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Smarter Smiles: Revolutionizing Oral Health with Artificial Intelligence (AI) Gadgets

Fizza Sahar Anwar¹

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In the ever-changing landscape of healthcare, technology continues to shake traditional practices, offering solutions that make healthcare more accessible, efficient, and personalized. Oral health, a cornerstone of overall well-being, is no exception. A new era is dawning in the realm of oral care—one driven by artificial intelligence (AI) and its integration into smart gadgets that promise to transform how we maintain our smiles.¹ AI-powered oral health devices are not just enhancing the daily brushing routine but also revolutionizing diagnostics, treatment, and prevention.² This editorial aims to explore how these advancements are changing the way we approach oral health.

Gone are the days when a toothbrush was merely a manual tool used to scrub away plaque.² Today, AI-driven electric toothbrushes are becoming essential companions in the pursuit of optimal oral hygiene. These smart devices come equipped with sensors and algorithms that monitor brushing techniques, detect areas of neglect, and provide real-time feedback to users via mobile apps.³ Renowned Brands have integrated AI into their toothbrushes, offering features such as pressure sensors that alert users when they're brushing too hard, timers that ensure each quadrant of the mouth receives equal attention, and motion-tracking technology that guides users toward better brushing habits.

The beauty of AI-powered toothbrushes lies in their ability to personalize the brushing experience. They collect data on brushing patterns and can suggest improvements tailored to an individual's specific needs. Over time, this consistent feedback helps users improve their oral hygiene habits, leading to a significant reduction in plaque buildup and gingivitis.⁴ What was once a routine task, has now become a data-driven, performance-enhancing activity that actively promotes better long-term oral health.

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Another exciting application of AI in oral health lies in diagnostics. Traditionally, identifying issues such as cavities, gum disease, or oral cancer required manual examinations, X-rays, and patient reports. While these methods are effective, they are often reactive, identifying problems only after they have become visible or symptomatic.⁵ AI-powered diagnostic tools have now been introduced that can analyze images from dental scans, X-rays, and even intraoral cameras with unparalleled precision. AI algorithms can be trained to detect early signs of cavities, gum recession, and even oral cancer with an accuracy level that rivals or surpasses that of human dentists. Using deep learning, AI systems can review dental images and highlight areas of concern for further investigation. The result is not only a more precise diagnosis but also a more proactive approach to oral health.⁶ With AI gadgets capable of detecting potential issues at their early stages, patients can receive timely treatment and avoid more complex and expensive procedures down the road.

In addition to this, Smartphones have already become indispensable in our daily lives, and now, they're also playing an increasingly vital role in managing our oral health. AI-powered oral health apps are revolutionizing how patients interact with their dental care routine.⁷ These apps sync with smart toothbrushes, intraoral cameras, and other AI devices, collecting real-time data and offering insights into a person's oral health. By creating a direct line of communication between patients and their oral health data, AI apps ensure that individuals take a proactive role in maintaining their smiles.

Moreover, AI is also enhancing remote consultations. Some tele-dentistry platforms now leverage AI to perform preliminary examinations, analyze dental images submitted by patients, and assist in making preliminary diagnoses.⁸

Orthodontics is another area where AI gadgets are making waves. Smart aligners, which have already replaced traditional braces for many patients, are becoming more personalized and data-driven thanks to AI.⁹ Companies

like Invisalign have incorporated AI algorithms into their aligner technology, enabling better treatment planning and monitoring. These smart aligners can track the patient's progress through embedded sensors and provide real-time feedback. The use of AI in orthodontics not only improves outcomes but also enhances patient satisfaction by reducing treatment time and discomfort.¹⁰

AI-powered gadgets can also predict potential oral health risks by analyzing a patient's habits, genetic predispositions, and medical history. Moreover, these gadgets can offer continuous feedback, making it easier for individuals to stay on top of their oral hygiene routines.

AI-powered gadgets are not just a passing trend; they represent a transformative shift in the way we approach oral health. By combining data-driven insights with personalized care, these smart devices are helping individuals maintain healthier smiles and giving dental professionals the tools they need to offer better diagnoses and treatments. As AI continues to advance, the potential for even more sophisticated, intuitive oral health tools will only grow, offering the promise of a future where oral health is not just reactive but proactive, personalized, and smarter than ever before.⁹ Through the integration of AI in dental care, we are witnessing the beginning of a new age in which technology and oral health are linked, empowering people to take control of their oral health and smiles.

DISCLAIMER

None.

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Effectiveness of Platelet Rich Fibrin in the Management of Pain and Healing of Dry Socket

Haleema Bibi¹, Zarnab Rizwan², Ghina Rizwan³, Syed Hamza Zia⁴

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ABSTRACT

Alveolar osteitis, also known as dry socket, is a common unwanted complication related to tooth extractions, frequently seen among females, especially in the mandibular teeth. Many treatment options to tackle this post-op complication have been used ranging from a less conservative to a radical surgical option with new developments being made. One such recent development has been the use of platelet-rich fibrin, which is also used for many other oral surgical procedures with promising and positive results.

One such case has been presented and documented with a 50-year-old female who presented with radiating post-op pain following 3 days after the extraction of her mandibular premolar. Segregated platelet-rich fibrin was extracted from the patient's blood and placed in the socket, secured with sutures. There was a remarkable decrease in her post-op pain by the 7th day with a complete recovery within 10 days.

Keywords: Alveolar Osteitis, Platelet Rich Fibrin, Post-Operative Pain

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INTRODUCTION

The term dry socket was used by an American dentist James Young Caward in 1896.¹ It is a common complication after surgical or non-surgical tooth extraction. The frequency of dry socket is greater in females than in males. According to Buchanan, the frequency of dry socket in mandibular extraction is greater as compared to maxillary extraction.¹ Dry socket appears as a severe, debilitating constant pain that continues throughout the night and it is mostly associated with foul taste and halitosis. Clinically an empty socket with exposed bone is seen.² Predisposing factors are smoking and tobacco use, oral contraceptives, traumatic tooth extraction, poor oral hygiene, previous history of dry socket, use of aspirin or other medications, age and sex, infections, improper aftercare, rinsing or spitting excessively.³ Prevention and treatment of dry socket encompass various strategies such as modifying surgical techniques, administering antibiotics, rinsing the mouth with antimicrobial agents before extraction, socket lavage, and applying different medications to the socket.⁴ Initially, French clinicians recommended using Platelet-Rich Fibrin (PRF) following tooth extraction to accelerate healing, reduce postoperative pain, and prevent dry socket. Recently, numerous authors have reported excellent results using PRF for the prevention of dry socket after the removal of lower third molars and for the treatment of dry socket.⁵ The majority of research on Platelet Rich Fibrin in oral surgery focuses on its use in sinus lifts, bone augmentation, and socket preservation, etc.⁵ PRF is a revolutionary blood-derived product used in wound regeneration.⁶ Recent studies suggested rapid epithelization and faster bone regeneration with Platelet Rich Fibrin.⁶ PRF in the extraction socket shows better healing and reduced incidents of dry sockets or prevention of dry socket incidents because the PRF causes the process of regeneration of hard and soft tissues and revascularization. So, platelet-rich fibrin can be used in dry sockets for management and delayed healing.⁶ PRF contains certain growth factors and other biologically active substances. These factors increase angiogenesis, chemotaxis, and epithelialization with enhanced osteogenesis and cause faster resolution of pain in dry socket because the kinins released from dry socket will be antagonized by these growth factors.⁵ PRF is effective, biocompatible, and safe because it is derived from the patient's own blood⁷, upon comparison

with existing treatment options. The use of Platelet Rich Fibrin showed faster and better alveolar mucosal healing, which is earlier than the Zinc oxide eugenol group.⁸ The benefits of this treatment include its ease of use, the fact that it can be performed by any dentist, and the fact that it has a rapid impact on pain levels, followed by a rapid epithelialization of the socket.⁴

CASE REPORT

A 50-year-old female presented to the oral and maxillofacial department of Islamic International Dental Hospital with the chief complaint of severe debilitating, radiating pain along with foul taste and smell from the last 2 days. It all began 3 days after the extraction of the lower right 2nd premolar that was extracted non-surgically but according to the patient, it took a lot of time to come out. The patient's medical history was unremarkable. Her dental history included multiple extractions on examination an open wound with ischemic white bone was seen that was fully exposed without soft tissue coverage. The Visual Analog Scale (VAS) is a widely used tool to measure subjective experiences such as pain intensity and a simple, reliable, and sensitive method to quantify pain levels, often employed in both clinical and research settings in which Pain was evaluated using a 10-point horizontal visual analog scale, with a score of "0" signifying "no pain" and "10" indicating "very severe pain."⁵ Pain recorded on VAS was 9. The socket was irrigated with normal saline to clear the debris. PRF was prepared according to Choukron's protocol.⁵ Venous blood was drawn from the patient's arm in a vacuum test tube of 10 ml without any anticoagulant and immediately put into a centrifuge for 12 minutes at 3000 RPM.⁵ 3 layers were formed in a test tube, the top layer contained a cellular plasma, a fibrin clot was formed in the middle layer, and red corpuscles were in the bottom part. The fibrin clot was separated from other layers and segregated Platelet Rich Fibrin was placed into an area of exposed bone and stabilized with sutures.⁵ The pain was evaluated post-Platelet Rich Fibrin placement first, third, seventh and tenth days through the same visual pain analogue scale and healing of the socket was evaluated through granulation tissue formation at socket walls.⁵ The pain was reduced to 5, 3, 1, and 0 on the 1st, 3rd, 7th, and 10th day (Figs 1-4) and all socket walls got covered till the 10th day.

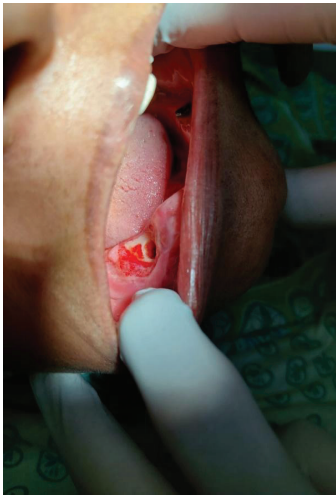


Figure 1: Pre-Operative Picture



Figure 2: Post-Operative Day 3 - After Placement of Platelet Rich Fibrin



Figure 3: Post-Operative Day 7 - After Placement of Platelet Rich Fibrin



Figure 4: Post-Operative Day 10 - After Placement of Platelet Rich Fibrin

DISCUSSION

Exodontia frequently has problems, such as dry sockets, which make patients more reticent. Bacteria are recognized to have a significant role in the multifactorial etiology of Alveolar Osteitis (AO).⁹ Several investigations have expanded the role of *Actinomyces viscosus* and *Treponema denticola* in dry socket.^{10,11} As a result, the use of antibiotics in mouthwash and intrasocket medicine became more widespread.⁵ Several pharmacological medications, such as chlorhexidine in the form of gel and mouthwash, were suggested and developed to prevent dry socket.¹²

Clinicians' priority is always to ensure that wounds heal quickly and easily since it is widely believed that growth factors may be present in the surrounding environment. Being a rich supply of growth factors, PRF is a promising biomaterial for accelerating bone regeneration and wound healing.¹³ This case report showed a decrease in post-operative pain of a patient after administering PRF in the socket and also early soft tissue healing was seen, results were comparable to Sharma et al.⁵ Platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), transforming growth factor-1 (TGF-1), bone morphogenetic protein-1 (BMP-1), coagulation factors, adhesion molecules, and various other angiogenic factors that stimulate the activation and growth of the cells promoting wound healing are among the cytokines, chemokines, and structural glycoproteins that make up PRF. These biochemical components help increase the remodeling of the fibrin network into a more lasting connective tissue and speed up angiogenesis, which

both aid in the better healing of soft tissue wounds.¹³ our study indicates rapid less painful healing with PRF in the treatment of dry socket from day 1 to day 7 and results are in conjunction with study done by Chenchev et al.⁴

The current case report demonstrated how significant pain was evaluated using the visual analog scale before, but when PRF was applied, there was a noticeably reduced level of discomfort. The usage of PRF decreased the intensity of pain our study indicates remarkable reduction in pain intensity from day 1 to day 7 relatable to the results of Kumar et al.¹⁴ PRF functions as an immunological regulator and may lessen the harmful consequences of inflammation prove from our study in which healing was rapid and without or less pain from day 1 to day 7 shows efficacy of PRF comparable to the results of Dohan et al.¹⁵

CONCLUSION

This study suggests that PRF (Platelet-Rich Fibrin) is a superior treatment for dry socket, being more effective, quicker, less invasive, and more cost-efficient. Since PRF is sourced from the patient’s own blood, it minimizes the risk of allergies or adverse reactions, unlike Alveogel, which may be perceived as a foreign substance. Therefore, PRF is recommended for regular use in the treatment of dry socket.

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None to declare.

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Awareness and Knowledge of Maxillofacial Prostheses Among Dental Practitioners and Students

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ABSTRACT

Objectives: The aim of the study was to determine the awareness and knowledge of maxillofacial prostheses among dental students and house officers in a Tertiary Dental Healthcare facility in Islamabad, Pakistan.

Materials and Methods: A cross-sectional study was conducted on 300 dental students and dental house officers at a Prosthodontics Department of a private dental college in Islamabad from August 2022 to October 2022 after obtaining approval from the Institutional Review Board. Sampling was done using a non-probability consecutive sampling technique. Data collection involved questioning the participants through a questionnaire designed for this study. SPSS V-25 was used to analyze data.

Results: Out of 300 participants 181 (60.3%) participants were BDS students while 119 (39.7%) were dental house officers in this study. 80.7% of students and house officers were aware of the aspects of maxillofacial prosthodontics including the scope and design. Social media proved a popular aid for the participants to gain insight [200 (66.7%)] followed by information gathered from other dentists which was 52 (17.3%). Participants were not completely aware of the different sources and types of maxillofacial prostheses.

Conclusion: House officers and dental students are not completely aware of various aspects of maxillofacial prostheses which include the types and identification of prostheses, the role of the Prosthodontist, the rehabilitation of the patients, and referring patients to a hospital.

Keywords: Awareness, Dental Students, House Officers, Maxillofacial Prostheses, Maxillofacial Rehabilitation

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INTRODUCTION

Prosthetic rehabilitation using maxillofacial prostheses has long been used for providing patients with a reliable solution to their aesthetic defects because due to extensive loss of tissue, surgical reconstruction cannot be used as a stand-alone option for treating large facial defects.^{1,2} Facial defects demand an extensive solution. Restoration of large facial defects is challenging as it requires choosing between surgical reconstruction and prosthetic restoration.^{3,4}

Acid attack burn cases, vehicle accidents, and oral carcinoma cases needing extensive tissue removal and rehabilitation of the defective parts with prostheses,^{5,6} are increasing day by day in countries like Pakistan. Patients require extensive surgical procedures in such cases but it's not possible to restore the large tissue defects by only surgical means. Here comes the role of maxillofacial prosthodontics in restoring craniofacial and maxillofacial defects with dental prostheses. Dental prostheses not only restore the aesthetics but restore the function as well.^{7,8} In addition, the restoration may be readily removed to allow evaluation of the health of the underlying tissue.⁹

Maxillofacial defect restoration involves a complex approach by a team of multidisciplinary specialists to tackle the various trials posed. Rehabilitation of maxillofacial deformities is a challenging and skill-based task, it involves many disciplines working together for the betterment of the patient.¹⁰ However more often than not, a prosthodontist is not a member of the tumor board and lack of consultation after surgery severely affects the rehabilitation process. There is a perceived need to bring awareness among surgeons and physicians and major interprofessional initiatives were deemed necessary to improve this collaboration.^{11,12}

Local literature in Pakistan is present but it mainly contributed to treatments and methods provided to patients for rehabilitation. This literature is insufficient regarding the major exposure of maxillofacial prosthetic rehabilitation in our young dental students and house officers and is basically creating a research gap. The other important aspect of the study is to contribute to the spread of information and to improve the proficiency of clinicians and students. Prosthodontists are the Dental Specialists dealing with the rehabilitation of maxillofacial defect in patients and Prosthodontics is

the Dental Specialty that mainly deals with these cases. With this study, we will be able to increase the level of cognition of our dental students and house officers about multiple options available and they will be able to refer the patients properly to concerned dental departments and accordingly, they will be able to provide proper care and treatment to patients.¹³

This study aims to assess the level of cognition of dental students and house officers in multiple facets of maxillofacial prosthetic rehabilitation.

The rationale of this study is to determine the awareness and knowledge of dental students and house officers who are involved in multiple aspects of maxillofacial prosthetic rehabilitation in a local dental healthcare facility in Islamabad, Pakistan. The results of this study will be useful to take initiatives to further enhance the exposure regarding this field. This study suggests a need for enhanced training and education to improve the exposure of dental students and practitioners. The dental students and house officers will be able to refer the patients properly to concerned dental departments and accordingly, they will be able to provide proper care and treatment to patients.

MATERIALS AND METHODS

This cross-sectional study was performed at Islamic International Dental College and Hospital Islamabad from August 2022 to October 2022 after obtaining approval from the Institutional Review Board. A total of 300 participants participated in the study. Sampling was done using a non-probability consecutive sampling technique. Only final-year students and Dental House Officers currently enrolled in their respective programs were included as a part of this study. Other students and dentists were not considered.

A questionnaire was adapted from sources.¹³ The reliability of the questionnaire was found to be Cronbach's Alpha of 0.89. A questionnaire-based approach already piloted by 13 Participants, consisted of two parts. The first part of the questionnaire included sociodemographic data (age, gender, educational status); the second part of the questionnaire consisted of questions to assess the knowledge and awareness of participants about various aspects of maxillofacial prostheses. The study included dental students and house officers at Islamic International

Dental College and Hospital Islamabad and excluded consultants, postgraduate residents, and demonstrators.

The analysis of data was done by using SPSS V-25. Percentage and frequency were calculated for all the data concocted. Mean and standard deviation were calculated for the Age of the study participants. Data normality was assessed using the Shapiro-Wilk test. This showed a parametric distribution of data. The Chi-square test was performed to deduce a statistical significance whose value was set as 0.05. Phi and Cramer’s test was performed to compare a set of knowledge between dental students and house officers.

RESULTS

A total of 300 participants participated in the study of which 127 (42.3%) were male and 173 (57.7%) were female. The age of the participants ranged from 18 to 28 years with a mean of 22.3 years. 181 (60.3%) participants were BDS students while 119 (39.7%) were house officers.

Table 1 shows that out of the total participants, 242 (80.75%) were aware of maxillofacial prosthodontics and 58 (19.3%) were unaware. Their main source of knowledge was social media 200 (66.7%) followed by other dental colleagues 52 (17.3%) depicting how internet sources play an active role in today’s learning.

Table 1: Results Showing the Total Percentage of Aware and Unaware Participants and Showing Results of Source of Knowledge.

		Frequency
Topic Awareness	Aware	242 (80.7%)
	Unaware	58 (19.3%)
Source of Knowledge	Social media	200 (66.7%)
	Books	36 (12%)
	Friends	12 (4%)
	Dentists	52 (17.3%)

Table 2 shows the total percentage of all aspects of a study showing that overall 80.7% of the BDS students and house officers were aware of this field of prosthodontics. Their main source of knowledge was social media followed by other dentist colleagues. House Officers demonstrated a far better knowledge regarding the maxillofacial prostheses as compared to the BDS students.

