine contained in the

local anaesthetic. The results of this research have shown that there were no significant changes in blood pressure and pulse rate before injection, after injection, and after tooth extraction. Before the extraction procedure, patients were given a set of questionnaires to be answered which include the feeling of the participants towards undergoing a tooth extraction, their experience of undergoing a tooth extraction, number of the previous extraction, and age of participants.

Regarding the feelings toward tooth extraction and physiological changes, the study showed that the participants were not fearful to undergo tooth extraction, this refutes the psychological stress which results in no change in the blood pressure and pulse rate reading. In addition to that, most of the patients had undergone tooth extraction once, and some had more than 4 teeth extracted, this may contribute to a less-fearful feeling toward tooth extraction. Lastly, the age group of the patient causes varying physiological changes which give different responses toward extraction, which is in context with the previous study done by Umino et al [19].

The current study comes in disagreement with a study done by Nakamura et al who stated that systolic blood pressures significantly increased during dental surgery [21]. This disagreement might be due to different populations or ethnicity participating in the study.

In this research, all the teeth were extracted simply through intra alveolar forceps extraction by closed method technique of extraction with the use of forceps and elevators. None of the patients had surgical or trans alveolar extraction, which comes in contrast with a study done by Tsuchihashi et al who stated that an increase in blood pressure during dental surgery cannot be predicted based on baseline blood pressure or the response to mental stress, but is related to the cause of tooth extraction such as pericoronitis [14].

With regard to age group, the results of a study done by K Matsumura suggest that middle-aged as well as older patients have a greater tendency to have increased blood pressure during dental surgery when compared to younger patients and that the autonomic nervous system regulation also differs during dental surgery between younger and older patients, which is found to be in context to our study [15].

Fanny et al in their study mentioned that high anxiety, younger age, and traumatic dental history were correlated with greater increases in heart rate during the administration of local dental anaesthesia, which is in context with the current study [22].

Age group as a parameter should be highly considered because it is significantly related to the medical disorders of the patients. The sample size of the study should be higher than this number and include other races such as Chinese and Indians to make a comparison between the groups.

CONCLUSION

This research has demonstrated that stress and anxiety do not significantly cause changes in blood pressure and pulse rate measurement before and after tooth extraction.

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CHAPTER 3

PREVALENCE OF ORAL HEALTH STATUS AMONG PREGNANT MOTHERS ATTENDING PRIMARY CARE CENTRE IIUM: A PRELIMINARY STUDY

Zurainie Abllah[1]*, Nurfathihah Ahmad[2], Nur Faiqah Nabilah Ahmad Sooaid[3]

[1] Dental Public Health Unit, Kulliyyah of Dentistry, International Islamic University Malaysia
[2] Kulliyyah of Dentistry, International Islamic University Malaysia

*Corresponding author email: drzura@iium.edu.my

SUMMARY

Pregnant mothers are highly susceptible to oral health problems. This research objectives are to identify the oral health problems among pregnant mothers, to assess knowledge and practice on oral care during pregnancy as well as oral health attitudes and behaviour using Hiroshima University-Dental Behavioural Inventory (HU-DBI) among pregnant mothers. A cross-sectional survey was conducted among 11 pregnant mothers attending the Primary Care Centre, IIUM from September until November 2015. Knowledge on oral health was assessed using a questionnaire in which the oral self-care and oral health attitudes & behaviours questions were included. Dental check-up was conducted to assess the caries and periodontal status of the patient. DMFT of the patient in which it was categorized into very low, low, moderate, and high score. As for the periodontal status, it was determined from the observation of the presence of calculus. The SPSS version 23 was used in this study. Out of 11 participants, 90.9% has caries in the mouth, and however 72.7% of them had very low DMFT score. High DMFT was only 9.1%. 27.3% of participants had dental calculus. 63.6% never have professional taught on oral health care, however 91% participants practice tooth-brushing twice or more daily and 54.5% use floss. The most striking behaviour from the participants is they don't feel afraid of attending dental clinic (100%). The highest score for HUDBI is 12 (mean= 4.92). It is concluded that dental caries is the most common oral health problem in this study, mostly never been professionally taught on oral health, also moderately score of good dental behaviours and attitudes.

Keywords: *pregnancy, oral health problems, knowledge, behaviours, attitudes*

INTRODUCTION

Pregnancy is one of the most precious and meaningful moment in a woman's life. Since the mouth is a portal of entry for infections that can affect local tissues and may spread to other parts of the body, thus, maintaining good oral health during pregnancy is necessary because preterm birth and development of pre-eclampsia associated with maternal periodontal disease [1].

At the period of preconception and pregnancy, most pregnant mothers experience the two most prevalent diseases of the mouth which are the periodontal disease and dental caries [2]. Occasionally pyogenic granuloma occurs in pregnant women. These common oral health problems are observed mostly due to inadequacies in oral health care which might not only influences her own oral health status but also may increase her risk of other diseases such as atherosclerosis, rheumatoid arthritis , and diabetes , impact pregnancy outcome , and her offspring's risk of developing early and severe dental caries [3].

The combination of high prevalence, insufficient treatment rates, missed preventive opportunities, and intermittent symptoms characterizing dental and oral disease as a "silent epidemic". Socioeconomic factors, lack of resources to pay for care, barriers to access to care, and lack of public understanding of the importance of oral health and effective self-care practices all represent underlying reasons cited for observed inadequacies in oral health.

Although preventable, these common oral health problems are highly prevalence, particularly among low-income women and members of racial and ethnic minority groups [4].

Hence, this research is conducted in order to find out the oral health problems in relation to pregnancy and increase the awareness among pregnant mothers to take better oral health care as prevention of the adverse effects towards the pregnancy. Because poor oral health can lead to bacteraemia as it enables the bacteria from the oral cavity to reach the foetus via blood stream leading to consequences such as pre-term labour. For these reasons, it is essential for health professionals such as dentists, nurses, physicians, and dental hygienist to provide pregnant women with appropriate and timely oral health care, including oral health education.

LITERATURE REVIEW

World Health Organization, WHO has defined that oral health is a state of free from diseases and disorders that affect the mouth (WHO, 2008). The most common oral disease in pregnancy is gingivitis with a prevalence of 60 to 75 percent. Meanwhile, a vascular lesion known as pregnancy oral tumor happens in up to 5 percent of pregnancies [5]. From studies, Mital et al found that the prevalence rates of gingivitis during pregnancy are found to range between 30 and 100%. During pregnancy, 50 to 90 percent of women develop "pregnancy gingivitis." [5]. Russell & Mayberry, 2008 while in a Thailand case-control study, pregnant women are found to be 2.9 times and 2.2 times more likely to have caries and gingivitis respectively as found by Rakchanok et al 2010. Periodontitis is associated with low birth weight and premature birth of baby and high levels of cariogenic bacteria that reside in mothers' mouth can lead to increased dental caries in the infant as stated by American Family Physician. 2008. During pregnancy, the oral cavity is potentially exposed more frequently to gastric acid that can wear away dental enamel due to frequent vomiting resulted from morning sickness. Furthermore, pregnant women have increased acidity in the oral cavity, increased sugary cravings, and neglecting of oral health. Moreover, teeth can

loosen during pregnancy as a result of increased levels of progesterone and estrogen affecting the periodontium which is the tooth supporting structures. In addition, gingivitis is aggravated by fluctuations in hormones level and changes in oral micro flora. Pregnant women also has decreased immune response that make it worsen [5]. Perera & Fernando who discovered that gingivitis and periodontitis developed in pregnancy credited to increased vascular permeability and potentially tissue oedema due to increased production of oestrogen and progesterone whereas the risk of tooth decay during pregnancy is caused by changes in food intake habits and oral hygiene regimes. Pregnancy gingivitis, benign oral gingival lesions, benign oral gingival lesions, tooth mobility, tooth erosion, dental caries and periodontitis are observed due to physiological changes during pregnancy [6]. Studies showed that 95.4% of pregnant women understand that cleaning their teeth will reduce tooth decay and 36% thought that pregnancy make their teeth worse and 43% thought that early dental caries is heredity and 79% of women visited their dentist when they have problem [7].

AIMS AND OBJECTIVES

This research aims to study the prevalence of oral health among pregnant mothers attending Primary Care Clinic IIUM. Meanwhile, our objectives are:

- To determine the prevalence and common of oral health problems among pregnant mothers.
- To assess the knowledge and practice of pregnant mothers on oral care during pregnancy.
- To assess the oral health attitudes and behaviour using Hiroshima University-Dental Behavioural Inventory (HU-DBI) among pregnant mothers.

METHODOLOGY

Study design

Through dental examination and questionnaires, a preliminary cross-sectional study on the prevalence of oral health attending Primary Care Centre IIUM was done. A convenient sampling method was used in collecting the data from September to November 2015.. The study is a preliminary study thus it itimated to get 30 patients. For the data collection, questionnaires and data examinations were performed after calibration inter-examiner (Kappa agreement 80%- supervisor, co-supervisor, students).

Patient selection

For the study, several inclusion and exclusion criteria of the patient was made. The inclusion criteria for this study are: (1) pregnant patients aged from 18 years old and above (2) any trimester of pregnancy. Meanwhile, the exclusion criteria are (1) pregnant patients aged less than 18 years old (2) high risk pregnancy or complication such as premature contractions, viral or bacterial infections, (3) mental handicapped

patients. The preliminary study was conducted for 3 months from September until November 2015.

For the 3 months duration of the preliminary study, the list of patients (n= 15) was obtained from the Primary Care Centre administration records.

Research tool and data collection

Patient's record

Patients were assessed with the demographic details and other epidemiological indicators which include age, sex, race, and medical problems of the patients. In addition, the experience of dental visit, oral self-care and maternal response on oral health attitudes and behaviour were also assessed from the questionnaire. Then after gaining the patient's consent, the dental examination proceeded in which the caries and periodontal health is recorded.

Together with the appointment date of each patient by weeks, the contact number, due date, status of patient either staff or student of IIUM and the department where the patient belongs to in IIUM are also included.

Data and statistical analysis

This cross-sectional study included 11 pregnant patients attending the Primary Care Centre, IIUM. Prior to dental examination, HU-DBI questionnaires were delivered by the researchers and patients answered in the questionnaires. For the calculation of the HU-DBI questionnaire score, one point was given for each agreed response for Part 5: Maternal Response on Oral Health Attitudes and Behaviours of questions number 4, 9, 11, 13, 14 and 18, and one point for each disagree response for questions number 2, 8, 10, 12, 15, 16 and 17. The number of healthy, decayed, filled and missing teeth (DMFT index) and the presence of gingival inflammation were recorded after clinical examination performed. All examiners were calibrated. The SPSS 23 was used to analyse data. Simple frequency tables and descriptive statistics (means and standard deviations) were analysed.

Ethical consideration

Ethical clearance was obtained from IIUM Research Ethics Committee (IREC) with ID number of IREC 416. All data regarding patient's identification and medical records are kept confidential.

RESULTS

During the entire course of the research which had taken place from September to November 2015, data from 11 respondents was successfully obtained.

Based on data in Table 1, the highest groups of the patients are from the age group 28-37 years old with a percentage of 73.7%. According to the races, 90.9% of the subjects are Malays with 54,5% of them being with their first pregnancy. Regarding the

education level, 82.8% of them are having the same educational level which is the University level. Besides, more than half of them are working with the income of more than Rm3000 monthly. As the conclusion for the patient's demographic data shows that the majority of the patients are from high education level and high-income family.

Table 1. Patient's demographic data

Patient's demographic data	**Percentage (%)**
Age	
18-27 years	27.3%
28-37 years	73.7%
>37 years	-
Maternal Parity (Number given birth)	
1	54.5%
2	18.2%
3	9.1%
4	18.2%
Race	
Malay	90.9%
Chinese	-
Indian	9.1%
Others	-
Month	
1-12weeks	45.5%
13-27weeks	45.5%
28-birth	54.5%
Education level	
None	-
Primary school	-
Secondary school	-
College	18.2%
University	82.8%
Occupation	
Housewife	18.2%
Working	63.6%
Student	18.2%
Income	
<RM3000	36.4%
>RM3000	63.6%
Others	-

Table 2 shows dental visit experiences among pregnant mothers. 81.8% of them had their dental check-up within a year. However, 63.6% of them did not go to dental visits during the pregnancy.

Table 2. Patient's experience on dental visit

Experience of dental visit	Percentage (%)
When is your last visit to dental clinics?	
Less than 1 year	81.8%
1-2 years ago	9.1%
more than 2 years ago	9.1%
Have you went to dental visit during pregnancy	
Yes	27.3%
No	63.6%
Not sure	9.1%
What types of dental care that you received during the visit?	9.1%
Dental check-up	9.1%
Dental treatment	54.5%
Both	

The results obtained from the questionnaire can help in understanding patient's oral self-care. Based on data in Table 3, 63.6% of them have not received any oral hygiene instruction. Most of them brush their teeth with the frequency of two and more than two times daily by using soft bristle toothbrush and fluoridated toothpaste. In addition, most of them are using interdental aid as a part of dental care. In the nutshell, it shows that the respondents are alert and taking a good care of their oral health.

Based on DMFT charted, data in Table 4 can be used to determine the caries experience of the subjects. 72.7% shows DMFT score less than 5 which indicate that the caries experience among the pregnant mothers is very low.

While in Table 5, pregnant mothers' attitudes and behavior toward oral health can be analyzed based on the questionnaire given. 72.7% of the respondents' experience gum bleeding during tooth brushing which indicates that they have gingivitis. Besides, more than half of the respondents noticed some white sticky deposits on their teeth in which shows plaque retention on their teeth. However, based on the results, it shows that most of them know the importance of taking care of their teeth.

Table 3. Patient's oral self-care

Patient's oral self-care	Percentage (%)
Ever received any oral hygiene education and instruction	
Yes	36.4%
No	63.6%
Frequency of toothbrushing per day	
0	9.1%
2	45.5%
>2	45.5%
Types of toothbrush	
Soft	90.9%
Medium	1.9%
Hard	-
Not sure	-
Types of toothpaste	
Fluoridated	90.9%
Non-fluoridated	1.9%
Technique of toothbrushing	
Horizontal	9.1%
Vertical	36.4%
Mixed	54.5%
Usage of mouthwash	
Yes	54.5%
No	45.5%
Usage of interdental aids	
Dental floss	54.5%
Interdental toothbrush	54.5%
Wood stick	54.5%

Table 4. Patient's caries experience based on decayed, missing, filled permanent teeth (DMFT)

Caries experience based on decayed, missing, filled permanent teeth (DMFT)	Frequency (%)
Very low (<5)	72.7%
Low (5-8.9)	9.1%
Moderate (9-13.9)	9.1%
High (>13.9)	9.1%

Table 5. Maternal response on oral health attitudes & behaviour

MATERNAL RESPONSE ON ORAL HEALTH ATTITUDES & BEHAVIOUR	Strongly Disagree & Disagree (%)	Neutral (%)	Strongly Agree & Agree (%)
Gums tend to bleed when brush teeth.	72.7%	-	27.3%
Some white sticky deposits noticed on my teeth.	54.4%	18.2%	27.3%
Cannot help having false teeth when old.	36.4%	36.4%	27.3%
I bothered by the colour of my gums I have used a dye to see how clean my teeth are.	36.4%	27.3%	27.3%
I brush each of my teeth carefully.	72.7%	9.1%	18.2%
I have never been professionally taught how to brush.	63.7%	1.2%	18.1%
I think I can clean my teeth without using toothpaste.	81.8%	9.1%	9.1%
I worry about having bad breath.	18.1%	-	81.9%
It is impossible to prevent gum disease with tooth brushing alone.	54.6%	-	45.4%
I put off going to the dentist until I have a toothache.	45.5%	18.2%	36.3%
I don't feel I've brushed well unless I brush with strong strokes	72.7%	18.2%	9.1%

DISCUSSION

As the findings revealed, it showed that regardless of the pregnancy trimester and age of the pregnant mothers, out of 11 patients, 90.9% has caries in the mouth, however 72.7% of them had very low DMFT score. High DMFT was only 9.1%. 27.3% of respondents had dental calculus. 63.6% never have professional taught on oral health care, which doesn't differ much as compared to Plunkett findings in 2008 and 2010 where the dentist or dental health worker who had talked about how to care of teeth and gums were only 51% and 55% respectively [8]. The highest score for HUDBI is 12 (mean= 4.92), which means there is moderately score of good attitudes and behaviour from the respondents.

From our data collection, we found out that only 27.3% of the respondents had gone for a dental visit during their pregnancy. This is significantly lower as compared to Oregon Pregnancy Risk Assessment and Monitoring, 2008; 2010 [8] in which for both years, 51% of the respondents visited the dental clinic while being pregnant. Since we conducted our research in a setting where most of the attending patients are from high

education level, we expected a higher percentage of pregnant mothers however our finding was unexpectedly much lower.

Meanwhile, for the oral self-care assessment, 91% of the respondents have performed tooth brushing of at least twice daily which might be an indicator that they actually really care for their oral health. This is proven from our final result in which the DMFT of high caries experience for our study was only 9.1%. This low DMFT score can be related with the facts that 54.5% of our respondents use mouthwash and interdental aids in their oral care. This is supported by Hunter who found that 88% of pregnant women indicated that they brushed their teeth two to three times a day; however, there is only 12% reported daily flossing [9]. On the other hand, the use of fluoridated toothpaste could also be one of the contributing factors to the low caries experience among the respondents.

Throughout the period of this research, several limitations had been encountered. The limited number of patients in the primary care centre and the patients within the 2 months of research conducted are just the repetition of the previously surveyed patients had restricted the research progress. Furthermore, some patients refused to take part in the research due to time factor since most of them are working and studying.

Despite the findings that the respondents had low caries experience, it shall not be forgotten that pregnant women usually experience some negative impact physically that may disturb routine oral self-care. Pregnant women may experience sickness which might leads to avoiding oral hygiene practices. This includes tooth brushing that may increasing the possibility for dental caries. The similar idea was expressed by Vladiakas & Lianos [10] about how pregnant women are at a higher risk of tooth decay for several reasons which are: neglect in oral hygiene, changes in saliva and mouth flora, nutritional changes and inadequate attention to oral health and vomiting.

CONCLUSION

From the study, dental caries is the highest prevalence of oral health problems among pregnant mothers. From the questionnaire, the oral health knowledge and practice of pregnant mothers are good which shows they taking care of oral health. Regarding oral health attitudes and behaviors, most pregnant mothers have good attitudes and behaviors towards dental care.

This study is preliminary study, and it is suggested in future the larger sample size can be obtained for better result analysis. Hopefully, the result can be beneficial in providing statistics on oral health of pregnant mothers as to help in educating patients regarding the importance of oral health measures to maintain oral health during pregnancy.

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CHAPTER 4

DENTIST'S KNOWLEDGE ON MANAGEMENT OF FIRST PERMANENT MOLAR WITH POOR PROGNOSIS IN CHILDREN

Nor Asilah Harun[1]*, Nurul Fatnin Wahida Mohd Padzli[2], Nurul Syahirah Zakaria[3]

[1] Department of Paediatric Dentistry and Dental Public Health, Kulliyyah of Dentistry, International Islamic University Malaysia, Kuantan Campus, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia
[2] Klinik Pergigian Permaisuri, Bandar Permaisuri, 22100 Setiu, Terengganu, Malaysia
[3] Klinik Pergigian Kudat, d/a Pejabat Kesihatan Kudat , Beg Berkunci 6, Jln Bawah, 89059 Kudat, Sabah, Malaysia

*Corresponding author email: norasilah@iium.edu.my

SUMMARY

The first permanent molars (FPM) has been identified as the permanent dentition tooth with the highest caries risk and a high prevalence of caries in children. The treatment would be conservative restoration. But when the tooth has become badly carious, unrestorable or non-vital in a developing dentition, it gives a significant challenge to decide whether to save the tooth by doing endodontic therapy or extracting the tooth. Orthodontically, the FPM is rarely the tooth of choice for extraction. However, in an ideal situation, the extraction of FPM will be followed by an eruption of a second permanent molar (SPM) to replace FPM, and the third molar will erupt to complete the dentition. Thus, this study aimed to assess the dentist's knowledge regarding the management of poor FPM, their treatment choice and the reasons behind their choices. A cross-sectional sample of 17 dentists completed a self-administered questionnaire covering; knowledge and practice of management of FPM with poor prognosis. Majority of them did not fully understand compensating and balancing extraction and the ideal timing for extracting FPMs. 64.7% believed in saving non-vital FPM in developing dentition rather than extracting them. However, 70% choose extraction to manage unrestorable and badly caries FPM. This indicated that most of the dentists who participated in this study were not aware of the enforced extraction of the FPM and the guideline of management of FPM with poor diagnosis.

Keywords: *dentist, enforced extraction, first permanent molar, poor prognosis tooth*

INTRODUCTION

The first permanent molars (FPM) are commonly referred to as "six-year molars" since they usually erupt between the ages of 6 and 7, and the root formation is complete by the age 9 – 10 years [1]. The FPM has significant importance in mastication and occlusion. Following the eruption, the FPM maintains a relatively consistent position,

stabilising the dentition, directing the remaining permanent teeth into an optimal position, and establishing the occlusion [2].

However, since it erupts at an early age and with the presence of grooves and pits on the occlusal surface, the children who still have not developed proper oral hygiene and has a high frequency of sugar intake makes this tooth vulnerable to caries development. The PFM has been identified as the permanent dentition tooth with the highest caries risk and a high prevalence of caries in children [3,4,5]. Furthermore, the PFM is affected by molar-incisor hypomineralization (MIH), with the prevalence rate ranging from 2.4 to 40.2 %, according to various studies, making them more susceptible to caries progression [6,7,8,9]. Caries progression is remarkably rapid in FPM during the first two years following eruption [10].

The treatment for caries in FPM would be conservative restoration with an appropriate restorative material. However, it is not always sufficient when the tooth has become badly carious and is no longer restorable or when the caries is too deep and jeopardise the tooth's vitality. A dilemma arises when teeth are restorable, yet the possible results leave the tooth with a doubtful prognosis, particularly in developing dentition of children. This situation gives the paediatric dentist and orthodontist a significant challenge to decide whether to save the tooth by doing endodontic therapy or extracting the tooth [11]. Before deciding on the best treatment option for FPM with a poor prognosis, many factors should be considered, including the extent of crown destruction, the degree of pulp maturation, the status of the developing dentition, the severity of dental pain, the patient's ability to tolerate long treatment under local anaesthesia, the long-term prognosis of restored FPM tooth and the attitude of the child's parent(s) [12].

Orthodontically, the FPM is rarely the tooth of choice for extraction. Nevertheless, extraction of FPM should be considered in a suitable clinical situation whereby the tooth is considered non-restorable and therefore not suitable for retention. Class I occlusion, premolar crowding, no missing permanent teeth, FPMs with poor treatment prognosis and dental age of 9–11 are the criteria suggested by Chen JW & Leggitt VR, 2012 that should be met before extraction of FPM is considered as the treatment option [13]. It is critical to carefully assess and weigh the risks and advantages of long-term treatment planning for young patients to get the optimal outcome.

Early loss of FPMs has detrimental implications, while some research showed that early extraction of FPMs may have beneficial orthodontic consequences when spontaneous space closing is considered [14,15]. Other consequences include accelerated second permanent molar (SPM) and third molar development and eruption, decreased caries and/or fillings on the proximal surfaces of adjacent teeth, tipping and mesial drifting of SPM, distal drifting and tilting of second permanent premolar, lingual tilting and retrusion incisors and counterclockwise rotation of the occlusal plane [15]. In an ideal situation, the extraction of FPM should be followed by an eruption of SPM to replace FPM, and then the third molar will erupt without

impaction to complete the dentition. However, a few factors can complicate this: the timing of the FPM extraction, the third molar development, developing dentition and malocclusion [16]. It was suggested that the ideal time for extraction of the FPM is at the chronological age of 8 to 10 years, after the eruption of the lateral incisors but before the eruption of SPM and/or second premolar or ''when there is radiographic evidence of early dentine calcification within the second molar root bifurcation'' as in the College of Surgeons of England guideline [16,17]. Conversely, a study has shown that timing of the extraction and malocclusion of the patient may not be as critical as suggested by the guideline, with evidence of complete spontaneous space closure in maxilla and mandible after extraction of FPM at an 'early' or 'late' timing [18].

Balancing and compensating extraction of FPM also need to be considered when encountering FPM with a poor prognosis. Balancing extraction is the removal of other FPM from the opposite side of the same dental arch, while compensating extraction refers to the extraction of other FPM from the opposite quadrant [19]. The purpose of balancing and compensating extraction is to preserve the dental midline and prevent overeruption in the developing dentition of a young patient [12].

A dentist should be equipped with adequate knowledge before deciding on the management of poor prognosis FPMs. Moreover, dentists have apparent disagreements regarding decision-making in managing badly decayed FPM as stated in the previous study [20]. The decision on the management of FPM with a poor prognosis should be standardised, guided by the available guidelines for the long term benefit of a young patient. Thus, this study is conducted to assess the dentist's knowledge regarding the management of poor FPM, their choice of treatment and to explore the reason behind their choices.

METHODOLOGY

Ethical approval for this cross-sectional study was obtained from IIUM Research Ethics Committee (IREC). A convenience non-probability sampling method was used for this study and was conducted among general practitioner dentist working in private dental clinics in Kuantan, Pahang, Malaysia, between May 2018 and October 2018.

Prior to data collection, a questionnaire on knowledge regarding the management of first permanent molars of poor prognosis in developing dentition was constructed in English. Validation of the questionnaire was carried out by content experts. A pre-test was performed to determine the reliability of the questionnaire by distributing it to seven dental officers from IIUM dental clinic and IIUM Medical Centre. Reliability tests using Cronbach's alpha coefficient was used to indicate the internal consistency of the responses.

The self-administered questionnaires consist of three sections: 1- Socio-demographic (5 questions), 2- Knowledge about first permanent molar eruption and extraction (8 questions), and 3- Treatment choice between root canal treatment (RCT) or extraction

of different clinical scenarios (4 clinical scenarios) and the reason; the first scenario, treatment of non-vital lower FPM in a young, healthy child ranging from age 8.5-10.5 years old, the second scenario of non-vital FPM and second permanent molar (SPM) root starts to form at the bifurcation in a healthy child, the third scenario of unrestorable vital FPM in a healthy child aged 8.5 to 10.5 years old and the last scenario is badly decayed FPM in 8.5 to 10.5 years old healthy child diagnosed with molar incisor hypomineralisation (MIH).

The data were analyzed statistically and descriptively in SPSS version 16.

RESULTS

A total of 17 dentists participated in this research, but 1 respondent did not answer the socio-demographic section. Table 1 shows the socio-demographic data of the respondents.

Table 1. Socio-demographic characteristics of the dentist

Socio-demographic characteristic	**N**	**%**
Gender		
Male	9	52.9
Female	8	48.1
Age		
20-29	3	17.6
30-39	8	47.1
40-49	1	5.8
50-59	3	17.6
60-69	1	5.8
Year of experience		
1-10	9	52.9
11-20	4	23.5
21-30	1	5.8
31-40	2	11.7
Graduate from university		
Government university	9	52.9
Private university	7	41.2

Four respondents (23.5%) answered all the questions correctly in section 2. All of the respondents (100%) know the first permanent molar eruption age, but only 8 (47.1%) know the ideal age to extract the first permanent molar if necessary. Only 6 (35.3%) respondents answered correctly for all the compensating and balancing extraction statements. The details of the respondents answered as in Figure 1.

