



الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يُونِيسْتِي اِسْلَام اِنْتَارَا بَغْسَا مَلِيسِيَا
Garden of Knowledge and Virtue

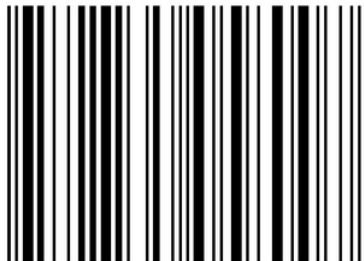
IJOHS

*IIUM Journal of
Orofacial and Health
Sciences*

A scientific journal
published by IIUM Press



eISSN 2735-0584



VOL. 4 ISSUE 1

2023

9 772735 058007

IIUM Journal of Orofacial and Health Sciences

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IIUM Journal of Orofacial and Health Sciences

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IIUM Journal of Orofacial and Health Sciences (IJOHS) is a peer reviewed biannual international journal dedicated to publish high quality of scientific research in the field of orofacial sciences, health sciences and interdisciplinary fields, including basic, applied and clinical research. The journal welcomes review articles, original research, case reports and letters to the editor. Areas that are covered include but are not limited to dental sciences, oral microbiology and immunology, oral maxillofacial and craniofacial surgery and imaging, dental stem cells and regenerative medicine, dental biomaterial, oral maxillofacial genetic and craniofacial deformities, dental public health and health sciences.

Publisher

IIUM Press

International Islamic University Malaysia (IIUM)

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Phytotherapy and oral health

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How to cite this article:

Alahmad, B. E. M. (2023). Phytotherapy and oral health. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 1-3.

<https://doi.org/10.31436/ijohs.v4i1.213>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.213>

Received:

8 February 2023

Revised:

21 February 2023

Accepted:

27 February 2023

Published Online:

28 February 2023

Phytotherapy is the use of extracts from natural origin as medicines or health-promoting agents. The use of medicinal herbs in the treatment of a variety of ailments is beneficial and efficient (Jaikaria *et al.*, 2016). Many different herbal plants can be used to extract phytotherapeutic chemicals, which are thought to offer a wide range of therapeutic effects and fewer adverse effects than synthetic medications. A significant contribution to pharmacotherapy has historically been made by natural compounds and their structural analogues. The World Health Organization (WHO) estimates that around 80% of people worldwide utilise traditional medicine, mostly plant extracts, for their healthcare. Due to cultural familiarity, accessibility, and price, traditional medicine has seen a resurgence in interest considering that it has been used to treat illnesses for thousands of years (Schuhladen *et al.*, 2019).

In addition to conventional treatment options, herbal agents have taken root into the oral care business in recent years owing to their physicochemical properties and therapeutic benefits, which include the ability to heal canker sores, gum inflammation, and tooth discomfort. The oral care sector has witnessed the emergence of oral hygiene products, particularly toothpaste, made with natural ingredients that are less toxic, more biocompatible,

sustainable, and at the same are having the desired therapeutic properties (Cheng *et al.*, 2019).

Many companies have started to use herbal ingredients in their products to provide additional therapeutic characteristics. Natural substances made from herbs and plant parts can be used singly or in combination to improve oral hygiene, prevent inflammation, and allergies, and even alleviate some autoimmune diseases. Due to their effective antifungal, antimicrobial, antiviral, and analgesic properties as well as their cheaper costs, availability, and low rate of side effects, these items are excellent alternatives to traditional medications (Teodoro *et al.*, 2022). Although much has been stated about the advantages of phytotherapy for oral health, there are still a lot of areas that need to be thoroughly investigated, particularly in terms of its effectiveness, mechanism of action, and potential interactions with the body and other medications.

For example, despite early attempts to identify prospective antimicrobial drugs from natural products, the actual efficacy and the precise mechanisms of action are still largely unknown because of the limitations of the assays employed. Such methods of evaluating antimicrobial activity, for instance, are somewhat troublesome for

a variety of reasons. First, bacteria in the oral cavity would never be exposed to a constant concentration of an exogenously introduced antimicrobial agent over a 24-hour period. Microorganisms in the oral cavity are rarely exposed to high concentrations of an antibiotic for longer than 30 seconds to a few minutes unless a chemical has an exceptional substantivity.

Second, the bacteria in classical Minimum Inhibitory Concentration/Minimum Bactericidal Concentration (MIC/MBC) assays are in suspension, whereas the oral bacteria associated with caries are enmeshed in the plaque biofilm matrix (Griffith *et al.*, 2022). Several studies have demonstrated that cells in biofilms are more resistant to antimicrobials than cells in suspension. It is therefore unlikely that reporting antibacterial activity against planktonic oral bacteria with continuous exposure to an antibiotic at a high concentration over the course of a day would accurately reflect how oral bacteria would react in the mouth (Jeon *et al.*, 2011).

Several natural products may exude potential in modulating the pathogenesis of dental caries, however very few *in vivo* investigations and even fewer clinical evaluations have been done. Although the evidence is not yet complete, it shows that novel and effective anticaries/antiplaque medicines may be developed using natural ingredients. More research must be done in order to assess the therapeutic effectiveness and safety of these drugs (Chen *et al.*, 2020).

Another challenging aspect of phytotherapy is the fact that it may be difficult to find new bioactive chemicals because of the intricacy of crude or semi-pure natural extracts and the chemical composition of its components (Thomford *et al.*, 2018). It is complicated to demonstrate the therapeutic efficacy of herbal medications because of their complicated chemical complexity. The relatively new idea of combining herbal medicines with allopathic entities to create the synergy of their therapeutic effects has drawn more and more attention in recent years. Moreover, the identification of the active components of an unusually complex

matrix sometimes necessitates purification and additional bioassays, which is tedious, difficult, and time-consuming. Furthermore, the geographical location, seasonal variations, and biological diversity all have an impact on the chemical composition of the natural products leading to uniformity issues which further requires more research on standardization to be done accordingly (Beutler *et al.*, 2019).

Despite so, it is apparent that the field of natural product research and pharmaceutical development related to dentistry is evolving quickly. The success rate of new therapeutic moieties could be increased through innovative drug development from natural products. Discovering new drugs from natural origin has the potential to help address numerous issues in oral health and advance the field. For the prevention and treatment of oral and dental issues, phytotherapy using extracts of natural origin as oral health-promoting agents can offer a viable and safe alternative to antibiotics and other synthetic drugs. Without understanding their pharmacokinetics and pharmacodynamics, the use of these products shouldn't be viewed as obsolete or ineffective. In fact, having a complete understanding of the benefits and drawbacks of these items will enable dental healthcare professionals to advise patients in the proper manner and help them achieve their goals in areas where modern oral healthcare methods are still limited.

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Knowledge and attitude on bruxism among International Islamic University Malaysia (IIUM) students

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Abstract

Bruxism is an oral habit of clenching and grinding teeth. In 2014, the prevalence of bruxism among youth has been increased to 51.2% which is higher than previous studies. Effects of bruxism can affect the quality of life. Hence, this study aimed to examine the level of knowledge and attitude among IIUM Kuantan students by developing a questionnaire as a research tool in this study, identifying the level of knowledge and attitude, determining the sociodemographic characteristics that contribute to the level of knowledge and attitude, and determining the correlation between the knowledge and attitude on bruxism. The domains such as type, symptom, risk factor, effect, prevention, and treatment on bruxism was assessed in the questionnaire. Data from 129 respondents was collected through Google form by using convenience sampling. As the result, the development of questionnaire as the research tool was completed by literature review, and pilot study ($\alpha=0.844$). Both of knowledge and attitude on bruxism were poor. Significant differences were detected using Kruskal Wallis test in term of knowledge between respondents' age ($p=0.008$), faculty ($p=0.009$), and level of study ($p=0.024$). Similarly sociodemographic characteristics which were age ($p=0.001$), kulliyah ($p<0.001$), and level of study ($p=0.002$) detected significant differences in term of attitude on bruxism. A fair positive correlation was determined by Spearman coefficient between knowledge and attitude on bruxism among the respondents ($r=0.461$, $p<0.001$). In conclusion, it is recommended for the healthcare authorities conducting an educational program to increase the level of knowledge and attitude on bruxism among the population.

Received:

13 April 2022

Revised:

2 September 2022

Accepted:

23 September 2022

Published Online:

28 February 2023

How to cite this article:

Jamaluddin, N. S. N., & Abdul Ghani, R. (2023). Knowledge and attitude on bruxism among International Islamic University Malaysia (IIUM) students. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 4–15. <https://doi.org/10.31436/ijoh.s.v4i1.145>

Article DOI:

<https://doi.org/10.31436/ijoh.s.v4i1.145>

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Keywords: attitude, bruxism, knowledge

Introduction

Bruxism is a condition of clenching and grinding the teeth. A study by Phuong *et al.* (2020) found that the prevalence of bruxism among Vietnamese students was 51.2%, which is higher compared to the range of bruxism's prevalence in previous studies, that is 8% to 31%. It can be categorized as awake and sleep bruxism, or primary and secondary bruxism. According to Guaita and Högl (2016), Inchara *et al.* (2020), and Abd Salam (*n.d.*), the common symptoms of

bruxism are headaches, jaw muscle and facial pain, dental wear, and broken teeth or fillings.

The risk factors of bruxism can be categorized as biological, psychological, and exogenous factors. Biological factor is including genetic, while the psychological factors include depression, anxiety, and stress. According to Smardz *et al.* (2019), the exogenous factors that can cause bruxism are consumption of certain drugs, alcohol, caffeine, and smoking. Chewing gum also has been identified as a habit that can lead to

bruxism (Aguilera *et al.*, 2017). Worsening bruxism can be prevented by regular dental examination and used of the occlusal splint to prevent further damage towards the teeth as it able to protect teeth during clenching and grinding habit (Guaita & Högl, 2016).

Changing lifestyle is needed by avoiding the exogenous factors especially for those who have bruxism as their family history background. The treatment for bruxism is non-steroidal anti-inflammatory drug. Besides, the injection of botulinum toxin also has been used in patient with severe bruxism that do not respond to any medication that has been provided (Guaita & Högl, 2016). Prolonged period of bruxism can cause further oral health problem such as temporomandibular disorder.

This study will be focusing on the assessment of knowledge and attitude on bruxism among IIUM Kuantan Campus students. The results of this study assist in alerting the relevant authorities in increasing the level of knowledge and attitude on bruxism among IIUM Kuantan students by conducting a campaign, and continuous educational program in the future. The exposure towards the type, symptoms, risk factors, effect, prevention, and treatment of bruxism can help in the early detection of bruxism. This intervention is hoped to reduce trends of symptoms, risk factors and effects of bruxism and improve the quality of life.

Materials and Methods

Ethical approval

Ethical approval was obtained from Kulliyyah Postgraduate and Research

Committee (KPGRC), Kulliyyah of Allied Health Sciences and followed by approval from IIUM Research Ethical Committee (IREC).

Study design and setting

The study adopted a cross sectional study design. It was conducted online through Google form to collect the data from the respondents in IIUM, Kuantan Campus from February until August 2021.

Sample size

The sample size has been calculated by using single proportion formula using 95% confidence interval, and 0.09 precision decided. The proportion in population used was from prevalence of bruxism among students in Vietnam which is 51.2% (Phuong, 2020). The total number of respondents for this study was 129 respondents including 10% of non-response rate.

Sampling method

This quantitative study employed a convenience sampling.

Inclusion criteria

Targeted population for this research included the undergraduate, postgraduate, local, and international students of IIUM Kuantan Campus.

Exclusion criteria

Students that unable to read and understand English were excluded as the questionnaire was available in English version only

Table 1. Knowledge items and references.

Questions	References
<p>Type Bruxism occurs during sleep. Improper alignment of teeth occurred due to bruxism. #</p>	<p>Phuong <i>et al.</i> (2020) Abd Salam (n.d.)</p>
<p>Symptom Headache is a symptom of bruxism. Bruxism usually remains unrecognized until the condition is worsened. Patients with bruxism are usually experienced jaw pain.</p>	<p>Abd Salam (n.d.) Smardz <i>et al.</i> (2019) Abd Salam (n.d.)</p>
<p>Risk factor Bruxism can be inherited. Severe bruxism may lead to depression, anxiety, and stress. # Smoking increases the risk of having bruxism. Bruxism patient will be advised to stop drinking coffee immediately. Reduce alcohol intake can lower the risk of bruxism. Consumption of antidepressant drug can reduce the risk of having bruxism. #</p>	<p>Ahlberg <i>et al.</i> (2020) Afridi (2018) Kuhn & Türp (2018) de Baat <i>et al.</i> (2020) de Baat <i>et al.</i> (2020) Smardz <i>et al.</i> (2019)</p>
<p>Effect Bruxism is more likely to affects teeth condition compared to muscle disorder. #</p>	<p>Inchara <i>et al.</i> (2020)</p>
<p>Treatment Treatment for bruxism will be focused on the teeth. #</p>	<p>Guaita & Högl (2016)</p>
<p>Prevention Worsen bruxism can be prevented by regular dental examination. Occlusal splint (mouth guard) can prevent teeth damage in bruxism.</p>	<p>Abd Salam (n.d.) Guaita & Högl (2016)</p>

Note: Negative items are identified with (#).

Table 2. Attitude items and references.

Questions	References
Type	
I think bruxism can be control if the patient is staying awake. #	Phuong <i>et al.</i> (2020)
I am aware that sleep disorder is associated with bruxism.	Abd Salam (n.d.)
Symptom	
I believe that grinding noise during sleep is a symptom of bruxism.	Abd Salam (n.d.)
I believe that excessive force of grinding can lead to fracture of teeth.	Guaita & Högl (2016)
Risk factor	
I believe that bruxism tends to occur in person with family history of bruxism.	Ahlberg <i>et al.</i> (2020)
I believe that smokers are more likely to have bruxism.	Kuhn & Türp (2018)
I believe that the relationship between bruxism and stress is a myth. #	Afridi (2018)
I think antipsychotic drug can prevent teeth grinding. #	Abd Salam (n.d.)
I think bruxism tends to worsen after alcohol consumption.	de Baat <i>et al.</i> (2020)
I believe gum chewing is a type of exercise that can reduce the effect of bruxism. #	Aguilera <i>et al.</i> (2017)
Effect	
I think bruxism can lead to joint disorder.	Abd Salam (n.d.)
Treatment	
I think medical doctor can help me when I have any pain or discomfort of jaw. #	Singh <i>et al.</i> (2020)
I think pain killer is included in treatment of bruxism.	Guaita & Högl (2016)
Prevention	
I think avoiding dental check-up is a reason of bruxism remains undetected.	Abd Salam (n.d.)
I think consumption of medicine is more effective than the used of occlusal splint (mouth guard) for treating bruxism. #	Guaita & Högl (2016)

Note: Negative items are identified with (#).

Questionnaire development

The questionnaire has been divided into three sections. First section consisted of sociodemographic data, including age, gender, course and year of study, academic performance, routine visit for dental check-up, underlying oral condition, hours spend on physical activities and sleep disturbance experienced. Second and third sections of questionnaire was developed to evaluate the knowledge an attitude on bruxism, respectively. It consists of six domains that will be assessed in the questionnaire, which are type, symptom, risk factor, effect,

prevention, and treatment of bruxism. The questions for knowledge and attitude of bruxism are presented in Table 1 and Table 2 respectively. The knowledge section will be on 'True', 'I am not sure', and 'False' choices. Correct answer will be given two marks, while incorrect and 'I am not sure' options will be given zero mark. Likert scale will be used in attitude section which consists of 'Strongly agree', 'Agree', 'Neutral', 'Disagree', and 'Strongly disagree'. Reverse coding is done for the negative items.

Pilot study

Twelve respondents have been involved in this study based on the suggestion from Connelly (2008). An additional section is provided in Google form for the respondents to point out their view on questionnaire and suggesting for improvement. The value of Cronbach’s alpha was calculated by using Statistical Package for the Social Sciences (SPSS) version 12.0.

Data collection

Data collection have been done from March to May 2021. Consent from the respondents

have been obtained directly at the beginning of online survey.

Data analysis

All data were analyzed by using SPSS version 12.0. The level of knowledge and attitude was evaluated based on the percentage of marks gained. It was categorized into three groups, which was shown in Table 3 by using modified Bloom’s cut-off point (Ramli *et al.*, 2018).

Table 3. Categorization for level of knowledge and attitude on bruxism among IIUM Kuantan students.

Percentage (%)	Knowledges	Attitudes	Level of knowledge and attitude
80-100	24-30	48-60	High
60-79	18-23	36-47	Moderate
≤ 59	0-17	0-35	Poor

Normality of the raw data have been checked before pursuing any of statistical analysis by checking the histogram, comparing means, and skewness. For the first objective, which is to identify the knowledge and attitude on bruxism among IIUM Kuantan Campus students, descriptive frequency was used. As for second objective, which is to find the related sociodemographic characteristics that contribute to the level of knowledge and attitude on bruxism, Kruskal Wallis and Mann-Whitney U tests were used. Lastly, the correlation analysis, Spearman correlation coefficient was used to determine the correlation between knowledge and attitude on bruxism among IIUM Kuantan Campus students.

Results

Questionnaire development

The questionnaire consists of three sections which are sociodemographic data,

knowledge on bruxism, and attitude on bruxism. The items were developed based on the current information that have been obtained from journals, articles, and Ministry of Health websites which were published between 2016 and 2020. The developed questionnaire in knowledge and attitude sections which consists of 30 items was tested by conducting a pilot study. According to the statistical analysis, the Cronbach’s alpha for knowledge on bruxism is 0.878, while the value for attitude on bruxism is 0.809. The overall value for Cronbach’s alpha is 0.844.

Descriptive analysis of the respondents

A total of 129 valid questionnaire responses were received which fulfilled the sample size requirement. The variables that have been collected for sociodemographic data were age, gender, kulliyah or faculty, level of study, academic performance, routine visit

for dental check-up, underlying oral condition, frequency on physical activities per week, and experience of sleep disturbance. The frequency and percentage

of respondents according to their sociodemographic characteristics was presented in Table 4.

Table 4. Sociodemographic data of respondents (n=129).

Sociodemographic Characteristics	Frequency	Percentage (%)
Age		
20	25	19.4
21	22	17.1
22	51	39.5
23	21	16.3
24	7	5.4
25	3	2.3
Gender		
Male	26	20.2
Female	103	79.8
Kulliyah		
Kulliyah of Medicine	11	8.5
Kulliyah of Dentistry	10	7.8
Kulliyah of Pharmacy	23	17.8
Kulliyah of Allied Health Sciences	53	41.1
Kulliyah of Nursing	17	13.2
Kulliyah of Sciences	15	11.6
Level of Study		
Year 1	25	19.4
Year 2	28	21.7
Year 3	59	45.7
Year 4	14	10.9
Year 5	3	2.3
Postgraduate	0	0
Academic Performance		
CGPA 3.50 and above	68	52.7
CGPA 2.80 to 3.49	38	29.5
CGPA 2.00 to 2.79	1	0.8
CGPA below than 2.00	0	0.0
Pass	22	17.1
Fail	0	0.0
Routine Visit for Dental Check-up		
At least once a year	41	31.8
Every 2 years	5	3.9
Less frequents than every 2 years	8	6.2
Only go to dentist when I have problem	75	58.1
Routine Visit for Dental Check-up		
At least once a year	41	31.8
Every 2 years	5	3.9
Less frequents than every 2 years	8	6.2
Only go to dentist when I have problem	75	58.1

Do you have any of these underlying oral conditions?		
None	64	49.6
Improper alignment of teeth	38	29.5
Development of teeth problem	9	7.0
Loss of tooth structure	4	3.1
Having more than one underlying oral condition	14	10.9
During last week, how many hours did you spend on physical activities?		
5 hours or more	11	8.5
Between 2.5 and 5 hours	32	24.8
Less than 2.5 hours	60	46.5
None	26	20.2
Do you experience sleep disturbance?		
Yes	18	14.0
No	111	86.0

Note: The total of highest frequency from each category is highlighted in bold.

Level of knowledge and attitude on bruxism

Both level of knowledge and attitude on bruxism were reported as poor. The

frequency for each category were presented in Table 5.

Table 5. Level of knowledge and attitude on bruxism.

Categories	Frequency	Percentage (%)
Knowledge		
Poor	119	92.2
Moderate	10	7.8
High	0	0
Attitude		
Poor	75	58.1
Moderate	53	41.1
High	1	0.8

Note: The total of highest frequency from each category is highlighted in bold.

Sociodemographic characteristics that contribute to level of knowledge and attitude on bruxism

There was a significant different in term of knowledge on bruxism between the respondents' age ($p=0.008$) among 20 years old ($\bar{X}=8.40$, $M=8.00$) and 25 years old ($\bar{X}=19.33$, $M=18.00$), and 23 years old ($\bar{X}=7.43$, $M=6.00$) and 25 years old ($\bar{X}=19.33$, $M=18.00$). Besides, there was also a significant different in knowledge on bruxism between the Kulliyyah of respondents ($p=0.009$) which were between Kulliyyah of Pharmacy ($\bar{X}=7.48$, $M=8.00$),

Kulliyyah of Dentistry ($\bar{X}=15.00$, $M=14.00$), and Kulliyyah of Nursing ($\bar{X}=8.00$, $M=8.00$). Next, a significant different is found in term of knowledge between respondents' level of study ($p=0.024$), which were between year 1 ($\bar{X}=7.84$, $M=8.00$) and year 5 ($\bar{X}=19.33$, $M=18.00$). The comparison between sociodemographic characteristics in knowledge is shown in Table 6.

A significant difference in term of attitude on bruxism was found between the respondents' age group ($p=0.001$) among 20 years old ($\bar{X}=33.12$, $M=33.00$) and 25 years

old (\bar{X} =42.67, M=41.00). There was also a significant different in attitude on bruxism between the respondents' Kulliyah ($p < 0.01$) which were between Kulliyah of Nursing (\bar{X} =32.47, M=32.00), Kulliyah of Allied Health Sciences (\bar{X} =36.06, M=36.00), Kulliyah of Dentistry (\bar{X} =38.60, M=39.00), and Kulliyah of Sciences (\bar{X} =33.20, M=34.00). Lastly, there were a significant different in term of attitude on bruxism

between respondents' level of study ($p=0.002$) students. There were significant different between year 1 (\bar{X} =33.00, M=33.00) and year 3 (\bar{X} =35.53, M=35.00), and year 1 (\bar{X} =33.00, M=33.00) and year 5 students (\bar{X} =42.67, M=41.00). The comparison between sociodemographic characteristics in attitude is shown in Table 7.

Table 6. Comparison between sociodemographic characteristics in knowledge.

Sociodemographic Characteristics	Mean	Median	p-value
Age			
20	8.40	8.00	0.008*
21	8.73	10.00	
22	10.47	12.00	
23	7.43	6.00	
24	11.14	12.00	
25	19.33	18.00	
Kulliyah			
Kulliyah of Medicine	9.27	10.00	0.009*
Kulliyah of Dentistry	15.00	14.00	
Kulliyah of Pharmacy	7.48	8.00	
Kulliyah of Allied Health Sciences	10.26	12.00	
Kulliyah of Nursing	8.00	8.00	
Kulliyah of Sciences	8.27	10.00	
Level of Study			
Year 1	7.84	8.00	0.024*
Year 2	8.93	11.00	
Year 3	9.97	10.00	
Year 4	9.71	12.00	
Year 5	19.33	18.00	

Note: (*) Statistically significance is displayed

Table 7. Comparison between sociodemographic characteristics in attitude.

Sociodemographic Characteristics	Mean	Median	p-value
Age			
20	33.12	33.00	0.001*
21	34.50	34.00	
22	35.73	36.00	
23	34.43	35.00	
24	37.57	38.00	
25	42.67	41.00	
Kulliyah			
Kulliyah of Medicine	35.27	35.00	<0.001*
Kulliyah of Dentistry	38.60	39.00	
Kulliyah of Pharmacy	34.26	35.00	
Kulliyah of Allied Health Sciences	36.06	36.00	
Kulliyah of Nursing	32.47	32.00	
Kulliyah of Sciences	33.20	34.00	
Level of Study			
Year 1	33.00	33.00	0.002*
Year 2	34.82	34.50	
Year 3	35.53	35.00	
Year 4	35.64	36.50	
Year 5	42.67	41.00	

Note: (*) Statistically significance is displayed.

However, there was no significant different that has been found in term of knowledge and attitude on bruxism between gender, academic performance, routine visit for dental check-up, underlying oral condition, frequency in physical activities, and sleep disturbance experience.

Correlation between knowledge and attitude on bruxism

The value for Spearman’s correlation coefficient was 0.461, which indicated that there was a fair positive correlation. The p-value indicate that there is a statistically significant between knowledge and attitude scores on bruxism as the p-value was less than 0.001.

Discussion

Bruxism is an involuntary oral habit of clenching and grinding the teeth. A study by

Machado (2014) reported that the prevalence of bruxism among youth was 13%. However, the current study by Phuong (2020) found that the prevalence of bruxism has increased to 51.2%. Bruxism remains unrecognized by the bruxers as its only can be detected by dentist due to excessive wear of tooth.

According to Abd Salam (n.d.), there are many signs and symptoms of bruxism such as headache, jaw and facial pain, tooth wear, and sleep disturbance, which are able to affect the individuals’ quality of life. Decision by the bruxers to do dental check-up might be too late as the condition can be worsen and cause another episode of oral condition which is temporomandibular disorder (Achmad *et al.*, 2020).

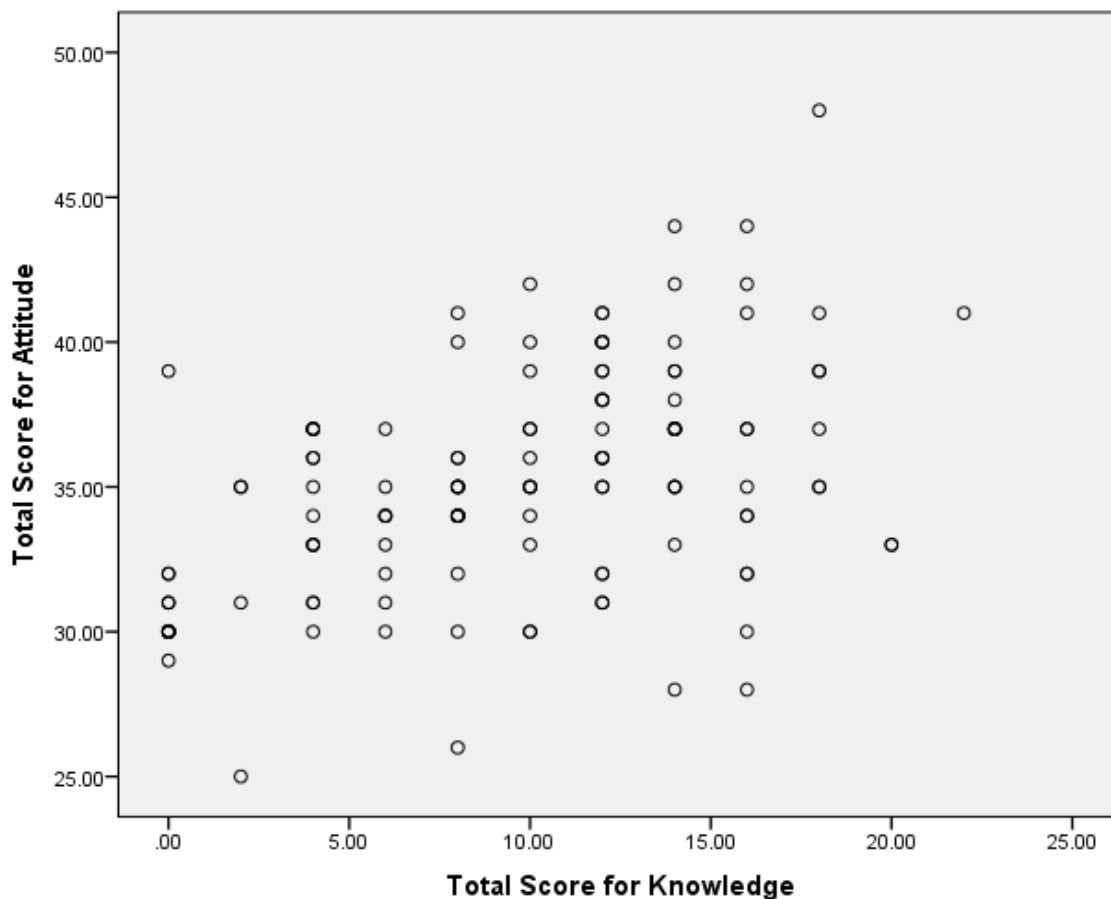


Figure 1. Correlation between knowledge and attitude on bruxism.

The first objective was to develop the questionnaire as a tool for this research. The questionnaire was developed through literature review and tested by pilot study. The advantage of developing questionnaire was to gain accurate information that needed in the study. As there was a limitation of time, the validation from expert were failed to be done. The result shown that the overall value of Cronbach alpha for knowledge and attitude on bruxism was 0.844. According to Stephanie (*n.d.*), the Cronbach's alpha value between 0.800 and 0.900 was considered as good internal consistency and reliable.

The second objective was to identify the level of knowledge and attitude on bruxism among IIUM Kuantan Campus. Both knowledge and attitude on bruxism among the respondents were poor. The result was aligned to a study in Dakshina Kannada, India by Singh *et al.* (2020) which has

reported that there is poor knowledge on bruxism. This study agreed that lack of spreading the information regarding term, risk factor, prevention and treatment of bruxism is the main reason on low knowledge among the population. The study by Inchara (2019) has also reported on low knowledge level among the bruxers. There was no study that measure the level of attitude on bruxism. Therefore, it can be concluded that lack of spreading information on bruxism lead to low knowledge and attitude among the respondents.

The highest frequency of answers by respondents was 'I am not sure'. A study by Singh *et al.* (2020) on the bruxism awareness found that the respondents were unaware on the treatment domain, as the respondents were not aware on the various treatment options. It was aligned with this study which reported that most of the respondents were not sure that the treatment on bruxism

include teeth and muscle as bruxism can lead to facial pain and headache. Besides, most of the respondents were also more comfortable to consult a physician compared to dentist when they have any jaw discomfort which the result was in agreed with the study by Singh *et al.* (2020), as the respondents were unaware on the dentist profession that actually covers on teeth and also jaw problem. The lack of awareness in this issue was due to the low spreading information towards the population.

The third objective was to determine the sociodemographic characteristics that contributes to the level of knowledge and attitude on bruxism among IIUM Kuantan Campus students. This objective was achieved by comparing the sociodemographic characteristics of the respondents which might contributes to level of knowledge and attitude on bruxism. The discussion was focusing on the knowledge and attitude based on sociodemographic characteristics of the students regarding to the oral related health as there is no previous study on level of knowledge and attitude on bruxism among students to be compared. It was found that there was significant difference in term of knowledge and attitude on bruxism between age groups. Surprisingly, this result was contrary from the finding by Abdullah *et al.* (2016) in Bertam, Penang and Abeer (2016) in Riyadh as there were no significant differences between the level of knowledge and attitude with age of the respondents as individual has different capability in understanding the knowledge and awareness that they gain despite of their age. However, it can be seen that the oldest age among the respondents in this study which was 25 years old had a higher level of knowledge (\bar{X} =19.33, M=18.00) and attitude (\bar{X} =42.67, M=41.00) on bruxism compared to other age groups. Thus, respondents with age of 25 years old have more knowledge on bruxism and able to understand it better than the other age group which will influence their attitude. Besides, different target group between previous and current study may cause the contrary findings.

Next, the result shows that there was a significant difference in term of knowledge and attitude between respondents' kulliyah or faculty. According to this result, it can be concluded that the respondents from Kulliyah of Dentistry have a better knowledge and attitude on bruxism as this study is more related to their discipline compared to the other field of study. Kulliyah of Dentistry has been reported as the highest mean score for knowledge and attitude. It is because dentistry students have a better exposure towards dental problem compared to other faculties. Therefore, the field of study was able to influence the level of knowledge and attitude on related issue, as the dentistry students have better knowledge and attitude on bruxism.

