EFFECT OF FIXED PROSTHESIS ON ABUTMENT TEETH AMONG PATIENTS ATTENDING U OF K DENTAL CLINICS

By:

TALAL ABDUL HAFIZ KHATTAB
BDS (University of Khartoum)

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Supervisor
Prof. Yahia Eltayeb Ibrahim
BDS, FFDRCSI
DEDICATION

I dedicate this work to my parents who inspired me to strive for excellence and made the study of dentistry possible.

To my wife and children for their love, support, encouragement and understanding.

To my colleagues and students.

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Last but not least, I thank the patients, my colleagues and my family who endured the hard times I spent working on this research.
## ABBREVIATIONS

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<td>FPDs</td>
<td>Fixed Partial Dentures</td>
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ABSTRACT

A few studies were done to screen the biological complications associated with crowns and retainers of bridges. The lack of information regarding clinical and laboratory parameters makes this study of great interest regarding failure of fixed prosthesis. The objective of this study was to observe the effect of fixed prosthesis on the abutment teeth in term of caries, loss of vitality and periodontal changes with clinical and radiographic procedures. This cross-sectional study targeted patients attending the Khartoum University Dental Clinic and the Khartoum Dental Teaching Hospital. The data was analysed using SPSS. T-test was used to compare mean and standard deviation between the abutment teeth and control teeth, a %90 confidence interval level. Ninety-six patients were recruited randomly and examined clinically and radiographically for dental caries, gingival disease and any sign of periapical involvement. The results demonstrated a 16% dental caries in the abutment teeth while 4.2% in control teeth. For periodontal changes, the abutment teeth showed 62% while control teeth showed 9.4%. Periapical involvement in the abutment teeth was 8.3% while no radiolucencies were detected in the control teeth. In this study, it can be concluded that good standards of oral hygiene is one of the most important
factors that should be maintained in patients seeking fixed prosthodontics treatment.
خلاصة البحث

شهدت السنوات الماضية اهتماماً متزايداً بتنوع العمل في تركيب الأسنان التوأم من حيث تطور عمر التركيبية والأسباب التي يمكن أن تؤدي إلى فشل التركيبية. هنالك القليل من الدراسات السابقة التي أجريت لدراسة المضاعفات الحيوية التي تحدث للأسنان المستخدمة في تدعيم الجسور التوأم والأسنان المغطاة بالتيجان الصناعية.

معظم هذه الدراسات لا توفر معلومات عن المواد والطرق التي استخدمت في صناعة هذه التركيبات والطرق القياسية المتاحة في تقييم هذه التركيبات عند تثبيتها.

قلة هذه المعلومات جعلت هذا البحث في غاية الأهمية لمعرفة العوامل التي تؤدي إلى فشل التركيبات التوأم. كان الهدف من هذه الدراسة هو تقييم أثار التركيبات التوأم على الأسنان الطبيعية المدعمة لها فيما يتعلق بالتسوس عند حافة التركيبية وكذلك التهابات اللثة وفقدان حياة السن كنتيجة لهذه التركيبات.

أجريت الدراسة في كلية طب الأسنان – جامعة الخرطوم، حيث تم إجراء فحص سريري لكل مرضي ومساعدة صور الأشعة تم تعبئة البيانات في استمارة خاصه لكل مريض.

أجري تحليل البيانات بواسطة برنامج (SPSS) (وابستخدم اختبار T-Test) تم مقارنة المتوسطات بين الأسنان المدعمة للتركيبية مع الأسنان المقابلة لها في نفس اليوس السني من الإتجاه الآخر. وجد أن نسبة الأسنان المصابة بالتسوس كانت 16 % بينما كان في أسنان التحكم المقابلة لها 24 %، بالنسبة للالتهابات اللثة فكانت نسبة 26 % بينما كانت في أسنان التحكم المقابلة لها تعدل 41%. كانت نسبة الأسنان التي اظهرت شفافية اشعاعية حوالى دوامة الجذر في التصوير الإشعاعي هي 16 % بالنسبة للأسنان الداعمة للتركيبية بينما كانت أسنان التحكم لا تظهر أي شفافية اشعاعية. في هذه الدراسة يمكن أن ننستنتج أن متسوї العناية بالفم هو أحد أهم العوامل التي يجب التحكم بها خاصة في حالة المرضى الراغبين في عمل التركيبات التوأم.
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Chapter one

INTRODUCTION

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LITERATURE REVIEW
INTRODUCTION

Fixed prosthesis is one of the most important options for missing teeth, highly requested in dental practice. In recent years, there has been an increasing interest in fixed partial denture (FPD) quality, expected life time and possible reasons for failure. In view of there convenience and psychological and social advantage, patient prefer replacement of missing dentition with FPDs rather than removable ones. However, the investment in time and money in FPDs can only be justified if the restoration are long lasting and aesthetically pleasing. (1).

During the life span of the (FPDs) biological and technical complications have been noticed. Most studies have described the biological complications (dental caries, periodontal changes and loss of vitality) in the long term follow-up periods. (2,3) Most of the time these biological complications occur during or after appropriately performed FPDs treatment procedures. The authors concluded that the most common complication associated with FPDs was caries. (3,4)

Other studies had focused on the effect of indirect restoration on periodontal tissues. They have reported that poor marginal adaptation, (5) deeper intra-cervicular margin placement “finishing line”, (5) rough
restoration surfaces, and over contoured restoration can contribute to localized periodontal inflammation.