Table 2: Awareness Level of House Officers and Dental Students about Various Aspects of Maxillofacial Prostheses

Variable			
Participants x Type of Defect	House officer	Aware	107 (89.9%)
		Unaware	12 (10.1%)
	Dental student	Aware	135 (74.5%)
		Unaware	46 (25.5%)
Participants x Name of Prosthesis	House officer	Nasal	47 (43.9%)
		Ocular	29 (27.1%)
		Auricular	31 (28.9%)
	Dental student	Nasal	70 (51%)
		Ocular	37 (27%)
		Auricular	30 (22%)
Participants x Source of information	House officer	Social media	72 (67.2%)
		Books	19 (17.7%)
		Friends	42 (39.2%)
		Dentists	9 (8.4%)
	Dental student	Social media	102 (74.4%)
		Books	8 (5.8%)
		Friends	22 (16.2%)
		Dentists	5 (3.6%)
Participants x knowledge that these prosthetics are given by a prosthodontist	House officer	Aware	99 (92.5%)
		Unaware	8 (7.5%)
	Dental student	Aware	117 (85.4%)
		Unaware	20 (14.5%)
Participants x dealing with the rehab of such patients	House officer	Yes	38 (35.5%)
		No	69 (64.4%)
	Dental student	Yes	34 (24.8%)
		No	103 (75.1%)
Participants x referring such patients to hospitals for maxillofacial defects	House officer	Yes	22 (20.9%)
		No	83 (79.1%)
	Dental student	Yes	6 (4.3%)
		No	131 (95.6%)
Participants x referral for the type of prosthesis	House officer	Nasal	28 (84.8%)
		Ocular	3 (9.1%)
		Auricular	2 (6.1%)
	Dental student	Nasal	3 (100%)
		Ocular	0 (0%)
		Auricular	0 (0%)

Table 3 shows the statistical significance of different aspects of maxillofacial prostheses which includes the types and identification of prostheses, the role of the prosthodontist, the rehabilitation of the patients, and, referring patients to a hospital.

Table 3: Results Showing Statistical Significance between House Officers and Dental Students

	Chi-Square Value	Phi and Cramer's Value
Participants x the type of defect	0.06	0.06
Participants x the name of the prostheses	0.60	0.60
Participants x having knowledge that these prosthetics are given by a prosthodontist	0.00	0.00
Participants x dealing with the rehab of such patients	0.01	0.01
Participants x referring such patients to hospitals for maxillofacial defects	0.00	0.00
Participants x referral for the type of prosthesis	0.00	0.00

A chi-square test was performed to deduce a statistical significance whose value was set as 0.05. The results concluded that a statistical significance was observed when comparing the participants with the knowledge that maxillofacial prostheses are prescribed by a prosthodontist, denoting that an association exists between the BDS students and house officers in their knowledge. Considering the rehabilitation of these patients, variance was observed between the participants. The remainder comparisons showed that statistical significance was absent and weak associations were noticed by the Phi and Cramer's Value denoting that a similar knowledge set existed between the BDS students and House Officers.

Fig-1 Shows that 181 house officers and 119 dental students participated in the study.

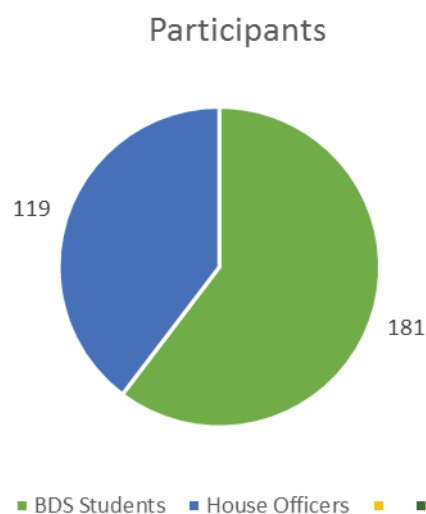


Fig-1. Pie Chart Showing the Number of Participants

Figure 2 shows a good percentage of house officers (89.9%) had knowledge and awareness regarding different types of maxillofacial prosthesis as compared to a lower percentage of BDS students (74.5%).

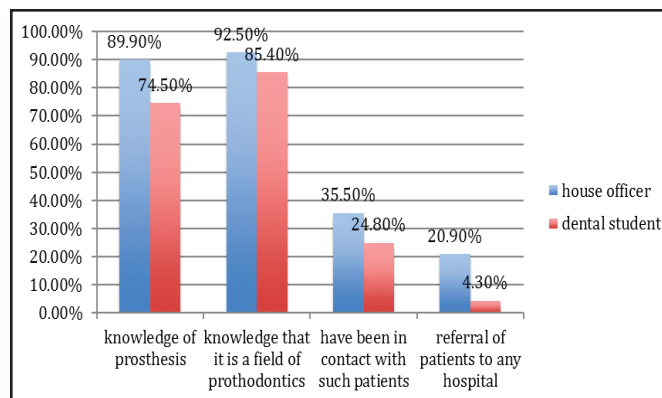


Figure 2. Knowledge and Awareness of Maxillofacial Prostheses among House Officers and Dental Students

DISCUSSION

Maxillofacial prostheses are a non-surgical option for aiding patients with facial impairments caused by birth defects, cancer, or injuries.^{14,15} These prostheses serve to replace facial components or areas of bone and soft tissue that are absent, allowing patients to regain oral capabilities like swallowing, speaking, and chewing. The ultimate objective is to enhance the patient's overall

quality of life. The finished prosthesis must be skin-like in appearance and touch.^{16,17} Maxillofacial prosthodontists are not widely recognized or fully comprehended by both the general public and medical professionals regarding their capabilities and the extent of their expertise.^{18,19} Due to insufficient knowledge, patients suffering from maxillofacial deformities are not appropriately informed and directed to a maxillofacial prosthodontist to receive proper rehabilitation.^{20,21}

This survey showed the level of awareness of BDS students and house officers. The study revealed that BDS students have little knowledge about maxillofacial prosthodontics as compared to house officers.

In this study highest percentage of 80.7% of house officers and BDS students have heard of maxillofacial prosthetic rehabilitation and 19.3% have not heard of maxillofacial prosthesis at all. 71.3% of BDS students and house officers have heard about this field mainly through Internet sources. This result is similar to the study conducted by Jain et al¹⁴ which found that 90% of students were aware of this field and 10% never heard about this field. He concluded that 26% of cohorts were aware of maxillofacial prosthetics through the means of the Internet. The results are similar to another study by Berge et al²² which found that the internet was the main source of information about maxillofacial prosthetics. A similar picture was observed in India in a study conducted by Rupali et al¹³ and it concluded that only 10% of medical practitioners were aware of maxillofacial prosthodontics.

The results of this study show that our BDS students and house officers have heard about maxillofacial prosthetics from other sources too which were Books 7.8%, Friends 3.7%, and Dentists 14%. Jain demonstrated a range of 38%, 25%, and 11% of participants gained knowledge from newspapers, friends, and others. Rupali demonstrated a range of 39.7 % by dental acquaintance followed by friends at 38.8 % and books at 31.5 %.

In our research majority of participants have sound knowledge of different types of defects. The role of the maxillofacial department is also very important in this matter.^{23,24} They treat the patients and do the surgeries resulting in large tissue defects and then they refer the

patients to the prosthodontics department. If the facilities are not there and there is no well-established surgical setting it affects the maxillofacial prosthodontics much. The cost of the material and the availability of materials are also very important, that's why very few dental hospitals in Pakistan are doing this reconstructive work.²⁵

The participants in our study are dental students who have little knowledge that prosthodontics is a subspecialty that deals with maxillofacial prosthetics and only 85.0% of dental students are aware when compared to 92.50% of house officers. 34.5% of house officers have seen patients with facial defects compared to 24.8% of dental students.

20.9% of house officers refer patients to dental hospitals and only 4.3% of dental students refer such patients and they are not aware of the hospitals and settings that are providing treatment to such patients.

In general, the results obtained in this study revealed the awareness of dental students about various aspects of prosthetic rehabilitation. The knowledge of house officers is good but their knowledge is also lacking about different prosthetic options, referral of patients, and different types of prostheses. Therefore there is an immense need to develop different methods and different awareness programs and also it is necessary to include this in dental students' curriculum so they become well aware of this field at their undergraduate level. It is mandatory to organize different workshops for house officers so as to improve their knowledge about this field. Based on these results it is recommended for institutes and concerned bodies to integrate the curriculum on maxillofacial prosthesis. This would in turn enhance better learning at the undergraduate level and lead to an improved approach for patients suffering from such issues.

This study has certain limitations as it is conducted on a small population size which includes only a single dental setting in Islamabad thus having limited data. Including more dental practitioners such as postgraduate residents and postgraduate clinicians would have shed light on the topic in a better way. Perhaps, replicating this study on different dental settings may provide a clearer picture. These are some factors that limit the applicability of the results to the local population.

CONCLUSION

Within the confines of this study, it became evident that dental students are less aware of maxillofacial prosthetics as compared to house officers, but it is also seen that house officers are also not completely aware of this field and they are not dealing with such patients, they do not know the exact referral department for such patients. Consequently, it is imperative to address this by implementing strategies to educate and inform dental students and house officers about the diverse range of maxillofacial prosthodontics.

DISCLAIMER

None to declare.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

ETHICAL STATEMENT

Ethical approval was provided by the Ethical Review Committee at Islamic International Dental College, Islamabad under ERC Ref. No. IIDC/IRC/2022/11/080).

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AUTHORS CONTRIBUTION

Conception and design of the study: H. Ijaz, M. A. Ghafoor.

Acquisition of data: H. Riaz, W. Ishaq.

Analysis and/or interpretation of data: S. A. Khan, M. F. Kamran.

Drafting the manuscript: H. Ijaz, M. A. Ghafoor, H. Riaz
 Revising the manuscript critically for important intellectual content: W. Ishaq, S. A. Khan, M. F. Kamran
 Approval of the version of the manuscript to be published: H. Ijaz, M. A. Ghafoor, H. Riaz, W. Ishaq, S. A. Khan, M. F. Kamran.

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Oral Health status of Visually Impaired Adolescents in schools of Karachi

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ABSTRACT

Objectives: The primary objective of this study was to evaluate the oral hygiene condition, gingival index, and DMFT (Decayed, Missing, and Filled Teeth) among visually impaired adolescents aged 12-18 years, and to explore the factors that influence these parameters.

Materials and Methods: An analytical cross-sectional study was conducted from October 2022 to April 2023 at four distinct special schools/institutions for visually impaired children located in Karachi, Pakistan. A total of 234 visually impaired children, with ages ranging from 12 to 18 years, were enrolled in this study. To analyze, the data was categorized into binary data. DMFT < 3 and >3, OHI <1.8 and >1.8, GI <1 and >1. The SPSS version 21 was used to perform statistical analysis of the data.

Results: Out of total participants, 55.1% reported brushing their teeth once a day, while 44.9% reported brushing their teeth twice or more. Majority of participants had an OHI-S score of ≤ 1.8 and an OHI-S score of <1. OHI-S > 1.8 was less frequent in females than in males, GI >1 was more frequent when the year of education in school increases.

Conclusion: Within the limitations of this study, it can be inferred that most of the children displayed inadequate oral hygiene, as observed in their oral health condition. There is a need for regular school-based oral health programs to train teachers, parents, and guardians to improve oral health related quality of life of visually impaired children.

Keywords: Dental Caries, Oral Hygiene, Visually Impaired Persons

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INTRODUCTION

Oral health is an indispensable aspect of overall well-being, thereby positively influencing the mental and physical well-being, interpersonal relationships and appearance, of individuals, thus contributing to their quality of life.¹ The ability of individuals to manage their routine personal hygiene practices, such as dental hygiene, is crucial for maintaining an independent existence.¹ The significance of oral health extends to children, especially those with special health needs, for whom it assumes even greater importance.²

Pakistan is one of the developing nations that is confronted with various disabilities, among which visual impairment is on the rise. According to estimates by the World Health Organization (WHO), approximately 2.2 billion people globally experience either near or distance vision impairment, with nearly half of these cases remaining untreated.³ The occurrence of blindness in children varies across different countries, with developed countries reporting a prevalence of 0.3 cases per thousand children, while developing countries report a prevalence of 1.5 cases per thousand children.⁴

Visual impairment as a disability appears to present challenges when it comes to achieving optimal dental health. Routine habits like using toothpaste containing fluoride, replacing toothbrushes that are worn out, rinsing the mouth, following a healthy diet, and regularly visiting the dentist are generally not difficult for typical children. However, children with visual impairments face daily challenges in acquiring fundamental skills, and maintaining proper oral hygiene is one of the difficulties they encounter.⁵ Studies have indicated that when compared to their classmates with normal vision, these kids typically practice poorer oral hygiene.⁶ Therefore, it is crucial to provide sufficient instruction on the appropriate maintenance of dental and oral tissues.

Multiple studies have reported about the complexity and difficulty of managing oral health issues for children with disabilities, who frequently struggle with the implementation of the necessary skills for controlling the dental plaque. Studies have also reported poor oral hygiene associated with visual impairment.⁷ Individuals with visual impairment face additional social and psychological pressures. In some cases, blindness may be part of a syndrome, thereby exacerbating other medical

challenges that surpass oral hygiene issues in magnitude.⁸ This situation has a profound impact on visually impaired children, leading to feelings of sadness, depression, isolation, and anxiety.⁹

The study done in 2017 conducted to examine status of oral health of visually impaired children in Pakistan shows 66% visually impaired children have never visited the dentist.¹⁰ Another study conducted in India (Bihar) in 2021 revealed that 78.7% exhibited changes in oral hygiene, including both soft and hard tissues.⁸ Similarly, a study in Malaysia demonstrated a caries prevalence of 85.2%.¹¹ A study conducted in Riyadh found that only 22.8% had good oral hygiene.⁷ However, it is important to highlight that numerous detailed studies have been conducted to evaluate the oral health status of adolescents with speech and hearing impairments. The study referenced have reported an overall caries incidence rate of 51% within this subset of the population.¹²

Visual impairment is a significant disability that affects a considerable proportion of the global population. Disabled children should receive equal opportunities for oral health and hygiene compared to their healthy peers.¹³ At present, there is limited information about the state of oral health of visually impaired children in Pakistan. Considering the insufficiency of satisfactory and comprehensive data pertaining to the current state of oral health among this specific demographic of children, it is imperative to undertake further investigation through this study. The primary aim of this study was to evaluate the oral hygiene condition, gingival index, and DMFT (Decayed, Missing, and Filled Teeth) among visually impaired adolescents aged 12-18 years, and to explore the factors that influence these parameters.

MATERIALS AND METHODS

An analytical cross-sectional study was conducted from October 2022 to April 2023 at four distinct special schools/institutions for visually impaired children located in Karachi, Pakistan. A total of 234 visually impaired children, with ages ranging from 12 to 18 years, were enrolled in this study. The sample size calculation was performed using WHO sample size calculator using data from study of Syed H et al.¹⁰ reporting frequency of DMFT in visually impaired children as 67%. Keeping a relative precision of 9%, and a 95% confidence interval, the required sample size was 234. Consent was obtained

beforehand from the relevant authorities of the schools/centers and the parents/guardians prior to assessing the oral health of these children. Approval from the ethics committee of Bahria University Dental College, Bahria University of Health Sciences campus Karachi, Pakistan was obtained in accordance with ethical guidelines. Children who were unable to comprehend the questions due to mental or physical disabilities, or were medically compromised, were excluded from the study.

The examination procedure and criteria employed were in accordance with the recommendations set forth in a modified version of WHO oral health assessment form from 1997.¹³ Furthermore, general characteristics such as the children's age, gender, and duration of schooling were also documented in the form. The following questions were posed to determine the current oral health status of the patients (Table 1). During the administration of the questionnaire, the students were allowed to seek clarification from the examiner as needed.

Table 1: Questions Asked to Assess Oral Health Status

1)	Do you rinse your mouth with water after every meal?
2)	Do you brush your teeth?
3)	How frequently do you brush your teeth?
4)	How long do you brush your teeth?
5)	Do you experience a metallic taste after brushing?
6)	Do you use mouthwash?
7)	Have you experienced tooth sensitivity?
8)	Have you noticed any unpleasant odor while speaking?
9)	Have you ever visited a dentist before?
10)	If yes, what was the reason for your visit?

All visually impaired students underwent a detailed and thorough clinical examination by a calibrated examiner. A comprehensive analysis was conducted on the oral cavity with the purpose of identifying any occurrences of oral lesions. The dental caries experience of the children was recorded by utilizing the dmft and DMFT indices. In addition, the gingival condition was evaluated by employing the Gingival index, which was devised by

Sillness and Loe.¹⁴ The oral cleanliness of the children was assessed by utilizing the Simplified Oral Hygiene Index developed by Greene and Vermillion JK.¹⁵

The examination was conducted on visually impaired children at their respective educational institutions or centers, with the children being seated on a conventional chair, and suitable illumination being provided either by natural light or a handheld torch. Throughout this examination, a sterile mouth mirror and a CPITN probe were utilized, while adhering to appropriate procedures and standard guidelines for controlling cross infection, which included the use of disposable gloves, gowns, and masks. The collected data was organized in a tabular format and subjected to statistical analysis.

For the purpose of analysis, the data was categorized into binary data. DMFT < 3 and >3, OHI <1.8 and >1.8, GI <1 and >1.

The SPSS version 21 was used to perform statistical analysis of the data. Descriptive statistics was performed to calculate the Frequencies, means and SD of qualitative and quantitative variables. Logistic regression model was utilized to identify the effect of demographic variables (Gender, age, years in school) and behavioral variables (brushing habit, frequency, and duration of brushing, rinsing habit, use of mouthwash, frequency of dental visit, reason for visit) on the probability of affecting the health status represented by indices like DMFT, OHI and GI. A p value ≤ 0.05 was considered as statistically significant.

RESULTS

Descriptive results

General characteristic:

A total of 234 children between the ages of 12-18 from four different special schools dedicated for blind children in Karachi Pakistan, participated in the study.

Out of total 234 participants 140 (59.8%) were males and 94 (40.2%) were female children. Among the participants, 173 (73.9%) were between the ages of 12-14 and 61 (26.1%) were between the ages of 15-18. Most students had less than 5 years of education (Table 2).

Table 2: General Characteristics of 12–17-Year-Old Visually Impaired School Children (n = 234)

Variable	Frequency (N)	Percentage (%)
Gender		
Male	140	59.8
Female	94	40.2
Age		
12-14	173	73.9
15-18	61	26.1
Years in school		
1-4	176	75.2
5-8	54	23.1
9-12	4	1.7

Oral health-related variables:

Oral health-related variables: Among all the individuals, 55.1% reported brushing their teeth once a day, while 44.9% reported brushing their teeth twice or more. A small percentage of children (5.1%) reported never brushing their teeth, and approximately 65% of them brushed their teeth for at least 1-2 minutes. Additionally, 50.4% of the children reported rinsing after every meal, and 10% of the participants used mouthwash in addition to tooth brushing. Most of the children (77.8%) had never visited a dentist, while 22.2% had visited the dentist before. Of those who visited the dentist, 30% reported doing so due to pain and sensitivity in their teeth.

Clinical examinations:

The average DMFT score in this study was 3.50 ± 5.83 . Approximately 41.0% of the participants had a DMFT score of three or more. The DT component had the highest contribution to the DMFT score. The mean OHI-S score was 1.22 (1.32) and the mean GI score was 0.19 (0.414). The majority of participants had an OHI-S score of ≤ 1.8 and an OHI-S score of < 1 (Table 3).

Table 3: Clinical Characteristics of 12–17-Year-Old Visually Impaired School Children (n = 234)

Variable	Frequency (N)	Percentage (%)
DMFT		
< 3	138	59.0
≥ 3	96	41.0
OHI		
≤ 1.8	174	74.4
> 1.8	60	25.6
GI		
< 1	200	85.5
≥ 1	34	14.5
	Mean (SD)	Range
DMFT	3.50 (5.83)	0.00-39.20
OHI	1.22 (1.32)	0.0-5.9
GI	0.19 (0.414)	0.0-2.0

OHI-S oral hygiene index-simplified, DMFT Decayed, Missing and Filled teeth, GI Gingival Index**Analytical results:**

Binary logistic regression was employed to examine the association between demographic variables (gender, age, years in school) and behavioral variables (brushing habit, frequency, and duration of brushing, rinsing habit, use of mouthwash, frequency of dental visit, reason for visit) on the likelihood of affecting oral health status as represented by DMFT, OHI, and GI indices.

