

Clinical Evaluation and Periapical Status of Crowns and Fixed Partial Dentures in a Selected Saudi Population: Retrospective Study

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Abstract

Background: Patient satisfaction is a critical component of clinical success in patients undergoing restorations. As a result, the purpose of this study was to assess the clinical performance of crowns and multi-unit fixed prosthodontics in order to determine the frequency of problems associated with crowns and fixed restorations in a Saudi subpopulation using clinical and radiographic parameters.

Methods: Three-hundred patients who received crowns and tooth-supported fixed partial dentures at dental polyclinics center in Hail region, Saudi Arabia between March 2021 and October 2021 were included in the study. The method of purposeful sampling was used. Clinical and radiographic examinations were used to identify patients who received crowns and FPDs at the dental center during the specified time. Patients with at least three-unit FPDs or a single crown with a natural contra-lateral tooth / teeth met the inclusion criteria. Six general dentists performed clinical and radiographic examinations. The criteria for evaluation the crowns and FPDs were technical and biological complications and satisfaction of the patients. Cross-tabulation is used to determine the frequency and percentage of the various parameters used in the current study.

Results: The majority of the restoration had non-acceptable marginal integrity 249 (83%). Most of the restorations 181 (60.3%) had acceptable morphology. Almost all of the restorations 289 (96.3%) had unsatisfactory color. Visible periodontal depth equal or more than 5 mm were found in 53 (17.7%). Most of the fixed restorations were associated with gingival bleeding 240 (80%), while periapical lesion was found on 72 (24% teeth in all patients. The most patients 219 (73%) reported to be non-satisfied with their fixed restorations. **Conclusions:** The technical and biological complications noted in the current study were higher to other studies of FPDs. The majority of patients were dissatisfied with the restoration.

Background

Fixed Dental Prostheses (FDPs) are prosthetic teeth that are permanently attached to the remaining teeth and replace missing teeth. The traditional crown and fixed partial denture treatment technique is widely used and very effective in restoring the functionality of one or more teeth that have been lost or are missing. The restorative material could be all metal, all porcelain, a metal-ceramic mix, or a metal mixed with processed resin [1]. All-ceramic fixed partial dentures (FPDs) have become widely used in clinical dentistry as new all-ceramic materials have been developed and made available for clinical use. All-ceramic systems have demonstrated good clinical performance, especially in the anterior area [2]. Fractures of posterior all-ceramic FPDs, on the other hand, have been reported as a major cause of failure for these restorations [3].

Despite the increasing popularity of dental implants, traditional crowns and fixed restorations continue to play an important role in the overall and practice of prosthodontic restoration, especially in developing countries [4]. A ceramic crown, on the other hand, is made up of complex operations that take place over several stages. As a result, there is a significant risk of introducing voids into the material, making it

brittle. Replacing manual operations with automated procedures, such as in CAD/CAM systems, may improve material properties. The automated fabrication procedures may improve ceramic restoration homogeneity, increasing the likelihood of clinical success.

Correct case selection, thorough diagnosis, rigorous preparation, and expert prosthesis construction are all required for the effectiveness and duration of biological investing tissue restoration and maintenance of health [5, 6]. A poorly managed prosthesis, on the other hand, is more likely to fail prematurely, causing irreversible damage to the teeth and supporting tissues below [7].

According to Goodacre et al. [6], dental caries was the most common complication associated with traditional fixed restorations. They discovered caries in 18% of abutments and teeth that require root canal treatment after prosthesis in 11% of abutments. Cosmetics (6%), periodontal disease (4%), tetracycline (4% of prostheses), loss of retention (7% of prostheses), and tetracycline were some of the complications (4%). The most common problems associated with fixed prostheses were porcelain fracture (3%), restoration loss (2%), necrotic pulp (3%), periodontal disease (0.6%), and cavities (2%). Caries (2%) was the most common problem as a result of post and core restorations, followed by loosening of post (5%), root fracture (3%), and periodontal disease (2%) [6].

