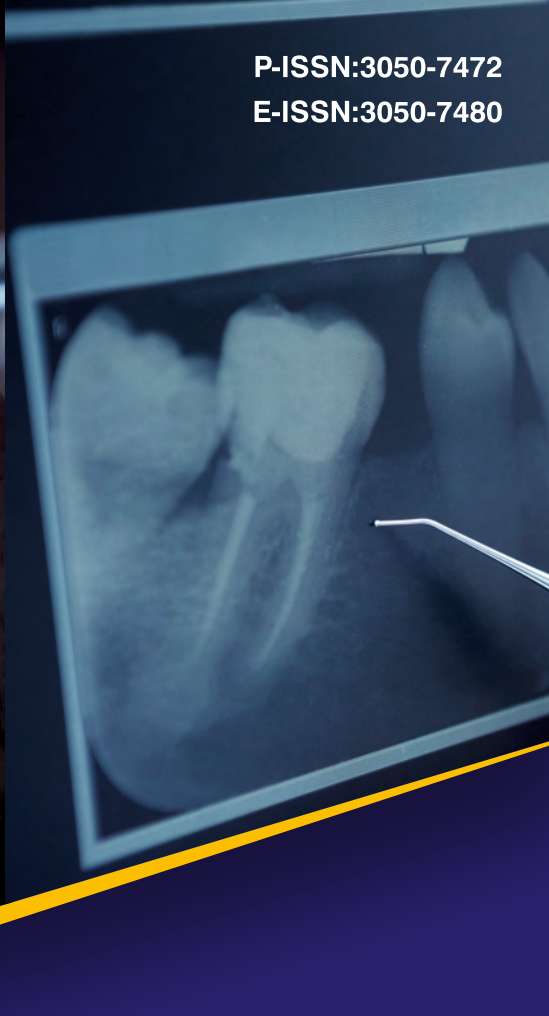

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Review Article

A 3-Year Clinical Review of Oral Biopsies Performed by a Single Oral Surgeon in Private Practice (2021–2024)

Parmanand Dhanrajani, Patrick Chung
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Abstract

Background: There is limited published data on the histopathological findings of oral biopsies performed in private oral surgery practices. This study reviews biopsy specimens collected in a single private practice to determine the relative frequency of oral pathologies. **Materials and Methods**: A retrospective review was conducted on oral biopsies performed by a single oral surgeon in Sydney, Australia, between 2021 and 2024. A total of 263 biopsy reports were analysed: 161 (61.2%) under general anaesthesia (GA) and 102 (38.8%) under local anaesthesia (LA). **Results**: Under GA, the most common diagnoses were dentigerous cysts (52.1%), dental follicles (17.8%), and radicular cysts or granulomas (8.1%). Under LA, fibroepithelial polyps (21.6%), radicular cysts or granulomas (17.6%), osteomyelitis or medication-related osteonecrosis of the jaw (7.8%), and squamous cell carcinoma (SCC) (6.9%) were predominant. Eight malignancies (3.0%) were identified: seven SCC and one metastatic colorectal adenocarcinoma. Compared with institutional series, private practice data revealed higher frequencies of benign cysts and reactive polyps and a fewer malignancies. **Conclusion**: This is the first comprehensive audit of oral biopsy histopathology from an Australian private oral surgery practice. The diagnostic profile differs from tertiary centres, with benign cystic and reactive lesions being predominant. Nonetheless, malignant lesions were identified, underscoring the importance of vigilance in primary surgical practice.

Keywords: Dentigerous cyst, fibroepithelial polyp, oral biopsies, oral pathology, oral squamous cell carcinoma, private practice

Clinical relevance

To the authors knowledge, this is the first comprehensive study of its kind to review and analyse the histopathology results specific to patients attending an oral surgery private practice. The frequency of diagnoses is different to that reported in the literature from tertiary referral centres with cysts and polyps predominant. Eight cases of malignancies were diagnosed and referred to a multidisciplinary department for further management.

Introduction

Histopathological examination remains the gold standard for diagnosing oral and maxillofacial lesions. Although clinical and radiographic assessments can suggest a provisional diagnosis, microscopic evaluation is essential for confirmation and management planning.[1,2]

Despite the substantial number of oral biopsies performed in private practice, few studies have examined diagnostic trends outside hospital-based settings. Most published audits originate from tertiary care institutions, which may receive a disproportionate number of complex or malignant cases. Regional and international biopsy audits from Australia,[3] Singapore,[4] and Malaysia[5] demonstrate variability in diagnostic patterns depending on referral pathways and population demographics.

This study aims to fill the gap by analysing 3 years of biopsy data from a single private oral surgery practice in Sydney, Australia, and comparing the diagnostic spectrum with regional and global findings.

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Materials and Methods

A retrospective review of 263 oral biopsy reports was conducted from July 2021 to June 2024 in a single private oral surgery practice in Sydney, Australia.

Ethics approval was obtained from the Institutional Review Board (IRB) of the Hospital Contribution Fund, Australia (IRB waiver granted due to retrospective, de-identified data).

Data collection

Patient demographics (age, gender, and ethnicity), anaesthesia type, and histopathological diagnosis were recorded. Specimens were obtained via scalpel excisional or incisional biopsy or punch biopsy (for mapping cases) and mounted on a rigid backing paper to maintain orientation.[6]

Inclusion criteria

All oral and maxillofacial soft tissue and cystic lesion samples were submitted for histopathological examination during the study period.

Exclusion criteria

Incomplete records, non-oral sites, or duplicate specimens.

All samples were processed and reported by an oral and maxillofacial pathologist. Reports were typically returned within 4–5 days for routine cases and within 24 h for urgent or malignant cases. Clinical photographs and relevant radiographs were provided with each submission.

Results

A total of 263 biopsies were reviewed. Patient ages ranged from 9 to 93 years (mean: 38 years), with a female-to-male ratio of 1.16:1 [Figure 1].

Ethnic distribution was as follows: European (58.5%), Asian (15.2%), Middle Eastern (12.1%), Indian (9.8%), Nepalese (4.5%), and African (3.0%).

Biopsy modality: [Figure 2]

- General anaesthesia (GA): 161 cases (61.2%)
- Local anaesthesia (LA): 102 cases (38.8%)

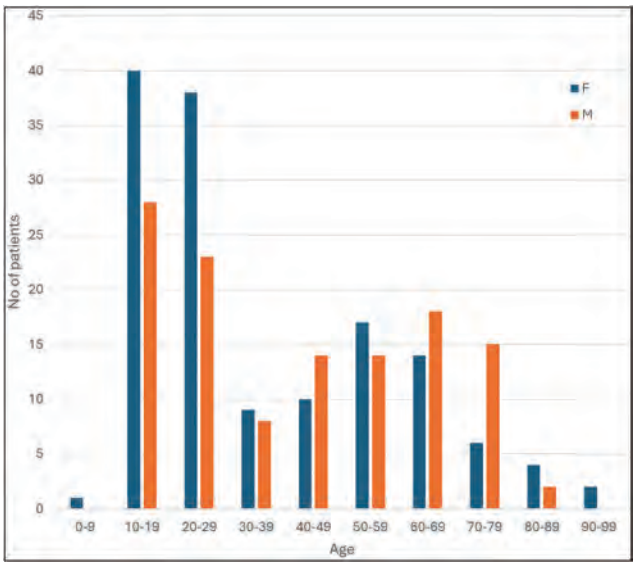

Figure 1: Age and sex distribution of patients undergoing oral biopsy

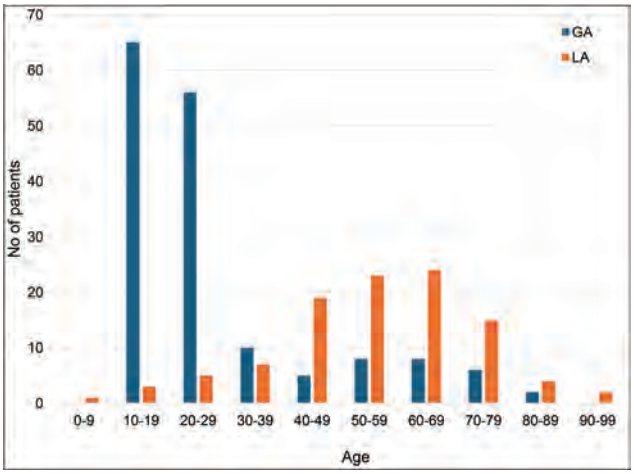

Figure 2: Distribution of biopsy procedures performed under local and general anaesthesia

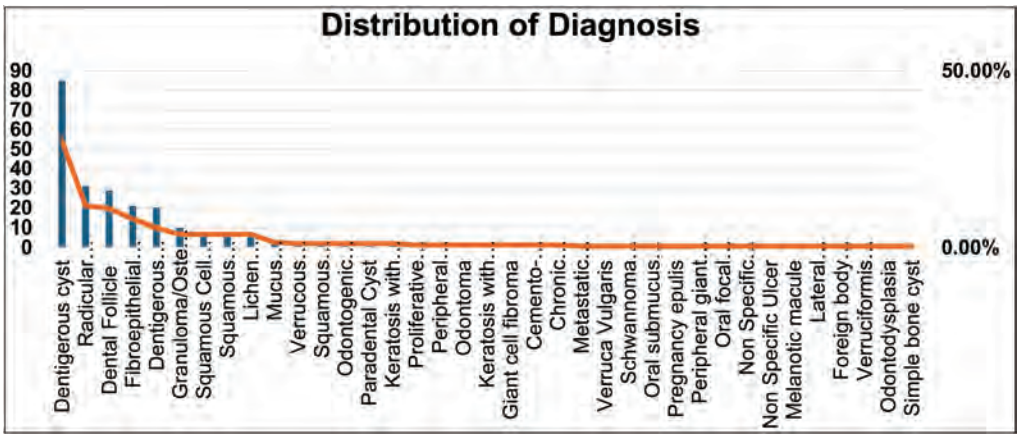

Figure 3: Overall distribution of histopathological diagnoses in all biopsy specimens

Table 1: Most common histopathological diagnoses in biopsies performed under general and local anaesthesia (LA)

Diagnosis	GA *n* (%)	LA *n* (%)
Dentigerous cyst	84 (52.1%)	6 (5.9%)
Dental follicle	29 (17.8%)	3 (2.9%)
Radicular cyst/granuloma	13 (8.1%)	18 (17.6%)
Fibroepithelial polyp	8 (5.0%)	22 (21.6%)
Osteomyelitis/MRONJ	4 (2.5%)	8 (7.8%)
Squamous cell carcinoma	0 (0%)	7 (6.9%)
Other benign lesions	23 (14.3%)	38 (37.3%)

GA: general anaesthesia, SCC: squamous cell carcinoma

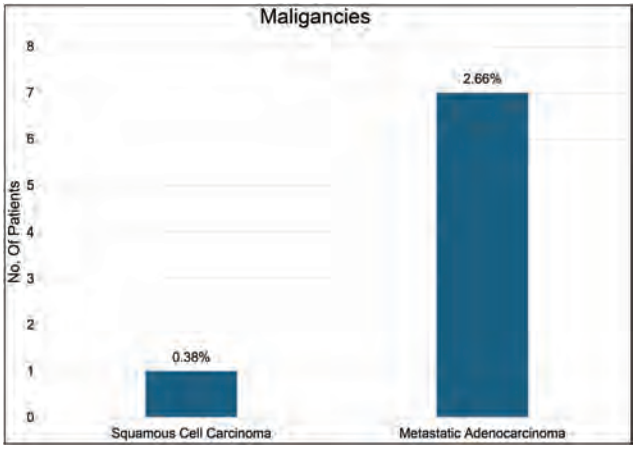

Figure 4: Distribution and anatomical sites of malignant lesions identified in the study

Most common diagnoses

Overall histopathological diagnoses in all biopsy specimens [Figure 3]:

GA: Dentigerous cysts (52.1%), dental follicles (17.8%), and radicular cysts/granulomas (8.1%) [Table 1].

LA: Fibroepithelial polyps (21.6%), radicular cysts/granulomas (17.6%), osteomyelitis/medication-related osteonecrosis of the jaw (MRONJ) (7.8%), and squamous cell carcinoma (SCC) (6.9%) [Table 1].

Malignant lesions: [Figure 4]

Eight malignant cases (3.0%) were reported — seven SCC and one metastatic colorectal adenocarcinoma.

SCC sites included the tongue ($n = 4$), buccal sulcus ($n = 2$), and maxilla/sinus ($n = 1$).

All malignancies were urgently referred to multidisciplinary oncology services and reviewed within 48 h.

Discussion

This 3-year review highlights a wide diagnostic range of oral lesions encountered in private surgical practice, dominated by benign odontogenic cysts and reactive mucosal lesions. The predominance of dentigerous cysts and fibroepithelial polyps contrasts with tertiary care hospital data, which often report higher proportions of dysplastic and malignant lesions [3,4,5]. These differences likely reflect referral bias with malignant and complex cases preferentially managed in hospital-based units.

The observed malignancy rate (3.0%) is lower than that reported in tertiary audits (5%–8%), consistent with the pattern that many suspicious lesions are referred directly to tertiary centres. Nonetheless, the identification of eight malignancies within a private setting underscores the crucial gatekeeping role of primary practitioners in early detection, biopsy, and referral.

The findings also suggest potential implications for referral patterns: benign cystic and reactive lesions appear more frequently in private practices, while tertiary care centres may disproportionately capture the oncologic pathology. Understanding these trends can guide diagnostic vigilance and training emphasis in community-based oral surgery.

The COVID-19 pandemic temporarily disrupted dental services and delayed diagnostic procedures, contributing to deferred presentations and potentially altered lesion severity. Integrating these observations reinforces the importance of maintaining access to diagnostic services during public health crises.

Limitations

- Single-surgeon, single-centre study.
- Retrospective design.
- Potential referral bias (private patients).

Conclusion

This study provides the first Australian audit of oral biopsy diagnoses in a private oral surgery setting. Benign cystic and reactive lesions predominated, but malignant lesions were also encountered. These findings emphasise the need for continued clinical vigilance, appropriate biopsy of suspicious lesions, and timely specialist referral in all practice environments.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Assessing the Standard of Incoming Referrals for Oral and Maxillofacial Surgery at Hospital Kuala Lumpur: A Critical Evaluation

Lekshman Raj Selvam[1], Ishvinder Kaur Virk[2], Nur Shahida Farisha binti Shamsul Ariffin[2], Jonathan Rengarajoo[1], Nur Ikram Hanim Bt Abdul Rahim[1], Kok Tuck Choon[1]

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Abstract

Background: A retrospective audit of 360 referral letters sent to the Department of Oral and Maxillofacial Surgery at Hospital Kuala Lumpur was carried out. The received referrals were evaluated against predetermined criteria. The findings revealed that the majority of the referral letters exhibited deficiencies and necessitated revisions to ensure they contained comprehensive clinical information. This paper delineates the study's findings and proposes a referral pro forma aimed at enhancing the quality of future referrals. **Aim**: To perform a comprehensive comparative analysis of referral letters submitted to the Department of Oral and Maxillofacial Surgery at Hospital Kuala Lumpur against a benchmark published paper, in the absence of local guidelines, with the objective of identifying any deviations from established standards. **Design**: A retrospective analytical review was conducted on a randomly selected sample of 360 referral letters submitted to the Department of Oral and Maxillofacial Surgery at Hospital Kuala Lumpur. **Materials and Methods**: The study encompassed referral letters spanning from January to December 2022. Upon selection, the referral letters were meticulously evaluated against a predetermined checklist for systematic comparison. **Results**: The analysis revealed significant deficiencies in the referral letters, with critical information such as patient date of birth, patient telephone number, general dental practitioners address, duration of symptoms, diagnosis, treatment provided medical and drug history, drug allergies, social history, required treatment and inclusion of radiographic evidence being notably inadequate or frequently omitted entirely. **Conclusion**: The findings of this study underscore a pressing need to enhance the quality of referral letters within Kuala Lumpur. The current state of referral documentation is fraught with inconsistencies and omissions that can severely impact patient care. The implementation of a standardized proforma is not just a recommendation, but a critical imperative to address these pervasive discrepancies and ensure the reliability and completeness of referral information.

Keywords: Hospital Kuala Lumpur, oral surgery referrals, referral quality

Introduction

The role of high-quality referral letters in ensuring effective clinical treatment is a topic warranting critical scrutiny. While often heralded as the essential link between primary and secondary healthcare providers, the reality is that the quality and comprehensiveness of these referrals are frequently inconsistent. This variability can lead to significant gaps in patient care continuity, undermining the very purpose of these communications. It is imperative to question the current standards and advocate for more stringent protocols to ensure that referral letters fulfil their intended role effectively.[1,2] They are adaptable communication tools that may be used to cover both simple and complicated clinical issues.[3] Sufficient information on referral letters is necessary in order for a secondary care dental practitioner to evaluate

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clinical need and urgency. Any shortcomings from the referral would result in delay in diagnosing and providing effective treatment for the public.[4] Patients may become more frustrated, anxious and distrustful of the healthcare system as a result of incomplete referrals.[5]

A high-quality referral letter ought to encompass three primary sections: (a) The basic referral information section such as patients demographic and contact details, (b) the clinical detail section, which includes the reason for referral such as the chief complaint, diagnosis, previous treatments and medical and drug history and (c) the additional information section, which contains radiographs, an explanation of urgency, if the referral letters were written in a structured, easily readable manner and the patient's preference for local or general anaesthesia. It is imperative for secondary care professionals and administrative staff to have access to sufficient information to assess the necessity and urgency of each referral for appropriate appointment scheduling.[3]

Numerous audits and studies have consistently highlighted the suboptimal quality of oral surgery referrals. Zakrzewska[6] research specifically noted the frequent absence of clinical detail in referrals, with a notable lack of diagnostic efforts. Additionally, the provided medical histories were often deemed insufficient. Zakrzewska advocated for the adoption of a standardised referral proforma by general dental practitioners (GDP) to address these deficiencies.[6] Prior research indicates that the implementation of standardised referral proformas has led to an increase in the volume and quality of information transmitted from dental clinics to dental hospitals by GDPs.[4]

Djemal *et al*.[7] observed that the implementation of referral proformas yielded a substantial enhancement in the comprehensiveness of patient information, as compared to traditional referral letters. A study demonstrated that the implementation of standardised proformas resulted in an increase in information provided compared to conventional referral letters.[8]

In Malaysia, the absence of a standardised format for oral surgery referrals remains a significant concern. In Wilayah Persekutuan Kuala Lumpur (WPKL), a generic referral form known as BK4 is employed, which permits GDPs to compose referrals at their discretion. Although this method provides flexibility, it fails to offer a structured framework necessary for the consistent and comprehensive documentation of referral information. This study undertakes a retrospective analysis of routine oral surgery referrals submitted to the Oral and Maxillofacial Department at Hospital Kuala Lumpur, Malaysia, revealing critical gaps in the current referral process.

Aim

The primary objective of this study is to evaluate the quality of referrals originating from government clinics in WPKL to the Department of Oral and Maxillofacial Surgery at Hospital Kuala Lumpur. By systematically analysing these referrals against established criteria for referral letters, as delineated in previous publications,[7-9] this study aims to develop a more standardised referral system or proforma. This initiative seeks to enhance the quality and consistency of future referrals received by Hospital Kuala Lumpur.

Materials and Methods

In the absence of established guidelines for oral surgery referral letters, we developed an evidence-based standard for this study, derived from a comprehensive review of existing literature.[7-9] Utilising these guidelines, we formulated a detailed checklist to encapsulate the essential components of an ideal oral surgery referral letter. This approach underscores the significant gap in current referral practices and highlights the pressing need for a structured framework to ensure the consistency and thoroughness of referral documentation.

A retrospective analysis was conducted on a simple randomly selected cohort of 360 oral surgery referral letters sent from GDPs to the Department of Oral and Maxillofacial Surgery at Hospital Kuala Lumpur between January and December 2022. The scope of the analysis was confined to referrals pertaining to apicectomy, third molar surgery, implant surgery and the management of hard and soft tissues, specifically from government clinics in WPKL. Excluded from the study were referrals originating from private clinics, inter-departmental sources and other medical healthcare providers. Data were obtained from the referral letters and categorised according to the devised checklist into three sections:

- Basic referral information section.
- Clinical details.
- Additional information.

The data extracted were tabulated in each respective component. The data obtained are presented in Tables 1–3.

Table 1: Basic referral information section

Basic referral information section (n = 360)			
No	**Components**	***N***	**%**
1	Date of referral	356	99
2	Gender	357	99
3	Patient name	357	99
4	Patient date of birth	0	0
5	Ethnicity	181	50
6	Patient NRIC	358	99
7	Patient telephone number	107	30
8	GDP name	359	99
9	GDP clinic address	239	66
10	GDP telephone number	0	0
11	Specific referring destination	359	99

Table 2: Clinical detail section

Clinical detail section (n = 360)			
No	**Components**	***N***	**%**
1	Reason of referral	297	83
2	Symptoms recorded	327	91
3	Duration of symptoms	239	66
4	Diagnosis made	267	74
5	Treatment already provided	168	47
6	Medical and drug history	302	84
7	Drug allergies	244	68
8	Social history	22	6

Table 3: Additional information

Additional information (n = 360)			
No	**Components**	***N***	**%**
1	Treatment required/other comments	239	66
2	Inclusion of any radiographs	90	25
3	Urgency with explanation	340	94
4	Examination and treatment done	359	99
5	Clear and legible	360	100

Discussion

The comprehensive analysis conducted on the referral letters within this study revealed that, despite patient details generally being satisfactory, several critical sections exhibited significant deficiencies or omissions. Specifically, information crucial for diagnostic and treatment purposes, such as the patient's medical history, details of prior treatments and diagnostic data, was frequently found to be incomplete or entirely absent. Additionally, important contextual information, including the urgency of the referral and the patient's specific preferences for anaesthesia, was often inadequately documented. These findings underscore the substantial variability and inconsistency inherent in the current referral letters, which could impede the efficiency and effectiveness of patient care. To address these shortcomings, the study suggests the implementation of a structured proforma. This standardised approach would ensure that all essential information is consistently captured, thereby improving the overall.

Patient date of birth was completely omitted in the data collected resulting in no referrals containing the date of birth of the patient. This may be due to the high number of patients' National Registration Identification Card numbers were recorded, where GDPs felt the date of birth was obtainable from it. Although commonly overlooked, Djemal *et al*. have stated that by using a proforma, there was an increase in the inclusion of the date of birth.[7]

As ethnicity may not have been adequately considered in previous studies, it is imperative to include this demographic information in referral letters within the Malaysian healthcare context. Given Malaysia's multicultural population, recording a patient's ethnicity is standard practice for demographic analysis. This study reveals that only 50% of referrals explicitly state the patient's ethnicity. This oversight could potentially hinder accurate patient identification and increase the risk of patient mix-ups.

It is noted that the patient phone number is only recorded in 30% of the referral letters. This coincides with a study by Djemal *et al*. where the study they conducted had resulted in the number of telephone numbers to be less than half of the referrals received. However, it was stated that data had an increment upon using a structured proforma.[7]

Only 66% of the referral letters consisted of the GDP's clinic address and no letters provided the GDP's phone number. These data obtained can also be noted in a study conducted by Moloney *et al*. where it was stated that there were no details of the General Medical Practioner provided.[3] This is vital information according to the Scottish Intercollegiate Guidelines Network, as communication with the GP is essential for patients who may have complicated medical history.[10]

Based on the data collected, it is seen that the symptoms recorded are higher than the number of letters containing diagnosis. This is contrary to the study carried out by Björkeborn *et al*. who stated that symptoms were not recorded as frequently as the diagnosis. Björkeborn *et al*. also claimed that this was due to the fact that dentists fail to write down the symptoms in their patient clerking.[5] However, although in the event the symptoms were satisfactory recorded, the duration of symptoms was only recorded in 66% of the letters.

At least 26% of referral letters received failed to come up with a provisional diagnosis for the patients referred. This is a relatively high number that coincides with Shaffie and Cheng[4] and Zakrewska's study in which diagnosis was only made in 61% and 50% of referral letters, respectively. However, this number increases twofold when a proforma is used according to the study conducted by Djemal *et al*.[4] A notable deficiency identified in the referral letters pertains to the documentation of prior treatments administered before the referral. This criterion is particularly crucial in cases such as swelling, where antibiotics may have been prescribed by GDPs before the patient is referred. A history of antibiotic prescribing helps assess treatment response and supports effective antibiotic stewardship.

Djemal *et al*. asserted that the most significant improvement observed with the adoption of a structured

proforma was in the documentation of treatments provided by GDPs, with the data exhibiting a 10-fold increase following the implementation of the proforma.[4]

A detailed medical and medication history is a vital part of any referral letter between healthcare professionals, as it supports continuity of care and informed clinical decisions. Particularly in cases requiring urgent referral to a tertiary centre for emergency management. However, in this study, it is noted that only 84% of the referral letters included the medical and drug history. This discrepancy can be overcome according to Djemal *et al*. study which states that the use of a proforma has increased the number of medical histories recorded. Also stated in McAndrew *et al*. that the referral letters that stated "no relevant medical history" are accepted as medical history due to the fact that it has been asked and considered. According to Björkeborn *et al*., drug history taking is important to have an updated list of medication for patients who are currently on anticoagulant medication as well as patients who are consuming antiresorptive medication such as bisphosphonates that may call for longer time to plan their surgery.

In this study, it is seen that the number of referrals that included drug allergies is only 68%. The number of referral letters that consist of medical and drug history is higher than drug allergies. This may be due to a lack of a holistic approach towards the patient. According to Björkeborn *et al*., the authors of that study claimed that it is essential that the allergy of patient be noted in the referral letter even when the patient does not have any.[5] This helps prevent potentially fatal incidents that could arise from missing information, particularly in emergency situations.

One of the lowest data recorded was the social history of the patients. With only 6% of incoming referrals which included this in the forms, it is one of the common components of a referral letter that is neglected. This corresponds with the study done by Shafie *et al*. where he stated that over 70% of referrals received did not include the smoking and alcohol consumption habits. He claimed that this may be due to the assumption that the GDP has a lack of importance towards smoking habits. Björkeborn *et al*. have highlighted that only a few referral letters contained smoking habits and tobacco usage. It is essential to enquire about social habits as smoking cessation and alcohol consumption cessation advice could be offered.

Only 66% of incoming referrals specified the required treatment for referred patients. A significant number of referrals utilise vague language such as "Kindly do the needful for this patient," failing to delineate the specific treatment expectations from the hospital. More precise requests would enable the hospital to effectively prioritise and allocate necessary treatments.

Björkeborn *et al*. have stated in their study that preoperative radiographs are required for most dentoalveolar surgeries, as they can give a chance to assess the referral. It is noted as well that previous studies have agreed that referrals for wisdom tooth surgery often lack radiographs.[11,12] This coincides with the data collected in this study, where only 25% of the referrals received included radiographs and findings. This may occur due to several reasons such as limited time in between patients, lack of x-ray machines, inadequate x-ray films and faulty equipment to take x-ray. Also, not all referrals may require an x-ray such as soft tissue lesions or injuries. It is the perception of the GDPs that the x-ray should be taken by the hospital and by the specialists who are about to perform the procedure.

While it is recognised that the high patient volume pressures may hinder GDPs from consistently producing comprehensive referral letters, this should not excuse the notable deficiencies observed. The implementation of a structured proforma is not merely a suggestion but a necessary intervention to address these critical shortcomings. Djemal *et al*. demonstrated that the use of a proforma substantially enhanced the quality and quantity of information in referral letters. Such an approach is imperative to ensure more efficient service, improve communication between primary and tertiary care providers and ultimately optimise patient care.

Conclusion

The study concluded that the referral letters within WPKL exhibit considerable room for improvement, as none of the analysed letters contained all the necessary information. The increasing patient volume in primary care has constrained GDP ability to consistently produce comprehensive referral letters. Rather than attributing blame, it is more constructive to propose a solution in the form of a structured proforma. Based on the findings, revising the current BK4 referral letter is imperative to develop a more systematic proforma for referrals to the Oral and Maxillofacial Department in WPKL. We have formulated a pro forma referral letter [Figure 1] as a guideline to create well-structured referral letters in the future. This new format is designed to empower GDPs to efficiently refer patients, ensuring that no crucial information is omitted. This approach aims to minimise disruptions in patient care and facilitate a seamless transition from primary to tertiary care.

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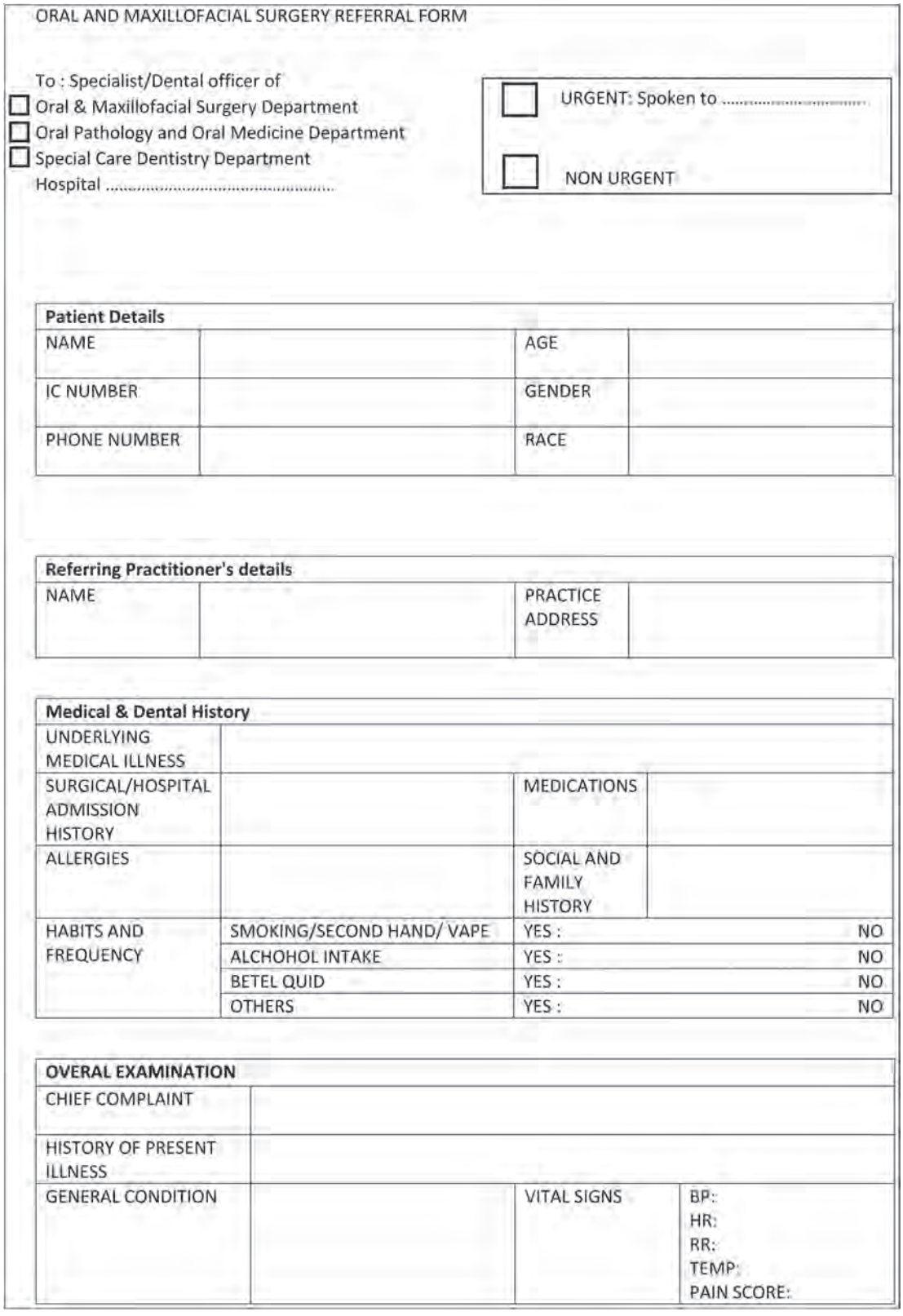
Conflicts of interest

There are no conflicts of interest.



