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Clinical and Radiographical Evaluation Fixed Bridge for Patients Previously Treated by Restorative Dentistry Board Students

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Abstract

Background and Objectives: Fixed partial dentures are commonly used in restorative dentistry to replace missing teeth, but their longevity can be compromised by biological, mechanical, and esthetic failures. This study aims to evaluate the prevalence and causes of failures in fixed partial dentures fabricated by trainees in the Restorative Dentistry Board to enhance educational outcomes and clinical practice.

Methods: A retrospective observational study design was employed at Shorish Dental Center, Sulaymaniyah, between September 2023 and March 2024, including 55 patients who received fixed partial dentures over the last five years. Clinical assessments and radiographs were used to identify failures, which were categorized into biological, mechanical, and esthetic types.

Results: The mean age of patients was 48.13 ± 11.34 years, with 60% female. Mechanical failures were the most common, occurring in 38.12% of cases, primarily due to loss of retention (12.7%) and bridge fractures (9.1%). Biological failures accounted for 25.4%, with gingival recession (7.3%) and periodontal disease (5.5%) being the main contributors. Esthetic failures represented 9.06%, with unacceptable color match (3.6%) and under-contoured margins (3.6%) as leading factors. Statistical significance was found in the correlation between porcelain fractures and patient dissatisfaction ($P \leq 0.003$), and between gingival recession and male patients ($P \leq 0.02$).

Conclusion: Mechanical factors, biological factors and Aesthetic issues were the main cause of failure in FPDs. Understanding these failure mechanisms can guide improvements in prosthesis design and trainee education.

Keywords: Clinical Competence, Dental, Fixed Partial Denture, Prosthodontics, Restorative Dentistry

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Introduction

Fixed partial dentures (FPDs), also known as fixed bridges, are dental restorations that replace missing teeth by attaching artificial teeth to adjacent natural teeth or dental implants.[1] These restorations are used to improve the function, appearance, and overall oral health of patients. FPDs are commonly used to replace one or more missing teeth and can be made from various materials such as porcelain fused to metal, zirconia, and glass ceramics.[2] Despite the advances in materials and techniques, fixed bridges are not exempt from failures. In FPDs, there are three main types of failures: biological failure, mechanical failure, and aesthetic failure.[3] Biologic failure occurs when the dental structure or surrounding tissue is affected, leading to issues such as caries, periodontal disease, or loss of vitality. Mechanical failure involves the structural integrity of the FPD, including fractures, chipping, or loss of retention.[4,5] Aesthetic failure refers to the appearance of the FPD, which may not meet the patient's expectations or cause discomfort due to unevenness or pressure points.[6] Research indicates that periapical involvement, caries, uncemented restorations, over-contoured restorations, inadequate occlusal planes, periodontal disease, failed post-retained crowns, poor aesthetics, crown perforations, and improper restoration margins can all be contributing factors to failure.[7] To fully understand the reasons for these failures, a comprehensive evaluation of fixed bridges treated by trainees is essential. The skill level of the practitioner is a critical factor in the success rate of FPDs. A study by Chansoria showed that the success rate of FPDs can be influenced by various factors including prosthesis design, material selection, patient-specific factors, and level of clinical expertise.[8] As such, it is necessary to identify the prevalence and types of failures associated specifically with FPDs fabricated by these individuals. According to a study by Kumar , having a solid knowledge of diagnostic and treatment techniques is the best approach to reducing the failures of fixed dental prostheses.[9] Therefore, the necessity of conducting the present study stems from the desire to enhance the educational outcomes and clinical practice of Restorative Dentistry Board trainees. Understanding the types and causes of FPD failures in treatments performed by these trainees can improve training programs, ultimately elevating the standard of patient care. This study aimed to systematically identify the prevalence, types, and causes of failures in FPDs made by Board of Restorative Dentistry students within a timeframe of one to five years post-treatment.

