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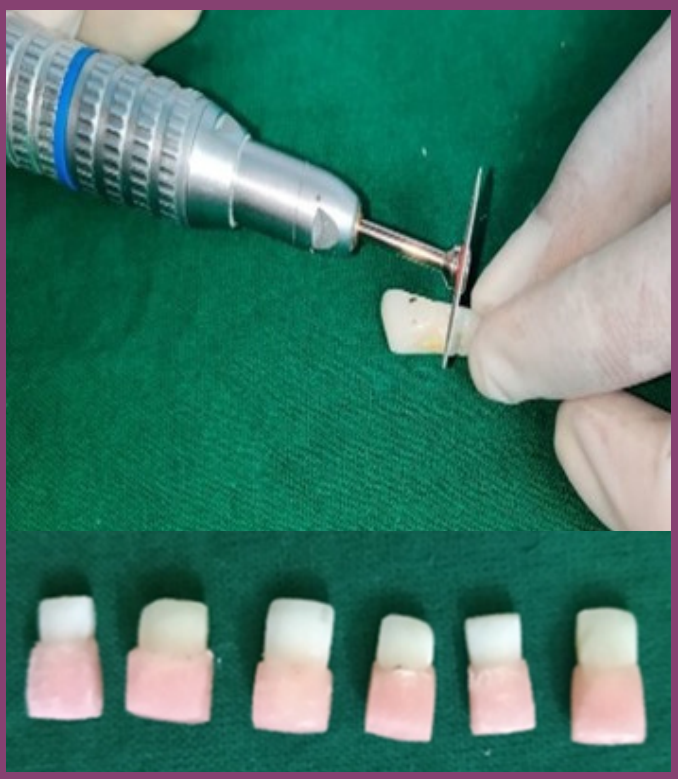

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# IIUM Journal of Orofacial and Health Sciences

# Editorial Board

# IIUM Journal of Orofacial and Health Sciences

## Aims and scope

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


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EDITORIAL Open Access

# Normality tests for statistical analysis in dentistry: A brief notes for researcher

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In the realm of dentistry research, statistical analysis is essential to deriving relevant conclusions from gathered data. The normality of the data distribution is one basic assumption that is frequently evaluated. This is important since it helps choose the right statistical tests and guarantees the validity of the findings. These brief notes provide an understanding of numerous normality tests and how to apply them in statistical analysis, making it an invaluable resource for dental researchers. There are multiple ways to assess if a variable follows a normal distribution, including visual inspections and a variety of statistical tests which are not only applicable to dental research but also other research areas. Usually, the normality of a continuous data distribution can be evaluated using several techniques:

## 1. Statistical tests of normality

There are mainly two types of statistical tests widely utilized for assessing normality of data distribution: the Kolmogorov-Smirnov (K-S) test and the Shapiro-Wilk test (Orcan, 2020). Even though Shapiro-Wilk test can be used with larger sample size, it is generally recommended for small sample sizes (less than 50 samples) (Barton & Peat, 2014). The Kolmogorov-Smirnov test, on the other hand, is usually applied to samples with n ≥50 (Mishra *et al.*, 2019). A p-value > 0.05 in the Shapiro-Wilk and Kolmogorov-Smirnov tests suggests that the data are normally distributed (Ahmad *et al.*, 2019; Ghasemi & Zahediasl, 2012).

## 2. Mean and median

A standard normal distribution is typically depicted as a bell-shaped curve, exhibiting symmetrical characteristics wherein the values of the mean and median values are roughly comparable. As a result, the large disparities between the mean and median values can help detect possible skewness and indicate a non-normal distribution. However, the small variations between the mean and median values indicate a normal distribution (Barton & Peat, 2014).

## 3. Standard deviation

The normal distribution is typically 95% of the data usually fall between -1.96 and +1.96 standard deviations from the two standard deviations above and below the mean (Smeeton, 2016). A practical way to check the normality is by adding and subtracting

the variable's double standard deviation from the mean. This produces an approximate range that encompasses 95% of the average values. This predicted range, which covers both the minimum and maximum values, should ideally overlap the actual range of data value. According to rule of thumb, a variable is probably not normally distributed if its standard deviation is greater than half of the mean value (Barton & Peat, 2014).

## 4. Skewness

A skewness values of zero serves as an indicator of perfect symmetry within the standard normal distribution. The tails are to the right when the skewness value is positive, and to the left when it is negative. The range of skewness values, which range from -1 to +1, represents an approximate normal distribution. Where skewness value <-1 or skewness value > +1 denote a moderate degree of skewness and values <-2 or >+2 denote a severe degree of skewness. A deviation from a normal distribution is strongly suggested by skewness values that are more than or equal to +3 or less than -3 (Mishra *et al.*, 2019; Barton & Peat, 2014; Kim, 2013).

## 5. Kurtosis

A kurtosis value of zero serves as an indicator of perfect symmetry within the standard normal distribution. A distribution that is more peaked than typical is indicated by a positive kurtosis value, whereas a negative kurtosis value denotes that the distribution shape is flatter than normal. Kurtosis values that lie between -1 and +1 are regarded as being close to a normal distribution. Kurtosis values that deviate from the normal distribution are those that fall below -1 and -3 or exceed +1 and +3. On the other hand, a kurtosis values of -3 or greater than +3 strongly suggests that the data is not normally distributed (Mishra *et al.*, 2019; Barton & Peat, 2014; Kim, 2013).

## 6. Critical values

Critical values or Z scores can be used to assess normality by dividing the skewness and kurtosis by their corresponding standard errors (Barton & Peat, 2014). In most cases, z-values of ±1.96 offer enough evidence to support the data's normality for small sample sizes ($n < 50$). On the other hand, an absolute z-value of ±3.29 is required for medium-sized samples ($50 \leq n < 300$) in order to determine that the sample distribution is normal. The evaluation of normality for sample sizes larger than 300 is based on histograms, where absolute values of kurtosis greater than seven and skewness greater than two may be used as references for non-normal distributions (Kim, 2013).

## 7. Histograms and plots

A histogram is the most commonly used graph to visually represents frequency distributions and whether the shape of the continuous data's distribution resembles an approximately normal bell curve (Bluman, 2018). If the graph is exhibiting approximate normal distribution the data is normally distributed. The normal Q-Q plot illustrates by plotting each data point against the expected value for a normal distribution. In an ideal scenario of normal distribution, the plotted points would align precisely along a straight line, and deviations from this line signal varying degrees of non-normality. The variations of the points from the straight line seen in the normal Q-Q plot are shown by the detrended normal Q-Q plots. All points in a normal distribution are uniformly distributed above and below the horizontal line at 0 and randomly cluster about it. In contrast, patterns like a J or an inverted U distribution are displayed by non-normal distributions (Barton & Peat, 2014).

## 8. Box plot and extreme values

A boxplots or box-whisker diagram is a very helpful tool for summarising a set of data. The boxplot's shape displays distribution of the data by five-number summary (minimum value, first quartile, median, third quartile and maximum value) and any

extreme values or outliers. At the center of the box plot is the median and interquartile range as the length of the box which the middle 50% of the observations fall. The whiskers, which represent the minimum and highest values within 1.5 times the interquartile range, are the lines that extend from the top and bottom of the box. Extreme values (asterisks) and outliers (circles) are used to represent values that fall outside of this range. The variable is unlikely to show signs of a normal distribution if there are a lot of extreme values present or if the median is not in the center of the box. Furthermore, the position of the median in the box plot at the bottom of the box indicates positive skewness, while it indicates negative skewness if the median is at the top of the box (Mishra *et al.*, 2019; Barton & Peat, 2014).

In summary, these are the ideal steps to take for consideration whether the data approximates a normal distribution to support the use of parametric tests or a non-normal distribution to support the use of non-parametric tests. However, the researchers tend to choose Shapiro-Wilk test or Kolmogorov-Smirnov (K-S) test to obtain numerical evaluations of normality. Ideally, some of the above steps are still important to be considered to further confirm the normality or non-normality of the data distribution.

Overall, normality test is part of parcel of statistical analysis in research including dentistry. Therefore, it is imperative to understand the ideal steps when performing normality test in order to select the correct statistical tests that suits the available data.

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ORIGINAL ARTICLE Open Access

# The awareness and perception of teledentistry among Malaysian dental professionals in universities and private practices

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## Abstract

The unexpected outbreak of COVID-19 has caused the temporary collapse and suspension of dental practices around the world. With the emergence of teledentistry, this incident unwittingly pushes for a revolutionary modification in the usual provision of dental care. The purpose of the study was to determine the level of awareness and perception of teledentistry among university and private-sector dental practitioners. This descriptive cross-sectional study used a pre-validated 27-item questionnaire with a 5-point Likert scale to assess the perceptions of university-based and private dental practitioners regarding teledentistry in four domains: the usefulness of teledentistry for patients, its benefits to dental practices, the potential improvements it can bring to dental practices, and concerns about the adverse effects of teledentistry. 150 dental practitioners participated in the research (30% overall response rate). More than 70% of respondents agreed that teledentistry can benefit both dentists and patients by improving communication and treatment monitoring. However, 45–80% of dentists had doubts regarding the technology's dependability, diagnostic accuracy, and patient data privacy. In conclusion, the results of this study suggest that Malaysian dentists are well-informed and prepared to implement teledentistry in their practices. However, additional research is necessary to determine the viability of commercial usage of teledentistry, both in Malaysia and internationally.

***Keywords:*** *awareness, perceptions, private practice, teledentistry, university*

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## Introduction

The sudden surge of COVID-19 has led to suspended dental practices around the globe, and this has forced a novel change to the traditional medium in oral healthcare services, seeking the best possible way to resume the needed care while preventing the spread of infection. Most dental procedures create aerosols that are full of saliva and blood. These are the biggest risks for airborne infections in dentistry because they can stay in the air longer and could get into a person's lungs.

Telemedicine is the process of giving diagnoses and treatment suggestions over long distances using videoconferencing (Aquilanti *et al.*, 2020; Jampani *et al.*, 2011). In the 1980s, teledentistry was first introduced as a type of telemedicine (Hung *et al.*, 2022; Jampani *et al.*, 2011). Since its introduction, teledentistry has managed more patients remotely. Jampani *et al.* (2011) saw teledentistry as a mode to help people in rural areas who do not have easy

access to specialists, which can improve communication between dentists and increase the number of consultations that can be done by sharing images, x-rays, and clinical data. Teledentistry became popular before the pandemic to triage patients and provide long-distance care (Hung *et al.*, 2022; Wu *et al.*, 2020). Although the benefits of the technology are well recognised, its usage in dentistry has been slow and has taken longer than in other fields to become a common practice tool.

Though not novel, the use of telemedicine in the medical and dental fields has gained popularity as a means of improving public access to healthcare. This is especially true when more research is done in many parts of the world to gauge the knowledge, awareness, perception, attitude, and practice of tele-technology, and many report that plenty of benefits can be gained from it, especially in dentistry. In Malaysia, however, the incorporation of telemedicine into the current healthcare system has faced many obstacles, with many medical professionals reporting high costs, privacy concerns, and a lack of technical knowledge as the main factors restricting its use (Oh *et al.*, 2006).

Surveys based on respondents' knowledge, attitude, awareness, and perception provide a deeper insight into the population's perspective on the topic or issue at hand. The purpose of these surveys is to uncover knowledge gaps and behavioural patterns among sociodemographic subgroups in order to conduct effective public health interventions (Almohammed *et al.*, 2021; Khokhar *et al*., 2022). These surveys can quantify the breadth of a known problem, validate or refute a hypothesis, and provide new perspectives on the reality of a condition. In addition, they can be used to set a baseline for future evaluations and to monitor the effectiveness of health education efforts in changing health-related behaviours. Aside from that, perception studies might offer an intervention strategy that reflects specific local circumstances and the cultural variables that influence them, aiding in the planning of activities that are suited to the group in question.

Although a handful of studies can be found on the topic of telemedicine and teledentistry, the actual numbers of these studies done in Malaysia are still scarce. Even the most convincing published evidence on the efficacy of teledentistry to date was mainly provided by studies on paediatric dentistry, orthodontics, and oral medicine (Estai *et al.*, 2016, 2018). Therefore, this study is designed to assess the awareness and perception of teledentistry among Malaysian private and university-based dental practitioners and the influence of sociodemographic background on the practice of teledentistry in their daily routine. Khokhar *et al.* (2022) quoted the findings from a PHD thesis at the University of Malaya (Wan Abdul Ghani, 2019) that evaluated the feasibility of teledentistry as a strategy for early detection of diseases, specifically oral cancer. They concluded that the sensitivity and specificity of teledentistry in detecting lesions were high. In addition, this technology was able to differentiate between malignant and non-malignant lesions (Wan Abdul Ghani, 2019).

## Materials and Methods

## Questionnaire preparation

This was a cross-sectional survey of general dental practitioners and dental specialists working in local universities and private practices. Ethical approval was obtained from the International Islamic University Malaysia Research Ethics Committee (IREC) (ID: IREC 2021-325) before commencing the study. Permission was also granted via email from the authors of a similar study (Al-Khalifa & AlSheikh, 2020) to use their pre-validated questionnaire in this study and to modify the survey to fit our population. The questionnaire has two sections, with the first section capturing the subjects' demographic information, professional background, and preferred communication channels. The second section of the questionnaire consists of a total of 27 five-point Likert scale questions. The questions were divided into four categories: practitioners' data security concerns, the capability of teledentistry to improve dental services in Malaysia, the

benefits of teledentistry for a dental practice, and the impact of teledentistry on patients.

A pilot study was conducted with randomly selected lecturers from the Kulliyyah of Dentistry at the International Islamic University of Malaysia to revalidate the modified questionnaires. After receiving the properly completed survey and constructive feedback from the subjects, additional modifications were made to the questions.

## Questionnaire distribution

The Malaysian Dental Council (MDC) database, local universities' dental teaching staff databases, and the alumni association of Kulliyyah of Dentistry were accessed to gather and compile a list of 500 active Malaysian dental practitioners and specialists based in local universities and private settings. All collected data was handled with care to ensure confidentiality and anonymity. To ensure that the sample represents the true generalisation of the Malaysian dental practitioner workforce, the sample was stratified based on demographic characteristics, professional qualifications, and gender. The questionnaire was then emailed to each subject, along with a brief explanation of the study's purpose and an informed consent form for participation in the study. Subjects who have not responded within the stipulated time frame will receive a three-weekly email reminder.

## Data collection and statistical analysis

The completed questionnaires were downloaded from Google Forms, and the data was manually entered into Microsoft Excel (Office 365, Microsoft Corp., USA). These data were then transferred for statistical analysis to IBM® SPSS® Statistics Version 28 (IBM Corporation, Armonk, USA).

## Result and Discussion

Between January and November 2020, 500 surveys were emailed to dental practitioners, and 150 respondents were recorded, indicating a 30% response rate.

Most of the respondents were in the range of 20–44 years old cumulatively. More than half of the respondents were female (67.3%) and specialists in their practice (61.3%). Only a small number of the respondents were from rural or remote areas of Malaysia (6.7%). Many of the respondents served in academic settings (76.7%), which were followed by private practitioners (23.3%) (Table 1).

The most popular methods of communication chosen by the respondents were as follows: in-person (27.5%), phone (19.4%), and email (18.6%). The results of the survey showed that communication through letters or faxes and the adoption of a forum were the least preferred methods of communication among the respondents. Figure 1 displays the results of the most preferred methods of communication among the subjects. It was noted that the respondents were free to choose more than one answer, which led to a wide range of answers.

## Domain of teledentistry: Teledentistry confidentiality and security issues

When data is exchanged over the internet, the possibility of forged digital data raises concerns about patient confidentiality, raises doubts about obtaining patient consent, causes software and hardware compatibility issues, and affects the reliability of the equipment used. These issues were supported by the findings of this study, where over 80% of respondents expressed concern about the possibility of digital forgeries. In addition, concerns regarding patient confidentiality were also high, as over 85% of respondents expressed their doubts about the technology's ability to protect every patient's personal data.

Table 1. Demographic and professional background of respondents.

| Characteristics | Frequency | (%) |
|---|---|---|
| **Age (years)** | | |
| 20-34 | 57 | 38.0 |
| 35-44 | 60 | 40.0 |
| 45-54 | 27 | 18.0 |
| 55-64 | 6 | 4.0 |
| **Gender** | | |
| Male | 49 | 32.7 |
| Female | 101 | 67.3 |
| **Qualification** | | |
| Consultants/Specialists | 92 | 61.3 |
| General dental practitioner | 42 | 28.0 |
| Resident/Graduate research | 9 | 6.0 |
| Others | 7 | 4.7 |
| **Work experience** | | |
| 0-5 years | 35 | 23.3 |
| 6-10 years | 37 | 24.7 |
| 11-15 years | 39 | 26.0 |
| >16 years | 39 | 26.0 |
| **Location of the main job** | | |
| City/town/urban area | 140 | 93.3 |
| Remote/rural area | 10 | 6.7 |
| **Work setting of your current main job** | | |
| Private | 35 | 23.3 |
| Academic/universities | 115 | 76.7 |

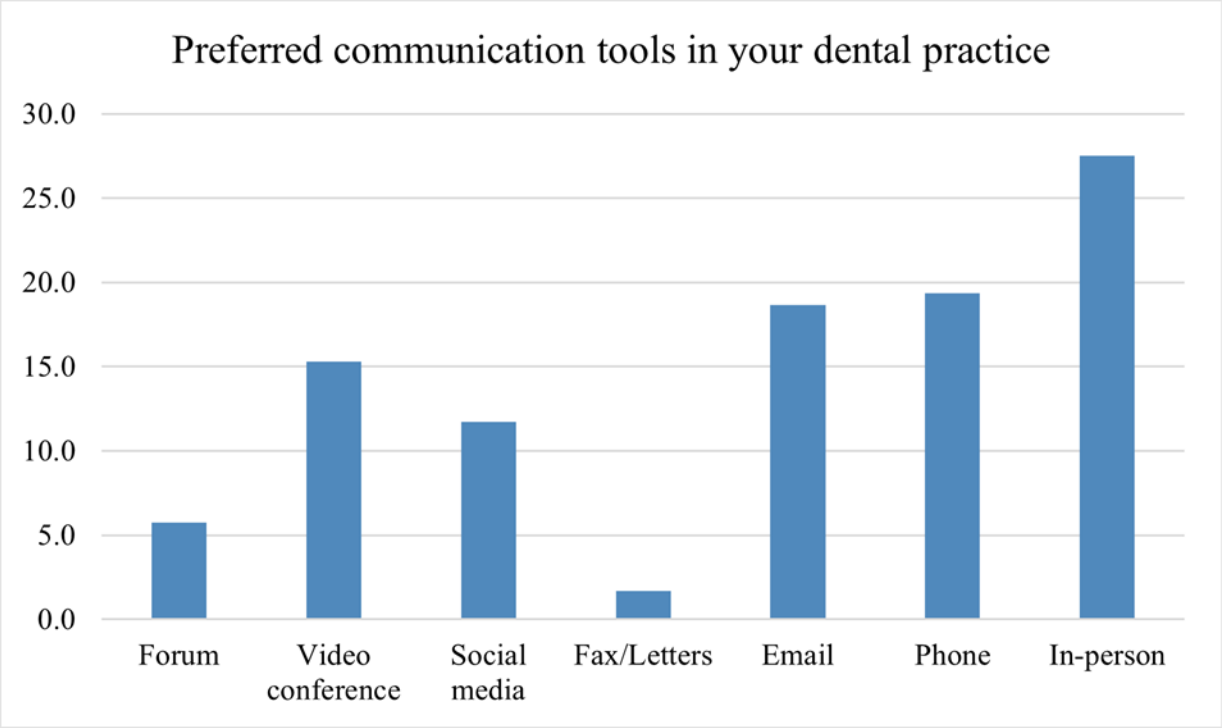


Figure 1. Preferred communication tools among dental practitioners (%).

The issues of unreliable tele-dental equipment and incompatible software and hardware accounted for approximately 78% of respondents' severe reservations, whereas a little more than 80% of participants expressed their concern about obtaining patient consent for teleconsultations, both of which showed a relatively high degree of concern (Table 2).

Kruskal-Wallis analysis has highlighted the statistical importance of the participants' age concerning confidentiality and security issues ($p = 0.028$) (Table 6). On the other hand, there was no statistical significance between the participants' gender, qualification, work experience (in years), location of the dental practice, and work setting.

Table 2. Teledentistry confidentiality and security issues.

| Questions | VC (%) | LC (%) | NA (%) | NP (%) | NC (%) |
|---|---|---|---|---|---|
| Gaining patient consent for teleconsultation | 54.0 | 28.7 | 10.0 | 3.3 | 4.0 |
| Confidentiality when data are sent online | 68.7 | 16.7 | 8.0 | 3.3 | 3.3 |
| Potential for digital forgery | 69.3 | 18.0 | 9.3 | 1.3 | 2.0 |
| Incompatible hardware and software | 50.0 | 28.0 | 13.3 | 6.0 | 2.7 |
| Reliability of tele-dental equipment | 46.0 | 32.0 | 13.3 | 4.7 | 4.0 |

VC=very concerned; LC=less concerned; NA=not feeling either way; NP=not particularly concerned; NC=not concerned at all

### Domain of teledentistry: Teledentistry benefits in practice improvement.

Most participants believed that teledentistry would enhance dental practice in several ways. More than 65% of respondents concurred that teledentistry will shorten waiting lists and wait times at dental offices and create a safer working environment for practitioners and patients, which was crucial during the COVID-19 pandemic outbreak. Furthermore, 74% of respondents agreed that teledentistry will benefit dental practices by improving communication and referral among peers. However, only a very small portion of the participants (25%) believed that patients could receive an accurate diagnosis through teleconsultation, and the remaining respondents were either neutral or had serious doubts about the validity of the diagnosis when it was made using teledentistry in a clinical setting (Table 3). Referring to the Kruskal-Wallis test done, it shows that there is no statistical significance between practitioners' sociodemographic background and their perceptions of tele-dental benefits in practice improvement (Table 6).

Table 3. Practitioners' perceptions of teledentistry's benefits in practice improvement.

| Questions | AS (%) | A (%) | N (%) | D (%) | DS (%) |
|---|---|---|---|---|---|
| Teledentistry would provide accurate diagnosis in a clinical setting | 6.7 | 18.7 | 30.0 | 30.0 | 14.7 |
| Teledentistry would help shorten the waiting list | 24.7 | 44.7 | 19.3 | 8.0 | 3.3 |
| Teledentistry would help to enhance oral care advice or post-operative care to the patients remotely | 44.7 | 40.7 | 10.0 | 2.0 | 2.7 |
| Teledentistry would provide a safe atmosphere for practising dentistry | 32.0 | 34.7 | 28.0 | 3.3 | 2.0 |
| Teledentistry would make patient referral more efficient | 26.0 | 48.7 | 20.0 | 2.7 | 2.7 |

AS=agree strongly; A=agree; N=neutral; D=disagree; DS=disagree strongly

### Domain of teledentistry: Usefulness of teledentistry in dental practice.

According to most respondents, teledentistry would benefit dental practice by improving ongoing education and clinical training and making it more time-efficient than a traditional referral method. More than half of the total respondents believed that the adoption of teledentistry would significantly lower dental practice costs, and about 20% of the respondents think that the cost of setting up the necessary infrastructure and equipment is high; however, this could be a topic of debate. On the other hand, only 29% of the respondents believed that teledentistry would shorten the time spent treating the patient. This is debatable, however, in situations where additional appointments must be made to support the diagnosis or treatment monitoring, such as dental photos or radiographs (Table 4). In addition to that, data analysis shows that there is no statistical significance between practitioners' sociodemographic backgrounds and their perceptions of the usefulness of teledentistry for dental practice (Table 6).

Table 4. Practitioners' perception of the usefulness of the teledentistry for dental practice.

| Questions | AS (%) | A (%) | N (%) | D (%) | DS (%) |
|---|---|---|---|---|---|
| Teledentistry would enhance clinical training and continuing education | 31.3 | 40.0 | 20.0 | 6.7 | 2.0 |
| Teledentistry would reduce the cost of dental practices | 22.0 | 29.3 | 38.0 | 8.7 | 2.0 |
| Teledentistry would increase treatment time spent with the patient | 10.7 | 22.0 | 38.7 | 20.0 | 8.7 |
| Teledentistry would be too expensive to set up | 5.3 | 16.7 | 46.0 | 24.0 | 8.0 |
| Teledentistry would provide adequate diagnostic information | 7.3 | 16.0 | 30.7 | 36.7 | 9.3 |

## Domain of teledentistry: Usefulness of teledentistry for patients

Approximately 75% of respondents concurred that teledentistry is especially beneficial for people who reside in remote or rural areas. Additionally, 82% of respondents thought that this technology was useful in terms of remote delivery of oral health advice and post-operative monitoring to their patients. Although only 56% of respondents agreed on the improvement of doctor-patient communication, with all these advantages, the majority (more than 70%) agreed that using this technology in healthcare should be covered by insurance policies. The remaining questions examined the cost-effectiveness of teledentistry for patients, and more than 60% of respondents agreed that using teledentistry for oral health care would allow patients to save money (Table 5). There is no statistical significance between practitioners' sociodemographic background and their perceptions of the usefulness of teledentistry for patients, as shown in Table 6.

Table 5. Practitioners' perceptions on the usefulness of teledentistry for patients.

| Questions | AS (%) | A (%) | N (%) | D (%) | DS (%) |
|---|---|---|---|---|---|
| Teledentistry would save money for patients | 17.3 | 44.7 | 30.7 | 5.3 | 2.0 |
| Teledentistry would improve communication with patients | 17.3 | 39.3 | 32.0 | 9.3 | 2.0 |
| Teledentistry would be helpful in monitoring a patient's condition | 32.0 | 50.0 | 11.3 | 5.3 | 1.3 |
| Teledentistry would be useful for patients in remote areas | 38.7 | 34.7 | 18.0 | 6.0 | 2.7 |
| Teledentistry would be covered by dental insurance plans | 33.3 | 38.0 | 26.0 | 0.7 | 2.0 |

AS=agree strongly; A=agree; N=neutral; D=disagree; DS=disagree strongly

### Preferred dental specialty for teledentistry application.

The majority of the respondents (90%) agreed that community dentistry and dental hygiene specialties are perfect for the application of teledentistry, followed by oral medicine (65%). Other specialties, such as prosthodontics, restorative dentistry, orthodontics, periodontics, paediatrics, and oral radiology, have an average of 40% agreement among participants. Oral surgery and endodontics are the least preferred specialties for teledentistry. About 30% of respondents agreed with this statement.

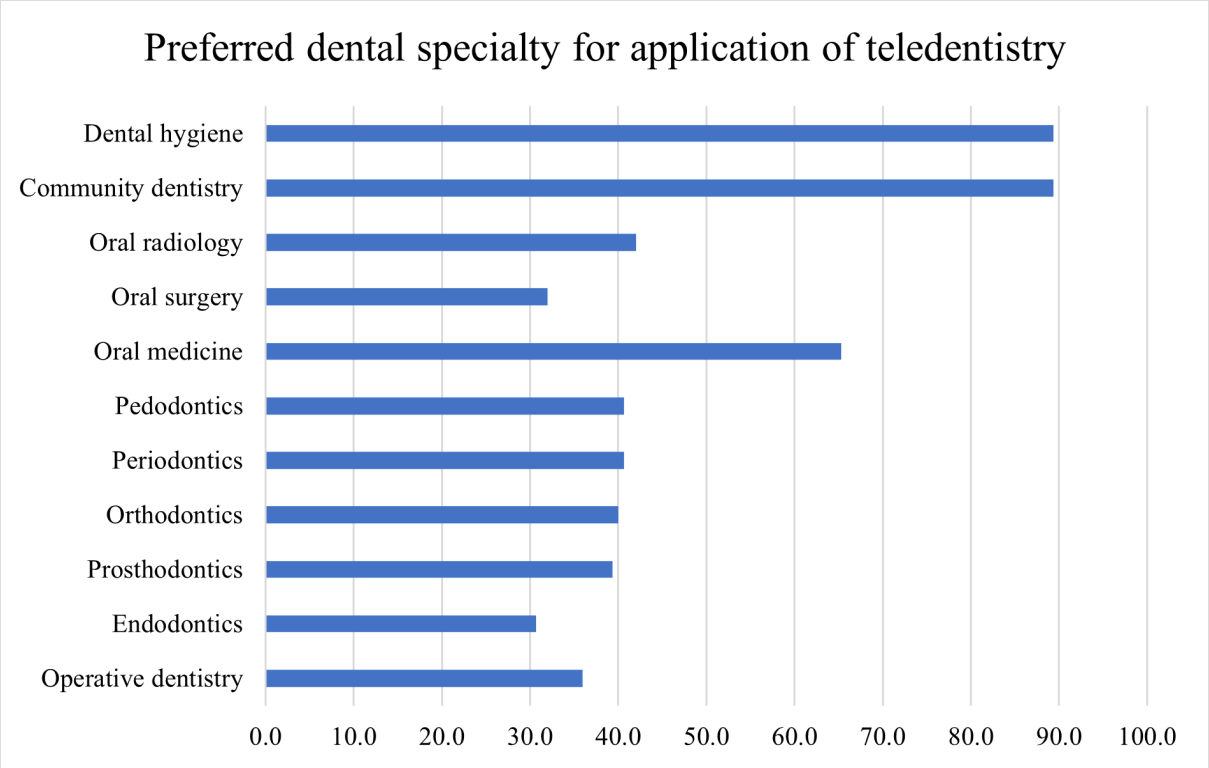


Figure 2. Preferred dental specialty for application of teledentistry.

### Statistical significance between the demographic variables of the respondents with four domains of teledentistry

The Kruskal-Wallis test only shows the statistical importance of the participants' age with questions regarding confidentiality and security issues ($p = 0.028$) (Table 6). On the other hand, there was no statistical significance between the participants' gender, qualification, work experience (in years), location of the dental practice, and work setting. Meanwhile, the other three domains of teledentistry have shown no significant association with participants' demographic backgrounds.

Table 6. Statistical significance between the demographic variables of the respondents with the four domains of teledentistry.

| Variable | Data security and patient consent (*p*-value) | The capability of teledentistry to improve practice (*p*-value) | The usefulness of teledentistry for dental practice (*p*-value) | The usefulness of teledentistry for patients (p-value) |
|---|---|---|---|---|
| Age | 0.028* | 0.399 | 0.885 | 0.120 |
| Gender | 0.342 | 0.868 | 0.408 | 0.474 |
| Qualification | 0.446 | 0.855 | 0.971 | 0.784 |
| Work experience (in years) | 0.117 | 0.481 | 0.894 | 0.708 |
| Location of current main job | 0.663 | 0.843 | 0.932 | 0.572 |
| Work setting of your main job | 0.053 | 0.294 | 0.641 | 0.120 |

*Significant *p*-value

## Discussion

A recent study of a similar design (Khokhar *et al*., 2022) was published while the current researchers were still collecting data, providing a good comparison of the results. The study was done on Malaysian dentists, including those who worked for the government, and used the same questionnaire that had already been validated in a study by Al-Khalifa & Al Sheikh (2020). As far as the literature search goes, it was considered the first study that was done on Malaysian dental practitioners, and therefore the findings from the previous studies were compared to see if there was any difference in terms of the awareness and perception of the similar samples on teledentistry during the peak period of the COVID-19 pandemic and the post-pandemic or endemic period.

One of the ways to prevent the unnecessary contact of patients with asymptomatic carriers of COVID-19, including healthcare workers, is by limiting the movement of patients in the clinic, which can be achieved using remote healthcare delivery. Through the application of teleconsultations and virtual clinics during the pandemic period, overcrowding of dental clinics will be greatly minimised, and it will also reduce unnecessary visits, which increase the risk of COVID-19 transmission and prevent the downfall of healthcare systems. This improvement is crucial when routine dental care has been largely discontinued during the pandemic, either by the respective regulating medical or dental bodies or by practitioners themselves (Coulthard, 2020; Khokhar *et al*., 2022; Sabino-Silva *et al*., 2020; Wadia, 2020).

One of the biggest advantages of teledentistry is the convenience it offers dental practices overall. More than 78% of dental practitioners in this study believed that the use of this technology is beneficial not only to the patients but also to the dental practitioners in the long run, and this result was in agreement with the result from the previous study (Khokhar *et al*., 2022), where they also reported that the majority of practitioners (70%) thought that teledentistry would benefit the patients. This is particularly important where, in

many rural areas, there may be limited access to dental services due to a shortage of dentists. Teledentistry can help address this issue by providing remote access to dental care and enabling patients to receive virtual consultations with dentists, even if they are located far from dental clinics. This can lead to earlier detection and treatment of oral health problems, reducing the risk of more serious and expensive problems in the future.