ORAL AND MAXILLOFACIAL SURGERY REFERRAL FORM

To : Specialist/Dental officer of
☐ Oral & Maxillofacial Surgery Department
☐ Oral Pathology and Oral Medicine Department
☐ Special Care Dentistry Department
Hospital .....

☐ URGENT: Spoken to .....

☐ NON URGENT

Patient Details			
NAME		AGE	
IC NUMBER		GENDER	
PHONE NUMBER		RACE	

Referring Practitioner's details			
NAME		PRACTICE ADDRESS	

Medical & Dental History			
UNDERLYING MEDICAL ILLNESS			
SURGICAL/HOSPITAL ADMISSION HISTORY		MEDICATIONS	
ALLERGIES		SOCIAL AND FAMILY HISTORY	
HABITS AND FREQUENCY	SMOKING/SECOND HAND/ VAPE	YES :	NO
	ALCHOHOL INTAKE	YES :	NO
	BETEL QUID	YES :	NO
	OTHERS	YES :	NO

OVERAL EXAMINATION			
CHIEF COMPLAINT			
HISTORY OF PRESENT ILLNESS			
GENERAL CONDITION		VITAL SIGNS	BP: HR: RR: TEMP: PAIN SCORE:

Figure 1: Pro forma referral letter

CLINICAL EXAMINATION: EXTRAORAL			
CLINICAL EXAMINATION: INTRAORAL			
XRAY TAKEN	YES:	NO:	
PROVISIONAL DIAGNOSIS			
TREATMENT PROVIDED			
REASON OF REFERRAL			
NAME		DATE	
SIGNATURE AND STAMP		CLINICAL STAMP/ADDRESS	

Figure 1: Continued

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Original Article

Outcome of Mouth Opening Assessment in Trismus Release Secondary to Noma: A Retrospective Study

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Abstract

Background: The most important aspects in the management of trismus are to achieve satisfactory mouth opening, and it is best evaluated by measuring the interincisal distance (IID). Hence, this study aimed to evaluate the pre-, intra- and postoperative IID achieved during the management of trismus secondary to noma. **Materials and Methods**: This was a retrospective study conducted at Noma Children's Hospital Sokoto using 3-year record. After obtaining ethical approval from the state ministry of health, the case records of patients who were managed for trismus secondary to noma were retrieved. Patients' demographics, site of ankylosis, surgical procedure, preoperative, intraoperative and postoperative IID were extracted and analysed using SPSS version 25. **Results**: There were 16 (38.1%) males and 26 (61.9%) females in the range of 5–25 years with mean ± SD of 10.0 ± 5.1 years. Unilateral ankylosis constitutes the majority 32 (76.2%). The mean ± SD preoperative (P1) and intraoperative (P2) IID are 5.0 ± 4.7 mm and 41 ± 6.6 mm, respectively. The mean ± SD postoperative IID at first and second reviews (P3 and P4) are 35 ± 8.2 mm and 32 ± 8.0 mm, respectively. Comparison of age categories and P3 yielded a reduction in IID with decreasing age which was not statistically significant (χ^2 = 12.336) df=6, *P* value = 0.055. However, a comparison of age categories and P4 revealed a reduction in IID which was significant (χ^2 = 30.707 df=6, *P* value = 0.000). **Conclusion**: The amount of mouth opening achieved following noma trismus release has been shown to be decreasing over time and has been also affected by age. Aggressive jaw exercise is a key factor in maintaining the achieved intraoperative IID during TMJ ankylosis management.

Keywords: Ankylosis, interposition arthroplasty, mouth opening, noma, trismus

Introduction

Trismus and ankylosis are two distinct conditions that affect temporomandibular joint (TMJ) and jaw movement. Whereas trismus refers to reduced ability to open the mouth due to muscle spasm, pain or inflammation, ankylosis refers to the fusion or fixation of the jaw to the skull base.[1] Although both the two terminologies can be used interchangeably, ankylosis has been used to describe the severe form of trismus and due to the variable range of reduction in mouth opening observed in noma survivors, the word trismus is preferred.[2] Noma-related trismus is an extremely disabling affliction that severely affects a patient's mastication, speech, appearance, access to routine dental care as well as psychological development.[3] The main factor here is the reduction in mouth opening, the extent of which depends on the duration of the trismus,

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the type of tissue component (fibrous or bony) and site of fusion (unilateral or bilateral).[4,5] Noma trismus is managed through aggressive jaw exercise, surgical excision of the scar, coronoidectomy, condylectomy, gap and interpositional arthroplasty.[6] The choice of the surgical procedure depends on each case and decision of the managing team. The most important aspects in the management of trismus are to achieve satisfactory mouth opening which is best evaluated by measuring interincisal distance (IID). The normal interincisal distance varies according to geographical location. A range of mouth opening was found to be at the range of 49.4 mm–57.2 mm among Nigerian population.[7] To achieve this range or any acceptable interincisal distance, aggressive physiotherapy must be instituted and maintained after surgery. Hence, this study aimed to evaluate and compare the pre-, intra- and postoperative IID in the management of trismus secondary to noma.

Materials and Methods

This was a retrospective study conducted at Noma Children's Hospital Sokoto for 3 years (November 2016–October 2019). Noma Children Hospital was established in 1999 by the Sokoto State government to provide free services to curtail Noma diseases that became endemic in the study region. Ethical approval was obtained from the state ministry of health (SKHREC/065/2022). The case records of patients who were managed for noma trismus were retrieved. Patients demographics including age, sex, laterality of the ankylosis, surgical procedure, preoperative (P1), intraoperative (P2) and postoperative (P3 and P4) IID were extracted. P3 was recorded 5 days postoperatively while P4 was recorded 2 weeks postoperatively. Case notes with the incomplete record were excluded from the study and the data obtained from this study were analysed using Statistical Package for the Social Sciences (IBM Corp., Armonk, NY, USA) version 25. The analysis of sociodemographic variables was done using descriptive statistics and association between age and interincisal distance was done using Chi-square and a *P* value less than 0.05 was taken as statistically significance.

Result

A total of 42 case notes were retrieved and analysed. There were 16(38.1%) males and 26 (61.9%) females in the range of 5–25 years with mean ± SD of 10.0 ± 5.1 years [Table 1]. Unilateral ankylosis constitutes the majority 32 (76.2%), whereas bilateral cases constitute 10 (23.8%) Figure 1. The mean ± SD preoperative (P1) and intraoperative (P2) IID are 5.0 ± 4.7 mm and 41 ± 6.6 mm, respectively. The mean±SD postoperative IID at first and second reviews (P3 and P4) are

Table 1: Mean and standard deviations of the age, pre, intra and, postoperative interincisal distance (IID)

Variable	Mean ± SD
Age	10.0 ± 5.1 years
Preoperative interincisal distance (P1)	5.0 ± 4.7 mm²
Intraoperative interincisal distance (P2)	41 ± 6.6 mm²
The postoperative interincisal distance at first review (P3)	35 ± 8.2 mm²
The postoperative interincisal distance at the second review (P4)	32 ± 8.0 mm²

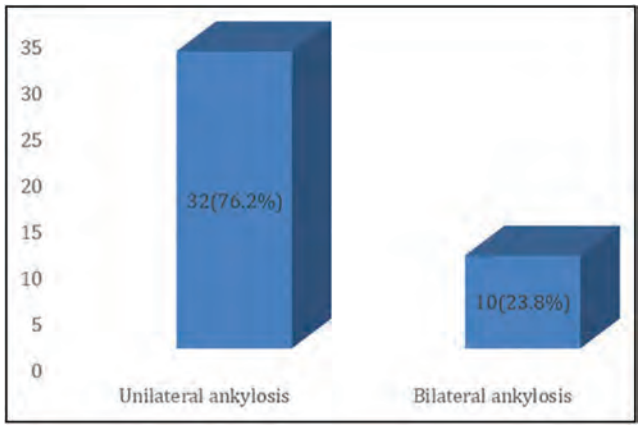

Figure 1: Type of the ankylosis among the study cases

Table 2: Comparison of age categories with postoperative IID

IID at P3 (mm)	Age category years					Test statistics (Chi square)	Level of significance
	5–10	11–15	16–20	21–25			
		n (%)			Total *n* (%)		
<30	12 (28.6)	5 (11.9)	4 (9.5)	2 (4.8)	23 (54.8)		
30–40	7 (16.7)	2 (4.8)	3 (7.1)	2 (4.8)	14 (33.3)	$\chi^2 = 12.336$, $df = 6$	*P* value = 0.055
>40	0 (0)	2 (4.8)	2 (4.8)	1 (2.4)	5 (11.9)		
Total	19 (45.2)	9 (21.4)	9 (21.4)	5 (11.9)	42 (100)		
IID at P4 (mm)							
<30	13 (31.0)	2 (4.8)	0 (0)	0 (0)	15 (35.8)		
30–40	16 (38.1)	4 (9.5)	4 (9.5)	0 (0)	24 (57.1)	$\chi^2 = 30.707$, $df = 6$	*P* value = 0.000
>40	1 (2.4)	0 (0)	0 (0)	2 (4.8)	3 (7.1)		
Total	30 (71.4)	6 (14.3)	4 (9.5)	2 (4.8)	42 (100)		

35 ± 8.2 mm and 32 ± 8.0 mm, respectively [Table 1]. Comparison of age categories and P3 yielded a reduction in IID with decreasing age which was not statistically significant (χ^2 = 12.336) df = 6 *P* value = 0.055. However, a comparison of age categories and P4 revealed a reduction in IID which was significant (χ^2 = 30.707, df = 6 , *P* value = 0.000) [Table 2].

Discussion

Noma is a devastating disease that destroys the orofacial structures and leaves a devastating sequelae. More than half of the noma survivors present with trismus/ankylosis that cause limitation of functions. The goal of trismus release is to establish and maintain adequate mouth opening good enough for functions such as mastication, speech, proper growth of the jaws as well as good ventilation.[8,9] There were more females than males in this study. This observation was in contrast to what was reported in the previous studies on TMJ ankylosis.[4,5,10,11] The female predisposition in this study is largely related to the female predilection in noma aetiology as previously reported.[12] An age of presentation of patients with TMJ ankylosis for surgical intervention was observed to be from 6 to 50 years in many previous hospital-based studies.[10,13,14] We recorded an age range of 5–25 years in this study. Patients with trismus/TMJ ankylosis secondary to noma are more likely to present early for surgery because of the urgent need for correction of the multiple defects associated with noma as compared to those patients with cases of ankylosis that is not noma-related. More so, the active search for noma cases, in which the cost of surgery is free for the patient, has been an opportunity for patients with noma-related trismus/TMJ ankylosis to present early for treatment.

Unilateral involvement was found to be more common in this study. This is contrary to the report of several authors.[15-17] It is more likely to have bilateral involvement in trismus/ankylosis caused by trauma compared to noma.[14] The type, laterality and extent of trismus are the driving force behind the choices of the type and combination of surgical techniques.

The main aimed of trismus release is to maintain the achieved mouth opening which is best measured using interincisal distance (IID) measurement. IID measurement can be done using ruler tape, manual or digital Vernier calliper as well as fingers breadth. In this study, the record of IID found in the case notes was measured with ruler tape. The average intraoperative IID recorded from this study is 41.0 mm and the range was 35.0 mm–46.0 mm. This IID achieved intraoperatively comparable to some previous literature[18-20] may be adequate for function especially, in children. In a study by Koruyucu *et al*.,[21] the mean value of maximal interincisal distance recorded was found to be 28.63 ± 4.34 for 3–5 years; 33.52 ± 4.84 for 6–11 years and 37.35 ± 5.52 for 12–15 years children. Similarly, Oginni *et al*.[22] conducted a study in Nigeria titled "a pilot study of maximum interincisal distance among adult Northern and Southern Nigerians," whereby they recorded the average maximum interincisal distance of 45.63 mm with a range of 31.0 mm–66.30 mm among individuals of 18–25 years. These observations buttress the fact that the surgical management of TMJ ankylosis yields acceptable functional interincisal distance.

Physiotherapy plays an essential role in maintaining the achieved interincisal distance and preventing or reducing the incidence of recurrence of the ankylosis. It is usually initiated 1–2 days postoperatively for a minimum of 6 months and requires commitment from both the operator and the patients.[21] Physiotherapy through jaw exercise can be done using various tools including; a tongue blade, wooden spatulas, acrylic screw, jaw stretcher, mouth gag and TheraBite. All the subjects in this study had postoperative jaw exercises with wooden spatulas. The average postoperative interincisal distance in this study at the first and second postoperative reviews (5 days and 2 weeks) was 35 and 32 mm, respectively. This showed a gradual reduction of the IID as compared to the average intraoperative IID which was about 41.0 mm. This could be due to non-aggressive jaw exercise due to reduction in monitoring that may cause by patient being discharge from the hospital environment. As evidenced from this study, a comparison of age categories and IID at the first review while patients are still on admission yielded a reduction in IID with lower age categories which was not statistically significant but, a comparison of age categories and IID at the second review revealed reduction in IID with the lower age category which was statistically significant. This could mean that the age of the patient has a significant role in gaining patients cooperation in maintaining the achieved IID. Patients of higher age are more likely to cooperate in the process of jaw exercise. Even with higher age, IID was seen to be better while patients are still on admission. Chen *et al*.[23] in their study compared the recurrence rate in the outcome of TMJ ankylosis release between children and adults. They reported a higher rate of recurrence with decreasing age. This has been attributed to the more active remodelling in younger children as well as a lack of cooperation during jaw exercise. Although a higher incidence of recurrence is more expected in children, the release of ankylosis should be treated as soon as possible especially when some level of cooperation is anticipated. Untreated ankylosis in children will result in severe facial disfigurement as well psychological disturbances. Karban *et al*.[24] advocated TMJ ankylosis release from 3 years and above with favourable outcomes. Administration of adequate postoperative analgesia, a longer period of hospital stays for jaw exercise supervision, patience

and the resilience of the caregiver could result in a more favourable outcome.

Conclusion

The amount of mouth opening achieved following noma trismus release has been shown to be decreasing over time and has been also affected by age. Aggressive jaw exercise is a key factor in maintaining the achieved intraoperative IID during TMJ ankylosis management. The age of the patients should be considered before intervention since age influences patient's cooperation in performing aggressive jaw exercises to prevent re-ankylosis.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Knowledge, Understanding and Impact of COVID-19 on Patients Undergoing Orthodontic Treatment

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Abstract

Background: This study was carried out to explore the levels of knowledge and understanding of coronavirus disease 2019 (COVID-19) as well as the post pandemic challenges of orthodontic patients. **Materials and Methods**: A cross-sectional questionnaire-based study involving Malaysian adult patients from five orthodontic clinics was carried out over 6 months using a validated, self-administered, bilingual questionnaire composed of 12 questions across three domains; knowledge, understanding and impact. **Results**: There were a total of 537 respondents. The median age of respondents was 22 years (interquartile range 4.0) and was predominantly females 68.9%. Overall, only a very small proportion of respondents (3.2%) were not aware at all that COVID-19 can spread very easily in the orthodontic setup. Majority (88.8%) were agreeable to visit the orthodontist during the pandemic if proper infection control was adhered to. Almost half of all respondents (47.3%) experienced some degree of pain due to missed appointments; however, only 2.0% experienced severe pain. Most respondents (73.6%) were aware that missed appointments could prolong orthodontic treatment. The majority (66.1%) of respondents were willing to undergo additional treatment to compensate for lost time. About 5.0% of respondents were adversely affected by the pandemic and unable to afford further treatment if necessary. **Conclusions**: Patients generally demonstrate good knowledge of COVID-19 transmission, the importance of cross infection procedures, and were supportive of adhering to strict appointment schedules. Insight into these domains provides valuable information that will assist healthcare workers and policy-makers in planning for effective pandemic preparedness.

Keywords: COVID-19, impact, knowledge, orthodontics, pandemic, understanding

Background

Healthcare systems worldwide were stretched in 2020 and 2021 when the World Health Organisation declared coronavirus disease 2019 (COVID-19) as a global pandemic in March 2020.[1,2] The pandemic had a very pronounced impact on the dental practices worldwide as it led to a significant loss of income as many practices were seeing fewer patients and a change in daily hygiene practices that lead to reduce cross-contamination.[3,4]

Within the field of dentistry, orthodontics treatment is predominantly elective, despite the necessity for monthly appointments and periodic adjustments of appliances.[5] However, during the height of the COVID-19 pandemic, many orthodontists were unable to provide these periodic appointments and were only allowed to manage patients with orthodontic emergencies.[6] In orthodontics, lack of regular follow-up inevitably leads to the increase in the overall treatment time. This will subsequently increase the burden faced by the orthodontic clinics as the overall treatment time for patients receiving orthodontic care may be prolonged.[7]

In May 2023, however, COVID-19 was reclassified as an endemic disease.[1] Shifting into endemicity meant that

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COVID-19 was no longer considered a global public health emergency but an ongoing disease and needs to be treated as one.

Most studies carried out during the pandemic focused on the problems faced by the dental practice and how they managed their dental emergencies during the lockdown. Eventually the studies moved toward the patients perspectives of the pandemic and what effect it had on them. From the orthodontic perspective however, not many studies have been carried out to assess the effect that the pandemic has had on the patients undergoing active orthodontic treatment.[8] In addition, it is imperative to investigate if socio-demographic factors influence a patient's perspective to better anticipate and manage expectations during future pandemics or disasters. A recent systematic review on the effects of COVID-19 found the need for more studies to be carried out to elucidate the effect that the pandemic had not only to the orthodontic services but also its effects on the patient from the patient's perspective.[9] It also called for the need for more studies that looked into the long-term effect of the pandemic on orthodontic patients.

This study was carried out to explore the knowledge, understanding and impact of COVID-19 on Malaysian adult orthodontic patients in the public health services.

Materials and Methods

Study design

This was a cross-sectional questionnaire-based study involving Malaysian adult patients attending government specialist orthodontic clinics in an urban setting. A validated, structured questionnaire from a previously published study by Ram *et al.*[10] was used after obtaining permission from the corresponding author. Forward and backward translation was done and an expert panel critically reviewed both translated versions to come up with the Malay version of the questionnaire. Content validity of the questionnaire was 0.96, indicating excellent content validity. The scale-level face validity-index based on average method was 0.90. The questionnaire had a Cronbach α value of 0.73 indicating good internal consistency.[11]

The final version of the self-administered questionnaire consisted of two parts, the socio-demographic section and 12 closed-ended questions in both Malay and English. Google Forms were the survey platform used and informed consent was obtained from all respondents. Only respondents who answered all questions were able to send in their responses.

Study population

This study included Malaysian patients aged 18 years and above who were undergoing orthodontic treatment and provided informed consent to participate. Proportionate stratified sampling was used to determine the number of samples from each of the five public orthodontic clinics in the Greater Klang Valley area of Malaysia. Participants were then recruited using convenient sampling from each clinic over a period of 6 months from March 2023 to August 2023. Non-Malaysian citizens, patients with impaired decision-making abilities, those who defaulted treatment during the study period, and individuals unable to read or comprehend English or Malay were excluded from the study.

Statistical analysis

Questionnaire responses were analysed descriptively using IBM Statistical Package for the Social Sciences statistics for Windows version 21 (IBM Corp., Armonk, N.Y., USA). Numerical data were summarised as mean and standard deviation or median and interquartile range (IQR), as appropriate and categorical data were summarised as frequency and percentage. Bivariate analysis was carried out with Pearson's Chi-square test or Fisher–Freeman–Halton exact test, as appropriate. Ethnicity was reclassified into Malay and non-Malay. Education level was reclassified into two groups: those with an undergraduate or postgraduate degree and those with no formal education up to a diploma level. Household income was classified following the Malaysian Department of Statistics classification,[12] the bottom 40% as the B40 group and the top 60% (M40 and T20) into the non-B40 group. Statistical significance was set at $P < 0.05$.

Results

There were 537 respondents with a median age of 22 years (IQR 4.0) that participated in our study. The demographic features of the respondents are displayed in Table 1. The respondents were mostly females (68.9%) and the majority

Table 1 : Demographic characteristics of study participants (n = 537)

Characteristic	n (%)
Median age [years] (IQR)	22.0 (4.0)
Sex	
Male	167 (31.1)
Female	370 (68.9)
Race	
Malay	320 (59.6)
Non-Malay	217 (40.4)
Highest educational level	
No formal education up to diploma	303 (56.4)
Undergraduate or postgraduate degree	234 (43.6)
Household income	
B40	379 (70.6)
Non B40	158 (29.4)

IQR: interquartile range

Table 2: Responses of study participants to the 12 questions ($n = 537$)

No	Question and responses	*n* (%)
Q1	Are you aware that the COVID-19 virus spreads easily in the dental setup?	
	a) Extremely aware	255 (47.5)
	b) Very aware	169 (31.5)
	c) Moderately aware	78 (14.5)
	d) Slightly aware	18 (3.4)
	e) Not at all aware	17 (3.2)
Q2	Are you willing to undergo treatment from an orthodontic team who were previously affected with COVID-19?	
	a) Definitely	200 (37.2)
	b) Probably	121 (22.5)
	c) Possibly	128 (23.8)
	d) Probably not	39 (7.3)
	e) Definitely not	49 (9.1)
Q3	Are you willing to disclose your COVID-19 status and undergo pre-treatment screening before every appointment?	
	a) Definitely	276 (51.4)
	b) Probably	102 (19.0)
	c) Possibly	109 (20.3)
	d) Probably not	36 (6.7)
	e) Definitely not	14 (2.6)
Q4	What is your view on visiting the orthodontic office after the COVID-19 pandemic?	
	a) I will visit the orthodontist if proper infection control precautions are followed	477 (88.8)
	b) I will have some fear or doubt even though the orthodontist follows the infection control precautions	37 (6.9)
	c) I will not visit even though the appropriate infection control procedures are followed	5 (0.9)
	d) I will only visit after this COVID-19 pandemic issue is resolved	18 (3.4)
Q5	Do you adhere to strict appointment timings for the clinical area's adequate sanitisation to counter-act COVID-19?	
	a) Definitely	400 (74.5)
	b) Probably	93 (17.3)
	c) Possibly	36 (6.7)
	d) Probably not	4 (0.7)
	e) Definitely not	4 (0.7)
Q6	Would you like to adhere to "strictly no accompanying person" (until and unless specified by the orthodontist) for future appointments?	
	a) Definitely	398 (74.1)
	b) Probably	70 (13.0)
	c) Possibly	44 (8.2)
	d) Probably not	15 (2.8)
	e) Definitely not	10 (1.9)
Q7	Do you have any pain or discomfort due to missed appointments during the COVID-19 pandemic?	
	a) Severe	11 (2.0)
	b) Moderate	85 (15.8)
	c) Mild	89 (16.6)
	d) Very mild	69 (12.8)
	e) None	283 (52.7)
Q8	For unexpected orthodontic problems, which of the following options do you choose?	
	a) I prefer telecommunication with the dental office	399 (74.3)
	b) I prefer to visit the dental office	87 (16.2)
	c) I will wait until my next appointment	51 (9.5)
Q9	Do you think the missed appointments will have an effect on your orthodontic treatment during the COVID-19 pandemic?	
	a) It will prolong my overall treatment	395 (73.6)
	b) It will affect my treatment outcome	88 (16.4)
	c) It will not prolong my overall treatment	19 (3.5)
	d) It will not affect the treatment outcome	35 (6.5)

Table 2. Continued

No	Question and responses	*n* (%)
Q10	Would you like to undergo additional treatment procedures, if indicated by your orthodontist, to compensate for the lost time?	
	a) Definitely	355 (66.1)
	b) Probably	104 (19.4)
	c) Possibly	66 (12.3)
	d) Probably not	7 (1.3)
	e) Definitely not	5 (0.9)
Q11	Does your current financial situation have any effect on future orthodontic appointments?	
	a) My financial situation is not affected, and I can afford further treatment	324 (60.3)
	b) My financial situation is affected, but I can afford the treatment	188 (35.0)
	c) My financial situation is affected, and I cannot afford further treatment	25 (4.7)
Q12	Protective gear and equipment to counter-act COVID-19 may increase future treatment costs. What is your opinion?	
	a) I understand the situation, and I will bear the extra amount	261 (48.6)
	b) I understand the situation, but I cannot bear the amount	133 (24.8)
	c) I won't pay the additional amount, as it was not informed before the start of treatment	37 (6.9)
	d) I expect the dental institution/clinician/government/insurance companies to bear the extra amount	106 (19.7)

were of Malay ethnicity (59.6%). A large proportion of respondents (70.6%) were from the B40 income level group. A detailed breakdown of the responses received for each of the 12 items in the questionnaire is displayed in Table 2.

Only a very small proportion of respondents (3.2%) were not aware at all that COVID-19 can spread very easily in the orthodontic setup [Question 1, Table 2]. Slightly more than half of respondents (51.4%) were willing to disclose their COVID-19 status and undergo pretreatment screening before each appointment [Question 3, Table 2].

A large proportion of respondents (88.8%) were willing to attend the orthodontic appointment if adequate infection control precautions were followed [Question 4, Table 2]. Majority of respondents (74.5%) were definitely willing to adhere to appointment timings [Question 5, Table 2] and 74.1% of respondents were willing to adhere to a "strictly no accompanying person" policy for future appointments dependent on the discretion of the orthodontic team [Question 6, Table 2].

Although almost half of all respondents (47.3%) experienced some degree of pain due to missed appointments, only 2.0% experienced severe pain [Question 7, Table 2]. Most respondents (90.0%) believed that postponed appointments during the COVID-19 pandemic would have some effect on overall treatment or treatment outcome [Question 9, Table 2].

A large proportion of respondents (66.1%) were willing to undergo additional procedures to compensate for lost time if required [Question 10, Table 2]. Although the majority of respondents indicated that they could afford further treatment, a small proportion (4.7%) could not afford further treatment [Question 11, Table 2]. Only slightly less than half of all respondents (48.6%) were willing to bear any increase in costs for treatment due to utilisation of protective gear and equipment to prevent transmission of COVID-19 [Question 12, Table 2].

When stratified according to ethnicity, statistically significant associations were found for questions 1, 3, 5, 6, 8 and 10. Stratification by education level revealed significant associations for questions 1, 2, 3, 4, 6, 9 and 11. When stratified by income level, significant associations were observed for questions 2, 3, 11 and 12.

Discussion

An aspect of pandemic preparedness involves having better understanding on the impact that an epidemic or pandemic may have on long-term specialised healthcare services, such as orthodontic treatment which is typically delivered over an extended period of time through scheduled appointments. Knowledge, understanding and impact of the pandemic on patients are crucial aspects that need to be explored to better prepare clinicians and policy-makers for future pandemics or crises.

This study was conducted at the tail end of the pandemic and the onset of the endemicity and showed a good number of patients being aware of the possible regarding the spread of COVID-19 within the orthodontic setting. However, for the small number who was still unaware of how COVID-19 spreads there is always the need for the orthodontic team to take proactive measures to regularly educate patients on the potential transmission mechanism, particularly through aerosols and droplets commonly generated during dental procedures.[13] This approach not only applies to COVID-19, but also to other airborne or droplet-borne diseases. We advocate incorporating these

patient education measures into routine care to ensure they reach a wider population of the patients and become second nature, ultimately enhancing infection control measures in dental settings.

Patients with a higher level of education had a significantly better level of awareness regarding the spread of COVID-19. This group was also more prepared to inform the clinician of their COVID-19 status and more accepting of pretreatment screening. This may be attributed to this subgroup's better access to and understanding of available information on the virus, as well as the public health importance of being forthcoming and receptive to pretreatment screening. The authors hold the view that it is essential to include patients' health or risk status as part of a pretreatment assessment at all times, especially during a pandemic. This necessity arises not only from the vulnerability of dental healthcare professionals to airborne or droplet-borne infections but also as a public health measure, given that patients may interact with others in waiting areas and other shared spaces within the clinic.[14] Screening patients for symptoms 1 day before their appointment through a phone call or online questionnaire enables the clinician to identify individuals who may be infected or are at high risk of an infections especially during a pandemic or endemic.[14]

In our study, 88.8% of the respondents were willing to visit their orthodontic clinic if proper infection control procedures were practised a value much higher than another study that found only 63.0% of participant would do the same.[10] The reason for this difference could be that by the time our study was conducted, most patients had a better understanding of the nature of the COVID-19 and were less fearful than they were during the initial stages of the pandemic. A recent study found that orthodontic patients were more eager to continue with their routine appointments despite the fear of COVID-19.[15] It is important to reassure patients that the clinic consistently implements standard infection control procedures, which are regularly updated in accordance with guidelines given by the relevant health authorities.[16] Furthermore, it is advisable that these new practices continue to be upheld even after the pandemic has ended.

The majority of respondents (74.5%) in this study said that they would definitely adhere to the appointment time. This finding is similar to other studies that have found that more than 70% of patients were definitely ready to adhere to the given timing.[5,13] Good appointment planning, such as staggered appointments, and waiting room organisation can minimise the numbers of patients in the waiting room at any given time. However, the staggered appointment system will only be successful if both the patient and operator adhere strictly to the given time.[17] Reducing the incidence of these breakages would enable the orthodontic team to manage appointment durations more effectively and avoid exceeding the allotted time.[17] Therefore, educating patients about the importance of strictly adhering to dietary restrictions is essential to minimise the frequencies of appliance breakage.

The majority of the respondents seemed to understand the necessity of minimising companions during the pandemic. This underscores the importance of patient education on how reducing the in-office traffic can reduce the risk of disease transmission.

It is common for orthodontic patients to experience some level of discomfort in the form of pressure, tension or soreness of the teeth or soft tissue surrounding the teeth after every visit.[18] Our study found that 52.7% of the respondents had no pain or discomfort due to missed appointments. This finding was higher than in other studies which reported that only 34.3%–39.0% of patients experienced no pain due to missed appointments.[7,8] One possible explanation for our finding is that significant time has passed since the lockdown was lifted and this may have led to recall bias among patients. Having learnt from the lockdown, it is advisable for orthodontists to educate the patients on the possibility of emergencies before orthodontic treatment. Familiarising patients with the different orthodontic components in their mouth would help them describe their situations more effectively over the phone during emergencies when seeking assistance from the orthodontic clinic. Effective communication helps the orthodontic team understand patient's issues, enabling the orthodontist to address their discomfort more effectively. It is important to provide management during discomfort, even during the height of the pandemic, as prolonged distress can affect appliance efficacy, patient cooperation and increase the stress patients may already be experiencing due to the pandemic or epidemic.[19]

About 74.3% of the respondents preferred communication through telephone in the event of an orthodontic problem during times of pandemic. This finding was similar to those from other studies.[9,20-22] Orthodontic emergencies are typically non-life threatening and can often be managed using tele-dentistry, especially during a pandemic or epidemic. This approach helps avoid clinic visits that may pose a risk to patients.[10,20] The pandemic has significantly accelerated the advancement of digital health, making virtual clinics and assessments the norm in some regions.[23]

The pandemic resulted in many orthodontic patients missing their regular follow-up appointments and these missed appointments have significant prolonged impact on the treatment duration.[4,7] Consequently, our study revealed that the majority of the respondents were aware that failed appointments results in prolonged treatment time. This finding aligns with similar results reported in other studies.[10,24] Treatment time for patients who

missed more than two appointments was nearly 1 year longer.[25] Our study also revealed that individuals with a higher level of education were more informed about this fact.