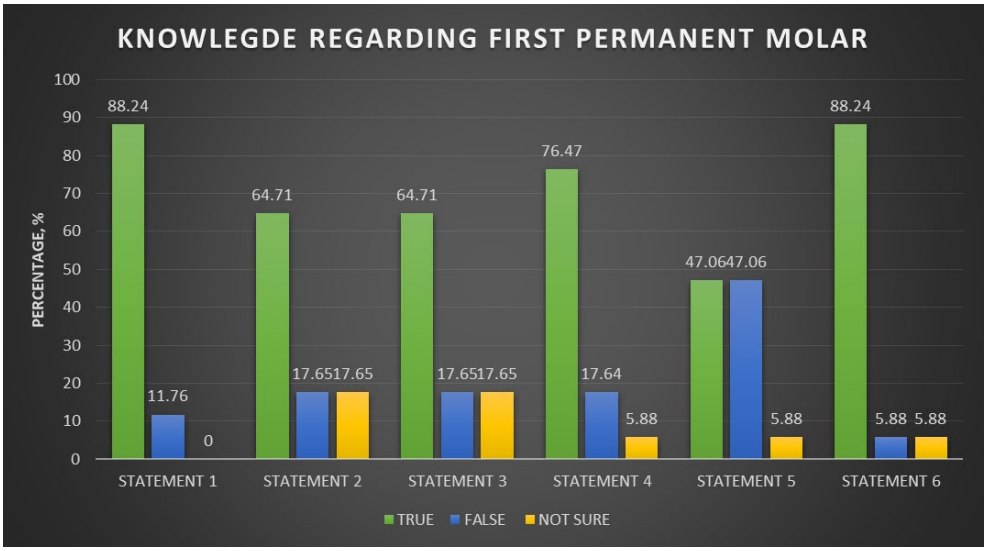

Figure 1. Knowledge regarding first permanent molar

Regarding the first scenario, a majority (64.7%) chose to do RCT, because they wanted to save the tooth (63.6%) and to get a good occlusion (36.4%). The result is shown in Figure 2 and Figure 3.

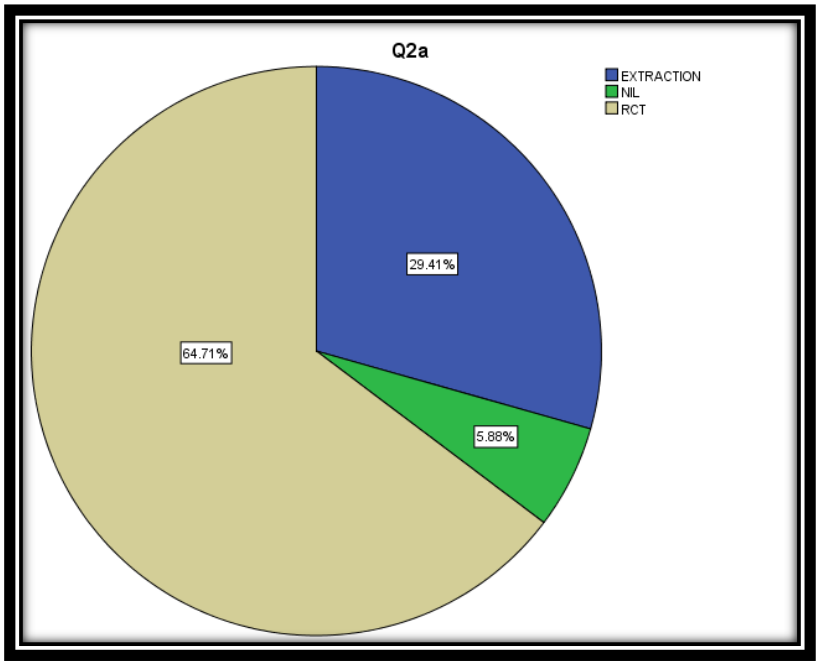

Figure 2. The treatment choice for clinical scenario 1

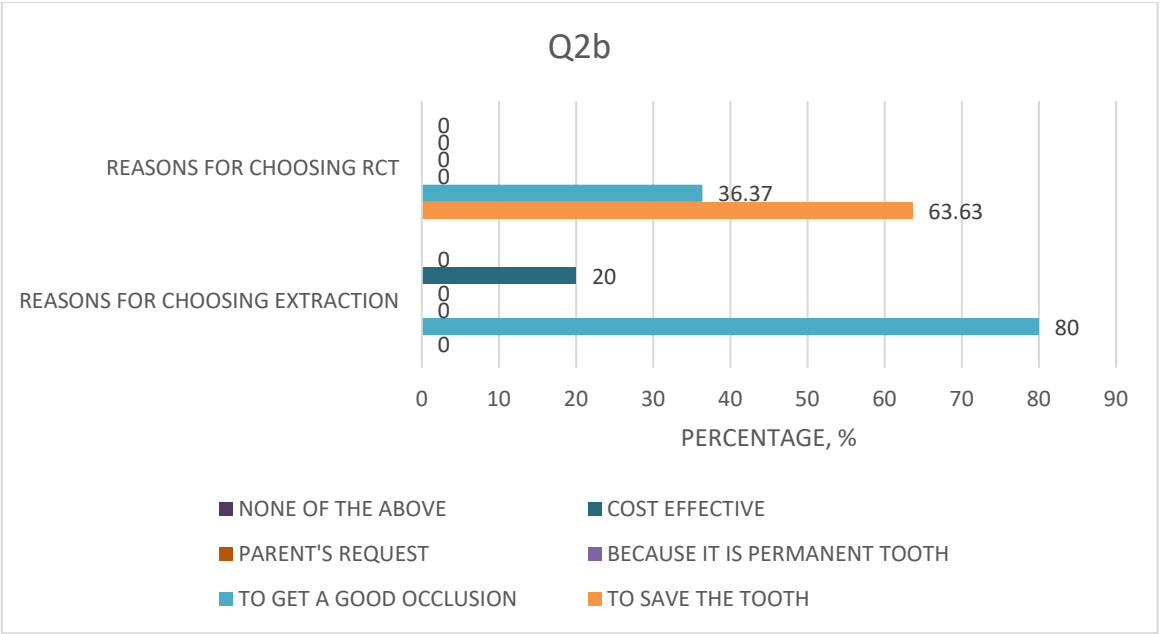

Figure 3. Reason for the treatment choice for clinical scenario 1

In clinical scenario 2, 64.7% of respondence chose RCT as their treatment choice, with 100% of them agreeing that the reason was to save the tooth. 35.3% chose extraction for the treatment, with a majority of them (83.3%) choosing to get a good occlusion as the reason. (Figure 4 and Figure 5).

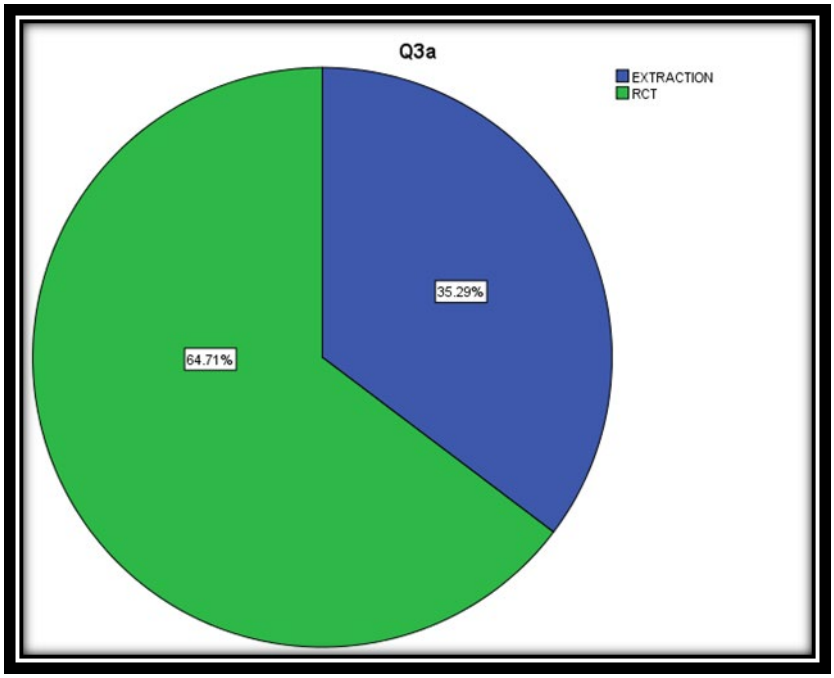

Figure 4. The treatment choice for clinical scenario 2

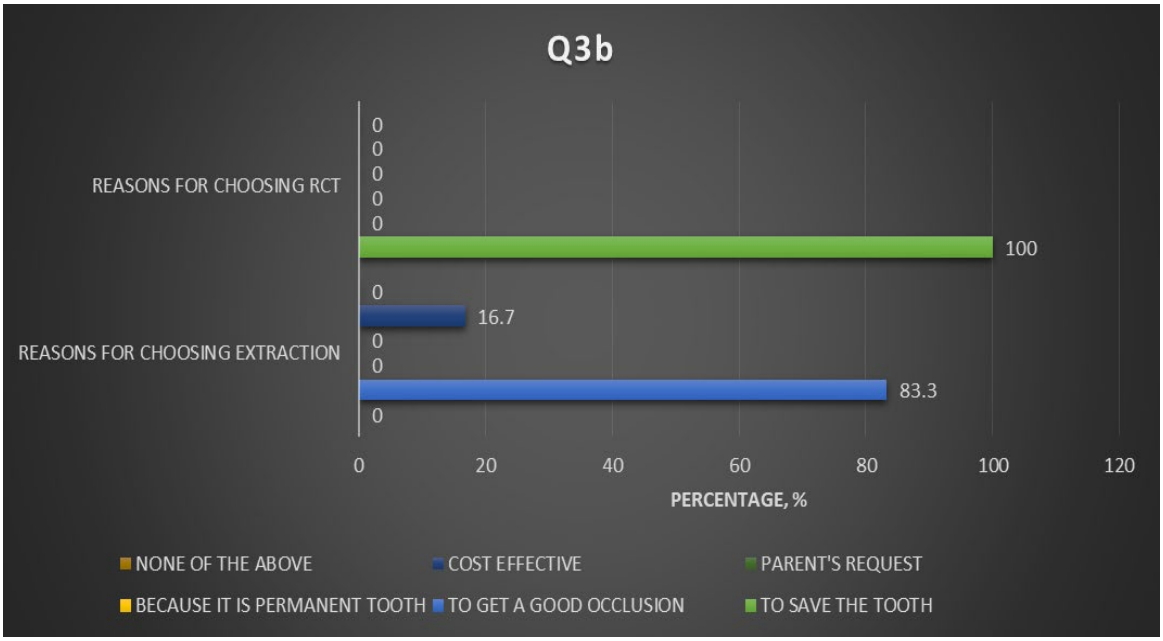

Figure 5. Reason for the treatment choice for clinical scenario 2

Concerning the second clinical scenario, a majority (70.6%) chose extraction, while 29.4% chose RCT (Figure 6). 66.7% of dentists chose extraction because they want a good occlusion (Figure 7).

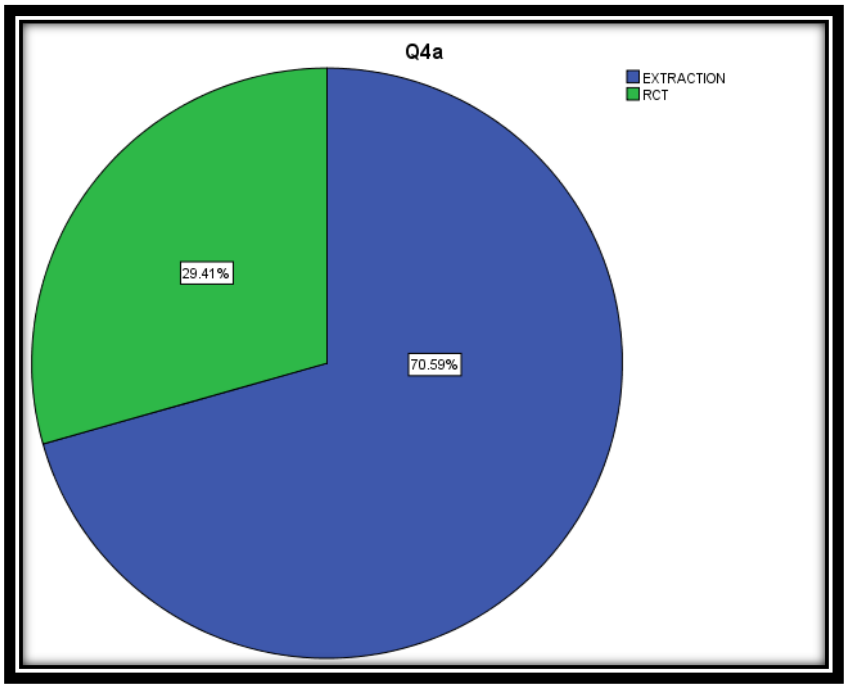

Figure 6. The treatment choice for clinical scenario 3

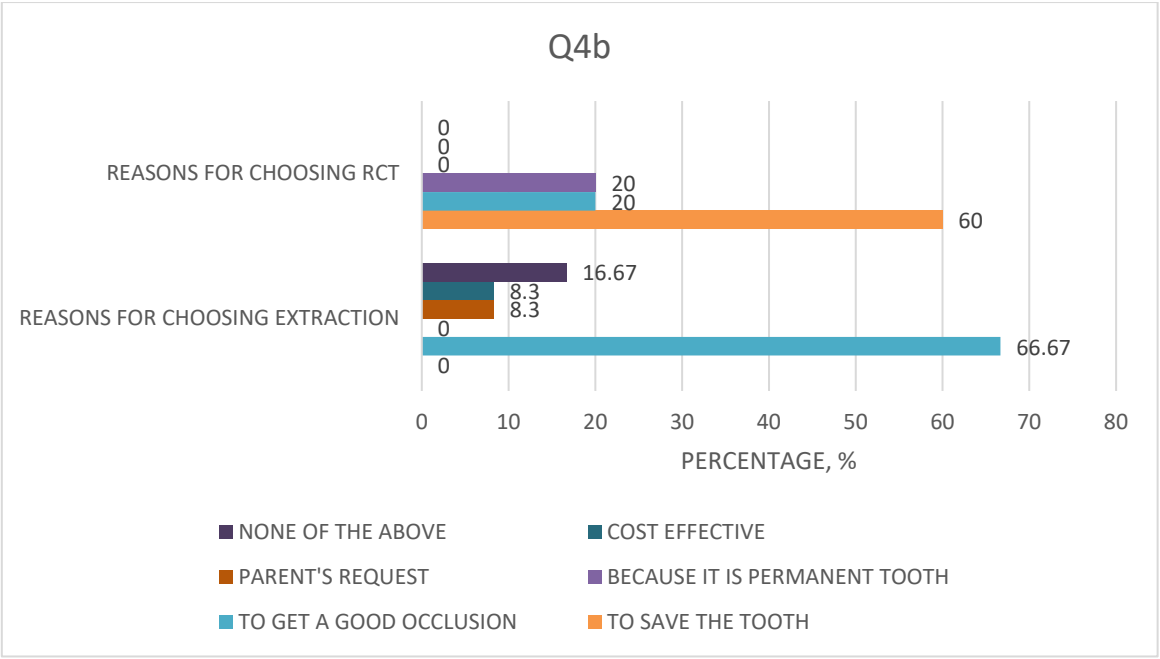

Figure 7. Reason for the treatment choice for clinical scenario 3

Regarding the fourth clinical scenario, most choose to extract the tooth, while 29.4% choose RCT as the treatment option (Figure 8). Most dentists (58.3%) choose extraction because they want to get a good occlusion (Figure 9).

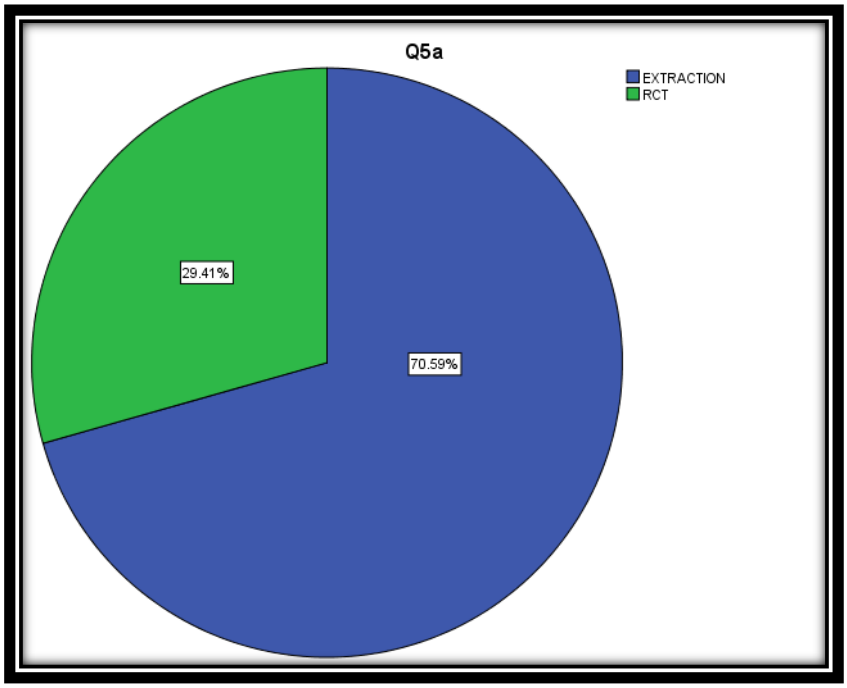

Figure 8. The treatment choice for clinical scenario 4

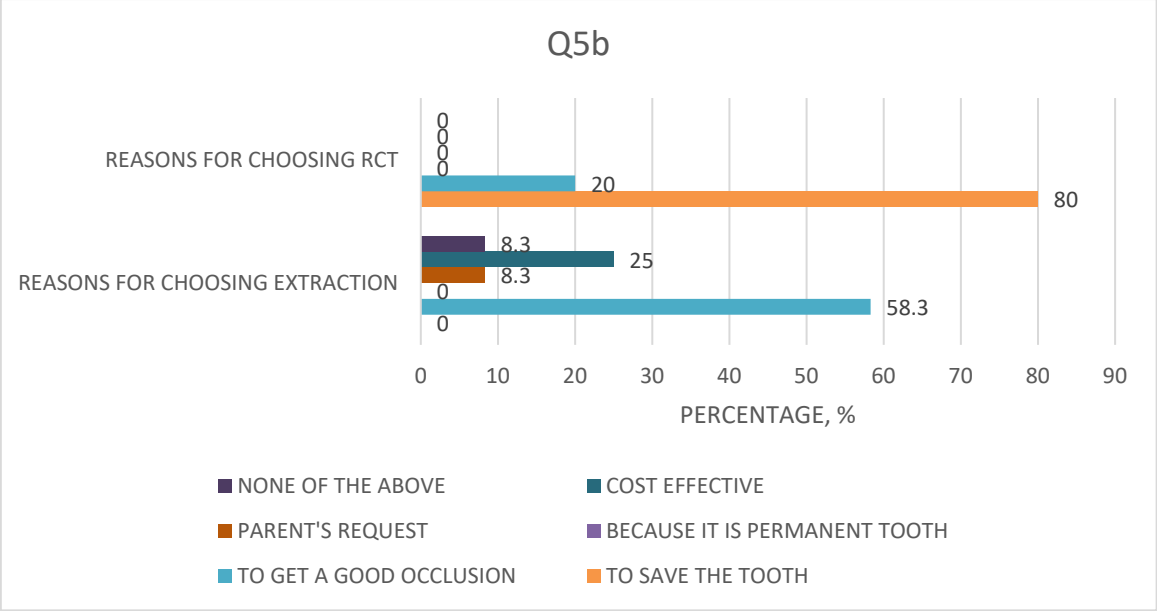

Figure 9. Reason for the treatment choice for clinical scenario 4

DISCUSSION

FPMs that have been compromised due to dental caries and/or MIH and their management in developing dentition are a real problem for dentists who work with children worldwide. This could be due to a lack of awareness about the available treatment options and which one is the most appropriate for the patient's age and clinical situation [20]. Many dentists advocate restoration and endodontic therapy in order to save the tooth [21]. On the other hand, others strongly believe that the eruption of an SPM can follow FPM extraction to give an appropriate replacement, and the third molar will erupt to complete the dentition for good occlusion [15,19]. Therefore, it is critical for practising dentists to have access to and follow proper clinical guidelines for managing FPM with a poor prognosis. Many management options for young, immature permanent teeth were outlined in the AAPD guidelines, while the Royal College of Surgeons of England published a guideline on the enforced extraction of the FPM [16, 22].

In this study, most of the participants did not fully understand compensating and balancing extraction and the ideal timing for extracting FPMs. This could be due to their undergraduate teaching and various educational backgrounds with different schools of thought. The previous study also discovered that dentists lacked sufficient knowledge of the best time to extract FPMs in children. Thus, the referral for FPM extraction was made later than the ideal timing for extraction [23].

For the first and second clinical scenario questions in this study about the treatment options of non-vital FPM in children age 8 to 10 years old and with evidence of root formation of SPM at the bifurcation, more than 60% of the respondent choose RCT as their treatment option. Their reason for the chosen treatment was to save the tooth.

Again, this showed that the dentist has a deficiency knowledge of the ideal timing for FPM extraction, the concept of long-term prognosis of RCT in children, and the spontaneous space closure that can occur following FPM extraction. The preference of choosing RCT over-extraction is also due to the conservative tendency of the dentist attributed to their educational background, which is to encourage the preservation of the tooth [24]. In addition, this result is also in line with the previous study in which the dentist also appeared to restore the compromised FPM in children when extraction would have been more appropriate [25].

Contrarily, for the third and fourth scenario questions about unrestorable and badly caries FPM of MIH tooth, 70% of respondents choose extraction as the treatment to get a good occlusion. This showed that the dentists knew that restoration techniques might fail in children because all restoration generally have a limited life span and may need to be replaced every 5 to 10 years. This will weaken the remaining tooth substances and may compromise the pulp vitality and the tooth structure. Therefore, extraction of FPM is the better option [26].

Overall result of this study indicated that most of the dentists who participated in this study were not aware of the enforced extraction of the FPM and the guideline of management of FPM with poor diagnosis inconsistent with the previous study conducted in the United Arab Emirates [27]. Training background probably influences the decision making. This demonstrates the importance of regularly disseminating best practice guidelines as part of ongoing professional development and upgrading the knowledge by attending continuous professional development events.

The limitation of this study is a small sample size, and further studies with a larger sample size should be conducted to investigate in-depth the knowledge, decision making and the practice of dentists in the management of FPM with poor prognosis. So standardisation of the clinical practice can be implemented for all the dentists in Malaysia.

CONCLUSION

In this study, the dentists have a deficiency of knowledge in the management of poor prognosis FPM and were lack awareness of the current clinical guidelines. Continuous professional development should emphasize the best clinical practice of managing compromised FPM.

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CHAPTER 5

A PILOT STUDY ON EXPECTATION AND SATISFACTION OF DENTURE PATIENTS IN IIUM DENTAL CLINIC

Norfaezah Ahmad[1]*, Amizah Sulaiman[2], Mazmira Mahidin[2], Musliana Mustaffa[3]

[1]Department of Prosthodontics, Kulliyyah of Dentistry, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia.
[2] Kulliyyah of Dentistry, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia.
[3] Department of Restorative, Kulliyyah of Dentistry, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia.

*Corresponding author email: drfaezah@iium.edu.my

SUMMARY

A patient's expectations can profoundly affect the satisfaction with a new denture construction. Previous studies have stated that prosthetic treatment failures occur not because of the clinical and technical problems but due to unrealistic expectations of the patient who expects the denture to be comparable to the natural dentition functionally and aesthetically. It is vital to determine the level of patient expectations and educate them so that their expectation could be kept at a reasonable level. In addition, this could ensure high satisfaction with the dental treatment. The objective of the study was to determine the patient expectation and satisfaction before and after denture construction. This research involves 40 patients who received one or a pair of complete dentures at the Kuliyyah of Dentistry, IIUM. The subjects were divided into two groups, a tested and a control group. The tested group received an informational pamphlet and none for the control group. Patients with partial dentition on both arches and patients with severe gag reflex were excluded from this study. The level of expectation and satisfaction of the patient toward the prosthesis was measured by using a self-administered questionnaire. There was no significance differences of expectation and satisfaction shown between the tested and control groups before treatment. However, after a session of denture education by using an informational pamphlet, the level of expectation reduced, and the level of satisfaction increased slightly in the tested group. The use of informational pamphlets during denture education does give a positive impact on the outcome of prosthodontics treatment.

Keywords: *complete denture, denture education, informational pamphlet, expectation, satisfaction*

INTRODUCTION

Complete dentures are a favoured treatment option for edentulous patients. It deserves to be noted that the complete dentures are commonly accepted as they provide a pleasing appearance and maintain normal speech, as well as supply occlusal

support and adequate means for mastication of food. Additionally, these dentures should be comfortable and should generally make a patient satisfied.

The great majority of completely edentulous patients are satisfied with their complete dentures while great emphasis is placed on the patients who remain dissatisfied despite the clinical perfection of their oral rehabilitation, as patients' satisfaction with their dentures seems to be associated with their quality of life. Denture education would be expected to have a much greater impact on patients' expectations and satisfaction with dentures. Therefore, this study aims to determine the effect of informational pamphlets on altering patient expectations.

The success of dental treatment is affected by the patients' satisfaction. Research has been done to study the perception and satisfaction of patients, particularly in denture construction. Besides that, a study has been done to determine the effect of denture education on patients' perception.

It is the responsibility of the practitioner to make his patients understand the value of a particular treatment through education and motivation as it is found that most the patients do not value their treatment prosthesis at the time of delivery [1]. However, a study by Davis et al. shows that patients' perceptions and satisfactions were unrealistically high before treatment and informational videotapes did not affect the expectations [2]. Psychological factors seem to be more important as there is little correlation between clinical variables and the patient's satisfaction [3]. In addition to that, in 2001, research proves that patient-related dependant factors are important to determine satisfaction with prosthesis [4].

Our null hypothesis was that there is no difference in expectation levels between patients who receive denture education through the informational pamphlet and those who do not receive the denture education (control group). While the alternate hypothesis of our study in patients who receive denture education through informational pamphlets have more reasonable expectations compared to the control group. The aims of our study thus were to determine the patient expectation and satisfaction before and after denture construction. Specifically, we also wanted to determine the effect of an informational pamphlet on altering patient expectations and to determine the relationship between the expectation level and the satisfaction level of the denture treatment.

METHODOLOGY

Study setting

The present study was conducted in Kulliyyah of Dentistry (KOD), International Islamic University Malaysia (IIUM), Kuantan Campus. The specific setting was at the student's polyclinic in Kulliyyah of Dentistry.

Study design and sampling method

The subjects involved in this study were patients who underwent treatment at Prosthodontics Clinic for complete dentures construction. The study design used was a randomized control-group design. This means that the patients were randomly assigned either to the tested group which comprised those who received denture education through an informational pamphlet or to the control group which did not receive denture education.

Raosoft sample size calculation determined that the sample size needed for this study was 40 subjects. Thus, 20 subjects were randomly allocated to the tested group and the other 20 subjects were allocated to the control group.

Patients who needed at least one complete denture were included in this study. Those with partial dentition in both arches and severe gag-reflex were excluded from the study.

Informational pamphlet

An informational pamphlet given to the tested group comprises of the information about complete dentures such as the definition and structure of dentures, types of dentures, function of dentures, the difference between the dentures and natural teeth, denture care and maintenance instructions. This informational pamphlet was given to the subjects during at the beginning of the denture construction procedure.

Questionnaire

A set of questionnaires develop and adapted as a tool to measure the expectation of patients and their satisfaction with the dentures. The questionnaire was divided into three sections which are demographic inquiries, patients' expectation inquiries, and patients' satisfaction inquiries.

Demographic inquiries consist of questions asked for patients' age, gender, education level, and past denture experience. The patient expectation of the denture was measured through seven statements related to general expectation, fit, function, comfort, appearance, mastication efficacy, and speaking ability. The last section about patients' satisfaction inquiries consists of six items to measure the satisfaction from the aspect of general satisfaction, artificial teeth shade, artificial teeth shape, speaking ability, comfort, and social confidence. Types of questions used in this questionnaire were closed-ended questions and rating scale questions with a Likert-type scale.

The data collection for this study consists of two phases. The first phase was when the participant first came to seek denture treatment. The patient was given information regarding this study and consent was taken from participants who agreed to participate. All 40 participants who were approached agreed to participate. An

informational pamphlet was given to participants number 21 up to 40 during the first phase.