Besides, there were also a significant difference in term of knowledge and attitude between the respondents' level of study. The mean for knowledge and attitude on bruxism among Year 5 students was higher compared to other level of study, which indicated that they might have increase in knowledge and better attitude as they have gained more knowledge and awareness throughout their prolonged period of study. However, it is contrary with the finding from Malekzadeh (2018) that discovered there was no significant different in term of knowledge with students in different semesters as this study has only involved the respondents from two different semester only. There will be no difference in term of knowledge as the duration of study is about the same. Therefore, it can be said that the duration of study will contribute to the level of knowledge and attitude as there will be more exposure on the issue throughout their academic studies.

The fourth objective was to determine the correlation between knowledge and attitude on bruxism among IIUM Kuantan Campus students. It has been found out that an adequate knowledge can lead to positive attitude on the certain issue. This indicated that the lack of knowledge will be resulted in poor attitude on bruxism.

Conclusion

It is important to alert the relevant authorities regarding the output of this study. The outcome from this study recommends that there is a need of conducting an educational program that related to bruxism. This program can increase the knowledge on bruxism and its prevention. It is also hoped that the trend of symptoms, risk factor, and effects of bruxism can be reduced.

Acknowledgement

High gratitude was dedicated to my supervisor, Assoc. Prof. Dr. Radiah Abdul Ghani for her continuous assistance, guidance, and support throughout this study.

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Prevalence of internet addiction among medical and non-medical students of International Islamic University Malaysia (IIUM), Kuantan

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Abstract

Internet addiction has become a serious problem with the increasing internet use, especially among college students and adolescents. Most of the available literature on internet addiction among college students was mainly related to medical students and showed a disturbing prevalence, however, this is not widely studied among non-medical students. This study describes the prevalence and factors associated with internet addiction among medical and non-medical students at International Islamic University Malaysia (IIUM), Kuantan. A total of 107 medical and 104 non-medical students of IIUM Kuantan participated in this cross-sectional study conducted from July 15, 2019, to August 25, 2019, using random sampling. The Internet Addiction Test (IAT) was distributed through social media platform. Descriptive statistics were used to describe the prevalence and socio-demographic characteristics of the respondents, while binary logistic regression was used to identify respondents' factors associated with internet addiction. The results showed that 67.3% of medical students and 65.4% of non-medical students were moderately addicted to the Internet. The significant predictors of internet addiction in medical students are age (OR 0.235 95% CI 0.068-0.812) and duration of internet use of 4-6 hours (OR 0.235 95% CI 0.068-0.812). Among non-medical students, the significant predictors were social networking (OR 0.137 95% CI 0.003-0.636), Internet TV (OR 3.574 95% CI 1.057-12.08), and time spent on the Internet from 4-6 hours (OR 0.247 95% CI 0.06-0.91). The prevalence of internet addiction among medical and non-medical students at IIUM Kuantan is of concern. Early identification based on these findings for each medical and non-medical faculty can be tailored to ensure successful intervention.

Keywords: *addictive disorders, internet addiction, medical students, non-medical students, youth*

Introduction

The internet is now an indispensable learning tool for students in higher education. Some of the activities for which students use the internet include searching for information, online courses, and communication. However, the internet can also be used for entertainment-related

activities such as social media, gaming, and video streaming, which can lead to "addiction."

Griffiths (2000) stated in his study that internet addiction is associated with addictive disorders and can be placed in the same range as alcohol and drug use disorders. In addition, there are six criterias to operationally define addictions: Salience,

Received:

7 April 2022

Revised:

27 October 2022

Accepted:

27 October 2022

Published Online:

28 February 2023

How to cite this article:

Azmi, F. N., Azmi, N. H., Jasmani, N. ., Mohd Salim, F. S. ., Abdul Hadi, A., & Abd Aziz, K. H. (2023). Prevalence of internet addiction among medical and non-medical students of International Islamic University Malaysia (IIUM), Kuantan. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 16-25. <https://doi.org/10.31436/ijoh.v4i1.142>

Article DOI:

<https://doi.org/10.31436/ijoh.v4i1.142>

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mood change, tolerance, withdrawal, conflict, and relapse. A study by Mythily *et al.* (2013) found that internet addiction is often related to comorbid psychiatric disorders and their symptoms.

Factors contributing to internet addiction include lack of rules for internet use at home, less likelihood of having confidants, feelings of sadness or depression, and perceived lower grades at school or work (Kuss *et al.*, 2013; Mythily *et al.*, 2013). Apart from these, other factors associated with internet addiction include the various functions of the internet, ease of access, user motivations, and impulsive browsing (Kapahi *et al.*, 2013).

Studies among medical students showed a worrisome prevalence of internet addiction, while studies among non-medical students were sparse (Ching *et al.*, 2017; Liu *et al.*, 2010; Pramanik *et al.*, 2012; Razieh *et al.*, 2012). Therefore, this study aims to describe the prevalence of internet addiction and its associated factors among medical and non-medical students at IIUM Kuantan.

Materials and Methods

Ethical consideration

Ethical approval was obtained from the Ethical Committee of International Islamic University Malaysia [IREC 2019-148].

Study design, population, and sampling method

This cross-sectional study was conducted among medical and non-medical students of Kulliyyah of Medicine and Kulliyyah of Science, International Islamic University Malaysia (IIUM), Kuantan Campus. The study was conducted from July 15, 2019, to August 25, 2019. A total of 107 medical and 104 non-medical students who are internet users participated in this study. Quota sampling was used to select participants, in which data collection is conducted until the number of participants reaches the sample

size calculated using the quota. The representative of each study year was approached and the link to an online-based questionnaire was distributed through WhatsApp and Telegram applications.

Study tool

The questionnaire was divided into three parts. The first part consisted of socio-demographic questions. The second part contained questions about the participants' internet use, and the third part consisted of the Internet Addiction Test (IAT). This IAT instrument was developed by Young (1998), consists of characteristics of pathological internet use (PIU), and is a reliable measure worldwide (Young, 1998). The items are rated on a six-point scale regarding participants' experience of their Internet use. We used the English and Malay versions of the Internet Addiction Test (MVIAT). The MVIAT was validated among 162 medical students in Malaysia by Chong Guan *et al.* (2015). The Malaysian version of the IAT showed good internal consistency with a Cronbach's α of 0.91.

Data analysis

The collected data were entered and analyzed using IBM SPSS Statistics for Windows version 24.0. Chi-square and Fisher's Exact Test were used to determine the appropriate variables to include in the binary logistic regression analysis. The data with a p -value of > 0.05 were excluded from the binary logistic regression analysis.

Binary logistic regression analysis was conducted to determine the independent factors associated with internet addiction after adjusting for the possible confounding factors. Due to the small sample size with many exposed variables to evaluate the association factors, the backward elimination (likelihood ratio) method was used in the multiple logistic regression to remove insignificant variables.

Results

Table 1 shows the socio-demographic data of medical and non-medical students at IIUM Kuantan. The mean age for medical students and non-medical students is 22 years and 100% of them are Malays. About 80% of the respondents are female, while the percentage of male respondents in both programs is about 20%. Of the 107 medical student respondents, 37 (34.6%) are in the

T20 income group, 36 (33.6%) are in M40, 30 (28%) are in B40, and only 4 (3.7%) are in the PGK (Pendapatan Garis Kemiskinan) income group. On the other hand, most non-medical students are from the B40 income group (45.2%) and only one from the PGK income group.

Table 1. Socio-demographic characteristics of medical and non-medical students in IIUM Kuantan (N=211).

Characteristics	Medical, N (%)	Non-medical, N (%)
Age (years)	*22.2(1.7)	
Gender		
Male	27(25.2)	21(20.2)
Female	80(74.8)	83(79.8)
Ethnicity		
Malay	107(100.0)	104(100.0)
Household Income		
T20	37(34.6)	20(19.2)
M40	36(33.6)	36(34.6)
B40	30(28.0)	47(45.2)
PGK	4(3.7)	1(1.0)

*Mean (sd)

Prevalence of internet addiction

Table 2 described prevalence of internet addiction among medical and non-medical students of IIUM. According to Xi Lu *et al.* (2015), an individual who gets IAT total score between 0 and 30 is deemed as normal Internet user, between 31 and 49 mild Internet user, between 50 and 79 moderate pathological internet users (PIU), and between 80 and 100 he is supposed to suffer

from severe PIU. This study shows that more than half of medical students and non-medical students are under moderate PIU, namely (67.3%) and (65.4%), respectively. About 30% of medical students and non-medical students are categorized into mild addiction or mild internet user. There are more non-medical students than medical students who are severely PIU, namely 5% among non-medical students and 2% among medical students.

Table 2. Prevalence of internet addiction among medical students and non-medical students of IIUM Kuantan (N=211).

Internet Addiction	Medical Students		Non-medical Students	
	n	%	n	%
Mild	33	30.8	31	29.8
Moderate	72	67.3	68	65.4
Severe	2	1.9	5	4.8

Information on the internet usage for medical and non-medical students of IIUM Kuantan

Information about the internet usage of medical and non-medical students at IIUM Kuantan can be found in Table 3. Regarding the type of devices used, all medical students and non-medical students use smartphones to browse the internet, which means that every student owns a smartphone (100%). Furthermore, more than 80% of medical and non-medical students used laptops to browse the internet. In contrast, most students do not use smart TVs or tablets to browse the internet. Interestingly, there is only one student who has used the internet via a smartwatch.

In terms of similarity, both medical and non-medical students (more than 90%) used the internet for communication, entertainment, and social networking. In addition, more than half of both medical and non-medical students used the internet for online banking, shopping, and as a search engine.

However, more non-medical students than medical students used the internet for gaming, TV, and news, while a higher percentage of medical students used the internet for educational purposes.

It is also observed that most medical students spent 1-4 hours per day on the internet, while most non-medical students spent 4-6 hours per day on the internet. We can also observe a difference in the pattern of internet usage per day: The majority (91%) of medical students used the internet from 6 p.m. to 12 a.m., and very few used the internet outside these hours. In contrast, among non-medical students, 22% used the internet from noon to 6 p.m. and 67% used the internet from 6 p.m. to noon.

Association of internet addiction with age, duration spend on internet, online banking, social network, and internet TV

Table 4 and 5 is the multiple logistic regression analysis after simultaneous adjustment with possible risk factors. It showed that duration of internet use and age were the protective factors for medical students. Students who used the internet for 4-6 hours had a 77% lower risk of suffering from internet addiction than students who used the internet for more than 6 hours. Regarding age, internet addiction was 23.5% less likely when age increased by 1 unit.

Table 3. Information on the internet usage for medical and non-medical students of IIUM Kuantan.

Characteristic	Variables	Medical Students		Non-medical Students	
		n	%	n	%
Gadget for internet usage					
Smartphone	Yes	107	100.0	104	100.0
	No	0	0.0	0	0.0
Laptop	Yes	93	86.9	87	83.7
	No	14	13.1	17	16.3
Smart TV	Yes	6	5.6	7	6.7
	No	101	94.4	97	93.3
Tablet	Yes	21	19.6	11	10.6
	No	86	80.4	93	89.4
Smartwatch	Yes	0	0.0	1	1.0
	No	107	100.0	103	99.0
Purpose of internet usage					
Communication	Yes	106	99.1	102	98.1
	No	1	0.9	2	1.9
Online banking	Yes	68	63.6	71	68.3
	No	39	36.4	33	31.7
Entertainment	Yes	100	93.5	95	91.3
	No	7	6.5	9	8.7
Social network	Yes	103	96.3	95	91.3
	No	4	3.7	9	8.7
Shopping	Yes	60	56.1	62	59.6
	No	47	43.9	42	40.4
Games	Yes	48	44.9	54	51.9
	No	47	43.9	50	48.1
Internet TV	Yes	11	10.3	17	16.3
	No	96	89.7	87	83.7
Education	Yes	79	73.8	64	61.5
	No	28	26.2	40	38.5
News	Yes	45	42.1	49	47.1
	No	62	57.9	55	52.9
Search engine	Yes	92	86.0	88	84.6
	No	15	14.0	16	15.4
Duration spends on internet usage per day					
	1-4 hours	48	44.9	37	35.6
	4-6 hours	30	28	38	36.5
	> 6 hours	29	27.1	29	27.9
The usual time of using the Internet					
	6am-12pm	3	2.8	11	10.6
	12pm-6pm	6	5.6	23	22.1
	6pm-12am	97	90.7	70	67.3
	12am-6am	1	0.9	0	0.0

In contrast, among non-medical students, the significant associated factors were duration of internet use, internet use for social networking, and internet TV. Students who used the internet for 1-4 hours were 75% less likely to have internet addiction than those who used the internet for more than 6 hours. Those who used the internet

for social networking were 85% less likely to have an internet addiction than those who did not use the internet for social networking. Those who used the internet for TV were 3 times more likely to have an internet addiction than those who did not use the internet. Otherwise, the other variables were not significant.

Table 4. Factors associated with internet addiction among medical students of IIUM Kuantan.

Medical students				
	Variables	Internet Addiction		
		aOR	95% CI	P
Time	1 - 4 hours	0.482	0.151 - 1.536	0.217
	4 - 6 hours	0.235	0.068 - 0.812	0.022
	> 6 hours	1		
Age		0.765	0.593 - 0.988	0.04

Table 5. Factors associated with internet addiction among non-medical students of IIUM Kuantan.

Non-medical students				
	Variables	Internet Addiction		
		aOR	95% CI	P
Time	1 - 4 hours	0.247	0.06 - 0.911	0.036
	4 - 6 hours	0.394	0.105 - 1.482	0.168
	> 6 hours	1		
Social Network	Yes	0.137	0.03 - 0.636	0.011
	No	1		
Internet TV	Yes	3.574	1.057 - 12.08	0.04
	No	1		

Discussion

67.3% of medical students and 65.4% of non-medical students are moderately addicted to the internet, followed by mild addiction (medical students: 30.8%, non-medical: 29.8%) and severe addiction (medical students: 1.9% and non-medical

students: 4.8%). The prevalence is similar in both groups. However, more non-medical students are found in the severe addiction group. Of concern is that there are no students without addiction in either group. In a study conducted in Malaysia among UPM medical students, the prevalence of internet addiction was 36.9%, which is lower than our study (Ching *et al.*, 2017). Another study

from China also showed a lower prevalence of internet addiction, which was only 16.2% (Liu *et al.*, 2010). According to Pramanik *et al.* (2012), their findings reflect that many medical students suffer from mild to moderate addiction. In another journal by Razieh *et al.* (2012), the prevalence of non-medical students in universities in Iran was higher than that of severely addicted students, which is consistent with our findings.

The high prevalence of internet addiction in our study may be due to good internet access (Gedam *et al.*, 2018). According to Frangos *et al.* (2010), university students are most likely to develop internet addiction because internet access is freely available in the dormitory, and parents do not intervene. Another possible explanation for the high prevalence could be the high-stress level among medical and non-medical students, as reported in one of the local studies, in which 18.6% of the university students had moderate, and 5.1% had severe or extreme stress levels (Shamsuddin *et al.*, 2013). Consequently, the internet became their escape mechanism to relieve stress (Ceyhan, 2008). A study by Akin and Iskender (2011) on Turkish medical students showed that internet addiction was positively associated with depression, anxiety, and stress.

Our study had a balanced number of medical and non-medical participants, 107 and 104 students. In this study, male students outnumbered female students in both courses, which was also observed in a study done by UNISZA in Malaysia (Haque *et al.*, 2016). Furthermore, the average age of the students in this study was 22 years, which is slightly similar to another study in Malaysia with an average age of 21 years (Ching *et al.*, 2017). In addition, the results showed that most medical and non-medical students were from families with higher income groups between T20 and M40, which is consistent with another study by Al-Naggar *et al.* (2011) on university students that found similar results.

Overall, the preferred devices for internet use among medical and non-medical students were smartphones and laptops.

According to Srijampana *et al.* (2014), most medical students used mobile phones to access the internet, while laptops were the second most used device.

In our study, the internet was mainly used by both medical and non-medical students for communication, entertainment, and social networking. In another study, medical students with addiction problems used the internet mainly for social networking and chatting (Srijampana *et al.*, 2014). Students with internet addiction prefer to use the internet for nonessential purposes, such as social networking, rather than educational purposes, which may be due to the psychological characteristics of young adults, free access to internet services, and limited or no parental supervision (Gedam *et al.*, 2018).

Our results show that non-medical students tend to use the internet more for gaming, internet television, and news, whereas medical students tend to use it more for educational purposes. However, a comparative study of medical and dental students found that both used the same nonessential purposes, such as social networking and gaming (Gedam *et al.*, 2018). Furthermore, this study also shows that the duration of internet use per day was longer for the non-medical students. It could be due to the nature of their course of study, in which they may have days with fewer classes than medical students. A cross-sectional study among art, engineering, and medical students found that time spent on the internet per day was significantly associated with non-medical, art, and engineering students (Ganapathi, 2015).

Most of the time, both medical and non-medical students surfed the internet at a similar time, from 6 pm to 12 am. This could be because students are usually off during this time. Similar results were observed in Bhola & Mahakud's (2014) study of college students, where 90% of the participants used the internet during the night or late evening, while only 10% used it during the day. They concluded that this could be due to the sense of privacy that college students

want to maintain with fewer distractions during the evening hours.

Our study showed that time spent using the internet was significantly associated with internet addiction in both medical and non-medical students. Medical students who used the internet for 4-6 hours were 77% less likely to have internet addiction than students who used the internet for more than 6 hours ($p=0.022$).

Similarly, non-medical students who used the internet for 1-4 hours were 75% less likely to be addicted to the internet than those who used the internet for more than 6 hours ($p=0.036$). Therefore, it can be assumed that students who use the internet for more than 6 hours are most probably more likely to be addicted. However, in this study, the majority of both medical and non-medical students used the internet for less than 6 hours.

previous studies have shown that more time spent on the internet is significantly associated with addiction. A study conducted by Chaudhari *et al.* (2015) among medical students in an urban area of Western Maharashtra showed that more time spent on the internet daily was significantly associated with internet addiction.

The duration of time spent on the internet may be associated with the purpose of internet use. Most medical students used the internet for educational purposes (73.8%) compared to non-medical students who used the internet primarily for social networking (61.5%). Again, this could be related to the type of study, as medical students with a heavier curriculum are more likely to use the internet in their free time to revise and study than non-medical students. A study by Siraj *et al.* (2015) among 186 4th year medical students at Universiti Kebangsaan Malaysia (UKM) in 2011-2012 confirmed this. It found that students used the internet mainly for courses and assignments and that users who used the internet for more than 6 hours had higher CGPA.

We also found that 14% of non-medical students were more likely to have an internet addiction if they used the internet for social networking than those who used it for other purposes ($p=0.011$). In comparison, internet use for social networking was not a significant factor for internet addiction among medical students. This finding is consistent with Jafarkarimi *et al.* (2016) study, which found that 47% of Universiti Teknologi Malaysia (UTM) participants were addicted to Facebook, the most popular social network with more than 2.2 billion users. Compared to medical students who may have busy schedules and heavy subjects, non-medical students have the privilege of having more free time and easier subjects that do not require constant studying to use the internet for social networking.

Nowadays, students prefer to use the internet rather than television to watch their favourite shows, such as football games or a current television dramas. One of the many reasons for this is that there was only one TV for each dormitory block, and the range of TV channels was limited. On the other hand, internet TV offers the advantage of being able to watch any program at any time. Students also have high-speed internet access on campus. In our study, internet TV was found to be significantly associated with internet addiction among non-medical students ($p\text{-value}=0.04$). Students who use the internet for TV are 3 times more likely to be addicted to the internet. Approximately 16% of non-medical students are addicted to the internet using the internet for TV. This is consistent with a study by Moghavvemi *et al.* (2017) in which 20% of YouTube users are addicted. In comparison, fewer medical students who were addicted used the internet for TV (10%). Thus, it could be concluded that medical students are less interested in the internet TV or do not have more free time than non-medical students.

Our study shows that age significantly affects internet addiction in medical students ($p\text{-value}=0.04$). Internet addiction was 77% less likely for every one-unit increase in age. This is supported by a study by Mak *et al.* (2014), which found that students aged 20

years and younger were four times more likely to develop internet addiction. Younger age was a related factor for internet addiction (Lin *et al.*, 2011). This could be because students at older ages have better self-control and time management. In addition, medical students in their fourth and final year of study are more engaged in clinical work than preclinical medical students.

Conclusion

The prevalence of internet addiction in our study was almost the same for both medical and non-medical students except that there was a slightly higher percentage of non-medical students who were severely addicted. In this study, internet usage for social networks and TV are significant factors for internet addiction. Because six in every ten students in IIUM Kuantan are moderately addicted to the Internet, thus some measures should be taken into action. Health promotion programs concerning internet addiction are advisable to be implemented to ensure the good psychological well-being of students.

Limitations

The major limitation of this study was in terms of generalizability since it was conducted in a single centre. Therefore, a multicenter population-based study was highly recommended to confirm the association between internet addiction and university students.

The sample size in this study was not significant since the overall population in the study size was small. Thus, the results that were obtained in this study cannot represent the prevalence of internet addiction among university students in Malaysia.

Furthermore, the sampling method used in this study was convenient sampling, a non-probability sample. Therefore, once again, this study cannot be generalized. Moreover, this study did perform comparison analyses

between medical and non-medical students. Hence, the differences between both groups could not be statistically determined as significant. Therefore, it is recommended to do advanced regression analysis in future studies.

Acknowledgement

The authors would like to acknowledge International Islamic University Malaysia for supporting this study.

Funding Declaration

This research was funded by Fundamental Research Grant Scheme (RACER/1/2019/SKK05/UIAM//1).

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Establishing cephalometric norms of upper and lower lips to Rickett's E-line in the Malay female population of Kuantan city: A pilot study

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Abstract

The purpose of the study was to determine the cephalometric norms of upper and lower lips to the Rickett's E-line in the Malay female population of Kuantan city, and to compare it with the Caucasian norms. This was a retrospective study involving 40 pre-existing lateral cephalometric radiographs taken from October 2017 to October 2021 of skeletal Class I females of pure Malay ethnic group aged 20 to 40 retrieved from two private dental clinics in Kuantan city of Pahang state, Malaysia (Dr Fatain's Dental Clinic Taman Tas; Dr Fatain's Dental Clinic Indera Mahkota 3). These radiographs were hand traced using acetate paper and 0.3 mm leaded propelling pencil on a light view box in a darkened room. The soft tissue outlines and the Rickett's E-line (from the tip of the nose to the soft tissue chin) were drawn and the distance of the upper and lower lips to this line was measured in mm with a metal ruler. The values were compared with the Caucasian norms [upper lip to E-line: -4 mm; lower lip to E-line: -2 mm (± 2)]. The cephalometric norms of upper and lower lips to the E-line among the Malay females of Kuantan city were -1.3 mm (± 2.0) and 0.19 mm (± 1.9) respectively. This value was significantly different than the norms of the Caucasian population ($p < 0.001$). In conclusion, the cephalometric norms of upper and lower lips to Rickett's E-line in the Malay female population of Kuantan city were established: upper lip -1.3 mm (± 2.0) and lower lip 0.19 mm (± 1.9), which were found to be more protrusive than the Caucasian norms.

Keywords: Malay female norm, lower lip, upper lip, Rickett's E- line

Received:

30 May 2022

Revised:

1 August 2022

Accepted:

6 December 2022

Published Online:

28 February 2023

How to cite this article:

Sivagnanam, M., & Cheong, J. M. (2023). Establishing cephalometric norms of upper and lower lips to Rickett's E-line in the Malay female population of Kuantan city: a pilot study. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 26–32. <https://doi.org/10.31436/ijohs.v4i1.164>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.164>

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Introduction

In the early 20th century, Sir Edward H. Angle, the father of modern orthodontics, postulated that achieving an ideal dental occlusion together with ideal jaw relationships were the orthodontic treatment goal (Profitt *et al.*, 2019). This was known as the Angle paradigm which dictated that the soft tissues would follow the hard tissue configurations, once the dentoskeletal relationships were established (Shetty *et al.*, 2021).

However, towards the mid-20th century, researchers realized that not only soft tissues play a major role in facial appearance, but they are also independent of the underlying dentoskeletal base (Subtelny, 1959; Ricketts, 1968). Eventually, the Angle paradigm slowly shifted towards the soft tissue paradigm which emphasized on clinical examination of facial soft tissues, apart from the hard tissue counterparts. (Ackerman *et al.*, 1999). Normal soft tissue proportions and adaptations were included as the new primary orthodontic treatment goal. The treatment approach was reversed as well, as the ideal soft tissue relationships

were planned prior to the hard tissues. It was believed that the relationship of the dentition to the lips and face is a key factor of facial aesthetics (Proffit *et al.*, 2019). Ultimately, the orthodontic treatment aims were to achieve a harmonious dentofacial complex that consisted of balanced hard and soft tissue proportions (Soh *et al.*, 2005; Lersinghanart *et al.*, 2020; Shetty *et al.*, 2021).

The lateral cephalometric radiograph (LCR) which is routinely used as a baseline record for orthodontic patients is an important diagnostic and treatment planning tool in orthodontic practice. It can be used to assess the skeletal, dental as well as the soft tissue parameters. Following the hard and soft tissue landmarks identification, along with reference planes construction, numerous cephalometric analyses can be performed on this radiograph. One such soft tissue analysis pertaining to the relationship of the lips to the nose and chin is the E-line (Ricketts, 1957). The Rickett's aesthetic line or Rickett's E-line is constructed by joining the soft tissue pogonion (soft tissue chin) to the pronasale (soft tissue at the tip of the nose). The distance of the upper and lower lips to this line indicates the protrusiveness of the lips. Ricketts observed that the lower lip lay 2 mm posterior to this line (-2 mm \pm 2), whilst the upper lip lay further behind (-4 mm). Lips which protruded beyond this aesthetic plane were deemed as undesirable, especially in adults (Ricketts, 1968), albeit lip fullness were associated with a more youthful look (Trookman *et al.*, 2009; Wollina & Goldman, 2017). However, these norms were based on Caucasian samples which cannot be generalised to the other ethnic groups due to the diversified anthropometric differences (Kumari & Das, 2017).

A few studies on the soft tissue profile of the Malaysian population have been conducted (Mohammad *et al.*, 2011; Purmal *et al.*, 2013; Purmal & Alam, 2013; Ab Talib *et al.*, 2014; Noor *et al.*, 2020). E-line of the Malaysian Chinese (upper lip: -0.04 mm \pm 1.00; lower lip: +1.66 mm \pm 0.91) and Malaysian Indian (upper lip: -2 mm \pm 1.02; lower lip: 0.13 mm \pm 0.99) populations revealed that both races

have more protrusive upper lips compared to the Caucasians. In addition, the Chinese race also has a far more protrusive lower lip compared to the Indians and the Caucasians (Purmal *et al.*, 2013). Previous research investigated the lips profile of the Malaysian Malay population using Ricketts analysis lacked sample size calculation (Mohammad *et al.*, 2011; Ab Talib *et al.*, 2014) and did not reveal the actual linear measurements of the lips to the E-line (Mohammad *et al.*, 2011). A recent study that compared the soft tissue cephalometric measurements among Malaysian Malays and Chinese, used the Holdaway analysis instead that merely measured the thickness of the lips (Noor *et al.*, 2020). Though lip thickness is one of the major elements of facial aesthetics, it fails to portray the protrusiveness of the face as opposed to comparing the position of the lips to the nose and chin using the E-line (Prabu *et al.*, 2012; Bozdag *et al.*, 2017).

Thus, this study aims to determine the cephalometric norms of upper and lower lips of the Malay female population of Kuantan city of Pahang state, Malaysia to Rickett's E-line, and to compare it with the Caucasian norms.

Materials and Methods

Ethical approval

The ethical approval for this study was obtained from the IIUM Research Ethics Committee (ID NO: IREC 2021-324).

Study design and setting

This was a retrospective study involving 40 pre-existing LCR of non-growing Malay female population aged 20 to 40 years, retrieved from October 2017 to October 2021. The priory consented radiographs were collected from the clinical records of two private dental clinics in Kuantan city (Dr Fatain's Dental Clinic Taman Tas; Dr Fatain's Dental Clinic Indera Mahkota 3).

Inclusion criteria

1. Skeletal Class I (ANB =1° to 5°) (Hassan, 1998).
2. All subjects with LCR that have adequate resolution and good quality pre-treatment cephalometric radiograph (Grade 1: Excellent, and 2: Diagnostically acceptable, according to National Radiological Protection Board (NRPB) guidance of UK).
3. All radiographs were taken from the same orthopantomograph machine (72kV, 10.0 milliampere and 40 milliseconds).
4. Subjects are pure Malay - Both parents of each subject are of Malay ethnic origin without any inter racial marriage for at least two generations.
5. Subjects with complete number of permanent teeth irrespective of presence of third molars.
6. Subjects with normal growth and development (no craniofacial or congenital disorders).
7. Subjects with no temporomandibular disorders.
8. Subjects with no prosthesis, orthodontic or major conservative work.
9. Subjects who have not undergone any surgery pertaining to the face (orthognathic or facial plastic surgery).

Exclusion criteria

1. Subjects whose radiographs are distorted or not sufficiently clear for landmark identifications (Grade 3: Unacceptable, according to NRPB).
2. Subjects' cephalometric radiographs are not in natural head position.
3. Bilateral anatomical landmarks which are too far apart.
4. Subjects with cleft lip and palate or other craniofacial deformity.
5. Subjects with any severe systemic medical conditions that might affect their physical growth.

Written consent from the patient was obtained by the on-site orthodontist at the

respective clinics prior to taking their radiographs. The radiographs were taken by the same operator; a trained dental nurse who was experienced in taking LCR; using the same orthopantomograph machine and cephalometric setup in order to maintain standardisation of the radiographs. The subjects were positioned at natural head posture with the Frankfort horizontal plane parallel to the floor and the teeth in maximum intercuspation.

These radiographs were hand traced by a single investigator (M.S) on an acetate paper using 0.3mm leaded propelling pencil and metal ruler. Calibration was done to achieve agreement with supervisor (C.J.M.) in terms of landmark identifications. Any names or labels that could identify the patient on the films were replaced with identification numbers. The tracings were done on a light viewing box. Any light apart from the area being traced will be blocked out. These tracings were then repeated two weeks apart for intra-reliability assessments using intraclass correlation coefficient (ICC). Four hard tissue and four soft tissue landmarks were identified from the tracings. The landmarks and definitions were displayed in Table 1.

The reference plane used was Rickett's E-line that was drawn from the pronasale to the soft tissue pogonion (Figure 1). The distance of the upper and lower lips to this line was measured in mm using a metal ruler. The values obtained were then compared with the Caucasian norms; upper lip to E-line: -4 mm, lower lip to E line: -2 mm \pm 2.

Sample size

Power analysis for mean difference from constant one sample *t*-test was conducted in G*Power (version 3.1.9.7) to determine the sufficient sample size, with a power of study = 0.80, alpha= 0.05 and effect size = 0.5. The minimum sample size calculated was 34.

Table 1. Definition of cephalometric landmarks.

Skeletal Landmark		
No	Points	Definition
1.	Sella (S)	The midpoint of the sella turcica.
2.	Nasion (N)	Junction of the nasal and frontal bones at the frontonasal suture.
3.	A point (A)	The point of deepest concavity on the anterior profile of the maxilla (maxillary alveolar process).
4.	B point (B)	The point of deepest concavity on the anterior surface of the mandibular symphysis.
Soft Tissue Landmark		
No	Points	Definition
5.	Pronasale (Pn)	The most prominent point on the apex of the nose (tip of nose).
6.	Labrale superius (Ls)	The most anterior point on the margin of the upper membranous lip.
7.	Labrale inferius (Li)	The most anterior point on the margin of the lower membranous lip.
8.	Soft tissue pogonion (Pg')	The most anterior point on the soft tissue outline of the chin.

