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Original article

Analyzing the Major Failures and Key Risks Linked to Dental Fixed Prostheses: *An in Vivo Clinical Study*

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ABSTRACT

This clinical investigation aimed to identify factors leading to fixed partial denture failures and their implications, crucial for enhancing clinical outcomes. Conducted in Tripoli, Libya, with 75 patients contributing 235 units, the study utilized John F. Johnston's and John J. Manappallil's classifications to categorize failure causes. Mechanical issues, predominantly in female patients, were identified as the primary cause of dental bridge failure, particularly in porcelain fused to metal (PFM) bridges with a "Fixed-Fixed" design, mostly in the upper jaw. The study underscores the importance of a multifactorial approach in preventing and managing fixed partial denture failures, emphasizing meticulous prosthesis design, manufacturing, and placement, alongside patient selection, diagnosis, treatment planning, and oral hygiene education.

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INTRODUCTION

Restoring lost teeth to meet functional demands is a major goal for dentists. For what it has a beneficial impact on the aesthetic, mastication as well as the occlusion [1,2]. Fixed prosthodontics offers a solution by allowing the replacement of missing teeth with restorations that are permanently fixed in the mouth. Understanding the potential complications associated with dental bridges in fixed prosthodontics is critical for clinicians. This understanding enhances their ability to conduct a comprehensive diagnosis, devise optimal treatment plans, set realistic patient expectations, and plan post-treatment care intervals effectively [3,4]. While there is accessible literature on clinical complications like bridge failure, there is a lack of comprehensive comparisons regarding the complications related to commonly used restorations and prostheses. Addressing this gap in research can provide valuable insights for clinicians in selecting the most suitable treatment options for patients [5].

Crowns/fixed dental prostheses are frequently requested due to their lower cost compared to the more expensive implants. Along with the increasing demand for fixed prostheses, failures are prevalent [6]. Therefore, it is essential to evaluate the success and survival rates of these manufactured restorations, as well as the causes and types of problems and failures associated with them. Understanding these factors can enable clinicians to select the most appropriate therapy for patients with fixed prostheses, set realistic expectations, and develop an effective maintenance regimen [7,8]. Failures in fixed dental prostheses can be categorized into three groups according to John. F. Johnston classification (1986) [9]: biological, mechanical, and esthetic. Biological failures involve various problems related to the health of the surrounding tissues and teeth, such as endodontic complications, periodontal diseases, gingivitis, secondary caries, tooth mobility, poor oral hygiene, root resorption, pain, swelling, bone resorption, abscess formation, food impaction, and periodontal pocketing. Mechanical failures, however, are associated with the structural soundness and proper function of the fixed dental prostheses, which may manifest as dislodged prostheses, improper dental preparation, and fractures

of the abutment, prosthesis. Esthetic failures are related to the appearance of the fixed dental prostheses and may present as mismatched shades and discrepancies in contour [5,7]. By taking these factors into account, clinicians can provide high-quality care to patients with fixed prostheses and ensure their long-term success [3,4,8,10].

The main advantages of John J. Manappallil's categorization technique (2008) is simple, practical, and applicable to all fixed dental prostheses failure cases. The system recognizes failure based on its severity and examines standard retreatment possibilities. Failure was classified accordingly. Failures can be grouped into 6 categories according to classification of "John J. Manappallil", with the severity ranging from Class I to Class VI [10]. However, classification categories do not indicate the actual cause of failure, which is considered a disadvantage. While this knowledge would be practical, the causes of failure are multifactorial, and identifying a single cause may reveal complex conditions underlying the assessment of failure. But it is still comprehensive and easy to apply, hence, suggested for studies and surveys on fixed prosthodontics failure [3].

Several meta-analyses have been conducted to consolidate the results of diverse studies and evaluate the success and longevity of fixed prostheses [8,10,11]. Scurria et al. found that fixed prostheses were anticipated to exhibit a survival rate of 92% at 10 years and 75% at 15 years when failure was defined as the removal of the prosthesis. However, these rates decreased to 87% at 10 years and 69% at 15 years when failure was defined as prosthesis removal and/or technical failure necessitating replacement [11]. The assessment of fixed dental prostheses lacks robust support from existing data. Limited research focusing on fixed partial dentures has revealed survival rates of 80% after 8 to 14 years in service, decreasing to 65% after 14 to 20 years. Over time, there is a notable increase in the failure rate. Specifically, at the 15-year mark, the anticipated survival rate for fixed partial dentures stands at 85% [12].

