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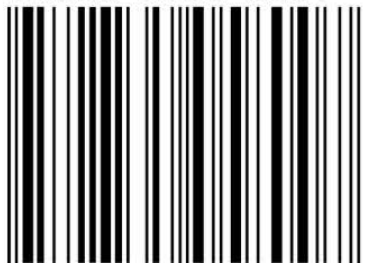
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# **IIUM Journal of Orofacial and Health Sciences**

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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.

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# Application of dental stem cell in dentistry: where are we now?

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## Introduction

Dental Stem Cells (DSC) appears to be closely linked to dentistry although the application of DSC has been widely acknowledged by other fields. DSC are undifferentiated cells obtained from the dental tissue. Specifically, these are undifferentiated cells with multipotential ability to differentiate into specific lineages. These stem cells are mesenchymal stem cell (MSC) which are harvested from specific dental tissues such as from the dental pulp of permanent teeth; DPSC (Dental Pulp Stem Cells), dental pulp of deciduous teeth; SHED (Stem Cell from Human Exfoliated Deciduous teeth) and from the periodontal ligament; PDLSC (Periodontal Ligament Stem Cells). Other dental stem cells could also be obtained from dental follicle of human third molar; DFSC (Dental Follicle Stem Cells) and from the apical papilla; SCAP (Stem Cells from Apical Papilla) (Abdullah *et al.*, 2013; Botelho *et al.*, 2017). Of these, DPSCs and SHEDs are dental stem cells which have been utilized in many of the tissue engineering and regeneration research.

Tissue engineering and regenerative medicine (TERM) is an evolving field in dentistry focusing on the development of alternative therapies for tissue and/or organ

repair with the aim to induce the formation of new functional tissues. Tissue engineering requires input from the TRIAD key players; stem/progenitor cells, scaffolds for cell growth and important growth factors (Murphy *et al.*, 2013). New development of nanomedicine, smart materials for cell and growth factor delivery as well as gene therapy provide better outcome hence overcome some of the limitations that currently exist in the clinics. Collaborative effort and interdisciplinary approaches are needed; involving clinicians as well as molecular biologists, stem cell researchers and material scientists, to ensure the output can be translated from bench to chairside or bedside.

DSC has been applied widely in many areas of research. The use of DPSC and SHED provide better choice due to its less invasiveness and reduce risk to the donors in comparison to other types of adult MSCs (Govindasamy *et al.*, 2011). The use of other stem cell sources such as embryonic stem cells (ESC) raised ethical concerns while donor's for induced pluripotent stem cells (iPSC) are concern towards the invasive techniques performed during the collection of the tissues hence limiting the clinical use although ESC and iPSC are considered as the best sources of stem cells due to their



pluripotency (Ghosh *et al.*, 2016; Lee & Seo, 2016; Huang *et al.*, 2019).

In dentistry, DSC has been applied in dental-related clinical application research such as regenerative endodontics and periodontal regeneration research since its discovery way back in early 2000 (Gronthos *et al.*, 2002; Miura *et al.*, 2003). In pulp regeneration, stem cells from DPSC were isolated, cultured and harvested *in vitro*. Stem cells were seeded onto scaffolds incorporated with signaling molecules and transplanted into the root canal of *ex vivo* tooth slides or *in situ* canine tooth. The formation of pulp-like tissues (connective tissues with blood vessel formation and dentin-like tissue deposition) was observed in many experimental studies (Nakashima *et al.*, 2017; 2011; Sun *et al.*, 2014; Yang *et al.*, 2015a,b) including one group utilizing SHED (<https://clinicaltrials.gov/ct2/show/>) which hold promise in pulp revitalization and regeneration. The use of DSC also has been applied in many fundamental studies related to biomaterial and natural products. Overall, the ultimate aim of most of these studies are to determine if the DSCs can be differentiated into specific lineages and to function appropriately in the presence of suitable scaffold material and growth factors hence providing a suitable TRIAD to be subjected for future TERM applications.

So, DSC research in Malaysia, where are we now? To the best of our knowledge, research in DSC is mostly being carried out in institutions offering dental programme; involving both IPTAs and IPTS. Based on author's experience, research on DSC are performed by small groups of local researchers in these universities, starting from basic such as looking into cell morphology and gene expression (Abdullah *et al.*, 2014) up into application such as looking into the potential of DSC to be differentiated into specific cell lineages (osteoblast-like cells, endothelial-like cells) when treated with certain growth factors or seeded on certain scaffolds (Farea *et al.*, 2014; Hashim *et al.*, 2019). According to a systematic review performed by Xuan *et al.*, (2021), studies on regenerative potential of DSC from DPSC/SHED started to be

published from 2009 onwards thus, suggesting that research in DSC already started few years earlier. Most of the research published include cell morphogenesis/proliferation and differentiation (dentinogenesis, cementoblast and osteogenesis), material biocompatibility and immunomodulation. DSC-based research also has been demonstrated to be further applied in research related to regenerative medicine looking into its potential in angiogenesis and cardiogenesis (Xuan *et al.*, 2021). Although the publication from the local researchers is still very limited, it indicates the potential of DSC-related research to be one of the areas that will become important in the new future.

Researchers involved in DSC areas needs to have collaboration with other institutes; either locally or internationally. Collaboration with industries will also open-up more potentials for DSC to be further applied in research and enhance publication. Collaboration with industries will also enable more high-end facilities to be utilized in stem cell research. Transfer of knowledge among the researchers are also important to ensure that we are being keeping abreast with all the new technologies which continue to expand limitlessly. Funding of grants from the responsible agencies is also require assisting the researchers to translate their research accordingly.

Overall, it is sufficient to say that DSC-related research is gaining its attention in Malaysia especially among the researchers. However, more are needed to be done especially on the public's awareness and knowledge regarding the importance of DSC since recent study-survey has demonstrated lack of awareness among Malaysians especially on the regenerative potential of DSC (Chiann *et al.*, 2021). Spreading awareness and knowledge regarding DSC among other types of stem cells should be given to the secondary and tertiary students and must not only focused to those with health-sciences background. Needless to say, requirement and guidelines must also be outlined by the Malaysian authority to ensure the application of DSC follows

appropriate standards in terms of safety, quality and efficacy before allowing the use of this stem cells in the near future.

## References

- Abdullah, M. F., Kannan, T. P. & Mokhtar, K.I. (2013). DPSCs and SHED in tissue engineering and regenerative medicine. *The Open Stem Cell Journal*, 4, 1-6
- Abdullah, M. F., Abdullah, S. F., Omar, N., Noor, S. N. F. M., Mahmood, Z., Mokhtar, K.I & Kannan, T. P. (2014). Proliferation rate of stem cells derived from human dental pulp and identification of differentially expressed genes. *Cell Biology International*, 9999 1-9
- Botelho, J., Cavacas, M. A., Machado, V., Mendes, J. J. (2017)Dental stem cells: recent progresses in tissue engineering and regenerative medicine. *ANNALS OF MEDICINE*, 49(8):644-651. Epub 2017 Jul 12.
- Chiann, K., Xuan, W. M., Hossain, M. S., Hanapi, N. S. M., Hashima E Nasreen, H. E., Islam, M. Z., Ahmed, I. A., Haque, N. (2021), Awareness and attitude towards dental pulp stem cell banking among Malaysians, *Health Policy and Technology*, 10 (2); 100502
- ClinicalTrials.gov. Revitalization of immature permanent teeth with necrotic pulps using SHED cells. 2017. Available from: <https://clinicaltrials.gov/ct2/show/> *ANNALS OF MEDICINE* 649.
- Farea, M., Husein, A., Halim, A. S., Abdullah, N. A., Mokhtar, K.I., Lim, C. K., Berahim, Z. *et al.* (2014). Synergistic effects of chitosan scaffold and TGFβ1 on the proliferation and osteogenic differentiation of dental pulp stem cells derived from human exfoliated deciduous teeth. *Archives of Oral Biology*,59:1400-1411.
- Ghosh, D., Mehta, N., Patil, A., Sengupta, J. (2016) Ethical issues in biomedical use of human embryonic stem cells (hESCs). *Journal of Reproductive Health and Medicine*. 2:S37- S47
- Govindasamy V, Ronald VS, Abdullah AN, Nathan KR, Ab Aziz, ZA, Abdullah M, *et al.* Differentiation of dental pulp stem cells into islet-like aggregates. *Journal of Dental Research*. 2011;90(5):646-52
- Gronthos, S., Brahim, J., Li, W., Fisher, L. W., Cherman, N., Boyde, A., *et al.* (2002). Stem cell properties of human dental pulp stem cells. *Journal of Dental Research* 81:531-535
- Huang, C-Y., Liu, C-L., Ting, C-Y., Chiu, Y-T., Cheng, Y-C., Nicholson, M. W., *et al.* (2019). Human iPSC banking: barriers and opportunities. *Journal of Biomedical Science*, 26(1):87;PMID: 31660969.
- Lee, J-H., Seo, S-J. (2016). Biomedical Application of Dental Tissue- Derived Induced Pluripotent Stem Cells. *Stem Cells International*. 2016:9762465;PMID: 27597868.
- Hashim, S. N. M., Yusof, M. F. H., Zahari, W., Chandra, H., Noordin, K. B. A. A., Kannan, T. P. *et al.* (2019). Human amniotic membrane as a matrix for endothelial differentiation of VEGF-treated dental stem cells. *Cellular and Molecular Bioengineering*, 12 (6): 599-613
- Miura, M., Gronthos, S., Zhao, M. *et al.* (2003). SHED: stem cells from human exfoliated deciduous teeth. *Proceedings of the National Academy of Sciences of the United States of America*. 100:5807-12
- Murphy, C. M., O'Brien, F. J., Little, D. G., Schindeler, A. (2013). Cell-scaffold interactions in the bone tissue engineering triad. *European Cells & Materials*, Sep 20;26:120-32.
- Nakashima, M., Iohara, K., Murakami, M., *et al.* (2017). Pulp regeneration by transplantation of dental pulp stem cells in pulpitis: a pilot clinical study. *Stem Cell Research & Therapy*, 8:61.
- Sun, H. H., Chen, B., Zhu, Q. L., Kong, H., Li, Q. H., Gao, L. N., *et al.* (2014). Investigation of dental pulp stem cells isolated from discarded human teeth extracted due to aggressive periodontitis. *Biomaterials* 35, 9459–9472.
- Xuan, W. M., Chiann, K., Hossain, M. S., Ismail, M. F., Haque, N. (2021). present status of research on the regenerative potential of dental pulp stem cells in malaysia: a systematic review. *Progress in Stem Cell*. 8(1):304-309
- Yang, J. W., Zhang, Y. F., Sun, Z. Y., Song, G. T., and Chen, Z. (2015b). Dental pulp tissue engineering with bFGF-incorporated silk fibroin scaffolds. *Journal of Biomaterials Applications*. 30, 221–229.
- Yang, J. W., Zhang, Y. F., Wan, C. Y., Sun, Z. Y., Nie, S., Jian, S. J., *et al.* (2015a). Autophagy in SDF-1α-mediated DPSC migration and pulp regeneration. *Biomaterials*. 44, 11–23.

# Minor oral surgery on impacted lower third molar done by IIUM Undergraduates: a retrospective study

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## Abstract

Minor oral surgery (MOS) is one of the important requirements for dental undergraduates to perform in Kulliyyah of Dentistry, IIUM. However, no assessment has been done on the suitability of the cases received by the students. Thus, this study was aimed to describe type of cases and level of difficulty in relation to undergraduate year of study. This study consisted of 97 subjects who had undergone MOS by IIUM undergraduate from September 2014 to October 2015. Data was collected from patient's documentation and orthopantomogram. Pederson index and relationship to inferior dental nerve were used to determine the difficulty index level. Statistical analysis was done using Chi-square test with statistical significance set at  $p \leq 0.05$ . The mean age of the patients was 24 years old, with male to female ratio 1:1.9. 52.6% of the cases were indicated for surgery due to recurrent pericoronitis. The types of cases mostly received by undergraduates were Class IA (30.9%) and Class IIA (48.5%) with mesioangular impaction (39.2%). Year 4 students received more difficult cases compared to Year 5 ( $p = 0.504$ ) with less complications postoperatively. Dental undergraduates received simple to moderate cases for MOS, and no significant association was found between year of undergraduate study and difficulty level of the cases.

**Keywords:** *impacted tooth, minor oral surgery, difficulty level, wisdom tooth, third molar*

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## Introduction

Lower third molar is the last tooth that erupts in the dentition, and it is the most frequently impacted tooth (Hupp, 2014). Minor oral surgery (MOS) on impacted lower third molar was reported as the most common surgical procedures done by the dentists (Ali *et al.*, 2014; Susarla *et al.*, 2003). This surgery involves several steps starting from the soft tissue flap elevation, bone guttering, and/or tooth sectioning (Batal & Jacob, 2006). In Malaysia, it is accounted as one of the clinical requirements that needs to be fulfilled by the dental undergraduates during their clinical years in dental school.

MOS, however, may lead to various risks & complications such as swelling, pain, paresthesia, alveolar osteitis, mandibular angle fracture, hemorrhage and trismus (Bataineh, 2001; Fuselier *et al.*, 2002; Gülicher & Gerlach, 2001; Halmos *et al.*, 2004; Hill *et al.*, 2001; Krimmel & Reinert, 2000; Susarla *et al.*, 2003).

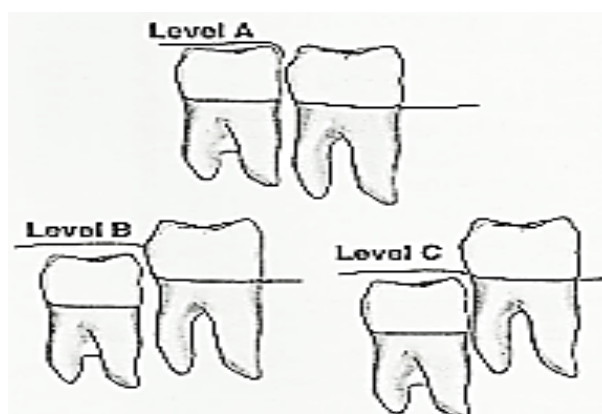
The factors that determine the difficulties of the surgery are tooth angulations, root forms, number of roots, relative depth, space availability, relationship to inferior alveolar nerve, and relative horizontal position (Yuasa *et al.*, 2002). Radiological assessment is valuable as it shows important details which determine the difficulty level of the



surgery (Blaeser *et al.*, 2003; Yuasa *et al.*, 2002). The assessment of this is essential in order to allow proper planning and management of the patient (Susarla & Dodson, 2004). Good surgical skills and technique, and application of the correct surgical principles are important in order to prevent further complications (Evans *et al.*, 2002).

The difficulty level of the surgery may be determined by using Pederson Index. The

index score is calculated based on the radiographic findings, which include depth of the tooth, ramus relationship, and angulation of the tooth (Bali *et al.*, 2013; Yuasa *et al.*, 2002). Depth of impacted third molar in relation to occlusal plane along with the distance or width between the vertical ascending mandibular ramus and the distal surface of the second molar were assessed by adapting Pell and Gregory's classification as described below (Figure 1 & 2).

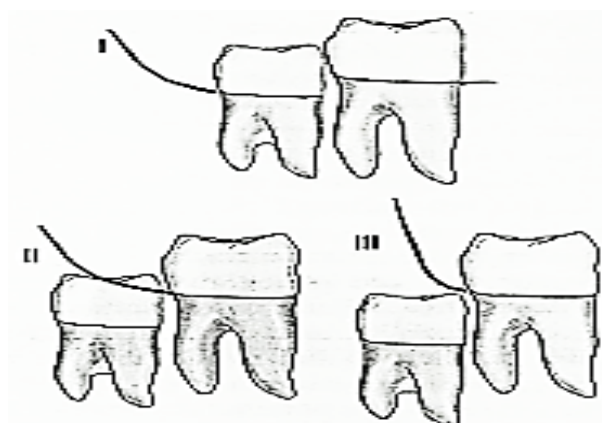


**Figure 1.** Classification based on the depth of third molar in relation to second molar

Class A: The occlusal level of the third molar is at the same level as the second molar.

Class B: The occlusal level of the third molar is between the occlusal of second molar and cemento-enamel junction of the second molar.

Class C: The occlusal level of the third molar is below the cemento-enamel junction.



**Figure 2.** Classification based on ramus relationship

Class I: There is sufficient space between distal of the second molar to the ramus for the mesiodistal width of the crown of the third molar.

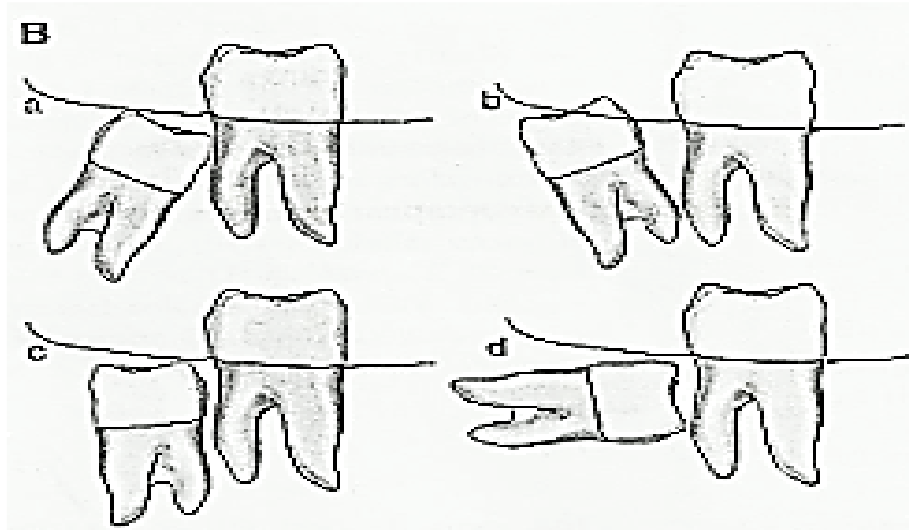
Class II: There is no sufficient space between distal of the second molar to the ramus, in which the crown of the third molar partially embedded in the ramus.

Class III: Most or the entire crown of the third molar embedded in the ramus.

Type or angulation of the impacted third molar was adapted from Winter's classification with reference to the angle formed between the intersected longitudinal axes of the second molar and third molar. It is either, (a) mesioangular impaction, (b) distoangular impaction, (c) vertical

impaction, or (d) horizontal impaction (Figure 3).

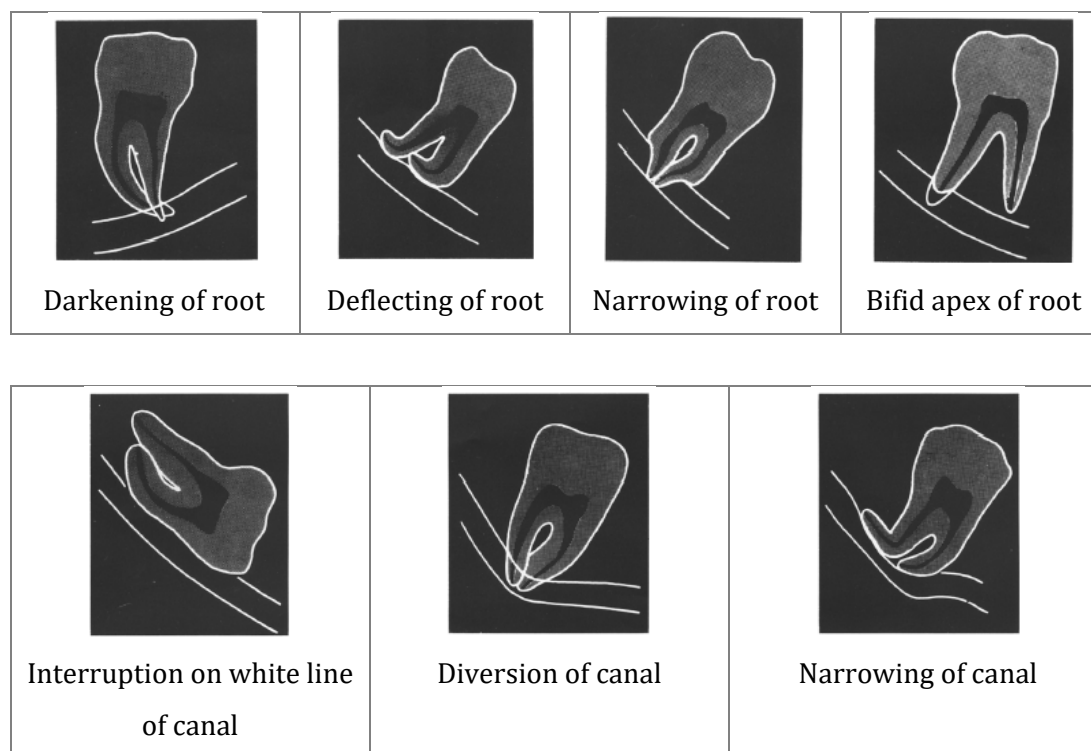
Then, the total scores of these three criteria are summed up and is classified into easy (3 to 4), moderate (5 to 6), and difficult (7 to 10). (Table 1).



**Figure 3.** Angulation of the third molar

**Table 1.** Pederson Index from Textbook of Oral and Maxillofacial Surgery 3rd Edition, Neelima Anil Malik

Pederson Index: Difficulty index for removal of impacted lower third molars		
Classification	Difficulty index value	Difficulty index (Total)
<b>Angulation</b>		
Mesioangular	1	
Horizontal/ Transverse	2	
Vertical	3	
Distoangular	4	
<b>Depth</b>		
Level A	1	Easy: 3 - 4
Level B	2	Moderate: 5 - 6
Level C	3	Difficult: 7 - 10
<b>Ramus relationship</b>		
Class I	1	
Class II	2	
Class III	3	



**Figure 4.** Seven signs of relationship of tooth to inferior dental canal

Therefore, accurate preoperative diagnosis and appropriate postoperative management can be achieved through a proper examination and investigation prior to the diagnosis (Susarla & Dodson, 2004) and should be related to the operator's knowledge and skills.

1. To describe the number of MOS cases for impacted lower third molar received by IIUM undergraduates.
3. To compare the level of difficulty of MOS cases by using Pederson index according to the year of study, quadrant of tooth, Pell & Gregory's classification, relationship to inferior dental nerve and tooth angulation.

5. To describe medications prescribed by IIUM undergraduates to the patients after MOS.

Hence, this research is important to assess case selection and suitability to the undergraduates and ultimately provide better treatment outcome to the patients.

## Materials and Methods

### Study Design

Retrospective study was implemented by utilizing records of all patients presented to IIUM Dental Clinic for MOS of impacted lower third molar by IIUM undergraduates from September 2014 to October 2015 via convenience sampling method.

### Patient Selection

The study was a 1-year study which involved 97 samples. Several inclusion and exclusion criteria were made. The inclusion criterion for this study was: (1) MOS cases done by IIUM undergraduates within the timeline, whilst the exclusion criteria were: (1) MOS cases done by IIUM Specialists, (2)

incomplete documentations and (3) cases other than impacted lower third molar.

## Research Tool and Data Collection

### *i. Patient's Record and Case Report*

Data of all patients underwent MOS for impacted lower third molar in IIUM Dental Clinic was screened for inclusion & exclusion criteria. Patients' data were collected from PearlSuitev2 version 0.1.1.0, patient's case note, as well as student's case reports. Demographic details and other epidemiological indicators - age, sex and race of the patients were collected from patient's record. Operator's year of undergraduate study was also recorded. The indications of MOS, presence of any postoperative complications and medications prescribed postoperatively were also extracted from the record.

### *ii. Radiographic Examination*

Orthopantomogram (OPG) via Planmeca Romexis 2.8.0 was used to assess the condition and status of impacted lower third molar as well as the surrounding components such as bone, adjacent teeth, root formation, and relation to inferior dental nerve.

Figure 5 showed orthopantomogram and assessment was made as follows; Red line represented the occlusal level of impacted third molar with the adjacent tooth as well as its relationship to the ramus, Yellow lines represented the angulation of the third molar, and White lines showed the relation of third molar with inferior dental nerve.

To reduce inter-examiner error, calibration was done with Oral and Maxillofacial Surgery specialist prior to assessment of preoperative radiograph.

## Data and Statistical Analysis

The data was analyzed using Statistical Package for Social Science (SPSS Graduate

Pack 16.0; SPSS Inc, Chicago, IL) version 16.0. Descriptive statistics were computed for each study variable. To measure the association between predictor and outcome variables, crosstab statistics were analyzed. Chi-square test was used to analyze the data. The level of statistical significance was set at  $P \leq 0.05$ .

## Ethical Consideration

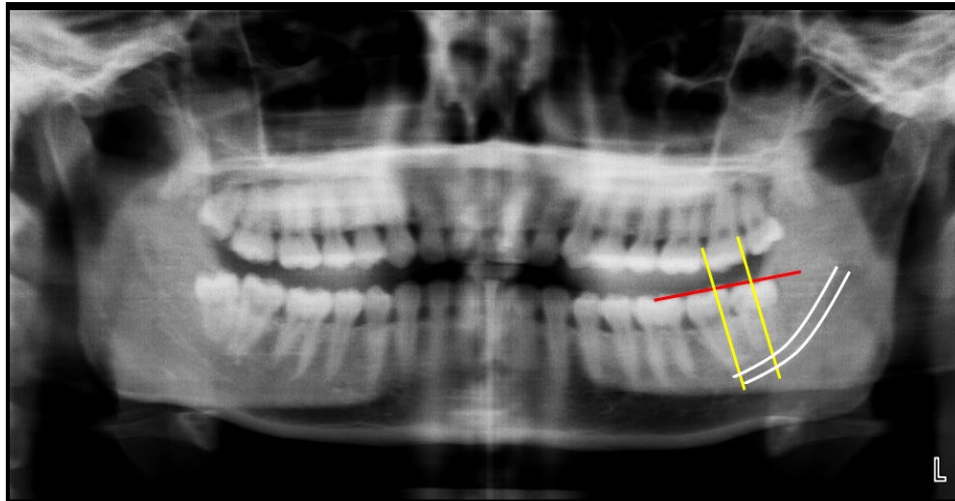
Ethical clearance was obtained from IIUM Research Ethics Committee (IREC). Approval date was on 8<sup>th</sup> December 2015 with ID number IREC 508. All data regarding patient's identification and medical records were kept confidential.

## Result

97 MOS cases performed by students from September 2014 to October 2015 were included in this study. From Table 2, most patients underwent MOS were in the age group between 15 and 24 years old, with a mean age of 24 years old. The male to female ratio was 1:1.9. 93.8% patients were of Malay ethnicity.

Based on Figure 6, the most common indication for MOS was recurrent pericoronitis followed by unrestorable caries. 8.2% of cases have more than one indication. In other cases, the teeth were removed as prophylaxis to prevent subsequent complications from the impaction.

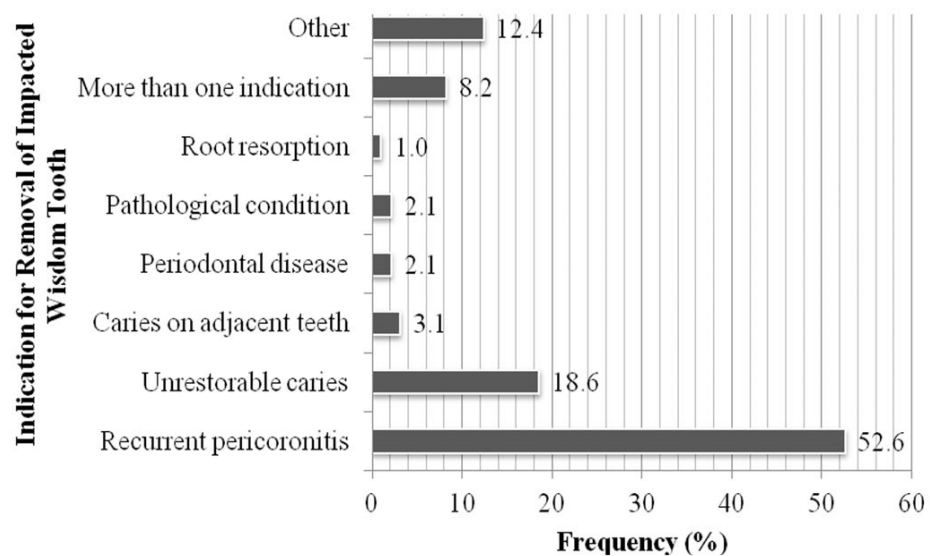
The occurrence of impacted lower third molar by quadrant was similar in number. Most cases were Class II ramus relationship (61.9%), and Class A (80.4%) in relation to the depth of impaction. No Class C case was done by students. Mesioangular and vertical impaction were the most common types of cases selected by students and the least common was distoangular impaction. Similar number of cases were recorded in term of proximity to the inferior alveolar nerve.



**Figure 5.** Orthopantomogram

**Table 2.** Patient’s demographic data

Patient’s demographic data	Frequency (%)
Age	
15-24	61 (62.9)
25-34	31 (32.0)
35-44	5 (5.2)
Gender	
Male	33 (34.0)
Female	64 (66.0)
Race	
Malay	91 (93.8)
Chinese	5 (5.2)
Indian	0 (0.0)
Others	1 (1.0)



**Figure 6.** Distribution of indication for removal of impacted lower third molar

The analysis for relation between associating factors and difficulty index level was done by Chi-square test (Table 3). Tooth quadrant, Pell and Gregory's classification and tooth angulation showed significant association with difficulty level ( $P < 0.05$ ). Majority of left impacted third molar (tooth 38) cases were of moderate difficulty, whilst majority of right impacted third molar (tooth 48) cases were classified as easy.

Assessment of complications that arise after the surgery in relation to difficulty index level was shown in Table 4. High number of complications occurred although the cases were easy or moderate. There was no significant difference between level of difficulty and presence of complications.

Table 5 showed the relationship between year of undergraduate study and presence of complications. More complications occurred in Year 5 cases as compared to Year 4 cases. However, there was no significant relationship between year of undergraduate study and presence of complications ( $p = 0.493$ ).

Table 6 showed that more than half of the cases were not prescribed with antibiotics. Regarding analgesic use, the most common type of analgesic prescribed was mefenamic acid (43.3%), followed by combination between paracetamol and mefenamic acid (39.2%).