A previous study was carried out in Khartoum by Abdulwahab. She reported a biological failure rate of 56% in crown and bridge work. The failure rate was distributed as follows: periodontal disease (55%), dental caries (6%), combination of periodontal disease and dental caries (3%), and dental caries with periapical involvement (1%).
JUSTIFICATION

The importance of this study is to improve the awareness regarding the clinical complications that can occur in fixed prosthodontics, enhance the clinician’s ability to complete a thorough diagnosis, develop the most appropriate treatment plan and communicate realistic expectations to patients.

Conclusions drawn will hopefully provide dentists with valuable prognostic information as well as with knowledge that can be used to avoid the most common prosthodontics pitfalls.
LITERATURE REVIEW

Restoring and replacing teeth with fixed prostheses still represents major activities of the dental profession, mainly because of the high prevalence of caries and periodontitis experienced by the adult and elderly population. Studies reported that caries is the main reason for unserviceable crowns and bridges.\(^{(r)}\)

The goal of the prosthodontist is to control oral disease while restoring esthetics and function with durable, biocompatible restorations. Knowledge of the responses of oral tissues to artificial crowns and fixed partial dentures is crucial in the development of treatment plans with predictable prognosis.\(^{(s)}\)

Greglibby et al,\(^{(0,1)}\) conducted a study on 9 patients, examined with a total of 98 fixed partial dentures, 31 (51\%) were identified as failures or had been replaced because of failure. Dental caries was the most frequent cause of failure which represented 83\%, followed by periapical involvements (50\%). Studies by Schwartz et al\(^{(11)}\) and Walton et al\(^{(21)}\) supported previous studies in which dental caries was the primary cause of
failure of FPDs. They reported a 8.6% and 22% dental caries incidence respectively.

There was a limited number of studies available that provided sufficient relevant information to calculate the occurrence of biological complications such as caries, loss of abutment vitality and recurrent periodontitis.

DENTAL CARIES:

Studies on caries were divided into that which led to repair and that which led to the loss of the FPD. The 1-year risk for caries on abutments was 5.9%, but only 6.2% of FPDs were lost as a result of caries. Only one study classified marginal discrepancies and found a correlation between the worst marginal discrepancy (open margins) and the presence of caries.

In comparison between radiographic and clinical examination techniques for interproximal caries, the thorough clinical examination seems to be more reliable in detecting secondary caries at crown margins than the radiographic evaluation.

Regarding the longevity of fixed partial dentures and uncontrolled infection progression, pathological changes of the endodontium before restoration and the impact of prosthetic procedures and materials on the pulp
still led to biological complications. \(^{(\text{12})}\) Secondary caries is the most frequent reason for a failure in fixed prosthodontics.

Given the severe pathological changes of the endodontium caused by early secondary caries, a thorough examination of the integrity of the crown margin during recall is essential. As known from non-restored teeth, the presence of carious lesions may be evaluated visually \(^{(\text{17})}\) or by using an explorer.

For crowned teeth only some studies correlated clinical findings with the true extension of secondary caries lesions. Estimation of treatment need may be even more difficult if the crown margin is placed subgingivally which may not protect the remaining structure from caries progression. However little is known about the diagnostic performance of radiography with regard to secondary caries. \(^{(\text{1})}\)

A study was conducted to show the use of radiographs in the diagnosis of secondary caries localized at crown margins, and to correlate clinical findings with regard to secondary caries with the findings at a radiographic evaluation in \(\text{100 randomly selected patients. The authors reported that the secondary caries was diagnosed clinically in } 11\%, 37% \text{ of } 164 \text{ interproximal surfaces but only in } 8\%, 37\% \text{ radiographically. In contrast,} \)
the frequency of interproximal carious lesions diagnosed clinically in non-restored teeth increased with the use of radiographs from $\text{r, r\%}$ to $\text{e, e\%}$. Hence they concluded that radiographs improve the diagnostic sensitivity for interproximal caries in non-restored teeth. ($^7$)

Risk factors for caries development, such as salivary factors, microbiologic factors, oral hygiene and diet were evaluated by a cross-sectional study. When the sum of the assumed negative factors was used, more caries was found among the patients with three or more factors with negative values in the group as a whole. Generally speaking there was no indication that caries disease development was caused by the presence of the fixed partial denture per se. ($^8$)

Similarly, but in a longitudinal study this time, oral hygiene was studied along with periodontal conditions and carious lesions were studied in patients treated with dental bridges. Carious lesions were recorded in $\text{r, r\%}$ of the abutment teeth surfaces at the $o$th year, in $\text{e, e\%}$ at the $o$th year and in $\text{r, r\%}$ at the fifteenth year examination. ($^3$)

The author also conducted another longitudinal study, but for $o$ years this time, wherein regarding dental caries he concluded that the incidence of carious lesions was about the same whether the crown margins had been located subgingivally, at the gingival margin or supragingivally.
LOSS OF VITALITY

Dental pulp is the highly vascular, richly innervated soft tissue structure whose principal role is tooth formation. After eruption, pulp tissue retains the important function of supporting the secretory odontoblasts which lay down reparative dentine in defensive response to dental injuries throughout life.

