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ORIGINAL ARTICLE

Severity of Failure of Conventional Tooth-Supported Fixed Dental Prostheses at a Tertiary Care Dental Hospital

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ABSTRACT

Objective: To determine the severity of failure of conventional tooth supported fixed dental prostheses (FPD) in patients reporting to a tertiary care dental hospital.

Methodology: A cross-sectional study was conducted at the Department of Prosthodontics, Foundation University College of Dentistry, Foundation University, Islamabad, Pakistan, from July 2025 to January 2026 using a non-probability consecutive sampling technique. A sample of 150 participants that fulfilled the inclusion and exclusion criteria was included. Demographic and prostheses related information including location of prostheses, type of prostheses, material of prostheses, duration of time the prostheses were employed and class of severity of failure were transferred to the proformas. The data was entered and analyzed in SPSS Statistics version 21.

Results: The mean age of the participants was 47.82 ± 15.188 years; 123 participants were females and 27 were males. 14% of the participants displayed class I level of failures, 4% class II, 7% class III, 33% class IV, 15% class V and 27% class VI. Most commonly involved site was the maxillary posterior region; the most commonly failed prostheses were long-span PFM FDPs that exceeded 5 years of employment.

Conclusion: Tooth supported-FPD provide one of the most durable treatment approaches for missing teeth. However, with the duration of their service, the tooth-supported FPD get vulnerable to biological as well as mechanical complications. Appropriate case selection, meticulous treatment planning, and regular follow-up are essential to minimize complications and enhance prosthesis longevity.

Keywords: Crown, Dental abutment, Dental prosthesis failure, Metal-ceramic restorations, Prosthesis removal

Authors' Contribution:
[1,2]Conception; Literature research; manuscript design and drafting; [3,4]Critical analysis and manuscript review; [5,6]Data analysis; Manuscript Editing.

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Introduction

Failures in fixed prosthodontics can present significant diagnostic and therapeutic challenges due to their multifactorial and often complex nature. Identifying the precise cause of failure is rarely straightforward, as it typically involves a combination of mechanical, biological, and aesthetic factors.[1] Although modern advancements in dental materials have led to the development of more durable and resilient restorative options,[2] fixed prostheses are still susceptible to failure over time, necessitating repair, removal, or complete replacement.[3] A wide range of factors may contribute to the failure of these restorations.[4] Mechanical failures are among the most common, including issues such as the loss of retention, fracture of the prosthesis itself, or damage to the

abutment tooth that supports the restoration. Biological failures can also compromise the success of fixed prostheses, with causes including the development of recurrent caries, pulp necrosis leading to devitalization of abutment teeth, and the onset of periodontal disease. Aesthetic failures may also warrant intervention, especially in anterior regions of the mouth, and can include visible cracks, fractures, excessive wear, or discoloration that affects the patient's satisfaction with their appearance. [5]

Various classifications for the causes of fixed prosthodontic failure have been proposed in the literature, highlighting the breadth and complexity of these issues.[6] A comprehensive review of these classifications and contributing factors has been conducted by Raghavan et al[7], underscoring the importance of a thorough diagnostic approach and individualized treatment planning to ensure long-term clinical success of fixed prostheses. John J. Manappallil[8] classified fixed dental prostheses failure based on severity of failure and the type and extent of intervention required to manage it. This classification has been shown in **Table-I.**

Dental literature is teemed with incidences of failure and complications related to fixed prosthodontics, including clinical studies on long-term survival of crowns and fixed partial dentures and causes of their deterioration. Studies have shown that periodontal diseases, caries, abutment fractures, periapical lesions, pain, and discomfort were the most often cited causes of failure.[9] According to local research, the majority of fixed dental prosthesis failures were caused by biological factors, such as recurrent caries, pulpal diseases or devitalization of abutment teeth, and/or periodontal issues. Furthermore, because the bulk of failures occurred in the posterior region, it was discovered that the position of the prostheses had a significant influence on their failure rate.[10] In a study conducted by Kavaz et al[11] on failures of fixed dental prostheses, utilizing Manapallil's classification of prostheses failure, it was noted that most patients (n=21 patients, 23.3%) were categorized in Class III whereas Class I and II failures showed the least number of patients (n=9 patients, 10% in each group). 18 patients (20%) exhibited Class IV, 13 patients (14.4 %) exhibited Class V and 20 patients (22%) exhibited Class VI.

The rationale of this study is to evaluate the patterns, causes, and severity of failures in fixed dental prostheses in order to improve diagnosis, treatment planning, and long-term treatment outcomes.