**Table 3.** Relationship between associating factors and difficulty index level

Factors	Difficulty Index			p value
	Easy	Moderate	Difficult	
<b>Undergraduate year</b>				
Year 4 student	18	24	7	0.504
Year 5 student	22	22	4	
<b>Quadrant of tooth</b>				
Left, 38	15	30	4	0.023*
Right, 48	25	16	7	
<b>Pell &amp; Gregory's classification</b>				
Class IA	22	8	0	<0.001*
Class IB	3	3	0	
Class IC	0	0	0	
Class IIA	15	28	4	
Class IIB	0	6	7	
Class IIC	0	0	0	
Class IIIA	0	1	0	
Class IIIB	0	0	0	
Class IIIC	0	0	0	
<b>Relation to inferior dental nerve</b>				
Close proximity	21	25	3	0.276
Away	19	21	8	
<b>Tooth angulation</b>				
Mesioangular	36	2	0	<0.001*
Horizontal	4	17	0	
Vertical	0	26	7	
Distoangular	0	1	4	

\*p-value < 0.05



**Table 4.** Relationship between difficulty index level and presence of complications

		Presence of complications		
		Yes	No	Total
<b>Difficulty index</b>	Easy	28	12	40
	Moderate	34	12	46
	Difficult	9	2	11
<b>Total</b>		71	26	97

\*p value = 0.768

**Table 5.** Relationship between year of study and presence of complications

		Presence of complications		
		Yes	No	Total
<b>Undergraduate year</b>	Year 4	34	15	49
	Year 5	37	11	48
<b>Total</b>		71	26	97

\*p value = 0.493

**Table 6.** Medications prescribed after MOS

Medications	Frequency (%)
Antibiotic	
Yes	35 (36.1)
No	62 (63.9)
Analgesic	
None	1 (1.0)
Paracetamol	6 (6.2)
Mefenamic acid	42 (43.3)
Ibuprofen	3 (3.1)
Arcoxia	1 (1.0)
Paracetamol & Mefenamic acid	38 (39.2)
Paracetamol & Ibuprofen	1 (1.0)
Paracetamol & Arcoxia	5 (5.2)

## Discussion

This research is the first study to evaluate MOS on impacted lower third molar performed by IIUM undergraduates. A total of 97 cases done by students from September 2014 to October 2015 were assessed in this study.

The mean age of patients underwent MOS in Kulliyah of Dentistry, IIUM was 24 years old. There were more female patients (66.0%) as compared to male. The high prevalence of female patients was similar to other studies (Al-Anqudi *et al.*, 2014; Quek *et al.*, 2003). This might be due to the smaller size of jaw in females as compared to males,

making less space for the third molar to erupt (Shetty & Banerjee, 2010).

Based on this study, the most common indication for the removal of the impacted lower third molar was recurrent pericoronitis (52.6%). This is in accordance with the guideline by National Institute for Health & Care Excellence (NICE) (2000). Another common indication was unrestorable caries (18.6%). This result was in agreement with another study that reported the most common indication for MOS was recurrent pericoronitis (49.25%), followed by caries (26.1%) (Abdulai *et al.*, 2014). However, we also found that impacted lower third molar removal due to

prophylactic reason was also high (12.4%). This is contradicted with the NICE Guideline (2000) & Clinical Practice Guideline by Ministry of Health (2005) that stated prophylaxis removal should not serve as an indication for MOS. This could be due to the lack of case selections from the waiting list available.

Radiological examination showed that most of the cases were mesioangulated (39.2%). This was in concurrent with other studies that showed mesioangular impaction of lower third molar contributed about 33.4 % to 62% in prevalence (Al-Anqudi *et al.*, 2014; Byahatti & Ingafou, 2012; Hassan, 2010; Ma'aitha, 2000; Obiechina *et al.*, 2001; Othman, 2009; Quek *et al.*, 2003). Based on Pell and Gregory's classification, the most common cases received by the students were Class IIA (48.5%), followed by Class IA (30.9%). There were no cases of Class C reported in the study as it has been specified by the department that students were not allowed to perform cases of Class C, as well as cases with direct communication with the inferior alveolar nerve canal.

Most of the students operated on moderate cases (47.4%), followed by easy cases (41.2%) and difficult cases (11.3%). The study showed that Year 4 students operated on more difficult cases as compared to Year 5 students. This is probably due to the limited number of patients for MOS in the waiting list, resulting in inability to allocate students according to the difficulty of cases. Additionally, students also brought their own patients for MOS, hence the mixture in case selection between Year 4 and Year 5 students.

The relationship between the difficulty level and presence of complications was not significant ( $p=0.768$ ). One of the probable reasons was most of the easy cases were done solely by the students with little help from the specialists. Thus, error in handling the surgery may occur and complications may result. In contrast, difficult cases were closely supervised by the skilled and experienced specialists resulting in minimal complications. Furthermore, higher number of complications noted in Year 5 students as

compared to Year 4 students. This is probably because Year 4 students were beginners in handling the surgical procedure, hence they were closely supervised by the specialists. Meanwhile, Year 5 students received less supervision from the specialists. Thus, they tend to do more mistakes, and this led to complications. One of the most common complications was pain. This is probably occurred as a result of insufficient prescription of analgesic postoperatively (Susarla *et al.*, 2003). From this study, it was found that the most common analgesic prescribed was mefenamic acid alone (43.3%), followed by prescription of both paracetamol and mefenamic acid to the patient (39.2%).

According to the World Health Organization (WHO) Pain Management Guidelines (2010), mild pain is prescribed with acetaminophen or paracetamol, or with non-steroidal anti-inflammatory drugs (NSAIDs), with or without adjuvants. Recent study showed combination of acetaminophen and ibuprofen can be more effective to control pain after MOS compared to other types of analgesic (Merry *et al.*, 2010). Pain may also be due to improper instructions given by the operator regarding the frequency of analgesic intake to the patient. According to WHO Pain Management Guidelines (2010), analgesic should be taken on regular basis at least one day postoperatively to control the pain effectively. Thus, there is a need to improve the knowledge on pain management and analgesic prescription post MOS.

Finally, our research showed that 36.1% of the patients were prescribed with antibiotic postoperatively. Recent studies revealed that average infection rates following MOS was less than 1% regardless of antibiotic administration (Bui *et al.*, 2003; Haug *et al.*, 2005; Mehrabi *et al.*, 2007). According to Clinical Practice Guideline (CPG) for management of impacted lower third molar provided by Ministry of Health in Malaysia (2015), antibiotics prescription is considered only in cases of acute infection and in medically compromised patients. However, it was found that pattern of antibiotic prescription by the

undergraduates did not comply to this guideline. Thus, there is a need to emphasize on appropriate antibiotics prescription to the students. Presently, the department is strictly following current guidelines by not prescribing antibiotic for non-indicated cases.

The main limitation in our study is the reduced number of cases presented due to incomplete or missing patient's documentation. Therefore, we recommend that this study should be further expanded by proper document keeping, followed by collecting bigger sample in order to obtain more comprehensive statistical analysis.

## Conclusion

Overall, our undergraduates of year 4 and 5 received 97 patients for MOS with majority of them were due to recurrent pericoronitis. The complication was lesser in Year 4 in comparison to Year 5 although Year 4 received more difficult cases. There was no relationship between year of undergraduate study and the difficulty level of MOS. We also discovered that there was prescription of antibiotics without appropriate indications postoperatively.

## References

- Abdulai, A.E., Nuamah, I.K., Sackeyfio, J., & Hewlett, S. (2014). Indications for surgical extraction of third molars: a hospital-base study in Accra, Ghana. *International Journal of Medicine and Biomedical Research*, 3(3), 155–160.
- Al-Anqudi, S.M., Al-Sudairy, S., Al-Hosni, A., & Al-Maniri, A. (2014). Prevalence and pattern of third molar impaction: A retrospective study of radiographs in Oman. *Sultan Qaboos University Medical Journal*, 14(3), 388–392.
- Ali, K., McCarthy, A., Robbins, J., Heffernan, E., & Coombes, L. (2014). Management of impacted wisdom teeth: teaching of undergraduate students in UK dental schools. *European Journal of Dental Education*, 18(3), 135–141.
- Bali, A., Bali, D., Sharma, A., & Verma, G. (2012). Is Pederson Index a true predictive difficulty index for impacted mandibular third molar surgery? A meta-analysis. *Journal of Maxillofacial and Oral Surgery*, 12(3), 359–364.
- Bataineh A.B. (2001). Sensory nerve impairment following mandibular third molar surgery. *Journal of Oral and Maxillofacial Surgery*, 59(9), 1012–1017.
- Batal, H.S., & Jacobs, G. (2006). Surgical Extractions. In: Koerner K. R. (ed.), *Manual of Minor Oral Surgery for The General Dentist (1<sup>st</sup> ed.)*. London: Blackwell Munksgaard, pp. 19–48.
- Blaeser, B.F., August, M.A., Donoff, R.B., Kaban, L.B., & Dodson, T.B. (2003). Panoramic radiographic risk factors for inferior alveolar nerve injury after third molar extraction. *Journal of Oral and Maxillofacial Surgery*, 61(4), 417–421.
- Bui, C.H., Seldin, E.B., & Dodson, T.B. (2003). Types, frequencies, and risk factors for complications after third molar extraction. *Journal of Oral and Maxillofacial Surgery*, 61(12), 1379–1389.
- Byahatti, S., & Ingafou, M.S. (2012). Prevalence of eruption status of third molars in Libyan students. *Dental Research Journal*, 9(2), 152–157.
- Evans, A.W., Aghabeigi, B., Leeson, R.M., O'Sullivan, C., & Eliahoo, J. (2002). Assessment of surgeon competency to remove mandibular third molar teeth. *International Journal of Oral and Maxillofacial Surgery*, 31(4), 434–438.
- Fuselier, J.C., Ellis, E.E., 3rd, & Dodson, T.B. (2002). Do mandibular third molars alter the risk of angle fracture? *Journal of Oral and Maxillofacial Surgery*, 60(5), 514–518.
- Gülicher, D., & Gerlach, K. (2001). Sensory impairment of the lingual and inferior alveolar nerves following removal of impacted mandibular third molars. *International Journal of Oral and Maxillofacial Surgery*, 30(4), 306–312.
- Halmos, D.R., Ellis, E., 3rd, & Dodson, T.B. (2004). Mandibular third molars and angle fractures. *Journal of Oral and Maxillofacial Surgery*, 62(9), 1076–1081.
- Hassan A.H. (2010). Pattern of third molar impaction in a Saudi population. *Clinical, Cosmetic and Investigational Dentistry*, 2, 109–113.
- Haug, R.H., Perrott, D.H., Gonzalez, M.L., & Talwar, R.M. (2005). The American Association of Oral and Maxillofacial Surgeons age-related third molar study. *Journal of Oral and Maxillofacial Surgery*, 63(8), 1106–1114.
- Hill, C., Mostafa, P., Thomas, D., Newcombe, R., & Walker, R. (2001). Nerve morbidity following wisdom tooth removal under local and general anaesthesia. *British Journal of Oral and Maxillofacial Surgery*, 39(6), 419–422.
- Hupp, J.R. (2014). Principles of Management of Impacted Teeth. In: Ellis, E. E. 3rd, Tucker, M. R. (eds.), *Contemporary Oral and Maxillofacial Surgery (6<sup>th</sup> ed.)*. Missouri: Elsevier Mosby, pp. 143–147.
- Krimmel, M., & Reinert, S. (2000). Mandibular fracture after third molar removal. *Journal of Oral and Maxillofacial Surgery*, 58(10), 1110–1112.
- Ma'aitha J.K. (2000). Impacted third molars and associated pathology in Jordanian patients. *Saudi Dental Journal*, 12, 16–19.
- Malik, N.A. (2012). Minor Oral Surgical Procedures. In: Malik, N. A. (ed.), *Textbook of Oral and Maxillofacial Surgery (3<sup>rd</sup> ed.)*. New Delhi: Jaypee Brothers Medical Publisher, pp. 147.
- Mehrabi, M., Allen, J.M., & Roser, S.M. (2007). Therapeutic agents in perioperative third molar surgical procedures. *Oral and Maxillofacial Surgery Clinics of North America*, 19(1), 69–84.

- Merry, A., Gibbs, R., Edwards, J., Ting, G., Frampton, C., Davies, E., *et al.*, (2010). Combined acetaminophen and ibuprofen for pain relief after oral surgery in adults: a randomized controlled trial. *British Journal of Anaesthesia*, 104(1), 80–88.
- Ministry of Health Malaysia (2005). Clinical Practice Guidelines: Management of Unerupted and Impacted Third Molar Teeth. Retrieved 8 January 2015, from <https://www.moh.gov.my/moh/attachments/3931.pdf>
- Ministry of Health Malaysia (2015). Clinical Practice Guidelines: Antibiotic Prophylaxis in Oral Surgery for Prevention of Surgical Site Infection. Retrieved 8 March 2021, from [https://www.moh.gov.my/moh/resources/Penerbitan/CPG/Dental%20&%20Oral/CPG Antibiotic Prophylaxis in Oral Surgery Nov 2015.pdf](https://www.moh.gov.my/moh/resources/Penerbitan/CPG/Dental%20&%20Oral/CPG%20Antibiotic%20Prophylaxis%20in%20Oral%20Surgery%20Nov%202015.pdf)
- National Institute for Health & Care Excellence (2000). Guidance on the Extraction of Wisdom Teeth. Retrieved 23 December 2015, from <https://www.nice.org.uk/guidance/ta1/chapter/1-guidance>
- Obiechina, A.E., Arotiba, J.T., & Fasola, A.O. (2001). Third molar impaction: evaluation of the symptoms and pattern of impaction of mandibular third molar teeth in Nigerians. *Odontostomatologie Tropicale = Tropical Dental Journal*, 24(93), 22–25.
- Othman R. (2009). Impacted mandibular third molars among patients attending Hospital Universiti Sains Malaysia. *Archives of Orofacial Sciences*, 4, 7-12.
- Quek, S.L., Tay, C.K., Tay, K.H., Toh, S.L., & Lim, K.C. (2003). Pattern of third molar impaction in a Singapore Chinese population: a retrospective radiographic survey. *International Journal of Oral and Maxillofacial Surgery*, 32(5), 548–552.
- Shetty, P., & Banerjee, S. (2010). Missing molars: A study on status of third molars. *Journal of Pharmaceutical and Biomedical Sciences*, 4(4), 1-3.
- Susarla, S. M., Blaeser, B. F., & Magalnick, D. (2003). Third molar surgery and associated complications. *Oral and Maxillofacial Surgery Clinics of North America*, 15(2), 177–18
- Susarla, S. M., & Dodson, T. B. (2004). Risk factors for third molar extraction difficulty. *Journal of Oral and Maxillofacial Surgery*, 62(11), 1363–1371.
- World Health Organization (2010). WHO Pain Ladder with Pain Management Guidelines. Retrieved 31 December 2015, from [https://www.southwesthealthline.ca/healthlibrary\\_docs/B.5.3.WHOPainLadder.pdf](https://www.southwesthealthline.ca/healthlibrary_docs/B.5.3.WHOPainLadder.pdf)
- Yuasa, H., Kawai, T., & Sugiura, M. (2002). Classification of surgical difficulty in extracting impacted third molars. *The British Journal of Oral & Maxillofacial Surgery*, 40(1), 26–31.

# Prevalence and reasons for missed dental appointments among patients treated by undergraduate dental students of Universiti Sains Islam Malaysia

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## Abstract

Missed dental appointments drastically affect treatment proficiency and productivity of dental care facility. This study aimed to determine the prevalence and reasons for missed dental appointments among patients treated by clinical dental students of Universiti Sains Islam Malaysia (USIM). A total of 202 folders from year 2018 to 2020 treated by year 3 to year 5 dental students were retrieved from a pool of patient's record files using simple random sampling methods. Information on missed appointments was recorded. Other patients' information was kept confidential. The percentage of missed dental appointments among patients under clinical dental students' care was 37.1% (95% CI=30.7, 44.0). The majority of patients who missed dental appointments were male (37.6%), adults (38.7%) and employee (40.2%) patients. The most reported reason for the missed dental appointment was due to personal matters (36%) and the least was forgetfulness (0.6%) and miscommunication (0.6%). In conclusion, missed dental appointment commonly occurs among patients and frequently it was due to personal matters. A proper explanation by the students before scheduling an appointment is crucial to avoid any future missed dental appointments.

**Keywords:** dental care, dental students, missed appointments, no-show, reminder system

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## Introduction

Dental healthcare services in the academic dental centre are provided by the dentist, dental specialist, and dental students under

close supervision. These services that are mostly utilised by patients are emergency treatment, preventive care or operative care (Jaafar *et al.*, 2018). The cost for patients being treated by dental students is usually

subsidised, whereas those being treated by dentists or specialists are charged at a normal rate. These subsidised treatments at the centre are the strategy to help fulfil the student's clinical requirements within their three years of clinical training (Serrano *et al.*, 2017).

Patients often turn to academic dental centre for subsidise dental services without compromising the quality of care provided by the practitioners (Balhaddad *et al.*, 2018). The quality of care includes dental capabilities and techniques, the manner during treatment, treatment procedures that could complete, the length of waiting time before treatment, and a complete and detailed explanation of the treatment plan (Lee *et al.*, 2013). Lack of competency demonstrated by clinical dental students in managing some of the clinical aspects and longer treatment time can affect patient satisfaction that leads to the frequent missed dental appointments made (Lee *et al.*, 2013; Machado *et al.*, 2015; Bukhari *et al.*, 2016).

In Malaysia, students are required to complete a structured clinical training before they are allowed to sit for a professional examination. These consist of minimum clinical experience (MCE) and expected clinical experience (ECE). The regulations were set to ensure that students are equipped with adequate skills in practising independent and safe dentistry. In a study, lack of exposure to certain clinical procedures was found to be associated with inadequate training and reduce confidence level (Ali *et al.*, 2017).

Missed dental appointments may cause loss of practical hours in clinical training and opportunity for students to provide oral care to other patients under their obligation. If a cancellation was made in less than 24 hours from the appointment time, it would be difficult for the student to contact another patient as a last-minute replacement. This will cause the affected student to require an extension to their clinical sessions to complete their clinical requirements (Awartani, 2003). The students claimed that many of the missed scheduled appointments by their patients had caused a loss of

valuable clinical sessions. Although a number of personal reminders had been sent, this problem is still recurring. However, there is limited evidence available for the faculty to determine and address the issues. Missed dental appointments can also adversely affect patients. Frequently missed dental appointments can cause incomplete dental treatment which can reduce the quality of care received by patients and delay the treatment needed (McQueenie *et al.*, 2019). Postponement in oral care provision can shift a mild form of disease to a severe form such as in case of carious lesions, gingival and periodontal diseases which eventually results in tooth loss.

The prevalence of missed dental appointments varied across studies between 9% to 40% (Awartani, 2003; Holtzman *et al.*, 2013; Albaloushi and Da'ar, 2015; Storrs *et al.*, 2016; Tandon *et al.*, 2016). The most common excuse for missed dental appointments among patients was forgetfulness, busy with other matters and not brought by a parent for regular dental care (Tandon *et al.*, 2016; Onyejaka *et al.*, 2018; Kirby and Harris, 2019; Penzias *et al.*, 2019). Factors that contributed to the missed dental appointments include age, gender and occupation status (Storrs *et al.*, 2016; West *et al.*, 2020). Thus, this study aims to determine the prevalence, reason, and treatment status of missed dental appointments among patients in the academic centre under clinical dental student's care. In addition, factors associated between sociodemographic profile and missed appointments were also assessed.

## Materials and Methods

This was a cross-sectional study conducted at Dental Polyclinic, Faculty of Dentistry, Universiti Sains Islam Malaysia (USIM). The study was approved by the Research Ethics Committee of USIM [Ref no: USIM/JKEP/2020-111]. Patients' folders were retrieved from a pool of patient's records by a simple random sampling method. The patient's folders were taken from year 2018 to 2020 treated by year 3 to year 5 dental students. Patients who



received dental treatment from outpatient clinics or specialist clinics were excluded.

In this study, we defined missed dental appointments as “a patient who does not turn up or absent without advanced notice or reschedule or cancel the appointment through call or any other methods within 24 hours”. The information of missed dental appointments was indicated from the patient’s records written by clinical dental students in the folder at least once. Additional information of missed dental appointments was also recorded including the frequency, reasons and status of the dental treatment. The status of treatment was recorded as ongoing, referred for specialist treatment, terminated or case completed.

The demographic information of patients in the folder i.e., age of first registration, sex and occupational status were documented. Age was further categorised as children (below 18 years old), adults (18 to 59 years old) and elderly (60 years and above). All the patients’ information documented for the study purposes were kept anonymous and confidential.

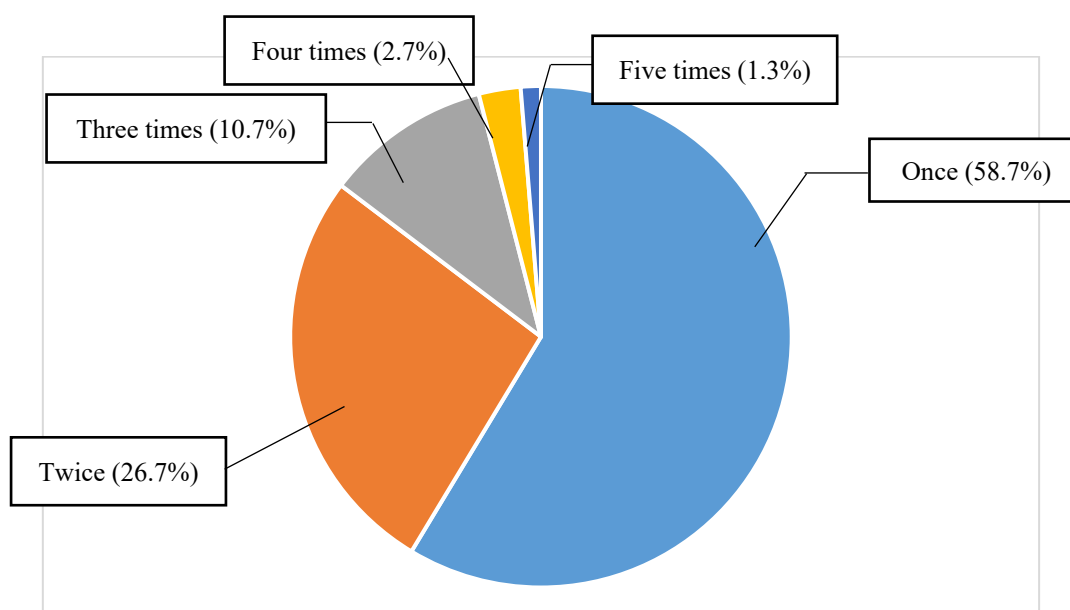
### Data analysis

Descriptive statistics (percentage and frequency) were assessed for different variables. Statistically significant difference was evaluated using the Pearson’s Chi-square test at 95% confidence ( $p < 0.05$ ). Data were analysed using IBM SPSS Program for Windows (version 26.0 SPSS Inc., Chicago, IL USA).

### Results

A total of 202 patients’ records were successfully retrieved. The mean age of the patient was 46.4 years old (SD= 17.81) ranging from 4 to 77 years old. The percentage of patients who missed dental appointments was 37.1% (95% CI=30.7, 44.0) with more than half of them missed dental appointments once (Figure 1).

The majority of missed dental appointment patients were among the adult age group (39.9%), male (37.6%) and employee (48.2%) patients as tabulated in Table 1. No significant association was found between the patient’s demographic profiles and missed dental appointments.



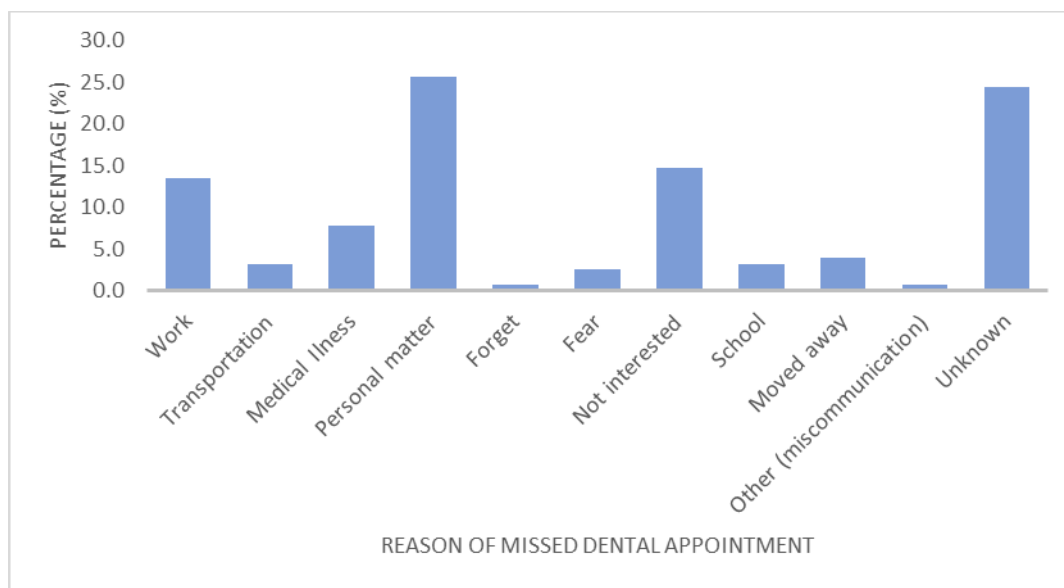
**Figure 1.** Frequency of missed dental appointments among patients

**Table 1.** Missed dental appointment according to the characteristic of patients

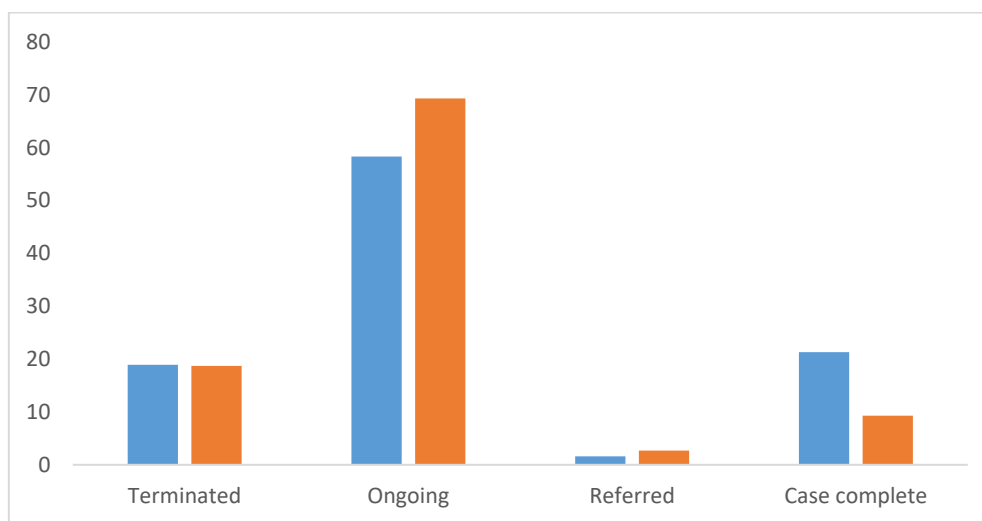
Characteristic	Came for appointment n (%)	Missed dental appointment n (%)	p-value
<b>Age</b>			
Children	8 (72.7)	3 (27.3)	0.478
Adult	83 (60.1)	55 (39.9)	
Elderly	36 (67.9)	17 (32.1)	
<b>Gender</b>			
Male	63 (62.4)	38 (37.6)	0.884
Female	64 (63.4)	37 (36.6)	
<b>Occupation</b>			
Unemployed	75 (65.2)	40 (34.8)	0.428
Employee	52 (59.8)	35 (40.2)	

Figure 2 shows the reason for patients' missed dental appointments in USIM dental students' polyclinic. A quarter of patients reported reasons for missed dental

appointments because of personal matters whereas forgetfulness (0.6%) and miscommunication (0.6%) were the least common reasons.



**Figure 2.** The reason for missed dental appointments among patients



**Figure 3.** Treatment status of patients attended to academic dental centre between missed and non-missed appointment (Blue=did not missed appointment; Orange=missed appointment)

## Discussion

A patient that attended our dental centre will undergo pre-assessment screening by a registered dentist in an outpatient clinic before being assigned to an undergraduate dental clinic or consultant assessment clinic. The waiting list will be stratified based on the complexity of the case. Suitable patients will be put on waiting list before being called by clinical students for further comprehensive dental examination in the respected clinic. After clinical examination and treatment plan agreed by patients, students are responsible to manage patients' appointments until case completion. Most of the time, patients' appointments will be scheduled through a text message or personal call. Students are encouraged to send a gentle reminder to ensure no last-minute cancellation. These reminders are for record purposes to avoid unreasonable termination. This method is proven to significantly improve the appointment rate and reduce the number of missed appointments (Penzias *et al.*, 2019). With proper appointment policies, reminders and patient's motivation, a missed appointment can be effectively controlled. Furthermore, it allows the affected student to arrange for a replacement for the clinical session. However, no data has been collected to establish this veracity.

This study showed that almost forty per cent of the patients treated by clinical dental students in this dental academic centre missed their dental appointment. The percentage of missed appointments in this study is slightly higher compared to other similar studies in another academic dental centre (Awartani, 2003; Storrs *et al.*, 2016). Less number of samples collected in this study could be the reason. Further research with a large number of samples is highly recommended.

Previous studies have shown that transportation, forgetfulness and miscommunication were the most common reasons for missed appointments among patients (Albarakati, 2009; Onyejaka *et al.*, 2018; AlSadhan, 2013). Surprisingly, the findings of this study showed the opposite results where these reasons were the least quoted reasons for missed appointments. This is most likely due to the dental care policy being practice in USIM which encourages that patients need to be reminded through call or text messages at least 24 hours before their scheduled appointment. Frequent communication through text messages and phone call help to reduce patient-dentist miscommunication problems (Storrs *et al.*, 2016). As USIM dental centre is located in the middle of the

city, the most frequent issue of transportation presented in previous studies is not an area of concern in this study as patients can easily reach the clinic by different modes of transportations. On the other hand, this study found that one-quarter of patients missed their dental appointments due to personal reasons however, no clear evidence has been shown and the exact cause needs further investigation. Moreover, a high percentage of unknown reasons for missed appointments should be evaluated carefully. This could be due to improper documentation of missed appointments by the dental student during their clinical sessions. Thus, it is important to emphasize on taking good clinical notes to avoid data records errors.

This study showed that a higher number of patients who missed their appointments were still undergoing treatment. According to a guideline provided by the dental centre, non-attending patients with more than three times will be put under consideration for termination. Therefore, it is important to discuss and inform patients regarding the cancellation policy to avoid more missed appointments in the future without any valid reason. This is to ensure the valuable clinical sessions are not wasted. It has been suggested that no-show rates are higher among patients who missed appointments in the previous three appointments (Tsai *et al.*, 2019). However, there were still some patients who missed more than three appointments being treated by USIM dental students. Major clinical procedures such as endodontic therapy or crown/bridge work that have been treated halfway could be the reason for patients' retainment. According to Storrs *et al.* (2016), after relief from acute symptoms of an initial endodontic session, the patient was less inclined to resume the treatment as they believed the treatment has completed. Thus, the treatment plan should be discussed to obtain full cooperation from patients. In the meantime, a supportive environment demonstrated by the oral healthcare personnel can help the patient to understand the importance of appointment-keeping behaviour to ensure frequent dental

clinic visits as planned (Horsley *et al.*, 2007; Sbaraini *et al.*, 2012).