Patients and methods

This retrospective observational study was done between September 2023 and March 2024. The investigators engaged in a systematic review of patient records and direct clinical assessments at Shorish Dental Center, Sulaymaniyah, Iraq. The study population comprised all patients who received FPDs from Restorative Dentistry Board trainees one to five years prior to the study. Patients for the study were selected using a convenience sampling method. In total 55 patients who met the inclusion criteria and consented to participate. Patients included in the study were those fitted with FPDs, including fixed bridges, who provided informed consent. The exclusion criteria included patients with other systemic diseases that affected periodontal health, medications that caused dry mouth, as well as patients with disabilities or conditions like Parkinson's disease that could impede their ability to maintain regular oral hygiene. The data collection for this study was meticulously designed to capture detailed information on the prevalence, types, and causes of failures in FPDs fitted by Restorative Dentistry Board trainees. The

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radiography method used was Orthopantomograph (panoramic or OPG), which creates a wide view of the teeth, jaws, gums, and surrounding structures in a single image. In this method, the patient would stand in front of the X-ray machine and remain still for a few seconds while the machine rotated around their head, creating an image of all the teeth and jaws. The data collection sheet included demographic information such as gender and age, along with specific clinical details regarding the FPDs. Parameters recorded included the time of installation, number of units, type of materials used (PFM, Zirconia, Full Ceramic), location (anterior or posterior tooth), and pontic design (ridge lap, ovate, conical, hygienic, modified ridge lap). Further, the clinical examination focused on identifying various failures categorized into mechanical, esthetic, and biological issues. Each category comprised specific failure modes such as loss of retention, color mismatch, fracturing, caries, periodontal disease. The article was approved by Kurdistan higher Council of Medical Specialties KHCMS committee, all procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation. Informed consent was obtained from all participants. For data analysis, Statistical Package for Social sciences (SPSS version 23) were utilized. Descriptive statistics were used to determine the frequency and distribution of FPD failures. The mean and standard deviation (SD) were computed for the age distribution of patients and the lifespan of the prosthesis. Inferential statistics, such as chi-square tests, were employed to assess the association between failure types and various independent variables. A p-value of less than 0.05 was considered statistically significant.

Results

The study evaluated 55 patients who had received FPDs placed by restorative dentistry board students over the past five years. The prevalence and causes of failure in these dentures were examined. The patients' mean age was 48.127 ± 11.341 years, with 32 (58.2%) patients under 50 and 23 (41.8%) patients above 50. 33 (60%) of the patients were female, and 50 (90.9%) were satisfied with their FPDs. The time since the prosthesis installation was between 1-20 month for 19 (34.5%) patients, 21-40month for 31 (56.4%) patients and 41-60 month for five (9.1%) patients. This information is depicted in Table (1).

Table (1): Demographic Characteristics Participations in the Study

Characteristics		Frequency (%)
Age		48.127 ± 11.341*
Age group	≤ 50	32 (58.2%)
	> 50	23 (41.8%)
Sex	Male	22 (40%)
	Female	33 (60%)
Satisfy	Yes	50 (90.9%)
	No	5 (9.1%)
Time of installation of the prosthesis	1–20 month	19 (34.5%)
	21-40 month	31 (56.4%)
	41-60 month	5 (9.1%)

* Mean ± S

Clinical examinations are shown in Table (2). A short span was observed in 36 (65.5%) patients, and a long span in 16 (29.1%) patients. 27 (49.1%) patients had no units in the past 1-6 years. Regarding the type of material used in the prosthesis, 10 (18.2%) patients had Porcelain Fused to Metal (PFM), 39 (70.9%) had zirconia, and six (10.9%) had full ceramic. The location of the prosthesis was in the anterior tooth for 19 (34.5%) patients, the posterior tooth for 27 (49.1%) patients, and both for nine (16.4%) patients. An examination of the Pontic design variable among patients showed that two (3.6%) had an ovate design, two (3.6%) a conical design, six (10.9%) a hygienic design, and 45 (81.8%) a modified ridge lap design.

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Table (2): Clinical Examination Participants in the Study

Characteristics		Frequency (%)
Number of units	Short span	36 (65.5%)
	Long span	16 (29.1%)
	Both	3 (5.5%)
No unit	1-6 month	27 (49.1%)
	7-12 month	22 (40%)
	13-24 month	6 (10.9%)
Type of material	PFM	10 (18.2%)
	Zirconia	39 (70.9%)
	Full ceramic	6 (10.9%)
Location	Anterior tooth	19 (34.5%)
	Posterior tooth	27 (49.1%)
	Both	9 (16.4%)
Pontic design	Ridge lap	0
	Ovate	2 (3.6%)
	Conical	2 (3.6%)
	Hygienic	6 (10.9%)
	Modified ridge lap	45 (81.8%)

Results indicated that mechanical failures were responsible for 38.12% of prosthesis fractures, biological failures for 25.40%, and esthetic failures for 9.06%, Figure (2).