The second phase was when the participant came for a review visit of the new denture. The same set of questionnaires was used for both the first and second phases.

Statistical analysis

Data obtained were recorded and analyzed using SPSS software version 19. Wilcoxon paired signed-rank test was used to determine the changes in expectation and satisfaction level pre-treatment and post-treatment.

RESULTS

Demographic data

A total of 40 individuals were recruited to participate in this research. The majority of the participants were male (n=22, 55%) and a total of 18 females (45%) take part in this research. The majority of participants fall into the elderly category (more than 60 years old) with a cumulative percentage of 52.5%. There were 19 participants (47.5%) who were within the 46 to 60 years old age group. 14 participants (35%) had lower education of at least primary school and 65% (n=26) had higher education of at least secondary school. Table 1 shows the demographic data of the participants.

Table 1. Demographics distribution of the participant

Demographic data		Participant (n)	Percentage (%)
Age	31– 45 years old	0	0
	46 – 60 years old	19	47.5
	> 60 years old	21	52.5
Gender	Male	22	55
	Female	18	45
Education level	Low level	14	35
	High level	26	65

Denture experience

Table 2 indicated data on the denture experience of the participants. The majority of participants have experienced wearing dentures before. This group of participants comprises 87.5% (n=35) of the study population. The other 5 participants have no experience of wearing dentures and intended to have a denture in order to improve their function and appearance. And only one (2.5%) of the participant has worn more than 2 sets of the denture before. As for the duration of wearing the denture, most of the participants have experienced wearing a denture for more than 10 years (n=18;45%). The highest frequency for the duration of wearing a current denture is

less than 5 years which is a total of 17 participants. Table 2 depicts the data on the denture experience of the participants.

Table 2. Data on denture experience of the participants

Denture experience	Answer	Participant (n)	Percentage (%)
Denture wearing experience	Yes	35	87.5
	No	5	12.5
Number of denture set worn before	1 - 2	34	85
	> 2	1	2.5
Duration of wearing denture	< 5 years	17	42.5
	6 - 10 years	5	12.5
	> 10 years	18	45
Duration of wearing current denture	< 5 years	17	42.5
	6 – 10 years	7	17.5
	> 10 years	16	40

Attitude towards denture hygiene care

Information regarding participants' denture hygiene care was asked in this study. 55% of participants wear dentures at night (n=22). 80% of the participants clean their dentures by using toothbrushes together with toothpaste or water as a denture cleanser. 22 out of 35 denture wearers clean their dentures every day. Only 27.5% of participants claimed that they have received any form of information regarding denture hygiene care and most of them claimed that they obtained it upon receiving their dentures.

The expectation of a new denture

The expectation level for both the control and test group yields the same results for pre-treatment for each of the components. However, the results for the post-treatment component are not uniform. Table 3 shows the results for expectations of participants for their new dentures. As can be seen from Table 3, for post-treatment, participants in the control group have only a higher value for the component general expectation towards new dentures. Other components are dominated by the test group for post-treatment.

Table 3. Results for the expectation of participants for their new denture

Component	Pre-tx		Post-tx	
	tested	control	tested	control
1. General expectation towards new denture	0.95 ± 0.224	0.8 ± 0.41	1.4 ± 0.503	1.6 ± 0.503
2. Function of new denture vs natural teeth (phonetics)	0.95 ± 0.224	0.8 ± 0.41	1.3 ± 0.470	1.0 ± 0.000
3. Comfort of new denture vs natural teeth	0.95 ± 0.224	0.8 ± 0.41	0.95 ± 0.224	0.8 ± 0.410
4. Appearance of new denture vs natural teeth	0.95 ± 0.224	0.8 ± 0.41	1.55 ± 0.605	1.5 ± 0.513
5. Ability of eat and chew of denture vs natural teeth	0.95 ± 0.224	0.8 ± 0.41	1.25 ± 0.444	1.0 ± 0.000

Satisfaction with current denture

For pre-treatment, there is no significant difference between the tested group and control group in satisfaction level towards current denture. However, for post-treatment the level of satisfaction indicated statically significance different for artificial tooth shade and tooth shape when participants demonstrated better level of satisfaction towards these components.

Table 4. Satisfaction level on current denture among participants for pre-treatment and post-treatment

Component	Pre-tx		Post-tx	
	tested	control	tested	control
1. Appearance	1.25 ± 0.639	1.40 ± 1.142	1.50 ± 0.607	1.20 ± 0.4100
2. Tooth shade	0.95 ± 0.224	1.00 ± 0.649	1.00 ± 0.000	1.25 ± 0.444
3. Tooth shape	0.95 ± 0.224	0.90 ± 0.553	1.00 ± 0.000	1.25 ± 0.444
4. Ability to speak	1.35 ± 0.813	1.35 ± 1.089	1.75 ± 0.851	1.70 ± 0.470
5. Ability to chew	1.70 ± 0.923	1.35 ± 1.089	1.65 ± 0.933	1.00 ± 0.000
6. Social confidence	1.35 ± 0.813	1.45 ± 1.146	1.75 ± 0.851	1.70 ± 0.470

DISCUSSION

Patient satisfaction has been the ultimate goal in any dental treatment. In a patient receiving complete denture prostheses, many factors have a combined role in achieving reasonable satisfaction. For an operating dentist, efficient mastication, good aesthetics, comfortable speech and wearing comfortable for the patient have been the ultimate concern. To meet both ends of the patient-dentist relationship and treatment outcome could be achieved by a psychological assessment as related to satisfaction.

Two studies conducted by Marinus et al evaluated the patient-dentist relationship after the treatment was completed. Patients were asked opinions regarding the

treatment and also their attitudes and expectation from the new denture were recorded with the help of a questionnaire. Treatment to be a success, not only do the operator's objectives have to be met, but also most importantly, the patient has to be satisfied [5]. However, a patient's personality also is a related factor in assessing the criteria for his/her satisfaction [6].

To achieve successful treatment, it is vital to consider a number of issues throughout the denture process. Before treatment even begins, the patient's motivation for denture treatment and emotional attitude towards dentures must be evaluated. Patients will thereby gain realistic expectations of what can and cannot be achieved, and dentists will understand what the patient really wants. Then, the dentist must communicate with the patient to help achieve success in treatment that helps in better mastication, speech, and appearance.

In this study, 35 out of 40 participants have experience in wearing the denture. The majority of the participants intend to have a new denture due to the shortcomings in their denture which includes chewing capacity being diminished, dentures constantly loosening and worn-down artificial teeth. Some other reasons include a spare denture, a lost denture and replacing a very old previous denture. According to Celebic et al not only the quality of the denture bearing area but the denture wearing experience itself seems to be more important in determining patient satisfaction with mandibular complete dentures [4].

Information on denture experience is included in this study because first-time denture wearers have no idea or maybe less idea about what to expect regarding denture. They usually expect dentures are comparable to natural dentitions, particularly in the aspect of comfort and function. Commonly, they think dentures will give a better aesthetic in terms of teeth arrangement, teeth shade, and teeth shape. So, this group of patients usually has unrealistic expectations and low satisfaction.

The denture hygiene regime of participants reflects the patient's motivation toward denture care. This also gives us information about knowledge regarding denture and denture education that the participants have. A vast majority of the participants clean their dentures by using toothpaste as a denture cleanser which is falsely practiced by the patients. Patients commonly report that they are not given instruction about cleaning dentures and general oral care. Therefore, correct prosthetic use and care are of great importance to patients, not only for aesthetic and functional reasons but also for the health of the supporting tissues and appropriate conservation of the prosthesis itself.

A patient's pre-treatment expectation may influence treatment outcomes and treatment failure may result from mismatched perceptions and expectations of the patient and the dentist. Since this study was designed to determine the correlation between patient expectation and satisfaction with the denture, initially before starting the treatment, patients were asked about their expectations, when comparing the

results with post-treatment, there was no significant difference was found between their expectations.

The results indicate that there was no significant difference in satisfaction shown between the tested and control groups before treatment. However, after a session of denture education by using an informational pamphlet, the level of satisfaction increases slightly in the tested group. This shows that there is a positive outcome in giving denture education to the patient in which they are more satisfied and better accepting of the new denture. Giving appropriate denture education to the patient is the responsibility of the dentist. Denture education includes basic instructions for the improvement of speech. The patient should be instructed to eliminate hard, resistant foods from the diet at the time of initial placement and for several days thereafter. A soft diet should be recommended for at least two weeks. The patient is told to swallow to reseat the mandibular denture because that action allows his tongue to assume a normal relationship with the artificial teeth, to incise foods by pushing inward on the morsel instead of pulling outward, to use small bites, and to chew slowly and deliberately. As for cleaning the denture, dentures are placed in a cleansing solution for at least 30 minutes at each cleaning. The dentures should be removed from the mouth and kept in water during sleeping hours. According to Anthony and Gibbons,1958, one teaspoon of Clorox and two teaspoons of Calgon dissolved in one cup of water make an excellent cleanser for complete dentures [7].

CONCLUSION

This study investigated the relationship between the effects of the informational pamphlet on altering patient expectations and satisfaction before and after denture construction. A group of 40 patients who received new dentures with and without an informational pamphlet was evaluated during their treatment.

The results indicate that there was no significant difference in expectation and satisfaction shown between the tested and control group before treatment. However, after a session of denture education by using an informational pamphlet, the level of expectation reduced, and the level of satisfaction increased slightly in the tested group.

Informational pamphlet represents a potential source of accurate, standardized information for both patient and dentist. Overall, the use of informational pamphlets during denture education does give a positive impact on the outcome of prosthodontics treatment.

ACKNOWLEDGEMENT

Millions of thanks to Assistant Professor Dr. Muhd Firdaus Che Musa for his guidance with statistical analysis in this research. Our heartfelt gratitude to all the participants who did not hesitate to participate in this study and without whom this study could have not been completed in the given time. We would like to express our gratitude to our friends for their cooperation during data collection from participants and in

making this research a success. Not to forget are our parents who gave us unconditional support throughout the journey of this research.

We would like to thank all the lecturers from the Department of Prosthodontics who have allowed us to carry out the data collection during the Prosthodontics clinical session and made this research a success.

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APPENDICES

CONSENT FORM

KULLIYYAH OF DENTISTRY INTERNATIONAL ISLAMIC UNIVERSITY

MALAYSIA BANDAR INDERA MAHKOTA 25200 KUANTAN, PAHANG

Tajuk kajian: **KAJIAN PILOT BERKENAAN TAHAP TANGGAPAN DAN KEPUASAN DI KALANGAN PESAKIT YANG MENERIMA GIGI PALSU DI POLIKLINIK, KULLIYAH OF DENTISTRY, UIAM.**

Research tittle: **A PILOT STUDY ON EXPECTATION AND SATISFACTION OF DENTURE PATIENT IN IIUM DENTAL CLINIC.**

BORANG PERSETUJUAN

Saya_____No.KP_____
mengesahkan bahawa saya telah menerima maklumat mengenai kajian yang dicadangkan dan saya telah berbincang dengan_____
dan saya diberi peluang untuk bertanya soalan yang berkaitan.
I _____*IC No.* _____
verify that I already received the information regarding this research and already discuss with _____ *and I had given a chance to ask any related questions.*

Saya memahami bahawa pelajar pergigian di bawah pengawasan Dr Norfaezah Ahmad akan mempunyai akses kepada maklumat peribadi saya bagi tujuan akademik di dalam kajian mereka yang bertajuk seperti di atas. Saya memahami bahawa semua maklumat akan disimpan dengan selamat dan saya bersetuju untuk mengambil bahagian di dalam kajian ini.
I understand that this dental students under supervision of Dr Norfaezah Ahmad had an access on my personal information to be used for academic purposes for this research as mentioned above. I also understand that all information will be kept confidential and I agree to take part in this research.
Saya dengan ini mengaku bahawa segala maklumat yang akan diberi adalah benar,
I hereby admit that all the information given is true.

Pesakit:
Patient:

Nama pesakit:
Name of patient:.....

No I/C
I/C Number:…….

Tandatangan:
Signature: .....

Tarikh/Date:.....

Pengkaji:

Investigator:

Tandatangan Pensyarah/ Doktor Pakar:
Lecturer's Signature/Specialist's Signature:.....

Tandatangan Pelajar:
Student's Signature:.....

Saksi:
Impartial witness:

Nama pesakit:
Name of patient:.....

No I/C
I/C Number:…….

Tandatangan:
Signature: .....

Tarikh/Date:.....

DENTAL CLINIC, KULLIYYAH OF DENTISTRY
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
BANDAR INDERA MAHKOTA 25200 KUANTAN,
PAHANG
TEL: +609-5705500

INFORMED CONSENT FORM FOR ELDERLY (60 YEARS AND ABOVE)

This informed consent form is for legal guardians of elderly (60 years and above) participating in the research titled, "A Pilot Study on Expectation and Satisfaction of Denture Patient in IIUM Dental Clinic."

Principal Investigator: Asst. Prof. Dr. Norfaezah Ahmad

Co-Investigator: Asst. Prof. Dr. Musliana Mustaffa

Student: Amizah Bt. Sulaiman, Mazmira Bt. Mahidin (Undergraduate Student)

Organization: Polyclinic, Kulliyyah of Dentistry, International Islamic University Malaysia, Kuantan Campus

Project Title: A Pilot Study On Expectation And Satisfaction Of Denture Patient In IIUM Dental Clinic

This Informed Consent Form has two parts:

- Information Sheet (to share information about the study with you)
- Certificate of Consent (for signature if you agree that your elderly may participate)

You will be given a copy of the full Informed Consent Form

Part I: Information Sheet

Introduction

We, Mazmira Bt. Mahidin and Amizah Bt. Sulaiman are 4th Year Dental Student of IIUM in Kuantan Campus. We are doing a research which can help our clinic to improve the satisfaction of our patients with their dentures. The subject for our research will include elderly, both men and women, in which we will ask them to answer our questionnaire. As the research involves the elderly, we will need consent from their legal guardian.

After you have got information about the study, and if you agree, then the next thing we will do is ask the elderly for their agreement as well. Both of you have to agree independently before we can begin.

You can think about it first and let us know later whether or not you agree to have your elderly participate in this research. Before you decide, you can talk to anyone you feel comfortable with.

There may be some words that you do not understand. Please ask us to stop as we go through the information and we will take time to explain. If you have questions later, you can ask us or other students.

Purpose

It is possible that the clinics in this region are not providing some of the services that are important for elderly. In this study we will talk to elderly men and women about their opinion on expectation and satisfaction of denture including oral and denture hygiene care. We will invite them to share their knowledge and understanding with us so that we can find ways of meeting their needs at the clinic.

Type of Research Intervention

A questionnaire

Selection of Participants

We want to talk to many elderly about their experience of wearing denture and what information or services they want for themselves. One part of their experience that we want to talk to them about is their satisfaction towards the denture and how they take a good care of their oral and denture hygiene. We would like to ask them to participate because they live in this region.

Voluntary Participation

You do not have to agree that your elderly can talk to us. You can choose to say no and any services that you and your family receive at this polyclinic will not change. We know that the decision might be difficult to make especially when it involves your elderly. You can ask as many questions as you like and we will take time to answer them. You can think about it and tell us your decision later.

Procedure

Your elderly will fill out a questionnaire which will be provided by us and collected by ourselves ***OR*** the questionnaires can be read aloud and she/he can give us the answer which she/he wants us to write.

If your elderly does not wish to answer some of the questions included in the questionnaire, she/he may skip them and move on to the next question. The information recorded is confidential, and no one else except us, Mazmira bt. Mahidin, Amizah bt. Sulaiman and our supervisors, Dr. Norfaezah Ahmad and Dr Musliana Mustaffa with access to the information will have access to her/his questionnaire. The questionnaires will be destroyed after some period of time.

Duration

We are asking your elderly to participate in our research which will take about 5 to 10 minutes only of their time. We will do this before they start their treatments. We will distribute or read for them our questionnaires about expectation of denture for them to answer all of the questions. There is also a questionnaire on satisfaction of the denture that we will provide to them after they have completed their prosthetic treatment. This also takes about 5 to 10 minutes. Altogether, we are asking for about less than 20 minutes of their time.

Risks and Discomforts

We are asking your elderly to share with us some very personal and confidential information, and she/he may feel uncomfortable talking about some of the topics. You must know that he/she does not have to answer any question or take part in the survey if he/she doesn't wish to do so, and that is also fine. He/she does not have to give us any reason for not responding to any question, or for refusing to take part in this research.

Benefits

There will be direct benefit to your elderly, therefore their participation is likely to help us find out more about the expectation and satisfaction of denture patient's needs and we hope that these will help our clinics to meet those needs better in the future.

Reimbursements

Your elderly will not be provided with any payment to take part in this research.

Confidentiality

We will not be sharing information about your elderly outside of the research team. The information that we collect from this research project will be kept confidential. Information about your elderly that will be collected from the research will be put away and no one but the researchers will be able to see it.

Sharing of research findings

At the end of the study, we will be sharing what we have learnt with the participants. Nothing that your elderly will tell us today will be shared with anybody outside the research team, and nothing will be attributed to him/her by name. We will also publish the results through conferences or publications in order that other interested people may learn from our research.

Right to refuse or withdraw

You may choose not to have your elderly participate in this study and your elderly does not have to take part in this research if she/he does not wish to do so. Choosing to participate or not will not affect either your own or your elderly's future treatment at the polyclinic here in any way. You and your elderly will still have all the benefits that would otherwise be available at this polyclinic. Your elderly may stop participating in this research at any time that you or he/she wish without either of you losing any of your rights here.

Who to contact

If you have any questions you may ask us now or later, even after the study has started. If you wish to ask questions later, you may contact any of the following:

- Mazmira bt. Mahidin
  UIAM Kuantan Campus, Jalan Sultan Ahmad Shah,
  Bandar Indera Mahkota, 25200, Kuantan,
  Pahang.
  +6 014 525 1769
  mazmiramahidin@ymail.com

- Amizah binti Sulaiman
  UIAM Kuantan Campus, Jalan Sultan Ahmad Shah,
  Bandar Indera Mahkota, 25200, Kuantan,
  Pahang.
  +6 012 312 0548
  amizahsulaiman@gmail.com

This proposal has been reviewed and approved by *IREC* which is a committee whose task it is to make sure that research participants are protected from harm. If you have any query please do not hesitate to contact IREC Secretariat.

- Secretariat
  IIUM Research Ethics Committee (IREC)
  Research Management Center (RMC), Kuantan Campus
  Level 1, Administrative Building (OCD)
  International Islamic University Malaysia
  Jalan Sultan Haji Ahmad Shah, Indera Mahkota
  25200 Kuantan, Pahang

Tel No: 09-570 4733 (Bro. Mohd A'imullah)
Tel No: 09- 570 4413 (Sis. Nor Azira Johari)
Website: http://www.iium.edu.my/irec

PART II: Certificate of Consent

Certificate of Consent

I have been asked to give consent for my elderly to participate in this research study which will involve them to complete questionnaire. I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily for my elderly to participate as a participant in this study.

Print Name of Legal Guardian _____

IC No of Legal Guardian _____

Signature of Legal Guardian_____

Date _____

Day/month/year

If illiterate

I have witnessed the accurate reading of the consent form to the legal guardian of the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness_____ AND Thumb print of participant
IC No of witness _____
Signature of witness _____
Date _____

Day/month/year

Statement by the researcher/person taking consent

We have accurately read out the information sheet to the legal guardian of the potential participant, and to the best of our ability made sure that the person understands that the following will be done:

1. Participant will need to answer questions on perception of denture before treatment

2. Participant will need to answer question on expectation of denture and oral hygiene and denture hygiene after treatment

We confirm that the legal guardian was given an opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly and to the best of our ability. We confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the legal guardian of the participant.

Print Name of Researcher/person taking the consent_____

An Informed Assent Form will not be completed.

PAMPHLET

KLINIK PERGIGIAN, KULLIYYAH PERGIGIAN,
UNIVERSITI ISLAM ANTARABANGSA MALAYSIA,
BANDAR INDERA MAHKOTA,
25200 KUANTAN,
PAHANG.
TEL: +609-5705500

BEFORE

AFTER

A DENTURE you can really live with!

Dentures are removable appliances that can replace missing teeth and help restore your smile. If you've lost all of your natural teeth, whether from gum disease, tooth decay or injury, replacing missing teeth will benefit your appearance and your health. That's because dentures make it easier to eat and speak better than you could without teeth.

Types of dentures

a) **Conventional**. This full removable denture is made and placed in your mouth after the remaining teeth are removed and tissues have healed, which may take several months.
b) **Immediate**. This removable denture is inserted on the same day that the remaining teeth are removed.
c) **Overdenture**. Sometimes some of your teeth can be saved to preserve your jawbone and provide stability and support for the denture. An overdenture fits over a small number of remaining natural teeth after they have been prepared by your dentist.

Dentures can help patients through:

a) **Mastication** or chewing ability is improved
b) **Aesthetics**, because the presence of teeth gives a natural appearance to the face, and wearing a denture to replace missing teeth provides support for the lips and cheeks.
c) **Speech**, enables patients to speak better.

d) **Self-esteem**, because improved looks and speech boost confidence in the ability to interact socially.
e) **Satisfaction and comfort** of the patient.

How your denture teeth differs from your natural teeth?

NATURAL TEETH	**ARTIFICIAL TEETH**
Natural teeth function independently & each individual tooth disperses the occlusal load	Artificial teeth functions as a group & the occlusal loads are not individually managed
Malocclussion can be non-problematic for long time.	Malocclussion poses immediate drastic problems
Non-vertical forces are well-tolerated	Non-vertical forces damages the supporting tissues
Incising does not affect the posterior teeth	Incising will lift the posterior part of the denture
The second molar is the favoured area for heavy and better mastication	Heavy mastication over the second molar area can tilt or lift the denture base

How do I take care of my dentures?

Rinse denture after eating to remove food debris.

Brush everyday with a special denture toothbrush.

Keep the dentures in water when you are not using them.

What should I do to maintain my dentures?

Avoid chewing gum while wearing dentures.

Avoid sticky foods like toffee and caramel while wearing dentures.

Remove dentures when sleep at night or playing contact sports.

QUESTIONNAIRE

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيبرسيتي إسلام انتارابغسا مليسيا

A PILOT STUDY ON EXPECTATION AND SATISFACTION OF DENTURE PATIENTS IN IIUM DENTAL CLINIC.

KAJIAN TERHADAP JANGKAAN DAN KEPUASAN PESAKIT GIGI PALSU DI KLINIK PERGIGIAN UIAM.

PART 1: SOCIODEMOGRAPHIC
BAHAGIAN 1: SOSIO DEMOGRAFIK
Please tick (√) or fill in the blank where applicable.
Sila tandakan (√) atau isi tempat kosong yang mana berkenaan.

	QUESTIONS *SOALAN*	ANSWERS *JAWAPAN*
1.	Age *Umur*	31-45 years 31-45 *tahun*
		46-60 years 46-60 *tahun*
		61-75 years 61-75 *tahun*
2.	Gender *Jantina*	Male *Lelaki*
		Female *Perempuan*
3.	Education *Pendidikan*	Never had formal education *Tidak pernah mendapat pendidikan formal*
		Primary school *Sekolah rendah*
		Secondary school *Sekolah menengah*
		Tertiary education *Pengajian tinggi*

PART 2: DENTURE EXPERIENCE
BAHAGIAN 2: PENGALAMAN MEMAKAI GIGI PALSU
Please tick (√) or fill in the blank where applicable.
Sila tandakan (√) atau isi tempat kosong yang mana berkenaan.

	QUESTIONS *SOALAN*	ANSWERS *JAWAPAN*
4.	Have you wear denture(s) before? *Pernahkah anda memakai gigi palsu sebelum ini?*	Yes *Pernah*
		No *Tidak*
5.	If yes, how many set of denture(s) have you worn? *Jika pernah, berapa banyak set/pasang gigi palsu yang anda pernah pakai?*	1-2 1-2
		3-4 3-4
		More than 4 *Lebih pada 4*
6.	Is/Are the denture(s) same set? *Adakah gigi palsu sama set/pasang?*	Yes *Ya*
		No *Tidak*
7.	How long have you had experience wearing denture(s)? *Berapa lama anda mempunyai pengalaman memakai gigi palsu?*	1-5 years *1-5 tahun*
		6-10 years *6-10 tahun*
		More than 10 years *Lebih pada 10 tahun*
8.	How long have you been wearing your current denture(s) for? *Sudah berapa lama gigi palsu yang anda pakai sekarang?*	1-5 years 1-5 tahun
		6-10 years *6-10 tahun*
		More than 10 years *Lebih pada 10 tahun*

PART 3: ATTITUDE TOWARDS DENTURE HYGIENE CARE
BAHAGIAN 3: SIKAP TERHADAP PENJAGAAN GIGI PALSU
Please tick (√) or fill in the blank where applicable.
Sila tandakan (√) atau isi tempat kosong yang mana berkenaan.

	QUESTIONS *SOALAN*	ANSWERS *JAWAPAN*
9.	Do you wear denture(s) during sleep at night? *Adakah anda memakai gigi palsu semasa tidur pada waktu malam?*	Yes, please write the reason …… …… ……. *Ya, sila nyatakan sebab* …… …… …….
		No *Tidak*
10.	Do you clean your denture(s)? *Adakah anda cuci gigi palsu anda?*	Yes, please write material(s) you use …… …… *Ya, sila nyatakan bahan yang anda guna* …… ……
		No *Tidak*
11.	How often do you clean your denture(s)? *Berapa kerap anda cuci gigi palsu baru anda?*	Everyday *Setiap hari*
		Every night before sleep *Setiap malam sebelum tidur*
		Whenever the denture(s) is/are dirty *Bila masa gigi palsu kotor*
12.	Have you received any information regarding denture hygiene care? *Pernahkah anda mendengar mana-mana maklumat tentang penjagaan gigi palsu?*	Yes, please write the source of information …… …… *Ya, sila nyatakan sumber maklumat* …… ……
		No *Tidak*

PART 4: EXPECTATION ON NEW DENTURE
BAHAGIAN 4: JANGKAAN TERHADAP GIGI PALSU BARU
Please tick (√) or fill in the blank where applicable.
Sila tandakan (√) atau isi tempat kosong yang mana berkenaan.

	QUESTIONS *SOALAN*	ANSWERS *JAWAPAN*
13.	What is your general expectation towards new denture? *Apakah jangkaan anda terhadap gigi palsu baru?*	Good *Baik*
		Intermediate *Sederhana*
		Bad *Teruk*
14.	Do you expect your new denture will be focus on fit of the denture? *Adakah anda harap gigi palsu baru anda akan fokus pada kesesuaian gigi palsu?*	Agree *Setuju*
		Disagree *Tidak setuju*
15.	Do you expect your new denture will be focus on function of the denture? *Adakah anda harap gigi palsu baru anda akan fokus pada fungsi gigi palsu?*	Agree *Setuju*
		Disagree *Tidak setuju*
16.	How comfortable you want to speak with your new denture? *Berapa selesa anda mahu bercakap dengan gigi palsu baru anda?*	Comfortable *Selesa*
		Intermediate *Sederhana*
		Not comfortable *Tidak selesa*
17.	How do you expect your appearance towards new denture? *Bagaimana jangkaan anda terhadap penampilan anda kepada gigi palsu baru?*	Good *Baik*
		Intermediate *Sederhana*
		Bad *Teruk*
18.	Do you expect you will be able to eat and chew with your new denture? *Adakah anda harap anda akan dapat makan dan kunyah dengan gigi palsu baru anda?*	Agree *Setuju*
		Disagree *Tidak setuju*
19.		Agree *Setuju*

	Do you expect you will be able to speak comfortably when you wear your new denture? *Adakah anda harap anda boleh bercakap dengan selesa bila menggunakan gigi palsu baru anda?*	Disagree *Tidak setuju*

PART 5: SATISFACTION ON CURRENT DENTURE
BAHAGIAN 5: KEPUASAN TERHADAP GIGI PALSU SEKARANG
Please tick (√) or fill in the blank where applicable.
Sila tandakan (√) atau isi tempat kosong yang mana berkenaan.

