Research Paper
Impact Factor: 4.164
Refereed Journal

IJMDRR
E- ISSN –2395-1885
ISSN -2395-1877

COMPLICATIONS ASSOCIATED WITH CROWNS AND FIXED PARTIAL DENTURES PROVIDED TO PATIENTS AT A TEACHING HOSPITAL.

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Abstract
Objective: *To evaluate complications associated with crowns and fixed partial dentures provided to patients.*
Design: *Descriptive cross-sectional study.*
Setting: *School of Dental Sciences, University of Nairobi.*
Subjects: *97 patients (35 male, 62 female) who had been provided with a total of 150 prostheses at the School of Dental Sciences between 2009 and 2015.*

Materials and Methods: *A structured, interviewer administered questionnaire was used to collect relevant information. A clinical and radiographic evaluation was conducted for the crowns and fixed partial dentures. The data collected was analyzed using the Statistical Package for Social Sciences (SPSS v. 21, IBM). Pearson's Chi square and Fisher's exact test were applied to test the relationship between various variables.*

Results: *Defective margins, loss of retention and porcelain fractures were the most common technical complications associated with crowns and FPDs affecting 14.7%, 14% and 10% of the prostheses respectively. Sensitivity was the most common biological complication affecting 17.3% of the prostheses. Fifty nine crowned teeth (86.8%) and 79(57.7%) abutments exhibited signs of gingivitis. Slight shade disharmony was evident in 52.9% of the crowns and 53% of the FPDs.*

Conclusion: *Sensitivity, porcelain fractures, defective margins and loss of retention were the most significant complications associated with both crowns and fixed partial dentures. Slight shade disharmony was evident on many prostheses however most were clinically acceptable not warranting any intervention.*

Key Words: Crowns, Fixed Partial Dentures, Complications

Introduction

In fixed prosthodontics, complications may be an indicator of clinical failure though this is not always the case as some complications can be managed without resulting in loss of the prostheses. Complications may reflect substandard care though it is well recognized that even in situations where treatment procedures have been performed appropriately they may still occur.[1] Several complications may arise related to crown and fixed partial denture (FPD) work.[2] These include biological, mechanical and aesthetic complications which if unattended may lead to eventual loss of the prosthesis and abutment teeth. Biological complications that have been documented in studies include pain, secondary caries, periapical pathology, periodontal disease and effect on opposing teeth. Mechanical complications include fracture of the porcelain, tooth/root fracture, fractured prosthesis, loss of retention and defective margins. Aesthetic complications on the other hand include recession, over contoured crowns, shade disharmony with adjacent teeth and chipping of porcelain with metal exposure.[2]
A systematic review of studies on complications of fixed prosthodontic work reported mean complications prevalence of 11% and 27% for single crowns and fixed partial dentures respectively. [1] In this review the most common complications for single crowns and fixed partial dentures included conditions that resulted in need for endodontic treatment, caries, periodontal disease, porcelain fracture and loss of retention. In another study, crown fracture, aesthetics and secondary caries were the most common reasons for crown replacement accounting for 27%, 18% and 15% respectively.[3] In an evaluation of post retained restorations, Petzfeldt et al[4] reported fracture of post, post loosening and fracture of teeth as some of the complications associated with these types of restorations.

Many patients provided with crowns and fixed partial dentures at the School of Dental Sciences, University of Nairobi are not followed up due to lack of a proper recall system. Occurrence of the above mentioned complications is therefore unknown, thus may remain unresolved leading to patient dissatisfaction, suboptimal service from the prostheses and even loss of the prostheses. Therefore the purpose of this study was to establish complications associated with crowns and fixed partial dentures provided to patients at this teaching hospital.

Materials and Methods

This was a descriptive cross sectional study. The study was conducted at the School of Dental Sciences, University of Nairobi. This university is located within the capital city of Kenya. The study population comprised of patients who had received crowns and tooth supported fixed partial dentures at the School of Dental Sciences between 2009 and 2015. Ethical clearance was obtained from the Kenyatta National Hospital/ University of Nairobi Ethics and Research Committee.