Crown preparation places the pulp at risk in a number of ways. High speed stripping of hard tissue poses the threat of pulpal over-heating. Also it opens a multitude of dentinal tubules that communicate directly with the pulp which becomes more vulnerable to chemical, physical and microbial irritants.

It is important to recognize that crowns are rarely made for intact teeth. Rather they are made to protect and restore teeth which have been damaged by wear, trauma or cycles of caries and repair. After a lifetime of cumulative insult, crown preparation can be the final straw bringing pulpal breakdown and the need for root canal treatment.

Bergenholtz and Nyman's much quoted study showed that 9% of crowned teeth, and 7% of uncrowned controls lost vitality during long term review. None of this was attributable to caries or other obvious
causes but the crowned teeth in their study did have advanced periodontal destruction.\(^{14}\)

Higher levels of pulp death were recorded where \(\%\) \(\%\) of teeth restored with full coverage crowns, compared with \(\%\) \(\%\) of unrestored controls lost vitality during \(\%\) \(\%\) years review period.\(^{1}\)

Failures of endodontic origin have been observed to affect mostly anterior bridges, which could be assumed to be due to over-sized pulps of anterior teeth and the amount of tooth reduction required for the metal ceramic restorations.\(^{10}\)

It was clear that loss of vitality of abutment teeth occurred at a later date than what could be attributed to the trauma from the preparation of the teeth. This may either indicate slow progressive tissue degeneration induced by the procedure or reflect the increased susceptibility of pulpal infection by dentinal tubules in advanced periodontitis.\(^{14}\) Pulpal necrosis was diagnosed primarily on the basis of the presence of periapical radiolucency.\(^{14,11}\) One study compared \(\%\) abutment teeth with \(\%\) non-abutment teeth and found a higher incidence of pulpal necrosis in abutment teeth \(\%\) vs. \(\%\).\(^{14}\)

Another study was carried out on \(\%\) patients who received a fixed partial dentures or single crown during the years \(\%\) – \(\%\). The study
evaluated each tooth for pulpal health, periodontal integrity and clinical acceptability of the restoration of the teeth examined. One hundred and sixty-six underwent root canal therapy before placement of the restoration leaving vital and crowned teeth. The authors found that patients were in need of root canal therapy, or had undergone root canal therapy after cementation of the fixed prosthesis.

Saunders and Saunders conducted a study in order to examine the peri-radicular status of crowned teeth in an adult population in Scotland. They examined full mouth periapical radiographs from adult patients. They were assessing the crowned teeth to determine the presence of a radiolucency which may indicate pulpal disease. The total number of crowns assessed was of which were vital preparations and were non vital (root canal treated). Eighty-seven of the vital crowned teeth showed radiographic signs of peri-radicular disease, while the non-vital teeth, had evidence of a peri-radicular radiolucency.

Valderhaug and et al did a study to examine peri-apical radiographic changes. They compared the clinical status of teeth with vital pulp to root filled teeth. All teeth were restored with crown and bridge retainers during the past years. It was found out that the survival rate of the restored teeth with vital pulps and the root filled teeth
were similar. Clinical failures marked approximately one-third of the restored teeth. The main reason for tooth failure was dental caries \( \% \). The teeth with vital pulps recorded a pulpal deterioration of \( \% \). (v)

\( \% \), \( \% \), \( \% \) PERIODONTAL CHANGES

Periodontal disease may be generalized, or localized to teeth with poorly designed, made or maintained restorations. Its progress may accelerate locally. If the loss of a periodontal attachment is diagnosed early enough and the cause is removed, no further treatment is usually necessary, however, if the disease has progressed to the point where the prognosis of the tooth is significantly reduced then the crown or bridge, or the tooth itself, may have to be removed. (v)

There is evidence suggesting that restoration factors such as poor margin adaptation, (v) intracrevicular margin placement, (v) rough surfaces (v) and over contouring (v) may contribute to localized gingival inflammation, increased probing depths and bone resorption. Margin location may inhibit home hygiene procedures that encourage dental caries and gingival inflammation. (v) Silness believed that subgingival margins were the most potentially damaging factor to the periodontium, followed by finishing lines positioned at the gingival crest margin. On the contrary, supra-gingival
margins were the least harmful since it allows visualization of tooth preparation finish lines hence facilitating refinement of the tooth-restoration junction. This results in a smoother surface which minimizes the attachment of bacterial deposits. (ττ)

Another factor that may influence the periodontal condition of the abutment is the overhanging direct restorations. Amalgam or composite restorations could contribute to gingival inflammation before FPD.

In fact removal of caries and the replacement of poorly contoured or poorly adapted direct restorations with well fabricated crown or FPDs could improve periodontal tissues health.