QUESTIONS *SOALAN*		ANSWERS *JAWAPAN*
20.	Generally, how satisfied are you with the appearance of your current denture(s)? *Secara umumnya, puaskah hati anda terhadap penampilan gigi palsu sekarang?*	Satisfied *Berpuas hati*
		Intermediate *Sederhana*
		Not satisfied *Tidak berpuas hati*
21.	Are you satisfied with the tooth colour? *Adakah anda berpuas hati dengan warna gigi?*	Yes *Ya*
		No, please write the reason …… …… *Tidak, sila nyatakan sebab* …… …… …….
22.	Are you satisfied with the tooth shape? *Adakah anda berpuas hati dengan bentuk gigi?*	Yes *Ya*
		No, please write the reason …… …… *Tidak, sila nyatakan sebab* …… ……
23.	How comfortable can you speak with your denture(s) in? *Selesakah anda bila bercakap menggunakan gigi palsu anda?*	Comfortable *Selesa*
		Intermediate *Sederhana*
		Not comfortable *Tidak selesa*
24.		Comfortable *Selesa*

	How comfortable can you chew with your denture(s)? *Selesakah anda bila mengunyah dengan menggunakan gigi palsu anda?*	Intermediate *Sederhana*
		Not comfortable *Tidak selesa*
25.	How comfortably can you speak to other people when you wear your denture(s)? *Selesakah anda bercakap dengan orang lain bila memakai gigi palsu anda?*	Comfortable *Selesa*
		Intermediate *Sederhana*
		Not comfortable *Tidak selesa*

CHAPTER 6

QUALITY OF LIFE (QOL) OF PATIENT WEARING REMOVABLE DENTURE AFTER TAKING TREATMENT IN POLYCLINIC, KULLIYYAH OF DENTISTRY, IIUM

Nur Erwanie Ramli[1], Nur Ain Nabilla Mohd Noor[1], Karimah Wahida Zulkifli[2]*

[1]Kulliyyah of Dentistry, International Islamic University Malaysia
[2]Unit of Prosthodontic, Kulliyyah of Dentistry, International Islamic University Malaysia

*Corresponding author email: kwsz@iium.edu.my

SUMMARY

This study aimed to measure Oral Health quality of life (OH-QoL) of patients wearing removable denture. A cross sectional descriptive and analytical study was carried out using validated Malay translated Oral Health Impact Profile (OHIP) questionnaires to assess OHQoL among 164 patients who had received removable dentures from January 2012 until December 2014 at Polyclinic, Kulliyyah of Dentistry, IIUM. Telephone interview method was applied to collect data. Functional limitation, physical discomfort and social disability of patients affected by the denture were included in OHIP which was presented by frequency tables. Influences of gender and type of dentures on OHIP were analyzed by X^2 test and independent sample "t" test. Among total 164 patients, male and female ratio was 1:1. Female patients are wearing more removable complete denture than male (56.2% vs 43.8%) while male patients are more wearing removable partial dentures than female (54% vs 46%). More of the patients with removable partial dentures were rarely affected their Oral Health related QoL than those with removable complete denture (61.1% vs 38.9%); however, types of dentures and OHQoL relationship was not significant. Although, more female patients mentioned that their OHQoL are rarely affected by wearing denture than their counterpart (52.1% vs 47.9%), this difference was also not significant ($p>0.05$). In conclusion, wearing removable denture rarely affected on OHQoL. Influences of gender and types of dentures on the OHQoL of the patients could not be proved. It may be due to limitation of data collection method used in the study and other factors.

Keywords: *gender, OHIP, patient, Quality of Life, removable dentures*

INTRODUCTION

Tooth loss results in deterioration of functional, physical, and social status of an individual. The fully edentulous condition negatively impacts oral health-related quality of life (OHQoL), including the inability to chew, poor speech, pain, and dissatisfaction with appearance [1]. OHQoL is a multi-dimensional idea which can be defined as a person's assessment of how functional, psychological, social factors, pain or discomfort affect his/her well-being- in the context of oral health according to

Strassburger et al [2]. It has been shown that many biological, mechanical, aesthetic, and psychological factors are related to acceptance of prosthesis and success of treatment [3].

Removable dentures represent one of the major treatment modalities for the replacement of missing teeth. Removable dentures serve as a simple and popular treatment option, yet the possibility for not accepting this treatment by patient should be considered [4]. Dentures are false removable teeth that are relatively quick and easy to fabricate. They can be partial, where only one or few teeth are replaced, or complete where all the teeth are missing in the jaw and are replaced [5]. This treatment may affect quality of life of patient. Quality of life often seems to be an umbrella term covering a variety of concepts, such as functioning, health status, perception, life conditions, behavior, happiness, lifestyle, symptoms, *etc.* [6]. Umbrella terms refer to an evaluation (an evaluation judgement) about selected aspects or the entirety of a life situation and that it doesn't refer to one unitary or objective entity [7]. Several studies have described the correlation between the effects of removable denture treatments on patient's quality of life. In this study, quality of life of patient after wearing removable dentures were assessed from the aspect of functional limitation, physical discomfort, and social disability by using Oral Health Impact Profile (OHIP) questionnaires. The OHIP questionnaires were given through telephone interview method. Barreto et al, also assessed variables such as type of denture use, gender, age, education level and area of residence in the OHIP questionnaires of his study [8]. Only type of prosthesis was found to influence quality of life [8]. Oral health has an effect on quality of life for the majority of people through its impact on day-to-day activities such as chewing and tasting food, speech and social functioning [9].

In this study, the quality of life (QoL) of patient wearing removable denture after treatment in IIUM was measured. The objective was to compare the quality of life (QoL) of the patients wearing partial and complete removable denture and to assess gender influence on quality of life (QoL) of patients wearing removable denture after taking treatment at Kulliyyah of Dentistry IIUM. In addition to that, the effects of the types of removable denture on quality of life of patient were assessed. The quality of life of patient after having treatment may indicate the success of the prosthodontics treatment. However, the success of this treatment is often judged differently by dentists and patients. In addition to that, there are no significant association between denture success and denture quality, or between denture complaints and denture quality. They suggested other aspects of care, perhaps dentist– patient interaction, may be mostly responsible for denture success [10].

Evidence for the effects of the removable denture on Oral Health Quality of Life is limited with very few studies offering high level of evidence. Thus, this is the reason why this research should be conducted. We hope this research can achieve the objectives outlined in providing crucial baseline information in order to facilitate future research and improving this treatment modality in IIUM Polyclinic.

MATERIALS AND METHODS

Study design, sample population, sample size, sampling method

The study design for this research was a cross sectional descriptive and analytical study with the sample population were patients who received removable dentures from Polyclinic, Kulliyyah of Dentistry, IIUM Kuantan from January 2012 until December 2014 which total of the patients were 741 patients. Sample size was computed by STATCALC software (EPI-6) using total patients 741; expected frequency of the patients who were improved quality of life after removable denture treatment (35%); worst acceptable (28%) is set. Computed sample size for 95% CI is 144 patients and 99% CI is 218 patients. We selected 95% CI for the study. Thus, sample size were 144 patients as attached in the Appendix 1. The sampling method for this study was voluntary sampling.

Data collection procedures

A cross-sectional descriptive and analytical study were carried out to assess Oral Health Quality of Life (OHQoL) among patients who had received removable dentures from 2012 January-2014 December at Polyclinic Kulliyyah of Dentistry, IIUM Kuantan. The OHQoL was evaluated using a shortened Malaysian version of Oral Health Impact Profile-14 (OHIP) where the validity and a reliability of this instrument have been tested [11]. However, among the total of 741 patients, only 164 patients were agreed to be part of the study. The patients were treated by the undergraduate dental students supervised by experienced specialist faculty member. A conventional protocol for construction of removable denture was followed. This included preliminary impressions for fabrication of custom trays, border moulding and final impressions. Centric relation maxilla-mandibular jaw relationship was routinely used except in cases of stable tooth contacts being present. Mounting of casts in a semi-adjustable articulator and an interocclusal record were done. Dentures were tried in the mouth at the wax setup stage and patients were allowed to return for adjustment after insertion.

The questionnaires consisted of three sections which were Section A: Demographic background, Section B: Clinical assessment and Section C: Quality of Life after wearing dentures as attached in the Appendix 2. 14 items questionnaires not including private questions such as name, age, occupation, etc, were asked to 164 patients. The questionnaires were constructed from an analysis of the literature detailing variables describing prosthetic needs and standard of life associated with oral health.

The questionnaires divided into four domains which were functional limitation, physical discomfort, social disability and financial. The domains were measured by 5 Likert scales which were very often, quite often, sometimes, seldom, and never.

Telephone interview method was applied to collect data after getting approval from the IIUM Research Ethics Committee no: 332 as attached in the Appendix 3. Type of

dentures and gender were considered for voluntary sampling method to select 82 male patients and 82 female patients.

The patients were included in this study based on the following inclusion criteria: (i) Patients who voluntarily participate in this study, (ii) Patients with completely answered questionnaires, (iii) Patients aged 40-70 years old, (iv) Patients wore dentures for at least 3 month and maximum 3 years. The exclusion criteria were: Patients age more than 70 years old.

Type of denture, gender influences, physical discomfort, functional limitation, and social disability were analyzed by frequency tables. Gender influences and type of removable dentures on OHIP were assessed using SPSS software version 16.0 and the inferential statistics: set alpha error=0.05, X^2 test and independent sample "t" test were applied. Total OHIP (QoL) score were analyzed by summary descriptive analysis (min, max, mean and SD). Thus, this study was provided extent of impact of wearing removable dentures on their QoL in aspect of functional limitation, physical discomfort, and social disability.

RESULTS

This study was conducted on 164 subjects who had received their removable dentures from polyclinic Kulliyyah of Dentistry, IIUM and were administered with Oral Health Impact Profile (OHIP) questionnaires containing questions related to Oral Health Quality of Life (OHQoL) towards removable dentures. The questionnaires consisted of three sections which were Section A: Demographic background, Section B: Clinical assessment and Section C: Quality of Life after wearing denture.

The demographic backgrounds of the patients were showed in Table 1 which consisted of gender, occupation, and race. Among total 164 patients, male and female ratio was 1:1. There were 29 patients for 41-50 years old age group, 83 for 51-60 years old age group and 52 for 61-70 years old age group. The data showed that the majority of the participants were from the age group of 51-60 years as shown in Figure 1. Most of the patients are unemployed rather than employed (59.8% vs 40.2%). Malay patients have the higher frequency compared to Chinese patient by percentage 91.5% vs 8.5%. The types of dentures issued by the student of KOD were removable complete dentures and partial dentures with percentage of 39.0% and 61.0% respectively as shown in Figure 2.

Table 1. Demographic background of patients

Social demographic background		**Frequency (%)**
Gender of patient	Male	50
	Female	50
Employment	Employed	40.2
	Unemployed	59.8
Race	Malay	91.5
	Others	8.5

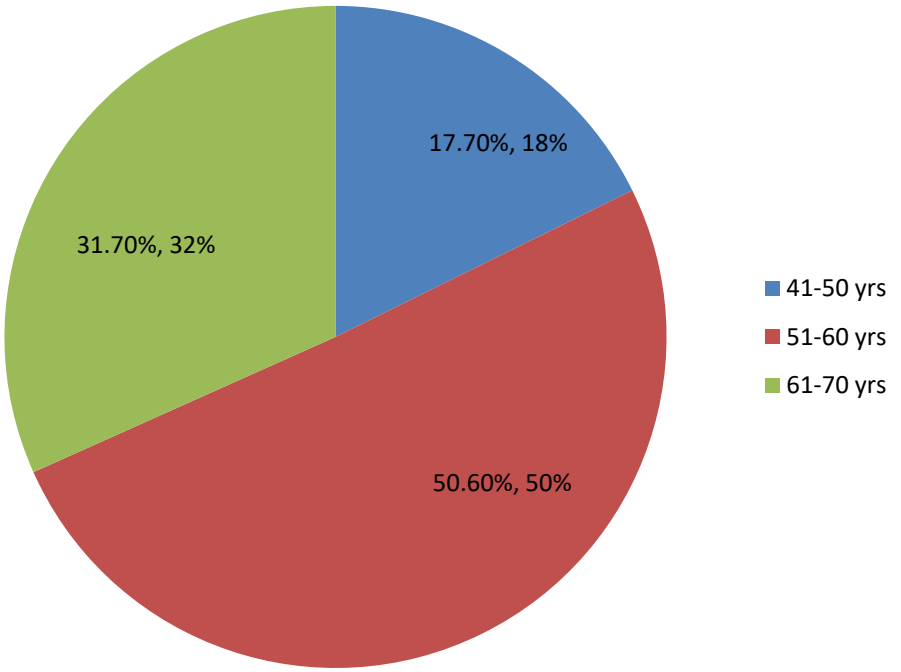

Figure 1. Age group of patients

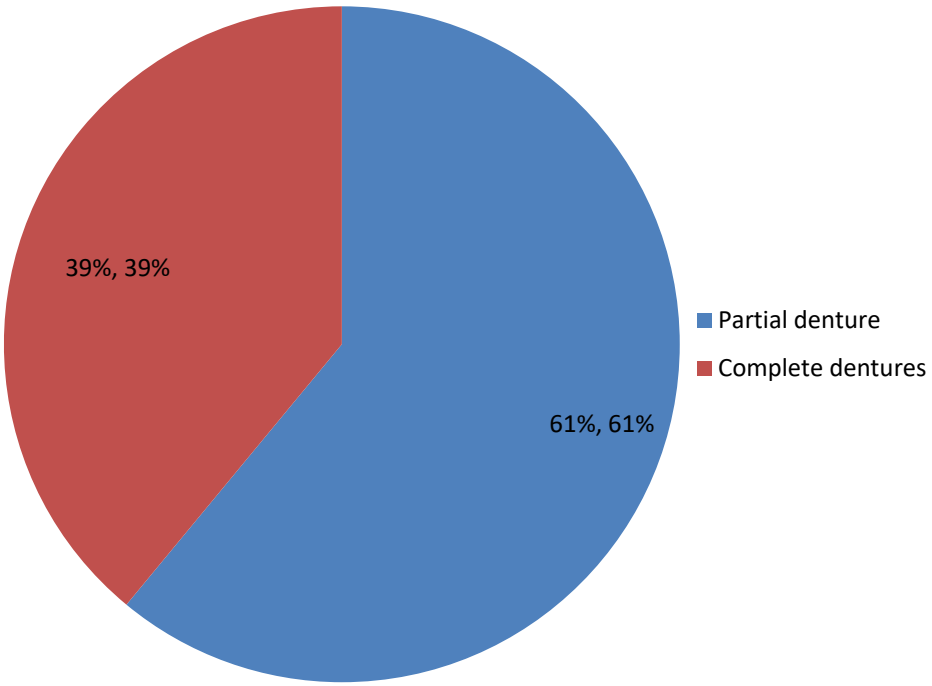

Figure 2. Type of removable denture

The questionnaires were divided into four domains which were functional limitation, social disability, physical discomfort and financial. For functional limitation (Table 2), the scoring 4-11 was poor, 12-15 seldom, 16-20 good. 48 patients had poor functional limitation, 41 patients seldom affect their functional limitation, and 75 patients had no effect on their functional limitation. While, for the social disability (Table 3), the scoring was 5-14 poor, 15-19 seldom, 20-25 good. 5 patients had frequent effect, 2 patients seldom affected, and the rest had no effect on their social disability. For physical discomfort (Table 4), 8-11 scored as poor, 12-15 seldom, 16-20 good. Only 2 patients frequently affected, 9 patients seldom affected, and the majority of the patient had no effect on physical discomfort. Lastly for financial domain (Table 5), the scoring was 1-2 often used money, 3 for sometimes used and 4-5 never used money. Three patients often spend their money on dentures, one patient seldom spend money and the rest never spend money on dentures. For the total score of quality of life, the scoring range were 34-41 poor QoL, 43-55 seldom affected, 56-70 had good QoL. Two patients had frequent effect on the quality of life (QoL), 18 patients sometimes affected on QoL, and majority had good quality of life after received removable dentures as shown in Table 6.

Table 2: Oral health function on QoL (score)

Range of score	Description	Quantity of patients
4-11	Frequently affected	48
12-15	Sometimes affected	41
16-20	Rarely affected	75

Table 3. Social effect (score)

Range of score	Description	Frequency of patients
5-14	Frequently affected	5
15-19	Sometimes affected	2
20-25	Rarely affected	157

Table 4. Effect on physical health (score)

Range of score	Description	Quantity of patients
8-11	Frequently affected	2
12-15	Sometimes affected	9
16-20	Rarely affected	153

Table 5. Financial effect (score)

Range of score	Description
1-2	Often used money
3	Seldom used money
4-5	Never spend money

Table 6. Total score of Quality of Life (QoL)

Range of score	Description	Frequency of patients
34-41	Poor QoL	2
43-55	Sometimes affected QoL	18
56-70	Good QoL	144

Removable denture treatment was applied to 164 patients. The number of the female patients with complete denture was more than the number of male patients, with an opposite result of partial denture. For the patients participating in the questionnaires the proportion of the complete dentures was observed to be 56.2% for females and 43.8% for male. Moreover, of the patients having partial denture 46.0% were female and 54.0% were male. The difference was not statistically significant (p=0.262) as shown in Table 7.

Table 7. Relationship between type of removable dentures and gender of patients

Gender of patients	Type of denture		P-Value
	Removable complete denture	Removable partial denture	
Male (%)	43.8	54	p=0.262
Female (%)	56.2	46	(p>0.05)

Majority of the female patients who were wearing removable complete denture having frequent effect on oral health related Quality of Life (OHQoL). While, OHQoL of female patients who were wearing removable partial denture sometimes affected. The differences were not statistically significant (p=0.147). On the other hand, male patients who were wearing removable complete denture sometimes affected on their OHQoL. As for removable partial dentures had no effect on their OHQoL. The differences were not statistically significant (p=0.467) as shown in Table 8.

Table 8. Effect of gender and types of dentures on OHQoL

Gender	Types of dentures	Frequently affected OH related QoL (%)	Seldom affected OH related QoL (%)	Never/Rarely affected OH related QoL (%)	P value
Female	Partial denture	0.0	83.3	54.7	p=0.147
	Complete denture	100.0	16.7	45.3	
Male	Partial denture	100.0	50.0	68.1	p=0.467
	Complete denture	0.0	50.0	31.9	

From Table 9, mean (standard deviation) of total QoL score of male and female patients were 61.48 (6.67) and 62.73 (5.97) respectively. Thus, there was no relationship between gender and total QoL score of the patients (p>0.05). The mean (standard deviation) age of male and female patients were 57.85 (6.67) and 56.26 (6.29)

respectively. Thus, there was no relationship between gender and age of the patients ($p>0.05$). Mean (standard deviation) duration of wearing denture for male and female patients were 22.46 (6.80) and 23.38 (7.02) respectively. Thus, there was no relationship between gender and duration of wearing denture of the patients ($p>0.05$).

Table 9. Independent sample T test for both genders

	Gender	Mean	Standard deviation	P value
Total QoL (score)	Female	62.73	5.97	p= 0.206
	Male	61.48	6.67	
Age of patients	Female	61.48	6.67	p=0.117
	Male	57.85	6.67	
Duration of wearing denture (month)	Female	57.85	6.67	p= 0.398
	Male	22.46	6.80	

Mean (standard deviation) of total QoL score of removable complete denture and partial denture were 61.98 (6.05) and 62.18 (6.55) respectively. Thus, there was no relationship between type of denture and total QoL score of the patients ($p>0.05$). The mean (standard deviation) age of patients wearing removable complete and partial denture were 58.56 (6.09) and 56.09 (6.62) respectively. Thus, the relationship between gender and age of the patients are statistically significant ($p<0.05$). Mean (standard deviation) duration of patients wearing removable complete and partial denture were 23.25 (6.80) and 22.71 (7.00) respectively. Thus, there was no relationship between gender and duration of wearing denture of the patients ($p>0.05$) as shown in Table 10.

Table 10. Independent sample T test for type of dentures

	Type of dentures	Mean	Std. Deviation	P value
Total QoL (Score)	Removable complete denture	61.98	6.05	p=0.848 (p>0.05)
	Removable partial denture	62.18	6.55	
Age of patient	Removable complete denture	58.56	6.09	p=0.017 (p<0.05)
	Removable partial denture	56.09	6.62	
Duration wearing dentures (months)	Removable complete denture	23.25	6.80	p=0.627 (p>0.05)
	Removable partial denture	22.71	7.00	

DISCUSSION

Limited number of research was present on Quality of Life (QoL) after wearing removable denture in Malaysia. Therefore, this study was conducted to assess the Oral Health Quality of Life (OHQoL) of subjects wearing removable denture after taking treatment from polyclinic Kulliyyah of Dentistry, International Islamic University Malaysia (IIUM). This study would help subjects to show their satisfaction with the prosthesis and help the student to pay increased attention to the factors patients concern.

This study was carried out on 164 subjects who had received removable dentures from polyclinic Kulliyyah of Dentistry, IIUM on the basis of questionnaires pertaining to Oral Health related Quality of Life. The Oral Health Impact Profile (OHIP) questionnaires include functional limitation, social disability, physical discomfort, and financial aspect. Besides, the social demographic background also includes in the questionnaires which involve gender, age group, occupation and race.

Among total 164 patients, the majority of patients are in the 51-60 years old age group, followed by 61-70 years old age group and the least are in 41-50 years old age group. The patient in the age group 51-60 is the highest due to they are self-motivated. According to subjects at this age are socially active, professionally engaged and most of them are economically sound, for which the treatment is mandatory. Whereas the age group 61-70 years is lesser because they are age compromised as Singh et al [12] stated that this subgroup are age compromised, social and economic dependence and in some cases medically compromised conditions like diabetes mellitus and hypertension limited for seeking denture treatment. The 41-50 years old age group is the least since in this age group patient is expected with employment and maybe seeking the prosthetic treatment from private healthcare setting.

From the social demographic background, the unemployed patient is more than the patient with employment. This unemployed patient can be categorized into lower socio- economic background. Heydecke et al [13] stated that edentulous patients are more likely to come from lower socio- economic background as reflected in the results concerning the demographic data of his study. The dental school also provides an affordable alternative for oral health treatment and so, it is not surprising that the majority of the patients are from the lower income group who could not afford private treatment. It would be expected that the majority of people who use the public healthcare services could not afford treatment in the private healthcare setting [14].

The male and female patients are equal in number in seeking the prosthetic treatment. This shows that both genders are equally conscious about the denture treatment [12]. This is supported by study by Ghani et al [15] that the gender differences were not associated with OHQoL. Malay patients have the higher frequency compared to Chinese patient. This is due to polyclinic Kulliyyah of Dentistry, IIUM located in Bandar Indera Mahkota, Kuantan where the majority is the Malay population followed by Chinese and Indian [16].

Since much of the tooth loss results from periodontal disease and dental caries, tooth loss is a reliable measure of a population's oral health status [17]. In the recent decades, the prevalence and extent of tooth loss have decreased in many countries [18]. The statistical analysis shows that more female wear removable complete denture than male. The male is predominant for partial dentures. It is supported by findings of several studies show a higher tooth loss in females than males [19]. However, most studies have shown significant gender differences in edentulism, with more males becoming edentulous than females [20]. On the contrary, Marcus et al, observed that the prevalence of edentulism had no relationship with gender [21]. In the present study, woman requested mainly partial dentures whereas men mostly requested complete dentures. It was shown that complete dentures were provided to more male than female. In contrast, within the UK population, tooth loss was similar in the two gender groups [21].

From the result also shows that female have never or rarely affected in OHQoL than male. However, Silverman et al, claimed that males accepted their dentures best [22]. It is also supported by Barenthin, and he found that women were somewhat more sensitive than men to the condition of their dentures [23].

Besides, the results also show that the partial dentures have better OHQoL compared to complete dentures. This supported by John et al, which reported that the partial dentures were more tolerable than their complete counterparts [24]. If the prior denture types and the patient complaints were evaluated together, patients wearing partial dentures were generally pleased with the conservatism and functionality expected from partial dentures.

In addition, the result also shows that the complete dentures in female patients are more frequent affected OHQoL, than males who wearing complete denture. While males wearing partial dentures are more frequent affected OHQoL than female who wear the partial denture. This is supported by Taylor et al which surveyed 29 male and 30 female complete denture patients ranging from 52-92 years of age and found that male patients were more satisfied with dentures than female [25].

The relationship between age and gender of patients are not statistically significant ($p>0.05$). Age and gender of patients was found not to have an influence on denture satisfaction. This finding is in agreement with Baer et al that gender may only represent a minor to moderate influence on satisfaction with complete dentures [26]. In studies conducted by Mersel et al, and Weinstein et al, age was found not to be a predictor of denture success [27,28]. However, the relationship between age of patients and types of dentures are statistically significant ($p<0.05$). In addition, Marcus et al, indicated that the older age groups required more removable complete dentures than the younger age groups, while the younger age groups required more removable partial dentures [29]. Besides, an earlier study showed that there was a need for the replacement of 24% of complete dentures and 55% of removable partial dentures in patients who were 60 years old [30]. Study from Wakabashi et al found that younger

patients (<65 years old) tend to less aesthetically satisfied with their denture than older patients [31]. Likewise, Frank et al, found that younger patients (less 60) tend be more dissatisfied about their denture treatment [32]. Also, Kimura et al, found younger patients treat with RPD have less OHQoL [33]. Such outcome could be attributed to higher social demand and self-concerns with aesthetics and oral function in comparison with older patients. On the contrary, Koyama et al, found that the older the patients (more than 65 years), the less likely to wear their RPDs [34]. They anticipated that older individuals might have less aesthetic and social demands and more impaired neuromuscular control, which could make them more indifferent to the treatment.

The duration of wearing denture to gender and types of dentures are not statistically significant ($p>0.05$). Many researchers concluded that time of wearing dentures and the age of the patients have no impact on quality of life. Denture age and quality of the patient's existing denture was not taken into account and was a weakness of the study by Rupal et al [35].

Most of the results are not statistically significant. There are some limitations in this research that may lead to such results. One of the limitations is dealing with elderly patient which is quite difficult. It is difficult to ask them to come to our Kulliyyah just to answer the questionnaires which takes only 10-15 minutes. That is why the telephone interview method was done to complete this research. However, this method caused the patients difficult to understand what the questions were about. Thus, extra time needed to explain to them until they can fully understand. Besides, it is difficult to determine the exact duration of wearing denture. Most of them unable to recall the specific date they started to wear the denture. This condition may be the reasons why the results are not statistically significant ($p>0.05$).

The results of this study highlight the need for more effective health promotion and prevention programs. However, the results of this study should provide motivation for the creation and sustainability of outreach programs in the rural areas or areas where access to oral health care is a problem. More research needed to be done with more domains included to have good results.

CONCLUSION

The findings of this study could also serve as motivation for a more vigorous national plan with regards to oral health. The high prevalence of edentulism clearly suggests that the levels of tooth loss are not decreasing. The public needs to be made aware of the importance of oral health to their quality of life. From the study, there was no gender influence and types of dentures on quality of life of patient wearing removable denture after taking treatment in Polyclinic, Kulliyyah of Dentistry, IIUM. The null hypothesis is accepted.

ACKNOWLEDGEMENT

We would like to express our gratitude and appreciation to all those who gave us the possibility to complete the research. A special thanks to our research supervisor, Dr. Karimah Wahida binti Zulkifli with her stimulating suggestions and encouragement, helped us to coordinate our research. We would like also to acknowledge with much appreciation the crucial role of the statistician, Dr. Tin Myo Han who spent her precious time on us for analyzing and interpreting the data collection. Last but not least, many thanks go to all patients who willing to answer the questionnaires. We would like to appreciate the guidance given by Research Subject Coordinator, Assoc. Prof. Dr. Khairani Idah Mokhtar as well as the panels especially in our research presentation that has improved our presentation skills by their comments and tips.