Patient satisfaction is a critical component of clinical success in patients undergoing restorations. The evaluation of satisfaction outcomes enables a direct evaluation of patients' thoughts and feelings about various aspects of prosthodontic rehabilitation. Improvements in dental health and aspects of quality of life (such as function, comfort, and aesthetics) influence patient satisfaction with ceramic treatments [8].

Treatment with crowns and fixed partial dentures necessitates a specific set of skills and knowledge. It is one of the most common treatment methods in dentistry. Previous studies [2, 8] investigated and reported on patient satisfaction with all-ceramic restorations in terms of oral hygiene and treatment satisfaction. However, no studies on the determinants of patient satisfaction with ceramic restorations and their clinical outcomes in a Saudi subpopulation have been published. As a result, assessing the achievement and survival of built restorations, as well as the causes and types of problems and failures associated with these prostheses, is critical. Understanding these variables will improve the dentist's ability to design the most appropriate therapy, provide realistic expectations to patients, and develop an acceptable maintenance regimen for fixed prosthesis patients [6, 9]. As a result, the purpose of this study was to assess the clinical performance of crowns and multi-unit fixed prosthodontics in order to determine the frequency of problems associated with crowns and fixed restorations in a Saudi subpopulation using clinical and radiographic parameters.

Method

This descriptive observational cross-sectional study was approved by the Ethical Committee of the College of Dentistry at the University of Hail. This was influenced by the availability of records for crowns and FPDs given to patients; records for work done prior to 2010 could not be found. The collection of data began in early 2021.

Patients who received crowns and tooth-supported fixed partial dentures at dental polyclinics center in Hail, Saudi Arabia between March 2021 and October 2021 were included in the study. This polyclinic is the largest in the Hail region. Central's dental services draw a large number of dental patients from all over the city and its surroundings. This dental polyclinic also educates interns and postgraduate students.

The method of purposeful sampling was used. Clinical and radiographic examinations were used to identify patients who received crowns and FPDs at the dental center during the specified time period. Following completion of the consenting procedures, all patients who responded and showed up for evaluation were included in the study.

Patients with at least three-unit FPDs or a single crown with a natural contra-lateral tooth / teeth met the inclusion criteria. Patients with FPDs greater than 3 units, on the other hand, were excluded from this study. Patients with FPDs who did not have natural contra-lateral tooth/teeth were also excluded from the study. Patients who had previously repaired FPDs were also barred from participating in the current study. Three-hundred patients satisfying the criteria for inclusion in this study were identified.

Clinical examination yielded a list of patients who received crowns and FPDs between 2010 and 2020. All teeth with artificial crowns and all abutments for FPDs were also radiographically examined. An x-ray viewer was used to examine the radiographs. Six general dentists performed clinical and radiographic examinations. The criteria for evaluation the crowns and FPDs is shown in Table 1. The Statistical Package for the Social Sciences, version 16.0, was used for statistical analyses (SPSS Inc., Chicago, IL, USA). Cross-tabulation is used to determine the frequency and percentage of the various parameters used in the current study.

Table 1
Parameters recorded in this study

Definition	Criteria	Parameters
Technical criteria or consideration		
Marginal integrity	Acceptable (Sierra)	Detectable slight marginal discrepancy; repair is unnecessary. Discoloration between the crown and the tooth.
	Unacceptable (Victor)	Restoration is mobile, lost, or fractured, or caries contiguous with the margin or restoration or tooth structure fractured.
Morphology	Acceptable (Sierra)	Continuous contour with an existing anatomical form of the adjacent and contralateral teeth with minor deviations.
	Retrievable (Tango)	Deviations that create discomfort. Can be adjusted.
	Unacceptable (Victor)	Restoration causes pain in the tooth or adjacent tissue.
Color	Acceptable (Sierra)	Slight mismatch between shade of the restoration and adjacent teeth, within normal range of tooth color, shade and/or translucency.
	Unacceptable (Victor)	Mismatch between restoration and adjacent teeth outside normal range of color, shade and/or translucency
Biological criteria or consideration		
Periodontal depth	Less than 5 mm	
	Equal or more than 5 mm	
Gingiva bleeding	Bleeding on probing	
	No bleeding on probing	
Periapical lesion	Yes	If the widening of the apical part of the periodontal ligament or if the periapical radiolucency in connection with the apical part of the tooth exceeds at least two times the width of the lateral part of the periodontal ligament, such teeth were categorized as having obvious periapical radiolucency.
	No	If the periodontal ligament was intact with no signs of periapical disease.
Ceramic surface	Yes (Charlie)	Chipping of ceramic impairing esthetics and function or exposing tooth structure; intraceramic fissures detectable with the explorer.
	No (Alpha)	Smooth surface (shiny after air-drying).
Dental carious	Yes (Bravo)	Caries is evident contiguous with the margin of the restoration
	No (Alpha)	No evidence of caries contiguous with the margin of the restoration.
Other parameters		