DMFT:

Data was analyzed using Univariate analysis to identify the factors affecting the oral health status of these children. The results showed that dental visits during the last 12 months ($P = 0.001$, OR = 0.33, 95% CI: .179-0.64) and gender ($P = 0.01$, OR = 2.00, 95% CI: 1.17–3.41) significantly influenced the prevalence of dental caries in visually impaired school children. The odds of having a DMFT score ≥ 3 were higher in females. Additionally, participants who did not require dental visits were less likely to have a DMFT score > 3 compared to those who visited the dentist (Table 4)

Table 5: Association of DMFT/dmft, OHI-S, GI and Behavioral Factors in 12–17 Visually Impaired School Children (n = 234)

Variable	N (%)	DMFT			OHI-S			GI		
		p- value	OR	95% CI	p- value	OR	95% CI	p- value	OR	95% CI
Brushing frequency										
Atleast once a day ^a	222 (94.8)	0.963	1.02	0.31-3.34	0.461	1.59	0.46-5.50	0.539	0.521	0.065-4.16
Never	12 (5.12)									
Brushing Duration										
Atleast 2 minutes ^a	142	0.42	0.79	0.45-1.39	0.20	1.50	0.80-2.82	0.225	1.59	0.75-3.35
More than 2 minutes	80									
Mouth rinse with water after each meal										
Once or more ^a	177(75.6)	0.461	0.79	0.42-1.46	0.75	0.89	0.441-1.81	0.58	0.77	0.319-1.89
never	57 (24.3)									
Dental visit in the past 12 months										
Yes ^a	52 (22.2)	0.001 ^b	0.339	.179-0.64	0.394	0.740	0.37-1.47	0.27	0.63	0.28-1.43
No	182 (77.7)									
Reason for the last dental visit										
Pain or sensitivity ^a	15 (28.8)	0.629	0.733	0.208-2.58	0.37	1.92	0.455-8.10	0.11	0.313	0.075-1.30
Others	37 (71)									

a Reference category, b Statistically significant

OHI-S oral hygiene index-simplified, DMFT Decayed, Missing and Filled teeth, GI Gingival Index

OHI:

The results also reported that gender ($P = 0.03$, $OR = 0.49$, $95\% CI: 0.25-0.94$), age ($P = 0.03$, $OR = 2.00$, $95\% CI: 1.06-3.78$) and years of education in school ($P = 0.006$, $OR = 2.49$, $95\% CI: 1.30-4.78$) were significantly predictors of $OHI-S > 1.8$. $OHI-S > 1.8$ was less frequent in females than in males, however, the frequency of $OHI-S > 1.8$ was higher in 15-18 years age groups and with greater years of education in school (Table 5).

Table 5: Association of DMFT/dmft, OHI-S, GI with Demographic Variables in Visually Impaired School Children (n = 234)

Variable	N (%)	DMFT > 3			OHI-S > 1.8			GI ≥ 1		
		p- value	OR	95% CI	p- value	OR	95% CI	p- value	OR	95% CI
Gender										
Male ^a	140 (59.8)	0.01 ^b	2.00	1.17-3.41	0.034 ^b	0.495	0.25-0.94	0.80	0.90	0.43-1.92
Female	94 (40.1)									
Age (years)										
12-14 ^a	173 (73.9)	0.07	0.56	0.30-1.04	0.03 ^b	2.00	1.06-3.78	0.08	1.96	0.91-4.20
15-18	61 (26)									
Years in school										
1-4 ^a	176 (75.21)	0.46	0.79	0.42-1.48	0.006 ^b	2.49	1.30-4.78	0.001 ^b	3.69	1.72-7.91
5-8	54 (23.07)									
9-12	4 (1.70)									

a Reference category, b Statistically significant

OHI-S oral hygiene index-simplified, DMFT Decayed, Missing and Filled teeth, GI Gingival Index

GI:

GI > 1 (P = 0.001, OR = 3.69, 95% CI: 1.72–7.91) was also significantly affected by years of education in school. GI > 1 was more frequent when the year of education in school increases.

DISCUSSION

Visually impaired children in our setting do not have access to proper healthcare, so the status of oral health is always a problem. Health care systems must develop curated programs to address the needs of visually impaired individuals.^{16,17} As a community health provider, we must develop customized programs to improve the oral health of blind individuals. Previously done studies shared data indicating lack of knowledge among visually impaired individuals regarding oral health care.¹⁸ The present investigation was aimed to determine the oral hygiene status, gingival index and DMFT, among 12-18 years old visually impaired adolescents and to identify the predicting factors.

Several studies¹⁹⁻²¹ conducted to ascertain the occurrence of oral diseases in disabled populations have reported notably inadequate levels of oral hygiene, as confirmed by the current investigation. It was evident and apparent from our research that these children demonstrated average to substandard levels of oral hygiene. This observation can be attributed to a specific cause, specifically reduced ability of visually impaired children to maintain their oral hygiene adequately. The underlying reason behind this inadequacy is due to lack of manual-visual coordination

that these children face and encounter daily.

In the current investigation, most of the children used a toothbrush daily, thus aligning with the results of prior research.²²⁻²⁴ Over fifty percent of the participants engaged in brushing for a duration of 1-2 minutes, yielding outcomes that are analogous to the investigation conducted by Jhon et al²³, Arora et al²⁴ and Parker et al.²⁵ The analysis demonstrated that a substantial number of visually impaired individuals engaged in rinsing after meals, but a small minority utilized mouthwash for this purpose. The reasons behind this phenomenon could be attributed to a lack of awareness regarding plaque buildup or the additional expenses highlighted in other scholarly investigations.^{26,27} Results indicated that these individuals exhibited a limited inclination towards seeking dental treatment, potentially attributable to the prioritization of other systemic issues or heightened levels of stress related to dental care. Consequently, compromised oral health ensued, aligning with prior research findings.^{24,25}

Within the current investigation, females demonstrated higher DMFT scores, consistent with previous studies⁹, yet in contrast to a study conducted in India which showed lower DMFT scores.²⁷ Our findings also revealed slightly

elevated OHI scores among males compared to females, which concurs with existing literature.²⁴ This distinction may be attributed to a less serious attitude exhibited by males towards oral healthcare. Notably, the association between the GI and OHI with age indicated a decline in oral care as individuals grew older, signifying a lack of dental visits and diminished prioritization of dental care. Furthermore, the OHI and GI exhibited an inverse relationship with the duration of schooling, suggesting inadequate training among teachers and staff members.

The participants in the study group demonstrated varying levels of gingivitis, with a considerable number displaying moderate to severe gingivitis. The heightened inflammation of the gums in these children may be attributed to unsupervised brushing, which can result in ineffective removal of plaque. This finding is consistent with the results reported by Ohito et al.²⁸ and Bhavsar et al.²⁹

Present study showed that 77.7% of the participants did not visit the dental healthcare facility in past 12 months, these results are in accordance with previously done studies which showed 92% have never visited dentist.³⁰⁻³¹ Furthermore, it was observed that 28% of these individuals sought dental treatment due to pain and sensitivity. Notably, sensitivity emerged as a prominent factor for seeking dental care, which is consistent with previous research findings.²³

The primary obstacles to guaranteeing equitable delivery of dental care for people with disabilities seem to be insufficient infrastructure and constrained time, as well as a dearth of suitable expertise and the overall challenges associated with delivering care to this specific demographic.³² These stressors encompass financial burdens, apprehension, and unfavorable attitudes towards dental care.^{33,34} In spite of the endeavors undertaken in developed nations to improve the oral well-being of these underprivileged youngsters, the health authorities in developing nations have not yet prioritized addressing this issue.³⁵

The strength of the study is that it is done in multiple centers of visually impaired children in Karachi, Pakistan. Limitations include limited sample size, cross-sectional study design and use of subjective parameters like DMFT that can underestimate the caries prevalence

and inclusion of children from schools only.

Future recommendations include study with large sample size, comparative study group and objective method of assessment. We also recommend oral health care training programs and workshops at special schools for teachers, parents, and guardians of these children with a focus on preventive procedures. A standardized community health program should be formulated and implemented with the help of health authorities. The collaboration between dental professionals and oral healthcare should be practiced in conjunction with general healthcare to attain a more comprehensive comprehension of an individual's physiological and psychological well-being.

CONCLUSION

Within the limitations of our study, it can be inferred that most of the children displayed inadequate oral hygiene, as observed in their oral health condition. Gender, dental visits in the past 12 months, age and years of education in school were found to be significant predictors of oral health status. Additionally, most of the children had a marked rise in the prevalence of dental caries, and many of them had untreated carious teeth and moderate to severe inflammation of the gums. Thus, the provision of adequate training and education about oral health is required for this group of society. There is a need for regular school based oral health programs to train teachers, parents, and guardians to improve oral health related quality of life of visually impaired children.

DISCLAIMER

None to declare.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

ETHICAL STATEMENT

Ethical approval was provided by the Ethical Review Committee at Bahria University. Ref No: ERC 20/2023

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AUTHORS CONTRIBUTION

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Open v/s Closed Surgical Exposure Technique for Impacted Maxillary Canine-Surgical and Orthodontic Perspective

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ABSTRACT

Objectives: To compare open and closed surgical exposure techniques for impacted maxillary canines in terms of postoperative pain, dislodgement of bonding bracket, food impaction, and overall patient satisfaction

Materials and Methods: A quasi-experimental study was conducted at Dental College HITEC (IMS) Taxilla Cantt for 18 months, from 1st Aug 2020 to 31st Jan 2022. The sample size for the study was 32, which was calculated using the Open EPI Sample Size Calculator, with a confidence level of 95% and prevalence of impacted canine as 1.2%. A nonprobability (purposive) sampling technique was used and the patients were screened from the OPD of the Oral & Maxillofacial Surgery Department, who were candidates for surgical exposure of impacted canine followed by orthodontic traction. They were divided into two groups, group A was surgically exposed with an open surgical technique, and group B patients were exposed via closed surgical technique. The outcome of both techniques was compared in terms of postoperative pain, complaint of food impaction at the surgical site and dislodgment of the bonding device.

Results: A total of 32 patients, and 58 impacted maxillary canines were treated with open and closed surgical exposure technique, postoperative outcome of both techniques were compared. Pain on postoperative day 2, according to Visual Analogue Scale, was moderate in 10 patients and severe in 6 for group A. Group B patients had mild pain in 10 patients while 6 had moderate pain. The orthodontic bonding device was dislodged in 6 patients of Group A and in 1 patient of Group B. 12 patients from Group A and 3 from Group B complained of food impaction at the site of surgical exposure.

Conclusion: The closed surgical exposure technique was found to be more beneficial and superior when compared with the open surgical technique in terms of postoperative pain, food impaction at the exposure site, and dislodgment of the traction device.

Keywords: Ankylosis, Impacted Canine, Orthodontic Traction, Post-Operative Pain, Tooth Eruption

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INTRODUCTION

A tooth that is not fully erupted in the oral cavity much past the anticipated age is known as an impacted tooth. After the mandibular third molar, the maxillary canine is the tooth that is impacted the most frequently.¹ Permanent canines are vital for both static and functional occlusal relationships in addition to aesthetics.²

Impaction of the upper canine can be caused by a variety of circumstances, however, the precise origin is unknown³ but the most common local etiological factors are loss of arch space, missing adjacent lateral incisors, ankylosis, root dilacerations, supernumerary teeth, retained deciduous teeth, trauma, reconstructive surgery for cleft lip/palate repair, and ankylosis and idiopathic causes.^{4,5}

Incidence of impacted canines among various populations is as high as between 0.3% to 2.4% and prevalence in females is twice in comparison to males.^{1,6}

Furthermore, compared to bilateral impaction, unilateral impaction is more frequent. In comparison with labial impaction, palatal impaction of the permanent canine has been reported to occur more frequently.⁷

Impacted maxillary canines can be guided to a suitable location in the dental arch and permitted to erupt with prompt diagnosis, prompt interception, and well-managed surgical and orthodontic treatment planning. Remarkably, impacted maxillary canines can be successfully treated only because of the collaborative treatment provided by general dentists, maxillofacial surgeons, orthodontists and periodontists.⁵

Treatment of an impacted maxillary canine requires patient counselling for multiple visits and a longer duration of orthodontic treatment which continues even after complete tooth eruption for tooth alignment in the arch. Treatment planning requires a thorough evaluation of the position, angulation, and orientation of the impacted maxillary canine.⁸

Most of the time, a combined intervention of surgical exposure followed by orthodontic traction is required as part of the treatment plan.⁹ The surgical technique should fulfill the aim of surgical exposure, and bonding of orthodontic traction device, along with the least discomfort to the patient and minimum loss of keratinized gingival

tissue. The two most common surgical techniques for the exposure of impacted canines are open surgical exposure which involves bonding an orthodontic traction device at the cusp tip and removing the soft tissue and bone covering the crown. The crown is then left exposed in the oral cavity for the remainder of the orthodontic treatment. The second surgical approach is the closed technique, which involves raising a flap, exposing the tooth's crown, bonding the device, moving the flap back to its original location, and suturing.^{6,9,10,11}

The pros and cons of both methods have been outlined by researchers, which makes the decision challenging.^{12,13} Although open surgical exposure may offer a shorter operating time and equivalent postoperative discomfort levels on the first day, some research indicates that both approaches produce comparable results in periodontal health and aesthetics.^{14,15}

While the open and closed surgical exposure techniques for impacted canines have been extensively studied in terms of basic outcomes such as duration of complete tooth eruption and immediate post-surgical complications, there is a significant gap in the literature regarding the dislodgment of bonding device, which is not an uncommon complication of surgical exposures. Moreover, there are no available studies on our local population that address the patient perception of pain and discomfort after surgical exposure of impacted canines.^{16,17}

This study aims to perceive an optimum surgical technique that is conducive to the best therapeutic outcome with minimum patient discomfort, postoperative pain, complication of orthodontic device detachment, and food impaction at the surgical site in a Pakistani cohort.

MATERIALS AND METHODS

The study was conducted at Dental College –HITEC (IMS) Taxilla Cantt, for a duration of 18 months, from 1st Aug 2020 to 31st Jan 2022. After seeking approval from the Ethical Review Board, an ERB letter with the number: F.2/2020/ERB/DC/HITEC-IMS was issued.

Informed consent (written and verbal) was taken from all the subjects. The sample size for the study was 32, which was calculated using the Open EPI Sample Size Calculator, with a confidence level of 95% and prevalence

of impacted canine as 1.2%.

Non-probability (purposive) sampling technique was used and patients were screened from the OPD of Oral & Maxillofacial Surgery Department of Dental College –HITEC (IMS), who were candidates for surgical exposure followed by orthodontic traction via bonding device. The sampling technique used in this research is purposive because the choice of surgical exposure technique is influenced by several factors such as the anatomical location of the canine, severity of impaction (depth and height), amount of overlying bone, and availability of attached gingiva. Keeping in view the recommended guidelines for the choice of surgical exposure techniques^{18,19}, it was not possible to select the patients on a probability basis. All these patients were referred from the Orthodontics Department of the same institute. Inclusion criteria for the study were males and females with varying age ranges of 15 to 25 years, who were being treated in the orthodontics department of the same hospital, all the patients were referred from the orthodontics department. Patients with cleft lip and palate, those with syndromic disease conditions, and who were referred from outside hospital settings were not included in the study as per exclusion criteria. This was done in order to overcome any possibility of bias and risk of loss of patient for the follow-up.

Diagnosis of impacted canine was based on clinical evaluation (palpable/non-palpable), and radiographic evaluation via periapical with or without SLOB technique was done. An OPG (orthopantomogram) of all patients was acquired. An occlusal view and a Cone Beam CT Scan were also procured where necessary.

The sample size for the study was 32, which was calculated using the Open EPI Sample Size Calculator, with a confidence level of 95% and prevalence of impacted canine as 1.2%.

Patients were allocated into two equal groups, group A: open surgical technique and group B: closed surgical technique. Anatomical location of the impacted tooth (palatal/labial), presence/absence of a retained deciduous tooth, dislodgment of bonding device, Visual Analogue Scale (VAS) postoperative pain score on days 2, 5, and 7 and complaints of food impaction were listed and documented for every patient on a proforma. A score of 0

on VAS indicated that the patient had no pain at all after surgery, while a score of 10 indicated the most severe pain the patient had encountered.

Group A patients underwent open surgical exposure involving bonding an orthodontic traction device at the cusp tip and removing the soft tissue and bone covering the crown. The crown is then left exposed in the oral cavity for the remainder of the orthodontic treatment. The closed technique was performed on Group B patients, which involves raising a flap, exposing the tooth’s crown, bonding the device, moving the flap back to its original location, and suturing.

SPSS version 26 was used to analyze data. Descriptive analysis was done for demographic data like age, gender distribution and anatomical location of canines. Chi-square test to compare the severity of pain among groups A and B at the 2nd, 5th and 7th postoperative days respectively, and to determine the relation of dislodgment of the device with surgical technique along with food impaction complaint at the surgical site. A p value of < 0.05 was considered to be significant.

RESULTS

Table 1 shows a total of 32 patients who were surgically exposed to 58 impacted canines, out of which 09 were males and 23 were females, the anatomical location of the impacted teeth, 36 canines were located in the palate, 18 were located labially and 4 canines were vertically located. And also, the mean age of patients is 17.3 years with a minimum age of 15 years and a maximum age of 23 years.

Table 1: Demographics Of Age, Gender and Anatomical Location Of Impacted Canine

Gender Distribution	Males=9 (28.1%)	Total Number Of Patients=32
	Females=23(71.9%)	
Age	Minimum Age=15 Years	Mean Age=17.3 Years
	Maximum Age=23 Years	
Anatomical Location Of Impacted Canines	Palatal=36 (62%)	Total No Exposed Canines=58
	Labial/Buccal=18 (31.1%)	
	Vertical=4 (6.9%)	

Table 2 shows the pain perception by the patients of

Groups A and B on 2nd, 5th, and 07th post-operative days. Group A patients underwent open surgical exposure and Group B patients were treated with closed exposure technique. Day 02 postoperative pain perception of Group B patients was significantly lesser than the Group A patients. Similarly day 05 pain perception by Group B patients was also significantly lesser than the Group A patients. Postoperative day 07 most of the patients from both groups had no pain but a few patients reported to have mild pain. No significant difference in pain was found on day 07 after surgical exposure among both groups of patients.

Table 2: Pain Score On Visual Analog Scale

Patient group	Post-Operative Pain Day 2 on VAS				
	No Pain	Mild	Moderate	Severe	
Group A Open Technique	0	0	10	6	P= 0.00
Group B Close Technique	0	10	6	0	
Post-Operative Pain Day 5 on VAS					
Group A Open Technique	2	6	8	0	P=0.03
Group B Close Technique	8	8	0	0	
Post-Operative Pain Day 7 on VAS					
Group A Open Technique	11	5	0	0	P=0.2
Group B Close Technique	14	2	0	0	

The number of surgical exposures that resulted in the complication of orthodontic traction device dislodgement is shown in Table 3. Overall 12% of surgical exposures had this complication. Group A patients had a statistically significant number of these complications in comparison to Group B, in which only 01 impacted canine had a dislodged device but re-exposure was required in that case. On the other hand, 06 patients of Group A with a dislodged device did not require any surgical intervention because of the already exposed crown.

Table 3: Orthodontic Bonding Device Dislodgment

Patient Group	Orthodontic Bonding Device Dislodgment		P=0.03
	Yes	No	
Open Technique	6	23	P=0.03
Close Technique	1	28	
Total =58	7=12.0 %	51=87.9%	

Table 04 presents patient perception regarding complaints of food impaction postoperatively.

Group A patients had this complaint statistically significant as compared to Group B patients.

Table 4. Food Impaction At The Site Of Exposure

Patient Group	Food impaction at the site of exposure		P=0.001
	Yes	No	
Open Technique	12	4	P=0.001
Close Technique	3	13	
Total = 32	15=47%	17=53%	

DISCUSSION

Results of this study revealed that females have more propensity for impacted canines in comparison to males. Palatal position in impacted canines is more prevalent than any other anatomical position. The findings of this study closely resemble those of studies conducted by Lövgren ML et al, Zabielskaite G et al, de Araujo et al, Manne R et al, Hamada Y and Mahardawi B^{1,2,3,4,5,6}

Sampaziotis D et al. in their systematic review and Parkin NA et al. who conducted a multicenter study in Sheffield, UK, discovered that there was no discernible difference between the two surgical approaches in terms of how long the process took, how patients felt about their pain, discomfort, and food impaction, as well as other treatment outcomes.^{14,15} The results of this study are in contrast to Sampaziotis D et al¹⁴ and Parkin NA et al.¹⁵ which revealed a higher postoperative pain perception and delayed recovery from pain among patients with open surgical exposures, moreover, discomfort and food impaction were also higher among these patients.