Teledentistry has the potential to greatly impact the way dental care is delivered, especially for people with disabilities or mobility issues who may face difficulties travelling to a dental clinic. Teledentistry can also be beneficial for people who have difficulty taking time off from work or school for appointments, as virtual consultations can be scheduled outside of traditional business hours. This can help increase access to care for people who may have previously been unable to receive the dental care they need. Moreover, teledentistry can also help increase patient engagement and education by providing real-time access to oral health information and resources. For instance, patients can use telecommunication technology to receive educational materials, such as videos and presentations, which can help them have a better understanding of their oral health and the treatments they are receiving. This can improve patient satisfaction and increase patient adherence to treatment plans, leading to better outcomes and improved oral health.

Another important aspect of teledentistry is the ability to leverage technology to improve the efficiency of dental services. For example, electronic health records (EHRs) can be used to store patient information and facilitate the sharing of information among dental professionals. This can help reduce the risk of errors, improve the accuracy of diagnosis, and streamline the delivery of care. In addition, teledentistry helps automate routine tasks, such as appointment scheduling, which can free up time for dental professionals to focus on more complex and time-sensitive tasks. By utilising remote technologies, dentists can also access information and resources that may not be available in their local area. Teledentistry is also cost-effective, as it eliminates the need for physical office space, reduces the cost of supplies, and allows for greater patient volume. This can result in lower costs for both patients and dental practices. They can also consult with specialists and other dental professionals, allowing for a higher level of collaboration and improving patient outcomes.

Despite the many benefits of teledentistry, some challenges must be addressed to ensure its success. One challenge is ensuring the privacy and security of patient information, as telecommunication technology can expose sensitive information to unauthorised individuals. This is evident when the majority of participants expressed significant worries about hardware being incompatible, digital forgery (90%), digital security (85%), and equipment dependability (80%). A study done in Saudi Arabia also expressed the same concern, where 50.9% of the participants agreed that dentists are afraid of making inaccurate diagnoses through teledentistry due to several reasons such as lack of training and expertise, which account for 24.7% of them; poor internet access for 37.5%; hardware shortage for 25.5%; and high costs for 12.3% of respondents (Khan *et al*., 2022). Thus, it is very important to use compatible hardware and software as well as strict security protocols to make sure that the integration of technological parts and the encryption of their databases are completely safe. In addition, the right infrastructure and design will also significantly reduce expenses in the long term, as these will prevent or minimise technical faults in digital operations (Hartvigsen *et al.*, 2007; Palmer *et al.*, 2005). Another challenge is ensuring the quality of care delivered through teledentistry. While virtual consultations can be a valuable tool for providing dental care, they may not always be as effective as in-person consultations. This requires dental professionals to be properly trained and certified in the use of telecommunication technology, as well as the development of quality control measures to ensure the delivery of high-quality care. Lack of standardisation in telehealth regulations can

lead to varying levels of quality and patient safety. To address these challenges, it will be important for governments, dental organisations, and healthcare providers to collaborate on developing and implementing standards for telehealth and establish clear regulatory and legal frameworks to ensure the protection of patients and the provision of proper dental care. As Khan *et al.* (2022) stated in their study in Saudi Arabia, where 400 of their respondents were ready to support government initiatives, patients could receive consultation via teledentistry (Khan *et al*., 2022).

With regards to the Kruskal-Wallis test performed earlier in this study, there is no significant relationship between patients' demographics and all four domains of teledentistry, probably owing to the smaller number of participants. However, a recently published systematic review study in Malaysia has agreed that work experience, postgraduate qualification, and internet access were found to be significantly important in the implementation of teledentistry (Lin *et al*., 2022). It was also reported that studies done in India and Pakistan have proven that junior dental practitioners and those with a postgraduate degree showed a better level of knowledge of teledentistry (Ramesh *et al*., 2013; Zahra *et al.*, 2020). This could be because teledentistry is a relatively new concept, and senior dental practitioners may not have received sufficient exposure to and training in the innovative technology.

With regards to which dental specialty could benefit the most from teledentistry, 90% of respondents chose community dentistry, dental hygiene, or dental public health as the preferred specialty, followed by oral medicine (65%). Only an average of 40% chose the remaining specialties, including prosthodontics, restorative dentistry, orthodontics, periodontics, paediatrics, and oral radiology. Oral surgery and endodontics were the least chosen specialties, indicating that these fields benefit the least from teledentistry. This represents a very narrow perspective for practitioners, with the usual notion of teledentistry deployment restricted only to screening, diagnosis, or patient education. From late 2020 to early 2021, many dental practitioners worldwide have improvised their practices, focusing on tele-education and tele-consultation, primarily to deal with the COVID-19 epidemic (Almohammed *et al*., 2021; Aquilanti *et al*., 2020; Carvalho, 2020; Khan *et al.*, 2022; Mandall *et al*., 2005; Wang *et al*., 2020; Zahra *et al.*, 2020).

However, recent improvements have shown that teledentistry has the potential for successful treatment, postoperative care, and effective treatment planning when used effectively. This is also proven by a study done in Saudi Arabia, where 429 of the respondents were seeing patients through teledentistry, with 208 of them using it for teleconsultation, 84 for telediagnosis, 70 for teletriage, and 67 for telemonitoring. Although it is relatively small in number, the study has proven the capability of tele-technology to deliver proper and better dental care (Khan *et al*., 2022). Another study from Italy also proved the implementation of teledentistry is possible, especially in telediagnosis, where a male patient has been diagnosed with sialolithiasis through the analysis of medical history and patient photos (Giudice *et al.*, 2020). He was then followed up by his dentist through the sharing of photos, and the patient's full recovery after 2 weeks was observed. This study has proven that when teledentistry is used for postoperative care and effective treatment planning, it ensures successful treatment and a better prognosis for patients.

As shown in this study, oral surgery is the least preferred dental specialty for teledentistry to be implemented. However, the study by Giudice *et al.* (2020) has proven otherwise, where the patients can benefit, not in terms of dental procedures but as a method to monitor post-operative conditions. Through photo collection and teleconsultation, patients can report to their respective dentists regarding pain improvement and functional recovery without the need to return to the clinic. The benefits are applied to both patients and the dentist, who can monitor the surgical site, the patient's oral hygiene, and the

improvement of oral function. Consequently, targeted teledentistry campaigns are required to broaden practitioners' perceptions by presenting the full scope of teledentistry and its applications. In such cases, an excellent foundation is laid for the usage and advancement of teledentistry in dental practices to assure the continuity of adequate dental care for patients while also ensuring pandemic safety.

The authors agree with Khokhar *et al.* (2022) regarding the lengthy items in the pre-validated questionnaires, which could be one of the factors that hampered the number of responses with the targeted samples. Instead, a more concise and specific questionnaire may yield a better response rate. The comparatively low response rate can also be attributed to the fact that the data for this study was collected just after the pandemic was over, with many countries having declared COVID-19 endemic and dental services returning to their normal operations worldwide (September 2022 to November 2022). Another weakness of the study was the use of a 5-point Likert scale, as several studies have found that respondents tend to choose the middle value as a safe, moderate choice rather than any value on either end of the spectrum. This may have an impact on the respondents' real awareness and perception levels (Mircioiu & Atkinson, 2017; Norman, 2010). A questionnaire-based study performed by Khan *et al. (*2021) has only used the 'yes' or 'no' answer in most questions regarding knowledge and attitude towards teledentistry implementation. This has proven to be more effective, as the result has mirrored a better understanding for the readers regarding the knowledge and attitude of dental practitioners regarding teledentistry.

The findings of this study revealed that Malaysian dental professionals have a favourable impression and attitude towards teledentistry. However, additional research on the efficacy of patient screening, data collection, diagnosis, and referral via teledentistry is required. Similarly, to examine the viability of teledentistry deployment, a study on the preparedness and willingness of Malaysian dental patients should be conducted. As technology continues to advance and telehealth becomes more widely adopted, we will likely see a growing number of dentists and patients embrace telemedicine and take advantage of its many benefits.

Comparing this study with a similar study done by Khokhar *et al.* (2022), the difference is that this study comprises both descriptive and statistical analysis, whereas the other study focuses solely on descriptive analysis. With a higher number of respondents (310), more than 50% of their respondents were aged 25–34 with work experience of 0–5 years. This study has 150 respondents, of whom more than half are specialists, and the age distribution among the respondents is even. The results are similar to the study, where it shows dental practitioners in Malaysia are ready to implement teledentistry in their practice; however, professional training and security issues are the main concerns among them.

## Conclusion

The current study revealed that, in general, Malaysian dental professionals have a high level of awareness and a positive perception of teledentistry. They also believe that this technology would benefit both dental professionals and patients because of its convenience, cost-effectiveness, and potential to raise the standard of oral care. While expressing a few concerns, most respondents supported the concept of teledentistry and demonstrated a high comprehension of the limitations of the technology, particularly in the aspects of ethics, data privacy, and technical constraints. For the technology to be fully commercialised and incorporated into the standard of oral care in Malaysia, proper guidelines and professional training should be established, and this would require the collaboration of the key relevant parties in Malaysia's healthcare sectors.

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## Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article. We affirm that this research was conducted in an unbiased manner, without any financial or personal relationships that could influence the objectivity or integrity of the findings presented. There are no financial or other associations that might pose a conflict of interest with regard to the content of this study.

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ORIGINAL ARTICLE Open Access

# Comparative evaluation of remineralization efficacy of ELSENZ and SHY-XT toothpastes on initial enamel lesions: A scanning electron microscopic study

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## Abstract

The present study was done to evaluate the remineralization potential of two different commercially available toothpaste, namely, ELSENZ and SHY-XT on initial enamel white spot lesion using Scanning Electron Microscope (SEM). The objective of this study is to evaluate and compare the remineralization efficacy of ELSENZ and SHY-XT toothpaste on initial enamel white spot lesion. This study included a total 12 samples of extracted human permanent anterior teeth that were collected from the Oral and Maxillofacial Department in College of Dental Science Amargadh, Bhavnagar, Gujarat. All samples were equally divided in three groups. In group 1, remineralization was done by ELSENZ (fluoro-calcium phosphosilicate) toothpaste, and in group 2, remineralization was done by SHY-XT (nano–hydroxyapatite and fluoride) toothpaste and group 3 was taken as control group in which deionized water was used. At the end of 12 days, pH cycling procedure, remineralization for all the samples were analysed by the scanning electron microscope. Statistical analysis was done by One Way Analysis of Variance to check the difference between the groups and Post hoc analysis was done by Tukey's test. The result showed that the maximum remineralization occurred in ELSENZ toothpaste group (P<0.00) followed by SHY-XT toothpaste group (P<0.50) and deionized water showed least remineralization potential (P<2.00). From the result of the study, we concluded that ELSENZ toothpaste has more remineralization potential on initial enamel white spot lesion as compared to SHY-XT toothpaste.

***Keywords:*** *demineralization, fluoridated toothpaste, initial enamel lesion, remineralization*

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## Introduction

Dental caries is an infectious bacterial oral disease, related to oral flora. Dental plaque and consumption of fermentable sugar can lead to demineralization of dental tissue. Nowadays, caries management has shifted into non-invasive treatment, using remineralizing agents that is effective on demineralized early enamel lesions (Indrapriyadharshini *et al.*, 2018).

The first clinical sign of demineralization is seen as "white spot lesion" that is reversible to normal enamel surface by using the remineralizing agents. Fluoride is the most commonly used remineralizing agent in the dentistry as fluoridated toothpaste. This fluoridated toothpaste converts hydroxyapatite crystals to fluorapatite crystals which are more resistant to acid challenge (Toda *et al.*, 2008).

The SHY-XT toothpaste contains fluoride, nano hydroxyapatite and potassium nitrate. Potassium nitrate depolarizes the dentinal nerve fibres and prevents the tooth sensitivity. By sealing the open dentinal tubules and establishing a layerover the

dentin surface, Nano Hydroxyapatite works profoundly to block dentinal tubules and relieve sensitivity while fluoride fortifies tooth enamel. The SHY-XT toothpaste aids in remineralizing the white spot lesion and alleviating discomfort brought on by sensitivity.

The fluoro-calcium phosphosilicate in ELSENZ toothpaste is an enhanced variety of bioactive glass. Over the course of 8 to 12 hours, ELSENZ produces acid resistant fluorapatite and releases fluoride. ELSENZ is a distinctive toothpaste to use for remineralization because of the combined actions of apatite production and ion release. These two toothpastes are different from normal fluoridated toothpaste in terms of having different remineralization contents with fluoride.

Dentifrices containing 1000ppm fluoride have been recommended for children as it is effective in reducing caries (Kielbassa *et al.*, 2009; Mir *et al.*, 1969; Shetty *et al.*, 2016; Wright *et al.*, 2014). However, the use of greater amount of fluoridated toothpaste may increase the risk for fluorosis, especially among children more than 6 years of age as they cannot spit during brushing (Reynolds *et al.*, 2008). Hence, non-fluoride containing dentifrices with remineralizing agents have been developed (Wright *et al.*, 2014). The process of remineralization is constrained by the availability of calcium and phosphate ions. Other than fluoride toothpaste, calcium phosphate-based remineralizing agents are the combination of calcium sucrose phosphate and inorganic amorphous calcium phosphate are commercially available that helps in remineralization of demineralized enamel (George *et al.*, 2015; Reynolds, 2008). In our study, we used experimental toothpastes having remineralizing agents with fluoride.

A medical literature has revealed till date no scanning electron microscope study has been conducted to compare the remineralizing efficacy of ELSENZ and SHY-XT toothpaste on initial enamel white spot lesion. So this study will be helpful in preventing the progress of demineralized enamel.

## Materials and Method

This study was designed and conducted in the Department of Pediatric and Preventive Dentistry in College of Dental Science and Hospital, Amragadh, Bhavnagar, Gujarat. Ethical clearance was obtained by Institutional Ethics Committee (CODS/IEC/111/2021) and study permission was taken from the Medical Government Collage, Department of Microbiology, Bhavnagar, Gujarat, India.

**Inclusion criteria**

- Permanent teeth without caries and without initial enamel white spot lesion.
- Permanent teeth with all four intact surfaces.
- Permanent teeth with non-visible cracks.

**Exclusion criteria**

- Teeth with initial enamel white spot lesion.
- Teeth with developmental defects.
- Teeth with hypoplastic enamel.
- Restored teeth / teeth with restoration.

**Preparations**

Extracted teeth were kept in the hydrogen peroxide before enamel block preparation.

- **Preparation of enamel blocks**
  The crowns of all the incisors were separated from the roots at the cemento-enamel junction using a water-cooled carborundum disc. Enamel blocks of 3 × 3 mm were prepared from a flatter labial surface and embedded in polymethyl methacrylate. The superficial surface of the enamel was ground flat with water-cooled carborundum disc and polished with grit waterproof silicon carbide paper to remove approximately 0.1 mm of the outermost enamel layer and prepared a flat surface then blocks were made in cold cure resins (Chandru *et al.*, 2020) (Figure 1 and 2).

- **Preparation of demineralizing solution**
  Demineralizing solution made with distilled water by adding 0.05 mM lactic acid, 2.2 mM of calcium chloride and 2.2 mM of sodium dihydrogen

orthophosphate. Potassium hydroxide pellets was added for the adjustment of pH of the solution to 4.5 (Chandru *et al.*, 2020).

- **Preparation of artificial saliva**
  Artificial saliva was prepared in distilled water by adding 3.90 mM of sodium phosphate, 4.29 mM of sodium chloride, 17.98 mM of potassium chloride, 1.1 mM of calcium chloride, 0.08 mM of magnesium chloride, 0.05 mM of sulfuric acid, and 3.27 mM of sodium bicarbonate. The pH of the artificial saliva was set at 7 (Figure 3).

## Sample size

Power analysis for mean difference from constant one sample t-test was conducted in G*Power (version 3.1.9.7) to determine the sufficient sample size, with a power of study = 0.95, alpha= 0.05 The minimum sample size calculated was 12.

## Methods

In this experimental study total 12 samples were allocated by using random sampling technique (Figure 4).

1) Group 1 ($n$ = 4): ELSENZ (Fluoro-calcium phosphosilicate) toothpaste.
2) Group 2 ($n$ = 4): SHY-XT (Nano-hydroxyapatite, and fluoride) toothpaste.
3) Group 3 ($n$ = 4) (control group): Deionized water.

Demineralizing solution was prepared, and its pH was set at 4.5. After that, all the samples were kept in demineralizing solution for 2 hours at 37 ℃ in an incubator for a day followed by washing the samples in deionized water (Chemi pure, deionized water, India) for 2 min then all samples were observed under Scanning electron microscopic to check the morphological changes (Figure 5). This protocol is followed in accordance to the study conducted by Cai *et al.* (2003) and Huang *et al.* (2009).

The evaluation of SEM images was done according to Bonetti et al., (2014) scoring criteria, after that all samples were coated with the experimental toothpaste namely, ELSENZ, SHY-XT and control group was treated with deionized water by using applicator brush (Figure 6). The samples were left stable for 3 min on green cloth on the floor, then all the samples were kept in the artificial saliva for 24 hours and every after 3 days new artificial saliva was prepared. This entire procedure was repeated for 12 days. At the end of 12 days pH cycling, SEM images of all selected samples from each group were taken to analysed remineralization by using Bonetti *et al.* (2014) grading criteria (Table 1).

## Statistical Analysis

Statistical analysis was done by One Way Analysis of Variance to check the surface roughness on tooth of difference between the groups. Post hoc analysis was done by Tukey's for the intergroup comparison of surface roughness. Data was analysed by the IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, N.Y., USA). A p-value of less than 0.05 was considered as statistically significant.

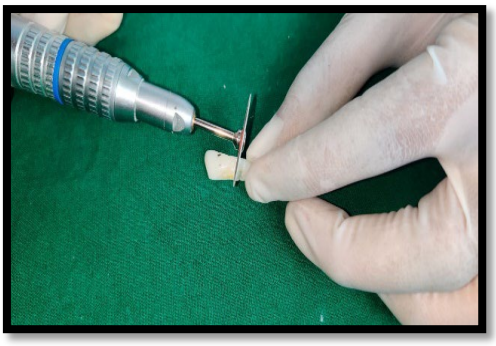

Figure 1. Preparing block for all 12 teeth at cervical area of teeth.

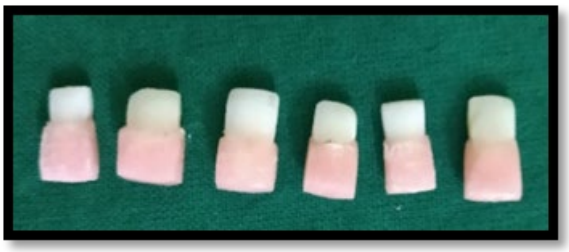

Figure 2. All samples in cold cure acrylic resin.

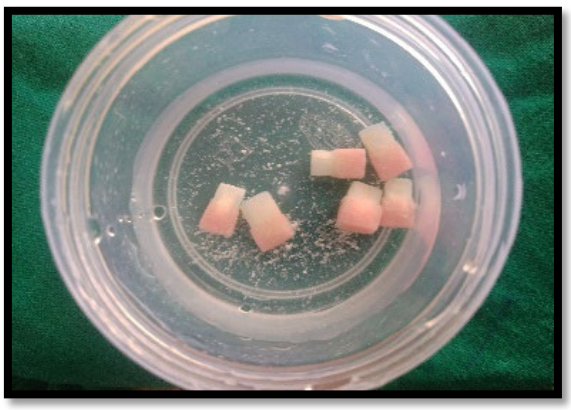

Figure 3. All the teeth kept in artificial saliva to prevent the dehydration of extracted teeth.


Figure 4. Divided the samples among three groups.

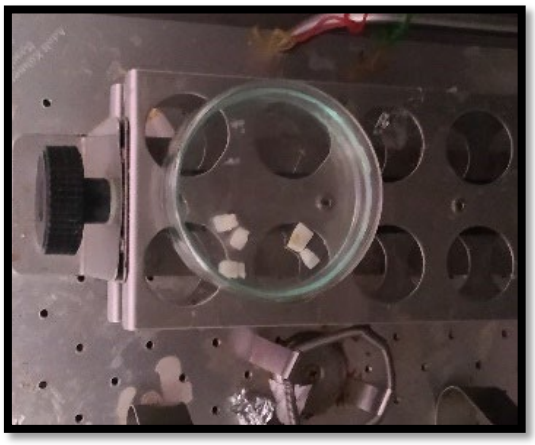

Figure 5. Placed samples in demineralized solution for 2 hours at 37 ℃ in incubator.

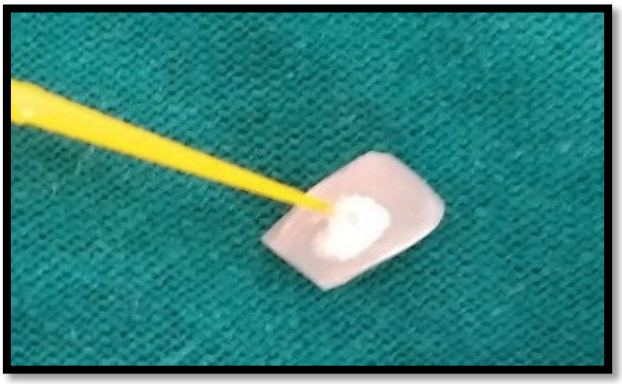

Figure 6. Samples were coated with the experimental toothpaste.

Table 1. Scoring criteria used for the evaluation enamel lesion by SEM images Bonetti *et al*. (2014).

| | |
|---|---|
| **Score 0** | Enamel surface remained perfectly intact with no grooves, pits, and porosity. |
| **Score 1** | Presence of surface irregularities on enamel surface, without demineralization of prismatic and/or interprismatic enamel. |
| **Score 1** | Presence of wrinkles and demineralization of prismatic /interprismatic enamel. Diffuse demineralization involved the rod core, with decomposition of Morphology of prism. |

## Result

Table 2 and Figure 7 showed the SEM images under 200x magnification and 2500x magnification in which the teeth surface was seen smooth and intact enamel surface before demineralization. Table 3 and Figure 8 showed SEM images under 200x magnification and 2500x magnification after demineralization. It revealed the appearance of collapsed rod and uneven enamel surface was seen with increase in porosity.

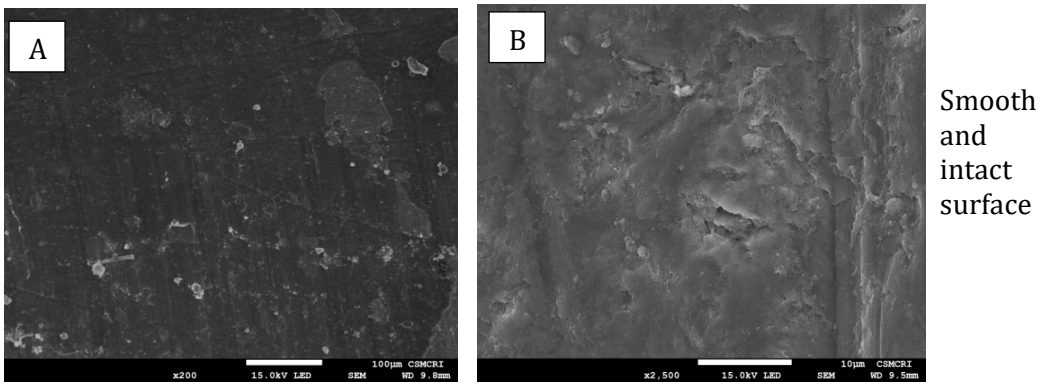


Figure 7. Smooth and intact enamel surface. A) SEM image of enamel before deminaralization under 200x magnification). B) SEM image of enamel before deminaralization (under 2500x magnification).

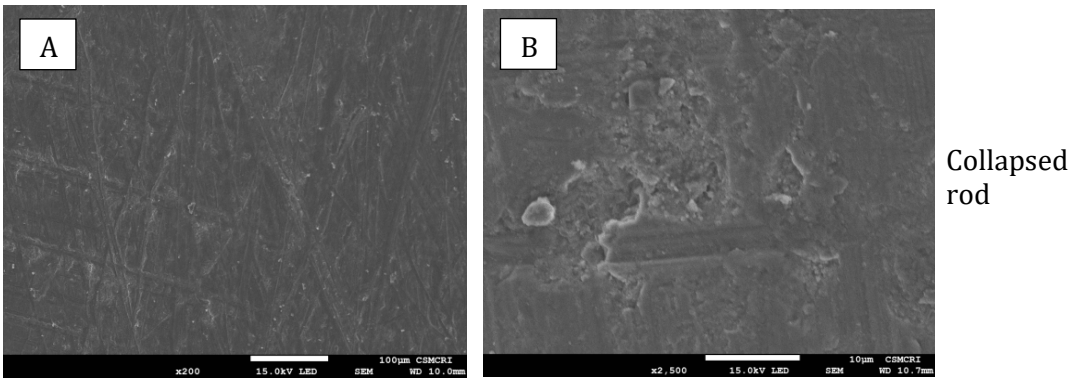


Figure 8. Appearance of collapsed rod and uneven enamel surface was seen with increase in porosity. A) SEM image of enamel after demineralization for 24 hours (under 200x magnification). B) SEM image of enamel after demineralization for 24 hours (under 2500x magnification).

Table 2. Comparison of the three materials under scanning electron microscope using Bonetti *et al.* (2014)' s rating before demineralization.

| | 200x Magnification | 2500x Magnification |
|---|---|---|
| GROUP 1 | Grade 0 | Grade 1 |
| GROUP 2 | Grade 0 | Grade 2 |
| GROUP 3 | Grade 0 | Grade 1 |

Table 3. Comparison of the three materials under scanning electron microscope using Bonetti et al. (2014)'s rating after demineralization.

| | 200x Magnification | 2500x Magnification |
|---|---|---|
| GROUP 1 | Grade 1 | Grade 2 |
| GROUP 2 | Grade 0 | Grade 1 |
| GROUP 3 | Grade 1 | Grade 2 |

After 12 days of remineralization by application of ELSENZ toothpaste (Fluoro-calcium phosphosilicate), SHY-XT Toothpaste (Nano -hydroxyapatite and fluoride), the morphological changes were observed in SEM under 200x magnification and 2500x magnification (Figure 9, Figure 10). Group 1 and Group 2 revealed layers of surface deposition of minerals obliterating the defects, filling up the rods and interred region, showing an uneven yet more homogeneous surface compared to the deionized water on enamel surface of teeth (Figure 11).

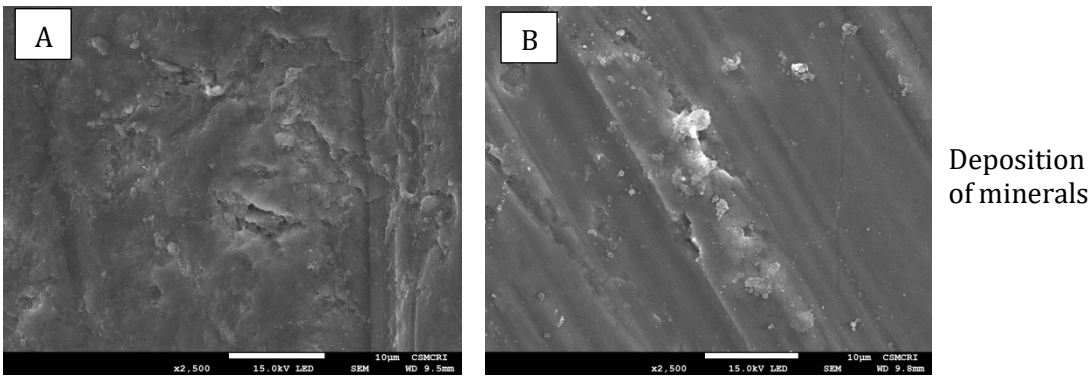


Figure 9. Layers of surface deposition of minerals obliterating the defects, filling up the rods and interred region, showing an uneven yet more homogeneous surface. A) Enamel surface after application of ELSENZ toothpaste (Under 200x magnification). B) Enamel surface after application of ELSENZ toothpaste (Under 2500x magnification)

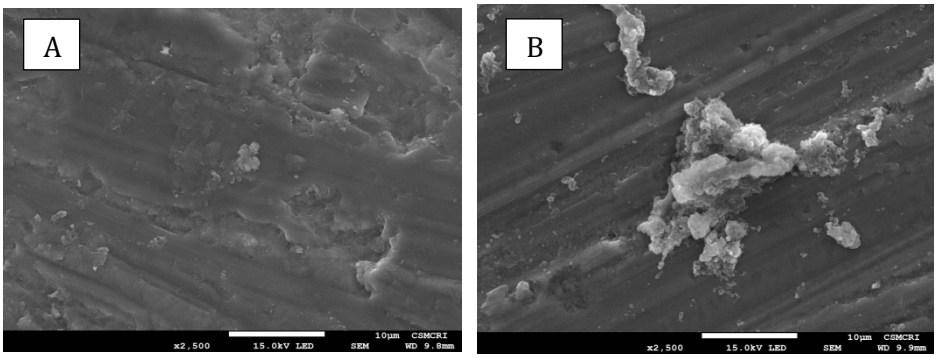


Figure 10. Layers of surface deposition of minerals obliterating the defects, filling up the rods and interred region, showing an uneven yet more homogeneous surface. A) Enamel surface after application of SHY- XT toothpaste (Under 200x magnification). B) Enamel surface after application of SHY-XT toothpaste (Under 2500x magnification)

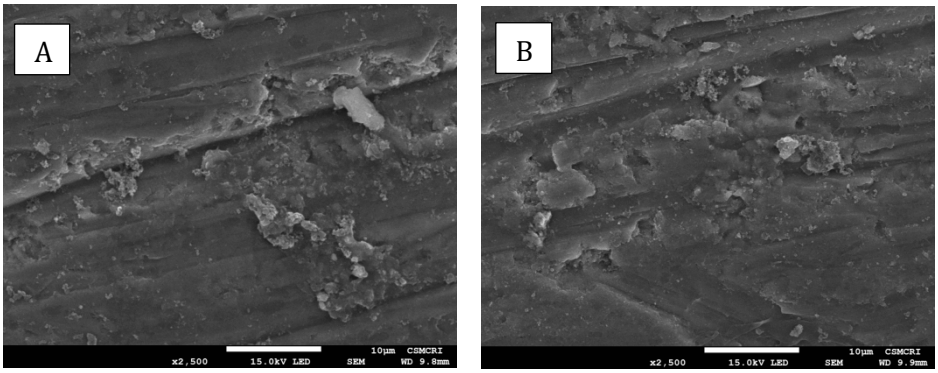


Figure 11. Layers of surface deposition of minerals obliterating the defects, filling up the rods and interred region, showing an uneven yet more homogeneous surface. A) Enamel surface after application of deionized water (Under 200x magnification). B) Enamel surface after application of deionized water (Under 2500x magnification).

Table 4 showed the comparison of the three materials under scanning electron microscope using Bonetti *et al.* (2014)'s rating criteria after remineralization. SEM observation under 200x magnification and 2500x magnification showed that there was decrease irregularities, rough and wrinkles on the demineralized enamel surface after remineralization. There were no discernible enamel rods or prismatic material but there were calcified deposits with crystals of fluorhydroxyapatite in them.

Table 4. Comparison of the three materials under scanning electron microscope using Bonetti *et al.* (2014)'s rating after remineralization.

| | 200x Magnification | 2500x Magnification |
|---|---|---|
| GROUP 1 | Grade 0 | Grade 0 |
| GROUP 2 | Grade 0 | Grade 1 |
| GROUP 3 | Grade 0 | Grade 2 |

Table 5 showed mean baseline score of surface roughness according to Bonetti *et al.* (2014) criteria that was not statistically significant among the groups. The difference between the groups after demineralization was also not statistically significant with a p-value of 1.17. After remineralization there was statistically significant change in the score in relation to the control group (2.00 ± 0.00, 95% CI). Table 6 showed that there was statistically significant difference between ELSENZ toothpaste and deionized water.

