

# A Clinical Study Assessing Complications of Different Types of Fixed Prosthesis in Multi Governmental Dental Centres

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## ABSTRACT

**Introduction:** Analyses of failures and complications of dental prosthesis are important to ascertain what might improve clinical procedures and for the selection of materials. In Saudi Arabia, we do not have enough data about the quality of fixed dental prosthesis in population.

**Purpose:** To evaluate the complications and failure of the different types of fixed dental prosthesis and its association with many factors in these subjects in multi governmental dental centres in Jeddah, Saudi Arabia.

**Materials and methods:** The study was carried out in 5 governmental dental centres in the city of Jeddah, Saudi Arabia. 197 patients contributing a total of 431 prosthesis were included through the inclusion and exclusion criteria. The patients were interviewed, and a complete clinical and radiographic examination for the prosthesis was performed. Also, the participants were asked if the identified problems with their prosthesis affected their lifestyle.

**Results:** Fixed dental prosthesis failure were significantly higher in PFM than all ceramic material. The most common complications were defective margin followed by caries. Over-contoured prosthesis shows a significantly higher caries association than normal contour. Short span FPDs has significantly less complications than long span.

**Conclusion:** All ceramic fixed dental prosthesis has better prognosis, less complications and higher success rate than PFM. Discrepancies at the prosthesis margins were associated with higher caries count and greater gingival inflammation of the supporting teeth. Over-contoured prosthesis is a contributing factor in the presence of dental caries around the defective prosthesis margin.

**Key words:** Prosthetic failure, Prosthetic complications, Fixed dental prosthesis, Saudi Arabia, Ceramic material, Porcelain fused to metal material

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## INTRODUCTION

The life expectancy for the general population in developed countries around the world has increased substantially over the past century [1,2]. One of the parameters defining the quality of life is oral health which also has improved substantially over the last 50 years.

The diagnosis and management of oral diseases has become complex, progressive, and cumulative. In addition to be an indicator of life quality, optimum oral hygiene improves self-esteem, helps in social networking, and restores one's physical ability [1-3].

Tooth loss occurs normally as part of aging and an indicator of dental health. The most common factors leading to tooth loss are dental caries and periodontal diseases.

Lifestyle (dietary habit, smoking, etc.) and age are important contributors to tooth loss as well. Improving dental hygiene behaviour may alter the progression of these disorders [4-7].

When seniors suffer from tooth loss, there is a great interest in restoring their missing teeth for accommodating their daily work, life, and body image. In this population, edentulism results from tooth loss.

Although edentulism rates are generally in decline [8-10], they are present with different prevalence across the world. Nowadays the rate of edentulism is decreased and it plays a part in increasing the number of fixed dental prosthesis units.

This is seen in dental practice as an increase in the numbers of dental crowns and fixed dental prosthesis in the general population. Given that fixed dental prosthesis are costly treatments, the willingness of patients to undergo these treatments for dental restoration reflect the general awareness about the importance of oral health [11].

There is insufficient evidence on the evaluation of fixed dental prosthesis. One of the few studies that evaluate the FPDs, and they found a survival rate of 80% after 8 to 14 years and 65 % after 14 to 20 years in service.

Also, they conclude that the failure rates for the fixed partial dentures were 2%, 7%, and 11% for the 1 to 5, 5 to 10, and 10 to 15 years in clinical service groups, respectively. The failure rate significantly increased with time.

The expected survival rate of fixed partial dentures was 85% at 15 years [11]. Furthermore, the same authors also found that the most common cause of failure in their study was tooth fracture.

Also, dental caries was one the causes of failure and the failure rate increased significantly with time as periodontal breakdown [12].

Although fixed dental prosthesis failure such as tooth fracture is one of the most devastating serious side effects there are other less serious but more common complications [13-22]. The two most common of those are periodontal disease and caries.

In a clinical survey they found that three quarters of the margins of single crowns and fixed dental prosthesis were defective [18]. And there was a statistically significant association between fixed dental prosthesis and gingival inflammation.

This association was noted whether the fixed dental prosthesis was faulty or not.

In addition to increased inflammation, the presence of a marginal discrepancy between the tooth and FDPs could allow the leakage of bacteria and their by-products which in turn can cause significant damage on the pulp.

Felton et al performed a quantitative study on the adaptation of the margin of fixed dental prosthesis and its relation to the periodontal health and they found there was a direct relationship between marginal discrepancies of the prosthesis and periodontal inflammation [19].

The second complication that may develop in patients with fixed dental prosthesis is dental caries. The development of caries in patients is due to multiple factors that have impact on the oral environment.

