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Crown and Bridge Failure in Patients Attending Royal Medical Services Dental Clinics: A Descriptive Study

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Abstract: ***Background**: Despite technological advancements, crown and bridge failures remain a significant concern. Several factors contribute to this increased risk, necessitating extensive studies across different populations to reduce these risks. This study investigates the factors contributing to crown and bridge failure within the Jordanian population while assessing their incidence and prevalence. **Methods**: We conducted a descriptive study at the Royal Medical Services (RMS) dental clinic to examine the causes of crown and bridge failure. Only porcelain-fused-to-metal crowns and bridges for patients over 18 years old were included, while full-ceramic restorations, medically compromised patients, and smokers were excluded. Data collected by a specialist included age, gender, prosthesis age, and five major failure categories. The RMS ethical committee approved the study. Failure causes were categorized into five groups: mechanical failure, design failure, lab work failure, aesthetic failure, and biological and periodontal failure. These were further analyzed and compared across the population. **Results**: We included 300 patients with a median age of 42 years and a median prosthetic age of 60 months. Lab work issues were the most common cause of failure (67%), followed by aesthetic (34%) and biological/periodontal issues (31%). Mechanical and design failures affected 33% and 22% of patients, respectively. The patients were divided into two groups based on prosthesis age, revealing significant differences in biological and periodontal failure between the groups (p-value = 0.018), with oral hygiene issues more prevalent in patients with shorter prosthetic lifespans. Age and gender disparities were also noted between the groups, with females and younger individuals more prevalent in the shorter prosthesis lifespan group. **Conclusion**: Our study provides insights into the potential causes of failure for patients with crowns and bridges. Additionally, we investigated the relationship between the age of prosthetics and these factors. These findings would help improve patient care and reduce these factors.*

Keywords: crown failure, bridge failure, dental, descriptive

1. Introduction

Crowns and bridges serve as a therapeutic approach for patients who aim to restore their dental structure. Dental professionals extensively utilize this technique. When correctly planned and implemented, these fixed prostheses ensure reliable functionality, aesthetic enhancement, and cost-effectiveness. However, inadequate implementation and execution increase the risk of premature failure, potentially causing irreparable harm to the teeth and underlying support structures (1, 2).

Many qualified practitioners have reported failure of the crowns and bridges. A recent survey has reported that about 37% of adults have at least one crown, while 7% have a bridge, with 3% aged 16–44 years and 14% aged 55–74 years (3).

Several factors have contributed to the failure of crowns and bridges, the most common of which is caries (4, 5). Many restorations can also fail because of cementation loss (partial or complete loss). Moreover, inadequate patient selection and suboptimal clinical execution of tooth core build-up, tooth preparations, impression taking, and jaw registration increase the likelihood of early restoration failure (4–7). These clinical shortcomings can adversely impact the long-term prognosis of the natural teeth underlying the failed restoration (1).

The management of failure cases requires a sound diagnosis and assessment. Technical skills and knowledge are crucial when dealing with failed or failing restorations (1). The success of the treatment lies in careful planning that will be tailored for each case. In certain instances, implementing conservative approaches will be beneficial, while in others, it will be contraindicated (2).

Despite tremendous advancements in the methods and materials used to construct these restorations, the failure cases still need to be investigated thoroughly to identify the potential factors that contribute to them. Therefore, this paper

aims to identify the factors that play a role in crown and bridge failure in patients attending our dentistry clinics at the Royal Medical Services (RMS) in Jordan. We strive to classify these factors into groups and assess their prevalence across a sample of the Jordanian population. This would further help dentists and professionals as well as guide their practice to improve these restorations and reduce the risks of failure.

2. Methodology

Study design

We conducted a descriptive study to explore the root causes of crown and bridge failure among patients attending the RMS dental clinic. The inclusion criteria comprised only porcelain-fused-to-metal crowns and bridges for individuals over 18 years old. The exclusion criteria included full-ceramic crowns and bridges, medically compromised patients, and smokers.

Data collection

Conservative dentistry specialists collected data from clinical examinations. The recorded variables include age, gender, age of the prosthesis, and evaluation of five major failure categories. The patients signed an informed consent form, and the study was approved by the ethical committee at the RMS.

Assessment tools

The dentistry specialist assessed the causes of crown and bridge failure and then categorized them into five major groups: (1) mechanical failure, which encompasses loss of retention, material fracture, distortion, wear and perforation, and lost facing; (2) design failure, including sub-causes such as abutment issues and under-prescribed work; (3) lab work failure, which involves marginal defects, defects in open margins and contacts, negative ledge, and positive ledge; (4) aesthetic failure; and (5) biological and periodontal failure, incorporating emergence profile, oral hygiene, and bone loss and caries.