Definition	Criteria	Parameters
Satisfaction	Yes	
	No	
Materials	PFM	
	Zirconia	
	Other	
Types	Crown	
	3 units bridge	
Location	Anterior	
	Posterior	

Results

Technical findings and complications were are shown in Table 2. The majority of the restoration had non-acceptable marginal integrity 249 (83%). However, acceptable marginal integrity was found only in 51 (17%). Most of the restorations 181 (60.3%) had acceptable shape whereas the non-acceptable morphology were only found in 25 (8.3%). The retrievable morphology were found in 94 (31.3%). Almost all of the restorations 289 (96.3%) had un-satisfactory color and the rest was evaluated as satisfactory 11 (3.7%).

Table 2
Technical complication recorded in the present study

Parameter	Measurement	n (%)
Marginal integrity	Acceptable	51 (17)
	Non-acceptable	249(83)
Morphology	Acceptable	181 (60.3)
	Retrievable	94 (31.3)
	Non-acceptable	25 (8.3)
Color	Acceptable	11 (3.7)
	Non-acceptable	289 (96.3)

Biological complication as a result of restorations were are shown in Table 3. Visible periodontal depth equal or more than 5 mm were found in 53 (17.7%). Most of the fixed restorations were associated with gingival bleeding 240 (80%), while periapical lesion was found on 72 (24% teeth in all patients).

Looseness of fixed restorations were found in 19 (6.3%). Dental caries was found in 26 (8.7%) the restored teeth in any of the patients.

Table 3
biological complication recorded in the present study

Parameter	Measurement	n (%)
Periodontal depth	Less than 5 mm	247 (82.3)
	Equal or more than 5 mm	53 (17.7)
Gingiva bleeding	Bleeding on probing	240 (80)
	No bleeding on probing	60 (20)
Periapical lesion	Yes	72 (24)
	No	228 (76)
Looseness of FPD	Yes	19 (6.3)
	No	274 (91.7)
Dental carious	Yes	26 (8.7)
	No	274 (91.3)

Table 3
other parameters

<i>Parameter</i>	<i>Measurement</i>	<i>n (%)</i>
Satisfaction	Yes	81 (27)
	No	219 (73)
Materials	PFM	242 (80.7)
	Zirconia	44 (14.7)
	Other	14 (4.6)
Types	Crown	213 (71)
	3 units bridge	87 (29)
Location	Anterior	84 (28)
	Posterior	216 (72)
Duration	< 6 months	16 (5.3)
	6 months – 1 year	16 (5.3)
	1–5 years	86 (28.7)
	5–10 years	114 (38)
	> 10 years	68 (22.7)

Patient satisfaction and other parameters of the fixed restoration are displayed in Table 4. The most patients 219 (73%) reported to be non-satisfied with their fixed restorations. The remaining patients had satisfaction with the restorations. The most of the restoration examined in this study were PFM 242 (80.7%), while the zirconia crown were in 44 (14.7%). Other restorations were only 14 (4.6%). The crown restorations were reported in the most examined patients 213 (71%), whilst the three unit bridge were presented in 87 (29%). The most fixed restorations were in the posterior 216 (72%), however the remaining were in anterior teeth 84 (28%).