Table 5. Mean and standard deviation of surface roughness on tooth in different stages of the study.

| Stage of the study | Magnification | Group | N | Mean | Std. Deviation | 95% Confidence Interval for Mean | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| Before demineralization | 200 | SHYXT | 4 | .00 | .000 | .00 | .00 |
| | | ELSENZ | 4 | .00 | .000 | .00 | .00 |
| | | Deionized water | 4 | .00 | .000 | .00 | .00 |
| | | Total | 12 | .00 | .000 | .00 | .00 |
| | 2500 | SHYXT | 4 | 1.00 | .000 | 1.00 | 1.0 |
| | | ELSENZ | 4 | 1.50 | .707 | -4.85 | 7.85 |
| | | Deionized water | 4 | 1.00 | .000 | 1.00 | 1.00 |
| | | Total | 12 | 1.17 | .408 | .74 | 1.60 |
| After demineralization | 200 | SHYXT | 4 | .00 | .000 | .00 | .00 |
| | | ELSENZ | 4 | .00 | .000 | .00 | .00 |
| | | Deionized water | 4 | .50 | .707 | -5.85 | 6.85 |
| | | Total | 12 | .17 | .408 | -.26 | .60 |
| | 2500 | SHYXT | 4 | 2.50 | .707 | -3.85 | 8.85 |
| | | ELSENZ | 4 | 2.50 | .707 | -3.85 | 8.85 |
| | | Deionized water | 4 | 2.50 | .707 | -3.85 | 8.85 |
| | | Total | 12 | 2.50 | .548 | 1.93 | 3.07 |
| After remineralization | 200 | SHYXT | 4 | .00 | .000 | .00 | .00 |
| | | ELSENZ | 4 | .00 | .000 | .00 | .00 |
| | | Deionized water | 4 | .00 | .000 | .00 | .00 |
| | | Total | 12 | .00 | .000 | .00 | .00 |
| | 2500 | SHYXT | 4 | .50 | .707 | -5.85 | 6.85 |
| | | ELSENZ | 4 | .00 | .000 | .00 | .00 |
| | | Deionized water* | 4 | 2.00 | .000 | 2.00 | 2.00 |
| | | Total | 12 | .83 | .983 | -.20 | 1.87 |

Table 6. Intergroup comparison of surface roughness on tooth at various stages and magnifications.

| Dependent Variable | (I) Intervention | (J) Intervention | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| Before demineralization (x2500) | SHYXT | ELSENZ | -.500 | .408 | .518 | -2.21 | 1.21 |
| | | Deionized water | .000 | .408 | 1.000 | -1.71 | 1.71 |
| | ELSENZ | SHYXT | .500 | .408 | .518 | -1.21 | 2.21 |
| | | Deionized water | .500 | .408 | .518 | -1.21 | 2.21 |
| | Deionized water | SHYXT | .000 | .408 | 1.000 | -1.71 | 1.71 |
| | | ELSENZ | -.500 | .408 | .518 | -2.21 | 1.21 |
| After remineralization (x200) | SHYXT | ELSENZ | .000 | .408 | 1.000 | -1.71 | 1.71 |
| | | Deionized water | -.500 | .408 | .518 | -2.21 | 1.21 |
| | ELSENZ | SHYXT | .000 | .408 | 1.000 | -1.71 | 1.71 |
| | | Deionized water | -.500 | .408 | .518 | -2.21 | 1.21 |
| | Deionized water | SHYXT | .500 | .408 | .518 | -1.21 | 2.21 |
| | | ELSENZ | .500 | .408 | .518 | -1.21 | 2.21 |
| After demineralization (x2500) | SHYXT | ELSENZ | .000 | .707 | 1.000 | -2.95 | 2.95 |
| | | Deionized water | .000 | .707 | 1.000 | -2.95 | 2.95 |
| | ELSENZ | SHYXT | .000 | .707 | 1.000 | -2.95 | 2.95 |
| | | Deionized water | .000 | .707 | 1.000 | -2.95 | 2.95 |
| | Deionized water | SHYXT | .000 | .707 | 1.000 | -2.95 | 2.95 |
| | | ELSENZ | .000 | .707 | 1.000 | -2.95 | 2.95 |
| After remineralization (x2500) | SHYXT | ELSENZ | .500 | .408 | .518 | -1.21 | 2.21 |
| | | Deionized water | -1.500 | .408 | .069 | -3.21 | .21 |
| | ELSENZ | SHYXT | -.500 | .408 | .518 | -2.21 | 1.21 |
| | | Deionized water* | -2.000* | .408 | .033 | -3.71 | -.29 |
| | Deionized water | SHYXT | 1.500 | .408 | .069 | -.21 | 3.21 |
| | | ELSENZ* | 2.000* | .408 | .033 | .29 | 3.71 |

*The mean difference is significant at the 0.05 level.

## Discussion

Remineralization of initial enamel white spot lesions is an important concept for prevention of demineralization. Fluoridated toothpaste converts the hydroxyapatite crystals of enamel into fluoroapatite crystals which is more resistant to acid challenge (Martins *et al.*, 2011). As a result, fluorides remineralization activity only rises in the presence of enough free calcium and phosphate ions (Petrou *et al.*, 2009). Fluoride free or fluoride supplemented products have been developed as an alternative to fluoride because of the calcium phosphate dependent effect of fluoride and other issues such as toxicity and the danger of fluorosis. In the current investigation, the *ex vivo* efficacy of two fluoridated toothpastes ELSENZ and SHY-XT was compared (Cai *et al.*, 2003).

Titty *et al.* (2018) compared the remineralizing effect of sodium monofluorophosphate, amine flinride-containing dentifrices, calcium sucrose phosphate, and inorganic amorphous calcium phosphate-containing dentifrice were found to be equivocal in their ability to remineralize early enamel lesions. This was determined by comparing the remineralizing effectiveness of calcium sucrose phosphate and fluoride dentifrices. Tulumbaci (2019) compared the efficacy of different remineralization agents on treating incipient enamel lesions of primary and permanent teeth. It was seen that Clinpro 5000 ppm fluoride is more efficient in remineralizing incipient enamel lesions compared to the deionized water, Colgate Cavity Protection, Sensodyne Rapid Relief, GC MI Paste Plus and Sensodyne Repair and Protect agents tested. In our study, ELSENZ toothpaste showed more remineralization effect as compared to SHY-XT toothpaste this can be due to presence of remineralizing agents with more fluoride content in ELSENZ toothpaste.

Chandru *et al.* (2020) observed that Colgate sensitive plus toothpaste with Pro Argin™ showed more remineralization potential because of presence of arginine, calcium carbonate and sodium monofluorophosphate. Arginine alone may be insufficient to remineralize demineralized lesions or to provide resistance to further acid challenge as compared to our study the ELSENZ toothpaste contain fluoro calcium phosphosilicate, the is actively protected teeth against acid attack for up to 12 hours after brushing,which is 6 time longer than other fluoride toothpaste, so it can be used as a noninvasive means of managing early enamel carious lesions.

In the current investigation, SEM was used to assess the enamel surfaces after various treatments. The teeth were incubated in a demineralization solution for two hours at 37°C, which could have accelerated the development of the first enamel lesion on the tooth surface and dramatically increased porosity compared to sound enamel (Figure 8). This provides a bigger surface area for the subsequent response of enamel mineral and enables for higher penetration of solution ion components (Figure 9). Fluoro-calcium phosphosilicate is an improved variety of bioactive glass is a component of ELSENZ toothpaste. This creates fluorapatite that is resistant to acids and releases fluoride over the course of 8 to 12 hours. The early enamel white spot lesions are encouraged to remineralize by the combined actions of apatite production and ion release (Figure 10.) Fluoride nano hydroxyapatite and potassium nitrate are both prevalent constituents in SHY-XT toothpaste. Potassium nitrate, a substance that depolarizes dentinal nerve fibers, alleviates sensitivity-related pain. Fluoride strengthens tooth enamel, whereas nano hydroxyapatite develops a layer on the surface of the dentin to significantly lessen dentin sensitivity. The SHY-XT toothpaste lessens pain associated with sensitivity and repairs damaged tooth enamel (Lv *et al.*, 2007).

In present study, it was seen that deionized water has limited remineralization potential because of its relatively poor mineral nucleation ability. This finding is similar to the findings of Robinson *et al.* (2017).

## Conclusion

Both experimental toothpastes have potential to remineralize the initial enamel lesions so both can be used as a non-invasive method of managing initial enamel white spot lesion, but ELSENZ toothpaste showed more remineralization effect as compared to SHY-XT toothpaste; so, ELSENZ toothpaste can be considered better option than SHY-XT toothpaste for remineralization of demineralized enamel surface.

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ORIGINAL ARTICLE Open Access

# The reasons for seeking dental services from unqualified operators: A qualitative study

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## Abstract

Dental services are widely available in Malaysia, but individuals are continuously reported seeking the services of non-dentists. This study was aimed at exploring the reasons for seeking dental services by individuals from unqualified operators. A qualitative study was carried out and recruited individuals who sought dental treatment from the operators. The participants were identified from the operators' online advertisement, and social media and using a snowball sampling method. Interviews were conducted face-to-face and through online meetings and recorded digitally. Structured, open-ended, and probing questions were asked using a list of topical guided questions. The recordings were transcribed, and thematic analysis was carried out using Atlas.ti Version 9. The eight participants included in this study had fitted orthodontic appliances and dental veneers and received tooth whitening services done by unqualified operators. The reasons were classified into two main themes. The dental aesthetic reasons are related to the dissatisfaction with teeth presentation including malocclusion, dental spacing and teeth whitening. The theme of *non-dental related* reasons is categorised into four subthemes: following the trend, cost of services, naïve and access to services. The reasons for seeking dental services from unqualified operators are multifactorial. Individuals who seek services from unqualified operators have a valid need for treatment, but their decision is strongly influenced by non-dental reasons, of which the high cost of treatment at private dental clinics and being naïve about dental services are likely the most important. More public campaigns should be done to educate and raise awareness on the issue to the public.

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## Introduction

Dental services in Malaysia are regulated and treatment can only be performed by dental professionals for better healthcare and to safeguard the population from health risks. Individuals who seek dental treatment from non-professionals are not addressing their dental health concerns but putting their health at risk as the result of complications of 'treatment' failure and cross infection such as severe gingivitis, dental infection, periodontitis, loss of tooth and pain.

In the past years, there have been reports involving non-dental professionals providing dental services to the public in journal articles and mainstream media (Che Musa *et al.*, 2019; Fatimah, 2017; MDA, 2017; Murali, 2017; Nor Azlida *et al.*, 2020). The

individuals are unqualified *operators*, aka *fake*, *bogus,* or *quack* dentists, with no proper education or training in the field who provide the services at obscure locations and at a lower cost than registered dental practitioners (Che Musa *et al.*, 2019). Thus far, the services offered by the operators include but are not limited to, tooth whitening, dental prosthesis, cosmetic veneers, and orthodontic braces.

It is safe to assume that the operators provide the services for monetary gains. However, it is not clear why individuals seek their services despite the widely available safe options at public and private clinics and hospitals. Factors such as online advertisement, access to dental clinics, long waiting times, high cost of treatment, and poor awareness have been mentioned to influence individuals seeking to fit fake braces (Nor Azlida *et al.*, 2020). Nevertheless, there is lacking scientific evidence to support the claim. A better understanding of the factors can help stakeholders plan strategies to better protect the population from illegal and unsafe practices. Hence, this study was aimed to understand why individuals seek treatment from the unqualified operators,

## Materials and Methods

The ethical approval for the study was obtained before data collection (USM/JEPEM/19120882). The participants were briefed about the purpose of the study before obtaining the written consent. No ethical concerns arose from the participants and no emotional distress was noticed during and after the interview.

## Study design and participants

This was a descriptive phenomenology study using an in-depth semi-structured interview method. The participants included were Malaysians aged over 18 years who can communicate in the Bahasa Malaysia or English language and received dental-related services from the operators. The study used a purposive sampling method and applied three different recruitment methods to increase the chance of finding a suitable participant. One method was by posting and sharing an online advertisement about the study on the researcher's social media and personal contact and asking the readers/recipient to disseminate it; the advertisement appealed to the potential participants to contact the researchers. Another method was by searching the operators' online advertisement and communicating with individuals who had commented in the discussion thread via personal message and shared the online advertisement. The third was using snowball sampling by asking individuals who had visited an operator to introduce someone they know with a similar experience. Each individual who responded was screened based on eligibility to participate, explained about the objective of the study and given an appointment for a recorded online or in-person meeting. This study planned to collect the sample size based on the concept of saturation sampling whereby data collection is ended when no new information emerged.

## Interviews

A trained researcher met the participants between February 2020 to February 2021 either using an online meeting platform (Webex by Cisco) or face-to-face according to the change in the Movement Control Order during the COVID-19 pandemic which restricted travelling and interaction between people. The participants then completed the consent forms and background questionnaires using online Google or paper forms, depending on the type of meeting, before the interview started. The interview began with icebreaking and was followed by topically guided questions (Castillo-Montoya, 2016). Simple layman conversation was used to frame the issues as an open-ended statement and probing questions starting with simple and general questions and then followed by specific questions. The interviews took between 30 minutes to 1 hour time to complete. At the end of the interview, the participants were counselled about seeking treatment from a qualified dentist, and the hazards and legality of the services operator. The sessions were recorded using the built-

in software in Webex or a digital audio recorder.

## Data analysis

The recordings were transcribed, and the transcript was double-checked by two researchers. Data was entered into Atlas.ti Version 9 software and thematic analysis was carried out. Themes and subthemes were coded and derived according to the 6-step thematic analysis checklist (Braun & Clarke, 2006); familiarization of data, generating codes, searching, and collating codes into themes, reviewing the themes, defining, and labelling themes, and writing the report. The analysis started by asking whether the participants had a true dental reason for visiting the operators and then explored the reason behind seeking each type of dental service; the finding uncovered one of the main themes. Other reasons included a mix of individual circumstances and experiences explaining the visit to the operators; to simplify understanding they were grouped into one theme. Codes, such as cost, sponsorships, discounts, influence, knowledge, curiosity, gullibility, and access were derived and used in the analysis to identify and classify the responses before deriving the subtheme. The subtheme labels of the second theme were derived by generalizing the range of responses without inclination to a particular response. In this report, the corrections to the English language spoken by the participants and supplementary information for clarifying the sentence are added in parenthesis when necessary.

Table 1. Sociodemographic information of participants.

| Characteristics | Category | Participants, n |
|---|---|---|
| **Sex** | Female | 8 |
| **Education level** | PMR or below | 2 |
| | SPM | 2 |
| | STPM, pre-university and equivalent | 1 |
| | Bachelor's degree | 3 |
| **Occupation** | Unemployed | 3 |
| | Self-employed | 4 |
| | White collar | 1 |
| **Monthly income (RM)** | <1000 | 5 |
| | 1000-3000 | 3 |
| **Living area** | Rural area | 3 |
| | Suburban | 1 |
| | Urban | 4 |
| **Recruitment** | Advertisement | 5 |
| | Snowball | 2 |
| | Operators' advertisement | 1 |
| **Services** | Orthodontic bracket | 5 |
| | Veneer | 2 |
| | Whitening | 1 |

## Result and Discussion

### Participants

A total of ten individuals responded to the advertisement and were interviewed but two were excluded after the interview because they only purchased online dental products for home use and neither visited nor received physical services. Two participants were interviewed face-to-face following the SOP during the recovery Movement Control Order period and eight, in an online meeting. The participants were all females ranging from 21-56 years old with diverse backgrounds, educational levels, occupations, incomes, and living areas (Table 1). Five participants had orthodontic bracket fitted (n=5), two had dental veneer fitted (n = 2) and one had tooth whitening service (n = 1) from unqualified operators.

The analysis found multiple and overlapping reasons for seeking services from unqualified operators and classified them into two major themes: dental aesthetics and non-dental reasons.

### Dental aesthetics

All participants elucidated their teeth characteristics related to aesthetics that led them to the operators. Three subthemes were identified based on the description of the dental conditions: malocclusion, dental spacing, and whitening (Table 2). In describing malocclusion, the participants who fitted orthodontic brackets used the terms 'double', 'not in line', 'front and back', and 'outward' for irregularities in the teeth alignment. Participants who fitted veneers described having the dental spacing as 'chipped' teeth, or 'gap' or 'holes' between the teeth. Another participant did not mention any condition but only wished to whiten her teeth.

*"…my teeth are like double, front and back." (P4)*

*"…my lower teeth are not in line, like front and back" (P3)*

*"… there is a gap between them. But now already aligned back, … One of my teeth very high and outward before" (P5)*

*"…that time there is a gap at my teeth, … much bigger than now… it makes me lose confidence." (P2)*

*"… I actually done braces before, but then my teeth still have a small gap." (P6)*

*"… because my teeth also chipped off that time, then I also don't want when I smile there is small hole there, and the veneer can help me solve this problem." (P7)*

*"For the whitening purpose" (P8)*

Table 2. The themes and subthemes of the reasons for seeking the services of operators.

| Theme | Subthemes | |
|---|---|---|
| Dental aesthetics | Malocclusion | Orthodontic brackets |
| | Dental spacing | Veneers |
| | Whitening | |
| Non-dental related reasons | Cost of services | Expensive at private clinics |
| | | Incentive:<br>i. Sponsorship: family members, friends, operator<br>ii. Discounts by operator |
| | Trend | Social media influencers, friends |
| | Naïve | Lack of awareness about dental professionals and services.<br>Curiosity<br>Gullible<br>i. Influenced by the desirable outcome.<br>ii. Influenced by the seller's promise of the desired outcome.<br>iii. Good review on the website |
| | Access to services at government dental services. | |

## Non-dental reasons

The non-dental reasons were categorized into four subthemes: cost of services, trend, naïve, and access to government clinics (Table 2). Of the former, one reason was the complaints about the expensive and unaffordable charges at the private clinics which compel them to accept the cheaper option offered by the operators. One participant assumed that the cost is cheaper because the venue is not a clinical set-up.

*"… at private clinic, the price is really expensive (RM4500) and I couldn't afford (it). …this one seems ok, then cheap also, that's why I'm interested to do." (P3)*

*Because of money…, … if I go to the private clinic, they request RM3000 and above, … he (the operator) said RM150, so, I went." (P5) "*

*"…it is very expensive (RM7000), …I wanted a cheaper one, maybe around RM5000, … I searched… I found out this offer (RM1700)." (P1)*

*"… I just felt like …it is cheap …(because) they did it at hotel. I didn't think much … (of it) at that time." (P1)*

Another reason was the monetary incentives, in the form of cash for part payment and discounts from friends, family members, promoters, and operators, which tempted them to accept the services.

*"…my son sponsored me RM500, …friend paid RM300… that's why I went" (P4)*

*"…they have ... Nano Whitening and want to sponsor me. What I need to do is just to help them promote…, then I can get it free of charge, but not totally free…, (I) need to pay half …" (P7)*

*"…I didn't actually need it … she came and said she can sponsor me…" (P7)*

Following current trend is mentioned by young participants who had veneers and tooth-whitening services; they claimed to have been influenced by social media influencers and friends.

*"…at that time, that is the trend, …a lot of people also doing it" (P7)*

*"I saw quite a lot of my friends also doing it, a lot of social media influencers also promoting it, quite trendy and famous." (P7)*

*"I think one of my friends also went before, that's why I just went to try" (P8)*

Naïve describes the participants' lack of awareness towards dentistry and gullibility. They did not know that the profession and range of services offered by dentists are regulated and that the untrained operators are not. There was also an assumption that the operators were dentists who were working part-time at the venue. Despite knowing that her operator was not a dentist, one participant accepted teeth whitening services because she believed it had no health risk as the procedure is very common and can be performed anywhere.

*"I don't know ... (that) dentist …(are) licensed and non-licensed …. I thought …(the operator was) a part-time or freelance dentist, I didn't expect (know) that they actually didn't (undergo) a proper training at all." (P1)*

*"I thought they just study, then have some knowledge regarding the braces, then maybe she wanted to help those who are poor to make their teeth (to look) nicer..." (P3)*

*"…like not really dangerous" (P3)*

*"I don't know after took off the braces, my teeth will go back to the original place without retainer." (P2)*

*"I don't know (that) dentist also can do this kind of stuff, … I just feel like they (the operator) can achieve (give) what I want..." (P6)*

*"because that time I never think this thing will be harmful..." (P7)*

The participant who had teeth whitening was curious about what the treatment had to offer and just wanted to try it out.

*"I just wanted to try and see..." (P8)*

Another aspect of naïve is being gullible whereby participants were directly and/or indirectly influenced and manipulated by the operators or peers. One participant who was not satisfied with the small gap between her teeth after her orthodontic treatment believed the operator's claim of a better result than an orthodontist. Another had questioned why her condition was not treatable. Others related that they were convinced of the ability of the operators based on previous clientele and good reviews on the advertisement.

*"First because he (the operator) came and ask, then my friend also tempted me." (P4)*

*"…still have a small gap (after an orthodontic treatment), I was actually not satisfied with it. Then I saw this offer, and she said can solve my problems, that's why I went." (P6)*

*"Private said if no 'geraham' (molar teeth) cannot do braces. But why they can do, private cannot do..." (P5)*

*"I did doubt if they are registered dentist … the woman said (a) nurse (was) also (treated by) her. Then I feel like ok… like not really dangerous." (P3)*

*".. I did visit their page, their review is good, that's why I go" (P7)*

Access to government dental services was another notable reason expressed by the participants. Participants in the study who sought orthodontic treatment at the government clinics were denied the services because their cases were not severe enough or they were too old; the clinics only provide orthodontic treatment for children under 18 years. The long waiting time also deters the participants from seeking treatment at government clinics. In an isolated case, a participant who had complications with her fake orthodontic appliance and alleged that she was turned down due to a lack of equipment and unavailable specialists continued her follow-up with the operator.

*"Government said if the tooth problem is not too serious, they won't take." (P3)*

*"… government need to wait for 2 to 3 years right; this one is much faster." (P2)*

*"…I want to do braces at government, …they offer treatment until 18 years old only…" (P5)*

*"… I asked (the) government (dentist) to open (remove the bracket) only, … the doctor said he needs to contact the specialist first …, … they don't have the equipment. … said sorry to me, … go back the same place to take it off." (P5)*

## Discussion

This study investigated the reasons for visiting unqualified operators for dental-related procedures and found two major themes: dental aesthetic issues and non-dental related reasons. The former is related to the dissatisfaction with the appearance of teeth requiring orthodontic treatment, veneers, and teeth whitening. The non-dental related reasons included 4 subthemes: the cost of services, trend, naïve and access to government dental services.

The dental conditions described by the participants are consistent with the description of aesthetic issues and hence, valid clinical reasons and treatment needs. However, fitting braces and veneers, and tooth whitening have also become a fashion trend in South Asia including Malaysia (Chu *et al.*, 2018; Hansen, 2013; Khalid & Quiñonez, 2015; Sorooshian & Kamarozaman, 2018). The trend of presenting oneself with fake braces among young adults to reflect their social status could partly contribute to the increase in the number of operators (Bernama, 2022a). Presenting good dental aesthetics with straight and white teeth is not just about following trends. Perception of aesthetics is embodied biologically, culturally, and socially with the intention to demonstrate/project class difference and social advantage through values attached to beauty, maturity, prestige, and status (Goldstein *et al.*, 2018; Khalid & Quiñonez, 2015). Nevertheless, aesthetic issues are of great concern to the participants as one participant highlights that it is affecting self-confidence. This study, however, did not investigate which category the participants belong to among the above. The dental aesthetics issues, including the participants' determination to address them, could be the major reasons, and the non-dental reasons strongly influenced the decision to seek the services from the operators. The decision of the participants to address their issues is therefore understandable.

The participants always choose the lower cost of services; thus, it is likely the second most important reason after aesthetics; this is supported based on the income background, awareness of the difference in the cost, and choice of lower service fees. The high cost of orthodontic treatment at private clinics is not affordable to many in the lower-income group (Han, 2019). Although the cost of orthodontic services at government clinics is lower compared to the private practitioners, the services have age restrictions, severity criteria and a long waiting time that does not suit the participants. Government clinics do not provide cosmetic services such as veneers and bleaching routinely. The focus is on promotive programs and primary oral health care whilst specialist care provides a corrective treatment for patients in need (MOH, 2022).

The operators seem to be proactive in marketing their services by inducing dental aesthetics trends through social media influencers and using the internet to reach individuals searching for cheaper alternatives (Hörster, 2015; Park, 2020).

They also promote their activities by offering discounts for their clients and sponsoring social media influencers. One of the participants is a social media influencer claiming to have received a half-price discount for promoting the operator's services on social media postings; targeting an influencer with a large fan base as a platform for marketing services and products could be a good strategy for the operators (Nor Azlida *et al.*, 2020). As of now, the impact of trends that are prompted and inspired by social media influencers is not clear, but they should be discouraged from collaborating with the operators. It is unfortunate to learn that there are family members who sponsored the participants; unless they have liaised with the operator, they might be thinking that they are helping the participants with their dental problems.

As mentioned earlier, the subtheme naïve can include characteristics including, but not limited to, the lack of knowledge, experience, rationale, or judgment about dentistry, the profession and risk of complication from the services, and gullibility towards the marketing approaches and influence of the operators. The news about the law enforcement raids on illegal dental operators' premises suggests an unknown size but expected to be a large demand for the services, implying a significant proportion of the public is still not aware of the existing regulations for check and balance of dental practice in Malaysia to ensure the safety and minimize the risks of treatment procedures (Iskandar, 2022; Bernama, 2022a). Hence, efforts to increase awareness of the regulation of dental services and the risk of getting services from illegal operators should be continuously promoted (Bernama, 2002b).

Although there is little issue regarding access to dental services in Malaysia, access to affordable services is not well documented. The cost of dental services can be unaffordable to many people, particularly cosmetic-related services and to those from the lower income groups. The limited services at the government clinic are comprehensible as they are focused on a targeted population including children, older people and those with special needs due to manpower and budget constraints (MOH, 2022).

The reasons for seeking dental services from illegal operators are multifactorial and involve interplays between the need for treatment, the understanding of how to obtain it, cost, and access. Curbing illegal practices can help safeguard the dental health of the population; one approach is by regulating and monitoring the provision of such services on websites and social media. Authorities may also collaborate with social media influencers to raise awareness among the public on this issue (Nor Azlida *et al.*, 2020).

The number of participants in the study is small due to difficulty in finding individuals meeting the criteria and obtaining their consent due to unwillingness to share the experience because of embarrassment and wanting to forget the experience and having difficulty meeting face-to-face due to Movement Control Order. This study also avoided recruiting older people who had their dental prostheses done by illegal operators for fear of spreading COVID-19 and because of their lack of skill in using online meeting software. Because of these, data saturation is not achieved as planned. Nevertheless, some findings have been consistent with the opinions of Nor Azlida *et al.* (2020). Based on these limitations, interpretations of the findings should be made with caution.

An advantage of this report is that the data was collected using a scientific method from the actual source who has experience dealing with the operators. In addition to overlapping findings, this report also offers new insights from the perspective of the participants and has described the reasons in the respective categories.

## Conclusion

The reasons for seeking dental services from unqualified operators are multifactorial and related to dental aesthetics issues and non-

dental related reasons. Malocclusions, dental spacing and teeth whitening are some of the dental reasons, but they are likely to be greatly influenced by the high cost of services at private dental clinics and being naïve about dental services and professions, and marketing strategies of the operators. Other concerning reasons are social trends relating to dental aesthetics and access to government dental services. Further related studies are recommended to understand the reasons for individuals seeking unqualified operators for dental prostheses and other treatments. Promoting awareness of dental services and enforcing the regulation may help curb the unqualified operators' operations.

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ORIGINAL ARTICLE Open Access

# Distribution of cases encountered in Oral Medicine Undergraduate Clinic: A retrospective analysis

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## Abstract

Oral Medicine (OM) is a dental specialty concerning the diagnosis and non-surgical management of oral conditions closely related to medical disorders. This study aims to evaluate the distribution of OM cases at the International Islamic University Malaysia (IIUM) undergraduate dental polyclinic and to determine its relationship with sociodemographic background via disease category. Students' OM logbooks across four academic years were used for convenient sampling. Disease categories were based on previously published studies. Total cases were classified into 22 diagnosis codes and analysed using SPSS version 23. A total of 1917 cases were recorded at the undergraduate dental polyclinic across four academic batches, from year 2010 until 2018**.** OM case with highest frequency was oral ulcer (31%), followed by temporomandibular disorder (23%), and pericoronitis (10%). In contrast, the least common cases were lichen planus (0.4%), oral potentially malignant disease (0.3%), and tumour (0.2%). With regards to age group, second decade age group was reported the most across the observation period. OM cases were higher in females across most disease categories and Malays were the highest ethnicity reported. The current study identified the most common OM cases encountered in IIUM undergraduate dental polyclinic. The findings may portray the disease burden in the Kuantan population in general. Knowledge of common cases is crucial to prepare clinicians with safe and competent management required in clinical practice.

***Keywords:*** *disease burden, oral medicine, retrospective*

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## Introduction

Oral Medicine (OM) is a specialty of dentistry concerning patient oral health and diagnosis. It also involves non-surgical management of conditions affecting the oral and maxillofacial region which are closely related to medical disorders or conditions (AAOM, 2022).

Diagnoses and non-surgical treatments in oral medicine include chronic facial pain, temporomandibular joint disorders (TMDs), salivary gland lesions, oral mucosal lesions and also oral potentially malignant disorders. An oral medicine specialist may advise the dental practitioners on the precautions needed in managing patients with complex medical conditions, patients

who have undergone special therapies and those being treated for cancer.

According to Axell *et al*., (1990), oral and dental health are often mistaken as one entity, and in many situations, the dentition becomes the only priority. This misconception may lead people to belittle the needs of oral health care as a whole. Oral diseases can be presented as pain or discomfort, speech interference and difficulty in swallowing and mastication. Symptoms such as xerostomia, halitosis or oral dysesthesia can disrupt one's daily activities, leading to poorer quality of life (Cebeci *et al*., 2009).

Knowledge of the frequency of disease in a focused population equips oral health care providers with insight into disease patterns in the population (Kelloway *et al*., 2014). Research done on global burden and risk distribution of disease contributes to decision and planning evaluations and their impact on the community (Bhatt *et al*., 2013).

Oral cancers, noma, and oral manifestations of Human Immunodeficiency Virus (HIV) are among the seven major oral diseases and conditions contributing to oral disease burden (WHO 2020). The Global Burden of Disease Study 2016 estimated that at least 3.58 billion people worldwide are affected by oral disease.

Several studies have been reported in literature with regards to disease frequency and prevalence. One example is a prevalence study performed in Turkey (Mumcu G *et al*., 2017). Of the 765 residents participating in the study, 41.7% had oral pathologies: 22.5% had one lesion, 7.6% had two and 4.6% had three or more. The most common oral lesion was excessive melanin pigmentation (6.9%), followed by fissured tongue (5.2%) and denture stomatitis (4.3%). The least common oral lesion was mucocele at only 0.1% occurrence. However, the study reported an almost equal prevalence of oral lesions in both sexes: 42.8% in males and 40.5% in females.

In Malaysia, a study conducted to determine the prevalence of tongue lesions in a dental outpatient clinic in Klang Valley (Koay *et al*., 2011) reported at least one type of tongue lesion diagnosed in 181 patients (30.2%) where16.7% were females and 13.5% were males. 24 of the total patients (4%) had two or more tongue lesions appearing simultaneously. Fissured tongue was ranked as the most prevalent tongue lesion.

Another study on the frequency of oral lesions was carried out in a Saudi population in 2009 (Al-mobeeriek & Aldosari, 2009). A total of 383 (15.0%) patients had oral mucosal lesions, with 42.3% being in males and 57.7% in females. The most affected age group was 31 to 40 years (21.4%), and the least commonly affected group was individuals older than 61 years old. The most common lesion was Fordyce granules (3.8%), followed by leukoedema (3.4%) and traumatic lesions (1.9%).

A survey by Mozafari (2012) in institutionalized elderly people in Iran revealed a higher prevalence of oral mucosal lesions compared with previous studies in other regions of Iran. The difference in frequency may be due to cultural differences, oral habits, level of education, or genetic differences. The author concludes that national programs promoting oral health are necessary to address the increased prevalence of oral lesion in the population. Thus, dentists and oral medicine specialists need to incorporate regular checkups into geriatric oral health care service (Mozafari *et al*., 2012).

The distribution of various diseases encountered in the International Islamic University Malaysia (IIUM) dental polyclinic has not been explored before; the exact nature of disease distribution in the Kuantan population, particularly those attending the IIUM dental polyclinic has not been scientifically evidenced. It is necessary for clinicians to equip themselves with knowledge of disease burden to equip themselves to provide accurate treatment to patients. Therefore, this study aimed to evaluate the distribution and sociodemographic data of OM cases

encountered in the IIUM undergraduate dental polyclinic.

## Materials and Methods

### Study design and participants

This study was a nine-year retrospective study performed on patients attending the IIUM undergraduates dental polyclinic in Kuantan. Archived data from four batches of IIUM dental undergraduates' OM logbooks and patients' case notes were used in this study.

Records of all the cases seen in OM undergraduate dental clinic were extracted from 2010-2018 using convenience sampling. The extracted records contained demographic and clinical data such as age, gender, ethnicity, diagnosis, and year of diagnosis. Prior to data collection, ethical approval from IIUM Research Ethics Committee was obtained (ID No: IREC 2019-046).