Also other considerations are the effects of preparation, tissue retraction, impression, provisionalization and luting procedures on periodontal health. (ττ)

Knoernschild et al (τττττ) did a study on periodontal tissue responses after insertion of artificial crown and FPDs. They considered the effect of crowns or FPDs on gingival inflammation. Probing depths and bone loss were evaluated. They reported that crowns and FPDs increased the incidence of advanced gingival inflammation adjacent to restorations, particularly if restorations had intracrevicular finish line placement, poor marginal adaptation, or rough surfaces. (ττττ)
Valderhaug and Birkeland (1981) reported an accelerated rate of attachment loss during the first 2 years after crown insertion. They stated that other factors not related to restoration could be more critical for example, the history of the patient's periodontal inflammation that develops after crown or FPD insertion. Trial and epidemiological evidence have suggested that crowned teeth may have a greater incidence of advanced gingival inflammation. However, studies have not confirmed that gingival tissues consistently developed an increase in inflammation after crown insertion. Such primary failures tended to occur during the period from the first month up to a couple of years. (1989)

In order to minimize the complications, great emphasis is placed on oral hygiene and periodontally healthy tissues prior to FPDs construction. Preventive dentistry and periodontics increasingly influence fixed partial dentures procedures. (1989)

Felton (1981) and his associates conducted a study on 24 crown restorations in 24 randomly selected patients using special criteria. The crowns were placed at the University of North Carolina, School of Dentistry. The crowns were in service for a minimum of 4 years and the crown margins were within the intracervicular crevice (subgingival). Scanning electron micrographs were used to detect the marginal discrepancies.
Periodontal indices of pocket depths (PD), cervicular fluid volume (CFV), and gingival index (GI) were accumulated for clinical measurements. The authors reported that correlation was found between marginal discrepancy and pocket depth. However, a strong correlation existed between marginal discrepancies and gingival index and between marginal discrepancies and cervicular fluid volume. These results established that a significant quantitative relationship existed between the marginal discrepancy and periodontal tissue inflammation for subgingivally located crown margins.

Martin (1926) and his colleagues conducted a study on 61 subjects to evaluate the periodontal response to posterior fixed partial denture retainers with different marginal configurations and locations. Assessments were made of the FPD retainers and the periodontal responses to both the long term and short term use of these retainers.

The apical extent of the cast fixed denture retainer margin was recommended to be at a subgingival location by many authors. The rationale for subgingival marginal placement included the enhancement of esthetics and tooth preparation retention form and the notation of the gingival sulcus as a caries free zone. There has not, however, been an agreement on the degree of the subgingival extension.

Another study also compared 89 crowns with subgingival margins with unrestored control for 4 yrs using gingival index, plaque index and
pocket depth. He found limited differences between crowned teeth and controls relative to PI and PD but found an elevated GI in crowns with subgingival margins. (r)

Various investigators have suggested that the margin should be placed at the base of the gingival sulcus \( r \) mm from the alveolar crest, \( s \) mm from the coronal extent of the junctional epithelial attachment, half the distance between the base of the sulcus and the gingival margin, or at the crest of the gingival margin.

There is considerable evidence that the subgingival retainer margin is often as whenever possible.

In the study conducted by Felton (\( s \))\(^{(a)}\), statistical analysis showed that clinically acceptable FPDs with clinically detectable deviations from ideal flat retainer/tooth marginal configuration were not associated with increased probing depth or bleeding on probing when compared to the matched, unrestored teeth. Sites adjacent to subgingival retainer margins were not associated with greater probing depth than sites adjacent to supragingival retainer margins.

The authors suggested that long term exposure to variations of FPD margin configuration and location within clinically acceptable, but less than ideal, parameters are not associated with the destruction of the supporting periodontal tissues.
Hunter and Hunter \(^{(\text{I.A})}\) reviewed the literature and reported that inadequate preparation was the suggested reason for many of the problems associated with crown restorations. The consequences of underpreparation are usually worse than the wider one.

**ATTACHMENT LOSS**

Pocket depth is the distance between the base of the pocket and the gingival margin. It may change from time to time even in untreated periodontal disease owing to changes in the position of the gingival margin, and therefore it is unrelated to the existing attachment of the tooth.

Level of attachment on the other hand, is the distance between the base of the pocket and a fixed point on the crown, such as the cemento-enamel junction.

Gingival recession is the distance between the cemento enamel junction and the gingival margin. Therefore, the attachment loss is considered as the sum of the pocket depth and the gingival recession.

Shallow pockets attached at the level of the apical third of the root connote more severe destruction than deep pockets attached at the coronal third of the root.

When the gingival margin is located on the anatomic crown, the level of attachment is determined by subtracting from the depth of the
pocket the distance from the gingival margin to the cemento-enamel junction. If both are the same, the loss of attachment is zero. (r)

OBJECTIVES

GENERAL:

To estimate the effect of fixed prostheses on the abutment teeth in terms of caries, loss of vitality and periodontal changes with clinical and radiographic procedures.
SPECIFIC:

1: To present data regarding the prevalence of biological complications associated with the fixed prosthesis.

2: To identify the most common complication associated with crown and bridge restorations.
Chapter Two

MATERIALS

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METHODS
MATERIALS AND METHODS

1.1 STUDY DESIGN AND STUDY AREA

This is a cross-sectional study based on clinical and radiographic examination, carried out in Khartoum Province at two different centers, University of Khartoum – Department of Conservation and Khartoum Dental Teaching Hospital between June and December 2022.