Table I: Manappallil's grading of failure based on severity

Class	Description
Class I	Failure can be resolved without replacing the prosthetic restoration
Class II	Failure can be resolved without replacing the prosthetic restoration; however, repair or restoration of the abutment tooth structure is needed.
Class III	Failure can only be solved by replacing the prosthetic restoration; there is no need for repair or restoration of the abutment tooth structure.
Class IV	Failure can only be resolved by replacing the prosthetic restoration; the abutment tooth structure needs repair or restoration.
Class V	Failure cannot be solved by simply replacing the prosthetic restoration; however, fixed prosthetic treatment can be performed by adding abutment teeth or planning a new prosthesis.
Class VI	Failure cannot be achieved by changing the prosthetic restoration, adding an abutment or planning a new prosthesis, and fixed prosthetic treatment is not possible.

Methodology

The study was carried out in the Department of Prosthodontics of Foundation University College of Dentistry in a period of 6 months starting from July 2nd, 2025 to January 2nd, 2026. The sample size was calculated using WHO calculator formula 1.1. Keeping the confidence level at 95% and margin of error at 5%, the sample size was calculated to be 139 to detect Class 1 failure among 10% of the patients (population proportion: 10%)[8]. For the purpose of this study, sample of 150 prostheses will be

considered. Non-probability, consecutive sampling technique was used to include patients in the study. Patients of both genders between the ages of 20 and 70 years who reported to the OPD of FUCD&H in the Department of Prosthodontics with problems pertaining to their crowns or fixed partial dentures (FPD) were selected for the study after obtaining their consent. Patients who were unable to understand the questions being asked in either Urdu or English, mentally impaired individuals including psychiatric and syndromic patients, and patients categorized as exacting or hysterical according to M. M. House Mental Classification[12] were also excluded from the study. All required information was entered in an organized manner that included the demographic characteristics of the patient such as age and gender. After an intraoral examination, the dental history, location of prostheses (maxillary anterior, maxillary posterior, maxillary anterior-posterior, mandibular anterior, mandibular posterior or mandibular anterior posterior), the type of prosthesis used by the patients (single unit, 2 unit cantilever, 3-unit FPD, more than 3 units FDP), the prosthesis material (all metal, PFM, zirconia) and the duration of time the prostheses were employed (less than 1 year, 1- 5 years, more than 5 years) were established. After thorough examination by the principal investigator, the cause of failure and the consequent required treatment plan was determined. The failure classification of the prosthetic restorations was made using Manappallil's[8] grading of failure based on severity.

SPSS version 22 was used for data entry and analysis. Descriptive statistics were calculated for both qualitative and quantitative variables. Frequency and percentage for qualitative variables such as gender, type of prostheses, location of prosthesis and severity of prosthesis failure were calculated. Mean and standard deviation for quantitative variables such as age and duration the prosthesis was used were calculated. Effect modifiers and confounders such as gender, age, location of prostheses, type of prostheses and duration of employment of prostheses were stratified using post-stratified Chi-Square Test. P value less than 0.05 was considered significant.

Ethical approval of the study was taken from Foundation University College of Dentistry, Foundation University Islamabad, (FF/FUCD/632/ERC/79 dated. 14 May, 2024)

Results

Out of 150 people that participated in the study, 24 were between the ages 18 – 30 years, 94 were between 31- 60 years and 32 were above 61 years of age. The mean age of the participants came out to be 47.82 ± 15.188 years. 123 participants were females and 27 were males. Frequencies and percentages of tooth-supported fixed dental prostheses failures, according to Manappallil's classification are shown in **figure I**. Significant association was found between age groups and class of failure, with a p value of 0.02 whereas no significant association was found between gender and Class of failure using chi square test with this p value of 0.228.

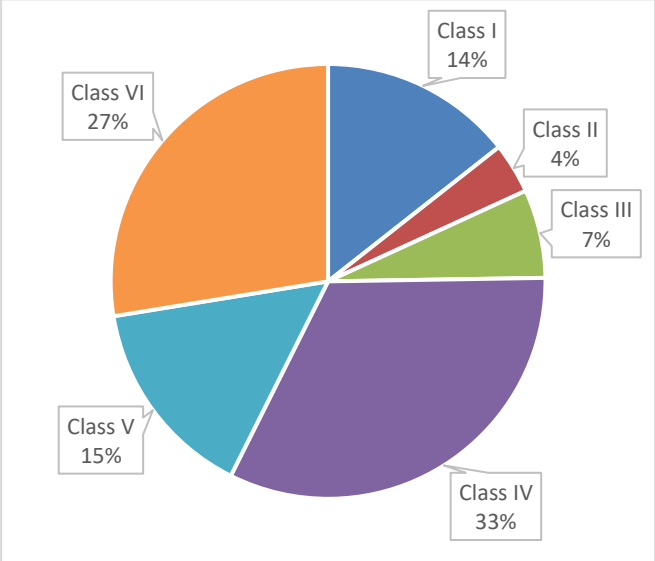

Figure 1: Percentage distribution according to Manapallil's Classification of Failure