In a study by Samar et al.¹⁶ they reported no significant post-operative pain after surgical exposures while in their meta-analysis, Cassina C et al.²⁰ found that the open surgical method is better than the closed method in terms

of time required for tooth eruption and alignment which is shorter as compared to closed technique but patient perceptions of pain and discomfort are same for both the techniques. These findings are in contrast to our study in which the open exposure group experience more pain as compared to close exposure technique.

However, the present study didn't evaluate the aesthetic and periodontal health outcomes of erupted canines due to the constraints of long-term follow-up, because these parameters can be observed only after the complete eruption of the impacted tooth which can take several months after surgical exposure. But Parkin NA et al.²¹ concluded in their study that there is no difference in aesthetics among erupted canines that were surgically exposed by either technique. Incerti P S et al.²² in 2016 in their systematic review concluded close surgical approach is better in terms of periodontal outcomes.

In their study on postoperative pain perception, Gharaibeh M T et al.¹² found that while patients in the closed-eruption group perceived pain regression more quickly, the open surgical method resulted in a considerably shorter procedure length. In addition, Björksved M et al.²³ found that the open surgical exposure group experienced noticeably greater post-surgery discomfort than the closed surgical exposure group, they also stated that patient pain perception and discomfort were higher in bilateral exposure cases. A study by M'arton et al.²⁴ found that postoperative discomfort increased till the 3rd to 4th postoperative day in the open exposure group but then settled by the end of the 7th post-operative day.

Compared to 76% of patients who were treated with the closed exposure technique, Chaushu et al.²⁵ observed that 80% of patients experiencing open exposure needed analgesics within the first 24 hours. The current study's findings are consistent with those of Gharaibeh M T et al.¹², Björksved M et al.²³, and Chaushu et al.²⁵

One of the relative risk factors of close exposure technique is the re-exposure procedure²⁶, this should be discussed with the patient at the time of consent. In the present study, 1 of the closed surgical exposure canine had dislodgement of the device on day 02 of surgery and the re-exposure was performed on day 07 of 1st surgical exposure. Lwin et al.²⁶ reported 10 patients required re-

exposure in a closed surgery group in their study. This might be due to the fact their study has a large sample size as compared to our study.

Although the dislodgement of the device was statistically significant in the open exposure technique but due to the reason of existing exposed crown, no surgical re-exposure was required.

Besides the surgical technique used, other factors like the extent of surgical exposure done, amount of bone removal, and patient threshold to perceive pain also contribute to the post-operative pain and discomfort reported by the patients.²⁴

The effects of additional factors including aesthetics, duration of tooth eruption and problems such as ankylosis, infection, and postoperative edema need to be further studied. The results of this study highlight how essential it is to select the best surgical method for impacted maxillary canines in order to improve patient comfort and lower complications. Targeted screening programs for early diagnosis in adolescent females may be helpful, given the increased susceptibility for impaction in females. Clinicians should also give priority to effective pain management techniques since patient perceptions of pain and discomfort Affect treatment adherence.

The study is single-centered, which is a limitation of this study. Future research featuring multiple centers in various areas of Pakistan would assist in extrapolating the results and account for regional differences in patient outcomes and clinical practice.

Moreover, other associated outcome variables like periodontal health, tooth eruption time, postoperative complications like ankylosis, and infections should be assessed in future studies. These factors would provide a more extensive insight into the positive aspects and drawbacks of both surgical approaches.

CONCLUSION

The closed surgical exposure technique was found to be more beneficial and superior when compared with the open surgical technique in terms of postoperative pain, food impaction at the exposure site, and dislodgment of the traction device.

DISCLAIMER

None to declare.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

ETHICAL STATEMENT

Ethical approval was provided by the Ethical Review Committee at HITEC-IMS Dental College, Taxila Cantt. (ERC No.F.2/2020/ERB/DC/HITEC-IMS)

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AUTHORS CONTRIBUTION

Conception and design of the study: M. Siddiq

Acquisition of data: M. Siddiq

Analysis and interpretation of data: M. Siddiq

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The Influence of Vertical Canine Position on Smile Esthetics: A Comparative Perception Based Study Among Orthodontists and Laypersons

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ABSTRACT

Objective: The research investigates the unique effect of altering vertical canine positions on smile esthetics, focusing on a comparative analysis of perceptions between orthodontic professionals and laypersons.

Materials and Methods: This cross-sectional comparative study was conducted in Armed Forces Institute of Dentistry, Rawalpindi from September 2020 till August 2023. Hundred respondents were chosen to evaluate five smile photographs. Each photo, derived from a standard close-up, digitally modified to adjust the vertical position of canine tooth in 0.5mm increments. Respondents were tasked with rating the attractiveness of each image on a visual analog scale, ranging from one to five.

Results: Orthodontist rated image A at 2 out of 5 (42%) and rating of 4 out of 5 by laypeople (36%) ($P<0.000$). Image B was rated 4 out of 5 by both orthodontist (48%) and laypeople (34%) ($P=0.002$). Image C received the highest score of 5 out of 5 from both orthodontist (66%) and laypeople (42%) ($P=0.031$). Image D garnered rating of 2 out of 5 from orthodontist (48%) and 3 out of 5 from laypeople (32%) ($P<0.001$). Image E rated 1 by 37 orthodontists and 15 laypersons. Most orthodontist (74%) rated image E as 1 and layperson 2 (32%) out of 5 respectively ($P<0.001$).

Conclusion: Orthodontists exhibited higher sensitivity in evaluating smile esthetics compared to laypersons. The 0.5mm vertical intrusion of canine was perceived to be most attractive.

Keywords: Attractiveness, Buccal Corridors, Gingiva, Intrusion, Incisal Show

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INTRODUCTION

The word esthetics is derived from a Greek word “aisthesis” which means “to perceive”.¹ One of the fundamental aims of orthodontic treatment is to create an aesthetically pleasing smile. However, beauty is a concept with both subjective and objective aspects. Consequently, perception of smile esthetics depends on multiple factors like cultural awareness, age and gender of the observer. In this context, observer’s knowledge and experience are one of the most significant factors.² It is widely acknowledged that the more experienced and knowledgeable the clinician is, the more he or she is sensitive to perception of the minor esthetic details in smile of the patient.

Social smile is the one which an individual usually presents to the world, while meeting a colleague or posing for the camera. Social smile is reproducible and thus is the focus of orthodontic diagnosis and treatment planning.³

A symmetrical dental arrangement is considered to be of utmost importance in smile esthetics.⁴ Harmony and balance in smile is achieved by paying attention to the intricate details.⁵ Canines have a substantial effect on smile esthetics and occlusal functionality. Wheeler has described canines as “a foundation that insures normal facial expression.” Vertical position of canines also has a marked effect on smile esthetics perception. The vertical position of tooth is categorized into two main features. Those related to incisor display and those related to gingival display. Sharma et al. found that the most attractive smiles were those exhibiting 1mm gingival recessions bilaterally on canines. Similarly, Acar et al. observed a considerable effect of canine vertical positions on smile aesthetics, with orthodontists and laypersons attributing 28.53% and 24.33% influence, respectively with a P value <0.0001). A similar study related to the vertical position of maxillary canines with respect to smile line conducted by Bin Muharib et al⁹ states that gingival margins of canines should be coincident with the upper lips on smile.

The study conducted by Patankar et al¹⁰ concluded that orthodontists were more critical in analyzing asymmetries in gingival margins of maxillary canines than laypersons and general dentists (P<0.05). These studies indicate a difference of perception among different populations.

The objective of this study is to determine and compare the influence of altered vertical position of canines on smile esthetics as a mean perception by an orthodontist and a layperson.

MATERIALS AND METHODS

This survey based cross-sectional study was conducted in Orthodontics Department of Orthodontics in Armed Forces Institute of Dentistry (AFID), Pakistan, after taking approval from the ethical committee (Ltr no: 918/Trg Dated 13 May 2020), from September 2020 till August 2023, encompassing a sample of one hundred participants were selected for this study, consisted of fifty orthodontists and fifty laypeople. The sample size was calculated by utilizing World Health Organization (WHO) sample size calculator 7.1, with confidence level of 95%. Perception of standard smile by orthodontist was equal to 80.24 ± 5.4 ¹¹ Precision of 1% was required for this study. The sampling technique was nonprobability consecutive. This study’s inclusion criteria included both male and female orthodontist and laypeople aged 18 to 40. The orthodontists related to this study were either who recently completed their training or currently undergoing training. Laypeople selected for this study were those who had no history of orthodontic treatment in the past. Exclusion criteria was any patient with history of body dysmorphic disorders, with any kind of known psychological disorders and respondents with any sort of eye disorder or defect in visual acuity. The data was collected from the shortlisted participants. Participants who consented to undergo the study agreed that they had been fully informed about the objectives of the study and the study causes no harm to any living or nonliving thing in any manner of speaking. A pre-validated questionnaire was selected.¹² Online application known as Google Forms was utilized to formulate the questionnaire. Questionnaire consisted of a total number of ten questions. The questionnaires were distributed among fifty orthodontists and fifty laypeople. Five images of a smile were attached in the questionnaire. One image of smile was taken as standard using a digital camera (Canon EOS-REBEL). The photograph was digitally manipulated using Adobe Photoshop CC 2018 software so that only desired area of face would be framed while in the other four images, the vertical position of canine was altered by digital manipulation of the photograph. The images presented in the questionnaires showed the level of vertical position of canines being changed at an increment of 0.5mm per

picture (Figure 1). One picture was taken as a standard picture which has normal vertical position of maxillary canines coinciding with the occlusal plane whereas the other images had intruded and extruded canines. The participants were asked to rate the images using a visual analog scale.^{13,14} The visual analog scale used for rating the images consisted of scores ranging from one to five. The score of one represented the least attractive smile. The score of five represented the most attractive smile. The scores given by the participants were noted down on a separate sheet of paper by the researcher along with the participants name, age, gender and occupation. The data was analyzed by using SPSS version 24.0. Mean and standard deviation were calculated for quantitative variables like vertical position of canines and age (Perception by orthodontists and laypersons). Frequency and percentage were calculated for qualitative variables like gender and occupation. The chi square test was used to test the difference between smile esthetic perception between orthodontist and layperson. The independent sample t test was used to test the difference of mean perception score between two groups P-value ≤ 0.05 will be taken as significant.

RESULTS

The mean age of both respondents was 30.47 ± 4.82 , minimum and maximum age in years was 18 and 40 years respectively. Similarly average vertical canine position was 2.35 ± 0.64 , minimum 1.19 and maximum was 3.47. Out of 100 responders, maximum 69% were female and 31% were male.

Majority of the responders were very clear (97%) how to rate image A to E in this study whereas just 3 (3%) were slightly confused and not clear about the objective of the study and was trained while data collection to control the

bias. The bar diagram of response against images A to E reflects in the figure 2. The comparison of perception score against A to E between orthodontist and laypersons is shown in (Table 1).

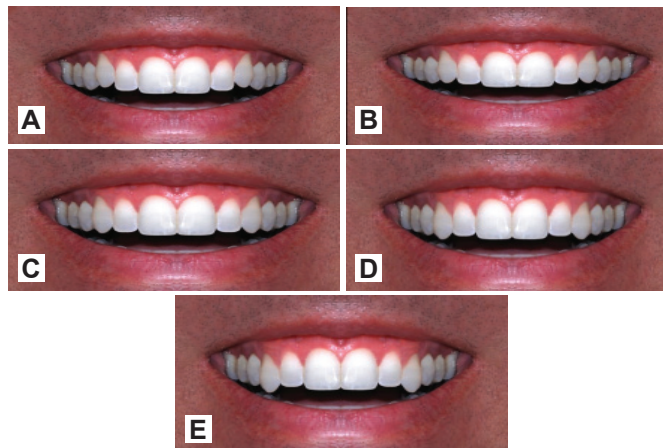


Figure 1: Altered Images with 0.5mm Increments Showing Change in Vertical Canine Position

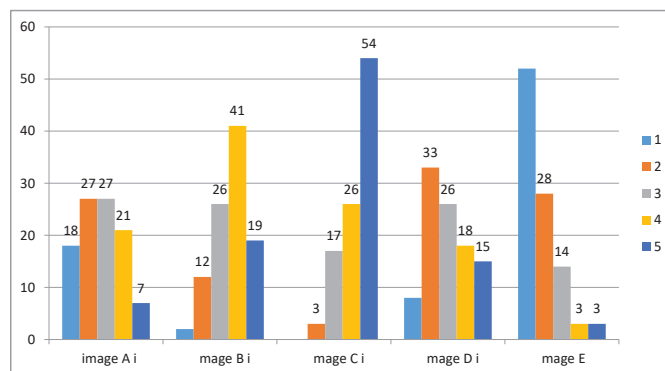


Figure 2: Bar Diagram of Smile Esthetic Perception Against Images A-E

Table 1: Cross tabulation of smile esthetic perception on images A to E with respect of respondent

Smile esthetic perception grades	Respondent		P value
	Orthodontist	Layperson	
Image A			
1	15	3	0.000
2	21	6	
3	11	16	
4	3	18	
5	0	17	
Image B			
1	2	0	0.002
2	9	3	
3	12	14	
4	24	17	
5	3	16	
Image C			
1	1	2	0.031
2	9	8	
3	7	19	
4	33	21	
5			
Image D			
1	7	1	0.000
2	24	9	
3	10	16	
4	4	14	
5	5	10	
Image E			
1	37	15	0.000
2	11	17	
3	1	13	
4	1	2	
5	0	3	

The independent sample t test was used to test the difference of mean perception score between two groups against image A to E. The results showed that the mean perception score of orthodontists (4.68 ± 0.62) was significantly greater than the average perception score of laypersons (3.76 ± 1.24) with p value 0.000.

The results were same after stratification with responder's gender and age groups. As the average smile esthetic perception score was greater than layperson with p value

0.000 in female and the results was same with p value 0.014 in male responders only (Table 2). Similarly, the results were same in both age groups and the orthodontist's smile perception score was greater than laypersons in less or equal to 30 years of age with p value 0.000 and in more than 30 years of age with p value 0.016. (Table 3)

Table 2: Comparison of Perception Score against Image A to E between Orthodontist and Layperson with Stratification of Responder's Gender

Gender	Respondent	Mean \pm Standard deviation	P value
Female	Orthodontist	4.65 \pm 0.68	0.000
	Layperson	3.75 \pm 1.11	
Male	Orthodontist	4.77 \pm 0.44	0.014
	Layperson	3.78 \pm 1.45	

Table 3: Comparison of Perception Score against Image A to E between Orthodontist and Layperson with Stratification of Responder's Age

Age	Respondent	Mean \pm Standard deviation	P value
Less or equal to 30 years	Orthodontist	4.73 \pm 0.59	0.000
	Layperson	3.73 \pm 1.14	
More than 30 years	Orthodontist	4.66 \pm 0.64	0.016
	Layperson	3.80 \pm 1.40	

DISCUSSION

Well positioned canine teeth are not only an important factor for good smile esthetics but they also determine the occlusion functionality of the dentition.^{15,16} Establishment of canine guidance is important for achieving a harmonious occlusion and balanced masticatory system. Canine teeth are known as the corner stones of the mouth because they are located lateral to the midline and separate incisors from the premolars.

Studies done by some authors concluded that perception of smile esthetics is not influenced by facial features such as eyes, shape of the face and nose.^{8,17} Whereas some authors suggested to utilize a close up of smiling photograph rather than a full face shot while assessment of difference of perceptions of smile esthetics because in their opinion, judgment of smile is made better when the observer is only observing the dental characteristics of the smile rather than the other facial features which

might be a distraction to the observer while perceiving the esthetics of the smile. In our study, we only utilized a smiling photograph rather than a full-face photograph and we modified a single smiling photograph and made five images from it consisting of variable vertical position of canine teeth in each image.

In our study we asked the observers to rate the five images and we displayed these images in a form of questionnaire with visual analog scale ranging from score one to five. To eliminate bias, the scores were recorded by only one evaluator who recorded the scores given by the observers on a separate sheet along with the observers name, age, gender and profession.

The results of study by John Katsis et al¹⁸ showed that there was not much difference in the smile esthetic perceptions of orthodontically treated fifteen years old based on the three-dimensional position of maxillary canine teeth as judged by nine residents of orthodontics department. In contrast to their study, our study showed that the difference in vertical position of the canine teeth affected the smile esthetic perception for both orthodontists and laypeople. Orthodontists were slightly more perceptive of the effect of changes in vertical position of canine teeth on smile esthetic perception.

The results of this study was very similar to study by Paiva et al¹⁹ who also used smiling photograph of a male patient and altered the vertical positions and the gingival margins of the canines utilizing one standard close up smiling image and alterations were made and ten photographs were produced, by an increment of 0.5mm varying from 1mm intrusion to 1mm of extrusion. Furthermore, they took a sample size of one hundred and twenty participants who rated the photographs where as in our study we took a sample size of one hundred participants who rated the smiling photographs. Similar to our study their study utilized a visual analog scale for scoring each image, however their score ranged from one to ten, one being the least attractive and ten being the most attractive whereas our score on visual analog scale ranged from one to five, one being the least attractive and ten being the most attractive.

This study, we selected fifty orthodontist and fifty laypeople according to the inclusion and exclusion criteria set for our study. We fully informed the participants about

the objectives of our study in order to avoid any confusion among the participants, furthermore we allowed our participants to ask questions if they had any kind of doubts in their minds regarding our study. Three percent of the participants expressed confusion regarding the objectives of our study, these participants were educated further about the objective of our study as in how it will help to bridge the gap between orthodontist and laypeople's opinion while formulating the treatment plan. These participants were fully trained before beginning the data collection procedure in order to ensure that there was no biasedness in our study.

In contrast to the study by Paiva et al¹⁹, we provided our participants with questionnaires comprising of ten questions generated with the help of Google Forms.¹² The questionnaire comprised of ten questions in which there were close up images of smile showing different vertical position of canine teeth and the raters were asked to rate each photograph on a visual analog scale ranging from one to five.

Among the five close-up smile photographs we used in our questionnaire for the responders to rate on visual analog scale, image C was the most ideal image because it represented the ideal vertical position of canine in the smile and it represented the vertical position of canine tooth which every orthodontist strives to achieve. According to the results of our study, the respondents gave the highest score to image C which shows that it represents the most esthetically pleasing smile with the most esthetic vertical position of canine.

A study conducted by Lemos et al²⁰ on the impact of variations in torque of the maxillary canines on the esthetic perceptions of smile among orthodontists and laypeople. Their study differed from our study as they compared the torque variations of the maxillary canine as compared to the vertical position of the canine teeth compared in our study.²¹⁻²³ Their study also compared the smile esthetic perceptions among orthodontists and laypeople similar to our study; however their sample size slightly varied from our sample size. They used both female and male models and used their smiling photographs in their study, where as in our study, we only utilized smiling photographs of one female model. They used both full face and close up smiling photographs for their study where as we only utilized close up smiling photographs with gingival

show for our study. Similar to our study, they asked the orthodontists and laypeople to rate the photographs based on the attractiveness of each photograph utilizing a visual analog scale.^{24,25} Their results showed that orthodontists and laypeople slightly differed in assessing the effect of torque incorporation on smile esthetics.^{21,22}

There were few limitations in our study. Firstly, in our study, we did not take our sample which was proportionate in gender distribution. The orthodontists as well as the laypeople were selected randomly, and no predetermined number of gender criteria was set for the selection. Over all in our study, there were thirty one percent respondents who were male (thirty-one males) and sixty nine percent respondents who were females (sixty-nine females). Thus, in our study, our sample mostly consisted of females. This disproportionate ratio of gender can incorporate gender bias in the study. The esthetic perception of both females and males can vary, thus gender bias can influence the results of our study. For better results, studies with equal distribution of gender among respondents and no gender biases are required.

Secondly, although we stated the objective of our study in clear laymen terminology so that it was comprehensible for both orthodontists and laypeople. The purpose of stating our objective was to remove any doubts about the study from the minds of both orthodontists and laypeople, so that they knew how their scores given for each image can influence the orthodontic treatment and can help enhance the understanding of orthodontists about what their patients desire in their smiles when they come to orthodontic department for treatment. Although we made sure that our objectives will be clear to both groups, three percent of the respondents (three out of hundred respondents) were not clear about the objectives. We aimed that all the respondents will be clear on the objectives of the study, however we realized we needed to be more elaborate. We tried to nullify this error on our part by training the three percent of respondents who were not clear about the objective and we made them ask any question they had in their minds.

