

Failures Related to Crowns and Fixed Partial Dentures Fabricated in a Nigerian Dental School

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Abstract

The purpose of this investigation was to document the failure rate and length of service of crowns and fixed partial dentures (FPDs) fabricated in a Nigerian dental school. The reasons for failure of the initial restorations and their length of service were also ascertained. Also, the numbers of retainers, pontics, and the types of restoration were recorded. Poor esthetics was the most frequent cause of failure, 66 units (40.5%); followed by fracture, 58 units (35.6%); and dental caries, 25 units (15.4%). These outcomes were contrary to findings previously reported in studies from western countries where dental caries was principally responsible for failures (22.0% to 38.0% of cases). The resin-retained FPDs had the shortest mean years of service at 2.7 years, while the three-unit metal-ceramic FPDs had the greatest longevity at 8.6 years. The overall mean years of service for replaced restorations were 5.6 years. The study found a decrease in the mean years of service as the number of units in the fixed-fixed partial dentures increased. This is in sharp contrast to previous reports where no relationship existed between length of service and the number of units in a FPD.

Keywords: Crowns, metal-ceramic crowns, complete metal crowns, fixed partial dentures, failures, length of service, longevity

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Introduction

Clinical follow-up studies of patients treated with artificial crowns and fixed partial dentures (FPD) (bridges) are not commonly reported in most developing African nations where these specialized treatments are not readily available or provided. Furthermore, longitudinal studies in developed countries are often limited to the reporting of results from studies on individuals treated in dental schools and other institutions or a selected group of patients treated by specialists.¹ Nonetheless, these reports are extremely valuable for the overall assessment of various factors considered significant to the longevity of different restorations. These reports also aid in assessing the value of various restorative materials and prosthesis designs.

Crowns are used to restore fractured teeth and teeth with large amalgam or composite resin restorations. They restore function and can vastly improve esthetics, while protecting the remaining tooth structure at the same time. In other words a well-designed and properly placed fixed restoration can not only restore function but also actually improve esthetics (Figure 1).

Individual crowns may also serve as retainers on abutment teeth when replacing a missing tooth or teeth (Figure 2). The resulting FPDs can be constructed in a wide variety of designs to include a conventional complete metal or metal-ceramic FPD, a cantilevered FPD, a resin-retained FPD (or "Maryland bridge"), and, more recently, an implant-supported restorations. These prostheses may be fabricated in a wide variety of materials from composite or acrylic resin, to resin-bonded-to-metal, complete metal, all-ceramic materials, and the more traditional metal-ceramic FPD. The choice of materials often depends on the mechanical and esthetic considerations of a particular clinical case, the availability of these materials or systems, patient and dentist preference, and economics. In many developing countries, where dental services are paid for out-of-pocket by the patient, economic factors may drive the decision-making.

The newer, all-ceramic products have excellent biocompatibility and provide a natural appearance for the final restoration. However, the brittle nature of ceramics, in general, continues to be



Figure 1. A. Maxillary right and left central incisors with horizontal fracture of the incisal one-third.
B. Restoration of the same fractured maxillary central incisors.

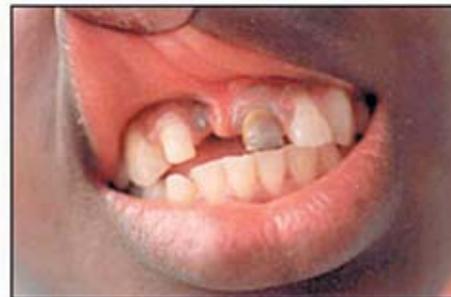


Figure 2. A. View of prepared maxillary right lateral incisor, missing right central incisor, and discolored prepared left central incisor.
B. Post-operative view with a three-unit fixed-fixed partial denture replacing the missing right central incisor.

a major factor that restricts the universal use of these materials in every clinical situation.²

³ The composite resin or acrylic resins have had moderate success when restoring anterior teeth where esthetics is of great importance. The initial color of a resin restoration may match adjacent teeth initially, and multiple shades could be used to provide characterization. However, clinical studies have shown there is an observable color shift over a period of three years.^{4,5}