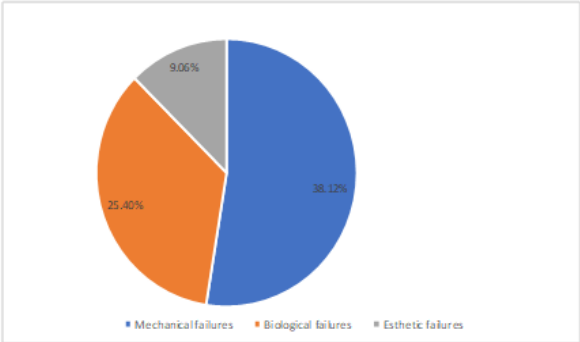

Figure (2): Pie Chart of Prosthesis Failure Factors

An analysis of mechanical failures in FPDs revealed that loss of retention occurred in seven (12.7%) patients, fracture of the bridge in five (9.1%), coronal tooth fracture in three (5.5%), and porcelain fracture in four (7.3%). Additionally, occlusal wear and perforation were each observed in one (1.8%) patient. Esthetic failures in FPDs showed unacceptable color match in two (3.6%) patients, over-contoured margin in one (1.8%) patient, and under-contoured margin in two (3.6%) patients. Investigating biological failures in FPDs indicated caries in two (3.6%) patients, periodontal disease in three (5.5%), occlusal problems in one (1.8%), gingival recession in four (7.3%), mobility of abutment in one (1.8%), food lodgment in 13 (1.8%) patients, and no cases of sinus opening, Table (3).

Table (3): Mechanical Failures, Esthetic Failures and Biological Failures of FPDs

Characteristics	Frequency (%)
Mechanical Failures	
Loss of retention	7 (12.7%) *
Fracture of bridge	5 (9.1%)
Coronal tooth fracture	3 (5.5%)
Porcelain fracture	4 (7.3%)
Occlusal wear	1 (1.8%)
Perforation	1 (1.8%)
Esthetic Failures	
Unacceptable color match	2 (3.6%)
Over contoured margin	1 (1.8%)
Under contoured margin	2 (3.6%)
Biological Failures	
Caries	2 (3.6%) *
Periodontal disease	3 (5.5%)
Occlusal problems	1 (1.8%)
Gingival recession	4 (7.3%)
Mobility of abutment	1 (1.8%)
Food Lodgement	3 (5.5%)
Sinus opening	0 (0)

*Frequency (%)

Radiographic findings showed no instances of carious lesions. One (1.8%) patient had a periapical lesion, one (1.8%) had bone loss, and three (5.5%) had inadequate root canal therapy (RCT), Table (4).

Table (4): Radiographic findings of FPDs

Characteristics	Frequency (%)
Carious lesions	None
Periapical lesion	1 (1.8%) *
Bone loss	1 (1.8%)
Inadequate Root Canal Therapy	3 (5.5%)

*Frequency (%)

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The relationship between sex and failure factors in FPDs across three domains (mechanical failures, esthetic failures, biological failures) was investigated. In the domain of biological failures, a significant association between gingival recession and sex was observed (P≤0.02), with four (18.2%) male patients experiencing gingival recession and no female patients reporting this condition. The relationship between satisfaction and failure factors in FPDs across the three domains was also examined. In the domain of mechanical failures, satisfaction was significantly correlated with porcelain fractures (P≤0.003); among those with porcelain fractures, two (40%) were dissatisfied with their prosthesis, and two (4%) were satisfied. The association between the time of prosthesis installation and failure factors in FPDs was analyzed. A significant correlation was found in the domain of mechanical failures, where the time of prosthesis installation was correlated with porcelain fractures (P≤0.020); among patients with porcelain fractures, two (6.5%) had the prosthesis installed for 21-40 years, and two (40%) for 41-60 years. The relationship between the number of units and failure factors in FPDs was examined across three domains: mechanical failures, esthetic failures, and biological failure. In the mechanical failure's domain, a significant correlation was observed between the number of units and the fracture of the bridge (P≤0.001). Specifically, among those who experienced a fracture of the bridge, a long span was present in three (18.8%) patients, and both long and short spans were noted in two (66.7%) patients. The association of the absence of units with failure factors in FPDs was analyzed across the domains of mechanical failures, esthetic failures, and biological failures. In the mechanical failure domain, the absence of units was significantly correlated with the fracture of the bridge (P≤0.002), where among those with bridge fractures, no units were reported in two (9.1%) patients aged 7-12 years and in three (50%) patients aged 13-24 years. In the biological failure domain, a notable correlation was found between gingival recession and the absence of units (P≤0.013). The radiographic outcomes also showed a significant difference between the absence of units and inadequate RCT (P≤0.013). The relationship of the type of material with failure factors in FPDs was investigated across mechanical failures, esthetic failures, and biological failures domains, as well as radiographic findings. No significant differences were observed between the type of material and failure factors in FPDs across these domains. The relationship of location with failure factors in FPDs was examined across the domains of mechanical failures, esthetic failures, and biological failures. In the mechanical failure domain, the location showed a significant correlation with the fracture of the bridge (P≤0.001), where among those with bridge fractures, the location was anterior in one (5.3%) patient and both anterior and posterior in four (44.4%) patients. The association of pontic design, specifically the ridge lap, with failure factors in FPDs was assessed across mechanical failures, esthetic failures, and biological failures domains, as well as radiographic findings. No significant differences were found between the ridge lap pontic design and failure factors in FPDs across these domains, Table (5).