CONCLUSION

There was difference in the scores given by orthodontist and layperson. The main reason is as miniesthetics analysis is integral part of orthodontic diagnosis and orthodontists were trained to analyze components of

smile thoroughly and were more perceptive as compared to laypeople.

DISCLAIMER

None to declare.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

ETHICAL STATEMENT

Ethical approval was taken from Ethical Committee of Armed Forces of Dentistry Rawalpindi (Ltr no: 918/Trg Dated 13 May 2020)

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AUTHORS CONTRIBUTION

Conception and design of the study: N. Adnan, E. Amin
 Acquisition of data: E. Amin
 Analysis and interpretation of data: N. Adnan, E. Amin, Z. Nisar, N. Arshad
 Drafting of the manuscript: N. Adnan, E. Amin, N. Arshad
 Critical review of the manuscript: N. Adnan, E. Amin, Z. Nisar, N. Arshad
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Have We Learned from The Past and Are We Ready for The Future? Online Teaching and Learning in Clinical Dental Education

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ABSTRACT

Objective: The COVID-19 pandemic compelled global educational institutions to shift to online teaching. In developing countries like Pakistan, this transition presented unique challenges. This research aims to explore the perceptions and challenges faced by faculty members engaged in online teaching, particularly in the context of clinical education, in Pakistan.

Materials and Methods: This is a qualitative, exploratory study. It seeks to analyze the experiences of medical institution that implemented online instruction for the first time during the COVID-19 pandemic. The lack of information prompted the use of descriptive phenomenology. The descriptive phenomenology assisted the participants in articulating their relevant observations, perspectives, and “lived experience”.

Each of the four groups consisted of six participants with online teaching experience and included both faculty members of basic sciences and clinicals. The acquisition of data consisted of semi-structured, open-ended interviews lasting approximately 60 to 90 minutes until data saturation was reached.

Results: The data analysis revealed significant themes related to online teaching. Faculty members identified challenges that affected the academic credibility of students and highlighted the need for adapting teaching methodologies for cognitive and skill-based learning outcomes. The absence of divergent perspectives among faculty members was evident.

Conclusion: The research concludes that faculty encountered diverse challenges while adapting to online teaching in a developing country. Tailored strategies for active student engagement, learning from developed countries, and adopting blended learning can facilitate successful integration. Continuous improvement and understanding unique challenges enable educators and policymakers to enhance online education quality in developing nations, promoting effective knowledge dissemination during future crises.

Keywords: Clinical Skills, Learning, Pandemic, Teaching

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INTRODUCTION

During the COVID-19 pandemic, the mode of education was changed globally. The online mode of teaching was adopted as traditional physical classes were not possible. In such circumstances, the virtual world revolutionized traditional teaching strategies.

Pakistan is a developing nation with limited resources in remote areas, and the majority of its educational institutions use traditional teaching methods. In response to COVID-19, Pakistani educational institutions adopted online instruction to continue the learning process. In most remote areas, people had access to communication devices, which became the only source of continuing academic activities and facilitating students' education while maintaining social distance.

In developed countries, online teaching has been practiced for decades. Despite this trend, the majority of educational facilitators also faced challenges while teaching online.¹ Unlike these countries, in developing countries where online learning is a new phenomenon, this transition was complicated by a lack of prior preparation for a new mode of teaching, minimum past exposure to technology, lack of knowledge of new didactic approaches, dearth of policies, communication gap, and lack of infrastructure.

However, as a result of the COVID-19 experience, in certain unfavorable situations such as earthquakes, floods, and political unpredictability, online education could be utilized to maintain continuity in education. In addition to teaching basic science subjects online, we could also teach clinical subjects. On the other hand, there has been little scholarly research on the topic of online clinical education in Pakistan. The purpose of this study was to investigate the obstacles and challenges encountered in online education in Pakistan along with its solutions. Moreover, it has investigated perspectives on clinical online education and assessment and innovative instructional methodologies and strategies. This research methodology may serve as a paradigm for online teaching preparation in comparable developing. In this context, we examine how these challenges acted as a driving force for the development of innovative solutions, such as the Blended learning, designed to address the complexities brought about by the pandemic and transform the landscape of dental education. nations. It is therefore expected to play a crucial role in the dissemination of

knowledge in the event of a future major crisis.

The review of relevant literature addresses various aspects of online learning and teaching. Online education seeks to establish an environment that is more engaging than traditional education². Nonetheless, it presents unique obstacles, such as a lack of experience and preparation, as well as institutional and technological barriers.³ According to Guskey, the transition to online learning requires taking into account learner skills such as self-regulation, IT skills, workload management, blended learning awareness, gender, and age. Learner contentment is crucial to the success of integrated or online learning, and dissatisfaction can arise when students struggle to use online methods effectively.⁴ The lack of timely instructor feedback and limited student-instructor interaction negatively affects learning outcomes.⁵

Some educational institutions were not adequately equipped for online teaching, resulting in setbacks in learning.⁶ This highlights the importance of institutional support in effectively implementing online teaching models. Another scholarly investigation was conducted to analyze the merits, limitations, potential advantages, and obstacles encountered in the realm of remote instruction during the COVID-19 global health crisis.⁷ In addition to the benefits of location flexibility, extensive content availability, and potential for innovative pedagogical methods, several limitations were identified. These include learners' varying capabilities and confidence levels, challenges associated with digital literacy, disparities in the distribution of IT infrastructure, the existence of a digital divide, and concerns regarding the quality of education.

In Pakistan, online learning faces diverse challenges, with internet accessibility being a major issue that disproportionately affects students from marginalized communities and remote areas.⁸

MATERIALS AND METHODS

We employed qualitative methodology based on a constructivist grounded theory approach. This is an exploratory qualitative research design. It investigates the online teaching experiences of Pakistani institution faculty members during the COVID-19 pandemic. Due to a dearth of understanding, descriptive phenomenology was used.⁹⁻¹¹ which allowed participants to convey their

experiences, observations and perspectives on online teaching to gain insight of that event in past and check their motivations. The sample collection method was purposive.

The criteria for the inclusion of participants was limited to the faculty members having online teaching experience. Four groups of participants were made, consisting of faculty members of basic sciences and clinical sciences. Each group comprises six participants having online teaching experience. In the first two groups, junior faculty members were included who had less than five years of teaching. The other two groups included senior faculty members having more than five years of experience. The written consent was taken prior to the interview. Each participant was informed that the data will remain confidential and safe.

This study was conducted at Hamdard College of Medicine and Dentistry. The study was approved by the institutional ethical review committee having ERC NO ERC/BDS/02-2023. The interview was based on semi-structured, open-ended interview questions. Pilot testing was done to analyze the study guide questions for their readability and comprehension. Each interview session was audio recorded. At the end of the interview sessions,

data saturation was reached, and field notes were also taken during and after the interviews. Each session was approximately 60 to 90 minutes long.

The data analysis was performed in several steps. Firstly, the data were transcribed in detail. Transcription was done verbatim using audio recordings. The second step was to organize the data by grouping answers across the respondents. Lastly, the coding of data was done in the thematic pattern. The thematic map was developed through the careful consideration of data step-wise. (Figure 1). Confidentiality was maintained with a password system for authorized access. Member checking ensured interpretation accuracy and validity. Theme refinement was carried out during the written phase.

The data that was gathered provided valuable insights into online teaching, specifically among faculty members, and identified the key factors that are associated with online clinical teaching and assessment. Furthermore, it is advisable to adequately equip ourselves in anticipation of prospects.

The faculty members have identified several issues that present challenges to the facilitator and have a significant impact on the academic credibility of students.

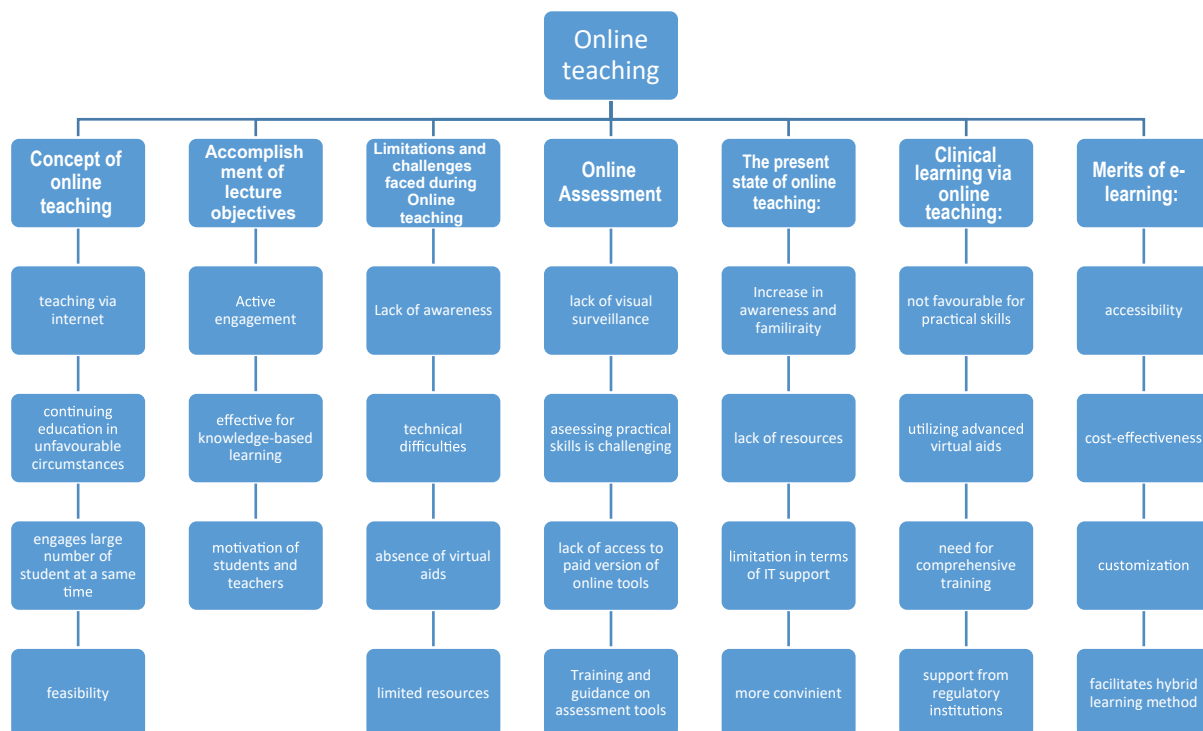


Figure 1: Thematic Map

FINDINGS: THEMES AND SUB-THEMES

Concept of online teaching

Online teaching refers to the *teaching via Internet* through various mediums like Zoom, Skype, conference calls, and Google Meet through webinars and video calls. Online teaching plays a vital role in continuing *education in unfavorable circumstances* where physical classes are not possible, like climatic conditions, political situations, or any pandemic disease, etc. Also, it engages a *larger number of students at the same time*, irrespective of their geographical locations. Furthermore, this mode of teaching facilitates the teacher to conduct their classes at their own pace and with much *feasibility*. For example, one of the participants stated that;

“Regarding online teaching, my concept is that it facilitates us, no matter wherever we are, it saves our time, it is cost-effective and we can also engage different groups of students on various locations”

Accomplishment of learning objectives

According to the participant, the facilitator needs to develop certain strategies to fulfill the learning objectives that promote student engagement and interaction in online learning environments. It is essential for every student to participate equally and there should be opportunities for *active engagement*. While comparing the *effectiveness of online teaching* for cognitive (knowledge-based) versus skill-based learning, cognitive learning may be more successful in online teaching, whereas skill-based learning may require more in-person instruction or resources. The participants emphasize the *role of teacher and student motivation* in achieving learning objectives in online teaching. The teacher and the student need to be motivated and engaged for online teaching to be successful. Moreover, *Limited resources* can impact the ability to fulfill certain learning objectives in online teaching, particularly for practical skills.

Limitations and challenges faced during Online teaching:

The facilitator faced challenges in the beginning due to *a lack of awareness and technical difficulties* in utilizing digital tools such as Zoom, Google Meet, and other online platforms. Both students and instructors faced challenges in acquiring the necessary skills to effectively navigate these platforms. Additionally, students residing in remote areas with *limited resources* encountered further

difficulties stemming from internet connectivity issues. Consequently, these connectivity issues resulted in delays and breaks during online lectures. The *prolonged duration of screen time* required for both students and teachers, as well as the need to effectively demonstrate procedures and models during online lectures, posed significant challenges in conducting lectures. The facilitator found it challenging to keep students engaged and motivated during the online lectures as they *lacked interest* and were unresponsive. Another major obstacle in learning was the *absence of virtual aids for practical classes* during online teaching. Additionally, instructors were deprived of the ability to leverage non-verbal cues and body language to facilitate effective communication and interaction among students in the virtual classroom setting. Moreover, the facilitators encountered difficulties as a result of students engaging in *doodling activities* during the online lectures.

Online Assessment

The process of conducting online assessments presented challenges due to the potential for students to engage in *deceptive behavior*, as the lack of direct monitoring makes it difficult to ensure academic integrity. The lack of *visual surveillance* posed a significant obstacle in ensuring that students refrain from seeking external assistance or utilizing unauthorized resources during online assessments. The utilization of online teaching methods, such as the implementation of assessment tools like Google Forms and Kahoot, may prove to be effective in evaluating students' theoretical knowledge. However, the evaluation of *practical skills presents a challenge* in the online teaching environment, as it necessitates the physical presence of students. The *absence of availability of paid software versions and restricted IT support* posed obstacles to the successful execution of online assessment methodologies. Facilitators frequently found themselves dependent on their endeavors to adequately prepare and administer assessments.

The assessment process is impeded by a lack of familiarity with the software. The transition from conventional paper-and-pencil assessments to online assessment modalities necessitates the acquisition of skills and knowledge related to learning management systems (LMS) and digital tools. The acquisition of knowledge and skills, both for faculty members and students, can present difficulties.

The present state of online teaching:

Different individuals hold *varying opinions* regarding the present state of online teaching. Some believe that physical classes are superior in terms of student understanding, interaction, and assessment, while others find online teaching more favorable due to increased software proficiency and student awareness. There is a noticeable increase in *awareness and familiarity with online teaching tools and platforms*. However, the lack of resources, IT guidance, and support from universities still hamper the overall favorability of online teaching. Over the past two years, there has been *progress* in terms of awareness, but resource constraints remain unchanged. While there is improved knowledge and proficiency in utilizing online platforms, the limited options and lack of updated versions of the software are still perceived as *limitations*. Online teaching offers *conveniences* such as time-saving, flexible access to recorded lectures, and cost reduction. However, despite these advantages, there are still shortcomings and potential for progress in terms of software advancements and overall effectiveness. Many believe that a *blended approach*, combining both online and physical lectures, is more effective than solely relying on online teaching. For instance, one of the participants said;

“Online teaching is more favorable than traditional teaching but I would like to add that blended type of teaching is more effective, which includes conducting a few online and some physical lectures. Online teaching had its own positive and negative values, some of them are that it’s not time-bound, if students are available, you can conduct the lecture, for a physical lecture, we need to have a lecture hall and multimedia availability.”

The present state of online teaching reflects a significant shift in education due to the impact of the COVID-19 pandemic. While there has been *adaptation* and increased familiarity, there is still *room for improvement*, particularly in terms of system infrastructure, software tools, and facilitation, to match the standards of the Western world.

Clinical learning via online teaching:

Faculty members express that online teaching is *not favorable for imparting clinical knowledge*, as practical skills, hands-on experience, and patient interaction are crucial aspects that cannot be fully conveyed through online methods, one of the participants stated;

“For clinical knowledge, we can make videos and make them learn, but when it comes to performance, their presence is highly important because the clinical work is to be performed on the patient, so videos can only guide you.”

While recognizing the potential of online teaching for clinical practice, faculty members emphasize the importance of *utilizing advanced virtual aids*, such as globally available videos and haptic technology, to enhance the learning experience and simulate clinical scenarios. Also, there is a lack of policy for resources, financial support, and infrastructure in their context, hindering the implementation of effective online teaching for clinical subjects. Faculty members acknowledge the *need for comprehensive training*, participation from government bodies, and support from regulatory institutions to facilitate the successful integration of online teaching for clinical education.

Merits of e-learning:

The numerous advantages of e-learning have been highlighted, including accessibility, convenience, continuity, cost-effectiveness, flexibility, customization, time-saving, increased reach, safety, and its potential to complement traditional education systems. E-learning allows students to attend lectures from anywhere, saving time and offering flexibility in terms of program selection and learning pace. E-learning ensures the smooth continuation of education in various circumstances, such as climatic changes, political conditions, or unexpected events like the COVID-19 pandemic where social distancing is a concern. Online teaching is considered more cost-effective than traditional education systems. It eliminates the need for travel and accommodation expenses and allows targeting a larger audience through virtual platforms. Recordings of lectures also enable students to review the material at their own pace. Online teaching allows for a wider reach and access to a larger audience. It transcends geographical boundaries and enables participation from remote areas. Lastly, E-learning facilitates *hybrid learning models*, where students can attend classes online or in person as per their availability. It can *supplement physical classes*, ensuring continuity in education when either faculty or students are unable to attend in person.

RESULTS

This study provides insights into online teaching within

medical and dental colleges, highlighting its importance in education continuity under adverse conditions. Key findings include the effectiveness of online teaching for cognitive learning but limitations in skill-based learning due to challenges like internet connectivity, engagement, and practical skill demonstration. The facilitators emphasize the numerous factors that are facilitating online teaching: having a policy for online teaching, adequate infrastructure and resources such as stable internet connection, separate rooms for online teaching, proper equipment, and access to reliable software like paid versions of Zoom. Proper training and guidance regarding online teaching and assessment tools, platforms, and techniques are necessary for teachers to effectively assess students' knowledge and clinical skills. Also, there is a need for training sessions for students to effectively utilize online learning tools. It also emphasizes the role of IT staff in providing guidance and technical support. Another factor is the faculty and student motivation and their willingness to actively engage in online teaching and learning. The impact of the teaching environment, whether

at home or in a dedicated space, on the effectiveness of online teaching; therefore, factors like a quiet and conducive environment contribute to a better learning experience. Cooperation and support from the university and the provision of virtual aids and appropriate online teaching tools are also crucial in facilitating the online clinical teaching process. A blended learning approach should be adopted as it offers innovative opportunities for teaching and learning. Particularly, flipped learning creates an experience in which the student learns the concept independently and then applies and reinforces it in the clinics. Blended learning allows for greater flexibility while acknowledging the positive and negative aspects of online teaching, such as non-reliance on fixed schedules and the need for proper infrastructure.

