ÖZGÜN ARAŞTIRMA ORIGINAL RESEARCH

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RADIOGRAPHICAL ASSESSMENT OF FIXED PARTIAL DENTURE ABUTMENT TEETH

SABİT PROTEZ DESTEK DİŞLERİNİN RADYOLOJİK OLARAK DEĞERLENDİRİLMESİ

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Öz

Amaç
Dişsizlik problemi çeken hastaların çoğu, psikolojik ve sosyal nedenler ve ayrıca sağladığı konfor nedeniyle hareketli protezler yerine sabit protezleri tercih etmektedir. Bununla birlikte, temel standartları sağlamayan bir sabit protez çeşitli problemlere sebep olabilir. Bu çalışmanın amacı sabit protezlerin Ante kuralına uyumluluk, sekonder çürük oluşumu ve periapikal lezyon açısından incelenmesidir.

Gereç ve Yöntem
Çalışma için Akdeniz Üniversitesi Diş Hekimliği Fakültesi'ne başvuran 380 hastaya ait panoramik radyograf incelendi. Üzerinde sabit protetik restorasyon bulunan destek dişler sekonder çürük ve periapikal lezyon açısından, restorasyonlar Ante kuralına uyup uymamaları açısından değerlendirildi. Periapikal lezyon sınıflandırması Periapikal İndeks'e (PAI) göre yapıldı. İstatistiksel analizler için SPSS 20.1 ve Microsoft Excel yazılımları kullanıldı.

Bulgular
İncelenen radyografların 166'sı kadınlar, 214'ü erkeklere aitti ve yaş aralığı 25-83' tü (46.0+- 11.1 erkekler ve 49,4+-11,0 kadınlar). Cinsiyet ve çürük oluşumu arasında anlamlı bir ilişki yoktu (p>0,05). Periapikal İndekse göre lezyon dağılımı %23 sınıf III, %1,8 sınıf IV, %1,3 sınıf V şeklindeydi. Ante kuralına uymayan restorasyonlarda daha fazla çürük oluşumu gözlendi (p<0,05).

Sonuç
Çalışma sonuçlarına göre dişsiz bölgelerin geleneksel sabit protezler ile tedavisi periapikal patoloji ve çürük oluşumuna sebebiyet verebilir. Destek dişlerin periapikal açıdan ve Ante kuralına uyum açısından dikkatli değerlendirilmesi sabit protezlerde oluşacak uzun dönem komplikasyonları azaltabilir.

Anahtar Kelimeler: Sabit protez, periapikal indeks, Ante kuralı

Abstract

Objective
Most of dental patients prefer reconstruction with fixed partial dentures (FPD) rather than removable ones because of comfort, psychological and social advantages of FPDs. However, a FPD which does not implement required standards and rules of FPDs may cause different dental problems. The aim of the present study was evaluation FPDs in terms of complying Ante's law, secondary caries and periapical lesions radiographically.

Material and Methods
Panoramic radiographs belonging to 380 patients who applied to Akdeniz University Faculty of Dentistry were examined in the present study. Current abutments of FPDs were evaluated in terms of complies with the Ante's law, secondary caries and periapical lesions radiographically. Periapical lesion classification was performed according to periapical index (PAI). Statistical analysis were performed using SPSS 20.1 and Microsoft Excel software program.

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Results
The present study comprised panoramic radiographs belongs to166 women and 214 men with an age range of 25 to 83 years old (46.0+- 11.1 years for men and 49,4+-11,0 years for women). No relationship was observed between gender and caries formation (p>0,05). Distribution of periapical lesions was found 23% class III, 1.8% class IV, 1.3% class V according to PAI. More caries were observed among the restorations which doesn't meet the requirements of Ante's law (p<0,05).

Conclusions
According to the results of the present study, the rehabilitation of edentulous regions with conventional FPDs may cause different periapical pathologies and caries. Careful evaluation of abutments regarding to Ante's law and periapical status may decrease the complications that could be observed in long term prognosis of FPDs.

Keywords: fixed partial denture, periapical index, Ante's law

Introduction

Clinical experience of dentists and evidence based dental practices together with patient preference determines treatment planning for tooth loss (1). Alternative treatment methods such as tooth supported, implant supported or adhesive dentistry are making the proper treatment options for clinicians challenging in contemporary fixed prosthodontics. Thus, evidence based dentistry is important in prosthodontic planning stage.

While their approved long term success (2) and low cost make fixed partial dentures (FPD) still the most preferred therapy for both clinicians and patients, tooth preparation for FPDs causes extensive loss of intact enamel and dentin. In the dental literature numerous papers describe the failures caused from biological factors such as secondary caries, periapical lesions and tooth loss related to FPD treatments because of extensive tooth substance loss, use of variety of dental materials and operative procedures harmful to the dental pulp (3-5).