Various studies evaluated caries development in patients with fixed partial denture cases [14,16-20,22,25-27,29]. Walton et al found that failure of crowns and fixed partial dentures was commonly related to caries.

In Saudi Arabia, we do not have enough data about the complications of fixed dental prosthesis. In this study, our objective is to evaluate the complications and failure of the different types of fixed dental prosthesis and its association with many factors in these subjects.

## MATERIALS AND METHODS

This study design was cross section. It was carried out in 5 dental cares governmental centres in the city of Jeddah, Saudi Arabia. All patients who had fixed dental prosthesis were included in this study. Patients who had removable dental prosthesis and direct restorations were excluded.

Before conducting this study, ethical approval was obtained from the King Abdulaziz University's Institutional Ethics Review Board (register number 196-11-19). The eligible patients were approached and consented to participate in the study.

The investigators communicated with them the study aims and scope, along with confidential and anonymous handling of the data. Patients who consented to participate were included in this study.

It was essential to equip the examiners with the required data to conduct clinical assessments; therefore, they attended a seminar that detailed the specifics of the study in the form of aims, measurement parameters, and study methods.

Regarding this, a radiographic assessment and a clinical evaluation were utilized to assess the quality of fixed dental prosthesis among these patients. A clinical examination was conducted by the first dentist with the help of a calibration process.

Moreover, radiographic evaluation was conducted by the second dentist. Calibration was conducted to identify the intra-examiner reliability, while evaluating the prosthesis parameters.

Pre-set guidelines were followed by both radiographic and clinical examiners. An experienced radiologist and prosthodontist conducted a calibration test on the examiners.

A standardized data collection form for the required clinical examination and evaluation was given to all examiners in the participating centres.

First section of the form was the demographic data and past dental history, and they were collected via review of medical records and personal interview before clinical evaluation.

These demographic data included: sex, age, nationality, occupation. Past dental history including age of prosthesis, prior interventions and other past medical conditions were also obtained.

The other section was evaluation the fixed dental prosthesis clinically and radiographically.

The data collection tool comprises a total of 9 items including: type of prosthesis, material of prosthesis, span length of fixed partial denture, margin of the prosthesis, contour, caries, gingival condition, patient awareness about pain, patient awareness about food impaction and

any patient complaints. To standardize the technique of evaluation, caries is defined as a decay at tooth surface either cavitated or non-cavitated examined clinically by blunt probe, dry field and good illumination or radiographically.

Gingival inflammation is defined as a redness either marginal or interproximal in the color of gingival tissue and edema or bleeding by gentle probing. Defective margin is a space or gap between the edge of a prosthesis margin and unprepared tooth structure detected by the tip of sharp explorer.

Over-contoured is defined as much excess restorative material than adjacent normal teeth. All the prosthesis were evaluated clinically by using a mouth mirror, sharp WHO explorer to detect the margin of the prosthesis, WHO probe to detect the presence of caries clinically in conjunction with radiograph and the gingival condition and health.

All the data were collected in Excel worksheet and collected from the different participating centres. The prosthesis was grouped according to their type of the prosthesis. Each type of prosthesis was further divided according to material of the prosthesis.

For fixed partial denture, these were divided either to short span (3 units) or long span (4,5 or 6 units), the full 10 items were analyses within these subgroups. Statistical analysis was performed using IBM SPSS Statistics version 25 (IBM Corporation, NY, U.S).

**RESULTS**

Of the 171 patients with 431 fixed dental prosthesis, 319 crowns and 112 fixed partial dentures (210 abutments and 201 pontics). 50.3 % of sample was men and 49.7% was women. 36.3% of patients was from age 21-30 years, 18.1% from age 31-40 years, 20.5% from age 41-50 years, 12.3% from age 51-60 years and 12.9% from age 61 and above (Table 1).

**Table 1: Age and gender distribution.**

Age group	Patients	Men	Women
21-30 years old	62	30	32
31-40 years old	31	19	12
41-50 years old	35	18	17
51-60 years old	21	8	13
< 61 years old	22	11	11
Total	171	86	85

Of 319 crowns, 61.75% was PFM and 38.24% was all ceramic.

The defective prosthesis was significantly more in PFM crowns (39.6%) than all ceramic (4%). 66.6% of defective PFM crowns was associated with caries.

Prosthesis that over-contoured was significantly more in PFM crowns (25.8%) than all ceramic crowns (1.6%).