To put it in a nutshell, the SWOT analysis was performed in order to identify the strengths, weaknesses, threats, and opportunities regarding online teaching in medical and dental colleges. (Figure 2)

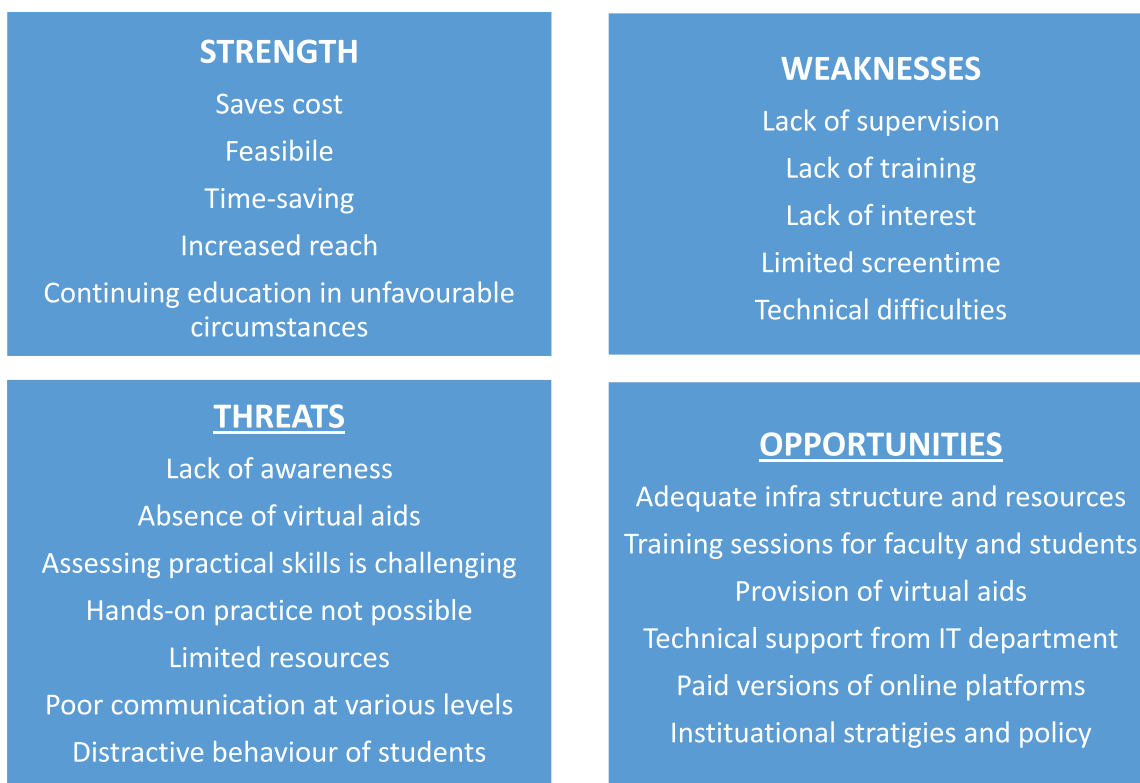


Figure 2: SWOT Analysis

DISCUSSION

The students admitted in 2019 faced a deficiency in clinical knowledge and practical skills due to interrupted

clinical rotations and limited interactions with patients and hands-on experiences¹² Medical and dental education typically involves a combination of classroom instruction

and practical sessions, with limited use of online resources. The COVID-19 pandemic further highlighted the need to adapt to online learning, impacting students at various stages of their educational journey.

During the early stages of the COVID-19 pandemic, students were not involved in patient care due to a shortage of personal protective equipment (PPE). As infection rates increased, educational institutions globally withdrew students from clinical settings. Social distancing emerged as a crucial preventive measure, leading to restrictions on student gatherings in educational environments until the development of vaccines or treatments.¹³

The advent of online learning has provided students with enhanced accessibility to a broader range and increased volume of material, hence facilitating a more efficient and effective learning experience. The transition from conventional to digital learning posed challenges. Students and instructors face increasing time restrictions, forcing departments to develop innovative methods to offer a personalized, self-directed learning experience. Some instructors encouraged students to use new technologies, but they stressed the necessity for robust institutional support. Implementation was seldom successful without institutional support and guidance. Online learning requires an institutional approach.¹⁴⁻¹⁶ To provide a coherent education, inter-faculty collaboration is essential.^{14, 17} Pettersson and Olofsson¹⁸ also identified poor educator skills as a barrier. Childs et al. suggest that the implementation or improvement of training programs might serve as a potential remedy in cases where a lack of training has been recognized as an issue.¹⁸

Childs et al.¹⁵ also recommended the implementation of a fundamental computer literacy policy. Time also hinders e-learning technology application, according to Pettersson & Olofsson¹⁸. Faculty had little time to master new technology, which lowers self-confidence. Distance teaching's pedagogical and organizational challenges worried teachers due to time constraints. Institutions should have given instructors protected time to build new technology skills, understand ideas, and reflect on procedures.¹⁷

Medical education in developed countries swiftly transitioned pre-clerkship curricula online, covering basic sciences, health systems sciences, and behavioral

sciences. Students demonstrated resilience and dedication by actively participating in diverse educational activities, including small-group discussions, laboratory sessions, simulations, and exploring innovative technologies like bedside ultrasonography. While online content updates and virtual activities proved beneficial, these changes necessitate further evaluation.¹²

Blended learning employs a student-centered approach to foster the development of clinical competencies in medical students. The utilization of advanced technological methods, such as the implementation of screen-based simulations for clinical skills and the integration of the Internet, has been observed to enhance students' motivation to learn, facilitate active engagement in the learning process, and enhance their clinical proficiency. The implementation of blended learning has the potential to address inadequacies in the practice of clinical skills, mitigate constraints related to time and space, and enhance the effectiveness and caliber of instruction.¹⁹⁻²⁴

During the later stages of the COVID-19 pandemic, faculty in developed countries embraced the "flipping" classroom model, which is a type of blended learning approach that offers personalized instruction for learning asynchronously.

The flipped clinical learning approach has demonstrated potential as a viable method for delivering remote clinical instruction to students in situations such as public health emergencies, instances of clinical site shortages, or as a substitute for missed clinical hours.²⁵

Inverted or "flipped classrooms" in medical education have raised the possibility of integrating Massive Open Online Courses (MOOCs) into medical training.¹⁶

The available evidence suggests that online teaching of clinical skills is just as effective as traditional methods. This review highlights the dearth of evidence regarding the implementation of a blended learning approach to teaching clinical skills in undergraduate education.²⁶

Numerous online assessment tools, such as Quizlet Live, Kahoot, and Nearpod, are available for educational purposes. Google quizzes conducted through Google forums are comparable to those of other educational tools. In addition, there are specific instruments for

conducting summative assessments that evaluate students' understanding of the subject knowledge. These tools include open book exams, essay questions, and assignments. The assessment of the psychomotor domain poses significant difficulties within the context of online education. The utilization of virtual objective structured clinical exams (OSCEs) and virtual patients has been identified as a viable approach for the evaluation of clinical reasoning abilities.

According to research, one of the most important factors for the success of the e-learning module is creating an environment in which all department leaders can communicate efficiently and effectively. This requires an institutional strategy to ensure that all departments can coordinate without difficulty through a formal mechanism. The formation of a team can help overcome the communication barrier.²⁷

CONCLUSION

A significant finding of the research emphasized the necessity for teachers to develop specific strategies to promote student engagement and interaction in online learning environments. By fostering active participation and ensuring equal opportunities for all students, faculty members can enhance the overall effectiveness of online teaching. Moreover, the study noted that while cognitive learning may excel in online settings, skill-based learning might still require in-person instruction or resources, highlighting the need for tailored teaching approaches for diverse learning outcomes. Embracing a blended learning approach is a crucial step toward successful online teaching in developing nations.

DISCLAIMER

None.

CONFLICT OF INTEREST

None to declare.

ETHICAL STATEMENT

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Predatory Journals and Publishers: Understanding Researchers' Knowledge and Perception Towards Predatory Publishing

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ABSTRACT

Objectives: This study aimed to understand the researchers' Knowledge and Motivation Towards Predatory Publishing.

Materials and Methods: The convenience sampling method was selected and all the faculty members and research scholars from Medical, Dental, and Allied Health Sciences Departments of the University. Participants who were absent on the day of data collection were excluded from the study. A pre-validated questionnaire prepared by Cobey et al was used and it was then peer-reviewed by the subject specialists for content validity and relevance. The questionnaire consists of participants' demographics, participants' perceptions, and experience in publishing in predatory journals.

Results: Out of the 150 survey respondents, 39 individuals (26%) indicated the existence of a formal policy regarding publication in predatory journals. Additionally, 29 participants (19.3%) acknowledged that they were aware the journal to which they submitted their work was predatory. Furthermore, 72 respondents (48%) indicated that they used the online submission platform to submit their manuscripts to the journal.

Conclusion: The study's findings suggested that most of the participants lacked awareness of predatory journals and exhibited a challenge distinguishing between predatory and reputable scholarly publications.

Keywords: Funding, Knowledge, Perception, Predatory, Pakistan, Researchers

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INTRODUCTION

Predatory publishing has become a significant concern in academic publishing, threatening the credibility of scientific research and international publication standards. The transition from closed-access to open-access publishing in the 1980s marked a pivotal moment in the publishing sector, facilitating unrestricted access to cutting-edge research globally.¹ Predatory publishing is a type of publishing model where authors pay a fee to publish their scientific articles in open-access mode. However, this type of publishing does not guarantee a peer review process or normal indexing services.² The term “predatory” is quite loose and complex, especially when considering authors who intentionally publish with these journals. In addition, low-quality, open-access journals in the developing world fall between deceptive predatory journals and legitimate journals with high standards. While these journals don’t meet high-quality publishing standards but are not necessarily predatory in nature. Therefore, the term “predatory” shouldn’t be used for these journals.^{3,4,5}

Predatory publishers and journals have surged from just a handful to over a thousand in the last decade. This issue affects authors from almost every field worldwide. It has been reported that researchers who have published in open access (OA) journals received unsolicited emails inviting them to submit their papers, become members of the editorial board, or serve on review panels. There are many of these “predatory” journals based in developing countries, including Nigeria, Pakistan, and India. It is commonly believed that most predatory publishers and journals operate out of developing countries in Asia and Africa.⁶ Pakistan was ranked 17th out of 20 OIC countries in a recent study by Machacek and Srholec on predatory publications, with 20 being the worst ranking.⁷ Many of these journals do not adhere to the policies established by organizations such as the World Association of Medical Editors (WAME), the Committee on Publication Ethics (COPE), the Council of Science Editors (CSE), and the International Committee of Medical Journal Editors (ICMJE).⁸

Predatory journals are typically not indexed in reputable scientific databases such as PubMed, Medline, JCR, Scopus, or Web of Science. These journals often lack genuine and transparent peer review processes, adequate quality control, proper licensing, and content preservation. They may falsely claim to have an impact factor, but this is not the legitimate impact factor assigned by the

Institute for Scientific Information (Thomson Reuters). Instead, they may use altered or fictitious impact factors like Journal IF, Real IF, Prognosis IF, or Unofficial IF.⁹

There are ongoing efforts to bring to light predatory practices in academic publishing. Jeffrey Beall was the first to compile a list of such publishers in 2018, known as Beall’s List.¹⁰ Beall’s list was a useful tool for assessing the credibility of journals. However, it faced severe criticism from many authors, journals, and publishers. Beall removed the list from his blog after receiving legal threats and pressure from his University of Colorado employer.¹¹ Following the issue, In June 2017, Cabell International introduced a subscription-based blacklist of predatory journals. In response to this, a coalition of scholarly publishing organizations developed a checklist called “Think. Check. Submit.” to help authors choose legitimate journals for their research.¹²

The study aimed to understand Researchers’ Knowledge and Motivation Towards Predatory Publishing.

MATERIALS AND METHODS

The current questionnaire-based study was carried out at Private Medical University from April to July 2023. Permission was granted by the Ethical Review Board of the institution BDC/ERB/2023/026 to conduct the census survey of the faculty. The convenience sampling selected the study participants including faculty members and research scholars from Medical, Dental, and Allied Health Sciences institutions. Participants who were absent on the day of data collection were excluded from the study. A pre-validated questionnaire prepared by Cobey et al¹³ was used and it was then peer-reviewed by the subject specialists for content validity and relevance. The questionnaire consists of participants’ demographics, participants’ perceptions, and experience in publishing in predatory journals. Participants were approached in their respective workplaces by researchers trained in this data collection process. The researchers explained the purpose and nature of the study and obtained verbal consent. Participants were then asked to fill out the survey form and return it at the end of the day. The Data was entered and analyzed for frequency and percentages using SPSS software version 22.

RESULTS

A total of 150 participants took part in the survey, and their demographic characteristics are outlined in Table 1.

Thirty-nine (26%) participants stated that there is a written policy for publishing in predatory journals. Twenty-nine (19.3%) of the participants mentioned that they were aware the journal they were submitting to was predatory. The online submission system was used by 72 (or 48%) of participants to submit their work to the journal. 87 (or 58%) of the participants reported that their manuscript was peer-reviewed. A total of 73 participants (48.7%) paid the article processing fees with their funds. Of the participants, 56 (37.3%) claimed that publication in predatory journals did not pose a career risk. 37 (24.7%) of the participants indicated that they would be more cautious in the future when selecting journals before submission. Table 2 outlines the knowledge and motivation of researchers towards predatory publishing.

Figure 1 outlines how the authors first become aware of the predatory Journals before submission. Thirty three (22%) of the participants responded that while reading the Journals they first became aware of predatory Journals.

Figure 2 outlines no of times the paper has been submitted previously to predatory journals. Fifty-two respondents (34.6%) were unable to recall the number of previous

submissions to predatory journals. Of the other participants 43(28.6%) of the participants responded that they had just once submitted previously in predatory journals.

Figure 3 outlines the Factors that influenced the decision to submit a manuscript to a predatory journal. Sixty-two participants (41.3%) found the journal appropriate for publication.

Table 1: Participants’ Demographic Characteristics.

Characteristics	n	(%)
Gender		
Male	60	40%
Female	90	60%
Research status		
Faculty member	106	70.7%
Research scholar	44	29.3%
Research Disciplines		
Medical College/Hospital	60	40%
Dental College/ Hospital	81	54%
Pharmaceutical Sciences	3	2%
Physical therapy	6	4%

Table 2: Knowledge and Awareness of Participants about Predatory Journals.

Items	Response	n(%)
Did the primary institution you were based at the year you published your paper have a written policy for publishing that prohibited predatory journals?	Yes	39(26%)
	No	58(38.7%)
	Don't know	53(35.3%)
We believe the journal in which you published may be predatory. When submitting, were you:	Aware that it was predatory	29(19.3%)
	Not aware that it was predatory, but now do consider it Predatory	27(18%)
	Not aware that it was predatory and continue to think.	31(20.7%)
	It is not predatory	63(42%)
Had the paper you published in this presumed predatory journal been submitted elsewhere previously?	Yes	40(26.7%)
	No	110(73.3%)
How was the paper submitted to the journal?	Online submission portal	72(48%)
	Via email	41(27.3%)
	Other	37(24.7%)
Did the paper receive peer review?	Yes	87(58%)
	No	63(42%)
Was the peer review substantial and helpful?	Yes	59(39.3%)
	No	91(60.7%)
Where did you obtain money to pay the fee to publish?	Research grant funding	15(10%)
	University/employer	20(13.3%)
	research funding	73(48.7%)
	Personal money	12(8%)
	Other	30(20%)
	No fee paid	
Did you see any career risks associated with publishing in this journal (eg, getting caught by a colleague)?	No	56(37.3%)
	Yes	29(19.3%)
	Reprimanded by supervisor	15(10%)
	Few citations	16(10.7%)
	Damage to reputation	15(10%)
	Retraction	7(4.7%)
	Continued emails from journal	6(4%)
	Missed opportunity for peer review	6(4%)
Has the experience of publishing in a potentially predatory journal affected how Do you evaluate future journals before submission?	No	39(26%)
	Yes	37(24.7%)
	Will check the details about the journal	30(20%)
	Consult with others	15(10%)
	Will only publish in known/prestigious/authentic journals	16(10.7%)
	Not published in open-access journals	9(6%)
	Fees Suggestions	4(2.7%)

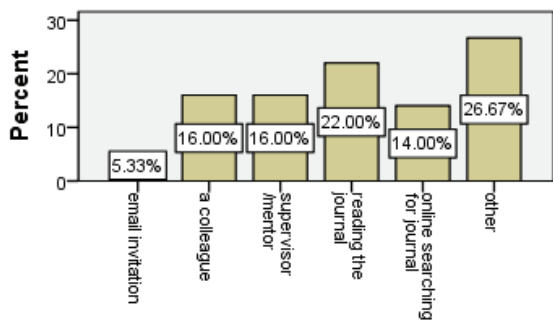


Figure 1: How Did You First Become Aware of This Presumed Predatory Journal Before Submission?

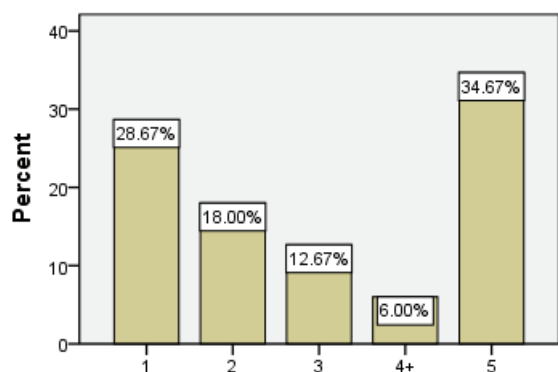


Figure 2: Outlines No of Times the Paper has been Submitted Previously to Predatory Journals

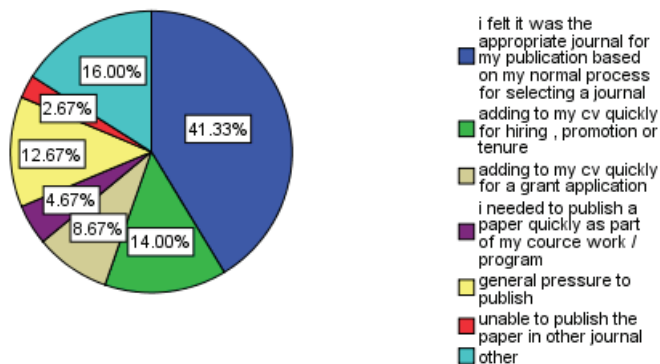


Figure 3: Outlines the Factors that Influenced the Decision to Submit a Manuscript to a Predatory Journal

DISCUSSION

This study is among the first to investigate the knowledge and motivation of Pakistani researchers concerning predatory publishing. Predatory journals have become a concern for researchers due to their easy publication processes.¹⁴ and promises of fast acceptance.¹⁵To avoid these journals, researchers can use different approaches

such as blacklists.¹⁶and systems that help authors choose legitimate journals¹⁷ Additional sources of information include scientific literature, friends, colleagues, emails, conferences, and media platforms, including social media.¹⁸

The escalation in predatory publications has been linked to the simultaneous rise in email solicitations that encourage novice researchers to submit work with promises of rapid publication and reduced costs.¹⁹ Upon exposure to an infographic, research participants gained insight into the deceptive characteristics of specific emails and publications. It is crucial to examine novel strategies employed by predatory journals to target researchers, especially those situated in developing nations.⁵ The researchers of the current investigation inquired about how participants initially became acquainted with the predatory journal before submission; among those surveyed, 22% encountered the journal while perusing an article, while 27% could not recall. Cobey et al.¹³ determined that merely 5.1% of participants stumbled upon the journal while reading the article, with the majority receiving an email solicitation. In a study conducted by AIRyalat SA et al ²⁰ 90.5% of respondents expressed disagreement or strong disagreement towards email solicitations from unfamiliar journals requesting manuscript submissions.

The survey revealed that 20.7% of participants were not aware that the journal was predatory, while 42% believed that it was not a predatory Journal. AIRyalat SA²⁰ found that 93% of potential authors were unaware of predatory journals and the significance of selecting the right publication for their research.

Universities and research organizations need to educate their researchers, especially those who are new to the field, about the existence of predatory journals and the risks associated with them. They should also be provided with guidance on how to avoid such journals.²¹

A reliable method to identify legitimate and predatory open-access (OA) journals is through their peer-review processes. Predatory journals tend to promise quick turnaround times, often within just a few hours, which raises doubts about the thoroughness of their peer review procedures. This indicates that predatory journals are motivated by profit and may lack the necessary resources

or be unwilling to invest the required time to carry out a robust peer-review process.¹⁰ The present study reported that 58% of the participants reported that their submitted manuscript was peer-reviewed, it was also reported by 60.7% of participants that the peer review was not substantial or helpful. According to Cobey et al¹³, 83.3% of participants reported peer review of their papers, while 16.7% said they did not. Among participants who reported peer-reviewing their papers, 79.7% found the process helpful, while 20.3% found it not to be substantial or helpful. Some open access (OA) and non-OA journals require authors to make a payment for publication upon acceptance of their manuscript. Pakistan, classified as a developing nation, encounters challenges in the authors' ability to finance these charges.²² According to the current study, 48.7% paid the processing expenses themselves, while 13.3% indicated that the institution paid through a research grant. As stated in the present study, 48.7% of individuals covered the processing fees personally, while 13.3% reported that the funding came from their respective institutions. Research conducted by Sheikh A²², found a significant portion of faculty members, specifically 316 (53%), of the opinion that the author's institution should handle the publication fee. Additionally, 173 (29%) proposed that the cost should be covered by research funding organizations, and 50 (8.4%) suggested that the author's department should take responsibility. Moreover, 33 (5.5%) recommended cost sharing among authors, while only 24 (4%) put forth alternative funding sources.