The limitations in this study were data extraction was done using conventional method which involved retrieving patient's records using patient folder. Currently, the record keeping system were shifted gradually to electronic records; thus, there is a possibility of some data were excluded in this study. In addition, our study only focusses on the reason of missed appointment from the dental student's perspective only. Thus, for future research, it is suggested to include more variables to further understand the reason why missed appointment among patient occur.

## Conclusion

More than one-third of dental students' patients missed their dental appointments. A quarter of the patients who missed these appointments is due to personal matters. Patients who adhere to their scheduled dental appointment mostly complete their treatment under dental students. A proper explanation of the clinic policies and dental procedures to be taken by the students before scheduling an appointment is essential to avoid any missed dental appointments so that patients' treatment plans can be completed. The findings of this study could provide useful preliminary data for the university to further improved the record-keeping system among dental student and structure remainder system to reduce missed appointment rate.

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## Conflict of Interest

The authors declare that they have no financial or other conflicts of interest in relation to this research and its publication.

## References

- Albaloushi H. M. & Da'ar O. (2015). Do patients with varying demographic and regional characteristics equally miss appointments across dental specialties? *European Scientific Journal*, 11(12), 45-60.
- AlBarakati S. F. (2009). Appointments Failure Among Female Patients at a Dental School Clinic in Saudi Arabia. *Journal of Dental Education*, 73(9), 1118-1124.
- Ali K., Slade A., Kay E., Zahra D. & Tredwin C. (2017). Preparedness of undergraduate dental students in the United Kingdom: a national study. *British Dental Journal*, 222(6), 472-477.
- AlSadhan S. A. (2013). Frequency of missed and cancelled appointments in King Saud University orthodontic clinic. *King Saud University Journal of Dental Sciences*, 4, 77-80.
- Awartani F. (2003). Broken Appointment Behavior in a Dental School Environment. *Journal of Contemporary Dental Practice*, 4(4), 100-107.
- Balhaddad A. A., Alshammari A., Alqadi A. & Nazir M. A. (2018). Patient Satisfaction with Dental Services and Associated Factors in a Saudi Dental Institution. *Journal of Clinical and Diagnostic Research*, 12(12), ZC36-ZC39.
- Bukhari O. M., Sohrabi K. & Tavares M. (2016). Factors affecting patients' adherence to orthodontic appointments. *American Journal of Orthodontics and Dentofacial Orthopedics*, 149, 319-24.
- Holtzman J. S., Atchison K. A., Gironde M. W., Radbod R. & Gornbein J. (2014). The association between oral health literacy and failed appointments in adults attending a university-based general dental clinic. *Community Dentistry and Oral Epidemiology*, 42, 263-270.
- Horsley B. P., Lindauer S. J., Shroff B., Tüfekçi E., Abubaker A. O., Fowler C. E., et al. (2007). Appointment keeping behavior of Medicaid vs non-Medicaid orthodontic patients. *American Journal of Orthodontics and Dentofacial Orthopedics*, 132, 49-53.
- Jaafar A., Nasir W. M., Ab Mumin N., Elias N. N. A. & Mohd Sabri M. A. (2018). Reasons for seeking dental care among adults at an academic dental centre and the associated factors. *Archives of Orofacial Sciences*, 13(2), 104-111.
- Kirby J. & Harris J. C. (2019). Development and evaluation of a 'was not brought' pathway: a team approach to managing children's missed dental appointments. *British Dental Journal*, 227(4), 291-297.
- Lee K. T., Chen C. M., Huang S.T., Wu Y. M., Lee H. E., Hsu K. J., et al. (2013) Patient satisfaction with the quality of dental treatment provided by interns. *Journal of Dental Sciences*, 8, 177-183.
- Machado A. T., Werneck M. A. F., Lucas S. D. & Abreu M. H. N. G. (2015). Who did not appear? First dental visit absences in secondary care in a major Brazilian city: a cross-sectional study. *Ciência & Saúde Coletiva*, 20(1), 289-298.
- Mark J. Storrs M.J., Helen M. Ramov H. M. & Ratilal Laloo R. (2016). An Investigation into Patient Non-Attendance and Use of a Short-Message Reminder System at a University Dental Clinic. *Journal of Dental Education*, 80(1), 30-39.
- McQueenie R., Ellis D. A., McConnachie A., Wilson P. & Williamson A. E. (2019) Morbidity, mortality and missed appointments in healthcare: a national retrospective data linkage study. *BMC Medicine*, 17(2).
- Onyejaka N. K., Emele I. E. & Eboh O. F. (2018). Appointment Failure among Dental Patients Attending a Government Dental Centre in Enugu, Nigeria. *Pesquisa Brasileira em Odontopediatria e Clinica Integrada*, 18(1), e4004.
- Penzias R., Sanabia V., Shreeve K. M., Bhaumik U., Lenz C., Woods E. R., et al. (2019). Personal Phone Calls Lead to Decreased Rates of Missed Appointments in an Adolescent/Young Adult Practice. *Pediatric Quality and Safety*, 4(4), e192.
- Sbaraini A., Carter S. M., Evans R. W. & Blinkhorn A. (2012). Experiences of dental care: what do patients value? *BMC Health Services Research*, 12(177).
- Serrano C. M., Botelho M. G., Wesselink P. R. & Vervoorn J. M. (2018). Challenges in the transition to clinical training in dentistry: An ADEE special interest group initial report. *European Journal of Dental Education*, 2018, 1-7.
- Tandon S., Duhan R., Sharma M. & Vasudeva S. (2016). Between the Cup and the Lip: Missed Dental Appointments. *Journal of Clinical and Diagnostic Research*, 10(5), ZC122-ZC124.
- Tsai W. C., Lee W. C., Chiang S. C., Chen Y. C. & Chen T. J. Factors of missed appointments at an academic medical center in Taiwan. *Journal of the Chinese Medical Association*, 82(5), 436-442.
- West A., Stones T. & Wanyonyi K. (2020). Deprivation, demography and missed scheduled appointments at an NHS primary dental care and training service. *British Dental Journal*, 228(2), 98-102.

# Evaluation on the perception of final year dental students on their confidence level regarding endodontic treatments: a cross sectional analysis

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## Abstract

Endodontics procedures are difficult and complicated that most of the practitioners would encounter. Therefore, dental students should gain their confidence and competent during their training. This research aimed to study the perception of final year students on confidence level regarding endodontic treatments from all public universities and their opinions on the quality of endodontic education. A Google Form was used to disseminate an online questionnaire to all dental students from public universities across Malaysia. The survey included both scaled answer and open-ended questions. 184 responses out of 235 students, were obtained (response rate = 78%). Perception of competence and confidence were significantly greater amongst the students from research-based universities group ( $P < 0.05$ ). 93.5% ( $n=179$ ) of participants agree that they were confident to do endodontic procedure on anterior tooth, whilst on posterior tooth, only 75.5% ( $n=139$ ) were confident. Only 6.5 percent of participants ( $n = 12$ ) did not feel confident doing root canal treatment on single-rooted teeth, but 76.1 percent ( $n = 140$ ) did not feel competent performing root canal treatment on multirooted teeth. Over 90% of the students rated the quality and the amount of time spent on endodontic education were adequate at their respective university as  $\geq 5$  on a Likert scale (1 = inadequate to 10 = adequate). In addition, when they were asked to give the suggestion on how to improve the quality of endodontic education, 10.9% of the students suggested to increase the number of practical session and to do regular discussion regarding endodontic cases. It is vital to improve undergraduate endodontic education in order to raise students' perceptions of their confidence and competence when doing root canal therapy.

**Keywords:** education, endodontics, root canal treatment, undergraduate dental students

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## Introduction

Endodontics is a specialist field of dentistry that focuses on the preservation of healthy periapical tissues as well as the healing of

infected or inflammatory periapical tissues. Endodontic failures are on the rise, and their treatment necessitates a large number of clinical cases to be handled quickly in general dentistry (Gilmour *et al.*, 2017).



According to studies done in Sweden and United Kingdom, the number of people seeking endodontic treatment has risen dramatically during the last few decades (Skudutylte & Eriksen, 2006, Brennan & Spencer, 2003).

This could be linked to a growth in population life expectancy along with a growing desire to keep their natural teeth. Because of the increase in endodontic treatment needs, endodontics should be taught as a basic theoretical and clinical skill in the undergraduate dental curriculum. Future dental clinicians' knowledge and skills will be enhanced as a result. As a result, they will be able to provide safe endodontic treatment while also providing quality care to patients by performing accurate diagnosis, treatment planning, and skilled endodontic treatment execution (Rolland *et al.*, 2007, Cowpe *et al.*, 2009, Al-Kadhim *et al.*, 2017).

In order to provide teaching and clinical training in endodontics, Malaysian undergraduate dental colleges must design and conduct programmes in accordance with the Malaysian Qualification agency (MQA), which set the minimum clinical experience (MCE) and expected clinical experience (ECE) of complete root canal treatment on 3 anterior teeth, 1 molar and passing one competency test. Students must also gain the competences required to execute endodontic treatment independently after graduation in order to acquire the requisite abilities.

The European Society of Endodontology has issued guidelines for undergraduate endodontics education in light of this. The European Society of Endodontology stated that the consistency and quality of a student's performance during preclinical and clinical years is more important than the overall number of clinical cases performed (De Moor *et al.*, 2013). The quality of finished root canal procedures is the most important measure in evaluating a student's skill.

In addition, preclinical evaluations of students' root canal treatments will improve the quality of patient care in clinics (Ilgüy *et*

*al.*, 2013). However, it is widely believed that the total number of cases completed by students throughout their graduating years has a significant impact on general competency since it indicates their readiness to work independently on endodontic cases in the future (Chambers, 2012). Research into the quality and outcome of endodontic treatments has found a significant prevalence of poorly executed endodontic procedures performed by students (Lynch & Bruke, 2006, Vukadinov *et al.*, 2014). The complexity of the root canal system, a lack of understanding of treatment goals, and poor clinical skills could all be contributing factors.

For undergraduate dental students and general practitioners alike, endodontics can be one of the most challenging and stressful fields. This difficulty is thought to be due to the recent expansion in the field of endodontics in terms of clinical management of pulp and periapical diseases, as well as the complex anatomical diversity and large number of developed instruments and materials used in treatment, as well as a lack of self-confidence that makes many students feel unprepared to deal with endodontic treatment procedures (Tanalap *et al.*, 2013). As all dental students complete their studies in the future, this degree of confidence is critical in assuring the quality of future general practitioners providing root canal therapy.

A recent study done by Almohaimede, 2018 have found a significant frequency of poorly performed RCTs with periradicular disease going unnoticed and untreated. This could be due to a variety of factors, including the difficulty of the technical procedures, a lack of understanding of the principles and goals of therapy, poor remuneration for the time spent, and insufficient undergraduate training (Almohaimede, 2018).

Davey *et al.* (2016) reported that the majority of dental students lack self-confidence in performing root canal treatment, mainly due to the lack of clinical experience. In dentistry, it is required to repeat clinical procedures in order to develop clinical competence (Chambers,

2012). It is not uncommon for recently graduated dentists to feel lacking in some clinical abilities, which is exacerbated by time constraints and practical opportunities in undergraduate courses. Keep in mind that this study looked at self-perceived confidence rather than competence (Murray & Chandler, 1999). However, while competence is more important in dentistry, the importance of confidence in acquiring competence should not be overlooked (Honey *et al.*, 2011). Therefore, teaching and number of practice in the clinic in undergraduate level can be very important to build confidence among students and ensuring the quality of root canal treatment procedure successfulness in the future.

The aim of this research is to study the perception final year students on their confidence level regarding root canal treatments from research based and non-research based public universities and their opinions on the quality of endodontic education.

## Materials and Methods

### Study design

A cross sectional study was conducted among Malaysian public university final year dental students' of 2020/2021 academic session who had performed at least one uncomplicated root canal treatment (with normal anatomy of pulp chamber and radicular pulp) throughout their clinical years. A questionnaire by Davey *et al.* (2014) was distributed among the students via Google form through their official university email. This study was conducted for 12 months starting from February 2020 until January 2021. An ethical approval was obtained from the Research Ethics Committee of Universiti Sains Islam Malaysia [USIM/REC/0720-129]. All participants agreed and consented for their participation in the study.

### Questionnaire

Distributed questionnaires consist of 3 sections related to the student's general

perception and confidence level in performing endodontic treatments, and their opinions on the learning process of the endodontic procedures. The first section was divided into two questions regarding their self-competence and self-confidence in performing endodontic treatments based on the type of tooth either single canal tooth or multirooted tooth. Second section was about students' perception on their level of confidence on endodontics performance based on the stages of the procedure as shown in Table 2. The third section was about the students' opinion on the time spent and quality of endodontic education at their university. A Likert scale scoring of "1 = Not confident at all" to "10 = Extremely confident" was employed with a cut-off point of 5 was later used to categorize the group of students into " $\geq 5$  = confidence" or " $< 5$  = non-confidence" for first and second section while " $\geq 5$  = adequate" and " $< 5$  = inadequate" for analysis purposes.

### Statistical analysis

Data were analysed using mean and standard deviation (SD), and frequency and percentage for descriptive analysis. Further analysis was performed using independent t-test for comparing mean between two groups on students' perception towards endodontic procedure. The significant level was set at  $p < 0.05$ . Data analysis was performed using IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.

### Results

A total of 184 out of 235 final year dental students from all the public universities participated in the study (response rate 78%). Table 1 showed the distribution of participants from different universities who participated in this study. The highest participation was Universiti Sains Malaysia (87.0%) whilst the lowest was from Universiti Teknologi MARA (23.6%).

Majority of the participants felt competent to perform an uncomplicated non-surgical endodontics treatment for single-rooted

tooth (93.5%) however, felt incompetent for multi-rooted tooth (76.1%). On the other hand, majority of participant felt confident to perform uncomplicated non-surgical

endodontics treatment on anterior and posterior tooth with a percentage of 97.3% and 75.5% respectively as shown in Table 2.

**Table 1.** Distribution of final year students participated in the study (n=184)

University		N (%)
Research based	University of Malaya	35/49 (71.4)
	Universiti Kebangsaan Malaysia	31/57 (54.4)
	Universiti Sains Malaysia	40/46 (87.0)
Non-research based	Universiti Teknologi MARA	21/89 (23.6)
	Universiti Sains Islam Malaysia	20/35 (57.1)
	International Islamic University of Malaysia	37/59 (62.7)

**Table 2.** Students' perception on their level of competence and confidence in performing uncomplicated root canal treatment in clinical practice

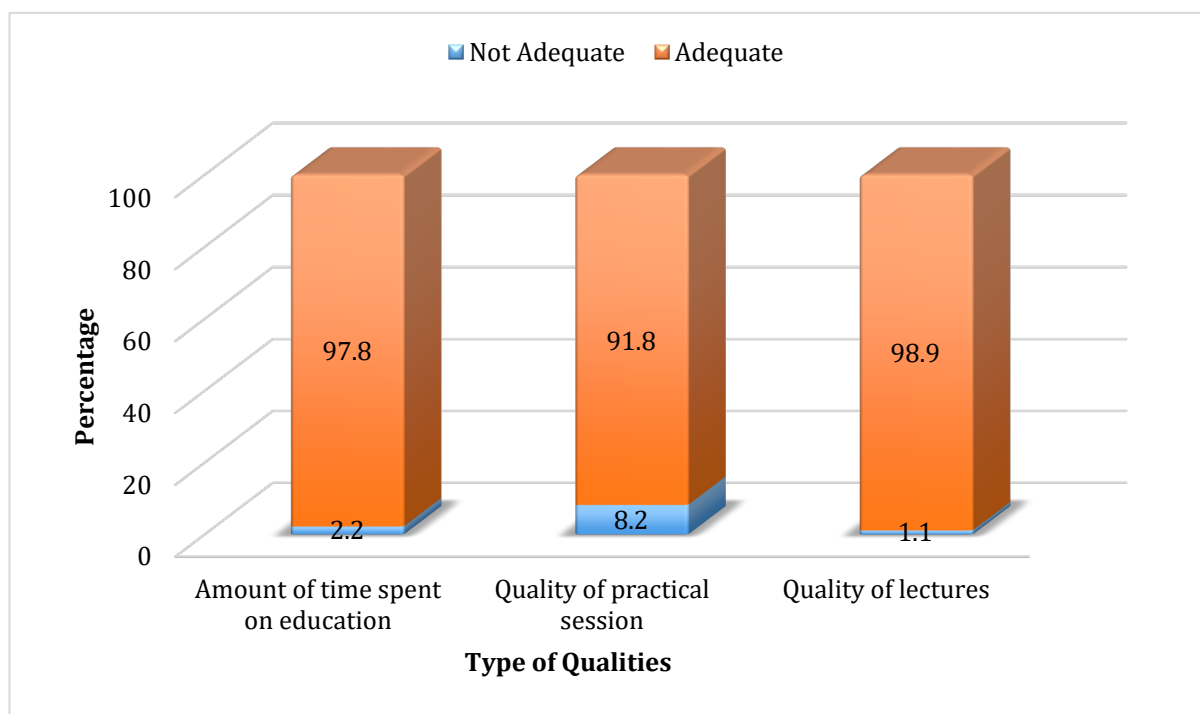
Type of tooth	Student's perception	N	%
Single-rooted	Competent	172	93.5
	Incompetent	12	6.5
Multi-rooted	Competent	44	23.9
	Incompetent	140	76.1
Anterior tooth	Confident	179	97.3
	Not confident	5	2.7
Posterior tooth	Confident	139	75.5
	Not confident	45	24.5

Descriptively, majority of the students had mean score of more than 5 which showed of perceived confident between university in performing every stage of root canal treatment. Most of the stages of RCT showed a significant difference of score between research and non-research-based university with  $p < 0.05$ . The detailed of the result with the p-value are shown in Table 3.

Majority of the participants responded that the amount of time spend on endodontics education, the quality of lecture and the quality of laboratory practical for endodontic session were adequate with the percentage of 97.8%, 98.9% and 91.8% respectively, as shown in Figure 1.

**Table 3.** The comparison of mean score of student’s perceptions in endodontics procedural stage

Endodontic procedural	Type of university		p-value
	Research based	Non-research based	
	Mean (SD)	Mean (SD)	
• Determining restorability of a tooth which is endodontically involved	7.11 (1.46)	6.81 (1.28)	.142
• Knowing when to refer patients for more complicated endodontic treatment that is beyond your capabilities	7.88 (1.57)	7.06 (1.43)	.000
• Providing analgesia to allow you to carry out root canal treatment	8.61 (1.16)	8.19 (1.27)	.021
• Isolating the tooth	8.59 (1.17)	8.13 (1.19)	.009
• Preparing the access cavity	7.60 (1.20)	7.46 (1.21)	.430
• Determining working length of each canal using an electronic apex locator and working length radiograph	7.51 (1.33)	7.08 (1.31)	.030
• Selecting appropriate irritant and irrigating the root canal system	8.17 (1.24)	7.56 (1.34)	.002
• Cleaning and shaping root canal system	7.55 (1.45)	6.99 (1.44)	.010
• Placing an interappointment dressing	8.22 (1.37)	7.47 (1.42)	.000
• Filling root canal systems	7.30 (1.35)	6.81 (1.41)	.017
• Understanding and appropriately managing the risks associated with uncomplicated non-surgical root canal treatment	7.24 (1.51)	6.36 (1.28)	.000
• Taking pre-operative, intra-operative and post-operative radiographs	7.57 (1.41)	7.65 (1.43)	.679
• Interpreting pre-operative, intra-operative and post-operative radiographs	8.09 (1.27)	7.53 (1.15)	.002
• Giving post-operative instructions to patients following root canal treatment	8.21 (1.29)	7.68 (1.26)	.006
• Assessing quality of a root filling post-operatively	7.98 (1.35)	7.36 (1.20)	.001
• Determining correct recall period for the patient	7.75 (1.38)	6.95 (1.41)	.000
• Knowing how to restore a tooth following root canal treatment	7.79 (1.38)	7.01 (1.42)	.000
• Knowing when a post is required to be placed in a root canal to allow tooth restoration	7.29 (1.49)	6.40 (1.53)	.000
• Knowing how to place a post in a root canal and using it to retain a restoration	6.66 (1.78)	5.81 (1.72)	.001



**Figure 1.** Students' opinion on the time spent and quality of endodontic education at their university

## Discussion

The goal of this study was to explore more about final-year dental students' perceptions of root canal treatment confidence and competence, as well as their perceptions of the quality of endodontic education at their university and to compare between research based and non research based public university, the rational of dividing public universities to research based and non research based, as research based universities are well established and enjoying more senior and experienced academic members as compare to non research based universities.

The evaluation of students perception toward their competence is a vital step for the quality validation of graduating dental students. The competency-based curriculum recognizes essential components for dental practice and provides a sequence of defined learning outcomes that helps students to graduate as a qualified beginner. A recent study suggested that competency-based

education may enhance the academic performance and metacognitive capability of students (Fan *et al.*, 2015). The improved metacognition of students allows them to perform their self-assessment, which is of significant importance for practical clinical learning (Martinez, 2006). Therefore, it is imperative for students to gain insight into their cognitive processes and develop adequate skills for conducting self-evaluation of their respective competence and confidence levels. The current study is aimed to explore the undergraduate dental students' self-perceived confidence level while performing various stages of endodontic treatment.

Majority of the participants, around 93.5% felt competent to do root canal treatment on single rooted tooth. The results of this study was higher than other study conduct in Saudi Arabia by (Alrahabi, 2017) which showed 78% of final year dental student were confident in performing root canal treatment on anterior teeth.

However, the level of students confidence towards performing root canal treatment on multi-rooted tooth which only 23.9% of them who feel competent, These findings were consistent with the outcomes reported by (Alrahabi, 2017, Almohaimede, 2018, Ayhan *et al.*, 2016). Most of the students felt not competent enough to perform root canal treatment on multi-rooted tooth regardless whether the students from research based or non research based universities.

Apart from that, as for performing root canal treatment based on the location of the tooth, 97.3% of the final year students feel confident when performing uncomplicated, non-surgical root canal treatment on anterior tooth.

A majority of participants (97.8%) ranked the amount of time spent on endodontic education as adequate, our findings were higher as compared by other study done by (Puryer *et al.*, 2016), who reported 72% of students were satisfied with the time spent in endodontic education. Alrahabi, 2017 and Almohaimede, 2018 reported adequacy level of 87% and 83% respectively which are comparable to our study.

Moreover, the quality of lecture and the quality of preclinical practical for endodontic session were adequate with the percentage of 98.9% and 91.8% respectively, these findings were comparable but higher with other studies (Javed *et al.*, 2021, Puryer *et al.*, 2016) who reported adequacy level of 78% and 75% respectively.

Nevertheless, according to the perception of confidence of the respondents related to every stage of non-surgical root canal treatment, briefly starting from how to determine the restorability of the tooth until knowing how to restore following the treatment, can be concluded that most of the final year dental students were confident in performing every stage of the root canal treatment even-though there was a significant difference ( $P < 0.05$ ) in confidence level between the two main groups which are research based and non-research based university. However, there was only a slight

mean difference in the overall comparison. From here, it shows that the students have acknowledge the theory and practical clinically very well but somehow due to certain circumstances, final year dental students lacked of clinical sessions to practice as much as they could. This can be proven through their answers to the last two open questions in the survey, most of students have highlighted a few factors that might influence their confidence level. The responses stated that, due to the outbreak of pandemic Covid-19 around the globe, preclinical and clinical sessions were reduced and they were given limited of time to complete all the required procedures. In addition, the availability of patient that indicated for endodontic treatment especially molar cases were low and difficult to obtain and had been worse in the current pandemic situation.

A lack of clinical experience in the undergraduate curriculum, according to (Murray *et al.*, 1999), diminishes the confidence that emerges with clinical practise. Furthermore, an overly crowded curriculum will undermine self-confidence. Therefore, most of the suggestions on how to improve and overcome these factors, majority of responses suggested to increase the number of practical sessions of endodontic treatment and do regular discussion upon any cases related to root canal treatment procedures. It can be seen here that, most of the final year students seemed to have a great concern toward the clinical care education.

It's important to remember that a student's high level of confidence in a technique doesn't guarantee that they'll be able to execute it successfully. Although students may possess the necessary skills, their context and internal judgement of their abilities may not give them with the self-belief (confidence) to perform the surgery. Overconfident students may endanger patients by performing treatments above their skill level (Gilmour *et al.*, 2017). More clinical experience is likely to boost confidence and competence, especially if the clinical experience is structured (Choudhry *et al.*, 2005). Although gaining more RCT

clinical experience does not ensure competence, it is vital that undergraduate students obtain appropriate clinical exposure to endodontic treatments; otherwise, they are unlikely to achieve competence or confidence (Youngson *et al.*, 2007). However, improving student experience is not always straightforward, as constraints like as a shortage of suitable case for undergraduate level (Gilmour *et al.*, 2017). Students must develop comprehension and an accurate self-assessment of their own proficiency levels and associated confidence, regardless of their prior experience, so that, if necessary, additional training and clinical experience can be obtained after graduation. After convocation, Dental officers must be able to use portfolios, reflection, and plans for personal development to address their 'weak' areas through training (Gilmour *et al.*, 2017).

## Limitation and Recommendation

### Limitation

Participant feedback was low, and the reason behind that was due to communicating with other universities was via online platform (WhatsApp Messenger). There were no Physical meetings due to current pandemic (Covid-19 outbreak) situation. Therefore, if there is any problems or inquiries, we had difficulties to attend with the problems. We were only depended on each of the representatives from the involved universities to spread the questionnaires and ask their batchmates to answer all the questionnaires.

### Recommendation

As for the recommendation, we suggest to expand the number of samples which can include the private dental schools in the study so that comparison of confidence level among dental students in public and private universities can be made and also their quality of education in each of the universities. Moreover to enhance participant feedback, a face to face communication with other universities

students to clarify the research objectives should be implemented. Further investigation on how different teaching methods, time spent teaching or the amount of clinical experience has an effect on student confidence

## Conclusion

Perception of confidence and competence when performing uncomplicated root canal treatment were not obviously different between universities. However, many participants did not feel confident and competent, at some circumstances, indicating that there is scope to enhance endodontic education at their respective universities. Participants suggested that more different teaching techniques be included, as well as an increase in the number of preclinical and clinical sessions, and self-assessment.

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## Conflict of Interest

The authors declare that they have no financial or other conflicts of interest in relation to this research and its publication.

## References

- Al-Kadhim, A.H., Rajion, Z.A., Malik, N.A., Jaafar, A. (2017). Morphology of maxillary first molar analyzed by cone-beam computed tomography among Malaysian: Variations in the number of roots and canals and the incidence of fusion. *IIUM Medical Journal Malaysia*, 16(2), 33-39.
- Almohaimede, A.A. (2018). Clinical undergraduate endodontic teaching in King Saud University: Student's experience, perception, and self-confidence levels. *International Journal of Dental and Oral Health*, 4(1),1-5.
- Aarahabi, M. (2017). The Confidence of Undergraduate Dental Students in Saudi Arabia in Performing Endodontic Treatment. *European Journal of Dentistry*, 11(1), 217-221.
- Awooda, E.M., Mudathir, M.S., Mahmoud, S.A. (2014). Confidence level in performing endodontic treatment among final year undergraduate dental students from the University of Medical Science



- and Technology, *Sudan Saudi Endodontic Journal*, 6, 26-30.
- Ayhan, T., Barut, G., Tanalp, J. (2016). The self-confidence levels of senior dental students during endodontic treatment procedures. *Turkey Endodontic Journal*, 1,19-22.
- Brennan, D.S., Spencer, A.J. (2003). Service provision trends among Australian private general dental practitioners: 1983/84 to 1998/99. *International Dental Journal*, 53,145-152.
- Chambers, D. (2012). Learning Curves: What Do Dental Students Learn from Repeated Practice of Clinical Procedures? *Journal of Dental education*, 76(3), 291-302.
- Choudhry, N.K., Fletcher, R.H., Soumerai, S.B. (2005). Systematic review: The relationship between clinical experience and quality of health care. *Annual of Internal Medicine*, 142, 260-273.
- Cowpe, J., Plasschaert, A., Harzer, W., Vinkka-Puhakka, H., Walmsley, A.D. (2010). Profile and competences for the graduating European dentist – update 2009. *European Journal of Dental Education*, 14, 193-202.
- Davey, J., Bryant, S.T., Dummer, P.M.H. (2015). The confidence of undergraduate dental students when performing root canal treatment and their perception of the quality of endodontic education. *European Journal of Dental Education*, 19, 229-234.
- De Moor, R., Hulsmann, M., Kirkevang, L.L., Tanalp, J., Whitworth, J. (2013). European Society of Endodontology. Undergraduate curriculum guidelines for endodontology. *International Endodontic Journal*, 46,1105-1114.
- European Society of Endodontology. (2006). Quality guidelines for endodontic treatment: Consensus report of the European Society of Endodontology. *International Endodontic Journal*, 39, 921-930.
- Fan, J.Y., Wang, Y.H., Chao, L.F., Jane, S.W., Hsu, L.L. (2015). Performance evaluation of nursing students following competency-based education. *Nurse Education Today*, 35, 97-103.
- Gilmour, A.S.M., Welply, A., Cowpe, J.G., Bullock, A.D., Jones, R.J. (2016). The undergraduate preparation of dentists: Confidence levels of final year dental students at the School of Dentistry in Cardiff. *British Dental Journal*, 221, 349-354.
- Honey, J., Lynch, D.C., Bruke, F.M., Gilmour, A.S. (2011). Ready for practice? A study of confidence levels of final year dental students at Cardiff University and University College Cork. *European Journal of Dental Education*, 15(2), 93-103.
- Ilgüy, D., Ilgüy, M., Fisekçioğlu, E., Ersan, N., Tanalp, J., Dölekoglu, S. (2013). Assessment of root canal treatment outcomes performed by Turkish dental students: Results after two years. *Journal of Dental Education*, 77, 502-509.
- Javed, M.Q., Khan, A.M., Bhatti, U.A. (2021). Evaluation of undergraduate dental students self-perceived confidence level regarding endodontic procedures: A questionnaire survey. *Saudi Endodontic Journal*, 11, 228-234.
- Lynch, C.D., Burke, F.M. (2006). Quality of root canal fillings performed by undergraduate dental students on single-rooted teeth. *European Journal of Dental Education*, 10, 67-72.
- Martinez, M.M. (2006). What is metacognition? *Phi Delta Kappan*, 87, 696-699.
- Murray, C.M., Chandler, N.P. (2014). Undergraduate endodontic teaching in New Zealand: Students' experience, perceptions and self-confidence levels. *Australian Endodontic Journal*, 40(3), 116-122.
- Murray, F.J., Blinkhorn, A.S., Bulman, J. (1999). An assessment of the views held by recent graduates on their undergraduate course. *European Journal of Dental Education*, 3, 3-9.
- Puryer, J., Amin, S., Turner, M. (2016). Undergraduate confidence when undertaking root canal treatment and their perception of the quality of their endodontic education. *Dentistry Journal (Basel)*, 5, 1-10.
- Rolland, S., Hobson, R., Hanwell, S. (2007). Clinical competency exercises: Some student perceptions. *European Journal of Dental Education*, 11,184-191.
- Seijo, M.O., Ferreira, E.F., Ribeiro Sobrinho, A.P., Paiva, S.M., Martins, R.C. (2013). Learning experience in endodontics: Brazilian students' perceptions. *Journal of Dental Education*, 77, 648-655.
- Skudutyte-Rysstad, R., Eriksen, H.M. (2006). Endodontic status amongst 35-year-old Oslo citizens and changes over a 30-year period. *International Endodontic Journal*, 39, 637-642.
- Tanalap, J., Guven, E., Oktay, I. (2013). Evaluation of dental students' perception and self-confidence levels regarding endodontic treatment. *European Journal of Dentistry*, 7(2), 218-224.
- Vukadinov, T., Blažić, L., Kantardžić, I., Lainović, T. (2014). Technical quality of root fillings performed by undergraduate students: A radiographic study. *Scientific World Journal*, 1-6.
- Youngson, C.C., Molyneux, L.E., Fox, K., Boyle, E.L., Preston, A.J. (2007). Undergraduate requirements in restorative dentistry in the UK and Ireland. *British Dental Journal*, 203 (Suppl. 5), 9-14.