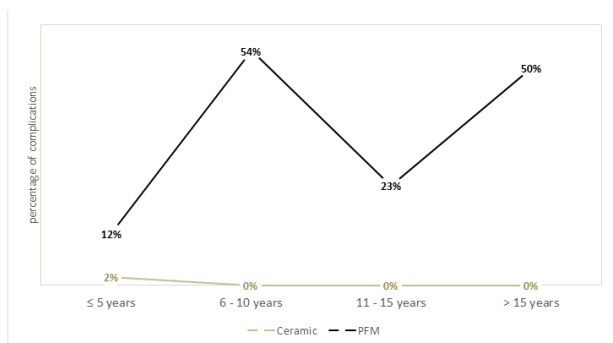
12% of PFM crowns was associated with patient complaint while 7% of ceramic crowns was associated with patient complaint.

The gingival inflammation was significantly higher in PFM crowns (49.7%) than all ceramic crowns (11.4%) (Table 2).

**Table 2: Crowns: Distribution according to the material used and complications.**

Complications	PFM Crowns		Ceramic Crowns		P-value
	n	%	n	%	
Closed margin	119	60.4	117	96	0.896
Defective margin	78	39.6	5	4	0
Defective margin with caries	52	26.3	2	1.6	0
Over-contoured	51	25.8	2	1.6	0
Discomfort / pain	24	12.1	9	7.3	0.009
Gingival inflammation	98	49.7	14	11.4	0
Total	197	61.8	122	38.2	

Of 197 PFM crowns, 118 crowns were survived  $\leq 5$  years and 12% of them was associated with defective margins and caries. 46 crowns were survived 6–10 years and 54% of them was associated with defective margins and caries. 13 crowns were survived 11–15 years and 23% of them was associated with defective margins and caries. 20 crowns were survived more than 15 years and 50% of them was associated with defective margins and caries. Of 122 ceramic crowns, 101 crowns were survived  $\leq 5$  years and 2% of them was associated with defective margins and caries. Rest of ceramic crowns have no complications (Figure 1).



**Figure 1: Crowns: Percentage of complications curves throughout years intervals.**

Of 112 FPDs, 87.5% was PFM and 12.5% was all ceramic.

The defective prosthesis was significantly more in PFM FPDs (59.2%) than all ceramic (21.4%).

81% of defective PFM FPDs was associated with caries.

Prosthesis that over-contoured was significantly more in PFM FPDs (45%) than all ceramic FPDs (14.2%).

26.5% of PFM FPDs was associated with patient complaint while 14.2% of ceramic FPDs was associated with patient complaint.

The gingival inflammation was significantly higher in PFM FPDs (73.4%) than all ceramic FPDs (28.5%) (Table 3).

**Table 3: FPDs: distribution according to the material used and complications.**

Complications	PFM		Ceramic		P-value
	Fixed Partial Dentures		Fixed Partial Dentures		
	n	%	n	%	
Closed margin	40	40.8	11	78.6	0
Defective margin	58	59.2	3	21.4	0
Defective margin with caries	47	48	2	14.2	0
Over-contoured	44	45	2	14.2	0
Discomfort / pain	26	26.5	2	14.2	0
Gingival inflammation	72	73.4	4	28.5	0
Total	98	87.5	14	12.5	

Of 98 PFM FPDs, 36 FPDs was survived ≤ 5 years and 11% of them was associated with defective margins and caries.

19 FPDs was survived 6–10 years and 58% of them was associated with defective margins and caries.

19 FPDs was survived 11–15 years and 79% of them was associated with defective margins and caries.

24 FPDs was survived more than 15 years and 75% of them was associated with defective margins and caries.

Of 14 ceramic FPDs, 2 FPDs was survived 11-15 years and was associated with defective margins and caries.

Rest of ceramic FPDs have no complications (Figure 2).

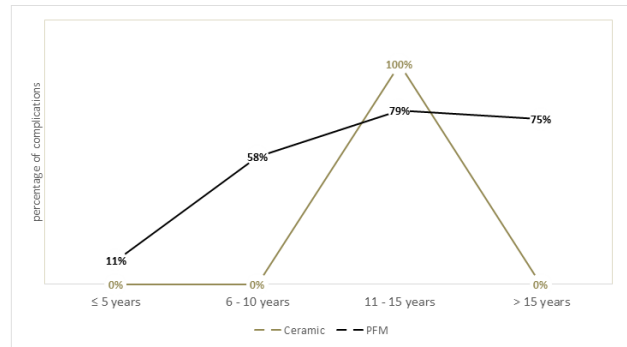


Figure 2: FPDs: Percentage of complications and failure curves throughout years intervals.

Of 112 FPDs, 45.5% was long span and 54.5% was short span. The defective prosthesis in long span was 74.5% while in short span was 52.4%. Patient compliant was more in percentage in long span than short (58.8% in long span and 13.1% in short span) (Table 4).