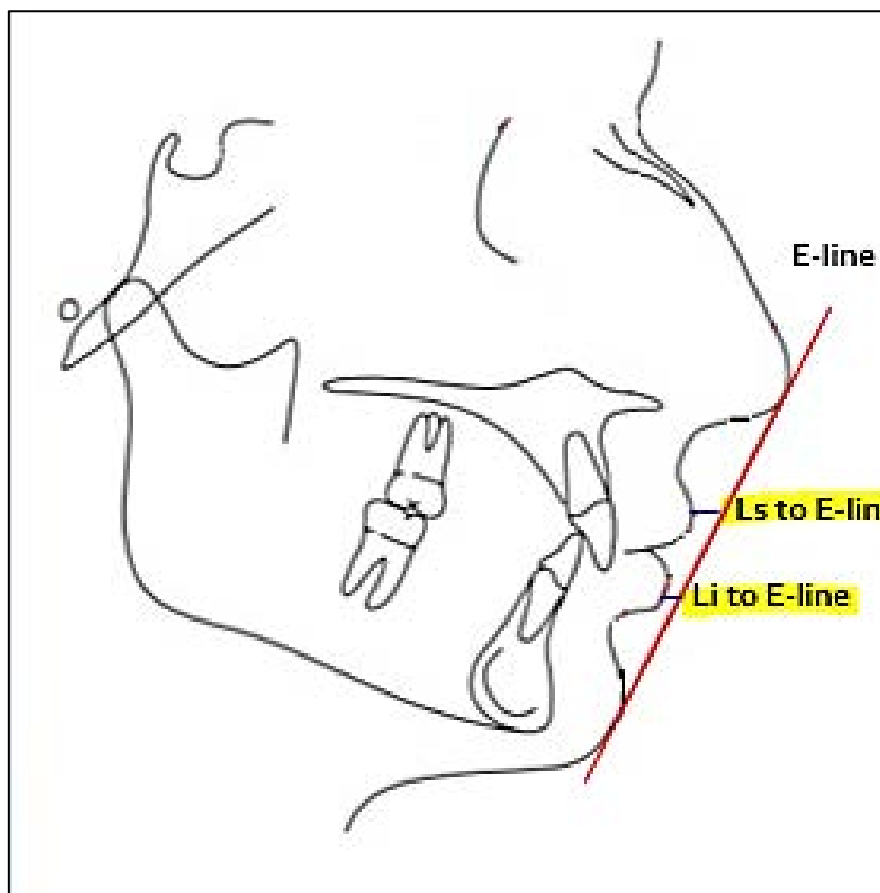


Figure 1. Rickett's E-line.

Statistical data analysis

Data analysis was performed using IBM Statistical Package for the Social Sciences (SPSS) software version 25.0 (Chicago, IL, United States of America). The significance level was set at $p < 0.05$.

Data was checked for normality distribution. Descriptive statistics was performed to obtain the mean and standard deviation for the distance of the upper and lower lips to the E-line. The intra-rater reliability was assessed using a two-way mixed, absolute agreement and single measure intraclass correlation coefficient (ICC). The means obtained for both the upper and lower lips of the Malay female population were compared

with the Caucasian mean using one sample t -test.

Results

The ICC score was 0.944 with a p value of less than 0.001 indicative of excellent intra-examiner reliability.

Table 2 displayed the mean and standard deviation of the upper and lower lips to Rickett's E-line. The measurement for the upper lip was -1.3 mm (± 2.0) whereas the lower lip was 0.19 mm (± 1.9). One sample t -test revealed significant differences between the Malay female and Caucasian population for both upper and lower lips ($p < 0.001$).

Table 2. Mean and standard deviation.

	N	Mean	Standard deviation
Upper lip	40	-1.3	2.0
Lower lip	40	0.19	1.9

Discussion

This study was based specifically on the Malay ethnic group despite Malaysia consisting of three major races. This is due to the fact that the relationship of the lips using the E-line for the Malaysian Chinese and Malaysian Indians were already conducted previously (Purmal *et al.*, 2013). However, the evidence of this relationship for the Malay population was still lacking. It is known from various studies that majority of adult patients seeking orthodontic treatment were females as they were more concerned of their facial appearance (Harris & Glassell, 2011; Lam *et al.*, 2020). In addition, laypeople were more sensitive to females' profile changes compared to males (Burcal *et al.*, 1987; Kalin *et al.*, 2021). Therefore, this pilot study focused on the Malay female population of Kuantan city. The results revealed that both the upper and lower lips of the Malay female population in this city were more protrusive when compared to the Caucasian norms. This finding is in accordance with previous

studies that found the Malaysian Malay population, when compared to Caucasians, had more proclined upper and lower incisors as well as more protrusive maxilla and mandible (Hasan, 1998; Norman *et al.*, 2020). Hence, it is agreeable that the lips of this ethnic group would be more forwardly placed following the incisor and jaw positions. In addition, the study by Hasan (1998) also concluded that the Malay population have less prominent chin, which could also contribute to protrusive lips, thus supporting the result of this study.

This study thus implies that the protrusiveness of the upper and lower lips of this population is not an anomaly, but a variation of the soft tissue spectrum. It emphasizes the need to educate the patients that it is a normal facial feature of this race, and ergo need not be treated to follow the Caucasian norms. This could help in the decision of the clinician to avoid extractions in order to retract the maxillary incisors especially in Class II division 1 and bimaxillary protrusion cases (Kalin *et al.*, 2021). Therefore, establishing the

cephalometric norms of the upper and lower lips to Rickett's E-line in the Malay female population aids in treatment planning and facilitating the overall treatment process, help meet the patients' expectations as well as enhancing quality orthodontic care.

Nevertheless, a few limitations of this study need to be acknowledged. As this is a retrospective study, record keeping is crucial as the study depends on the quality of the pre-existing radiographs. Apart from that, LCR provides a two dimensional view of a three dimensional object, and thus may fail to accurately represent the actual anatomic landmarks (Adams *et al.*, 2004). Moreover, cephalometric tracings are subjected to errors due to measuring errors or difficulty in locating certain landmarks (Durão *et al.*, 2014). However, these errors were rectified by calibration and intra-examiner reliability test. In addition, as this study was based entirely on the Malay female population of Kuantan city only, the results should be interpreted with caution. Perhaps, more sample size could be recruited in future studies to evaluate the cephalometric norms of different ethnic groups in Malaysia.

Conclusion

The cephalometric norms for the Malay female population of Kuantan city are: upper lip -1.3 mm (\pm 2.0) and lower lip 0.19 mm (\pm 1.9). This value was found to be significantly different than the Caucasian population ($p < 0.001$). Hence, the Malay female population of this city have more protrusive upper and lower lips when compared to the Caucasian norms.

Acknowledgement

This research was funded by Kulliyyah of Dentistry Postgraduate CHAIN grant from International Islamic University Malaysia (CHAIN 22-003-0003). The authors would like to thank the statistician Dr Mohamad Shafiq B Mohd Ibrahim for his contribution regarding the statistical data analysis. The authors also report no conflicts of interest.

No personal gain was sought by either researchers or participants.

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Patient satisfaction levels for complete dentures (F/F) delivered by undergraduate dental students

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Abstract

One important aspect of acceptance of full denture treatment is that of patient's perceived outcome. A teaching environment is the best place for future clinicians to understand this aspect of treatment. The aim of this study was to assess the satisfaction levels of patients who received complete dentures delivered by undergraduate dental students at the University of Otago. Participants' attitude toward dentures was measured via a 16-item questionnaire based on Patient's Denture Assessment (PDA) questionnaire. It comprises of items that assessed factors related to dentures and was quantified on a four-point scale. A total of 60 edentulous patients wearing maxillary and mandibular dentures were recruited then contacted using a list of patients whose treatment were carried out and completed in the undergraduate clinic from 2010-2018 and were sent an explanatory letter, an informed consent form, and a self-administered questionnaire in a return envelope to the University of Otago Faculty of Dentistry. Bivariate analysis was then carried out on the responses. 55% of the invited participants responded to the survey. The mean extent of PDA impacts was 0.15 (range 0.0-0.71). There were no significant differences in the experience of the prevalence and extent of PDA impacts by gender and age. 81.8% reported their denture to be very important to them and 91% found it "very easy" or "easy" to eat and swallow. 88% enjoyed their meals "well" or "very well". Bivariate analysis showed those aged 70 years old or younger were less likely to report issues with the denture, while there was no statically significant difference between genders. Overall, the participants expressed satisfaction with the treatment received at the faculty over the sub-groups of function, speech/aesthetics, upper denture, lower denture, and considered the denture to be of high importance.

Received:

25 December 2022

Revised:

24 January 2023

Accepted:

31 January 2023

Published Online:

28 February 2023

How to cite this article:

Barazanchi, A., Pande, N., Park, J., & Hong, C. L. (2023). Patient satisfaction levels for complete dentures (F/F) delivered by undergraduate dental students. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 33-46. <https://doi.org/10.31436/ijohs.v4i1.202>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.202>

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Keywords: complete denture, satisfaction level

Introduction

Historically New Zealand has one of the highest prevalence of edentulism in the world (Thomson, 2012). While there has been a considerable decline in the rate of edentulism, there are still approximately 22% of 65-74-year-old New Zealanders edentulous (Thomson, 2012). This is concerning as edentulism is associated with malnutrition, poorer systemic health,

negative social interactions and overall poorer quality of life (Slade and Spencer, 1994; Thomson, 2012).

Measurement of the Oral Health Related Quality of Life (OHRQoL) is a useful tool in evaluating the impact of oral rehabilitation (Strassburger *et al.*, 2004). It encompasses a range of factors including and not limited to function, pain, comfort, psychological, social factors and overall wellbeing in relation to oral health (Strassburger *et al.*, 2004).

Numerous studies have indicated that conventional denture treatment improves OHRQoL (Eric *et al.*, 2017; Martins *et al.*, 2021). For instance, one study found that edentulous patients who requested conventional dentures had significant improvements in their quality of life after treatment (Eregie *et al.*, 2021). Similarly, Shrestha *et al.* found that treatment with new complete dentures amongst edentulous patients resulted in significant improvement in OHRQoL with regards five of the seven subscales measured (Shrestha *et al.*, 2020). These included functional limitation, psychological discomfort, psychological disability, physical disability and handicap. Also, research indicates that despite the success of implant overdentures, conventional dentures are still required as part of dental treatment due to relatively good satisfaction rates and financial limitation, with edentulism being usually related to low SES. (Meijer *et al.*, 2003).

Clinical studies have also showcased that denture treatment is an effective method in improving nutrient intake amongst edentulous patients. Given the loss of masticatory function, malnutrition associated with tooth loss cannot be fully repaired (Rahn *et al.*, 2009), however the impact of tooth loss is generally reduced. De Marchi *et al.* (2008) indicated that edentulous individuals without dentures were more likely to be malnourished, while those with complete dentures had adequate nutritional status. Another study by Han and Kim (2016) found that edentulous patients without dentures had 1.89 times the risk of being undernourished in comparison to edentulous patients with conventional dentures.

However, patient dissatisfaction with dentures can prevent these aforementioned benefits from reaching their full potential. Patient satisfaction can be challenging to achieve, as various factors need to be considered. These include aesthetics, comfort, fit, ease of mastication and speech (Berg, 1984; Rahn *et al.*, 2009; Sharka *et al.*, 2019). Patient specific factors such as personality, self-perception, socioeconomic factor expectations, attitude, denture

wearing experience, ridge form and anatomy also needs to be accounted for adding to the complexity of measuring treatment satisfaction based on these factors (Čelebić, *et al.*, 2003).

While a teaching institution is where future clinicians are educated about factors affecting patient's satisfaction with removable prostheses, there are limited number of studies examining satisfaction of treatment for patient being treated in those institution. Thus, the primary aim of this project was to investigate the level of satisfaction with complete dentures delivered by dental students at the University of Otago's Faculty of Dentistry, between 2010 and 2018, and how it compares to other reported results in other teaching institutes.

Materials and Methods

Participants

A convenience sample of 60 edentulous patients wearing maxillary and mandibular dentures were recruited from the undergraduate students' electronic completed list from 2010-2018 and asked to participate in the survey (37 males, 23 females), with age ranging from 56 to 82 year old. The complete dentures were fabricated by undergraduate dental students at the University of Otago, under supervision by the faculty staff. Participants with an implant, root over-dentures and those only requiring denture relines were excluded from the study. Selected participants could read and respond in English. Initially, participants were contacted via their home phone or cell phone. They were briefly informed about the purpose and nature of the study. All patients who agreed to take part and met the inclusion criteria were sent an explanatory letter, an informed consent form, and a self-administered questionnaire in a return envelope to the University of Otago Faculty of Dentistry. All participants gave their informed consent verbally and in written form before commencement of the study. This study was approved by the University of Otago Human Ethics Committee approval number D19/166. Research consultation

with Māori and approval gained from Ngāi Tahu Research Consultation Committee. Participants' confidentiality and anonymity were ensured throughout the process.

Survey

The questionnaire for the self-assessment of dentures was developed through a validated PDA Patient's Denture Assessment (PDA) questionnaire consisting of question items that assessed factors related to dentures. Participants' attitude towards dentures was rated through a questionnaire and assessed via a four-point Likert scale, where each question item was measured by words characterising the best situation. The questionnaire was comprised of five factors, which were categorised into 'function', 'lower denture', 'upper denture', 'aesthetic and speech' and 'importance'. Table 1 represents the 16 question items derived from the PDA, which were translated from Japanese to English in the study by Komagamine and colleagues (Komagamine *et al.*, 2014). All 60 participants were sent out surveys to their residential houses to complete the questionnaire, and to repost the completed questionnaire back to the faculty. IBM SPSS Version 26 (IBM, New York, USA) was used to carry out the statistical analysis.

Results

Responses were received from 33 of the 60 invited participants, giving a response rate of 55%, results are summarised in Table 1. Of the 33 who participated in the survey,

53.1% were male, with a mean age of 68.6 years (sd 11.6; range 40-86). The majority (69.7%) responded to all 15 PDA questions. One in four (24.2%) responded to 14 questions, while one responded to 11 and 12 questions, respectively. In the analyses for the overall prevalence and extent of PDA impacts, all 33 responses were included. For the bivariate analyses by the PDA subscales, only those who had provided responses to all items within each of the four PDA subscales were included.

Most participants (81.8%, n=17) reported their denture as being very important to them. Only one participant (3.0%) rated their denture as being unimportant. Table 2 showed the results of the bivariate analyses for the overall prevalence and extent of PDA impacts by gender and age. Overall, 60.6% of participants reported experiencing 1+ PDA impacts. The mean extent of PDA impacts was 0.15 (range 0.0-0.71). There were no significant differences in the experience of the prevalence and extent of PDA impacts by gender and age.

The results for the bivariate analyses for the prevalence of 1+ PDA subscales impacts by gender and age were shown in Table 3. A higher proportion of females reported having experienced impacts with their lower dentures than male, but this did not reach statistical significance. Those aged ≤ 70 years old were significantly less likely to report any aesthetic and speech impacts. No other statistical significance differences were noted by gender and age for the other three PDA subscales.

Table 1. Question items used in the questionnaire derived from the PDA (Patient’s Denture Assessment) and participants’ response quantified as a percentage.

Subscale	Questionnaire items	Percentage
Function	1. How much pain do you feel with your dentures?	No pain - 61% Occasional - 36% Pain - 3% Frequent Pain – 0% Constant Pain – 0%
	2. How easy is it for you to swallow food and water?	Very easy - 58% Easy - 33% Difficult - 6% Very Difficult - 3%
	3. How well do you enjoy your meals?	Very well - 58% Well - 30% Poorly - 9% Very Poorly - 3%
	4. How worn out does your jaw feel?	Very worn - 3% Worn - 6% Slightly Worn - 24% Not Worn - 61% No answer - 6%
Aesthetics and Speech	5. How worried are you about other people watching?	Very worried - 9% Worried - 6% Somewhat worried - 12% Not worried - 73%
	6. How easy is it for you to speak?	Very easy - 49% Easy - 39% Difficult - 12% Very difficult – 0%
	7. How worried are you about your mouth?	Very worried - 3% Worried - 0% Somewhat worried - 30% Not worried - 67%
	8. How often do your dentures click when chewing?	Always - 3% Frequently - 6% Occasionally - 39% No clicking - 43% No answer - 9%
Lower Denture	9. How often does food debris get stuck under your lower denture?	Constantly - 9% Frequently - 27% Occasionally - 45% Does not get stuck - 13% No answer - 6%

	10. How is your lower denture detained on the ridge	Very well - 30% Well - 39% Poorly - 19% Very poorly - 6% No answer - 6%
	11. How does your lower denture fit?	Very well - 34% Well - 39% Poorly - 15% Very poorly - 12%
	12. How uncomfortable is your lower denture?	Very uncomfortable - 6% Uncomfortable - 12% Comfortable - 46% Very comfortable - 30% No answer - 6%
Upper Denture	13. How often does food debris get stuck under your upper denture?	Constant - 3% Frequently - 9% Occasionally - 42% Does not get stuck - 43% No answer - 3%
	14. How does your upper denture fit?	Very well - 55% Well - 27% Poorly - 3% Very poorly - 15%
	15. How often does your upper denture fall down?	Constantly - 3% Frequently - 6% Occasionally - 24% Does not fall down - 67%
Importance	16. How important is your denture to you?	Unimportant - 3% Somewhat important - 9% Important - 6% Very important - 82%

Table 2. Prevalence and extent of PDA by gender and age.

	Prevalence of PDA impacts (%)		Extent of PDA (mean number of PDA impacts) (sd)
	No impacts	1+ impacts	
Sex^a			
Male	9 (52.9)	8 (47.1)	0.11 (0.2)
Female	4 (26.7)	11 (73.3)	0.17 (0.2)
Age			
≤ 70 years	6 (35.3)	11 (64.7)	0.12 (0.1)
> 70 years	7 (43.8)	9 (56.3)	0.19 (0.2)
Total	13 (39.4)	20 (60.6)	0.15 (0.2)

^a missing data for one participant

Table 3. Prevalence of 1+ PDA subscale impacts.

	Functional ^a (%)		Aesthetic and speech ^a (%)		Lower denture ^a (%)		Upper denture ^a (%)	
	No impacts	1+ impacts	No impacts	1+ impacts	No impacts	1+ impacts	No impacts	1+ impacts
Sex								
Male	13 (76.5)	4 (23.5)	14 (87.5)	2 (12.5)	9 (64.3)	5 (35.7)	12 (80.0)	3 (20.0)
Female	12 (92.3)	1 (7.7)	12 (85.7)	2 (14.3)	4 (28.6)	10 (71.4)	11 (73.3)	4 (26.7)
Age								
≤ 70 years	12 (80.0)	3 (20.0)	16 (100.0)	0 (0) ^b	6 (40.0)	9 (60.0)	13 (81.3)	3 (18.8)
> 70 years	13 (81.3)	3 (18.8)	10 (71.4)	4 (28.6)	7 (53.9)	6 (46.2)	10 (71.4)	4 (28.6)
Total	25 (80.7)	6 (19.4)	26 (86.7)	4 (13.3)	13 (46.4)	15 (53.6)	23 (76.7)	7 (23.3)

^a Number of responses for each PDA subscale differ as only those who responded to all items within each of the subscales were included.

^b p<0.05, Chi-square test

When asked about the function of their dentures, 97% of participants responded with 'no pain' or 'occasional pain' on wearing dentures (Figure 1). Almost all of the participants (91%) found it 'very easy' or 'easy' to swallow food and water. There were similar results for participants enjoying their meals, where 88% could enjoy their meals 'well' or 'very well'. Eighty-five percent of the participants felt like their jaw were 'not worn' or only 'slightly worn' when using their dentures.

Regarding aesthetics, the majority of the respondents (73%) were 'not worried' about other people watching while using their dentures (Figure 2). Regarding speech, 88% of respondents found it 'very easy' or 'easy' to speak when wearing their dentures. Eighty-two percent of patients experienced 'no clicking' or 'occasional clicking' when chewing. It was noticeable that 97% of respondents were either 'not worried' or 'somewhat worried' about their mouth in general.

Fifty-eight percent of respondents experienced 'no food trap' or 'occasional food trap' under their lower denture. It was noticeable that 6% of participants did not answer this section as they commented that they took their dentures out when eating (Figure 3). Approximately one-third (69%) of the respondents felt their lower denture fitted 'very well' or 'well'. Seventy-six percent of patients found their lower denture 'very comfortable' or 'comfortable', and again, 6% did not answer this section, commenting that they could not use the lower denture at all.

Regarding the upper denture, 85% experienced 'no food trap' or 'occasional' food trap under their denture (Figure 4). The fit of the upper denture was 'very good' or 'good' in 82% of the respondents. Ninety-one percent of the respondents 'never' experienced their upper denture falling out or only 'occasionally'. It was noteworthy that, regardless of function, speech, and aesthetics, 97% of respondents felt their denture was important to them

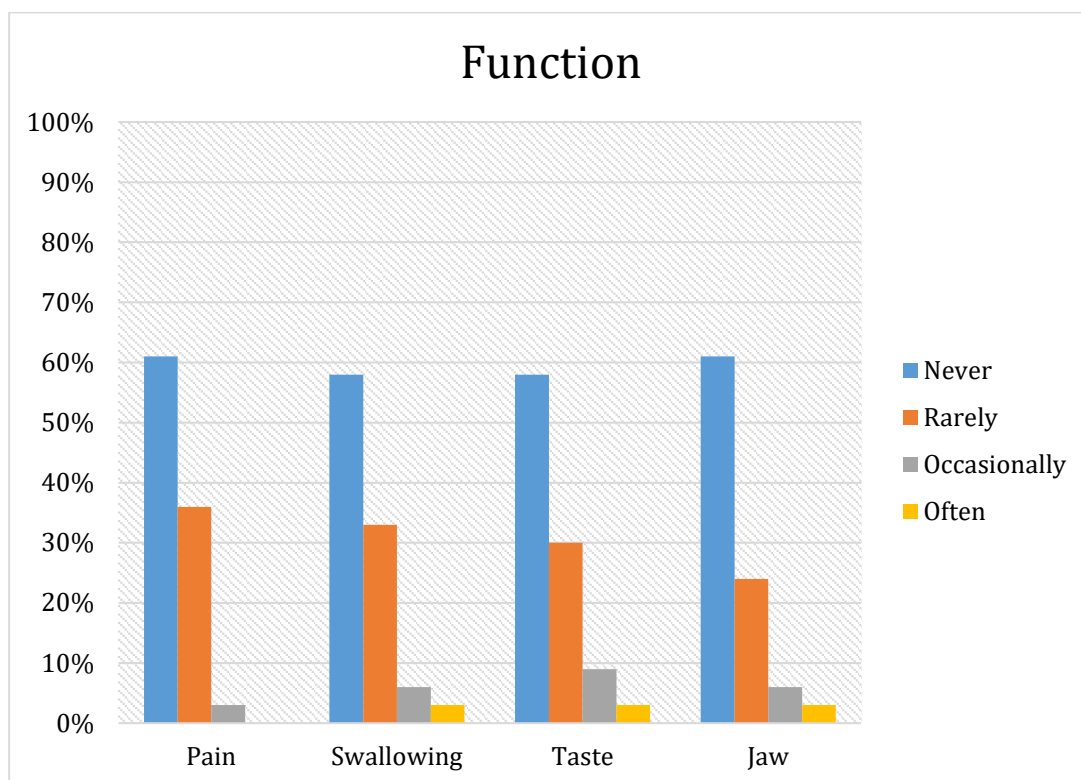


Figure 1. Response of participants regarding subgroup 'Function' quantified as a percentage by a four-point scale.

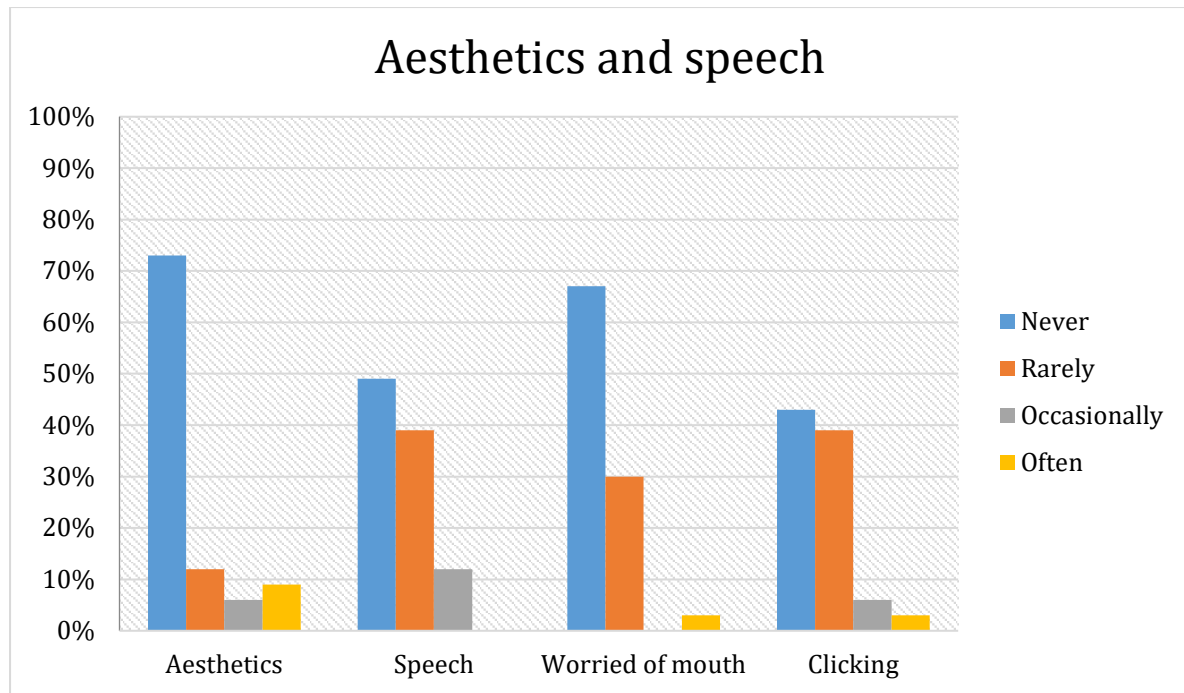


Figure 2. Response of participants regarding subgroup 'Aesthetics and Speech' quantified as a percentage by a four-point scale.

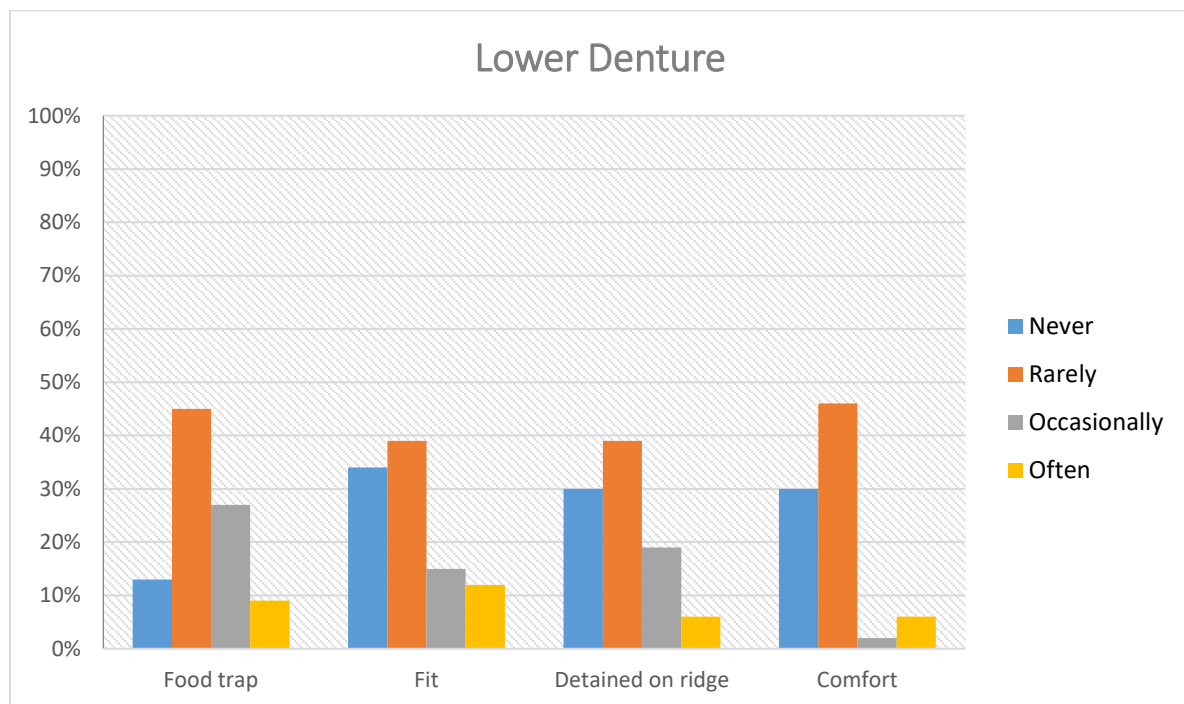


Figure 3. Response of participants regarding subgroup 'Lower Denture' quantified as a percentage by a four-point scale.

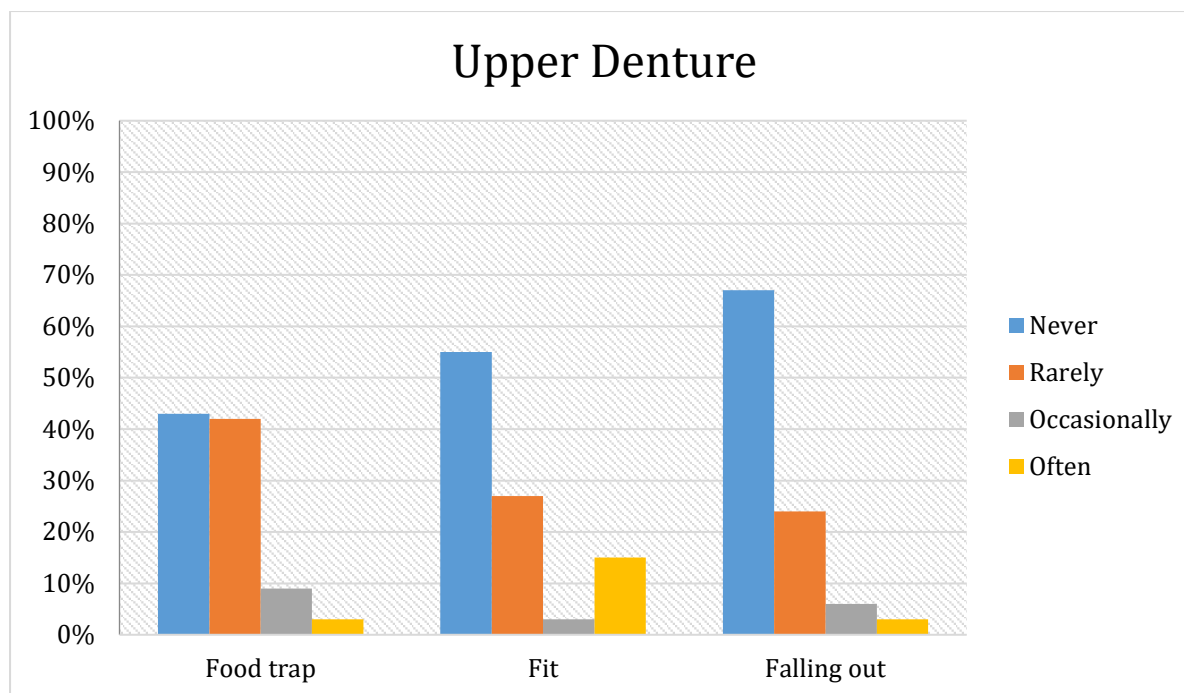


Figure 4. Response of participants regarding subgroup ‘Upper Denture’ quantified as a percentage by a four-point scale.

Discussion

Using PDA scale, our study has found that the sample of patients who responded have high satisfaction levels with dentures fabricated at the University of Otago’s faculty of dentistry.

Patient satisfaction is essential with regards to any dental treatment but more difficult to achieve with dentures. Complete dentures are essentially an inferior replacement of dentition and can in turn negatively impact ones’ nutrition, health, self-esteem and thus overall quality of life. Patient self-assessment is an inexpensive and economical method in measuring the success of the denture. In the literature, there have being several methods being employed to assess patient satisfaction with dentures including use of visual and OHIP scales, making it difficult to carryout direct comparisons between studies (Assunção *et al.*, 2010). In the present study, the questionnaire was derived from a validated Patient Denture Assessment (PDA) questionnaire created by Komagamine and colleagues (Komagamine *et al.*, 2014). The

questionnaire was categorised into ‘function’, ‘lower denture’, ‘upper denture’, ‘aesthetic and speech’ and ‘importance’ to measure the level of satisfaction with complete dentures (F/F) delivered by dental students at the University of Otago’s Faculty of Dentistry between 2006 and 2018. Patient satisfaction is generally not based on one sole factor but on many, and consequently, a multidimensional patient self-assessment questionnaire was chosen that can capture both positive and negative denture-related effects.