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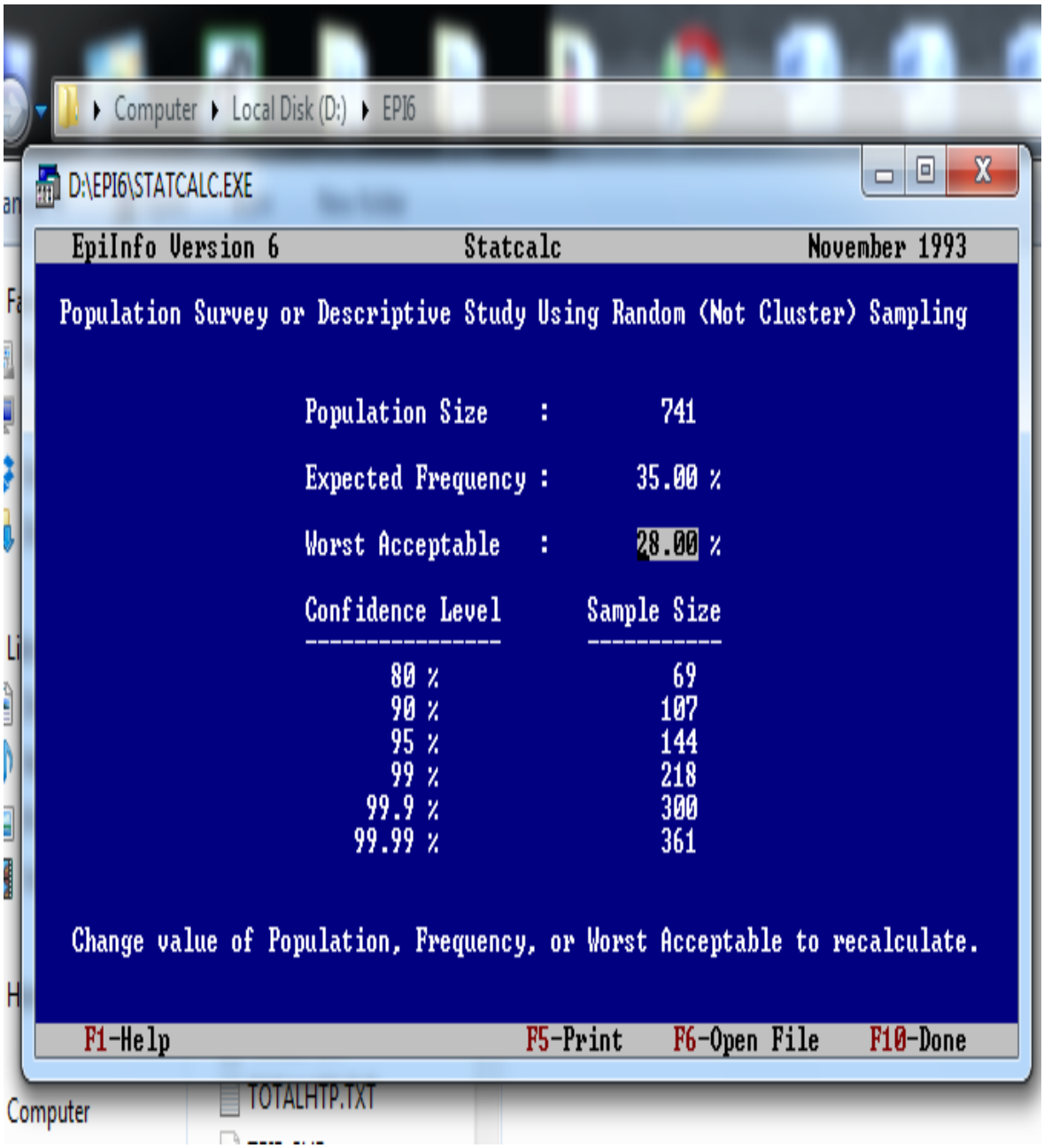
APPENDIX 1


Computer ▸ Local Disk (D:) ▸ EPI6
D:\EPI6\STATCALC.EXE
EpiInfo Version 6 Statcalc November 1993
Population Survey or Descriptive Study Using Random (Not Cluster) Sampling
Population Size : 741
Expected Frequency : 35.00 %
Worst Acceptable : 28.00 %
Confidence Level Sample Size
80 % 69
90 % 107
95 % 144
99 % 218
99.9 % 300
99.99 % 361
Change value of Population, Frequency, or Worst Acceptable to recalculate.
F1-Help F5-Print F6-Open File F10-Done
Computer
TOTALHTP.TXT

APPENDIX 2

The aim of this questionnaires is to look into what extent problems related to you and affect your daily life. We would like to know how often you have experienced a problems listed while wearing the denture. What you have to do is (/) provided for each question.

A-1	Name	
A-2	Age	---------- Year
A-3	Gender	Female ☐ Male ☐
A-4	Occupation	Employed ☐ Unemployed ☐
A-5.	Race	Malay ☐ Chinese ☐ India ☐ Others ☐

Section B: Clinical Assessment

B-1.	Type of denture	Removable full denture ☐ Removable partial denture ☐
B-2	Duration wearing denture	-------- months

Section C: Quality of Life after wearing denture

C- 1	Have you experienced difficulty chewing any food because of problems with your denture?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-2	Have you felt problems related to your dentures cause bad breath?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-3	Have you experienced discomfort eating any food because of your problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐

C-4	Have you had ulcers in your mouth?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-5	Have you felt uncomfortable due to food getting stuck in between your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-6	Have you felt shy because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-7	Have you avoided eating certain foods because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-8	Have you avoided smiling because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-9	Has your sleep been disturbed because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-10	Has your concentration been disturbed by because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-11	Have you avoided going out because of because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-12	Have you experienced problems in carrying out your daily activities because of because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-13	Have you had to spend a lot of money due to because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐
C-14	Have you felt less confident of yourself due to because of problems with your dentures?	Very often ☐ Quite often ☐ Sometimes ☐ Seldom ☐ Never ☐

THANK YOU FOR YOUR COOPERATION

LAMPIRAN 2

Bahagian ini ingin mengetahui sejauh mana masalah berkaitan dengan gigi palsu mengganggu kehidupan seharian anda. Kami ingin mengetahui berapa kerap anda pernah mengalami masalah yang tersenarai sepanjang pemakaian denture ini. Apa yang perlu anda lakukan ialah menanda (/) pada kotak yang disediakan untuk setiap soalan-soalan berikut.

Bahagian A: Latar Belakang Demografi

A-1	Nama	
A-2	Umur	……. tahun
A-3.	Jantina	Perempuan ☐ Lelaki ☐
A-4.	Pekerjaan	Bekerja ☐ Tidak Bekerja ☐
A-5.	Bangsa	Melayu ☐ Cina ☐ India ☐ Lain-lain ☐

Bahagian B: Penilaian Klinikal

B-1.	Jenis gigi palsu	Gigi palsu separa ☐ Gigi palsu penuh ☐
B-2.	Jangka masa pakai gigi palsu	…….. bulan

Bahagian C: Kualiti Hidup Selepas Pakai Gigi Palsu

C-1.	Pernahkah anda mengalami kesukaran mengunyah sebarang makanan disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐

C-2.	Pernahkan anda merasakan yang masalah gigipalsu anda menyababkan nafas berbau?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-3.	Pernahkah anda mengalami rasa tidak selesa untuk makan sebarang makanan disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-4.	Pernahkah anda mengalami tompok-tompok putih yang pedih (ulser) di dalam mulut anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-5.	Pernahkah anda merasa tidak selesa disebabkan makanan terlekat di celah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-6.	Pernahkah anda merasa malu disebabkan masalah gigipalsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-7.	Pernahkah anda mengelak daripada memakan makanan tertentu disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-8.	Pernahkah anda mengelak daripada senyum disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-9.	Pernahkah tidur anda terganggu disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐

C-10.	Pernahkah tumpuan anda terganggu disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-11.	Pernahkah anda mengelak daripada keluar berjalan-jalan disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-12.	Pernahkah anda mengalami masalah untuk menjalankan kerja-kerja harian anda disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-13.	Pernahkah anda terpaksa mengeluarkan perbelanjaan yang tinggi disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐
C-14.	Pernahkah anda merasa kurang yakin dengan diri anda disebabkan masalah gigi palsu anda?	Sangat kerap ☐ Kerap ☐ Kadang-kadang ☐ Sekali-sekala ☐ Tidak pernah ☐

TERIMA KASIH ATAS KERJASAMA ANDA

APPENDIX 3

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
(Company No. 101067-P)

KULLIYYAH OF MEDICINE

Our Ref. : IIUM/305/14/11/2/IREC 332
Date : 5th February 2015

Dr. Karimah Wahida Zulkifli (Principal Investigator)
Department of Restorative
Kulliyyah of Dentistry,
International Islamic University Malaysia,
Indera Mahkota Campus
25200 Kuantan, Pahang.

Dear Dr. Karimah Wahida Zulkifli,

The IIUM Research Ethics Committee (IREC) has reviewed your study protocol as mentioned below:-

ID NO.	:	**IREC 332**
TITLE	:	**Quality of Life (QOL) of Patient Wearing Removable Denture After Treatment in IIUM**
REGISTRATION DATE	:	**22nd January 2015**
CO-INVESTIGATOR	:	**-**
STUDENT	:	**Nur Erwanie Ramli and Nur Ain Nabilla Mohd Noor (Undergraduate Student)**
NAME OF SITE	:	**Polyclinic, Kulliyyah of Dentistry**
DURATION	:	**1st December 2014 - 31st December 2015**

The IIUM Research Ethics Committee (IREC) operates in according to the Declaration of Helsinki, International Conference of Harmonization Good Clinical Practice Guidelines (ICH-GCP), Malaysia Good Clinical Practice Guidelines and Council for International Organizations of Medical Sciences (CIOMS) International Ethical Guidelines.

The following documents have been received and reviewed to the above study:-

1. Study Protocol: version 1, dated 22nd January 2015
2. Participant Information Sheet:
   i. Version 1, dated 22nd January 2015 (English)
   ii. Version 1, dated 22nd January 2015 (Malay)
3. Consent Form: version 1, dated 29th January 2015 (English)
   i. Version 1, dated 22nd January 2015 (English)
   ii. Version 1, dated 22nd January 2015 (Malay)

QUALITY SYSTEM
SIRIM
CERTIFIED TO MS ISO 9001:2000
Registration No. AR 3074

Garden of Knowledge and Virtue

Office Address: Kulliyyah of Medicine, International Islamic University Malaysia Kuantan Campus, Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan, Pahang Darul Makmur
Tel: +609 570 4000 **Fax:** +609 571 6770 **Website:** www.iiumedic.edu.my

Decision by IIUM Research Ethics Committee (IREC):

(√) Approved
( ) Disapproved

Date of Approval: **4th February 2015**

The investigator(s) are required to:

a) notify IREC of any change in protocol and obtaining further ethical approval as appropriate.
b) report any adverse incident during the course of a study to IREC even if the incident is not directly related to the study.
c) to report serious adverse event (SAE) within 24 hours.
d) to report minor adverse event within 2 weeks.
e) complete and return the IREC Progress Report Form on **every six (6) month** to the IREC Secretariat. On every six (6) month the investigator will be given two (2) weeks duration to submit the report and failure to submit, IREC will terminate the ethics approval.
d) complete and submit the End of Project Report Form to the IREC Secretariat's Office.

Thank you.

Yours sincerely,

PROF. DATO' DR. TARIQ ABD RAZAK
Chairman, IREC

Copy : Protocol File - IREC 332

CHAPTER 7

DETERMINATION OF THE LEVEL AND LOCATION OF THE MENTAL FORAMINA AMONG PATIENTS ATTENDING KULLIYYAH OF DENTISTRY USING PANORAMIC RADIOGRAPH

Rostam Iffendi Idris[1]*, Khairunnisa Ahmad Bustami[2], Nazih Shaaban Mustafa[3]

[1]Department of Restorative Dentistry, International Islamic University Malaysia, Malaysia
[2]Department of Paediatric Dentistry and Dental Public Health, International Islamic University Malaysia, Malaysia
[3]Department of Oral Maxillofacial Surgery and Oral Diagnosis, International Islamic University Malaysia, Malaysia

*Corresponding author email: rostamiffendi@iium.edu.my

SUMMARY

The mandibular canal is a canal within the mandible that is beginning in mandibular foramen on the medial surface of the ascending mandibular ramus. It runs obliquely downward and forward in the ramus, and then horizontally forward in the body till mental foramen. It carries inferior alveolar neurovascular bundle. Generally, the mental foramen is difficult to locate due to lack of consistent anatomic landmarks for reference and the foramen cannot be clinically visualized or palpated. As a result, variable anatomical positions of the foramen have been described. Most studies and textbooks describe the location of the mental foramen as below and between the apices of the first and second premolar or as being below the apex of the second premolar. However, individual variation could place the mental foramen anywhere from below the canine to between the roots of the first molar. When the mandibular teeth are lost, the alveolar bone that housed them resorbs in a varying degree. The good knowledge on the location of the mandibular canal, mental foramen and a preoperative evaluation of the true relationship between the roots of the mandibular third molar and the inferior alveolar nerve, mental foramen and lower premolars would help in predicting, and possibly avoiding, sensory impairment during any surgical procedure in the area. This study was aimed to determine the level and location of the mental foramina in patients attending Kulliyyah of Dentistry (Malays and Chinese) compared to standard anatomical level by assessing panoramic radiograph results.

Keywords: *Mental foramina/foramen, mental nerve, inferior alveolar nerve, mandible, location, level*

INTRODUCTION

The main goal in the surgical management of any patient was preserving the form and the function of anatomical structures. Among the important anatomic landmarks were the mental foramina. Mental foramen is the opening located at the level of the second premolar, midway between the alveolar crest and the inferior border of the mandible. They transmitted mental nerve and vessels. The sensations of the chin, labial vestibule, gingival mesial to the first mandibular molar and lower lip area were derived from this nerve.

There are some variations of mental foramina with regard to the size according to the patient's age. At birth, the mandibular canal was large in size, and ran near the lower border of the bone; the mental foramen opened beneath the socket of the first deciduous molar tooth. After birth, the mandibular canal, after the second dentition, was situated just above the level of the mylohyoid line; and the mental foramen occupied the position usual to it in the adult. Whereas in the adult the mental foramen opened midway between the upper and lower borders of the bone, and the mandibular canal ran nearly parallel with the mylohyoid line. While in the old age, the mandibular canal, with the mental foramen opening from it, is closed to the alveolar border [1].

It was very crucial for the surgeon to know exactly the anatomy of the mental foramen in order to perform various operations of the mandible such as the placement of implants, an open reduction of a mandibular fracture and orthognathic surgery [2]. While for the clinicians, in order to administer local anaesthesia, knowing the precise localization and position of mental foramina was a key to achieve an effective nerve block and reducing the injury to the neurovascular bundle that subsequently resulting in paraesthesia or anaesthesia of the chin, lower lip, and gingiva of ipsilateral side.

There was racial dissimilarity in the position of the mental foramina [3-5,7,11]. In Mongoloid, the positions of mental foramina were in line with the long axis of the second lower premolar. Whereas in Caucasoid, they were slightly anterior and in Negroids were slightly posterior to the long axis of the second lower premolar [6] There had been extensive studies on the morphologies and locations of the mental foramina. However, only few studies had been performed on the level of the mental foramen with regard of the racial and gender.

The anatomic variations of mental foramina had been reported in many studies by using variety types of measurements. Direct measurements were obtained from the cadaver [6] or through a surgical exposure in living subjects [2]. Computed Tomography (CT) scan was reported had a higher resolution as compared to Panoramic radiograph [12]. *"It can help clinicians to acquire in-depth information on maxillofacial structure, trabecular structure, alveolar processes, skeletal measurements and surgical treatment for jaw deformity or implant therapy. Particularly in the mandible, it is clinically significant to accurately identify the location of the mandibular foramen, canal wall, mental foramen, and so on, all of which transmit inferior alveolar nerves."* [14]. Miloro (2004)

reported that when reformatted cross-sectional images are evaluated, CT had a less than 0.5 error [16].

The features of mental foramen studied on panoramic radiograph were simplified on the Table 1.

Table 1. Features of Mental Foramina studied on Panoramic Radiograph

Horizontal Position	Position 1	Anterior to the long axis of the first mandibular premolar tooth
	Position 2	In line with the long axis of the first mandibular premolar tooth
	Position 3	Between the long axes of the first and second mandibular premolar teeth
	Position 4	In line with the long axis of the second mandibular premolar tooth
	Position 5	Between the long axes of the second mandibular premolar and first mandibular molar teeth
	Position 6	In line with the first mandibular molar teeth
Vertical Position	MF-ABC	Distance from the center of mental foramen to the alveolar bone crest of the nearest tooth in dentulous patient
	MF-SB	Distance from the center of mental foramen to superior border of the mandible in edentulous patient
	MF-IB	Distance from the center of mental foramen to inferior border of the mandible
Shape	Round Oval Irregular	
Accessory foramen	Present Absent	

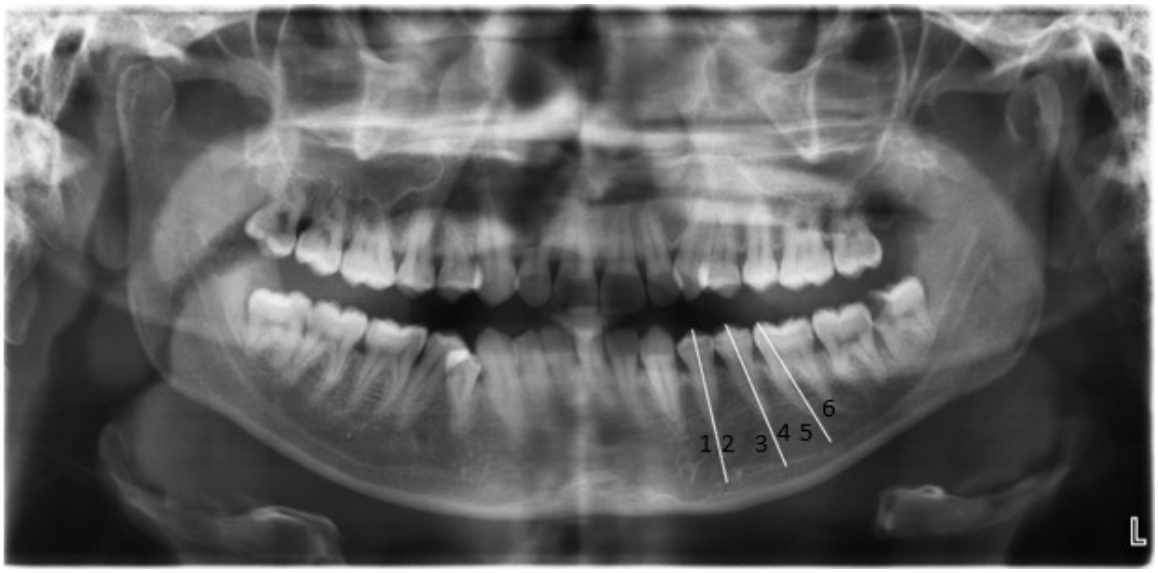


Figure 1. Positions of mental foramina according to the horizontal positions in dentuluous subjects ; Position 1 - Anterior to the long axis of the first mandibular premolar tooth, Position 2 - In line with the long axis of the first mandibular premolar tooth , Position 3 - Between the long axes of the first and second mandibular premolar teeth, Position 4 - In line with the long axis of the second mandibular premolar tooth, Position 5 - Between the long axes of the second mandibular premolar and first mandibular molar teeth and Position 6 - In line with the first mandibular molar teeth

Figure 2. Vertical position of mental foramina in dentuluous subjects measured from the center of mental foramen to the alveolar bone crest of the nearest tooth (MF-ABC) and the center of mental foramen to superior border of the mandible (MF-IB)

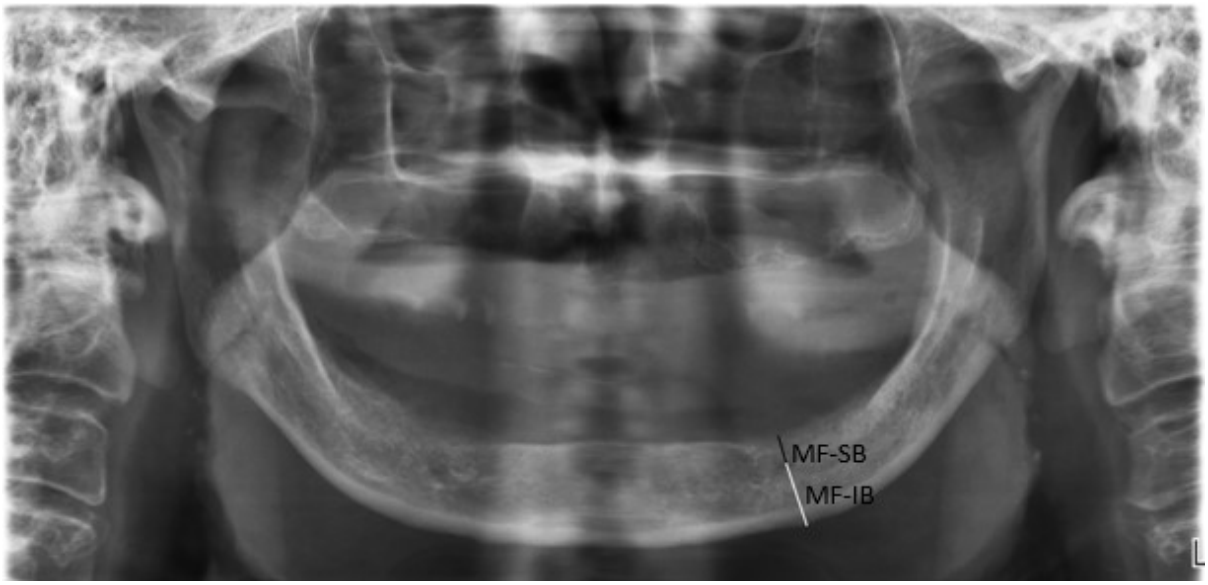


Figure 3. Vertical position of mental foramina in edentuluous subjects measured from the center of mental foramen to superior border of the mandible (MF-SB) and the center of mental foramen to inferior border of the mandible (MF-IB)

The aim of this study was to determine the level of mental foramina in Malaysian populations (Malay and Chinese) compared with standard anatomical level.

Rationale and justification

The results of this study could be very beneficial to the oral surgeons and clinicians in locating the mental foramina in Malays and Chinese ranging from 20-70 years old and avoiding complications from local anesthesia, surgical and other invasive procedures.

Hypothesis

There might be some variation in the level of mental foramina in Malaysian populations exclusively Malay and Chinese races compared with standard anatomical level.

Mosby's Dental Dictionary (2008) defined mental foramen as "*an opening on the lateral aspect of the body of the mandible inferior to the apices of the mandibular second or first premolar. The mental vessels and nerve pass through this foramen to travel through the mandibular canal to supply the lip. In edentulous mandibles, the bone may have resorbed, so that it is in such a position that the denture base will cover it*". As mandibular growths, mental foramina, the location where the mental nerve emerges, alters its direction anteriorly to posterosuperiorly in adults. Thus, it was significant to locate the foramen intraorally and radiographically before administering a mental or incisive local anesthetic block [8].

In Malaysia, the Malay population was defined in Article 160 of the Malaysian Constitution as someone who born to a Malaysian citizen who professed to be a Muslim, habitually spoke the Malay language, adhered to Malay customs and cultures, and was domiciled in Malaysia or Singapore. As of 2004, Malays made up an estimated 64.5% of the population. It was predicted that this proportion would increase steadily due to birth rates higher than other ethnic groups [22].

Malaysian Chinese was a Malaysian of Chinese origin. Most were descendants of Chinese who arrived between the fifteenth and the mid-twentieth century. Within Malaysia, they were usually simply referred to as "Chinese" in all languages. The term Chinese Malaysian was also sometimes used to refer to this community [22].

One of the methods of viewing and evaluating mental foramina accurately other than using computated tomography (CT) scan or direct measurement was by using a panoramic radiograph. Panoramic radiograph was a panoramic scanning dental X-ray of the maxillary, mandibular arch and its surroundings. It showed a two-dimensional view of a half-circle from ear to ear. The one that was used in this research was the digital type which was Planmeca Promax (Planmeca Promax 3D, Planmeca Oy, Helsinki, Finland) that came with its Planmeca Romexis (Planmeca Romexis Planmeca Oy, Helsinki, Finland) software to guide the measurements.

The horizontal position of the mental foramen had been extensively studied and described by many of the researchers. According to Green [9], the average position of the mental foramen was anterior (mesial) to the longitudinal axis of the second premolar in Caucasoids and more posterior (distal) in Melanesians, Mongoloids, and Negroids [2, 5, 6] had described the most common location of the mental foramen was on the same vertical line with the long axis or root of the lower second premolar. The previous studies had shown that the most typical horizontal location of mental foramen was in line with the root of lower second premolar in Malays [17, 18] and Chinese [9].

Most of them demonstrated symmetrical distributions of left and right mental foramina [5, 6, 11, 18]. The presence of accessory mental foramen was less than 10% in all cases reported [3, 4, 15, 21, 24]. The most frequent shape of mental foramen was oval in most of the studies [3, 15, 21, 23] and round in two of the cases [4, 24].

Thus, this study would also evaluate the gender differences in each feature as in Apinhasmit study [6], the gender differences were significant ($p < 0.05$) with longer distances in male. In Koreans also, there was significant difference in the distance from the superior border of the mental foramina to the lower border of the mandible [2].

According to Al-Khateeb [4], with advancing and increasing of age, the location and position of mental foramina became more posterior.

The vertical positions of mental foramina to the alveolar bone crest and lower border of the mandible in Malay and Chinese population were also being studied in this

research. Philips et al reported that the average distance from buccal cuspal tip of the second premolar to the center of mental foramen was about 28.00mm in panoramic view. Another study in Korean population conducted by Kim et al [2] mentioned that the average distance from superior border of the mental foramen to the cuspal tip of lower second premolar was 25.69mm in panoramic view and 23.42 mm in direct measurement. Agarwal [3] mentioned that the distance between mental foramen and alveolar margin in Indians was about 14.05mm (right) and 13.82mm (left) whereas the distance between mental foramen and lower border of the mandible was 12.16mm (right) and 12.11mm (left).

Therefore, Apinhasmit [4] wrote that the mean distances from mental foramen to the lower border of the mandible and to the buccal cuspal tip of the lower second premolar were 14.88mm and 24.27mm respectively. Al Talabani [3] had done an extensive study regarding the vertical position of mental foramen. He mentioned that mental foramen was situated slightly just below the midpoint of alveolar bone crest and the inferior border of the mandible. In his studies, he divided the subjects into two categories according to the dental status; dentulous and edentulous. In dentulous subjects, mean distance between the center of mental foramen and alveolar bone crest was 23.50mm in men and 21.43 in women. The mean distance between the center of mental foramen and the inferior border of the mandible was 15.9mm in men and 14.08mm in women. In edentulous subjects, the mean distance between the center of mental foramen and the superior border of the mandible was 16.92 mm in men and 14.21 mm in women whereas the mean distance between the center of mental foramen and the inferior border of the mandible was 16.40mm in men and 13.99 mm in women.

Objectives

General objective

To determine the level of mental foramina in Malaysian populations (Malays and Chinese) compared to standard anatomical level by assessing panoramic radiograph results.

Specific objectives

1. To review demographic background of patients who were taken panoramic radiograph for the study.
2. To verify the numbers of mental foramen, symmetric of left and right mental foramina, presence of accessory foramen and shape of mental foramen.
3. To measure horizontal and vertical position of the mental foramen in each subject using panoramic radiograph software.
4. To compare differences of the level of mental foramen according to gender, races, and dental status.
5. To identify the changes in the position of mental foramen according to age.

METHODOLOGY

Regarding this retrospective research, supposedly it included all the main races in Malaysia (Malay, Chinese and Indian), but due to the small number of Indians, they needed to be excluded. Otherwise, the data were not valid.

Study design

The type of this study design was retrospective cross-sectional descriptive study.

Study population

All panoramic radiographs taken at Oral Radiology Unit, Kulliyyah of Dentistry, International Islamic University Malaysia, Kuantan from November 2010 to June 2011.

Sample population

Panoramic radiographs without any gross lesions were included.