Table 4. FPDs: Distribution according to the material used and complications.

Complications	Long Span		Short Span		P-value
	n	%	n	%	
Closed margin	13	25.4	38	62.2	0
Defective margin	38	74.5	23	52.4	0.054
Defective margin with caries	36	70.5	22	36	0.066
Over-contoured	35	68.6	14	22.9	0.002
Discomfort / pain	30	58.8	8	13.1	0
Gingival inflammation	43	84.3	33	54	0.251
Total	51	45.5	61	54.5	

Of 51 Long span FPDs, 12 long span FPDs was survived ≤ 5 years and 7% of them was associated with defective margins and caries. 8 long span FPDs was survived 6–10 years and 87% of them was associated with defective margins and caries. 17 long span FPDs was survived 11–15 years and 88% of them was associated with defective margins and caries. 14 long span FPDs was survived more than 15 years and 93% of them was associated with defective margins and caries. Of 61 short span FPDs, 34 short span FPDs was survived ≤ 5 years and 8% of them was associated with defective margins and caries. 12 short span FPDs was survived 6–10 years and 33% of them was associated with defective margins and caries. 4 short span FPDs was survived 11–15 years and 50% of them was associated with defective margins and caries. 11 short span FPDs was survived more than 15 years and 45% of them was associated with defective margins and caries (Figure 3).

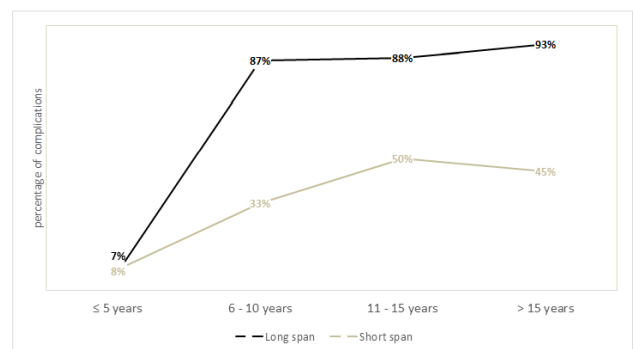
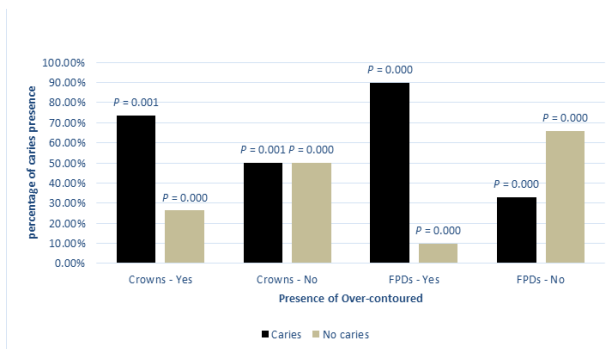


Figure 3: FPDs: Percentage of complications and failure curves throughout years intervals.

Of 83 defective margin crowns, 53 of them were over-contoured and 30 were not. 73.6% of over-contoured defective margin was significantly associated with caries and 26.4% was not. While in the presence of proper contour the percentage of caries drop up to 50%. Of 61 defective margin FPDs, 52 of them were over-contoured

and 9 were not. 90% of over-contoured defective margin was significantly associated with caries and 10% was not. While in the presence of proper contour the percentage of caries drop up to 33% (Figure 4).



**Figure 4: Crowns and FPDs: Presence of caries in a defective margin prosthesis and its relation to over-contour.**

## DISCUSSION

Analyses of failures and complications of dental prosthesis are important to ascertain what might improve clinical procedures and for the selection of materials.

The rationale for the selection of cross-sectional study design was based on its efficacy for deriving conclusive results as established in other similar studies [13,14,16,20-25]. However, the present study is different in its scope, objective of variables and region. This study evaluates two different types of prosthesis (crowns and FPDs), focusing on the relation between two different materials in each type (PFM and ceramic) and the complications associated with this prosthesis. We focus on the effect of defective margins on the occurrence of complications and its relation to caries. This study is conducted across multiple governmental dental centres in Jeddah for evaluating prosthesis that made by different clinical experience, different laboratory technicians background and different socioeconomic status of patients.

Our study shows that the failure and complications in both types of prosthesis (crowns and FPDs) are significantly more in PFM than all ceramic material. This could be due to the tendency of regional laboratories to use a non-precious metal substructure. The main advantage of base metal alloys is their lightweight. These alloys also have a high modulus of elasticity, which even in thin sections provides rigidity. However, the downside of this rigidity is that it renders such base metals difficult to manipulate. In these situations, casting conditions must be precisely controlled to obtain exactly fitting restorations. Furthermore, these alloys are difficult to finish and hard to adjust. If this is not attended to by the dentist there will be a poor marginal adaptation [26]. For that reason, both a dentist and a technician should strive to provide restorations that possess an ideal adaptation to prepared tooth surfaces.