Reliability and Validity of the Patient’s Denture Assessment (PDA) has been evaluated by various studies (Komagamine *et al.*, 2014, Rezeki *et al.*, 2017). Internal consistency and test-retest reliability were utilised to demonstrate the reliability of the PDA questionnaire (Komagamine *et al.*, 2014). Internal consistency for the questionnaire items and the five categories was measured using Cronbach’s alpha, which showed that the Cronbach’s summary score was 0.78, demonstrating that the result of the reliability test of the PDA was satisfactory (Komagamine *et al.*, 2014). Furthermore, the PDA established good

validity by evaluating discriminant validity (Komagamine *et al.*, 2014). Studies concluded that the reliability of the PDA questionnaire was satisfactory, as determined by the assessment of its internal consistency and test-retest reliability. It also showed good validity, as demonstrated by the results of the factor analysis and convergent validity (Komagamine *et al.*, 2014).

Removable prostheses are not only dependent on the technical quality of the dentures, and defining the criteria of successful results in complete denture patients can be difficult. Psychological and emotional factors may be of great importance in maladaptive patients, irrespective of them seeking technical advice. For example, research indicates that there may be a relationship between neuroticism and the patient's capability to adequately wear their dentures (Critchlow and Ellis, 2010). Thus they are likely to benefit from counselling to reduce the risk of dissatisfaction with their dentures (Critchlow and Ellis, 2010).

Research has indicated there is an association between no or poorly designed dentures and a poorer diet in various populations with different diets (Nowjack-Raymer and Sheiham, 2003; Salazar *et al.*, 2021). Poorer nutrition is detrimental to health. It can increase the risk of metabolic syndrome and health problems associated with it (Truswell and Mann, 2007). For example, high saturated fat intake and low vegetable intake increases cholesterol levels, which in turn can lead to increased risk of cardiovascular disease (Truswell and Mann, 2007). Thus patient satisfaction with dentures, especially with regards to masticatory abilities is vital and should always be taken into account.

In this study, the most of the responses in regard to function were positive. Sixty-one percent of participants reported that their complete denture (F/F) caused no pain. Fifty-eight percent of participants responded that their complete dentures made swallowing of food and water very easy and they were able to enjoy their meals.

Sixty-one percent also responded that they did not perceive their dentures as worn. The majority of the remaining participants selected the next best category for each question, indicating good satisfaction levels in association with function. Participants with full dentures were 62% more likely to have chewing difficulties compared to participants with natural teeth or fixed prosthesis (Choi *et al.*, 2014). This, in turn, influences their diet and therefore nutrient intake. Research indicates that complete denture wearers have a lower fibre intake, higher fat intake (particularly saturated fatty acids) and overall 200 kcal higher energy intake compared to the recommendations of physiological needs (Pancheva *et al.*, 2018). Furthermore, findings by Bradbury *et al.* (2008) indicated that denture wearers consume fewer fruits and vegetables than dentate individuals, as a result of the chewing difficulties associated with dentures. Hence, even with dentures that appear satisfactory, follow up of patient's nutritional intake and general health should always be at the forefront of a clinician's mind during the maintenance and monitoring phase of treatment, noting any sudden weight loss or changes in the patient's general health post denture insertion.

The quality of complete dentures is closely related to denture usage, and the quality of complete dentures is the product of underlying latent variables, including anatomical factors, anatomical forms, the accuracy of the reproduction of retruded jaw relationships *etc.* (Fenlon *et al.*, 2007). Other important factors which can affect patient satisfaction include, previous denture wearing experience, attitudes and expectations, patient demographics, residual ridge form and anatomy, patient-dentist relationship, the quality of construction and time since delivery (Critchlow and Ellis, 2010). To help such patients, the dentist must be able to listen to their concerns and communicate with them efficiently.

The clinical quality of complete dentures does not always equate to patient satisfaction. While studies examining the association between these two variables

have produced inconsistent results, many of the findings tend to suggest that there is no significant association between the two. One study found that the clinical quality of complete dentures was not significantly associated with patient satisfaction two years after delivery (Fenlon and Sherriff, 2014). Two other studies have also found no significant link between denture quality and patient satisfaction of complete dentures (Berg *et al.*, 1984; Diehl *et al.*, 1996). This imposes the fact that the success of a denture should be evaluated by measuring patient satisfaction, along with clinical examination.

Dentures delivered by University Hospital of Dentistry, Tokyo Medical and Dental University students also produced positive and similar results (Komagamine *et al.*, 2014). Patient Denture Assessment (PDA) was also utilised in that study, however, results were measured via the 100 mm Visual Analogue Scale (VAS). The mean VAS values for pain, ease of swallowing boluses and water, meal enjoyment and jaw wear levels were comparable to the best two categories of the PDA questionnaire (Komagamine *et al.*, 2014). Similarly, favourable results were obtained with regards to questions examining mastication by complete dentures designed by students attending the Dental Faculty of Marmara University in Turkey (Turker *et al.*, 2009; Komagamine *et al.*, 2014). Questionnaire answers were quantified via a 7-point scale. With regards to chewing capacity, level of comfort during eating and attitude toward eating, these findings were comparable to the second-best category of the PDA questionnaire (Turker *et al.*, 2009).

In regards to aesthetics and speech, the most of the participants were satisfied. 73% were not concerned about people watching, and 88% found it either very easy or easy to speak with the dentures. Although 43% reported no clicking when chewing, 39% did report occasional clicking. Positive values were also obtained University Hospital of Dentistry, Tokyo Medical and Dental University students and Dental Faculty of Marmara University (Turker *et al.*, 2009; Komagamine *et al.*, 2014). Both results were

comparable to the second-best category of the PDA questionnaire.

Questions tailored to mandibular and maxillary dentures produced slightly less favourable results in this study. Forty-five percent and 42% of participants stated that debris gets stuck under their lower and upper dentures respectively. Furthermore, 27% stated that debris gets stuck under their lower denture frequently. Overall, participants were more satisfied with maxillary dentures compared to mandibular dentures. A higher percentage of respondents experienced 'no food trap' of 'occasional food trap' with upper dentures (85%) in comparison to lower dentures (58%). Similarly, the upper dentures had a better fit (82%) than lower dentures (69%). In addition, 6% of participants did not share their experience on food trap under their lower denture, nor the comfort of the lower denture.

Similar unfavourable findings were obtained by The University Hospital of Dentistry with regards to debris and mandibular dentures (Turker *et al.*, 2009). Like this study, the score was more favourable for maxillary dentures (Turker *et al.*, 2009). With regards to the fitting of the denture, positive outcomes were obtained (Turker *et al.*, 2009). In contrast, VAS scores obtained by The University Hospital of Dentistry were less favourable for mandibular dentures but adequate for maxillary (Komagamine *et al.*, 2014).

These findings are expected due to the differences in the underlying anatomical structures. The presence of the palate generally provides adequate support for the maxillary denture, while the posterior palatal seal enables retention (Rahn *et al.*, 2009). However, in the mandible the tongue is present and therefore there is complete reliance on musculature and ridge anatomy (Rahn *et al.*, 2009). Furthermore, post extraction resorption of the mandibular ridge is four times the rate of the maxilla (Rahn *et al.*, 2009). Therefore, it is more challenging to design an adequate mandibular denture compared to a maxillary denture. This in turn makes achieving

patient satisfaction a more difficult task. According to Čelebić *et al.* (2003), patients with the best mandibular ridge form were least satisfied with their mandibular denture. In contrast, patients rated to have the best maxillary ridge form were most satisfied with their maxillary denture (Čelebić *et al.*, 2003). Another study indicated that there was a significant relationship between lower ridge resilience and patient satisfaction (Magnusson, 1988). Research has also found that the anatomy of the lower ridge is a key variable in determining the success of the denture (Critchlow and Ellis, 2010). One factor strongly agreed upon by both the University of Otago's Faculty of Dentistry and The University Hospital of Dentistry patients was that their dentures were very important to them.

Due to a limited number of studies measuring patient satisfaction levels for complete dentures delivered by general dental practitioners, we were not able to directly compare our findings with private practices. However, findings of a review examining seven studies stated that regardless of the adequacy of designed dentures, a percentage of patients remained unsatisfied with the delivered prosthesis (Critchlow and Ellis, 2010). These dentures were all delivered by qualified dental practitioners and the percentage of residual dissatisfaction ranged from 7.2% to 21 % (Critchlow and Ellis, 2010). As different methods, sample sizes, and means of measuring patient satisfaction were used, we cannot make direct comparisons to our findings. However, it is important to note that, in this study, a small percentage of patients were also not satisfied with the delivered complete dentures. This raises the question whether patient satisfaction was attributed to the quality of the fabricated dentures or due to patient-specific factors. The success of complete denture treatment does not depend on the assessment by the dentist, but on patient self-assessment results.

Another common theme amongst our study with previously conducted research was the importance of aesthetics to patients.

Fourteen percent of participants reported to be worried about aesthetics often or occasionally, which was greater than the other variables examined under this category. Other studies have reported the importance of aesthetics in achieving patient satisfaction. A study indicated that the patient's perception of the aesthetics of their maxillary denture had an impact on their satisfaction levels (Carlsson *et al.*, 1967). Literature has also found that rehabilitation with new dentures improved patient satisfaction which in turn was likely to be associated with better aesthetics and comfort (Allen and Mc Millan, 2003 De Lucena *et al.*, 2011; ELsyad *et al.*, 2019).

Our research also highlights the importance of an additional psychological factor-interpersonal relationship between the dentist and the patient. A large number of participants praised the staff and students in charged with their denture making process. They commented on how helpful, kind and patient they were. As most of our participants were satisfied with their dentures, it is possible that their positive relationship with the students contributed to the overall satisfaction levels. This could be attributed to longer appointment times at the Dental School opposed to private practice, allowing for a better relationship to establish. Several studies have found that high-domineering dentists had more unsatisfied patients than undomineering dentists (Waas, 1990).

Regardless, our findings indicate that patients were generally satisfied with the complete removable dentures delivered by University of Otago's Faculty of Dentistry students. The results are similar to dentures delivered by dental students from Dental Faculty of Marmara University and University Hospital of Dentistry, Tokyo Medical and Dental University (Turker *et al.*, 2009; Komagamine *et al.*, 2014). Hence it is possible to conclude that dentures fabricated by University of Otago dental students are generally adequate and compare well with other teaching institutions. Currently, a large percentage of dentures in the private sector are being designed by clinical dental technicians.

Therefore, it would be interesting to conduct a similar study with larger sample size, examining patient satisfaction of dentures delivered by clinical dental technician students.

Given the persistence of edentulism in the population, the results of this study are of importance. University of Otago's Faculty of Dentistry is the sole dental institution in New Zealand. Therefore, it gives us some indication of the clinical skills expected from future dental professionals, with regards to denture fabrication. Although the clinical skills and therefore presumably patient satisfaction is likely to improve throughout practice, the results are overall positive. With limitations discussed, the results indicate that complete dentures fabricated by undergraduate students at the University of Otago's Faculty of Dentistry have a high satisfaction rates. Using the PDA questionnaire in assessing patient satisfaction with complete dentures helped obtain a detailed understanding of the patients' perceptions in using their dentures, as the questionnaire demonstrated good validity and reliability (Rezeki *et al.*, 2017; Komagamine *et al.*, 2017).

There are some limitations to the current study including the relatively low sample size and response rate of 60% may have given rise to non-response bias as the non-response could be unequal among the participants regarding satisfaction from their dentures, and may also undermine the ability to generalise the results to a larger population. Another is the lack of clinical examination as there are several other factors effect satisfaction, particularly success of lower denture, such as fit and occlusal relationship a clinical examination may shed further light on the findings (Fenlon and Martyn, 2008). Self reported satisfaction has been reported to underestimate the functional performance as rated by dental clinician, particularly for older adults, who make up the bulk of the participants in this study (De Lucena *et al.*, 2011; Reis *et al.*, 2022).

Conclusion

This study aimed to examine the patient satisfaction levels of complete dentures fabricated by University of Otago's undergraduate students using a validated PDA survey. Results indicated that patients were largely satisfied with the dentures delivered. These findings suggest that the prosthodontics aspect of the BDS course has been taught effectively. In the future, a study with larger sample size and inclusion of Clinical Dental Technician students would make the findings more applicable to the New Zealand population.

Acknowledgement

The authors wish to thank the participants who took part in this study, Professor Richard Cannon for his contribution towards ethics approval.

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Patients' satisfaction and quality of life after dental implant rehabilitation: A cross-sectional study

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Abstract

Perceiving patients' satisfaction and improving patients' quality of life is a challenging task. This study aimed to assess the patient's quality of life and satisfaction after receiving a dental implant rehabilitation. All patients with dental implant placed between 2015 and 2019 were included. A self-administered questionnaire consisted of a demographic, patient satisfaction assessment, and the short version of the Malaysian Oral Health Impact Profile, S-OHIP (M) questionnaire. The patients indicated their rate on a 5-point Likert scale from 0 to 4. Statistical analyses were made using the SPSS version 26, statistical significance was considered for $p < 0.05$. A total of 58 patients with 91 implants completed the questionnaire were included. In general, the majority of participants 56 (96.6%) were satisfied with the dental implant mainly with the speech function and maintenance procedure. The Cronbach's Alpha coefficient for the nine items of satisfaction was 0.798. The mean OHIP-14 score was 2.1 (SD: 3.11; range from 0 to 12) with the highest score for psychological discomfort (mean: 0.92, SD: 1.35) and the lowest score for psychological disability (mean: 0.00, SD: 0.00). All domains of OHIP-14 had Coefficient of Variance, $CV > 1$ (ranged from 1.47 to 8.77) which considered being high variance. Overall, all participants had OHIP-14 scores ranging from 0 to 12 which can be considered a low score that indicated higher Oral Health-Related Quality of Life (OHRQoL). The correlation between patient satisfaction and quality of life is significant ($P < 0.05$).

Keywords: dental implant, dental implant satisfaction, Oral Health Impact Profile (OHIP), Oral Health-Related Quality of Life (OHRQoL), rehabilitation

Introduction

The term "oral health-related quality of life" or OHRQoL refers to a multidimensional concept that includes biopsychosocial components of oral health (Locker & Allen, 2007) and is based on the World Health Organization definition that considers health as the state of complete physical, mental and social well-being. Most researchers defined OHRQoL as the individual's perception of

orofacial disorders and dental treatments (John, 2021).

The Oral Health Impact Profile (OHIP) is one of the most extensively used methods for measuring OHRQoL. Slade and Spencer (1994) established the OHIP with 49 items (OHIP-49) derived from remarks acquired in interviews with dental patients. These questions were distributed based on seven variables derived from Locker's theoretical model which consists of functional limitation, physical pain, psychological

Received:

31 December 2022

Revised:

2 February 2023

Accepted:

8 February 2023

Published Online:

28 February 2023

How to cite this article:

Saad, N. A., Omar, N. I., Ahmad Yaziz, Y., & Abdul Manab, E. E. (2023). Patients' satisfaction and quality of life after dental implant rehabilitation: A cross-sectional study. *IUM Journal of Orofacial and Health Sciences*, 4(1), 47-58. <https://doi.org/10.31436/ijohs.v4i1.203>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.203>

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discomfort, physical disability, psychological disability, social disability, and handicap (Locker, 1998a). Based on the same variables, Slade (1997) produced a 14-question short form called OHIP-14, which demonstrated strong reliability, validity, and accuracy.

Improving the quality of life is a significant treatment goal for implant-supported prostheses, and patient satisfaction should be recognized as a critical component of treatment quality and therapeutic success (Wang *et al.*, 2021). With the growing popularity of dental implant awareness, patients are more likely to understand and accept the drawbacks of implant therapy. However, since patient education was still limited (Kohli *et al.*, 2015), it was difficult to balance patients' expectations with dentists' evaluations of prosthesis function. In general, the implant therapy approach also prioritized implant preservation and peri-implantitis prevention, nevertheless, patients were more likely to emphasize comfort and aesthetics (Jayasinghe *et al.*, 2017).

Hence, it has been suggested that the impact of implant treatment outcome should be additionally evaluated by the treatment in terms of patients' satisfaction (Zarb & Albrektsson, 1998). Professionals' inability to accommodate patients' expectations might lead to oral rehabilitation failure and result in common psychosocial responses such as anxiety, insecurity, low self-esteem, and introversion. (Cibirka *et al.*, 1997). The evaluation of dental implants considers a variety of factors, including aesthetics, comfort, usefulness, longevity, hygiene, presentation, and psychological satisfaction (Dong *et al.*, 2019).

Analysis regarding patients' satisfaction and quality of life after dental implant rehabilitation was rarely reported (Lang & Zitzmann, 2012). Only one pilot study concerning patient-reported outcomes is available in Malaysia with 95.2% of subjects satisfied with its function (Alam *et al.*, 2015). Meanwhile, no research has been carried out to measure patients' quality of life and satisfaction with dental implants placed in

the Periodontal Specialist Clinic, Mak Mandin in Seberang Perai Utara, Pulau Pinang. Therefore, the objective of this research is to assess the quality of life and satisfaction level following dental implant treatment among patients in Periodontal Specialist Clinic, Mak Mandin by evaluating their OHRQoL using OHIP-14.

Materials and Methods

This cross-sectional study was performed in accordance with the Declaration of Helsinki 1975, as revised in 2013, registered with the National Medical Research Register (NMRR-20-2750-57068) and approved by the National Institutes of Health (NIH) and Medical Research and Ethics Committee (MREC). All patients were informed about possible risks and benefit as well as the procedures of the study and all gave written informed consent. All participants were given sufficient time for consideration of their participation in this study.

Populations/ patients selection

All invited patients were treated in a government dental clinic (Periodontal Specialist Clinic, Mak Mandin, Seberang Perai Utara Pulau Pinang) with at least one dental implant rehabilitation within the years 2015 to 2019. Ninety-one dental implants with 17 placed in the anterior region and 74 placed in the posterior region were included. All patients had to fulfill the following criteria:

Inclusion:

- Adult patients at age 18 years old and above.
- Received and completed dental implant/s treatment a year prior to inclusion.
- Received at least a single Straumann® dental implant.
- Voluntary consent was given to participate in the study.
- Completed questionnaires.

Exclusion:

- Non-Malaysian citizen.

- Ongoing dental implant treatment or had placed dental implant/s less than one year.
- Uncontrolled systemic conditions

Intervention

The use of questionnaire was designed in Malay and English and contained 3 parts which included:

1. Demographic

Demographics data related such as age, gender, race, educational level, medical status, and smoking status.

2. Patient satisfaction

Patients answered nine questions adopted from Kim *et al.* (2014) and Pommer *et al.* (2011) regarding their satisfaction with chewing function, speech function, implant comfort, cleanability, appearance or aesthetic, surgical placement procedure, maintenance procedure, cost, and general use of a five-point Likert scale: completely unsatisfied, unsatisfied, uncertain, satisfied and completely satisfied.

3. Oral health impact profile (OHIP)

The last part consisted of patients' oral health-related quality of life assessment regarding their dental implants. The question was designed according to the short version of the Malaysian Oral Health Impact Profile, S-OHIP(M) (Saub *et al.*, 2005). The assessment was carried out in terms of function, appearance, physical and psychological comfort, and social ability. Patients were asked about the frequency of complaints during the last few months using a five-point Likert scale: never, rare, occasional, often, and very often. A total of 14 OHRQoL-factors were rated on a scale of 0–4 (0 = "never", 1 = "rarely", 2 = "occasionally", 3 = "often", 4 = "very often"). There was no weighting of every single factor (Allen & Locker, 1997). The OHIP summary score was calculated as the sum of the 14 sub-scores (range 0–56) and characterized impairment.

A higher OHIP score indicates a poorer OHRQoL. If more than five questions in total, two questions in a subgroup, or one of the three questions on problems specific to patients with prostheses were not answered, the patient was excluded.

Outcomes

The primary outcomes of this study were the level of satisfaction and quality of life among patients who received dental implant rehabilitation while the secondary outcome of this present study was the correlation between satisfaction and quality of life.

Analysis

Data were imported into the Microsoft Excel Spreadsheet Software. For statistical analysis, the IBM SPSS data editor version 26.0 (IBM, Armonk, New York, USA) software was used. Descriptive analysis was conducted using mean, standard deviation, median, minimum, and maximum for continuous data. For categorical data, percentages were given. A P-value less than 0.05 was considered statistically significant.

Results

Demographic

Fifty-eight (58) out of seventy-three (73) patients were enrolled in this study, with a total number of 91 implants installed. In these analyses, 38 patients (65.5%) were females. The reasons for the exclusion of fifteen (15) patients are given in Figure 1.

All enrolled patients graduated at least from secondary school with 74.1% being college/university graduates. At the time of intervention, 5.2% of the patients were smokers and 5.2% were former smokers with the remaining were non-smokers (n=52, 89.7%).

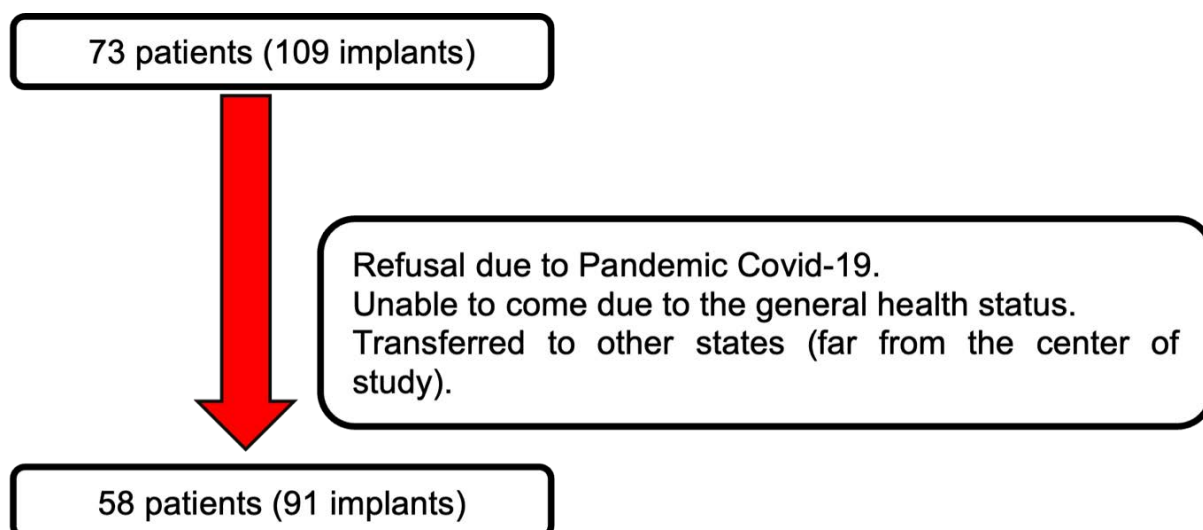


Figure 1. Recruitment of patients.

Patients were aged 28–75 years (mean 51.78 years, SD ± 10.115 years). Follow-up time was 1-6 years (mean 3.64 years, SD ± 1.465 years) after implant placement. The patients received one to nine implants

(mean 1.57, SD ± 1.186) (Table 1). No patient received implant-supported dentures, while 63.7% were restored with fixed single crowns, and 36.3% were restored with bridges.

Table 1. Patients' characteristic.

Total 58 patients / 91 implants	Number (percentage)	Mean (SD)
Gender		
Male	20 (34.5%)	
Female	38 (65.5%)	
Race		
Malay	15 (25.9%)	
Chinese	40 (69.0%)	
Indian	3 (5.2%)	
Age (years)		
20 to 29	1 (1.7%)	51.78 ± 10.115
30 to 39	8 (13.8%)	
40 to 49	14 (24.1%)	
50 to 59	22 (37.9%)	
60 to 69	12 (20.7%)	
70 and above	1 (1.7%)	
Education level		
No formal education	0 (0%)	

Primary school	0 (0%)	
Secondary school	15 (25.9%)	
College/ University	43 (74.1%)	
Medical condition		
No known medical illness	36 (62.1%)	
Medical illness	22 (37.9%)	
Smoking status		
Non-smoker	52 (89.7%)	
Smoker	3 (5.2%)	
Former smoker	3 (5.2%)	
Implants live (year)		
1	10 (11%)	3.64 ± 1.465
2	13 (14.3%)	
3	14 (15.4%)	
4	23 (25.3%)	
5	25 (27.5%)	
6	6 (6.6%)	
Number of implants		
1	37 (63.79%)	1.57 ± 1.186
2	15 (25.86%)	
3	5 (8.62%)	
9	1 (1.72%)	
Prosthesis		
Single crown	58 (63.7%)	
Bridge	33 (36.3%)	
Implant-supported denture	0 (0%)	

SD: Standard Deviation

Patients' satisfaction

The answers for all 9 questions regarding the satisfaction of the 58 evaluable questionnaires are summarized in Figure 2. Half (29) of them gave a total satisfaction level of the dental implant in each item.

- **General satisfaction:** 89.7% of all patients were completely satisfied with their implant therapy. Only 6.9%

responded with satisfied and 3.4% were uncertain.

- **Cost:** 87.9% of the patients were satisfied with the cost of implant rehabilitation, and only 12.1% responded as less satisfied with the overall cost of the dental implant.
- **Maintenance procedure:** 87.9% of the patients were very satisfied with the maintenance of the implant-supported

restoration, and 12.1% responded and rated themselves as satisfied.

- **Surgical placement procedure:** 86.2% of the patients were completely satisfied with the surgical placement procedure, 10.3% responded to be mostly satisfied, and 3.4% of patients were less satisfied with the surgical procedure.
- **Aesthetics/appearance:** 77.6% of the patients were completely satisfied with the aesthetics of the implant-supported restoration, 15.5% responded were satisfied, and 6.9% of patients were uncertain about the aesthetics.
- **Cleansibility:** 96.6% of the patients had no problems with the cleanability of their restoration. Only two patients (3.4%) perceived the cleanability to be inferior.

- **Implant comfort:** 82.8% of patients answered completely satisfied.
- **Speech function:** 93.1% of patients were completely satisfied with their speech function, and 6.9% of patients responded as satisfied.
- **Chewing function:** 75.9% of the patients were completely satisfied with their implant chewing function.

The Cronbach's Alpha coefficient for the nine items of satisfaction was 0.798. All satisfaction items had a low and acceptable coefficient of variance (CV) of distribution (CV<0.3). Satisfaction of speech function and maintenance procedure recorded a very good coefficient of variance (CV<0.1).

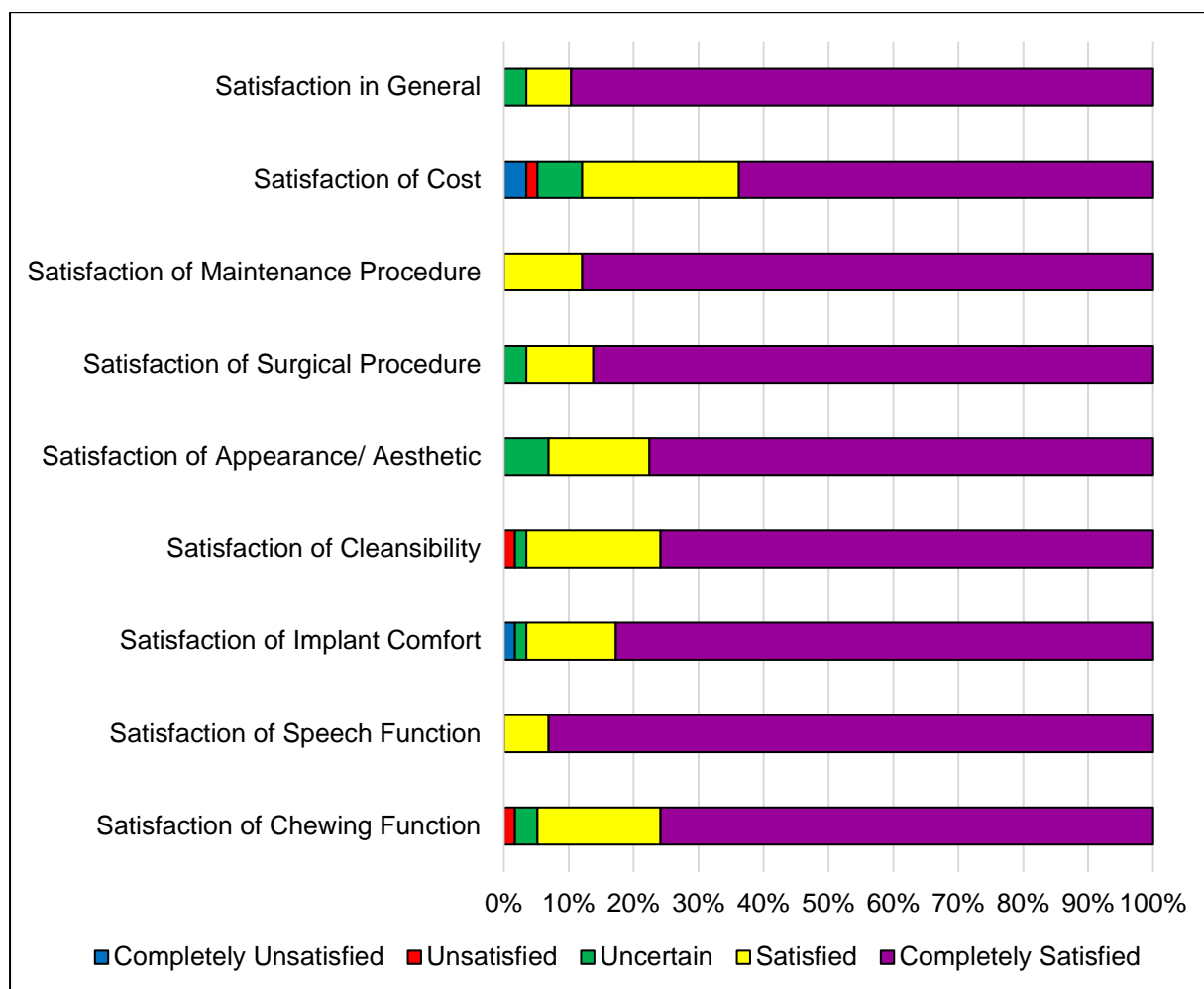


Figure 2. Patients' satisfaction answered in ordinal categories.

Table 2. Analysis of distribution in the level of satisfaction

Item/ domain	Mean	SD	CV
Satisfaction of patients			
General	3.86	0.437	0.11
Cost	3.43	0.957	0.28
Maintenance Procedure	3.88	0.329	0.08
Surgical Placement Procedure	3.83	0.464	0.12
Appearance/ Aesthetic	3.71	0.593	0.16
Cleansibility	3.71	0.593	0.16
Implant Comfort	3.76	0.657	0.17
Speech Function	3.93	0.256	0.07
Chewing Function	3.69	0.627	0.17
Cronbach's Alpha coefficient			
Items/ domains		0.798	

Oral-Health Impact Profile-14 (OHIP-14)

The answers for all 14 questions of the 58 evaluable questionnaires are summarized in Figure 3. The mean OHIP-14 score was 2.1 (SD: 3.11; median:1, range from 0 to 12) with the highest score for psychological discomfort (mean: 0.92, SD: 1.35) and the lowest score for psychological disability (mean: 0.00, SD: 0.00).

All domains had CV > 1 (ranging from 1.47 to 8.77). The Cronbach's Alpha coefficient for the domains and sub-domains of OHIP-14 was 0.634 and 0.610 respectively.

Twenty-eight (28) patients (48.3%) experienced no impairment of OHRQoL of the dental implant in the last few months, thus exhibiting the best possible OHIP score of zero. Nine (15.5%) of them avoided eating certain food due to the implant. Twenty-five (43.1%) of them felt discomfort due to food getting stuck in between the implant. Only five (8.6%) of the participants had trouble chewing food because of the implant.

Correlation between satisfaction and OHIP-14

Statistical analysis showed a statistically significant correlation between general satisfaction and total S-OHIP-14 score (p-value = 0.047). There was noted a statistically significant correlation between total satisfaction and total S-OHIP-14 score (p-value = 0.028).

Discussion

This study evaluated the effect of dental implant rehabilitation on OHRQoL and satisfaction. It was shown that implant treatment had a beneficial effect on OHRQoL and patient satisfaction with regard to dental appearance, function, and comfort.