Sample size calculation

The assumption of the prevalence regarding the abnormalities of mental foramen was 3 %. According to calculation by EPI INFO software (Centre for Disease Control and Prevention, USA) based on total panoramic radiograph (800); sample size for the study was (60) panoramic radiograph in 95% Confidence level.

Inclusion and exclusion criteria

Panoramic radiographs which were taken from the subjects who were Malay and Chinese, dentulous and edentulous, adults, both sexes, aged between 20-70 years old would be included in the study.

Panoramic radiographs which were taken from the patients who had any trauma or surgery on the mandible and had facial bony malformation were excluded in this study whereas pregnant women and subjects with severe systemic disease were also excluded.

Study area

The study was conducted at the Oral Radiology Unit, Kulliyyah of Dentistry, International Islamic University Malaysia, Kuantan

Data collection and analysis

We called selected subjects whose panoramic radiographs were involved in the study, explained about the research and how it would be conducted. Subjects who agreed to

be involved in this research were given a consent letter to be signed. General health and socio-demographic data were collected by questionnaires. Their levels of mental foramina were determined by Planmeca Promax (Planmeca Oy, Helsinki, Finland) connected to a desktop/ PC with Planmeca Romexis (Planmeca Oy, Helsinki, Finland) software. SPSS package version 16.0 (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc.) were used for data entry and analysis. Chi-square test were used to test the hypothesis.

RESULTS

Socio-demographic of the subjects

In the study, panoramic radiograph results of 60 Malaysian subjects of different races, ages and gender were reviewed to assess mental foramina (MF) regarding the numbers of MF, symmetric of left and right MF, presence of accessory foramen, position and shape of MF.

Age

In the study, minimum, maximum and mean (±SD) age of the subjects were 20 years old, 69 years old, and 45.3(±13.6) years old respectively. Age group of the subjects was presented in Table 2.

Table 2. Age group of the subjects

Age group	**No.**	**%**
20- 29	8	13.3
30-39	11	18.3
40-49	13	21.7
50-59	17	28.3
60-69	11	18.3
Total	60	100.0

Race

There were 29 panoramic radiographs of Malay subjects and 31 panoramic radiographs of Chinese subjects assessed (Figure 4).

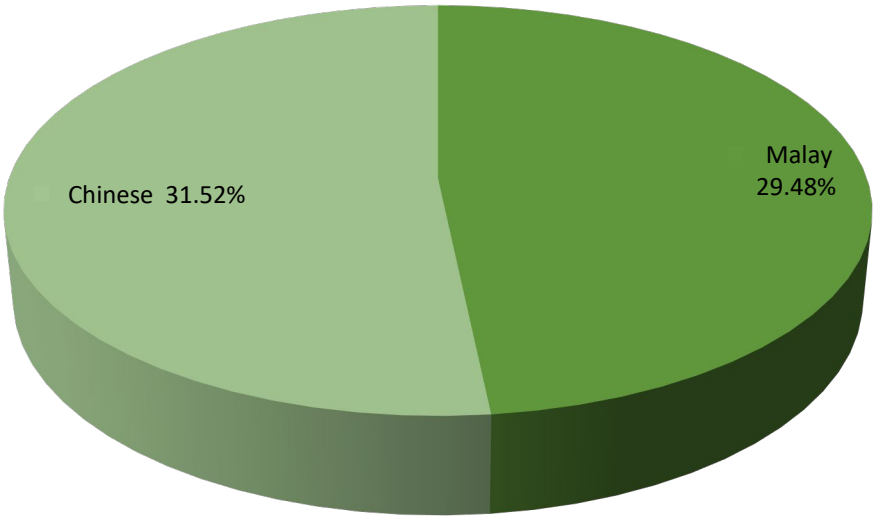


Figure 4. Race distribution of subjects who were taken panoramic radiograph (n= 60)

Gender

There were 23 panoramic radiographs of male subjects and 37 panoramic radiographs of female subjects assessed (Figure 5).

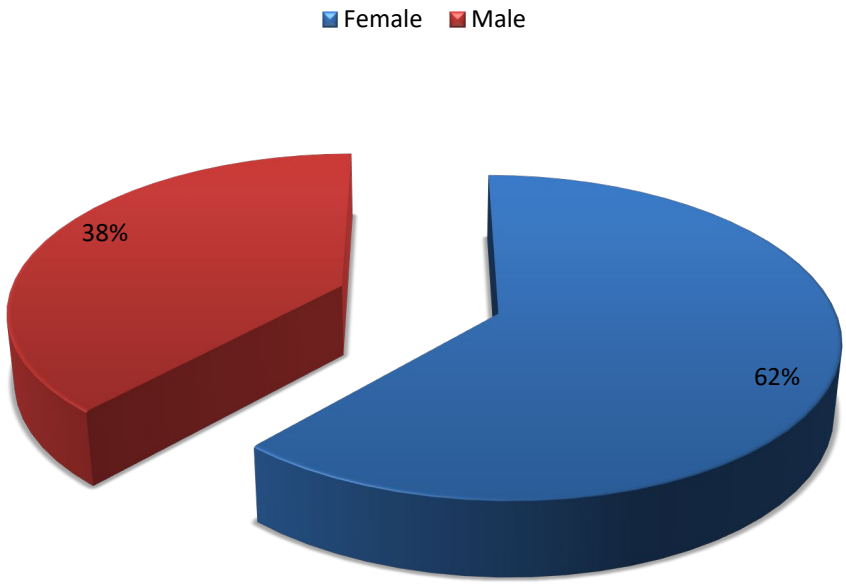


Figure 5. Gender distribution of subjects who were taken panoramic radiograph.

Race and gender of the subjects

The distribution of subjects according to race and gender of subjects is shown in Table 3.

Table 3. Race and gender distributions of subjects

Race	Male		Female		Total
	No.	%	No.	%	
Malay	14	23.3	15	25.0	29
Chinese	9	15.0	22	36.7	31
Total	23	38.3	37	61.7	60

Symmetry of Mental Foramina

Out of 60 subjects, 62% (37/60) were observed to have symmetrical left and right mental foramen and 38% (23/60) were not having symmetrical left and right mental foramen as described in Table 4.

Table 4. Frequency of symmetry of left and right Mental Foramina

Symmetry of MF	Frequency	%
Symmetry	37	61.7
Asymmetry	23	38.3
Total	60	100.0

Table 5. Symmetry of Mental Foramina in accordance with gender

Gender	MF Distribution				Total
	Symmetric		Asymmetric		
	No.	%	No.	%	
Male	16	26.7	7	11.7	23
Female	21	35.0	16	26.7	37
Total	37	61.7	23	38.4	60

$X^2 = 1.0$ $p = 0.32$

Symmetry of Mental Foramina in accordance with race

Out of 60 subjects, 16(27%) of Malay subjects and 21(35%) of Chinese subjects were observed to have symmetrical left and right MF. On the other hand, 13(22%) of Malay subjects and 10(17%) of Chinese subjects were observed to have asymmerical left and right MF. Although there was some gender variation regarding symmetry of MF, this variation was not statistically significant ($p>0.05$) (Table 6).

Table 6. Symmetry of the Mental Foramen according to race (n=60)

Race	**MF Distribution**				**Total**
	Symmetric		**Asymmetric**		
	No.	%	**No.**	%	
Malay	16	26.7	13	21.7	29
Chinese	21	35.0	10	16.7	31
Total	37	61.7	23	38.4	60

$X^2 = 1.0$ $p = 0.32$

Shape of Mental Foramina

Among those 60 subjects, the most frequent shape of MF was irregular shape (48% and 52%) followed by round shape (37% and 30%) in both left and right respectively (Table 7).

Table 7. Frequencies of shape of Mental Foramina (left and right) (n=60)

	Round		**Oval**		**Irregular**	
	No.	%	**No.**	%	**No.**	%
Right MF	22	37	9	15	29	48
Left MF	18	30	11	18	31	52

$X^2 = 0.6667$ $p = 0.717$

Shape of Mental Foramina in accordance with gender

In this study, the most frequent shape of MF in male and female subjects was irregular shape (22% and 27%) in right side and (18% and 33%) in left side respectively. The second most frequent position was round shape (13% and 23%) in right side and (13% and 17%) in left side respectively. Although there was some gender variation in the shape of MF, it was not statistically significant ($p>0.05$) (Table 8 and 9).

Table 8. Shape of the right Mental Foramina (n=60)

Gender	Shape						Total
	Round		Oval		Irregular		
	n	%	N	%	n	%	
Male	8	13.3	2	3.3	13	21.7	23
Female	14	23.3	7	11.7	16	26.7	37
Total	22	36.6	9	15.0	29	48.3	60

$X^2 = 1.5$ $p = 0.46$

Table 9. Shape of the left Mental Foramina (n=60)

Gender	Shape						Total
	Round		Oval		Irregular		
	No	%	No	%	No	%	
Male	8	13.3	4	6.7	11	18.3	23
Female	10	16.7	7	11.7	20	33.3	37
Total	18	30.0	11	18.4	31	51.6	60

$X^2 = 0.4$ p = 0.82

Shape of Mental Foramina in accordance with age

In this study, the most frequent shape of right MF in Malay subjects was irregular shape (28%). In Chinese, irregular shape and round shape of right MF were similarly frequent (20%). On the other hand, for left MF, both Malays' and Chineses' most frequent shape was irregular shape (27% and 25%) respectively. Although there was some racial variation in the shape of MF, it was not statistically significant (p>0.05) (Table 10 and 11).

Table 10. Shape of the right Mental Foramina (n=60)

Gender	Shape						Total
	Round		Oval		Irregular		
	No	%	No	%	No	%	
Malay	10	16.7	2	3.3	17	28.3	29
Chinese	12	20.0	7	11.7	12	20.0	31
Total	22	36.6	9	15.0	29	48.3	60

$X^2 = 3.8$ p = 0.15

Table 11. Shape of the left Mental Foramina (n=60)

Gender	Shape						Total
	Round		Oval		Irregular		
	No	%	No	%	n	%	
Malay	9	15.0	4	6.7	16	26.7	29
Chinese	9	15.0	7	11.7	15	25.0	31
Total	18	30.0	11	18.4	31	51.7	60

$X^2 = 0.8$ p = 0.68

Horizontal position of Mental Foramina

Frequency of horizontal position of Mental Foramina

In Malaysian subjects, the most frequent horizontal position of MF was in line with the long axis of the second mandibular premolar tooth (left -44%) and (right- 51%) respectively followed by between the long axes of the first and second mandibular premolar teeth (left -39%) and (right-37%) (Table 12).

Table 12. Frequency of horizontal position of Mental Foramina

Horizontal Position	Left		Right	
	No	%	No	%
Anterior to the long axis of the first mandibular premolar tooth	0	0	1	2.4
In line with the long axis of the first mandibular premolar tooth	3	7.3	1	2.4
Between the long axes of the first and second mandibular premolar teeth	16	39.0	15	36.6
In line with the long axis of the second mandibular premolar tooth	18	43.9	21	51.2
Between the long axes of the second mandibular premolar and first mandibular molar teeth	4	9.8	2	4.9
In line with the first mandibular molar teeth	0	0	1	2.4
Total	41	100	41	100

$X^2 = 3.93$ $p = 0.5595$

Gender difference in horizontal position of Mental Foramina

The most frequent horizontal position of right and left MF in male was the same in between the long axes of the first and second mandibular premolar teeth and in line with the long axis of the second mandibular premolar tooth (17%). In female, the most frequent horizontal position of right and left MF was in line with the long axis of the second mandibular premolar tooth (34% and 27%) respectively followed by between the long axes of the first and second mandibular premolar teeth (20% and 22%) respectively. Although there were some gender variations in the horizontal position of MF, it was not statistically significant ($p>0.05$) (Table 13 and 14).

Table 13. Relationship between horizontal position of right Mental Foramina and gender

Horizontal Position	**Male**		**Female**	
	No	**%**	**No.**	**%**
Anterior to the long axis of the first mandibular premolar tooth	0	0	1	2.4
In line with the long axis of the first mandibular premolar tooth	1	2.4	0	0
Between the long axes of the first and second mandibular premolar teeth	7	17.1	8	19.5
In line with the long axis of the second mandibular premolar tooth	7	17.1	14	34.1
Between the long axes of the second mandibular premolar and first mandibular molar teeth	1	2.4	1	2.4
In line with the first mandibular molar teeth	0	0	1	2.4
Total	16	39.0	25	60.8

$X^2 = 3.60$ $p = 0.61$

Table 14. Relationship between horizontal position of left Mental Foramina and gender

Horizontal Position	**Male**		**Female**	
	No	**%**	**No**	**%**
Anterior to the long axis of the first mandibular premolar tooth	0	0	0	0
In line with the long axis of the first mandibular premolar tooth	1	2.4	2	4.9
Between the long axes of the first and second mandibular premolar teeth	7	17.1	9	22.0
In line with the long axis of the second mandibular premolar tooth	7	17.1	11	26.8
Between the long axes of the second mandibular premolar and first mandibular molar teeth	1	2.4	3	7.3
In line with the first mandibular molar teeth	0	0	0	0
Total	16	39.0	25	61.0

$X^2 = 0.522$ $p = 0.91$

Racial differences in horizontal position of Mental Foramina

The most frequent horizontal position of MF in Malays subjects was between the long axes of the first and second mandibular premolar teeth in both right and left side (24% and 29% respectively) followed by in line with the long axis of the second mandibular premolar tooth in right and left (20% and 15%) respectively. On the other hand, in Chinese, the most frequent horizontal position of MF was in line with the long axis of the second mandibular premolar tooth in right and left (32% and 29%) respectively followed by between the long axes of the first and second mandibular premolar teeth in both right and left side (12% and 10%) respectively. Although there were some racial variations in the horizontal position of MF, it was not statistically significant ($p>0.05$) (Table 15 and 16).

Table 15. Relationship between horizontal position of right Mental Foramina and race

Horizontal Position	**Malay**		**Chinese**	
	No	**%**	**No**	**%**
Anterior to the long axis of the first mandibular premolar tooth	1	2.4	0	0
In line with the long axis of the first mandibular premolar tooth	0	0	1	2.4
Between the long axes of the first and second mandibular premolar teeth	10	24.4	5	12.2
In line with the long axis of the second mandibular premolar tooth	8	19.5	13	31.7
Between the long axes of the second mandibular premolar and first mandibular molar teeth	1	2.4	1	2.4
In line with the first mandibular molar teeth	0	0	1	2.4
Total	20	48.7	21	51.1

$X^2 = 5.8$ $p = 0.32$

Table 16. Relationship between horizontal position of left Mental Foramina and race

Position	**Malay**		**Chinese**	
	No	**%**	**No**	**%**
Anterior to the long axis of the first mandibular premolar tooth	0	0	0	0
In line with the long axis of the first mandibular premolar tooth	1	2.4	2	4.9
Between the long axes of the first and second mandibular premolar teeth	12	29.3	4	9.8
In line with the long axis of the second mandibular premolar tooth	6	14.6	12	29.3

Between the long axes of the second mandibular premolar and first mandibular molar teeth	1	2.4	3	7.3
In line with the first mandibular molar teeth	0	0	0	0
Total	20	48.7	21	51.3

$X^2 = 7.3$ $p = 0.63$

Age differences in horizontal position of Mental Foramina

The age differences in horizontal position of both left and right MF were statistically significant ($p<0.05$) (Table 17 and 18).

Table 17. Age differences in horizontal position of right Mental Foramina

Age Group		**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**Total**
Horizontal Position	Anterior to the long axis of the first mandibular premolar	1	0	0	0	0	1
	In line with the long axis of the first mandibular premolar tooth	0	0	0	0	1	1
	Between the long axes of the first and second mandibular premolar teeth	3	5	4	3	0	15
	In line with the long axis of the second mandibular premolar tooth	4	6	4	6	1	21
	Between the long axes of the second mandibular premolar and first mandibular molar teeth	0	0	2	0	0	2
	In line with the first mandibular molar teeth	0	0	1	0	0	1
Total		8	11	11	9	2	41

$X^2 = 33.7$ $p = 0.03$

Table 18. Age differences in horizontal position of left Mental Foramina

Age Group		20-29	30-39	40-49	50-59	60-69	Total
Horizontal Position	Anterior to the long axis of the first mandibular premolar	0	0	0	0	0	0
	In line with the long axis of the first mandibular premolar tooth	1	0	0	1	1	3
	Between the long axes of the first and second mandibular premolar teeth	6	2	3	5	0	16
	In line with the long axis of the second mandibular premolar tooth	1	8	5	3	1	18
	Between the long axes of the second mandibular premolar and first mandibular molar teeth	0	1	3	0	0	4
	In line with the first mandibular molar teeth	0	0	0	0	0	0
Total		8	11	11	9	2	41

$X^2 = 22.2$ $p = 0.04$

Vertical position of Mental Foramina

Vertical position of Mental Foramina in accordance with gender

Vertical position of Mental Foramina in accordance with gender in dentulous subjects

In dentulous subjects, mean(±(SD) of distance from the center of mental foramen to the alveolar bone crest of the nearest tooth (MF-ABC) in male and female were (17.3(±2.6) mm and 14.8(±2.2) mm) respectively in right side and (17.0(±2.5) mm and 15.3(±2.3) mm) respectively in left side. This gender variation of both right and left measurements of MF-ABC were statistically significant ($p<0.05$). The mean (±(SD) of distance from the center of mental foramen to inferior border of the mandible (MF-IB) in male and female subjects were (13.7(±1.8) mm and 13.3(±1.7) mm) respectively in right side and (14.5(±2.0) mm and 12.5(±1.8) mm) respectively in left side. The gender variation of MF-IB of right side was not statistically significant ($p>0.05$) whereas the gender variation of MF-IB of left side was statistically significant ($p<0.05$) (Table 19).

Table 19. MF-ABC and MF-IB values in dentulous subjects according to gender

Gender	n	*MF-ABC (mean±(SD))		*MF-IB (mean±(SD))	
		Right (mm)	Left (mm)	Right (mm)	Left (mm)
Male	16	17.3(±2.6)	17.0(±2.5)	13.7(±1.8)	14.5(±2.0)
Female	25	14.8(±2.2)	15.3(±2.3)	13.3(±1.7)	12.5(±1.8)
'p' value		0.002	0.034	0.455	0.002

***MF-ABC** Distance from the center of mental foramen to the alveolar bone crest of the nearest tooth in dentulous patient.

***MF-IB** Distance from the center of mental foramen to inferior border of the mandible.

Vertical position of Mental Foramina in accordance with gender in edentulous subjects

In edentulous subjects, mean(±(SD) of distance from the center of mental foramen to superior border of the mandible (MF-SB) in male and female were (12.4(±5.0) mm and 6.3(±4.5) mm) respectively in right side and (12.5(±5.8) mm and 5.1(±3.7) mm) respectively in left side. This gender variation of both right and left measurements of MF-ABC were statistically significant ($p<0.05$). The mean (±(SD)) of distance from the center of mental foramen to inferior border of the mandible (MF-IB) in male and female subjects were (13.2(±3.2) mm and 11.8(±1.7) mm) respectively in right side and (13.9(±2.3) mm and 11.5(±3.0) mm) respectively in left side. The gender variations of MF-IB of right and left side were not statistically significant ($p>0.05$) (Table 20).

Table 20. MF-SB and MF-IB values in edentulous subjects according to gender

Gender	n	*MF-SB (mean(±SD))		*MF-IB (mean±(SD))	
		Right (mm)	Left (mm)	Right (mm)	Left (mm)
Male	7	12.4(±5.0)	12.5(±5.8)	13.2(±3.2)	13.9(±2.3)
Female	12	6.3(±4.5)	5.1(±3.7)	11.8(±1.7)	11.5(±3.0)
'p' value		0.014	0.003	0.230	0.079

***MF-SB** Distance from the center of mental foramen to superior border of the mandible in edentulous patient

MF-IB Distance from the center of mental foramen to inferior border of the mandible

Vertical position of Mental Foramina according to race

Vertical position of Mental Foramina according to race in dentulous subjects

In dentulous subjects, mean(±(SD) of distance from the center of mental foramen to the alveolar bone crest of the nearest tooth (MF-ABC) in Malay and Chinese were (15.2(±2.9) mm and 16.4(±2.2) mm) respectively in right side and (15.0(±2.7) mm and 16.9(±1.9) mm) respectively in left side. This race variation in right MF-ABC was not statistically significant ($p>0.05$) whereas the gender variation in left MF-ABC was

statistically significant ($p<0.05$). The mean (±(SD) of distance from the center of mental foramen to inferior border of the mandible (MF-IB) in Malay and Chinese subjects were (13.5(±1.7) mm and 13.4(±1.8) mm) respectively in right side and (13.9(±2.1) mm and 12.7(±1.9) mm) respectively in left side. The race variation of MF-IB of both right and left side were not statistically significant ($p>0.05$) as provided in Table 21).

Table 21. MF-ABC and MF-IB values in dentulous subjects according to race

Race	**n**	***MF-ABC (mean±(SD))**		***MF-IB (mean(±SD))**	
		Right (mm)	**Left (mm)**	**Right (mm)**	**Left (mm)**
Malay	20	15.2(±2.9)	15.0(±2.7)	13.5(±1.7)	13.9(±2.1)
Chinese	21	16.4(±2.2)	16.9(±1.9)	13.4(±1.8)	12.7(±1.9)
'p' value		0.146	0.013	0.897	0.061

***MF-ABC** Distance from the center of mental foramen to the alveolar bone crest of the nearest tooth in dentulous patient.

MF-IB Distance from the center of mental foramen to inferior border of the mandible.

Vertical position of Mental Foramina according to race in edentulous subjects

In edentulous subjects, mean(±(SD) of distance from the center of mental foramen to superior border of the mandible (MF-SB) in Malay and Chinese subjects were (9.4 (±5.7) mm and 7.8(±5.4) mm) respectively in right side and (8.9(±5.6) mm and 6.9(±6.0) mm) respectively in left side. This race variations of both right and left measurements of MF-ABC were not statistically significant ($p>0.05$). The mean (±(SD)) of distance from the center of mental foramen to inferior border of the mandible (MF-IB) in Malay and Chinese subjects were (12.8(±3.2) mm and 11.9(±1.3) mm) respectively in right side and (13.0(±3.4) mm and 11.8(±2.5) mm) respectively in left side. The race variations of MF-IB of right and left side were not statistically significant ($p>0.05$) (Table 22).

Table 22. MF-SB and MF-IB values in edentulous subjects according to race.

Race	**n**	***MF-SB (mean (±SD))**		***MF-IB (mean±(SD))**	
		Right (mm)	**Left (mm)**	**Right (mm)**	**Left (mm)**
Malay	9	9.4 (±5.7)	8.9(±5.6)	12.8(±3.2)	13.0(±3.4)
Chinese	10	7.8(±5.4)	6.9(±6.0)	11.9(±1.3)	11.8(±2.5)
'p' value		0.555	0.469	0.442	0.402

***MF-SB** Distance from the center of mental foramen to superior border of the mandible in edentulous patient.

MF-IB Distance from the center of mental foramen to inferior border of the mandible.

DISCUSSION

This study was conducted based on the study of Al-Talabani et al (2008) in which he analyzed and critically evaluated the position of the mental foramen of 170 subjects by using computer-based location [5]. Instead of using Photoshop and AutoCad that were recommended by him, this research was using Planmeca Romexis software that was integrated with panoramic radiograph unit which is the research is still limited.

Based on the results achieved from 60 panoramic radiographs (29 Malays and 31 Chinese) of the subjects, 16(27%) of Malay patients and 21(35%) of Chinese patients were observed to have symmetrical left and right mental foramen. According to the shape of mental foramen, the most frequent shape of right mental foramina in Malay patients was irregular shape (28%). In Chinese, irregular shape and round shape of right mental foramina were similarly frequent (20%). On the other hand, for left mental foramina, both Malays and Chinese's most frequent shape was irregular shape (27% and 25%) respectively. Based on the horizontal position of mental foramen, the most frequently position in Malay patients was between the long axes of the first and second mandibular premolar teeth in both right and left side (24% and 29% respectively) followed by in line with the long axis of the second mandibular premolar tooth in right and left (20% and 15%) respectively. On the other hand, in Chinese, the most frequent horizontal position of mental foramen was in line with the long axis of the second mandibular premolar tooth in right and left (32% and 29%) respectively followed by between the long axes of the first and second mandibular premolar teeth in both right and left side (12% and 10%) respectively. While in vertical position of mental foramen, they were divided into dentulous and edentulous patients. For dentulous patients, mean(±(SD) of distance from the center of mental foramen to the alveolar bone crest of the nearest tooth (MF-ABC) in Malay and Chinese were (15.2(±2.9) mm and 16.4(±2.2) mm) respectively in right side and (15.0(±2.7) mm and 16.9(±1.9) mm) respectively in left side. The mean (±(SD)) of distance from the center of mental foramen to inferior border of the mandible (MF-IB) in Malay and Chinese patients were (13.5(±1.7) mm and 13.4(±1.8) mm) respectively in right side and (13.9(±2.1)) mm and 12.7(±1.9) mm) respectively in left side. On the other hand, for edentulous patients, mean(±(SD)) of distance from the center of mental foramen to superior border of the mandible (MF-SB) in Malay and Chinese patients were (9.4 (±5.7)) mm and 7.8(±5.4) mm) respectively in right side and (8.9(±5.6) mm and 6.9(±6.0) mm) respectively in left side. The mean (±(SD)) of distance from the center of mental foramen to inferior border of the mandible (MF-IB) in Malay and Chinese patients were (12.8(±3.2) mm and 11.9(±1.3) mm) respectively in right side and (13.0(±3.4) mm and 11.8(±2.5) mm) respectively in left side.

The study indicated that the level of mental foramen in Malaysian populations (Malays and Chinese) compared with variety of anatomical level. In term of age differences in horizontal position of right mental foramina, the most likely position was in line with the long axis of the second mandibular premolar tooth with the frequency was 21 followed by position between the long axis of the first and second mandibular premolar teeth with the frequency was 15 with significant '*p*' value ('*p*'

value = 0.03). For the age differences in horizontal position of left mental foramina, the most frequent location was in line with the long axis of the second mandibular premolar tooth with the frequency was 18 followed by the position between the long axis of the first and second mandibular teeth with the frequency was 16 with significant '*p*' value ('*p*' value = 0.04). For the vertical position of mental foramina in accordance with gender in dentulous subjects, the distance from the center of mental foramina to the alveolar bone crest of the nearest tooth was significant in the right and left position (0.002 and 0.034 respectively). And also, for the distance between the center of left mental foramina to the inferior border of the mandible was significant with '*p*' value was 0.002. The vertical position of mental foramina in accordance with gender in edentulous subjects showed significant '*p*' value only on distance between center of mental foramina to the superior border of the mandible for both right and left foramen with 0.014 and 0.003 respectively. Lastly was the vertical position of mental foramina according to race in dentulous subjects showed significant '*p*' value on the distance between the center of mental foramina to the alveolar bone crest of the nearest tooth for left side only with the value was 0.013.

To compare, frequency of horizontal position of mental foramen was correspondence with the previous studies [2, 5, 6, 9, 17, 19]. According to the symmetrical of mental foramen, they were correspondence to the most of the studies [5, 6, 11, 18]. Other than that, the distance between mental foramen and superior border of mandible or alveolar bone crest for male showed longer distance compared to female in this study and Apishasmit. For vertical position of mental foramen, Malay and Chinese populations proved that they were shorter than Kurdish. And the other difference between Malay and Chinese populations to the most of the studies was shape of the mental foramina. In Malay and Chinese populations, the typical shape of mental foramina was irregular compared to other studies [3, 15, 21, 23] that was oval in shape. This difference of mental foramen might be due to some anatomical variations in term of races. Thus, we could not use their standard level into our races as a guide practically.