Previously reported studies⁶ have assessed design factors related to clinical failure. The number of retainers and total units, the location, date of insertion, jaw position, and length of prosthesis were significant risk factors. The reasons for failure included loss of retention⁷, periodontal disease⁸, cementation failure, and, to a lesser extent, dental caries.⁹ However, other studies¹⁰ list dental caries as the most frequent cause of failure followed by periapical involvement. Tank et al.¹¹ in their systematic review of the survival and complication rates of FPDs revealed the 10-year risk for caries and periodontitis leading to FPD loss was 2.6% and 0.7%, respectively, while the risk for loss of retention was 6.4%, for abutment fracture 2.1%, and for material fractures 3.2% (Figure 3). Long-term clinical studies have shown the failure rate of adhesive FPDs is higher than that of conventional FPDs¹². In fact the failure rate of resin-retained (adhesive) FPDs has been reported to be as high as 25%³, compared to between 9.5%⁹ to 13%¹⁴ for conventional FPDs.

The FPDs inserted at the College of Dentistry King Saud University, Saudi Arabia, reported a lower failure rate than those placed in general dental practice.¹⁵ It was, therefore, the purpose of this investigation to document the failures related to and the length of service of crowns and FPDs fabricated in a Nigerian dental school, and to compare those outcomes to previously reported findings.

Materials and Methods

This study was a retro-prospective examination of artificial crowns and FDPs fabricated in the conservative clinic at the Obafemi Awolowo University, Ile-Ife, Nigeria, between January 1998 and December 2003. A review of patients'



Figure 3. A. Facial porcelain fracture of a metal-ceramic crown on the left lateral incisor.

B. Post-operative appearance of the repaired metal-ceramic crown.

records (for patients treated between 1998-2000) was conducted to determine whether the existing crowns and FPDs were replacements, the reason for failure of the initial restorations, and the actual length of service (longevity). The numbers of retainers, pontics, and type of restorations (acrylic/composite resin, complete metal (chrome cobalt), or metal-ceramic restoration) were recorded. For patients treated between 2001-2003, one examiner conducted the clinical evaluation. The classifications of the failures were similar to those reported by Schwartz et al.¹⁶, Walton et al.¹⁷, and Libby et al.¹⁰ to allow for comparison with previous research. A restoration that required repair or replacement was considered a failure. A failure due to periodontal disease would exhibit soft tissue pathosis, alveolar bone loss, cervical pocket formation, and excessive mobility.¹⁶

The data collated were subjected to descriptive analysis.

Results

Four hundred and fifty six (456) crowns were fabricated for 278 patients between January 1998 and December 2003. Of these patients, 153 (55.0%) were males and 125 (45.0%) were females ranging from 18-69 years of age with a mean age and standard deviation of 29.9 ± 10.8 years.

Acrylic resin crowns accounted for 283 (62.1%) of the restorations, followed by 136 (29.8%) metal-ceramic crowns, and 37(8.1%) complete metal crowns. Of the 456 crowns fabricated, 163 (46.0%) represented the replacement of failed restorations (Table 1). Poor esthetics (discoloration of acrylic resin and poor color match of metal-ceramic crowns) was the most frequent cause of failure occurring in 66 units (40.5%) of those 163 restorations, followed by crown fracture, fracture of acrylic resin crown, and porcelain failure which accounted for 58 units (35.6%) of failure. Dental caries was responsible for only 25 failures (15.4%) Table 2. The mean years in service for the replacement crowns ranged from 4.7 years (because of poor esthetics) to 6.6 years (failure due to crown fracture).

During this same period, 76 FPDs, totaling 260 units, were fabricated for 76 patients (32 females and 44 males). The distribution of those prostheses is shown in Table 3. Resin-bonded FPDs were constructed for patients 20 years old and younger, while a two-unit cantilevered FPD

was fabricated mostly for patients 40 years old and younger. A three-unit or six-unit FPD was found more commonly in patients older than 40 years of age. The mean years of service of the various FPD types are shown in Table 3. The resin-bonded prostheses invariably had the shortest mean years of service (2.7 years), while a three-unit fixed-fixed partial denture survived the longest (8.6 years). Of the 76 total FPDs, 22 prostheses (29.0%) involving 54 units represented replacement of failed restorations (Table 1). As shown in Table 4, porcelain failure (fracture) was the most frequent reason given for replacement and accounted for 9 of these 22 cases (40.9%), followed by cementation failure that accounted for 6 cases (27.3%). For FPDs, the mean years in service ranged from 4.2 years (cementation failure) to 7.6 years (periodontal reasons). The overall mean years of service for replaced restorations were 5.6 years.