A low impact was observed for almost all the items included in the OHIP questionnaire with 74.1-100% of responses ranging from "Never" to "Rare" with no significant differences between groups. A higher impact was only observed for the item "food stuck discomfort". There was no significant correlation between the item "food stuck

discomfort” and the types of prosthesis (single crown and linked crown or bridge) or location of the implant (anterior, premolar, and molar) with a p-value more than 0.05. Whereas the average satisfaction level of all the items was very high which was between

87.9% to 100% with the main drawback being satisfaction regarding the cost of the therapy. To summarize, these results indicate profound patient satisfaction.

Table 3. Analysis of OHIP-14.

Domain/ Subdomain	Mean (SD)	CV
Functional limitation	0.22 (0.75)	3.41
Chewing difficulty	0.17 (0.653)	
Bad breath	0.05(0.223)	
Physical pain	0.21 (0.669)	3.19
Eating Discomfort	0.16 (0.556)	
Ulcers	0.05 (0.292)	
Psychological discomfort	0.92 (1.35)	1.47
Food Stuck Discomfort	0.93 (1.323)	
Felt Shy	0.03 (0.184)	
Physical disability	0.55 (1.202)	2.19
Avoid Certain Food	0.55 (1.202)	
Avoid Smiling	0.00 (0.00)	
Psychological disability	0.00 (0.00)	-
Disturb Sleep	0.00 (0.00)	
Disturb Concentration	0.00 (0.00)	
Social disability	0.03 (0.263)	8.77
Avoid Going Out	0.00 (0.00)	
A problem in Daily Activities	0.03 (0.263)	
Handicap	0.12 (0.462)	3.85
Spend Money due to Implant Problem	0.10 (0.447)	
Felt Less Confident	0.02 (0.131)	
Total score	2.1 (3.11)	1.48
Cronbach’s Alpha coefficient		
Domains	0.634	
Subdomains	0.610	

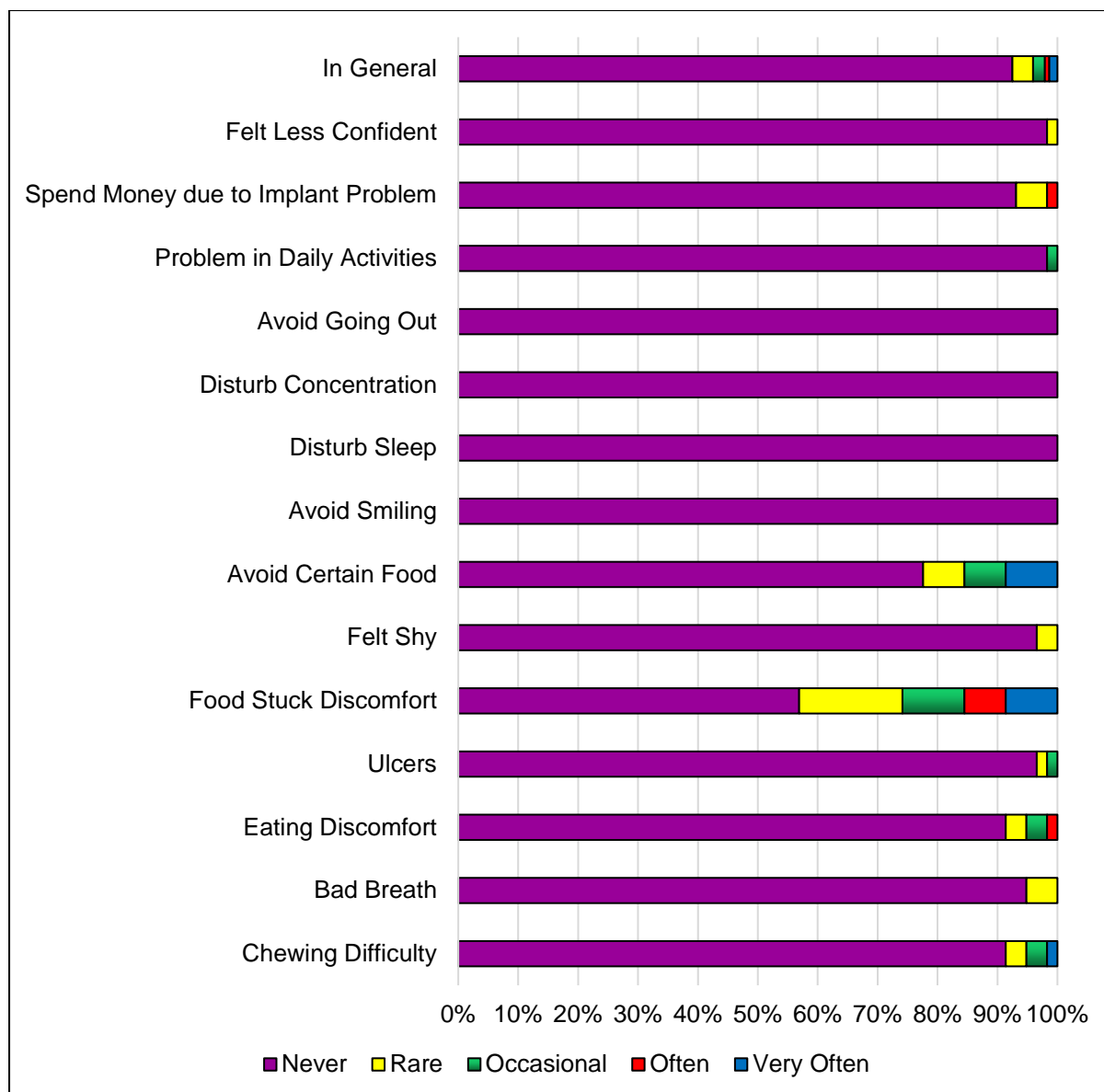


Figure 3. OHIP-14 answer in ordinal categories.

A new current study of 26 participants reported that the total OHIP-14 score was low (7.87) for dental implants after 2 years of placement (Sanz *et al.*, 2022). Another study showed that the mean OHIP score was 11.3 after 10 years of dental implant placement among 95 participants (Wang *et al.*, 2021). These reports are concomitant with the present study which showed a low S-OHIP-14 score. All the participants in this study had lower OHIP-14 scores indicating higher Oral Health-Related Quality of Life (OHRQoL).

A study with small samples indicated that 20 out of 21 (95.2%) participants with

posterior dental implants were satisfied with the implant function and stability (Alam *et al.*, 2015). However, there was no timing of the intervention or changes in satisfaction over a certain period of time following implant installation reported in this study. This study concluded that the satisfaction of implant patients was high, which was in relation to the successful clinical success criteria and surface electromyography (sEMG) findings. The majority of participants in this present study demonstrated high satisfaction with dental implant rehabilitation. These results might have been influenced by the fact that treatments were performed by specialists.

According to Cronbach's Alpha coefficient, this present study had acceptable internal (inter-items) consistency (reliability) within the group of domains and sub-domains of S-OHIP-14 and had good and acceptable internal consistency within the nine items of satisfaction. It is mean how closely related a set of items are as a group (Ursachi *et al.*, 2015).

In regard to dental patient satisfaction, there was no standard questionnaire available (Yao *et al.*, 2018). In this study, patient satisfaction was evaluated through nine specific questions, regarding function, aesthetics, comfort, procedures, cost, cleanability, and general. Literally, previous studies have shown that these items influence patients' decisions (Azarpazhooh *et al.*, 2016).

There are some limitations in the present study even after strict inclusion and exclusion criteria. Firstly, subjects with systemic diseases such as renal and hepatic disease, AIDS, diabetes mellitus, and CVD were not sought in this study. A recent systematic review showed that prediabetes and poorly controlled diabetes mellitus suffer more often from peri-implantitis, especially in the post-implantation time (Wagner *et al.*, 2022). A study by French *et al.* (2021) indicated an over two times higher risk for dental implant failure in patients with diabetes mellitus. Moreover, these patients show higher implant loss rates than healthy individuals in the long term (Wagner *et al.*, 2022). According to Kanjevac *et al.* (2018), complications in bone mineral metabolism are occasionally in patients with kidney diseases compared with individuals without kidney-related disorders. Likewise, crestal bone loss around dental implants has been reported among patients with AIDS, cardiovascular diseases, and liver diseases (May *et al.*, 2016; Yoon *et al.*, 2016; Ting *et al.*, 2018).

Different implant systems may have different types of implant surface & abutment connections that may affect different outcomes/implant success/survival. In a long clinical study, the authors concluded that the roughest

titanium plasma-sprayed surface demonstrated the highest probability for failure, while the anodized showed the lowest probability (Wennerberg *et al.*, 2018). However, another study showed that the implant-abutment connection design had no influence on implant survival and biological complication rates, only the conical connections showed lower marginal bone loss and fewer prosthetic complications than external hexagonal connections after 1 year of loading (Camps-Font *et al.*, 2021)

A major limitation of this present study is it is a cross-sectional study with no available baseline data for comparison. There were no data regarding patients' expectations at baseline regarding the therapeutic outcome of dental implant rehabilitation, which may also influence satisfaction (Yao *et al.*, 2014). To overcome these limitations and avoid a possible 'recall bias' (Locker, 1998b), prospective studies are required in the future.

Conclusion

Within the limitation of this study, it can be concluded that a high level of patient satisfaction and quality of life after dental implant rehabilitation was found among patients in Periodontal Specialist Clinic, Mak Mandin. The study also concluded that the OHRQoL give a positive impact on patients' satisfaction levels. Further study is required to explore any correlation between the level of satisfaction and OHRQoL with clinical and radiographic evaluation. A multi-center study should be considered, so a larger sample size can be obtained involving other states in Malaysia to get a more significant result.

Acknowledgement/ fundings

The authors would like to thank the Director-General of Health Malaysia for permission to publish this paper. We are also indebted to the heads of departments in the Dental Division of Pulau Pinang for giving us

permission and support to conduct this study.

Author Contribution

NAS conceived and planned the presented idea. NAS and NIO performed the experiment and wrote the manuscript under YAY and EEAM supervision and support. The installation of the implants was performed by other clinicians who were not involved in this study and some of the implants were installed by YAY. NAS performed the data analysis in consultation with the EEAM.

Conflict of Interest

The authors declare no conflict or competing interests exist.

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Pathogens from fomites in clinical setting: A scoping review

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Abstract

Fomites can potentially transmit infectious or contagious pathogens thus contribute to the widespread of hospital-associated infections (HAIs). A scoping review was conducted to identify the types of fomites and pathogens as well as factors of pathogen distribution in clinical setting according to Arksey & O'Malley framework and PRISMA-ScR guidelines. Three online databases were used to collect the relevant data which revealed that there were 46 reported fomites in clinical setting that have been associated with bacteria, virus, and fungi. The most contaminated fomite with more than 10 species of pathogens was the mobile phone. This distribution might be due to the attitudes of healthcare workers and patients and their practice towards cleaning of mobile phones that prominent especially in Intensive Care Units (ICUs). Future study could investigate the effectiveness of proper hygiene to evaluate the contribution of this action towards the reduction of fomites contamination in the hospital.

Keywords: *clinical settings, fomite, mobile phone, hospital-associated infection (HAIs), Intensive Care Units (ICUs)*

Received:

10 April 2022

Revised:

13 July 2022

Accepted:

26 July 2022

Published Online:

28 February 2023

How to cite this article:

Muhammad, I., Wan Ismail, W. N. I., Samsuddin, N., & Alias, N. (2023). Pathogens from fomites in clinical setting: A scoping review. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 59-79. <https://doi.org/10.31436/ijohs.v4i1.144>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.144>

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Introduction

Fomites are inanimate objects, including hair, particles of bedding and clothing, and skin cells, mobile phones, handrails, door knobs, bodily fluids and any equipment with the affinity of colonizing with microbes and transporting them between persons either directly or indirectly (Lopez *et al.*, 2013; Shaffer, 2013). Bacteria, viruses and fungi are microorganisms that are known as agents or pathogens that can cause fomite-transmitted infection. Long survival duration of pathogens on fomites had cause fomites to become a reservoir which increased the risk transmission of hospital-acquired infections (HAIs) (Olise & Simon, 2018; Massari, 2016; Otter *et al.*, 2013).

Around 2 million patients infected with HAIs had suffered in United State of America (USA) where the mortality was estimated to be 90,000 deaths, annually. This rank HAIs infection to be in top five death leading cause in USA (Klevens *et al.*, 2007; Centre for Disease Control, 1992). The increase risk transmission of HAIs would indirectly lead to economic pressure since the cost of treatment would escalate (Stone, 2009). It was estimated the annual hospital costs of HAIs in USA to be between US\$28 billion to 45 billion per year (Douglas, 2009). A study conducted in Malaysia showed that in 100 patients, the prevalence of HAIs was 13.9%. Around half a million US\$ worth of antibiotics were needed to cure HAIs infection, yearly (Hughes *et al.*, 2005).

Humidifier, nebulizer, urine-measuring device, thermometer and pressure transducer were among identified hospital fomites in a review in 1987 before computer keyboards, hand soap or sanitizer dispenser and ultrasound probe were added into the list 30 years later (Kanamori, Rutala & Weber, 2017). Stethoscope, white coats, neckties and digital devices were frequently contaminated by methicillin-resistant *Staphylococcus aureus* (MRSA) and Gram-negative rods (GNRs) (Haun, Hooper-Lane & Safdar, 2016). *Acinetobacter lwoffii*, MRSA and *Pseudomonas aeruginosa* were isolated from mobile phones samples which known as one of the threatening fomites in hospital (Aftab *et al.*, 2015).

Various aspects and factors contributed to colonization and the complexity of pathogens transmission in clinical setting (Monegro, Muppidi & Regunath, 2020). Contamination from the healthcare workers' hands and personal protective equipment (PPE) might associate with direct contact to fomites in the hospital (Jackson *et al.*, 2019; Huttenen & Syrjänen, 2014). Poor hygiene and incorrect disinfection procedure could also lead to more pathogen's contamination (Massari, 2016).

A few studies were conducted on pathogens from fomites in clinical or community settings. Most of them focused on the route of transmission of pathogens mediated by fomite and was published together with modelling of transmission pathway, observational epidemiological studies, microbiologic studies, intervention studies and outbreak reports (Otter *et al.* 2013). The published data regarding the transmission did not include various range of pathogens and the causal factors.

This scoping review would aid the research field by focusing on the literature regarding pathogens from fomites in order to synthesise the knowledge on their contamination by diverse range of pathogens and to determine the factors contributing to the distribution and species of pathogens in clinical setting.

Material and Method

Study design

This scoping review followed and referred the Arksey and O'Malley framework and guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco *et al.*, 2018). The study design of the framework was created by Arksey and O'Malley (2005) before it was advanced by Levac, Colquhoun and O'Brien (2010). The framework consisted of six stages which were identifying the research question, determining the relevant study, study selection, charting the data, collating, summarizing and reporting results and consultation.

Search strategy

Literature searching process was done on PubMed, Scopus and Taylor & Francis Online to achieve diverse context of pathogens in clinical fomites. These four databases were selected due to accessibility and availability of wide range of literatures. Multiple combinations of search terms was used to obtained a diverse context of pathogens originated from clinical fomites. The search strategy was developed and improvised by the author and supervisor. Simple calibration was done to resolve inconsistencies of literatures obtained by trying various search terms. The terms that gave out relevant and highest amounts of articles were selected. The following search string was used by authors in all the data search: (Pathogens OR Germs OR Infectious Agents) AND Fomites AND ("Clinical Setting" OR "Medical Setting" OR Hospital) AND (Distribution OR "Reported pathogens" OR Factor OR Source OR Effect OR Impact OR Department OR Ward OR Unit).

Study selection

Studies obtained from the search string would be sorted alphabetically and screened for duplicates. After removing the duplicates, the studies would be screened for inclusion criteria. Studies were included if the research consists of information that

could achieve one of the research objectives (type of fomite, pathogens isolated and pathogen distribution associated factors), quantities research, published in 2010-2021 and available full-text in English. Studies that did not explore pathogens from fomites in clinical settings or deviate from the main purposes of the study were excluded.

Another screening process was conducted to ensure the eligibility of the articles. This was done to ensure the articles had relevant discussion that aligned with the scoping review objectives. The quality of selected articles in the review was assessed by the author and supervisor. Both of them would wholly appraise the articles to ensure the validity and reliability of the evidence. The selected studies were then compiled in Microsoft Excel for further process. Figure 1 represented the research flow diagram based on PRISMA-ScR outlining the selected studies that passed the criteria for full review.

Data extraction and charting

The data compiled in Microsoft Excel consisted of: Titles, author/year, country, ward/department, type of fomite, pathogens isolated and pathogen distribution associated factors. The data that did not related to the scoping review objectives was not extracted from the articles. The findings would helped in answering the scoping review objectives where the data obtained would be represented in table format. The full text papers were stored in PDF format for references purposes.

Result

Study selection

An amount of 375 articles were retrieved with 232 articles from PubMed, four articles from Scopus and others from Taylor & Francis Online. The 371 articles remaining were screened based on the inclusion criteria after duplicates were removed. The

314 articles were excluded in the next step due to the articles did not meet the inclusion criteria and had no full-text documents. Next, 57 full-text articles were assessed for eligibility, of which 14 articles were excluded for having irrelevant discussion or study objectives. Finally, 43 articles were chosen for full review and were included in the final analysis. Table 1 illustrated the articles included in the scoping review.

Study overview

Out of 43 articles chosen, 37 studies had reported on contamination of fomites and its associated types of pathogens as shown in Table 2. Seven articles explored on the factors related to fomites contamination in clinical settings. Only two papers discussed on both aspects: fomites contamination and its associated types of pathogens and the related factors.

Identification of fomites

Among 37 papers reported about fomites, nine of them conducted investigation on the mobile phones of the medical students, healthcare workers and patients. Four studies recorded about faucet and bedside table contamination and three papers researched on stethoscope and bed rails. Two studies performed inquiry on contamination of scissors, keyboard, sink, trolley, pen and thermometer while only one study identified ball pits, floor, wall, medical charts and door handles as fomites.

Localization of fomites

All studies of the particular fomites were carried out in multiple department or wards of the hospital. However, the data showed that ICUs were likely to be chose for a for single research setting study based on a study conducted by Chen *et al.* (2014) regarding the relation of bacterial contaminations in different wards.

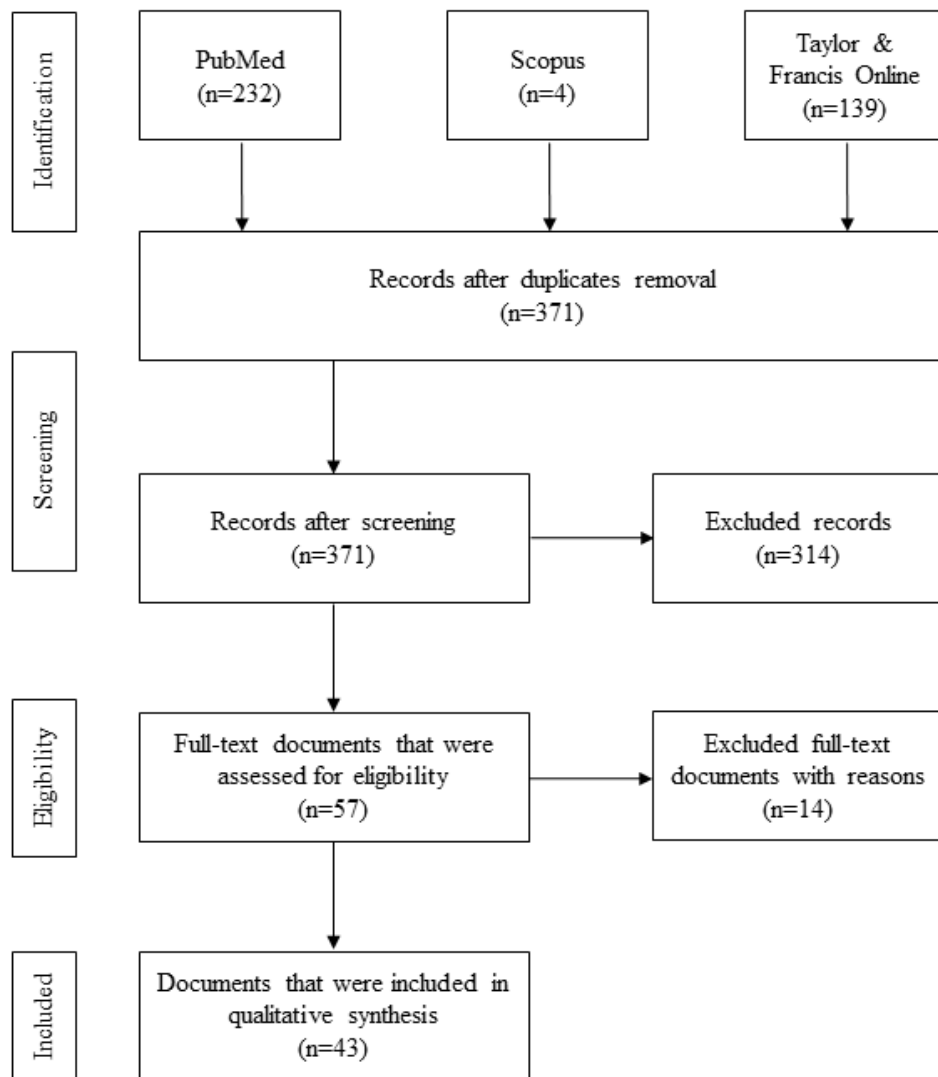


Figure 1. The flow diagram for data collection and extraction based on PRISMA-ScR guideline.

Table 1. List of articles accepted in the scoping review

No.	Title	Reference
1.	An outbreak of Legionnaires disease associated with a decorative water fall fountain in hospital	Haupt <i>et al.</i> (2012)
2.	Are balls pits located in physical therapy clinical settings a source of pathogenic microorganisms?	Oesterle <i>et al.</i> (2019)
3.	Are hospital floors an underappreciated reservoir for transmission of health care-associated pathogens?	Deshpande <i>et al.</i> (2017)
4.	Bacterial colonization on writing pens touched by healthcare professionals and hospitalized patients with and without cleaning the pen with alcohol-based hand sanitizing agent	Halton <i>et al.</i> (2011)
5.	Bacterial contamination and antimicrobial susceptibility patterns of intensive care units medical equipment and inanimate surfaces at Ayder Comprehensive Specialized Hospital, Mekelle, Northern Ethiopia	Darge <i>et al.</i> (2019)
6.	Bacterial contamination and stethoscope disinfection practices: A cross-sectional survey of healthcare workers in Karachi, Pakistan	Rao <i>et al.</i> (2017)
7.	Colonization of patients, healthcare workers, and the environment with healthcare-associated <i>Staphylococcus epidermidis</i> genotypes in an intensive care unit: A prospective observational cohort study	Widerström <i>et al.</i> (2016)
8.	Comparison of keyboard colonization before and after use in an inpatient setting and the effect of keyboard covers	Das <i>et al.</i> (2018)
9.	Contamination of medical charts: An important source of potential infection in hospitals	Chen <i>et al.</i> (2014)
10.	Contamination of X-ray cassettes with methicillin-resistant <i>Staphylococcus aureus</i> and methicillin-resistant <i>Staphylococcus haemolyticus</i> in a radiology department	Kim <i>et al.</i> (2012)
11.	Dissemination of human adenoviruses and rotavirus species A on fomites of hospital paediatric units	Ganime <i>et al.</i> (2016)
12.	Do mobile phones of patients, companions and visitors carry multidrug-resistant hospital pathogens?	Tekerekoğlu <i>et al.</i> (2011)
13.	Extended-spectrum β -lactamase-producing Enterobacteriaceae in cell phones of health careworkers from Peruvian pediatric	Loyola <i>et al.</i> (2016)

	and neonatal intensive care units	
14.	Faucet aerators as a reservoir for carbapenem-resistant <i>Acinetobacter baumannii</i> : A healthcare-associated infection outbreak in a neurosurgical intensive care unit	Lv <i>et al.</i> (2019)
15.	Hand hygiene after touching a patient's surroundings: The opportunities most commonly missed	FitzGerald <i>et al.</i> (2013)
16.	Hand sanitizer dispensers and associated hospital-acquired infections: Friend or fomite?	Eiref <i>et al.</i> (2012)
17.	Health care workers' mobile phones: A potential cause of microbial cross-contamination between hospitals and community	Ustun <i>et al.</i> (2012)
18.	Identification of microorganisms on mobile phones of intensive care unit health care workers and medical students in the tertiary hospital	Kotris <i>et al.</i> (2017)
19.	Influence of biological fluids in bacterial viability on different hospital surfaces and fomites	Esteves <i>et al.</i> (2016)
20.	Isolation and characterization of <i>Stenotrophomonas maltophilia</i> isolates from a Brazilian hospital	Gallo <i>et al.</i> (2016)
21.	Isolation of pathogenic bacteria from fomites in the operating rooms of a specialist hospital in Kano, North-western Nigeria	Nwankwo <i>et al.</i> (2012)
22.	Methicillin resistant <i>Staphylococcus aureus</i> contamination of phlebotomy tourniquets and faucets	Abeywickrama <i>et al.</i> (2018)
23.	Knowledge, attitude, and practices of healthcare personnel regarding the transmission of pathogens via fomites at a tertiary care hospital in Karachi, Pakistan	Aftab <i>et al.</i> (2015)
24.	Microbial contaminants isolated from items and work surfaces in the post-operative ward at Kawolo General Hospital, Uganda.	Sserwadda <i>et al.</i> (2018)
25.	Microbial flora on cell-phones in an orthopaedic surgery room before and after decontamination	Murgier <i>et al.</i> (2016)
26.	Mobile phone technology and hospitalized patients: A cross-sectional surveillance study of bacterial colonization, and patient opinions and behaviours	Brady <i>et al.</i> (2011)
27.	Mobile phones as a potential vehicle of infection in a hospital setting	Foong <i>et al.</i> (2015)
28.	More than just teddy bears: Unconventional transmission agents	Hardy <i>et al.</i> (2018)

	in the operating room	
29.	Neonatal resuscitation equipment: A hidden risk for our babies?	Winckworth <i>et al.</i> (2016)
30.	Nosocomial infections in the ICU: Pens and spectacles as fomites	Murad <i>et al.</i> (2016)
31.	Nursing and physician attire as possible source of nosocomial infections	Wiener-Well <i>et al.</i> (2011)
32.	Potential sources of transmission of hospital acquired infections in the volta regional hospital in Ghana	Tagoe <i>et al.</i> (2011)
33.	Prevalence of antibacterial resistant bacterial contaminants from mobile phones of hospital inpatients	Kumar <i>et al.</i> (2014)
34.	<i>Pseudomonas aeruginosa</i> infections due to electronic faucets in a neonatal intensive care unit	Yapicioglu <i>et al.</i> (2012)
35.	Quantitative assessment of interactions between hospitalized patients and portable medical equipment and other fomites	Suwantararat <i>et al.</i> (2017)
36.	Sphygmomanometer cuffs: A potential source of infection!	Zargaran <i>et al.</i> (2015)
37.	Sphygmomanometers and thermometers as potential fomites of <i>Staphylococcus haemolyticus</i> : Biofilm formation in the presence of antibiotics	Sued <i>et al.</i> (2017)
38.	Stethoscopes as potential intrahospital carriers of pathogenic microorganisms	Campos-Murguía <i>et al.</i> (2014)
39.	Surface microbiology of the iPad tablet computer and the potential to serve as a fomite in both inpatient practice settings as well as outside of the hospital environment	Hirsch <i>et al.</i> (2014)
40.	Transfer of dry surface biofilm in the healthcare environment: The role of healthcare workers' hands as vehicles	Chowdhury <i>et al.</i> (2018)
41.	<i>Trichosporon asahii</i> among intensive care unit patients at a medical center in Jamaica	Fanfair <i>et al.</i> (2013)
42.	The occurrence of nosocomial pathogens on cell phones of healthcare workers in an Iranian tertiary care hospital	Khashei <i>et al.</i> (2019)
43.	Use of portable electronic devices in a hospital setting and their potential for bacterial colonization	Khan <i>et al.</i> (2015)

Table 2. The findings of studies on fomites.