This study had some limitation in terms of racial issue, patient and time. Regarding the racial issue, a lot of people debated about the origin of race. Intermarriage was the main concern of it like marriage of the Malays to other races and their children were considered as Malays. Then, another limitation was patient. It was quite difficult to get patients especially non-Malays due to small numbers of them who visited the dental clinic, Kulliyyah of Dentistry. That may explain why some of the results were insignificant. Another example was supposedly this study needed to include all the three main races in Malaysia, but due to the small number of Indian patients, this race needed to be excluded. Lastly was limitation of time. This retrospective study was conducted about a year, so there was a smaller number of panoramic radiographs taken with adequate socio-demographic data. The improved points of this study compared to other studies were this study not evaluated the mental foramen regarding the position only, but also the shape of the mental foramina.

From this study, it might reduce complications from local anaesthesia, surgical and other invasive procedures by using the average results. A further study to determination the level of mental foramina in Malaysians population compared with standard anatomical level should be carried out by using more precise equipment to measure the data like Cone Beam Computed Tomography (CBCT) scan that provide more details than panoramic radiograph.

CONCLUSION

The study indicated that the level of mental foramen in Malaysian populations (Malays and Chinese) compared with standard anatomical level are varied.

In term of age differences in horizontal position of right and left mental foramina, the most likely position was in line with the long axis of the second mandibular premolar teeth. For the vertical position of mental foramina in accordance with gender in dentulous and edentulous subjects, the distance from the center of mental foramina to the alveolar bone crest of the nearest tooth was significant in the right and left position. The distance between the center of left mental foramina to the inferior border of the mandible was significant. Lastly was the vertical position of mental foramina according to race in dentulous subjects showed significant value on the distance between the center of mental foramina to the alveolar bone crest of the nearest tooth for left side. The result showed symmetrical of the mental foramen and the distance between mental foramen and superior border of mandible or alveolar bone crest for male showed longer distance compared to female. In Malay and Chinese populations, the typical shape of mental foramina was irregular in shape.

From this study, it might reduce complications from local anaesthesia, surgical and other invasive procedures by using the average results that have been revealed as guidance.

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CHAPTER 8

EFFECTIVENESS OF TOOTHBRUSHING AMONG UNDERGRADUATE STUDENTS OF INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

Sobrina Mohamed Khazin[1]*, Zulaika Hosni[2], Tin Maw[3]

[1] Department of Restorative Dentistry, Kulliyyah of Dentistry, International Islamic University Malaysia
[2] Love Dental Care, Private Practice, Bandar Baru Bangi
[3] Retiree

*Corresponding author email: sobrina@iium.edu.my

SUMMARY

Toothbrushing is the most common method used to remove dental plaque. The removal of plaque is important because it is the main cause of oral diseases such as dental caries and periodontal diseases. This study aimed to assess the effectiveness of toothbrushing on the removal of plaque among the undergraduate students at International Islamic University Malaysia (IIUM) Kuantan Campus. This study compared the plaque score before (baseline) and after (post-brushing) toothbrushing. Prior to toothbrushing, students were instructed to chew on plaque disclosing tablet, and baseline plaque score was measured by using O'Leary Plaque Index. Afterwards, students were given a standardized toothbrush and toothpaste to brush their teeth. Post-brushing plaque score were taken immediately after toothbrushing. A total of 57 students participated in the study. The baseline plaque score was ranged from 33.3%-94.6% (SD: 70.8%±15.65) and post-brushing plaque score was ranged from 3.6%-70.8% (SD: 34.0%±15.83). The mean plaque score changes at baseline and post-brushing were statistically significant (p<0.001), however, using 95% confidence interval estimation, the changes were minimal (95% CI: 36.75, 36.85) and only 5.3% achieved optimal post-brushing plaque score. It can be concluded that, IIUM students were able to reduce their plaque score to a certain extent, but the reduction was not up to optimal level.

Keywords: *optimal plaque score, oral hygiene, plaque biofilm, plaque index, toothbrushing*

INTRODUCTION

Background of study

Good oral hygiene is essential to prevent oral diseases such as dental caries and periodontal diseases. The major cause of these oral diseases is dental plaque. Many had claimed that they had engaged in daily oral hygiene but still can't maintain oral health [1]. Thus, maintaining and improving oral health does not only depend on the frequency of cleaning but also effective daily removal of plaque biofilm.

There are many methods to maintain good oral health, and the most common method used is toothbrushing [2]. Mechanical toothbrushing has been shown to be an effective method of removing plaque [3]. There are many reasons people brush their teeth. Brushing may be health-directed or health-related. Some individual brush to maintain oral health, others as part of the grooming process; or to obtain fresh breath; or it has become a force of habit, and many for a combination of reasons. Toothbrushing usually starts from young ages. Knowledge and skill about toothbrushing acquired from parents, care givers and oral health education from various sources. The knowledge and toothbrushing skill acquired is well established at adolescent and young adults, which an individual practice throughout their life. This habit should be efficient to maintain good oral hygiene for prevention of oral diseases and eliminate halitosis.

Rationale of study

There has been many studies that had proven the effectiveness of toothbrushing as a method of plaque removal, however, this study will look into the plaque control at a community level, specifically, undergraduate students of IIUM Kuantan Campus. This study will be able to give an overview on how efficient is the toothbrushing on plaque removal among young adults attending IIUM Kuantan Campus. The result of this study may provide further necessary intervention for oral hygiene education and instruction among the community of IIUM Kuantan Campus.

Objectives of study

The general objective of the study is to assess the effectiveness of toothbrushing on plaque removal among undergraduate students of IIUM Kuantan Campus.

The specific objectives are as follows:

1. To assess the frequency of toothbrushing.
2. To measure plaque score before and after toothbrushing.
3. To ascertain the effect of toothbrushing on plaque score.

METHODOLOGY

Research setting and study design

This study is a cross-sectional study which involves measurement of plaque score before and after intervention such as toothbrushing on undergraduate students at IIUM Kuantan Campus.

Sample

Sample size was estimated using Epi Info™ Statcalc software. With the estimated undergraduate student's population at IIUM Kuantan Campus was 2790, at 95% confidence interval, the sample size required were 61 students.

Sampling method

Consecutive sampling method was used in this study. Sixty-one students were selected based on the inclusion and exclusion criteria (Table 1) and their willingness to participate in the study.

Table 1: Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
i. Undergraduate student of IIUM Kuantan Campus	i. Students of Kulliyyah of Dentistry, IIUM ii. Severe crowding iii. Smokers iv. More than 1 missing tooth per quadrant and missing opposing tooth v. Medically compromised patient vi. Wearing orthodontic and prosthetic appliance vii. Has crown, bridges and implants

Screening procedures

Four hundred questionnaires (Appendix 1) were distributed among undergraduate students of IIUM Kuantan Campus, however, only 76 were interested to participate in the study. All responded students were then re-screened by the researcher (SMK and ZH) to determine the eligibility. Students that meet the criteria were invited to participate in the study. All students were informed on the objectives of the study, what will it involved, and how it will be conducted. Written consent was taken (Appendix 2), demo-academic background and toothbrushing habits of each student were recorded (Appendix 3).

Recording method

All students were required to chew on the Dental Plaque Disclosing Tablet (Erythrosin FD&C Red disclosing agent) and spread the agent throughout the mouth using their tongue to disclose plaque on tooth surface (Figure 1). Students' teeth were examined visually using dental mouth mirror, and baseline plaque score was recorded on plaque score chart (Figure 2A) (Appendix 3) based on visible continuous plaque along gingival margin of surfaces of each tooth surfaces (mesial, buccal, distal, and lingual) except third molars using O'Leary Plaque Index. The surface was marked red in the chart when there is presence of plaque regardless of the amount, and the segment will be left empty if no plaque was visible. Teeth that were not included in the measurement was crossed out to aid in measuring the plaque score (Figure 2B).

Figure 1. Teeth were stained pink indicating presence of plaque. (Taken from https://stock.adobe.com/my/images/close-up-of-a-mouth-of-a-person-with-stained-dental-plaque/383287608)

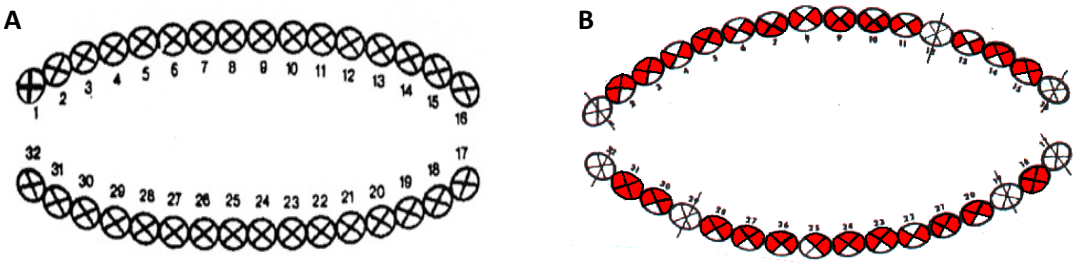

Figure 2. Plaque Control Record. A: Chart before recording. B: Chart after recording of plaque score, surface with presence of plaque were marked in red.

Students were then instructed to brush their teeth as how they routinely brush. They were given a brand-new standardized design toothbrush (Figure 3) aided with toothpaste. Post-brushing plaque score was recorded immediately after toothbrushing, using same method with baseline plaque score. Baseline and post-brushing plaque score were examined by one single operator (SMK). The plaque score was calculated using the following formula:

$$\text{Plaque Score} = \frac{\text{(The number of plaques containing surfaces)}}{\text{(The total number of available surfaces)}} \times 100$$

Figure 3. Standardized toothbrush bristle design.

Effectiveness of toothbrushing

The baseline and post-brushing plaque scores were divided into two groups: optimal and suboptimal groups. The plaque score of ≤10% is considered optimal plaque score, and plaque score of >10% is considered suboptimal score. Participants who achieved optimal plaque score will be considered as effective toothbrushing.

Data analysis

Data collected were tabulated in IBM SPSS Data Editor version 18.0. Descriptive analysis was used to describe the demo-academic background, brushing habits, and plaque score of students. Paired t-test was used to determine the significant difference between baseline and post-brushing plaque score. Chi-squared test was used to ascertain the effect of toothbrushing to plaque score reduction.

RESULTS

Demo-academic background of students

The response rate for this study was 93.4%, although 61 students were required to obtain minimum sample size, only 57 students agreed to participate which consisted

of 56.1%(n=32) female and 43.9%(n=25) male students. The age was ranged from 19-26 years old (Table 2). The distribution of students according to Kulliyyah and year of study is presented in Table 3 and Table 4 respectively.

Table 2: Distribution according to age group (N=57)

Age group	No. of students (%)
19-22	31 (54.4)
23-25	24 (42.1)
26	2 (3.5)
Total	57 (100)

Table 3. Distribution with accordance to Kulliyyah (N=57)

Kulliyyah	No. of students (%)
Kulliyyah of Medicine	13 (22.8)
Kulliyyah of Nursing	6 (10.5)
Kulliyyah of Science	16 (28.1)
Kulliyyah of Allied Health Sciences	13 (22.8)
Kulliyyah of Pharmacy	9 (15.8)
Total	57 (100)

Table 4. Distribution according to academic year (N=57)

Attending Year	No of students (%)
Year 1	15 (26.3)
Year 2	13 (22.8)
Year 3	8 (14.0)
Year 4	18 (31.6)
Year 5	3 (5.3)
Total	57 (100)

Brushing frequency

More than 50% of students practiced toothbrushing twice daily (morning and night) (56.1%, n=32). Some brushes thrice daily (morning, night, and after meal) (35.1%, n=20), and only minority brush once daily (morning only) (7%, n=4) (Table 5).

Table 5. Distribution of time of toothbrushing (N=57)

Time of toothbrushing	No of students (%)
Morning	4 (7.0)
Night	0
After meal	0
Morning and Night	32 (56.1)
Morning and After Meal	1 (1.8)
Night and After Meal	0
Morning, Night and After meal	20 (35.1)
Total	57 (100)

Plaque score

The mean baseline plaque score was 70.7% (SD:15.56), with minimum of 33.3% and maximum 94.6%. The average post-brushing plaque score was 33.9% (SD:15.83), with minimum 3.6%, and maximum 70.8%. Based on Figure 4, it appears that there is a reduction in plaque score at post-brushing compared to baseline. It was also shown through paired t-test, there was a statistically significant difference between baseline and post-brushing plaque score (p<0.001). However, based on confidence interval estimation (Figure 5), the differences between baseline and post-brushing plaque score were minimal (95% CI: 36.75, 36.85).

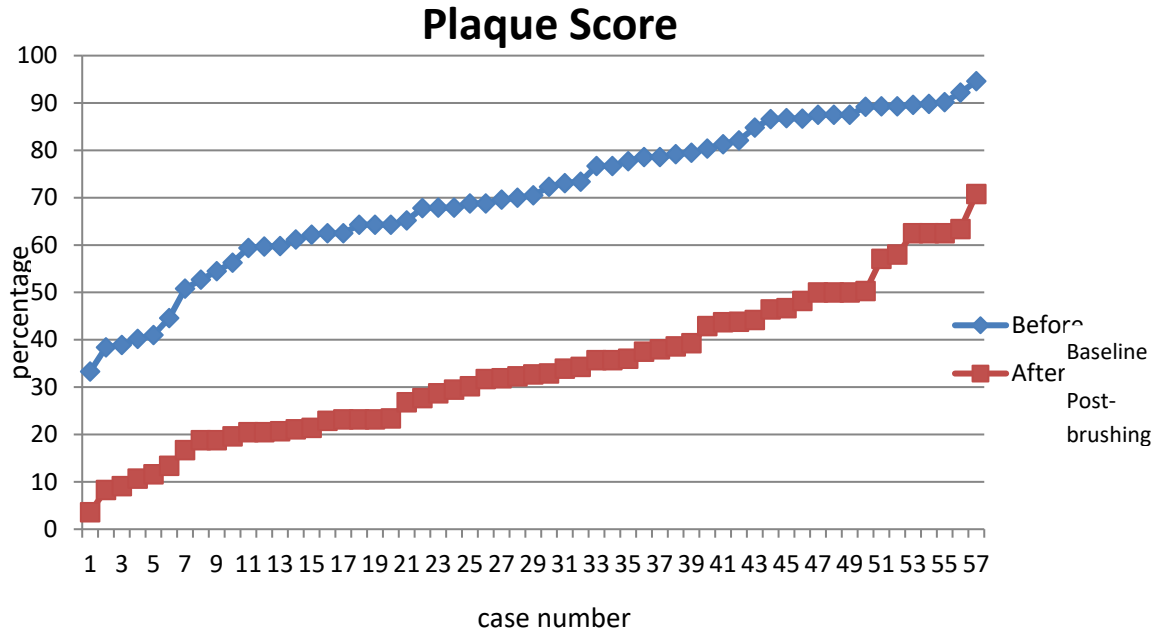

Figure 4. Distribution of plaque score at baseline and post-brushing

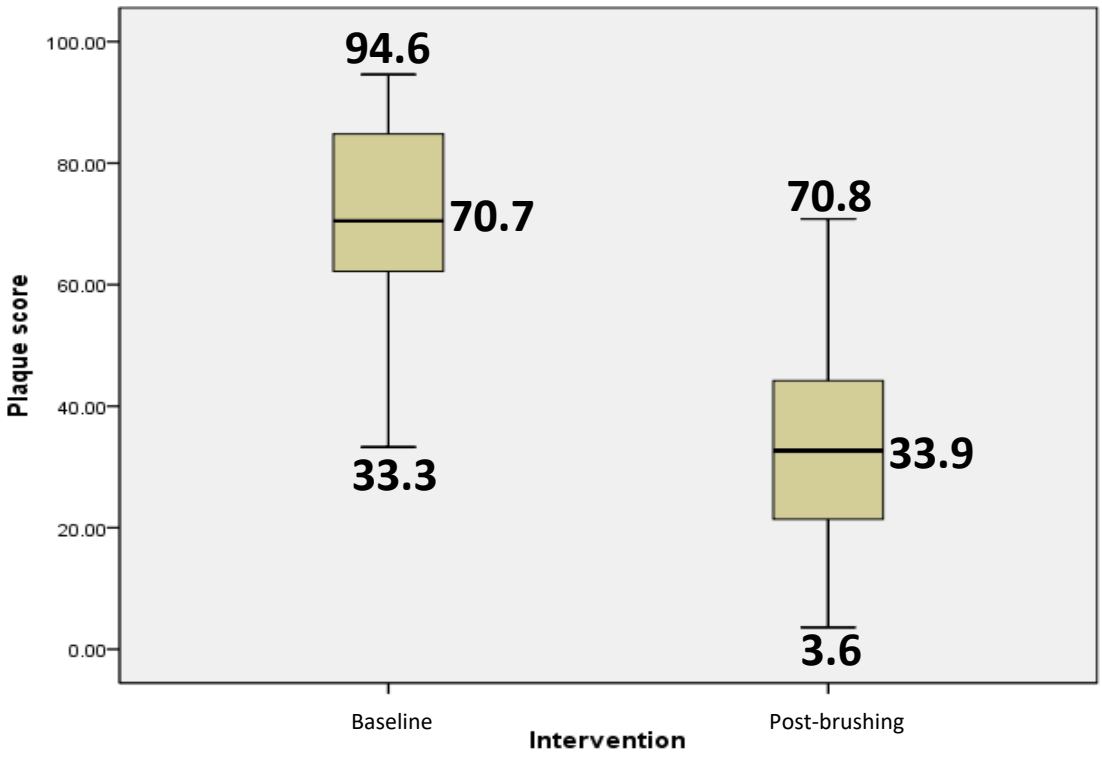

Figure 5. Comparison of minimum, maximum and mean plaque score at baseline and post-brushing

At baseline, 100% of the students' plaque score were suboptimal and at post-brushing, only 5.3% of the students' plaque score were optimal. A cross analysis between the plaque score groups (optimal/suboptimal) and the plaque score at baseline and post-brushing were conducted however it was not statistically significant (p>0.05) (Table 6).

Table 6. Association between the changes in plaque score at baseline and post-brushing (N=57)

	Baseline n (%)	**Post-brushing n (%)**	***p*-value**
Optimal plaque score (≤10%)	0 (0)	3 (5.3)	0.079
Suboptimal plaque score (>10%)	57 (100)	54 (94.7)	

DISCUSSION

Plaque control can be achieved through mechanical and chemical removal. The most common plaque removal method is by toothbrushing [2] and it has been proven to be effective in removing plaque [3–5]. However, proper technique and quality of tooth brushing is needed in order to maintain good oral health [6].

Brushing at least twice daily is considered as a social norm and also recommended by several professional bodies such as the Centres for Disease Control and Prevention (CDC) [7] and the Ministry of Health Malaysia [8] to reduce incidence of oral diseases [9]. The present study have shown that majority of the students brushes at least twice daily. However, previous literatures have shown that frequency of toothbrushing alone cannot render disease-free oral cavity. Duration and technique of toothbrushing plays a major role in plaque removal [10], which was not within the scope of this study. It is also important to take note that 7% of the students brushes once daily in the morning. It has been recommended that night time brushing before sleep should not be ommitted [8], because at night time, the salivary flow rate is lowered, less saliva is able to provide protective mechanism against bacteria on the tooth surface. Based from these findings it can be noted that the students have the awareness on oral hygiene, with minority requires emphasis on oral health education. High frequency of tooth brushing are not applicable to all individual but at least once a day thorough toothbrushing is needed to prevent plaque maturity [4].

Plaque score index is used to evaluate the level of plaque on tooth surfaces to determine patient's oral hygiene in clinical setting. It can also be used for research purposes to test efficacy of plaque removal using oral care products [11]. There are several indices described in the literature, utilizing different methods of recording plaque. It has been mentioned that the quantification of plaque gives the advantage of more sensitive result in evaluating the amount of plaque [12] however, it is time consuming and gives strain to the eyes and making the recorder's reading less accurate after long period of time. In this study, quantification of plaque was not done, but only the presence or absence of plaque were noted using the O'Leary Plaque Index which is less time consuming and less cumbersome than other types of plaque index.

Majority of the students in this study had high plaque score at baseline with the highest value of 94.6%. However, most of the students managed to reduce their post-brushing plaque score to below 50%. The differences in plaque score at baseline and post-brushing shows that the students can reduce the plaque score by means of toothbrushing to a certain extent. This also correlates with the point estimation using paired t-test to be statistically significant difference (p<0.001). Nonetheless, further investigation was made using confidence interval estimation, it was shown despite the difference is statistically significant, the difference is small (95% CI: 36.75, 36.85). Hence, there is not enough evidence to indicate that there is significant difference in mean between baseline and post-brushing plaque score of the students.

Obtaining optimal oral hygiene has been regarded as strongly related to prevention of oral diseases. Hence, the limit of plaque score to be considered good was ≤10% [13,14], which was used in this study. Despite the evident reduction in plaque score post-brushing compared to the baseline, only 5.3% (n=3) achieved plaque score of ≤10% post-brushing, and statistical analysis shows that the students cannot achieve good oral hygiene through toothbrushing (p>0.05). This finding supports the findings of previous study that have shown that toothbrushing alone cannot achieve optimal plaque removal [9]. In addition to the minimal changes in difference between baseline

and post-brushing plaque score, also probably shows lack of knowledge on brushing techniques among the students.

CONCLUSION

Within the limitation of this study, 93% of the students brushes at least twice daily, with a minimal difference between baseline and post-brushing plaque score and only 5.3% of students achieved good plaque score post-brushing. It can be concluded that the students were able to remove plaque to a certain extent using toothbrushing, but majority were not able to remove plaque effectively to achieve optimal plaque score. Hence, further oral hygiene education and instruction need to be emphasized among the undergraduate students of IIUM Kuantan Campus and empower them on the importance of maintenance of good oral health.

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APPENDIX 1

A SURVEY OF ORAL HEALTH STATUS WITH TOOTHBRUSHING HABIT AND CIGARETTE SMOKING AMONG STUDENTS OF IIUM KUANTAN CAMPUS 2010/2011

We are fourth year dental students, Kulliyyah of Dentistry; we would like to conduct a survey regarding oral health status with tooth brushing habits and smoking among the students of IIUM Kuantan Campus, as part of our student project.
This study is looking towards finding out the effects of tooth brushing and smoking on dental status among the students in Kuantan campus. The findings will be useful because the results can be use in promoting oral health care and oral health education. We are very much appreciated if you can answer all the questions below according to your own experience. Your cooperation is highly appreciated.

1. Gender: ☐ Female ☐ Male

2. Kulliyyah:

Medicine ☐ Pharmacy ☐ Nursing ☐

Sciences ☐ CTS ☐ Biomedical ☐ Biotechnology

☐ Allied Health Sciences

3. Age: _____ (as of last birthday)

4. Smoking status: Smoker ☐ Non-smoker ☐

If you tick on smoker, please proceed to question number 5 and 6.

If you tick non-smoker, please proceed to question number 7 until 12.

5. Duration of smoking:

Less than 1 year ☐ More than 1 year ☐

6. Amounts of cigarette smokes each day

1 – 10 ☐ 11 – 20 ☐ more than 20 ☐

7. Do you have any systemic diseases?

Yes ☐ No ☐

If yes, please

specify,_____

8. Are you taking any medication?

Yes ☐ No ☐

If yes, please

specify,_____

9. If you are female, are you pregnant?

Yes ☐ No ☐

10. Are you currently wearing any orthodontic appliance or removable dental prosthesis?

Yes ☐ No ☐

11. Have you received dental treatment such as crown or bridges or implants?

Yes ☐ No ☐

12. Have you had any dental extractions before (excluding baby tooth and wisdom tooth)?

Yes ☐ No ☐

If yes, how many times?

_____

Please fill this form and drop at the student society center before **21st January 2011**.

We are looking for volunteers participating as our subject for further clinical examination in this research project. If you agree to participate you will be asked to join in a clinical examination dental check-up only which will take about 30 minutes. You will be free to withdraw from the study at any stage. Kindly state your phone number in the box provided below for further attachment.

Phone no. ☐

The participants will be assigned a number and the data will be anonymized as much as possible. The results may be published in a journal or presented in a conference.

Thank you very much for your kind cooperation.

APPENDIX 2

ORAL HYGIENE PRACTICE: THE EFFECTIVENESS OF TOOTHBRUSHING AMONG IIUM KUANTAN CAMPUS STUDENTS 2010/2011

Consent form

Dated…….....

I have read and understood the information sheet and the consent form.
I understand that I am under no obligation to take part in this study.
I understand that I have the right to withdraw from this study at any stage without given any reason.

I agree to participate in this study.

Name of the participant……..

Signature of participant……...

Signature of researcher……

Name of the researcher

APPENDIX 3

Demographic Background

Name: _____ Nationality:_____
Age:_____ Hometown:_____
Gender:_____ Contact No: _____

Social Background

Parent's occupation:_____
Smoking: Yes / No
If yes,
Do you regularly smoke? _____
How many cigarettes per day?
_____
Do you smoke right after waking up in the morning? Yes / No

Academic Background

Kulliyyah:_____
Major (for KOS, KOAHS):
_____
Year:
_____

Medical History

Do yo have any systemic disease? Yes / No
If yes,
specify,_____
Are you under any medication? Yes / No
If yes,
specify,_____

Dental History

Do you regularly go for dental check-up? Yes / No
If yes, how many times per
year?_____
Have you ever recieved any oral hygiene instruction? Yes / No
If yes,
When had you recieve the oral hygiene instruction?
_____

Where had you recieve the oral hygiene instruction?

_____

From whom did you recieve the oral hygiene instruction?

_____

Toothbrushing Habits

How many times per day do you brush your teeth?

_____

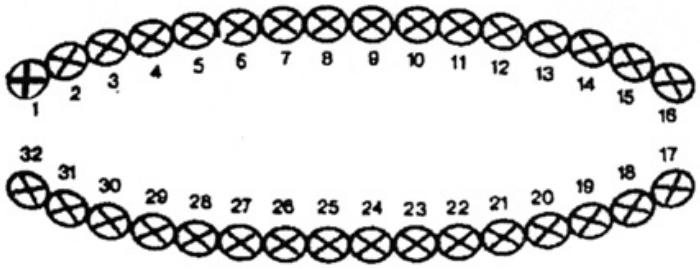
When do you brush your teeth? (circle which applicable)

a) morning; after waking up, after breakfast
b) evening; after taking bath, before sleep
c) after meal; breakfast, lunch, dinner
d) other: specify,

How long do you take to brush your teeth each time?

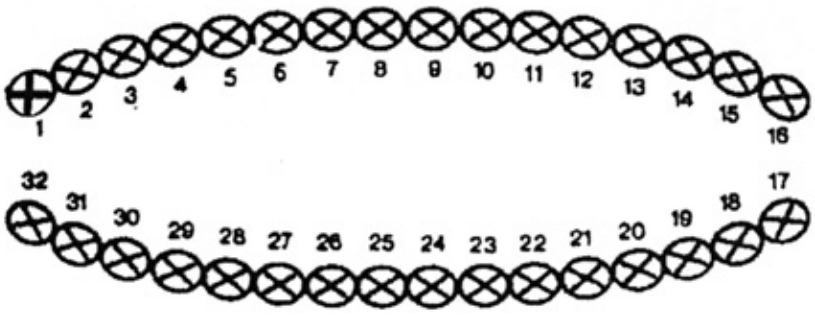
_____

Plaque Score baseline



O'Leary Plaque Index = # of surfaces with plaque divided by total # of surfaces x 100 = _____ %

Plaque Score post-brushing



O'Leary Plaque Index = # of surfaces with plaque divided by total # of surfaces x 100 = _____ %

CHAPTER 9

THE EFFECTIVENESS OF TWO DIFFERENT AT-HOME TOOTH WHITENING PRODUCTS AS EVALUATED BY DINO-LITE DIGITAL MICROSCOPE

Muhammad Afif Naufal Mohamad[1], Mohamad Nasrul Shahmi Mohd Nasir[1], Haszelini Hassan[2], Hikmah Mohd Nor[3], Bo BoKo[4]

[1] Kulliyyah of Dentistry, International Islamic University Malaysia (IIUM)
[2] Department of Oral Maxillofacial Surgery & Oral Diagnosis, Kulliyyah of Dentistry, IIUM
[3] Department of Prosthodontics, Kulliyyah of Dentistry, IIUM
[4] Department of Fundamental Dental Medical Sciences, Kulliyyah of Dentistry, IIUM

*Corresponding author email: dr_haszelini@iium.edu.my

SUMMARY

Many desires brighter and whiter teeth in a quicker and easier way but in less expensive way. Therefore, over-the-counter tooth whitening solutions such as toothpaste, mouth rinses, gel, varnish paints, and strips are regarded a good option, albeit their efficiency is questioned. Different types of oxidizing agents such as hydrogen peroxide and carbamide peroxide used in the tooth whitening products as bleaching agents may produce different degree of shade change. Thus, this study aimed to evaluate the effectiveness of two different at-home tooth whitening products related to the changes in tooth shade and enamel surface appearance. Twenty-one samples of extracted human teeth were used in this study. The samples were divided into seven groups and were exposed to two at-home tooth whitening products; Beyond Care (6% hydrogen peroxide) and White Smile (16% carbamide peroxide) according to the recommended guidelines and exceeded the recommended guideline by 3 times and 5 times for each whitening product for 14 consecutive days. Photos of enamel surface appearance and tooth shades of samples were taken using Dino-Lite Digital Microscope and DSLR camera at pre- and post-treatment. Comparison was made using Ivoclar Vivadent shade guide. The results revealed that six samples that were exposed to Beyond Core White (CW) in the respective exposure time showed changes in shade. Meanwhile, only two samples treated with White Smile (WC) showed changes after being exposed to five times the recommended guideline. However, no significant surface change in enamel was observed. Samples with mild fluorosis had shown improvement after being exposed to five times the recommended guidelines for both agents. In conclusion, no shade changes were observed in all samples that were tested using the recommended guidelines. The whitening efficacy of Beyond Core White was found to be superior to White Smile at three and five times the recommended guidelines.