The incidence of edentulism has been employed as a metric to assess the effectiveness of oral health care systems and to reflect the oral health status of a population [13]. This metric has been tracked in various countries for an extended period [13,14,15]. Notably, the rate of edentulism has decreased significantly in Western nations, a trend that can be at least partially attributed to enhanced oral health services [16]. This trend is also reflected in the rising need for fixed dental prostheses and crowns in dental practice, as patients recognize the importance of maintaining good oral health. The growing awareness of the significance of oral health and the desire to maintain a natural-looking smile have contributed to the increased willingness of patients to undergo expensive fixed dental prosthesis procedures [12]. However, the prevalence of edentulism remains high in certain other countries [16,17,18]. Given the global aging trend, an increase in the number of edentulous individuals is anticipated [19].

Issues with fixed prostheses such as problems with retention, caries, root canal issues, periodontal diseases, tooth or porcelain breakage, and unsatisfactory appearance are common [11, 20, 21, 22]. These complications can have a significant impact on oral health, particularly in regions where the prevalence of missing teeth is higher [23, 24], which is why understanding the variations in edentulism rates across different parts of the world is crucial for developing effective treatment strategies [25].

Tooth fracture is recognized as the primary reason for failure in fixed dental prostheses, emphasizing its crucial role in their durability and efficacy. Moreover, dental decay has been pinpointed as another notable factor influencing the failure of fixed partial dentures. Furthermore, as periodontal deterioration progresses, there is a substantial increase in the failure rate, underscoring the vital importance of periodontal health in the effectiveness and longevity of fixed dental prostheses [26].

A clinical investigation discovered that 75% of the margins of individual crowns and fixed dental prostheses exhibited defects, suggesting a substantial concern regarding the quality of these restorations. Moreover, a statistically significant link was established between fixed dental prostheses and gingival inflammation, irrespective of the prosthesis's condition. This correlation can result in heightened inflammation and the potential infiltration of bacteria and their by-products, which may inflict considerable harm on the pulp. This research has demonstrated that the failure of crowns and fixed dental prostheses is frequently associated with caries [27]. Furthermore, a quantitative study conducted by Felton et al. established a connection between discrepancies in the prosthesis's margins and periodontal inflammation, underscoring the critical significance of appropriate margin adaptation in fixed dental prostheses [28].

The primary objective of this research is to explore the multifaceted factors contributing to the failure of dental bridges within the city setting of Tripoli. This study seeks to ascertain the prevalence of dental bridge failures within the demographic of Libyan dental patients in Tripoli, with a specific focus on comparing the incidence rates between single and multiple-unit fixed partial dentures. Furthermore, the research aims to conduct a comprehensive evaluation of the diverse types of fixed dental prostheses used in dental care within the Libyan context and their correlation with various influencing factors among the local dental patient population. By shedding light on the causes and classifications of failures associated with dental bridges, this study endeavors to offer valuable insights that can enhance clinical practices and ultimately elevate patient outcomes in the field of dentistry.

METHODS

The study design was cross-sectional, and it was conducted in three dental care centers in Tripoli city, spanning from August 2023 to February 2024. The study population included all patients who had fixed dental prostheses and received no regular maintenance after their insertion at the dental clinic. Patients with post and core, direct restorations, implants and removable dental prosthetics, were excluded. The final sample consisted of 75 patients, contributing a total of 235 units of fixed dental prostheses. The cross-sectional design allowed for a comprehensive assessment of the study population at a single point in time, providing valuable perceptions into the prevalence and types of fixed dental prosthesis failures in this population.

The research employed the classification systems of John F. Johnston and John J. Manappallil to classify failures in dental bridges. John F. Johnston's classification system categorizes bridge failures based on underlying causes, whereas the Manappallil classification system for fixed partial denture failures describes six classes according to the severity of the failure and the necessary treatment approach (Table 1).