Discussion

A primary foundation of achieving favorable long-term success with crowns and fixed prostheses is regular patient recalls to evaluate these restorations and supporting structures. When patient recall compliance is poor, as it is in this part of the world, long-term follow-up becomes extremely difficult. Therefore, the causes of failure and the length of service of restorations were determined by evaluating patients when they either presented for a repair or requested replacement of their existing restorations (Figure 4).

Table 1. New restorations vs replacement restorations.

Type of restoration	New		Replacement		Total	
	No	(%)	No	(%)	No	(%)
Artificial crowns	293	(64.3)	163	(35.7)	456	(100.0)
Fixed partial dentures	54	(71.0)	22	(29.0)	76	(100.0)

Table 2. Reasons for artificial crown failures.

Cause of failure	Acrylic resin		PFM		Full metal		Total		Mean years of service
	No	(%)	No	(%)	No	(%)	No	(%)	
Caries	11	(6.8)	9	(5.5)	5	(3.1)	25	(15.4)	6.5
Cementation failure	4	(2.5)	2	(1.2)	-	-	6	(3.7)	5.3
Poor esthetics	58	(35.6)	8	(4.9)	-	-	66	(40.5)	4.7
Crown fracture	6	(3.7)	52	(31.9)	-	-	58	(35.6)	6.6
Defective margins	2	(1.2)	2	(1.2)	1	(0.6)	5	(3.0)	4.8
Periodontal disease	2	(1.2)	1	(0.6)	-	-	3	(1.8)	5.6
Total	83	(51.0)	74	(45.3)	6	(3.7)	163	(100.0)	5.6

Table 3. Failure of FPDs by type of bridge design and number of units.

Type of FPDs	No	(%)	No and % of FPDs failed		Mean years of service
2-unit Cantilevered	17	(22.4)	6	(7.9)	4.0
Resin – bonded	8	(10.5)	5	(6.6)	2.7
Fixed – fixed					
3 – Units	22	(28.9)	5	(6.6)	8.6
4 – Units	18	(23.7)	4	(5.3)	6.4
5 – Units	7	(9.2)	1	(1.3)	4.5
6 – Units	4	(5.3)	1	(1.3)	4.2
Total	76	(100.0)	22	(29.0)	

Table 4. Reasons for FPD failures.

Cause of failure	No and % of FPDs failed		Mean years of service
Dental caries	3	(13.6)	7.0
Cementation Failure	6	(27.3)	4.2
Poor esthetics	2	(9.1)	4.5
Porcelain fracture	9	(40.9)	5.6
Defective margin	1	(4.6)	4.5
Periodontal disease	1	(4.6)	7.6
Total	22	(100.1)*	5.6