### Case selection

The inclusion criteria for the study were OM cases presented and approved by OM specialists and well recorded in the logbook. Cases that did not have supervisor's approval in the logbook were excluded. Where only partial information was extracted from students' OM logbooks, patients' folders were retrieved from the record-keeping room.
OM cases were defined based on the year of diagnosis. The categorization of diagnosis is further elaborated in Figure 1.

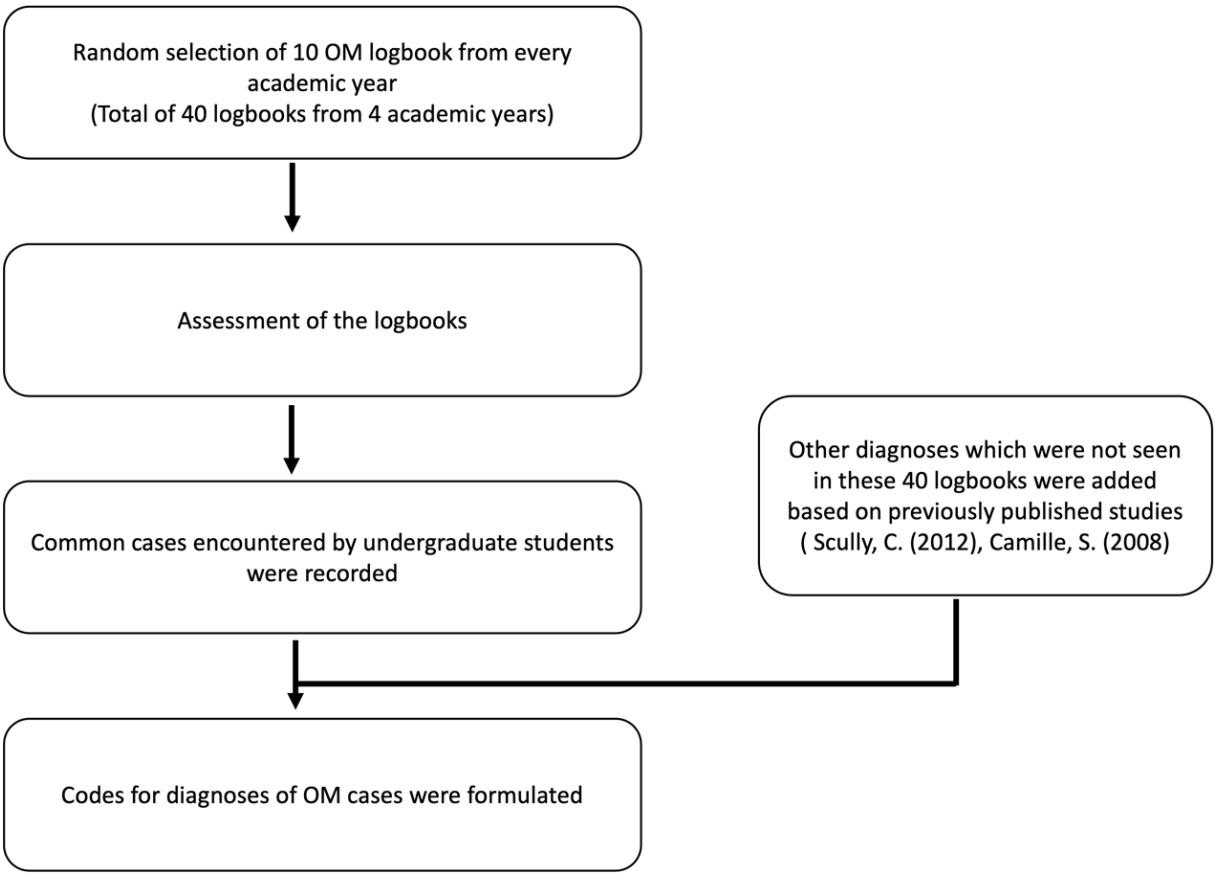


Figure 1. Process for determining diagnosis category.

## Data analysis

Data was collected and processed using SPSS software (IBM Corp. Released 2015. Version 23.0. Armonk, NY: IBM Corp.). Categorical variables were analyzed as frequencies and percentages.Result and Discussion

## Results

A total of 1917 cases were recorded at the IIUM undergraduate dental polyclinic across four academic years over a duration of 9 years (Table 1).

Figure 2 demonstrates the number of cases diagnosed based on year. The highest number of reported cases was recorded in 2016 and the lowest in 2010.

Table 2 shows the distribution of OM cases and their percentages. During the observation period, 22 diagnoses were recorded. The most frequent OM case encountered at the IIUM undergraduate dental polyclinic was oral ulcer, which contributed to 30.9% of the total cases. OM cases with the lowest frequencies were tumours or neoplasms, oral potentially malignant diseases, and lichen planus or lichenoid reactions, making up four, six, and eight cases, respectively.

The distribution of OM cases according to age group is presented in Table 3. Diagnosis was highest in the second decade group, except for denture stomatitis, soft tissue hyperplasia, and keratosis, which were highest in patients older than 50.

Regarding gender distribution, clear differences in the frequency of oral ulcer and pericoronitis were observed between males and females (Table 4). Females were diagnosed at higher than half of the total disease frequency when compared to male subjects. On the other hand, males more frequently reported keratosis, candidiasis, and teeth anomaly.

Table 5 shows the distribution of cases according to ethnicity. The Malay population had the highest number of cases across majority of the diagnoses. Chinese and Indian ethnicities were also represented, however, their numbers were relatively lower.

Table 1. Number of oral medicine cases according to academic batch.

| Academic batch | Number of oral medicine cases |
|---|---|
| 2013/14 | 408 |
| 2015/16 | 445 |
| 2016/17 | 538 |
| 2017/18 | 526 |
| **Total** | **1917** |

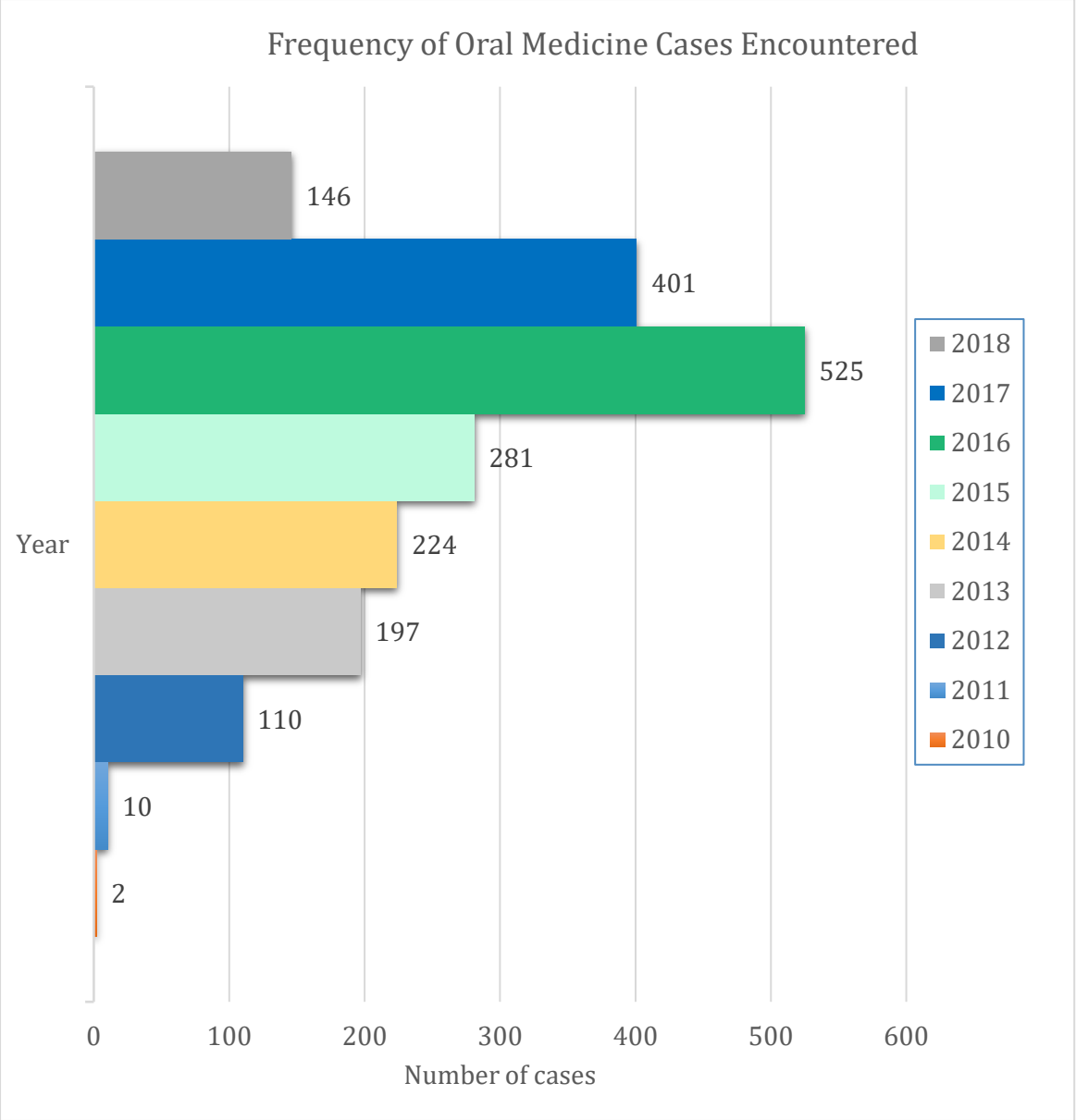


Figure 2. Frequency of oral medicine cases according to year.

Table 2. Distribution of OM cases and their percentages.

| Oral diagnoses | Frequency (n) | Percentage (%) |
|---|---|---|
| Ulcer | 593 | 30.9 |
| TMD | 450 | 23.5 |
| Mucocele/ Salivary gland disease | 41 | 2.1 |
| Denture stomatitis | 83 | 4.3 |
| Pericoronitis | 193 | 10.1 |
| Candidiasis | 19 | 1 |
| Trigeminal Neuralgia/ Neuropathy | 24 | 1.3 |
| Soft tissue hyperplasia | 73 | 3.8 |
| Keratosis | 73 | 3.8 |
| Pigmented lesion | 45 | 2.3 |
| Lichen planus/ lichenoid reaction | 8 | 0.4 |
| Odontogenic infection/cyst | 36 | 1.9 |
| Angular cheilitis/ cheilitis | 41 | 2.1 |
| Bone lesion | 22 | 1.1 |
| Tumor/ neoplasms | 4 | 0.2 |
| Dry socket | 11 | 0.6 |
| Viral infection | 17 | 0.9 |
| Geographic tongue | 46 | 2.4 |
| Nicotinic stomatitis | 10 | 0.5 |
| Teeth anomaly | 21 | 1.1 |
| Others | 101 | 5.3 |
| OPMD | 6 | 0.3 |
| **Total** | **1917** | **100** |

TMD = Temporomandibular disorder, OPMD = Oral potentially malignant disease

Table 3. Distribution of OM case according to age group.

| Diagnosis | Age group | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | <21 | 21-30 | 31-40 | 41-50 | 51-60 | >60 | |
| Ulcer | 27 | 232 | 22 | 16 | 25 | 16 | **338** |
| TMD | 35 | 155 | 28 | 21 | 11 | 5 | **255** |
| Mucocele/ Salivary gland disease | 5 | 13 | 2 | 2 | 3 | 3 | **28** |
| Denture stomatitis | 0 | 2 | 3 | 6 | 19 | 19 | **49** |
| Pericoronitis | 16 | 88 | 4 | 0 | 0 | 0 | **108** |
| Candidiasis | 1 | 7 | 0 | 3 | 2 | 3 | **16** |
| Trigeminal Neuralgia/ Neuropathy | 1 | 9 | 3 | 3 | 0 | 1 | **17** |
| Soft tissue hyperplasia | 2 | 10 | 4 | 8 | 11 | 7 | **42** |
| Keratosis | 1 | 7 | 7 | 9 | 12 | 6 | **42** |
| Pigmented lesion | 0 | 14 | 4 | 3 | 4 | 5 | **30** |
| Lichen planus/ lichenoid reaction | 0 | 0 | 0 | 0 | 1 | 0 | **1** |
| Odontogenic infection/cyst | 1 | 11 | 4 | 5 | 5 | 2 | **28** |
| Angular cheilitis/ cheilitis | 2 | 12 | 0 | 2 | 8 | 2 | **26** |
| Bone lesion | 0 | 7 | 1 | 4 | 2 | 3 | **17** |
| Tumor/ neoplasms | 1 | 0 | 1 | 1 | 0 | 1 | **4** |
| Dry socket | 2 | 3 | 3 | 0 | 1 | 1 | **10** |
| Viral infection | 3 | 7 | 0 | 1 | 1 | 0 | **12** |
| Geographic tongue | 3 | 11 | 2 | 5 | 3 | 5 | **29** |
| Nicotinic stomatitis | 0 | 0 | 0 | 2 | 2 | 2 | **6** |
| Teeth anomaly | 3 | 8 | 0 | 1 | 0 | 0 | **12** |
| Others | 5 | 26 | 8 | 3 | 10 | 8 | **60** |
| OPMD | 0 | 1 | 0 | 1 | 1 | 1 | **4** |
| **Total** | **108** | **623** | **96** | **96** | **121** | **90** | **1134** |

TMD = Temporomandibular disorder, OPMD = Oral potentially malignant disease

Table 4. Distribution of OM cases according to gender.

| Oral diagnosis | Gender | | Total |
|---|---|---|---|
| | Male | Female | |
| Ulcer | 142 | 232 | **374** |
| TMD | 94 | 184 | **278** |
| Mucocele/ Salivary gland disease | 11 | 17 | **28** |
| Denture stomatitis | 20 | 34 | **54** |
| Periocoronitis | 33 | 86 | **119** |
| Candidiasis | 12 | 4 | **16** |
| Trigeminal Neuralgia/ Neuropathy | 7 | 11 | **18** |
| Soft tissue hyperplasia | 13 | 35 | **48** |
| Keratosis | 34 | 9 | **43** |
| Pigmented lesion | 13 | 18 | **31** |
| Lichen planus/ lichenoid reaction | 1 | 1 | **2** |
| Odontogenic infection/cyst | 14 | 16 | **30** |
| Angular chelitis/ cheilitis | 11 | 16 | **27** |
| Bone lesion | 9 | 8 | **17** |
| Tumor/ neoplasms | 4 | 0 | **4** |
| Dry socket | 5 | 5 | **10** |
| Viral infection | 5 | 8 | **13** |
| Geographic tongue | 15 | 16 | **31** |
| Nicotinic stomatitis | 6 | 0 | **6** |
| Teeth anomaly | 9 | 3 | **12** |
| Others | 31 | 34 | **65** |
| OPMD | 5 | 0 | **5** |
| **Total** | **494** | **737** | **1231** |

TMD = Temporomandibular disorder, OPMD = Oral potentially malignant disease

Table 5. Frequency of OM cases according to ethnicity.

| Oral diagnosis | Ethnicity | | | | Total |
|---|---|---|---|---|---|
| | Malay | Chinese | Indian | Others | |
| Ulcer | 338 | 10 | 0 | 3 | **351** |
| TMD | 237 | 15 | 4 | 4 | **260** |
| Mucocele/ Salivary gland disease | 22 | 3 | 0 | 1 | **26** |
| Denture stomatitis | 34 | 17 | 0 | 1 | **52** |
| Pericoronitis | 114 | 0 | 0 | 2 | **116** |
| Candidiasis | 14 | 1 | 0 | 0 | **15** |
| Trigeminal Neuralgia/ Neuropathy | 14 | 0 | 2 | 1 | **17** |
| Soft tissue hyperplasia | 37 | 1 | 2 | 1 | **41** |
| Keratosis | 34 | 5 | 0 | 1 | **40** |
| Pigmented lesion | 28 | 0 | 1 | 1 | **30** |
| Lichen planus/ lichenoid reaction | 1 | 0 | 0 | 0 | **1** |
| Odontogenic infection/cyst | 25 | 1 | 0 | 0 | **26** |
| Angular chelitis/ cheilitis | 21 | 5 | 0 | 1 | **27** |
| Bone lesion | 16 | 0 | 0 | 0 | **16** |
| Tumor/ neoplasms | 4 | 0 | 0 | 0 | **4** |
| Dry socket | 10 | 0 | 0 | 0 | **10** |
| Viral infection | 12 | 1 | 0 | 0 | **13** |
| Geographic tongue | 26 | 2 | 0 | 0 | **28** |
| Nicotinic stomatitis | 6 | 0 | 0 | 0 | **6** |
| Teeth anomaly | 9 | 1 | 0 | 2 | **12** |
| Others | 54 | 8 | 0 | 1 | **63** |
| OPMD | 5 | 0 | 0 | 0 | **5** |
| **Total** | **1061** | **70** | **9** | **19** | **1159** |

## Discussion

The current study successfully reports OM cases commonly observed in the IIUM undergraduate dental polyclinic. The diagnoses indicate common oral diseases present in the Kuantan population.

Oral ulcer was the most prevalent OM lesion reported in patients attending the IIUM undergraduate dental polyclinic across the years studied (30.9%). A previous study on the distribution of oral lesions in Turkey by Mumcu *et al*. reported a 1.2% prevalence of recurrent aphthous stomatitis. The difference in observation can be attributed to convenient sampling data collection method used on subjects who have or are visiting the clinic to receive treatment for oral ulcer used in this study, while Mumcu *et al*. used cluster sampling method whereby the oral ulcer subjects were taken from areas screened by the researcher.

In the current study, 60% of subjects (737 out of 1231) attending the IIUM undergraduate dental polyclinic were female. The high percentage of female subjects suggests that oral diseases are more likely in the female population, or that females were more conscious of their oral health than males (Farah *et al*., 2008).

The female to male ratio distribution of oral ulcer cases in this study was 1.6:1. A similar figure was reported by Cebeci in the Turkish population, where the ratio is 2:1(3). Oral ulcer is more prevalent in females and may be associated with changing levels of sex hormones i.e. progesterone and estrogen. A study by Balan et al., reported that 30% of 40 healthy young woman with normal menstrual cycles complained of aphthous ulcer among other oral discomforts (Balan *et al*., 2012).

Oral ulcers were most prevalent in young adults between the ages of 21 to 30 years old when compared to other age groups. This finding is in agreement with a previous study reporting highest prevalence of oral ulcers in age group 25 to 34 years old (Cebeci *et al*., 2009). This may be due to increased work stress leading to anxiety and depression in this age group (Melchior *et al*., 2007). Higher anxiety levels is a proven risk factor for recurrent aphthous ulcers ( Al-Omiri *et al*., 2012).

The second highest OM diagnosis recorded was temporomandibular joint dysfunction (TMD), with 540 cases reported over the nine- year duration. Subjects who complained of pain/discomfort and dysfunction of the temporomandibular joint area and adjacent muscle that may also involve pain radiating to ear, throat, and neck region are common symptoms present with temporomandibular joint dysfunction. The aetiology of TMD is broad and can be categorized into biomedical, psychosocial, and biopsychosocial concepts (Suvinen *et al*., 2005).

The ratio of females to males affected with TMD recorded in this study is 2:1 and was highest in the 21–30-year-old age group. This data is corroborated by results from a previous study reporting pain and discomfort of temporomandibular joint and musculature in a distinct number of women of reproductive age (Lövgren *et al*., 2016). Women of this age group are mainly affected due to fluctuating sex hormones and psychological depression *(Giannakopoulos et al*., 2010).

Pericoronitis was the third highest OM case diagnosed with 193 out of 1917 diagnoses made in this study. Pericoronitis is a condition commonly involving the mandibular third molar, where periodontal tissue surrounding an impacted or partially erupted tooth is inflamed as a result of plaque accumulation (Hazza'a *et al*., 2009). Among the total pericoronitis cases, females (72%), and those in the 21-30 age group showed the highest diagnosis frequency. This finding is in agreement with a previous study reporting a high prevalence of pericoronitis among females between 19-23 years old. The study further relates the occurrence of pericoronitis in response to the menstrual cycle, pregnancy and also the period revolving the eruption of the mandibular third molar (Ayanbadejo *et al*., 2007).

The current study recorded 34 keratosis cases in males, and only nine in females. Similarly, other studies carried out in Turkey, Thailand and Malaysia reported higher incidences of keratosis in males compared to females. In Turkey, the male to female case distribution reported for keratosis was 18:11, in Thailand, 7:2, and in Malaysia was 7:5 cases. The high number in males suggests that keratosis is highly associated with tobacco as a predisposing factor.

Similarly, the incidence of nicotinic stomatitis is higher in males than females due to tobacco consumption being an aetiology for this oral lesion, and male smokers outnumbering females. In the present study, six males were reported with nicotinic stomatitis, compared to no females reported. In a previous study by Cebeci *et al*., (2009), seven cases of nicotinic stomatitis was reported in males, and two in females.
Only six cases of oral potential malignant disorder (OPMD) were recorded in the current study (0.3%), while in the Chiang Mai and Kuala Lumpur population, 3.0% and 3.4% prevalence was reported, respectively. OPMD cases include leukoplakia, erythroplakia and oral submucous fibrosis.

On the other hand, the OM cases with lowest frequency were tumour/neoplasms, OPMD, and lichen planus/lichenoid reaction with 0.2%, 0.3%, and 0.4% prevalence respectively. The results show lower distribution of oral lesions when compared to data from other studies. For example, Mumcu *et al.* reported a 0.5% prevalence of lichen planus in the Turkish population. Another study reported a link between tobacco habits and the prevalence of lichen planus in dental school out-patients in Malaysia and Thailand at 3.8% and 2.1%, respectively. In the current study, the subjects' habits were not recorded; therefore, a link between tobacco habits and oral lesion prevalence could not be established.

Ethnicity-wise, all OM cases were recorded at highest frequency in Malays. This may be due to Malays being the majority ethnic group (91.5%) visiting the undergraduate dental clinic, followed by Chinese (6.0%), Indian (0.8%) and others (1.6%). A previous study conducted in Malaysia had similar results, which majority of the subjects were Malay (53.6%), followed by Chinese (22.7%), and Indian (23.6%).

## Conclusion

The current study identifies the most common OM cases encountered in the IIUM undergraduate dental polyclinic. The results portray the disease burden in Kuantan population in general. The findings could serve as a baseline data for future studies of OM cases in the general population at a national level. Knowledge on the common cases presenting at dental practice is crucial especially for the teaching institutions to prepare safe and competent future clinicians with basic management skills required in daily practice.

Further studies targeting a larger population is recommended. A national level study involving multiple centers would yield better insight for the current oral disease distribution in the Malaysian community.

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ORIGINAL ARTICLE Open Access

# Utilisation trends and oral health-related quality of life among patients attending Visiting Dental Services in Selangor

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## Abstract

This study aimed to assess utilisation trends and oral health-related quality of life (OHRQoL) among patients attending Visiting Dental Service (VDS) in Selangor, Malaysia. This two-phased study involved a secondary analysis of data from the Selangor VDS's (seventeen VDSs) patient database (2017 to 2019) and a cross-sectional survey among patients from twelve VDSs. A self-administered questionnaire that consisted of a validated Short Oral Health Impact Profile (S-OHIP) scale was used. The S-OHIP score for each participant was calculated using Additive Scores (ADD) that range from being the "least affected" with a score of 0 to the "most affected" with a score of 56. Statistical analysis was done using a t-test and one-way ANOVA, with the statistical significance set at p=0.05. This study found that the adult group and Malay ethnicity recorded the highest attendance from 2017 to 2019. Extraction of permanent teeth was the most frequently provided treatment from 2017 to 2019 (70.2%, 67.6%, 61.2%). A total of 124 respondents from twelve VDSs completed the survey. The mean age was 32.72 ± 9.75 years old. The respondents' mean total score of S-OHIP was 9.69 ± 7.64 and significantly differed by gender (p=0.007). The S-OHIP dimension that mainly affected the respondents was psychological discomfort due to 'food stuck' (18.5%). VDS utilisation trends in Selangor increased from 2017 to 2019, with dental extraction being the treatment in demand. The OHRQoL of patients attending the VDSs was encouraging despite the less-than-ideal condition, highlighting the urgent need for a more permanent solution to VDS.

***Keywords:*** *Oral Health-Related Quality of Life, Short Oral Health Impact Profile (S-OHIP), Visiting Dental Service*

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## Introduction

Oral healthcare services were still underutilised in Malaysia, particularly among adults and young children (NIH, 2019). Parts of the reasons for the poor utilisation of oral healthcare were work or other responsibilities and the inability to take time off (NIH, 2019). In addition, the general perception of oral healthcare needs remains low among the population, and there was a lack of awareness about the importance of regular dental visits to maintain optimal oral health (NIH, 2019).

A local study on the prevalence of oral healthcare utilisation in the last 12 months was 13.2% (Tan *et al.*, 2021), which was lower than the finding in the National Oral Health Survey of Adults 2010 (NOHSA 2010), with 27.4% (OHD, 2013; NIH, 2019).

Furthermore, about 15% of the Malaysian population had never seen a dentist in their lifetime (NIH, 2019). It was evidenced that the utilisation of oral healthcare was discouraged by a majority of individuals who believed they were not sick enough to seek care and those who self-medicate while they were sick (Varenne *et al*., 2006; Agbor & Azodo, 2011). In addition, diverse demographic and socioeconomic characteristics were considered important factors influencing oral healthcare utilisation in Malaysia (Tan *et al*., 2021).

Recognising the relationship between individuals' quality of life and oral health is crucial as their interplay significantly impacts an individual's daily functioning. Furthermore, according to Sischo and colleagues, oral health-related quality of life (OHRQoL) is an integral part of general health and well-being (Sischo & Broder, 2011). By definition, OHRQoL is defined by an individual's subjective evaluation of how one's well-being is influenced by factors such as comfort during eating, sleeping, social interaction, self-confidence, and contentment with oral health (DHHS, 2000). Research exploring OHRQoL provides valuable insights into various facets of an individual's functional and emotional well-being, satisfaction and expectations with care, and self-perception (Sischo & Broder, 2011). A widely used epidemiological measure of OHRQoL, developed by Slade and Spencer, was called the Oral Health Impact Profile (OHIP) (Slade & Spencer, 1994). OHIP comprises 49 items, categorised into seven domains such as functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap (Slade & Spencer, 1994). OHIP was translated and validated into Malay (Saub *et al*., 2007). The short version, designated as the S-OHIP(M), which contains 14 items of 7 domains, is also available. OHIP has been used in several studies in Malaysia to assess the OHRQoL of a particular population, such as the residents of nursing homes in Terengganu, Malaysia (Mohd *et al*., 2020) and individuals with and without temporomandibular disorders (TMD) (Mohamad *et al*., 2019). However, no published study has been found that measures OHRQoL among patients attending public oral healthcare in Malaysia.

Oral healthcare service is one of the essential services provided by the Ministry of Health Malaysia (MOH) to its population. Healthcare within the public sector provides universal and comprehensive healthcare coverage funded by general taxation. In addition to dental clinics, oral healthcare services are delivered in schools, mobile dental clinics, and teams such as flying squads.

Regarding different types of dental clinical settings available in the MOH, the ministry has established the Visiting Dental Service (VDS) at the local Health Clinic (Klinik Kesihatan). The VDS also aims to increase access to dental services within the population, especially in densely populated areas with limited oral health personnel. The government dental teams from the nearby district primary dental clinics generally provide the VDS. The VDS is responsible for providing primary dental treatments such as dental examination, tooth filling, and tooth extraction to the population.

Health Clinic with VDS usually has one dental surgery room with equipment similar to any other dental surgery room. However, areas such as the waiting areas for the patients have to be shared with other units in the Health Clinic. The lack of human resources and specific dental equipment renders it unable to function as a main dental clinic. The types of dental treatment offered may be limited due to the inadequate facilities at the clinic. In practice, the VDS is regularly scheduled in periodic weekly, fortnightly, or monthly visits. The scheduling mainly depends on dental personnel's availability from the main dental clinic. The delivery method of dental service of VDS is quite similar to the dental care delivery commissioned by the Nganampa Health Council Dental Programme on the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands in the northwest of South Australia (Wooley, 2006).

Until 2021, there were seventeen VDSs from seven districts (Gombak, Hulu Selangor,

Klang, Kuala Langat, Kuala Selangor, Sabak Bernam, and Sepang) in Selangor that were still operating. Various efforts were being made by all State Oral Health Divisions to upgrade the VDS to function as a main dental clinic.

This study highlights the utilisation trends of the VDSs in Selangor, Malaysia. The estimated population of Selangor, including non-citizens, in 2020 is 6,538,100 (DOSM, 2021). Data from the Health Informatics Centre, MOH revealed that the public dental facility ratio to Selangor population till 31st December 2018 was 1:30,104 (MOH, 2019). This ratio was the highest in Malaysia. This shows that Selangor needs a high number of dental facilities to meet the oral health needs of its population. Although private oral health services can help to reduce this figure, a study found that the public sector remains the primary supplier of oral healthcare (80.7%) and has remained consistent over time (NIH, 2019).

This study aimed to assess utilisation trends and oral health-related quality of life (OHRQoL) among patients attending VDSs in the state of Selangor, Malaysia. Selangor, which has the highest population in Malaysia, is seen as needing more dental service facilities than other states. To visualise the population's overall acceptance of the VDSs, it is important to understand the impact the VDSs have on the population by focusing on the utilisation trends of VDSs. The local population's need for oral health care will indicate the necessity to maintain or upgrade the existing facilities. Assessment of OHRQoL is also necessary among patients to see the impact of oral health on their quality of life. Findings from this study can be used for future planning of the public oral healthcare facilities, particularly in Selangor.

## Materials and Methods

### Sampling

This study comprised two phases. Phase 1 was a retrospective study that analysed data from the VDS's patient database in Selangor from 2017 to 2019. Phase 2 was a cross-sectional quantitative survey using a self-administered questionnaire at selected VDSs in the Health Clinics. Data collection for Phase 1 was done in May 2021, and Phase 2 was carried out in June and July 2021.

The sampling method for Phase 2 of the study was convenience sampling due to limited resources and time constraints. The Movement Control Order implemented in Selangor due to the COVID-19 pandemic further worsened the time constraint. It has affected both the movement of the researcher and the operating hours of all VDSs in the state of Selangor. There was an overall reduction in patient attendance in all VDSs. Random sampling was not feasible in this study where specific practical criteria were met, such as easy accessibility, availability at a given time, or the willingness to participate in the study (Dörnyei, 2007). The sample size calculation was done using Epiinfo™ software with a confidence interval set at 95%. The finalised sample size needed in this study after 10% consideration of non-respondents (Shiv Kumar Mudgal *et al*., 2020) was 101 participants.

### Data instrumentations

Two separate datasheets were prepared for the secondary data collection in Phase 1. The first data sheet collected the total number of patients who visited the VDSs by different categorisations. The categorisation was as follows: 0 to 6 years old, primary school children, secondary school children, special needs, antenatal mothers, adults, and elderly. The patients' ethnicities were also captured and entered into the datasheet. The second datasheet was prepared to collect the total number of dental treatments by the category of patient and the type of dental treatment delivered. The study only collected data 3 years before the COVID-19 pandemic because most VDSs operated according to the schedule before the pandemic.

The questionnaire of Phase 2 consisted of two main sections; i) Demographic Profile and ii) S-OHIP(M). The questionnaire was in Malay and had close-ended questions. S-OHIP(M) section contained fourteen items divided into seven domains: i) functional

limitation, ii) physical pain, iii) psychological discomfort, iv) physical disability, v) psychological disability, vi) social disability, and vii) handicap *(Saub et al*., 2005). The respondents answered the questions using a five-point frequency Likert scale (very often, quite often, sometimes, seldom, and never) (Saub & Locker, 2006).

## Data analysis

Phase 1 and 2 data was analysed using IBM Statistical Package for Social Science (SPSS) Statistics Software Version 27. Data cleaning was performed, which involved detecting, diagnosing, and editing corrupted data (Van den Broeck *et al*., 2005). This was accomplished by running the frequency distribution for each item and ensuring that only the correct number ranges were used. If any coding numbers were invalid or questionable, the original data report of Phase 1 and the questionnaire of Phase 2 were referred to the correct answer. In the case of missing data in Phase 2, all respondents with missing data were included for descriptive analysis. However, the total exclusion of the respondents with missing data on questions using the Likert scale was done to the S-OHIP score's numerical data.

For data scoring of the S-OHIP(M), responses were made on a five-point Likert-type scale and coded 4= 'very often', 3 = 'quite often', 2 = 'sometime', l= 'seldom' and 0= 'never' (Slade, 1997). The response of 'don't know' was coded as missing. The additive score (ADD) was used to compute the S-OHIP(M) score for each respondent (Allen & Locker, 1997). The ADD scores were calculated by summing the response codes for the 14 items and ranged from 0 to 56. The higher the scores of ADD, the worse the OHRQoL (Saub *et al*., 2005).