In our study, we found that about 26% of total 319 crowns and 54.4% of total 112 FPDs margins were open and 65% of crowns and 80% of FPDs prosthesis that had defective margins were significantly associated with caries. Creating an exposed prepared tooth rough surface between the restoration and tooth margins will play as a host for bacterial colonization and then subsequently caries initiation and propagation. And this could explain the high prevalence of caries around the defective margins. Comparably, one of the reports on failed prosthesis was published by Mojon et al [20]. They found that 74% of the margins of single crowns and fixed dental prosthesis were defective. They also found that about 20% of prosthesis that had open margins were associated with caries.

In our cross-sectional study, we found that out of 730 prosthesis units, open margin was the most frequent complication or failure followed by caries. Schwartz et al and Walton et al reported that caries was the most frequent cause of failure followed by defective margins as the second most cause of failure [25,26]. Karlsson concluded with that a deficiency in the margin makes the surface more prone to caries and the most serious deficiency is an open margin [27]. Other studies reported that the most common reason for failure and reason for removing fixed dental prosthesis was caries [16,22,26,27]. Furthermore, the results of this study show a significant relationship between the over-contoured prosthesis and the presence of caries around the defective margin. The presence of caries is increased around the defective margin if the prosthesis were over-contoured than that prosthesis with good contour.

The results of our study also show that there are a significant association between faulty prosthesis (crowns or FPDs) and gingival inflammation, and this is consistent with what other results found [20,23,24]. This high prevalence of gingival inflammation measurements could be due to lack of professional maintenance where oral hygiene measures are regularly reinforced. Also, these data indicated that periodontal health is potentially directly influenced by the discrepancy between the margin of the prepared tooth and the margin of the restoration. These technical problems are influenced by the operating clinician and technician and are more readily controlled. However, control of the biologic problems are less easily done and may not be related to the prosthetic treatment. These biologic problems may be influenced by gingival relation of the restorations (secondary caries, gingivitis, or periodontitis) and the outline. An optimal program prophylactic dentistry procedure will potentially greatly reduce the biologic problems among patients receiving fixed prosthesis.

The findings of our study show that out of 112 FPDs, 61 FPDs (54.5%) of these were short span and the rest was long span (either 4,5 or 6 units), and the percentage of failures or complications was higher in long span fixed partial denture than in short span. Comparably, one of the studies that did on failed short and long span prosthesis was published by De Backer et al, they found that there was a statistically significant difference

between the short span FPDs and long span FPDs [28,29]. It would make sense to say that fixed dental prosthesis should be as simple as possible. Extra abutments do not necessarily mean better security; they may carry more risk for irreversible complications.

A possible explanation for why our study shows a high prevalence of complications is the nature of the selected sample, and the lack of both initial data and follow up visits. Most of the patients from our study group were recruited from governmental care centres where the dental care is freely provided but with lower treatment quality. The lower quality of the delivered prosthesis could also be another potential reason for the reported high complication rate; for example, more than a quarter of the prosthesis were over-contoured. Given the lack of dental awareness and education level in general, most of these patients accepted their prosthesis at the time of the insertion visit. These results imply that the role of dental professionals and practitioners is of two folds; competent practice based on full knowledge of the biological and mechanical mechanisms of failure and improving their clinical skills and play a proactive role in improving public awareness on the possible complications of dental prosthesis and the importance of early detection.

The study's main strength was the wide range of participants' age, ethnicity, and sex. It was distributed among 5 dental centres, thereby sampling different treatment approaches. The study has some limitations. One of the limitations of this study is that the study group was from a single city in Saudi Arabia, this limited the generalisability of the results based on the different sociodemographic conditions in other regions. Furthermore, the results of this study would provide a basis for further research on this field in the region future. Also, research efforts should be directed to adopt the same research objective and use a large sample size approach for drawing more comprehensive results.

### CONCLUSION

Within the limitation of this study, the conclusions can be summarised as follows:

- All ceramic fixed dental prosthesis has better prognosis, less complications and higher success rate than PFM.
- Discrepancies at the prosthesis margins were associated with higher caries count and greater gingival inflammation of the supporting teeth.
- Over-contoured prosthesis is a contributing factor in the presence of dental caries around the defective prosthesis margin.
- Short span FPDs have better prognosis, less complications and higher success rate than long span FPDs.

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