# Perceived knowledge and perceptions toward biostatistics among dental and medical undergraduate students in International Islamic University Malaysia

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## Abstract

Research into dental and medical student on biostatistics may inform the educational policy changes. Therefore, it was vital to assess the level of knowledge and perception about biostatistics among dental and medical undergraduate students in order to determine their proficiency in this subject. A cross-sectional study was undertaken among dental and medical undergraduate students in International Islamic University Malaysia, Kuantan. The assessment of perceived and perception toward biostatistics was based on a 5-points Likert scale including 50 questions distributed into five domains to assess the knowledge, course value, difficulty, behavioural and expectations. A total of 158 out of 190 students responded to the questionnaire yielding a response rate of 83.2%. It was observed that more than 70% of students acknowledged that knowledge gained from biostatistics courses is useful to their future career, and almost 80% realized the relevance of biostatistics to real health issues. This study concludes that undergraduate dental students have almost similar and moderate level of knowledge in biostatistics as compared to the medical students. However, it is important to have additional practice and training through workshop to improve their level of comprehension in biostatistics.

**Keywords:** *biostatistics, dentistry, knowledge, medicine, perception*

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## Introduction

Biostatistics was often regarded as a field where it was limited to those who had a mathematical background just because the term 'statistics' was associated with mathematics. Only those who were related to the field of statistics and a few of the general population were aware of the important part of biostatistics in dental research and evidence-based practice in

dentistry (Sujatha *et al.*, 2018). In the context of health care delivery, nowadays, many clinicians and academicians believe that by reviewing articles related to one's field, it might have an impact on patient care and thus, improving the education in dental and medical research. Having said that, most of the articles to be reviewed were often accompanied by statistics. Hence, it was vital for all dental and medical undergraduate students to acquire the knowledge of

biostatistics. Moreover, the acknowledgement of evidence-based practice (EBP) in clinical studies and practice also require a thorough understanding of biostatistics knowledge among early researchers in medical or dental studies (Penmetsa *et al.*, 2017).

Pimenta *et al.* (2015) states that in order to improve statistical skills and knowledge among dental students and practitioners, one should have a positive perception toward biostatistics. Dental students and medical students were very well motivated about the study of their courses but in minor branches such as biostatistics, it was often being disregarded and was insinuated as something of lesser importance (Penmetsa *et al.*, 2017). Consequently, this kind of perception towards biostatistics often leads to cutbacks of permanency in the biostatistics knowledge. Besides that, the assessment and comprehension of biostatistics perception such as general perception towards biostatistics subject, training and research among dental students and clinicians may be helpful in improving statistical skills.

A recent study in India, reported that although biostatistics was a difficult subject when placed alongside dentistry, the majority agreed that acquiring knowledge about the subject would be beneficial for their career (Batra *et al.*, 2014). Studies on postgraduate dental students showed that they had good ability to write on the statistical section in their scientific writing (Kumar *et al.*, 2014). Despite a clear acceptance of the importance of biostatistics, a study was shown that some medical professionals had a substandard knowledge of it (West & Ficalora, 2007). Statistical knowledge, when it was taught effectively, can lead to a positive attitude of students and dental professionals towards the subject. As a result, effective interpretation of scientific data could be achieved with their own capability.

Hence, the main rationale of this study was to assess the level of knowledge and perception about biostatistics among dental and medical undergraduate students in

order to determine their proficiency in this subject. Evidently, in the light of these findings, we believe that it could provide the means and ways to improve the teaching methods of biostatistics. Moreover, it could enhance the awareness on the importance of biostatistics in improving one's analytical thinking ability, understanding and interpreting statistical results in scientific studies.

## Materials and Methods

A cross-sectional study was carried out among year 4 and year 5 undergraduate dental students and year 4 undergraduate medical students in IIUM Kuantan Campus between March 2020 to March 2021. The study was approved by the IIUM Research Ethics Committee (IREC 2020-040). The sample size was calculated using G\*Power software (Ahmad *et al.*, 2018). The calculated sample size based on Mann-Whitney Test with power = 0.80, Alpha= 0.05 and effect size = 0.5 which lead to the minimum sample size required per group is 67. The minimum sample size required for this study is 134, however, the current study was carried out among 158 participants. The sample was selected based on the inclusion criteria which were year 4 undergraduate medical students, year 4 and year 5 undergraduate dental students and exclusion criteria for those who did not give consent for the study.

## Pilot study

A pilot study was conducted among 34 undergraduate Year 2 and Year 3 medical students to check the feasibility of the questionnaire and to test the process of distribution of questionnaire as they already undergo the biostatistics lecture during year 1 of their study. Self-administered questionnaires were established by adapting questions from an existing survey (Daher & Amin, 2010). The questionnaire was given to the students via Google Form platform. The reliability of the questionnaire was then examined using Cronbach's alpha and the result was shown as in Table 1.

**Table 1.** Result of questionnaire reliability test

Domain	Number of Item	Cronbach's $\alpha$
Knowledge	14	0.898
Domain Course Value (A)	9	0.858
Domain Difficulties (B)	11	0.694
Domain Behavior (C)	5	0.927
Domain Expectation (D)	11	0.817

### Study design and questionnaire

A set of self-administered questionnaires containing consent form, questions regarding demographic details and self-assessment instrument were used for the study. The demographic details were name, age, gender, course, year and possession of personal computer, SPSS software as well as G\*Power software. The perceived knowledge and perception towards Biostatistics were assessed by using a self-assessment questionnaire. The responses were graded from 5-points Likert scale. The resulting questionnaire had 50 items. The 50 questions which assessed perceived knowledge (very low =1, low = 2, moderate = 3 high = 4 and very high = 5) and perception (strongly disagree = 1, disagree = 2, neutral = 3 agree = 4 and strongly agree = 5) towards the course fell into 5 domains, namely knowledge, course value (A), difficulties (B), behavior (C) and expectation (D).

The knowledge domain was about student's current perceived knowledge regarding the course, especially on the application of biostatistics in research studies. The course value domain was about perceptions of the usefulness, relevance and worth of the subject in professional life. The difficulties domain was about the difficulties faced by the students and factors that may influence interest in the subject. The behaviour domain was about how students perceived lecturer behaviour towards them. Lastly, the expectation domain was about the possible actions that may influence the outcome of the course study. For the result, presentation and interpretation, the Likert scale for perceived knowledge was combined into very low-low, moderate, high-very high and

for perception, strongly disagree-disagree, neutral and agree-strongly agree.

### Statistical Analysis

Data was analysed using IBM SPSS version 25. Categorical variables were described by frequencies and percentage. Mann Whitney U test was used to compare perceived knowledge and perception between dental and medical students. The significance level was set at 0.05. In order to classify the scores as positive or negative perception, for example the calculation for the domain C where there are five variables, the maximum score expected will be 25 ( $5 \times 5$ ) and the cut-off will be 17.5 ( $5 \times 5 \times 0.7$ ). Any score above 17.5 was considered an indicator of positive perception.

### Results

Overall, the questionnaire was a satisfactory level of consistency, reflected by the given reliability coefficient. Items of the (B) behavior domain showed the highest consistency, while the difficulties domain showed the lowest value as shown in Table 1. The characteristics of the study sample were shown in Table 2. A total of 158 out of 190 students responded to the questionnaire yielding a response rate of 83.2%. There were 57% dental students and 43% medical students participating in this study which consists of 24.7% males and 75.3% females. Almost all the students (98.1%) had a personal computer, but only 66.5% had SPSS computer software. The possession of G\*Power software or other software for sample size calculation was reported to be only 12%. Other than that, 22.5% of the students know and 77.5% do not know about biostatistics prior to entering dental and medical programs in

IIUM. Among them, 41.1% were able to define biostatistics and 79.7% of the students knew the usage of biostatistics in their field. Furthermore, almost more than

70% of them did consult with their biostatistician and perceived their current level of knowledge in biostatistics was moderate.

**Table 2.** Characteristics of study sample

	Dental n (%)	Medical n (%)	Total n (%)
Gender			
Male	25(27.8)	14(20.6)	39 (24.7)
Female	65(72.2)	54(79.4)	119 (75.3)
Course of study	90(57)	68(43)	158(100)
Has personal computer			
Yes	88(97.8)	67(98.5)	155(98.1)
No	2(2.2)	1(1.5)	3(1.9)
Has SPSS software			
Yes	84(93.3)	21(30.9)	105(66.5)
No	6(6.7)	47(69.1)	53(33.5)
Has G*Power Software			
Yes	11(12.2)	8(11.8)	139(88)
No	79(87.8)	60(88.2)	19(12)
Do you know about Biostatistics subject prior to entering dental/medical school?			
Yes	21(23.3)	14(20.6)	35(22.2)
Maybe	8(8.9)	10(14.7)	18(11.4)
No	61(67.8)	44(64.7)	105(66.5)
Do you able to define Biostatistics?			
Yes	33(36.7)	32(47.1)	65(41.1)
Maybe	48(53.3)	32(47.1)	80(50.6)
No	9(10)	4(5.9)	13(18.2)
Do you know the usage of Biostatistics?			
Yes	66(73.3)	60(88.2)	126(79.7)
Maybe	23(25.6)	7(10.3)	30(19)
No	1(1.1)	1(1.5)	2(1.3)
Perceived current level of knowledge of Biostatistics			
Very low-Low	24(26.7%)	9(13.2)	33(20.9)
Moderate	62(68.9%)	52(76.5)	114(72.2)
Very high-High	4(4.4%)	7(10.3)	11(7)
Did you ever consult your biostatistician?			
Yes	35(38.9)	8(11.8)	43(27.2)
No	55(61.1)	60(88.2)	115(72.8)

Responses to each survey question were presented in Table 3 until Table 7. Firstly, looking at the responses regarding their perceived knowledge on biostatistics, the response can be divided into lowest response, very low-low, moderate and high-very high response. It was observed that both the dental and medical students' perceived knowledge on probability and non-probability sampling were more than 60%. However, there was a difference in term of usage of both sampling technique as the medical students perceived more than 60% compared to dental students. The usage of statistical analysis such as One-way ANOVA, Mann Whitney U test and Kruskal Wallis test presented that the dental students' perceived knowledge were less than 60% compared to medical students which were more than 60%.

Regarding the course value domain, highest response had been observed which 84.4% of students from dentistry realized the relevance of the subject to the real health issues at the end of module, 81.1% thought that the sequencing of the topic was logical and 77.8% agreed that the gained knowledge and experience were useful to their career. However, only 38.9% agreed that their skills improved in solving problems, 51.1% felt that they were confident to do basic statistical and epidemiological analysis and 50.0% felt they gained skill in designing research. On the other hand, 85.3% of medical students realized the relevance of biostatistics to the real health issues and 82.4% medical students gained skill to read scientific papers. Plus, about 79.4% of the medical students understood the main concepts of biostatistics yet only 63.2% were confident to do basic statistical analysis. About 64.7% agreed that the course focused on the concept instead of calculation and 64.7% found their skill improved in problem solving.

For the difficulties domain, most of the dental and medical students admitted liking clinical studies more than biostatistics (74.4%-77.9%) and had a lack of practicing exercise for biostatistics topics (69.1%-73.3%). They also agreed that biostatistics

subjects need creative thinking (66.7%-69.1%) and must deal with numbers (57.4%-61.1%). Furthermore, most of them "strongly disagree" to "disagree" on not seeing the relation between statistics and dentistry or medicine (64.4%-72.1%) and lectures were not interesting at this level (55.6%-63.2%). However, only 35.6% of dental students and 42.6% of medical students simply were not interested in the subject. Other than that, in relation to behavioural domain as shown in the Table 6, most of the dental and medical students "strongly agree" to "agree" on lecturer were facilitator of instruction who guided the students (91.2%-93.3%) and sources of knowledge (92.6%-93.3%). Most of them also agreed that they work, and effort were acknowledged (86.7%-91.2%) and being treated with respect during of the time they were taking the biostatistics course (92.6%-95.6%), and they also believe that the responsibility of the student to initiate debate or questions during lectures (73.3%-77.9%).

Last but not least for expectation domain, most of the dental and medical students believe that they were in need of more practical and workshop for planning and data collection for the courses (76.5%-82.2%), to be provided specific textbook for biostatistics (60%-66.2%), carried out short exam quiz before the progress test (66.2%-67.8%) and lectures should be followed by smaller group session (60%-70.6%). They also agreed to emphasise on using biostatistics in their respected courses (63.3%-67.6%) by giving more time for the whole course (54.4%-57.8%) and agreed for attendance to be strictly taken during the computer lab sessions (63.3%-67.6%). Nevertheless, only 46.7-47.1% of the dental and medical students agreed to make the module pure for biostatistics so that the attention will not be withdrawn to other subjects and 42.6%-58.9% agreed to introduce this course as earlier in year two of their studies. Overall, it is observable from Table 8 that most of the dental and medical students were reflecting positive perceptions in course value, behavioural and expectation.

**Table 3.** Percentage of dental and medical students' response to questions on perceived biostatistics knowledge

Questions Domain: Knowledge	Very Low- Low	DENTAL Moderate	High-Very High	Very Low- Low	MEDICAL Moderate	High-Very High	<i>p</i> value
Knowledge on probability sampling method	19 (21.1%)	61 (67.8%)	10 (11.1%)	5 (7.4%)	43 (63.2%)	20 (29.4%)	0.001*
Usage of probability sampling method	29 (33.0%)	51 (58.0%)	8 (9.1%)	8 (11.8%)	43 (63.2%)	17 (25.0%)	0.000*
Knowledge on non-probability sampling method	25 (28.1%)	54 (60.7%)	10 (11.2%)	6 (8.8%)	45 (66.2%)	17 (25.0%)	0.001*
Usage of non-probability sampling method	32 (36.0%)	50 (56.2%)	7 (7.9%)	6 (13.2%)	46 (67.6%)	16 (19.1%)	0.001*
Knowledge on parametric test	17 (18.9%)	54 (60.0%)	19 (21.1%)	6 (8.8%)	46 (67.6%)	16 (23.5%)	0.214
Usage of one Sample t-test	17 (18.9%)	52 (57.8%)	21 (23.3%)	6 (8.8%)	43 (63.2%)	19 (27.9%)	0.159
Usage of independent t-test	21 (23.3%)	48 (53.3%)	21 (23.3%)	8 (11.8%)	39 (57.4%)	21 (30.9%)	0.080
Usage of paired t-test	23 (25.6%)	48 (53.3%)	19 (21.1%)	10 (14.7%)	38 (55.9%)	20 (29.4%)	0.079
Usage of Analysis of Variance (ANOVA)	32 (35.6%)	46 (51.1%)	12 (13.3%)	9 (13.2%)	41 (60.3%)	18 (26.5%)	0.001*
Knowledge on non-parametric test	28 (31.1%)	52 (57.8%)	10 (11.1%)	14 (20.6%)	45 (66.2%)	9 (13.2%)	0.179
Usage of one sample Wilcoxon test	35 (38.9%)	45 (50.0%)	10 (11.1%)	17 (25.0%)	42 (61.8%)	9 (13.2%)	0.100
Usage of Mann Whitney test	40 (44.4%)	43 (47.8%)	7 (7.8%)	13 (19.1%)	43 (63.2%)	12 (17.6%)	0.001*
Usage of Wilcoxon signed rank test	42 (46.7%)	40 (44.4%)	8 (8.9%)	22 (32.4%)	37 (54.4%)	9 (13.2%)	0.068
Usage of Kruskal Wallis test	41 (45.6%)	40 (44.4%)	9 (10.0%)	16 (23.5%)	41 (60.3%)	11 (16.2%)	0.006*

\*Significant at p value less than < 0.05



**Table 4.** Frequency and percentage of dental and medical students' response to questions regarding biostatistics course value

Questions Domain A: Course Value	DENTAL			MEDICAL			p value
	Strongly Disagree-Disagree	Neutral	Agree-Strongly Agree	Strongly Disagree-Disagree	Neutral	Agree-Strongly Agree	
The course focuses on the concept of interpretation more than calculations.	0 (0.0%)	36 (40.0%)	54 (60.0%)	3 (4.4%)	21 (30.9%)	44 (64.7%)	0.708
I realized the relevance of Biostatistics to the real health issues.	1 (1.1%)	13 (14.4%)	76 (84.4%)	1 (1.5%)	9 (13.2%)	58 (85.3%)	0.892
Sequencing of topics was logical.	0 (0.0%)	17 (18.9%)	73 (81.1%)	2 (2.9%)	18 (26.5%)	48 (70.6%)	0.105
The gained knowledge and experience are useful to my career as a doctor.	0 (0.0%)	20 (22.2%)	70 (77.8%)	2 (2.9%)	13 (19.1%)	53 (77.9%)	0.942
I understood the main concepts of Biostatistics.	3 (3.3%)	34 (37.8%)	53 (58.9%)	2 (2.9%)	12 (17.6%)	54 (79.4%)	0.008*
I gained skills to read scientific papers.	7 (7.8%)	23 (25.6%)	60 (66.7%)	1 (1.5%)	11 (16.2%)	56 (82.4%)	0.021*
My skills improved in solving problems.	6 (6.7%)	49 (54.4%)	36 (38.9%)	3 (4.4%)	21 (30.9%)	44 (64.7%)	0.002*
I gained skills to design research.	4 (4.4%)	41 (45.6%)	45 (50.0%)	3 (4.4%)	17 (25.0%)	48 (70.6%)	0.014*
I gained confidence in my ability to do basic statistical analysis.	7 (7.8%)	37 (41.1%)	46 (51.1%)	3 (4.4%)	22 (32.4%)	43 (63.2%)	0.116

\*Significant at p value less than < 0.05

**Table 5.** Frequency and percentage of dental and medical students' response on difficulties of biostatistics

Questions Domain B: Difficulties	DENTAL				MEDICAL		p value
	Strongly Disagree-Disagree	Neutral	Agree-Strongly Agree	Strongly Disagree-Disagree	Neutral	Agree-Strongly Agree	
Lack of practicing exercise for these topics.	7 (7.8%)	17 (18.9%)	66 (73.3%)	6 (8.8%)	15 (22.1%)	47 (69.1%)	0.571
Too many lectures for one day.	33 (36.7%)	45 (50.0%)	12 (13.3%)	23 (33.8%)	33 (48.5%)	12 (17.6%)	0.540
Subjects need creative thinking.	6 (6.7%)	24 (26.7%)	60 (66.7%)	4 (5.9%)	17 (25.0%)	47 (69.1%)	0.738
Lectures are difficult to understand.	23 (25.6%)	36 (40.0%)	31 (34.4%)	28 (41.2%)	32 (47.1%)	8 (11.8%)	0.002*
I like clinical studies more than biostatistics.	4 (4.4%)	19 (21.1%)	67 (74.4%)	6 (8.8%)	9 (13.2%)	53 (77.9%)	0.749
Lectures are lengthy.	25 (27.8%)	47 (52.2%)	18 (20.0%)	24 (35.3%)	37 (54.4%)	7 (10.3%)	0.121
There are no specific references.	18 (20.0%)	42 (46.7%)	30 (33.3%)	28 (41.2%)	22 (32.4%)	18 (26.5%)	0.025*
I must deal with numbers.	7 (7.8%)	28 (31.1%)	55 (61.1%)	9 (13.2%)	20 (29.4%)	39 (57.4%)	0.491
I am simply not interested in this subject.	21 (23.3%)	37 (41.1%)	32 (35.6%)	14 (20.6%)	25 (36.8%)	29 (42.6%)	0.407
I cannot see the relation between statistics and dentistry/medicine at this level.	58 (64.4%)	23 (25.6%)	9 (10.0%)	49 (72.1%)	12 (17.6%)	7 (10.3%)	0.378
Lectures are not interesting.	50 (55.6%)	33 (36.7%)	7 (7.8%)	43 (63.2%)	18 (26.5%)	7 (10.3%)	0.463

\*Significant at p value less than < 0.05

**Table 6.** Frequency and percentage of dental and medical students' response on their behaviour towards biostatistics

Questions Domain C: Behavioural	Strongly Disagree-Disagree	DENTAL			MEDICAL		<i>p</i> value
		Neutral	Agree-Strongly Agree	Strongly Disagree-Disagree	Neutral	Agree-Strongly Agree	
Lecturer is the facilitator of instruction & guiding students.	0 (0.0%)	6 (6.7%)	84 (93.3%)	2 (2.9%)	4 (5.9%)	62 (91.2%)	0.582
Lecturer is the source of knowledge.	0 (0.0%)	6 (6.7%)	84 (93.3%)	2 (2.9%)	3 (4.4%)	63 (92.6%)	0.830
I am treated with respect.	0 (0.0%)	4 (4.4%)	86 (95.6%)	2 (2.9%)	3 (4.4%)	63 (92.6%)	0.416
My work and efforts are acknowledged.	0 (0.0%)	12 (3.3%)	78 (86.7%)	1 (1.5%)	5 (7.4%)	62 (91.2%)	0.400
It is the responsibility of the students to initiate debate/question during lectures.	2 (2.2%)	22(24.4%)	66 (73.3%)	2 (2.9%)	13(19.1%)	53 (77.9%)	0.536

**Table 7.** Frequency and percentage of dental and medical students' expectations regarding biostatistics

Questions Domain D: Expectations	DENTAL				MEDICAL		p value
	Strongly Disagree-Disagree	Neutral	Agree-Strongly Agree	Strongly Disagree-Disagree	Neutral	Agree- Strongly Agree	
Need more practical, workshop for planning and data collection to have real experience in dealing with data.	0 (0.0%)	16 (17.8%)	74 (82.2%)	2 (2.9%)	14 (20.6%)	52 (76.5%)	0.333
Provide specific textbooks for biostatistics.	2 (2.2%)	34 (37.8%)	54 (60.0%)	5 (7.4%)	18 (26.5%)	45 (66.2%)	0.613
Carry out shorts exam (quiz) before the progress test to evaluate the understanding of the student.	5 (5.6%)	24 (26.7%)	61 (67.8%)	5 (7.4%)	18 (26.5%)	45 (66.2%)	0.785
The lecture should be followed by smaller grouping session.	4 (4.4%)	32 (35.6%)	54 (60.0%)	3 (4.4%)	17 (25.0%)	48 (70.6%)	0.194
Give more time for the whole course.	7 (7.8%)	31 (34.4%)	52 (57.8%)	9 (13.2%)	22 (32.4%)	37 (54.4%)	0.511
Emphasize on using biostatistics in your courses.	5 (5.6%)	28 (31.1%)	57 (63.3%)	4 (5.9%)	18 (26.5%)	46 (67.6%)	0.611
Attendance to be strictly taken during the computer lab session.	5 (5.6%)	27 (30.0%)	58 (64.4%)	4 (5.9%)	22 (32.4%)	42 (61.8%)	0.737
Make the module pure for biostatistics, so the attention will not be withdrawn to other subjects.	11 (12.2%)	37 (41.1%)	42 (46.7%)	13 (19.1%)	23 (33.8%)	42 (47.1%)	0.696
Introduce this course earlier in year two.	15 (16.7%)	22(24.4%)	53 (58.9%)	5 (7.4%)	34(50.0%)	29 (42.6%)	0.248
I must study at home before class meetings.	4 (4.4%)	31 (34.4%)	55 (61.1%)	4 (5.9%)	20 (29.4%)	44 (64.7%)	0.716
Disconnect the internet during the lab session to avoid distraction.	29 (32.2%)	32 (35.6%)	29 (32.2%)	24 (35.3%)	28 (41.2%)	16 (23.5%)	0.362

**Table 8.** Frequency distribution of positive perception

	Positive perception	
	No	Yes
<b>A: Course Value</b>		
Dentistry	23(25.36)	67(74.4)
Medical	14(20.6)	54(79.4)
<b>B: Difficulties</b>		
Dentistry	71(78.9)	19(21.1)
Medical	54(79.4)	14(20.6)
<b>C: Behavioral</b>		
Dentistry	6(6.7)	84(93.3)
Medical	4(5.9)	64(94.1)
<b>D: Expectation</b>		
Dentistry	35(38.9)	55(61.1)
Medical	30(44.1)	38(55.9)

## Discussion

The significance of biostatistics was recognized completely in different dental and medical schools in both developed and developing countries (Chaoubah, 2021; Bourzgui *et al.*, 2019; Sami, 2010). Nevertheless, there are a variety of existence biostatistics in dental and medical from school to school with respect to the distributed time, scope and topic covered. In this study, the level of perceived knowledge and perception of dental and medical students regarding biostatistics was assessed and compared among the dental and medical undergraduate students. In the present study, a significant difference was seen among dental and medical students for the level of perceived knowledge in biostatistics. It was observed that medical students had slightly better perceived knowledge about biostatistics than the dental students. In this study, there was also a significant difference among IIUM dental and medical undergraduate students for the level of perception in the course value domain. Majority of the medical students showed positive perception regarding course value compared to dental students in understanding the main concepts of the course, reading scientific papers, designing research and improved skill in solving problems. This result was also in agreement with a study done by Daher & Amin (2010)

dental students in the knowledge of probability, non-probability sampling method and usage of probability sampling, non-probability sampling, ANOVA, Mann Whitney U test and Kruskal Wallis test. However, there were no significant differences observed for the others' perceived knowledge and usage on statistical analysis. As an insight, the medical students were exposed to the biostatistics course during year 1 block four of their study where for the whole 4 weeks, they focused only on biostatistics which include both theory and practical. In contrast, the dental students were exposed to a biostatistics course for the whole year 4. However, there was no designated week where they would be focusing on biostatistics only. The study also in line with previous research that medical students had perceived better biostatistics knowledge (Ercan *et al.*, 2008).

and Abou Dargham *et al.* (2021) where more than half of undergraduate medical students showed they understood the main concept of the courses. However, the skill to design research, read scientific papers and solve the problem for the medical students were consistent with our current study for the dental students (Daher & Amin, 2010; Abou Dargham *et al.* 2021). Nevertheless, more than half of the dental (51.1%) and medical (63.2%) students gained confidence in their ability to do basic statistical analysis

compared to other studies by Daher & Amin (2010) and Abou Dargham *et al.* (2021) which are less than 40%.

Other than that, there was a significant difference among dental and medical students for difficulties in understanding the lectures where 34.4% of the dental students agreed that lectures were difficult to understand. In contrast, only 11.8% of medical students agreed that the lectures were difficult to understand. This was in line with the other study where 61.6% of the medical students stated it were difficult to understand the lectures (Daher & Amin, 2010). From the current findings, students found there were no specific references may be due to lack of resources that were suggested by the lecturers for the students to refer to. Thus, this had caused the students to rely solely on what the lecturer provided. It was also reported by the other studies that more than 50% of the students agreed that no specific references were provided (Daher & Amin, 2010; Abou Dargham *et al.*, 2021).

Moreover, there was no significant difference observed between dental and medical students in behaviour and expectation domain. As both dental and medical students showed positive perception as the lecturer was the facilitator and source of knowledge for them. They also agreed that their work and effort are acknowledged and treated with respect during the courses. This study was also coherent with the other studies (Daher & Amin, 2010; Abou Dargham *et al.*, 2021). Furthermore, for the expectation domain most of the dental and medical students need more practical classes in dealing with the data, the need to provide specific textbooks and carry out short quizzes while the lecturer should follow up by creating small grouping sessions and giving more time for the whole courses. The finding of this study was also in line with other studies by Shetty *et al.* (2015), Chima *et al.* (2015) and Hood & Neumann (2013).

### Limitation

There were several limitations of this study. Firstly, although there were slight

differences in the level of perceived knowledge between IIUM undergraduate dental and medical students, there was no relation to the students' academic performances. This may have a possible effect on the reported perception. Second, there were no open comments given. This feature of open comments may allow improvements to be done on our ends by looking from the students' perspectives thus, improving the exposure of biostatistics to the students.

### Conclusion

In a nutshell, this study concludes that undergraduate dental students have almost similar and moderate level of knowledge in biostatistics as compared to the medical students. However, it is important to have additional practice and training through workshop to improve their level of comprehension in biostatistics.

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### Conflict of interest

There is no conflict of interest.

### References

- Abou Dargham, N., Sultan, Y., Mourad, O., Baidoun, M., Aboul Hosn, O., El Naga, A.A., Bahmad, H.F., Azakir, B. (2021). Perception of biostatistics by Lebanese medical students: a cross-sectional study. *Alexandria Journal of Medicine*, 57(1), 103-109.
- Ahmad, W.M.A.W., Ibrahim, M.S.M., Adam, H., Khamis, M.F. (2018). *Sample size calculations made easy using G\*Power*. Penerbit USM, Universiti Sains Malaysia. ISBN 978-967-461-255-9.
- Batra, M., Gupta, M., Dany, S.S., Rajput, P. (2014). Perception of dental professionals towards biostatistics. *International Scholarly Research Notices*. Hindawi Publishing Corporation.