A histogram plot was used to check the normality of the data. The data was discovered to be approximately normally distributed. The association of mean total S-OHIP score with two categorical variables was examined by independent t-test, while one-way ANOVA was applied to examine the association of mean total S-OHIP score with three or more categorical variables. Statistical significance was set at $p \leq 0.05$.

## Ethics

Ethical clearance was obtained from the Research Ethics Committee of the Universiti Teknologi MARA's Faculty of Dentistry and the MOH's Medical Research Ethics Committee (MREC). This study was also registered with the National Medical Research Registry (NMRR), MOH (NMRR-21-388-58227 (IIR)) and granted permission from the Oral Health Programme, MOH to conduct the study at the selected VDS facilities.

## Results

### Phase 1

Data from seventeen participating VDSs was analysed. Generally, the number of 'new' (first-time attendees in that year) and total (new and recurrent) patients for the entire VDSs increased from 2017 to 2019 (Table 1). Six VDSs showed a consistent increase of 'new' attendance from the year 2017 to 2019, which were VDS Kuang, Sg. Dusun Kg.Soeharto, Jenjarom, Telok Panglima Garang, Bagan Terap and Dengkil. The same VDSs, including VDS Selisik, showed a consistent increase in total attendance from 2017 to 2019.

In terms of group comparison by category (Table 2), the adult group recorded the highest total attendance from 2017 to 2019, with 2444, 2492, and 3483 adult patients, respectively, for each year, with an overall of 8419 adult patients compared to other groups. It was followed by the antenatal group with 1783, 2359, and 2645 patients, respectively, for the years 2017, 2018, and 2019. The smallest number in attendance for new patients and total visits for each year was the special needs group.

Table 1. New and total attendance by VDSs, 2017-2019.

| VDS | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|
| | New | Total | New | Total | New | Total |
| Batu Arang | 888 | 1111 | 782 | 1083 | 882 | 1181 |
| Kuang | 770 | 914 | 827 | 981 | 843 | 1001 |
| Kalumpang | 280 | 340 | 242 | 290 | 301 | 416 |
| Rasa | 128 | 144 | 97 | 104 | 528 | 686 |
| Selisik | 91 | 94 | 89 | 100 | 224 | 272 |
| Sg Dusun Kg Soeharto | 204 | 255 | 248 | 268 | 368 | 442 |
| Pulau Indah | 255 | 304 | 166 | 196 | 298 | 337 |
| Pulau Ketam | 119 | 145 | 128 | 158 | 55 | 64 |
| Bandar | 219 | 220 | 97 | 98 | 122 | 122 |
| Bukit Changggang | 162 | 167 | 170 | 183 | 148 | 179 |
| Jenjarom | 654 | 694 | 840 | 1008 | 1141 | 1448 |
| Telok Panglima Garang | 258 | 300 | 495 | 573 | 553 | 661 |
| Ijok | 172 | 183 | 151 | 156 | 175 | 187 |
| Jeram | 742 | 978 | 506 | 622 | 662 | 844 |
| Bagan Terap | 120 | 149 | 127 | 150 | 271 | 341 |
| Sg Air Tawar | 62 | 69 | 56 | 56 | 113 | 120 |
| Dengkil | 489 | 717 | 1025 | 1043 | 1395 | 1458 |
| **Total** | **5613** | **6784** | **6046** | **7069** | **8079** | **9759** |

Regarding ethnicity (Table 3), the Malay ethnicity recorded the highest percentage for new attendance (75.1%, 76.3%, 77.7%) and total overall attendance (73.7%, 74.9%, 76.4%), respectively, for each year (2017-2019). Meanwhile, the number of new and total attendance of Chinese and Indian ethnicity were roughly comparable, ranging from 9-12%.

Phase 1 of the study also documented the type and number of treatments performed in the VDSs from 2017 to 2019 (Table 4). Extraction of permanent teeth was the most frequently provided treatment from 2017 to 2019 (70.2%, 67.6%, 61.2%), followed by extraction of deciduous teeth (13.2%, 13.4%, 12.2%). The least frequently provided treatments were surgical treatment and treatment for complications after tooth extraction.

Table 2. The distribution of new and total attendance by category of patient, 2017-2019.

| Patient Category | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2017* | | 2018 | | 2019 | | Total** | |
| | New (%) | Total (%) | New (%) | Total (%) | New (%) | Total (%) | New (%) | Total (%) |
| **0 to 6 years old** | 516 (19.0%) | 593 (19.8%) | 745 (27.4%) | 812 (27.1%) | 1460 (53.7%) | 1593 (53.1%) | 2721 (100%) | 2998 (100%) |
| **Primary school Children** | 315 (26.1%) | 369 (25.6%) | 370 (30.6%) | 445 (30.9%) | 523 (43.3%) | 626 (43.5%) | 1208 (100%) | 1440 (100%) |
| **Secondary school Children** | 63 (22.1%) | 68 (21.3%) | 63 (22.1%) | 67 (21.0%) | 159 (55.8%) | 184 (57.7%) | 285 (100%) | 319 (100%) |
| **Antenatal mother** | 1761 (26.4%) | 1783 (26.3%) | 2339 (35.0%) | 2359 (34.8%) | 2576 (38.6%) | 2645 (39.0%) | 6676 (100%) | 6787 (100%) |
| **Adult (18 to 59 years old)** | 1951 (29.6%) | 2444 (29.0%) | 1980 (30.0%) | 2492 (29.6%) | 2659 (40.3%) | 3483 (41.4%) | 6590 (100%) | 8419 (100%) |
| **Elderly (60 years old and above)** | 506 (29.5%) | 788 (27.7%) | 526 (30.7%) | 860 (30.2%) | 682 (39.8%) | 1198 (42.1%) | 1714 (100%) | 2846 (100%) |
| **Special needs** | 12 (21.8%) | 22 (25.6%) | 23 (41.8%) | 34 (39.5%) | 20 (36.4%) | 30 (34.9%) | 55 (100%) | 86 (100%) |

* Year of 2017- VDS Dengkil not included
** % within the category of patient

Table 3. New and total attendance of patients by ethnicity, 2017-2019.

| Ethnicity | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2017* | | 2018 | | 2019 | |
| | New N (%) | Total N (%) | New N (%) | Total N (%) | New N (%) | Total N (%) |
| **Malay** | 3846 (75.1%) | 4474 (73.7%) | 4615 (76.3%) | 5296 (74.9%) | 6279 (77.7%) | 7456 (76.4%) |
| **Chinese** | 523 (10.2%) | 685 (11.3%) | 628 (10.4%) | 807 (11.4%) | 761 (9.4%) | 1029 (10.5%) |
| **Indian** | 610 (11.9%) | 741 (12.2%) | 648 (10.7%) | 798 (11.3%) | 827 (10.2%) | 1041 (10.7%) |
| **Other** | 92 (1.8%) | 107 (1.8%) | 107 (1.8%) | 117 (1.7%) | 161 (2.0%) | 173 (1.8%) |
| **Non-citizen** | 53 (1.0%) | 60 (1.0%) | 48 (0.8%) | 51 (0.7%) | 51 (0.6%) | 60 (0.6%) |
| **Total**** | **5124 (100.0%)** | **6067 (100.0%)** | **6046 (100.0%)** | **7069 (100.0%)** | **8079 (100.0%)** | **9759 (100.0%)** |

*Year of 2017- VDS Dengkil not included
**% within year

Table 4. The distribution of dental treatments provided in VDSs in Selangor, 2017-2019.

| Types of Treatment | Year | | | |
|---|---|---|---|---|
| | 2017* N (%) | 2018 N (%) | 2019 N (%) | Total N (%) |
| **Restoration of deciduous teeth** | 70 (2.5) | 54 (1.7) | 136 (3.1) | 260 (2.5) |
| **Restoration of permanent teeth** | 88 (3.1) | 184 (5.9) | 418 (9.4) | 690 (6.6) |
| **Extraction of deciduous teeth** | 375 (13.2) | 419 (13.4) | 544 (12.2) | 1338 (12.8) |
| **Extraction of permanent teeth** | 1993 (70.2) | 2115 (67.6) | 2731 (61.2) | 6839 (65.6) |
| **Scaling** | 84 (3.0) | 149 (4.8) | 332 (7.4) | 565 (5.4) |
| **Abscess** | 230 (8.1) | 200 (6.4) | 293 (6.6) | 723 (6.9) |
| **Complication after extraction** | 1 (0.04) | 5 (0.2) | 3 (0.1) | 9 (0.1) |
| **Surgical** | 0 (0.0) | 2 (0.1) | 2 (0.04) | 4 (0.03) |
| **Total**** | **2841 (100.0)** | **3128 (100.0)** | **4459 (100.0)** | **10428 (100.0)** |

*Year of 2017- VDS Dengkil not included
**% within year

## Phase 2

The finalised number of respondents that met the inclusion criteria for Phase 2 was 124 from 12 VDSs. Table 5 shows the sociodemographic of participants who completed the questionnaires. The study participants were 18 to 68 years old, with a mean age of 32.72 ± 9.75. Table 6 shows the response to each of the S-OHIP items. The mean total score was 9.69 ± 7.64. The most frequently ('very often' and 'quite often') reported S-OHIP dimension that affected was psychological discomfort due to 'food getting stuck between teeth or dentures', 23(18.5%) followed by 'feeling shy due to their oral health problems', 14(11.3%).

Table 5. Sociodemographic background of the respondents.

| Sociodemographic | *N | *% |
|---|---|---|
| **Gender** | | |
| Male | 16 | 12.9 |
| Female | 108 | 87.1 |
| **Ethnicity** | | |
| Malay | 107 | 86.3 |
| Chinese | 4 | 3.2 |
| Indian | 11 | 8.9 |
| Others | 2 | 1.6 |
| **Age group** | | |
| 18-39 years old | 102 | 82.3 |
| 40-59 years old | 19 | 15.3 |
| 60 & above | 3 | 2.4 |
| **Education level** | | |
| No formal education and primary school | 5 | 4.0 |
| Secondary school | 57 | 46.0 |
| College and higher | 61 | 49.2 |
| **Occupational** | | |
| Government | 28 | 22.6 |
| Private | 34 | 27.4 |
| Self-employed | 13 | 10.5 |
| Unemployed | 49 | 39.5 |
| Retired | 0 | 0.0 |
| **Transportation to clinic** | | |
| Own transport | 119 | 96.0 |
| Public transport | 4 | 3.2 |
| Other | 0 | 0.0 |
| **Distance between home and clinic** | | |
| Less than 5km | 64 | 51.6 |
| 5 to 10km | 43 | 34.7 |
| More than 10km | 17 | 13.7 |
| **Desired dental treatment** | | |
| Oral examination | 35 | 28.2 |
| Scaling | 23 | 18.5 |
| Filling | 6 | 4.8 |
| Tooth extraction | 19 | 15.3 |
| Others with reason stated | 2 | 1.6 |
| Other with no reason stated | 34 | 27.4 |
| More than 1 treatment | 5 | 4.0 |

*Frequency and percentage with missing data

Table 6. Prevalence of response to Short Oral Health Impact Profile (S-OHIP).

| Domain and Items | Very Often N (%) | Quite often N (%) | Sometimes N (%) | Seldom N (%) | Never N (%) |
|---|---|---|---|---|---|
| **Functional limitation** | | | | | |
| Difficulty chewing any food (N=119) | 1(0.8) | 3(2.4) | 14(11.3) | 41(33.1) | 60(48.4) |
| Problems cause bad breath (N=112) | 0(0.0) | 8(6.5) | 27(21.8) | 49(32.3) | 37(29.8) |
| **Physical pain** | | | | | |
| Discomfort eating any food (N=116) | 0(0.0) | 7(5.6) | 20(16.1) | 35(28.2) | 54(43.5) |
| Ulcer in mouth (N=117) | 0(0.0) | 0(0.0) | 21(16.9) | 45(36.3) | 51(41.1) |
| **Psychological discomfort** | | | | | |
| Discomfort due to food getting stuck (N=122) | 3(2.4) | 20(16.1) | 33(26.6) | 56(45.2) | 10(8.1) |
| Felt shy (N=118) | 1(0.8) | 13(10.5) | 16(12.9) | 37(29.8) | 51(41.1) |
| **Physical disability** | | | | | |
| Avoided to eat certain foods (N=118) | 2(1.6) | 8(6.5) | 17(13.7) | 39(31.5) | 52(41.9) |
| Avoided to smile (N=120) | 3(2.4) | 5(4.0) | 7(5.6) | 26(21.0) | 79(63.7) |
| **Psychological disability** | | | | | |
| Sleep has been disturbed (N=121) | 1(0.8) | 2(1.6) | 14(11.3) | 34(27.4) | 70(50.5) |
| Concentration has been disturbed (N=123) | 0(0.0) | 7(5.6) | 12(9.7) | 38(30.6) | 66(53.2) |
| **Social disability** | | | | | |
| Avoided to go out (N=123) | 0(0.0) | 1(0.8) | 7(5.6) | 9(7.3) | 106(85.5) |
| Problems in daily activities (N=123) | 0(0.0) | 0(0.0) | 17(13.7) | 19(15.3) | 87(70.2) |
| **Handicap** | | | | | |
| Spent a lot of money (N=123) | 0(0.0) | 2(1.6) | 8(6.5) | 26(21.0) | 87(70.2) |
| Felt less confident (N=123) | 0(0.0) | 9(7.3) | 7(5.6) | 34(27.4) | 73(58.9) |

*Frequency and percentage with missing data.

Table 7 shows factors associated with the mean S-OHIP score. The mean total S-OHIP score between males and females differed significantly (p=0.007). The mean total S-OHIP scores were not significantly different between ethnicity (p=0.130), age group (p=0.962), education level group (p=0.801) and occupation (p=0.566).

Table 7. Associated factors with S-OHIP Score.

| Variables | *S-OHIP score Mean (SD) | P-value |
|---|---|---|
| **Gender** | | |
| Male (N=11) | 15.45 (7.66) | 0.007 |
| Female (N=86) | 8.95(7.36) | |
| **Ethnicity** | | |
| Malay (N=85) | 10.32 (7.76) | 0.130 |
| Chinese (N=2) | 1.00 (1.41) | |
| Indian (N=8) | 5.50 (5.50) | |
| Other (N=2) | 8.50 (0.71) | |
| **Age group** | | |
| 18-39 years old (N=82) | 9.6 (7.38) | 0.962 |
| 40-59 years old (N=14) | 10.21 (9.54) | |
| 60 & above (N=1) | 10.00 (0.00) | |
| **Education level group** | | |
| No formal education & primary school (N=2) | 9.50 (0.71) | 0.801 |
| Secondary school (N=43) | 9.12 (7.95) | |
| College & higher (N=52) | 10.17 (7.57) | |
| **Occupation** | | |
| Government (N=26) | 10.77 (8.68) | 0.566 |
| Private (N=26) | 9.00 (6.69) | |
| Self-employed (N=8) | 12.25 (8.87) | |
| Unemployed (N=37) | 8.86 (7.30) | |

*Without missing data.

## Discussion

### Patient's utilisation trends of VDS

Despite the increasing trends in the overall attendance of the VDS from 2017 to 2019, the utilisation of VDSs was considered low. It is similar to a study highlighting the Malaysian population's low utilisation rate. Despite the MOH's attempts to encourage participation and utilisation of oral healthcare services, oral healthcare utilisation remains low in Malaysia (Tan *et al*., 2021). However, this study did not focus in-depth on the factors that lead to the lack of utilisation of VDSs.

Several demographic groups continue to have discrepancies in dental care utilisation (Lutfiyya *et al*., 2019). The previous study observed the inequalities in oral healthcare utilisation in Malaysia. Utilisation of oral healthcare was higher among females, married individuals, younger adults, those with higher education, those who had medical check-ups in the last 12 months, and

those with higher incomes (Tan *et al*., 2021). This study found that Malay ethnicity and adults were more likely to utilise the VDSs.

The total attendance of primary and secondary schoolchildren was among the lowest in VDS. It would be due to the incremental dental programme in schools delivered by the School Dental Service (SDS) by the MOH. The group with the lowest utilisation rate was observed among the special needs group. People with disabilities have numerous challenges when it comes to dental care. People with disabilities may require special accommodations such as disabled parking and lifts. The unavailability of such facilities creates a significant barrier to routine dental treatment for those with disabilities (Hansen *et al*., 2021). Although it was low, the need to serve this group still exists because this group will usually be affected more in terms of their health and oral health. Compared to the general population, adults with disabilities have a higher prevalence and severity of oral diseases (Beange, 1996). Due to the demand from the special needs group regarding their oral health care, it is important for the dental team to receive enough training to ensure this particular population receives adequate and satisfactory oral care. In all circumstances, the dental team is responsible for adapting in order to reduce oral healthcare barriers (Hansen *et al*., 2021).

Various factors influence the utilisation of health facilities, especially oral healthcare facilities. Low utilisation of oral healthcare may also be related to a low perceived need for oral healthcare (Adunola *et al*., 2019). However, this study did not focus on factors influencing the utilisation of VDSs. Improving the utilisation of oral healthcare by the public is critical. Appropriate interventions to reinforce existing programmes that promote regular and timely oral health check-ups are required to improve the utilisation of oral healthcare (Tan *et al*., 2021).

## Dental treatment delivered at the VDS

This study revealed that extracting permanent (n=6839, 65.6%) and deciduous (n=1338, 12.8%) teeth was the most frequent dental treatment conducted at VDSs. It was similar to the findings of the study conducted at a rural outreach dental clinic in Udo, Southern Nigeria. The most commonly administered treatment in that study was extractions (41.5%) (Okeigbemen & Nnawuihe, 2015). However, this study could not determine whether the teeth extraction was due to periodontal problems, caries, or other indications. It has been observed in this study that treatment on deciduous teeth was high as well, especially extraction (n=1338, 12.8%). These findings suggest the appropriateness of delegating the dental therapist in the VDS to cater the dental treatment to children besides the dentist.

The data collected from the participants for this study focused on curative treatment. Thus, it is not within the scope of this research to analyse the preventive treatment conducted in the VDSs. It is recommended that preventive treatments be considered in future research.

## The Oral Health-Related Quality of Life of patients attending the VDS

The mean total score of S-OHIP for this study was 9.69 ± 7.64. It was quite similar to the baseline of overweight/obese adolescents in Klang Valley, with a mean of 9.83 ± 6.68 (Tengku H *et al*., 2021). It was lower than the study on an adult with a periodontal problem in Kuantan 14.73 ± 9.24 (Husain *et al*., 2020) and the study on adults in Selangor 10.96 ± 8.81 (Saub *et al*., 2005). However, it was higher compared to the study OHRQoL among residents of a care home in Terengganu at 6.28 ± 5.72 (Mohd *et al*., 2020) and the study among adults living with HIV/AIDS at 8.8 ± 7.92 (Mohamed *et al*., 2017). This variation in mean score could be attributed to population differences in their sociodemographic background and the sample size. A study in Canada found that children from low-income families had lower OHRQoL than children from high-

income families (Locker, 2007). A local study on Health-Related Quality of Life (HRQOL) of low socioeconomic status populations in Malaysia found that low QoL was associated with low household income (Puteh *et al*., 2019).

Males reported a higher mean total S-OHIP score of 15.45 ± 7.66 than females 8.95 ± 7.35. It differed from the result of a previous study based on the L-OHIP measure that claimed that oral problems had the same impact on both male's and females' quality of life (Saub & Locker, 2006). The previous study also stated that poor oral health had the most significant impact on the Indians' quality of life, in contrast to the latest study, which found that Malays (10.32 ± 7.75) had the highest impact among ethnic groups. However, both studies reported the same result which those with tertiary education (college or higher) had more impact than those with a lower education (secondary and lower). The different amounts and characteristics of samples between the previous study (n=214) and this study (n=97-without missing data) could cause dissimilarity and bias in the results.

## Conclusion

The limited sample size of this study does not represent the population. However, this study revealed utilisation and OHRQoL among patients attending the VDSs in Selangor. Overall, the utilisation rate of VDSs in Selangor was low but increasing. Enhancement of the services and facilities of the VDSs is able to improve the situation.

Despite the low utilisation rate of the Selangor population to the VDSs, the OHRQoL of patients attending the VDSs was considered high. It is a valuable finding for the future allocation of oral healthcare services as it is apparent that even in the less-than-ideal condition of the current VDSs, the patients' OHRQoL was not heavily affected. It should be viewed as an opportunity to improve the current condition of the VDSs in terms of their physical condition with adequate human resources. Perhaps further studies with a different approach, such as qualitative inquiries among the patients, need to be conducted to explore the factors influencing their utilisation rate of VDSs.

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## Conflict of Interest

The authors declare that no conflict of interest exists.

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REVIEW ARTICLE Open Access

# Oral health care in children with disabilities: A narrative review

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## Abstract

Children with disabilities face discrepancies in receiving oral health services due to several barriers. This article aims to provide an overview on the oral health status of children with disabilities, impact on Quality of Life of children with disabilities and their family members, approaches in oral health education and/or services, roles of medical/oral health care providers, carers/parents, and special schools/centres, and future aspiration concerning these children. Articles were searched using online databases (Google Scholar, MEDLINE/PubMed) using various terms. Additional articles were searched manually from the reference list of the previously searched articles. Children with disabilities showed a higher prevalence of caries and periodontal disease and had irregular dental visits owing to the limitations encountered by the carers/parents. The psychological and physical health of carers/parents, and the well-being of children with disabilities are interrelated, suggesting the need for a comprehensive support system to address the specific needs of these groups. Oral hygiene care services for these children could be improved using oral health education tools, strengthening dental outreach programs, and/or adopting behaviour modification techniques. Oral health in children with disabilities is a global concern, therefore a holistic approach addressing this problem from the individual to international level, including interprofessional collaboration is imperative.

***Keywords:*** children with disabilities, oral health care, oral health services, oral health status, special needs children

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## Introduction

According to the World Health Organization (WHO), disabilities or impairments are problems in body function or structure such as a significant deviation or loss, and can involve an anomaly or defect (WHO, 2001). There are three components classified in the international classification of functioning, disability and health WHO namely body functions and structures, activities and participation, and environmental factors. Examples of impairments in body functions and structures include mental function, sensory function, loss of a limb, loss of vision/speech/memory. The limitation in activities and participation include the difficulty communicating, seeing, hearing, mobility, self-care, working, problem solving, engaging in social activities, and obtaining health care services. The environmental factors include support and

relationships, individual and societal attitudes, services, systems and policies.

The variety in distribution and severity of oral diseases in children with disabilities in different parts of the world and within the same country or region could be due to disparities in the accessibility and/or utilisation of oral health services (Petersen, 2004). Several factors are reported in literature including lack of training and skills among oral health care providers specific to these children, difficulties in dealing with behavioural issues, inadequate referral facilities, inadequate exposure during undergraduate studies, prioritisation of other medical issues by carers/parents, socioeconomic background of the carers/parents, poor oral health literacy (OHL) of carers/parents/public/oral health care providers/policymakers, time constraints, insufficient financial reimbursement, lack of support from family members and society, as well as unmet needs for routine medical care that lead to unmet needs for oral care (Shenkin *et al*., 2001, Kane *et al*., 2008, Bindal *et al*., 2015, Abduludin *et al*., 2019, Craig *et al*., 2019, Zhou *et al*., 2021).

Apart from these factors, the child's developmental profile also influences accessibility to oral health services (Zhou *et al*., 2021). This includes children with multiple developmental disabilities, Autism Spectrum Disorders (ASD), developmental delays, cerebral palsy, epilepsy, or other syndromes who might be fully dependent on their carers/parents not only for the access to oral health services but with their daily oral health care as well (Zhou *et al*., 2021). Data from Medicaid (a federal and state program that helps cover healthcare costs of low income groups) in Washington, United State of America showed underutilised preventive dental care in preschool children with disabilities under the Access to Baby and Child Program compared to those without disabilities (Craig *et al*., 2019).

Various oral health education programs targeting these children and their carers/parents have been developed to improve oral health services and patient care. However, due to several barriers in the accessibility to oral health services, the oral health care of these children seem insurmountable although there are evident of positive outcomes when the appropriate approaches are utilised. This article aims to provide an overview on the oral health status of children with disabilities, impact on Quality of Life of children with disabilities and their family members, approaches in oral health education and/or services, roles of medical/oral health care providers, carers/parents, and special schools/centres, and future aspiration concerning these children.

Literature search was carried out on Google Scholar using keywords 'children with disabilities', 'oral health services', 'oral health status' and 'oral health care'. Another search strategy was MEDLINE/PubMed database using keywords 'children with disabilities', 'special needs children', 'oral health services', 'oral health status', and 'oral health care'. The literature search was conducted from September to December 2021 by two authors independently. Then, the discussion was made on the potential articles to be included in the manuscript. Articles published in English from 2001 to 2021 were reviewed for their scientific contents. Additional articles were selected from the reference list of the previously searched articles. 52 published articles were included in this review, most of them are cross-sectional and qualitative studies, and also review articles.

## Oral health status of children with disabilities

The oral health status of children with disabilities has been assessed in several countries. A recent study in China reported of poor oral health status; caries experience in 30.3%, gingivitis in 90% and visible dental plaque in 95% of the recruited children (Zhou *et al*., 2019). The age of these children were 2-6 years old with the average age of 3.87 ± 0.93 years old. In the United Arab Emirates (UAE), 85.2% of children with disabilities had caries with a mean decayed, missing, filled teeth (dmft/DMFT) score of 5.67 ± 4.69 (Alkhabuli *et al*., 2019). The age

of these children were 3-17 years; 7 (13%) children in the 3-5 years age group, 23 (42.6%) in the 6-10 years age group and 24 (44.4%) in the 11-17 years age group. Despite studying at a centre for children with disabilities that offered an intensive rehabilitation program for these children, a high prevalence of dental caries was evident. Another study reported higher mean scores of the decayed component of DMFT in children with Down Syndrome (DS) in the UAE compared to children without DS; 2.73 ± 0.22 and 1.65 ± 2.46 respectively (Ghaith *et al*., 2019). Findings from a case control study conducted in Serbia revealed dmft/DMFT scores of 12.4 ± 7.7/5.4 ± 4.4 in children aged 6-11 years old, and a DMFT of 20.9 ± 9.6 in children aged 12-16 years old compared to the non-medically compromised children (Mandić *et al*., 2018). In the non-medically compromised children, the dmft/DMFT scores were 5.7 ± 6.9/1.0 ± 1.7 in children aged 6-11 years old, and the DMFT score was 7.7 ± 5.3 in children aged 12-16 years old. Children with disabilities had statistically higher dmft/DMFT scores in both primary and permanent dentitions than the children without disabilities. The data indicate lack of access or utilisation of oral health care could be due to a greater difficulty of treating children with disabilities owing to the inability of these children to communicate and cooperate during dental treatment (Mandić *et al*., 2018). A screening conducted in India revealed 38% caries prevalence and 59.09% gingival bleeding in children with various disabilities, indicating significant problems in their oral health and the need for oral care (Mehta *et al*., 2015). In Taiwan, the overall mean dmft/DMFT score was 12.5 ± 5.0 in these children (Chen *et al*., 2014). A similar study was conducted in Nigeria, however some of the children were either ill or uncooperative resulting in exclusion from the study. The study was conducted at a private institution attended by carers/parents from the upper and middle socioeconomic status, which hindered comprehensive assessment of the oral health status of these children from various socioeconomic backgrounds (Oredugba & Akindayomi, 2008). Nevertheless, authors reported a high prevalence of caries in these children with a mean dmft score of 0.7 ± 1.77 and mean DMFT score of 0.4 ± 1.44 (Oredugba & Akindayomi, 2008). The dmft/DMFT scores were much lower compared to other countries. Conversely, in Libya, the mean dmft scores in children with and without ASD were 1.13 ± 1.84 and 2.85 ± 3.32 respectively (Fakroon *et al*., 2015). Meanwhile, the mean DMFT scores of the former and latter were 0.22 ± 0.08 and 1.15 ± 0.27 (Fakroon *et al*., 2015). These findings suggested that children with ASD had lower caries prevalence compared to children without ASD, could be attributed to the higher awareness among their carers/parents (Fakroon *et al*., 2015). Based on the majority of reported studies, the needs for oral health care in children with disabilities were somewhat equivalent (Chen *et al*., 2014; Mehta *et al*., 2015; Mandić *et al*., 2018; Alkhabuli *et al*., 2019; Ghaith *et al*., 2019; Zhou *et al*., 2019).

In Malaysia, caries prevalence in these children was 54.9% with a mean dmft of 1.03 ± 2.13 and DMFT of 1.22 ± 2.23 (Mokhtar *et al*., 2016). The majority of carious teeth (85.2%) in these children aged 2 to 6 years old were untreated and required dental treatment (Mokhtar *et al*., 2016). This condition could be associated with multiple factors, one of them is the recruited children mostly had mental disabilities and possibly fully dependant on their carers/parents with their daily oral health care. In another study, caries prevalence in visually impaired children was much higher (85.2%) (Vinoven *et al*., 2021), almost similar to caries prevalence in children with cerebral palsy (81.7%) (Ahmad *et al*., 2020b). Approximately 56% of the children with cerebral palsy could not walk, crawl, creep, or scoot, 31.2% of them could crawl, creep and scoot while 12.9% could walk with the support from carers/parents (Ahmad *et al*., 2020b). This indicates that the majority of children with cerebral palsy are dependent on their carers/parents with their daily oral health care, and this situation could explain a higher prevalence of caries in these children; 97.9% and 81.7% of the caries affected deciduous and permanent dentition

Table 1. Caries prevalence and dmft/DMFT scores in children with disabilities from different countries.

| Studies | Country | Age of children | Type of impairments/disabilities | Findings |
|---|---|---|---|---|
| Zhou *et al*., 2019 | China | 2-6 years old (mean age of 3.87 ± 0.93) | 1. Intellectual impairments:<br>• Mild (IQ 50-70)<br>• Moderate to profound (IQ below 50)<br>• Unspecific (too young or too uncooperative to receive the IQ test)<br><br>2. Adaptive behaviours; conceptual skills, social skills, and practical skills. Each of them was ranked as "high or average," "limited (need assistance or supervision)" or "low (totally depend on others)" | Caries prevalence was 30.3% among the recruited children |
| Alkhabuli *et al*., 2019 | United Arab Emirates | 3-17 years old | 1. DS<br>2. ASD<br>3. Mental disability<br>4. Hearing impairment<br>5. Multiple disabilities | Caries prevalence was 85.2% of among the recruited children with a mean (dmft/DMFT) score of 5.67 ± 4.69 |
| Ghaith *et al*., 2019 | United Arab Emirates | 4-18 years old<br><br>DS (mean age of 9.3 ± 2.8)<br><br>Children without DS (mean age of 11.7 ± 4.4) | DS | DMFT score was 2.73 ± 0.22 |
| | | | Without DS | DMFT score was 1.65 ± 2.46 |
| Mandić *et al*., 2018 | Serbia | 6-11 years old | Medically compromised (no specific disabilities mentioned) | dmft/DMFT scores of 12.4 ± 7.7/5.4 ± 4.4 |
| | | 12-16 years old | | DMFT score was 20.9 ± 9.6 |
| | | 6-11 years old | Non-medically compromised | dmft/DMFT scores were 5.7 ± 6.9/1.0 ± 1.7 |
| | | 12-16 years old | | DMFT score was 7.7 ± 5.3 |

| | | | | |
|---|---|---|---|---|
| Mehta *et al*., 2015 | India | 3-15 years old | 1. Intellectual impairment<br>2. Visual impairment<br>3. Hearing impairment<br>4. Physical impairment | Caries prevalence was 38% among the recruited children |
| Chen *et al*., 2014 | Taiwan | ≤14 years old | 1. ASD<br>2. Mental retardation<br>3. Limb disability<br>4. Infrequent disease caused by DNA impairment<br>5. Visual impairment<br>6. Voice/speech mechanism disability<br>7. loss of function of primary organs<br>8. Balance mechanism disability<br>9. Multiple disabilities | Mean dmft/DMFT score was 12.5 ± 5.0 |
| Oredugba & Akindayomi, 2008 | Nigeria | 0-21 years old | 1. Attention deficit hyper activity disorder (ADHD)<br>2. ASD<br>3. Cerebral palsy<br>4. DS<br>5. Learning disability<br>6. Seizure disorder | Mean dmft score was 0.7 ± 1.77 and mean DMFT score was 0.4 ± 1.44 |
| Fakroon *et al*., 2015 | Libya | 3-14 years old | ASD | Mean dmft scores was 1.13 ± 1.84 and mean DMFT score was 0.22 ± 0.08 |
| | | | Without ASD | Mean dmft scores was 2.85 ± 3.32 and mean DMFT score was 1.15 ± 0.27 |
| Mokhtar *et al*., 2016 | Malaysia | 2-17 years old (mean age of 11.57 ± 3.53) | 1. Mental disabilities<br>• DS<br>• ASD<br>• Attention deficit hyperactivity disorder ADHD<br>• Global developmental delay<br>• Slow learner | Caries prevalence was 54.9% among the recruited children with a mean dmft of 1.03 ± 2.13 and DMFT of 1.22 ± 2.23 |

| | | | | |
|---|---|---|---|---|
| | | | 2. Physical disabilities<br>• Hearing impairment<br>• Blindness and limb deficiency<br>• Multiple disabilities | |
| Vinoven *et al.*, 2021 | Malaysia | 7-18 years old (mean age of 11.4 ± 3.05) | Visual impairment | Caries prevalence was 85.2% among the recruited children |
| Ahmad *et al.*, 2020b | Malaysia | 5-17 years old (mean age of 12.0 ± 4.89) | Cerebral palsy | Caries prevalence was 81.7% among the recruited children<br><br>97.9% and 81.7% of the caries affected deciduous and permanent dentition respectively |
| John *et al.*, 2017 | Malaysia | 6-12 years old (mean age of 9.22 ± 1.785) | 1. Global developmental delay<br>2. ASD<br>3. Intellectual disability<br>4. Slow learner<br>5. CHARGE syndrome<br>6. Speech disabilities<br>7. Attention deficit hyperactivity disorder ADHD<br>8. DS<br>9. Dyslexia<br>10. Cerebral palsy | 62% of the recruited children had caries, 80% had no dental restoration |

respectively (Ahmad *et al*., 2020b). Assessment of the oral health status of children with different types of learning disabilities in a Special Education Integrated Programme school showed that 62% of the children had caries, 70% had moderate to severe plaque score index and 80% had no dental restoration (John *et al*., 2017). Caries prevalence in these children was corroborated with caries prevalence reported in the UAE (Alkhabuli *et al*., 2019). Despite studying at a special school, poor oral health status in these children was observed. However, education tools facilitated by their teachers appeared to have a positive impact on promoting good oral hygiene in these children (Shahabudin *et al*., 2016). This was observed in visually impaired children in two schools (Shahabudin *et al*., 2016). A systematic review analysing the oral health status of children with disabilities in Asia revealed that children who suffered from intellectual disability or ASD had significantly more caries than children without intellectual disability or ASD, and lived in the countries with high DMFT scores in children 12 years old (Ningrum *et al*., 2021). However, not all Asian countries offer Special Care Dentistry (SCD), therefore the prevalence of oral health problems in these children may be underestimated (Ningrum *et al*., 2021). The summary of findings from different studies is shown in Table 1.