Reference	Country	Ward/Department	Fomite	Types of Pathogens		
				Bacteria ^a		Others ^a
				Gram-positive	Gram-negative	
(Brady <i>et al.</i> , 2011)	United Kingdom	Surgical/Urology	Mobile phone	CoNS, <i>S. aureus</i> , <i>Corynebacterium</i> spp., <i>Streptococcus</i> spp., <i>E. faecium</i> , <i>Enterobacter cloacae</i> , <i>Micrococcus</i> spp., <i>Dermacoccus nishinomiyaensis</i> , <i>Kocuria kristinae</i> , <i>Lactococcus garvieae</i> , <i>Gemella morbillorum</i> , <i>Bacillus</i> spp., Alpha-hemolytic <i>Streptococcus</i>	<i>Sphingomonas paucimobilis</i> , <i>Rhizobium radiobacter</i> , <i>A. ursingii</i> , <i>Moraxella</i> spp., <i>Burkholderia cepacia</i>	Fungi: <i>Candida albicans</i>
(Halton <i>et al.</i> , 2011)	United State of America	NA	Pen	<i>Micrococcus</i> spp., <i>Staphylococcus</i> spp., <i>Enterococcus</i> spp.	NA	NA
(Tagoe <i>et al.</i> , 2011)	Ghana		Door handle, lavatories, desk surfaces, faucet	<i>S. aureus</i>	<i>E. coli</i> , <i>P. aeruginosa</i>	NA
(Tekerekoğlu <i>et al.</i> , 2011)	Turkey	NA	Mobile phone	CoNS, <i>S. aureus</i> , <i>Streptococcus</i> spp., MRSA, <i>Bacillus</i> spp., <i>Enterococcus</i> spp. (ESBL and high-level	<i>Escherichia coli</i> , <i>Klebsiella</i> spp., <i>Proteus</i> spp., <i>P. aeruginosa</i> , <i>A. baumannii</i>	NA

				aminoglycoside-resistant)	(carbapenem resistant)	
(Wiener-Well <i>et al.</i> , 2011)	Israel	Medical and Surgical	Uniform	MSSA, MRSA	<i>A. baumannii</i> , <i>A. lwoffii</i> , <i>E. cloacae</i> , <i>K. pneumoniae</i> , <i>K. oxytoca</i> , <i>Citrobacter freundii</i> , <i>E. coli</i> , <i>Pantoea agglomerans</i> , <i>P. stutzeri</i> , <i>P. putida</i> , <i>P. aeruginosa</i> , <i>P. fluorescens</i>	NA
(Eiref <i>et al.</i> , 2012)	United State of America	Surgical ICU	Hand sanitizer dispenser	CoNS, MSSA, <i>Micrococcus</i> spp., <i>Bacillus</i> spp., Diphtheroid, aerobic actinomycetes	Non-lactose fermenter non-enteric, lactose-fermenter enteric	NA
(Haupt <i>et al.</i> , 2012)	United State of America	NA	Water wall fountain	NA	<i>Legionella</i>	NA
(Kim <i>et al.</i> , 2012)	Korea	Radiology	X-ray cassette	MRSA, methicillin-resistant <i>S. haemolyticus</i>	NA	NA
(Nwankwo, 2012)	Nigeria	Operation Theatre	Floor	<i>B. circulans</i> , <i>Micrococcus</i>	<i>E. coli</i> , <i>Salmonella enterica</i>	Fungi: <i>Penicillium</i> , <i>Aspergillus</i> spp.
			Operating lamp	<i>Streptococcus</i> spp., CoNS, <i>B. circulans</i>	NA	NA
			Wall	<i>Streptococcus</i> spp., CoNS	NA	NA

			Sink	NA	<i>P. aeruginosa, P. mirabilis</i>	NA
			Suction tube	<i>Streptococcus</i> spp., <i>S. aureus, E. faecalis</i>	<i>P. aeruginosa, P. mirabilis, P. vulgaris</i>	Fungi: <i>Aspergillus</i> spp.
			Scissors	CoNS, <i>Micrococcus</i>	NA	NA
			Trolley	<i>B. circulans, Streptococcus</i> spp.	NA	Fungi: <i>Penicillium</i>
			Anaesthetic machine	<i>Micrococcus</i>	NA	NA
(Ustun & Cihangiroglu, 2012)	Turkey	Various	Mobile phones	MRSA, MSSA, ESBL positive, ESBL negative, MR-CoNS spp., MS-CoNS spp., <i>Enterococcus</i> spp.	<i>Klebsiella</i> spp.	NA
(Yapicioglu <i>et al.</i> , 2012)	Turkey	Neonatal ICU	Electronic faucet	NA	<i>P. aeruginosa</i>	NA
(Fanfair <i>et al.</i> , 2013)	Jamaica	ICU	Sink, bed rails, faucet, drawer, washbasin,	NA	NA	Fungi: <i>Trichosporon asahii</i>
(Campos-Murguia <i>et al.</i> , 2014)	Mexico	Various	Stethoscope	<i>E. faecalis, S. aureus</i>	<i>K. pneumoniae, A. baumannii, B. cepacia</i>	NA
(Chen <i>et al.</i> , 2014)	Taiwan	Various	Medical chart	CoNS, <i>S. aureus</i> , MRSA, <i>E. faecalis, S. viridans,</i>	<i>S. paucimobilis, P. aeruginosa, E. coli, K.</i>	NA

				<i>Corynebacterium</i> spp., <i>Bacillus</i> spp.	<i>pneumoniae</i> , <i>Pantoea</i> spp., <i>A. baumannii</i>	
(Hirsch <i>et al.</i> , 2014)	United State of America	Pharmacy	iPads	MRSA, vancomycin- resistant enterococci	<i>P. aeruginosa</i>	NA
(Kumar <i>et al.</i> , 2014)	Saudi Arabia	NA	Mobile phone	CoNS, <i>S. aureus</i> , <i>E.</i> <i>cloacae</i> , <i>E. faecalis</i>	<i>P. stutzeri</i> , <i>S.</i> <i>paucimobilis</i>	NA
(Foong <i>et al.</i> , 2015)	Australia	NA	Mobile phone	MRSA	Coliforms	NA
(Khan <i>et al.</i> , 2015)	United State of America	NA	Portable electronic devices	CoNS, MRSA, <i>Bacillus</i> spp., <i>Streptococcus</i> spp., <i>S. aureus</i> , <i>Enterococcus</i> spp.	<i>Acinetobacter</i> spp., <i>Pantoea</i> spp., <i>Pseudomonas</i> spp., <i>Enterobacter</i> spp., <i>Moraxella</i>	NA
(Zargarani <i>et al.</i> , 2015)	United Kingdom	Various	Sphygmomanometer cuff	<i>Bacillus</i> spp., CoNS, Diphtheroid, <i>Enterococcus</i> spp., <i>Micrococcus</i> spp., viridans streptococci, <i>S. aureus</i>	Coliform, <i>Proteus</i> spp.	NA
(Gallo <i>et al.</i> , 2016)	Brazil	NA	Bed rails, trolley, bedside table, ambubag, intravenous pump	NA	<i>Stenotrophomonas</i> <i>maltophilia</i>	NA
(Ganime <i>et al.</i> , 2016)	Brazil	Pediatric	Accompanying arm chair, bed rails, door knob, bedside table,	NA	NA	Virus:

			cardiac monitor keyboard, incubator door locks			Human adenovirus, Rotavirus A
(Loyola <i>et al.</i> , 2016)	Peru	Pediatric, neonatal ICU	Mobile phone	<i>Enterobacter</i> spp.	<i>E. coli</i> , <i>K. pneumoniae</i> , <i>K. oxytoca</i>	NA
(Murad & Inam Pal, 2016)	Pakistan	ICU	Pen	<i>Acinetobacter</i>	NA	Fungi: <i>Candida</i>
			Spectacles	Vancomycin-resistant <i>E. faecium</i>	NA	NA
(Murgier <i>et al.</i> , 2016)	France	Operation Theatre	Mobile phone	CoNS, <i>C. tuberculostearicum</i> , sporulating bacteria	<i>A. lwoffii</i> , <i>Radioresistens</i> , <i>Enterobacteria</i> , <i>Roseomonas mucosa</i> , <i>P. oryzihabitans</i>	Unidentified fungi
(Winckworth <i>et al.</i> , 2016)	United Kingdom	Neonatal ICU	Resuscitation equipment	CoNS,	<i>E. coli</i> , <i>E. cloacae</i>	NA
(Deshpande <i>et al.</i> , 2017)	United State of America	Patient room	Floor	MRSA, vancomycin- resistant enterococci, <i>Clostridium difficile</i>	NA	NA

(Kotris <i>et al.</i> , 2017)	Croatia	ICU	Mobile phone	CoNS, <i>S. aureus</i> , <i>Sarcina</i> spp., <i>Bacillus</i> spp., <i>Corynebacterium</i> spp.	<i>Neisseria</i> spp., non-fermenting bacteria	NA
(Rao <i>et al.</i> , 2017)	Pakistan	Various	Stethoscope	<i>S. aureus</i>	<i>E. coli</i>	NA
(Sued <i>et al.</i> , 2017)	Brazil	Various	Sphygmomanometers, thermometers	Oxacillin-resistant <i>S. haemolyticus</i>	NA	NA
(Abeywickrama <i>et al.</i> , 2018)	Sri Lanka	Various	Tourniquet, faucet	MRSA	NA	NA
(Das <i>et al.</i> , 2018)	United State of America	Medical	Keyboard	CoNS, <i>S. aureus</i> , α -haemolytic <i>Streptococcus</i> , γ -haemolytic <i>Streptococcus</i> , <i>Bacillus</i> , Diphtheroid, <i>Micrococcus</i>	Rod-shaped bacteria	NA
(Hardy <i>et al.</i> , 2018)	France	Operation Theatre	Stuff bear	<i>S. aureus</i>	<i>A. ursingii</i> , <i>A. baumannii</i> , <i>P. stutzeri</i>	NA
(Sserwadda <i>et al.</i> , 2018)	Uganda	Post-surgical	Scissors	<i>S. aureus</i>	<i>K. pneumoniae</i>	NA
			Infusion stands, light switch	<i>S. aureus</i>	<i>Enterobacter</i> spp., <i>K. pneumoniae</i> , <i>Serratia merscescans</i>	NA
			Patient beds	<i>S. aureus</i>	<i>P. vulgaris</i>	NA

			Tables, sink taps	<i>S. aureus</i>	<i>K. pneumoniae, P. vulgaris</i>	NA
(Darge <i>et al.</i> , 2019)	Ethiopia	ICU	Stethoscope	CoNS, <i>S. aureus</i>	<i>E. coli, P. vulgaris, S. typhi, E. aerogenes, C. freundii, K. pneumoniae</i>	NA
			Thermometer	CoNS	<i>E. coli, C. freundii</i>	NA
			Sphygmomanometer	CoNS, <i>S. aureus</i>	<i>K. pneumoniae</i>	NA
			Bedside table, mattress, computer	CoNS, <i>S. aureus</i>	NA	NA
(Khashei <i>et al.</i> , 2019)	Iran	Various	Mobile phone	<i>Staphylococci, Streptococci, Micrococci</i>	NA	NA
(Lv <i>et al.</i> , 2019)	China	ICU	Faucet aerator	NA	Carbapenem-resistant <i>A. baumannii</i>	NA
(Oesterle <i>et al.</i> , 2019)	United State of America	Pediatric	Ball pits	<i>B. fastidiosus, B. galactosidilyticus, B. mojavensis/subtilis, B. plakortidis, B. sporothermodurans, B. thuringiensis/cereus, B. lentus, B. horikoshii, Sporolactobacillus terrae, E. faecalis, Macrocooccus brunensis, Paenibacillus xylanilyticus, S. hominis, S. oralis, S. sobrinus,</i>	<i>A. lwoffii, K. variicola, M. caprae, Pseudoxanthomonas yeogluensis, P. agarici, P. fragi, P. pertucinogena, Psychrobacter immobilis, Raoultella terrigena, Stenotrophomonas rhizophila, Rhodotorula mucilaginosa</i>	NA

Aerococcus viridans,
Vagococcus
salmoninarum, M.
flavusx, Mycobacterium
aichiense/novocastrense

Note: ^a: Listed bacteria, fungi and virus did not cover the whole species listed in the reference articles.

Abbreviation: MRSA: methicillin-resistant *S. aureus*; MSSA: methicillin-sensitive *S. aureus*; CoNS: coagulase-negative *Staphylococci*; MR-CoNS: methicillin-resistant coagulase-negative *Staphylococci*; MS-CoNS: methicillin-sensitive coagulase-negative *Staphylococci*; ESBL: extended spectrum beta-lactamase; NA: not available.

Factors of pathogens contamination

Various factors or reasons of pathogens distribution in clinical setting were shown in Table 3. Seven studies had revealed a total of 11 factors related to pathogens distribution. Nevertheless, three factors identified might

lead to similar cause which contributed by health workers. The other identified factors were contributed from environment, patients, biological fluids, hands, mobile phones and medical equipment.

Table 3. Factors of pathogens distribution on fomites in clinical setting.

Factor	Reference
Lack of education and knowledge of the patient and surrounding people	(Brady <i>et al.</i> , 2011)
Healthcare workers' attitude	(FitzGerald <i>et al.</i> , 2013)
Knowledge and practice gap of healthcare workers	(Aftab <i>et al.</i> , 2015)
Biological fluids	(Esteves <i>et al.</i> , 2016)
Poor hygiene	
Portability of mobile phone	
Hospital environment	(Widerström <i>et al.</i> , 2016)
Healthcare workers	
Patients transferred from other hospital	
Shared portable medical equipment	(Suwantarat <i>et al.</i> , 2017)
Contaminated hands	(Chowdhury <i>et al.</i> , 2018)

Discussion

Types of pathogens from fomites in clinical setting

Two types of pathogens were identified on mobile phones where majority of them were bacteria. The mobile phones of the patients contained a much bigger proportion of infection than the device used by the healthcare workers. Multi-drug resistant bacteria were not detected on the mobile phones of the workers, contrary to predictions by Tekerekoğlu *et al.* (2011). A research conducted by Brady *et al.* in 2011 showed that there was a relationship between *S. aureus* nasal colonization and the presence of this pathogen on the patient's mobile phone. Another research involving the same fomite on healthcare workers was conducted on the following year. The researchers managed to demonstrate the contamination of pathogens which was

believed to be contributed by improper touching of the phone unconsciously while treating the patients (Ustun & Cihangiroglu, 2012). This contaminated device had a potential to serve as a vector of nosocomial pathogens in a hospital setting which indirectly could also lead to transmission in the healthcare workers' homes.

Foong *et al.* (2015) revealed that MRSA and coliforms had contaminated the mobile phones of the people in the hospital. Another group of researchers had conducted a study in 2016 to investigate the trend of the mobile phone's contamination in the ICU ward. More than 70% of the workers did not practice disinfection as standard of operation and nearly half of them frequently touched the mobile phones during working (Loyola *et al.*, 2016). However, Kotris *et al.* (2017) who studied on fomite contaminations in the same department, stated that the isolated pathogens on the

mobile phones obtained from the research were non-pathogenic.

Another group of researchers had studied the same device but in different department. The researchers demonstrated the contamination of CoNS, *C. tuberculostearicum*, *A. lwoffii*, *Radioresistens*, *Enterobacteria*, *R. mucosa*, *P. oryzihabitans*, fungi and sporulating bacilli on the mobile phones of the healthcare workers (Murgier *et al.*, 2016). The most recent study on mobile phones depicted that Gram-positive *Staphylococci* as the most prevalent microorganism that contaminated this device in the hospital (Khashei *et al.*, 2019). The healthcare workers' uniforms especially physicians and nurses were contaminated with various pathogens of Gram-negative bacteria and some of Gram-positive bacteria (Wiener-Well *et al.*, 2011). The ball pits of the paediatric physical therapy department had found contamination of bacteria where nine of the pathogens were identified as opportunistic pathogens (Oesterle *et al.*, 2019). Three studies on the stethoscopes had reported different number of isolated bacteria (Darge *et al.*, 2019; Rao *et al.*, 2017; Campos-Murguía *et al.*, 2014).

Sphygmomanometers and thermometers were also among the common bacteria-contaminated fomites that had direct contact with patients (Sued *et al.*, 2017). Interestingly, sphygmomanometers cuff was reported to be contaminated with different species of bacteria than of sphygmomanometer which could contribute to a number of infections such as nosocomial meningitis, bacteraemia, diphtheria, infective endocarditis and urinary tract infections (Zargarán *et al.*, 2015).

Another study showed that patient beds and infusion stand had greater bacterial contamination levels compared to swabbed surfaces and equipment (Sserwadda *et al.*, 2018). This was likely due to medical practitioners' hands as a means of transmission point during patient care in the hospital.

A study conducted by Eiref *et al.* in 2012 showed that bacteria had contaminated the 100% waterless alcohol-based hand

sanitizer dispensers from surgical ICU, including commensal skin flora and Gram-negative enteric. Although the reported bacteria were not usually associated with HAIs, they could still potentially become opportunistic pathogens in immunocompromised patients or those with indwelling medical devices.

Pens and spectacles were also in the list of contaminated fomites in the hospital setting. Only one study was conducted on them where four species of bacteria and a species of fungi were found on pens while spectacles were reported contaminated with vancomycin-resistant *E. faecium* (Murad & Inam Pal, 2016). The researchers also reported the relationship between the vancomycin-resistant *E. faecium* and the outbreaks in many hospitals where the bacteria usually affect the urinary tract and bloodstream of the victim or patient.

Electronic faucet was another vector for pathogens transmission where the most contaminated faucets' components were the output, magnetic valve and mixing device (Yapicioglu *et al.*, 2012). The researchers acknowledged that the magnetic valve was made of *P. aeruginosa* biofilm-friendly rubber, plastic and polyvinylchloride membranes.

An outbreak of legionellosis in hospital had led to a study on the contaminated water wall fountain. The study found that the usage of floodlights and an electric fireplace on the back side of the wall which might warmed the fountain water to temperature favourable for *Legionella* growth (Haupt *et al.*, 2012).

X-ray cassettes in the radiology department were contaminated by two species of bacteria which were MRSA and methicillin-resistant *S. haemolyticus*. Both of the species were believed to be transferred from contaminated workers' hands or patients' skin and clothing (Kim *et al.*, 2012).

Stuff toys that were brought by the paediatric patients into the operating rooms also included as one of the fomites in hospital setting. The toys were discovered to

be contaminated with a species of Gram-positive bacteria and three species of Gram-negative bacteria (Hardy *et al.*, 2018). The findings suggested that bringing these unusual transmission agents into the operating room could contribute a considerable, potentially pathogenic contribution to the bacteria load, thus increasing the risk of surgical site infection.

Factors of various distribution of pathogens from fomites in clinical setting

There was only one study that discussed on the comparison of the wards and departments in relation to pathogen contamination from fomites in clinical setting. Based on the study, most of the medical charts examined had bacteria contamination with nearly 70% in general wards and more than 80% in ICUs (Chen, Chen & Wang, 2014). The researchers emphasised that the contamination of ICUs that similar to general wards could lead to increase in nosocomial infection.

The factors associated with contaminated fomites distributions in hospital setting were discussed in a few studies. A study in 2016 demonstrated the widespread of hospital-acquired methicillin-resistant *S. epidermidis* due to healthcare workers, patients referred from other hospitals and the hospital environment. Almost all workers, more than half of the referred patients and 50% of the hospital environment were reported to be contaminated (Widerström *et al.*, 2016).

In contrast, Aftab *et al.* (2015) depicted that the huge gap between the knowledge and practices of the healthcare workers contributed to the large distribution of pathogen. Majority of the workers recognised and knowledgeable on the potential fomites in hospital. Yet, only a small number of them practised the appropriate hygiene and sanitisation. Similarly, previous study also reported the same root cause had high potential in leading to the pathogen's transmission in the hospital (Brady *et al.*, 2015).

The attitude of the healthcare workers that did not comply with the hand hygiene routine might increase the contamination of clinical fomites (Chowdhury *et al.*, 2018; FitzGerald *et al.*, 2013). The poor hygiene and portability of mobile phones of patients or healthcare workers might contribute to the ESBL producing and multidrug resistant bacteria across the wards and department in hospital (Loyola *et al.*, 2016).

Biological fluids could also facilitate the pathogens transmission through sharing between hosts (Esteves *et al.*, 2016). Shared portable medical equipment were usually contaminated with the pathogens found in the clinical setting (Suwantararat *et al.*, 2017). The contaminated portable medical equipment was often touched or used by the hospitalized patients which could contribute to a rise in nosocomial infections.

Limitation of study

The study conducted was restricted by the imbalance of obtained data in achieving the study objectives. Most of the studies obtained from the database were investigating and discussing on the types of reported pathogens on fomites in clinical settings. The studies did not include factors behind the emergence of pathogens as a part of their research purposes. This review also did not focus on the effects of the hygiene or actions that reduced the pathogen contamination on the hospital fomites. There was also a problem of getting access to full-text documents which effect the scope of the review.

Conclusion

In conclusion, there were 46 reported group of fomites in clinical setting that were associated with various pathogen contamination which were bacteria, fungi and virus. The most reported contaminated fomite was mobile phone with more than 10 identified species of pathogens, including MRSA, MR-CoNS and ESBL pathogens. The various distribution of contamination might be due to several factors, including the healthcare workers and the patients'

attitude and practice towards cleaning of the mobile phones. ICUs had a higher potential to be contaminated with pathogens compared to other departments in the hospital.

The scoping review study was just a preliminary stage to more studies of this in the future. It is suggested for future study to address the exact mechanism of pathogen distribution throughout the clinical setting. More studies should be conducted in discovering the effectiveness of proper hygiene to evaluate the effect of this action towards fomite contamination in the hospital. Future study should lean more on investigation and construction of appropriate and effective plan that could tackle the problem of fomites contamination in clinical setting.

Acknowledgement

The authors would like to thank the people that had provided moral and physical support either directly or indirectly in creating this review paper. This research was supported by the Fundamental Research Grant Scheme (FRGS) for Research Acculturation of Early Career Researchers (RACER/1/2019/SKK11/UIAM//1).

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Concentrated Growth Factor as an alternative membrane material in periodontal regeneration: A case report

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Abstract

The risk of further periodontal breakdown increases with a deep intrabony defect. Non-surgical periodontal therapy could pose a challenge and surgical intervention is mainly required to manage the defect. Autologous platelet concentrates such as concentrated growth factor (CGF) may improve surgical outcome due to its enrichment with growth factors. Nevertheless, the outcomes of using CGF as a biomaterial in periodontal regenerative therapy is inconclusive. This case report describes the regenerative management of an intrabony defect on all the first molars of a 24-year-old Malay lady diagnosed with Generalised Periodontitis, Stage III, Grade C. A guided tissue regeneration strategy was utilised on all the first molars except on tooth 46, which was treated with xenografts and a biologic adjunct of CGF. Patient was recalled regularly every week up to two months following the procedure, followed by a three-month interval review. The results showed promising outcomes with an average of 4 mm probing pocket depth reduction and 79.1% radiographic bone fill for both regenerative strategies. The utilisation of biologic adjuncts such as CGF, could offer a viable alternative to collagen membrane in periodontal regeneration without compromising clinical results.

Keywords: Concentrated Growth Factor, guided tissue regeneration, membrane, periodontitis, xenograft

Introduction

In achieving a successful outcome following non-surgical periodontal therapy (NSPT), various factors play a pertinent role. These include operator, patient, instrument design and tooth anatomic or site factors. The presence of anatomic features, specifically intrabony defect and furcation involvement

increase the risk of future periodontal breakdown as these limit complete removal of subgingival biofilm and deposits in the periodontal pocket (Jepsen *et al.*, 2011; Graziani *et al.*, 2017). It poses a dilemma to either proceed with non-surgical or surgical periodontal treatment in such cases. As recommended by the current clinical guidelines, periodontal regenerative surgery is recommended for deep intrabony defect

Received:

7 June 2022

Revised:

10 August 2022

Accepted:

8 November 2022

Published Online:

28 February 2023

How to cite this article:

Mohd Noh, N. Z., Salehuddin, N. Q., Ali, S. N., Mohamad, I. H., & Ariffin, F. (2023). Concentrated Growth Factor as an alternative membrane material in periodontal regeneration: A case report. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 80–88. <https://doi.org/10.31436/ijoh.v4i1.165>

Article DOI:

<https://doi.org/10.31436/ijoh.v4i1.165>

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and class II furcation involvement as favourable outcomes have been reported (Sanz *et al.*, 2020).

However, selection of cases for regenerative surgery is crucial as there are many factors that may also influence the clinical outcomes following the regenerative therapy. One of the critical factors is from the surgical perspective as the choice of flap design may influence the outcome of treatment. In comparison to conventional approach, papilla preservation flap design offers a benefit of preserving the interdental tissue over the defect (Cortellini *et al.*, 1995, 1999). This flap design provides a better flap closure and complete membrane coverage, consequently leading to superior clinical outcomes. In addition, the application of adjunct biologic agents such as enamel matrix protein and recombinant human growth factors has also been reported to significantly enhance better outcomes following regenerative therapy (Bosshardt, 2008; Suárez-López Del Amo *et al.*, 2015). Another alternative adjunct regenerative material which is gaining traction is concentrated growth factor (CGF). However, the results of using CGF as a biomaterial in regenerative therapy is inconclusive.

Therefore, this case report aims to discuss regenerative management of a periodontitis patient presented with intrabony defects with 1) guided tissue regeneration (GTR) and 2) xenografts with biologic adjunct of CGF strategies.

Case Report

A 24-year-old Malay lady was referred to the Postgraduate Periodontics Clinic for management of generalised deep periodontal pockets. The patient was fit and healthy with no known underlying systemic risk factors. Upon clinical examination, she was presented with a full mouth plaque score of 36.6% and gingival inflammation was observed mainly on her lower anterior teeth. Full mouth periodontal examination revealed deep probing pocket depth (PPD) ranging from 5 mm to 10 mm with bleeding on probing. Radiograph taken in July 2019 demonstrated periodontitis due to the presence of alveolar bone loss with prominent vertical bone loss affecting the mesial root surface of all the first molars (Figure 1). Based on clinical examinations and radiographic investigation, she was diagnosed with Generalised Periodontitis, Stage III, Grade C (Tonetti *et al.*, 2018).



Figure 1. Panoramic radiograph of the patient illustrates generalised bone loss with vertical bone loss on the mesial root surface of all the first molars.

With consent, she was managed initially with professional mechanical plaque removal involving scaling and root debridement (SRD), which was completed in two consecutive days. An adjunct combination of antibiotic comprising of 500 mg amoxicillin and 400 mg metronidazole was prescribed to the patient for a week. She was called two weeks later for a compliance review and chairside brushing was conducted. During her periodontal review five months later, her gingival condition has improved as compared to the baseline visit. A good oral hygiene was maintained with full mouth plaque score of 22.6% and a marked improvement in reduction of PPD was observed, with the only deepest PPD of 6 mm to 8 mm were observed on the mesial surface of all the first molars.

After considering all factors, regenerative therapy was proposed for all the first molars and agreed by the patient. The regenerative

therapy was completed in four different sessions. After assessing the planned surgical sites, the modified papilla preservation technique (MPPT) of flap design was employed for regenerative management on the mesial surface of all the first molars as the interdental space width was ranging between 4 mm to 5 mm. After local anaesthesia was administered using mepivacaine hydrochloride (2% Scandonest), intrasulcular incision was performed around the surgical site (tooth 16, 26, 36 and 46) and its adjacent teeth on buccal, lingual or palatal and interdentally. Horizontal incision was made approximately at the level of buccal cemento-enamel junction (CEJ) of the respective tooth (Figure 2). Full thickness mucoperiosteal flap was elevated and the interdental papilla was elevated and reflected to the palatal or lingual site through the interdental space (Figure 3).

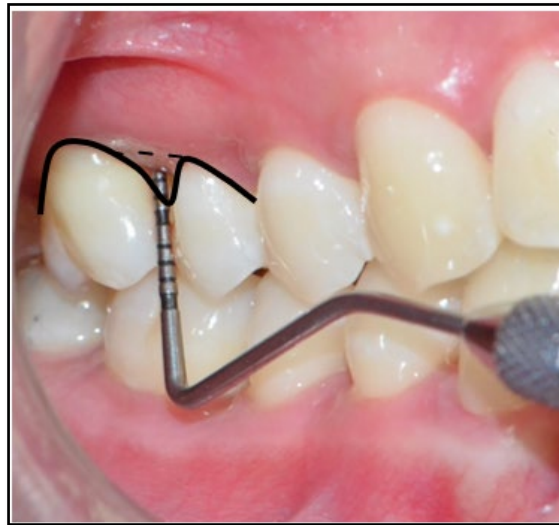


Figure 2. Surgical plan involving MPPT design. A horizontal incision was performed at the level of buccal CEJ on tooth indicated for regeneration.

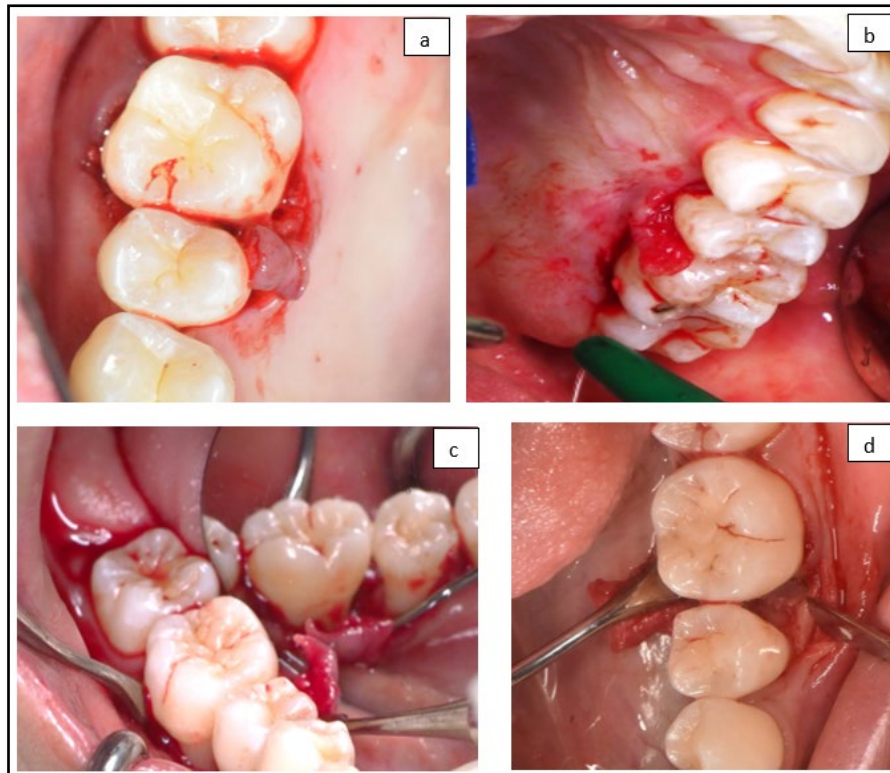


Figure 3. Papilla reflection from the buccal to palatal or lingual site of the tooth a) 16, b) 26, c) 46 and d) 36.

After the removal of chronic inflammatory tissue and the localised SRD was done, all four sites (tooth 16, 26, 36 and 46) were presented with a three-wall bone defect about 5 mm to 6 mm in depth. Prior to the placement of xenografts (i.e., Geistlich Bio-

Oss® and OsteoLemb) on the mesial bone defect of the tooth, collagen membrane (i.e., OsteoBiol®, PericardLemb) was measured and covered the intrabony defect of tooth 16, 26 and 36. The xenografts were then packed to the mesial bone defect under the collagen membrane (Figure 4).

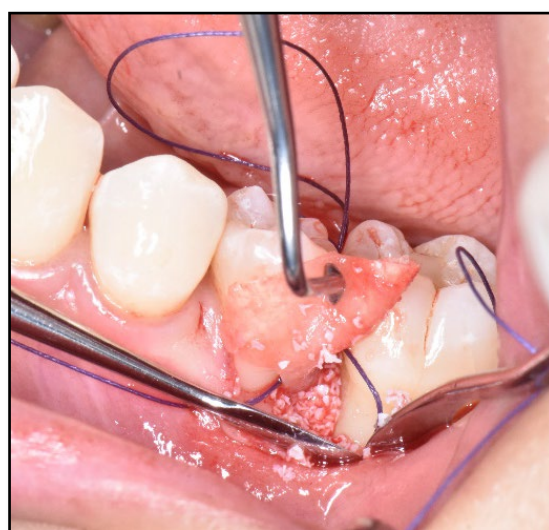


Figure 4. Placement of xenograft under the collagen membrane on tooth 36.

During regenerative procedure on tooth 46, fortunately blood could be drawn from the patient. About 10 mL blood was collected into serum vacutainers (BD vacutainer®, USA) and immediately centrifugated with a centrifugation machine (Table Top Centrifuge Kubota 2420, Tokyo, Japan) using alternate speed to fabricate the CGF. The alternate speed was set following the protocol used by other studies: 30 seconds acceleration, two minutes at 2700 rpm, four

minutes at 2400 rpm, four minutes at 2700 rpm, three minutes at 3000 rpm, 36 seconds deceleration and stop (Kim *et al.*, 2014; Takeda *et al.*, 2015; Durmuslar *et al.*, 2016) (Figure 5). The CGF was later compressed with a PRF box® to form a CGF membrane. Then, Geistlich Bio-Oss® was packed into the mesial bone defect and covered with the adjunct of CGF membrane prior to flap approximation (Figure 6).

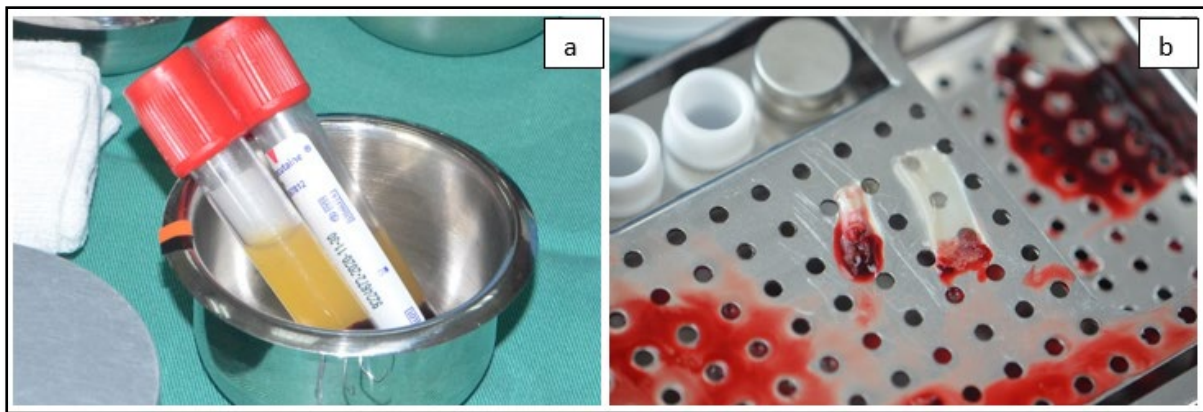


Figure 5. Blood was drawn and centrifuged to form a) CGF gel and compressed to form b) the CGF membrane.



Figure 6. Placement of CGF membrane prior to the flap approximation on tooth 46.

All sites were secured with Laurel sutures for flap approximation and Coe-Pak™ periodontal dressing was applied. Patient received post operative care and instructions as proposed by Cortellini and Tonetti (2000). She was recalled weekly up to two months for a review where professional prophylaxis was performed as necessary. She was then followed-up regularly for every three months up to one-year post operative.

During her recent periodontal review in March 2022, she was presented with periodontal stabilisation. Periodontal probing was performed and the previous deep PPD on all the first molars have healed to disease-free PPD, with an average of 4 mm probing pocket depth reduction. Radiographic examination revealed that all treated defects have been filled to almost similar height of the alveolar crest on the distal side of the adjacent tooth and the angular bony defects have been eliminated. The average percentage of radiographic bone fill was 79.1%. Moreover, intact lamina dura could be noticed, indicating stabilised bone formation. The comparison between pre-operative and post-operative radiographs were shown in Figure 7. The patient is satisfied with her current periodontal conditions and is now under supportive periodontal treatment phase.