- Bourzgui, F., Abidine, Z., Diouny, S., Serhier, Z., Bennani, O.M. (2019). Assessment of knowledge, perception regarding biostatistics and interpretation of research among Moroccan Dental professionals. *International Journal of Dentistry Research*, 4(2), 49-54.
- Chaoubah, A. (2021). The important role played by Biostatistics in Health professionals' training. *Revista Brasileira de Oftalmologia*, 80(2), 89-90.
- Chima, S.C., Nkwanyana, N.M., Esterhuizen, T.M. (2015). Impact of a short biostatistics course on knowledge and performance of postgraduate scholars: Implications for training of African doctors and biomedical researchers. *Nigerian Journal of Clinical Practice*, 18, 62-70.
- Daher, A.M., Amin, F. (2010). Assessing the perceptions of a biostatistics and epidemiology module: Views of Year 2 medical students from a Malaysian university. A cross-sectional survey. *BMC Medical Education*, 10(34).
- Ercan, I., Ozkaya, G., Ocakoglu, G., Yazici, B., Sezer, A., Ediz, B., et al. (2008). determining biostatistics knowledge of students and physicians in Medical School. Faculty of Medicine, Uludag University Anadolu University, Turkey. Available from: [https://www.researchgate.net/publication/228500164\\_Determining\\_Biostatistics\\_Knowledge\\_of\\_Students\\_and\\_Physicians\\_in\\_Medical\\_School](https://www.researchgate.net/publication/228500164_Determining_Biostatistics_Knowledge_of_Students_and_Physicians_in_Medical_School).
- Hood, M., Neumann, D.L. (2013). Evaluation of a workshop to reduce negative perceptions of statistics in undergraduate psychology students. *Psychology Learning and Teaching*, 12, 115-125.
- Kumar, L., Shahnawaz, K., Choudhary, S.K., Sarker, G., Barman, S.K., Singh, J.B. (2014). Attitudes toward biostatistics among postgraduate medical students in Kishanganj, Bihar. *Journal of Evolution of Medical and Dental Sciences*, 3(3), 758-761.
- Li, C., Wang, L., Zhang, Y., Li, C., Xu, Y., Shang, L., Xia, J. (2018). Assessment of a block curriculum design on medical postgraduates' perception towards biostatistics: a cohort study. *BMC Medical Education*, 18(1).
- Penmetsa, G.S., Dubba, K., Mohammad, Z. (2017). Knowledge, attitude and perception regarding biostatistics among postgraduate students in dental institutions of Andhra Pradesh. *Journal of Indian Association of Public Health Dentistry*, 15, 68-72.
- Pimenta, R., Faria, B.M., Pereira, I., Vieira, M. (2010). Comparison of attitudes towards statistics in graduate and undergraduate health sciences' students. *Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8)*, International Association of Statistical Education (IASE).
- Sami, W. (2010). Biostatistics education for undergraduate medical students. *Biomedica*, 26, 80-85.
- Shetty, A.C., Al-Rasheed, N.M., Albwardi, S.A. (2015). Dental professionals' attitude towards biostatistics. *Journal of Dentistry and Oral Hygiene*, 7(7), 113-118.
- Sujatha, B.K., Reddy, M.N.T., Vijayan, S. (2018). Assessment of knowledge, attitude, and perception about biostatistics among faculty and postgraduate students in a dental institution, Bengaluru City. *Journal of Dental Research and Review*, 5(54).
- West, C.P., Ficalora, R.D. (2007). clinicians attitudes towards biostatistics. *Mayo Foundation for Medical Education and Research*, 82(8), 939-943.



# The effect of implantoplasty on dental implant fracture resistance: a systematic review

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## Abstract

An increase in dental implant placements in recent years has seen a growth in the reported cases of post-operative complications such as peri-implantitis. One of the available treatment modalities to overcome such complications is implantoplasty. Although this procedure is not new, the long-term effect of implantoplasty has not been addressed extensively. The aim of this systematic review was to investigate the change in fracture resistance of dental implants after implantoplasty. Three electronic databases and reference lists of included studies were searched to assess the potential effect of implantoplasty on implant fracture resistance. Titles and abstracts were screened by two reviewers in parallel. The extracted information regarding implant fracture resistance was reported based on the guidelines set by the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement. A total of 56 studies were identified, of which, nine studies were included. Narrow platform implants (<3.75 mm) were more susceptible to fracture following implantoplasty compared to wider platforms (≥5 mm). Implants with internal hexagon connection may have a higher risk of fracture after implantoplasty compared to other connection designs such as external hexagon and conical connections. Other potential factors which may affect implant fracture resistance after implantoplasty include crown to implant ratio, implant material, and the amount of peri-implant bone loss. Within the limitation of in vitro studies, there is no clear evidence to demonstrate the effect of implantoplasty on implant fracture resistance. Methodological differences between the available studies did not allow for clear comparison between them. Furthermore, the limited amount of clinical reports of this resective procedure, in combination with patient and operator variability, affect the clinical assessment of this treatment modality.

**Keywords:** dental implant, implantoplasty, peri-implantitis, systematic review

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## Introduction

Dental implants have shown to provide good functional and aesthetic outcomes for prosthetic rehabilitation of partially or fully

edentulous patients (Berglundh *et al.*, 2002). However, they are susceptible to plaque accumulation due to its non-shedding nature, which can lead to peri-implant inflammation such as peri-implant mucositis

and peri-implantitis. A systematic review of the European and American population in 2015 found that the weighted mean prevalence of peri-implant mucositis and peri-implantitis were 43% and 22% respectively (Derks & Tomasi, 2015).

Peri-implantitis can have devastating outcomes for patients as the supporting bone around the implant is affected. Various systematic reviews revealed that it was impossible to decontaminate implant surface completely through mechanical or chemical methods alone, while a combination of these methods yielded a better outcome (Louropoulou *et al.*, 2014; Stavropoulos *et al.*, 2019). These reviews also suggested that roughened implant surfaces initially introduced to increase the rate of osseointegration, have a higher tendency to accumulate and retain plaque which may negatively impact the management of peri-implant infection.

A multitude of non-surgical and surgical treatment protocols have been suggested to treat peri-implantitis around osseointegrated dental implants. A Cochrane review including nine randomized controlled trials showed insufficient evidence to support or refute the effectiveness of any specific treatment protocol for peri-implantitis (Esposito *et al.*, 2012). There was also no consensus on surface decontamination methods for dental implants to obtain a predictable long-term result (Heitz-Mayfield & Mombelli, 2014).

Surface decontamination is important to decrease the bacterial load around the dental implant and achieve a biocompatible surface for direct apposition of alveolar bone. Non-surgical debridement with or without antimicrobials has been shown to have limited efficacy when it is employed for peri-implantitis due to insufficient decontamination of the implant surface (Figuro *et al.*, 2014). In this context, various methods to decontaminate the implant surface have been introduced such as mechanical, chemical debridement and laser therapy. Non-surgical debridement has been suggested as the pre-treatment phase of peri-implantitis management while surgical

access should be considered when peri-implantitis persists (Heitz-Mayfield & Mombelli, 2014). Surgical therapy can be carried out through either a regenerative or resective approach depending on the defect morphology and the objective of the surgical intervention.

Implantoplasty is used as an adjunct to resective procedures to smoothen and remove contaminated implant surface in order to reduce or eliminate bacterial colonization on the implant surface (Stavropoulos *et al.*, 2019). This procedure aims to achieve a relatively smooth implant surface and reduce the screw shape topography of the implant to facilitate ongoing implant maintenance. This has been successfully implemented by numerous clinicians and researchers to manage peri-implantitis with good clinical and radiographic outcomes in areas with limited potential for bone regeneration due to the anatomy of the defect (Matarasso *et al.*, 2014; Monje *et al.*, 2021; Schwarz *et al.*, 2013). Instrumentation of the implant surface will inevitably result in a narrower implant, which will likely decrease the maximum force it can withstand before fracturing. Therefore, the aim of this systematic review was to investigate the impact of implantoplasty on fracture resistance of dental implants.

## Materials and Methods

This systematic review was conducted based on the guidelines given by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher *et al.*, 2009), and Cochrane Collaboration (Higgins, 2021). This review aimed to address a focused question “Will implantoplasty on dental implants affect its fracture resistance?” using the PICO (participant/problem, intervention, comparison/control, and outcome) method (Miller & Forrest, 2001).

**P:** Dental implants  
**I:** Implantoplasty  
**C:** Pristine implants  
**O:** Fracture resistance

## Type of Studies

The following inclusion criteria were applied during literature search on studies without restriction in publication year: (a) In vitro studies; (b) reported the fracture resistance of dental implants before and after implantoplasty; (c) published in an English peer-reviewed journal; (d) available in full-text.

## Search Strategies

The following electronic databases were searched for ongoing and unpublished studies up to July 31, 2021: MEDLINE, Scopus and EMBASE (Table 1). The following search format was performed using Boolean operators: (implantoplasty OR implant surface modification) AND (fracture resistance OR fracture OR breakage). The bibliographies of all eligible articles were analysed for additional studies. Two calibrated reviewers (R.G and A.T.S) carried out the search for title, abstract, and full-text using the eligibility criteria in parallel. Opengrey.eu was used to search for grey literature. In case of uncertainty, the final decision was made by a third author (W.D). The reasons for excluding inapplicable studies were reported. The selected studies were imported into a reference managing program (EndNote 20; Clarivate Analytics, Philadelphia, PA, USA).

## Data Collection

A data extraction form was designed and carried out by two reviewers (R.G and A.T.S) with the following aspects:

1. Study details: title, authors' names, contact address, study location, language and year of publication, published or unpublished data, source of funding
2. Dental implants: brand, diameter, length, material, instrumentation sequence, abutment-implant interface, number of implants in test and control groups, type of loading
3. Outcomes: fracture resistance of implants, location of implant fracture

## Assessment of Quality and Risk of Bias

The In Vitro Critical Appraisal Tool (IV-CAT) was used to assess the risk of bias and study quality of the studies included in this review to ensure the validity of the assessment (de Vries, 2018).

## Results

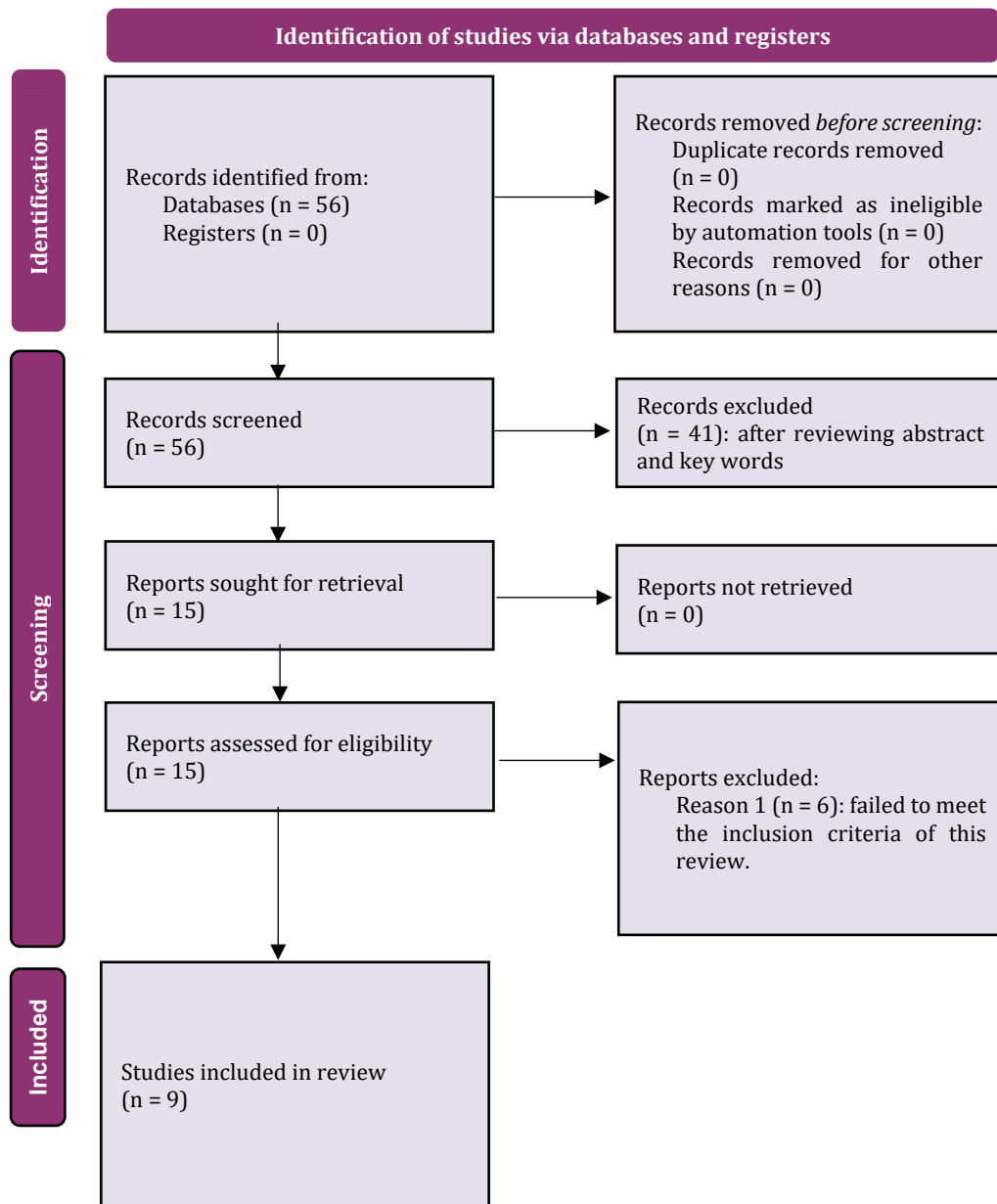
### Characteristics of the trial settings and investigators

A total of 56 studies were identified from the initial electronic literature search (Figure 1). No additional studies were found through screening of the reference lists of these studies. Out of these 56 studies, only 15 were eligible for full-text evaluation after review of the abstracts and key words.

After full-text evaluation, six studies were excluded because they failed to meet the inclusion criteria. The remaining nine studies were further analysed in depth and included in this review.

**Table 1.** Electronic search strategy employed to identify relevant studies

Databases	Keywords
<b>Published studies</b> MEDLINE(PubMed), Scopus, Embase via Ovid	<i>(implantoplasty OR implant surface modification) AND (fracture resistance OR fracture OR breakage)</i>
<b>Unpublished studies</b> MetaRegister of controlled trials OpenGrey (www.opengrey.eu) (July 28, 2021)	<i>(implantoplasty OR implant surface modification) AND (fracture resistance OR fracture OR breakage)</i>



**Figure 1.** Flowchart of study selection

### **Risk of bias in included studies**

Using the In Vitro Critical Appraisal Tool (IV-CAT), the included studies were assigned a low risk of bias and were recommended to be included in the review. All studies reported on primary in vitro research and utilised a framework for post-conduct appraisal.

### **Incomplete outcome data and selective reporting**

Eight out of the nine studies obtained and reported all of the outcome data. One study which compared the fracture resistance of narrow and wide platform implants did not carry out the fracture resistance test on the 4.7mm wide platform implants in the control group (Chan *et al.*, 2013). This was because the wide implants in the test group fractured at the abutment screw and not at the implant body.

### **Effects of interventions**

This review included nine studies with a total of 420 dental implants. The abutment connection design of these 420 dental implants consisted of 154 external connections, 230 internal connections, and 36 conical Morse taper connections. 86.7% of the total implants were bone level fixtures made of titanium while the remaining 13.3% were tissue level fixtures made of titanium and zirconia. 57.7% of the titanium implants included in this review were made of grade IV titanium while the other 42.3% were made of grade V titanium. Meta-analysis and quantitative analysis were not possible due to the limited number of included studies and heterogeneity of the extracted data.

### **Outcome**

Two studies in this review investigated the effect of abutment connection design on the fracture resistance of dental implants (Camps-Font *et al.*, 2020; Gehrke *et al.*, 2016). The 2016 study by Gehrke *et al.* found

that the conical Morse taper connection design provided the highest fracture resistance in 11mm long, 4.0mm regular diameter implants regardless of implantoplasty status. Implantoplasty in conical Morse taper connection implants reduced the fracture resistance by approximately 20% whilst external hexagon and internal hexagon implants experienced a more drastic decrease in fracture resistance after implantoplasty at approximately 37% and 40% respectively. Camps-Font *et al.* (2020) found conflicting results, whereby external hexagon connection implants had the highest fracture resistance in comparison to internal hexagon and conical Morse taper connection implants independent of implantoplasty in 3.5mm narrow platform, 10mm long implants. Regardless of the abutment connection design, there was a similar reduction of fracture resistance of approximately 29% after implantoplasty for each of the designs.

Two out of the four studies with narrow diameter implants showed a statistically significant decrease in fracture resistance following implantoplasty (Bertl *et al.*, 2020; Camps-Font *et al.*, 2020). The exceptions, (Leitao-Almeida *et al.*, 2020; Leitão-Almeida *et al.*, 2021) both included groups with the greatest amount of exposed implant threads, 7.5mm, albeit with 15mm long implants. Bertl *et al.* (2020) carried out an extensive study involving 112 dental implants of different materials, levels and diameters. The results indicated that implantoplasty reduced the fracture resistance of 3.3mm narrow platform tissue level titanium implants the most. Likewise, the other study which investigated the effects of platform diameter on fracture resistance concluded that 3.75mm diameter implants were more prone to fracture after implantoplasty compared to 4.7mm diameter implants (Chan *et al.*, 2013). An acknowledged limitation of this study was that the 4.7mm diameter implants in the control group were not tested for fracture resistance. The rationale given was that the test implants

fractured at the abutment screw, which did not influence the implant body. Out of the six studies which involved regular diameter implants, three studies (Chan *et al.*, 2013; Costa-Berenguer *et al.*, 2018; Sivoilella *et al.*, 2021) concluded that implantoplasty did not affect the fracture resistance while the other three (Bertl *et al.*, 2020; Gehrke *et al.*, 2016; Jorio *et al.*, 2021) found a significant decrease in fracture resistance after implantoplasty.

Most of the articles used tungsten carbide burs with or without additional silicone polishing burs or Arkansas stones (Bertl *et al.*, 2020; Camps-Font *et al.*, 2020; Chan *et al.*, 2013; Costa-Berenguer *et al.*, 2018; Gehrke *et al.*, 2016; Jorio *et al.*, 2021; Leitao-Almeida *et al.*, 2020; Leitão-Almeida *et al.*, 2021; Sivoilella *et al.*, 2021). Two of the included studies performed the implantoplasty with diamond burs of various grits followed by polishers (Chan *et al.*, 2013; Jorio *et al.*, 2021). Bertl *et al.* (2020) and Gehrke *et al.* (2016) were the only studies which carried out computer-controlled implantoplasty to standardise the complete removal of implant threads for all of the tested implants.

Sivoilella *et al.* (2021) investigated the difference between tungsten carbide burs with Arkansas stones and diamond sonic tips with Arkansas stone on fracture resistance. They found that the implants treated with diamond sonic tips were more conservative in terms of structure loss but did not have a significantly higher fracture resistance compared to the tungsten carbide burs group. Another study, which investigated the effect of different implantoplasty protocol on fracture resistance of implants, found that diamond burs and silicon carbide stone did not result in a statistically significant change in fracture resistance of implants (Jorio *et al.*, 2021).

The study by Leitao-Almeida *et al.* (2021) suggested that a greater degree of bone loss is associated with a decrease in fracture resistance. The implants in the test group which underwent implantoplasty did not

have a statistically significant difference in fracture resistance compared to the pristine implants in the control group.

Another study led by the same author, the year before, manipulated the crown to implant ratio by adjusting the height of the abutment (Leitao-Almeida *et al.*, 2020). It was found that implantoplasty on an implant with a crown to implant ratio of 2.5:1 led to a decrease in fracture resistance in comparison with pristine implants (Table 6). Costa Berenguer *et al.*, (2018) carried out a study on 4.1mm diameter implants with the external hexagonal connection. The results indicated that implantoplasty did not significantly affect the fracture resistance in the tested implants.

A summary of the findings is presented in Table 2.

## Discussion

Implant fracture is one of the most frustrating mechanical complications that can occur with dental implants. The effect of implantoplasty on fracture resistance of dental implants showed conflicting results which may be attributed to the different implants used in these studies. This review only included *in vitro* studies as it is impractical to perform implant fracture resistance tests on human subjects. To the author's knowledge, there are no *in vivo* studies available at present. In a clinical setting, implantoplasty is a lot more challenging for the operator due to the limited access *intra-orally* and blood affecting visibility. The results of these studies may not truly reflect on the fracture resistance of dental implants after implantoplasty in the oral cavity. More studies, designed to evaluate the short and long-term effects of implantoplasty in patients are needed.

**Table 2.** Comparison between studies

Author (year)	Brand	Number of implants	Diameter x length	Exposed length	Type of test	Abutment connection	IP protocol	Results
<b>Gehrke et al., 2016</b>	Implacil De Bortoli, São Paulo, Brazil	60	4.0mm x 11mm (60)	5mm (60)	Static (60)	External hexagon (20) Internal hexagon (20) Conical Morse taper (20)	Conical carbide cutter burs in mechanical lathe machine (model BV-20, Ferrari, South Africa)	IP reduced FR. Conical Morse taper abutment connection had the highest FR
<b>Camps-Font et al., 2020</b>	Biomimetic Ocean, Avinent Implant System, Santpedor, Spain	48	3.5mm x 10mm (48)	5mm (48)	Static (48)	External hexagon (16) Internal hexagon (16) Conical Morse taper (16)	Tungsten carbide bur, two silicon carbide (SiC) polishers	IP reduced FR in narrow implants. External hexagon connection had the highest FR
<b>Bertl et al., 2020</b>	Institut Straumann AG, Basel, Switzerland	112	3.3mm x 10mm (66) 4.1mm x 10mm (66)	3mm (112)	Dynamic, then static (112)	Internal hexagon (112)	Computer-controlled instrumentation	IP reduced FR in all implants tested, but more so in narrow titanium tissue level implants.
<b>Chan et al., 2013</b>	TRI-Vent Implants, TRI Dental Implants, Baar, Switzerland	32	3.75mm x 10mm (16) 4.7mm x 10mm (16)	5mm (32)	Static (32)	Internal hexagon (32)	30- and 15- µm diamond burs, Arkansas burs and fine silicone polishers	IP reduced FR in narrower 3.75mm platform implants.
<b>Sivolella et al., 2021</b>	Zimmer Biomet, Palm Beach Gardens, Florida, USA	18	4.0mm x 13mm (18)	6mm (18)	Static (18)	External hexagon (18)	Two tungsten carbide bur (decreasing tothing) (9) Diamond sonic tips (9)	IP did not affect FR. IP protocol did not significantly affect FR



<b>Jorio et al., 2021</b>	TRI-Vent Implants, TRI Dental Implants, Baar, Switzerland	50	4.1mm x 11mm (50)	6mm (50)	Cyclic, then static (40) Cyclic only (10)	Internal hexagon (50)	Diamond burs (106-, 40-, 4µm), Arkansas stone (10) SiC bur, Arkansas stone, silicone polishers (10)  Diamond burs (30- and 15µm), Arkansas stone and silicone polishers (10)  Control (no implantoplasty) (20)	IP and cyclic loading decreased FR. IP protocol did not affect FR
<b>Leitao-Almeida et al., 2021</b>	Ocean E.C., Avinent Implant System S.L., Santpedor, Spain	32	3.5mm x 15mm (32)	3mm (16) 7.5mm (16)	Static (32)	External hexagon (32)	Tungsten carbide bur, two SiC polishers (32)	IP did not affect FR in narrow diameter dental implants. Increase in exposed implant surfaces led to decreased FR
<b>Costa-Berenguer et al., 2018</b>	Titamax Smart Cortical, Neodent, Curitiba, Brazil	20	4.1mm x 13mm (20)	6mm (20)	Static (20)	External hexagon (20)	Tungsten carbide bur, two SiC polishers (20)	IP did not affect FR in standard diameter dental implants
<b>Leitao-Almeida et al., 2020</b>	Ocean E.C., Avinent Implant System S.L., Santpedor, Spain	48	3.5mm x 15mm (48)	7,5mm (48) Crown to implant ratio: 2:1 (16) 2.5:1 (16) 3:1 (16)	Static (48)	External hexagon (48)	Tungsten carbide bur, two SiC polishers	IP reduced FR in implants with CIR of 2.5:1. Mean total value of all implants showed no significant difference in FR after IP

IP = implantoplasty; FR = fracture resistance; SD = standard deviation; N = newton; CIR = crown-implant ratio; n/a = not available; SiC = silicon carbide

However, these *in vitro* studies still provided us with valuable insights into the effect of implantoplasty on the mechanical integrity of implants.

This review adopted the classification of implant diameter as proposed by Al-Johany *et al.* (2017), which described narrow platform diameter as  $\geq 3.0$  mm to  $< 3.75$  mm; regular diameter as  $\geq 3.75$  mm to  $< 5$  mm; and wide diameter as  $\geq 5$  mm. A recent systematic review that looked at dental implant fracture reported that implants of narrower diameter have a higher incidence of fracture (Goiato *et al.*, 2019). Similarly, narrower implants in this systematic review were found to be at a higher risk of fracture after implantoplasty, especially in the presence of significant bone loss around the implant. Narrow diameter implants have a smaller contact area between the implant surface and the alveolar bone, which may increase stress concentration in the implant body (Qian *et al.*, 2009). Implantoplasty on narrow diameter implants will likely compromise its structural integrity by further reducing the implant diameter.

There is insufficient evidence to state whether external hexagon or conical Morse taper connection is more fracture resistant (Camps-Font *et al.*, 2020; Gehrke *et al.*, 2016). However, there is some indication that internal hexagon connection may be the weakest abutment connection design. Interestingly, the other studies which used implants with external hexagon connection showed that implantoplasty did not affect fracture resistance (Costa-Berenguer *et al.*, 2018; Leitao-Almeida *et al.*, 2020; Leitão-Almeida *et al.*, 2021; Sivoilella *et al.*, 2021). Internal hexagon connection implants, on the other hand, showed a decrease in fracture resistance after implantoplasty in two studies. One study showed a reduction in narrow implants only (Chan *et al.*, 2013), and the other study acknowledged a reduction in regular diameter implants (Jorio *et al.*, 2021). A possible explanation could be that implantoplasty further reduces the thickness of the thin lateral fixture wall at the neck of the implant where the fixture connects to the internal connection abutment, which compromises the integrity

of the implant body. This suggests that external hexagon connection implants that have undergone implantoplasty may be less likely to fracture compared to other connection designs.

Implantoplasty instrumentation protocol may not have a significant effect on the fracture resistance but diamond sonic tips seem to be more conservative in nature, albeit more time consuming (Sivoilella *et al.*, 2021). Two of the studies utilised computer-controlled instrumentation (Bertl *et al.*, 2020; Gehrke *et al.*, 2016). This ensured that the implantoplasty done on each implant was standardised with identical pressure and surface roughness. However, as implantoplasty has to be performed by a trained operator in a clinical setting, the other studies in this review may have higher clinical relevance because it allows for variability amongst clinicians. Bertl (2020), as well as Jorio (2021) carried out cyclic loading on the implants prior to static loading until failure to better simulate masticatory forces. Both studies found that implantoplasty resulted in a decrease in fracture resistance. Cyclic loading on implants can increase the stress at the interface between implant and bone, which affect the mechanical properties of the implant (Chen *et al.*, 2010).

Most implant fractures were also found to occur at the platform, which indicates that mechanical stress may be concentrated in this zone, especially when the amount of bone loss increases. Narrow implants irrespective of platform connection included in this review demonstrated a tendency to fracture at the platform level. However, the risk of implant body and prosthetic screw fracture increased after implantoplasty (Camps-Font *et al.*, 2020; Leitao-Almeida *et al.*, 2020; Leitão-Almeida *et al.*, 2021). Similar findings were reported for regular diameter implants, which showed weakening of the implant body following implantoplasty (Costa-Berenguer *et al.*, 2018). Gehrke *et al.* (2016) on the other hand found that in regular diameter dental implants with external and internal hexagonal connections, fracture is similarly more likely to occur at the platform level, but

with less risk of damage to the abutment and implant body after implantoplasty. The study by Bertl *et al.* (2020) focusing on 112 Straumann implants indicated that 110 of the implants of various diameter (3.3mm and 4.1mm), material (grade IV titanium and titanium-zirconia) and level (bone and tissue) fractured at the implant body irrespective of implantoplasty status. The remaining two were bone level regular diameter titanium implants without implantoplasty which fractured at the neck. This study was the only one in this review which compared implants with different levels and materials. They stated that grade IV titanium tissue level implants were more likely to fracture compared to titanium-zirconia alloy bone level implants.

One study documented a difference in fracture resistance due to the degree of simulated bone loss around the implant (Leitão-Almeida *et al.*, 2021). This sparse evidence suggests that the fracture resistance of dental implants decrease as the amount of bone loss around the implant increases (Leitão-Almeida *et al.*, 2021). This study is similar to earlier work done by the same authors (Leitao-Almeida *et al.*, 2020). In this earlier study, a crown to implant ratio of 2.5:1 was significantly less resistant to fracture after implantoplasty compared to ratios of 2:1 and 3:1 (Leitao-Almeida *et al.*, 2020). A study which utilised finite element analyses to evaluate the effects of implantoplasty on implants of different bone levels observed that stress on the implant increased as the bone level decreased up to approximately half the length of the implant (Tribst *et al.*, 2017). With further bone loss past this point, the stress on the implant decreased with decreasing implant bone levels, and the micro strain exerted on the bone tissue drastically increased. This study also suggested that implantoplasty resulted in an increase in stress concentration on the implant, which implied that the critical stress point will be achieved earlier, contributing to implant fracture.

The majority of the included studies employed a fatigue testing protocol according to the ISO 14801:2007 guidelines, as revised in 2016 (Bertl *et al.*, 2020; Camps-

Font *et al.*, 2020; Costa-Berenguer *et al.*, 2018; Jorio *et al.*, 2021; Leitao-Almeida *et al.*, 2020; Leitão-Almeida *et al.*, 2021; Sivoilella *et al.*, 2021). It is important to note that this guideline specifically states that while it simulates the functional loading of the dental implant body and associated prosthetic component under worst case conditions, it is not applicable for predicting the *in vivo* performance of an implant.