Statistical analysis

We conducted a statistical analysis using the R software (version 4.3.3). We then presented continuous variables using the median (IQR), while the categorical variables were shown as frequencies (percentages: %). Next, we employed the Wilcoxon (Mann–Whitney U) and one-way ANOVA tests for continuous variables to assess the correlation between demographic and clinical variables with study groups. Finally, we utilized the chi-squared (X^2) and Fisher-exact tests for categorical variables. A significance level of $p < 0.05$ was considered statistically significant.

3. Results

Patients' characteristics

This study included 300 patients, among whom 202 (67%) were female and 98 (33%) were male. The median age of the patients was 42 years (95% CI: 36–48). Additionally, the age of the prosthetic was recorded for each patient in months, with a median age of 60 months (95% CI: 24–108).

Distribution of failure causes among the study population

Within the patient cohort, the most common cause of failure was lab work issues, impacting the highest number of individuals, with 202 patients affected (67%). Following this, aesthetic failure affected 101 patients (34%), while biological and periodontal failures were close behind, affecting 93 patients (31%). Mechanical failure was observed in 98 patients (33%), and design failure affected 65 patients (22%), making them comparatively less prevalent among the failure causes. Further evaluation of each failure was documented (**Table 1**). In cases of mechanical failure, wear and perforation emerged as the most common causes, followed by loss of retention and material fracture. Conversely, lost facing was the least prevalent among these issues. Regarding design failure, only abutment and under-prescribed work were reported, with abutment comprising the majority at 57 cases (88%).

Concerning lab work failure, positive ledges were the most common cause, accounting for 187 cases (93%), while negative ledges comprised only 6 cases (3.0%). Other lab work failures, such as marginal defects, open margins, and contacts, constituted the minority of the causes.

Regarding aesthetic failure- which included issues related to shape, shade, and texture—it constituted all 101 cases (100%). Lastly, biological and periodontal failure included oral hygiene as the predominant issue, comprising 58 cases (62%), followed by emergence profile in 24 cases (26%) and bone loss and caries in 11 cases (12%).

Evaluation of prosthesis age in failure causes

The patients were categorized based on the age of their prosthesis (in months) into two groups: Group A, comprising 160 patients with prostheses lasting more than 60 months; and Group B, consisting of 123 patients with prostheses lasting less than 60 months. We further examined the causes of failure across these two groups. Only the biological and periodontal failure causes showed significance (p-value = 0.018) between the groups, with patients in Group B experiencing the majority (67%) of oral hygiene problems compared to 56% in Group A. Bone loss and caries were reported in 20% of Group A, whereas Group B had no reports of these issues. Additionally, age and gender were significantly different between the two groups. The median age in Group A was 43 years (95% CI: 38–51), whereas in Group B, it was 41 years (95% CI: 33–47) (p-value = 0.001). Females were more prevalent in Group B (90, 73%), while in Group A, females numbered 98 (61%) (p-value = 0.035). Further details are shown in **Table 2**.

4. Discussion

Dental practitioners commonly employ crown and bridge restorations to restore patients' dentition. Despite advancements in materials, technologies, and cement used for their construction and retention, instances of failure and subsequent replacement of these restorations have occurred (2). A range of factors have been linked to their failure, each associated with different failure rates and consequences, necessitating further investigation. Therefore, this study aims to evaluate the diverse causes of crown and bridge failure among patients treated at RMS dental clinics.

Our study included 300 patients who underwent clinical examinations by a conservative dentistry specialist to investigate the causes of failure. Mechanical failures were observed in 33% of the cases, with wear and perforation being the most common, followed by loss of retention and material fracture. Conversely, lost facings were least frequent. In a study by Walton et al. (1986), mechanical failures accounted for 69.5% of cases compared to 28.5% for oral diseases (8). Causes included cementation failure, defective margins, post and core failure under crowns/bridges, precision attachment breakages, and fractured porcelain facings (8). Misdirected forces could lead to mechanical fractures, potentially damaging the underlying tooth or core. Hence, it is advisable to conduct a risk assessment before deciding between salvaging the restoration and risking damage to the supporting abutment to prevent complications (9).

Design failure was observed in 22% of the cases, indicating a lower prevalence among other failure categories. The reported causes included abutment issues and under-prescribed work, with abutment-related issues being predominant. The potential loss of vitality in abutment teeth is a significant risk associated with crown and bridge treatment and should be carefully monitored (10). Reuter et al. noted a higher incidence of abutment failure when root canal treatment was performed after bridge cementation compared to cases where abutments were vital or had undergone root treatment before bridge construction (11).

Lab work failure accounted for the majority of failure causes among other failure categories, affecting 67% of the population. Positive ledges were the most prevalent issue, accounting for 93% of cases, while negative ledges were rare, comprising only 3.0%. Other lab work failures—such as marginal defects, open margins, and contacts—constituted the minority of causes. Marginal damage often occurs when using the sliding hammer technique, which has been reported to be uncomfortable and unreliable for patients. Furthermore, this technique is not recommended for patients with periodontally involved teeth, given the risk of unintended extraction (12).