Discussion

In comparison to NSPT, periodontal surgery, mainly regenerative therapy, offers a superior benefit in managing deep intrabony defect and class II furcation involvement. There are various regenerative strategies, including GTR, enamel matrix derivatives (EMD), bone substitutes, growth factors and combination of the strategies (Nibali *et al.*, 2020). Regenerative therapies resulted in a greater clinical attachment level gain of 1.34 mm as compared to open flap debridement alone in the presence of deep intrabony defect (Nibali *et al.*, 2020). In addition,

superior clinical outcomes of furcation closure or class I conversion is achieved on class II furcation-involved molars with regenerative therapies in comparison to open flap debridement (Jepsen *et al.*, 2020).

Prior to the regenerative therapy, patient's periodontal condition was stabilised with the first and second steps of the therapy (Sanz *et al.*, 2020). After considering various factors, regenerative therapy was proposed to the patient as various studies had reported a long-term survival of regenerated tooth. Cortellini and colleagues (2004) reported that the survival of regenerated teeth was greater than 96% up to 16 years following the procedure. This corroborates the finding by a recent longitudinal study that evaluated their patients according to several site-specific and patient-related factors for 21 to 26 years after the GTR therapy (Cieplik *et al.*, 2020). Even though regenerative therapy may ensure the longevity of tooth, both studies emphasised that the outcomes were greatly influenced by smoking and diabetic status, and compliance to periodontal maintenance and monitoring. This shows that patient selection for regenerative therapy is crucial to ensure a good clinical outcome and tooth survivability.

As mentioned earlier, papilla preservation technique offers an advantage in preserving the interdental tissue over the defect (Takei *et al.*, 1985). Cortellini and his team (1995, 1999) has introduced a modification on Takei's technique, which consists of modified papilla preservation technique (MPPT) and simplified papilla preservation technique (SPPT) design. Since the interdental space width on the indicated teeth was more than 2 mm, MPPT flap design was employed for this patient. From a recent systematic review and meta-analysis, it was suggested that EMD or GTR combined with papilla preservation flaps shall be considered as treatment of choice in managing deep intrabony defect of 3 mm and more (Nibali *et al.*, 2020).

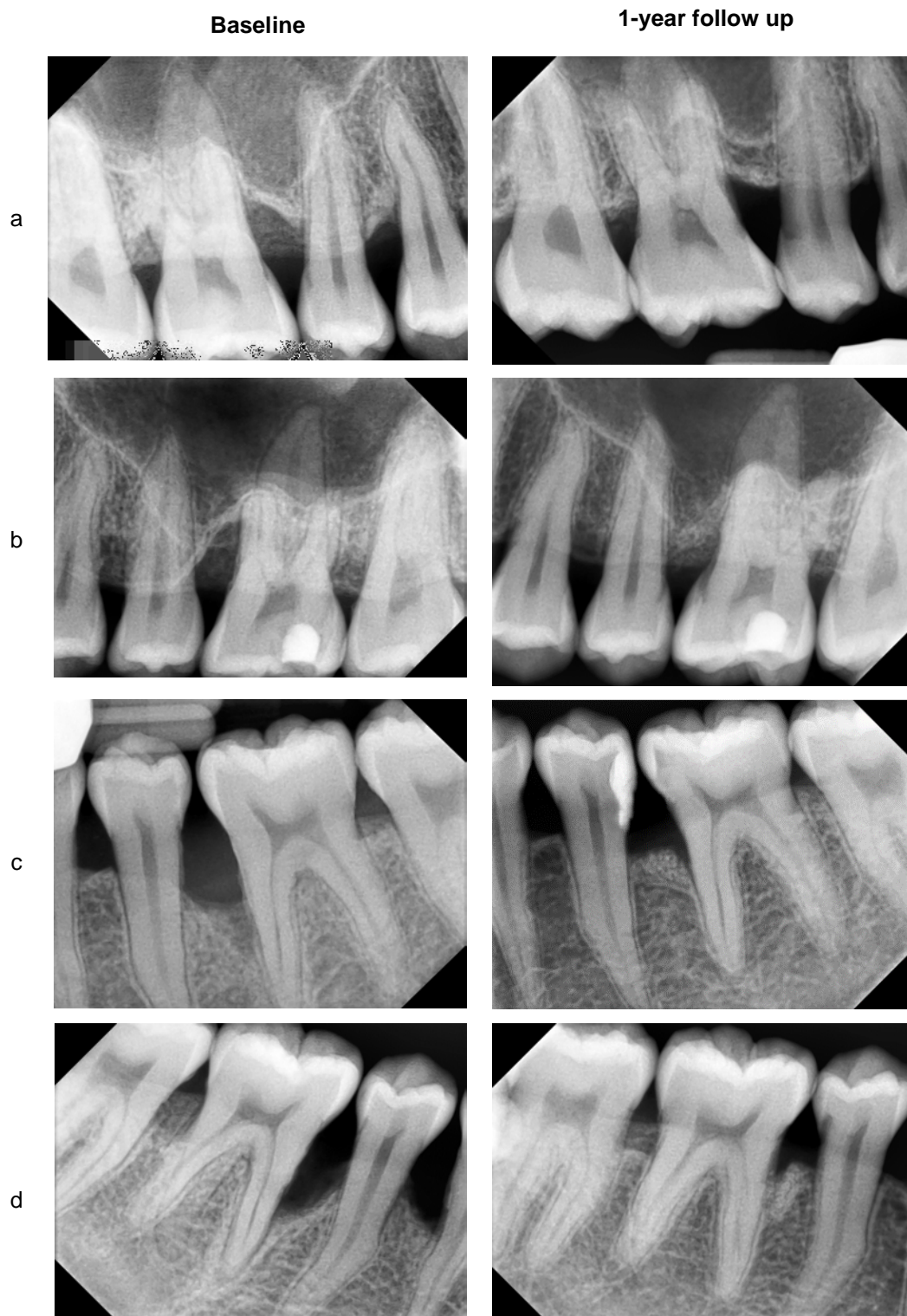


Figure 7. Pre-operative and post-operative (one-year follow-up) intraoral periapical radiographs of tooth a) 16, b) 26, c) 36, and d) 46.

Recently, the application of platelet concentrates such as concentrated growth factor (CGF) has been widely applied in the clinical setting. CGF is a recent generation of platelet concentrate that was first introduced in 2005 by Sacco (Chen and Jiang 2020). It provides a high suspension of various growth factors such as platelet-derived growth factor (PDGF), transforming growth factor beta (TGF- β), insulin-like growth factor (IGF), epidermal growth factor (EGF) and vascular endothelial growth factor (VEGF) which are beneficial for healing (Rodella *et al.*, 2011; Borsani *et al.*, 2015). Its autologous nature also minimises the risk of cross-reaction and can serve as an alternative source of growth factors to the expensive recombinant human growth factors.

Since all sites were presented with a three-wall bone defect, a predictable outcome following GTR can be expected (Becker & Becker, 1993). In addition, there were higher bone gain and percentage of bone fill in three-wall bone defects due to its capacity to provide better blood clot retention and allow better repopulation of osteoprogenitor cells during regeneration (Cortellini *et al.*, 1993). As evidenced from this patient, tooth 46 that received CGF membrane revealed similar clinical and radiographic outcome to the other three sites that were managed with GTR strategy. However, to date, there is no study that compares between the GTR and CGF membrane alone in the regenerative management of periodontitis. On the other hand, the application of CGF as adjunct has shown promising results in regenerative therapies. Adjunct application of CGF with bone graft performed better than the sole use of bone graft in terms of probing depth reduction and bone fill one year after the surgery (Qiao *et al.*, 2016; Qiao *et al.*, 2017; Xu *et al.*, 2019). A finding by Lei and his colleagues (2020) revealed that the adjunct application of CGF during GTR therapy has resulted in similar clinical outcomes at six months of observation with the control without CGF. These studies therefore reinstate the potential of CGF in enhancing the clinical outcome.

Another interesting point is the application of CGF also influences post-operative pain. Besides optimising the growth factors, the regular, cross-linked fibrin matrix of CGF with increased stability, strength, and protection against plasmin degradation resulted in a significant amount of CD34 positive cells. CD34 positive cells, which are responsible for maintenance and growth of vascular tissues, accelerate wound-healing regeneration by enhancing their ability to stimulate angiogenesis (Rodella *et al.*, 2011; Mijiritsky *et al.*, 2021). Subsequently, earlier healing with pain reduction is observed, as revealed by studies investigating post-operative pain following the management of alveolar osteitis (Kamal *et al.*, 2020; Kamal *et al.*, 2020). This was also reported by the patient in this study as lesser pain was experienced on the site receiving CGF in comparison to the non-CGF sites.

Conclusion

Regenerative therapy is one of the treatment options that can be suggested to patients in managing intrabony defect. Even though resorbable GTR is the ideal regenerative technique, adjunct application of CGF membrane could be utilised as an alternative to collagen membrane in periodontal regeneration without compromising clinical outcomes.

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Different extra-coronal restoration options of hemisected teeth on structurally compromised mandibular molar: Report of two cases

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Abstract

Structurally compromised teeth tend to be extracted due to its their poor prognosis, however, hemisection may serve as an alternative option in selected cases. This case report is aimed to discuss two cases of hemisected mandibular molars with two different approaches for post-hemisection restoration. Case 1 presents with terminal tooth 37 diagnosed with a cracked tooth involving severe bone loss on the mesial root. The tooth was hemisected and restored with a mesially cantilevered full ceramic crown. Case 2 presents with root caries on an endodontically treated tooth 46 on a patient with bruxism, with an inadequate ferrule on the distal segment. The tooth was hemisected utilizing the socket preservation technique, and the tooth was restored with a conventional fixed-fixed bridge with a second abutment on tooth 47.

Received:

5 August 2022

Revised:

5 January 2023

Accepted:

6 January 2023

Published Online:

28 February 2023

How to cite this article:

Mohamed Khazin, S., & Omar, S. H. (2023). Different extra-coronal restoration options of hemisected teeth on structurally compromised mandibular molar: Report of two cases. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 89-98. <https://doi.org/10.31436/ijohs.v4i1.187>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.187>

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Keywords: cracked teeth, mesially cantilevered bridge, root caries, socket preservation

Introduction

Mandibular molar teeth may have their furcation area or one of its roots severely compromised by caries, periodontal disease, or tooth fracture. Such compromised teeth are often extracted and replaced by fixed or removable prostheses or single tooth implant. However, root resection can serve as an alternative treatment to extraction in selected cases.

Hemisection is a type of root resective procedure that involves the removal of one or two unrestorable roots together with the corresponding coronal structure of a multi-rooted tooth. Hemisection is indicated for teeth with endodontic failures, vertical root fracture or non-restorable portion of a multi-rooted tooth (Ng & Gulabivala, 2014). Despite this available treatment option, the effectiveness of this approach has been questioned. The majority of the failure of this

approach is due to endodontic and restorative components (Gulabivala & Ng, 2014). Hence, multiple factors need to be considered prior to restoring such compromised teeth which is discussed in this article.

Case Report 1: Hemisection of the mesial segment of tooth 37 and restored with a mesial cantilever bridge

A 42-year-old gentleman presented with pain upon biting on his lower left second molar (tooth 37) which was temporarily restored 1 year ago at the outpatient clinic. Clinically, it was noted that there were fractured temporary restoration with secondary caries, tenderness to vertical percussion, 10mm periodontal probing

depth on the mid-buccal pocket with class II furcation involvement with other sites less than 3mm probing depth, and no mobility. Upon investigation, the offending tooth did not respond to the cold test (Endo Frost, Roeko, Langenau, Germany) and electric pulp test (Digitest™ Pulp Vitality Tester, Parkell Inc., New York, USA), responsive on the bite test using tooth sleuth on mesiobuccal cusp, and transillumination showed evidence of crack on mid-buccal surface. Radiographically, there were J-shaped radiolucency on periapical of mesial root extending to the furcation area and periapical radiolucency on the distal root (Figure 1). Generally, the patient has a healthy periodontium. Tooth 37 was diagnosed with pulpal necrosis with symptomatic apical periodontitis associated with a cracked tooth.



Figure 1. Pre-operative radiograph of tooth 37 showing radiopacity on the occlusal indicating restoration in close proximity with the mesial pulp horn. Presence of radiolucency mesial to the restoration above the alveolar bone. Presence of J-shaped radiolucency radiolucency on the mesial root involving the furcation area. Presence of periapical radiolucency on distal root.

Non-surgical root canal treatment (NSRCT) was commenced under local anaesthesia; an inferior alveolar nerve block was given using Mepivacaine hydrochloride (2% Scandonest) and rubber dam was applied. Visually, the procedure was aided with a dental operating microscope (DOM) OPMI@ pico (Carl Zeiss, Inc, Oberkochen, Germany). Temporary restoration and carious lesion were removed, and the access cavity revealed three distinct root canal orifices. A metal band was placed to stabilize the crack and a crown build-up was done using composite restoration. NSRCT was proceeded, all three canals were obturated

with gutta percha and AH-plus sealer (Dentsply Mailelefer, USA) using warm vertical compaction technique and composite core placed 2mm apical to the orifices (Figure 2). The tooth was reviewed after 1-month, however, symptoms persisted with no improvement of periodontal probing depth.

Surgical hemisection of the mesial segment of the tooth was performed, via raising a full thickness envelop flap from the mesial of tooth 36 and releasing incision distal to tooth 37 (Figure 3A). Long tapered fissure bur was used to section the crown vertically

at the furcation area. The mesial segment was elevated and extracted using forceps. Post-operative radiograph was taken (Figure 3B) to assess the hemisected surface of the remaining tooth segment for root spurs or overhanging dentine (Ng & Gulabivala, 2014). The overhanging dentine was trimmed and osteoplasty was performed at the furcation area to get a 4mm distance from the crown margin to the alveolar bone crest. The flap was re-approximated using vicryl 5/0. At 6 months

review, tooth 37 showed no symptoms and evidence of healed soft and hard tissues (Figure 3C-D). The edentulous space was replaced with a mesial cantilever full-ceramic crown on the remaining distal segment of tooth 37 (Figure 4A-B). The mesial cantilever was designed with reduced occlusion and large proximal mesial contact. The tooth was reviewed for up to one year, and despite the mesially tilted distal root, the tooth remained asymptomatic and functional (Figure 4C).

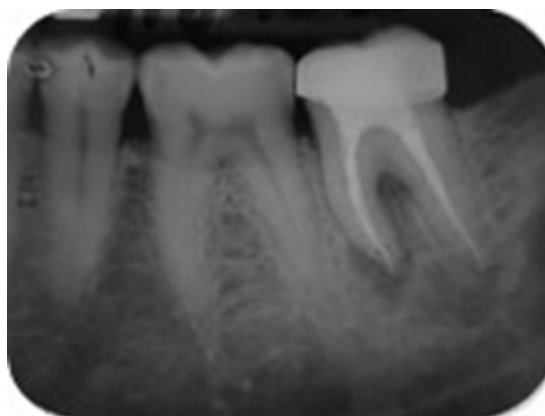


Figure 2. Immediate post-operative radiograph of tooth 37. Showing evidence of radiopacity on occlusal indicating the metal band to stabilize the crack. Composite core were evident in the pulp chamber with no gap at the root filling material. Obturation appears to be well condensed to the radiographic apex with slight root canal sealer extrusion on both roots. No changes in the radiolucency on both mesial and distal roots compared to pre-operative radiograph.

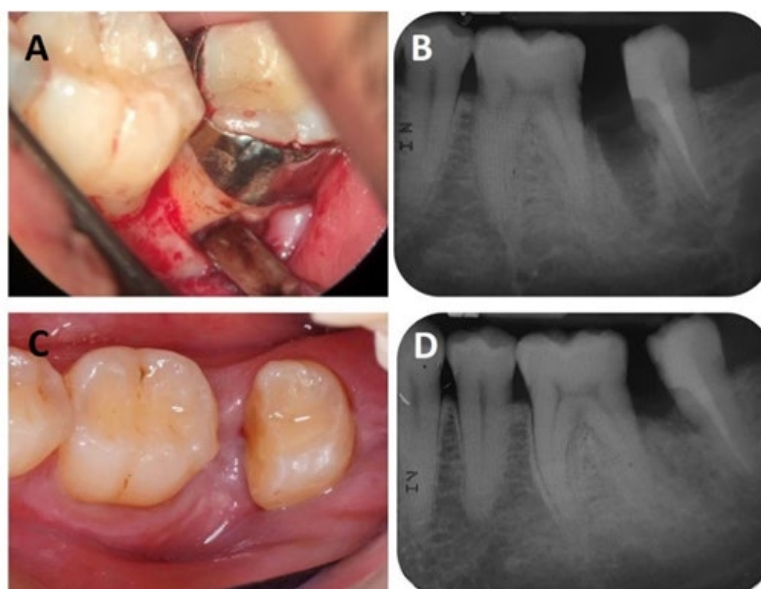


Figure 3. Hemisection of tooth 37. A: Envelope flap raised on buccal and lingual gingiva prior to hemisection. B: Post-hemisection radiograph, showing overhanging dentine at furcation area mesial to the remaining tooth segment and absence of periapical radiolucency on the remaining root. C: Clinical photograph 6 months post-hemisection showing healed soft tissue and clean mesial hemisected surface. D: 6 months post-hemisection radiograph showing mesial drifting of the distal tooth segment and healed bony lesion.



Figure 4. Bridge insertion and 1-year follow-up of tooth 37. A: Clinical photograph showing occlusal view of mesial cantilever full ceramic crown with broad mesial proximal contact on pontic. B: Clinical photograph showing buccal view of mesial cantilever full ceramic crown with reduced occlusion on the pontic and broad mesial proximal contact. C: 1 year review radiograph showing no evidence of periapical radiolucency on tooth 37 with no difference in bone level at mesial in comparison with 6 months review.

Case report 2: Hemisection of a distal segment of tooth 46 and restored with a fixed-fixed conventional bridge

A 48-year-old Malay gentleman with a history of bruxism presented with root caries on an endodontically treated mandibular right first molar (tooth 46). Tooth 46 has a large defective disto-occlusal temporary restoration with an overhanging margin on the distal area detected using the sickle-probe that run through the restoration margin and root surface. Tooth 46 has normal periodontal probing depth circumferentially, no mobility, and not tender to percussion. Radiographically, there was a presence of radiolucency underneath the temporary restoration indicates secondary caries and a periapical radiolucency on the distal root. All the roots were root canal treated with presence of voids on mesial roots and short obturation length on distal root (Figure 5). Tooth 46 was diagnosed with previously treated; asymptomatic apical periodontitis associated with distal root caries.

Non-surgical root canal retreatment was performed for the mesial roots followed by a

composite core placement. The obturation homogeneity and length appears satisfactory. (Figure 6). The non-surgical root canal retreatment was carried out under local anaesthesia and rubber dam isolation, visually aided with DOM and followed by a surgical hemisection of the distal segment of the tooth. A full thickness envelope flap was raised from distal of 47 to mesial of 45, tooth 46 was sectioned vertically at the furcation area using long tapered fissure bur (Figure 7A). The distal segment was elevated and extracted using root forceps. Osteoplasty was performed similar to Case 1. Collaplug® (Zimmer Dental, USA) was placed in the socket to stabilize the clot (Figure 7B). Post-operative radiograph was taken 3 months after (Figure 7C). The edentulous space was replaced by a 3-unit fixed-fixed conventional bridge on the hemisected 46 (restored as two PFM premolars of porcelain-fused metal) and 47 (full metal) that act as abutments. (Figure 8A). A hard occlusal splint was prescribed to the patient to reduce the muscle activity and at the same time to protect the prosthesis. At 1-year review, teeth 46 and 47 were asymptomatic and radiographically showed an absence of periapical radiolucency (Figure 8B).



Figure 5. Pre-operative radiograph of tooth 46 showing radiopacity on disto-occlusal of the crown indicating restoration. Evidence of radiolucency apical to the restoration at the distal involving the root and in proximity with the distal root canal obturation. Evidence of well condensed obturation material in mesial and distal root canals, but short obturation on distal canal. Presence of radiolucency at periapical area of distal root and furcation area. Evidence of bone loss at distal with crown-root ratio of 1:1 at distal and 1:2 at mesial. The roots appeared to be divergent.



Figure 6. Immediate post-operative radiograph of tooth 46 showing radiopacity on the disto-occlusal of the crown indicating restoration with good margin. Root canals appeared to be well-obtured. Radiolucency at the periapical area of distal root and furcation area are still evident.



Figure 7. Hemisection of tooth 46. A: Envelop flap raised and tooth sectioned to half vertically at the furcation area. B: Distal segment was extracted and socket placed with collaplug. C: 3 months post-hemisection radiograph showed healed socket with bone recession on distal.

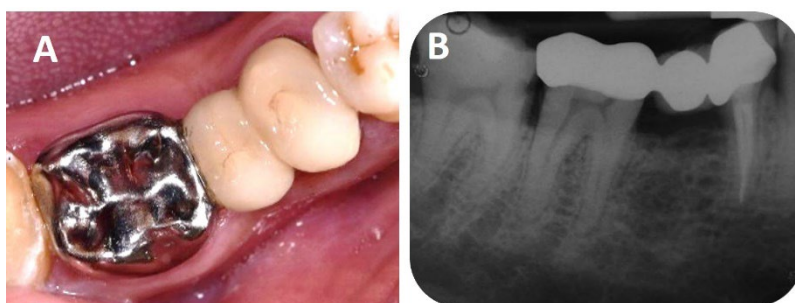


Figure 8. Bridge insertion and 1-year follow-up for tooth 46. A: Occlusal view of fixed-fixed bridge with full metal on abutment tooth 47 and porcelain-fused metal on hemisected tooth prepared as two premolars. B: 1 year review radiograph, showing no evidence of periapical radiolucency on both 46 and 47. The margins of the bridge appeared intact.

Discussion

Crack and dental caries extending to the root often present with restorative treatment challenges. In such cases, periodontal involvement is a frequent sequelae (Banerji *et al.*, 2010), which further complicates treatment modality. However, periodontal intervention were not prescribed for both of the cases. For Case 1, the deep probing depth and furcal involvement was not due to primary periodontal disease but due to cracked tooth. In the case of cracked tooth, when symptoms persisted after endodontic treatment, the tooth requires either extraction or resective surgery (Kahler, 2008). For Case 2, there was no periodontal involvement to indicate periodontal intervention.

Both cases have a poor prognosis considering the periodontal probing depth of more than 5mm with furcal involvement (Olivieri *et al.*, 2020), as presented in Case 1 and subgingival root caries with unfavourable crown-to-root ratio (American Association of Endodontists, 2017), as presented in Case 2. Surgical hemisection was opted instead of extraction for both cases, to preserve the natural teeth in the oral cavity, postponing implant placement to later stages.

Prior to hemisection, endodontic treatment is indicated in both cases reported. Tooth 37 in Case 1 was diagnosed with pulpal necrosis which is indicated for root canal treatment, and tooth 46 in Case 2 required endodontic

re-treatment due to the failed restoration, suboptimal obturation, and persistent apical periodontitis. Endodontic treatment should commence prior to hemisection in both cases to improve aseptic technique during endodontic treatment by providing proper isolation and crown build-up (Ng & Gulabivala, 2014). Furthermore, untreatable canals such as calcification or existing mishaps that might hinder adequate chemomechanical debridement of the root canal maybe made aware earlier notifying that hemisection may not be suitable (Green, 1986).

A surgical hemisection can be offered in such compromised teeth and has been shown to have a good long-term prognosis with proper case selection (Figure 9) (Setzer *et al.*, 2019). The survival rate of hemisected teeth may range from 79.4 to 100% (Table 1). The difference in survival rate can be due to several factors. According to Lang and Tonetti (1996), there are three factors to be evaluated: patient-related factor, tooth-related factor, and site-related factor. Park *et al.*, (2009) added another factor which is resection-related factor (Table 2). Several studies have shown that the type of coronal restoration placed on the resected segment play a role in the survival of hemisected tooth (Fugazzotto, 2001; Lee *et al.*, 2012; Megarbane *et al.*, 2018; Park *et al.*, 2009). However, the evidence is not conclusive (Setzer *et al.*, 2019), and the type of coronal restoration should be placed based on individual tooth and clinicians' judgement (Megarbane *et al.*, 2018).

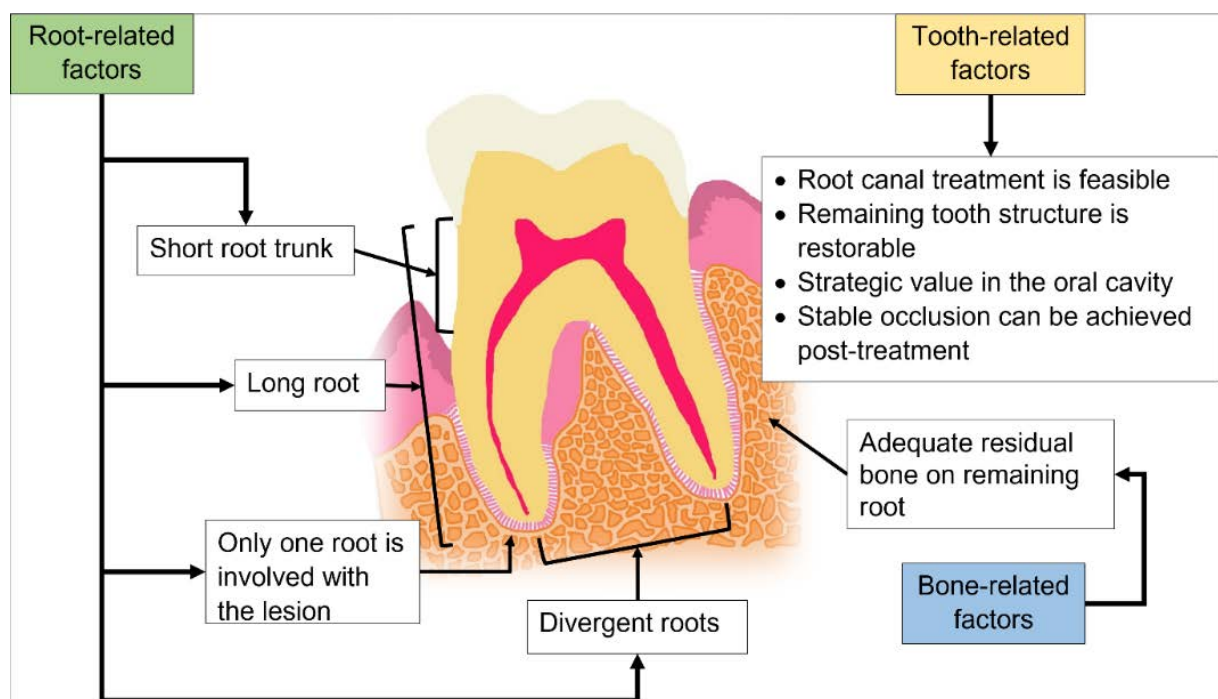


Figure 4. Schematic diagram on indications of hemisection.

Table 1. Overview of study characteristics from the literature on survival rate of hemisected teeth.

Author	Follow-up period (year)	Study design	Sample size	Survival rate (%)
Erpenstein, 1983	1-7	Retrospective	34	79.4
Fugazzotto, 2001	1-15	Retrospective	21	95.1
Zafiropoulus <i>et al.</i> , 2009	4	Retrospective	76	80.4
De Beule <i>et al.</i> , 2017	1-27	Retrospective	111	82.8
Megarbane <i>et al.</i> , 2018	5-40	Retrospective	12	100
Setzer <i>et al.</i> , 2019	1-15	Systematic review and meta-analysis	111	81.9

Terminal tooth in general when endodontically treated will have a reduced survival compared to anteriorly located teeth (Ng *et al.*, 2010). The prognosis of a hemisected terminal tooth can be improved when the tooth is restored as an abutment of fixed prosthesis rather than a lone standing terminal tooth (Fugazzotto, 2001) due to the distribution of occlusal forces to the adjacent teeth. The ideal option to restore hemisected tooth 37 in Case 1 would be a fixed-fixed bridge on teeth 37 and 36. However, to include a sound tooth 36 as an abutment for a fixed-fixed prosthesis, there is a risk of compromising its pulpal health (Mohamed Khazin *et al.*, 2022). Hence, in this case, a mesial cantilevered bridge was placed on the hemisected tooth 37. To compensate for the

occlusal load, several modifications to the pontic were undertaken: (1) small pontic (Vujasin *et al.*, 2018), (2) broad mesial proximal contact, and (3) slight under occlusion on the pontic and light contact on the hemisected abutment (Mostafavi & Falahchai, 2017), which can reduce the occlusal stress and improve the survival of the hemisected tooth at the same time preserving the sound tooth 36. Furthermore, the outcome of restoring hemisected molar without splinting to adjacent tooth have similar clinical outcome to single crown implants in the molar area (Schmitz *et al.*, 2019).

Table 2. Factors for survival of resected molars.

Resective-related	Patient-related	Tooth-related	Site-related
<ul style="list-style-type: none"> Periodontal reason for resective surgery have higher survival rate compared to resective surgery due to fracture/caries (Park <i>et al.</i>, 2009). Periodontal reason for resective surgery have higher failure rate than other reason for resective surgery (Lee <i>et al.</i>, 2012). 	<ul style="list-style-type: none"> Smoking: impaired healing (Park <i>et al.</i>, 2009). Older patients have higher failure rate than younger patients (Lee <i>et al.</i>, 2012; Yuh <i>et al.</i>, 2013). Patients undergoing regular dental check-ups have higher survival rate (Lee <i>et al.</i>, 2012). Patient with diabetes have higher failure rate (Megarbane <i>et al.</i>, 2018). Denture wearers, presence of multiple decayed or filled teeth on other sites have higher failure rate (Lee <i>et al.</i>, 2012). 	<ul style="list-style-type: none"> Resected segment that are splinted to adjacent teeth (bridge) have higher survival rate than single crown or direct restoration (Lee <i>et al.</i>, 2012). No significant difference between the survival rate of resected tooth restored as bridge abutment or as single crown (Megarbane <i>et al.</i>, 2018; Park <i>et al.</i>, 2009). Distal root resection without splinting has lower survival rate than mesial root resection (Park <i>et al.</i>, 2009). The use of post have higher failure rate (Lee <i>et al.</i>, 2012). 	<ul style="list-style-type: none"> Pre-operative bone support of >50% at remaining root have higher survival rate than those with <50% bone support. (Lee <i>et al.</i>, 2012; Park <i>et al.</i>, 2009). Pre-operative mobility of Grade II and above have higher failure rate (Lee <i>et al.</i>, 2012).

The prosthetic treatment offered to the hemisected tooth 46 reported in Case 2 was a fixed-fixed conventional 3-unit bridge. When the distal segment of tooth 46 is hemisected, the load will be subjected to the remaining slender and curved mesial root with a larger occlusal table compared to tooth 37 presented in Case 1. It has also been shown that a distally cantilevered bridge has the greatest strain upon masticatory load (Vujasin *et al.*, 2018), especially on patients with parafunctional habit (Fugazzotto, 2001). Considering the anatomy of the

mesial root and the occlusal load, tooth 46 was restored with a fixed-fixed bridge with a second abutment on tooth 47. Furthermore, the buccolingual width of the pontic was reduced to the size of a premolar (Figure 8) (Mostafavi & Falahchai, 2017), and a hard occlusal splint was prescribed to reduce the possible occlusal trauma (Mokbel *et al.*, 2019). Tooth 47 was restored with a full metal restoration to lessen the circumferential removal of tooth structure, reducing the risk of pulpal disease (Mohamed Khazin *et al.*, 2022) and minimize

the wear of opposing dentition. Metallic materials induce lesser wear on antagonist enamel than the other type of materials because of their low hardness and high ductility properties. The later properties is advantageous in absorbing the occlusal forces (Branco *et al.*, 2020; Choi *et al.*, 2016). Because of the anatomical structure, there is a limited reference on the distal root resection compared to mesial root in mandibular molars.

From the periodontal aspect, the bone level and furcation involvement also play a major determinant in the outcome of hemisected teeth. It has been shown that molars with Class III furcation involvement (McGuire & Nunn, 1996), pre-operative bone support less than 50% (Lee *et al.*, 2012; Park *et al.*, 2009), and pre-operative mobility of grade II or more (Lee *et al.*, 2012) have a poorer prognosis due to large degree of bone loss (McGuire & Nunn, 1996). Moreover, socket preservation (Figure 7B) can also be applied to reduce the bone resorption post-hemisection and maintain the original topography of the alveolar ridge (Mokbel *et al.*, 2019).