Besides caries, the assessment of periodontal status was also conducted in some studies. The prevalence of periodontal disease was high at 86.8% indicating poor periodontal status in these children (Alsanabani *et al*., 2012). In another study, poor knowledge on oral health, poor oral hygiene practice and high plaque maturity was observed in hearing-impaired children compared to children without disabilities (Tugeman *et al*., 2016). In children with cerebral palsy, 90.3% of them had dental plaque, suggesting ineffective oral hygiene practice could be due to impairment and dependency on carers/parents, as well as irregular dental visits (Ahmad *et al*., 2020b). The simplified Oral Hygiene Index score for children with mixed and permanent dentition was not significantly different between children with DS compared to children without DS; mean scores were 1.36 ± 1.16 and 1.42 ± 1.14 respectively (Ghaith *et al*., 2019). However, the Calculus Index was observed to be significantly higher in children with DS compared to children without DS; mean scores were 0.25 ± 0.52 and 0.07 ± 0.27 respectively (Ghaith *et al*., 2019). The prevalence of gingivitis was equivalent between children with DS compared to children without DS; 65.4% and 70.4% respectively (Ghaith *et al*., 2019). Although caries prevalence in children with ASD showed lower dmft/DMFT scores, more than 90% of these children presented with gingival bleeding or had supra and/or subgingival calculus (Fakroon *et al*., 2015), indicating the need for oral hygiene measures. The summary of findings from different studies is shown in Table 2.

Apart from caries and periodontal status, much attention has been directed towards the orthodontic aspect of children with disabilities. Findings documented in literature provide insights into this side of oral health in these children. For example, the occurrence of anterior crossbite in children with DS is associated with bottle feeding, and non-nutritive sucking habits for 24 months or more, whereas the posterior crossbite is associated with bottle feeding and non-nutritive sucking habits for 24 months or more, in addition to respiratory infection in the previous 6 months (Oliveira *et al*., 2011). In children with cerebral palsy, the occurrence of anterior open bite is associated with non-nutritive sucking habits for 24 months or more (Oliveira *et al*., 2011). In another study, assessment of the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) showed that 50.0% of children with DS and learning disabilities, 40.0% of children with ASD, 20.0% of children with visually impairment and 18.2% of children with hearing impairment required 'Great' need of orthodontic treatment (Soni *et al*., 2011). Meanwhile, 32.5% of children with mental retardation required 'Great' and 'Very Great' need of orthodontic treatment (Soni *et al*., 2011). When the Aesthetic Component of IOTN is assessed, 50.0% of children with DS,

Table 2. Periodontal status in children with disabilities from different countries.

| Studies | Country | Age of children | Type of disabilities | Findings |
|---|---|---|---|---|
| Zhou *et al*., 2019 | China | 2-6 years old (mean age of 3.87 ± 0.93) | 1. Intellectual impairments;<br>• Mild (IQ 50-70)<br>• Moderate to profound (IQ below 50)<br>• Unspecific (too young or too uncooperative to receive the IQ test)<br>2. Adaptive behaviours; conceptual skills, social skills, and practical skills. Each of them was ranked as "high or average," "limited (need assistance or supervision)" or "low (totally depend on others)" | Gingivitis in 90% and visible dental plaque in 95% of the recruited children |
| Mehta *et al*., 2015 | India | 3-15 years old | 1. Intellectual impairment<br>2. Visual impairment<br>3. Hearing impairment<br>4. Physical impairment | 59.09% gingival bleeding among the recruited children |
| Alsanabani *et al*., 2012 | Malaysia | 7-18 years old (mean age of 13.9 ± 3.17) | Not mentioned | Prevalence of periodontal disease was 86.8% |
| Tugeman *et al*., 2016 | Malaysia | 7-14 years old (mean age of 12.0 ± 2.12) | Hearing impairment | 50.8% of hearing-impaired children had matured plaque compared to children without hearing impairment 13.2% |
| Ahmad *et al*., 2020b | Malaysia | 5-17 years old (mean age of 12.0 ± 4.89) | Cerebral palsy | 90.3% of the children had dental plaque |
| Ghaith *et al*., 2019 | United Arab Emirates | 4-18 years old<br>DS (mean age of 9.3 ± 2.8) | DS | Mean score of the Simplified Oral Hygiene Index for children with mixed and permanent dentition was 1.36 ± 1.16 |

| | | | | |
|---|---|---|---|---|
| | | Children without DS (mean age of 11.7 ± 4.4) | | Mean score of the Calculus Index was 0.25 ± 0.52<br><br>Prevalence of gingivitis was 65.4% |
| | | | Without DS | Mean score of the Simplified Oral Hygiene Index was 1.42 ± 1.14<br><br>Mean score of the Calculus Index was 0.07 ± 0.27<br><br>Prevalence of gingivitis was 70.4% |
| Fakroon *et al.*, 2015 | Libya | 3-14 years old | ASD | 90% of the children presented with gingival bleeding or had supra and/or subgingival calculus |
| | | | Without ASD | 41.8% of the children had no signs of periodontal disease |
| John *et al.*, 2017 | Malaysia | 6-12 years old (mean age of 9.22 ± 1.785) | 1. Global developmental delay<br>2. ASD<br>3. Intellectual disability<br>4. Slow learner<br>5. CHARGE syndrome<br>6. Speech disabilities<br>7. Attention deficit hyperactivity disorder ADHD<br>8. DS<br>9. Dyslexia<br>10. Cerebral palsy | 70% had moderate to severe plaque score index |

Table 3. Orthodontic aspects in children with disabilities from different countries.

| Studies | Country | Age of children | Type of disabilities | Findings |
|---|---|---|---|---|
| Oliveira *et al*., 2011 | Brazil | 3-12 years old | DS | The occurrence of anterior crossbite is associated with bottle feeding, and non-nutritive sucking habits for 24 months or more, whereas the posterior crossbite is associated with bottle feeding and non-nutritive sucking habits for 24 months or more, in addition to respiratory infection in the previous 6 months |
| | | | Cerebral palsy | The occurrence of anterior open bite is associated with non-nutritive sucking habits for 24 months or more |
| Soni *et al*., 2011 | India | 12-15 years old | 1. DS<br>2. Learning disabilities<br>3. ASD<br>4. Visual impairment<br>5. Hearing impairment | Assessment of the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) showed that the children required 'Great' need of orthodontic treatment<br>Assessment of the Aesthetic Component of IOTN showed that the children required 'Great' need of orthodontic treatment |
| | | | Mental retardation | Assessment of the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) showed that the children required 'Great' and 'Very Great' need of orthodontic treatment<br>Assessment of the Aesthetic Component of IOTN showed that the children required 'Great' need of orthodontic treatment |

23.3% of children with mental retardation and 10.0% of children with ASD required 'Great' need of orthodontic treatment (Soni *et al*., 2011). The summary of findings from different studies is shown in Table 3.

A study conducted in Hong Kong, China highlighted that a high percentage of children with disabilities (77.5%) had never visited a dentist (Zhou *et al*., 2019). Even though the percentage of children with disabilities who had never visited a dentist was high, they had a lower dmft score than those who had visited a dentist. Children with disabilities who had higher dmft score were associated with other factors; night bottle-feeding habit, the use of a non-fluoride-containing toothpaste and lower household income family. In contrast, a study in Belgium reported a high percentage of children with DS (66%) had visited a dentist within the last six months (Descamps & Marks, 2015). More than half (67%) of the parents graduated from tertiary education level and they had no problem in the accessibility to oral health services, probably might explain a higher percentage of dental visit among these children (Descamps & Marks, 2015). In Netherlands, a much higher percentage of children with ASD (81%) had visited a dentist within the last six months (Kind *et al*., 2021). A higher percentage of dental visit reported in the Netherlands could be due to highly motivated parents who are involved in ASD specific programs or participating in the conferences or websites, dental costs that are covered by the medical insurance for all children up to 18 years old, and the accessibility to oral health services (Kind *et al*., 2021). In Malaysia, 61.3% of children with cerebral palsy had at least one dental visit in their lifetime, while 38.7% of these children had never visited a dentist since birth (Ahmad *et al*., 2020b). Of these, 19.4% had been to a dentist about more than three years ago (Ahmad *et al*., 2020b). The plausible explanation of this could be attributed to the limited access to oral health services which includes logistic difficulties, behavioural issues, lack of educational experience and training in providing the treatment, as such precludes effective management of these children (Vozza *et al*., 2015).

## Impact on Quality of Life of children with disabilities and their family members

In Brazil, the worst Quality of Life observed in carers/parents of children with disabilities was linked to the need for daily care including the daily living, educational and rehabilitation process of these children (Barros *et al*., 2019). Carers/parents with low educational level were unable to enter the labour market and instead dedicated themselves to household tasks and caring for their children (Barros *et al*., 2019).

A study investigating Oral Health Related Quality of Life (OHRQoL) revealed a negative impact of untreated caries and caries severity on children with disabilities and their family members (Faker *et al*., 2018). Most carers/parents reported the impacts was more toward the children with disabilities (69.5%) than to the family members (49.6%), and the most frequently reported impacts were 'pain in the teeth, mouth, or jaws'. However, comprehensive dental rehabilitation followed by recall visits and provision of dental kits for self-oral hygiene care showed positive long-term clinical effects on OHRQoL in these children (El-Meligy *et al*., 2016). These findings suggest that OHRQoL of these children can be improved when appropriate measures are undertaken. However, limited studies addressing the OHRQoL in these children and their family members hinder effective evaluation of the overall situation, thus the actual impact of OHRQoL on them remain unknown. Perhaps, this limitation warrants more studies on OHRQoL involving these children and their family members so that the intervention strategies can be implemented.

Another aspect is that, carers/parents of children with disabilities tend to face negative social stigma from society, resulting in social isolation (Abduludin *et al*., 2019). Instead of receiving social support, some carers/parents may experience prejudice while struggling to care for their children with disabilities. Family function plays an important role in the physical and

psychological health of carers/parents, and social support from extended family members, friends, and neighbours in addition to immediate family members allow collective care for these children (Raina *et al*., 2005).

A study on the financial expenses to cater to the needs of a child with cerebral palsy in Malaysia averaged RM29,710.76 per year (Kamaralzaman *et al*., 2018). These expenses include healthcare costs, developmental costs and non-healthcare costs resulting in a huge financial burden for the carers/parents (Kamaralzaman *et al*., 2018). In another study involving carers/parents of children with cerebral palsy in Malaysia, families with three or more children from lower socioeconomic backgrounds and with lower education levels shouldered a larger total financial burden (Abduludin *et al*., 2019). Most of the carers/parents need financial help for basic necessities and/or special equipment for their children with disabilities, and accompanying their children for dental visits incur additional transportation cost. While financial support from the Social Welfare Department is available, the policymakers must plan effective long-term solutions to support carers/parents of children with various disabilities (Kamaralzaman *et al*., 2018). In the United State of America, although children with disabilities are eligible for Medicaid oral health care coverage, their carers/parents experience other treatment barriers such as inability to get time off from employment, lack of child care services for other children, and difficulty accessing public transportation for the handicapped (Schultz *et al*., 2001). Although family members receive financial assistance from policymakers, carers/parents have to bear other costs that place a significant impact on the family's financial stability, especially in family from lower socioeconomic backgrounds.

Another aspect highlighted in literature is the interrelation between well-being of children with disabilities and their carers/parents. The psychological and physical health of carers/parents was greatly influenced by their child behaviour and caregiving demands (Raina *et al*., 2005), and the well-being of children with disabilities is also closely related to the well-being of their other family members (Abduludin *et al*., 2019). This situation must be tackled effectively so that the well-being of these children and their carers/parents are taken care of from various authorities.

## Approaches in oral health education and/or services to children with disabilities

In order to improve the quality of patient care involving children with disabilities, the oral health education programs targeting these children and their carers/parents have become effective platform for the oral health care providers. For example, children with visual impairment were given oral health modules printed in braille for the blind and in font size 18 for the partially blind, including an audio narration of the module (Shahabudin *et al*., 2016). The use these modules, facilitated by their teachers were proven to be effective where a reduction in the plaque score in partially blind and totally blind children was observed after 1 month, indicated a positive impact on promoting good oral hygiene among these children (Shahabudin *et al*., 2016). In Hong Kong, China, the use of a toothbrushing visual module that was provided to the carers/parents to facilitate toothbrushing of their children with ASD at home showed a significant improvement in the oral hygiene status and gingival health over 6 months observation period (Du *et al*., 2021).

The behavioural management by means of tell-show-do method during clinical examination could improve the child's behaviour (Alkhabuli *et al*., 2019; Zhou *et al*., 2019). A multistage visual protocol to facilitate children with ASD to undergo dental treatments as behavioural management showed an effective approach as well (Cagetti *et al*., 2015). This can be observed when these children were able to proceed through each stage of treatment with minimal refusal (Cagetti *et al*., 2015). Additionally, multisensory-adapted dental

environments could improve the behaviour of children with disabilities and would be an alternative approach in the clinical settings (Ismail *et al*., 2021). Apart from that, the use of intravenous sedation in uncooperative child with DS prior to oral examination was also effective in managing behaviour (Primarti & Pertiwi, 2007). Evaluation of salivary cortisol levels could be useful to help in treatment planning and appointment scheduling in children with ASD because the oral health care providers could consider behaviour modification techniques in these children (Abdulla & Hegde, 2015). This is because a significant correlation was observed between salivary cortisol levels and behaviour during the day and in the evening in children with ASD (Abdulla & Hegde, 2015). As the salivary cortisol levels increased, the behaviour among these children became worsened and vice versa. The researchers highlighted that the salivary cortisol acts as a stress marker and evaluating the diurnal variations of salivary cortisol levels can help the oral health care providers to comprehend the behaviour pattern and eventually could utilise the appropriate behaviour modification procedures and treatment planning involving these children (Abdulla & Hegde, 2015). Despite concern pertaining to behavioural issues in children with disabilities, when an appropriate approach is used, the behaviour can be managed effectively.

In Malaysia, dental outreach programs have been used to educate these children. For example, children with cerebral palsy attending the Community Base Rehabilitation centre benefit from the dental outreach program offered by public dental clinic (Abduludin *et al*., 2019). Another dental outreach program has benefited visually impaired children at a special education school as well (Ahmad *et al*., 2020b). The use of a specific module in oral health education for these children consisting an innovative oral health educational tool kit and exhibition materials provided an opportunity to improve the knowledge, skills, attitudes, and personal values among dental students in developing their professionalism in patient care (Ahmad *et al*., 2020b). Their experience through this program could lead to a high standard of dental practice and high-quality patient care involving these children in the future (Ahmad *et al*., 2020b). There have been limited dental outreach programs reported in literature, therefore it is rather difficult to draw robust conclusion as to whether this approach could benefit children with various disabilities. Perhaps, more dental outreach programs targeting these children can be planned by the authorities to help overcome the barriers in the accessibility and/or utilisation of oral health services among these children.

## Roles of medical/oral health care providers, carers/parents, special schools/centres

A survey assessing the experience of final-year dental students and new graduates in Malaysia revealed lack of training, confidence and skills to provide oral health services to patients with disabilities (Fuad *et al*., 2015). The implication is that, it could lead to ineffective treatment, which could cause further oral health complications and increased cost burden (Alumran *et al*., 2018). To date, most dental schools do not offer a specific module in SCD and the teachings about SCD were not properly established yet due to the limited number of trained oral health care providers in this area (Naimie *et al*., 2020).

In order to overcome this limitation, some approaches have been carried out to improve knowledge and awareness among dental students. For example, an assessment of the knowledge and awareness of dental students in Saudi Arabia in regards to the oral health care of children with disabilities by mean of questionnaires and video education intervention revealed a valuable approach in improving their knowledge (Salama *et al*., 2015). Early exposure, knowledge and training to provide oral health services to the children with disabilities should begin in dental colleges/schools (Salama *et al*., 2015). In Malaysia, an outreach program involving the

undergraduate dental students and visually impaired children showed positive impact in developing professional patient care (Ahmad *et al*., 2020a). In addition to this, the outreach program provided an opportunity for the dental students to gain early exposure to oral health services in children with disabilities (Ahmad *et al*., 2020a). Upon graduating from dental schools/colleges, training acquired by dentists in SCD should be enhanced so that a comprehensive oral health services to this group can be provided (Bindal *et al*., 2015). Such continuous training would not only benefit dentists but also all oral health care providers so that their skills, awareness and attitudes towards these children can be improved.

Oral health literacy refers to the ability of individuals to acquire and understand basic oral health information and services that are needed to make appropriate health decisions (Sabbahi *et al*., 2009; Horowitz & Kleinman, 2012). To date, there are limited studies addressing the association between the OHL of carers/parents/public/health care providers/policymakers and children with disabilities. Assessment of OHL in all groups allows us to identify the contributing factors that result in poor oral health status in these children, thus significant measures targeting all groups could be undertaken to improve the situation. Despite the limitation, when the OHL of carers/parents of children with disabilities was assessed, the majority of them have moderate levels of OHL (Fabillah *et al*., 2015). A similar study on carers/parents of children with visual impairment reported good attitude and practice towards their children's oral health, however minimal understanding on their children's oral health could leads to a higher caries prevalence (Vinoven *et al*., 2021). Although the OHL is not assessed directly, it could be postulated that a lower OHL in carers/parents might contribute to the prevalence of malocclusion in children with disabilities due to lack of awareness on the use of bottle feeding and non-nutritive sucking habits in these children (Oliveira *et al*., 2011). Children with cerebral palsy are usually fully dependant on their carers/parents and are unable to communicate, as a result carers/parents face difficulties to understand the needs for oral health care (Abduludin *et al*., 2019). This situation might explain the reason of untreated caries in children with cerebral palsy because the carers/parents are not able to recognise the early signs of oral health problem in their children.

It is understood that lower OHL levels in carers/parents are associated with decreased accessibility or utilisation of oral health services, while a higher OHL levels are associated with better communication between these children and their oral health care providers, hence improved oral health services (Bersell, 2017). This is proven when a multistage visual protocol was used by carers/parents of children with ASD in which the carers/parents demonstrated to understand the importance of oral health care for their children (Cagetti *et al*., 2015). In a study conducted in Libya, although the OHL or carers/parents is not assessed directly, it could be suggested that carers/parents who had increased awareness of factors causing dental caries, practised healthier eating behaviours and provided conducive living conditions for their child could contribute to a lower incidence of tooth decay in their children with ASD (Fakroon *et al*., 2015). In Malaysia, when the OHL of carers/parents of children with disabilities was assessed, the majority of them have moderate levels of OHL in which 70% had secondary education level and almost half of them (45%) had visited a dentist within the last 12 months (Fabillah *et al*., 2015). In Saudi Arabia, some parents of children with ASD have lack of confidence in taking care of their children's oral health, perform oral health care for their children when oral health problems occur, and prefer to find a dentist who has better understanding on the condition of their children (AlHumaid *et al*., 2020). These situations might correlate poor oral health practices and status among these children (AlHumaid *et al*., 2020).

Due to the OHL barrier, more appropriate intervention programs for the carers/parents of children with disabilities should be carried out to improve their knowledge and understanding of the needs

of these children. This could ultimately improve oral health services to these children (Fabillah *et al*., 2015). Undoubtedly, the needs for continuous oral health promotion (Zhou *et al*., 2019) and/or more appropriate intervention programmes (Fabillah *et al*., 2015) are indispensable. Another aspect that could lead to disparities in receiving oral health services in these children is the recruitment process used in research studies. Children with multiple disabilities and syndromes (Zhou *et al*., 2019), cerebral palsy (Ahmad *et al*., 2020b), DS (Descamps & Marks, 2015) and ASD (Kind *et al*., 2021) have different impairments and mobility, which affect their levels of dependency for daily activities, such as tooth brushing and feeding (Ahmad *et al*., 2020b). This dependency might include their accessibility to receiving oral health services as well. Based on the aforementioned differences, the findings imply that an effective preventive approach by oral health care providers, OHL in carers/parents, the public, health care providers and policymakers, and effective behavioural management in these children are pivotal to ensure that the discrepancies in access to oral health services in these children can be minimised. Efforts to improve prevention and quality of care, reduce costs, and reduce oral health disparities could not be achieved without improvements in OHL across various groups (Horowitz & Kleinman, 2012).

The existence of special schools/centres that provide support, rehabilitation program and/or education to these children are common in many countries. In the United Arab Emirates, children with disabilities studying at Ras Al-Khaimah Rehabilitation Centre for Disabled receive an intensive rehabilitation program, examined and medically diagnosed according to the centre's protocol with full medical records (Alkhabuli *et al*., 2019). In Hong Kong, China, Special Child Care Centres provide training and care for preschool children with ASD, mental, physical and/or sensory impairments, helping them to prepare for primary education (Zhou *et al*., 2021, Du *et al*., 2021). In Libya, the Libya Benghazi Centre of Autism provides care and support not only for these children but also to the families whose children are diagnosed with ASD (Fakroon *et al*., 2015). In Malaysia, Special Education Integrated Program schools are available to provide support for these children with different types of learning disabilities (John *et al*., 2017).

## Future aspirations

Transferring knowledge and experiences in disease prevention into action programmes are limited by the social, economic and cultural factors (Petersen, 2004). Minimising the disparities in oral health services require broad approaches that target populations at highest risk of oral disease, and improve accessibility to the existing care (Petersen, 2004).

Early clinical exposure to managing children with disabilities in dental schools/colleges is still inadequate and this needs to be emphasised in the curriculum (Fuad *et al*., 2015, Naimie, 2020) to prepare undergraduate dental students for the task of providing oral health services to these children later on. It has been reported that there was positive effect of education on the likelihood of caring for children with disabilities in which the oral health care providers who had not been exposed to theoretical and hands-on training in dental schools were less likely to care for these children (Casamassimo *et al*., 2004). Conversely, dentists who had received education in children with disabilities experienced fewer barriers to providing oral health services to these children (Casamassimo *et al*., 2004).

Oral health education tools for visually impaired students are beneficial (Shahabudin *et al*., 2016) and could benefit hearing-impaired children as well, however oral health education methods/tools that specifically target the needs of the latter group should also be developed (Tugeman *et al*., 2016) to ensure that the oral health education in this group of children is equally effective. When planning interventions for the children with disabilities and their carers/parents, it is essential for the oral

health care providers to consider the child's behavioural issues as an important determinant of child and carers/parents well-being (Raina *et al*., 2005). The implementation of interventions at mid-level oral health care providers such as dental hygienists (Bersell, 2017) and feasibility of dental home care (Abduludin *et al*., 2019) have also been highlighted in literature. At the global level, priority actions for oral health such as fluoride supply, improvement of nutrition, control of tobacco use and health promotion in schools (Petersen, 2004) must be strengthened. An established training program should be emphasised at the national level. For example, a program entitled 'Pediatric Dentistry and Advanced Education in General Dentistry (AEGD) Residency Collaborative on ASD' conducted at the Nova Southeastern University College of Dentistry and funded by the Health Resources and Services Administration provides valuable services to a population of children with disabilities (Ocanto *et al*., 2020). However, to develop such a program, financial assistance from policymakers and/or Non-Government Organisation (NGO) is required.

Development of a new model addressing the roles of individuals, carers/parents, society, stakeholders, and NGOs to tackle issues related to the children with disabilities, aiming to improve oral health services to these children would be helpful. This includes oral health education and promotion, inter-professional collaborations, and implementation of guidelines/policies by the decision-makers to reduce inequalities in access to oral health services in these children. Togetherness is integral, every individual needs to play a significant role to contribute to the betterment of oral health services for children with disabilities in the country. Improving OHL can be a predictable approach to reduce the disparities in the accessibility or utilisation of oral health care (Horowitz & Kleinman, 2012).

## Conclusion

The majority of children with disabilities have higher caries prevalence and periodontal disease, and show the need for orthodontic intervention. Barriers hindering accessibility to oral health services in children with disabilities must be tackled effectively, taking into consideration the various form of disabilities and the use of appropriate educational methods/tools to help these children and educate their carers/parents in oral health care. Guidelines/policies related to SCD in dental curriculum and support systems for these children and their carers/parents should be planned comprehensively to ensure their needs are fulfilled. The oral health of children with disabilities is a global concern, therefore a holistic approach addressing this problem from the individual to the international level including inter-professional collaborations is imperative.

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## Conflict of interest

None

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OPINION ARTICLE Open Access

# Cultivating dental excellence: Advancing dental education in Malaysian higher institutions

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Dental education plays a crucial role in safeguarding a nation's oral health, and Malaysia is no exception (Komabayashi *et al.*, 2007). In this context, dental education refers to the academic and practical training provided to individuals pursuing careers in dentistry. It encompasses the curriculum content, teaching methods, assessments, faculty development, and infrastructure within higher educational institutions that prepare students for professional practice as a qualified dentist. Much like in other countries, there is a growing need to emphasise the significance of Malaysian dental education in advancing the healthcare system. For instance, a well-designed dental curriculum equips future dental practitioners with the skills and knowledge needed to address the diverse oral health needs of the population, thereby enhancing the effectiveness and treatment modalities of oral healthcare services (Mays, 2021).

In recent years, dental schools in Malaysia have transitioned towards adopting a competency-based curriculum model, marking a significant departure from traditional content-based approaches (Lin *et al.*, 2023a). This shift reflects a growing recognition of the need to align dental education with contemporary healthcare demands and evolving professional standards. The competency-based model emphasises the acquisition of specific knowledge, skills, and attitudes requisite for dental practice, moving away from rote memorisation towards competency attainment and proficiency demonstration (Malaysian Dental Council, 2021). Under this framework, students are expected to actively engage in experiential learning, clinical simulations, and real-world patient care experiences, allowing for the integration of theory into practice and the development of critical thinking and problem-solving abilities. Therefore, the adoption of the competency-based curriculum model is essential in advancing dental education within Malaysian higher institutions, ensuring that graduates are equipped with the requisite competencies to excel in an ever-evolving healthcare landscape while upholding the highest standards of patient care and professionalism. Considering these developments, there is a growing imperative to advance dental education in Malaysian higher institutions. This emphasis on dental education reflects a broader commitment to enhancing the quality of healthcare delivery and promoting the well-being of the Malaysian populace.

Furthermore, the evolving relationship between dental education and the healthcare system is characterised by a shift towards interdisciplinary collaboration and

the integration of oral health into primary care (Johnsen, 2020). This trend reflects a growing recognition of the interconnectedness between oral health and general health, as well as the need for a more holistic approach to patient care. By fostering collaboration between dental and other health professionals, dental education can contribute to the development of comprehensive healthcare delivery models that prioritise holistic care and address the underlying determinants of health. Dentistry transcends being a mere profession; it constitutes a pivotal component of public health. The integral connection between dental health and overall well-being underpins the paramount need for maintaining good oral hygiene to avert various health concerns. Dental professionals serve as the vanguards in this endeavour, as they not only diagnose and treat but also educate patients on oral health. To ensure that the people of Malaysia receive optimal care, it is imperative to furnish dental students with a top-tier education. While the quality of dental education in Malaysia has made commendable progress, there remains room for enhancement.

A comprehensive dental education is essential for producing proficient and compassionate practitioners equipped to address the diverse oral health requirements of Malaysia's population. This call for excellence in dental education mirrors the achievements of the well-established medical education system in the country, which has thrived through dedicated faculty development, curriculum refinement, and innovative teaching methods (Mat Nor and Yusoff, 2021). Consequently, the time is ripe for dental education to follow this successful trajectory. It becomes imperative to underscore the importance of establishing a dedicated dental education unit or department to enrich existing curricula. This initiative is not merely about cultivating the professional development of faculty members within dental schools and improving the education of prospective dentists; it is a fundamental step towards ensuring the holistic health and well-being of the Malaysian populace.

Dental educators are entrusted with the task of shaping the future of dentistry, and as such, they must be equipped with the knowledge and skills required to do so effectively (Khehra *et al.*, 2022). This entails investing in training that encompasses innovative teaching methods, the latest technological advancements in dental practice, and pedagogical strategies that engage and inspire students (Lin *et al.*, 2023c). Such training includes not only technical proficiency but also ethical values, communication skills, and adaptability to the evolving landscape of dental education. Prior research has explored various novel teaching techniques among undergraduate dental students in Malaysia. For instance, one study introduced a hybrid approach combining team-based and case-based learning for teaching dental materials science, which was favourably received by students compared to traditional lectures (Lin *et al.*, 2023b). Additionally, another study implemented a student-generated video activity as part of a new teaching method, which students perceived as a positive experience that empowered them to take a more active role in their learning (Omar *et al.*, 2018). Furthermore, a separate study introduced virtual role-playing simulations in clinical settings among Malaysian undergraduate dental students, resulting in high satisfaction among students (Arunachalam *et al.*, 2020).

Digital dental education has also emerged as a transformative approach with the potential to drive lasting change in dental pedagogy. It encompasses a range of technologies and methodologies, including online learning platforms, virtual simulations, augmented reality tools, and tele-dentistry, among others. These modalities provide opportunities for interactive and immersive learning experiences that transcend traditional classroom settings, enabling students to engage with course materials, clinical scenarios, and expert instructors remotely (Moussa *et al.*, 2022). While digital dental education holds great promise, it is essential to recognise that its successful implementation requires careful planning, investment, and ongoing evaluation.

Addressing issues such as digital literacy, technological infrastructure, and student engagement will be critical to maximising the potential of digital platforms and ensuring equitable access to quality dental education for all learners.

In nurturing well-trained educators, not only does one facilitate the dissemination of knowledge, but they also foster the mentorship and inspiration of the next generation of dentists. Therefore, setting up dedicated dental education units or departments will allow for a concentrated effort to enhance the quality of dental education. By centralising resources and expertise, such a dental education department or unit can facilitate structured mentorship programmes between experienced faculty members and aspiring dental students. Mentors within this department or unit can provide invaluable guidance, sharing their wealth of knowledge and practical insights gained from years of experience in clinical practice (Nathwani and Rahman, 2022). Through regular interactions, mentorship relationships can foster personal and professional development, instilling a sense of confidence and enthusiasm in students as they navigate their dental education journey.