Table 1. Manappallil's classification

Class I	Cause of failure is correctable without replacing restoration (Figure 2a).
Class II	Cause of failure is correctable without replacing restoration; however, supporting tooth structure or foundation requires repair or reconstruction (Figure 2b).
Class III	Failure requiring restoration replacement only. Supporting tooth structure and/or foundation acceptable (Figure 2c).
Class IV	Failure requiring restoration replacement in addition to repair or reconstruction of supporting tooth structure and/or foundation (Figure 2d).
Class V	Severe failure with loss of supporting tooth or inability to reconstruct using original tooth support. Fixed prosthodontic replacement remains possible through the use of other or additional support for redesigned restoration (Figure 2e).
Class VI	Severe failure with loss of supporting tooth or inability to reconstruct using original tooth support. Conventional fixed prosthodontic replacement is not possible (Figure 2f).

The analysis focused on the frequency and percentage of fixed prosthesis failures based on different factors, including the cause of failure, gender, prosthesis material, arch location, and number of units in the prosthesis. Informed consent was secured from all patients who agreed to take part in the research. The consent process involved providing detailed information about the study objectives, procedures, potential risks and benefits, and the voluntary nature of participation. The data entry and analysis were conducted using (IBM SPSS version 28 software, IBM Inc., Chicago, IL, USA).

RESULTS

The study investigated 75 patients from three dental centers in Tripoli city, with 49 females (65.3%) and 26 males (34.7%). The reasons for bridge failure are presented in Figure 1, illustrating the relative frequency of each contributing factor. The figure revealed that mechanical issues (52.0%) were the primary cause of bridge failure in Tripoli city, accounting for a significant proportion of cases. This finding suggested that aspects related to the fit, alignment, or stability of the bridge may play a crucial role in its failure. The multifactorial nature of dental prosthesis failure implies that more than one contributing factor may be present in each case, emphasizing the importance of a comprehensive approach to the prevention and management of dental bridge failure.

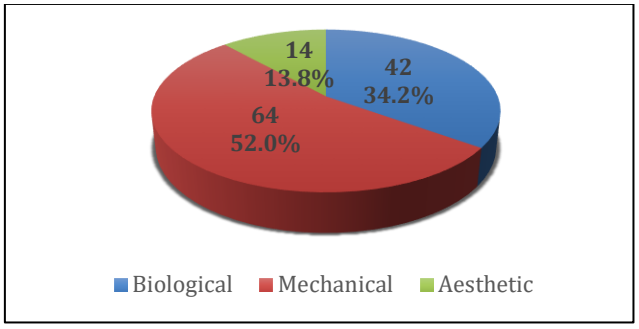

Figure 1. Nature of Fixed Prosthesis Failure.

Among the 235 analyzed dental prostheses, 48 (64.0%) were constructed from porcelain fused to metal (PFM), while 27 (36.0%) were made of zirconia. As shown in table 1, the failure number and percentage values provide a detailed

breakdown of these materials' performance in the context of prosthesis failure. A substantial proportion of the failed PFM dental restorations were associated with the "Fixed-Fixed" bridge design. This design was noted in 32 cases (66.7%) of the total PFM restoration failures. On the other hand, 48.2% of single crowns made from zirconia failed according to the design prosthesis. According to the number of units, single-unit restorations fabricated from both PFM and zirconia materials exhibited higher failure rates, at 27.1% and 48.2% respectively. Furthermore, the majority of these PFM restoration failures were observed in the "maxillary arch", totaling 35 (72.9%), suggesting a potential vulnerability of the upper jaw to bridge failure when using PFM materials. The data in Table 2 also showed that posterior zirconia bridges had a failure rate of 55.6%, while anterior-posterior PFM bridges had a failure rate of 39.6%. Both types of bridges, considering their materials and locations, showed the highest failure rates among the examined restorations.

Table 2. Distribution of prosthesis Failures according to material type (frequency and percentage).