Interestingly, while most patients in our study were receptive to the potential need for additional treatment procedures to address missed appointments during the pandemic, a study conducted 2 years earlier found that only 46.3% were willing to undergo such additional procedures.[10] Most patients in our study (73.6%) recognised and understood that the number of missed appointments invariably extends the duration of orthodontic treatment. This awareness may stem from thorough patient education provided during each orthodontic visit.[26]

Slightly less than half (48.6%) of the respondents were willing to bear the expenses of protective gear, 24.8% understood the situation but were unwilling to bear the increase in cost. The patients with higher education level and those from the higher income background were more willing to bear the extra costs. The remaining respondents were not understanding of the increased cost associated with miss appointments and were expecting the public healthcare system to cover these expenses. This may be attributed to the lockdown and pandemic adversely affecting the livelihood of many individuals leading to a negative impact on their financial situation.[27,28] Special consideration should be given to individuals in this situation, particularly patients from a lower income group. Clinics should explore options such as an instalment plan or deferred payment arrangement allowing patient to pay later when their financial circumstances improve.

A possible limitation of this study is self-reporting bias. Respondents may not provide entirely honest answers and may opt for more "favourable" response instead of truthful ones. Nevertheless, this is an unavoidable aspect of self-reporting. This study was conducted toward the end of the pandemic phase and during the endemic phase, so the results may vary from those studies conducted at the height of the pandemic. We believe that the timing of this study more accurately reflects the assessment of knowledge and understanding of the COVID-19 pandemic, as it is less influenced by the fear experienced by patients in the early stages. The true impact of the COVID-19 pandemic on patients, including long-term income loss and the effects of missed orthodontic reviews, may not have been fully experienced during the early phase. Instead, these effects can be genuinely felt and appreciated only after an extended period like toward the end of the pandemic or during the endemic phase. This highlights the importance of assessing patient's impact at the tail end of a pandemic. Another limitation of this study is that the data are only representing orthodontic patients in a Malaysian urban setting.

Conclusion

Patients appear to generally have good knowledge on the spread of the COVID-19, cross infection procedures practices and seem to be supportive of keeping to strict appointment timing during routine visits to the orthodontist. While the COVID-19 pandemic may have ended, its impacts such as prolonged treatment duration and enhanced infection control practices are still felt. Effective pandemic preparedness relies on learning from all stakeholders involved, particularly patients and clinicians. It is imperative for all orthodontic practices to continuously learn and improve clinical practices and patient education measures to ensure we are better prepared if and when the next epidemic or pandemic strikes.

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Author contributions

PY: designed the study, prepared the research proposal, analysed and interpreted the data and wrote major parts of the manuscript. FYKW: proposed the idea, prepared the research proposal, carried out data collection and contributed to writing the manuscript. HPS: conducted statistical analysis, analysed and interpreted the data and wrote major parts of the manuscript. LMN: conducted statistical analysis and wrote parts of the manuscript. All authors read and approved the final version of the manuscript.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethical policy and Institutional Review Board statement

This research was performed in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia (NMRR-ID-23-00083-Z2R) and the study complies with Malaysian legislation and guidelines. Informed consent was obtained from all respondents.

Consent for publication

Not applicable.

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Conflicts of interest
There are no conflicts of interest.

Abbreviations

COVID-19	Coronavirus disease 2019
IQR	Interquartile range

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Original Article

Reasons and Pattern of Teeth Extraction among Dental Patients in a Tertiary Care Hospital, Northwestern Nigeria

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Abstract

Background: Tooth extraction is one of the most common dental procedures performed by the dentist. The indication for dental extraction may depend on the patient's economic status, lack of resources and facilities in the dental setting, and proper information dissemination to the populace. Hence, this study aimed to present an analysis of reasons and patterns of teeth extraction among patients presenting in a tertiary healthcare sector in the northwestern part of Nigeria. **Materials and Methods**: This was an 8-year cross-sectional retrospective study conducted after obtaining consent from an ethical committee of the institution. Demographic variables, presenting complaints, history of dental visitation, indication, and the tooth extracted were recorded. Data were analysed using Statistical Package for the Social Sciences version 25 (IBM Corp., Armonk, NY, USA). **Results**: A total of 536 teeth extractions were carried out among 508 patients within the study period. There were 359 (70.7%) males and 149 (29.3%) females in the age range of 18–70 years and a mean ± SD of 34.26 ± 11.85. Most of the patients 425 (83.7%) visited for the first time, and pain 462 (90.9%) was the main reason for the presentation. Dental caries and its sequelae 401 (74.8%) constitute the main reason for the extraction and, lower molars were the most commonly extracted teeth compared to others, with a statistically significant difference. **Conclusion**: Dental caries and its sequelae have been the most common indication for teeth extraction, especially in association with the most vulnerable lower molars. With available resources, expertise, and proper information dissemination, damage to more teeth could have been avoided through prevention and conservation.

Keywords: Dental caries, extraction, lower molars, pericoronitis, teeth

Introduction

Dental caries and periodontal diseases are the two major public dental health problems despite the increase in global dental awareness.[1,2] Patients, especially from underdeveloped and developing countries, tend to neglect these conditions, resulting in opting for teeth extraction.[3] A lack of awareness regarding oral health among the general population, improper organisation of dental services, as well as availability of dental services are some of the factors that could cause increased morbidity due to dental diseases.[4] Even where dental services are readily available, factors such as oral health needs, anxiety, socioeconomic factors, as well as traditional and cultural beliefs could be some of the hindering factors to the utilisation of available dental services.[5] Several measures have been available to conserve diseased teeth for optimal function, depending

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on the aetiology of the condition.[6-8] Teeth extraction has been reserved for teeth damaged beyond repair, but for a myriad of reasons, this continues to be the most popular option for the treatment of diseased teeth in low socioeconomic environments.[9,10]

This study aims to investigate the reasons and patterns of tooth extraction among adult dental patients attending the dental clinics of Yariman Bakura Specialist Hospital in Gusau, Zamfara State, Northwest Nigeria—the only state-owned tertiary healthcare facility in the region. The findings are expected to provide valuable insights that can inform the development of policies aimed at improving oral health awareness, promoting early utilisation of dental services, and enhancing the uptake of oral health promotion initiatives, particularly among vulnerable populations.

Materials and Methods

This retrospective study was conducted using dental extraction records spanning an 8-year period, from January 2014 to February 2022, at the Department of Dental and Maxillofacial Surgery, Ahmad Sani Yariman Bakura Specialist Hospital, Gusau, Zamfara State, Nigeria. The hospital is currently the only specialist healthcare facility in the state with a well-equipped dental clinic, strategically located in the capital city, Gusau.

Zamfara State is situated in the northwestern region of Nigeria. It shares borders with the Republic of Niger to the north, Kaduna State to the south, Katsina State to the east, and the states of Sokoto, Kebbi, and Niger to the west. The state covers a land area of approximately 31,418 km^2 and has an estimated population of 3.1 million people, predominantly residing in rural areas, with farming as the primary occupation (National Population Commission, 2006).

Ethical approval for the study was obtained from the Research and Ethics Committee of Ahmad Sani Yariman Bakura Specialist Hospital. Inclusion criteria encompassed all patients aged 18 years and above who underwent dental extraction during the study period, regardless of the indication for extraction. Patient records with incomplete data necessary for analysis were excluded from the study.

Data were collected using a structured proforma, capturing demographic variables such as age, gender, educational level, residential location, occupation, and marital status. Additional information included presenting complaints, dental visitation history, frequency of tooth brushing, reasons for extraction, and the specific tooth or teeth extracted. The collected data were analysed using IBM Statistical Package for the Social Sciences Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

Results

A total of 536 tooth extractions were performed on 508 patients during the study period. The cohort comprised 359 males (70.7%) and 149 females (29.3%), with ages ranging from 18 to 70 years and a mean age of 34.26 ± 11.85 years. Farming was the most common occupation, accounting for 172 patients (33.9%). The largest age group was 21–30 years, representing 124 individuals (24.4%) [Table 1].

Patient history showed that the majority—425 patients (83.7%)—were visiting the dentist for the first time. Pain was the predominant reason for presentation to the dental clinic, reported by 462 patients (90.9%), while only 46 patients (9.1%) came for routine dental check-ups [Figure 1].

Of the 536 teeth extracted, dental caries and its sequelae accounted for the majority of cases (401 teeth, 74.8%), followed by impaction/recurrent pericoronitis (74 teeth, 13.8%), periodontitis (23 teeth, 4.3%), and other causes (38 teeth, 7.1%) [Figure 2]. Further analysis showed that lower molars were the most frequently extracted teeth, primarily due to dental caries and its sequelae—a finding that was statistically significant [Table 2].

Table 1: Sociodemographic distribution of the study cases

Sociodemographic	Frequency *n* (%)
Gender	
Male	359 (70.7)
Female	149 (29.3)
Total	508 (100)
Age group	
11–20	89 (17.5)
21–30	124 (24.4)
31–40	57 (11.2)
41–50	101 (19.9)
51–60	42 (8.3)
61–70	78 (15.4)
71–80	17 (3.30
Total	508 (100)
Level of education	
Primary	54 (10.6)
Secondary	72 (14.2)
Tertiary	96 (18.9)
Others/nil	286 (56.3)
Total	508 (100)
Occupation	
Farming	172 (33.9)
Business	115 (22.6)
Civil servant	89 (17.5)
Others	132 (26.0)
Total	508 (100)

Discussion

Dental extraction remains one of the most frequently performed procedures in dental practice, whether carried out routinely or surgically. This study investigated the reasons and patterns of tooth extraction among adults, with a notable predominance of male patients—a finding consistent with several studies conducted both locally and internationally. Similar gender distribution patterns were reported by Osunde *et al*.,[11] Taiwo *et al*.,[12] and Formete *et al*.[13] in Nigeria, as well as Alsaegh and Albadrani[14] in the UAE, Shakeel *et al*.[15] in Pakistan, and Sharif *et al*.[16] in Saudi Arabia. A possible explanation for this gender disparity is that male patients may be more inclined than females to opt for extractions rather than pursue conservative treatment options, a trend previously observed in related studies.[17,18]

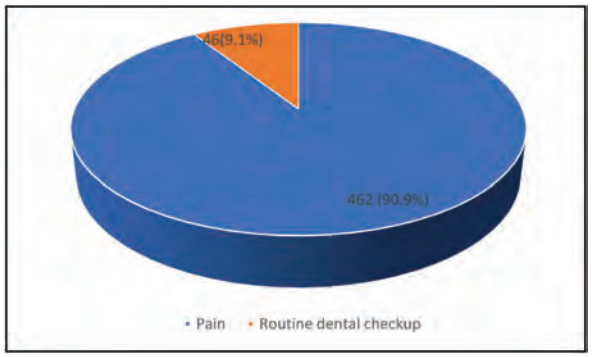

Figure 1: Reasons for presentation to the dental clinic

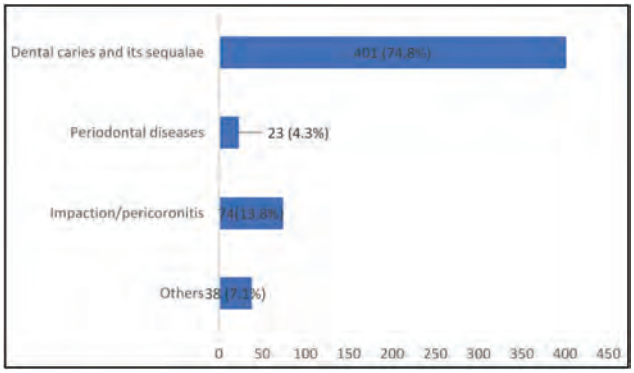

Figure 2: Indication for the tooth/teeth extraction

This study also observed that tooth extraction was most common among young adults aged 21–30 years. This aligns with the findings of Taiwo *et al*.[12] in their study on the pattern and indications for tooth extraction in a tertiary care hospital in Kebbi State, Nigeria. During this age period, molars—particularly the third molars—would have fully erupted and may have been significantly compromised by caries, given that dental caries and its sequelae were the most common indications for extractions.

Most patients in the current study presented to a dentist for the first time in their lives, with pain or swelling being the main reason for seeking care. Routine dental visits are recommended every 6 months, especially for individuals at risk of developing oral health problems.[19] Regular check-ups enable early detection and intervention before caries or periodontal disease progresses to more complex conditions requiring tooth extraction. Data obtained during these visits can also help dentists assess an individual's risk profile and provide tailored preventive advice, including oral hygiene instructions, dietary counselling, and cessation of tobacco or alcohol use.[19]

Teeth are typically extracted when there is irreversible pulpal or periapical pathology that cannot be managed with endodontic therapy or if the tooth damage is deemed unrestorable. Other common indications include vertical root fractures, orthodontic needs, or prosthetic planning.[20] For clarity, this study categorised the reasons for extraction into four groups: dental caries and sequelae, periodontal disease, impaction/pericoronitis, and other causes. Among these, dental caries and its complications were the leading reasons for extractions, consistent with findings from multiple studies.[12,21,22] For instance, Sharif *et al*.,[16] in a study titled *"Analysis of Tooth Extraction Causes and Patterns,"* found caries to be the predominant reason for tooth removal. Saheeb and Sede,[23] in Nigeria, reported similar findings. The rising prevalence of dental caries in the Nigerian population has been attributed to the increasing consumption of refined carbohydrates.[24]

Table 2: Analysis of the teeth extracted against the indication for the teeth extraction

Teeth extracted/indication for the extraction	Dental caries and sequelae	Periodontal diseases	Impaction/ pericoronitis	Others	Total
Upper incisors and canines	20 (3.7%)	1 (0.2%)	5 (0.9%)	2 (0.4%)	28 (5.2%)
Upper premolars	8 (1.5%)	0 (0%)	2 (0.4%)	5 (0.9%)	15 (2.8%)
Upper molars	89 (16.6%)	6 (1.2%)	11 (2.1%)	4 (0.7%)	110 (20.5%)
Lower incisors and canines	13 (2.4%)	1 (0.2%)	3 (0.6%)	1 (0.2%)	18 (3.4%)
Lower premolars	12 (2.2%)	3 (0.6%)	2 (0.4%)	0 (0%)	17 (3.2%)
Lower molars	259 (47.8%)	12 (2.2%)	51 (9.5%)	26 (4.9%)	348 (64.9%)
Total	401 (74.8%)	23 (4.3%)	74 (13.8%)	38 (7.1%)	536 (100%)

$\chi^2 = 29.901$, $df = 15$, $P = 0.012$

Environmental and socioeconomic factors may also contribute significantly to these findings. In areas like Zamfara State, where dental services are limited and public awareness is low, many patients may not recognise the importance of early dental intervention. Furthermore, low socioeconomic status and the absence of health insurance coverage may prevent individuals from accessing restorative dental care, making extraction the more affordable and accessible option.

This study also found that the lower molars were the most commonly extracted teeth, a trend corroborated by various studies.[22,25,26] Their early eruption, susceptibility to deep pits and fissures, and difficulty in achieving proper oral hygiene due to limited accessibility are likely contributors.[22] For patients presenting with molar pathology, preventive oral health education—such as proper brushing techniques and the importance of regular dental visits—could be beneficial in improving long-term outcomes. It is also essential to educate patients on the availability of conservative treatment options, which many may not be aware of, particularly in underserved regions.

Conclusion

Dental caries and its sequelae remain the most common indications for tooth extraction, particularly affecting the more vulnerable lower molars. With adequate resources, skilled personnel, and effective dissemination of oral health information, many of these extractions could have been prevented through timely preventive measures and conservative treatment approaches.

Ethical policy and Institutional Review Board statement

The study was approved by the research and ethical committee of Ahmad Sani Yariman Bakura Specialist Hospital Sokoto (AYBSH/0012/2023). All the participants provided written informed consent for the participation in the study. All procedures performed in the study were conducted in accordance with the ethical standards given in 1964 Declaration of Helsinki, as revised in 2013.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Original Article

Knowledge, Attitude and Practice Towards Root Canal Treatment and Teeth Replacement Options Among Adult Patients Attending Government Dental Clinics in Kuala Langat, Selangor

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Abstract

Introduction: Root canal treatment (RCT) and teeth replacement are essential for oral function, as emphasised in Malaysia's National Oral Health Strategic Plan, which aims for 50% of individuals aged 60 and above to retain at least 20 teeth by 2030. **Aim**: To assess knowledge, attitude and practice regarding RCT and teeth replacement among adult patients in Kuala Langat, Selangor, and associated factors. **Materials and Methods**: A cross-sectional study with ethical approval was conducted among 456 adults aged 18–59 years attending three government dental clinics in Kuala Langat. Systematic random sampling was employed, and data were collected using a validated self-administered questionnaire. Descriptive and inferential statistical analyses were performed. **Results**: Half (50.4%) were unaware of RCT, and only 15.1% had undergone the procedure, though most (94.2%) reported a positive experience. However, 52.2% did not receive cuspal coverage or a crown post-RCT, and 42.8% preferred extraction over RCT. Removable dentures were the most preferred replacement option (46.5%), primarily for functional reasons (74.1%). Among those who did not replace missing teeth, the main reason was lack of knowledge (45.7%). Regression analysis showed higher education ($P = 0.011$) and income ($P = 0.035$) were significantly associated with greater RCT knowledge. Education was also associated with preference for RCT over extraction ($P = 0.002$). Lower knowledge of replacement options was observed among non-Malays (including Orang Asli) ($P = 0.008$) and those single, divorced or widowed ($P = 0.023$). **Conclusion**: Knowledge gaps persist in Kuala Langat, highlighting the need for targeted awareness among groups influenced by education, income, ethnicity and marital status.

Keywords: Dental extraction, exodontia, restorative options, root canal treatment, teeth replacement

Introduction

The prevailing trend in dentistry, which prioritises the long-term preservation of natural dentition, has established root canal treatment (RCT) as a viable alternative to tooth extraction. RCT is often preferred over extraction in cases where an irreversibly inflamed or necrotic tooth has favorable restorability and prognosis. RCT has been shown to prevent further microbial infiltration into the peri-radicular area while preserving the proprioceptive function of the periodontal ligament, which enhances occlusal feedback and contributes to a superior sensory experience.[1] In contrast, patients who underwent tooth extraction often experienced a decline in quality of life.[2,3] Even with teeth replacement, prosthetic replacements

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cannot fully replicate the physical, biochemical and sensory properties of a natural tooth.[4]

In cases where extraction is inevitable, the missing teeth need to be replaced. Several teeth replacement options exist, including removable prostheses (dentures) and fixed prostheses (bridges, dental implants and implant-supported/retained dentures). The choice of treatment depends on factors such as the number of teeth requiring replacement, alveolar bone height, condition of the abutment teeth, treatment duration, patient acceptance, the clinician's expertise and cost.[5] Replacing missing teeth after extraction is essential to prevent drifting or overeruption of adjacent teeth, altered speech, ineffective mastication and a collapsed facial profile, all of which may negatively impact oral health-related quality of life.[6,7]

Edentulism has been a significant contributor to the oral health disease burden among older adults.[8] Recognising the importance of preserving natural teeth, the Ministry of Health, Malaysia established the National Oral Health Strategic Plan (NOHSP) 2022–2030. This plan aims for at least 50% of adults aged 60 and above to retain a minimum of 20 natural teeth by 2030, the year Malaysia is expected to become an ageing nation with 15% of its population comprising older adults.[9,10] However, the Malaysia National Oral Health Survey of Adults (NOHSA) 2020 reported that only 34.3% of older adults retained at least 20 natural teeth, highlighting a substantial gap from the 50% target set by NOHSP 2022–2030. The survey further revealed that nearly half (48.4%) of Malaysian adults required dental prostheses, yet fewer than a quarter (16.8%) actually had them.[11] This research sought to provide insights into the knowledge, attitude and practice (KAP) related to the retention and replacement of missing teeth within the local community while establishing a baseline for future oral healthcare research in government healthcare settings.

Materials and Methods

Study design and data collection

This cross-sectional study was conducted across three primary government dental clinics in Kuala Langat, Selangor. These primary clinics, managed by the government, serve as the main facilities for addressing the community's oral healthcare needs and provide essential treatments that are convenient and accessible. Kuala Langat was selected due to the absence of restorative specialist clinics within the district, where most RCT cases of simple complexity and removable denture cases are managed by primary government dental clinics. Consequently, patients requiring specialised root canal therapy or fixed prosthetic services must travel to other districts for treatment. Additionally, the rural population in Kuala Langat (13.2%) is significantly higher than the state's rural population (4.2%), highlighting the prominence of rural areas within the district.[12]

The sample size was determined using the single proportion formula, based on the prevalence of respondents with a knowledge of RCT in Kelantan, Malaysia, which was reported as 55.4%.[13] With a precision of 5%, the required sample size to achieve 80% power was 380 respondents. After accounting for a 20% non-response rate, the final adjusted sample size was 456 respondents.

The study was conducted from August to September 2024, with respondents systematically sampled from the daily outpatient clinics of three government dental clinics during this period. Eligible participants were Malaysian citizens aged 18–59 years who could communicate and read in either Malay or English, were not fully edentulous, and did not have any learning disabilities. Participation was voluntary and anonymous, with all respondents providing written informed consent.

The questionnaire used in the present study was adopted from *Awareness and Attitude of Patients Towards Retaining Teeth and Their Options for Teeth Replacement* by Ceng *et al.*,[13] which was modified and validated from two previous questionnaire[14,15] into bilingual format (Malay and English) to suit the Malaysian community, with a pilot study conducted among 30 patients.[13] The questionnaire comprised yes/no, multiple-choice and closed-ended questions, divided into three sections. Part 1 collected the sociodemographic profile of the participants, including variables such as age, gender, ethnicity, marital status, education level, occupation and monthly income. Part 2 assessed knowledge, attitudes and practices regarding RCT, comprising 13 items covering RCT information, previous RCT experiences, patients' concerns, completion of RCT with crown placement, factors influencing the choice of RCT in government or private clinics, patient practices when experiencing toothache, and treatment preferences between RCT and extraction. Part 3 focussed on teeth replacement options, containing five items related to preferred replacement methods and reasons for choosing or not choosing to replace missing teeth.

Ethical approval and consent to participate

Ethical approval for this study was granted by the Medical Research and Ethics Committee (MREC), Ministry of Health, Malaysia (Approval No: NMRR ID-24-01819-XFQ). Informed consent was obtained from all participants. The study adhered to the ethical guidelines of the 1975 Declaration of Helsinki, ensuring the protection of participants' rights and the confidentiality of all data.

Data analysis

The data were analysed using IBM SPSS Statistics for Windows, Version 27.0 (Armonk, NY: IBM Corp.,

USA). Descriptive statistics provided an overview of the sociodemographic characteristics. The association between categorical independent variables and knowledge of RCT, preference for RCT versus extraction and knowledge of teeth replacement options was assessed using the chi square test. All variables underwent further analysis using simple logistic regression. Additionally, variables with a bivariate outcome of $P < 0.10$ were included in multiple logistic regression for further analysis.

Results

Of the 456 respondents, the majority were female (63.8%), middle-aged adults (50.2%), Malay (75.9%), married (71.9%), had education levels below tertiary levels (52.0%), were employed in the non-governmental sector (51.5%), and reported a household income between MYR 1501 and 4000 (47.1%). A summary of the sociodemographic characteristics is presented in Table 1.

Table 2 summarises the KAP of respondents regarding RCT. Less than half (49.6%) of the participants had heard of RCT. Among those familiar with the procedure, the most recognised aspect was its indications (77.9%), followed by cost (45.1%), number of required visits (31.4%) and procedural details (29.2%). The primary sources of information were dental clinics (71.2%), the internet (41.6%) and relatives or friends (27.9%). In contrast, television and radio were less common sources, with only 6.6% and 4.0% of respondents, respectively, obtaining knowledge about RCT through these channels. Regarding attitudes, among the 456 respondents, only 69 (15.1%) had previously undergone RCT. The majority (94.2%) recalled their experience as positive, with more than half (65.2%) reporting no pain during or after the procedure. However, slightly more than half (52.2%) did not receive a permanent filling or crown upon completion of RCT. The most frequently reported concerns about the procedure were high treatment costs (56.5%), pain (46.4%) and the possibility of requiring extraction despite undergoing RCT (43.5%). Additionally, 30.4% of respondents were apprehensive about the prolonged treatment duration, while the risk of instrument fracture within the root canal was the least concerning factor (14.5%). Regarding treatment costs, almost all respondents (90.8%) perceived government dental clinics as a more affordable option for RCT than private clinics. Furthermore, a substantial proportion (74.3%) reported that the cost of RCT in private dental clinics deterred them from seeking RCT.

Table 1: Respondents' sociodemographic profile ($N = 456$)

Variables	*N* (%)
Gender	
Male	165 (36.2)
Female	291 (63.8)
Age	
Young adults (18–35)	227 (49.8)
Middle-aged adults (36–59)	229 (50.2)
Ethnicity	
Malay	346 (75.9)
Non-Malay	110 (24.1)
Marital status	
Married	328 (71.9)
Single/divorced/widowed	128 (28.1)
Level of education	
Below tertiary education	237 (52.0)
Tertiary education and above	219 (48.0)
Occupation	
Governmental	64 (14.0)
Non-governmental	235 (51.5)
Unemployed/retiree	157 (34.4)
Total household income (monthly)*	
≤MYR 1500	96 (21.1)
MYR 1501–4000	215 (47.1)
>MYR 4000	145 (31.8)

*Household income was grouped into three categories: ≤MYR 1500, MYR 1501–4000 and >MYR 4000, to ensure sufficient representation from each income group

Regarding practices, in response to toothache, the majority of respondents (65.8%) sought treatment from a dentist, while nearly one-quarter (28.5%) self-medicated with antibiotics and painkillers. A small proportion (6.1%) continued to rely on traditional home remedies. When given the choice between RCT and tooth extraction, slightly more than half (57.2%) preferred RCT, whereas 42.8% opted for extraction. Furthermore, most respondents (81.1%) expressed a preference for RCT to be performed by dental specialists rather than general dental practitioners.

As presented in Table 3, removable dentures were the most recognised teeth replacement option (49.6%), followed by fixed prostheses such as bridges and crowns (30.7%). Notably, 38.8% of respondents did not know about available treatment options for replacing missing teeth. Regarding preferences, nearly half (46.5%) favoured removable dentures, while bridges and crowns were the second-most preferred choice (35.7%). The primary motivation for seeking teeth replacement was to restore functionality, such as biting and chewing (74.1%), followed by aesthetic considerations (16.5%). A small proportion (9.3%) pursued teeth replacement based solely on recommendations. However, almost one-fifth (17.8%) chose not to replace their missing teeth. Among them, the majority (45.7%) did not know that missing teeth require replacement, while 28.4% did not perceive it as necessary. Some respondents identified financial constraints (16.0%) or a lack of time (6.6%) as factors that hinder them from replacing missing teeth. The most influential factor in determining a prosthetic option was professional advice

Table 2: Patients' knowledge, attitude and practice towards root canal treatment (RCT)

Variables	*N*	*N* (%)
Knowledge towards RCT		
Do you know about endodontic/RCT?		
Yes	456	226 (49.6)
No		230 (50.4)
Regarding RCT, do you know about*		
Indication of RCT	226	176 (77.9)
Cost of RCT		102 (45.1)
Number of visits needed		71 (31.4)
Procedures of RCT		66 (29.2)
Where did you come to know about RCT?*		
Dental clinic	226	161 (71.2)
Internet		94 (41.6)
TV		15 (6.6)
Radio		9 (4.0)
Relatives/Friends		63 (27.9)
Attitude towards RCT		
Have you ever received RCT before?		
Yes	456	69 (15.1)
No		387 (84.9)
How do you recall the experience of RCT?		
Well	69[a]	65 (94.2)
Badly		4 (5.8)
Have you experienced pain during or after RCT?		
Yes	69[a]	24 (34.8)
No		45 (65.2)
Have you got a permanent filling/crown placement done after your RCT?		
Yes	69[a]	33 (47.8)
No		36 (52.2)
What is your concern associated with RCT?*		
Pain	69[a]	32 (46.4)
Long treatment time		21 (30.4)
The possibility to remove the tooth despite undergoing RCT		30 (43.5)
Breaking the 'file' (instrument) into the root canal		10 (14.5)
High treatment cost		39 (56.5)
Did the price of government dental clinic influence your decision about NOT taking RCT in government dental clinic?		
Yes	456	42 (9.2)
No		414 (90.8)
Did the price of private dental clinic influence your decision about NOT taking RCT in private dental clinic?		
Yes	456	339 (74.3)
No		117 (25.7)
Practice towards RCT		
What did you do to relieve pain in case of toothache?		
I used home remedies to relieve toothache.	456	28 (6.1)
I used self-prescribed antibiotics and painkillers.		130 (28.5)
I visited the dentist.		298 (65.4)
If indicated, do you prefer RCT or tooth extraction?		
Tooth extraction	456	195 (42.8)
RCT		261 (57.2)
Do you prefer a specialist or a general practitioner for RCT?		
Dental specialist	456	370 (81.1)
General dental practitioner		86 (18.9)

*Multiple-choice questions in which each respondent could select more than one option.

[a]Question applicable only to respondents who had undergone RCT ($N = 69$)

Table 3: Patients' options for teeth replacement

Variables	*N*	*N* (%)
Which of the following can replace missing teeth?*		
Bridges/crown	456	140 (30.7)
Removable denture		226 (49.6)
No idea		177 (38.8)
Which one will you choose to replace missing teeth, if necessary?*		
Bridges/crown	456	163 (35.7)
Removable denture		212 (46.5)
No treatment		81 (17.8)
If no treatment, why?		
Financial constraints	81	13 (16.0)
Did not feel the need		23 (28.4)
No time		8 (9.9)
No idea that missing teeth can be replaced		37 (45.7)
What is your reason for teeth replacement after teeth extraction?		
I was told to do so	375[a]	35 (9.3)
It does not look nice		62 (16.5)
I cannot bite/chew		278 (74.1)
What is the reason that affects your options for teeth replacement?		
Cost of treatment	456	173 (37.9)
Duration of treatment		87 (19.1)
Opinion from dentist		196 (43.0)

*Multiple-choice questions in which each respondent could select more than one option.

[a]*N* = 375 represents the total number of respondents who chose to replace missing teeth with bridges/crowns (*n* = 163) and removable dentures (*n* = 212)

from a dentist (43.0%), followed by cost (37.9%) and treatment duration (19.1%).

Table 4 shows that gender, education level, occupation and household income were significantly associated with patients' knowledge of RCT in the simple regression analysis. However, in the multivariate analysis, only education level and household income remained statistically significant. Respondents with tertiary education or higher were 1.68 times more likely to have knowledge of RCT compared to those with education below the tertiary level (OR = 1.68; 95% CI = 1.13, 2.50; *P* = 0.*011*). Similarly, respondents with a monthly household income exceeding MYR 4000 had 1.86 times greater knowledge of RCT than those with a household income of MYR 4000 or below (OR = 1.86; 95% CI = 1.04, 3.32; *P* = 0.*035*). The Hosmer–Lemeshow test yielded a nonsignificant *P* value (*P* = 0.*477*), indicating a good-fitting model with an overall predictive accuracy of 62.5%.

As shown in Table 5, education level and household income were identified as significant factors influencing patients' preference for RCT over extraction. Meanwhile, age (*P* = 0.057) met the inclusion criterion (*P* < 0.10) and was included in the multiple logistic regression model, while other variables were treated as control factors.

Multivariate analysis demonstrated that education level was statistically significant, with tertiary level-educated individuals being nearly twice as likely to prefer RCT over extraction compared to those with education below the tertiary level (OR = 1.94; 95% CI = 1.28, 2.95; *P* = 0.002). The Hosmer–Lemeshow test produced a nonsignificant *P* value (*P* = 0.233), reflecting a good-fitting model with an overall predictive accuracy of 61.4%.