The school records were searched manually for patients who had been provided with crowns and FPDs between 2009 and 2015. A total of 208 patients were identified and called up for review. Ninety seven patients availed themselves for review and were included in the study upon satisfying consenting procedures. These patients had been rehabilitated with 69 FPDs and 81 single crowns. These prostheses had been provided by undergraduate students, intern doctors and graduate students during their training at the institution.

An interviewer administered questionnaire was used to collect information on socio-demographic data, history of pain or sensitivity associated with the prostheses, history of documentation and any other information relevant to the study. The length of service, materials used and level of training of clinicians were established from the patient notes on file. A clinical examination was conducted to assess the condition of the crowns and FPDs, the California Dental Association criteria was used.[5] The periodontal status of the abutment teeth was evaluated by assessment of gingival scores (Loe and Silness 1963), probing pocket depths, periodontal attachment levels and tooth mobility. This was followed by radiographic examination of all crowned and abutment teeth.

All these data was collected by the first author who had undergone calibration by one of the senior Prosthodontists in the department. Basic descriptive statistics were performed. Chi square test and Fisher's exact test were performed to identify associations between different variables. The level of significance was set at 0.05.

Results

A total of 97 patients took part in the study, their ages ranged from 23 to 76 years averaging 44.65($\pm$ 12.61 SD) years. Thirty five (36.1%) were male and 62 (63.9%) were female. These patients had been provided with a total of 69 fixed partial dentures and 81 crowns. The FPDs had a total of 241 units consisting of 143 abutments and 98 pontics. A large number of these prostheses (72.7%) had been provided by graduate students (Table 1). Majority of the prostheses had been fabricated by porcelain fused to metal, a total of 78(96.3%) crowns and 68(98.6%) FPDs. The remaining 3(3.7%) crowns had been fabricated from all ceramic materials whereas 1(1.4%) FPD had been fabricated from heat cure acrylic. At the time of examination 13(16%) crowns and 3(4.3%) FPDs were missing or had been replaced, hence a total of 68 crowns and 66 FPDs containing 137 abutments and 94 poetics were present.

The mean length of service for crowns was 35.94 ($\pm$ 20.05 SD) months (Figure 1) whereas that of FPDs was 42.79($\pm$ 22.25 SD) months (Figure 2). Length of service was defined as the lifetime of FPDs and crown units from cementation up to the time of examination. This was calculated only for prostheses that were present at the time of examination since the time of failure for missing restorations or restorations that had been replaced could not be accurately determined.

Biological complications

Sensitivity was the most common biologic complication affecting 18 (27.2%) FPDs and 8 (11.8%) crowns. Two FPDs (3%) and 1 crown (1.5%) were affected by caries. Loss of vitality was witnessed on 2 FPD abutments on two different prostheses while no crowned tooth was affected.

Gingival recession was present on 2(1.5%) FPD abutments. Out of 137 abutments which were evaluated 31(22.6%) had mild gingivitis, 75 (54.8%) had moderate gingivitis while 4(2.9%) had severe gingivitis. One abutment had a probing depth of 6mm whereas the rest had a robbing depth that was between 1-3mm. Two (1.4%) abutments had periodontal attachment loss (PAL) greater than 5mm, 26(19%) between 3-4mm and 9 (6.6%) between 1-2mm.

Forty seven (69.1%) crowned teeth had moderate gingivitis whereas 12(17.7%) had mild gingivitis, none exhibited signs of severe gingivitis. Six (8.8%) crowned teeth had probing depths greater than 3mm. Periodontal attachment loss of between 1-2 mm was present in 7 (10.3%) of the teeth whereas 8(11.8%) had between 3-4mm attachment loss.

Technical complications

Using the CDA criteria 12(18.8%) FPDs and 9(13.2%) crowns that were evaluated had defective margins and were recommended for replacement. One of the three FPDs which were missing at the time of examination had also been replaced due to defective margins. A statistically significant relationship was demonstrated between the clinician's level of training and the presence of defective margins (Fisher's Exact Test = 10.306, p= 0.003). There was no statistically significant association between defective margins and sensitivity ($\chi^2 = 3.09$, p = 0.079).