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Table (5): Radiographic findings of FPDs

Characteristics		Failure factors in FPDs		P-value*
		Biological failures Gingival recession		
		Yes	No	
Sex	Male	4 (18.2%)	18 (81.2%)	0.02
	Female	0	33 (100%)	
		Mechanical failures Porcelain fractures		
		Yes	No	
Satisfaction	Dissatisfied	2 (40%)	3 (60%)	0.003
	Satisfied	2 (4%)	48 (96%)	
		Mechanical failures Porcelain fractures		
		Yes	No	
Time of prosthesis installation	21-40 years	2 (6.5%)	29 (93.5%)	0.020
	41-60 years	2 (40%)	3 (60%)	
		Mechanical failures fracture of the bridge		
		Yes	No	
Number of units	long span	3 (18.8%)	13 (81.2%)	0.001
	long and short spans	2 (66.7%)	1 (33.3%)	
		Mechanical failures fracture of the bridge		
		Yes	No	
Absence of units	Aged 7-12	2 (9.1%)	20 (90.9)	0.013
	Aged 13-24	3 (50%)	3 (50%)	
		Radiographic outcomes		
		Yes	No	0.013
Absence of units		2 (66.6%)	1 (33.4%)	
		Mechanical failures fracture of the bridge		
		Yes	No	
Location with failure	Anterior tooth	1 (5.3%)	18 (94.7%)	0.001
	Both	4 (44.4%)	5 (55.6%)	

*P-value Chi-square

Discussion

The current study aimed to identify the types, prevalence, and causes of failures in FPDs among 55 patients who received these restorations from dental students. The findings indicated that the majority of units were short span, and approximately 50% of patients had no unit over the past six years. The material most commonly used for the prostheses was zirconia, and the location was predominantly in the posterior teeth. The pontic design was most frequently a modified ridge lap. Mechanical factors were the main cause of failure in FPDs, with the most important mechanical factors being loss of retention and fracture. Biological factors of failure in FPDs included gingival recession and periodontal disease. Aesthetic issues of failure in FPDs included color matching and marginal contour. The study by Kalla examined 118 patients who had experienced fixed prosthesis failures to investigate the