Comparing the possible outcome of both cases reported in this article, based on the type of coronal restoration, tooth 37 in Case 1 would have a lower survival compared to tooth 46. It has been suggested that resected terminal tooth have lower survival compared to resected intermediate tooth and resected tooth restored as bridge and splinted to adjacent tooth have higher survival compared to single crown or non-splinted resected tooth (Lee *et al.*, 2012). However in terms of mesial or distal root resected, tooth 37 would have a higher survival compared to tooth 46. Studies have suggested that removal of mesial segment of a molar would have better prognosis compared to removal of distal segment (Megarbane *et al.*, 2018). Nonetheless, considering all the modifications made to the treatment of the hemisected teeth, together with the adequate ferrule of 2mm and the presence of more than 50% of bone support on the remaining tooth segment, the cumulative survival rate of hemisected teeth is 81.9% (Setzer *et al.*, 2019). Furthermore,

the success of hemisected teeth is equivalent to the success of a single tooth implant (Fugazzotto, 2001). Both teeth in Case 1 and Case 2 appeared to be asymptomatic and functional at 1-year review.

Conclusion

Hemisection can be a relevant, practical, and successful treatment option for structurally compromised teeth when proper case selection and prosthesis design are considered, to avoid fracture of the hemisected tooth due to biomechanical impairment. It can also be used as a means to preserve the natural teeth postponing implant placement to later stages.

Acknowledgement

The authors would like to thank Dr Lim Fei Yee, Dr Nik Madihah, Dr Goo Chui Ling, Dr Tew In Meei, Associate Prof Dr Safura Anita Baharin, and Prof Dr Dalia Abdullah for their valuable help and guidance with the case.

Conflict of interest

All author declares no conflict of interest.

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Where is the missing chicken bone? A case of foreign body cystic bronchiectasis

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Abstract

Aspiration of foreign body among adult usually occur in geriatric populations and those with impaired airway reflexes from a neurologic abnormality, altered mental status resulting from sedative or alcohol use, or trauma with decreased levels of consciousness. Symptoms are usually acute requiring prompt intervention. Longstanding neglected foreign body aspiration can cause irreversible damage to the lung parenchyma and respiratory tract with residual respiratory sequelae. Here we present a rare case of a healthy lady who experience chronic productive cough and recurrent chest infections due to neglected foreign body aspiration leading to irreversible cystic bronchiectasis of the lung.

Received:

16 August 2022

Revised:

28 December 2022

Accepted:

8 January 2023

Published Online:

28 February 2023

How to cite this article:

Zainal, N. F., Haroon, R., & Ahmad, N. F. (2023). Where is the missing chicken bone? A case of foreign body cystic bronchiectasis. *IIUM Journal of Orofacial and Health Sciences*, 4(1), 99-104. <https://doi.org/10.31436/ijohs.v4i1.188>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.188>

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Keywords: *chronic cough, cystic bronchiectasis, foreign body aspiration*

Introduction

Foreign body aspiration (FBA) may present with various clinical symptoms depends on the location of where the foreign body lodged as well as either total or partial occlusion. In acute setting of FBA or obstruction of the larynx, there will be a brief episode of choking and gagging which later developed into inspiratory stridor with bouts of coughing, associated with hoarseness, aphonia and cyanosis once the foreign body passes through the vocal cords into the subglottic and tracheal region. The moment foreign body dislodges further into the bronchi, in case of smaller size, these symptoms might resolve with a relatively

asymptomatic period. (Dikensoy *et al.*, 2002; Jawarkar *et al.*, 2016).

Chronic and neglected FBA in adult later may mimic other lung diseases like chronic obstructive pulmonary disease (COPD), asthma, or obstructive pneumonia, leading to incorrect diagnosis of disease (Swanson *et al.*, 2003). Overlooked FBAs are frequently diagnosed from bronchoscopy or computed tomography (CT) imaging of thorax intended for investigation of chronic productive cough, recurrent pneumonia, haemoptysis, or in routine chest radiograph (CXR) in asymptomatic individually who came for health screening (Al-Majed *et al.*, 1997; Castillo-Latorre *et al.*, 2021; Dikensoy *et al.*, 2002; James *et al.*, 2006; Jawarkar *et al.*,

2016; Palasamudram Shekar *et al.*, 2018; Wu *et al.*, 2012).

Case Presentation

A 41-year-old lady who presented with chronic cough was initially diagnosed with bronchitis in private centre for the past 10 years. She was started on several types of metered dose inhalation (MDI) therapy. There was multiple history of hospitalizations due to pneumonia where the symptoms improved on regular nebulization of bronchodilator medication and intravenous antibiotics. Apart from that, there was no record of intubation which

require intensive care in the past. Patient later presented with worsening respiratory symptoms for 1 month at a private centre. Chest radiograph shows right middle lobe collapse with right lower zone bronchiectasis (Figure 1). Thus, contrast-enhanced computed tomography (CECT) thorax was done and revealed a large intraluminal calcified lesion within the right lower lobe bronchus. Associated localized cystic bronchiectasis at the right middle and lower lobes as well as superimposed lung infection is also observed. Upon further questioning, she admitted previous history of aspiration while eating chicken about 10 years ago.

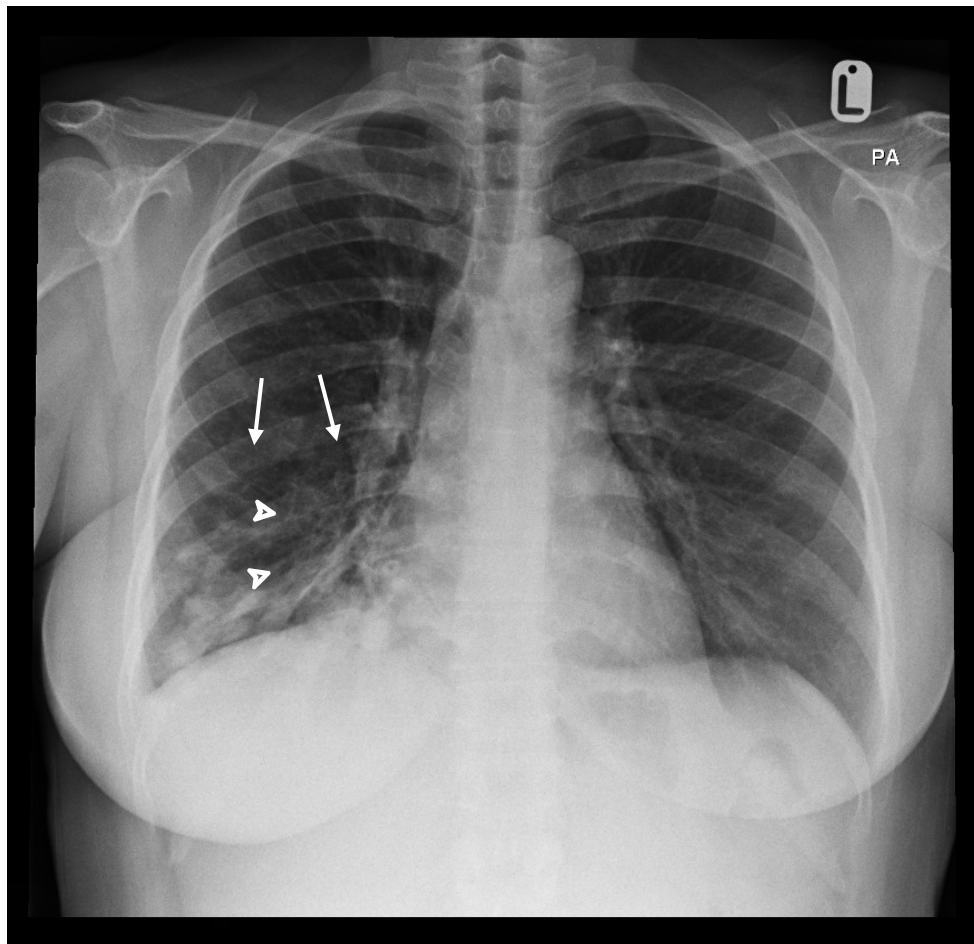


Figure 1. Frontal chest radiograph shows air space opacities at right middle and lower zones with obliteration of right cardiac border in keeping with consolidation. The right transverse fissure is retracted inferiorly (arrow) suggestive of right middle lobe collapse. Bronchiectasis is noted at right lower zone (arrowhead).

Later, she came to our centre for removal of foreign body, most probably chicken bone. Repeated CECT thorax was performed for re-assessment prior to foreign body removal and revealed overall reduced right lung volume with collapsed consolidation of the right middle and lower lobe. A calcified and corticated foreign body akin to bone is seen impacted within the right lower lobe bronchus (Figure 2). The adjacent bronchial wall is irregular and thickened.

Multiple saccular dilatations of bronchi are seen distally in the right middle and lower lobes giving rise to 'bunch of grapes' appearances (Figure 3a). Air fluid level is observed within most of these saccular dilatations (Figure 3b). Minimal right pleural effusion is noted.

Multiple enlarged lobulated mediastinal lymph nodes are also present (Figure 4).

Hence, correlating with clinical history, the diagnosis of an impacted foreign body (chicken bone) within the right lower lobe bronchus causing progressive cystic bronchiectasis of the right middle and lower lobes with superimposed lung infection and lymphadenopathies was made.

The patient underwent rigid bronchoscopy and removal of impacted foreign body. Bronchoscopy findings revealed a calcified chicken bone lodged in the right bronchus intermedius which is then successfully retrieved. Pus and secretions are also observed within the right bronchus intermedius which is then cleared by bronchoalveolar lavage. No complication during and following the procedure. Fluid from bronchoalveolar lavage sent for gram stain, bacterial and fungal culture and also acid-fast bacilli (AFB) stain yield negative result.

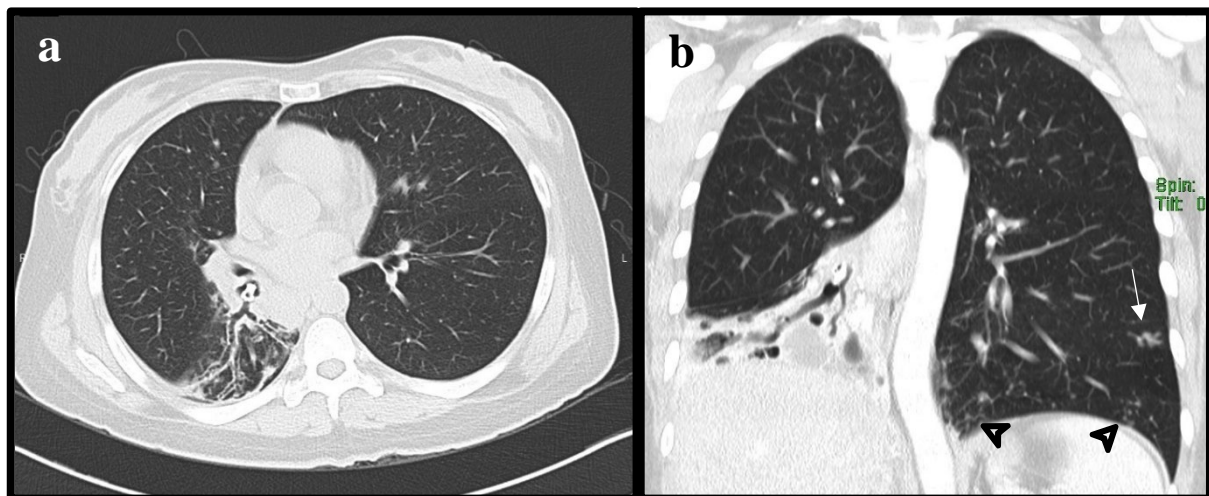


Figure 2. CT thorax with lung window in axial (a) and coronal (b) view shows a calcified and corticated foreign body (chicken bone) impacted within the right lower lobe bronchus. Scattered small solid lung nodules (arrow) and tree in bud appearance (arrowhead) at left lower lobe likely due to lung infection.

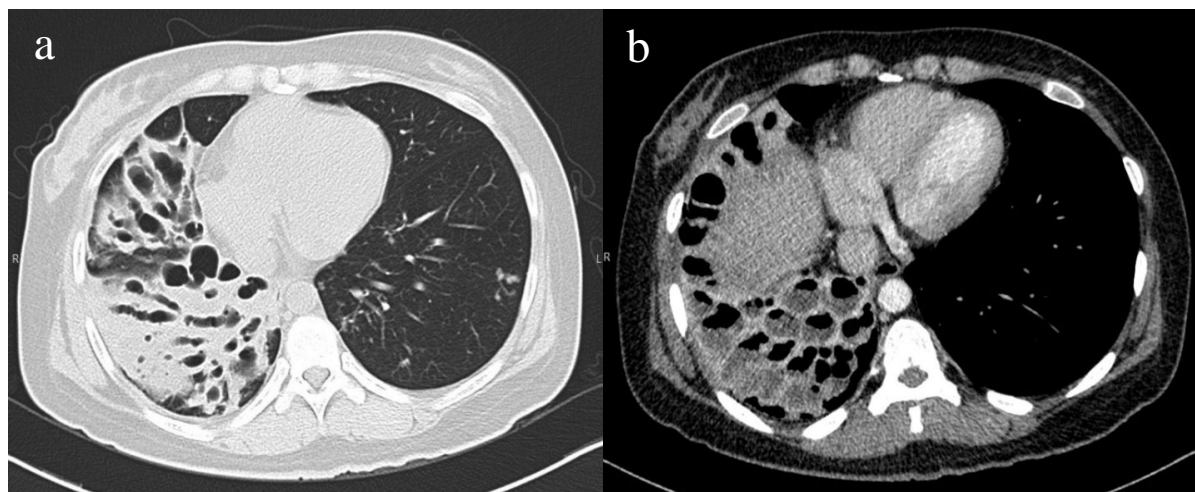


Figure 3. Axial contrast-enhanced CT thorax in (a) lung window and (b) mediastinal window demonstrate multiple cystic bronchiectasis in the right middle and lower lobes. (b) Air fluid level is observed within most of these saccular dilatations.

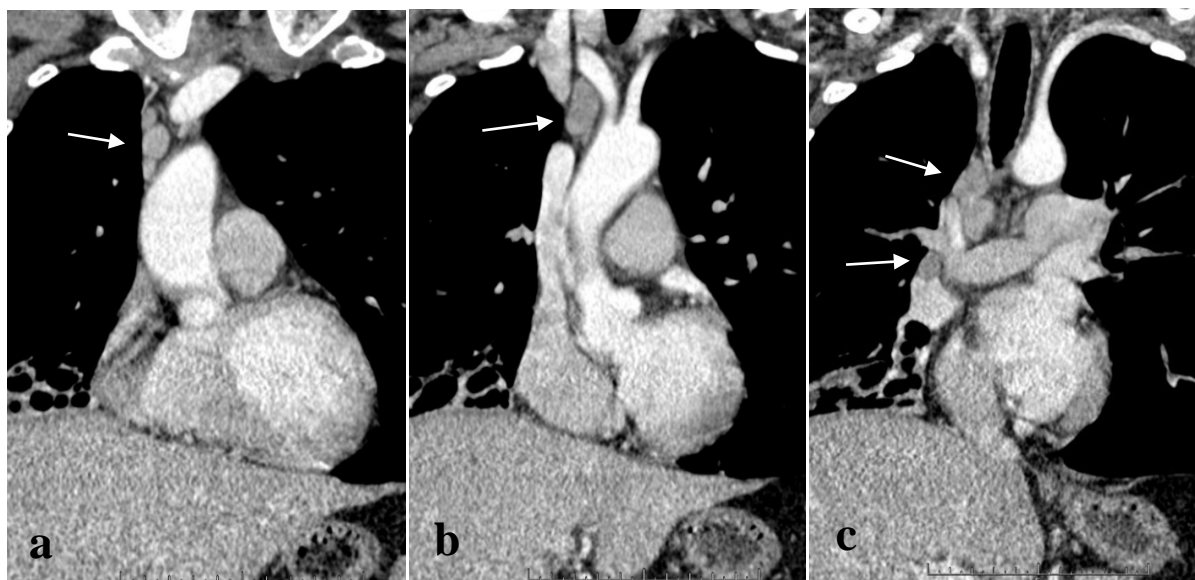


Figure 4. Multiple enlarged lobulated mediastinal lymph nodes at level 2R, 3A, 4R, and 7.

Discussion

Bronchiectasis is a progressive respiratory disease characterized by permanent abnormal dilatation of bronchial tree. Bronchiectasis is characteristically categorised according to morphological appearance and three types have been described, which also represent a spectrum of severity. In cylindrical bronchiectasis, bronchi have smooth tubular configuration with uniform calibre and do not taper distally which giving parallel walls

appearance. Varicose bronchiectasis is often seen with fibrosis and has irregular contours with beaded appearances where dilated bronchi have interspersed sites of relative narrowing. Cystic bronchiectasis is the most severe form and exhibits saccular dilatation

of bronchi that extend to the pleural surface, often with air-fluid levels. (Juliusson & Gudmundsson, 2019). According to one study, the relative prevalence of bronchiectatic changes based on types revealed that cylindrical bronchiectasis is the most common with prevalence of 47%,

followed by cystic type with prevalence of 45.1%. Varicose bronchiectasis type is relatively uncommon with prevalence of 9.9% (Habesoglu *et al.*, 2011).

Its pathogenesis is a consequence of an initial insult to the airway followed by a vicious cycle of repeated infection and inflammation with combination of ineffective mucociliary clearance causing further damages to the airways and progressive destruction of lung tissues. Widened airways with scarred and thickened walls later cause mucus stasis which harbour pathogens leading to recurrent infections and inflammatory processes. As time progresses, mucous plug formation from retained secretion causes further airway obstruction, obliteration and destruction resulting in more advanced bronchiectasis.

A myriad of conditions has been reported and documented as causes of adult bronchiectasis. It can further be categorized into idiopathic, impaired host defences, post infective, hypersensitivity such as in allergic bronchopulmonary aspergillosis (ABPA) or autoimmune, mechanical obstruction, congenital malformation, and others. In one study, it is reported that most of bronchiectasis sample being studied is idiopathic which is up to 40%. Among those cases which aetiologies are identified; the most common cause of bronchiectasis is post infective, frequently by bacterial pneumonia or tuberculosis, which accounts for 20% of cases. Other commonly identified aetiologies include COPD related (15%), connective tissue disease related such as rheumatoid arthritis, Sjögren syndrome and systemic sclerosis (10%), immunodeficiency related (5.8%) and asthma related (3.3%). (Lonni *et al.*, 2015). Another study reported FBA as a cause of bronchiectasis in 5.6% of 1003 resections carried out for bronchiectasis in South African population (Le Roux *et al.*, 1986).

Aspirated foreign body can be organic or inorganic material with organic material being the most common foreign body extracted. Amongst organic foreign body aspirated are nuts or seeds, corn kernel,

vegetable matter and bones while regular inorganic foreign body retrieved are dental material, denture fragments, plastic pieces, pills or even nasal ring as reported in one article. (Al-Majed *et al.*, 1997; Castillo-Latorre *et al.*, 2021; Dikensoy *et al.*, 2002; James *et al.*, 2006; Jawarkar *et al.*, 2016; Palasamudram Shekar *et al.*, 2018; Swanson *et al.*, 2003). Clinical presentation for FBA varies according to the level of obstruction and depends on either acute or chronic occurrence. In neglected or overlooked FBA, the impacted foreign body usually small and tend to lodge distally within the bronchi, leading to chronic respiratory symptoms. In this case, clinical presentations might be due to complication of aspirated foreign body such as bronchiectasis or obstructive pneumonia, which consist of prolonged productive cough, haemoptysis and recurrent pneumonia that is not fully responded to adequate antibiotic; or it can be completely asymptomatic (Al-Majed *et al.*, 1997; Jawarkar *et al.*, 2016; Palasamudram Shekar *et al.*, 2018; Wu *et al.*, 2012).

Diagnosis of aspirated foreign body rely mostly on high clinical suspicion. Standard radiological imaging such as frontal and lateral chest radiograph or occasionally a lateral soft tissue neck radiograph should be performed for suspected FBA. The initial chest radiograph findings might be normal since most of foreign bodies are radiolucent; however, some clues on suspicious foreign body might be demonstrated later such as presence of atelectasis, air trapping, pulmonary infiltrates, and mediastinal shift, especially when associated with ipsilateral decreased breath sounds (Dikensoy *et al.*, 2002). Diagnosis of FBA by solely chest radiograph is challenging, as one study shows that only 32% of the foreign body identified on chest radiograph (Swanson *et al.*, 2003). On some occasions, the foreign body is only detected on other imaging intended for other respiratory conditions such as bronchiectasis, obstructive pneumonia, or chronic productive cough. Bronchiectasis is among frequently observed lung changes in chronic foreign body retention with high resolution computed tomography (HRCT) thorax is a gold standard. Bronchial dilatation is

evaluated in relation to the accompanying pulmonary artery, where a broncho-arterial ratio exceeding 1:1 and lack of normal bronchial tapering over 2 cm in length, distal from an airway bifurcation should be considered abnormal. Other findings associated with bronchiectasis include bronchial wall thickening, mucus plugging and tree-in-bud opacities. (Juliusson & Gudmundsson, 2019).

The use of rigid and flexible bronchoscopy is the preferred instrument for further evaluation and removal of foreign body. Bronchiectasis due to retained foreign body is usually localised and requires surgical resection for curative treatment. Complete resolution of bronchiectasis following removal of foreign body by using flexible bronchoscopy has been reported in one of the literatures (Mansour *et al.*, 1998). In cases with localised bronchiectasis or unresolving pneumonia, flexible bronchoscopy should always be considered for the possibility of a longstanding foreign body to prevent from an unnecessary surgical procedure. Proper training and experience are crucial to optimise the outcome and minimising the risk of complications in tracheobronchial foreign body removal. (Dikensoy *et al.*, 2002).

Conclusion

Diagnosis of FBA is challenging especially in healthy adult with trivial or no history of choking prior. Nevertheless, in cases of bronchiectasis, recurrent pulmonary infection, lung abscess, middle lobe syndrome and chronic productive cough where other common and possible aetiologies are excluded, longstanding FBA should always be considered as one of the possible aetiologies. Proper and adequate imaging is crucial in aiding the diagnosis besides comprehensive clinical assessments. Further evaluation and removal of the foreign body by utilising bronchoscopy in such cases can reduce disease burden and improve quality of life as the resolution of the parenchymal or bronchial pathology can

be achieved and unnecessary surgery can be avoided.

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Spontaneous sequestration on oral mucosa associated with removable retainer

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Abstract

A 45-year-old female with Class III incisor relationship on Class I skeletal pattern came to orthodontic specialist clinic after referral from prosthodontic department. She requested to have lower dentition spaces to be closed before dental implant to be fitted. She had upper and lower dentures previously but not quite happy with the aesthetic. She is fit and healthy with diabetes mellitus type 2. Fixed appliance was done on the lower arch as the upper teeth were nicely aligned. Lower retainer was fitted after fixed appliance was removed (debonded). Several week later, she came with the complain of exposed bone on her lingual oral mucosa. The aetiology of sequestration, oral osteonecrosis and the association to diabetes mellitus is discussed in this case report.

Received:

19 May 2022

Revised:

9 January 2023

Accepted:

25 January 2023

Published Online:

28 February 2023

How to cite this article:

Abdul Aziz, A. H., Chong, J. K. H., & Mohd Sahudi, R. (2023). Spontaneous sequestration on oral mucosa associated with removable retainer. *IUM Journal of Orofacial and Health Sciences*, 4(1), 105–109. <https://doi.org/10.31436/ijohs.v4i1.160>

Article DOI:

<https://doi.org/10.31436/ijohs.v4i1.160>

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Keywords: *diabetes mellitus, fixed appliances, osteonecrosis, retainers, sequestration*

Introduction

Diabetes mellitus type 2 remains one of the major non-communicable diseases in Malaysia. An estimate of 3.9 million Malaysians aged 18 years and above suffer from diabetes mellitus (Chung, 2020). This is nearly 18.3% or one in five adults that suffers from this multi-systemic disorder. Diabetes mellitus type 2 could affect microvasculature, which lead to retinopathy, nephropathy, and neuropathy with impact on quality of life and life expectancy (Faselis *et al.*, 2020). It results in poor wound healing, reduce blood supply and is detrimental to oral health. A prolonged diabetic condition could proceed to harmful effect of bone metabolism and diminished bone micro built up mechanism (Clidhna & Cynthia, 2019).

These changes could predispose to bone dehiscence, sequestration, reduce osseus mucosa healing attachment and oral osteonecrosis in some condition.

Osteonecrosis of the jaw is an oral mucosa lesion affecting the bone of the maxilla or mandible. The lesion could be painful or asymptomatic. The diagnosis is done by the persistent presence of non-healing exposed bone or sequestration for a minimum of few weeks. It can be prevented by optimal oral hygiene, oral antimicrobial mouth rinses and antibiotic therapy (Khan *et al.*, 2016). The predisposing factors of osteonecrosis of the jaw can be multifactorial, such as immunocompromised patient, uncontrolled systemic disease such as diabetes mellitus, complication of radiotherapy and medication related to antiresorptive or

antiangiogenic drugs (Mandlin, *et al.*, 2021; Johnson *et al.*, 2019; Yehuda *et al.*, 2021). The lesion could also be introduced by traumatic incidence due to oral surgery, periodontal therapy and dental appliances.

There are many studies associating diabetes mellitus (DM) with oral health (Shawnda *et al.*, 2021; Melanie *et al.*, 2020; Nisha *et al.*, 2021). These studies concluded that, there is a need to improve dental health education on DM, to consider the risk of DM in every dental patient and to emphasize on preventive oral care to diabetic patient. Orthodontic treatment such as fixed appliances (braces), functional appliances, removable appliance, headgear and retainers could cause accidental trauma and pain to patient (Azrul *et al.*, 2019). The protruding wire from fixed appliances, sharp edges on removable appliances and fracture of stainless-steel clasps from Hawley's retainer can cause idiopathic trauma to oral soft tissue mucosa.

Case Presentation

A 45-year-old female diabetic mellitus type 2 patient came to USIM dental clinic for dental treatment. She was diagnosed with diabetic for the last 10 years ago and on medication (Tab metformin 1000mg x bd) with regular medical check-up at local government clinic. Apart from that, she does not take any other medication nor undergoes any oral carcinoma therapies. She was an irregular dental attendee and only came for occasional dental check-up. She had teeth restoration, scaling and extraction done before without any complication. She has a Class III incisor relationship on Class I skeletal pattern. Her molars and canines were both in Class I relationships. Apart from that, her overjet, overbite, curve of spee and centrelines were in normal range. Oral hygiene condition and periodontal status were all good. Her lip were competence and nasio-labial angle was average. No known habit was noted. All teeth presented except for upper lateral incisors, lower left second premolar and lower right second incisor. The teeth were missing due to extraction. The extraction was done due to caries and without any severe complication.

Apart from that, mild spacings (between 1 to 2mm) were noted on lower and upper arches with proclined lower incisors. The aetiology of her mild spacing was due to the missing teeth. The treatment aims for her is to close lower anterior space, place dental implant on 35 space and to issue new upper denture. Although there were mild spaces on distal of upper canines, she declines upper fixed appliance due to aesthetic reason. General risk of orthodontic treatment such as pain, trauma, root resorption and teeth decalcification were discussed with patient and informed consent was taken from her.

Lower fixed appliance (0.22 MBT prescription) was fitted to close the spaces and retroclined the lower incisors. The procedure begins with very light force 0.012 nickel titanium arch wire (Therma-Ti® Lite by American Orthodontic, USA), light force 0.014 nickel titanium (Therma-Ti® Lite by American Orthodontic, USA), medium force 0.016 nickel titanium (Therma-Ti® Lite by American Orthodontic, USA) and finished in 0.018 stainless steel arch wire (vacuum-remelted 304V by American Orthodontic, USA). The final arch wire was chosen as to maintain the proclination of lower incisors. Light force power chain from 46 (lower right first molar) to 34 (lower left first premolar) on 0.018 stainless steel were utilized to close the lower spaces for several months. In total, the orthodontic treatment takes around one year to completed and Hawley retainer were issue immediately after fixed appliance was debonded as shown in Figure 1.

The construction of her Hawley retainers consisted of prosthetic tooth on lower right lateral incisor, two Adam's clasps on lower first molars and labial bow to retain the aligned lower anterior teeth position. Her new upper denture was also fitted by colleague from prosthodontic department, and she was then referred to oral surgeon for dental implant on her lower tooth.

Several weeks later (after debonded procedure) she came and complaint of unusual lesion formation on her lower mucosa as shown in Figure 2.



Figure 1. Lower Hawley Retainer.



Figure 2. Oral sequestration located at lower lingual.

The oral lesion was asymptomatic and does not cause any pain. We could not establish any reason why she could not feel the pain from the lesion as no further investigation was done at the time. The mucosa surrounded the lesion was red in colour with no visible discharge. The lesion only occurs at one place and does not increase in size. Further examination on the complaint site revealed a sequestration of the soft tissue mucosa with some exposure of osseous bony structure. This could be due to sharp or tight contact between her Hawley's retainer and tissue mucosa that induce the early stage of traumatic osteonecrosis. Chlorhexidine mouth wash was then prescribed, and her lower retainer was trimmed at the lesion spot. She was then instructed to wear the retainer full time and to arrange an appointment with us as soon as possible if the lesion became worst. A month later, she was called for a review appointment and the oral mucosa lesion site has healed nicely.

Discussion

An almost similar situation was reported in 2018 whereby a 43-year-old man was diagnosed of lingual mandibular osteonecrosis after several days an excessive pressure was applied during impression procedure (Carmen *et al.*, 2018). A detachment of small soft tissue mucosa was reported on mandibular mylohyoid crest. The sequestrations, as similar to our case, is a typically correlated with reduced blood supply of soft tissue and bone in response to various systemic disease. Reduced micro blood supply will lead to ischemic lesion of lingual mandibular area (Visscher *et al.*, 2013). Any trauma to oral mucosa could initiate or worsen the lesion.

In many cases, Hawley retainers were constructed based on patient study model and sometimes minute deformation on the impression were not visible. This in turn will translate to high pressure spot or sharp point on the appliance. This will compress the soft tissue mucosa when patient wear the appliance. Extra care should be taken during impression procedure as not to put any

pressure point on the impression tray. Almost all patients will develop small painful ulcer and discontinue to wear the appliance. In this case, there are possibility of ischemia and neuropathy of her oral mucosa due to DM that preceded to osteonecrosis.

Apart from systemic diseases, patient undergoes treatment with bisphosphonates and antiangiogenic antiresorptive drug were commonly associated with osteonecrosis (Julia *et al.*, 2020; Toshikazu *et al.*, 2021; Tocaciu *et al.*, 2017). However, in our case, patient does not take any of the medication nor undergoes any oral carcinoma therapies. Patient also claim does not have any other known medical condition. This situation was managed by the removal of high/sharp spot on the Hawley retainer to alleviate the pressure from the mucosa soft tissue. Thus, promoting blood supply recovery and wound healing. Chlorhexidine mouth wash was also prescribed as it is known to reduce oral inflammation (Kakarla & Prem, 2020). No analgesic was needed as the patient does not feel any pain and discomfort. Patient was recall in a month time to review the lesion. A one-month review was chosen as to give ample time for the lesion to heal. In the recall appointment, the lesion has completely closed and heal.

Conclusion

Well controlled diabetes mellitus is crucial for averting harmful effects on oral health. It could result in reduce blood supply and reduced tactile/pain sensation. This could lead to trauma induced oral osteonecrosis in certain unfavourable condition. Although orthodontic induced sequestration of oral mucosa is a rare occurrence, several caution must be taken during the treatment to prevent this unfortunate event. A detailed medical history must be taken and clarified before any dental treatment is done. Apart from that, impression procedure must be done with extra pre-caution to prevent any pressure point on the study model. Hawley retainers must be checked for any sharp point or pressure spot before appliance fitting. Patient should be reminded to check for any pain of lesion that occurs on the soft

tissue and should call for appointment as soon as possible.

Acknowledgements

We would like to thank the academic and staff from Faculty of Dentistry, Islamic Sciences University of Malaysia (USIM) for the cooperation and the help given.

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