A total of 6(9.1%) FPDs and 4 (5.9%) crowns that were present for evaluation were affected by porcelain fracture. Additionally, five out of the thirteen crowns that were missing had been replaced due to porcelain fracture, hence the total amount of crowns affected by porcelain fractures was 9(11.1%) There was no statistically significant association between porcelain fracture and the length of service (Fisher's exact test = 0.657, 0.702) nor between porcelain fracture and the crowned tooth type (Fisher's exact test = 7.289, p= 0.199).

Six (8.7%) FPDs and 15(18.5%) crowns had decremented at least once in the lifetime of the prostheses. This data for documentation was inclusive of restorations which were missing or had been replaced There was no statistically significant relationship between length of service and history of loss of retention (Fisher's Exact test = 3.228, p= 0.624).
Four (4.9%) crowned teeth had fractured; three of these fractured teeth had been extracted.

Esthetic complications
Out of the 68 crowns which were evaluated clinically, 36(52.9%) exhibited slight shade disharmony that was clinically acceptable. Thirty five FPDs (53%) out of 66 also exhibited slight shade disharmony. There were no crowns or FPDs that had gross shade disharmony. There was no significant association between presence of shade disharmony and level of clinician's training (χ^2 = 1.089, 0.297). Twenty one crowns (30.8%) and 12 (18.1%) FPDs were overcontoured.

Table 1: Level of clinician training

Type of restoration	Undergraduate n (%)	Graduate n (%)	Intern n (%)	Total
Crown	23(28.4%)	54(66.7%)	4(4.9%)	81
FPDs	14(20.3%)	55(79.7%)	0	69
Overall	37(24.6%)	109(72.7%)	4(2.7%)	150

Table 2: Complications associated with crowns

Complication	Number of crowns affected n (%)
Sensitivity	8 (11.8%)
Caries	1(1.5%)
Gingivitis	59(86.8%)
Periodontitis	15(22.1%)
Defective margins	9(11.1%)
Porcelain fracture	9(11.1%)
Tooth fracture	4(4.9%)
Slight shade disharmony	36 (52.9%)
Overcontoured	21(30.8%)
Loss of retention	15(18.5%)

Table 3: Complications associated with fixed partial dentures

Complication	Number of prostheses/abutments affected. n(%)
Sensitivity	18 (27.2%) prostheses
Caries	2(1.5%) abutments
Gingival recession	2(1.5%) abutments
Loss of vitality	2(1.5%) abutments
Gingivitis	79(57.7%) abutments
Periodontitis	37(26.8%) abutments
Defective margins	13(18.8%) prostheses
Porcelain fracture	6(8.7 %) prostheses
Slight shade disharmony	35 (53%) prostheses
Overcontoured	12(18.2%) prostheses
Loss of retention	6(8.7%) prostheses