Moreover, the evolution of dental education extends to curriculum enhancement. The dynamic nature of the dental field necessitates a continuous process of curriculum refinement (Kassebaum and Tedesco, 2017). Dental institutions must remain responsive to the ever-advancing frontiers of dental science by regularly updating their curricula. Introducing interdisciplinary learning opportunities is crucial, allowing dental students to collaborate with other healthcare or allied dental professionals (Jackson *et al.*, 2018). This collaborative approach grants them a more comprehensive and holistic perspective on healthcare, a skillset that is increasingly essential in the modern healthcare society. Such an objective can only be achieved through comprehensive and well-structured education, emphasising the importance of interdisciplinary collaboration in delivering effective patient care. Furthermore, the inclusion of courses on cultural competency and ethics serves to prepare future dentists to serve diverse communities with sensitivity and competence (Smith *et al.*, 2022). In the quest for excellence, dental education must establish rigorous and transparent assessment methods as part of quality assurance. Dental schools should define clear criteria for student assessment and continually evaluate their teaching and assessment strategies (Tonni *et al.*, 2020). This practice ensures that graduates consistently meet national and international standards, guaranteeing the delivery of the highest quality dental care to the public.

In adapting to emerging educational delivery models, dental educators must indeed heed the voices of various stakeholders, including policy makers/regulators, employers, alumni, students, and patients. Incorporating these perspectives ensures that educational reforms align with regulatory standards, meet industry demands, address student needs, and ultimately, improve patient outcomes. This multi-stakeholder approach fosters a more holistic understanding of the challenges and opportunities facing dental education, facilitating the development of innovative and responsive teaching methodologies. Looking ahead, the future of dental education and oral healthcare systems will be characterised by dynamic integration, leveraging advancements in technology and interdisciplinary collaboration (Raponi *et al.*, 2023). Dental educators would also need to embrace flexible learning modalities, such as online platforms and virtual reality-based training, to accommodate diverse learning styles and promote lifelong learning (Thurzo *et al.*, 2023). Embracing a culture of continuous improvement and innovation, these educational systems will empower dental professionals to adapt and thrive in an ever-evolving landscape, ensuring the delivery of high-quality, patient-centred care for generations to come.

In parallel, there is an imperative to foster research and innovation in dental education. Collaborative efforts between dental schools, research institutions, and the dental

industry can yield groundbreaking discoveries and advancements in oral healthcare. Such progress not only benefits the nation but also contributes to the global dental community, reinforcing the importance of research and innovation in shaping the future of dentistry. Interdisciplinary research holds paramount importance in developing a robust educational framework to bolster the sustainability of change in higher education delivery models (Newman, 2023). By fostering collaboration between experts in dentistry, education, policy-making, and other relevant fields, interdisciplinary research can offer holistic insights into the complex dynamics influencing educational reforms. Such research endeavours can delve into the multifaceted aspects of implementing new curriculum delivery models, considering factors like curriculum design, pedagogical approaches, resource allocation, stakeholder engagement, and long-term impact assessment. By integrating diverse perspectives and methodologies, interdisciplinary research facilitates a deeper understanding of the challenges and opportunities inherent in educational change, thus enabling the development of evidence-based strategies tailored to the specific needs and contexts of the current dental education.

Furthermore, as the field of dentistry continues to evolve with the emergence of new technologies and treatment modalities, dental schools must remain adaptable. It is essential that institutions incorporate these advancements into their curricula, ensuring that their graduates are well-prepared to embrace the latest tools and techniques in their practice (Thurzo *et al.*, 2023). This adaptability, in turn, positions graduates to be competitive on a global scale, equipping them with the skills and knowledge to excel in an ever-changing dental landscape. Finally, it is highly encouraged to implement quality assurance measures (Sadler, 2017). This is to ensure that dental education programs meet established standards and produce competent graduates who can address the diverse oral health needs of the population.

In conclusion, dental education in Malaysia is at a crucial juncture. It is time to invest in the growth of dental education by focusing on faculty development, innovative curriculum design, and the implementation of contemporary teaching and learning strategies. This will not only produce exceptional dental professionals but also position Malaysia's dental education on par with global standards. The advancement of dental education is not just a matter of academic prestige; it is about ensuring the oral health and overall well-being of the nation's population.

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CASE REPORT Open Access

# Tuberculous encephalopathy mimicking limbic encephalitis and large intraparenchymal mass: A case report

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## Abstract

We report a 17-year-old gentleman presented with acute encephalopathy and neuropsychiatric disturbances. Contrast-enhanced CT and MRI brain revealed bilateral enhancing grey matter lesions involving both basal ganglia with perilesional oedema. The peculiarity of the lesions raising confusions whereby limbic encephalitis and intracranial masses were initially given consideration hence causing a delay in treatment. Tuberculous encephalopathy has different imaging appearances depending on the stage of maturity which will be further discussed here. Definitive treatment for this patient comprises of daily 10-months dose of anti-tuberculous drugs with prompt neurosurgical intervention if required. However, these should be delivered at a timely fashion to improve the outcome for both survival and neurological sequelae.

***Keywords:*** *case report, encephalitis, limbic, tuberculous*

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## Introduction

Being the most devastating clinical manifestation of tuberculosis due to its high mortality and distressing neurological sequelae, CNS TB accounts for 1% of all TB cases and approximately 5-10% of extrapulmonary TB (Cherian & Thomas, 2011). Risk factors for CNS TB includes age (children > adult), HIV co-infection, malnutrition, recent measles in children, alcoholism, malignancies, the use of immunosuppressive agents in adults and diseases prevalence in the community (Cherian & Thomas, 2011). However, Dastur only first described TB encephalitis as an autopsy finding in 1960 (Hee-Jin *et al.*, 2011). Unfortunately, no prevalence of TB encephalitis and large intraparenchymal mass was well documented to date in comparison to the more recognized form of CNS TB which includes tuberculoma, meningitis (accounting for 90% of CNS TB) and less commonly tuberculous abscess and miliary form (Taheri *et al.*, 2011). The uniqueness of this uncommon imaging manifestation of a very common disease as well as it being misleading towards limbic encephalitis and intraparenchymal mass may pose diagnostic challenges for clinicians.

## Case Report

Our patient is a young 17-year-old previously well gentleman presented with

acute encephalopathy and neuropsychiatric disturbance comprising of general unwellness, lethargy and headache for the past 1 month. Apart from previous travel history to Selangor and Johore, patient denied previous history of high risk behaviours and worked as a garbage collector. On general examination patient was noted to be dysphonic, drowsy and lethargic with Glasgow Coma Score (GCS) of 11/15. Further physical examination revealed slight neurological deficit whereby power of all 4 limbs of 4-5/5, up-going right plantar reflex and significant neck stiffness. Except for raised total white blood count with neutrophil predominance and raised CK, the rest of the blood investigations are normal. Contrast-enhanced computed tomography (CT) of the brain demonstrated bilateral enhancing grey matter lesions involving both basal ganglia with perilesional oedema (Figure 1). No abnormal leptomeningeal enhancement is observed. Gadolinium-enhanced MRI showed multiple enhancing lesions at deep grey matter with haemorrhages (Figure 2). Patient was treated as cerebritis, but unfortunately took at-own-risk discharge home.

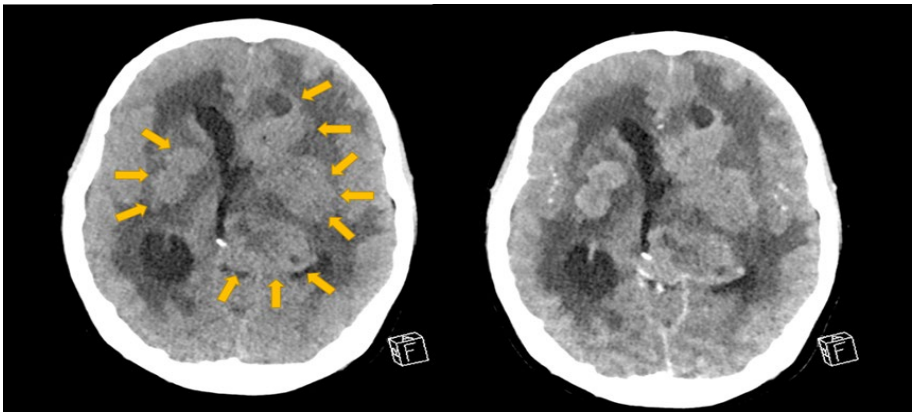

Figure 1. Unenhanced and contrast-enhanced axial CT brain showing isodense bilateral basal ganglia lesions with involvement of the left thalamus (yellow arrow) and causing extensive vasogenic oedema. Homogenous enhancement post contrast is noted.

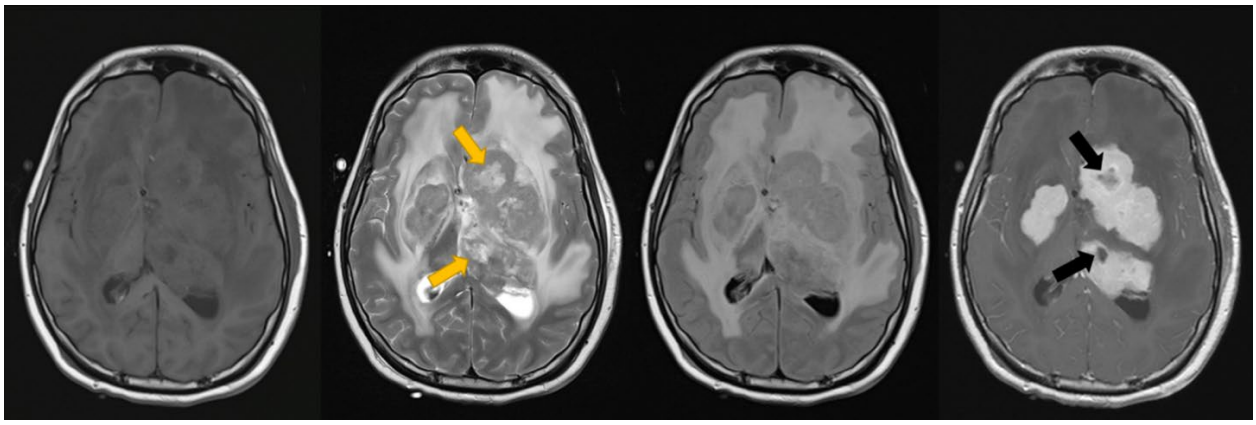

Figure 2. Axial images of MRI brain T1, T2, T2 FLAIR and T1 post contrast. Note the appearance of the basal ganglia lesions which are isointense on T1, T2 and T2 FLAIR with homogenous enhancement post contrast. Note also the appearance of central T2 hyperintensi ty (yellow arrow) with minimal or no contrast enhancement (black arrow) which likely represent caseating tuberculomas with liquefied centre.

However, the patient was readmitted in the ensuing month for worsening neurological deficit with otherwise similar GCS. Infectious screenings are normal with increased level of CRP and LDH. FBP showed mild anisopoikilocytosis, neutrophilia and lymphopenia with no evidence of abnormal lymphoid cells. CSF fluid revealed high total protein, positive globulin and lymphocytosis. Repeat MRI revealed more extensive involvement of the lesions involving medial part of temporal lobe, possibly due to limbic encephalitis (Figure 3). The lesions also had progressively worsened with masses-like appearance with areas of liquefaction (Figure 4). Contrast enhanced CT thorax, abdomen and pelvis was also performed to look for primary tumour considering paraneoplastic encephalitis as a possible diagnosis but no significant mass was found. Repeated brain biopsy was carried out which eventually yielded positive AFB hence the patient was immediately commenced on anti-tuberculous medication. However, patient eventually succumbed due to nosocomial pneumonia.

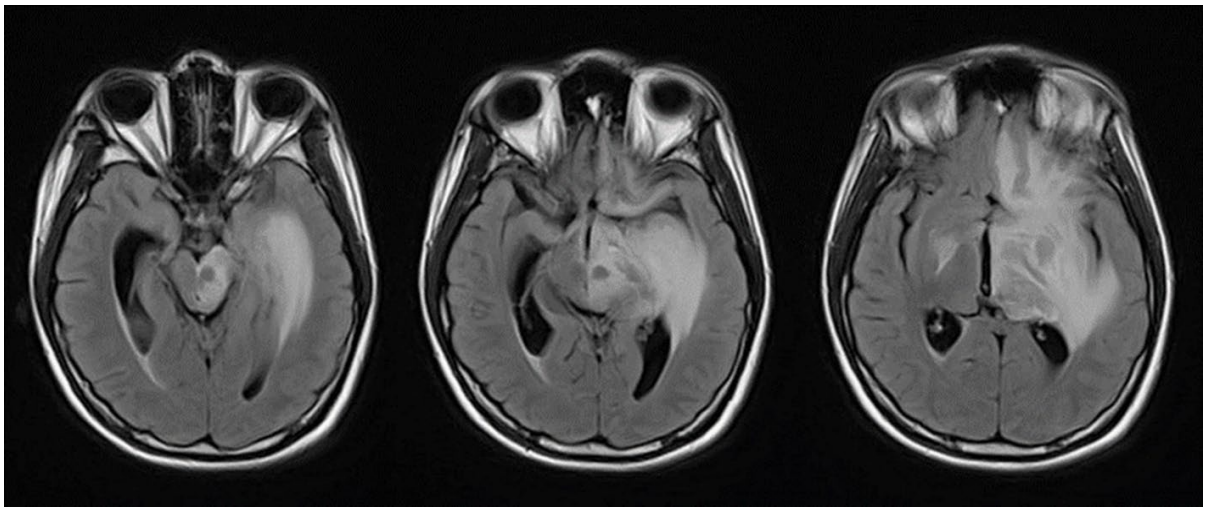

Figure 3. Axial MRI T2 FLAIR at different slices of temporal lobe. Note the white matter hyperintensity involving the medial aspect of the left temporal lobe which may mimic limbic encephalitis.

## Discussion

Tuberculous encephalitis (TBE) is a much rarer form of CNS tuberculosis typically seen in young children (Cherian & Thomas, 2011; Taheri *et al.*, 2011). To date, only 13 cases of possible TBE had been reported since the initial report by Dastur et al in 1966 (Hee-Jin *et al.*, 2011; Sharma, 2015; John, 1986; Fernando & Miguel, 2015; Vandana *et al.*, 2013; Venkatram *et al.*, 2017). In TB-endemic area like Malaysia, previous exposure to tuberculoprotein causes sensitization by 'allergic' or type IV direct hypersensitivity reaction due to cell-mediated immunity to tuberculoprotein.

Some literature also proposed that there is pathological similarity between this condition and other demyelinating disorders (Hee-Jin *et al.*, 2011; Fernando & Miguel, 2015). MR may show diffuse or focal hyperintense lesions in the white matter with marked gadolinium enhancement ((Hee-Jin *et al.*, 2011). Sometimes, gyriform pattern of contrast enhancement may also be demonstrable (John, 1986). Symmetrical basal ganglia hyperintensity on T2 and fluid-attenuated inversion recovery (FLAIR) sequences is demonstrated in basal ganglia encephalitis (Fernando & Miguel, 2015). Areas of restricted diffusion may also be manifested (Sharma, 2015). Nevertheless, our patient demonstrated only focal markedly enhancing tuberculous cerebritis predominantly involving both basal ganglia

regions. Otherwise, these changes were seen as rather asymmetrical in distribution as evaluated on T2-weighted and FLAIR sequences. Furthermore, neither gyriform pattern of enhancement post IV Gadolinium administration nor areas of restricted diffusion on diffusion-weighted imaging was observed.

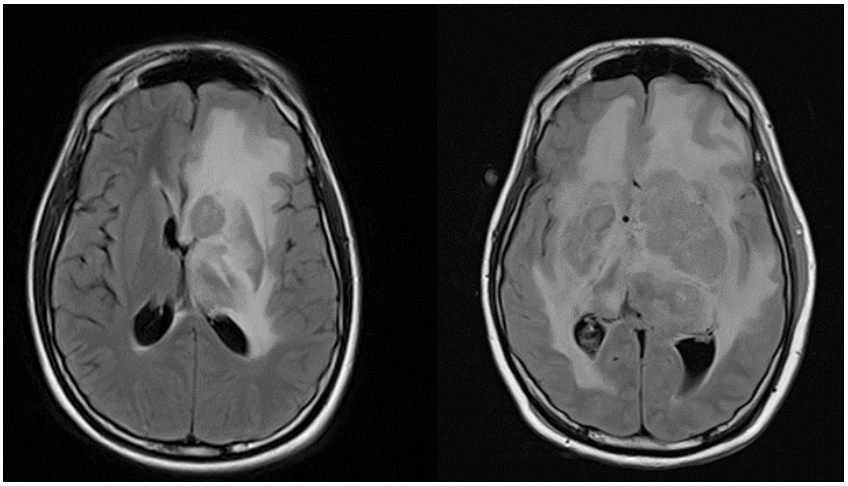

Figure 4. Axial MRI T2 FLAIR at initial presentation and repeat imaging at about 3 months later without proper treatment. The scan shows worsening of the bibasal ganglia and thalami lesions with extensive vasogenic oedema.

Involvement of the temporal lobe and limbic system prompts the diagnostic possibility of limbic encephalitis. This entity, however, remains a diagnostic challenge for clinicians since it may manifest a widely variable spectrum of clinical presentations. It can be further divided into 2 subgroups; paraneoplastic or non-paraneoplastic (Kelley *et al*., 2017). MR findings typically include T2-FLAIR hyperintensities with/ without restricted diffusion and contrast enhancement. To date, we have discovered case reports of two cases concerning tuberculous limbic encephalitis (Toudou, Obenda & Souirti, 2017; Daher, Monzer & Abi-Saleh, 2020). When compared to our 17-year-old patient, these two reported patients similarly presented with encephalopathic symptoms. However, these cases also demonstrated typical features of tuberculous meningitis and tuberculomas on MRI not predominant in basal ganglia; very much unlike our patient. The most recent case in 2020 also depicted pulmonary involvement when the patient synchronously developed unresolving upper lobe pneumonia with mediastinal lymphadenopathies yielding numerous acid-fast bacilli from transbronchial needle aspiration.

CNS TB may also rarely present as a large intraparenchymal mass which may mimic a tumour (Sharma, 2015; Venkatram *et al.*, 2017). This could either be a giant tuberculoma or multiple tuberculomas forming a conglomerate mass (Sharma, 2015; Venkatram *et al.*, 2017). Uncommonly, tuberculomas predominate the basal ganglia region (Venkatram *et al.*, 2017) though this region is where high metabolic activity takes place making it susceptible to infections (John, 1986). As in our case, the confusion was oblivious due to symmetrical lentiform involvement of the lesions. Tuberculomas are known to exhibit different imaging profile based upon the stage of maturity (Rock *et al.*, 2008; Venkatram *et al.*, 2017; Khatri *et al.*, 2018). Referring to our case, two serial MRIs showed enlarging mass-like appearances of multiple tuberculomas at both basal ganglia regions which generally depicted as non-caseating tuberculoma and caseating tuberculoma with liquefied centre. Non-caseating tuberculoma is demonstrable as hypo- to isointense on T1, hyperintense

on T2 and subsequent homogenous enhancement post contrast. Whereas on the second MRI, caseating tuberculoma with liquefied centre is depicted as centrally hypointense on T1 and hyperintense on T2. Table 1 summarizes the MR appearances of tuberculous brain lesions according to its stage of maturity (Khatri *et al.*, 2018).

Table 1. MR appearances of tuberculous brain lesions according to its stage of maturity (Khatri et al. 2018).

| Stages of maturity | MR appearances |
|---|---|
| Non-caseating | Hypo- to isointense on T1, hyperintense on T2. Homogenous enhancement post contrast. Seen in the earliest imaging of our patient. |
| Caseating with solid centre | Hypointense on T1, strikingly hypointense on T2. Attributed to the granulation tissue and compressed glial tissue in the central core resulting in greater cellular density than the brain parenchyma. |
| Caseating with liquid centre | Centrally hypointense on T1, hyperintense on T2. This is demonstrated in the later imaging of our patient (Figure 2). |
| Capsule formation in caseating granulomas: peripheral hypointense rim on T2, rim enhancement post contrast, may be related to a layer of collagenous fibre with high protein concentration, low water content and a layer of outer inflammatory cells. | |

The recommended first line treatment agents for CNS TB are daily 10-months doses of Isoniazid, Rifampicin, Pyrazinamide and Ethambutol. Patient should be treated for a minimum of 10 months (Cherian & Thomas, 2011). Extension to at least 12 months for failed responders or should treatment interruptions occur. Prompt neurosurgical referral is required should hydrocephalus or tuberculous brain abscess take place. Ventriculoperitoneal shunt or endoscopic third ventriculostomy may be opted if the duration of illness is more than 4 weeks. Patient with GCS of >8 and <14 are better off with early shunt procedure (Cherian & Thomas 2011). The single most important determinant of outcome for both survival and sequelae is the stage of the CNS TB at which treatment is started (Cherian & Thomas 2011).

## Conclusion

TB encephalitis and large intraparenchymal mass are uncommon entities of CNS TB showing different radiological spectrum which needs to be considered by radiologists from the more common conventional tuberculoma or TB meningitis. The many faces of CNS TB in general should prompt this diagnosis to be included should atypical, intriguing imaging presentation is encountered. Failure in early recognition hence correct treatment at a timely fashion of CNS TB would result in considerable magnitude of the sequelae while the disease stage at which treatment is commenced is the single most important determinant for prognosis.

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CASE REPORT Open Access

# Upper tract transitional cell carcinoma: An array of imaging conundrum

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## Abstract

We report a 38-year-old gentleman who presented with painless haematuria for 6-months duration. Contrast-enhanced CT renal revealed a large, calcified intrapelvic mass with calyceal extension confined within the right kidney with moderate pelvicalyceal dilatation but no evidence of synchronous lesion elsewhere. Histopathological analysis showed high grade urothelial carcinoma of the renal pelvis with invasion of renal parenchyma. Upper tract urothelial carcinoma (UTUC) which was once thought similar to urothelial carcinoma of the bladder (UCB), is increasingly being recognized as a different entity. However, heterogenous array of imaging manifestations of UTUC is also increasingly being encountered and pose diagnostic challenges though UTUC is not as prevalent as UCB which is easier to diagnose. Despite distinctive features against renal cell carcinoma (RCC), UTUC may mimic numerous other renal pathologies especially the benign ones hence imaging plays a pivotal role in ascertaining the diagnosis. This disease is usually treated with radical nephroureterectomy with superadded neoadjuvant chemotherapy for high-risk cases. Less invasive endoscopic resection is also offered in certain cases but stringent surveillance of the whole urinary tract as well as post-operative follow-up are mandatory.

***Keywords:*** *upper tract transitional cell carcinoma, upper tract urothelial carcinoma*

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## Introduction

Urinary tract tumours show a wide range of pathological subgroups, which include urothelial carcinoma, adenocarcinoma, renal cell carcinoma, squamous cell carcinoma, and others (Lee, Dickstein & Kamat, 2011). All areas of the urinary tract lined with urothelium are susceptible to urothelial carcinoma, of which the majority of the cases (90-95%) arises from the lower tract (bladder, urethra). The remaining (5%) arises from the upper tract (renal pelvis, calyces and ureter). UTUC commonly arises from the extra-renal portion of the pelvis, followed by the infundibulocalyceal regions (Browne *et al.*, 2005). While UCB is prevalent, UTUC remains scanty. However, it is challenging to determine the precise incidence of UTUC since a lot of statistics combined this with renal cell carcinoma (Browne *et al.*, 2005). However, Prando, Prando & Prando (2010) suggested that urothelial carcinoma of renal pelvis and pelvicalyceal system constitutes about 10-15% of all renal tumours (Prando, Prando & Prando, 2010). Synchronous UCB constitutes 2-4%, while metachronous UCB occurs in 40% of patients with tumours affecting the upper urinary tract. These are the reasons for complete urothelial screening as well as

bladder monitoring when these patients attend follow-up.

Patient demographics include 6th-7th decades of life and male predominance with a ratio of 3:1. Risk factors for developing urothelial carcinoma include smoking, increasing age, male gender, exposure to cancer-causing chemicals (aniline, aromatic amines, azo dyes, benzidines), excessive caffeine intake and cyclophosphamide therapy. These substances are metabolized and excreted into the urine and act locally on the urothelium (Browne *et al.*, 2005). UTUC is also associated with structural abnormalities such as horse-shoe kidney, urine stasis, Balkan endemic nephropathy, analgesic abuse, human papilloma viral infection and hereditary non-polyposis colorectal cancer. Presentations include haematuria (either gross or microscopic), acute renal colic and dull flank pain caused by obstructive uropathy (Prando, Prando & Prando, 2010). Imaging plays an important role yet challenging to ascertain the diagnosis and guide subsequent management, unlike in UCB which is usually detected on cystoscopy (Lee, Dickstein & Kamat, 2011; *Browne et al.*, 2005). UTUCs that invade the muscle wall usually have a very poor prognosis with 5-year–specific survival is <50% for pT2/pT3 and <10% for pT4 UTUC (Rouprêt *et al.,* 2020).

## Case Report

Our patient is a 38-year-old gentleman presented with painless haematuria for 6-months duration. This patient is a passive smoker with no other risk factor for urothelial carcinoma. Urine microscopy revealed numerous red and white blood cells. The patient is also mildly anemic with hemoglobin of 10.6 g/L while the renal profile was unremarkable. Contrast-enhanced computed tomography (CT) renal depicted enlargement of the right kidney with extensive hypodense renal pelvic mass infiltrating into the infundibulocalyceal system with hydronephrosis. No synchronous lesion is detected throughout the urinary system and the contralateral urinary tract is normal. The patient was later subjected to right radical nephroureterectomy.

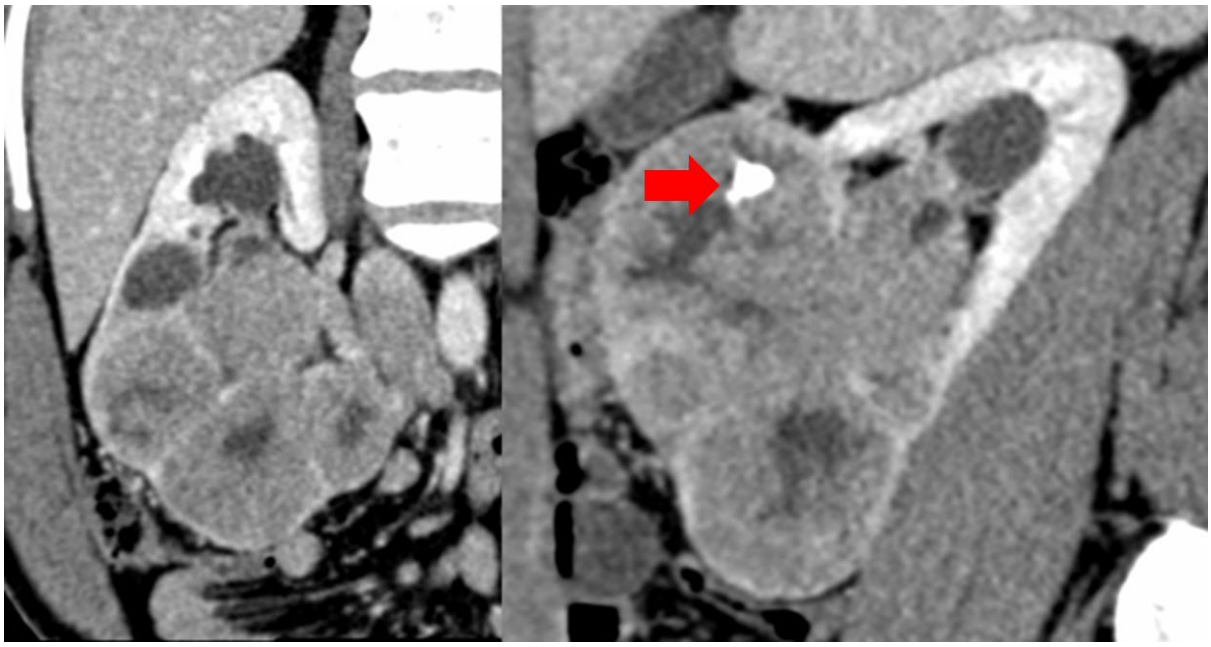

Figure 1. Coronal oblique and sagittal reformatted CT renal in nephrographic phase showing the right renal mass with preserved reniform contour, infiltrative appearance and homogenous low attenuation of the tumour, rendering the diagnosis of urothelial carcinoma. These are mainly seen

involving the interpolar region and the lower pole. Note the coarse calcification within the superior aspect of the mass (red arrow).

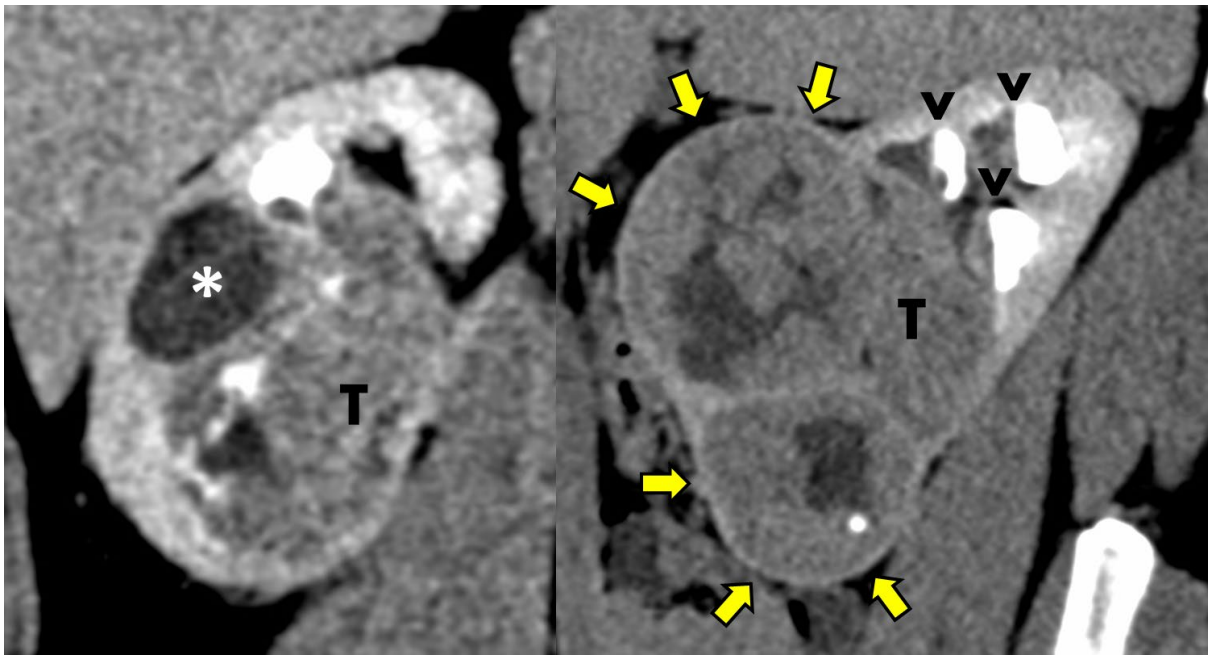


Figure 2. Coronal and sagittal reformatted CT renal in excretory phase demonstrating 'phantom calyces' (white asterisk) and 'oncocalyces' (yellow arrows). Note the urine-contrast level seen at the dilated upper pole calyces (black arrow heads). T = tumour.