A preceding exploratory study was conducted to estimate the number of cases attending these centres during the period of the study. Ninety-Six subjects wearing either anterior or posterior FPDs were selected randomly out of 959 patients. All the selected patients were systematically healthy and from different socio-economic groups.

The number of subjects included in the study was determined after referring to previous studies in which roughly similar numbers were included. (11, 12)

1.2 DATA COLLECTION

Clinical examinations were carried out on two paired eligible sites before any intra-oral data were collected. One tooth was the abutment, and the other the matched, unrestored tooth on the opposite side.
The examination sheet was designed for this purpose included the patient name, age, gender, tel. no, location of tooth and arch, the type of prosthesis, the material used for construction and duration since cementation of the prosthesis. Following this, a clinical examination for caries on the margins of the abutment, periodontal parameters for detecting any changes and finally radiographs for assessing peri-radicular areas for abutment teeth and radiographs for the control tooth (contra-lateral to the abutment teeth).

4.3 CRITERIA OF EVALUATION

The criteria used for choosing the control tooth were that the tooth had to be sound, free of any extra coronal restorations and free of subgingival restorations. Patients with missing contra lateral teeth and those with absent opposing and neighbouring teeth to the selected abutments or control were excluded.

For any included patient, a complete demographic data, dental and medical history were taken. Any patient with generalised periodontitis was excluded. A thorough examination was then conducted to assess biological problems (caries, periodontal changes and loss of vitality) associated with crowned teeth.
INSTRUMENTS AND SUPPLIES

The clinical examination was carried out under well lit conditions (dental chair light) using standard mouth mirror, graduated periodontal probe (Williams), spoon excavator, dental sharp explorer and cotton rolls. A long cone dental X-ray machine with exposure time 8.0 seconds and 0.6 Kilovoltage, X-ray peri-apical film size (22x53), kodak ultra speed film.

CARIES ASSESSMENT

All crowns and bridges were examined using a sharp explorer around the retainers or crown margins in the abutment teeth. A spoon excavator was used in cases with roughening in the tooth substance, either enamel, dentine or cementum on all surfaces (buccal, lingual, distal and mesial). The presence or absence of cavitation or softening due to dental caries was recorded in the examination sheet under the dental caries chart. The same examination was carried on the matched tooth. Radiographs aided the clinical examination.

PERIODONTAL ASSESSMENT

To check the condition of the periodontium and to detect any changes we tested the gingival and plaque indices were used. The probe tip was vertically positioned parallel to the bucco lingual axis and slightly inclined
towards the tooth surface in a location adjacent to the proximal contact or FPD connector. The assessments were consistently made at this same location.

Finally the restoration was examined for over-contouring, marginal discrepancies, marginal roughness and location of margin if restoration using the tip of the explorer.

**Evaluation of the periodontal health of the abutment teeth:**

Teeth with artificial crowns were evaluated using surrogate measures such as probing depths, radiographically determined alveolar bone levels and gingival index scores. Similar measurements were also made on each patient's contra-lateral tooth as the control.

Means and standard deviations of restored and control groups were usually reported and additional statistical analysis was performed to determine differences among groups.

All scores and measurements were registered on the examination sheet.
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\^ ATTACHMENT LOSS

It was calculated as the distance from the cemento enamel junction to the base of the sulcus. In cases of visible recession it was calculated by measuring the recession and adding it to the periodontal pocket depth. A periodontal pocket depth of more than \$2\$ mm is considered as attachment loss.

\^ ENDODONTIC ASSESSMENT

All crowned teeth were X-rayed in all subjects to assess the presence of endodontic and/or peri-apical disease using peri-apical films. Each tooth, crowned separately or served as an abutment, was evaluated by means of a peri-apical radiograph, digital radiograph, digital palpation of the surrounding and underlying hard tissues and percussion with a mirror handle. The same examination procedures were applied to the control teeth.
All measurements were done by one examiner who had been calibrated before data collection to attain an acceptable intra-examiner variation among examining subjects with similar prosthesis and a similar extent of periodontal disease.

Informed consent was obtained from all subjects after the nature of the procedure and the possible discomfort and risks have been fully explained.
Chapter Three

RESULTS
 RESULTS

In this study, a total of 801 fixed prosthesis (50 crowns and 85 fixed partial dentures) were evaluated in 69 patients recruited randomly from the dental clinics at the University of Khartoum and Khartoum Dental Teaching Hospital. The patients were consented and the nature of the clinical examination was fully explained to the participant. There were 44 (44%) males and 65 (65%) females (Table 1) with the mean age of 83 years (range 81-87 yrs) (Table 2). Sixty-three (85%) of the fixed prosthesis were in the maxilla and 14 (14%) were in the mandible (Table 3). Of the total samples, 79 (79%) were posterior and 39 (39%) were anterior. There were 74 (74%) in the right and 32 (32%) in the left side.

Of the total number of crowns, 21 (21%) were fabricated from full metal (mainly of base metal alloys) while 29 (29%) were fabricated of porcelain fused to metal (Table 4). The 85 bridges examined consisted of
In addition, \( \xi \% \) were designed as fixed with 2 or more abutments, and the remaining \( \alpha \% \) were simple cantilevers replacing a single tooth. (Table 5).