Variable			Type of material				Total
			Porcelain fused to metal		Zirconia		
			n	%	n	%	
Design of Prosthesis	Single crown	**n**	**13**	50.0	**13**	50.0	**26**
		%	27.1		48.2		34.7
	Fixed - Fixed	**n**	**32**	72.7	**12**	27.2	**44**
		%	66.7		44.4		58.7
	Fixed - Free	**n**	**3**	60.0	**2**	40.0	**5**
		%	6.2		7.4		6.7
	Total		**48**	64.0	**27**	36.0	**75**
Number of Units	1 unit	**n**	**13**	50.0	**13**	50.0	**26**
		%	27.1		48.2		34.7
	2 units	**n**	**5**	83.3	**1**	1.7	**6**
		%	10.4		3.7		8.0
	3 units	**n**	**12**	63.2	**7**	36.8	**19**
		%	25.0		25.9		25.3
	4 units	**n**	**5**	62.5	**3**	37.5	**8**
		%	10.4		11.1		10.7
	5 units	**n**	**3**	75.0	**1**	25.0	**4**
		%	6.3		3.7		5.3
	More than 5 units	**n**	**10**	83.3	**2**	16.7	**12**
		%	20.8		7.4		16.0
	Total		**48**	64.0	**27**	36.0	**75**
Dental Arch	Maxillary arch	**n**	**35**	67.3	**17**	32.7	**52**
		%	72.9		63.0		69.3
	Mandibular arch	**n**	**13**	56.5	**10**	43.5	**23**
		%	27.1		37.0		30.7
	Total		**48**	64.0	**27**	36.0	**75**
Location of Prosthesis	Anterior	**n**	**13**	81.3	**3**	18.7	**16**
		%	27.1		11.1		21.4
	Posterior	**n**	**16**	51.6	**15**	48.4	**31**
		%	33.3		55.6		41.3
	Anterior and posterior	**n**	**19**	67.9	**9**	32.1	**28**
		%	39.6		33.3		37.3
	Total		**48**	64.0	**27**	36.0	**75**

From table 3, the study outcomes concerning bridge design indicated a notable association with the "Fixed-Fixed" bridge design, which was significantly more prevalent in cases of bridge failure, accounting for 44 (58.7%) of the total instances. According to the findings, single-unit restorations exhibited a higher rate of failure compared to multi-unit restorations when considering the number of units. However, when there were more than one unit involved, the predominant mode of failure was the three-unit fixed-fixed bridge design (40.9%). In addition, the data analysis revealed

that a significant majority, specifically 77.3%, of failures in fixed-fixed bridge design occurred within the upper arch region. According to fixed-fixed design, anterior-posterior fixed-fixed bridges exhibited the highest failure rate, at 59.1%. In contrast, single crowns and fixed-free designs exhibited lower failure rates, representing 26 (34.7%) and 5 (6.6%) of the total cases, respectively. The disproportionate prevalence of the "Fixed-Fixed" design among cases of bridge failure suggests a potential susceptibility associated with this particular design. According to the data presented in Table 2, porcelain-fused-to-metal fixed-fixed bridges exhibited a higher failure rate (72.7%) compared to zirconia fixed-fixed bridges (27.2%).

Table 3. Distribution of prosthesis failures according to design of prosthesis (frequency and percentage).

Variable			Design of Prosthesis						
			Single crown		Fixed - Fixed		Fixed - Free		**Total**
			n	%	**n**	%	**n**	%	
Number of Units	1 unit	**n**	**26**	100.0	**0**	0.0	**0**	0.0	**26**
		%	100.0		0.0		0.0		34.7
	2 units	**n**	**0**	0.0	**5**	83.3	**1**	16.7	**6**
		%	0.0		11.4		20.0		8.0
	3 units	**n**	**0**	0.0	**18**	94.7	**1**	5.3	**19**
		%	0.0		40.9		20.0		25.3
	4 units	**n**	**0**	0.0	**6**	75.0	**2**	25.0	**8**
		%	0.0		13.6		40.0		10.7
	5 units	**n**	**0**	0.0	**3**	75.0	**1**	25.0	**4**
		%	0.0		6.8		20.0		5.3
	More than 5 units	**n**	**0**	0.0	**12**	100.0	**0**	0.0	**12**
		%	0.0		27.3		0.0		16.0
	Total		**26**	34.7	**44**	58.7	**5**	6.6	**75**
Dental Arch	Maxillary arch	**n**	**14**	26.9	**34**	65.4	**4**	7.7	**52**
		%	53.8		77.3		80.0		69.3
	Mandibular arch	**n**	**12**	52.2	**10**	43.5	**1**	4.3	**23**
		%	46.2		22.7		20.0		30.7
	Total		**26**	34.7	**44**	58.7	**5**	6.7	**75**
Location of Prosthesis	Anterior	**n**	**6**	37.5	**10**	62.5	**0**	0.0	**16**
		%	23.1		22.7		0.0		21.4
	Posterior	**n**	**20**	64.5	**8**	25.8	**3**	9.7	**31**
		%	76.9		18.2		60.0		41.3
	Anterior and posterior	**n**	**0**	0.0	**26**	92.9	**2**	7.1	**28**
		%	0.0		59.1		40.0		37.3
	Total		**26**	34.2	**44**	58.7	**5**	6.7	**75**