Table 6 highlights the factors significantly associated with patients' knowledge of teeth replacement options, which include ethnicity and education level, both of which were further examined in the multivariate model. Marital status was also included due to its *P* value of 0.075 (<0.10). Multivariate analysis revealed that non-Malays had a lower knowledge of teeth replacement options than Malays, as reflected by a lower odds ratio (OR = 0.55; 95% CI = 0.35, 0.86; *P* = 0.*008*). Additionally, single, divorced or widowed individuals demonstrated lower knowledge of teeth replacement options than married individuals (OR = 0.61; 95% CI = 0.40, 0.93; *P* = 0.*023*). The logistic regression model demonstrated a good fit, as evidenced by the nonsignificant Hosmer–Lemeshow *P* value (*P* = 0.306), and an overall predictive accuracy of 60.5%.

Discussion

The present study found that fewer than half (49.6%) of respondents had knowledge of RCT, a finding consistent with previous studies conducted in Kelantan (55.4%)

Table 4: Factors associated with patients' knowledge towards root canal treatment (RCT) (results of multiple logistic regression) (*N* = 456)

Variable	Knowledge towards RCT, *n* (%)								
	Bivariate analysis					Multivariate analysis			
	N (%)	Do not know about RCT (%)	Know about RCT (%)	Unadjusted odd ratio[a] (95% CI)	*P* value[1]	*β* (SE)	Wald	Adjusted odd ratio (95% CI)	*P* value[2]
Included constant						−0.36 (0.39)	0.85		0.356
Gender									
Male	165 (36.2)	94 (57.0)	71 (43.0)	Reference	***0.036***				
Female	291 (63.8)	136 (46.7)	155 (53.3)	1.51 (1.03, 2.22)					
Level of education									
Below tertiary education	237 (52.0)	140 (59.0)	97 (41.0)	Reference	***<0.001***			Reference	
Tertiary education and above	219 (48.0)	90 (41.1)	129 (58.9)	2.07 (1.42, 3.01)		0.52 (0.20)	6.43	1.68 (1.13, 2.50)	***0.011***
Occupation									
Governmental	64 (14.0)	21 (32.8)	43 (67.2)	Reference					
Non-governmental	235 (51.5)	127 (54.0)	108 (46.0)	0.42 (0.23, 0.74)	***0.009***				
Unemployed/retiree	157 (34.4)	82 (52.2)	75 (47.8)	0.45 (0.24, 0.82)					
Total Household Income									
≤MYR 1500	96 (21.1)	59 (61.5)	37 (38.5)	Reference				Reference	
MYR 1501–4000	215 (47.1)	114 (53.0)	101 (47.0)	1.41 (0.87, 2.32)	***0.002***	0.33 (0.26)	1.64	1.39 (0.84, 2.31)	0.200
>MYR4000	145 (31.8)	57 (39.3)	88 (60.7)	2.46 (1.45, 4.18)		0.62 (0.30)	4.43	1.86 (1.04, 3.32)	***0.035***

[1]Chi square test, [2]multiple logistic regression analysis, number in bold = $P < 0.05$.

[a]Simple logistic regression analysis, $P < 0.05$, RCT= Root canal treatment.

$P = 0.477$ (Hosmer and Lemeshow), $R^2 = 0.06$ (Cox and Snell), 0.08 (Nagelkerke).

Model X^2 (6) = 28.18, $P < 0.001$.

Overall predictive accuracy = 62.5%

Table 5: Factors associated with patients' preference for root canal treatment (RCT) and extraction (results of multiple logistic regression) (*N* = 456)

Variable	Preference for RCT and extraction, *n* (%)								
	Bivariate analysis					Multivariate analysis			
	N (%)	Extraction (%)	RCT (%)	Unadjusted odd ratio[a] (95% CI)	*P* value[1]	*β* (SE)	Wald	Adjusted odd ratio (95% CI)	*P* value[2]
Included constant						−0.55 (0.24)	0.05		0.817
Age									
Young (18–35)	227 (49.8)	87 (38.3)	140 (61.7)	Reference	0.057				
Middle-aged (36–59)	229 (50.2)	108 (47.2)	121 (52.8)	0.70 (0.48, 1.01)					
Level of education									
Below tertiary education	237 (52.0)	125 (52.7)	112 (47.3)	Reference	***<0.001***				
Tertiary education and above	219 (48.0)	70 (32.0)	149 (68.0)	2.38 (1.62, 3.48)		0.66 (0.21)	9.71	1.94 (1.28, 2.95)	***0.002***
Total household income									
≤MYR 1500	96 (21.1)	47 (49.0)	49 (51.0)	Reference					
MYR 1501–4000	215 (47.1)	102 (47.4)	113 (52.6)	1.06 (0.66, 1.72)	***0.005***				
>MYR4000	145 (31.8)	46 (31.7)	99 (68.3)	2.06 (1.21, 3.51)					

[1]Chi square test, [2]multiple logistic regression analysis, number in bold = $P < 0.05$.

[a]Simple logistic regression analysis, $P < 0.05$, RCT = root canal treatment.

$P = 0.233$ (Hosmer and Lemeshow), $R^2 = 0.06$ (Cox and Snell), 0.07 (Nagelkerke).

Model X^2 (4) = 26.0, $P < 0.001$.

Overall predictive accuracy = 61.4%

Table 6: Factors associated with patients' knowledge towards teeth replacement options (results of multiple logistic regression) (*N* = 456)

Variable	Knowledge towards teeth replacement options, *N* (%)								
	Bivariate analysis					Multivariate analysis			
	N (%)	Do not know about teeth replacement options (%)	Know about teeth replacement options (%)	Unadjusted odd Ratio[a] (95% CI)	*P* value[1]	β (SE)	Wald	Adjusted odd ratio (95% CI)	*P* value[2]
Included constant						0.57 (0.16)	12.43		***<0.001***
Ethnicity									
Malay	346 (75.9)	121 (35.0)	225 (65.0)	Reference	***0.003***		6.98	Reference	***0.008***
Non-Malay	110 (24.1)	56 (50.9)	54 (49.1)	0.52 (0.34, 0.80)		−0.60 (0.23)		0.55 (0.35, 0.86)	
Marital status									
Married	328 (71.9)	119 (36.3)	209 (63.7)	Reference	*0.075*		5.20	Reference	
Single/divorced/ widowed	128 (28.1)	58 (45.3)	70 (54.7)	0.69 (0.45, 1.04)		−0.50 (0.21)		0.61 (0.40, 0.93)	***0.023***
Level of education									
Below tertiary education	237 (52.0)	103 (43.5)	134 (56.5)	Reference	***0.034***				
Tertiary education and above	219 (48.0)	74 (33.8)	145 (66.2)	1.51 (1.03, 2.20)					

[1]Chi square test, [2]multiple logistic regression analysis, number in bold = $P < 0.05$.

[a]Simple logistic regression analysis, $P < 0.05$, RCT = root canal treatment.

$P = 0.306$ (Hosmer and Lemeshow), $R^2 = 0.04$ (Cox and Snell), 0.05 (Nagelkerke).

Model X^2 (3) = 16.23, $P = 0.001$.

Overall predictive accuracy = 60.5%

and Pahang (57.0%), which highlighted a general lack of public awareness regarding RCT in Malaysia.[13,16] These studies also reported that knowledge of RCTs in Malaysia was largely limited to individuals with pulpal symptoms or prior treatment experience. This corresponds with our finding that the most recognised aspect of RCT among those familiar with the procedure was its indications (77.9%), likely because they had experienced symptoms that prompted the need for treatment. Meanwhile, tertiary level-educated individuals and those with a household income exceeding MYR 4000 per month demonstrated greater knowledge of RCT. This can be attributed to the tendency of highly educated individuals to actively seek health-related information, including details about RCT, leading to enhanced knowledge.[17] Similarly, higher-income groups are less constrained by the cost of RCT, making them more likely to access and understand RCT as a viable treatment option.[18]

Despite only a small proportion of respondents (15.1%) having undergone RCT, it is concerning that slightly more than half (52.2%) did not receive a permanent restoration or crown placement following treatment. The European Society of Endodontology position statement on the restoration of root-filled teeth underscores the importance of cuspal coverage in root-filled teeth as it enhances survival and reduces the risk of biomechanical failure, particularly in posterior teeth. Critical factors influencing the need for cuspal coverage include the extent of tooth structure loss, the ferrule effect, proximal contacts, the presence of cracks and occlusal considerations such as excursive and protrusive guidance as well as deflective contacts.[19] Furthermore, evidence has shown that crown placement within 4 months post-RCT is optimal as delaying beyond this period has been associated with a threefold increase in the risk of tooth extraction.[20]

In cases of toothache, while most respondents (65.4%) would visit the dentist, a significant proportion (28.5%) preferred self-medication with painkillers and antibiotics. A major concern with self-medication is antibiotic misuse as it allows individuals to obtain and consume medication without prescription, proper diagnosis or medical supervision.[21] This practice has been linked to incomplete courses, inappropriate drug selection and the overuse of broad-spectrum antibiotics, all of which contribute to antibiotic resistance, a global health threat recognised by the World Health Organisation.[22]

Regarding the preference between RCT and extraction, a slightly higher percentage of respondents (57.2%) chose RCT. Individuals with at least tertiary-level education

were more likely to favour RCT than those with lower education levels as higher education is associated with greater oral health awareness. This group tends to recognise the importance of preserving natural teeth and prioritises long-term oral health.[23] The present findings align with this trend as the proportion of respondents opting for RCT in this study was higher than that reported in rural areas of India (39.8%) but lower than that in Iran (65.8%–77.7%) and Poland (79.0%).[14,23,24] Studies have indicated that patients opt for extraction over RCT due to concerns regarding its success and durability, the need for immediate pain relief and the inability to commit to multiple lengthy appointments.[25,26] Over the decades, the debate over tooth retention versus extraction has been widely explored, particularly in comparisons between RCT and extraction followed by dental implant placement. Current literature suggests that both RCT and dental implants have comparable success and survival rates, exceeding 90% over a 10-year period.[27-30] However, treatment decisions should not be based solely on generalised success and survival rates but should incorporate a thorough individual case assessment and comprehensive treatment planning, considering both clinical factors and patients' preferences.[31]

Removable dentures (49.6%) were the most widely recognised teeth replacement option, likely due to their availability at all primary clinics included in this study. In contrast, fixed prostheses such as bridges and crowns (30.7%) were unavailable in government facilities within the study area and were only offered at specialist clinics in other districts. Notably, a substantial proportion of respondents (38.8%) did not know about teeth replacement options, with knowledge gaps particularly evident among non-Malays and individuals who were single, divorced or widowed. The non-Malay population in Kuala Langat district included the indigenous Orang Asli community, the largest in the state of Selangor, who were often known to have limited oral health knowledge and awareness.[32,33] Additionally, marital status influences oral health knowledge as married individuals may have benefited from spousal support, fostering shared health behaviours and greater knowledge of oral care.[34,35]

A similar trend was observed in respondents' preferred teeth replacement options, with removable dentures (46.5%) being the most chosen, followed by bridges and crowns (35.7%). These findings align with NOHSA 2020, which reported that removable dentures, both partial or full, were the most commonly worn dental prostheses among Malaysians.[11] A similar local study found that dental implants were the preferred choice when cost was not disclosed; however, once informed, Malaysians favoured dentures.[36] As dental implants are generally more expensive than removable dentures, they were more commonly preferred among higher-income groups.[37] The primary motivation for teeth replacement was functional, with 74.1% expressing concerns about biting and chewing, while only 16.5% prioritised aesthetics. This contrasts with findings from India, where aesthetic concerns were the main reason for seeking teeth replacement.[38] While both function and aesthetics influence decision-making, anterior teeth replacements were typically driven by aesthetic considerations, whereas posterior teeth replacements were primarily done for functional purposes.[39] Moreover, females have been reported to have greater aesthetic concerns than males.[40] Among those who chose not to replace missing teeth, nearly half (45.7%) stated that their primary reason was having no idea that teeth replacement was possible. This may explain findings from the NOHSA 2020 national survey, which reported that while almost half (48.4%) of Malaysian adults required prosthetic treatment, but fewer than a quarter (16.8%) actually wore them.[11]

Limitations and future directions

The current study has certain limitations. Firstly, it was conducted exclusively in the Kuala Langat district of Selangor, which may not be representative of the wider population at the state or national level. Moreover, factors influencing the uptake of RCT and extraction, such as facilitators and barriers, patient and health care provider (HCP) perspectives including HCP preferences for performing RCT or extraction and the impact of systemic-related factors were not captured due to the quantitative nature of this study. Future research incorporating qualitative methods, such as in-depth interviews or focus group discussions, is recommended to explore these factors more comprehensively on a broader scale.

Conclusion

The present study provides insights into the KAP related to RCT and teeth replacement options among patients attending government dental clinics in Kuala Langat, Selangor. Addressing these disparities could enable stakeholders and policymakers to develop more effective strategies, overcome logistical challenges and optimise available resources to enhance dental health knowledge and awareness. Such efforts would be particularly beneficial in densely populated states like Selangor, ultimately contributing to improved oral healthcare outcomes, as advocated in the NOHSP 2022–2030.

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Author contributions

YSN contributed to study design, data collection, data analysis, research administration and drafting the article;

MR contributed to data collection and article preparation; NZI and MFN contributed to data validation and review the manuscript. All authors read and approved the final version of the manuscript.

Data availability statement

Data that support the findings of this study are available from the Ministry of Health, Malaysia, but restrictions apply to the availability of these data and so are not publicly available. The data, however, can be obtained from the corresponding authors from the Ministry of Health Malaysia on reasonable request and with permission from the Director-General of Health Malaysia.

Ethical policy and Institutional Review Board statement

Ethical approval for this study was granted by the MREC, Ministry of Health, Malaysia (approval no: NMRR ID-24-01819-XFQ). Informed consent was obtained from all participants. The study adhered to the ethical guidelines of the 1975 Declaration of Helsinki, ensuring the protection of participants' rights and the confidentiality of all data.

Consent for publication

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Development and Validation of Knowledge, Attitude and Screening Practice Questionnaire on Interceptive Orthodontics Treatment for Dental Therapists in Johor

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Abstract

Context: Dental therapists are the first liners in screening oral problems in Malaysian school children under the School Dental Service Programme, which can detect and refer interceptive orthodontic cases early to dental officers. **Aims**: This study intends to develop a valid and reliable instrument to evaluate knowledge, attitude and screening practices on interceptive orthodontics among dental therapists in Johor. **Settings and Design**: This cross-sectional study was conducted among 91 dental therapists in Johor. **Materials and Methods**: A bilingual questionnaire was developed and underwent content, face and construct validity. **Statistical Analysis Used**: Content validation was performed by five experts using the content validity index (CVI). Knowledge domain was validated using the item response theory Rasch model, while attitude and screening practice domains were validated using exploratory factor analysis (EFA). **Results**: All items demonstrated fair item-level CVI (>0.80) and substantial modified Kappa (K* >0.76). Scale-level CVI (Scale-level Content Validity Index/Average) and Scale-level Content Validity Index/Universal Agreement scores were 0.99 and 0.95, respectively. For the knowledge domain, the Rasch model retained 9 out of 14 items, with overall difficulty ranging from −3 to 0 and a discrimination parameter of 1.27. The Kaiser–Meyer–Olkin measure of sampling adequacy for attitude and screening practice domains was 0.82 and 0.71, respectively, with significant Bartlett's test of sphericity ($P < 0.001$). EFA revealed that the attitude domain comprises two factors with a total of eight items, while the screening practice domain consists of two factors with a total of seven items, with good factor loadings (>0.6) for all items. Cronbach's α scores indicated satisfactory reliability across all domains (>0.6). **Conclusions**: The developed questionnaire demonstrates valid psychometric properties and good reliability, making it a suitable tool for evaluating knowledge, attitude and screening practices related to interceptive orthodontics among dental therapists in Johor.

Keywords: Dental therapist, exploratory factor analysis, interceptive orthodontics, item response theory, questionnaire

Introduction

Interceptive orthodontics deploy any technique to eliminate potential misalignments of the dentition.[1] By correcting or intercepting a malocclusion, interceptive orthodontics may simplify future treatment or even eliminate the need for future treatment.[2]

A best practice guideline has been outlined by Borrie and Bearn[3] regarding indicated cases for interceptive orthodontics which includes crossbites (anterior and posterior), eruption problems and impaction (including incisors and canines), poor quality first permanent molars, infra-occluded primary molars, non-nutritive sucking habits, midline shifts due to unilateral loss of primary teeth and increased overjet causing risk of trauma.

The mixed dentition stage offers the greatest opportunity for occlusal guidance and interception of malocclusion. Should these malocclusions be delayed to a later stage, treatment may become more complicated, where extractions may be

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necessary for orthodontic camouflage.[4] A survey reported that only 16.7% orthodontists felt that referrals were received at an ideal age, thus needing improvement in the timing of referrals for class II correction to optimise growth-related functional appliance treatment.[5] This reflects an ongoing issue of delayed referrals of interceptive orthodontic cases in Malaysia.

Dental therapists are the first liners in screening oral problems in Malaysian school children under School Dental Service (SDS) programme, which allows them the best opportunity to detect malocclusions early.[6] Upon detecting potential interceptive cases, dental therapists should be prompt in consulting dental officers for further assessment and initiate referral pathways as necessary. In Malaysia, there are only a few published studies regarding the orthodontic interface of dental therapists.

This study aims to develop a valid and reliable instrument to assess knowledge, attitude and screening practices on interceptive orthodontics among dental therapists.

Materials and Methods

This was a two-stage study, comprising content and face validation of the developed questionnaire in the first stage, followed by construct validation in the second stage, utilising item response theory analysis for the knowledge domain and exploratory factor analysis for attitude and screening practice domain [Figure 1].

First stage: Questionnaire development

In the first stage, an extensive literature search was conducted to identify relevant resources related to interceptive orthodontics.[6-9] A preliminary bilingual questionnaire comprising four sections was developed:

- Part A: Sociodemographic.
- Part B: Knowledge.
- Part C: Attitude.
- Part D: Screening practices.

The questionnaire was curated in English, subsequently underwent forward and backwards translation into the Malay language and verified by a language expert.

For content validity, the questionnaire draft underwent evaluation by a panel of five content experts comprising two orthodontists, two paediatric dental specialists and one dental public health specialist using Content Validity

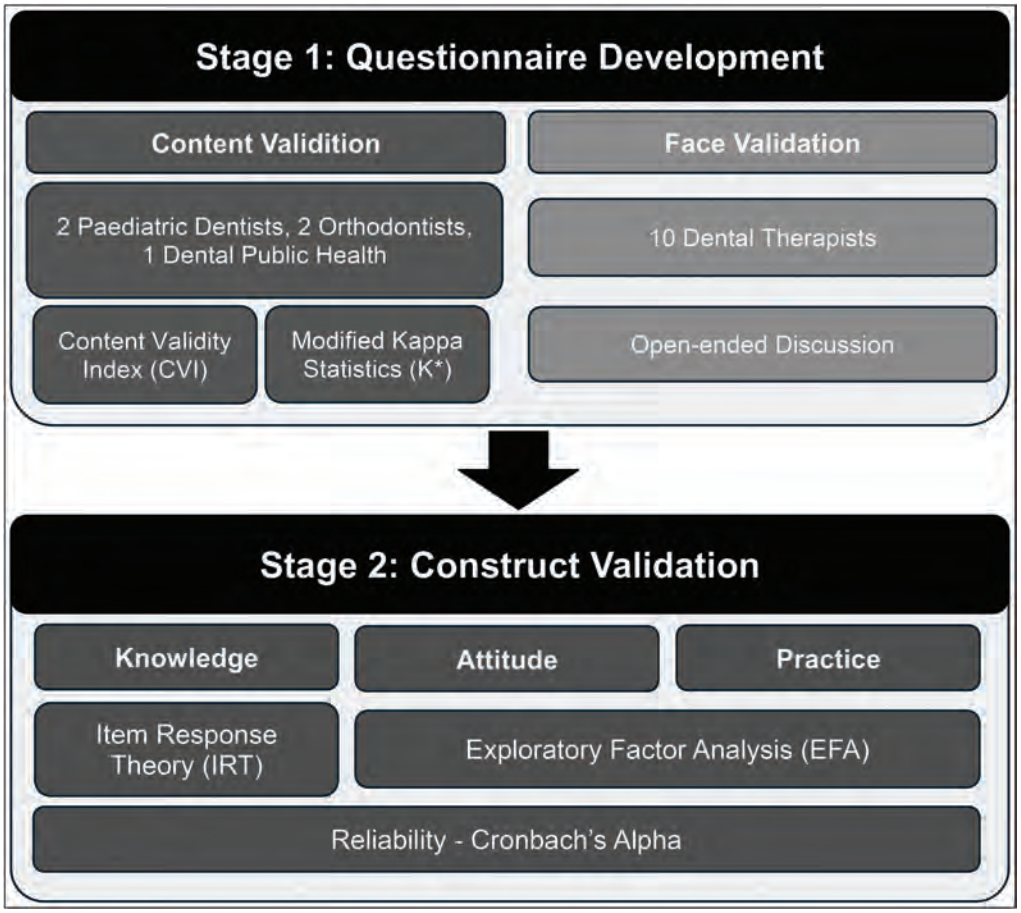

Figure 1: Flowchart of study

Index (CVI) and modified Kappa statistics (K*). CVI[10] and K*[11] are based on the proportion of agreement.[12] In contrast, the Scale-evel CVI Average (S-CVI/Ave) was calculated by computing all the I-CVI values and the total scores averaged by the total number of assessment items. Revisions were done accordingly based on expert feedback.

For face validity, an online group interview was conducted with 10 dental therapists of managerial role (Grade U32 and above) as layman experts to assess clarity, readability and relevance of the questionnaire. Based on their feedback, minor adjustments were made, including the addition of one filter item (S7: "Adakah anda terlibat dalam Program Pergigian Sekolah? *Are you involved in the SDS Programme?*") to exclude respondents not involved in SDS. Subsequently, the finalised version of the questionnaire was used throughout the study. The finalised questionnaire consisted of 38 items:

- Part A: Seven sociodemographic items.
- Part B: 14 knowledge items.
- Part C: Nine attitude items.
- Part D: Eight screening practice items.

Second stage: Construct validation

Data collection was done from September 2024 to October 2024 through convenience sampling. A total of 99 dental therapists responded via self-administered Google Forms. Based on the filter item (S7), eight respondents not involved in SDS were excluded, resulting in a final sample size of $N = 91$. Data were analysed using Statistical Package for the Social Sciences version 29.0 (IBM Corp., Armonk, NY, USA), R Software version 4.3.3 in RStudio environment version 2024.09.0 + 375. The level of significance was set at $\alpha = 0.05$. Construct validation for the knowledge domain is done by Item Response Theory (IRT), while attitude and screening practice domain is done by EFA.

Sample size for IRT commonly ranges from 100 to 500.[13-15] The sample size of 91 was deemed marginally acceptable. The knowledge domain consisted of unidimensional items with dichotomous responses and analysed using the Rasch model via the ltm R package (version 1.2-0). Acceptable difficulty ranged from −3 to +3, and acceptable discrimination ranged from 0.35 to 2.5.[14,16] Item fit was determined by chi-square goodness-of-fit per item.[14,16]

EFA was conducted on items from attitude (nine items) and screening practice (eight items) domains, excluding two descriptive items (P4 and P8). A minimum recommended sample size of two to five participants per item[15,17,18] justifies adequacy of sample size of $N = 91$. Sampling adequacy was also determined by the Kaiser–Meyer–Olkin measure of sampling adequacy (KMO > 0.5) and a significant Bartlett's test of the sphericity ($P < 0.001$). Principal axis factoring was used for component extraction, followed by Varimax rotation to optimise factor loading. Determination of the number of extracted factors was done by the criterion of eigenvalues >1.0 and visual inspection of the scree plot. A factor loading >0.4 was considered acceptable.[14,19]

Internal consistency was assessed using the Cronbach's α coefficient for each domain, where a cut-off value of >0.65 is considered good.[14,20]

Results

Questionnaire development (content and face validity)

Various useful resources regarding interceptive orthodontics were identified to generate important items for each domain of the questionnaire. Following expert evaluation for content relevance and clarity, several revisions were made until consensus was achieved. Final content validity metrics are presented in Table 1.

At item level, all items except S5 and A4 achieved perfect agreement (I-CVI and K* = 1.00). The items S5 and A4 scored an I-CVI of 0.80 and a substantial K* of 0.76 and thus were retained. At the scale level, S-CVI/Ave and S-CVI/UA were 0.99 and 0.95, respectively. At this point, the content validity of the questionnaire has been established.

Face validation was conducted with 10 senior dental therapists via an online meeting. Feedback confirmed that the questionnaire was generally clear, readable and free of ambiguity. Minor adjustments were made, and item S7 ("Adakah anda terlibat dalam Program Pergigian Sekolah? *Are you involved in SDS Programme?*") was added to exclude ineligible respondents.

The final draft of the questionnaire contained four sections with 38 items.

- Part A: Seven sociodemographic items.
- Part B: 14 knowledge items.
- Part C: Nine attitude items.
- Part D: Eight screening practice items.

Participant characteristics

Descriptive statistics are presented in Table 2. The respondents ($N = 91$) had a mean age of 38.14 years (SD = 7.745) and average work experience of 14.78 years (SD = 7.714). The sample was predominantly female (98.9%), reflective of the dental therapist demographic in Johor. A majority (60.4%) worked in an urban setting. Most respondents (92.3%) held a diploma, while 7.7% had completed secondary school or equivalent. Notably, more than half (58.2%) reported no prior training in orthodontics.

Item response theory

Items in the knowledge domain are described in Table 3. For the IRT analysis of the knowledge domain, items K4, K6

Table 1: Content validity items

	Items	I-CVI	Modified Kappa statistics (K*)
Part A: Sociodemographic	S1	1.00	1.00
	S2	1.00	1.00
	S3	1.00	1.00
	S4	1.00	1.00
	S5	0.80	0.76
	S6	1.00	1.00
Part B: Knowledge	K1	1.00	1.00
	K2	1.00	1.00
	K3	1.00	1.00
	K4	1.00	1.00
	K5	1.00	1.00
	K6	1.00	1.00
	K7	1.00	1.00
	K8	1.00	1.00
	K9	1.00	1.00
	K10	1.00	1.00
	K11	1.00	1.00
	K12	1.00	1.00
	K13	1.00	1.00
	K14	1.00	1.00
Part C: Attitude	A1	1.00	1.00
	A2	1.00	1.00
	A3	1.00	1.00
	A4	0.80	0.76
	A5	1.00	1.00
	A6	1.00	1.00
	A7	1.00	1.00
	A8	1.00	1.00
	A9	1.00	1.00
Part D: Practice	P1	1.00	1.00
	P2	1.00	1.00
	P3	1.00	1.00
	P4	1.00	1.00
	P5	1.00	1.00
	P6	1.00	1.00
	P7	1.00	1.00
	P8	1.00	1.00
	P9	1.00	1.00
	P10	1.00	1.00
Scale-level Content Validity Index/Average			0.99
Scale-level Content Validity Index/Universal Agreement			0.95

and K11 were answered correctly by all participants (only one response) and thus removed from the IRT analysis. The unidimensionality assumption was not met ($P < 0.05$).

Comparison between the Rasch and two-parameter logistic (2PL) models is shown in Table 4. The analysis of variance test indicated no significant differences ($P = 0.079$). Moreover, the Rasch model had lower Akaike information criterion (AIC) and Bayesian information criterion (BIC) values and was therefore selected for further analysis.

The knowledge section analysed using the Rasch model showed the psychometric properties of the domain, as shown in Table 5. Items K7 and K14 fell outside the acceptable difficulty range, while item K3 was borderline (−3.0017). Items K3, K8 and K9 did not fit the model well ($P < 0.05$) but were retained based on acceptable difficulty levels. The amount of information tapped by the items between −3 and +3 difficulty range was 69.99%. Test information function shown in Figure 2 shows that the test provided the highest information around knowledge theta (θ) value of −2, indicating the scale is most effective for respondents with lower knowledge levels.

Exploratory factor analysis

For attitude domain, EFA was done on all nine attitude items (A1–A9). The KMO measure of sampling adequacy was 0.822, while Barlett's test of sphericity was significant ($P < 0.001$), supporting the use of EFA.[15,21] All items had communalities >0.5, except item A5 (0.399). Therefore, item A5 was removed. EFA was proceeded by extracting two factors based on eigenvalue. Component correlation matrix revealed no correlation between factors (0.175); thus, Varimax rotation was deployed and revealed two interpretable factors that explain 59.36% of total variance which is more than the criterion of 50%.[22] All items in attitude domain had acceptable loading of more than 0.4. The two extracted factors were positively worded items (A2, A3, A4, A6, A8, A9) and negatively worded items (A1, A7), as shown in Table 6.

For screening practice domain, all items except items P4 and P8 were subjected to EFA. The KMO value was 0.713, and Barlett's test of sphericity was significant ($P < 0.001$), confirming suitability for EFA. Communalities were acceptable (>0.5) for all items except for items P6 (0.447) and P7 (0.329). Item P6 was retained due to proximity to the threshold of 0.5, while P7 was removed. EFA was proceeded by extracting two factors based on the eigenvalue. Component correlation matrix revealed no correlation between factors (0.266); thus, Varimax

Table 2: Sociodemographic data of participants

Variables	Mean (SD)	Frequency (%)
Age (years)	38.14 (7.745)	
Gender		
Female		90 (98.9)
Male		1 (1.1)
Work experience (years)	14.78 (7.714)	
Place of work		
Urban		55 (60.4)
Rural		36 (39.6)
Highest level of education		
Diploma		84 (92.3)
Secondary school or equivalent		7 (7.7)
Training in regard to orthodontics		
Yes		38 (41.8)
No		53 (58.2)

Table 3: Items in knowledge domain

	Item	Response
K1	Masalah maloklusi gigi tidak boleh dirawat *Malocclusion cannot be treated*	Ya/*Yes* **Tidak/*No***
K2	Masa dan turutan pertumbuhan gigi penting dalam rawatan ortodontik *Time and sequence of tooth eruption is important in orthodontic treatment*	**Ya/*Yes*** Tidak/*No*
K3	Tabiat menghisap ibu jari, menujah lidah ke depan dan bernafas melalui mulut boleh menyebabkan maloklusi *Thumb sucking, tongue thrusting and mouth breathing habits can cause malocclusion*	**Ya/*Yes*** Tidak/*No*
K4	Gigitan silang atau "crossbite" ("anterior" dan "posterior") dan "traumatic overbite" adalah sejenis maloklusi gigi *Crossbites (anterior and posterior) and traumatic overbite are types of malocclusions*	**Ya/*Yes*** Tidak/*No*
K5	Gigi yang tidak tersusun boleh mempengaruhi pertuturan dan fungsi mengunyah *Irregular teeth can affect speech and chewing ability*	**Ya/*Yes*** Tidak/*No*
K6	Kegigian campuran atau "mixed dentition" bermula lebih kurang dari umur 6 hingga 13 tahun *Mixed dentition stage starts approximately from age 6–13*	**Ya/*Yes*** Tidak/*No*
K7	Jika gigi susu dicabut awal, kehilangan ruang mungkin berlaku *With premature loss of primary teeth, space loss may occur*	**Ya/*Yes*** Tidak/*No*
K8	Terdapat rawatan ortodontik tertentu setelah kehilangan awal gigi susu *There is specific orthodontic management after premature loss of primary teeth*	**Ya/*Yes*** Tidak/*No*
K9	Rawatan ortodontik hanya dapat dimulakan setelah semua gigi kekal tumbuh *Orthodontic treatment can only be started after all permanent teeth has erupted*	Ya/*Yes* **Tidak/*No***
K10	Rawatan ortodontik awal untuk menyelaraskan gigi kacip atas yang jongang boleh mengelakkan trauma gigi *Aligning the proclined upper incisors can prevent dental trauma*	**Ya/*Yes*** Tidak/*No*
K11	Penyiasatan radiografi adalah penting untuk kes gigi kekal yang lewat tumbuh *Radiographic investigation is important in cases of delayed eruption of teeth*	**Ya/*Yes*** Tidak/*No*
K12	Pertumbuhan gigi kanin (taring) ektopik perlu disyaki jika ketiadaan bonjolan kanin atau pertumbuhan gigi yang tidak simetrik selepas umur 10 tahun *After the age of 10, ectopic canine should be suspected by the absence of the canine bulge or presence of asymmetrical eruption*	**Ya/*Yes*** Tidak/*No*
K13	Cabutan gigi geraham kekal pertama yang berprognosis buruk pada masa yang sesuai membolehkan gigi geraham kekal kedua bergerak ke hadapan dan seterusnya menghasilkan oklusi yang memuaskan *Ideal timing of extraction of first permanent molars with poor prognosis can lead to an acceptable occlusion with successful mesial migration of the second permanent molars*	**Ya/*Yes*** Tidak/*No*
K14	Sesetengah maloklusi memerlukan rawatan pembedahan *Some malocclusions require surgical intervention*	**Ya/*Yes*** Tidak/*No*

Bold responses are correct answers

Table 4: Analysis of variance between Rasch model and two-parameter logistic (2PL) model

Model	AIC	BIC	Log-likelihood	LRT	*df*	*P* value
Rasch	690.31	720.44	-333.15			
2PL	693.52	748.76	-324.76	16.78	10	0.079

AIC: Akaike information criterion, BIC: Bayesian information criterion

Table 5: Rasch model for knowledge domain

Item	Percentage correct	Difficulty (SE)	*Z* values	χ^2	*P* value ($>\chi^2$)	Cronbach's α
K1	0.93	−2.61 (0.47)	−5.55	8.70	0.1914	0.667
K2	0.91	−2.32 (0.42)	−5.53	9.46	0.1493	
K3	0.96	−3.00 (0.55)	−5.43	13.06	0.0421*	
K5	0.82	−1.56 (0.31)	−4.96	12.05	0.0609	
K7	0.98	−3.62 (0.72)	−5.02	4.55	0.6024	
K8	0.73	−0.98 (0.26)	−3.80	19.30	0.0037*	
K9	0.49	0.04 (0.22)	0.18	27.13	0.0001*	
K10	0.90	−2.20 (0.40)	−5.50	6.84	0.336	
K12	0.89	−2.09 (0.38)	−5.45	11.83	0.066	
K13	0.73	−0.98 (0.26)	−3.80	6.29	0.3913	
K14	0.97	−3.27 (0.62)	−5.29	2.51	0.8678	
Discrimination		1.27 (0.18)	7.01			

Item K4, K6 and K11 were excluded due to all correct responses. * *P* value <0.05 for Chi-square goodness-of-fit test.