With respect to location of the failed prostheses in the maxillary and mandibular arches, the most

common prosthesis locations were the maxillary posterior region (22.7%) and the mandibular posterior region (22.0%), followed by maxillary anterior–posterior region (18.0%), mandibular anterior–posterior region (16.7%), maxillary anterior region (10.7%) and mandibular anterior region (10.0%). The maxillary anterior region displayed the majority of class I failure; maxillary posterior region, Class VI; maxillary anterior- posterior, Class V; mandibular anterior and mandibular posterior, Class IV and mandibular anterior- posterior, Class IV and VI. Chi- Square test revealed that there was a significant association (p<.001) between the location of prostheses and the class of failure.

This study revealed that 37 (24.7%) failed prostheses were single unit crowns, most of which displayed Class VI level of failure; 5 (3.3%) were 2-unit cantilever prostheses showing the majority of class I level failure; 25 (16.7%) were 3-unit fixed dental prostheses (FDP), which mostly exhibited class IV level failure; and 83 (55.3%) were more than 3-unit FDPs, and they predominantly displayed Class IV level failure. Pearson's Chi Square test showed that the number of units of the prostheses had a significant association with Class of failure (p< .001). In terms of duration of time the prostheses were in use, 31 (20.7%) had prostheses in use for less than 1 year and they exhibited predominantly Class IV level of failure. 45 (30.0%) had prostheses in use for 1–5 years and they displayed a majority of class I failure. 74 (49.3%) had prostheses in use for more than 5 years, which showed mostly of Class VI failure. Statistical analysis revealed a significant association between duration of service and class of failure of prostheses with a p value less than .001.

Out of 150 cases assessed, 140 cases (93.3%) failed prostheses were porcelain-fused-to-metal (PFM) prostheses, while 10 (6.7%) were zirconia prostheses. The majority of the PFM prostheses exhibited class VI failure and majority of the Zirconia prostheses, Class IV failure. Pearson's Chi Square test showed that the material of the prostheses had a significant association (p=.010) with class of failure.

Discussion

This study evaluated failed tooth supported dental prosthesis among 150 participants, majority of whom belonged to 31 – 60 years age group. The most common class of failure seen in the middle age group was class IV as they required restoration of abutment teeth as well as replacement of the prostheses. The possible reasons for that maybe excessive occlusal forces, prolonged use of the prosthesis, inability or amotivation to maintain oral hygiene and age-related changes in oral conditions. Moreover, the patients are more likely to seek professional help with their existing prostheses when the prostheses exhibit problems interfering with routine functions as with Class IV failure. This has demonstrated by Hawthan et al[13] in 2023 in a long-term retrospective clinical study of tooth-supported fixed partial dentures.

A vast majority (82%) of the participants of this study were females and only 18% were male. It should be noted that both men and women showed a prevalence of Class IV failure by Manappallil's classification. This has also been demonstrated by Dewan et al[9]. Gender of the patients does not have statistically significantly association with the level of prosthesis failure.

It was observed that the most common level of failure was Class IV according to Manappallil's failure classification. This indicates that the majority of failed prostheses required both remaking of the prosthesis and restoration of the abutment. Possible reasons for this may include recurrent caries beneath the retainer and endodontic failure of the abutments. This was followed by Class V and Class VI levels of failure, indicating more severe deterioration, which required the addition of abutment teeth, planning of a new prosthesis, or resulted in the inability to design a new fixed dental prosthesis. These finding were not consistent with

the findings of Kavaz et al[11], who demonstrated in his study that majority of the failed prosthesis were class III, followed by class VI. In 2023, Raghavan et al[7] describes that most common causes of tooth supported prostheses failure were biological in nature that mainly included recurrent dental caries, pulpal and periapical pathologies, root caries, periodontal disease and gingival inflammation.

This study showed that PFM FPDs were most commonly seen within the failed prostheses, which is coincidental with the finding by Naz et al[10]. Possible reasons for that might be, its inherent risk of porcelain chipping, more tooth preparation required which renders the abutments structurally compromised, frequent requirement of abutments to undergo root canal treatment, compromised esthetics due to the metal substructure or gingival darkening and the possibility of metal allergies. Moreover, as opposed to Zirconia, the accuracy of fit of PFM protheses is dependent on the technical expertise of the laboratory technician.