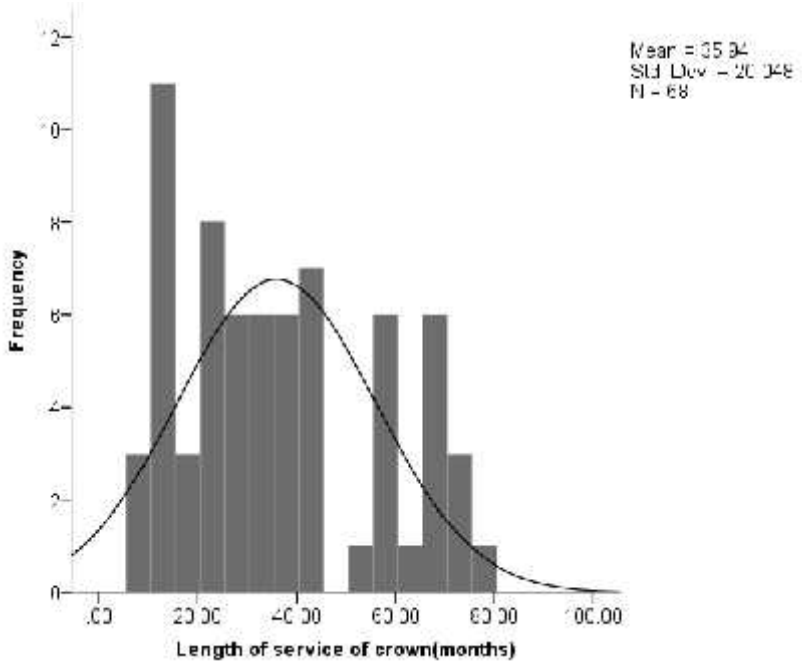

Figure 1: Length of service of crowns

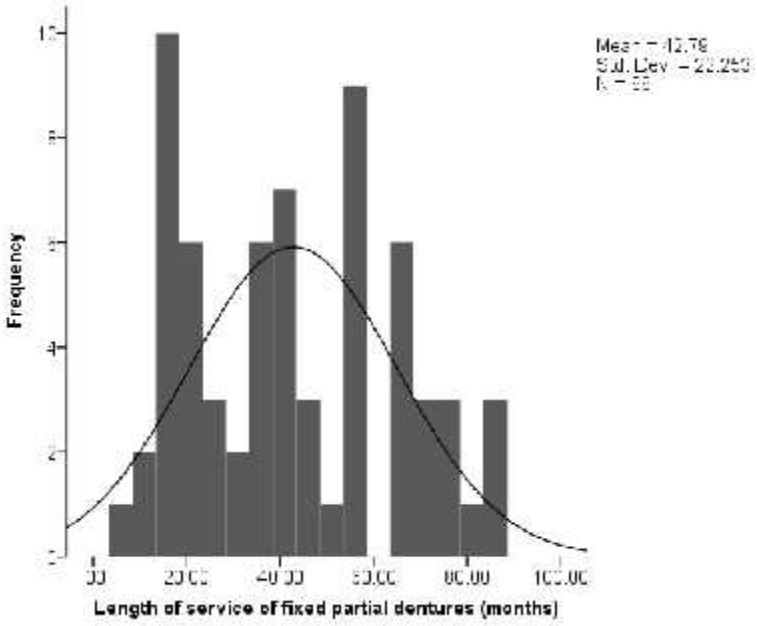

Figure 2: Length of service of fixed partial dentures

Discussion

Defective margins, porcelain fractures and loss of retention were among the most common complications associated with crowns. These findings compared well with a systematic review by Goodacre et al,[1] who reported that porcelain fractures and defective margins were among the most common complications associated with crowns. However, the findings differed slightly in that need for endodontic treatment was highlighted by Goodacre et al as among the most common complications however in this study there was no incidence of a crowned tooth that was in need of endodontic treatment. This may partly be attributed to the relatively short mean length of service captured in the study. Biological complications like caries and loss of

vitality have been shown to occur after a long duration of time. One study quoted an average of 9.7 years whereas the mean length of service in our study was 3 years.[6]

Absence of a crowned tooth in need of endodontic treatment in our study may also be attributed to the fact that it is institutional practice within the school to perform endodontic treatment on teeth with history of pulp capping and very large restorations prior to crowning. This serves to minimize the occurrence of this complication.

Sensitivity, defective margins, porcelain fractures and loss of retention were the most common complications associated with FPDs. These findings differed from those reported by Goodacre et al,[1] in the systematic review whereby caries, need for endodontic treatment and loss of retention were the most common complications associated with conventional FPDs.

The low incidence of caries and loss of vitality in this study may be explained by the comparatively shorter mean length of service for the FPDs (3.5 years). It may also be attributed to careful patient selection for crowns and FPDs, the population evaluated generally exhibited good oral hygiene with a low average plaque score of 1.4. This could be an indicator that patients selected for these kinds of treatment were well motivated patients maintaining good oral hygiene hence at low caries risk. On the other hand, presence of defective margins in many of the failed restorations could imply that in the long-term these crowned and abutment teeth would be susceptible to caries and loss of vitality.

Porcelain fractures and defective margins were common complications for both crowns and FPDs. Intra-oral porcelain has the potential to fracture; fracture may occur due to several reasons which include high occlusal forces, trauma, incompatible coefficients of thermal expansion between the porcelain and the metal alloy, low-elastic modulus of the metal alloy, improper design and micro-defects within the porcelain material.[7] This complication usually presents an esthetic challenge due to exposure of underlying metal, more so in the esthetic zone.