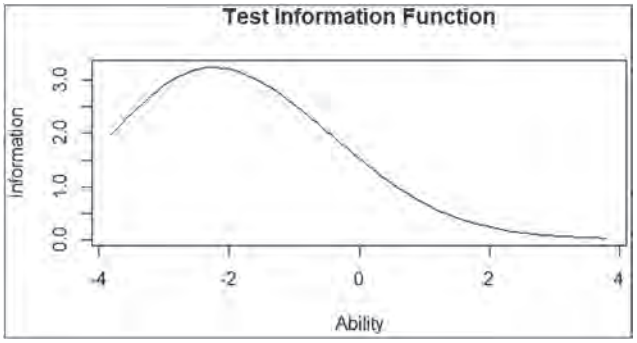

Figure 2: Test information function of knowledge domain

rotation was deployed and revealed two interpretable factors, accounting for 56.12% of total variance. All items in the screening practice domain had acceptable loading of >0.4. The two factors are "Current screening practices" (P1, P2, P3, P5, P6) and "Willingness to improve screening practice" (P9, P10), as shown in Table 7.

Reliability

For measure of reliability, the questionnaire had Cronbach's α coefficient of 0.667, 0.778 and 0.746 for knowledge, attitude and screening practice domains, respectively. For the attitude subdomains, the positively worded factor has acceptable internal consistency of 0.861 while the negatively worded factor has unsatisfactory internal consistency of 0.295, as shown in Table 6. On the contrary, the screening practice subdomains revealed Cronbach's α coefficient of 0.762 and 0.705 for both factors (current screening practices and willingness to improve screening practice), respectively, as shown in Table 7.

Scoring of attitude domain

Scoring of attitude domain is shown in Figure 3. The majority of respondents (76.4%) disagreed with the statement that malocclusion is less important to treat compared to other oral health problems. Eight out of 10 respondents (81.4%) agreed that a child's dentition significantly affects quality of life. Most respondents (73.7%) agreed that age is an important factor in initiating orthodontic treatment, and 86.8% emphasised the importance of knowing the timing and sequence of tooth eruption. While 83.6% agreed that early identification of malocclusion is important, 40.7% expressed uncertainty whether orthodontic screening should start at the age of seven. More than half (58.3%) reported that making referrals for orthodontic consultation is difficult and time-consuming. In addition, a large majority agreed that elimination of deleterious oral habits such as thumbsucking or tongue thrust (85.8%), as well as correction of anterior and posterior crossbites (87.9%), can prevent a developing malocclusion.

Scoring of screening practice domain

Scoring of practice domain is shown in Figures 4 and 5. With regard to current practices, more than half of the respondents (52%) reported that they "often" or "always" perform orthodontic screening for schoolchildren. Equal proportions of respondents indicated "sometimes" (42.9%) and "never/rarely" (41.8%) when asked about difficulties in recognising malocclusions requiring referral. For referral of children in the mixed dentition stage, responses were divided, with 38.5% reporting "often/always" and 37.4% "never/rarely." Only a minority (17.6%) found it difficult

Table 6: Exploratory factor analysis of attitude domain

Factors	Items	Factor loading	Cronbach's α
Positively worded	**A2**: Pada pendapat anda, adakah susunan gigi kanak-kanak memberi impak yang ketara kepada kualiti kehidupan mereka? *Do you think that a child's teeth would have a significant impact on his/her quality of life?*	0.668	0.861
	A3: Pada pendapat anda, adakah umur merupakan faktor penting dalam memulakan rawatan ortodontik? *Do you think that age is an important factor in starting orthodontic treatment?*	0.717	
	A4: Adakah anda rasa penting untuk mengetahui masa dan turutan pertumbuhan gigi (kegigian kekal & kegigian susu)? *Do you think it is important to know the time and sequence of tooth eruption (primary and permanent dentition)?*	0.846	
	A6: Pada pendapat anda, adakah penting jika maloklusi dikenalpasti pada peringkat awal? *Do you think that early identification of malocclusion is important?*	0.863	
	A8: Pada pendapat anda, adakah menghentikan tabiat (seperti menghisap ibu jari atau menujah lidah) boleh mengelakkan kejadian maloklusi? *Do you think that eliminating oral habits such as (thumbsucking or tongue thrust) can prevent a developing malocclusion?*	0.713	
	A9: Pada pendapat anda, adakah rawatan pembetulan gigitan silang atau "crossbite" (*anterior'* dan "*posterior*") dan *traumatic overbite* boleh mengelakkan kejadian maloklusi? *Do you think that eliminating crossbites (anterior and posterior) and traumatic overbite can prevent a developing malocclusion?*	0.801	
Negatively worded	**A1:** Pada pendapat anda, adakah maloklusi kurang penting untuk dirawat berbanding dengan masalah kesihatan mulut yang lain? *Do you think that malocclusion is less important to be treated in relation to other oral health problems?*	0.649	0.295
	A7: Pada pendapat anda, adakah rujukan untuk konsultasi ortodontik sukar dan mengambil masa yang panjang? *Do you think referrals for orthodontic consult are difficult and time-consuming?*	0.828	
Excluded	**A5**: Pada pendapat anda, adakah saringan ortodontik sesuai dilakukan pada umur 7 tahun? *Do you think that orthodontic screening should start at the age of 7 years old?*		

Table 7: Exploratory factor analysis of screening practice domain

Factors	Items	Factor loading	Cronbach's α
Current screening practices	**P1:** Adakah anda pernah melakukan saringan ortodontik untuk kanak-kanak sekolah? *Have you done orthodontic screening for school children?*	0.729	0.762
	P2: Adakah anda berasa sukar untuk mengenal pasti maloklusi yang memerlukan rujukan ortodontik? *Do you find difficulties in recognising malocclusions that need orthodontic referral?*	0.711	
	P3: Adakah anda pernah merujuk kanak-kanak dalam kegigian campuran atau "*mixed dentition*" untuk konsultasi ortodontik? *Have you referred a child with mixed dentition for orthodontic consultation?*	0.719	
	P5: Adakah anda berasa sukar untuk menentukan bila masa yang sesuai untuk merujuk kanak-kanak yang mempunyai masalah maloklusi? *Do you find it difficult to decide on when is the right time to refer children with a developing malocclusion?*	0.775	
	P6: Adakah anda pernah menangguhkan rujukan ortodontik sehingga semua gigi kekal telah tumbuh? *Have you delayed an orthodontic consultation referral until all permanent teeth in a child has erupted?*	0.656	
Willingness to improve screening practice	**P9:** Pada pendapat anda, adakah *Continuous Dental Education* (CDE) mengenai maloklusi akan membantu dalam amalan anda? *Do you think that CDE on malocclusions would be beneficial to your practice?*	0.831	0.705
	P10: Pada pendapat anda, adakah garis panduan kebangsaan saringan ortodontik untuk kanak-kanak boleh membantu anda dalam amalan anda? *Do you think a national guideline for orthodontic screening in children would help you in your practice?*	0.894	
Excluded	**P7**: Adakah anda merujuk kepada garis panduan/indeks untuk rujukan ortodontik? *Do you follow specific guideline/index for orthodontic referral?*		

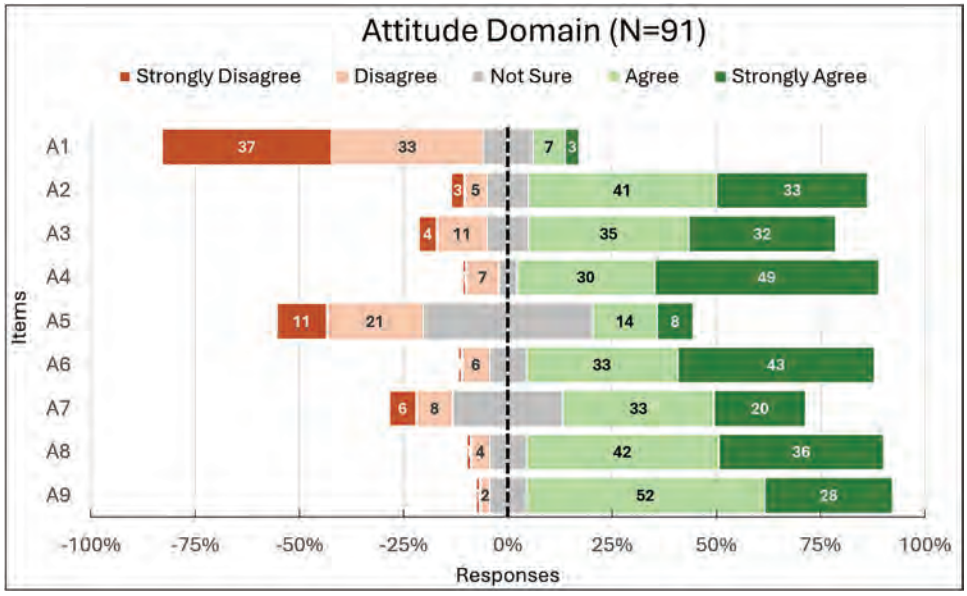

Figure 3: Scoring of attitude domain

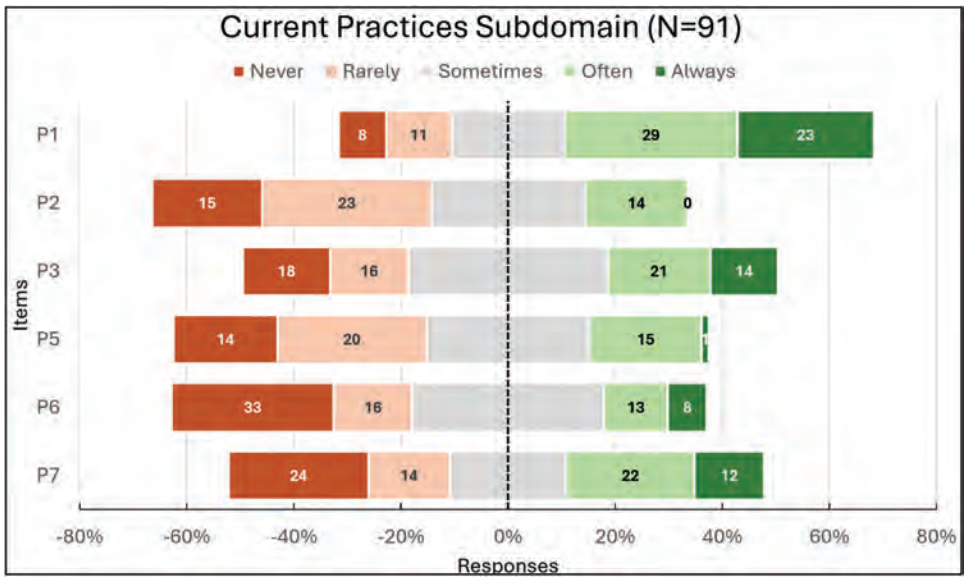

Figure 4: Scoring of current screening practice subdomain

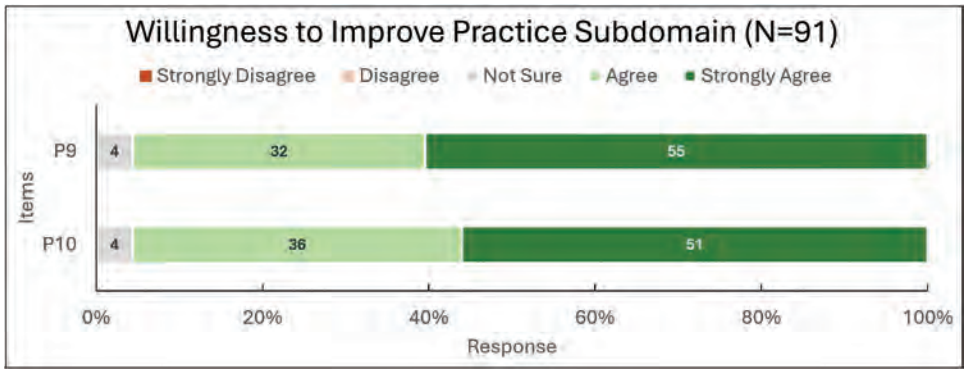

Figure 5: Scoring of willingness to improve screening practice subdomain

to determine the appropriate timing for referral of a child with developing malocclusion. About one-third of the respondents (36.3%) reported that they had never delayed an orthodontic referral until all permanent teeth in a child have erupted. About a quarter (26.4%) never followed specific guidelines or indices for orthodontic referral. When it comes to willingness to improve current practice, almost all respondents (95.6%) agreed that continuous dental education (CDE) on malocclusions, as well as the introduction of a national guideline for orthodontic screening in children, would be beneficial to their practice.

Discussion

To the best of our knowledge, this is the first study to develop and validate a questionnaire assessing knowledge, attitude and screening practices related to interceptive orthodontics for dental therapists in Malaysia. The instrument demonstrated satisfactory psychometric properties, including content, face and construct validity.

The sample size of 91 may be marginally acceptable for IRT, which may pose a certain degree of statistical error limited to IRT. For EFA, sample size of $N = 50$ has been regarded as a reasonable absolute minimum[22,23] and thus considered adequate. The disparity between participants from urban and rural workplace may pose an underrepresentation of dental therapists from rural settings.

The Rasch model was chosen over the 2PL model for its parsimony and lower AIC/BIC values. Unlike the 2PL model which estimates a separate discrimination parameter for each item, the Rasch model assumes uniform discrimination across items, providing simpler interpretation. Both AIC and BIC are aimed to balance the goodness-of-fit of the model with its complexity, to avoid overfitting or underfitting, where AIC tends to overfit, while BIC tends to underfit.[24] Lower AIC and BIC values indicate a better-fitting model.[25]

For knowledge domain, the scale is best suited for identifying respondents with lower knowledge levels ($\theta \approx -2$). This suggests the questionnaire could be extended to broader populations with limited orthodontic knowledge, such as schoolteachers or parents to support oral health promotion initiatives. Several knowledge items (K4, K6, K7, K11, K14) were removed due to low difficulty value, which could be revised in the future to improve the psychometric challenge for professional populations.

For attitude domain, EFA revealed a two-factor structure, with all factor loadings above 0.4, indicating close relations between factors and items. The extracted factors of positively worded and negatively worded factors are similar to a study by Fallis,[26] which explains that individuals responded differently to the negatively and positively worded items.[26,27] Previous studies[26,28-30] support usage of both positively and negatively worded items to minimise agreement bias,[26,31-33] which is the tendency to agree with the survey items regardless of content. Negatively worded items serve as "cognitive speed bumps" that require respondents to engage in more controlled, as opposed to automatic, cognitive processing.[26,34] The internal consistency in negatively worded item was low ($\alpha = 0.295$), likely due to the limited number of items in that subscale.[35] Future studies should consider adding more well-constructed negatively worded items to improve internal reliability. Nonetheless, overall attitude factor demonstrates good internal consistency.

Item A5 ("*Do you think that orthodontic screening should start at the age of 7 years old?*") was removed due to low communality and low factor loading. The American Association of Orthodontists recommends orthodontic screening of all children at age 7.[36] However, this ideology is not a cultural norm in Malaysia at this moment. Overall, the respondents demonstrated positive attitudes towards interceptive orthodontics.

For screening practice domain, the EFA resulted in a good-fitting two-factor model as well, with good reliability. Item P7 (*"Do you follow guideline/indices for orthodontic referral?")* was removed due to low communality. This may be because dental therapists are not extensively trained to use orthodontic screening guidelines such as index of orthodontic treatment need (IOTN), where a quarter of the respondents never followed any orthodontic indices for referrals. However, ongoing efforts have been made by Ministry of Health to introduce such index through CDE, for example, briefing on Orthodontic Referral Guidelines in dental services facility of Ministry of Health Malaysia (*"Taklimat Garis Panduan Rujukan Rawatan Ortodontik Di Fasiliti Perkhidmatan Pergigian KKM"*) during their service.

Overall, orthodontic screening was carried out regularly by half of the respondents, but referral practices showed inconsistencies. Respondents are open to improve current screening practices through CDE and implementation of a national guideline for orthodontic screening in children. It could be argued that IOTN-dental health component requires effort in classifying cases for dental officers, moreover for dental therapists. A simple screening index, namely "Index of Interceptive Orthodontics Referral (IIOR)," has been developed by Sinniah *et al*.,[37] which may be of a valuable tool for dental therapists.

The limitation of this study was the limited sample size obtained, as well as sampling bias due to convenience sampling. This study has also selection bias whereby the demographic of dental therapists was restricted within the state of Johor and is not representative of the entire dental therapist's workforce in Malaysia. However, this study

offers valuable initial validation and lays groundwork for further studies with larger populations.

Adaptation of this validated questionnaire for broader application to dental therapists across all Malaysian states would allow for validation of the tool at a national level as well as generating baseline data, comparison across states, and monitoring of improvements over time. The data could guide policy decisions to improve orthodontic referral timing and outcomes for schoolchildren in Malaysia.

Future studies should aim for larger, randomised samples, possibly recruited during professional association meetings to improve response rates. Increased sample size allows more detailed psychometric evaluation, especially for knowledge domain by higher order IRT, for example, 3PL, to account for guessing parameter. Future works may modify existing questionnaire, especially to increase psychometric difficulty of knowledge items. Additionally, expanding the item pool in the attitude and screening practice domains would enhance reliability.

Conclusion

In conclusion, this study reported validation of knowledge, attitude and screening practice questionnaire for interceptive orthodontics in Malay and English language that was developed among dental therapists in Johor. The final questionnaire consisted of four sections and 31 items (seven items on sociodemographic, nine items on knowledge domain, eight items on attitude domain and seven items on screening practice domain). This validated instrument can serve as a foundation for future national surveys, professional development initiatives and policy-making efforts aimed at enhancing early orthodontic intervention and referral practices for schoolchildren in Malaysia.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Smile Perception Amongst Patients Undergoing Orthodontic Treatment and Dentists in Rural Pahang: A Cross-sectional Study

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Abstract

Introduction: This cross-sectional study analyses the smile perception of patients undergoing orthodontic treatment and dental professionals. **Methods**: A photograph of a woman's smile was digitally altered in relation to three variables: dental midline, overbite depth and occlusal canting. Ninety-one evaluators rated 16 photographs of two groups: patients undergoing orthodontic treatment ($n = 45$) and dentists ($n = 46$) in rural Pahang. Sixteen photographs, 13 digitally altered and three original photographs were randomly compiled into a catalogue of four pages. Both groups scored the photographs using a visual analogue scale. Data were analysed using SPSS Version 22.0. The mean and standard deviation values were tabulated and calculated for each group. The comparison between both groups was conducted using an Independent *t* test. **Results**: There was no significant difference in the perception of the dental smile between patients undergoing orthodontic treatment and dentists for midline deviation and overbite depth. The results showed a significant difference between varying levels of canting of the occlusal plane. Patients' undergoing orthodontic treatment perceived the canting of the smile more critically, as shown through the changes in 1 mm (P value < 0.022), 2 mm (P value < 0.022) and 3 mm (P value < 0.027) of the occlusal plane. **Conclusions**: The overall aesthetic perception was similar for deviated upper midline position and overbite level; however, there is a significant difference, in which patients undergoing orthodontic treatment are more aware of the occlusal canting. Therefore, it is of paramount importance to understand different aesthetic norms to achieve excellent treatment results in line with expectations for each patient.

Keywords: Cross-sectional, midline deviation, occlusal canting, overbite, smile perception

Main Points

Since there may be discrepancies between the perception of the dental professional and the patient undergoing treatment when it comes to aesthetics and perceiving smiles, the purpose of this study is to comprehensively assess and compare altered dentofacial aesthetics among patients undergoing orthodontic treatment and dentists in rural Pahang to render suitable treatment within an appropriate time frame. The results show that there was no significant difference in the perception of the dental smile between patients undergoing orthodontic treatment and dentists for midline deviation and overbite depth and that the overall aesthetic perception was similar for deviated upper midline position and overbite level; however, there is a significant difference, in which patients undergoing orthodontic treatment are more aware of the occlusal canting. The patients' undergoing orthodontic treatment perceived the canting of the smile more critically which can have an impact on finishing treatment mechanics as well as duration of treatment.

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Introduction

The increased realisation of aesthetics importance and the perception of beauty and deformities by oneself are the contributing factors in an increase of orthodontic treatment.[1] Recent studies show gender, age,[2] facial types and personal experience[3] play a role in the determination of attractiveness. An individual seeks orthodontic treatment for multiple reasons that include improving appearance, the function of the teeth, external factors such as being affected by the behaviours and thoughts of others, and improving confidence.[1]

Society has placed importance on physical attractiveness over the years.[3] Facial attractiveness and smile attractiveness are strongly connected since attention is mainly directed toward the mouth and eyes of the speaker's face during an interaction. This attractiveness will influence mating success, kinship opportunities, personality evaluations, performance and employment prospects.[4]Smile analysis includes assessing the patient's smile arc, tooth and gingival display, presence of buccal corridor space, the coincidence between facial and dental midlines, tooth proportionality, gingival aesthetics, tooth colour and occlusal plane (OP) inclination.[5] Many adults and adolescents perceive their smile as unpleasant and seek orthodontic treatment to improve it.[6]

Assessing beauty is highly subjective as the perception varies from person to person and is influenced by personal experiences and social environment.[3] There can be differences in opinion regarding aesthetics between laypeople and professionals for the same reasons.[7] Roden-Johnson *et al*.[8] reported that general practitioners, orthodontists and laypersons evaluated smiles differently.[9] However, other researchers reported that smile attractiveness did not differ between dental professionals and laypeople.[3]

Many recent studies focus on comparing the perception of a layperson with dental professionals.[9] Dental professionals face difficulties during treatment and to a certain extend prolong treatment to correct the discrepancies to achieve a perfect occlusion.[10] Therefore, these studies conducted helped in understanding the impact of smile perception between a dental professional and laymen in making the best treatment result without compromising the aesthetic of the face and the teeth.[10] There are limited studies that compare the perception of orthodontic patients with dental professionals.[6]

The purpose of this study is to comprehensively assess and compare altered dentofacial aesthetics among patients undergoing orthodontic treatment and dentists in rural Pahang. The primary aim is to determine the perception of a smile in terms of dental midline shift, overbite and occlusal canting among patients undergoing orthodontic treatment and dentists. The secondary aim is to compare the perception of a smile in terms of dental midline shift, overbite and occlusal canting between patients undergoing orthodontic treatment and dentists. The study outcome is to shorten the finishing and detailing stage of orthodontic treatment with satisfactory aesthetics Pahang without compromising the functional occlusion.

Methods

This study is a comparative cross-sectional study, which involved data collection and analysis of patients undergoing orthodontic treatment and dentists in rural Pahang. This study received ethical approval from the [Medical Research And Ethics Committee, Ministry of Health Malaysia (NMRR-20-2734-57397). Informed consent was obtained before the start of the questionnaire. Inclusion criteria were all orthodontic patients aged 13 years old and above and dentists with more than a year of working experience. Single arch treatment was excluded from the study. Section 1 consists of demographic questions. In Section 2, 16 altered photographs of a woman's smile were portrayed digitally.

Five photographs for dental midline shift were adopted from the study of Aldhorae *et al*.[11] Six photographs for overbite were adopted from Sriphadungporn and Chamnannidiadha.[2] Finally, five photographs for

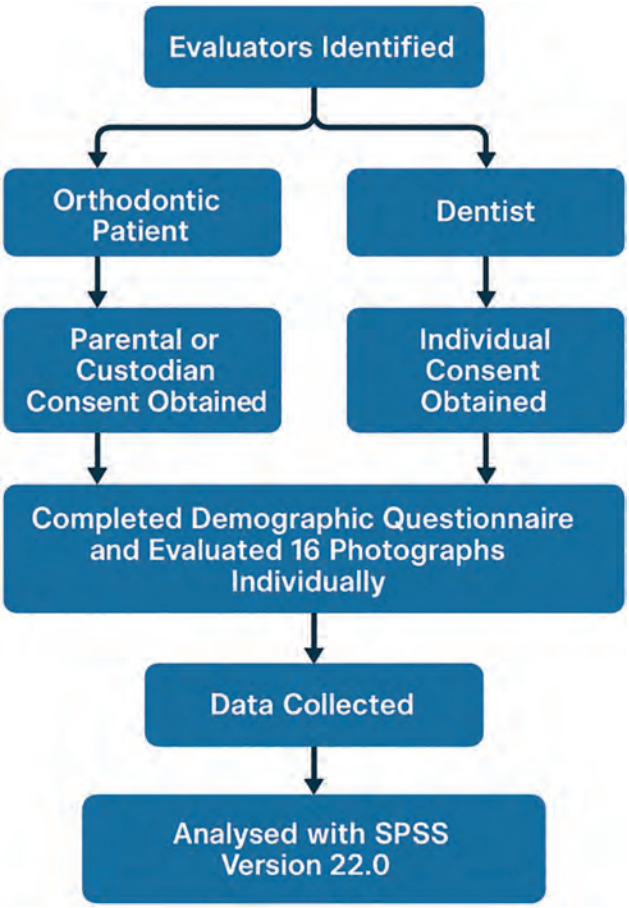

Figure 1 : Obtaining consent and data analysis flowchart

occlusal canting photos were adopted from An *et al*.[6] The original authors made alterations using a software image editing program involving the dental midline of the anterior maxillary teeth, position of the incisal edge of the maxillary central incisors and canting of the maxillary OP.

Sixteen photographs, 13 digitally altered and three original images were compiled into a catalogue of four pages. Each page consisted of four random photographs of different variables and arranged in two columns for the catalogue as shown in Figure 1. The evaluators scored the photograph on the visual analogue scale from 0 to 10, with 0 being the least attractive to 10 being the most attractive. The nose and chin were erased to reduce the number of variables in the images. However, part of the nose was left during the evaluation of the dental midline. All the data were inserted and analysed using SPSS Version 22.0 (IBM Corporation, Armonk, New York, USA) [Figures 2-5].

Results

A total of 45 patients undergoing orthodontic treatment and 46 dentists who met the inclusion criteria were included in this study. Among these participants, 28.6% were male, while 71.4% were females. Out of 91 responses, 85.7% were Malay, 4.4% were Chinese and 9.9% were Indians. The majority of participants were aged 26–35 years (46.7%), followed by those under 16 (27.2%) and 17–25 years (23.9%). Only a small proportion were aged 36–50 years (1.7%), and there were no participants above 51 years of age [Table 1]. Both groups assessed 0 mm midline deviation as the ideal smile, whereas the 3 mm and 4 mm deviation were found to be a less attractive trait. However, there was no significant difference between the two groups for this parameter [Table 2].

Patients undergoing orthodontic treatment and dentists assessed 0 mm overbite as the ideal, whereas an increase in 2 mm overbite was deemed the least attractive. There was no significant difference [Table 3] between the two groups for the altered overbite as the *P* value was not significant.

Patients undergoing orthodontic treatment and dentists find the 0 mm occlusal canting trait the most attractive. Patients undergoing orthodontic treatment deemed 3 mm occlusal canting as least attractive, whereas dentists tend to find 4 mm canting as least attractive. There is a notable distinction between the two groups concerning occlusal canting. Specifically, the *P* value for 1 mm ,2 mm and 3 mm are 0.022, 0.022 and 0.027, respectively [Table 4].