The data presented in table 4 offers a comprehensive overview of the failed prostheses categorized by the number of units, enhancing our understanding of how the complexity of a bridge impacts its clinical performance. The majority of unsuccessful restorations, whether single-unit or multi-unit, were found to be located in the maxillary arch, as indicated in table 4. In particular, a significant proportion of single-unit restoration failures, amounting to 80.9%, were observed in the posterior quadrants of both the upper and lower dental arches. Furthermore, the distribution of failures between single-unit restorations made from zirconia and PFM materials, as shown in table 2, was found to be balanced.

The findings of the present investigation revealed a clear pattern in the distribution of failed dental bridges across the dental arches, as shown in table 5. The majority of bridge failures, amounting to approximately 52 cases (69.3%), were observed in the maxillary arch. Conversely, a relatively smaller number of failures, 23 cases (30.7%), were reported in the mandibular arch. A significant proportion of failed fixed partial dentures in the upper jaw were those spanning from the anterior to the posterior segments (46.2%). On the other hand, a significant number of failed fixed partial dentures in the lower jaw were located in the posterior quadrants (69.6%). This disproportionate distribution of bridge failures suggests a greater susceptibility of the maxillary arch to complications associated with dental bridges compared to the mandibular arch.

Table 4: Distribution of prosthesis failures according to number of units (frequency and percentage).

Variable			Number of Units												
			1 unit		2 units		3 units		4 units		5 units		More than 5 units		Total
			n	%	n	%	n	%	n	%	n	%	n	%	
Dental Arch	Maxillary arch	n	14	26.9	6	11.5	12	23.1	7	13.5	3	5.8	10	19.2	52
		%	53.8		100.0		63.2		87.5		75.0		83.3		69.3
	Mandibular arch	n	12	52.2	0	0.0	7	30.4	1	4.4	1	4.4	2	8.6	23
		%	46.1		0.0		36.8		12.5		25.0		16.7		30.7
	Total		26	34.7	6	8.0	19	25.3	8	10.7	4	5.3	12	16.0	75
Location of Prosthesis	Anterior	n	6	37.5	2	12.5	3	18.8	2	12.5	0	0.0	3	18.8	16
		%	23.1		33.3		15.8		25.0		0.0		25.0		21.4
	Posterior	n	20	64.5	2	6.5	8	25.8	1	3.2	0	0.0	0	0.0	31
		%	86.9		33.3		42.1		12.5		0.0		0.0		41.3
	Anterior and posterior	n	0	0.0	2	7.1	8	28.6	5	17.9	4	14.3	9	32.1	28
		%	0.0		33.3		42.1		62.5		100.0		75.0		37.3
	Total		26	34.7	6	8.0	19	25.3	8	10.7	4	5.3	12	16.0	75

Table 5. Distribution of prosthesis Failure frequency and percentage based on prosthesis location in relation to the dental arch.

Variable			Dental Arch				Total
			Maxillary arch		Mandibular arch		
			n	%	n	%	
Location of Prosthesis	Anterior	n	13	81.3	3	18.7	16
		%	25.0		13.0		21.4
	Posterior	n	15	48.4	16	51.6	31
		%	28.8		69.6		41.3
	Anterior and posterior	n	24	85.7	4	14.3	28
		%	46.2		17.4		37.3
	Total		52	69.3	23	30.7	75

According to Manappallil's classification, our study's findings revealed that the majority of defects fell under Class IV (26.6%), with Class III following closely at 21.3% (Table 6). In Class IV scenarios, a notable incidence of failures was observed in fixed partial dentures located in the maxillary arch and featuring PFM crowns. These failures necessitate the replacement of the fixed partial denture and the restoration or reconstruction of the supporting tooth structure.