A significant number of prostheses possessed defective margins, a total of 18.8% FPDs and 11.1 % of the crowns. Accurate marginal fit of indirect restorations is critical for long term success. This is because ill-fitting margins will render the tooth more susceptible to cement dissolution, once this occurs marginal leakage ensues and this usually results in secondary caries and may lead to loss of vitality of the abutment if undetected. Ill fitting margins also result in plaque retention which also predisposes the abutment to recurrent caries. Defective sub gingival margins may compromise gingival health by causing an alteration in local bacteria.

Defective margins may arise due to clinical or laboratory errors. Clinical errors may arise due to improper preparation of finish lines or inadequate retraction of the gingival during impression taking. Presence of air bubbles within the margin captured on the impression may also contribute to these errors.[8] A statistically significant association was established between the level of clinician's training and presence of defective margins, this is expected because graduate students who have more experience would be expected to make better finish line preparations and take better impressions, moreover they are able to make better assessments of the marginal fit prior to cementation. Laboratory errors on the other hand may arise due to poor die trimming, surplus untrimmed porcelain/wax, and difficulty in identification of the finish line, chipped dies and failure to utilize a spacer which results in a tightly fitting crown that lifts off during cementation resulting in a marginal gap.[8]

All crowns and FPDs within our study that were noted to have defective margins that could not be corrected were indicated for replacement. Defective margins may present as marginal gaps, positive or negative margins. Positive margins in the absence of a gap can be corrected. However marginal gaps and negative ledges pose a much bigger problem that is difficult to correct and often necessitate replacement of the prosthesis.[8]

Base alloys have been shown to have increased problems with casting accuracy, cast ability and porcelain-alloy compatibility when compared to precious metals.[9] these challenges may have contributed to the large number of defective margins and porcelain fractures in this study since base metal alloys were utilized for all the porcelain fused to metal prostheses.

The most common esthetic complication encountered was shade mismatch. This maybe partly attributed to the use of porcelain fused to metal, this material was utilized for 78(96.3%) crowns and 68(98.6%) FPDs in this study. Porcelain Fused to Metal prostheses have an esthetic limitation that arises due to the presence of underlying metal beneath the porcelain and the layer of opaque porcelain which is usually necessary to mask the underlying grayish shade from the metal. This usually results in a restoration that lacks translucency usually associated with natural teeth.[10] the shade mismatch however was slight and was clinically acceptable in most cases. The subjectivity of visual color matching that is practiced in the institution may also have contributed to the slight shade discrepancy.

It is not surprising that 47 (69%) crowned teeth and 79 (57.6%) FPD abutments in this study had a GI score of 2 and above since crowns and FPDs abutment have been shown to harbor increased plaque accumulation with resultant gingival inflammation.[11] this was well demonstrated in a study conducted by Vaulderhaug et al, [12] in which they evaluated the periodontal conditions in patients with bridges. In their findings they reported that the gingival of crowned teeth was more commonly inflamed as compared to that of control teeth. These crowned teeth more frequently registered a GI score of 2 and 3 as compared to the control teeth. However, in our study the periodontal status of control teeth was not recorded hence the periodontal status of the crowned and abutment teeth cannot be solely attributed to the presence of prostheses.

Summary

A number of technical, biological and esthetic complications were identified in this study. Sensitivity, porcelain fractures, defective margins and loss of retention were the most significant complications associated with both crowns and fixed partial dentures. Slight shade disharmony was common however in majority of the prostheses the disharmony was within acceptable range. This information is useful in treatment planning and communication of appropriate expectations to patients. Furthermore, causes of commonly occurring complications maybe investigated with the aim of minimizing their occurrence.

Acknowledgements

The authors want to thank the University of Nairobi for facilitating the study, Beryl Adhiambo for assisting in retrieval of patient records, Dr Hope Mwakisha and Tracy Gichuhi for their assistance during data collection and Desmond Owino for his assistance in the data analysis.

Disclosure: The authors did not receive any funding to carry out the research; there was no affiliation with any person or institution which may have posed a conflict of interests.

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