Publishing in predatory journals in Pakistan carries significant career risks for researchers and academics. These risks include damaging one's credibility, hindering career progression, and potentially leading to the loss of valuable research, as highlighted in various research papers.^{23, 24 25}

The survey specifically explored the understanding of researchers' Knowledge and Motivation Towards Predatory Publishing." The survey targeted the faculty members and postgraduate students at the Medical university and is the first kind of study done in Pakistan. The current study has several limitations. First, data was collected using convenience sampling, meaning only participants present on the data collection day were included. Additionally, participants were selected from just one university, resulting in a small sample size. Future studies should involve a larger sample and

consider incorporating other important variables.

CONCLUSION

The present study concluded that most of the participants in the study were unaware of the predatory Journals and that they could not differentiate between predatory and legitimate journals. It is recommended to encourage and spread awareness through arranging workshops, and lectures for researchers in different universities and research institutions.

DISCLAIMER:

None.

CONFLICT OF INTEREST

None to declare.

ETHICAL STATEMENT

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Regenerative Endodontics in Pakistan: A Survey of Dental Specialists' Knowledge, Attitudes, and Practices

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ABSTRACT

Objectives: This study aimed to evaluate the awareness, attitudes, and practices regarding regenerative endodontic procedures (REPs) among dental clinicians in Pakistan. The focus was on understanding clinicians' knowledge of REPs, their perceptions of its efficacy compared to traditional methods, and their practical approaches to managing immature necrotic permanent teeth.

Materials and Methods: This descriptive cross-sectional survey involved 178 dental clinicians from various specialties, including endodontics, Pediatric dentistry, Orthodontics, Prosthodontics, Periodontics, Oral Surgeons and general practice. Data were collected using a structured questionnaire covering demographics, knowledge, attitudes, and clinical practices related to REPs. Statistical analysis was performed to identify trends and significant associations.

Results: The survey revealed that 66.3% of participants believed there is sufficient evidence supporting REPs, and 83.1% considered REPs superior to apexification. Most clinicians (73.6%) preferred REPs over Osseo-integrated implants for managing immature necrotic permanent teeth, though 58.4% would refer these cases to endodontists. For disinfection, 41% favoured a combination of antibiotics and calcium hydroxide, while 48.3% relied on clinical guidelines from the American Association of Endodontists (AAE) and published literature for their protocols. Despite high levels of knowledge and positive attitudes towards REPs, practical gaps were identified, indicating a need for further training and standardized clinical guidelines.

Conclusion: Dental clinicians in Pakistan exhibit good knowledge and positive attitudes towards REPs. However, practical implementation shows variability, underscoring the need for enhanced education and standardized protocols to ensure optimal clinical outcomes in regenerative endodontics.

Keywords: Apexification, Dental Education, Dental Pulp Necrosis, Endodontic Procedures, Regenerative Endodontics

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INTRODUCTION

Managing young permanent teeth affected by pulp necrosis is a considerable difficulty for dental practitioners.¹ Immature teeth with pulp necrosis due to decay or trauma often exhibit incomplete root formation, thin dentinal walls, and an open apex. These anatomical challenges hinder the effectiveness of conventional endodontic cleaning, shaping, and obturation techniques.²

The management of necrotic immature permanent teeth involves two main approaches: apexogenesis and apexification. Apexogenesis preserves pulp viability to support root development, while apexification uses materials to create a barrier for root-end closure.³ Despite its widespread use, apexification has limitations. Repeated intracanal medication, especially with calcium hydroxide, increases reinfection risk, and extensive instrumentation can weaken canal walls.⁴

A growing body of research investigating the regenerative potential of the dental pulp suggests the possibility of inducing the biological substitution of cells constituting the dentin-pulp complex. This approach could lead to the regeneration of pulp tissues, the stimulation of continued root development, and potentially, the revitalization of the entire tooth structure.⁵ Regenerative endodontic procedures are based on three core principles of tissue engineering: the use of mesenchymal stem cells (MSCs), scaffold materials, and growth factors.⁶ Research interest in tissue engineering, particularly in its application to pulp regeneration, has noticeably increased in recent years, which is a significant accomplishment for the field of dentistry.⁷ Consequently, the American Association of Endodontists (AAE) recommends that young permanent teeth with dead pulp should get regenerative endodontic treatment.⁸

It is possible to conclude that the current application of regenerative endodontics is simply a preview of the developments and applications that are anticipated to take place in the next ten years. On the other hand, these cutting-edge treatments must enter clinical practice after being developed in laboratory settings. Because of this, there is a need for improved research quality as well as collaboration efforts across various physicians and researchers.⁸

Regenerative endodontics represents a fundamental change from conventional endodontic procedures,

with a specific emphasis on the restoration of pulp tissues such as dentin, blood vessels, and nerve tissues through regeneration.⁹ The unique healthcare, socio-economic, and educational landscape of Pakistan provides an opportunity to explore regional differences in the adoption of regenerative endodontic protocols. Many dental practitioners rely on traditional therapies due to limited exposure, insufficient training, or lack of confidence in adopting regenerative techniques. By investigating practitioners' perspectives, this study aims to identify barriers such as inadequate education, limited resources, and unclear protocols, as well as factors that facilitate adoption. Examining clinical practices across specialties will offer insights into the practical application of regenerative techniques, highlighting areas for improvement. This research seeks to bridge these gaps, enhance current knowledge, and support the development of targeted educational programs and treatment strategies to advance clinical practice. The objective of this study was to determine the levels of awareness, attitudes, and practices regarding regenerative endodontic procedures (REPs) among clinicians representing different dental specialties in Pakistan.

MATERIALS AND METHOD

A descriptive cross-sectional questionnaire-based survey was conducted among Pedodontists, Endodontists, General Practitioners, orthodontists, prosthodontists and oral surgeons across Pakistan. After obtaining ethical approval (#34-ERB /024) from the institutional ethical board of Saidu College of Dentistry, Saidu Shareef Swat. A convenience sampling technique was used for selecting the participants. The sample size for this study was determined using the OpenEpi software, based on the anticipated proportion of 34.6%² of participants who responded to their opinions and beliefs about regenerative endodontic procedures. To achieve a confidence level of 95% with an absolute precision of 7%, the calculated sample size required was 178 participants. The questionnaires were distributed via a web-based survey using Google Forms and were sent through electronic media including WhatsApp, Facebook and Gmail. Before completing the online questionnaire, participants were required to fill out a consent form. The survey proceeded only for those who provided their consent.

The questionnaire utilized in this study was adopted from the research conducted by Jamal et al.², following

explicit consent obtained through email correspondence. The questionnaire consisted of three sections: Part A, comprised of four inquiries focused on sociodemographic details and the professional status of dentists; Part B (Q5–10), addressing queries regarding dentists’ viewpoints, convictions, and stances concerning the utilization of Regenerative Endodontic Procedures (REPs); and Part C (Q11–17), concentrating on clinical protocols, to be completed exclusively by respondents indicating their personal engagement in performing REPs (Q10). Data was analyzed using IBM SPSS version 27. Frequencies and percentages were computed for summarizing categorical variables.

RESULTS

A total of 185 participants were approached and out of them 178 responded to the survey. Most of them were endodontists (34.8%), had work experience of 0-5 years (64%), worked in an academic institution (42.7%) and did not attend a course on stem cells and regeneration (89.9%). (Table 1)

Table 1: Profile of Participants.

Questions	Characteristics	n (%)
What’s your specialty?	Endodontist	62 (34.8)
	Periodontist	8 (4.5)
	General Physician	35 (19.7)
	Prosthodontist	32 (18.0)
	Orthodontist	20 (11.2)
	Oral Surgeon	21 (11.8)
How many years in practice since graduation?	0-5 years	114 (64.0)
	5-10 years	38 (21.3)
	10-15 years	24 (13.5)
	15-20 years	1 (0.6)
	>20 years	1 (0.6)
Where do you practice?	Academic institution	76 (42.7)
	Government based practice	49 (27.5)
	Part time educator with private practice	43 (24.2)
	Private practice	10 (5.6)
Have you attended a course on stem cells and regeneration?	Yes	18 (10.1)
	No	160 (89.9)

About one-third of participants believed that there

is enough evidence to support REPs (66.3%) and evidence that functional pulp tissue can be regenerated with REPs (66.9%). More than three-fourths had a view that REPs are a better treatment option than apexification (83.1%). Nearly one third thought that tooth can be regenerated in the laboratory during 1-10 years (35.1%). Most of the participants had the perception that implanting a regenerated tooth is a better option compared to the use of Osseo-integrated dental implants (76.4%). The majority said they refer the patient to an endodontist if there would be a need to perform REPs (58.1%) (Table 2).

Table 2: Opinions and Beliefs Toward REPs

Questions	Characteristics	n (%)
Do you believe there is enough evidence to support REPs?	Yes	118 (66.3)
	No	60 (33.7)
Do you believe there is enough evidence that a functional pulp tissue can be regenerated with REPs	Yes	119 (66.9)
	No	59 (33.1)
Do you believe that REP is a better treatment option compared with apexification?	Yes	148 (83.1)
	No	30 (16.9)
When do you believe an entire tooth can be regenerated in the laboratory?	0-10 years	63 (35.4)
	10-20 years	28 (15.7)
	20-30 years	39 (21.9)
	>30	47 (24.4)
	It will never happen	1 (0.6)
	Do you believe that implanting a regenerated tooth is a better option compared to the use? Of Osseo-integrated dental implant?	Yes
	No	42 (23.6)
When indicated and possible, are you willing to perform REPs or you prefer to refer to endodontist?	Perform REPs myself	74 (41.6)
	Refer to an endodontist	104 (58.4)

More than half of them said the case of tooth with necrotic pulp and immature apex would be most comfortable case for doing REPs (54.5%) and will perform it in two visits (61.8%). Majority were using mixture of antibiotics and calcium hydroxide to achieve disinfection of the root

canal system (53.4%). Ratio of 1:1:1 of ciprofloxacin: metronidazole: minocycline was mostly preferred by participants (63.5%). Around of participants said that they would deliver the stem cells in the root canal system using initial bleeding from the peripheral area (48.9%). Nearly half of participants were relaying on The AAE’s clinical consideration for REPs (48.9%) and published literature (48.3%) for developing the protocol for REPs (Table 3).

Table 3: Distribution of Clinical Practice Related to REPs

Questions	Characteristics	n (%)
Which cases would you be comfortable doing REPs on?	Tooth with necrotic pulp and an immature apex	97 (54.5)
	Tooth with necrotic pulp and mature apex	31 (17.4)
	Both of the above	50 (28.1)
How many visits would you require to perform REPs?	1 visit	12 (6.7)
	2 visits or more	110 (61.8)
	Can be done over 1 visit or continued for more visits	56 (31.5)
Which of the following would you use to achieve disinfection of the root canal system?	Mixture of antibiotics	54 (30.3)
	Calcium hydroxide	29 (16.3)
	Both of above	95 (53.4)
Which ratio of the antibiotic mixture would you prefer?	1:1:1 of ciprofloxacin: metronidazole: minocycline	113 (63.5)
	1:2:1 of ciprofloxacin: metronidazole: minocycline	43 (24.2)
	1:2:2 of ciprofloxacin: metronidazole: minocycline	6 (3.4)
	2:2:1 of ciprofloxacin: metronidazole: minocycline	16 (9.0)

Which concentration of each antibiotic would you prefer in the antibiotic mixture? (mg/ml)	0.1	46 (25.8)
	1	124 (69.7)
	10	8 (4.5)
How would you deliver the stem cells in the root canal system?	Orthograde delivery of the stem cells through a syringe	33 (18.5)
	Initiating bleeding from the periapical area	87 (48.9)
	Both of the above	58 (32.6)
The sources that you use to develop your protocol is based on: (multiple response)	The AAE’s clinical consideration for REPs	87 (48.9)
	Published literature	86 (48.3)
	Continuous education course	56 (31.5)
	Colleagues unsure	18 (10.1)

DISCUSSION

An encouraging finding of our study is that, although most of the participants had work experience ranging from zero to five years, only few of them attended a course on stem cells and regeneration, indicating the need to upgrade their knowledge and skill set and learning new endodontic techniques. Oral surgeons were ranked second in terms of attending these courses, after endodontists.

The majority of participants believed that there was sufficient data to support REPs and the regeneration of functional pulp tissue using REPs Furthermore, a greater percentage of dentists (83.1%) concurred that restorative enamel grafting (REP) is a superior therapeutic choice than apexification. A 2019 Indian study revealed a lack of understanding of regenerative endodontics. Other surveys, however, indicated that respondents knew more about using REP rather than apexification.⁸ According to Saudi Arabian research, 85% of dentists claimed they advise patients to get REPs.² The higher preference in the most recent studies may be explained by the fact that newer research on REPs indicates that REPs outperform apexification in terms of enhanced root thickness and length.¹⁰

Dental implants are used to replace lost teeth, endodontic therapy for pulp necrosis, and cavity fillings are all examples of current dental repair procedures that involve synthetic materials. By using biologically based

treatment procedures for critical tissue regeneration, the fields of Tissue Engineering and Regenerative Medicine and Dentistry (TERMD) on the other hand, offer the possibility of regenerating living tissues.¹¹ Based on our growing understanding of the mechanisms governing tooth growth, the natural regulation of tooth morphology in the human body, and the research of signal pathways involved in tooth regeneration, tooth regeneration engineering has garnered a lot of attention recently. In 2012, there were approximately 473 publications on tooth regeneration, and research in this field has continued to increase over time.^{12,13} The results of our survey highlight the significance of this ongoing progress in dental tissue bioengineering, since the majority of participants believed that complete teeth would one day be regenerated.

Given the abundance of research that supports regenerative endodontics procedures, it is not unexpected that a significant fraction of our study participants (76.4%) favoured REP over osseointegrated titanium implants.^{14,15} The results align with other comparable surveys conducted in the United States.² Only 57.6% of dentists, however, preferred to choose regenerative dentistry over implant or prosthesis insertion, with 35.7% remaining uncertain. Despite the success of dental implants, we believe that the incidence of pain and inflammation following dental implants should be minimized to provide optimal treatment alternatives.¹⁶

The majority of our participants said that they refer their patients to endodontists to undergo REPs (58.4%). This might be possible that REPs fall in the domain of endodontics. However, 41.6% of our participants were willing to perform it themselves. This depicts a positive response that dental practitioner was enthusiastic to learn and apply the technique in their clinical settings. A significant portion of endodontists also suggested that regenerative endodontic procedures should be utilized in dentistry.¹⁷ According to an Indian study, dental residents believe that stem cell and regenerative dental treatment is the most successful (43%) and safest method (48.7%), thus they would prescribe it to patients.¹⁸

In this study, approximately half of the participants reported feeling at ease conducting REPs on teeth that had an immature apex and necrotic pulp (54.5%). However, in the study by Jamal M et al², this percentage was greater at 72%. Predominantly, REP success is

documented in situations with necrotic immature teeth.^{19,20} The regenerative endodontic procedure (REP) can promote the continuous development of root width and length in immature teeth, requiring an appropriate coronal seal, a suitable matrix for tissue ingrowth, and effective infection control.²¹

The efficient removal of germs and their byproducts from the root canal system is the main factor determining the outcome of endodontic treatment.²² The American Association of Endodontics (AAE) and the European Society of Endodontology (ESE) presently advise using Ca(OH)₂ paste or antibiotic mixtures.^{23,24} The majority of our participants (53.4%) chose to use a combination of antibiotics and calcium hydroxide. Findings of other studies reported that almost the same proportion of participants were using a mixture of antibiotic paste (40.4%) and both calcium hydroxide and mixture of antibiotic paste (39.4%).^{2,17,25} Those who adhered to the ESE guidelines exhibited a preference for Ca(OH)₂ in comparison to those who followed alternative rules. The risks of antibiotic resistance, sensitization, cytotoxicity, obtaining the recommended antibiotic mixture, removal from the root canal difficulty, and coronal discoloration are just a few of the drawbacks of TAP/double antibiotic paste (DAP) that are mitigated by the more affordable Ca(OH)₂.⁵

The toxic impact on apical papilla stem cells (SCAP) is positively correlated with TAP concentration. While antibacterial activity declines at concentrations <1 mg/mL, concentrations of 1 mg/mL do not influence SCAP survival and no toxic effects are observed at lower doses (0.01–0.1 mg/mL). The best concentration of the antibiotic combination to combat endodontic bacteria with the least amount of harm to stem cells has not yet been established. Generally speaking, the AAE advises using TAP or DAP at low concentrations (0.1–1.0 mg/mL).²³ The majority of study participants (95.5%) chose concentrations between 0.1 and 1 mg/mL, indicating that they followed the current guidelines.

All published studies by RET propose the usage of a scaffold.^{19, 20} Approximately 50% of the participants thought that the most effective way to introduce stem cells into the root canal system was to start bleeding from the periapical area. However, the need for blood collection from the patient using other techniques like PRF, CGF,

and PRP, in addition to the additional expenditures and the need for the right tools and training to prepare the scaffold in an aseptic environment, maybe the factors limiting their adoption.

This survey reveals that nearly half of the participants were relied on The AAE's clinical consideration for REPs (48.9%) and published literature (48.3%) for developing the protocol for REPs whereas some were also depended on continuous education courses and one-tenth were unsure about it. Previous surveys also reported published literature as a source on which participants were depending for REPs protocol development.^{2,19} This reveals a lack of standard treatment protocol. However, the reliance of half of the participants on AAEs indicates that dentists are not uniformly using a single protocol. Thus, there is a need to emphasize the use of a standardized guidelines and protocols should be to maximize the possibility of favorable clinical outcomes for REPs.

The present survey includes both endodontists and other dental practitioners so to assess knowledge among other dental practitioners a larger survey should be conducted to generalize the findings of this study.

CONCLUSION

The present survey revealed good knowledge and attitude of study participants towards REPs However, there are some aspects of practice which needs serious attention which can be addressed with ongoing training and education.

DISCLAIMER

None.

CONFLICT OF INTEREST

None to declare.

ETHICAL STATEMENT

Ethical approval acquired from the Institutional ethical review board of Saidu Medical College, Saidu Shareef Swat. (#34-ERB/024)

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AUTHORS CONTRIBUTION

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All manuscripts submitted for publication must be accompanied by a cover letter certifying the originality of the work, freedom from conflict of interest, and conduct of research per ethical guidelines established for human subjects and animal welfare. Please note that **no article will be processed without a Cover Letter, Ethical Approval, and Authorship & Conflict of Interest Statement**. Upon initial submission, the team confirms that all the valid documents are present and complete. If the submission is incomplete, the article is returned to the author for completion. The authors will have two weeks to complete the submission. Failure to do so within the time limit will result in the automatic deletion of the article from the online submission system without prior notice. There is **no publication fee to submit or publish content in FUJD**.

2. Manuscript Preparation and Format

The main document with the manuscript text and tables should be prepared with MS Word in proper and clear British English. This journal adheres to a double-blinded peer-review policy. The title page should **NOT** be included in the main document. The manuscript text should be typewritten in double-spaced, 12-point font, Alignment justified throughout, Continuous line numbers, and Times New Roman on A4-sized paper with 2.5 cm margins on the top, bottom, right, and left. Page numbers should be added at the bottom right corner.

The arrangement of the sections is as follows: Title Page, Abstract and Keywords, Introduction, Materials and Methods, Results, Discussion, Conclusion, Acknowledgments (if any), Disclaimer, Conflict of Interest, Ethical statement, Funding Disclosure, Supplementary Materials (if any), Authors' contributions, References, Tables, and Figures with Legend for Figures. Make sure to start each section on a new page. Tables and figures should be included at the end of the manuscript

and not in the middle of the text. Additional material, which is not pivotal, but supporting in nature to the theme of the manuscript, can be submitted as "Supplementary Material" and will be published only online (not in print).