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reasons for these failures. The most frequent mechanical factors causing prosthesis failure were, in order of occurrence, loss of retention, bridge fracture, coronal tooth fracture, porcelain fracture, perforation, and occlusal wear. Similarly, the most common biological factors were caries, periapical pathology, occlusal problems, mobility of abutment, sinus issues, and food lodgement.[10] Another study conducted by Zavanelli in Brazil included 62 patients over 18 years old who used fixed prostheses for treating toothlessness. This study evaluated patient satisfaction with FPDs, the incidence of fractures, and clinical complications after one year. The most frequent mechanical factors leading to prosthesis failure were prosthesis loosening, ceramic fracture, and abutment tooth fracture. The study indicated that biological failures were observed in 30.65% of the prosthesis fracture cases, The biological factors contributing to the most failures were gingival recession, periodontal pockets, support periodontal involvement, and recurrent caries.[11] Studies from Switzerland, Spain, and Germany, also reported similar findings to the current study.[12-14] Prosthesis failures can occur for various reasons during the treatment process and long after treatment has been completed. Chandranaik's study investigated the cause of failure in patients with failed fixed partial dentures. The main causes were mechanical issues such as loss of retention and porcelain fracture, biological factors such as caries, and aesthetic problems such as color and margin mismatch.[15] Dental prosthetics replace missing teeth and prevent the negative consequences of tooth loss while protecting damaged teeth.[16] These prosthetics are tasked with restoring the aesthetics and health of the oral cavity and modifying the smile design.[17] Additionally, they address internal oral defects such as the loss of oral tissue, including jaw and palate.[18] fixed dental prostheses, due to their ability to evenly distribute pressure across the jaw and teeth, aid in maintaining oral health. These prostheses can prevent the resorption of the jaw bone and contribute to the even distribution of chewing forces.[19] Losing one or several teeth can cause adjacent teeth to shift gradually over time. If unaddressed, the space created leads to a change in the position of the teeth, causing surrounding teeth to move to fill the space. This situation underscores the importance of treatment with dental prostheses.[20] The use of PDs is recognized as a prevalent method for addressing tooth loss and replacing missing teeth.[21] Given the increasing demand for fixed prostheses, it is imperative to pay closer attention to the factors that lead to prosthesis failure and disrupt the prosthesis usage process. Additionally, the manufacturing techniques of the prostheses and the individual aspects of the user are significant considerations.[9] Zirconia was the most common material, and a modified ridge was commonly used as the pontic design. The prosthesis material used was zirconia can provide good durability and be suitable for prosthesis fabrication.[22] Pontiac design chosen for its aesthetic appeal and functional use during eating, also reported the modified ridge lap as a common pontic design.[23] The most prevalent issues in prosthesis failure may be attributed to restoration and prosthesis design, clinical execution, and patient factors, which should be considered when following up and intervening to increase treatment success.[24]

Conclusions

The study found that mechanical problems like bridge fractures and retention loss were the main reasons for failures in fixed partial dentures (FPDs), followed by biological issues such as gum recession and food getting stuck. Aesthetic issues, particularly color matching, also played a role in failure rates. However, most patients were happy with their FPDs despite these challenges,

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showing positive overall results. This highlights the importance of continual learning and improvement in dental techniques to make prosthetics more durable and aesthetically pleasing.

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Conflict of interest

The authors declare no conflict of interest regarding the publication of this study.

References

1. Paquette JM, Wu JC, Sheets CG, Stewart DL. Replacing missing teeth with fixed partial dentures. In: Goldstein RE, editor. Esthetics in Dentistry. 3rd ed. Hoboken: Wiley; 2018:541-78. doi:10.1002/9781119272946.ch17/
2. Hinz S, Bensel T, Bömicke W, Henningsen A, Rudolph J, Boeckler AF. Impact of the veneering technique and framework material on the failure loads of all-ceramic CAD/CAM fixed partial dentures. Mater (Basel). 2022;15(3):756. doi: 10.3390/ma15030756/
3. Afridi S, Khan S, Raza M, Khan A, Khan H, Zubair N. Frequency of various grades of failure and their number of units involved in non-maintained metal ceramic fixed dental prosthesis. Pak J Health Sci. 2022;3(5):120-3. doi: 10.54393/pjhs. v3i05.205/
4. Borg P, Puryer J, McNally L, O'Sullivan D. The overall survival, complication-free survival, and related complications of combined tooth-implant fixed partial dentures: A literature review. Dent J (Basel). 2016;4(2):15. doi: 10.3390/dj4020015/
5. Dewan H, Haroon TM, Mogla S, Gupta A, Loganathan J, Ahammed AN, et al. Assessment of failure rate of fixed partial dentures: A clinical study. J Pharm Bioall Sci. 2022;14(1). doi: 10.4103/jpbs.jpbs_718_21/
6. Susaniawaty Y, Dharmautama M. Esthetic failure in fixed partial dentures. J Dentomaxillofac Sci. 2016;1(1):161. doi: 10.15562/jdmfs. v1i1.100/
7. Singh RK, Sengupta C, Anjum S, Joseph JK, Farheen E. Clinical failure and its management in fixed partial denture: A systemic review. Int J Dent Sci Innov Res. 2020;3(4):245-52.
8. Chansoria S, Chansoria H. Abutment selection in fixed partial denture. J Dent Med Sci. 2018;17(3):4-12. doi: 10.9790/0853-1703010412/
9. Kumar A, Thakur R, Sharma P. Fixed partial denture failures: A review of classification. J Adv Med Dent Sci Res. 2021;9(5):82-5. doi: 10.21276/jamdsr/
10. Kalla K, Raman R, Kumar AS, Kaushal P, Anto N, Jain R. Evaluation of causes of failures of FPDs. J Adv Med Dent Sci Res. 2020;8(12):31-4. doi: 10.21276/jamdsr/
11. Zavanelli A, Mazaro J, Nóbrega P, Falcón-Antenucci R, Zavanelli R. Data collection about failures in fixed partial dentures: 1-year monitoring. RGO Rev Gaúch Odontol. 2018; 66:250-6. doi: 10.1590/1981-86372018000300093313/
12. Sailer I, Feher A, Filser F, Lüthy H, Gauckler LJ, Schärer P, et al. Prospective clinical study of zirconia posterior fixed partial dentures: 3-year follow-up. Quintessence Int. 2006;37(9):685-93.
13. Agustín-Panadero R, Serra-Pastor B, Loi I, Suárez MJ, Pelaez J, Solá-Ruíz F. Clinical behavior of posterior fixed partial dentures with a biologically oriented preparation technique: A 5-year randomized controlled clinical trial. J Prosthet Dent. 2021;125(6):870-6. doi: 10.1016/j.prosdent.2020.03.031/
14. Matta R-E, Eitner S, Stelzer SP, Reich S, Wichmann M, Berger L. Ten-year clinical performance of zirconia posterior