There are many other factors at play in these studies which can affect the results and add to the observed heterogeneity amongst the studies. It is difficult to make a complete extrapolation of these findings in a real clinical scenario as patients differ in the degree of edentulism, being either fully or partially edentulous. For partially edentulous patients, edentulism location, prosthodontic rehabilitation and force distribution differ significantly between patients which will clearly affect the fracture resistance of dental implants (Stavropoulos *et al.*, 2019). More studies in this area are needed to further understand the various factors associated with a change in fracture resistance after implantoplasty.

## Conclusion

This systematic review showed that the true impact of implantoplasty on fracture resistance of dental implants is not clear due to multiple potential confounding factors such as the extent of bone loss, implant diameter and connection design. However, within the limitations of this review, the results revealed that narrow platform implants with internal hexagon connection may be more susceptible to fracture. To overcome this limitation of narrow diameter implants, the use of titanium-zirconia alloy and bone level implants should be considered to increase the structural strength of the implants. A small number of clinical cases with implantoplasty, patient and operator variability, and ethical implications of fracture resistance evaluations will affect potential clinical assessment of this treatment modality. Clinicians are advised to take these into consideration during treatment planning,

especially for patients with increased risk of peri-implantitis.

## References

- Al-Johany, S. S., Al Amri, M. D., Alsaeed, S., & Alalola, B. (2017). Dental Implant Length and Diameter: A Proposed Classification Scheme. *Journal of Prosthodontics*, 26(3), 252-260.
- Al-Omiri, M., Hantash, R. A., & Al-Wahadni, A. (2005). Satisfaction with dental implants: a literature review. *Implant Dentistry*, 14(4), 399-406.
- Albrektsson, T., Dahlin, C., Jemt, T., Sennerby, L., Turri, A., & Wennerberg, A. (2014). Is marginal bone loss around oral implants the result of a provoked foreign body reaction? *Clinical Implant Dentistry and Related Research*, 16(2), 155-165.
- Berglundh, T., Persson, L., & Klinge, B. (2002). A systematic review of the incidence of biological and technical complications in implant dentistry reported in prospective longitudinal studies of at least 5 years. *Journal of Clinical Periodontology*, 29 Suppl 3, 197-212; discussion 232-193.
- Bertl, K., Isidor, F., von Steyern, P. V., & Stavropoulos, A. (2020). Does implantoplasty affect the failure strength of narrow and regular diameter implants? A laboratory study. *Clinical Oral Investigations*.
- Blomberg, S. (1985). Psychiatric aspects of patients treated with bridges on osseointegrated fixtures. *Swedish Dental Journal. Supplement*, 28, 183-192. <https://www.ncbi.nlm.nih.gov/pubmed/3864260>
- Camps-Font, O., Gonzalez-Barnadas, A., Mir-Mari, J., Figueiredo, R., Gay-Escoda, C., & Valmaseda-Castellon, E. (2020). Fracture resistance after implantoplasty in three implant-abutment connection designs. *Medicina Oral, Patologia Oral, Cirugia Bucal*, 25(5), e691-e699.
- Chan, H. L., Oh, W. S., Ong, H. S., Fu, J. H., Steigmann, M., Sierraalta, M., & Wang, H. L. (2013). Impact of implantoplasty on strength of the implant-abutment complex. *The International Journal of Oral & Maxillofacial Implants*, 28(6), 1530-1535.
- Chen, L., Guo, X., Li, Y., & Li, T. (2010). Finite element analysis for interfacial stress and fatigue behaviors of biomimetic titanium implant under static and dynamic loading conditions. *Zhong Nan Da Xue Xue Bao Yi Xue Ban*, 35(7), 662-672.
- Costa-Berenguer, X., Garcia-Garcia, M., Sanchez-Torres, A., Sanz-Alonso, M., Figueiredo, R., & Valmaseda-Castellon, E. (2018). Effect of implantoplasty on fracture resistance and surface roughness of standard diameter dental implants. *Clinical Oral Implants Research*, 29(1), 46-54.
- de Vries, R. W., P. (2018). In Vitro Critical Appraisal Tool (IV-CAT): Tool Development Protocol (1.0.0) Zenodo
- Derks, J., & Tomasi, C. (2015). Peri-implant health and disease. A systematic review of current epidemiology. *Journal of Clinical Periodontology*, 42 Suppl 16, S158-171.
- Espósito, M., Grusovin, M. G., & Worthington, H. V. (2012). Treatment of peri-implantitis: what interventions are effective? A Cochrane systematic review. *European Journal of Oral Implantology*, 5 Suppl, S21-41.
- Figuro, E., Graziani, F., Sanz, I., Herrera, D., & Sanz, M. (2014). Management of peri-implant mucositis and peri-implantitis. *Periodontology 2000*, 66(1), 255-273.
- Gehrke, S. A., Aramburu Junior, J. S., Dedavid, B. A., & Shibli, J. A. (2016). Analysis of Implant Strength After Implantoplasty in Three Implant-Abutment Connection Designs: An In Vitro Study. *The International Journal of Oral & Maxillofacial Implants*, 31(3), e65-70.
- Goiato, M. C., Andreotti, A. M., dos Santos, D. M., Nobrega, A. S., de Caxias, F. P., & Bannwart, L. C. (2019). Influence of length, diameter and position of the implant in its fracture incidence: A Systematic Review. *Journal of Dental Research, Dental Clinics, Dental Prospects*, 13(2), 109-116.
- Heitz-Mayfield, L. J., & Mombelli, A. (2014). The therapy of peri-implantitis: a systematic review. *The International Journal of Oral & Maxillofacial Implants*, 29 Suppl, 325-345.
- Higgins, J. G., S. (2021). *Cochrane Handbook for Systematic Reviews for Interventions Version 6.2*
- Howe, M. S., Keys, W., & Richards, D. (2019). Long-term (10-year) dental implant survival: A systematic review and sensitivity meta-analysis. *Journal of Dentistry*, 84, 9-21.
- Jorio, I. C., Stawarczyk, B., Attin, T., Schmidlin, P. R., & Sahrman, P. (2021). Reduced fracture load of dental implants after implantoplasty with different instrumentation sequences. An in vitro study. *Clinical Oral Implants Research*.
- Leitao-Almeida, B., Camps-Font, O., Correia, A., Mir-Mari, J., Figueiredo, R., & Valmaseda-Castellon, E. (2020). Effect of crown to implant ratio and implantoplasty on the fracture resistance of narrow dental implants with marginal bone loss: an in vitro study. *BMC Oral Health*, 20(1), 329.
- Leitão-Almeida, B., Camps-Font, O., Correia, A., Mir-Mari, J., Figueiredo, R., & Valmaseda-Castellón, E. (2021). Effect of bone loss on the fracture resistance of narrow dental implants after implantoplasty. An in vitro study. *Medicina Oral, Patologia Oral, Cirurgia Bucal*.
- Lindhe, J., Meyle, J., & Group, D. o. E. W. o. P. (2008). Peri-implant diseases: Consensus Report of the Sixth European Workshop on Periodontology. *Journal of Clinical Periodontology*, 35(8 Suppl), 282-285.
- Louropoulou, A., Slot, D. E., & Van der Weijden, F. (2014). The effects of mechanical instruments on contaminated titanium dental implant surfaces: a systematic review. *Clinical Oral Implants Research*, 25(10), 1149-1160.
- Matarasso, S., Iorio Siciliano, V., Aglietta, M., Andreuccetti, G., & Salvi, G. E. (2014). Clinical and radiographic outcomes of a combined resective and regenerative approach in the treatment of peri-implantitis: a prospective case series. *Clinical Oral Implants Research*, 25(7), 761-767.
- Miller, S. A., & Forrest, J. L. (2001). Enhancing your practice through evidence-based decision making: PICO, learning how to ask good questions. *Journal of Evidence-Based Dental Practice*, 1(2), 136-141.

- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Group, P. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLOS Medicine*, *6*(7), e1000097.
- Monje, A., Pons, R., Amerio, E., Wang, H. L., & Nart, J. (2021). Resolution of peri-implantitis by means of implantoplasty as adjunct to surgical therapy: A retrospective study. *Journal of Periodontology*.
- Moraschini, V., Poubel, L. A., Ferreira, V. F., & Barboza Edos, S. (2015). Evaluation of survival and success rates of dental implants reported in longitudinal studies with a follow-up period of at least 10 years: a systematic review. *International Journal of Oral and Maxillofacial Surgery*, *44*(3), 377-388.
- Qian, L., Todo, M., Matsushita, Y., & Koyano, K. (2009). Effects of implant diameter, insertion depth, and loading angle on stress/strain fields in implant/jawbone systems: finite element analysis. *The International journal of oral and maxillofacial implants*, *24*(5), 877-886.
- Schwarz, F., Hegewald, A., John, G., Sahm, N., & Becker, J. (2013). Four-year follow-up of combined surgical therapy of advanced peri-implantitis evaluating two methods of surface decontamination. *Journal of Clinical Periodontology*, *40*(10), 962-967.
- Sivolella, S., Brunello, G., Michelon, F., Concheri, G., Graiff, L., & Meneghello, R. (2021). Implantoplasty: Carbide burs vs diamond sonic tips. An in vitro study. *Clinical Oral Implants Research*, *32*(3), 324-336.
- Stavropoulos, A., Bertl, K., Eren, S., & Gotfredsen, K. (2019). Mechanical and biological complications after implantoplasty-A systematic review. *Clinical Oral Implants Research*, *30*(9), 833-848.
- Tribst, J. P. M., Dal Piva, A. M. O., Shibli, J. A., Borges, A. L. S., & Tango, R. N. (2017). Influence of implantoplasty on stress distribution of exposed implants at different bone insertion levels. *Braz Oral Research*, *31*, e96.

# Review: exploring the potential of *Nigella sativa* for tooth mineralization and periodontitis treatment and its additive effect with doxycycline

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## Abstract

Oral disease has been a worldwide concern as the incidence and cost of treatment continues to rise. Management of the disease is challenging as success is often influenced by an individual's lifestyle and diet. *Nigella sativa* (*N. sativa*) or black seed is a medicinal plant that has received growing interest due to its effectiveness against various conditions including cardiovascular disease, diabetes, cancer, as well as infectious diseases caused by bacterial, viral, and fungal infections. This narrative review studies *N. sativa* that has also shown great potential in dental health attributed to its role in stimulating the process of remineralization. Apart from that, *N. sativa* promotes healing of oral tissues as it induces the differentiation potential of heterogeneous cell populations in periodontal ligament cells. The anti-osteoporotic, antioxidant and anti-inflammatory properties of *N. sativa* also improve periodontal healing, particularly by preventing further destruction of bone components. This article discusses the occurrence of periodontitis and the therapeutic role of *N. sativa* with emphasis on the regulation of genes, for instance, the alkaline phosphatase (*ALP*) that is involved in tissue specialization and remineralization. It is speculated that the activity of *N. sativa* in remineralization can be enhanced by combination with other commonly used periodontitis antibiotics such as doxycycline. *N. sativa* is purported to induce periodontal tissue regeneration whilst minimizing toxicity. Thus, it may serve as an alternative or enhance the existing treatment for periodontitis when administered as a combined formulation.

**Keywords:** doxycycline, gene expression, mineralization, *Nigella sativa*, periodontitis

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## Introduction

Periodontal disease and dental caries affect up to 50% of the worldwide population. The

percentage of affected individuals are higher among adults and older group of people (Nazir, 2017). The economic impact, whether directly or indirectly, due to

periodontal disease treatments, accounted for about 442 billion USD per year (Tonetti *et al.*, 2017). These data portray the serious implication of periodontal disease not only to an individual's oral health but also financial status. The Malaysian healthcare system, through its dental services, spent approximately RM 2,800 per patient to treat periodontal diseases (Mohd-Dom *et al.*, 2013). A study by Jin *et al.* (2016) stated that chronic periodontitis is among the global disease burden and affected almost 12% of people worldwide between the years 1990 to 2010.

Periodontal disease or gum disease can be characterized into two conditions which include gingivitis and periodontitis. Gingivitis is the mildest form that causes the gum to be red, swollen and tend to bleed easily. This condition is often reversible as the main cause of gingivitis is poor oral hygiene (Shaw *et al.*, 2016). Nevertheless, if gingivitis is left untreated, eventually periodontitis may develop. This occurs due to plaque accumulation reaching beyond the gum line. The presence of bacteria and its toxin initiates an inflammatory response, and eventually, chronic inflammation in the gingiva will slowly destroy the gum tissue and teeth, gingival, periodontal ligament, cementum, and the alveolar bone. As the gingival tissue is inflamed, the tissue itself loses its attachment to the tooth surface, creating a periodontal pocket (Arigbede *et al.*, 2012).

Periodontal disease can be classified into four categories. Firstly, aggressive periodontitis where there is a rapid attachment loss between gingiva and tooth as well as alveolar bone destruction. Secondly, chronic periodontitis which involves inflammation of the periodontium, and this causes the progressive loss of attachment and bone destruction. The main difference between aggressive and chronic periodontitis is the onset. Aggressive periodontitis tends to occur earlier as compared to chronic periodontitis. Wiebe and Putnins (2000) mentioned that the three criteria that govern the categorization are the depth of the pocket, the clinical attachment loss and the number of teeth

affected whether more or less than 30%. The third type of periodontitis may be the result of a systemic disease including respiratory disease, heart disease and diabetes. The effects are suggested to occur due to the infection of bacteria in systemic circulation and cytokine storm released from the extensive inflammatory response. The fourth type is necrotizing periodontitis which affects mostly immunocompromised and malnourished individuals. This condition is attributed to necrosis of the periodontium, gingival tissue, periodontal ligament, and alveolar bone (Wiebe & Putnins, 2000).

Currently, gingivitis can be prevented and treated by advocacy of proper oral hygiene such as frequent tooth brushing. However, for periodontitis, a comprehensive periodontal treatment is required, which may include a non-surgical procedure called scaling and root planing (SRP). This procedure is performed by a dentist to scale all the plaque, bacterial toxins and tartar deposition on the tooth and root surfaces followed by root planing. Root planing smoothens out the surfaces and prevents any re-adherence of plaque or tartar, allowing a condition that induces the healing processes and reattachment of the gum to the tooth (Smiley *et al.*, 2015). SRP is also referred to as deep cleaning, a gold standard in treating periodontitis in which the procedure is commonly coupled with treatment using tetracycline antibiotics, specifically the doxycycline hyclate (Tomasi & Wennström, 2004). Although the treatment is a common practice, the procedure has been reported to be technically challenging and may cause recurrence. The problem with current treatment is that SRP itself induces pain to the patients and may cause patients to retract from getting treatment. The second problem is the presence of bacterial biofilm at the site of treatment. Bacterial biofilm which is embedded in layers has optimal defence against antibiotic effect when compared to the planktonic bacteria (Dincer *et al.*, 2020). Due to the resistant properties, higher doses of antimicrobial as high as 10 to 1000 times will be required than normal to kill it (Gebreyohannes *et al.*, 2019). However,

the administration of drugs at high dosage can cause local toxicity affecting the surrounding area (Shaddox & Walker, 2010). This, in turn, hinders the remineralization of tooth and dentin structures (Holmes & Charles, 2009; Ioannou *et al.*, 2010).

Continuous studies were conducted to improve the treatment for periodontitis (Alshareef *et al.*, 2020; Shaddox & Walker, 2010). It is postulated that an effective therapeutic strategy is to provide a comprehensive treatment that could deliver antimicrobial protection, reduce inflammation, and stimulate remineralization of the alveolar bone. The use of phytomedicine has gained a lot of interest particularly in targeting a wide range disease with more accessible, cost-effective, and fewer side effects in comparison to the synthetic medicines (Yimer *et al.*, 2019). Among medicinal plants, *N. sativa* has been considered one of the highly valued nutrient-rich plants in history around the world. A lot of studies are progressively conducted to validate its traditionally claimed benefits and use (Ramadan, 2007).

Research on the use of traditional medicines opens new boundaries for the alternative approach in the management of oral diseases (Cruz *et al.*, 2017). The World Health Organization (WHO) defines traditional medicine as any sum of total knowledge, skill and practices which comes from a particular culture through theories, beliefs, and experiences in health-related conditions. Traditional medicine is identical to modern medicine in that it aims to provide maintenance of health which also paves way for improvement of life quality (Chaudhary & Singh, 2011). In fact, traditional medicine has long existed before modern medicine hundreds of years earlier and has been proved to contribute fruitful finding to modern medicine such as the emergence of the first pharmacologically active compound morphine in the year 1805 (Yuan *et al.*, 2016). *N. sativa* is a medicinal plant that has been studied for its antimicrobial and anti-inflammatory properties (Ahmad *et al.*, 2013; Al-Ghamdi, 2001; Forouzanfar *et al.*, 2014). In this review, the therapeutic role of

*N. sativa* as a comprehensive bioactive natural product that can be an alternative treatment modality for periodontitis is discussed, particularly via promoting remineralization of the tooth and alveolar bone. A detailed emphasis is given on the effects of *N. sativa* towards genes involved in remineralization.

## Methodology

This article adopts the narrative review approach in which relevant articles written in English were retrieved from Scopus, Science Direct and Google Scholar database. Articles and books from the year 1991 to 2020 were selected to include fundamental knowledge on teeth and its development as well as recent studies related to *N. sativa*, mineralization and its impact towards periodontitis. In the light of genetic impact of *N. sativa* on alkaline phosphatase expression, we included keyword search of “*Nigella sativa* and its constituents’ therapeutic properties”, “mineralization”, “alveolar bone remodelling”, “periodontal ligament gene expression”, “ALP gene expression” and “*N. sativa* genetic impact”. Six themes were covered under the following subtopics: (1) Teeth mineralization, demineralization, and remineralization, (2) Periodontal tissue, (3) Gene expression of the periodontal ligament, (4) *N. sativa* and its therapeutic properties on dental health, (5) *N. sativa* effects on teeth mineralization and ALP expression, (6) *N. sativa* additive effect. This review also covers the possible use of *N. sativa* coupled with antibiotics to enhance its effect in treatment.

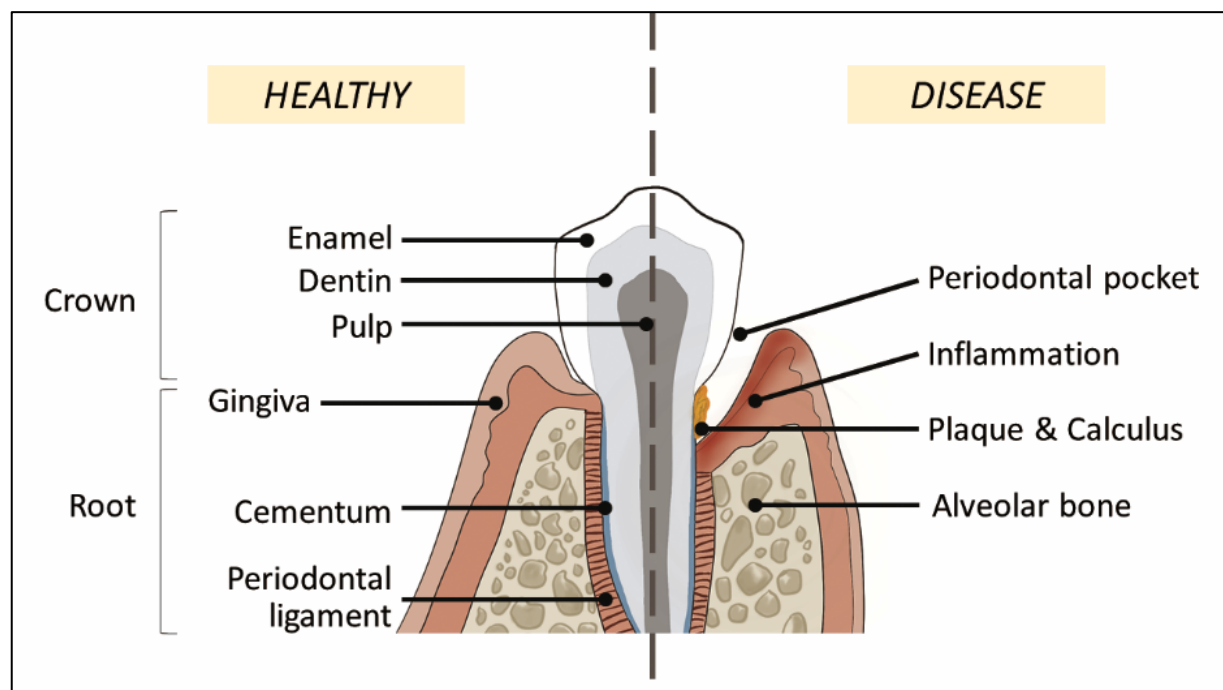
## Teeth mineralization, demineralization, and remineralization

Human teeth are structurally formed by three layers which include the enamel, pulp-dentin complex, and cementum (Figure 1). Enamel is the outermost whitish calcified layer that makes up the crown structure and teeth root. Pulp-dentin complex is present in the inner layer consisting of dentin as the immediate layer after enamel and pulp having all the capillaries supplying blood



and nerve to the teeth. Cementum covers the root surface to maintain dental and periodontal attachment (Boskey, 2007). For dentin and cementum, almost 90% of these structures are made up from collagen,

specifically from collagen type I. On the other hand, nearly 90% of the enamel structure is composed of non-collagenous protein (Margolis *et al.*, 2014).



According to Caruso *et al.* (2016), mineralization starts at the dentin structure through a process known as dentinogenesis. This process is further subdivided into three distinct stages dependent on the site of mineralization. The first stage is vesicle derived mineralization that occurs in the mantle or the outer layer of dentin. Within odontoblastic processes, matrix vesicles (MVs) are vesicular bodies found in dentin and are present in the extracellular environment during the mantle dentine mineralization process (Garcés-Ortíz, 2013). MVs are formed via budding events of odontoblasts that reside in the basement membrane. The vesicles produced would then provide initial mineralization components, including enzymes required for dentin (Golub, 2009). The second stage is the extracellular matrix (ECM) molecule-derived mineralization. This process appears when odontoblasts secrete type I collagen and proteoglycans, particularly chondroitin sulphate which functions to attract calcium ions and acts as a transporter

for mineral from cells into the ECM. These components make up the matrix of dentin and induce differentiation of pre-dentin to dentin. Some non-collagenous proteins (NCPs) are also being secreted influencing the nucleation and also inhibition of mineralization. Finally, the third stage is blood-serum-derived mineralization where there is a passive deposition of proteoglycans, lipid and ECM secreted from odontoblasts or from the dentinal lymph. These depositions give rise to the formation of a thin amorphous matrix in the peritubular dentin (Goldberg *et al.*, 2011). In the matrix-derived mineralization, type I collagen is the main component of dentin being incorporated equivalent to more than half of mineral contents while there are some parts of NCP present acting as a promoter or an inhibitor. These proteins inhibit immature mineralization of dentin until proper orientation and arrangement of collagen fibril are achieved (Van Der Rest & Garrone, 1991).

After the mineralization of dentin, the enamel structure undergoes a similar process by the action of ameloblasts cells which shares a common origin with odontoblasts from mesenchymal stem cells (Moradian-Oldak, 2012). These cells secrete enamel matrix protein and proteinases, which contribute to the immediate mineralization of enamel. Enamel crystal ribbon is initially formed within the mineralized dentin surface along with the secreted enamel matrix proteins that grow away outwards from the dentin. Consequently, full-scale enamel thickness is produced, causing ameloblasts to become protein-resorbing cells to remove enamel matrix proteins. Due to the removal, the structure is compensated by minerals and water making up the structure with approximately 95% mineral contents. Further calcification process of teeth occurs as calcium is transferred from the blood into the enamel matrix where they are deposited (Abou Neel *et al.*, 2016).

Under normal circumstances, demineralization of the teeth occurs all the time, particularly when subjected to acidic contents from the diet as well as from normal oral microbiota (Abou Neel *et al.*, 2016). Demineralization of the tooth indicates minerals wearing off from the enamel and dentin, which can cause the teeth to become porous. Nevertheless, the number of minerals being washed away are small and do not affect the deeper hard tissues. Saliva involves in the mechanism that the acid produced from diets or normal flora in the oral cavity. However, periodontitis, an inflammation event affecting the periodontium of the tooth, largely promotes demineralization of the teeth (Gasner & Schure, 2020). Untreated and prolonged gingivitis leads to the extensive growth of bacterial biofilm deep beyond the gingival margin. This condition causes the deepening of the periodontal pocket (Figure 1). The condition worsens following the destruction of the periodontium (consisting of the periodontal ligament, cementum, gingiva, and alveolar bone) whereby demineralization that extends up to the alveolar bone, further

weakens tooth attachment and ultimately causing tooth loss (Larsen & Fieehn, 2017). Remineralization can be promoted by keeping away the bacterial plaque from depositing in the teeth through proper brushing and flossing the teeth. Another way is to use fluoride contained toothpaste as it strengthens and induce remineralization. Vitamin D and natural products may also help in promoting remineralization (Philip, 2019). Factors that promote remineralization includes the time-dependent exposure of tooth surface to the calcium, phosphate and fluoride brought by the saliva (Garcia-Godoy & Hicks, 2008).

### Periodontal tissue

Periodontal tissue is located between the cementum and the alveolar bone, as depicted in Figure 1. It is characterized by the dense fibrous connective tissue that acts as a support medium and attachment for the teeth to its socket. The major component of periodontal tissue essential for normal teeth function is the periodontal ligament (PDL) which contains a heterogeneous cell population that are fibroblastic in nature as well as cells that contribute to mineralized tissue formation (Dean, 2017; Maeda *et al.*, 2011; Marchesan *et al.*, 2011).

This remodelling capacity allows it to differentiate into specialized tissues which are bone, cementum, and connective tissue fibres. Meanwhile, the undifferentiated cells present around the blood vessels, namely ectomesenchymal cells, have the capability to differentiate into cementoblasts, osteoblasts and fibroblasts (Caetano-Lopes *et al.*, 2007).

The PDL functions as a supportive structure that strengthens the teeth attached to the alveolar bone socket (Dean, 2017). The principal fibres of the periodontal ligament are the key element that serves as a bridge that unites the root cementum with the bone by strong fibrous connection (Matsuo & Takahashi, 2002). Besides, the periodontal ligament, particularly the principal fibres, also acts as an attachment medium and shock-absorber that can withstand heavy

occlusal force during mastication (Li *et al.*, 2018). In addition, blood-origin macrophage also supplies the area with multinucleated cells which are osteoclasts and odontoclasts. These two cells are involved in the process of bone and tooth resorption (Dean, 2017).

Other functions of the PDL are sensory and nutritive. Nerve ends are deposited inside the periodontal ligament, providing receptors for pain and pressure (Dean, 2017). The periodontal ligament also possesses well-vascularization which arises from the dental arteries. This vascularization provides nutrient for the cell surrounding vitality (Dean, 2017).

### Gene expression of the periodontal ligament

According to Choi *et al.* (2011), the gene expression involved in osteogenic events of PDL follows a temporal sequence beginning from the proliferation stage, subsequently the bone matrix formation and maturation stage, and finally the mineralization stage. During the proliferation stage, *c-myc*, a cell growth-regulated gene expressed in PDL encodes proteins that induce proliferation by functioning as transactivation factors. After cell proliferation is downregulated, alkaline phosphatase (*ALP*) mRNA expression is elevated to enter the cell differentiation stage. *ALP* is one of the biomarkers that influence PDL cell differentiation into osteoblastic cells (Choi *et al.*, 2011). As the bone matrix continues to develop, *ALP* expression elevates, thus making the protein as one of the markers for osteoblastic cells.

Human *ALP* is categorized into four subtypes which are tissue nonspecific, intestinal, placenta and germ cells. Tissue nonspecific *ALP* (*TNAP*) is responsible for bone and teeth mineralization (Millán, 2013). *TNAP* is mainly expressed by chondrocytes, osteoblasts, and odontoblasts (Chaudhary *et al.*, 2016; Hoylaerts *et al.*, 2015). *TNAP* is concentrated in the vesicles which bud off from those cells to supply through vesicle-derived mineralization. During the mineralization process, *TNAP*

activity catalyses the conversion of *PPi* into *Pi*. *PPi* is an inhibitor of hydroxyapatite crystal formation. Meanwhile, *Pi* is needed to form hydroxyapatite crystal (Orimo, 2010). *ALP* gene is located on chromosome 2q37.1 (Lee *et al.*, 2007). Inhibition of *ALP* gene expression may halt the mineralization process leading to hypomineralization, thus highlighting its crucial role (Orimo & Shimada, 2008).

During PDL differentiation, the *BMP* gene was also expressed, particularly *BMP-2* and *BMP-4*. *BMP-2* and *-4* showed similar expression patterns to *ALP* (Choi *et al.*, 2011). *BMP* is important as a chemoattractant for differentiation of undifferentiated mesenchymal stem cells into areas of bone loss, thus increasing the bone matrix protein. Besides being expressed in the PDL fibroblasts, gingival fibroblasts also express *BMP* and *ALP* (Rahman *et al.*, 2015).

The active expression of *ALP* was followed by the expression of osteocalcin (*OC*). *OC* is a protein that is routinely used as a serum marker for osteoblastic bone formation and currently suggested to demonstrate hormonal roles that extend to involve regulation of whole-body metabolism, cognition, and reproduction (Zoch *et al.*, 2016). The increase in *OC* gene expression in PDL cells was shown to correlate with the formation of bone nodules. At the terminal differentiation of osteoblastic cells, *c-fos* expression was prominent (Choi *et al.*, 2011). *c-fos* is a cell growth-regulated transcription factor that has a specific association with bone tissue (Yamaguchi *et al.*, 2002).

Other than that, in the events of infection or orthodontic tooth movement due to orthodontic force, interleukin-1 (*IL-1*) and interleukin-8 (*IL-8*) are expressed in PDL, which invoke an early inflammatory response and osteoclastic bone resorption (Lee *et al.*, 2013). *IL-8* plays a key role in neutrophils activation and recruitment whereas *IL-1 $\beta$*  is an important bone resorption cell mediator (Tuncer *et al.*, 2005). Following traumatic condition, necrotic cells are formed, and the nearest

healthy ligament cell will aid in repair. However, excessive chemokine response may develop chronic hyperinflammatory lesion leading to periodontal ligament and alveolar bone loss (Huang *et al.*, 1999; Nibali *et al.*, 2013). It is evident that IL-1 is essential in the pathogenesis of periodontitis. Therefore, the genes encoding IL-1 production had been regarded as a potential predictor of periodontal disease progression (Grigoriadou *et al.*, 2010).