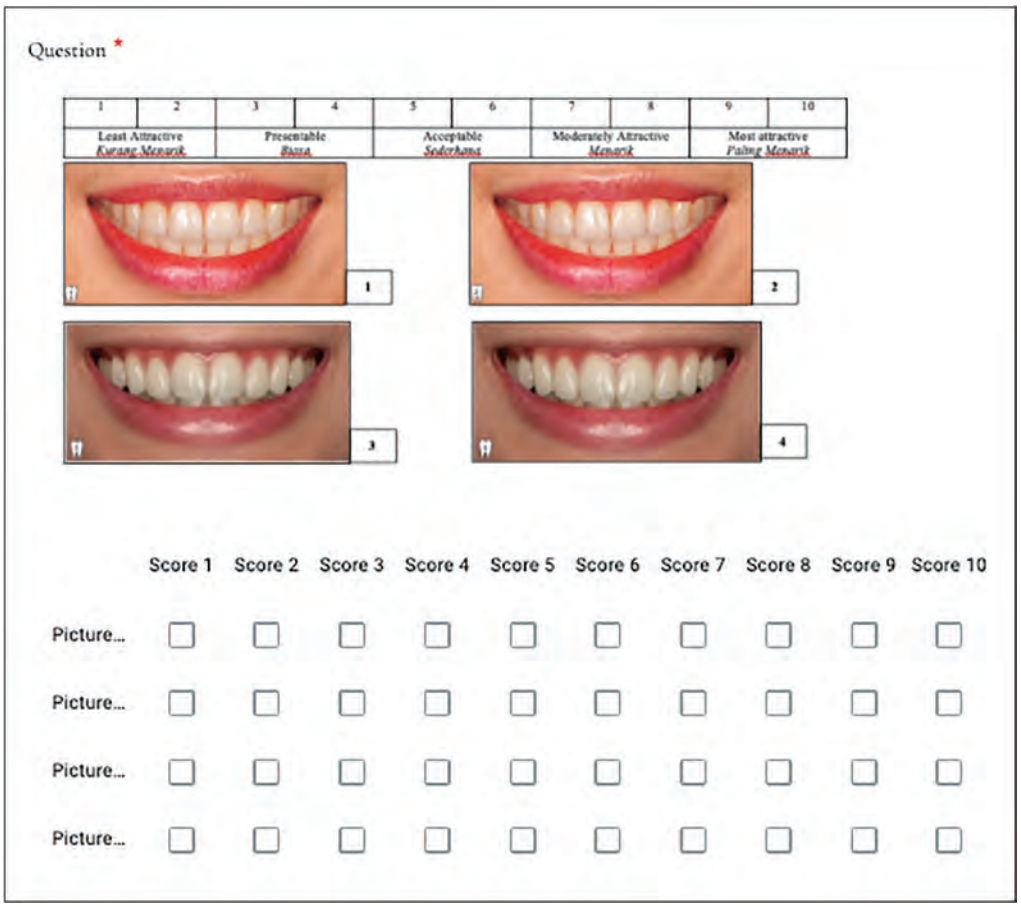

Figure 2: Data collection using catalogue of four random photographs in two column

Figure 3: Manipulation of maxillary dental midline: (A) No midline deviation, (B) 1 mm midline deviation, (C) 2 mm midline deviation, (D) 3 mm midline deviation, (E) 4 mm midline deviation[1]

Figure 4: Manipulation of maxillary central incisor edge: (A) 0.5 mm intruded (overlapping of 50% incisal clinical crown length), (B) 0mm extruded (overlapping of 60% incisal clinical crown length), (C) 0.5 mm extruded (overlapping of 70% incisal clinical crown length), (D) 1 mm extruded (overlapping of 80% incisal clinical crown length), (E) 1.5 mm extruded (overlapping of 90% incisal clinical crown length), (F) 2.0 mm extruded (overlapping of 100% incisal clinical crown length

Discussion

The demand for orthodontic treatment is high in Malaysia.[12] The definite need for treatment for 12 years old is 51.4%,[13] 13 to 14 years old is 27.1%[14] and 16 years old is 56.4%. Local studies reported that the desire for treatment for 12 years old is 22%,[13] whereas 16 years old is 47.2%.[14] Kiyak[9] reported that patients seeking orthodontic treatment were more concerned about improving aesthetics and social acceptance than oral function or general health.[9,15] It is essential to assess not just the clinician's viewpoint on aesthetics, but also the patients' viewpoint.[16] Thus, this study is pivotal to understand the perception of both dentists and patients to deliver a satisfactory outcome according to the patient without compromising the functional occlusion of the patient.[17]

Limited studies have established threshold levels of noticeability of various aesthetic discrepancies among layperson with orthodontic experience.[6]However, many studies have evaluated the smile perception among laypersons with no orthodontic experience, dentists, dental students, orthodontists and prosthodontists. From the orthodontic standpoint, this research holds considerable significance since the laypersons' cohort represents the primary audience for these treatments.[18]

Figure 5: Manipulation of the occlusal plane of the maxillary arch: (A) No occlusal plane canting, (B) 1 mm occlusal plane canting, (C) 2 mm occlusal plane canting, (D) 3 mm occlusal plane canting, (E) 4 mm occlusal plane canting[6]

Table 1: Age distribution of participants (*N* = 92)

Age Group	*n*	%
Under 16 years	25	27.2%
17–25 years	22	23.9%
26–35 years	43	46.7%
36–50 years	2	2.2%
Over 51 years	0	0%
Total	92	100%

An ideal dental midline should coincide with the facial midline. The soft tissue nasion, middle part of the upper lip at the vermillion border, and the chin point should be aligned.[19] According to the findings of this study, patients undergoing orthodontic treatment and dentists exhibit equal attentiveness to changes in the dental midline of the anterior maxillary teeth. The result showed that the capacities of both groups to perceive changes in each millimeter of deviation were not significant. A systematic review reported that a mean deviation of 2.38 mm is acceptable among laypersons.[20] Some investigators reported that a maxillary midline deviation of 4 mm was undetectable by laypersons and general dentists.[21] Some studies reported that laypersons could detect midline deviation up to 3 mm and 4 mm .[22–24] These divergent results can be due to the heterogeneity of the population being studied.[19] A precise dental midline has the potential to look artificial compared to a displaced dental midline.[19] Some investigators reported that a displaced midline is acceptable if the tooth structure maintains parallelism to the facial midline.[19] Correction of the dental midline can be a daunting task, increasing the complexity and duration of orthodontic treatment.[19] Patients undergoing orthodontic treatment and dentists regarded accurate midline as the most attractive trait and this correlates with Kokich[21] whom strongly believe that an accurate midline is aesthetically ideal.

An overbite is defined as the vertical overlapping of the mandibular incisors by the maxillary incisors in centric occlusion, which is approximately 1-3 mm . Normally, the overbite is about 30% or one third of the clinical crown height of the mandibular incisors.[25] Laypersons demonstrated the preference for the ideal,[18,20,26]0.5 mm intruded[26] and 1.0 mm extruded[18,26] central incisors position as attractive. The most preferred situation is that the maxillary lateral incisor position is 1.0 mm to 1.5 mm shorter than the maxillary central incisor with the maxillary central incisor and canine placed at the same level.[20]The incisal edge position should be located below the tips of the canine to achieve a convex or consonant smile.[27] Patients undergoing orthodontic treatment and dentists showed no significant differences for the differing overbite depths in this current study, which is agreeable with other studies.[18,26] Clinically, the placement of the maxillary central incisor edges should follow the lower lip.[28] Any changes in the vertical position should be evaluated together with the mandibular function as the vertical position of the maxillary central incisors affects the mandible's lateral excursive and protrusive movement.[28] Thus, scientific data obtained from this research are essential for professionals to manage the aesthetic expectation of patients and to outline a realistic treatment plan with proper finishing.[28] When the bracket position changes, the position of the incisal edge changes and the percentage of soft tissues displayed are modified.[28] Hence, optimising smile aesthetics during bracket positioning and also during finishing and detailing phases is fundamental.[18,28]

An OP is an imaginary surface, that is, anatomically related to the cranium which touches the incisal edges of the incisors and the tips of the occluding surfaces of the posterior teeth.[29] As for the dentist, occlusal canting plays an important role from the aesthetical point of view. These results correlate with the previous studies regarding dentists having different perceptions of smile aesthetics, and dentists

Table 2: The differences in smile perception of midline deviation between patients undergoing orthodontic treatment ($n = 45$) and dentists ($n = 46$)

Parameter of Midline Deviation	Patients Undergoing Orthodontic Treatment Mean (SD)	Dentists Mean (SD)	Mean Difference 95% (CI)	*P* value
0 mm / Ideal	3.11 (1.402)	3.00 (1.350)	1.146	0.701
1 mm Midline Deviation	3.09 (1.258)	2.85 (1.366)	1.094	0.384
2 mm Midline Deviation	2.87 (1.455)	2.74 (1.405)	1.191	0.672
3 mm Midline Deviation	2.40 (1.355)	2.30 (1.396)	1.147	0.741
4 mm Midline Deviation	2.33 (1.331)	2.33 (1.461)	1.165	0.980

P value < 0.05 is significant

Table 3: The differences in smile perception with altered overbite in patients undergoing orthodontic treatment ($n = 45$) and dentists ($n = 46$)

Parameter of Overbite	Patients Undergoing Orthodontic Treatment Mean (SD)	Dentists Mean (SD)	Mean Diffference 95% (CI)	*P* value
−0.5 mm Overbite	3.49 (1.058)	3.59 (1.127)	0.911	0.670
0 mm / Ideal	3.60 (1.136)	3.67 (1.136)	0.946	0.757
+0.5 mm Overbite	3.22 (1.126)	3.52 (1.130)	0.939	0.209
+1.0 mm Overbite	3.49 (1.218)	3.46 (1.110)	0.970	0.895
+1.5 mm Overbite	3.36 (1.209)	3.28 (1.148)	0.982	0.769
+2.0 mm Overbite	3.07 (1.074)	3.22 (1.114)	0.912	0.513

P value < 0.05 is significant

Table 4: The differences in smile perception for differences in the occlusal canting between patients undergoing orthodontic treatment ($n = 45$) and dentists ($n = 46$)

Parameter of Occlusal Canting	Patients Undergoing Orthodontic Treatment Mean (SD)	Dentists Mean (SD)	Mean Difference 95% (CI)	*P* value
0 mm / Ideal	3.29 (1.079)	3.67 (1.194)	0.948	0.110
1 mm Occlusal Canting	3.04 (1.296)	3.65 (1.197)	1.039	0.022*
2 mm Occlusal Canting	3.00 (1.348)	3.63 (1.236)	1.077	0.022*
3 mm Occlusal Canting	2.84 (1.147)	3.41 (1.257)	1.003	0.027*
4 mm Occlusal Canting	2.87 (1.179)	3.26 (1.290)	1.030	0.132

**P* value <0.05 is significant

are less liberal of some dental conditions than the general public.[20] The latter is supported by Kokich[21] findings that the dentists rated incisal plane asymmetry as the most noticeable dimension. In this study, patients undergoing orthodontic treatment and dentists can detect deviations from 1 mm to 3 mm occlusal canting. An[6] reported that laypersons with orthodontic experience rate occlusal canting of 2.0 mm and 3.0 mm as unattractive. Senışık *et al*.[29] reported that laypersons were unable to detect an incisal plane asymmetry up till a 3 mm discrepancy. The differences among laypersons with experience and without orthodontic experience could mean that the experience of orthodontic treatment affects ones' perceived ability to evaluate occlusal canting.[6] Other than that, the perception of an occlusal canting is also dependent on the degree of canting.[6] The correction of asymmetry may be considered an enormous challenge because of complex mechanics during treatment and uncertainty in terms of stability after an orthodontic treatment.[30]

This study has some significant findings on smile perception of the orthodontic patients. However, it has several limitations to be considered. Despite these insights, several limitations should be acknowledged. The images used in this study were sourced from three different previous studies. Consequently, the photographs varied in terms of subject and style, and participants may have recognised these differences. This lack of standardisation could influence perception and introduces potential bias and should be considered a limitation of the study. In addition, duplicate images were not included for calibration purposes. This lack of calibration may affect the reliability of the findings and should be addressed in future studies. Furthermore, the result of this study is evaluations of digitally manipulated photographs without considering the dynamics of speech and the smile.[18] Moreover, high qualities and resolution of the photo might affect the judgement of smile perceptions.[31] Ethnicity may have a significant association with the perception of smile perception.[17] Future studies should be conducted on a larger scale with various age groups and ethnicities using a full-frame sensor on a complete facial profile, taking into account calibration and image standardisation.

Conclusions

The overall aesthetic perception was similar for deviated upper midline position and overbite level between patients undergoing orthodontic treatment and dentists. However, there is a significant difference, in which patients undergoing orthodontic treatment are more aware of the occlusal canting. Therefore, it is of paramount importance to understand different aesthetic norms to achieve excellent treatment results in line with expectations for each patient.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Evaluation of the Reliability and Validity of Family Impact Scale Questionnaire Translated into Malayalam by Assessing Traumatic Dental Injury in Children

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Abstract

Objectives: To evaluate the validity and reliability of the family impact scale (FIS) after it has been translated and culturally adapted for Malayalam-speaking parents and to assess the impact of children's traumatic dental injuries on family functioning. **Materials and Methods**: A case–control study was conducted across eight schools. A total of 258 children aged 12–15 years were examined for dental trauma, with 86 identified as cases and 172 as controls. Their parents completed the Malayalam version of the FIS tool, which was translated and back-translated by professional bilingual translators, reviewed by experts and pilot-tested for clarity and cultural appropriateness. Internal consistency, test–retest reliability and criterion validity were analysed. **Results**: The Malayalam FIS demonstrated high internal consistency (Cronbach's $\alpha = 0.838$). The test–retest reliability was also strong, with intra-class correlation coefficients values indicating stability over time. The total FIS score was significantly higher in the case group (20.73 ± 6.69) compared to the control group (14.98 ± 2.04), with a mean difference of 5.75, indicating a greater negative impact on families in the case group. Domains of the FIS – parental activity, parental emotions and financial burden showed a moderate-to-strong correlation with the total FIS score, supporting the tool's criterion validity. **Conclusion**: The Malayalam-translated FIS is a valid and reliable instrument to assess the impact of dental trauma on families. The results suggest that traumatic dental injury has a negative impact on the family, affecting various aspects of daily life and emotional well-being.

Keywords: Family impact scale, quality of life, traumatic dental injury

Introduction

Traumatic dental injury (TDI) is a frequent dental issue affecting children worldwide, with most cases affecting the upper central incisors.[1] The esthetic and functional implications of TDIs can result in considerable psychological distress in children, including anxiety, reduced self-esteem and social withdrawal.[2] In addition to impacting the affected child, dental trauma often exerts a significant emotional and practical burden on families. Parents concern for the child's emotional well-being can disrupt family routines and contribute to overall decreased quality of life.[3]

Quality of health refers to a person's perception of their physical, mental and social well-being within their daily life, often influenced by factors like disease, disability or treatment.[4] Oral health-related quality of life (OHRQoL) is a multidimensional construct that includes a subjective evaluation of the individual's oral health, functional well-being, emotional well-being, expectations and satisfaction with care and sense of self.[5] To accurately capture OHRQoL, several validated measurement tools have been developed. While these instruments provide valuable insights into the individual's experiences, they often overlook the broader

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influence that oral health can have on the family unit. Recognising this gap, Locker *et al*.[6] developed the family impact scale (FIS) as part of the child OHRQoL suite. The FIS questionnaire is a 14-item questionnaire that assesses the burden experienced by families due to a child's oral condition, including emotional stress, disruption of family activities and financial difficulties.[7] This perspective is particularly important in paediatric dentistry, where caregivers are deeply involved in the child's treatment, coping and decision-making processes.

The validity and reliability of the FIS questionnaires have been well documented. Since its development, the FIS has been translated and culturally adapted into several languages, including Brazilian Portuguese, Arabic, Spanish and Turkish among others, to ensure its applicability in diverse populations.[8] It has been previously validated in some Indian languages also.[9,10]

Literature does not show any longitudinal studies conducted in Kerala that evaluate the impact of TDI on families of children. The purpose of translating the FIS into Malayalam is to make the scale linguistically accessible to Malayalam-speaking populations, particularly in regions like Kerala state, parts of Pondicherry state and Lakshadweep, India. Therefore, the translated and validated FIS can serve as a reliable tool for assessing the quality of life of families. It can also support the planning and management of health programs in Kerala and other Malayalam-speaking territories of India.

Materials and Methods

A case–control study was conducted among school children in Kannur District for a period between June 2024 and March 2025. Before the start of the study, the study design was comprehensively reviewed and approved by the Institutional Ethical Committee and Review Board of Kannur Dental College (IEC No: IECKDC/2023-01/014).

Purposive sampling was done for this study. The sample size calculation was performed using the prevalence of TDI among cases and controls determined in a previous study by Vieira-Andrade RG.[11] The following equation was used to calculate the sample size.

$$\text{Sample Size} = \frac{(r+1)^2 \times p(1-p)\left(Z_{1-\beta} + Z_{1-\alpha/2)}{}^2\right)}{r\left(p_1 - p_2\right)^2}$$

r = control to cases ratio (0.5 as were taking in 1:2), P_1 = proportion in cases, P_2 = proportion in controls, $Z_{1-\beta}$+ = power (0.84 for 80%), $Z_{1-\alpha/2}$ = error (1.96 at 5%), Therefore, the total sample size is taken as 258.

Patient selection

School children between the ages of 12 and 15 years with permanent dentition were included in the study. Physically, mentally and medically compromised children, children without consent, children with enamel hypoplasia and children with congenital abnormalities were excluded.

Data collection

The Kannur district has been divided into four zones, namely, north, south, east and west in accordance with the geographic location. Two schools were selected from each zone randomly by using the lottery method. Children were then selected from the selected schools according to the inclusion criteria. As per the sample size, 86 cases affected by dental trauma and 172 subjects as controls were identified in the ratio of 1:2. This was done to ensure improved precision of the odds ratio and to reduce standard error, resulting in narrower confidence intervals and to detect true associations with rare outcomes such as TDIs.

Clinical examinations for TDI classification were performed with the patient positioned in a sitting position under a light source. The classification of TDI was performed according to Ellis and Davey classification.[12]

For the family impact measurement, parents of the participants were provided with a questionnaire that was divided into three parts. The first part consists of questions regarding personal information. The socioeconomical status was assessed using the modified Kuppuswamy Scale.[13] The second part of the questionnaire consists of TDI questions, such as when, where and how the trauma occurred; which teeth were affected; and the type of trauma. The third part of the questionnaire refers to the QoL assessment. Quality of life was measured using the Malayalam-translated FIS (M-FIS). The FIS consists of 14 items divided into four sub-scales: parental/family activity (PA), parental emotions (PE), family conflict (FC) and financial burden (FB).

Following processes were conducted for translation and validation of M-FIS.

Translation of the questionnaire into Malayalam

The English questionnaire was translated into Malayalam by two certified bilingual legal translators. A review panel comprising five individuals, that is, three dentists and two non-dentists evaluated the translation for correctness of the scientific terminology, logical language flow and overall clarity of each item.

Back translation

Back-translation was conducted by independent native professional translators fluent in both Malayalam and English. The back-translated version was then compared with the original English version. Any discrepancies were discussed by the research team in collaboration with the translators.

Expert panel review

The finalised Malayalam version was reviewed by three independent dental professionals fluent in both Malayalam

and English. Their task was to assess the appropriateness of the translation and ensure alignment with the regional dialect and professional terminology.

Pilot testing

To evaluate comprehension, the Malayalam questionnaire was pilot-tested on 20 volunteer participants whose demographic characteristics closely matched the target study population.

Scoring

Each questionnaire item included five response options:

- Never = 0.
- Once or twice = 1.
- Sometimes = 2.
- Often = 3.
- Every day or almost every day = 4.

Responses marked as 'don't know' were recorded but excluded from the total T-FIS score calculations. The overall T-FIS scores and subscale scores were computed as the sum of the respective response codes.

Statistical analysis

Statistical analysis was performed using IBM Statistical Package for the Social Sciences version 22 (IBM Corp., Armonk, NY, USA). To evaluate internal consistency within each domain, Cronbach α was calculated. The reliability of measurements within each domain was further assessed using intra-class correlation coefficients (ICC) along with their corresponding 95% confidence intervals. Pearson's correlation coefficient was employed to determine the strength and direction of linear relationships between continuous variables, while Spearman's correlation coefficient was used to assess the strength and direction of monotonic relationships between variables. All statistical tests were conducted at a 95% confidence level, with significance set at $P < 0.05$.

Results

The Table 1 presents the demographic details of the study population, including age, gender distribution and socioeconomic status. The mean age of the participants is 10.87 years, with a standard deviation of 0.87 years, indicating a relatively homogenous age group. The majority of the participants are male (72.1%), while females constitute 27.9% of the sample. The participants come from diverse socioeconomic backgrounds. The mean socioeconomic status scores show that majority of the participants are between lower to lower middle class.

Table 2 shows the characteristics of dental trauma among the participants. Central incisors were the most common teeth affected by trauma [76 (88.3%)], enamel and dentine fractures were the most common types of fractures [63 (73.2%)] and accidental falls were the most common cause of trauma 38 (44.2%).

Table 3 shows the Cronbach α values of 0.838 indicates a high level of internal consistency for the 14-item questionnaire.

Table 4 presents the reliability measures for different domains assessed in the study. The Cronbach α values range from 0.71 to 0.75, indicating acceptable reliability. ICC values, along with their 95% confidence intervals,

Table 1: Demographic details

Age	
Mean ± standard deviation	10.87 ± 0.87
Gender	
Male *n* (%)	186 (72.1%)
Female *n* (%)	72 (27.9%)
Socioeconomic status – Kuppuswamy Scale	
Upper	20.3 ± 4.61
Upper middle	16.3 ± 3.44
Lower middle	20.6 ± 4.42
Upper lower	15.9 ± 4.8
Lower	20.4 ± 7.03

Table 2: Dental trauma characteristics among participants

Have your child been affected by any dental trauma?	Yes	86
	No	172
	Less than a month	08 (9.3%)
	>1 to <3 months	11 (12.8%)
	>3 to <6 months	41 (47.7%)
	>6 months	26 (30.2%)
Where?	House	61 (70.9%)
	Street/park	4 (4.7%)
	School	9 (10.5%)
	Others	12 (13.9%)
How?	Accidental fall	38 (44.2%)
	Fight	05 (5.8%)
	Running impact	31 (36%)
	Traffic accidents	04 (4.7%)
	Others	08 (9.3%)
Teeth affected?	Central incisors	76 (88.3%)
	Lateral incisors	09 (10.5%)
	Canine	01 (1.2%)
Type of trauma (Ellis classification)	Class 1 and 2	63 (73.2%)
	Class 3	10 (11.6%)
	Class 4	5 (5.8%)
	Class 5	4 (4.7%)
	Class 6	4 (4.7%)
Did you seek dental treatment at the time of that incident	Yes	64 (74.4%)
	No	22 (25.6%)

Table 3: Reliability of the Malayalam family impact scale questionnaire

No of items	No of respondents	Cronbach α
14	258	0.838

Table 4: Internal consistency and reliability for various domains

Domain	No of items	Cronbach α	ICC (95% confidence interval)
Parental activity	5	0.750	0.317–0.437
Parental emotions	4	0.720	0.326–0.458
Family conflict	4	0.729	0.337–0.468
Family burden	1	0.71	0.216–0.31

ICC: intra-class coefficient

provide insights into the reliability of measurements within each domain.

Table 5 shows criterion validity of the translated FIS questionnaire The five items under the PA domain to measure the FIS score, proves a moderate to high correlation (0.404–0.689) with a very high statistical significance. The items under the PA proves a moderate to high validity in measuring FIS score. PE domain to measure the FIS score, proves a moderate-to-high correlation (0.498–0.691) with a very high statistical significance. The FC domain used to measure the FIS score provides a low-to-moderate correlation (0.341–0.581) with a very high statistical significance. The items under the FC domain provides a low-to-moderate validity in measuring the FIS score. The family burden domain is used to measure the FIS score and provides a moderate correlation of 0.492 with a very high statistical significance. The 14 items under the four domains used to measure the FIS score proves correlates to the FIS scale with a very high statistical significance and good criterion validity.

Table 6 shows the result proved that on comparing the mean of total FIS score between the cases and controls under the study, the data observed that the mean total FIS score was higher among those individuals who had trauma (20.73) than among those who did not have trauma (14.98) and this difference in observation between the cases and controls attain a statistical significance with *P* value less than 0.05.

Table 7 shows the comparison between the FIS scores and the socioeconomic status of cases and controls. All subgroups among the cases have high FIS core with upper middle class having the maximum, that is, 22.5 ± 4.62. On analysing the FIS score across the socio-economic status in cases and controls, it was observed that there exists a statistical significance between the cases and controls of various socioeconomic statuses with *P* value less than 0.05.

Table 5: Criteria validity of the translated family impact scale questionnaire

Domains	Items	Pearson correlation (*r*) with total FIS	*P* value
Parental activity	Have you or other parent taken time off work?	0.404	<0.01*
	Has your child required more attention from you or the other parent?	0.627	<0.01*
	Have you or the other parent had less time for yourselves or other family members?	0.689	<0.01*
	Has your sleep or that of the other parent been disrupted?	0.624	<0.01*
	Have family activities been interrupted?	0.682	<0.01*
Parental emotions	Have you or the other parent been upset?	0.686	<0.01*
	Have you or the other parent felt guilty?	0.691	<0.01*
Parental emotions	Have you or the other parent worried that your child will have fewer life opportunities?	0.591	<0.01*
	Have you felt uncomfortable in public places?	0.498	<0.01*
Family conflict	Has your child argued with you or the other parent?	0.581	<0.01*
	Has your child been jealous of you or other family members?	0.341	<0.01*
	Has your child's condition caused disagreement or conflict in the family?	0.432	<0.01*
	Has your child blamed you or the other parent?	0.546	<0.01*
Family burden	Has your child's condition caused financial difficulties for your family?	0.492	<0.01*

*Statistically significant

Table 6: Comparison of mean FIS scores, mean PA scores, mean PE scores, mean FC scores and mean FB scores) between children with and without trauma

Variables	Trauma present	Trauma absent	*P* value
Total FIS scores	20.73 ± 6.69	14.98 ± 2.04	<0.001*
PA scores	8.89 ± 3.68	5.88 ± 1.81	<0.001*
PE scores	5.98 ± 2.65	4.00 ± 0.00	<0.001*
FC scores	4.47 ± 1.35	4.09 ± 0.29	0.066
FB scores	1.37 ± 0.84	1.00 ± 0.00	<0.001*

PA: parental activity, PE: parental emotions, FC: family conflict, FB: family burden, FIS: family impact scale.

Mann–Whitney *U* test, *$P < 0.05$ = statistically significant

Table 7: Comparison between the FIS scores and the socioeconomic status of cases and controls

Socioeconomic status	Cases	Controls	*P* value
Upper	20.3 ± 4.61	18 ± 0	<0.001*
Upper middle	22.5 ± 4.62	15.3 ± 1.90	
Lower middle	21.53 ± 6.76	12.76 ± 0.98	
Upper lower	20.3 ± 7.11	13.9 ± 0.98	
Lower	20.4 ± 7.03	11.9 ± 0.88	

FIS: family impact scale

*Mann–Whitney U test. $P < 0.05$ = statistically significant

Discussion

The Malayalam-translated FIS ensures an internal consistency of all items. The Cronbach α value of 0.838 indicates a high level of internal consistency for the 14-item questionnaire, indicating that the instrument can produce consistent responses in assessing family impacts due to dental trauma. Literatures show that a value above 0.70 is considered acceptable in social science research.[14] A high correlation between the first and second administration of the questionnaire suggests good test–retest reliability.[15] Criterion validity results in this study ensured that all dimensions of the family's experience are adequately captured in the translated version, with no essential aspects omitted or misinterpreted.

Criterion validity assessed whether the FIS effectively captures the intended impact of dental trauma on the family and found that the items were to be coherent.[16] The findings showed a strong correlation between the Malayalam version of the FIS and these validated instruments, thereby supporting the criterion validity of the translated scale.

In our study, the TDIs negatively affected the quality of life with a score of 20.7. Milani *et al*.[17] found that the effect of TDI on OHRQoL diminished due to dental trauma. Abanto *et al*.[18] analysed the impact of children's TDI on parents' QoL and revealed a negative effect, with an FIS total score of 8.33. A study by Bani *et al*.[7] shows a negative impact on parents' QoL, with an T-FIS total score of 16.8 adversely affect the quality of life of Turkish parents, with PE being the most significantly impacted subscale. This may be because parents find themselves in a difficult situation in change of their daily routine, multiple visits to the doctor, interruption in their work and possible feelings of guilt or being upset and unexpected financial responsibility.[19] However, some studies reported that the oral health-related quality of life of children and their families was not affected by TDI, which could be due to the predominance of uncomplicated TDIs being assessed in those studies.[7]

Our data suggest that families experienced minimal to certain disruptions in daily life, emotional well-being or financial stability due to their child's condition. In cases of dental trauma, the financial strain is high in Indian families as dental treatment is not covered under health insurance. This can lead to significant stress as parents may worry about how to finance the required care while balancing other family responsibilities. Moreover, the stress caused by financial strain can exacerbate the emotional distress associated with the childs injury, creating a cycle of tension and anxiety.[7,20]

The results shows that upper middle class has a high FIS score. This could be due to upper-class families typically holding higher expectations for achievements in education, career and social standing, which can result in increased stress and tension within the family. Our results agree with those of studies by Farooq *et al*.[21] In contrast, some studies indicate that families from lower socioeconomic backgrounds often experience a more pronounced impact from dental trauma, largely due to restricted access to dental care and the FBs associated with treatment.[18]

The PA, PE, family burden sub-scales in the questionnaire shows significant responsiveness, which indicates a high impact of trauma in the family. The results are in agreement with those of studies by Abanto *et al*.[8] and Antunes *et al*.[19] Literature on family impact also shows a significant association between children's TDI and parents feeling upset and guilty.[6,22]

The limitation of this study is that participants' parents may inaccurately recall the circumstances or factors related to the TDI, leading to certain recall bias in the data. The severity of dental trauma was not considered in this study, which could affect the discriminant validity scores. This study has been done in the North Malabar region of Kerala state and should be tested for applicability in other Malayalam dialect-speaking areas also.

Conclusion

The present study validated the Malayalam version of the FIS and confirmed its reliability and cultural appropriateness in assessing the impact of TDI on families. The tool demonstrated strong internal consistency and test–retest reliability, with significant differences in FIS scores observed between children with and without TDI. The results suggest that TDI has a negative impact on the family, affecting various aspects of daily life and emotional well-being.

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Conflicts of interest

There are no conflicts of interest.

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Comprehensive Multidisciplinary Management of a Case with Mandibular Condylar Osteoma

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Abstract

Mandibular condylar osteoma is a rare condition that causes asymmetry, occlusal discrepancies, and functional issues. This case report outlines a multidisciplinary treatment approach. The initial diagnosis used a bite splint to confirm joint-origin pain. Treatment began with condylar resection and reconstruction plating to maintain vertical ramus height. Surgically assisted expansion was done with an acrylic cap-splint hyrax appliance, followed by orthodontic decompensation. The second surgery included a Le Fort I osteotomy, right-side sagittal split Ramus osteotomy , and a left-side costochondral graft. Post-surgical orthodontics lasted 12 months. Aesthetic crown-lengthening periodontal surgery preceded full-mouth rehabilitation. Three-year post-orthodontic and 1-year post-restorative follow-up showed long-term case stability.

Keywords: Condylar osteoma, costochondral graft, orthognathic surgery, surgical orthodontics, surgically assisted rapid maxillary expansion

Introduction

Facial symmetry and proportion are central to aesthetic appeal. While slight asymmetry is acceptable, significant discrepancies often indicate underlying skeletal anomalies.[1,2] One such condition is condylar osteoma, a rare growth on the mandibular condyle that can cause severe facial asymmetry.[2-4] This case report outlines the diagnosis and successful multidisciplinary management of a 33-year-old male with a condylar osteoma.

Incidence, aetiology, and pathophysiology

The aetiology and pathogenesis of this disorder are unknown, although there have been some suggestions in the literature about its relationship to trauma.[5] There are also suggestions in the literature as to gene alteration of IGF-1, resulting in altered chondrogenesis. Saridin, with the utilisation of F^{18} uptake on positron emission tomography scans, has found no effect of blood flow in the causation of the problem. Rushton[6] has implied that this disease process continues into adulthood, and in most cases causes severe asymmetry, both skeletal and dental, resulting in deformity of the face. This also causes an open bite on the affected side, and/or a canted maxillary occlusal plane, due to supraeruption of teeth. This presentation has also been confirmed by other authors who have described this phenomenon.[2,4] Minimal difference in prevalence between male and female (1.25:1) and no difference between right and left sides were noted.[7]

Case overview

The patient, a 33-year-old Middle Eastern male, presented with jaw pain, limited mouth opening (24 mm), and progressively worsening facial asymmetry. He had undergone a full-mouth rehabilitation in Jordan, but

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lacked pretreatment records. He exhibited psychological stress related to his appearance, which impacted his social life.

Clinical Examination

Extraoral assessment revealed a gross facial asymmetry, with the left side being both vertically and horizontally longer. A 10 mm mandibular deviation to the right was evident, along with a canted occlusal plane. Intraorally, he had a posterior open bite on the left and a scissor bite on the right. Class III molar relationship and anterior crossbite were present. Dentition showed heavy restorations, marginal gingivitis, and failing restorations on the maxillary right side.

Radiographic and imaging analysis

Panoramic and zonogram radiographs confirmed a significant enlargement of the left condyle, with an exophytic growth extending anteriorly towards the pterygoid plates. Computed tomography scans identified a well-demarcated, homogenous bony lesion, 10 mm × 15 mm in size, consistent with a peripheral osteoma. Bone scans showed increased activity on the left side, suggesting active growth.

Cephalometric analysis revealed Class III malocclusion due to maxillary retrusion and mandibular protrusion. Facial height was increased on the left side. Posteroanterior cephalograms showed a 10 mm mandibular deviation, 7 mm occlusal cant, and transverse discrepancies in the maxillary arch [Figure 1A–D].