fixed partial dentures. J Oral Rehabil. 2022;49(1):71-80. doi: 10.1111/joor.13276/
15. Chandranaik M, Thippanna R. Fixed partial denture failures: A clinical survey for evaluation of the factors responsible. CODS J Dent. 2017;9(1):41-5. doi: 10.5005/jp-journals-10063-0031/
16. Alshehri MD, Alqahtani WM, Asiri EM, Asiri MN. Awareness of the consequences of teeth missing and prosthodontics treatment options among people of Aseer region, Saudi Arabia. J Family Med Prim Care. 2021;10(1):307-11. doi: 10.4103/jfmpc.jfmpc_1621_20/
17. Bulancea B, Costin L, Cioloca CH, Budala DG, Vasluianu RI, Cretu C, et al. Restoring the aesthetic function in oral rehabilitation. Rom J Med Dent Educ. 2024;13(1):38-44.
18. Sadr-Eshkevari P, Flint RL, Alpert B. An overview of maxillofacial approaches to smile design. Dent Clin North Am. 2022;66(3):343-60. doi: 10.1016/j.cden.2022.02.001/
19. Sindhusha VB, Rajasekar A. Assessment of clinical and patient-centered outcomes in nonsurgical periodontal therapy. Cureus. 2024;16(3). doi: 10.7759/cureus.56464/
20. Rosalen NP, Muniz FWMG, Scalco NR, Dezingrini Kd, Colussi EL, Pires AL, et al. What variables are associated with use of and need for dental prosthesis? A cross-sectional study. Gerodontology. 2022;39(2):177-86. doi: 10.1111/ger.12552/
21. Saikia UP, Chander NG, Balasubramanian M. Effect of fixed dental prosthesis on the brain functions of partially edentulous patients: Pilot study with power spectrum density analysis. Eur Oral Res. 2020;54(3):114-8. doi: 10.26650/eor.20200032/
22. Hajjaj MS, Alamoudi RA, Babeer WA, Rizg WY, Basalah AA, Alzahrani SJ, et al. Flexural strength, flexural modulus and microhardness of milled vs. fused deposition modeling printed zirconia; effect of conventional vs. speed sintering. BMC Oral Health. 2024;24(1):38. doi: 10.1186/s12903-023-03829-8/
23. Udhayaraja P, Ariga P, Jain AR. Awareness on pontic design among general dental practitioners: A knowledge, attitude, and practice survey. Drug Invent Today. 2018;10(6):860.
24. Briggs P, Ray-Chaudhuri A, Shah K. Avoiding and managing the failure of conventional crowns and bridges. Dent Update. 2012;39(2):78-86. doi: 10.12968/denu.2012.39.2.78/