### ***Nigella sativa* (*N. sativa*) and its therapeutic properties on dental health**

*N. sativa* or commonly known as black seed or *Habbatus sauda'* is a medicinal seed that is known for its therapeutic effects. *N. sativa* seed and its extracted oil are used as a therapy due to its wide properties including antimicrobial and anti-inflammatory. The main active compound of *N. sativa* is thymoquinone (30-40%) which is proposed to be responsible for the antimicrobial and anti-inflammatory properties (Ahmad *et al.*, 2013). Thymoquinone (TQ) has been shown to possess antimicrobial effects demonstrated by the growth inhibition of bacteria such as *Staphylococcus aureus* (*S. aureus*) when treated with the active compound. TQ has been demonstrated to be more effective against gram-negative bacteria and that with wide range of antibiotic resistance (Ahmad *et al.*, 2013). Anti-inflammatory effects of TQ are attributed to its ability to inhibit key inflammatory cytokines such as IL-1 and nuclear factor  $\kappa$ B. Besides TQ, other bioactive constituents of *N. sativa* such as dithymoquinone, thymol, and thymohydroquinone are also being studied for their therapeutic properties (Gholamnezhad *et al.*, 2016).

In relation to oral care, TQ offers a promising therapeutic candidate due to its ability to reduce dental caries and plaque index of teeth (Al-Attas *et al.*, 2016; Angius *et al.*, 2015). TQ is proved to be effective as an inhibitory agent against attachment and colonization of dental microbes such including *Streptococcus mitis* (*S. mitis*) and

*Streptococcus mutans* (*S. mutans*) (Harzallah *et al.*, 2011). Besides influencing bacterial colonization, TQ also exerts both antioxidant and anti-inflammatory effects. Periodontitis can be caused by oxidative stress in which reactive oxygen species (ROS) increase beyond the tolerable limit of antioxidant capabilities. Diminished antioxidant scavenging activities lead to periodontal tissue destruction through lipid peroxidation. In the case of *Porphyromonas gingivalis* (*P. gingivalis*) induced inflammation through its lipopolysaccharide (LPS), which causes the excessive formation of mitochondrial ROS. TQ, with its antioxidant properties, is suggested to induce ROS scavenging activity, thus reducing the further breakdown of periodontal tissues (Bullon *et al.*, 2014). Thus, this impedes the action of ROS that disrupts with the osteoclastic activity. TQ has been shown to reduce alveolar bone loss, infiltration of inflammatory cells and osteoclasts activities while improving osteoblastic differentiation on periodontium (Al-Ghamdi, 2001). Therefore, the coupled effect of the antimicrobial and anti-oxidative property of TQ is suggested to be a suitable candidate in the formulation of treatments in the management of periodontitis.

### ***N. sativa* effects on teeth mineralization and ALP expression**

*N. sativa* can induce anti-osteoporotic conditions due to its antioxidant and anti-inflammatory properties that prevent the destruction of bone components (Rukshar & Neha, 2013). These properties are beneficial in treating periodontitis. *N. sativa* has been reported to induce the expression of ALP which is linked to the mineralized-tissue-forming cell differentiation as well as increasing bone nodule formation (Wirries *et al.*, 2013). Other genes such as OC, osteopontin (OPN) and BMP gene are also stimulated by *N. sativa* specifically by its active component the thymoquinone (Islam *et al.*; 2016Wirries *et al.*, 2013). BMP genes, particularly BMP-2, increases its expression through the ERK pathway, which is known to involve in bone formation and osteoblast

differentiation (Jun *et al.*, 2010; Su *et al.*, 2010).

Alveolar bone loss is a key feature of periodontitis progression, and this condition is associated with enhanced osteoclast formation. Periodontitis induces osteoclast formation by increasing the differentiation of quiescent osteoclast precursors into osteoclasts (Lee *et al.*, 2015). Thummuri *et al.* (2015) highlighted that TQ could reduce osteoclastogenic activity exerted by receptor activator of nuclear factor kappa B ligand (RANKL) through inhibition of MAPK and NF-kB signalling pathway. NF-kB and MAPK are involved in osteoclast differentiation alongside with JUN and p38. Through activation of the MAPK pathway, *c-fos* is induced, thus increasing the osteoclastogenesis, which leads to bone resorption (Boyle *et al.*, 2003; Lee *et al.*, 2009). Meanwhile, inhibition of TQ halts both the activation of MAPK and p38, leading to decreased cellular differentiation of osteoclasts, in turn reducing its downstream effects.

The destructive effects of periodontitis are also incited by subgingival plaque microflora and LPS derived from pathogens (Hienz *et al.*, 2015). TQ could also prevent osteoclastogenic activity by LPS through the MAPK, NF-kB and TLR signalling pathway (Thummuri *et al.*, 2015). This is complementary to the antimicrobial properties of TQ, which is beneficial to the suppression of bacterial biofilm formation.

### ***N. sativa* additive effect**

*N. sativa* has been reported to possess additive effect in eliminating microbial when combined with doxycycline (Aljabre *et al.*, 2015; Forouzanfar *et al.*, 2014; Halawani, 2009). Doxycycline is an antibiotic in tetracycline class that has frequently been used for periodontitis treatment (Garret *et al.*, 1999; Kopytynska-Kasperczyk *et al.*, 2015). In fact, doxycycline is semi synthetic and more active compared to other antibiotic in the tetracycline class. Doxycycline is effective in eliminating many bacteria species includes enterococci,

*Streptococcus pyogenes*, anaerobic, various *Nocardia* spp. and *S. aureus* which is originally resistant to tetracycline (Kogawa & Salgado, 2012). Doxycycline is bacteriostatic, exerting antibacterial action by inhibiting bacterial growth and prevent the bacteria from reproducing (Loree & Lappin, 2019). Doxycycline binds to the 30S ribosomal subunit in protein translation process to stop amino acid from being linked and inhibit the bacterial protein synthesis (Kogawa & Salgado, 2012; Raval *et al.*, 2018). Besides, it has anti-collagenase properties that can help to protect and maintain the collagen composition on the site of treatment (Raval *et al.*, 2018) while at the same time eradicating the pathogenic bacteria. On the downside, doxycycline must be administered at proper dose as gastrointestinal effect will arise from the usage of the antibiotic such as stomach irritation, ulceration (Raval *et al.*, 2018) and phototoxic reaction (Skidmore *et al.*, 2003). Hence, addition of any compound on top of doxycycline that can buffer the toxic effect can be considered to ensure an effective treatment.

### **Conclusion**

Traditional medicine had used medicinal herbs as therapeutic agents to cure oral diseases. It has been suggested that *N. sativa* or black seed have great benefits in improving oral health. Evidence of a coupled effect (antimicrobial and antioxidant) of TQ towards the main pathogenicity of periodontitis further highlights its potential as an alternative treatment modality. Further research is essential to study the optimal dosage of *N. sativa* that is therapeutically effective as well as analysis on the toxicological profile to ensure the safety. Several genes, especially the *ALP* gene, can be a suitable candidate as the downstream target.

*N. sativa* coupled with tetracycline has an additive effect against pathogenic bacteria. In this light, a possible therapeutic approach is that *N. sativa* can be combined with doxycycline, a type of tetracycline antibiotic to serve as antimicrobial, remineralization

and regeneration agent for remediating cell structures damaged by periodontitis. Nevertheless, the correct formulation is needed to achieve stability for the formulation. Doxycycline can be effective, but without proper dosage quantification and without additional compounds to enhance its efficacy, disease recurrence is inevitable.

### Conflict of interest

The authors declare no conflict of interest and that the review was conducted in the absence of any financial relationships that could be construed as a potential conflict of interest.

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### References

Abou Neel, E.A., Aljabo, A., Strange, A., Ibrahim, S., Coathup, M., Young, A.M. *et al.* (2016). Demineralization–remineralization dynamics in teeth and bone. *International Journal of Nanomedicine*, 11, 4743.

Ahmad, A., Husain, A., Mujeeb, M., Khan, S.A., Najmi, A.K., Siddique, N.A. *et al.* (2013). A review on therapeutic potential of *Nigella sativa*: A miracle herb. *Asian Pacific Journal of Tropical Biomedicine*, 3(5), 337-352.

Al-Attas, S.A., Fat'heya, M.Z., Turkistany, S.A. (2016). *Nigella sativa* and its active constituent thymoquinone in oral health. *Saudi Medical Journal*, 37(3), 235.

Al-Ghamdi, M.S. (2001). The anti-inflammatory, analgesic and antipyretic activity of *Nigella sativa*. *Journal of Ethnopharmacology*, 76(1), 45-48.

Aljabre, S.H., Alakloby, O.M., Randhawa, M.A. (2015). Dermatological effects of *Nigella sativa*. *Journal of Dermatology and Dermatologic Surgery*, 19(2), 92-98.

Alshareef, A., Attia, A., Almalki, M., Alsharif, F., Melibari, A., Mirdad, B. *et al.* (2020). Effectiveness of probiotic lozenges in periodontal management of chronic periodontitis patients: clinical and

immunological study. *European Journal of Dentistry*, 14(2), 281.

Angius, F., Madeddu, M.A., Pompei, R. (2015). Nutritionally variant streptococci interfere with *Streptococcus mutans* adhesion properties and biofilm formation. *New Microbiologica*, 38(2), 259-66.

Arigbede, A.O., Babatope, B.O., Bamidele, M.K. (2012). Periodontitis and systemic diseases: a literature review. *Journal of Indian Society of Periodontology*, 16(4), 487.

Boskey, A.L. (2007). Mineralization of bones and teeth. *Elements*, 3(6), 385-391.

Boyle, W.J., Simonet, W.S., Lacey, D.L. (2003). Osteoclast differentiation and activation. *Nature*, 423(6937), 337-342.

Bullon, P., Newman, H.N., Battino, M. (2014). Obesity, diabetes mellitus, atherosclerosis and chronic periodontitis: a shared pathology via oxidative stress and mitochondrial dysfunction?. *Periodontology 2000*, 64(1), 139-153.

Caetano-Lopes, J., Canhao, H., Eurico Fonseca, J. (2007). Osteoblasts and bone formation. *Acta Reumatológica Portuguesa*, 32(2).

Caruso, S., Bernardi, S., Pasini, M., Giuca, M.R., Docimo, R., Continenza, M.A. *et al.* (2016). The process of mineralisation in the development of human tooth. *European Journal of Paediatric Dentistry*, 17(4), 322-326.

Chaudhary, A., Singh, N. (2011). Contribution of World Health Organization in the global acceptance of Ayurveda. *Journal of Ayurveda and Integrative Medicine*, 2(4), 179.

Chaudhary, S.C., Kuzynski, M., Bottini, M., Beniash, E., Dokland, T., Mobley, C.G. *et al.* (2016). Phosphate induces formation of matrix vesicles during odontoblast-initiated mineralization in vitro. *Matrix Biology*, 52, 284-300.

Choi, M.H., Noh, W.C., Park, J.W., Lee, J.M., Suh, J.Y. (2011). Gene expression pattern during osteogenic differentiation of human periodontal ligament cells in vitro. *Journal of Periodontal and Implant Science*, 41(4), 167-175.

Cruz Martinez, C., Diaz Gomez, M., Oh, M.S. (2017). Use of traditional herbal medicine as an alternative in dental treatment in Mexican dentistry: a review. *Pharmaceutical Biology*, 55(1), 1992-1998.

Dean, R. (2017). The periodontal ligament: development, anatomy and function. *Oral Health Dental Management*, 16(6).

Dincer, S., Uslu, F.M., Delik, A. (2020). Antibiotic Resistance in Biofilm. In: Dincer S, Ozdenefe MS, Arkut A, *Bacterial Biofilms*. London: IntechOpen, pp. 135-148.

Forouzanfar, F., Bazzaz, B.S.F., Hosseinzadeh, H. (2014). Black cummin (*Nigella sativa*) and its constituent (thymoquinone): a review on antimicrobial effects. *Iranian Journal of Basic Medical Sciences*, 17(12), 929.

Garcés-Ortiz, M., Ledesma-Montes, C., Reyes-Gasga, J. (2013). Presence of matrix vesicles in the body of odontoblasts and in the inner third of dentinal tissue: A scanning electron microscopy study. *Medicina Oral, Patologia Oral y Cirugia Bucal*, 18(3), e537.

- García-Godoy, F., Hicks, M.J. (2008). Maintaining the integrity of the enamel surface: the role of dental biofilm, saliva and preventive agents in enamel demineralization and remineralization. *The Journal of the American Dental Association*, 139, 25S-34S.
- Garrett, S., Johnson, L., Drisko, C.H., Adams, D.F., Bandt, C., Beiswanger, B. *et al.* (1999). Two multi-center studies evaluating locally delivered doxycycline hyclate, placebo control, oral hygiene, and scaling and root planing in the treatment of periodontitis. *Journal of Periodontology*, 70(5), 490-503.
- Gasner, N.S, Schure, R.S. (2020). Periodontal Disease. In: *StatPearls*. Treasure Island FL: StatPearls Publishing LLC.
- Gebreyohannes, G., Nyerere, A., Bii, C., Sbhatu, D.B. (2019). Challenges of intervention, treatment, and antibiotic resistance of biofilm-forming microorganisms. *Heliyon*, 5(8), e02192.
- Gholamnezhad, Z., Havakhah, S., Boskabady, M.H. (2016). Preclinical and clinical effects of *Nigella sativa* and its constituent, thymoquinone: A review. *Journal of Ethnopharmacology*, 190, 372-386.
- Goldberg, M., Kulkarni, A.B., Young, M., Boskey, A. (2011). Dentin: structure, composition and mineralization: the role of dentin ECM in dentin formation and mineralization. *Frontiers in Bioscience (Elite edition)*, 3, 711.
- Golub, E.E. (2009). Role of matrix vesicles in biomineralization. *Biochimica et Biophysica Acta (BBA)-General Subjects*, 1790(12), 1592-1598.
- Grigoriadou, M.E., Koutayas, S.O., Madianos, P.N., Strub, J.R. (2010). Interleukin-1 as a genetic marker for periodontitis: Review of the literature. *Quintessence International*, 41(6), 517-25.
- Halawani, E. (2009). Antibacterial activity of thymoquinone and thymohydroquinone of *Nigella sativa* L. and their interaction with some antibiotics. *Advances in Biological Research*, 3(5-6), 148-152.
- Harzallah, H.J., Kouidhi, B., Flamini, G., Bakhrouf, A., Mahjoub, T. (2011). Chemical composition, antimicrobial potential against cariogenic bacteria and cytotoxic activity of Tunisian *Nigella sativa* essential oil and thymoquinone. *Food Chemistry*, 129(4), 1469-1474.
- Hienz, S.A., Paliwal, S., Ivanovski, S. (2015). Mechanisms of bone resorption in periodontitis. *Journal of Immunology Research*, 2015.
- Holmes, N.E., Charles, P.G. (2009). Safety and efficacy review of doxycycline. *Clinical Medicine. Therapeutics*, 1, 471-482.
- Hoylaerts, M.F., Kiffer-Moreira, T., Sheen, C., Narisawa, S., Millán, J.L. (2015). Functional significance of calcium binding to tissue-nonspecific alkaline phosphatase. *PLoS one*, 10(3), e0119874.
- Huang, G. T. J., Potente, A. P., Kim, J. W., Chugal, N., & Zhang, X. (1999). Increased interleukin-8 expression in inflamed human dental pulps. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 88(2), 214-220.
- Ioannou, I., Dimitriadis, N., Papadimitriou, K., Vouros, I., Sakellari, D., Konstantinidis, A. (2010). The effect of locally delivered doxycycline in the treatment of chronic periodontitis. A clinical and microbiological cohort study. *Journal of Oral and Maxillofacial Research*, 1(4), e1.
- Islam, M.T., Sultana, N., Riaz, T.A., Ferdous, J., Guha, B., Mohagon, S. *et al.* (2016). Thymoquinone is knocking at the door of clinical trial. *International Archives of Medicine*, 9(122), 1-25.
- Jin, L.J., Lamster, I.B., Greenspan, J.S., Pitts, N.B., Scully, C., Warnakulasuriya, S. (2016). Global burden of oral diseases: emerging concepts, management and interplay with systemic health. *Oral Diseases*, 22(7), 609-619.
- Jun, J.H., Yoon, W.J., Seo, S.B., Woo, K.M., Kim, G.S., Ryoo, H.M. *et al.* (2010). BMP2-activated Erk/MAP kinase stabilizes Runx2 by increasing p300 levels and histone acetyltransferase activity. *Journal of Biological Chemistry*, 285(47), 36410-36419.
- Kogawa, A.C., Salgado, H.R.N. (2012). Doxycycline hyclate: a review of properties, applications and analytical methods. *International Journal of Life Science and Pharmaceutical Research*, ISSN, 2250-0480.
- Kopytynska-Kasperczyk, A., Dobrzynski, P., Pastusiak, M., Jarzabek, B., Prochwicz, W. (2015). Local delivery system of doxycycline hyclate based on  $\epsilon$ -caprolactone copolymers for periodontitis treatment. *International Journal of Pharmaceutics*, 491(1-2), 335-344.
- Larsen, T., Fiehn, N.E. (2017). Dental biofilm infections—an update. *Apmis*, 125(4), 376-384.
- Lee, D.E., Kim, J.H., Choi, S.H., Cha, J.H., Bak, E.J., Yoo, Y.J. (2015). Periodontitis mainly increases osteoclast formation via enhancing the differentiation of quiescent osteoclast precursors into osteoclasts. *Journal of Periodontal Research*, 50(2), 256-264.
- Lee, Y.H., Nahm, D.S., Jung, Y.K., Choi, J.Y., Kim, S.G., Cho, M. *et al.* (2007). Differential gene expression of periodontal ligament cells after loading of static compressive force. *Journal of Periodontology*, 78(3), 446-452.
- Lee, H.S., Lee, J., Kim, S.O., Song, J.S., Lee, J.H., Lee, S.I. *et al.* (2013). Comparative gene-expression analysis of the dental follicle and periodontal ligament in humans. *PLoS one*, 8(12), e84201.
- Lee, M.S., Kim, H.S., Yeon, J.T., Choi, S.W., Chun, C.H., Kwak, H.B. *et al.* (2009). GM-CSF regulates fusion of mononuclear osteoclasts into bone-resorbing osteoclasts by activating the Ras/ERK pathway. *The Journal of Immunology*, 183(5), 3390-3399.
- Li, Y., Jacox, L.A., Little, S.H., Ko, C.C. (2018). Orthodontic tooth movement: The biology and clinical implications. *The Kaohsiung Journal of Medical Sciences*, 34(4), 207-214.
- Loree, J., Lappin, S.L. (2019). Bacteriostatic Antibiotics. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing LLC.
- Maeda, H., Wada, N., Fujii, S., Tomokiyo, A., Akamine, A. (2011). Periodontal ligament stem cells. in *Stem Cells. InTech, Croatia*, 619-636.
- Marchesan, J.T., Scanlon, C.S., Soehren, S., Matsuo, M., Kapila, Y.L. (2011). Implications of cultured periodontal ligament cells for the clinical and experimental setting: a review. *Archives of Oral Biology*, 56(10), 933-943.
- Margolis, H.C., Kwak, S.Y., Yamazaki, H. (2014). Role of mineralization inhibitors in the regulation of hard tissue biomineralization: relevance to initial

- enamel formation and maturation. *Frontiers in Physiology*, 5, 339.
- Matsuo, M., Takahashi, K. (2002). Scanning electron microscopic observation of microvasculature in periodontium. *Microscopy Research and Technique*, 56(1), 3-14.
- Millán, J.L. (2013). The role of phosphatases in the initiation of skeletal mineralization. *Calcified Tissue International*, 93(4), 299-306.
- Mohd-Dom, T.N., Abdul-Muttalib, K., Ayob, R., Lan, Y.S., Mohd-Asadi, A.S., Abdul-Manaf, M.R. *et al.* (2013). Periodontal status and provision of periodontal services in Malaysia: trends and way forward. *Journal of Public Health Medicine*, 13(2), 38-47.
- Moradian-Oldak, J. (2012). Protein-mediated enamel mineralization. *Frontiers in Bioscience: A Journal and Virtual Library*, 17, 1996.
- Nazir, M.A. (2017). Prevalence of periodontal disease, its association with systemic diseases and prevention. *International Journal of Health Sciences*, 11(2), 72.
- Nibali, L., Fedele, S., Donos, N., & D’Aiuto, F. (2013). The role of interleukin-6 in oral diseases. *Dimensions of Dental Hygiene*, 11(1), 28-34.
- Orimo, H. (2010). The mechanism of mineralization and the role of alkaline phosphatase in health and disease. *Journal of Nippon Medical School*, 77(1), 4-12.
- Orimo, H., Shimada, T. (2008). The role of tissue-nonspecific alkaline phosphatase in the phosphate-induced activation of alkaline phosphatase and mineralization in SaOS-2 human osteoblast-like cells. *Molecular and Cellular Biochemistry*, 315(1-2), 51-60.
- Philip, N. (2019). State of the art enamel remineralization systems: the next frontier in caries management. *Caries Research*, 53(3), 284-295.
- Rahman, M.S., Akhtar, N., Jamil, H.M., Banik, R.S., Asaduzzaman, S.M. (2015). TGF- $\beta$ /BMP signaling and other molecular events: regulation of osteoblastogenesis and bone formation. *Bone Research*, 3, 15005.
- Ramadan, M.F. (2007). Nutritional value, functional properties and nutraceutical applications of black cumin (*Nigella sativa* L.): an overview. *International Journal of Food Science and Technology*, 42(10), 1208-1218.
- Raval, J.P., Chejara, D.R., Ranch, K., Joshi, P. (2018). Development of injectable in situ gelling systems of doxycycline hyclate for controlled drug delivery system. In *Applications of Nanocomposite Materials in Drug Delivery*, 149-162. Woodhead Publishing.
- Van Der Rest, M., Garrone, R. (1991). Collagen family of proteins. *The FASEB Journal*, 5(13), 2814-2823.
- Rukshar, A., Neha, G.B. (2013). Effects of *Nigella sativa* against osteoporosis. *International Journal of Pure and Applied Bioscience*, 1(2), 6-14.
- Shaddox, L.M., Walker, C.B. (2010). Treating chronic periodontitis: current status, challenges, and future directions. *Clinical, Cosmetic and Investigational Dentistry*, 2, 79.
- Shaw, L., Harjunmaa, U., Doyle, R., Mulewa, S., Charlie, D., Maleta, K. *et al.* (2016). Distinguishing the signals of gingivitis and periodontitis in supragingival plaque: a cross-sectional cohort study in Malawi. *Applied and Environmental Microbiology*, 82(19), 6057-6067.
- Skidmore, R., Kovach, R., Walker, C., Thomas, J., Bradshaw, M., Leyden, J. *et al.* (2003). Effects of subantimicrobial-dose doxycycline in the treatment of moderate acne. *Archives of Dermatology*, 139(4), 459-464.
- Smiley, C.J., Tracy, S.L., Abt, E., Michalowicz, B.S., John, M.T., Gunsolley, J. *et al.* (2015). Systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts. *The Journal of the American Dental Association*, 146(7), 508-524.
- Su, J.L., Chiou, J., Tang, C.H., Zhao, M., Tsai, C.H., Chen, P.S. *et al.* (2010). CYR61 regulates BMP-2-dependent osteoblast differentiation through the  $\alpha\beta 3$  integrin/integrin-linked kinase/ERK pathway. *Journal of Biological Chemistry*, 285(41), 31325-31336.
- Thummuri, D., Jeengar, M.K., Shrivastava, S., Nemani, H., Ramavat, R.N., Chaudhari, P. (2015). Thymoquinone prevents RANKL-induced osteoclastogenesis activation and osteolysis in an in vivo model of inflammation by suppressing NF-KB and MAPK Signalling. *Pharmacological Research*, 99, 63-73.
- Tomasi, C., Wennström, J.L. (2004). Locally delivered doxycycline improves the healing following non-surgical periodontal therapy in smokers. *Journal of Clinical Periodontology*, 31(8), 589-595.
- Tonetti, M.S., Jepsen, S., Jin, L., Otomo-Corgel, J. (2017). Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. *Journal of Clinical Periodontology*, 44(5), 456-462.
- Tuncer, B. B., Özmeriç, N., Tuncer, C., Teoman, İ., Çakılcı, B., Yücel, A. *et al.* (2005). Levels of interleukin-8 during tooth movement. *The Angle Orthodontist*, 75(4), 631-636.
- Wiebe, C.B., Putnins, E.E. (2000). The periodontal disease classification system of the American Academy of Periodontology-an update. *Journal-Canadian Dental Association*, 66(11), 594-599.
- Wirries, A., Schubert, A.K., Zimmermann, R., Jabari, S., Ruchholtz, S., El-Najjar, N. (2013). Thymoquinone accelerates osteoblast differentiation and activates bone morphogenetic protein-2 and ERK pathway. *International Immunopharmacology*, 15(2), 381-386.
- Yamaguchi, N., Chiba, M., Mitani, H. (2002). The induction of c-fos mRNA expression by mechanical stress in human periodontal ligament cells. *Archives of Oral Biology*, 47(6), 465-471.
- Yimer, E.M., Tuem, K.B., Karim, A., Ur-Rehman, N., Anwar, F. (2019). *Nigella sativa* L. (black cumin): a promising natural remedy for wide range of illnesses. *Evidence-Based Complementary and Alternative Medicine*, 2019.
- Yuan, H., Ma, Q., Ye, L., Piao, G. (2016). The traditional medicine and modern medicine from natural products. *Molecules*, 21(5), 559.
- Zoch, M.L., Clemens, T.L., Riddle, R.C. (2016). New insights into the biology of osteocalcin. *Bone*, 82, 42-49.



# Management of radix entomolaris on permanent mandibular first molar complicated with ledge: a case report

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## Abstract

Radix entomolaris is a supernumerary root located distolingually on permanent mandibular molars. It is considered as an anatomical variant and usually curved buccolingually. The presence of radix entomolaris can be endodontically challenging to treat and susceptible to endodontic mishaps such as ledge. This report describes the management of ledge in a radix entomolaris with type-3 curvature on tooth 46. Ledge was bypassed using pre-curved K-files #10, #15, and #20 sequentially and preparation was continued using step-back technique. Then, the root canal was obturated using gutta percha and root canal sealer. Diagnostic and clinical challenges in managing radix entomolaris, and prevention and management of ledge were also discussed.

**Keywords:** endodontic mishap, distolingual root, glide path, radix entomolaris, root canal treatment

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## Introduction

Permanent mandibular first molar (PMFM) is the first permanent teeth to erupt, and its eruption is frequently overlooked leading to early caries and endodontic intervention is often required. Several morphologic variations of the PMFM have been mentioned in the literature and one of the major variants is the presence of radix entomolaris (RE) (Abella *et al.*, 2012) which is a supernumerary root located lingual to the distal root of PMFM (Calberson *et al.*, 2007).

The complexity of the internal anatomy of RE can complicate non-surgical root canal treatment (NSRCT). RE can have severely

curved root canal with small radius of curvature (Abella *et al.*, 2012) hence increases the risk of endodontic mishaps such as ledge which can further complicate the treatment modalities.

Presence of ledge can also influence the outcome of NSRCT; may exclude the possibility of thorough disinfection and obturation especially on the root canal system apical to the ledge (Jafarzadeh and Abbott, 2007b). This in turn will lead to persistent endodontic pathosis and post-treatment disease.

This report presents a case of RE in a Malay patient and is aimed to discuss the diagnostic

and clinical challenges in managing RE, and prevention and management of ledge.

## Case Report

A 36-year-old Malay gentleman was referred from undergraduate clinic for endodontic management of tooth 46 due to severely curved distal root. The patient was medically fit and healthy and presented with asymptomatic fractured temporary restoration on right PMFM (tooth 46) (Figure 1A). The tooth had delayed response to cold test and electric pulp test. Radiographically, presence of carious lesion reaching the mesial pulp horn, severely short distal root, and curved mesial root with signs of apical periodontitis (Figure 1B). Diagnosis of asymptomatic irreversible pulpitis with asymptomatic apical periodontitis was given.

Non-surgical root canal treatment was commenced under local anaesthesia; inferior alveolar nerve blocked using Mepivacaine hydrochloride (2% Scandonest) and rubber dam isolation, and visually aided with dental operating microscope OPMI® pico (Carl Zeiss, Inc, Oberkochen, Germany). Temporary restoration and carious lesion were removed, and access cavity revealed three distinct root canal orifices. However, the distal root canal orifice is not located at the centre according to the law of symmetry (Krasner and Rankow, 2004), and map of the chamber floor indicates presence of another distal root canal located lingually. The orifice of distolingual root canal was scouted and located far lingually. Calcification was present that hinders the direct view of the root canal and was removed using ultrasonic scaler Start-X #3 (Dentsply Sirona, Switzerland) and the orifice was enlarged lingually (Figure 1E) to allow access to the root canal.

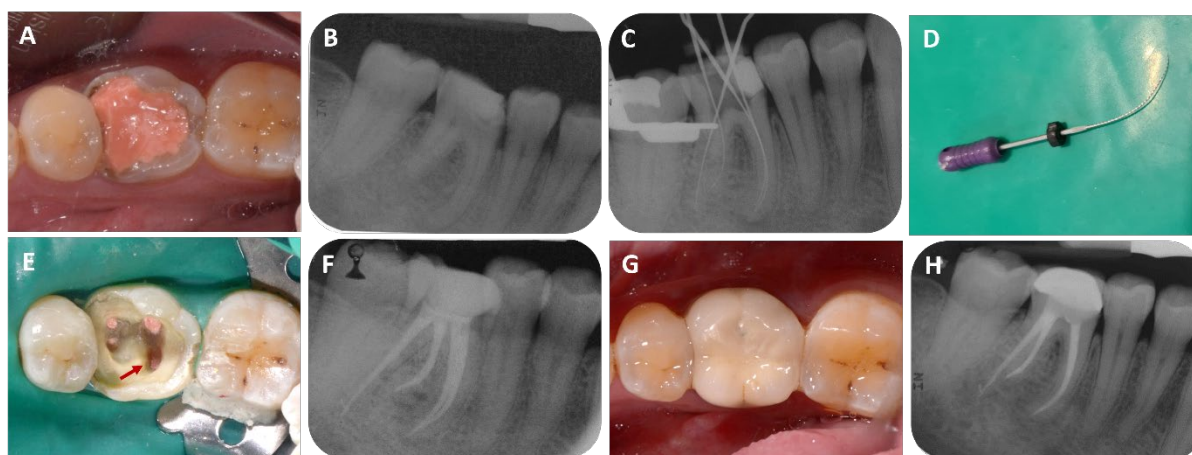
Working length was determined using electronic apex locator Root ZX mini (J Morita Corp, Japan) and verified with periapical radiograph. Radiographic outlines of the distal root canals showed two separate roots with different curvatures (Figure 1C); a curvature of more than 30-degrees was

noted on the disto-lingual root canal (Figure 1C-D). These findings together with the unusual location of the disto-lingual root canal orifice indicated presence of RE.