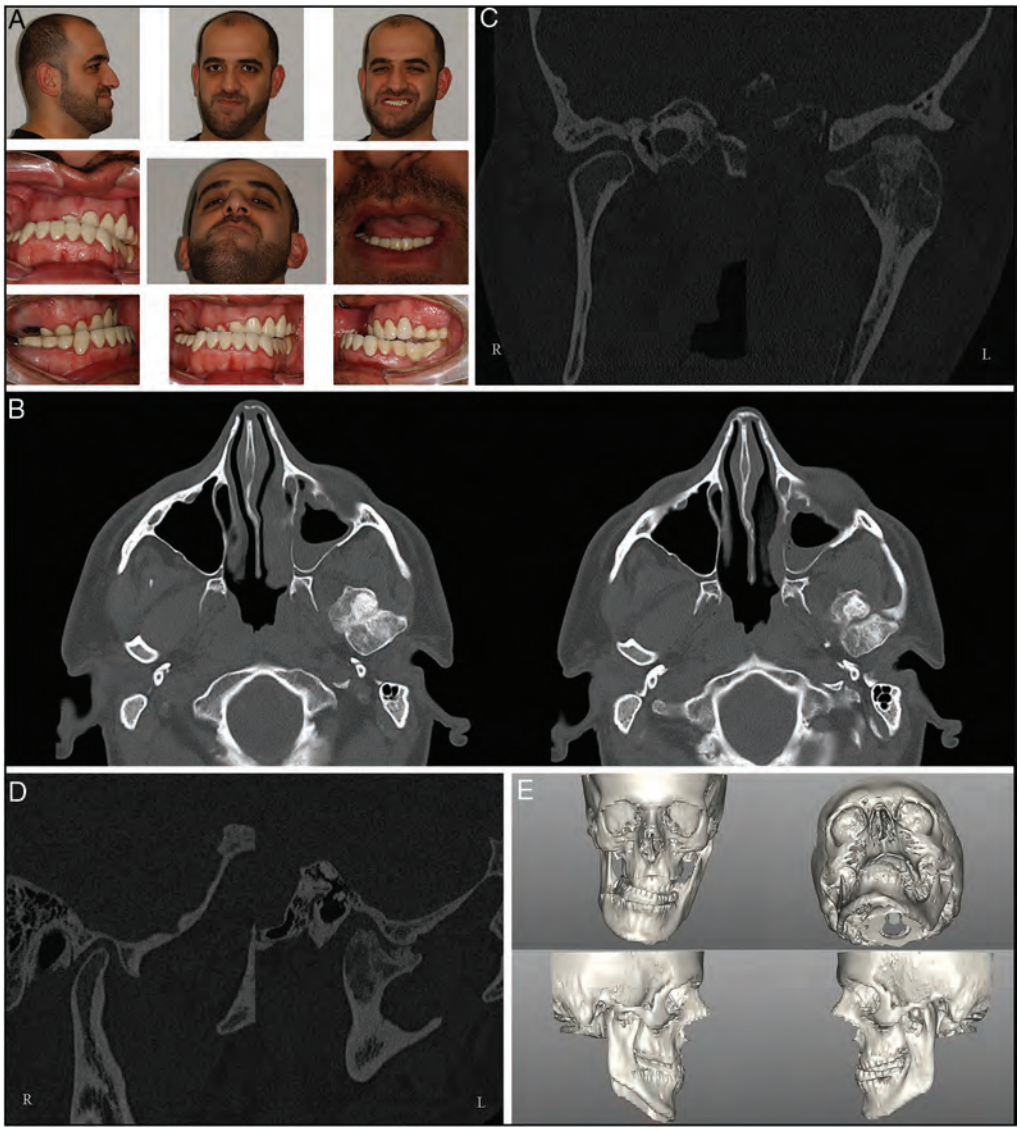

Figure 1: (a) Pretreatment clinical extraoral and intraoral photographs note the extent of deformity caused due to over-growth on the left side, also the extent of open bite on the left side. (b) Axial slices of computed tomography (CT) scan showing the size of the abnormal condyle, anterior–posterior extension, and mediolateral extension. Noted is the homogenous nature of the bone and lack of lytic areas, suggesting osteochondroma. (c) Coronal sections of both the normal (right) condyle and the abnormal (left) condyle. (d) Sagittal view of a CT scan showing normal (right) and abnormal (left) condyles. (e) Three-dimensional reconstruction of a CT scan showing the extent of deformity

Diagnosis

The final diagnosis included Class III malocclusion, maxillary retrusion, mandibular protrusion, and severe skeletal and dental asymmetry due to a growing condylar osteoma (Wolford type IIb).[4] Histopathology confirmed the diagnosis. Functional limitations included restricted mouth movements and associated muscle pain.

Treatment plan

The comprehensive plan involved the following:

1. Attain periodontal and endodontic clearance.[6,8]
2. **Initial surgery:** Resection of the hyperplastic condyle and placement of a reconstruction plate.[9]
3. **Expansion:** Surgically assisted rapid palatal expansion using a cap-splint hyrax appliance after a bone-borne device failed.[10-12]
4. **Orthodontic preparation:** Decompensation and coordination using a fixed 22-slot straight wire appliance.
5. **Definitive surgery:** Lefort I osteotomy for maxillary advancement and cant correction, sagittal split Ramus osteotomy (SSRO) on the right side, and left condylar reconstruction with a costochondral graft.[13-15] During surgical correction of the jaws, an effort was made to maintain interocclusal spacing for further restorative needs.[16]
6. **Post-surgical orthodontics:** Settling and reshaping teeth, followed by aesthetic periodontal surgery.
7. **Final restorations:** Performed with full-contour zirconia crowns after 1-year stabilisation.

Surgical objectives

- Remove the hyperplastic condyle.
- Restore vertical height with a temporary plate.
- Expand the maxilla by 4 mm at cuspids and 10 mm at molars [Figure 2A and B].
- Correct skeletal asymmetry and occlusion.
- Replace the condyle with a costochondral graft.

Orthodontic and aesthetic objectives

- Decompensate dentition and attain proper arch form.
- Achieve normal overjet, overbite, and Class I canine relationships.
- Improve facial aesthetics, including tooth show at rest and smiling.

Treatment progress

The condyle was removed via a preauricular and transparotid approach. The failed bone-borne expander was replaced with a cap-splint hyrax appliance bonded to ceramic crowns, achieving the desired expansion. Orthodontic preparation progressed to surgical wire placement. Virtual planning was done using mounted three-dimensional (3D) models and cone beam computed tomography (CT). Presurgical records were made, and the patient was planned for the second surgery utilising virtual surgical planning [Figure 3A and B].

During the second surgery, the maxilla was advanced 7 mm, and cant was corrected (3.5 mm intruded on the left, 3.5 mm down graft on the right). SSRO allowed mandibular repositioning.[13] A rib graft shaped into a condyle was placed over the preserved meniscus.[14,15] Intermaxillary fixation was maintained for 4 weeks. Interocclusal space was maintained with a surgical splint to enable future restorations with minimal tooth reduction.[16,17]

Postoperative orthodontics included bracket adjustments and space maintenance by interocclusal and interdental bonding for final restorations. Periodontal crown lengthening

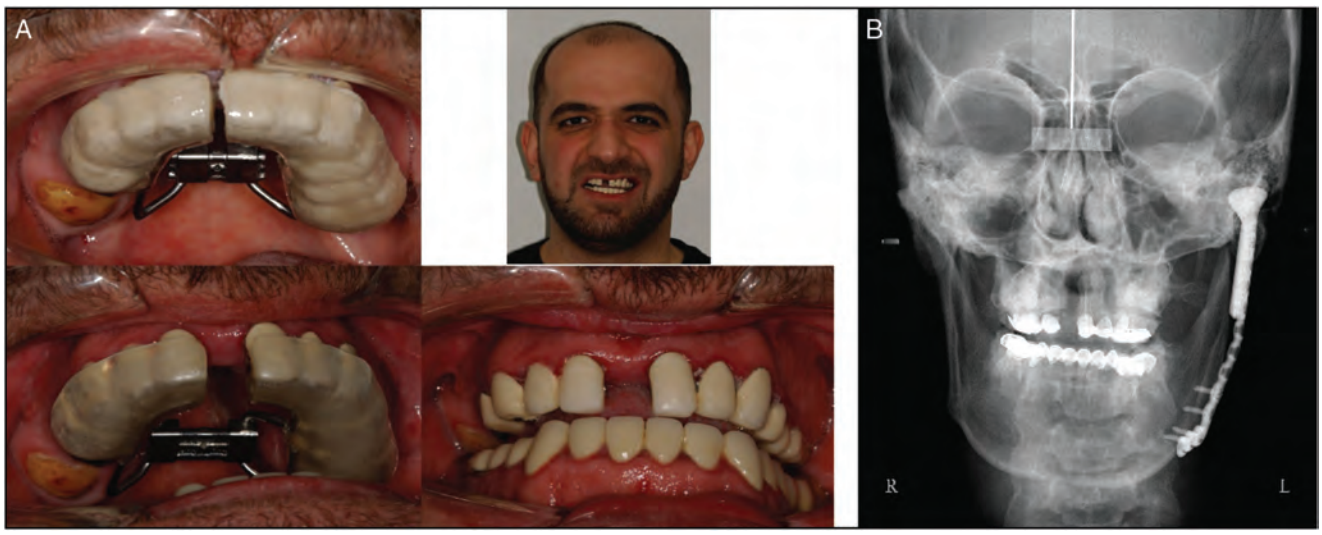

Figure 2: (a) Photograph illustrating pre-expansion and post-expansion done with the cap-splint expander. (b) Posterior/anterior cephalogram indicating the extent of expansion achieved. Also note the reconstruction plate used to maintain the plane of dissection left joint to allow placement of the costochondral graft

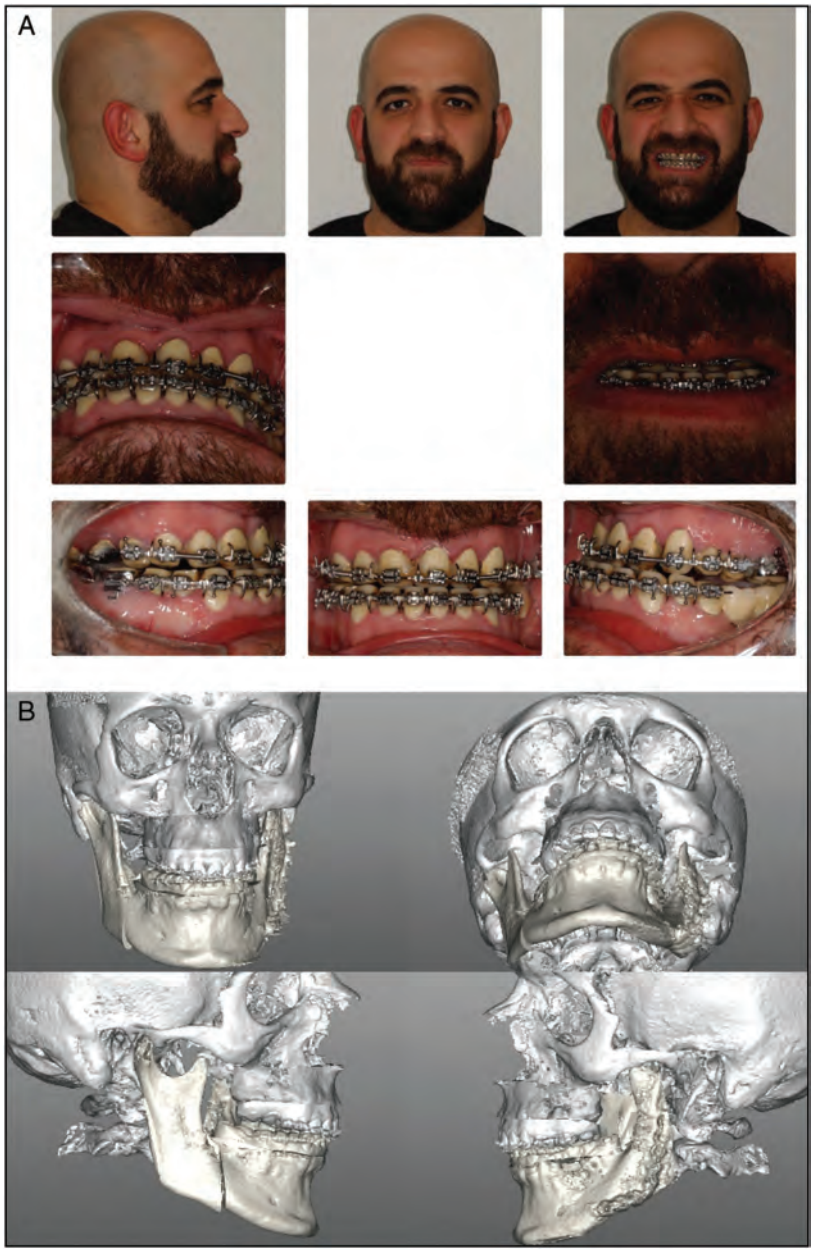

Figure 3: (a) Presurgical, second surgery, extraoral, and intraoral photographs. (b) Three-dimensional images of virtual surgical planning illustrating the final occlusal plan. Note maintained an open bite to allow future restoration of teeth

and tissue recontouring were performed for better aesthetic results. Braces were removed after 14 months. Retention was achieved using Hawley and spring aligners.

Final results

- Expansion of 4 mm (cuspids) and 8 mm (molars) was attained.
- Mouth opening increased to 40 mm with minor deviation.
- Stable Class I canine relationships and functional occlusion were attained.
- Favourable facial and dental aesthetics were attained [Figure 4A and B].
- Restorations were completed using Vortek full-contour zirconia crowns [Figure 5A and B].
- Final results achieved show significant change in both skeletal and dental structures as shown in 3D superimpositions [Figure 6A–C].

Treatment alternatives considered

- Simple resection without addressing skeletal imbalance and using the condylar stump as the new condyle.
- Use of metal prosthesis for condylar replacement.
- Genioplasty was suggested but declined for personal reasons.

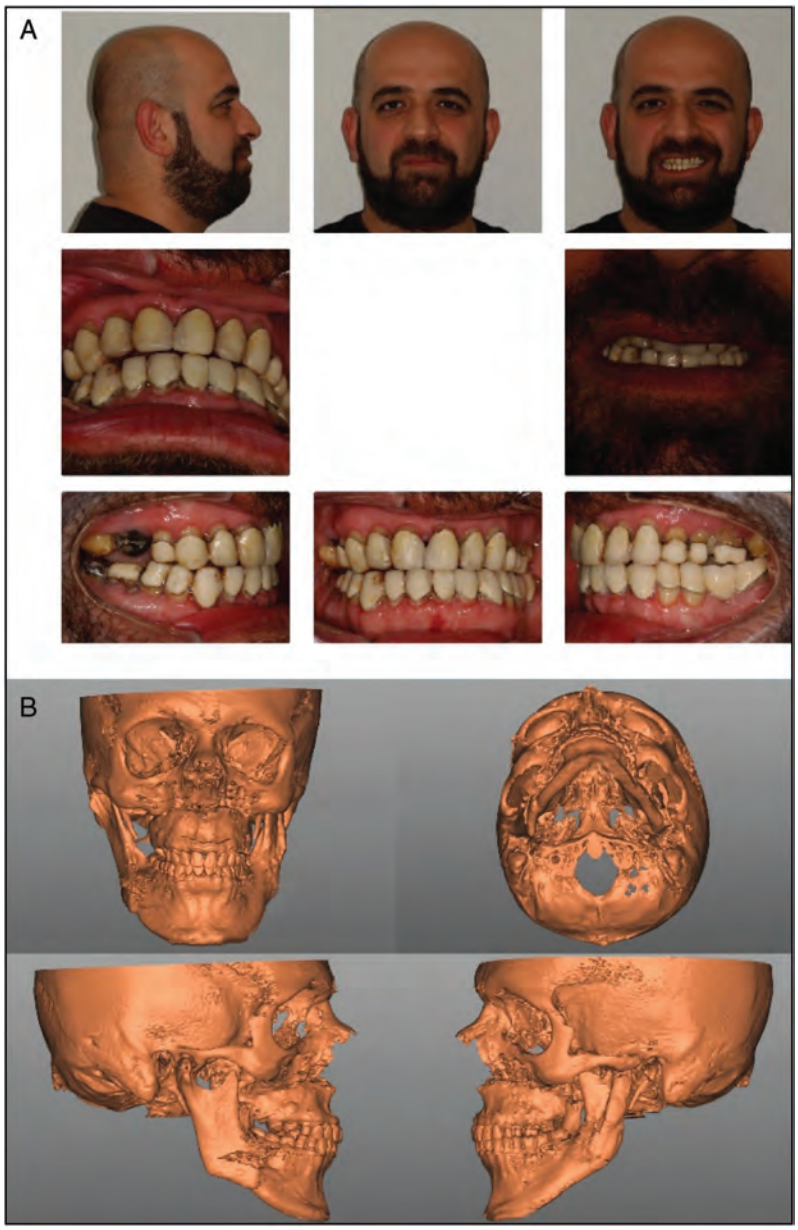

Figure 4: (a) Post-orthodontic treatment, extraoral, and intraoral photographs. (b) Posttreatment three-dimensional reconstruction of cone beam computed tomography images with overlayed STL. Scans of final occlusion

Discussion

Differentiating condylar osteoma from osteochondroma and hemimandibular hyperplasia is critical. Osteomas are homogenous and continue to grow post-maturity, unlike hemimandibular hyperplasia.

The chosen treatment approach was effective and stable, with minimal long-term morbidity. A costochondral graft was preferred due to its autogenous origin, lower revision rate, because the patient was older, and fewer complications compared to metal prostheses.[18,19]

Orthodontic arch coordination and expansion were challenging due to existing restorations. The transition from bone-supported to tooth-supported appliances was critical. Virtual planning ensured minimal tooth reduction and ideal occlusion.

Periodontal crown lengthening contributed to the functional and aesthetic success. The collaborative effort across specialties resulted in restored function, appearance, and improved quality of life.[20-23] The material of choice was Verotek full-contour zirconia; this was chosen because of its aesthetic and functional versatility needed in this case.[24] Third molars were left in their position due to patient preference and their asymptomatic status.[25]

Conclusion

This case demonstrates successful management of a somewhat rare condylar osteoma through coordinated

Figure 5: (a) Postrestoration, 3-year follow-up, extraoral and intraoral photographs. Note the micro aesthetic and macro aesthetic balance of the dentition, face, and smile. (b) Three-dimensional reconstruction of a cone beam computed tomography scan, with overlay of the final STL scan of the restored occlusion

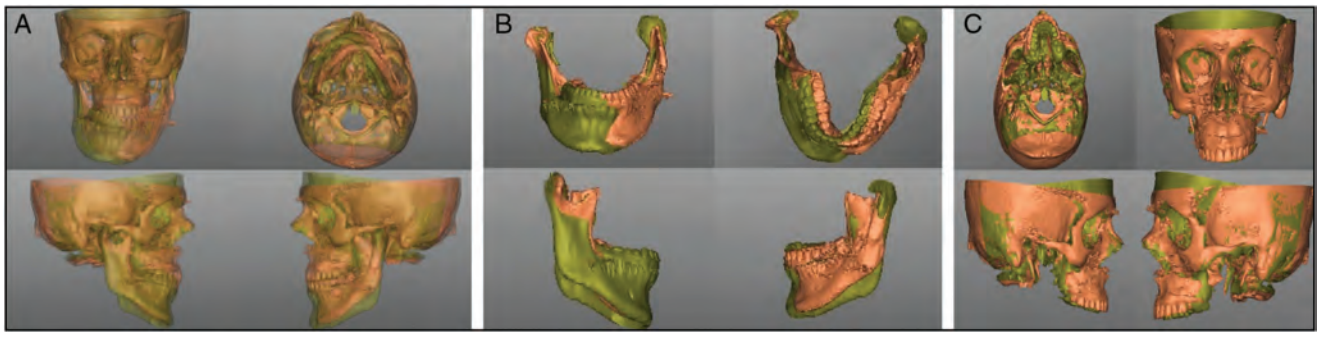

Figure 6: (a) Three-dimensional reconstructed over superimposition of pretreatment cone beam computed tomography comparing overall changes from pretreatment phase to 3 years posttreatment (note superimposition is done with 50% transparency setting). (b) Three-dimensional reconstructed regional superimposition of the mandible. (c) Three-dimensional reconstructed regional superimposition of the maxilla

surgical, orthodontic, and restorative interventions. It highlights the importance of a multidisciplinary approach for optimal functional and aesthetic outcomes. Most notably, the patient regained confidence and social well-being, as he expressed joy in finding a partner—a testament to the profound impact of facial reconstruction.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Role of Paediatric Dentist in Early Diagnosis of Sjögren's Syndrome: A Case Report

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Abstract

Introduction: Sjögren syndrome (SS) is a progressive chronic autoimmune disease characterised by mononuclear cell infiltration of exocrine glands. This results in dryness of the eyes, mouth and other exocrine glands. SS is rare among the paediatric age group. The diagnosis of SS can be challenging due to its heterogeneous clinical presentation and nonspecific symptoms. Labial salivary gland biopsy (LSGB) plays an integral role in the diagnosis of SS. **Case Report**: Here, we describe a case of a 9-year-old female patient who presented with the dryness of mouth. This case report highlights the role of paediatric dentists in the early diagnosis of SS among children, through clinical examination and LSGB. **Conclusion**: LSGB is a low-risk procedure with high disease specificity for SS and is minimally invasive. Timely diagnosis of SS necessitates appropriate vigilant monitoring for potential symptoms, along with referrals and collaborative communication among rheumatologists, dental professionals, paediatricians and ophthalmologists. The patients symptoms were better controlled following intervention, and ongoing preventive dental care was established.

Keywords: Keratoconjunctivitis sicca, labial salivary gland biopsy, Sjögren syndrome, timely diagnosis, xerostomia

Introduction

Sjögren's syndrome (SS) is a chronic systemic autoimmune condition marked by the lymphocytic infiltration of exocrine glands and other organs. While primary SS (PSS) is not linked to other underlying illnesses, secondary SS can occur in the presence of other autoimmune disorders such as rheumatoid arthritis, lupus, scleroderma or polymyositis.[1] SS affects 1–23 persons per 10,000 inhabitants.[2,3] SS predominantly affects females, with a high female-to-male ratio of 9:1 and peak incidence in the 40–55 age group.[4] SS is rare in children, with an estimated prevalence of 0.53 per 100,000 and a mean age of onset around 11 years. Similar to adults, a female predominance is observed in the paediatric population, with a male-to-female ratio of approximately 1:4.7.[5]

The hallmark characteristics of SS include dry eyes (keratoconjunctivitis sicca), dry mouth (xerostomia), swelling of the major salivary glands, accompanied by fatigue and musculoskeletal problems.[4] In addition to that, SS is also associated with extra-glandular systemic organ involvement in 25% of the patients, which has a significant impact on their long-term quality of life.[4,6] The disease can be further complicated by a four-fold increased risk of developing non-Hodgkin's B-cell lymphoma.[7]

In the paediatric population, the most common presentation of childhood SS is recurrent parotitis.[4] Children typically do not report dryness as frequently, due to their good saliva and tear reserve. Instead, they often present with extra-glandular clinical features that are suggestive of other autoimmune diseases.[5] As a result, the definitive diagnosis of SS in the paediatric patients is often

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delayed and deemed challenging due to its nonspecific symptoms.

Therefore, labial salivary gland biopsy (LSGB) offers a more objective assessment.[6] LSGB has been widely used in clinical practice for more than 40 years[8,9] and plays an integral role in the established 2016 American-European Consensus Group and the proposed American College of Rheumatology/European League Against Rheumatism (ACR/EULAR) classification criteria.[10] While these guidelines primarily address the classification of primary SS, the proposed criteria may also be relevant to SS associated with other autoimmune diseases or secondary SS.[11] The final classification criteria are based on the weighted sum of five items [Table 1]. Individuals who have a total score ≥ 4 meet the criteria for PSS.[11] Although the ACR/EULAR classification criteria are widely used in the diagnosis of PSS in adults, they have not been validated for use in paediatric populations. Due to the limited number of paediatric studies, various classification criteria have been applied in clinical and settings. Despite the lack of validation, the ACR/EULAR criteria are frequently utilised in paediatric cases, guided by expert clinical judgment.[4]

SS is a rare autoimmune condition in the paediatric population, often presenting with nonspecific symptoms that can lead to delays in diagnosis. Effective management of paediatric SS requires a multidisciplinary approach involving paediatricians, rheumatologists, ophthalmologists and dental professionals. Among these, paediatric dentists are frequently consulted for the management of oral symptoms such as xerostomia. However, their role extends beyond symptom relief. This case report highlights the unique and pivotal contribution of paediatric dentists in the early detection and diagnosis of SS. By recognising oral manifestations and performing a LSGB, a key diagnostic tool with high specificity, paediatric dentists can directly facilitate timely diagnosis and referral for systemic evaluation. This collaborative, cross-specialty approach is essential for initiating appropriate management and improving outcomes in children with SS. This case report has been prepared in accordance with CARE guidelines.

Table 1: American College of Rheumatology/European League Against Rheumatism classification criteria for primary Sjögren's syndrome

Item	Weight/score
Labial salivary gland with focal lymphocytic sialadenitis and focus score ≥ 1 foci/4 mm^2	3
Anti-Sjögren's syndrome-related antigen A (SSA)/Ro+	3
Ocular staining score ≥ 5 (or van Bijsterfeldscore ≥ 4) on at least one eye	1
Schirmer test ≤ 5 mm/5 min on at least one eye	1
Unstimulated whole saliva flow rate ≤ 0.1 mL/min	1

Case Report

A 9-year-old female was referred by a rheumatologist to the paediatric dental unit for LSGB as part of a diagnostic workup for suspected SS. She presented with persistent dry mouth, accompanied by recurrent bilateral angular cheilitis over the previous month. Notably, she denied experiencing ocular dryness. There was no family history of autoimmune diseases.

Her medical history was significant for mixed connective tissue disease, subclinical hypothyroidism, iron deficiency anaemia and allergic rhinitis. At the time of presentation, she was on prednisolone 10 mg daily, methotrexate 12.5 mg weekly, folate 5 mg weekly, calcitriol 0.25 mcg every other day, calcium lactate 300 mcg daily, omeprazole 10 mg daily and amlodipine 2.5 mg daily.

Extraoral examination revealed no tenderness or swelling over the bilateral parotid glands. However, the skin was generally dry with multiple scratch marks. Intraorally, the lips appeared dry [Figure 1], although the oral mucosa remained mildly moist. Multiple retained deciduous teeth were also noted. A previous computed tomography (CT) scan–taken during an episode of facial cellulitis–incidentally revealed small calcifications in the parenchyma of both parotid glands, though there was no enlargement at the time [Figure 2].

The patient's diagnostic journey progressed as follows: Initial symptoms of dry mouth and angular cheilitis led to

Figure 1: Photograph showing dry skin and lips

further investigation during follow up for her pre-existing autoimmune condition. Despite the absence of ocular symptoms, the incidental radiological findings, clinical presentation, and concern for salivary gland involvement prompted additional testing. Serological workup revealed positive antinuclear antibody, rheumatoid factor, anti-Smith and anti-RNP antibodies, while anti-SSA/Ro was negative. Unstimulated whole saliva flow rate was found to be <0.1 mL/min, contributing one point to the 2016 ACR/EULAR classification score. These findings raised the suspicion of SS, prompting referral for a LSGB to confirm the diagnosis.

To further investigate, an LSGB was performed under general anaesthesia. A small elliptical incision was made at the lower labial mucosa, and minor salivary gland tissue was collected [Figure 3]. The biopsy specimen was fixed in 10% formalin and sent for histopathological analysis. Microscopic examination revealed focal lymphocytic sialadenitis (FLS), with a focus score of ≥1 focus per 4 mm², contributing three points to the ACR/EULAR classification score. Mild ductal dilatation and acinar atrophy were noted, without germinal centre formation [Figure 4].

Figure 2: Computed tomography of face shows the bilateral parotid gland parenchymal calcification (white arrows)

Collectively, the clinical, serological, radiological, and histological findings contributed to a total score ≥4 based on the 2016 ACR/EULAR criteria, thereby confirming the diagnosis of SS. Given the patient's established diagnosis of mixed connective tissue disease, the SS is classified as secondary SS, occurring in association with another underlying systemic autoimmune disorder. These findings provided critical guidance for rheumatologists, ophthalmologists and paediatric teams in formulating a comprehensive care plan.

Diagnosing SS in the paediatric population poses unique challenges due to its rarity in children and typically subtle or nonspecific clinical manifestations. Ocular symptoms may be absent, and serological markers are not always definitive, making histopathological confirmation through LSGB particularly valuable. In addition, interpreting oral dryness in children is often difficult, as complaints may be vague or under reported. In this context, paediatric dentists play a crucial role, not only in symptom management but also in the early recognition and diagnosis of systemic disease through targeted and specific procedures such as LSGB.

For symptomatic relief of dry mouth, the patient was prescribed *Oral7*® moisturising mouthwash and toothpaste. The mouthwash was selected for its content of natural enzymes (lactoperoxidase, glucose oxidase,

Figure 3: Left: Photograph shows elliptical incision marking on the lower lip for biopsy. Right: Photograph shows the resultant wound after obtaining the specimen

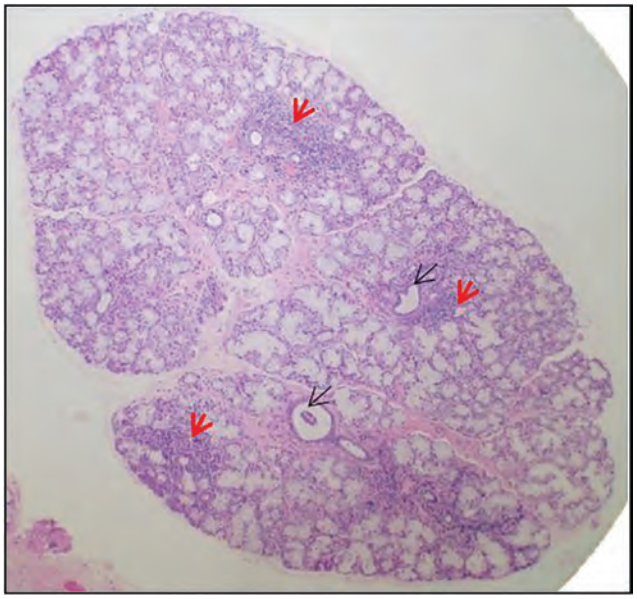

Figure 4: Photomicrograph with haematoxylin and eosin staining shows focal lymphocytic sialadenitis (red arrows), ductal dilatation (black arrows) with mild acini atrophy (magnification 10×)

lysozyme and lactoferrin), which mimic components of healthy saliva and support neutralisation of oral acids to maintain pH balance. Its alcohol-free formulation was chosen to avoid exacerbating dryness. The accompanying *Oral7*® toothpaste provided 1000 ppm fluoride for caries prevention and excluded sodium lauryl sulphate, a known mucosal irritant and drying agent. As part of her preventive care and caries prevention, fissure sealants were placed on all first permanent molars and a 3-monthly topical fluoride therapy schedule was initiated to reduce caries risk from the effects of chronic dry mouth.

At follow up visits, the patient reported subjective improvement in oral comfort, and there were no further episodes of angular cheilitis. Clinical oral examinations showed improved oral hygiene and moist oral mucosa. Preventive dental measures were well maintained, and no new carious lesions were noted. These outcomes underscore the benefit of early diagnosis and coordinated, multidisciplinary care in improving the quality of life and disease control in paediatric SS patients.

Written informed consent was obtained from the patient's parent/legal guardian for the publication of this case report, including relevant clinical details and accompanying images. Every effort has been made to protect the patient's identity and ensure confidentiality.