Table 6. Distribution of Manappallil's Classification Based on Prosthetic Materials and Design of Prosthesis (frequency and percentage).

Variable			Manappallil's classification												
			Class I		Class II		Class III		Class IV		Class V		Class VI		Total
			n	%	n	%	n	%	n	%	n	%	n	%	
Type of material	Porcelain fused to metal	n	4	8.3	1	2.1	7	14.6	13	27.1	12	25.0	11	22.9	48
		%	44.4		50.0		43.8		65.0		85.7		78.6		64.0
	Zirconia	n	5	18.5	1	3.7	9	33.3	7	25.9	2	27.8	3	11.1	27
		%	.6		50.0		56.2		35.0		14.3		21.4		36.0
	Total		9	12.0	2	2.7	16	21.3	20	26.6	14	18.7	14	18.7	75
Design of Prosthesis	Single crown	n	4	15.4	1	3.8	10	38.5	7	26.9	2	7.7	2	7.7	26
		%	44.4		50.0		62.5		35.0		14.3		14.3		34.7
	Fixed - Fixed	n	4	9.1	1	2.3	6	13.6	12	27.3	9	20.5	12	27.3	44
		%	44.4		50.0		37.5		60.0		64.3		85.7		58.7
	Fixed - Free	n	1	20.0	0	0.0	0	0.0	1	20.0	3	60.0	0	0.0	5
		%	11.2		0.0		0.0		5.0		21.4		0.0		7.6
	Total		9	12.0	2	2.7	16	21.3	20	26.6	14	18.7	14	18.7	75

Figure 2 from (a) to (f) illustrate examples of images for each category of Manappallil's classification system, which address common dental bridge failures seen in clinics. These figures help to better understand and use the classification system, and they provide an approach to evaluating the severity of fixed partial denture failures and planning treatment.

Figure 2. Demonstrate visual examples for each category of Manappallil's classification.

(a) Class I Failure: All-ceramic prostheses lacking occlusal contact, managed with prostheses modification rather than replacement. (b) Class II Failure: Adjusting the abutment tooth and surrounding tissues to retain the existing restoration. (c) Class III Failure: Restoration replacement required due to patient dissatisfaction, with satisfactory supporting structure condition. (d) Class IV failure: Restoration replacement required due to fracture of natural crown of upper central incisor, necessitating post and core and new crown. (e) Class V failure: Loss of supporting teeth, required alternative support for redesigned restoration. (f) Class VI failure: Loss of supporting teeth, excluded conventional fixed prosthodontic replacement.

DISCUSSION

The clinician's intellect should be creative, progressive, and original, as these are essential elements in successful treatments and handling repairs when faced with a fixed partial denture failure [29]. Complications are typically issues that arise during or following an effectively performed fixed prosthodontic treatment procedure [30]. The present study aimed to examine the factors associated with dental bridge failure in Tripoli city. The gender distribution of the study population showed a higher incidence of dental bridge failure in female patients (65.3%), aligning with previous research findings [5,14,31,32]. This result corroborates the study conducted by Naz et al., which reported a higher prevalence of dental bridge failure in female patients (73.8%) compared to male patients (26.2%) [5]. In the other studies, a higher percentage of edentulousness was seen among males than among females [33,34,35,36]. Numerous factors have been documented in the existing literature as contributors to the failure of dental crowns and bridges [3,7,37,38]. The investigation of dental bridge failure reasons in the present study revealed a diverse range of contributing factors, with mechanical issues emerging as the most prevalent cause. This result indicates that aspects related to the fit, alignment,

or stability of the bridge may play a significant role in its failure. Consequently, meticulous attention to prosthesis design, fabrication, and placement is critical to ensure long-term durability and reliability. Gogna et al. reported in 2009 that the most frequent mechanical failure was the dislodgement of crowns, which can be partially attributed to the fact that a significant number of these restorations were located on posterior teeth, which are exposed to greater masticatory forces and, consequently, a higher likelihood of dislodgement [39]. In contrast, the study conducted by Naz et al., identified biologic reasons as the most prevalent cause of dental bridge failure, accounting for 87.2% of the cases. Specifically, endodontic failures represented more than half of the failed prostheses in their study, emphasizing the significance of addressing biologic factors in the prevention and management of dental bridge failure [5]. This finding is consistent with several other studies that have also reported biologic factors as the leading cause of dental bridge failure [40,41,42].