Keywords: *carbamide peroxide, enamel, fluorosis, hydrogen peroxide, tooth whitening*

INTRODUCTION

Nowadays, the demand for tooth whitening treatment has been rising and this can be proved by a wide variety of whitening options available in the market. The majority of people seek teeth whitening treatment because of discolouration, which can be caused by both intrinsic and extrinsic stains. According to American Dental Association Council on Scientific Affair in their study in 2009, the tooth whitening is one of the most popular aesthetic procedures in dentistry for over past 20 years. Nowadays, the tooth whitening procedure not only can be done in the dental clinic by the dentist, but the availability of different modalities of tooth whitener in the market has provided an alternative and better access to whitening for the public [1]. For example, do it yourself whitening, at home tooth whitening products and others.

Tooth whitening agent and its effects on dental tissue

Tooth whitening is a chemical process involving the oxidation of organic material which is broken down to produce less complex molecules. Most of these smaller molecules are lighter in colour than the original larger molecules. Hydrogen peroxide and carbamide peroxide are amongst commonly used oxidizing agents in the teeth whitening products. Recently, the use of tooth whitening agents containing carbamide peroxide is more favourable by the dentists in comparison to hydrogen peroxide-containing whitening agents. Usually, in office bleaching, it was carried out using high concentration of the hydrogen peroxide in the range of 15 to 38% while in at home whitening procedure, 10% carbamide peroxide materials were used normally which are safer and more stable. Previous studies have proven that the higher the concentration of hydrogen peroxide, the greater the risk of harm to soft tissue damage from accidental contact. However, according to American Dental Association (1994), there were none published studies on the use of 10% carbamide peroxide have reported any adverse effect on soft tissue of the mouth. Plus, the usage of high concentration of hydrogen peroxide may cause pulp sensitivity to the patient since the hydrogen peroxide penetrates readily and rapidly to reach the pulp which gives discomfort to the patient. It may cause irreversible damage to the pulp and cause the teeth to become non vital. There are no reports of teeth become non vital even with prolong used of 10% carbamide peroxide in previous studies. However, the usage of high concentration of hydrogen peroxide (30 to 38%) in tooth bleaching occasionally can cause cervical resorption of the teeth while there were no reports of 10% carbamide peroxide causing dental hard tissue resorption.

In addition, several studies had been conducted in relevant to whitening treatment for dental fluorosis. Enamel fluorosis is a hypermineralization of enamel characterized by greater surface and subsurface porosity than in normal enamel because of excess fluoride intake during the period of enamel formation [2]. This change in the enamel is characterized by altered appearance of the tooth ranging from fine white lines to pitting or staining of enamel. Browne D et al. [3] described Dean's Index of Fluorosis as a recommended index to grade enamel fluorosis. The index has proven to be a robust classification and is recommended for use by the World Health Organisation

in its publication Oral Health Surveys-Basic Methods 4th Edition. Dean's Index scores the two teeth that are most affected and grades from very mild, mild, moderate, or severe and the percentage of the labial surface affected by fluorosis is noted. Table 1 shows the criteria for Dean's Index of Fluorosis as cited by him in the Journal of the American Dental Association 1934.

Table 1. Criteria for Dean's Index of Fluorosis

Score	**Criteria**
Normal	The enamel represents the usual translucent semivitri form type of structure. The surface is smooth, glossy, and usually of a pale creamy white color.
Questionable	The enamel discloses slight aberrations from the translucency of normal enamel, ranging from a few white flecks to occasional white spots. This classification is utilized in those instances where a definite diagnosis of the mildest form of fluorosis is not warranted and a classification of "normal" is not justified.
Very mild	Small opaque, paper white areas scattered irregularly over the tooth but not involving as much as 25% of the tooth surface. Frequently included in this classification are teeth showing no more than about 1-2 mm of white opacity at the tip of the summit of the cusps of the bicuspids or second molars.
Mild	The white opaque areas in the enamel of the teeth are more extensive but do not involve as much as 50% of the tooth.
Moderate	All enamel surfaces of the teeth are affected, and the surfaces subject to irritation show wear. Brown stain is frequently a disfiguring feature.
Severe	Includes teeth formerly classified as "moderately severe and severe." All enamel surfaces are affected, and hypoplasia is so marked that the general form of the tooth may be affected. The major diagnostic sign of this classification is discrete or confluent pitting. Brown stains are widespread, and teeth often present a corroded-like appearance.

LITERATURE REVIEW

Tooth discoloration resulted from various and complex causes. They are usually classified into intrinsic and extrinsic staining or internalized in nature. In a study conducted by Carey in 2004 [4], it mentioned that the intrinsic staining or internal staining can be attributed to factors such as genetics, age, antibiotics, high levels of fluoride, and developmental disorders. These may cause discolouration of dentin make it darker or yellower in colour which requires professionally applied tooth whitening treatments. Extrinsic staining, sometimes called external staining, is largely due to environmental factors including smoking, pigments in beverages and foods, antibiotics, and metals such as iron or copper. Coloured compounds from these sources are directly absorbed onto the surface of the enamel or into acquired dental

pellicle which causing a stain. These staining can be removed by at home tooth whitening products.

The contemporary bleaching agents are typically either hydrogen peroxide (HP) or carbamide peroxide (CP). Tooth bleaching occurs when there is decomposition of peroxide into free oxygen radicals which break down the large, pigmented molecules that reflects a specific wavelength of light responsible for the colour of stain in the dental substrate. It was degraded into smaller, less pigmented molecules within the teeth which result in a reduced colour reflectance. The low molecular weight hydrogen peroxide is readily penetrating through the interprismatic enamel. These free radicals have unpaired electron that react rapidly with most organic molecules generating more free radicals, disrupting the electron configuration of large, pigmented molecule. Thus, it will result in elimination of those molecules which causing the discoloration.

From other point of view, Joiner [5] stated that it is also believed that the peroxide used in the whitening regimen cause reduction in tooth colour by diffusing into the enamel and dentin and oxidizes a variety of organic and inorganic-coloured compounds. The oxidation of organic and inorganic compound of enamel may affect the tooth colour. Meanwhile, Meireles et al. [6] mentioned that peroxide-containing whiteners will break down into water and oxygen when in contact with outer enamel surface. Then, the water and oxygen will diffuse through the enamel where it causes oxidation of organic pigment that is mainly located within dentin, resulting in a reduction of discoloration.

Joiner [5] in his article mentioned that the levels of primarily used HP and CP are ranged from 5.3 to 38% and 10 to 37%, respectively. However, the percentage of peroxide used in at-home whitening products are significantly lesser compared to the in-office bleaching products which are 3 to 6% and 10% for hydrogen peroxide and carbamide peroxide, respectively. Meanwhile, the in-office bleaching treatment is usually carried out using hydrogen peroxide at a concentration ranging from 15 to 38%. In addition, teeth whitening product also causes changes in surface roughness of enamel, surface microhardness, surface morphology and colour changes. According to Hosoya et al. [7], teeth treated with whitening agents displayed significantly increased surface roughness of enamel compared to control groups. In a study conducted by Ontiveros et al. [8], they reported that there was a colour change in shade guide in relation to baseline colour after 2 weeks of overnight treatment with 22% CP. There might be some adverse reactions such as gum irritation or tooth sensitivity that will occur upon application of tooth whitening either do it yourself (DIY) whitener or in office whitening procedure [9,10].

Therefore, this study aimed to evaluate the effectiveness of two different at-home tooth whitening products related to the changes in tooth shade and enamel surface appearance on the extracted human teeth using Dino-Lite digital microscope. The null hypothesis tested was that different exposure times do not affect the efficacy of the whitening products and do not cause enamel changes.

METHODOLOGY

Ethical clearance was obtained from ethics review committee of International Islamic University Malaysia (IREC 758). This study was conducted at Kulliyyah of Dentistry IIUM in which the sampling method used was purposive sampling where twenty-one freshly extracted human teeth were collected at Polyclinic Kulliyyah of Dentistry from December 2016 to July 2017. All samples were collected according to the inclusion criteria; permanent teeth, sound or have minimal loss of crown structure. The exclusion criteria include primary tooth, hypomineralized tooth, tooth containing intrinsic staining, loss of more than half of crown structure, big carious lesion and heavily restored teeth.

All samples were cleaned to remove any residual tissues attached to the tooth and gross debris by using distilled water. Then, the samples were stored in a specimen container containing 0.1% Thymol solution in cold room at 4°C to inhibit fungal growth. All samples were painted with nail varnish to expose a standardized 4x4mm window area on facial surfaces. Samples were randomized and equally divided into seven groups (three teeth in each group) including a control group.

Prior to the whitening product application, tooth shade of each sample was determined by using a commercial shade guide, Ivoclar Vivadent. Pre-treatment photos were taken using DSLR camera (Canon EOS 450D with Micro Lens EF 100mm and Macro Twin Lite MT-24EX) displaying the 4x4mm treatment area together with the matched shade guide. Dino-Lite Digital Microscope AM4115T Dino-Lite Edge was then used to examine the 4x4mm window area of each sample with magnification of 60x10. Subsequently, samples were placed in Biotene mouthwash (10 ml for each sample in one specimen container) for 24 hours at 37°C to resemble the human's oral environment prior to initiating the experiment.

After 24 hours, samples were taken out from specimen container and dried with filter paper. Two whitening products used in this experiment were Beyond Core White Whitening Gel, 6% hydrogen peroxide (HP) (30 minutes exposure based on manufacturer's recommended guideline) and White Smile Whitening Pen, 16% carbamide peroxide (CP) (20 minutes exposure based on manufacturer's recommended guideline). The whitening gels were applied to the samples according to the treatment protocol as shown in Table 2 and Table 3. The details for teeth whitening application protocol (for 14 consecutive days) is shown in Appendix 1.

Table 2. Tooth whitening protocol by experimental group

	Distilled water (control)	**Beyond Core White Whitening Gel 6% Hydrogen Peroxide**	**White Smile Whitening Pen 16% Carbamide peroxide**
Recommended guideline	3	3	3
3 times recommended guideline	-	3	3
5 times recommended guideline	-	3	3
Total number (n)	3	9	9
Total number of samples (N)		21	

Table 3. Duration of application of the whitening agents for 14 consecutive days

Whitening agent	**Beyond Core White Whitening gel 6% Hydrogen Peroxide**	**White smile Whitening Pen 16% Carbamide peroxide**
Recommended guideline	30 minutes	20 minutes
3 times recommended guideline	90 minutes	60 minutes
5 times recommended guideline	150 minutes	100 minutes

Samples were cleaned with a soft bristle toothbrush and distilled water after each application of the whitening chemicals. They were dabbed dry with filter paper and immersed back into the oral rinse in the specimen container. All specimen containers were stored in the incubator at 37°C. The treatment procedure was repeated for 14 days consecutively as instructed in the manual. At day 14, after the procedure was completed, the samples were immersed in oral rinse for two hours. The samples were then transferred into specimen container containing distilled water at room temperature.

After completing the treatment protocols, the shade of the samples was determined at daylight with black background using the Ivoclar Vivadent shade guide. The shade guide was designed in letter A (red-yellow), B (yellow), C (grey) and D(red-yellow-grey) where it shows different hues and also numerical values 1 (least chromatic) to 4 (most chromatic) which indicate chroma of the samples. The values of the samples then were determined according to the value order of this shade guide (B1, A1, B2, D2, A2, C1, C2, D4, A3, D3, B3, A3.5, B4, C3, A4, C4). Once the shade of the samples was determined, photos of each sample with the matched shade guide were recorded

using Canon DSLR camera and Dino-Lite Digital Microscope in the window area of each samples at 60x10 magnification.

Figure 1. Ivoclar Vivadent shade guide used in this study

RESULTS

Eight samples showed improvement in tooth shade after 14 consecutive days of whitening gel application as evaluated through visual assessment using Ivoclar Vivadent shade guide. Three samples that were kept in the control group did not show any alteration in tooth shade after being placed in distilled water for 14 consecutive days. the post-operative changes in tooth shade of samples is shown in Table 4.

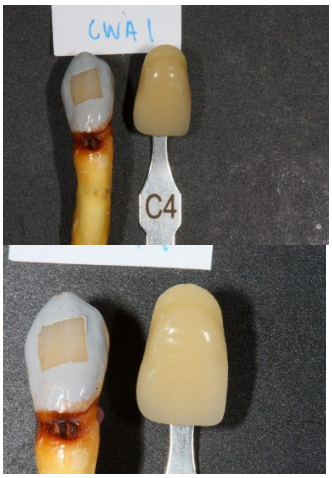
Table 4. Post-operative changes in tooth shade of samples

	5 times Recommended Guidelines (A)			**3 times Recommended Guidelines (B)**			**Recommended Guidelines (C)**		
Samples number	A1	A2	A3	B1	B2	B3	C1	C2	C3
Beyond Core White 6% hydrogen peroxide (CW)	+	+	+	+	+	+	-	-	-
White Smile 16% carbamide peroxide (WC)	-	+	+	-	-	-	-	-	-
Distilled water (DH_2O)							-	-	-

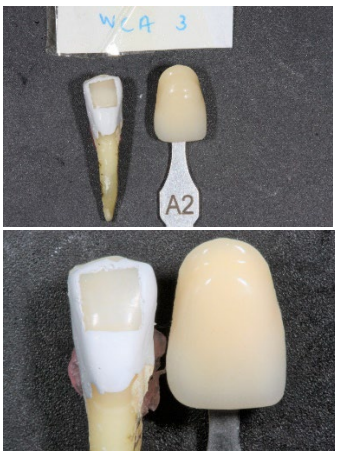
(+) = improved shade
(-) = no change

Canon DSLR camera had been used to take photos of pre- and post-application of whitening gels onto standardized 4x4mm window on enamel surfaces of samples. Tooth shade of each sample were determined pre- and post-application and were included in the photos. Table 5 illustrated the pre- and post-treatment samples which showed improvement in shade after 14 days of application.

Table 5. Pre- and post-treatment samples that shows improvement in shade

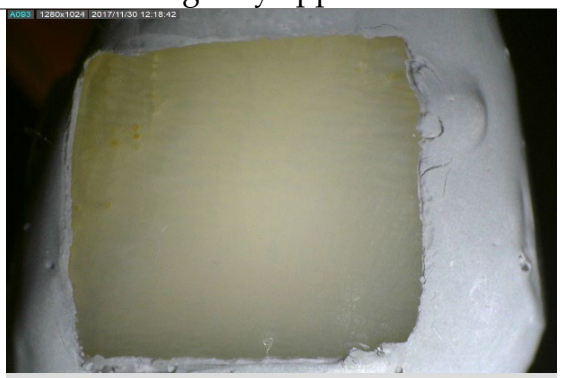
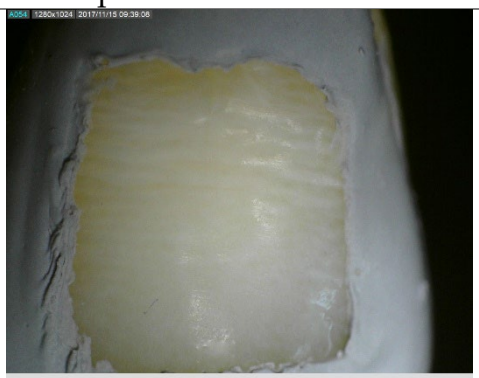
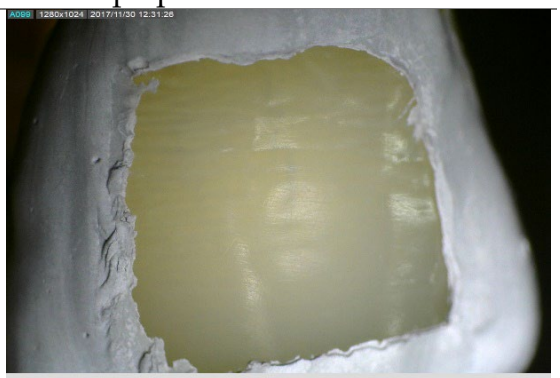
Samples	Pre-application	Post-application
CWA 1	 The grey hue (C) with chroma of 4 is recorded.	 Chroma improved from 4 to 3 with grey hue of tooth shade.
CWA 2	 The yellow hue (B) with chroma of 2 is recorded.	 Chroma improved from 2 to 1 with yellow hue of tooth shade.
CWA 3	 The red-yellow hue (A) with chroma of 2 recorded.	 Chroma improved from 2 to 1 with red-yellow hue of tooth shade.

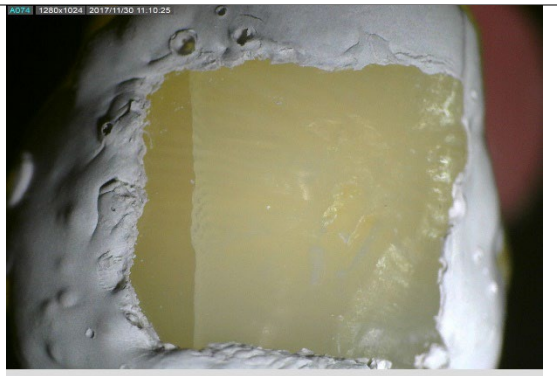
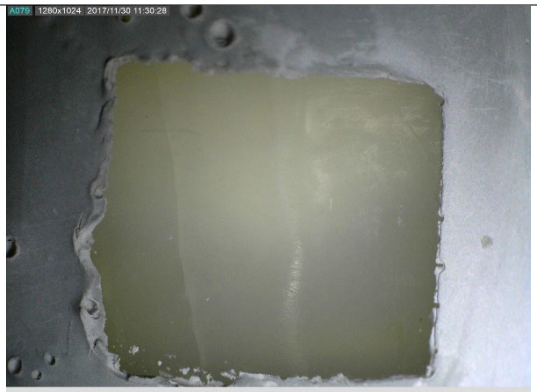
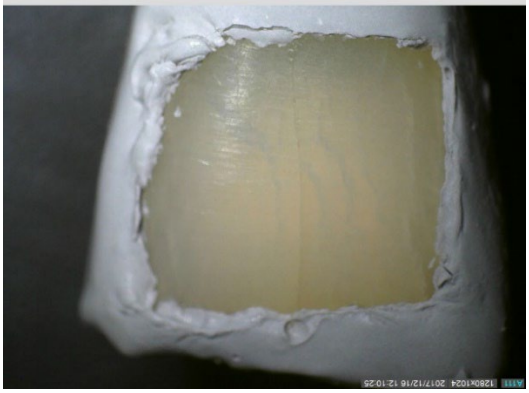
CWB 1	 The grey hue (C) with chroma of 2 is recorded.	 Chroma improved from 2 to 1 with grey hue of tooth shade.
CWB 2	 The grey hue (C) with chroma of 4 recorded.	 Chroma improved from 4 to 3 with grey hue of tooth shade.
CWB 3	 The yellow hue (B) with chroma of 4 recorded.	 Chroma improved from 4 to 3 with yellow hue of tooth shade.

WCA 2	 The red-yellow hue (A) with chroma of 3.5 recorded.	 Chroma improved from 3.5 to 3 with red-yellow hue of tooth shade.
WCA 3	 The red-yellow hue (A) with chroma of 2 recorded.	 Hue and chroma improved from A2 to B2 with yellow hue of tooth shade.

In this study, a few samples with fluorosis were found based on Dean's Fluorosis Index. Pre-treatment photos of each sample with fluorosis were recorded with Dino-Lite Microscope. After 14 days of whitening gel application, these samples have shown a remarkable improvement in the surface enamel appearance. The appearance of enamel surface with fluorosis was significantly improved. Both whitening products used in this experiment exhibited a good outcome on fluorosed samples. Pre- and post-treatment photos recorded using Dino-Lite Microscope with magnification 60x10 were displayed in Table 6.

Table 6. Surface changes of the samples

Sample	Pre-application	Post-application
CWA 3		
	Sample was scored questionable since there were a few white flecks that differed from translucency of normal enamel.	White flecks faded 14 days post-application with whitening gel, rendering enamel surface to usual smooth and glossy appearance.
CWB 1		
	Sample was scored moderate since there were white opaque areas on the labial surface accompanied with brown stain.	The opacity areas diminished and the sample was now scored with very mild fluorosis with presence of few white opaque areas.
CWC 3		
	Sample was scored very mild since there was paper white areas scattered on the labial surface but not involving 25% of tooth surface.	Paper white areas faded 14 days post-application with whitening gel, rendering enamel surface to usual smooth and glossy appearance.

WCA 1		
	Sample was scored mild since there was opaque areas in the labial surface but not involving 50% of the tooth.	The opacity areas diminished and the sample was now scored with very mild fluorosis with a slight aberration from the translucency of normal enamel.
WCB 1		
	Sample was scored questionable since there was a slight aberration from the translucency of normal enamel.	Enamel surface was smooth and glossy as of normal enamel surface after 14 days of whitening gel application.
WCC 2		
	Sample was scored very mild since there was white opaque areas scattered on the labial surface but not involving 25% of tooth surface.	There was diminished white opaque areas on the labial surface but the presence of few white flecks still visible on the enamel surface. Previously very mild score of fluorosis improved to questionable.

Statistical analysis

Beyond Core White (6% hydrogen peroxide): Chi square test showed there was significant difference (p=0.011) in shade changes for different duration of exposures of Beyond Core White whitening agent.

White Smile 16% carbamide peroxide: There was no significant difference (p=0.076) in shade changes for different duration of exposures.

DISCUSSION

The increasing demand for teeth whitening treatment in the market has driven many manufacturers to develop whitening products to be used either in dental office or at-home. Furthermore, the growing availability of at-home teeth whitening treatments has generated worries about the lack of supervision provided by dentists. Although teeth whitening is a conservative and economical method of treating tooth discoloration, the treatment is known to have deleterious effects on the natural tooth structure such as enamel erosion and surface roughness.

As mentioned previously by Joiner [5], the levels of primarily used hydrogen peroxide (HP) and carbamide peroxide (CP) are ranged from 5.3 to 38% and 10 to 37%, respectively. In-office whitening treatment meanwhile uses relatively high percentage levels of HP and CP ranging from 25 to 35% for shorter period. The percentage of peroxide content in at-home products on the other hand, is remarkably lower which ranged from 3 to 6% and 10% for HP and CP respectively. In this study, we looked at the effects of two different peroxide concentrations: 6% HP (Beyond Core White Whitening Gel) and 16% CP (White Smile Whitening Pen) on tooth shade. The results showed no noticeable changes in tooth shade following the treatment protocol following manufacturer's recommended guideline. Hence, it can be concluded that the low percentage levels of peroxides in at-home products did not produce an effective tooth whitening effect according to the recommended guideline. However changes in tooth colour were found in samples treated with 6% hydrogen peroxide at three times and five times the suggested guideline, while changes in tooth shade in samples treated with 16% carbamide peroxide were only observed at five times the indicated guideline.. The results also revealed that there are differences between the two peroxide-based at home whitening agents. According to Banerjee [11], 10% carbamide peroxide is equivalent to 3.5% hydrogen peroxide. This is because carbamide peroxide slowly releases about one third of its volume as hydrogen peroxide. Thus, the whitening effect using carbamide peroxide-containing product needed a longer treatment time to be effective in comparison to hydrogen peroxide since the hydrogen peroxide released slowly from the carbamide peroxide.

The result also showed no significant changes onto enamel surface appearance of the examined teeth. This is in line with the study conducted by Joiner [5] which mentioned that the peroxide containing products have no significant harmful effects to surface of enamel. However, there were several studies evaluated that the use of 10% carbamide

peroxide produced slight surface changes while the use of highly concentrated hydrogen peroxide, commonly used in office teeth whitening treatment had caused more severe alteration on enamel microstructure when observed under scanning electron microscope (SEM). Meanwhile, there was improvement shown in some samples with mild fluorosis. Teeth whitening treatment has become a treatment of choice in case of fluorosis. Dental fluorosis is characterized by the presence of bilateral, thin and horizontal white striations and stained plaque areas [12]. The major causative factor to dental fluorosis is excessive fluoride ingestion during tooth development. The severity of dental fluorosis can be classified into mild, moderate and severe fluorosis. For less severe cases, a conservative method such as enamel microabrasion, tooth bleaching or a combination of these techniques have shown to reduce superficial enamel opacity. In our study, there were several samples with questionable, very mild, mild and moderate fluorosis. These samples have shown a reduction in the enamel opacity after 14 consecutive days of application with whitening gel. Castro et al. [12] in their study further mentioned that at-home bleaching treatment led to assimilation of the colour of the fluorotic stain with the colour of surrounding enamel areas. Freedman et al. [13] supported the previous statement which mentioned mild fluorosis or snow capping can benefit from tooth whitening with peroxide.

CONCLUSION

It is concluded that the two at-home whitening products used in the experiment, Beyond Core White Whitening Gel and White Smile Whitening Pen were not effective for teeth whitening treatment since there were no changes in tooth shade detected after 14 consecutive days of application following manufacturer's recommended guideline. Changes in tooth shade were only recognized in samples treated with treatment protocols exceeding the recommended guideline.

There were also no significant changes on surface appearance shown on the enamel after application of at-home tooth whitening agents. However, it was shown that peroxide-based whitening products was effective in treatment of mild fluorosis as evaluated by Dino-Lite Microscope.

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APPENDIX 1

Teeth whitening application protocol (for 14 consecutive days)

CORE WHITE (30 minutes recommended guideline)

Exposures	Samples	Application time	Removal time
5x	CWA 1	8:00 AM	10:30 AM
	CWA 2	8:05 AM	10:35 AM
	CWA 3	8:10 AM	10:40 AM
3X	CWB 1	8:15 AM	9:45 AM
	CWB 2	8:20 AM	9:50 AM
	CWB 3	8:25 AM	9:55 AM
1X	CWC 1	8:30 AM	9:00 AM
	CWC 2	8:35 AM	9:05 AM
	CWC 3	8:40 AM	9:10 AM

WHITE SMILE (20 minutes recommended guideline)

Exposures	Samples	Application time	Removal time
5x	WCA 1	8:45 AM	10:25 AM
	WCA 2	8:50 AM	10:30 AM
	WCA 3	8:55 AM	10:35 AM
3X	WCB 1	9:00 AM	10:00 AM
	WCB 2	9:05 AM	10:05 AM
	WCB 3	9:10 AM	10:10 AM
1X	WCC 1	9:15 AM	9:35 AM
	WCC 2	9:20 AM	9:40 AM
	WCC 3	9:25 AM	9:45 AM

INDEX

A

B

C

D

E

F

G

H

I

K

L

M

O

P

Q

R

S

T

V

W

NOTES

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