Discussion

Calcifications in the parotid gland can occur in several pathological conditions, including sialolithiasis, chronic sialadenitis and benign or malignant tumours. However, these cases are usually solitary.[12] The presence of diffuse speckled calcifications in both parotid glands is highly specific of SS, with retrospective studies showing 23%–35.2% of affected individuals having bilateral calcifications on CT scans.[12] This radiographic presentation was well observed in our case. The pathophysiology of bilateral parotid calcifications in SS is not fully understood but is thought to result from a combination of chronic inflammation, ductal obstruction and glandular atrophy, which together promote mineral deposition within the salivary tissue.[13] Despite this, the diagnostic value of identifying these calcifications has not been recognised, as routine CT scans of the parotid glands are not typically performed in patients with SS.

One of the objective methods of diagnosing SS is through minor salivary gland biopsy, due to its high disease specificity, wide availability and minimal invasiveness.[6,9] A systematic review by Guellec *et al*.[14] concluded that LSGB has a good diagnostic value for SS with specificity and sensitivity of 63.9%–85.7% and 89.7–91.9%, respectively.[14] In addition, the lower lip is typically chosen as the biopsy site due to its ease of manipulation and minimal risk of excessive bleeding.[6] A retrospective study conducted by Gordon *et al*.[8] demonstrated that only 3.6% of patients reported temporary numbness, with no reported case of permanent neurologic complications.[8] Major salivary gland biopsies have been used in diagnosing SS. However, these procedures are not commonly performed due to the risks of facial nerve damage and salivary fistulae.[6]

LSGB is important not only for the diagnosis of SS but also for its early detection, disease stratification and prognostic evaluation. The degree of lymphocyte infiltration and focus score is often associated with the disease activity of SS and useful to identify the initial stages of SS before there is obvious damage to gland function.[6] Early referral to specialists such as ophthalmologists, rheumatologists and paediatricians is critical to prevent or reduce the severity of both oral and systemic complications. Prompt involvement of a rheumatologist ensures comprehensive evaluation for systemic autoimmune involvement and initiation of appropriate immunomodulatory therapy. Ophthalmologic assessment is essential for detecting and managing ocular dryness and preventing long-term complications such as keratoconjunctivitis sicca or corneal damage. In paediatric patients, coordination with a paediatrician allows for holistic monitoring of growth, development and enables prompt management of serious systemic manifestations, such as interstitial lung disease and lymphoma. Early multidisciplinary collaboration facilitates timely diagnosis, reduces the risk of irreversible glandular damage, and improves long-term outcomes by enabling personalised, preventive and symptom-targeted care.[3,15]

The general recommendation for the LSGB is a 0.5–1 cm long fusiform incision from the lower lip mucosa to the

muscle layer.[6] The standardised consensus guidance for the histopathological assessment of LSGB in SS by Fisher *et al*.[10] recommended the minimum number of minor salivary gland tissue for biopsy to be four glands. If the salivary glands are too small (< 2 mm), six glands should be taken. All the minor salivary glands should be surgically separated with minimum gland surface area of 8 mm^2. The same authors also mentioned that histological examination should determine the presence of FLS, which is the most characteristic feature of SS. FLS is characterised by the presence of dense aggregates (foci) of at least 50 mononuclear cells, primarily lymphocytes, located around ducts or blood vessels.[10] If FLS is present, the focus score should be calculated. Focus score ≥ 1 (i.e., ≥1 focus per 4 mm) is used as the classification criteria based on the 2016 ACR/EULAR 2016 criteria.[11] Fisher *et al*.[10] highlighted that histological reports should also include the extent (none, mild, moderate and severe) of atrophy, fibrosis, duct dilatation and non-specific chronic sialadenitis.[10] The findings in this case report align with the typical histopathological features of SS, including FLS with a focus score of ≥1, acini atrophy and ductal dilatation.

Since the importance of LSGB in aiding the diagnosis is undeniable, the attending medical professional in this case, referred to the paediatric dentist for the lip biopsy to further confirm the diagnosis. Although the paediatric dentists are very often referred to manage the oral symptoms, but they also play a crucial role in assisting the medical counterparts to perform the biopsy. Although labial salivary gland (LSG) biopsy is a valuable diagnostic tool for Sjögren's syndrome, it is not without limitations. These include the potential for false-negative results and the risk of complications such as pain, cutaneous haematoma and inflammation of the biopsy site. These adverse effects are typically mild and self-limiting, resolving within a few weeks. However, in rare instances, more serious complications such as altered sensation or permanent nerve damage to the lip may occur.[16] In addition, the diagnostic sensitivity can vary, and obtaining an adequate tissue sample may be challenging, particularly in cases with atrophic submucosa.

In addition, paediatric dentists are in a unique position for early detection of SS since one of the hallmark symptoms is dry mouth. The therapeutic management of oral dryness is well explained in the 2019 EULAR recommendations for the management of SS.[2] The management of oral dryness may be approached based on two mechanisms: salivary gland stimulation (non-pharmacological or pharmacological) or saliva substitution, depending on the severity of glandular dysfunction.[2] Preventive regimes to prevent dental caries are recommended. This involves the daily use of fluoride toothpaste, weekly use of neutral fluoride rinse and 6 monthly applications of 5% neutral fluoride.[17]

The rarity of paediatric SS limits the generalizability of this case. A single case report provides valuable insight but cannot establish definitive diagnostic protocols or clinical guidelines. Moreover, the lack of long-term follow-up restricts conclusions on disease progression or treatment outcomes. Further research involving larger paediatric cohorts is essential to validate current diagnostic tools and optimise management strategies in this population.

The patient's family appreciated the multidisciplinary coordination and reported improved quality of life after initiation of targeted management for oral symptoms. The non-invasive nature of the biopsy and the effectiveness of the prescribed oral care regimen contributed to overall satisfaction with the care process.

Conclusion

Given that dry mouth is often the earliest presenting symptom, paediatric dentists play an important role in collaborating with rheumatologists to ensure early diagnosis and ongoing management of SS in paediatric patients. Clinical findings and LSGB performed by paediatric dentists can aid in the diagnosis of SS. Moreover, LSGB has a unique advantage in disease stratification and prognostic evaluation. Timely diagnosis relies on careful monitoring for its symptoms, prompt referral and effective communication among rheumatologists, paediatricians, ophthalmologists and dental professionals. A collaborative multidisciplinary approach plays an integral role in improving clinical outcomes and quality of life among SS patients.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Event: 15th Scientific Conference and AGM of Malaysian Association for Prosthodontics (MAP)

Theme: From Basic to Brilliance
Date: 4th to 5th July 2025
Venue: Courtyard by Mariott Kuala Lumpur South.

From Ridge Deficiency to Aesthetic Excellence: Biologically and Prosthetically Driven Single Anterior Tooth Implant Rehabilitation – A Case Report

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Rehabilitating a missing tooth in the anterior maxilla presents significant aesthetic and biological challenges, especially in cases with hard tissue deficiency and a thin, soft tissue phenotype. This case describes an implant-supported rehabilitation of a missing maxillary lateral incisor (tooth 12) following orthodontic space creation, ridge augmentation, and soft tissue optimisation. Initial CBCT revealed inadequate labio-palatal ridge width. Horizontal ridge augmentation was performed using a sandwich grafting technique with tenting screws to maintain space and protect the graft. Autogenous bone and allograft mix was placed on the ridge, followed by a layer of xenograft to enhance volumetric stability and covered by a resorbable collagen membrane. Implant positioning was digitally planned using a prosthetically and biologically driven approach via R2GATE software. Through a fully guided protocol, a 3.75 × 8.5 mm MegaGen BlueDiamond implant was placed 4mm from the future free-gingival margin with 2mm of labial bone remaining. Connective tissue augmentation using a de-epithelialized free gingival graft was placed via a tunnelling technique to enhance peri-implant mucosal thickness and buccal contour. A chairside implant provisional crown with optimum emergence profile was fabricated to support the transmucosal soft tissue maturation. Definitive rehabilitation involved a CAD/CAM-fabricated zirconia abutment and a high-aesthetic zirconia crown. A cement-retained design was selected to preserve incisal aesthetics as the axis of the implant was through the incisal edge due to anatomical limitations. Special care was taken during cementation to prevent extrusion of cement into the transmucosal space. Treatment resulted in excellent peri-implant soft tissue integration with the implant-supported crown and a stable marginal bone level. The patient reported high satisfaction with function and aesthetics. This case highlights the importance of integration of biologically and prosthetically driven implant placement to achieve predictable aesthetic and long-term stability of peri-implant tissue in a single anterior implant rehabilitation.

PEEK into the Future of Overdentures Elevating Overdentures: The PEEK Revolution

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Implant-retained overdentures are a well-established option for patients with severe mandibular ridge resorption, significantly improving function and quality of life. The McGill and York consensus statements endorse two-implant retained overdentures as the standard of care for edentulous mandibles. This clinical report presents the prosthodontic rehabilitation of a healthy 57-year-old Malay female patient with ill-fitting maxillary and mandibular complete dentures, with primary concern regarding mandibular denture instability. Clinical examination revealed a knife-edge maxillary ridge and palatal erythema. The treatment aimed on improving aesthetics and function with retentive denture for the patient. A new acrylic maxillary complete denture was then fabricated, while the mandible was restored with an implant-retained overdenture supported by two endosseous implants in regions tooth 33 and 43 (⌀ 3.3 mm × 10 mm, BLT Straumann®, Switzerland). The Straumann® Novaloc® attachments were used as abutments. The Novaloc® attachment system offers a reliable alternative to conventional Locator® attachments, delivering comparable retention. The system's PEEK retentive inserts demonstrate reduced wear compared to traditional nylon, enhancing long-term performance and durability. The patient expressed high satisfaction with the improved mastication and aesthetics. This treatment approach significantly enhanced denture retention and stability, resulting in improved function and overall appearance.

Construction of a Custom Ocular Prosthesis with Surgical Deepening of the Inferior Fornix: A Case Report

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Rehabilitation of an anophthalmic socket following enucleation, particularly in paediatric retinoblastoma cases, demands a multidisciplinary approach to restore both function and facial symmetry. This case report

presents a comprehensive strategy combining surgical and prosthodontic interventions to address chronic discomfort and poor prosthesis retention caused by inadequate inferior fornix depth. A two-stage protocol was employed, beginning with a diagnostic impression using a modified duplicate denture technique to capture the socket's anatomy. This guided the fabrication of a surgical-grade polymethyl methacrylate (PMMA) conformer for postoperative stabilization. Subsequent surgical deepening of the inferior fornix was performed to optimize the anatomical foundation for prosthetic retention. Three weeks post-surgery, a custom ocular prosthesis was fabricated, tailored to the refined socket contours. The intervention resulted in marked improvements in prosthetic fit, patient comfort, and aesthetic outcome. This case underscores the critical role of inferior fornix deepening in managing complex anophthalmic sockets and highlights the synergy between surgical precision and prosthetic customization in achieving long-term rehabilitation success.

Integrative Biologically and Prosthetically Driven Implant Therapy for Long-term Peri-implant Tissue Stability – A Clinical Case Report

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Prosthetically driven implantology alone cannot guarantee stability of peri-implant tissue over long-term with subsequent risk of marginal bone loss and soft tissue dehiscence. Adequate crestal bone thickness is required to maintain facial marginal bone level. In addition, adequate supra-crestal soft tissue thickness and keratinised mucosal width are required to minimise crestal bone remodelling and support the development of a favourable emergence profile, contributing to long-term aesthetic outcome. This case report presents an integration of biologically and prosthetically driven implant dentistry, aimed at optimising long term hard and soft tissue stability around dental implant and its functional stability. Clinically the patient presented with thin gingival phenotype with soft tissue deficiency buccally at a missing tooth 46 area. To enhance soft tissue thickness, an epithelialised-connective tissue graft was harvested from the palate, de-epithelialised extra-orally, and placed underneath the buccal flap during subcrestal implant placement. Surgical procedure was carried out under local anesthesia with full-thickness flap elevation and subcrestal implant placement using surgical guide, following both the manufacturer's recommendations and pre-established implant planning protocol. Healing abutment was connected to support buccal folding flap during tissue healing. Subcrestal implant placement aimed to achieved 4mm vertical soft tissue thickness. At the 6-month follow-up, a favourable emergence profile and increased soft tissue thickness was established. This profile was captured using a customised transfer coping with flowable composite resin and putty silicone. The final restoration consisted of a CAD-CAM titanium abutment and cement-screw retained zirconia crown. Occlusion was carefully managed, with light contact centered at occlusal fossa and occlusal forces limited to static contact, avoiding lateral interferences. This integrated biologically and prosthetically driven approach emphasises the importance of soft tissue management in maintaining peri-implant tissue health and functional stability for long-term implant and prosthesis success.

Prosthodontic Rehabilitation in a Medically Compromised Patient Using Cu-Sil Dentures and the Scandinavian Approach

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Prosthodontic care in medically compromised patients requires a conservative, biologically respectful approach to preserve function and minimize risk. This case report details the prosthodontic rehabilitation of a patient with metastatic cervical cancer, utilizing Cu-Sil dentures and the Scandinavian prosthodontic philosophy to address systemic and intraoral complexities. A 67-year-old female undergoing chemotherapy and anticoagulant therapy for metastatic cervical squamous cell carcinoma presented with ill-fitting dentures. Examination revealed Kennedy Class I partial edentulism, mobile mandibular anterior teeth (Grade I–II), generalized gingivitis, and a knife-edge mandibular ridge. Due to systemic frailty, surgical options were contraindicated. A maxillary Cu-Sil denture was chosen to preserve natural teeth using silicone gaskets, maintaining proprioception and retention. The mandibular prosthesis followed the Scandinavian approach, focusing on plaque control, periodontal health, and minimal complexity. A selective pressure impression with wax spacers managed the thin mandibular ridge, while a double-bar splint stabilized mobile anterior teeth. Wrought wire clasps were used on compromised abutments to reduce stress. The prostheses exhibited good retention, tissue adaptation, and occlusion. The patient reported improved mastication, nutrition, speech, and morale. At one- and two-month reviews, no signs of trauma, instability, or worsening periodontal health were noted. Oral hygiene was maintained effectively due to the design's simplicity and biological compatibility. This case highlights the effectiveness of combining Cu-Sil dentures with the Scandinavian approach for minimally invasive, functionally stable prosthodontic rehabilitation in medically compromised patients. The treatment enhanced oral health and quality of life without surgical intervention, making it a practical option in palliative dental care.

Functional and Aesthetic Considerations in Mandibular Co-Cr Denture Design

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This case report describes the prosthodontic rehabilitation of a 64-year-old Malay female patient presented with a chief complaint of a loose maxillary denture, which had become unstable following recent extractions of the upper posterior teeth. She had previously discontinued using a mandibular denture because of discomfort and was initially reluctant to get a replacement, fearing it would still be intolerable. The clinical examination revealed an edentulous maxilla and a Kennedy Class I mandibular partially dentate arch, characterized by spaced anterior teeth and mobility of tooth 31. A comprehensive treatment plan was developed, involving fabrication of a new maxillary complete denture and a mandibular cobalt-chromium (Co-Cr) removable partial denture. The mandibular denture design required careful consideration of both functional and aesthetic factors, including biomechanics for free-end saddles, reduced vestibular depth, high frenal attachments, anterior spacing, and future adaptability. A customized framework incorporating RPA clasping and an interrupted lingual plate with a mesh extension lingual to tooth 31 was selected to optimize support, stability, and esthetics. The treatment outcomes were successful, demonstrating a significant improvement in the patient's oral health–related quality of life (OHRQoL), chewing ability, and overall denture satisfaction. This case highlights the importance of individualized denture design in managing anatomical and patient-specific challenges to achieve both functional and aesthetic success.

From Systemic Challenge to Functional Restoration: Comprehensive Prosthodontic Rehabilitation in a Patient with Autoimmune Disease

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This case report describes the comprehensive prosthodontic rehabilitation of a 28-year-old female patient with a complex medical background, including renal tubular acidosis, hypokalemia, and Sjögren's syndrome. The patient presented with long-standing partial edentulism, predominantly affecting the anterior region, resulting in compromised masticatory function, reduced vertical dimension, and aesthetic concerns. Her systemic condition, associated xerostomia, and irregular dental attendance necessitated a carefully coordinated and multidisciplinary treatment approach. A reorganised occlusal scheme was implemented, incorporating an increased occlusal vertical dimension (OVD) to restore functional space and facial harmony. The maxillary arch was rehabilitated using porcelain-fused-to-metal fixed prostheses, including a fixed-fixed bridge (13–23) and cantilever bridges (15–14, 25–24). The mandibular arch was restored with a cobalt-chrome removable partial denture supported by surveyed crowns on teeth 35, 34, and 45. Interim restorations were utilised to assess patient adaptation to the altered OVD prior to definitive prosthesis delivery. Management of xerostomia included fluoride therapy, salivary substitutes, and dietary modifications tailored to the patient's risk profile. Treatment was delivered in sequenced phases: prevention, stabilisation, provisionalisation, definitive restoration, and maintenance. Regular monitoring and patient education were emphasised throughout to enhance long-term outcomes. Upon completion of treatment, the patient demonstrated improved oral function, aesthetic satisfaction, and psychological well-being. This case highlights the importance of personalised treatment planning, interdisciplinary coordination, and phased rehabilitation in managing medically compromised patients requiring complex prosthodontic care.

Functional and Aesthetic Rehabilitation of a Worn Dentition: A Multimodal Approach with Ceramic-composite Sandwich Technique

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Tooth wear is a growing clinical challenge that often presents with functional, aesthetic, and structural deterioration. This case report outlines the full-mouth rehabilitation of a patient with long-standing posterior partial edentulism, reduced occlusal vertical dimension (OVD), and significant palatal enamel loss secondary to chronic acidic exposure from apple cider vinegar consumption. The patient also expressed aesthetic concerns related to tooth form and smile appearance. A digitally guided, reorganised occlusal scheme was established to restore the vertical dimension and ensure a predictable functional outcome. Interim composite restorations were used at the proposed increased OVD to assess neuromuscular adaptation and patient tolerance. The maxillary arch was rehabilitated using a minimally invasive approach combining palatal glass ceramic veneers and injection-moulded composite on the facial surfaces, constituting a conservative "sandwich technique" for structural and aesthetic enhancement. A fixed-fixed porcelain fused to metal bridge was constructed between teeth 13 and 15, and implant supported crown 16 to restore posterior support. In the mandible, a cobalt-chrome removable partial denture was prescribed, supported by surveyed metal-ceramic crowns on teeth 45 and 47 to enhance retention and stability. The integration of digital planning throughout diagnosis and restorative phases allowed for precise control of occlusal vertical dimension, aesthetic evaluation, and guided prosthetic

execution. The result was a predictable, functionally stable, and aesthetically pleasing outcome with high patient satisfaction. This case highlights the efficacy of a digitally driven, multidisciplinary approach in managing complex tooth wear through a combination of ceramic, composite, fixed, removable, and implant-supported prosthesis.

Publication Trends in Removable Partial Dentures Research from 1948 to 2022

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The objective of this study was to identify publication trends and growth patterns in removable partial denture (RPD) research from 1948 to 2022 by analyzing publication volume, trending topics, and the most frequent and high-impact terms in the RPD-related literature. Articles were retrieved from the Scopus database using the search terms "removable partial denture*" OR "removable prostho*". Data analysis and visualization were performed using Microsoft Excel, Biblioshiny (RStudio Desktop), and VOSviewer. A total of 2,484 articles published between 1948 and 2022 were analyzed to explore publication trends, keyword co-occurrence, and high-impact terms. The analysis revealed a 4.9% annual growth rate in RPD publications. From 1948 to 1999, research primarily focused on foundational RPD concepts and cobalt-chromium frameworks, emphasizing mechanical and material properties. Around the year 2000, a shift toward titanium frameworks was observed. Since 2012, research has increasingly focused on new technologies and non-metal frameworks, with trending topics such as "polyetheretherketone (PEEK)" and "digital dentistry." "Quality of life" emerged as the most frequently used author keyword, indicating ongoing interest in patient-centered outcomes. The keywords "digital impression," "PEEK," and "milling" were identified as the top three high-impact terms based on annual citation counts and normalized citation scores. Overall, the output and citation frequency of RPD-related research remain relatively low compared to other dental topics. However, the growing emphasis on digital technologies and advanced materials like PEEK suggests a notable shift in the direction of RPD research, while interest in quality-of-life outcomes continues to be significant.

Revolutionising Denture Care: The Innovative Eugenol-based Denture Cleanser Tablet Formulation - An in-vitro Pilot Study

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Denture biofilm, resistant to conventional cleaning methods, can lead to infections, often caused by *Candida albicans*. Eugenol, a natural extract derived from plants, has demonstrated remarkable antimicrobial activity against a wide range of fungi, gram-negative, and gram-positive bacteria. This study presents a novel approach to denture care by developing an innovative effervescent denture cleanser tablet formulated with eugenol. The aim of the present study is to formulate a novel eugenol-based denture cleansing tablet and to evaluate its antifungal and antibacterial efficiency. The study was conducted in five stages. First, effervescent denture cleanser tablets were prepared using two formulations: one containing eugenol and the other as a placebo. Second, the tablets' physicochemical properties, including hardness, thickness, diameter, pH, effervescence time, and content analysis, were assessed. Third, microbial strains were cultivated, focusing on three microbes: *Candida albicans*, *Streptococcus mutans*, and *Escherichia coli*. Fourth, denture cleansing solutions of the novel eugenol-based tablets, placebo tablets, distilled water (negative control), 0.12% Chlorhexidine (positive control), and Polident® were prepared. Fifth, the agar well diffusion test was used to measure inhibition zones around wells inoculated with the cleansing solutions, evaluating the antimicrobial effectiveness of the solutions. The novel eugenol-based denture cleanser tablet met most physicochemical parameters, although its hardness was lower. The eugenol concentration of 5.294% in the tablet was acceptable for topical use after rinsing. The eugenol-based tablet exhibited a mean inhibition zone of 21.26 mm against *Candida albicans*, demonstrating superior antifungal activity compared to 0.12% Chlorhexidine (12.53 mm). For antibacterial effects, it showed moderate activity with inhibition zones of 8.20 mm against *Streptococcus mutans* and 9.21 mm against *Escherichia coli*, while 0.12% Chlorhexidine recorded higher zones respectively. Polident® showed minimal antibacterial effect and no antifungal activity. The placebo solution and distilled water showed no antimicrobial activity. The novel eugenol-based denture cleanser tablet demonstrated promising antifungal activity and moderate antibacterial activity highlighting its potential as an effective denture cleanser. This pilot study also highlights how revisiting basic natural compounds can inspire brilliant innovations in prosthodontic care and oral hygiene.

Finite Element Analysis of Stress Distribution in Implant-supported Crowns: Influence of Computer-aided Design/Computer-aided Manufacturing (CAD/CAM) Zirconia and Three-dimensional (3D) Printed Ceramic Filled Hybrid Material Combinations for Crowns and Abutments

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This study aimed to evaluate the stress distribution associated with different combinations of three-dimensional (3D) printed ceramic filled hybrid material and computer-aided design/computer-aided manufacturing (CAD/CAM) zirconia, used as crowns and abutments in implant-supported restorations, through finite element analysis (FEA). A mandibular first molar implant-supported crown was modelled, comprising five experimental groups in which the crown and abutment materials were systematically varied between 3D printed ceramic filled hybrid material and CAD/CAM zirconia. A 600N vertical load (Load Case 1) and a 225N oblique load at 45° to the central implant axis (Load Case 2) were applied. The von Mises stress (VMS) was recorded at the different components of implant and peri-implant bone. At the crown, Group ZR-VST had the highest VMS (214.39 MPa; 112.72 MPa), while Group VST-ZR had the lowest (173.66 MPa; 101.58 MPa) in Load Case 1 and 2, respectively. At the CAD/CAM custom abutments, Groups ZR-VSC and ZR-VST demonstrated the lowest stress in both loading, which were 46.66MPa and 44.62MPa; 45.34MPa and 41.95MPa, respectively. Areas of stress concentration included the occlusal surface of the crown, the cement layer at the neck, the top region of the abutment, the top of the titanium base (Ti-base) abutment, the internal connection with the abutment screw, the collar at the gingival margin, the first thread of the abutment screw, and the cervical region of the Ti-base abutment. Stress at the fixture level in both cortical and cancellous bone was comparable across all groups under both loading conditions. The findings suggest that modifications in implant-supported restoration and abutment materials, as well as different combinations of crowns and custom abutments, substantially influence stress distribution across multiple components including the crown, cement layers, custom abutment, abutment screw, Ti-base abutment, and fixture. while exerting minimal effect on the peri-implant bone.

Effect of Induced Stress on the Corrosion Rate of Titanium Alloy in Artificial Saliva Solution

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Corrosion behaviour of titanium alloy (Ti-6Al-4V) especially in oral conditions may affect longevity of dental implant. Significant correlation between corrosion of implant material and implant survivability was found. However, impact of stress corrosion on titanium alloy in the oral environment are limited. Current study aims to assess the effect of induced stress on the corrosion rate of titanium alloy (Ti-6Al-4V) in artificial saliva solution of varying pH. 90 medium-sized titanium alloy wire samples grouped equally into three different geometries: I-shape of 6 cm long (i.e., control), U-bend of 10 cm long and C-ring of 10cm long samples. Each shape of different anchorage radius represents the amount of induced stress introduced. Samples were weighted before immersed into artificial saliva solution with varying pH of acidic (pH 6), neutral (pH 7) and alkaline (pH 8) for 480 hours/20 days and weighted every interval of 48 hours. The weight loss method is used to measure the corrosion rate. Data collected and statistical analyses were performed. U-bend samples (induced stress value (ISV) of 339.055N/mm²) in acidic pH 6, showed highest percentage weight-loss (0.0339%±0.0120), followed by C-ring (ISV of 169.528N/mm²) with moderate loss (0.0225%±0.0076), and I-shape (ISV of 0.0N/mm²) with lowest loss (0.0157%±0.0068). All groups experienced highest loss within 48 hours before stabilizing. Corrosion rates are similar with the highest rate in U-bend samples in acidic pH (0.00051mmpy±0.00012), followed by C-ring (0.00022mmpy±0.00006) and I-shape at (0.00015mmpy±0.00006). The results demonstrated that higher induced stress and acidic conditions lead to higher percentage weight-loss and corrosion rates comparatively. Induced stress has a significant effect on corrosion rate of titanium alloy in artificial saliva solution of varying pH. The highest corrosion rate of titanium alloy samples is observed in samples with high amount of induced stress and exposed to acidic pH.

Assessment of Accuracy and Reproducibility of Intra-oral Scanners as Impression Taking Method for Post and Core

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The integration of digital workflows in restorative dentistry has revolutionized the fabrication of customized fibre-reinforced posts and zirconia cores (P+C) using CAD/CAM technology. While prefabricated fibre posts remain widely used in clinical practice, their inability to conform precisely to the internal anatomy and morphology of the root canal often results in suboptimal adaptation. Customised posts offer a more precise fit, but their fabrication through a fully digital workflow depends heavily on the accuracy of intraoral scanners (IOS) in capturing post-space geometry. To compare the accuracy and reproducibility of two intraoral scanners (IOS) namely Trios 5 and Primescan and the combination technique of the traditional silicone impression and digital scanner (TS+DS) against traditional silicone impression techniques in recording post-space depths in various types of extracted teeth. A total of 42 extracted teeth were categorized into seven groups based on tooth type: mandibular lateral incisors, maxillary central incisors, maxillary canines, maxillary first premolars, mandibular second premolars, maxillary first molars, and mandibular first molars. For each tooth, five impressions were taken using different techniques: traditional polyvinyl siloxane

(PVS), Trios 5 intraoral scanner (IOS), Primescan IOS, and combination techniques where PVS impressions were scanned with both Trios 5 and Primescan. Post-space depths were measured with a K-file and compared to measurements obtained from the three methods (PVS, Trios 5, and Primescan). Traditional impressions were measured with digital calipers, and Standard Tessellation Language (STL) files from IOS were analysed using Exoviewer3D 2.4 software. Reproducibility was assessed by superimposing digital impressions (Trios 5 and Primescan) and the combination technique impressions (PVS-Trios 5 and PVS-Primescan). Data were analysed using pairwise comparison, Kruskal Wallis Test and Mann-Whitney U Test. The study revealed statistically significant differences in both accuracy and reproducibility among the impression techniques. Traditional polyvinyl siloxane (PVS) impressions demonstrated the highest accuracy, with no significant difference compared to the control ($p > 0.05$), while both Trios 5 and Primescan intraoral scanners showed significantly lower accuracy ($p < 0.001$), with Trios 5 underperforming the most. In terms of reproducibility, the combination technique—where PVS impressions were scanned using IOS—showed significantly higher percentage similarity compared to direct intraoral scans ($p < 0.001$). Superimposition analysis indicated that direct scans with Trios 5 and Primescan had lower consistency, especially in deeper regions of the post space. These findings underscore the superior performance of traditional and hybrid techniques in achieving accurate and reproducible impressions for post and core fabrication. Traditional PVS impressions remain the most accurate and reproducible method for capturing post-space morphology. While digital intraoral scanners offer clinical convenience, their limitations in depth accuracy—particularly with Trios 5—highlight the need for caution in fully digitizing post and core workflows. The combination of traditional and digital techniques presents a promising alternative, enhancing the precision of custom post fabrication and bridging the gap between accuracy and efficiency in restorative dentistry. These findings underscore the need for further refinement in IOS technology to match the reliability of traditional methods, ensuring better clinical outcomes in restorative dentistry.

Surface Roughness of Lithium Disilicate Glass Ceramics Before and After Crystallization with Different Milling Techniques: Wet vs Submerged Milling

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This study investigates the impact of wet milling and submerged milling on the surface roughness of milled lithium disilicate glass ceramic with sequential milling and before and after crystallization process. Submerged milling is gaining traction for its potential to dissipate heat, reduce friction, remove debris more efficiently, increase milling tool longevity, and ensure accurate and efficient milling of final products. A total of 24 Hass Amber® Mill lithium disilicate blocks were divided into 2 groups according to different milling methods: wet milling group ($n = 12$) and submerged milling group ($n = 12$). The milling process was performed using a 5-axis CRAFT 5X milling machine. The milled surfaces of the lithium disilicate glass ceramic were evaluated for surface roughness (Ra) using a 3D optical non-contact surface profilometer and observed through Scanning Electron Microscopy (SEM), both before and after the crystallization process. The diamond-coated milling burs (GC 25, GC 20, GC 10) were initially observed under SEM and at 1st, 6th, and 12th milling. Overall comparisons between the surface roughness of lithium disilicate discs of the two groups were done using Paired T-test. Comparisons between the surface roughness of the disc before and after crystallization were done using Paired T-test. The comparison of surface roughness intragroup was done using one-way ANOVA. Significance was set at p value < 0.05. Results indicated that the mean surface roughness of lithium disilicate discs milled with submerged milling technique was significantly lower than that of wet milled discs, both before ($p < 0.001$, $t = 7.093$) and after crystallization ($p < 0.001$, $t = 6.020$). Within each milling group, Ra reduced after crystallization, with significant differences pre- and post-crystallization (wet: $p < 0.001$, $t = 3.344$; submerged: $p < 0.001$, $t = 4.683$). One-way ANOVA results showed that there was no significant difference in surface roughness between discs in the same group ($p > 0.05$ for all groups), suggesting that the 12-cycle milling sequence did not significantly affect the surface roughness. SEM analysis showed loss of abrasive particles on milling bur in both wet and submerged milling groups. This study concludes that submerged milling is more effective in reducing surface roughness compared to wet milling and that crystallization plays a crucial role in further reducing the surface roughness of lithium disilicate glass ceramics. Also, using sequential milling tool usage up to the 12th mill did not affect the surface roughness of milled lithium disilicate.