Failures that occurred within the period of 1 year were mostly class IV, which showed that early complications included biological failures as well as biomechanical failures, including recurrent caries, pulpal pathologies and prosthetic failures. Failures that occurred within 1-5 years showed a majority of class I failure, which included minor occlusal discrepancies requiring occlusal adjustment, food impactions caused by minor contour discrepancies, dislodged prostheses that were recemented and minor aesthetic complications like porcelain chipping. This has also been shown by Alqarawi et al[14] in a literature review that identifies that porcelain chipping and ceramic fractures as among the most frequent technical complications associated with fixed dental prostheses. Most of the prostheses experienced failure after being in service for approximately 5 years, majority of whom exhibited class VI failure, demonstrating that following removal of the prostheses, fabrication of a new tooth- supported fixed partial denture was no longer possible.

A majority of the single unit crowns suffered class IV level of failure after 5 years of service. The possible reasons for that include loss of retention due to inadequate tooth preparation, short clinical crowns, insufficient taper, fracture of the crowned tooth or root because all occlusal forces are concentrated on a single abutment. This finding can be supported by recent literature discussing loss of retention, inadequate tooth preparation geometry, short clinical crowns, and fracture of abutment teeth under concentrated occlusal forces.[15] Most of the 2-unit cantilevers displayed Class I level of failure within the 1st year of employment while most of the 3- unit FDPs showed class IV level of failure within 1 to 5 years of employment. A study by Alenezi et al[16] showed that short-span prostheses demonstrated comparatively fewer technical complications than long-span prostheses, while long-span FDPs were associated with greater complication rates after long-term service. Common complications included porcelain chipping and loss of retention. Vast majority of the patients showed class VI level of failure after 5 years of use. These finding are concurrent with the finding of Alsterstål-Englund et al[17] who reported that long-term tooth-supported fixed dental prostheses commonly develop severe biologic complications such as caries, endodontic failure, abutment loss, and root fractures after 5–10 years of service, which may render further conventional FDP replacement impossible. This corresponds clinically to advanced failures such as Manappallil's Class VI failure.

In terms of location of the prostheses in the arches, maxillary anterior region showed a majority of Class I level of failure, that mostly included minor cosmetic considerations such porcelain chipping, food impactions brought on by minor contour discrepancies, dislodged prostheses that were recemented, and minor occlusal discrepancies that needed occlusal correction. Porcelain chipping is a common technical complication, as reported in the systematic review by Laumbacher et al[18]. The majority of FDP failures occurred in the maxillary

posterior region, among which Class VI was the most common type of failure. The second most common region showing failure was the mandibular posterior region, with the majority of cases demonstrating Class IV failure. Recent study by Alsalhi et al[19], suggests that fixed dental prostheses in the posterior region are more prone to failure due to higher functional demands. This is mainly because they are subjected to greater occlusal forces owing to their proximity to the temporomandibular joint, have broader occlusal tables that increase load distribution, and experience cumulative fatigue-related stress over time. Maxillary anterior-posterior region exhibited a majority of class V level of failure, Mandibular anterior region, class IV and mandibular anterior- posterior region class IV and VI level of failures. There were multitude of reasons behind these failures most of which have been described for the remaining 3 regions as mentioned earlier.

This study evaluated the severity of failure according to Manapallil's classification without taking into consideration factors like, opposing dentition, occlusal schemes, operator's experience, patient's oral hygiene status, smoking or parafunction habits. One of the limitations of this study, is the predominance of female participants, which is likely due to hospital policies of offering treatment at subsidized rates to the families of employees of the organization. Moreover, the sample largely included PFM FPDs, mostly because it is the most commonly prescribed material for FPDs due to its low cost. Therefore, the sample may not accurately reflect the characteristics of the general population. Another limitation of this study is the employment of non-probability consecutive sampling technique which may have introduced selection bias and limited the representativeness of the sample. Thus, the sample might not be true representative of the population.

Conclusion

Tooth supported fixed partial prostheses provide one of the most durable treatment approaches for missing teeth. However, with duration of their service, the tooth supported fixed dental prostheses get vulnerable to biological as well as mechanical complications. Long plan FPDs, that extended to the posterior regions and that had a duration of employment greater than 5 years were associated with failures. Appropriate case selection, meticulous treatment planning, and regular follow-up are essential to minimize complications and enhance prosthesis longevity.

Recommendations: Keeping in mind the findings of this study, the patients should be educated about regular dental follow-ups so that early detection and managements of recurrent caries, pulpal pathologies, periodontal disease and abutment mobility can be done. Long-span bridges should be avoided because they are associated with high risk of biological and mechanical complications. Judicious use of materials as and when indicated should be preferred over personal conveniences.

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