The duration of use of the prosthesis among the patients was predominantly in the range of 2-5 years, with few patients extending over 10 years of use (Table 6). With regard to the patient satisfaction, \( \alpha \% \) were reasonably satisfied with the prosthesis both functionally and aesthetically, \( \xi \% \) were semi-satisfied with some complains either functionally or aesthetically, while \( \gamma \% \) were not satisfied at all due to different reasons. (Table 7). With regard to the prevalence of caries among the abutment teeth \( \gamma \% \) of teeth were affected, while the control group showed prevalence of only \( \xi \% \) and this difference was statistically significant \( (P<\cdot\cdot\cdot) \) (Table 8). Upon radiographic examination of the abutment teeth and the control group, the periapical status of the abutments demonstrated a statistically significant difference \( (p<\cdot\cdot\cdot) \) (Table 9). Fourteen out of the out of the \( \gamma \% \) abutment teeth and crowned teeth \( (\gamma \%) \) showed an evidence of periapical radiolucency of varying degrees, whiles no changes were detected in the control teeth.
In evaluating the periodontal changes around abutment teeth and the control, 3 parameters were used: - a) Gingival index, b) Plaque index, and c) Periodontal attachment loss. The gingivae around the abutment teeth showed more inflammation compared to the control group and the difference was statistically significant (p=0.000) (Table 9). According to the plaque index, the plaque accumulation around abutment teeth was similar to the control (p=0.18) (Table 9). No statistical significant differences were found for the periodontal attachment loss between the abutment teeth and the control (p<0.05) (Table 9).

Visual examination of the restoration revealed that the retainers were deficient in 54 cases (72%) while the remaining 122 (28%) were sound (Table 10a). Only over one quarter of the margins were rough (24%) (Table 10b) while 3.7% (5 cases) of the margins were overcontoured (Table 10c). For the marginal finishing line, 47% were placed supragingivally, 51 were at the crest of the gingival and 7% were subgingivally. (Table 10d).
<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>٤٨</td>
<td>٤٤.٤٪</td>
</tr>
<tr>
<td>Female</td>
<td>٦٠</td>
<td>٦٠.٦٪</td>
</tr>
<tr>
<td>Total</td>
<td>١٠٨</td>
<td>١٠٠٪</td>
</tr>
</tbody>
</table>

Table ١: Gender distribution of the sample

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>٣٧٫٩٤</td>
</tr>
<tr>
<td>Minimum</td>
<td>١٨</td>
</tr>
<tr>
<td>Maximum</td>
<td>٦٧</td>
</tr>
</tbody>
</table>

Table ٢: Age distribution of the sample
<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>63</td>
<td>38.3%</td>
</tr>
<tr>
<td>Lower</td>
<td>40</td>
<td>41.7%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 3: The arch distribution of the fixed prosthesis

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full metal</td>
<td>11</td>
<td>22%</td>
</tr>
<tr>
<td>PFM</td>
<td>39</td>
<td>78%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
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</tbody>
</table>

Table 4: Distribution of cases restorations according to material type

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single crown</td>
<td>0.</td>
<td>46.3%</td>
</tr>
<tr>
<td>Cantilever</td>
<td>14</td>
<td>13%</td>
</tr>
<tr>
<td>Fixed-fixed</td>
<td>44</td>
<td>40.7%</td>
</tr>
<tr>
<td>Prosthesis Type</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>2-5 years</td>
<td>75</td>
<td>8.25%</td>
</tr>
<tr>
<td>5-10 years</td>
<td>46</td>
<td>5.6%</td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>5</td>
<td>0.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>108</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 5: Distribution of cases according to prosthesis type.

<table>
<thead>
<tr>
<th>Satisfaction</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfied</td>
<td>66</td>
<td>9.15%</td>
</tr>
<tr>
<td>Semi-satisfied</td>
<td>43</td>
<td>6.1%</td>
</tr>
<tr>
<td>Not satisfied</td>
<td>9</td>
<td>0.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>108</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 6: Distribution according to duration of prosthesis use.

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Paired differences</th>
<th>Std Error</th>
<th>% Confidence interval of the difference</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Patient satisfaction with prosthesis

Paired Samples Test
Table 8: Statistical analysis between case (Abutment) and control