*Rounded-up percentages

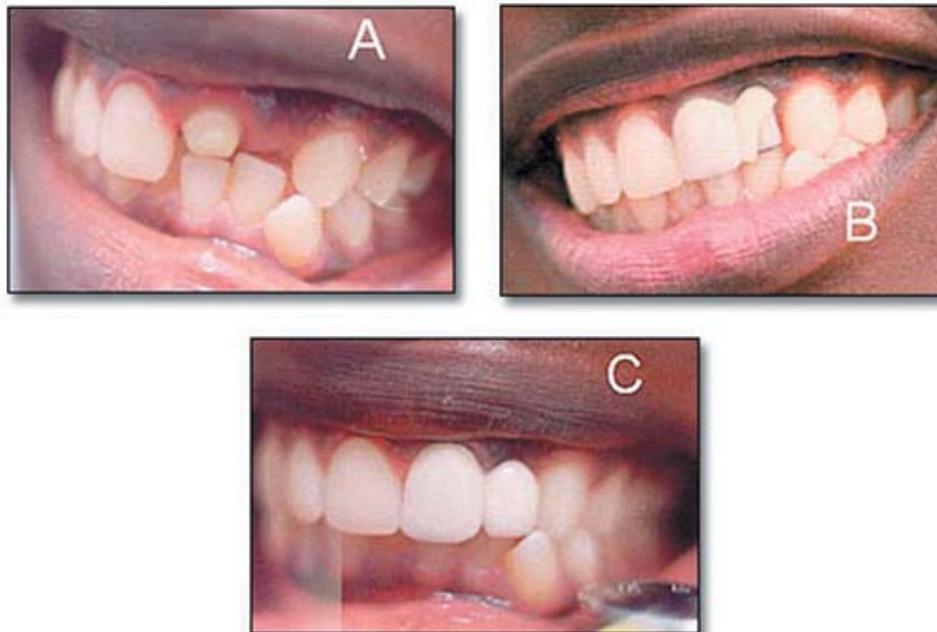


Figure 4. A. The prepared maxillary left central incisor and missing left lateral incisor. B. Fracture of the two-unit metal-ceramic cantilevered fixed partial denture replacing the maxillary left lateral incisor. C. Post-operative appearance of the replacement cantilevered metal-ceramic fixed partial denture.

Over the course of the past decade, demand for esthetically pleasing restorations has increased dramatically. This trend has led to the development of all-ceramic (porcelain) systems. However, because of technical difficulties fabricating these restorations and the inherent brittleness of these materials, all-ceramic restorations have not become popular among Nigerian patients. The metal-ceramic restoration remains the restoration of choice, because it combines both esthetic and strength. In addition metal-ceramic restorations are able to withstand high masticatory forces generated during chewing associated with the more fibrous Nigerian diet. Although complete metal and metal-ceramic restorations are considered to be definitive restorations, more acrylic resin provisional crowns were fabricated mainly because of economic factors because patients pay for their restorations themselves.

Poor esthetics was the most frequent cause of failure in this study, accounting for 40.5% of crown failures (Table 2). This finding ran counter to studies by Walton et al.¹⁷ and Libby et al.¹⁰ in western countries where dental caries was the primary cause of failure accounting for 22.0% and 38.0% of failed restorations, respectively. This outcome may be explained by the fact most restorations in the present study were made for anterior teeth. The margins were sub-gingival in the labial surfaces and supra gingival in the palatal/lingual surfaces. These locations allow for improved oral hygiene at home as compared to hygiene levels for the posterior teeth in the same patient. Also, it has been reported sub-gingival margins create more inflammation than supra-gingival margins.^{18,19} Dental caries accounted for only 15.4% of crown failures in this study, and restorations had a mean length of service of 5.6 years. This longevity was much shorter than the 10.9 years and 16 years reported by Walton et al.¹⁷ and Libby et al.¹⁰, respectively. For metal-ceramic crowns and FPDs, porcelain failure (fracture) was the most frequent reason for repair or replacement (Figure 3). Long-term

clinical studies have shown the failure rate of resin-retained FPDs was higher (shorter years of service) than when conventional FPDs were placed.¹¹ Such a finding was also supported by the outcomes obtained in this study. Resin-retained FPDs had the lowest mean years of service, a mere 2.7 years (Table 3), a finding very much in agreement with the result of Hussey et al.¹³, who reported a range of 1-42 months and a mean of 2.7 years of service. Apparently, these failures occur because clinicians often fail to adhere to basic principles of fixed bridge prosthodontics namely that abutment teeth should be matched for effective root surface area (bony support).²⁰

The overall mean years of service for crowns and FPDs in this study was 5.6 years. This value compares favorably well with the average lifespan of 6.1 years reported by Fayyad and al-Rafee¹⁵, but is lower than the mean length of service of 8.3 years reported by Walton et al.¹⁷ authors contend the lifespan of a FPD is correlated with the number of retainers but not with the number of units.⁶ This study found a decrease in the mean years of service as the number of units in a FPDs increased (Table 3). The mean year of service for a three-unit FPD was 8.6 years and just 4.2 years for a six-unit FPD. This finding differed from previous studies where no relationship was noted between length of service and the number of units in a FPD.^{16,17}

Conclusions

In the present study poor esthetics was the most frequent cause of failure of restorations, followed by fracture. This ran counter to findings previously reported in studies from western countries where dental caries was principally responsible for failures. The study also found a decrease in the mean years of service as the number of units in the fixed-fixed partial dentures increased. This is in sharp contrast to previous reports where no relationship existed between length of service and the number of units in a FPD.

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