Authors should be limited the use of abbreviations to a minimum. Abbreviations are not to be used in titles. Abstracts may contain abbreviations for terms mentioned many times in the Abstract, but each abbreviation must be defined the first time it is used. Do not start a sentence with a number. Drug and chemical names should be stated in standard chemical or generic nomenclature. Units of measure should be presented according to the International System (SI) of Units. All units must be preceded by one space except percentage (%) and temperature (°C). Descriptions of genes or related structures in a manuscript should include the names and official symbols provided by the US National Centre for Biotechnology Information (NCBI) or the HUGO Gene Nomenclature Committee. For generic and brand names of medicine, use generic names. If a brand name should be used, insert it in parentheses after the generic name. Failure to do so may result in delays or manuscript unsubmission.

3. Manuscript Types

The types of manuscript accepted for publication in FUJD includes;

- A. **Original Article:** These include randomized controlled trials, intervention studies, studies of screening and diagnostic tests, outcome studies, cost-effectiveness analyses, case-control series, and surveys with high response rates.
 - Structured abstract: 250 words (Structured format: Objectives, Materials and Methods, Results, Conclusions) with 3 to 6 MeSH keywords.
 - Maximum word count of text: 3500 words
 - Maximum of 25 references with at least half from the previous five years.
 - Maximum 4 allowed tables and figures
 - Use the following section headings in the main text: Introduction, Materials and Methods, Results, Discussion, and Conclusion. This is followed by Acknowledgments (if any), Disclaimer, Conflict of Interest, Ethical Statement, Funding Disclosure, Supplementary Materials (if any), Authors' contribution, References, Tables, and Figures with legends for Figures. Do not use any other sub-headings.
 - State clearly when and where the study was conducted.
 - Quote the ethical approval and informed consent, if applicable.

- A clinical trial number should be included for all randomized controlled trials.

B. Narrative Review: A narrative or traditional literature review is a comprehensive, critical, and objective analysis of the current knowledge on a topic. It is expected that these articles would be written preferably by individuals who have done substantial work on the subject or are considered experts in the field.

- Unstructured abstract (i.e., no subheadings): 250 words with 3 to 6 MeSH keywords.
- Maximum word count of text 4500 words.
- Maximum of 75 references with at least half from the previous five years.
- Maximum 3 allowed tables or figures.
- Follow a logical sequence and use sub-headings as required.
- FUJD does not accept narrative review articles written by undergraduate students.
- Make sure to state any acknowledgements, disclaimers, conflicts of interest, and funding disclosure.

C. Systematic Reviews: A systematic review attempts to identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria to answer a specific research question. Researchers conducting systematic reviews use explicit, systematic methods that are selected with a view aimed at minimizing bias, to produce more reliable findings to inform decision-making.

- Structured abstract: 250 words (Structured format: same as the original article) with 3 to 6 MeSH keywords.
- Maximum word count of text 4500 words.
- Maximum of 75 references.
- Maximum 4 allowed tables or figures.
- Section headings of the main text should be the same as the original article.
- The manuscript should be written following PRISMA guidelines.

D. Meta-Analysis: Meta-analysis is a systematic review of a focused topic in the literature that provides a quantitative estimate of the effect of a treatment intervention or exposure. It includes the use of statistical methods to summarize the results of independent studies. By combining information from all relevant studies, meta-

analysis can provide more precise estimates of the effects of health care than those derived from the individual studies included within a review. Not all systematic reviews contain meta-analysis.

- Structured abstract: 250 words (Structured format: Same as the original article) with 3 to 6 MeSH keywords.
- Maximum word count of text 4500 words
- Maximum of 75 references
- Maximum 3 allowed tables or figures
- Section headings of the main text should be the same as the original article.
- The manuscript should be written following PRISMA guidelines.

E. Case Report: These are short discussions of a case or case series with unique features not previously described that make an important teaching point or scientific observation. They may describe novel techniques or use of equipment or new information on diseases of importance.

- Unstructured abstract (i.e., no subheadings): 150 words with 3 to 6 MeSH keywords.
- Maximum word count of text 1250 words.
- Maximum of 20 references.
- Maximum 2 allowed tables or figures.
- Section headings of the main text should be Introduction, Case Report (state clearly when the case was seen, describe the follow-up of the patient), Discussion, Conclusion, Acknowledgments (if any), Disclaimer, Conflict of Interest, Ethical statement, Funding Disclosure, Supplementary Materials (if any), Authors' contribution, References, Tables, and Figures with Legend for Figures. Do not use any other sub-headings.
- Ensure that a statement is present within the text of your manuscript which declares that the consent of the patient/guardian was taken before the writing of the manuscript. FUJD does not require a signed patient consent form; however, keep it with you in case the journal asks for it in the future to verify this.

F. Short Communication: These reports should be concise presentations of preliminary experimental results, instrumentation and analytical techniques, or aspects of clinical or experimental practice that are not fully investigated, verified, or perfected but which may be of widespread interest or application. The Editors reserve the right to decide what

constitutes Short Communication.

- Unstructured abstract: 150 words with 3 to 6 MeSH keywords.
- Maximum word count of text 1500 words
- Maximum of 10 references
- Maximum 2 allowed tables or figures
- Use the following three headings in the main text: Introduction, Patients/Materials and Methods, Results, and Conclusion. This is followed by Acknowledgments (if any), Disclaimer, Conflict of Interest, Ethical statement, Funding Disclosure, Supplementary Materials (if any), Authors' contribution, References, Tables, and Figures with legends for Figures. Do not use any other sub-headings.

G. Letter to the Editor: These should be short and decisive observations or a short comment on a previously published article within the journal. A letter to the Editor is a brief report that is within the journal's scope and of particular interest to the community, but not suitable as a standard research article. They should not be preliminary observations that need a later paper for validation.

- Abstract and keywords: Not required.
- Maximum word count of text: 500 words
- Maximum of 5 recent references
- Maximum 1 allowed table or figure
- Should not be signed by more than 3 authors
- No section heading is required in the main text however, state Acknowledgement (if any), Disclaimer, Conflict of Interest, Ethical Statement, Funding Disclosure and Authors Contribution before the References.
- Letters to the Editor may be edited for clarity or length and may be subject to peer review at the Editors' discretion.

4. Reporting Guidelines

Authors are strongly encouraged to refer to the scientific reporting guidelines for health research, hosted by the EQUATOR Network (Enhancing the Quality and Transparency of Health Research).

Authors should adhere to these scientific reporting guidelines when drafting their manuscripts. Separate guidelines are available for each study design and topic under study. Although FUJD has not submitted these checklists mandatory, doing so will aid in the processing of the manuscripts. The most used

study design methods are STROBE (Observational Studies in Epidemiology e.g., cohort, case-control, and cross-sectional studies), CONSORT (Randomized Control Trials), TREND (Non-Randomized Controlled Trials), PRISMA (Systematic Reviews and Meta-Analyses), MOOSE (Meta-Analysis of Observational Studies), CARE (Case Reports), ORION (Infection Control Intervention Studies), STARD (Diagnostic Accuracy Studies), and SPIRIT (Study Protocols). If you are not sure which guideline to use, use the new tool developed by EQUATOR Network and Penelope Research to guide the authors.

5. General Guidelines

A. Title Page

The title page should contain the following information (in order, from the top to bottom of the page): Article category, article title, names (spelt out in full) of all authors*, and the institutions with which they are affiliated; indicate all affiliations with a superscripted Arabic numeral after the author's name and in front of the matching affiliation, corresponding author details (name, e-mail, mailing address, telephone, and fax numbers). The title page template is available on the journal's website.

*The name of each author should be written with the family name last, e.g., Hamida Jamil, and authorship is restricted only to direct participants who have contributed significantly to the work; each author may list a maximum of 3 affiliations only.

B. Abstract and Keywords

An abstract (no longer than 250 words) and 3-6 relevant keywords (in alphabetical order) are required for the following article categories: Original Articles, Narrative Reviews, Systematic Reviews and Meta-analysis. For Case Reports and Short Communications, an abstract should be no longer than 150 words and 3-6 relevant keywords.

Abstracts for Narrative Reviews, Case Reports, and Short Communications should be unstructured (in one single paragraph with no section headings), and include information on the background/purpose of the report, methods, results (or case report), and conclusions.

Abstracts for Original Articles, Systematic Reviews, and Meta-analyses should be structured into the following sections:

Objective: Briefly explain the importance of the study topic and state a precise study question/purpose/objective.

Materials and methods: Briefly introduce the methods used to perform the study; include information on the study design, setting, subjects, interventions, outcome measures, and analyses as appropriate.

Results: Briefly present the significant results, with data and statistical details such as *p*-values where appropriate; be sure that the information in the abstract matches that in the main

text.

Conclusion: State the meaning of your findings, being careful to address the study question directly, and confine your conclusions to aspects covered in the abstract; give equal emphasis to positive and negative findings.

Keywords should be taken from the Medical Subject Headings (MeSH) list of Index Medicus

No abstract or keywords are required for Correspondence and Letters to the Editor.

C. Main Text

The main text for Original Articles, Systematic Reviews, Meta-analyses and Short Communications should be organized into the following sections: Introduction, Materials and Methods, Results, Discussion, and Conclusion. This is followed by Acknowledgments (if any), Disclaimer, Conflict of Interest, Ethical Statement, Funding Disclosure, Supplementary Materials (if any), Authors' Contribution, References, Tables, and Figures with Legends for Figures. Subheadings are not allowed however, for Systematic Reviews and Meta-analysis, following PRISMA guidelines, the author can use sub-headings for clarification and ease of reading.

Sections for Case Reports are Introduction, Case Report (state clearly when the case was seen, describe the follow-up of the patient), Discussion, Conclusion, Acknowledgments (if any), Disclaimer, Conflict of Interest, Ethical Statement, Funding Disclosure, Supplementary Materials (if any), Authors' Contribution, References, Tables, and Figures with Legend for Figures. Do not use any other sub-headings. For all article categories, each section should begin on a new page.

D. Abbreviations

Where a term/definition will be continually referred to, it must be written in full when it first appears in the text, followed by the subsequent abbreviation in parentheses. Thereafter, the abbreviation may be used. An abbreviation should not be first defined in any section heading; if an abbreviation has previously been defined in the text, then the abbreviation may be used in a subsequent section heading. Restrict the number of abbreviations to those that are necessary and ensure consistency of abbreviations throughout the article. Ensure that an abbreviation so defined does appear later in the text (excluding in figures/tables), otherwise, it should be deleted.

E. Numbers

Numbers that begin a sentence or those that are less than 10 should be spelt out using letters. Centuries and decades should be spelt out, e.g., the Eighties or nineteenth century. Laboratory parameters, time, temperature, length, area, mass, and volume should be expressed using digits.

F. Units

Système International (SI) units must be used, except for blood pressure values which are to be reported in mmHg. Please use the metric system for the expression of length, area, mass, and volume. Temperatures are to be given in degrees Celsius.

G. Names of Drugs, Devices and Other Products

Use the Recommended International Non-proprietary Name (rINN) for medicinal substances, unless the specific trade name of a drug is directly relevant to the discussion. Generic drug names should appear in lowercase letters in the text. If a specific proprietary drug needs to be identified, the brand name may appear only once in the manuscript in parentheses following the generic name the first time the drug is mentioned in the text.

For devices and other products, the specific brand or trade name, the manufacturer, and their location (city, state, country) should be provided the first time the device or product is mentioned in the text, for example, "SPSS version 21 was used (SPSS Inc., Chicago, IL, USA)". Thereafter, the generic term (if appropriate) should be used.

H. Gene nomenclature

Current standard international nomenclature for genes should be adhered to. For human genes, use genetic notation and symbols approved by the HUGO Gene Nomenclature Committee. Besides, you can also access The Human Genome Variation Society which guides naming mutations. In your manuscript, genes should be typed in italic font and include the accession number.

I. Statistical requirements

Statistical analysis is essential for all research papers except Narrative Reviews and Case Reports. Use correct nomenclature of statistical methods (e.g., two-sample t-test, not unpaired t-test). Descriptive statistics should follow the scales used in the data description. Inferential statistics are important for interpreting results and should be described in detail. All p -values should be presented to the third decimal place for accuracy. The smallest p -value that should be expressed is $p < 0.001$ since additional zeros do not convey useful information; the largest p -value that should be expressed is $p > 0.99$.

J. Personal communications and unpublished data

These sources cannot be included in the references list but may be described in the text. The author(s) must give the full name and highest academic degree of the person, the date of the communication, and indicate whether it was in oral or written (letter, fax, e-mail) form. A signed statement of permission should be included from each person identified as a source of information in a personal communication or as a source for unpublished data.

K. Tables

Tables should supplement, not duplicate, the text. They should have a concise table heading, be self-explanatory, and be numbered consecutively in the order of their citation in the text. Items requiring explanatory footnotes should be denoted using superscripted lowercase letters (a, b, c, etc.), with the footnotes arranged under the table in alphabetical order. Asterisks (*, **) are used only to indicate the probability level of tests of significance. Abbreviations used in the table must be defined and placed after the footnotes in alphabetical order. If you include a block of data or table from another source, whether published or unpublished, you must acknowledge the source by adding a credit line as the first footnote beneath each table. This credit line should be a complete bibliographical listing of the source publication (as a reference), or other credit lines as supplied by the copyright holder. For example, “Reprinted with permission from Calfee DR, Wispelwey B. Brain abscess. *Semin Neurol* 2000;20:357.” (“Data from . . .” or “Adapted from . . .” may also be used, as appropriate.)

Do not intersperse tables in the text. Tables should appear before the figure legends. Insert a page break between the end of the table and the start of the figure legends. If a table contains artwork, supply the artwork separately as a digital file.

L. Figures

General guidelines

The number of figures should be restricted to the minimum necessary to support the textual material. Figures should have an informative figure legend and be numbered in the order of their citation in the text. All symbols and abbreviations should be defined in the figure legend in alphabetical order. Items requiring explanatory footnotes should follow the same style as that for tables as described in Section “Tables”. It is best to use Adobe Photoshop to create and save images, and Adobe Illustrator for line art and labels. Do not submit art created in Microsoft Excel, Word, or PowerPoint. These files cannot be used by the typesetter.

Unless you have written permission from the patient (or, where applicable, the next of kin), the personal details (such as their name, date of birth, hospital or social security numbers, or other personal or identifying information) of the patient must be removed. If their face is shown, use a black bar to cover their eyes so that they cannot be identified.

All lettering should be done professionally and should be in proportion to the drawing, graph, or photograph. Photomicrographs must include an internal scale marker, and the legend should state the type of specimen, original magnification, and stain.

Figures must be submitted as separate picture files at the correct resolution. The files should be named according to the figure number, e.g., “Fig1.tif”, “Fig2.jpg”.

Images of patients or research subjects should not be used unless the information is essential for scientific purposes and explicit permission has been given as part of the consent. Even where consent has been given, identifying details should be omitted if they are not essential.

If identifying characteristics are altered to protect anonymity, authors should provide assurances that such alterations do not distort scientific meaning.

Formats

Regardless of the application used, when your electronic artwork is finalized, please “save as” or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/half-tone combinations given below):

EPS: Vector drawings. Embed the font or save the text as “graphics”.

TIFF: Colour or grayscale photographs (halftones) — always use a minimum of 300 dpi (dots per inch).

TIFF: Bitmapped line drawings — use a minimum of 1000 dpi.

TIFF: Combination of bitmapped line/half-tone (colour or grayscale) — a minimum of 600 dpi.

Black-and-white artwork can be halftone (or grayscale) photographs, radiographs, drawings, line art, graphs, and flowcharts. FUJD/OJS will only accept digital artwork. For best results, line art should be black on a white background. Lines and types should be clean and evenly dark. Avoid screens or cross-hatching, as they can darken or be uneven in printing and lead to unacceptable printing quality. All colour artwork should be saved in CMYK, not RGB.

Please do not: Supply files that do not meet the resolution requirements detailed above; Supply files that are optimized for screen use (such as GIF, BMP, PICT, WPG) as the resolution is too low; Submit graphics that are disproportionately large for the content.

Lower resolutions (less than 300 dpi) and JPEG format (.jpg extension) for grayscale and colour artwork are strongly discouraged due to the poor quality they yield in printing, which requires 300 dpi resolution for sharp, clear, detailed images. JPEG format, by definition, is a lower resolution (compressed) format designed for quick upload on computer screens.

Arrows, asterisks, and arrowheads (or other markers) should be white in dark or black areas and black in light or white areas, and large. If not, these highlighting marks may become difficult to see when figures are reduced in size during the typesetting process. Use 1-point (or thicker) rules and leader lines. Capitalize the first word of each label and all proper nouns. Consider using all capitals if you need a higher level of labels. Where there are alternate terms or spellings for a named structure, use the most common one and make sure it is

consistent with what is used in the text. Avoid using multiple fonts and font sizes for the labels; use only one or two sizes of a serif font.

M. Acknowledgments

After the conclusion section, general acknowledgements for consultations and statistical analyses should be listed concisely, including the names of the individuals who were directly involved. Consent should be obtained from those individuals before their names are listed in this section. Those acknowledged should not include secretarial, clerical, or technical staff whose participation was limited to the performance of their normal duties.

N. Conflict of Interest

It is required that a list of disclosures from every named author is submitted alongside the manuscript. In it, each author should identify any financial or non-financial conflicts relevant to the article. If no conflicts exist, please state so in this section. Please see our editorial policy on conflicts of interest available on the Journals website.

O. Funding Disclosure

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P. Reference Guide

Foundation University Journal of Dentistry adheres to the Vancouver style of referencing for publication. Authors are responsible for the accuracy and completeness of their references and correct in-text citations. If massive corrections to the references are found to be necessary for the event that your manuscript is accepted, FUJD Editor reserves the right to rescind the accepted decision and reject the article.

- In the main text, tables, and figure legends, References should be indicated by superscripted numbers e.g.,¹ according to the order of appearance in the text and placed after punctuation. [The actual authors can be referred to, but the reference number(s) must always be given.]
- If you wish to cite two or more references together, place a comma between the numbers, e.g.,^{1,2}
- If you wish to cite a series of consecutive references use a dash, e.g.,²⁻⁵
- References are listed in numerical order, and in the same order in which they are cited in the text. The reference list appears at the end of the paper.

- In the reference list, Use Arabic numerals (1, 2, 3, 4, 5, 6, 7, 8, 9) for listing the references.
- References cited in tables or figure legends should be included in sequence at the point where the table or figure is first mentioned in the main text.
- Manuscripts accepted for publication may be cited and should include the manuscript’s DOI if known.
- Do not cite abstracts unless they are the only available reference to an important concept.
- Do not cite uncompleted work or work that has not yet been accepted for publication (i.e., “unpublished observation”, or “personal communication”) as references.
- Vancouver Style does not use the full journal name, only the commonly used abbreviation. Journal title abbreviations should be those used by the U.S. National Library of Medicine. If you are uncertain about the correct abbreviation for a journal title, please search for the journal at <https://www.ncbi.nlm.nih.gov/nlmcatalog>.
- If more than 1 author: give all authors’ names and separate each by a comma and space.
- For articles with 1 to 6 authors, list all authors. For articles with more than 6 authors, list the first 6 authors then add ‘et al.’
- Enter the author’s surname followed by no more than 2 initials (full stop).
- Book title, chapter, section title, and article – capitalize the first letter of the first word of the title, proper nouns, proper adjectives, and acronyms.
- Presented papers, unless they are subsequently published in proceedings or peer-reviewed journals, may not be cited as references.
- org may not be cited as a reference.
- For most manuscripts, authors should limit references to materials published in peer-reviewed professional journals.
- Also, the authors should verify all references against the original documents.
- The reference list is a numbered list and should be single-spaced with a one-line space between each entry.

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2. Foundation University Journal of Business & Economics (FUJBE) –
ISSN (Print): 2414-4770; ISSN-E: 2519-0172 (*HEC Recognized – “Y” Category*)
3. Foundation University Journal of Psychology (FUJP) – ISSN (Print): 2519-710X;
ISSN-E: 2520-4343 (*HEC Recognized – “Y” Category*)
4. Foundation University Journal of Engineering & Applied Sciences (FUJEAS) –
ISSN: 2706-7351 (*HEC Recognized – “Y” Category*)
5. Foundation University Journal of Rehabilitation Sciences (FUJRS) –
ISSN-P: 2709-5134; ISS-E: 2789-2700 (*HEC Recognized – “Y” Category*)
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