The study findings indicated that a significant proportion of failed dental bridges were made from PFM materials, with remarkable number of failures associated with the "Fixed-Fixed" bridge design. This design was more commonly linked to bridge failures, particularly in the maxillary arch, suggesting a potential vulnerability when using PFM materials in this area. These results align with previous research highlighting a higher failure rate in PFM bridges compared to other materials [5,37,42]. The study underscored the importance of careful material and design selection for dental bridges, especially considering the risks associated with the "Fixed-Fixed" design.

The distribution of failed bridges according to the number of units provided valuable insights into this relationship. The data presented a comprehensive overview of the number of failed prostheses associated with each category of the number of units. This information facilitates understanding the impact of bridge complexity on its clinical performance. The study found that one unit restoration had a higher failure rate compared to other types of restorations. This finding is supported with previous research by Naz et al., who reported that single crowns and fixed partial dentures of up to 3 units are the most commonly used restorations, and therefore, more failures are likely to be reported in such prostheses. Specifically, Naz et al.'s results showed that 59.5% of failed restorations examined were single-unit crowns, followed by 16% of 3 unit fixed partial dentures [5]. Additional research indicated that, fixed partial dentures spanning more than four units are associated with an increased likelihood of failure [43,44]. For instance, Randow reported increased failure rates of long-span bridges, ranging from 7% for prostheses of 7 units to 23% for prostheses having 10 units [43]. Therefore, to reduce the failure rate of a prosthesis and improve prosthesis longevity, long-span prostheses should be avoided.

The findings of the present investigation found a distinct pattern in the distribution of failed dental bridges across the dental arches. A significant proportion of the bridge failures, amounting to 88.9 % were observed in the posterior region of the dentition. Notably, these failed posterior bridges were 51.6 % PFM and 48.4 % zirconia restorations. The majority (64.5 %) of the failed posterior bridges were of the "Single crown" configuration, suggesting potential vulnerabilities associated with this particular design in the posterior regions of the dental arches. Additionally, the study findings highlighted the prevalence of failures in the anterior-posterior bridges, with the majority of these occurring in the maxillary arch (85.7 %). This observation implies challenges related to the use of PFM materials in the anterior-posterior segments, particularly in the maxillary region. Regarding the anterior bridges specifically, 81.3 % of the failed restorations were located in the maxillary arch, again indicating potential issues with the performance of PFM materials in this specific area of the dentition. Naz et al. noted a higher failure rate in dental restorations replacing posterior tooth structure (79.9%) compared to those in the anterior region (13.4%) [5]. Similarly, Saleem et al. reported that 60% of failed restorations were located in the posterior segment of the arch [45]. These findings contrast with Cheung's study, which indicated a higher failure rate in anterior fixed restorations [46].

The present study utilized Manappallil's classification system to analysis the distribution of failure types based on prosthetic materials and bridge designs. The findings of the current study revealed that Class IV failures were the most prevalent, accounting for 26.6% of all failures, closely followed by Class III failures at 21.3%. Further analysis indicated that Class IV failures were most common in PFM restorations (65.0%) and fixed-fixed design bridges (60.0%), while Class III failures were predominantly observed in zirconia restorations (56.2%) and single crown preparations (62.5%).

These results are consistent with the findings of a clinical survey conducted by Meshramkar et al., which aimed to assess the correlation between the nature and type of failure in crowns and fixed partial dentures. The study found that class III failures were the most common, accounting for 25.7% of crown failures and 30.0% of bridge failures, with the highest incidence in PFM crowns (26.7%) and bridges (42.0%) [47]. Similar findings were reported by Sajan et al., who found that class III failures were the most prevalent at 32.27%, attributed to defective margins, technical failures, and aesthetic concerns. Additionally, Class VI failures, accounting for 24.05%, were associated with long-span fixed partial dentures with potentially serviceable supporting teeth [48]. Chandra et al. also found that class III and IV failures were most common in different subjects. Furthermore, the study by Iswalhia et al. corroborated the present findings, revealing that failures in Class III accounted for 30% of all failures, followed by Class IV at 24%. Classes II and IV had an 8% failure

rate, while Classes V and VI were at 15% and 11%, respectively. These consistent findings across multiple studies emphasize the importance of understanding the factors contributing to fixed dental prosthesis failures to enhance treatment outcomes and provide a reliable clinical assessment.