Prior to root canal preparation, manual glide path was ensured for all root canals using K-files #8, #10, and #15 (Dentsply Sirona, Switzerland) followed by rotary PathFile 013, 016, and 019 (Dentsply Sirona, Switzerland). During root canal preparation on RE, ledge was created, noticed due to loss of working length. The ledge was managed by pre-curving the tip of 21mm length K-file #10, the curved tip was inserted towards the wall opposite to the ledge, and the K-file was gently slide to the full working length bypassing the ledge. Sequentially, K-files #15 and #20 were used in the same manner. Preparation of RE was continued using step-back technique to ISO #25. The other root canals were prepared using ProTaper Next (Dentsply Sirona, Switzerland) to size X2. 3% sodium hypochlorite (NaOCl) (Coltène/Whaledent, Switzerland) was copiously used to irrigate the root canals throughout the procedure. Final irrigation protocol was performed using NaOCl, 17% ethylenediaminetetraacetic acid, and 0.2% chlorhexidine, activated by EndoActivator (Dentsply Sirona, Switzerland).

The root canals were obturated using gutta percha (GP) and AH-Plus sealer (Dentsply Detrey, Germany). Warm vertical compaction technique was utilised for all root canals except for RE, where cold lateral compaction was used instead. The GP cone for the RE was pre-curved and treated with 70% isopropyl alcohol prior to obturation to improve rigidity of GP and maintain the pre-curved state to bypass the ledge. GP was cut at 2mm below orifice (Figure 1E) and sealed with composite resin Smart Dentine Replacement (Dentsply Detrey, Germany), obturation radiograph taken (Figure 1F) and composite core placed. Tooth was restored with porcelain-fused to metal crown (Figure 1G) as definitive restoration.

At 6-month and 1-year review, tooth 46 remained asymptomatic and absence of periapical radiolucency radiographically (Figure 1H).



**Figure 1.** Treatment on tooth 46. A: Pre-operative photograph. B: Pre-operative radiograph. C: Working length radiograph. D: Impression of canal curvature on K-file. E: Clinical photograph of obturation. Orifice of RE is relocated more lingually (arrow). F: Obturation radiograph. G: Cementation of PFM crown. H: 1-year review radiograph

## Discussion

The presence of RE is often overlooked especially due to its rare incidence in Western countries, however, its incidence in Malaysian population can range between 11.3% to 21.4% (Deng *et al.*, 2018; Pan *et al.*, 2019). Its presence is significant in endodontics, as it poses several challenges during NSRCT: (1) diagnosis, (2) orifice location, (3) root canal preparation, and (4) root canal obturation.

Diagnosis of RE is important to avoid intra-operative complications or missed canal (Abella *et al.*, 2012), and it can be made through thorough clinical and radiographical examination. The clinical crown can be inspected for the presence of prominent occlusal distal lobe, *tuberculum paramolare* and cervical prominence (Calberson *et al.*, 2007). However, in this case, minimal coronal tooth structure limits the inspection to diagnose RE.

Periapical radiograph utilizing parallax technique can be used to inspect the root anatomy and prevent overlapping of the distal roots. A mesial view angulated at 25-degrees can improve the visibility of RE compared to distal view (Wang *et al.*, 2011). Three-dimensional radiograph such as cone beam computed tomography (CBCT) can be supplemented to allow clinicians to further

visualize and anticipate the complexity of the root anatomy in third dimension whilst eliminating superimposition. The variation of RE can also be further classified according to its morphology and curvature using CBCT (Calberson *et al.*, 2007). The radiation dose for a small field of view CBCT is less than that of conventional CT scan, however based on the concept of “As Low As Reasonably Achievable”, CBCT should only be undertaken when more complex anatomy is to be anticipated (Patel *et al.*, 2014). In this case, CBCT was not warranted, but another periapical radiograph should have been taken due to the unclear presence of RE on pre-operative radiograph.

Besides diagnostic challenge, the orifice can be frequently missed due to the presence of calcification. Visual aids such as dental loupes or dental operating microscope can be useful. The law of symmetry and chamber floor map (Krasner and Rankow, 2004) can aid in the location of the orifice. Usually, the orifice will be located more distolingually than the main distal root canal.

The RE is usually curved buccolingually, hence orifice relocation may be warranted to gain straight line access (Figure 1E). However, caution must be taken to prevent strip perforation by avoiding excessive dentine removal due to the slender and curved root.

RE can have variations in the degree and location of curvature (De Moor *et al.*, 2004). There are three curvature variations: (1) type 1: straight root, (2) type 2: curvature at the cervical third of root and continue as straight root to the apex, and (3) type 3: 2 curvatures; at cervical third and at middle or apical third of the root. It was also reported that most RE has severe curvature of greater than 25-degrees buccolingually.

In this patient's case, a type 3 RE is probable because two curvatures were observed on the initial scouting file (Figure 1D). Having multiple curvatures increases the chance of shaping aberration such as ledge, which occurred in the case reported. Other endodontic mishaps such as perforation, canal transportation and zipping, and instrument separation can also occur.

To manage a curved root canal, it is mandatory for all endodontic hand files to be pre-curved at the tip prior to introducing to the root canal. Small diameter and taper files should be used for initial scouting file such as K-file #10, to provide critical information regarding the extent and degree of curvature (Alovisi *et al.*, 2016) (Figure 1D).

Glide path should also be established prior to shaping. This is to ensure smooth pathway of shaping files to the apex. Previously, the use of rotary nickel-titanium (NiTi) PathFile system was recommended (Abella *et al.*, 2012) however, recently newer rotary glide path files have been introduced with one file system such as ProGlider, Wave One Gold Glider, and TruNatomy Glider. The efficacy of different glide path systems has been investigated, and the results from *ex vivo* studies utilizing micro-CT have shown that rotary glide path system produces less canal aberrations, canal transportation, and faster working time compared to manual glide path using hand instrument (Pasqualini *et al.*, 2012; Alovisi *et al.*, 2016; Paleker and van der Vyver, 2016; Vorster *et al.*, 2018). Comparable results were also seen between different rotary glide path systems in preserving the root canal anatomy (Plotino *et al.*, 2020). A systematic review and meta-analysis have shown that rotary glide path systems reduce debris extrusion and

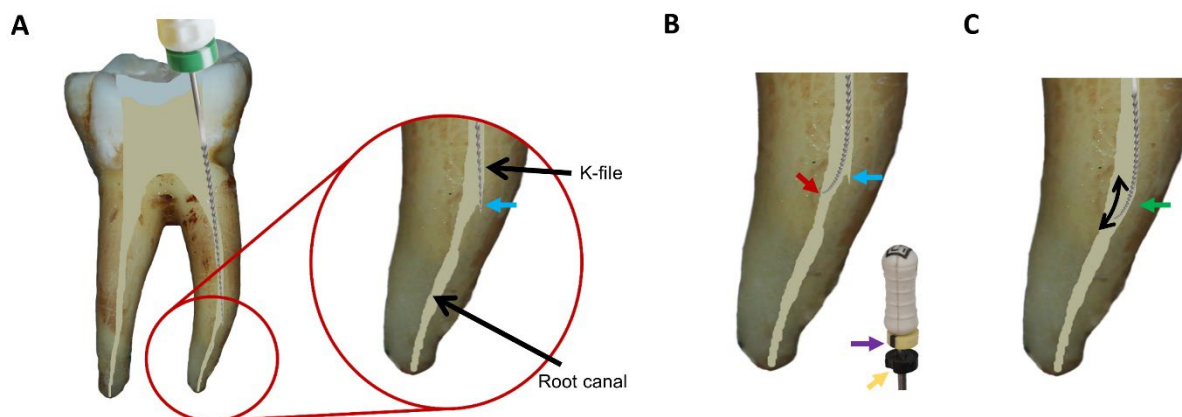
improves the preservation of root canal anatomy after preparation. However, the effect of glide path on the shaping ability of consequent rotary NiTi instruments remained unclear (Plotino *et al.*, 2020).

Ledge can be prevented by enlarging the root canal orifice and removing the dentinal shelf to reduce the degree of curvature and gained straight line access coronally. Furthermore, pre-curving the file prior to insertion is also necessary. Additionally, endodontic files should not be forced apically but negotiated slowly apically with adequate lubricant using balanced-force technique. However, in this case, enlarging the orifice further is risky; RE is slender and liable to strip perforation. Pre-curving ProTaper Next is not possible without permanently distorting the file, due to the metallurgy. It is preferable to use martensitic NiTi file such as Hyflex, ProTaper Gold, or TruNatomy in this case.

The first step in managing ledge is to recognise the ledge. There will be a loss of tactile sensation of the tip of the instrument binding into the root canal, and the feeling of instrument hitting a solid wall (Figure 2A). The second step is to bypass the ledge through negotiation with endodontic file. Shortest file that can reach the working length should be used. This will allow better control when manoeuvring the file in the root canal. Introduce a small (#10 or #15) pre-curved file tip towards the wall opposite to the ledge (Figure 2B), with slight rotation motion together with "picking" motion to allow advancement of the file, bypassing the ledge, and gently slide it to the full working length. However, if there is resistance, and the file cannot advance, changing the direction of the curved tip and repeating the process can be done until the ledge can be bypassed. The use of C+ file have been introduced to ease in the attempt of bypassing ledge. To remove the ledge, the file should be maintained apical to ledge but coronal to foramen to prevent unnecessary enlargement of apical foramen. Utilising a filing motion and occasionally very short push-pull movements to remove the ledge is effective (Figure 2C). Adequate lubrication and frequent irrigation are needed to

prevent debris accumulation and canal blockage. Once ledge is removed, root canal preparation can be continued using rotary NiTi instruments (Jafarzadeh and Abbott,

2007a). In this case, although ledge was bypassed, step-back technique using K-files were used for apical preparation.



**Figure 2.** Bypassing and removing ledge. A: Ledge formation (blue arrow). B: To bypass the ledge, pre-curved tip of endodontic file (red arrow) is directed opposite to the ledge (blue arrow) guided by the line (purple arrow) or notch (yellow arrow) on the rubber stopper. C: To remove ledge, brushing the canal wall apical to the ledge (green arrow)

Obturation of a curved root canal can be performed using several techniques; warm vertical compaction, cold lateral compaction, and carrier based obturation (Jafarzadeh and Abbott, 2007b). When cold lateral compaction is opted, NiTi finger spreader is advocated to improve the depth of penetration of spreader into the curved root canal. However, in the case of severely curved root canal, thermoplastic or carried based gutta percha (GP) might be more applicable (Jafarzadeh and Abbott, 2007b). Obturation of a ledged root canal, however, poses a greater challenge; GP cone might not be able to bypass the ledge and obturation will be short of the working length. This can be improved by pre-curving the GP tip and treated with 70% isopropyl alcohol to increase the rigidity to bypass the ledge (Jafarzadeh and Abbott, 2007b), which was performed in this case, and was able to be obturated to the working length (Figure 1E). Alternatively, thermoplastic GP using continuous wave technique (Jafarzadeh and Abbott, 2007a) or obturation using bioceramic root canal sealers can be used to be injected into the root canal.

At 1-year review, there were evidence of healed bony lesion at the periapex of tooth 46. Despite the complication of ledge, the RE

was able to be cleaned, shaped, and obturated to the working length, which have contributed to the favourable prognosis of the tooth. It is to be suggested that clinicians should be updated on the endodontic instruments and materials to help in the prevention and management of mishaps, and have sound knowledge and understanding on root canal morphology associated with RE to improve the endodontic treatment outcome.

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### References

- Abella, F., Patel, S., Durán-Sindreu, F., Mercadé, M., Roig, M. (2012). Mandibular first molars with disto-lingual roots: review and clinical management', *International Endodontic Journal*, 45(11), 963-978.
- Alovisi, M., Cemenasco, A., Mancini, L., Paolino, D., Scotti, N., Bianchi, C.C., Pasqualini, D. (2017). Micro-CT evaluation of several glide path techniques and ProTaper Next shaping outcomes in maxillary first molar curved

- canals. *International Endodontic Journal*, 50(4), 387-397.
- Calberson, F.L., De Moor, R.J., Deroose, C.A. (2007). The radix entomolaris and paramolaris: clinical approach in endodontics. *Journal of Endodontics*, 33(1), 58-63.
- Deng, P.U., Halim, M.S., Masudi, S.A.M., Al-Shehadat, S., Ahmad, B. (2018). Cone-beam computed tomography analysis on root and canal morphology of mandibular first permanent molar among multiracial population in East Coast Malaysian population. *European Journal of Dentistry*, 12(03), 410-416.
- Jafarzadeh, H., Abbott, P.V. (2007a). Dilaceration: review of an endodontic challenge. *Journal of Endodontics*, 33(9), 1025-1030.
- Jafarzadeh, H., Abbott, P.V. (2007b). Ledge formation: review of a great challenge in endodontics. *Journal of Endodontics*, 33(10), 1155-1162.
- Krasner, P., Rankow, H.J., 2004. Anatomy of the pulp-chamber floor. *Journal of Endodontics*, 30(1), 5-16.
- De Moor, R.J.G., Deroose, C.A.J.G., Calberson, F.L.G. (2004). The radix entomolaris in mandibular first molars: an endodontic challenge. *International Endodontic Journal*, 37(11), 789-799.
- Paleker, F., van der Vyver, P.J. (2016). Comparison of canal transportation and centering ability of K-files, ProGlider File, and G-Files: a micro-computed tomography study of curved root canals. *Journal of Endodontics*, 42(7), 1105-1109.
- Pan, J.Y.Y., Parolia, A., Chuah, S.R., Bhatia, S., Mutalik, S., Pau, A. (2019). Root canal morphology of permanent teeth in a Malaysian subpopulation using cone-beam computed tomography. *BMC Oral Health*, 19(1), 1-15.
- Pasqualini, D., Bianchi, C.C., Paolino, D.S., Mancini, L., Cemenasco, A., Cantatore, G., et al. (2012). Computed micro-tomographic evaluation of glide path with nickel-titanium rotary PathFile in maxillary first molars curved canals. *Journal of Endodontics*, 38(3), 389-393.
- Patel, S., Durack, C., Abella, F., Roig, M., Shemesh, H., Lambrechts, P., et al. (2014). European Society of Endodontology position statement: the use of CBCT in endodontics. *International Endodontic Journal*, 47(6), 502-504.
- Plotino, G., Nagendrababu, V., Bukiet, F., Grande, N.M., Veettil, S.K., De-Deus, G., et al. (2020). Influence of negotiation, glide path, and preflaring procedures on root canal shaping-terminology, basic concepts, and a systematic review. *Journal of Endodontics*, 46(6), 707-729.
- Vorster, M., van der Vyver, P.J., Paleker, F. (2018). Canal transportation and centering ability of WaveOne Gold in combination with and without different glide path techniques. *Journal of Endodontics*, 44(9), 1430-1435.
- Wang, Q., Yu, G., Zhou, X.D., Peters, O.A., Zheng, Q.H., Huang, D.M. (2011). Evaluation of X-ray projection angulation for successful radix entomolaris diagnosis in mandibular first molars in vitro. *Journal of Endodontics*, 37(8), 1063-1068.



# The future direction of the Dental Public Health in Malaysia

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## Abstract

The continued recognition of Dental Public Health as one speciality in dentistry provides an opportunity for the speciality to rediscover and re-evaluate itself. As a discipline, public health dentistry evolved for many years to address the issues faced by our dynamic society, particularly Malaysia. Increased investment is necessary to see a tangible improvement in oral health. In this light, public health dentistry represents the nation's dental conscience, as changes in DPH mirror both changes in society and the dental practice. Prevention and access to dental care for the underprivileged groups are as pertinent as providing medical and dental care for people with infectious diseases. Changes could be implemented through national oral health objectives and strategies and a myriad of new financing mechanisms. Despite the progressive changes in today's world, the speciality's goal to improve the public's oral health and its commitment to work through 'organised community efforts' to achieve this goal remains. This article highlights the need for a long-term solution that could ensure the sustainability of DPH in Malaysia. It empowers DPH specialists to use their expertise for patients' benefit across the three pillars of public health - health improvement, care, and protection. This could be achieved through the support of the dental community.

**Keywords:** *community, dentistry, Dental Public Health, Malaysia specialist*

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## Introduction

Undoubtedly, 2020 has been an unforgettable, challenging year for everyone across the globe. The emergence of the highly contagious SARS-CoV-2 coronavirus in 2019 (Sakurai *et al.*, 2020) has shaken the world to its core. The whole world stood still as lockdowns were enforced to curb the spread of the virus. Covid-19 related lockdowns and restrictions have had a significant impact on a country's economy as well as people's social and emotional well-being (Duke Global Health Institute, 2020). As the saying goes, pandemics are lived forward and understood backwards. This statement reflects the situation during the COVID-19

pandemic where the public and dental professionals grapple with the reality of

living with COVID-19 restrictions (Che Musa *et al.*, 2021b; Epstein *et al.*, 2020). The profession is facing critical challenges to spread health promotion messages to the public more than ever. In this regard, there are concerns over what the future holds for dentistry and Dental Public Health (DPH) in particular.

In addition, the pandemic significantly affects patients and dental professionals (Guo *et al.*, 2020). Studies also found that oral health inequalities have increased during the pandemic due to economic and social restrictions (Marmot, 2020; Watt, 2020). Based on current demands (Ahmadi

*et al.*, 2020; Epstein *et al.*, 2020), there is a need to explore sustainable ways for dental professionals to embrace the new norms. Such initiative could help convince the public and encourage them to seek high quality, safe dental care (Passarelli *et al.*, 2020; Watt, 2020).

DPH focuses on preventing and promoting oral health (Chesnutt, 2016) plays a significant role in ensuring access to dental health. The DPH ecosystem was working successfully before pandemic. This is evident in the success of DPH teams in disseminating dental agenda in Malaysia (Oral Health Division Malaysia, 2011; Oral Health Programme Malaysia, 2019), as it has provided significant input in improving access to dental care. To achieve and maintain these goals, DPH personnel must be skilled in various areas, such as population-based oral health planning, therapies and methods for oral disease prevention and control, as well as oral health promotion (Hiremath, 2007; Patel *et al.*, 2018). As DPH offers independent support and assistance to organisations throughout the health and social care system, it must be retained to guarantee that patient needs are fulfilled and acknowledged, and the population oral health is prioritised. Thus, DPH leadership and expertise are an essential component of the equation in improving population oral health and reducing oral health inequalities. While the linkages between oral and general health are well documented and understood within the dentistry community, there is much to do to ensure the proper integration of oral care into general patient care.

Influencing the broader social determinants of health is another crucial role for DPH, as to recognise the impact of adverse socioeconomic and environmental circumstances to poor oral health outcomes (Che Musa *et al.*, 2020). Such impact is linked to climate change and the dental profession needs to evaluate how dental public care could be more sustainable to fulfil the aspiration of the Ministry of Health based on their report in 2018 and 2020 (Ministry of Health Malaysia, 2018, 2020).

Moreover, this speciality is also responsible in setting the potential budget on public health and for prioritising disease preventive measures and health improvement at the local, regional, and national levels. In this light, higher investment is required to achieve measurable improvements in oral health for Malaysia (Che Musa *et al.*, 2021a). Funding could be channelled to local governments, which have legislative responsibility for health improvement to ensure health promotion programmes could be done with sufficient and sustainable. Moreover, it is necessary to increase dental health programmes' reach, engagement and impact to communities. Oral health improvement programmes such as community water fluoridation and tooth brushing supervision with fluoridated toothpaste should be intensified to emphasise the importance of dental health care among the public. It is a notion that needs to be spread through by all means necessary (Che Musa, 2017).

The DPH speciality also among other dental specialist's disciplines that experiences such regular upheaval. Hence, this speciality requires a long-term solution which allows this speciality to become sustainable and provide adequate dental care to the population health across the three pillars of public health - health improvement, healthcare public health, and health protection. Changes could be implemented through national oral health objectives and strategies and a myriad of new financing mechanisms. Despite the progressive changes in today's world, the speciality's goal to improve the public's oral health and its commitment to work through 'organised community efforts' to achieve this goal remains. It is hoped that, DPH specialists and other health professionals in Malaysia will have a solid and secure platform to work from in the future and that DPH workforce will receive the necessary support and funding from each relevant organisation.

## References

- Ahmadi, H., Ebrahimi, A., Ghorbani, F. (2020). The impact of COVID-19 pandemic on dental practice in Iran: a questionnaire-based report. *BMC Oral*



- Health*, 20(1), 354. doi:10.1186/s12903-020-01341-x
- Che Musa, M. F. (2017). Malaysia healthcare system. *Journal of Biotechnology and Strategic Health Research*, 2(3), 7-10.
- Che Musa, M. F., Ab Halim, N., Sayed Kamar, S. H., Abllah, Z., Supa'at, S., Mohd Ibrahim, M. S. (2021a). Current concept of oral health and its potential implications for policy and practice of dental health coverage and insurance: post COVID-19 measurement. *IIUM Journal of Orofacial and Health Sciences*, 2(1), 4-13.
- Che Musa, M. F., Bernabe, E., Gallagher, J. E. (2020). The dental workforce in Malaysia: drivers for change from the perspectives of key stakeholders. *International Dental Journal*, 70(5), 360-373.
- Che Musa, M. F., Sayed Kamar, S. H., Hassan, Y. F. (2021b). Living With COVID-19 is a reality among dental fraternity: a reflection. *Journal of Biotechnology and Strategic Health Research*, 5(1).
- Chesnutt, I. G. (2016). *Dental Public Health at a Glance*. Oxford, England: Wiley Blackwell.
- Duke Global Health Institute. (2020). Will low-income countries be left behind when COVID-19 Vaccines Arrive? Retrieved from <https://globalhealth.duke.edu/news/will-low-income-countries-be-left-behind-when-covid-19-vaccines-arrive>
- Epstein, J. B., Chow, K., Mathias, R. (2020). Dental procedure aerosols and COVID-19. *The Lancet: Infectious Diseases*, 1.
- Guo, H., Zhou, Y., Liu, X., Tan, J. (2020). The impact of the COVID-19 epidemic on the utilization of emergency dental services. *Journal of Dental Sciences*.
- Hiremath, S. S. (2007). *Textbook of Preventive and Community Dentistry*. New Delhi: Elsevier Publication.
- Marmot, M. (2020). Society and the slow burn of inequality. *Lancet*, 395(10234), 1413-1414.
- Ministry of Health Malaysia. (2018). *Annual Report: Ministry of Health Malaysia 2018*. Retrieved from Putrajaya:
- Ministry of Health Malaysia. (2020). *National Health and Morbidity Survey 2019 (fact Sheet): Non-communicable diseases, healthcare demand and health literacy*. Retrieved from Shah Alam: <http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2019/Fact Sheet NHMS 2019-English.pdf>
- Oral Health Division Malaysia. (2011). *National Oral Health Plan for Malaysia 2011-2020*. Retrieved from Putrajaya: <http://www.moh.gov.my/>
- Oral Health Programme Malaysia. (2019). *Annual Report 2018*. Retrieved from Putrajaya: [http://ohd.moh.gov.my/images/pdf/annual\\_rpt/annual\\_rpt18.pdf](http://ohd.moh.gov.my/images/pdf/annual_rpt/annual_rpt18.pdf)
- Passarelli, P. C., Rella, E., Manicone, P. F., Garcia-Godoy, F., D'Addona, A. (2020). The impact of the COVID-19 infection in dentistry. *Experimental Biology and Medicine (Maywood)*, 245(11), 940-944.
- Patel, R., Witton, R., Potterton, R., Smith, W., Kaimi, I. (2018). Dental Public Health in Action: Understanding oral health care needs and oral health-related quality of life in vulnerable adults in Plymouth. *Community Dent Health*, 35(4), 197-200.
- Sakurai, A., Sasaki, T., Kato, S., Hayashi, M., Tsuzuki, S. I., Ishihara, T., et al. (2020). Natural History of Asymptomatic SARS-CoV-2 Infection. *The New England Journal of Medicine*, 383(9), 885-886.
- Watt, R. G. (2020). COVID-19 is an opportunity for reform in dentistry. *The Lancet*, 396, 462.

# Remote teaching and learning during COVID-19 “lockdown” period in Malaysia: one institution’s experience

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## Abstract

The coronavirus disease (COVID-19) has prompted significant changes for most programs' teaching methods worldwide, especially during the “lockdown” period. Most education institutions in Malaysia were indefinitely closed, with the teaching and learning activities were resumed remotely. This letter highlights Kulliyah of Dentistry, International Islamic University Malaysia’s approaches in handling our teaching and learning activities (i.e., lectures, tutorials, seminars, practical, and the assessment), as well as the challenges faced by lecturers and students during the previous “lockdown” period.

**Keywords:** COVID-19, e-learning, Malaysia, remote, teaching and learning

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Dear Editor,

The coronavirus disease (COVID-19) has instigated a nationwide “lockdown” in Malaysia which began on 18 March 2020 upon the Movement Control Order, issued by the government. Even though the whole country was not in a total lockdown, many sectors have been badly affected including the education sector, in which all education institutions were indefinitely ordered for closure by the government (Ismail *et al.*, 2021). Because of that, education institutions were inevitably urged to resume teaching and learning activities remotely via online mode.

Kulliyah of Dentistry (KOD), International Islamic University Malaysia (IIUM) is a dental faculty (kulliyah) which is located in Kuantan, Pahang, a state in the East Coast of Malaysia. During that period, the Kulliyah have consolidated on the following approaches in order to advocate the Ministry of Higher Education’s order for remote e-learning:

1. *Asynchronous lectures:* KOD utilized Google Classroom (<https://classroom.google.com/u/0/h>) as a platform to arrange the

conduct of each course. Students and all co-teachers were invited to join their respective Google Classroom. Usually, lecturers uploaded their recorded teaching videos into the Google Classroom before their respective sessions in the timetable. Most students were in favour of this approach as they can listen to the recorded lecture at their own suitable times. In this way, students can “pause” and “re-play” the lecture as they like. This has helped them to discern and process all information, especially the intricate concepts in which they might have missed during a one-off, face-to-face class session.

2. *Synchronous seminars, tutorials, and discussions:* The use of high internet bandwidth meeting platforms like Google Meet (<https://meet.google.com/>) and Zoom (<https://zoom.us/>) were reserved for seminars, tutorials, and discussions. The usage of these platforms was usually kept at optimal, taking into consideration of those students with internet difficulties.
3. *Practical:* Most laboratory practical sessions were postponed, except for those pre-recorded practical demonstration and experiment that involves simulations software which is free to be accessed and used by the students, *i.e.*, RatCVS and OBSIM software in pharmacology course. Each student was given the chance to experience to conduct the experiment by using their own devices. Unfortunately, some software was not designed to be used in smartphones, thus students without desktop or laptop might not be able to use them. In order to ensure the successful conduct of simulation experiments, the session usually requires a well-prepared

step-by-step student’s instructions manual.

4. *Clinical session:* All clinical sessions were postponed during this period.
5. *Assessment:* For continuous assessment, online assessment tools like Quizizz (<https://quizizz.com/>), Kahoot (<https://kahoot.com/>), Google Form (<https://www.google.com/forms/about/>) and “Poll” function in Telegram (<https://web.telegram.org/z/>) were utilized. These online assessment tools are convenient and freely available to both students and lecturers. In addition, these tools are embedded with a detailed performance analysis feature which is very convenient for getting the assessment marks. However, for examinations, the Kulliyah utilized our university’s e-learning platform, iTaLeem (<https://italeemc.iium.edu.my/>). The running of the examination through iTaLeem was aided with Zoom platform for monitoring.

In view of these newly employed approaches, we experienced some challenges in conducting remote online teaching and learning as both parties were still new and in the midst of adapting to this remote exercise. This remote teaching and learning exercise require lecturers to give extra efforts in making sure that at least a decent teaching video materials being uploaded in the Google Classroom prior to each class. As many of the lecturers were still amateur in online learning at that time, they were still not familiar with most of the online teaching tools. In view of this matter, the university had given us tremendous support by providing many in-house trainings prior to the start of remote online teaching and learning. In fact, local and international universities openly shared their online learning

experiences and expertise intra- and inter-universities to address this sudden order to implement remote teaching and learning activities.

On the other side, students' limitation on the internet access had been one of the important challenges during the conduct of online learning. Despite the availability of the high-tech online learning tools, students who subscribed to a limited data plan encountered problems in downloading the large sized-video lectures. Those who lived in the rural areas did not have stable internet connection, and some unfortunate students did not even have any internet access. On that note, it seems that online learning was not convenient for the unfortunate students. Even for those with an access to internet, there were some technical hiccups that occur during the conduct of the live synchronous session, and these have somehow demotivated both lecturers and students for online learning. On this regard, the university has allowed those students who faced internet problems as well as those having unavoidable issues in studying at home to return to the university. This great initiative was indeed remarkable to curb from education inequalities should the situation not properly addressed at the early stage of remote teaching and learning exercise.

Other than that, we found that it was difficult to develop student-lecturer and student-student relationships with the conduct of remote teaching and learning. As university has been a place for students networking and social opportunities for so long, these social skills were somehow impeded in comparison to the usual face-to-face class interaction (Schleicher, 2020).

In lieu of our previous experience with full remote online teaching and learning, it requires for an utmost commitment from the lecturers and students. Despite these challenges, the first episode of remote teaching learning during COVID-19 lockdown period has kickstarted the e-learning in many educational institutions, including us, and the era has been seen as the rising era of e-learning (Hermawan, 2021).

Now that all education institutions in Malaysia have re-opened, it seems appropriate to use blended learning approach (online plus face-to-face) as a precautionary measure to stop the spurting cases of COVID-19 in education institutions. It is also important to decide on how many percent of the online learning component that is appropriate to be incorporated so that the learning objectives are fulfilled. At the same time, education institutions need to revamp the teaching and learning environment with e-learning to suit with the current generation.

Author's Information: Dr. Azlini Ismail was a part of IIUM Educator 4.0 team, which was appointed by the University to coordinate the e-learning activities at Kulliyyah of Dentistry, International Islamic University Malaysia.

## References

- Hermawan, D. (2021). The rise of e-learning in covid-19 pandemic in private university: challenges and opportunities. *IJORE: International Journal of Recent Educational Research*, 2(1), 86-95.
- Ismail, A., Ismail, N. H., Abu Kassim, N. Y. M., Lestari, W., Ismail, A. F., & Sukotjo, C. (2021). Knowledge, perceived risk, and preventive behaviors amidst Covid-19 pandemic among dental students in Malaysia. *Dentistry Journal*, 9(12), 151.
- Schleicher, A. (2020). The impact of COVID-19 on education: Insights from education at a glance 2020. Retrieved from: <https://www.oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020.pdf>

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