Aesthetic failure, which constituted 34% of the cases, encompassed issues regarding shape, shade, and texture. Other causes of aesthetic failure reported in the literature include color and contour discrepancies (8). Instances such as aesthetic fractured porcelain facings could be more economically managed if the crown or bridgework were retrievable, especially if attempts at intra-oral repair had proven unsuccessful (9).

Biological and periodontal failures accounted for 31% of the cases, with oral hygiene emerging as the predominant issue, comprising 62% of the cases, followed by emergence profile at 26% and bone loss and caries at 12%. Other reported causes of biological failure in the literature include caries, which constitutes most failure cases, along with issues related to endodontic treatment and re-treatment, periodontal concerns, occlusion, and metal allergies (8). Providing crown and bridge work for patients can be both time-consuming and costly. In specific situations, teeth linked with crowns or bridges might not be salvageable, particularly in cases involving severe caries or notable periodontal bone loss. In these scenarios, adopting a conservative crown and bridge removal strategy can benefit the clinician and alleviate the patient's financial burden (2). This includes instances such as endodontic issues, failure in the cementation of a retainer on a structurally sound bridge, inadequate tooth preparations, poor restoration fit, occlusal factors, and inappropriate design and material selection (13).

In addition to evaluating failure categories, we investigated the correlation between the age of the prosthesis and the causes of failure. Only biological and periodontal failure causes exhibited a significant association. Oral hygiene issues were more prevalent among patients with a shorter prosthesis age, whereas bone loss and caries were more common among those with a longer prosthesis age. The longevity of prostheses varies depending on the type (14). Even rough, over-the-counter crowns can lead to restoration failures (15). Attempts to repair them with different materials and methods might fail, necessitating the removal of these restorations (16, 17).

However, the study's primary limitations include the lack of patient grouping, with individuals falling within the same category. Additionally, a larger sample size would be beneficial for establishing more generalized results.

In conclusion, our study delves into the causes of crown and bridge failures. Our findings indicate that lab work failure is the most prevalent, followed by aesthetic failures, with design failures being the least common. Additionally, we observed a significant association between the age of the prosthesis and biological causes, particularly in oral hygiene (which was linked to shorter prosthesis age), and bone loss and caries (which were associated with longer prosthesis age). These insights will enhance patient care by targeting the areas contributing to failure and reducing failure rates. We recommend future studies to dive deeper into these causes for further understanding.

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Table 1: The distribution of the causes of failure across the population

Characteristic	N = 300[1]
Age	42 (36, 48)
Age of Prosthesis	60 (24, 108)
Gender	
Female	202 (67%)
Male	98 (33%)
Mechanical Failure	
Loss of retention	29 (30%)
Material fracture	29 (30%)
Distortion	4 (4.1%)
Wear and perforation	33 (34%)
Lost facing	3 (3.1%)
Design Failure	
Abutment	57 (88%)
Under-prescribed work	8 (12%)
Lab-work Failure	
Marginal defect	8 (4.0%)
Defects, open margins, and contacts	1 (0.5%)
Negative ledge	6 (3.0%)
Positive ledge	187 (93%)
Esthetic Failure	101 (100%)
Biological and Periodontal Failure	
Emergence profile	24 (26%)
Oral hygiene	58 (62%)
Bone loss and caries	11 (12%)
[1] Median (IQR); n (%)	

Table 2: The effect of age-related prosthetics on crown and bridge failure

Characteristic	Group A (N = 160[1])	Group B (N = 1231)	p-value[2]
Age	43 (38, 51)	41 (33, 47)	0.001
Gender			
Female	98 (61%)	90 (73%)	0.035
Male	62 (39%)	33 (27%)	
Mechanical Failure			
Loss of retention	19 (30%)	8 (29%)	
Material fracture	17 (27%)	9 (32%)	>0.9
Distortion	3 (4.8%)	1 (3.6%)	
Wear and perforation	21 (33%)	10 (36%)	
Lost facing	3 (4.8%)	0 (0%)	
Design Failure			
Abutment	37 (95%)	19 (83%)	0.2
Under-prescribed work	2 (5.1%)	4 (17%)	
Lab-work Failure			
Marginal defect	6 (5.6%)	2 (2.4%)	
Defects, open margins, and contacts	0 (0%)	1 (1.2%)	0.2
Negative ledge	5 (4.6%)	1 (1.2%)	
Positive ledge	97 (90%)	80 (95%)	
Esthetic Failure	45 (100%)	52 (100%)	
Biological and Periodontal Failure			
Emergence profile	13 (24%)	10 (33%)	0.018
Oral hygiene	31 (56%)	20 (67%)	
Bone loss and caries	11 (20%)	0 (0%)	

[1] Median (IQR); n (%)
[2] Wilcoxon rank sum test; Pearson's chi-squared test; Fisher's exact test