The current study sheds light on the factors that contribute to dental bridge failure, providing valuable insights that highlight the importance of careful prosthesis design, fabrication, and placement. The findings also underscore the need for targeted interventions and improvements in dental bridge design and placement, particularly in the upper jaw and in regions where PFM materials are used.

CONCLUSION

The study on dental bridge failure in Tripoli city found a higher incidence of failure in female patients and highlighted the significance of careful prosthesis design, fabrication, and placement. The study sample had a significant gender imbalance, favoring females. Female patients were overrepresented due to the majority of cases coming from females in the clinics. Mechanical issues, especially in PFM bridges, were identified as a common cause of failure, indicating the need for careful material and design considerations. Furthermore, failure classification systems, which serve as valuable tools for identifying trends and patterns, can be used as a guide for the development of effective treatment plans for fixed dental prostheses. According to the findings of the study, the most common classification of failure was class IV, which often required repairing or reconstructing the supporting tooth structure and rebuilding or replacing the restoration. Proper patient selection, accurate diagnosis, and comprehensive treatment planning were emphasized as crucial for increasing the longevity of fixed prostheses. Clinical and technical skills were identified as key factors in ensuring the success and durability of dental bridges, leading to improved clinical practices and patient outcomes.

Limitations

This study's limitations include its restricted geographical scope, which may limit the generalizability of its findings to a broader population. The unequal gender distribution of participants may have skewed the results, and the cross-sectional design only provides a snapshot of fixed partial denture failures at a single point in time, without addressing longevity or overall quality. Additionally, the study's classification system focuses on clinical and mechanical aspects but underemphasizes patient-specific factors such as age, general health, and oral hygiene practices, which could significantly impact prosthesis outcomes.

Recommendations

Enhancing research in this field involves conducting longitudinal studies to track changes in complications associated with fixed dental prostheses over time, providing insights into the long-term effects of different prosthesis types and materials. Future research should strive for gender balance among patients with bridge failure in Tripoli to enhance result reliability. Larger sample sizes are crucial for a comprehensive understanding of these issues, and considering patient-specific factors is essential for a thorough analysis.

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Conflicts of Interest

None declared.

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تحليل العوامل والأسباب الرئيسية الخطرة المساهمة في فشل تركيبات الأسنان الثابتة: دراسة سريرية على كائن حي

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المستخلص

هدف هذا التشخيص السريري الي تحديد العوامل التي تؤدي الي فشل التركيبات السنية الثابتة وآثارها، وهو أمر بالغ الأهمية لتعزيز النتائج السريرية. أجريت هذه الدراسة في طرابلس، ليبيا، بمشاركة 75 مريضاً لديهم 235 وحدة، واستخدمت تصنيفات كلا من: جون إف جونستون وجون جيه مانابااليل لتحديد أسباب فشل التركيبات الثابتة. وجدت الدراسة ان أكثر المشاكل هي ميكانيكية، اغلبها عند المرضي الاناث كانت السبب الرئيسي لفشل جسر الاسنان، معظم التركيبات الفاشلة كانت في الجسور الخزفية المندمجة مع المعدن (PFM) ذات التصميم " الثابت - الثابت"، ومعظمها في الفك العلوي. تؤكد الدراسة على أهمية اتباع نهج متعدد العوامل في منع وإدارة فشل تركيبات الاسنان الثابتة، مع التركيز على التصميم والتصنيع ومكان وضع التركيبة، إلى جانب اختيار المريض والتشخيص وتخطيط العلاج والتثقيف حول نظافة الفم.

الكلمات الدالة. الدعامات، طقم الأسنان الجزئي الثابت، الفشل، التحقيق، الدراسة السريرية.