<table>
<thead>
<tr>
<th>Pair</th>
<th>Abutment - Control</th>
<th>A</th>
<th>N</th>
<th>E</th>
<th>V</th>
<th>Mean</th>
<th>LOWER</th>
<th>UPPER</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GICASE</td>
<td>.33</td>
<td>168</td>
<td></td>
<td></td>
<td>.594</td>
<td>.3345</td>
<td>.7345</td>
<td>.416</td>
<td>167</td>
</tr>
<tr>
<td>1</td>
<td>GICONTRO</td>
<td>.20</td>
<td>168</td>
<td></td>
<td></td>
<td>.505</td>
<td>.2025</td>
<td>.4345</td>
<td>.428</td>
<td>167</td>
</tr>
<tr>
<td>2</td>
<td>PICASE</td>
<td>.21</td>
<td>168</td>
<td></td>
<td></td>
<td>.526</td>
<td>.2095</td>
<td>.4415</td>
<td>.428</td>
<td>167</td>
</tr>
<tr>
<td>2</td>
<td>PICONTRO</td>
<td>.18</td>
<td>168</td>
<td></td>
<td></td>
<td>.442</td>
<td>.1765</td>
<td>.4045</td>
<td>.428</td>
<td>167</td>
</tr>
<tr>
<td>3</td>
<td>PALCASE</td>
<td>.12</td>
<td>168</td>
<td></td>
<td></td>
<td>.673</td>
<td>.1165</td>
<td>.6045</td>
<td>.428</td>
<td>167</td>
</tr>
<tr>
<td>3</td>
<td>PALCONTR</td>
<td>.06</td>
<td>168</td>
<td></td>
<td></td>
<td>.374</td>
<td>.0585</td>
<td>.3295</td>
<td>.428</td>
<td>167</td>
</tr>
<tr>
<td>4</td>
<td>PINVCASE</td>
<td>1.92</td>
<td>168</td>
<td></td>
<td></td>
<td>.277</td>
<td>.1665</td>
<td>.2505</td>
<td>.428</td>
<td>167</td>
</tr>
<tr>
<td>4</td>
<td>PINVCONT</td>
<td>2.00</td>
<td>168</td>
<td></td>
<td></td>
<td>.000</td>
<td>.0000</td>
<td>.0000</td>
<td>.428</td>
<td>167</td>
</tr>
</tbody>
</table>

Paired Samples Statistics

Table 8: Statistical analysis for periapical and periodontal status of case and controls.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No discrepancy</td>
<td>123</td>
<td>73.2%</td>
</tr>
<tr>
<td>Discrepancy</td>
<td>40</td>
<td>26.8%</td>
</tr>
</tbody>
</table>
Table ١·١: Deficiencies around the margins of crowns and retainers.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No roughness</td>
<td>١٢٦</td>
<td>٧٤.٤٪</td>
</tr>
<tr>
<td>Roughness</td>
<td>٤٣</td>
<td>٦.٥٪</td>
</tr>
<tr>
<td>Total</td>
<td>١٦٨</td>
<td>١٠٠٪</td>
</tr>
</tbody>
</table>

Table ١·٢: The percentage of crowns and retainers with rough margins

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No over-contouring</td>
<td>١١٨</td>
<td>٧٠.٢٪</td>
</tr>
<tr>
<td>Over-contouring</td>
<td>٥٠</td>
<td>٣٩.٨٪</td>
</tr>
<tr>
<td>Total</td>
<td>١٦٨</td>
<td>١٠٠٪</td>
</tr>
</tbody>
</table>

Table ١·٣: Over-contoured crowns and retainers margins

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supra-gingival</td>
<td>٧٠</td>
<td>٤١.٧٪</td>
</tr>
<tr>
<td>At the level of the crest</td>
<td>٥١</td>
<td>٣٠.٤٪</td>
</tr>
<tr>
<td>Sub-gingival</td>
<td>٤٧</td>
<td>٢٨.٠٪</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Total</td>
<td>١٦٨</td>
<td>١٠٠%</td>
</tr>
</tbody>
</table>

Table ١٠٤: The location of the marginal finishing line

Chapter Four

DISCUSSION
CONCLUSIONS

\section*{Discussion}

In this study an attempt was made to investigate the quality of crown and bridge work and its effect on the abutment teeth, which may ultimately lead to failure of the restorations. Before starting this study we hypothesized that not all Sudanese dental practitioners can offer an ideal type of treatment for several reasons. Among these are lack of training, high cost of treatment, shortage in number of qualified technicians and other related
reasons. In the past, the most predominant type of material used was acrylic resins adhered to stainless steel crowns which generally poorly fit around the abutment teeth. This usually ends with a catastrophic effect on the teeth such as caries, loss of tooth vitality and severe periodontal changes. In addition, acrylic get worn and its color changes resulting in poor aesthetics and occlusal disturbances.

This work tried to discover the effect of the cast restorations on the abutment teeth in a total of 801 fixed prosthesis (20 crowns and 85 fixed partial dentures) evaluated in 69 patients recruited randomly from the dental clinics at the University of Khartoum and Khartoum Dental Teaching Hospital. We found that dental caries represented a frequency of 61% as a cause of failure of restorations and periapical involvements represented a frequency of 3.8% as a cause of failure. These findings are in agreement with several previous investigations reported from other countries (1, 11, 21). Gregglibby et al. (1991), conducted a clinical and retrospective chart review during a six month period including 98 patients with 99 fixed prosthesis. They have found that dental caries was the most frequent cause of failure (83%) followed by periapical involvement (51%) among other factors (11). Schwartz et al. (1994) found that dental caries was the most frequent cause of failure (47%) and Walton reported a frequency of 22% (11).
Knoernschild et al. (1991) summarized the data on clinical trial and epidemiologic evidence published in English. They have found that crowns and fixed partial dentures increased the incidence of gingival inflammation adjacent to these restorations. Our findings are in agreement with these observations where we have also found that restorations increased the incidence of gingival inflammations. 