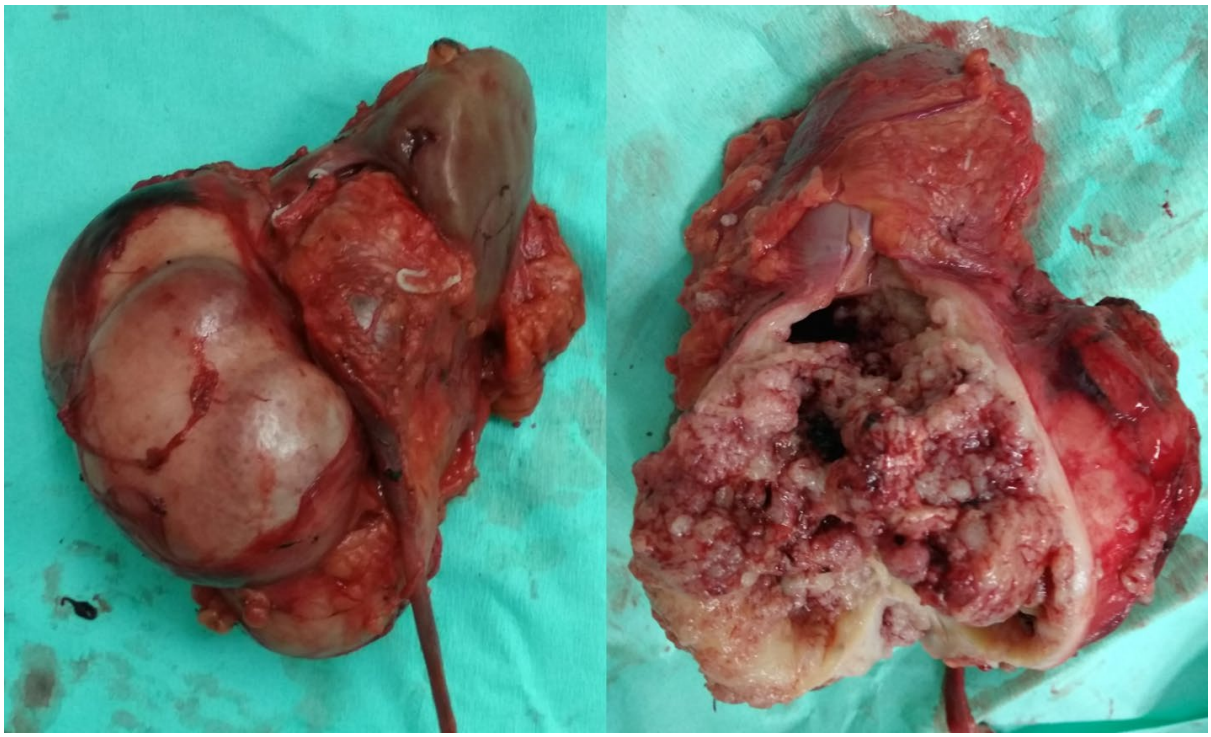

Figure 3. Cut section of the enlarged kidney revealed an irregular tumour with predominant involvement of the renal pelvis and infiltrating into the renal parenchymal tissue of the lower pole. The tumour showed papillary projections with extensive areas of necrosis.

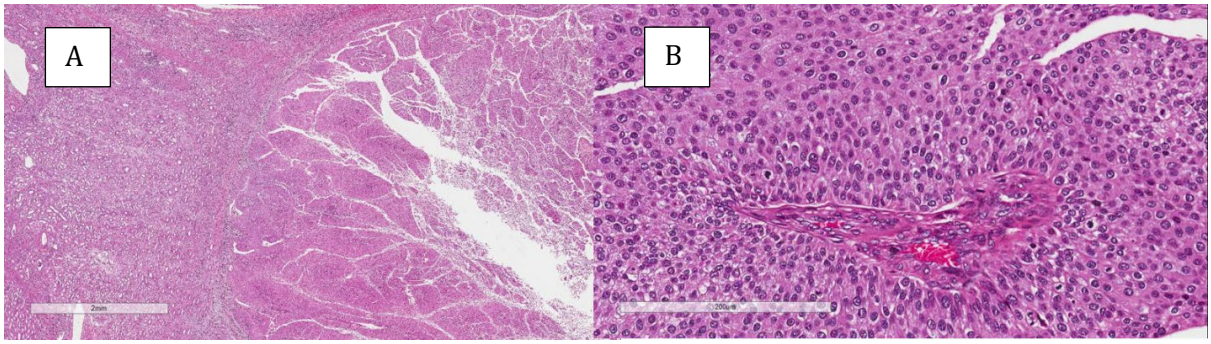


Figure 4. (A) Malignant urothelial cells arising from the renal pelvis arranged in papillary architecture, solid sheets and nesting patterns (H&E x20). (B) The malignant cells display moderate nuclear pleomorphism with irregular hyperchromasia, prominent nucleoli, and clear-pale to eosinophilic cytoplasm. Mitosis is brisk (H&E x 200)

## Discussion

Computed tomography (CT) urography has the highest diagnostic accuracy of the available imaging techniques for radiological evaluation of UTUC (Raza et al., 2011; Rouprêt et al., 2020). Nonetheless, previous scholars reported that UTUC shares similar imaging characteristics with renal inflammatory lesions as well as other renal carcinomas like clear cell RCC. Pelvicalyceal carcinoma that is eccentric, localised and infiltrative inducing renal contour deformity may imitate RCC. Whereas if calcified, this pelvicalyceal carcinoma could mimic long-standing inflammatory kidney disease (Prando, Prando & Prando, 2010). Numerous benign lesions may mimic malignancies of the upper tract such as malakoplakia, infection, endometriosis, fibroepithelial polyps, hematoma, urolithiasis, ureteropelvic junction (UPJ) obstruction, tuberculosis and sloughed papilla (Lee, Dickstein & Kamat, 2011). Therefore, it is of utmost importance to differentiate these entities since they entail different treatment regimes. A thorough CT urography should be performed with attempts made to completely delineate the pelvicalyceal system and ureter as well as to enable the identification of renal vasculature, assess renal enhancement and excretion (Lee, Dickstein & Kamat, 2011). It is equally crucial to detect tumour in the contralateral kidney. In a nutshell, concerning the radiological imaging of the tumour, it is absolutely necessary to carry out a thorough assessment which include its enhancement pattern, lesion location, lesion multiplicity, urinary wall thickness and presence of periureteral fat stranding.

There are several imaging features which render UTUC distinct from RCC which include propensity of the right kidney, preserved reniform contour, infiltrative rather than expansible appearance and homogenous low attenuation of the tumour. These findings are depicted in this patient (Figure 1). Less remarkable features are linear calcification and intraabdominal metastases (Raza *et al.*, 2011; Zhu *et al.*, 2016). Zhu et al. proposed right kidney involvement in 83% (Zhu *et al.*, 2016), however Ronan *et al.* suggested no side predominance with equal distribution between right and left kidneys and about 2-4% cases occurring bilaterally (Browne *et al.*, 2005). Renal medullary involvement is also observed in 93% (Zhu *et al.*, 2016). Raza *et al.* and Zhu *et al.* also reported preservation of reniform contour in 90%, however there are other tumours which may demonstrate clear boundaries and these include clear cell RCC, chromophobe RCC and Wilm's tumour (Zhu *et al.*, 2016).

Zhu et al. proposed infiltrative appearances of the tumour with poorly defined margins in all cases of UTUC (Zhu *et al.*, 2016), which is portrayed in this case. Infiltrative appearance is defined as thickening or induration involving the pelvicalyceal wall with infiltration of the renal parenchyma due to obliteration of the renal sinus/

peripelvic fat which usually demarcates a non-infiltrative tumour from renal parenchyma (Prando, Prando & Prando, 2010; Browne *et al.*, 2005). Hence, UTUC is generally centred at the collecting system hence the filling defect appearance (Raza *et al.*, 2011). These masses usually result in distortion of the normal architecture of the kidney and pelvicalyceal amputation at varying degrees which does not alter the renal contour. This is different from clear cell RCC which usually resides within the renal cortex and exhibits expansible and exophytic morphology (Prando, Prando & Prando, 2010). Expansile component in UTUC is observed in only 21% (Zhu *et al.*, 2016). Even though the majority of infiltrative TCCs are located centrally, eccentric or peripheral tumours may occur and this may retain or distort the renal contour. If renal contour is compromised, this may simulate RCC. Other renal tumor that depicts infiltrative appearance includes renal medullary carcinoma commonly seen in young person with sickle cell trait. Uncomplicated pyelonephritis may also show similar appearance (Zhu *et al.*, 2016).

UTUC also depicts homogenous low tumoral attenuation compared to renal cortex/ medulla in all phases of post intravenous contrast in all cases (Raza *et al.* 2011; Zhu *et al.*, 2016). Bata *et al.* (2011) even discovered attenuation difference between UTUC and clear cell renal carcinoma in corticomedullary and nephrographic phases of CT renal protocol. Hence this feature is helpful in differentiating UTUC from tumours having abundant blood supply such as renal medullary carcinoma, clear cell RCC and renal angiomas. However, other hypovascular renal tumours need to be considered including renal lymphoma, chromophobe RCC and collecting duct carcinoma (Lee, Dickstein & Kamat, 2011). The presence of stipple sign which refers to contrast tracking into papillary lesion interstices may also be seen (Browne *et al.*, 2005). This is however also pertinent to blood clots or fungal balls (Browne *et al.*, 2005). On ultrasound (US), UTUC frequently appears mildly hyperechoic in comparison to the adjacent renal parenchyma. It also typically presents as a soft tissue mass located centrally within the echogenic renal sinus fat. On the other hand, high grade TCC may show mixed sonographic echogenicity (Browne *et al.*, 2005). Raza et al. (2011) also concluded that UTUC is the more likely diagnosis if cystic / necrotic change is absent and the tumour is seen extending towards the pelviureteric junction.

It is reported that UTUC also displays linear calcifications in 21%. In UTUC, peripheral or intratumoral calcifications occur in 2-7% and these may be in the form of punctate, linear or granular calcifications. Hence, these appearances may mimic cholesteatoma, leukoplakia, tuberculosis, tubular ectasia and small pelvicalyceal calculi (Prando, Prando & Prando, 2010; Browne *et al.*, 2005). On the other hand, cortical RCC often demonstrates stippled calcifications. Other renal neoplasms which demonstrate calcifications include the rare mucinous adenocarcinoma of renal pelvis in which the calcifications may occur at the periphery or centre of the mass (Prando, Prando & Prando, 2010). Differentiating renal tuberculosis from UTUC may pose a challenge particularly if multiple stricture-like pelvicalyceal lesions and calyceal amputations are present (Prando, Prando & Prando, 2010). UTUC also features intraabdominal metastases in 38% and regional lymphadenopathy in 28% (4). However, Browne *et al.* postulated that bones, liver and lungs are the commonest sites for metastases (Browne *et al.*, 2005). Papillary RCC, chromophobe RCC and renal lymphoma are rarely associated with renal vein infiltration or nodal metastasis (Zhu *et al.*, 2016).

Above all, there are unusual appearances of UTUC which are increasingly encountered and further diversify possible imaging features of UTUC (Prando, Prando & Prando, 2010). These include tumours in hydronephrotic kidney which are found incidentally due to obstruction of the pelviureteric junction. Hydronephrosis is an associated rather than incidental finding in this patient and it is detected predominantly involving the interpolar and lower pole calyces as an extension from the renal pelvic mass. No calyceal contrast opacification is

detected in the excretory images indicating 'phantom calyces'. Tumour-filled distended calices are called 'oncocalyces'. These are made worse by possible calyceal amputations by the mass. Even if the patient presents with hydronephrosis alone, meticulous evaluation is necessary particularly in elderly patients, those with horseshoe kidney or chronic UPJ obstruction in view of urine stasis. However, in diffuse disease, hydronephrosis may not be seen since the mass has entirely replaced the system (Prando, Prando & Prando, 2010). Pre-operative diagnosis of renal mass in non-functioning kidney due to long-standing staghorn calculus is difficult to ascertain whereby in such case, renal biopsy is mandatory. Stricture-like lesions if multiple may confuse UTUC with renal tuberculosis.

Due to its soft, frond-like growth, urothelial carcinoma completely fills the dilated collecting system by adapting to the geometry of the space it occupies. This is another unusual characteristic observed in this patient as extensive projections inside hydronephrotic sacs that resemble papillary fronds (Figure 2). Other uncommon imaging features of UTUC are transpelvic infiltrating solid masses which extend through the retroperitoneum, calcified and non-calcified focal infiltrative parenchymal mass and tumours predominantly invading the perirenal fat. Apart from these, other unusual characteristics include renal vein invasion of the tumour as the only finding, large multiloculated cystic masses with irregular and thick septa as well as paraaortic nodal metastases with undetectable primary tumour (Prando, Prando & Prando, 2010).

Reference standard treatment of UTUC is radical nephroureterectomy (Lee, Dickstein & Kamat, 2011). However, endoscopic local resection or otherwise known as fulguration is generally less radical and aims to spare nephrons hence minimizes patient morbidity. Patients with low-grade papillary lesions, poor performance status, shorter life expectancy, single kidney, and those who declined radical surgery are typically the ones who should employ this less intrusive procedure (Lee, Dickstein & Kamat, 2011). In accordance with surgical planning, urologists must ascertain the tumor's location (renal pelvis, mid ureter, or distal ureter), its extent (extraluminal or intraluminal), whether hydroureteronephrosis is present, and whether it has invaded any nearby organs. On the other hand, neo-adjuvant chemotherapy before definitive surgery is beneficial for certain patients with high-risk characteristics, such as our patient, who has a significant tumour burden, sessile architecture, and high-grade pathology. This leads to greater rates of both downstaging of the tumour bulk and complete remission (Lee, Dickstein & Kamat, 2011). Imaging is pertinent to identify suspicious lymph nodes and metastatic disease since these would indicate a need for immediate chemotherapy with adjunctive therapy depending on tumour response (Lee, Dickstein & Kamat, 2011). Stringent follow-up is mandatory to detect metachronous tumour, local recurrence of metastases; which are based on urinary cytology, imaging and cystoscopy finding (Taneja, 2011).

The following Table 1 summarizes several distinctive CT features of UTUC which helps in differentiating it from RCC.

Table 1. CT differentiating features of UTUC against RCC.

| CT features | UTUC | RCC |
|---|---|---|
| Enhancement pattern | Homogenous low attenuation | High attenuation on corticomedullary phase (hypervascular) |
| Location | Arise from pelvicalyceal wall, favours right kidney | Arise from renal cortex |
| Reniform contour | Preserved | Not preserved due to the lesion being exophytic |
| Growth pattern | Infiltrative | Expansible |
| Cystic / necrotic change | Absent | Present |
| Additional features | • Pelvicalyceal amputation causing phantom calyces/ oncocalyces<br>• Tumour extension towards pelviureteric junction | |

## Conclusion

UTUC displays heterogenous imaging manifestations affecting the kidney down to the bladder. Individual CT features most predictive of UTUC against centrally located RCC such as tumor found to be centered on the collecting system, a focal filling defect in the pelvicalyceal system, preservation of reniform contour, absence of cystic or necrotic change, homogeneous but modest tumor enhancement, and extension of the tumor toward the ureteropelvic junction subsequently guides patients' management. It is indispensable that radiologists provide the necessary information to the attending urologist with good understanding of the radiological features that have an impact on the treatment.

## Conflict of Interest

None declared.

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CASE REPORT Open Access

# Five parapremolars in a non-syndromic patient: A case report

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## Abstract

Supernumerary teeth or hyperdontia are additional or an excessive number of teeth present in normal deciduous or permanent dentition. The prevalence of supernumerary teeth is between 0.1 and 3.8% in permanent dentition and between 0.3 and 0.8% in deciduous dentition. In Sabah, the prevalence of supernumerary teeth is 10.32% among orthodontic patients. The condition is more common in male patients. A case report involved a fit and healthy 19-year-old male student who presented with multiple supernumeraries. Upon clinical examination, there were three erupted supernumeraries on the bilateral mandibular premolar region, and additional two impacted supernumeraries being discovered after further radiographic investigation. This anomaly was found during an annual dental school checkup program. The patient had congenital absence of the lower left third molar. Primary dental care was carried out such as filling for carious teeth, scaling, oral hygiene reinforcement and regular monitoring. The patient declined any other dental treatment options such as extraction of the non-functioning supernumerary parapremolar teeth, or orthodontic treatment to improve his malocclusion. Currently, the patient is under oral hygiene maintenance with regular dental follow-ups. In a nutshell, the importance of regular dental follow-ups and review is crucial to monitor any signs and symptoms of pathology such as cystic formation of unerupted supernumeraries. Reinforcement of oral hygiene and caries risk assessment should be carried out during reviews to improve and maintain the patient's quality of life.

***Keywords:*** *adolescent, malocclusion, premolars, supernumerary teeth, Sabah*

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## Introduction

Supernumerary teeth, or hyperdontia, are additional or an excessive number of teeth present in normal deciduous or permanent dentition (Parolia *et al.*, 2011). Supernumerary teeth commonly present as a single tooth at 80%, two teeth at 15 to 20%, three teeth at 3 to 4%, and 1% for four teeth and above (Lubinsky & Kantaputra, 2016). The prevalence of supernumerary teeth is between 0.1 and 3.8% in permanent dentition and between 0.3 and 0.8% in deciduous dentition (Bahoudela *et al.*, 2022; Hussein & Majid, 1995; Rajab & Hamdan, 2002; Roslan *et al.*, 2018). In Sabah, the prevalence of supernumerary teeth ranges from 3.1% to 10.3% among orthodontic patients (Lee, 2020; Loke, 1998). The prevalence of parapremolars among non-syndromic patients ranges from 0.24 to 9.1% (Khalaf *et al.*, 2018). The condition is commonly found in male patients, and in patients with a cleft lip and palate, Gardner syndrome, and cleidocranial dysostosis. The etiology for supernumerary teeth remains unclear (Parolia *et al.*, 2011; Rajab & Hamdan, 2002). However, several authors have suggested it is hereditary, and involves

hyperactivity of the dental lamina (Bahoudela *et al*., 2022; Parolia *et al*., 2011; Rajab & Hamdan, 2002). Supernumerary teeth are often discovered during routine dental examinations or as an accidental radiographic finding. Patients with erupted supernumerary teeth often come to a dental clinic for treatment of caries on an adjacent tooth or malocclusion caused by it.

Parolia *et al*., (2011), categorized supernumerary teeth according to morphology, eruption, location, and chronology. In terms of morphology, supernumerary teeth can be described as conical, tuberculate, supplemental, and odontoma. Eruption type wise depends on the pattern such as fully or partially erupted and impacted. Supernumerary teeth are classified according to their position, for example mesiodens (premaxilla), paramolar (molar region), distomolar (distal to third molar) and parapremolar (premolar region). The chronology divides into two periods which are during deciduous or permanent dentition (Parolia *et al*., 2011).

The presence of supernumerary teeth brings few clinical complications to the dentition of the patient, including malocclusion, dental caries, and difficulty to maintain good oral hygiene. Supernumerary teeth such as mesiodens commonly cause delayed eruption of successor teeth, as well as crowding, median diastema, rotation, and root resorption of adjacent teeth (Meighani & Pakdaman, 2010). Hence, this case report describes the complications that occurred with the presence of five parapremolars in the maxilla and mandible in a non-syndromic patient with non-surgical management and its review protocol.

## Case Report

A 19-year-old sixth-form student came for an incremental dental care (IDC) checkup, which is routinely carried out at Kolej Tingkatan 6 Tawau annually. The patient was fit and healthy with no active chief complaint. Upon intra-oral examination (Figure 1), there were supernumerary teeth at the premolar region bilaterally on the mandibular arch. Two supernumerary teeth were in the right premolar region while one was seen clinically on the left premolar region. In addition, the patient presented with poor oral hygiene, dental caries on the occlusal and interproximal lower molars, severe crowding, a buccally displaced upper right canine, a deep overbite and a posterior crossbite due to the presence of the supernumerary teeth.

The patient was sent for dental panoramic tomogram (DPT) imaging at a private clinic to rule out unerupted supernumerary teeth at other regions on both arches (Figure 2). The DPT showed impacted supernumerary teeth at the lower left premolar region and upper left premolar region, and congenital absence of the lower left third molar.

The patient returned to Klinik Pergigian Tawau for periapical radiograph (PA) investigation where three separate PAs were taken, with one horizontal parallax technique on the upper left quadrant (Figures 3–6). The purpose of the PAs was to assess the location of the supernumerary teeth, and their effects on adjacent teeth, such as external root resorption and eruption cyst. Figure 3 shows there was both one erupted and one unerupted, supplemental-type, supernumerary tooth on the lower left quadrant, while on the lower right quadrant, both supplemental-type supernumerary teeth were fully erupted (Figure 4). One conical-shaped supernumerary tooth was seen located between the upper left first and second premolar (Figure 5). A parallax technique with mesial horizontal shift was used to assist in determination of the position of the supernumerary tooth in the upper left premolar region. For this case, the supernumerary tooth shifted mesially when periapical radiograph with mesial horizontal shift was taken (Figure 5 & 6). Hence, the unerupted supernumerary tooth was located at the palatal region of the upper left premolars (Figure 6). The absence of external root resorption was observed in all PA radiographs. Upper and lower dental impressions were taken for the purpose of study models for his dental anomalies (Figure 7).

Figure 1. Patient's intraoral condition at first visit.


Figure 2. Dental Panoramic Tomogram (DPT) view of patient to rule out other supernumerary teeth and clinically undetected pathology at other regions of the jaw.

Figure 3. Periapical radiograph (PA) view of supernumerary teeth at third quadrant. Two erupted premolars with one unerupted and one erupted parapremolar.

Figure 4. PA view of supernumerary teeth at fourth quadrant. Two erupted premolars and two erupted parapremolars overlapping each other. Mesial caries noted on lowerright first molar.

Figure 5. One conical-shaped supernumerary tooth located between upper left first and second premolar.

Figure 6. The single supernumerary tooth moved towards mesial when the angle of radiograph shifted mesially.

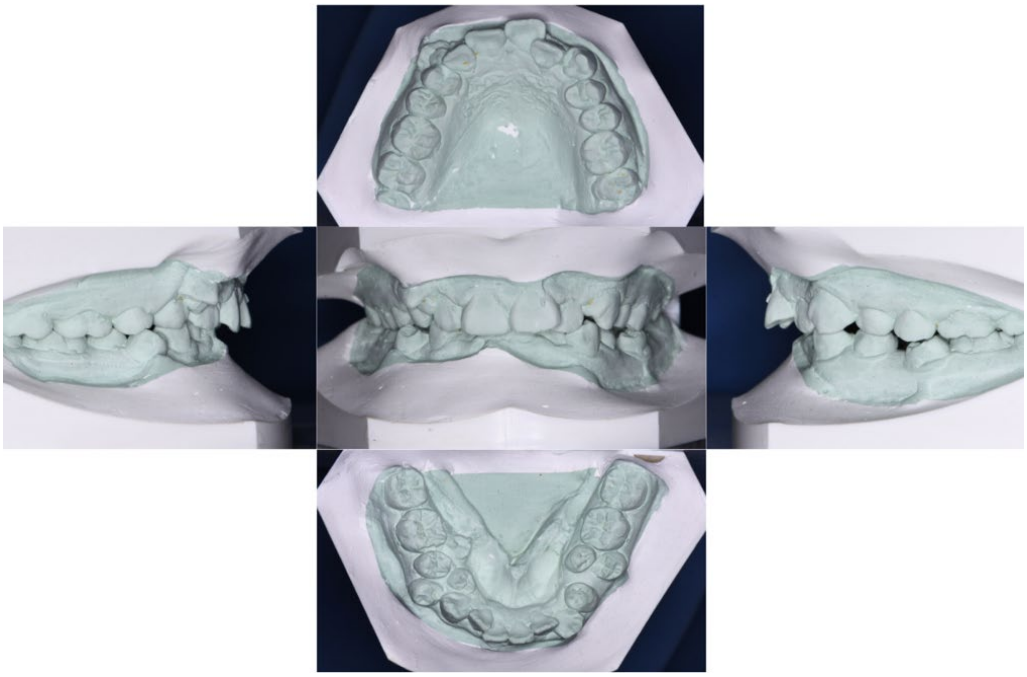


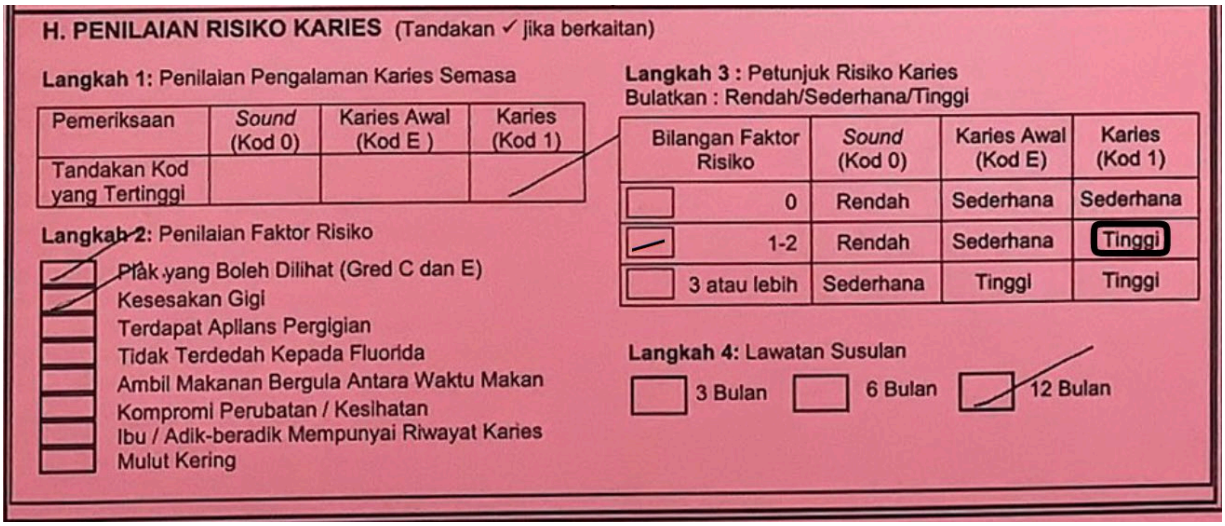
Figure 7. Malocclusion seen on the dental cast of the patient.

Further intraoral examinations were carried out including periodontal charting, plaque index and caries risk assessment. The Basic Periodontal Examination (BPE) score for the patient was 2 for all sextants with an average pocket depth of 2–3mm at the supernumerary teeth region. The patient's plaque index and calculus index were 52.98% and 29.76% respectively with a high caries risk (Figure 8).

The diagnoses for this patient were dental caries on lower molars, moderate generalized gingivitis, Class II division 2 malocclusion with Class II molar relationship bilaterally, deep overbite, severe crowding, buccally displaced upper right canine, crossbite due to the presence of supernumerary teeth, impacted supernumerary teeth. His Index of Orthodontic Treatment Needs (IOTN) score was 4d, which was severe contact point displacements greater than 4mm.

A treatment plan was formulated and discussed with the patient (Table 1). However, the patient only opted for primary dental care such as fillings for carious teeth, full mouth scaling, oral hygiene reinforcement and regular monitoring. The patient was not interested in any other dental treatment options such as extraction of non-functioning supernumerary parapremolar teeth or orthodontic treatment to eliminate his malocclusion. The risks and consequences were explained to the patient, including risk of an infected eruption cyst and dental caries at the crowding region.

Routine dental treatment was initiated with full mouth ultrasonic scaling, restoration of carious teeth 36, 37, 46, and 47, fissure sealants on 16, 17, 26, and 27 with fluoride vanish application on mild white spot lesion of the anterior teeth. Oral hygiene reinforcement was given to the patient with a two-week recall for an oral hygiene review.



**H. PENILAIAN RISIKO KARIES** (Tandakan ✓ jika berkaitan)

**Langkah 1:** Penilaian Pengalaman Karies Semasa

| Pemeriksaan | *Sound* (Kod 0) | Karies Awal (Kod E ) | Karies (Kod 1) |
|---|---|---|---|
| Tandakan Kod yang Tertinggi | | | ✓ |

**Langkah 2:** Penilaian Faktor Risiko

- [✓] Plak yang Boleh Dilihat (Gred C dan E)
- [✓] Kesesakan Gigi
- [ ] Terdapat Aplians Pergigian
- [ ] Tidak Terdedah Kepada Fluorida
- [ ] Ambil Makanan Bergula Antara Waktu Makan
- [ ] Kompromi Perubatan / Kesihatan
- [ ] Ibu / Adik-beradik Mempunyai Riwayat Karies
- [ ] Mulut Kering

**Langkah 3 :** Petunjuk Risiko Karies
Bulatkan : Rendah/Sederhana/Tinggi

| Bilangan Faktor Risiko | *Sound* (Kod 0) | Karies Awal (Kod E) | Karies (Kod 1) |
|---|---|---|---|
| [ ] 0 | Rendah | Sederhana | Sederhana |
| [✓] 1-2 | Rendah | Sederhana | **Tinggi** |
| [ ] 3 atau lebih | Sederhana | Tinggi | Tinggi |

**Langkah 4:** Lawatan Susulan

[ ] 3 Bulan [ ] 6 Bulan [✓] 12 Bulan

Figure 8. Patient's caries risk assessment from LP8 Card.

Table 1. Treatment plan and options for the patient.

| Phase | Treatment |
|---|---|
| Primary dental care | • Ultrasonic scaling<br>• Restoration of teeth 36, 37, 46 and 47<br>• Fissure sealant application on teeth 16, 17, 26 and 27<br>• Fluoride varnish application on teeth 12 and 22 |
| Maintenance phase | • Re-evaluation of:<br>- Plaque score<br>- Dental caries<br>- Calculus index<br>- Pocket depth |
| Surgical phase (Optional) | • Extraction of supernumerary teeth<br>• Surgical removal of impacted supernumerary tooth |
| Corrective phase (Optional) | • Fixed appliance orthodontic treatment |

The patient was recalled after two weeks for a review of his oral hygiene at Form 6 College (Figure 9). His plaque index score had reduced to 28.57%. The patient was still motivated to maintain his oral hygiene. However, he still insisted on primary dental care only.

The patient was recalled for a review after six months as part of the maintenance phase at primary dental clinic (Figure 10). His plaque index score was 25%. Mild calculus was noted on the lower and upper incisors with a calculus score of 3.57%. There was no new caries on his teeth. He was discharged from primary dental care and advised to attend an annual dental checkup, and oral hygiene was reinforced.

Figure 9. Patient's intraoral condition at two-week review after treatment.

Figure 10. Patient's intraoral condition at six-month review.

## Discussion

Supernumerary teeth contribute to several clinical complications including dental caries, malocclusion, poor oral hygiene, and cystic formation. Development of caries and accumulation of plaques are the results of patient being unable to clean the crowded site effectively (Kolawole & Folayan, 2019). Patients with severe malocclusion also have increased risk of dental caries (Feldens *et al*., 2015). In this case, the patient initially presented with poor oral hygiene and multiple dental caries on the lower molars. However, oral hygiene reinforcement was given at the two-week review and the improved result of oral hygiene status at the six-months review showed that the patient was able to maintain his oral hygiene despite only opting for primary dental care treatment. Oral hygiene instructions and patient education played a major role in motivating the patient to maintain good oral hygiene.

The development of pathological cysts such as infected dentigerous cysts are also observed in patients with impacted supernumerary teeth (Lustmann & Bodner, 1988). The prevalence of dentigerous cysts in impacted normal dentition ranged from 11.4 to 35.5%, while in impacted supernumerary teeth it ranged from 0.7 to 5.5% (Johnson *et* al., 2014; Noujeim & Nasr, 2021; Stafne *et al*., 1931). Early identification of supernumerary teeth is essential so that early treatment or interception can be planned and executed. This would minimize and avoid development of more severe malocclusion and cystic formation. Annual dental reviews and intraoral PAs around the supernumerary teeth will aid in monitoring for future potential cystic changes.

Imaging modalities for supernumerary teeth varies according to investigation needs. Cone beam computed tomography (CBCT) can be used to obtain information about unerupted supernumerary teeth such as the location, size and dimension of eruption cysts and the detection of external root resorption of adjacent teeth (He *et al*., 2023). For detection of erupted supernumerary teeth in the oral cavity, dental panoramic

tomogram (DPT) is sufficient and is widely used (Bahoudela *et al*., 2022). A periapical radiograph (PA) can be used to determine the location of a single unerupted supernumerary tooth and its root morphology before dental extraction. In this case, PA and DPT were used to determine the location of unerupted supernumerary teeth and to rule out any clinically undetected unerupted supernumerary teeth in other regions of the oral cavity.

Treatment of supernumerary teeth varies according to the intraoral condition affected. It includes regular follow ups, dental extraction, and surgical removal of impacted supernumerary teeth. Removal of supernumerary teeth is recommended when there is associated pathology, malocclusion of adjacent teeth, and delayed permanent tooth eruption, as well as an increased risk of caries risk where crowding is present making it difficult to maintain oral hygiene (Parolia *et al*., 2011). Care of surrounding anatomical structures during surgical removal is crucial when the surgical area is near to vital structures such as the mental foramen, inferior alveolar nerve, and maxillary sinus spaces. In a situation where the patient does not wish to have supernumerary teeth removed, it is important to reinforce oral hygiene and regular monitoring of unerupted supernumerary teeth (Khalaf *et al*., 2018; Parolia *et al*., 2011; Rajab & Hamdan, 2002).

Correction of malocclusion is important for the patient to maintain good oral hygiene, and to improve masticatory function and esthetics. Removable or fixed orthodontic appliances are the treatment for correction of malocclusion once supernumerary teeth are removed (Rajab & Hamdan, 2002; Roslan *et al*., 2018). These appliances are required to correct any misalignment of teeth or closure of space, and to correct an overjet or overbite.

## Conclusion

To conclude, long-term follow-ups are crucial to monitor for any signs and symptoms of cystic formation on impacted supernumerary teeth when the patient opts for non-extraction. A caries risk assessment and reinforced oral hygiene should be carried out during every review appointment to decrease the chances of dental caries and periodontal disease and to improve the quality of life of the patient.

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