Table 4
other parameters reported in the present study

Parameter	Measurement	n (%)
Satisfaction	Yes	81 (27)
	No	219 (73)
Materials	PFM	242 (80.7)
	Zirconia	44 (14.7)
	Other	14 (4.6)
Types	Crown	213 (71)
	3 units bridge	87 (29)
Location	Anterior	84 (28)
	Posterior	216 (72)
Duration	< 6 months	16 (5.3)
	6 months – 1 year	16 (5.3)
	1–5 years	86 (28.7)
	5–10 years	114 (38)
	> 10 years	68 (22.7)

Discussion

Radiographs supplement the clinical examination by providing important information. A thorough understanding of the extent of bone support and root morphology of each standing tooth is required to develop a comprehensive crown and bridge treatment plan [10]. The majority of surveyed dentists use radiographs for the abutment tooth or teeth in crown and bridge work, both frequently (40.94%) and infrequently (35.57%).

Treatment outcome evaluation remains critical in providing scientific evidence that informs treatment planning and patient education for decision making. Over a seven-year period, crowns and FPDs provided at the School of Dental Sciences were evaluated.

In comparison to primary health care centers, crowns and FPDs were mostly performed at Hail dental polyclinics center practice. In other countries, such as the United Kingdom, more crown and FPDs work in the National Health Service (NHS) rather than in private practice [11].

In our study, the success rate for crowns was low. This was significantly lower than the success rate for crowns reported in various studies [12–15]. Cheung et al. [13] discovered a 20.7% failure rate for a mean

length of service of 35 months. Hochman et al. [12] reported a failure rate of 6% for a mean lifespan of 6.3 years, whereas Libby et al. [14] reported a failure rate of 15% for a mean service length of 16 years. Vaulderhaug et al. [15] conducted a 15-year prospective study and found failure rates of 4%, 12%, and 32% after 5, 10, and 15 years, respectively.

Researchers identified several critical areas of concern with provisional restorations, including esthetics, comfort, speech and function, periodontal health, maxillomandibular relationships, and continued evaluation of the fixed prosthodontic treatment plan [16–18]. Provisional treatment can also be an important tool in the psychological management of patients when there is a mutual understanding of treatment outcome and limitations [19]. The use of provisional restorations is dependent on a reasonable turnaround time between tooth preparation and the completion of definitive treatment. When this happens, provisional treatment is usually well tolerated. Longer time-periods of use can promote tooth sensitivity and potential pulp damage [20]. The most common complications associated with crowns in the current study were defective margins, porcelain fractures, and non-acceptable color matching. These findings were consistent with those of Goodacre et al [21], who reported that porcelain fractures and defective margins were among the most common complications associated with crowns. However, the findings differed slightly in that, whereas Goodacre et al. [21] highlighted the need for endodontic treatment as one of the most common complications, there was no incidence of a crowned tooth requiring endodontic treatment in this study. This may be due in part to the study's relatively short average length of service. Crowns and FPDs were both plagued by porcelain fractures and faulty margins. Intra-oral porcelain is prone to fracture. 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 can all cause fracture [22]. Due to the exposure of underlying metal, this complication usually presents an esthetic challenge, especially in the esthetic zone.

The majority of crowns and FPDs in our study that had defective margins that could not be corrected were recommended for replacement. Marginal gaps, positive or negative margins, and defective margins can all be signs of defective margins. Positive margins can be corrected in the absence of a gap. However, marginal gaps and negative ledges pose a much larger problem that is difficult to correct and frequently necessitates prosthesis replacement [23].

Defective margins can occur as a result of clinical or laboratory errors. Clinical errors can occur as a result of improperly prepared finish lines or insufficient gingiva retraction during impression taking. The presence of air bubbles within the impression's margin may also contribute to these errors. Localized periodontal inflammation can be exacerbated by poor marginal adaptation, subgingival margin placement, and over-contoured crowns. Vaulderhaug et al. [24] conducted a longitudinal study to assess periodontal conditions in FPD patients. They discovered that the gingiva of crowned teeth was more commonly affected.