Valderhaug et al. (1991) found that the amount of dental plaque did not differ between the crowned teeth and the control teeth during the observation period, while gingival score 2 and 3 were more frequent in crowned teeth than in the control teeth during this period. This was mainly observed when the crown margins were located sub-gingivally. In our work, no statistically significant differences were found regarding plaque accumulation between abutment and controls. Our findings are also in agreement with findings on gingival inflammation reported by Valderhaug et al. (1991). 

Evidence suggests that restoration factors such as poor margin adaptation, intracrevicular margin placement, rough surfaces, and overcontouring could contribute to localized gingival inflammation, increased probing depths, and bone resorption. In this study, we found no statistical significant differences for the periodontal attachment loss between the abutment teeth and the control.
On visual examination of the restoration, it was observed that the retainers were deficient in ٥٠ cases while the remaining ٤٧ cases were sound. In addition, it was also observed that only over one quarter of the margins were rough, while in ٠٠ cases the margins were over contoured. For the marginal finishing line, ٠٠ (٪٢٤) were placed supragingivally, ٠٠ (٪٠٣) were at the crest of the gingiva and ٠٠(٪٨٢) were subgingivally.

These findings together highlight the importance of the proper fabrication of such restorations to avoid any biological complications. Additional studies may be necessary to further clarify the effects of restoration placement on the abutments and surrounding structures.

٤٣ Conclusions and recommendations

In this study we can conclude that good standards of oral hygiene is one of the most important factors that should be controlled in patients seeking fixed prothodontic treatment. Control of the periodontal health is crucial both before and after cementation of fixed restorations. Therefore,
future studies should also try to document the periodontal disease history of the patient as well as the influence of the restorations.

Although radiography might give indications of the periapical condition of a tooth, which reflects the condition of the pulp, it might not give accurate status of tooth vitality. Thus radiography cannot be considered as a reliable method for determining the health of the pulp.

In this work, it was observed that we are still dependent on conventional crown and bridge work and in our study we have not seen a single case of adhesive bridge work, which might be a suitable alternative for conventional work in certain cases. This could eliminate or reduce the damage to abutment teeth in particular loss of tooth vitality and subsequently loss of teeth due to highly invasive nature of conventional tooth preparations. In addition, it is of high importance to improve both knowledge and skills of the general practitioners which could lead to improvements in the quality of crown and bridge work undertaken by them.

It is also necessary to introduce training programs for the technicians to improve the technical quality of the laboratory.

Finally, it is of great importance to seek funds/subsidies that might help in reducing the cost of crown and bridge work from the official governments channels such as the federal ministry of health and other organisations.
References

1. Hochman N, Mitelman L, Handi PE, Zalkind M. A clinical and radiographic evaluation of fixed partial dentures (FPDs) prepared by


7. Quirynen M, Marechal N, Busscher HJ, Weerkanp AH, Darius PL, Vansteenberghe D. The Influence of Surface Free Energy and


Appendix

Examination Sheet For a Clinical Study of Biological Failures on fixed Prosthodontics

- Index No.: □□□

- Name: ...........................................................

- Age: □

- Sex: Male □ Female □

- Location of prosthesis: Upper □ Lower □
  Anterior □ Posterior □

- Type of Prosthesis: Single Crown □ Cantilever □
  Fixed-Fixed □

- Material of the Prosthesis: Full metal □ PFM □

- Duration of the Prosthesis: ٢-٥ years □ ٥-٠١ years □
  >٠١ years □

-Degree of Patient Satisfaction:
  Satisfied □ Semi-satisfied □ not satisfied □

Results of the Clinical Examination: FDI
Caries:

<table>
<thead>
<tr>
<th>17</th>
<th>16</th>
<th>15</th>
<th>14</th>
<th>13</th>
<th>12</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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<tbody>
<tr>
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</tr>
</tbody>
</table>

- **Periodontal Examination:** -

- **Gingival Index**

  - ' = No signs of inflammation
  - \(\downarrow\) = Sign of inflammation, no bleeding on probing.
  - \(\uparrow\) = Signs of inflammation, bleeding on probing.
  - \(\uparrow\uparrow\) = Spontaneous bleeding.

- **Loss of attachment:**

<table>
<thead>
<tr>
<th>17</th>
<th>16</th>
<th>15</th>
<th>14</th>
<th>13</th>
<th>12</th>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Plaque Index:**

- ' = No plaque
- \(\downarrow\) = Plaque detected by probe
- \(\uparrow\) = Plaque detected by naked eye
- \(\uparrow\uparrow\) = Abundant of plaque
### Periapical Involvement (Periapical X-ray):

<table>
<thead>
<tr>
<th>17</th>
<th>16</th>
<th>15</th>
<th>14</th>
<th>13</th>
<th>12</th>
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<td>2</td>
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<td>41</td>
<td>33</td>
<td>4</td>
<td>34</td>
<td>33</td>
<td>37</td>
</tr>
</tbody>
</table>

### Condition of the restoration

- **Over contoured:**
  - Yes: ☐
  - No: ☐

- **Marginal discrepancies:**
  - Yes: ☐
  - No: ☐

- **Marginal roughness:**
  - Yes: ☐
  - No: ☐

- **Location of Finishing Line:**
  - Supragingival: ☐
  - Subgingival: ☐

  - At the level of the crest: ☐
  - Subgingival: ☐