Long-term success requires accurate marginal fit of indirect restorations. This is due to the fact that ill-fitting margins make the tooth more susceptible to cement dissolution; once this occurs, marginal leakage occurs, which usually results in secondary caries and, if unnoticed, can lead to abutment vitality loss. Ill-fitting margins also cause plaque retention, predisposing the abutment to recurrent caries. Defective subgingival margins may jeopardize gingival health by altering local bacteria.

After a long period, biological complications such as caries and loss of vitality have been observed [25]. Some studies [26–28] found no secondary caries. Secondary caries was found in 21.7% of the FPDs cemented with resin cement in a 5-year clinical study of posterior Cercon FPDs by Sailer et al. [29]. Secondary caries was discovered in 8.7% of the FPDs in the current study. This could be because the average length of service in our study was 1–10 years. The FPDs' comparatively shorter mean length of service may explain the low incidence of caries and loss of vitality in this study (3.5 years). It could also be attributed to careful patient selection for crowns and FPDs, as the population studied had generally good oral hygiene, with a low average plaque score of 1.4. This could be an indication that patients chosen for these types of treatments were well-motivated patients who practiced good oral hygiene and thus had a low caries risk. On the other hand, the presence of defective margins in many of the failed restorations may imply that these crowned and abutment teeth will be susceptible to caries and loss of vitality in the long run.

Porcelain-fused-to-metal (PFM) has long been regarded as the gold standard for prosthetic fabrication due to its ability to combine good mechanical properties with acceptable esthetic results, as well as its ability to provide biological quality required for periodontal health [25]. This could explain why it was chosen for 44 (14.7%) crowns and 242 (80.7%) FPDs in this study.

Patients' perceptions of success have been shown to differ from those of clinicians. It was interesting to note that patient attitudes toward the prostheses did not always match the clinician's findings. Out of 300 prostheses, 81 (27%) were rated as satisfactory by patients. As a result, patient satisfaction may not be a reliable predictor of success.

There are several repair systems available for repairing fractured porcelain; these systems typically involve the bonding of resin composite to the fractured porcelain. This technique has a poor long-term prognosis due to the composite's decreasing bond strength to porcelain over time, increased wear on the composite when compared to porcelain, and poor color stability associated with resin composites [22]. Furthermore, color matching porcelain to composite is difficult due to differences in optical properties, so this technique frequently results in inferior esthetics.

The current study represented clinical evaluation and periapical status of fixed prosthodontic restorations in a selected Saudi population, and it provided a theoretical basis for clinical care to some extent. The sample size and experimental method had a significant impact on the outcomes of fixed prosthodontic restorations. However, there are a few drawbacks that must be addressed. Because this was a single-center study, the sample size should have been larger. Furthermore, the resolution of the traditional radiographs used in this study was lower than that of the CBCT, which may have influenced the results.

Further multicenter research using advanced techniques such as CBCT may be able to overcome the limitations of the current study.

Conclusions

Under limitation of the present study, it is possible to conclude that the technical and biological complications noted in the current study were higher to other studies of FPDs. The majority of patients were dissatisfied with the restoration. As a result, patient satisfaction may not be a reliable predictor of success.

Abbreviations

FPDs: fixed partial dentures; PFM: Porcelain-fused-to-metal

Declarations

Ethics approval and consent participate

The Medical Ethics Committee of college of Dentistry, University of Hail, Saudi Arabia, approved the protocol of this study. All methods were performed in accordance to the declaration of Helsinki.

Informed consent

Informed consent was waived by the ethics committee of college of Dentistry, University of Hail due to retrospective nature of the study.

Consent for publication

"Not Applicable".

Competing interests

The authors declare no competing interests.

Availability of data and materials

The data that support the findings of this study are available on reasonable request from the corresponding author.

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Authors' contributions

AHA, MDA and AAM contributed to the research concept, study design, data collection, statistical analysis, writing the original draft and reviewing and editing the final manuscript. BNA, MAA, RHA, GDA, BZA, RAA and RFA contributed to the research concept, data collection and writing and reviewing the original draft. All authors read and approved the final manuscript.

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