In the dental literature there are also numerous papers evaluated treatment outcomes of FPDs. Most of research papers investigating the survival of restorations define the survive of a FPD as remaining the prosthesis in situ or without modification over the study period. On the other hand, periapical status of a FPD has a major importance related to survival rate of treatment because the periapical status and caries formation determine the prognosis of abutments and also FPDs. In the current dental literature, almost whole of the observation studies about FPDs are related to dental implants. As a result of this situation, although there are a lot of advancements in the materials and techniques in the modern dentistry, there is a lack of data in the current dental literature related to periapical and caries status of the tooth supported FPDs. It is only possible to observe the patterns and rates of changes and determine causes of failures like secondary caries or periapical status in longitudinal studies. Pol et al. (6) mentioned that radiographic outcomes were rarely reported for teeth-supported 3 unit FPD in the dental literature. Thus, the aim of the present study was evaluation the FPDs abutments in regards to complying the Ante's law, secondary caries and periapical lesions to give an idea to the clinicians and also patients via dentists about the prognosis of a natural tooth as an abutment for a FPD which may be valuable in planning stage of the FPDs or implant supported therapies and to guide dental practice

Material and Methods

Study Sample
Present study was conducted on the Department of Prosthodontics clinics of the Akdeniz University Faculty of Dentistry. Informed consent was obtained from all subjects on a written form approved by the Ethical Committee of the Medical Faculty of the Akdeniz University. Panoramic radiographs evaluated in the present study were routine dental radiographs taken in the first appointment of the patients and none of the panoramic radiograph was taken for the methodology of the present study. Totally 380 panoramic radiographs (166 females and 214 male) were evaluated that belongs to the patients applied to the clinics of Akdeniz University Faculty of Dentistry. Current FPDs were evaluated in terms of complying Ante's law, secondary caries and periapical lesions of abutments radiographically. A total of 786 FPDs (597 bridges and 189 single crowns) of participants were evaluated radiographically.

Data Records
Information registered for each patient comprehended age and gender. Figure 1. shows the division of regions in the maxilla and mandible for the methodology of the present study. Maxilla and mandible were sectioned three part as right first premolar to third molar, anterior teeth from canine to canine and left premolar to third molar teeth respectively Region 1, Region 2 and Region 3."Universal numbering system", also called the "American system", was used for describing the tooth evaluated (5). Numbers between 1 and 32

were used for permanent teeth. The tooth designated "1" is the maxillary right third molar and the count continues along the upper teeth to the left side. Then the count begins at the mandibular left third molar, designated number 17, and continues along the bottom teeth to the right side. Each tooth has a unique number or letter, allowing for easier use on keyboards (Fig. 1).

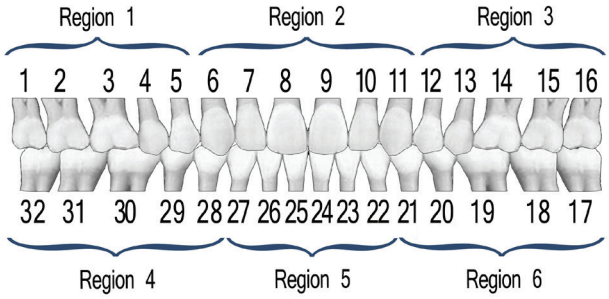

Figure 1. Division of maxillary and mandibular teeth into regions in the present study and universal numbering system

The data obtained were registered to Microsoft Excel program (Microsoft Excel 2002, Microsoft Corp, Redmond, Wash) by two observers.

Radiographic Measurements

Radiographs were routine diagnostic digital images which were taken using a Promax® Dimax 3 (Planmeca Oy, Helsinki, Finland) with standard exposure values (66 Kvp,9 Ma, 16 sec) in order to evaluation current status of patients before any dental approach. Measurement and interpretation were performed with Planmeca Romexis version 2.4.2.R (2010). Evaluations were performed by two observers and each observer evaluated the radiographs two different times. Assessment of secondary caries presence based on radiographic image saved as "exist" or "not". Lesions were determined with visual examination of periapical radiolucency and evaluated according to PAI. (7). Classification of periapical lesions of abutments was performed according to PAI which is prepared by Ørstavik et al . Description of the PAI scoring system is; I- Normal periapical structures, II- Small changes in bone structure, III- Changes in bone structure with some mineral loss, IV- Periodontitis with well-defined radiolucent area, V- Severe periodontitis with exacerbating features. Ørstavik et al. (7). was considered to be a sign of periapical pathology PAI III, IV and V (PAI > 2). Class II is a stage to observe histological symptoms and there is no a visible sign of bone destruction. Class II stage is included in the Class I stage because that evaluation was made on the radiographically in the present study.

Abutments and missing teeth were recorded. Cantilevers were recorded with number of missing tooth. Regions of restorations were recorded as previously stated. Restorations were assessed in terms of complying the requirements of Ante's law and recorded as "complies" or "does not comply". Calculation of the periodontal surface was carried out using the averages of Jepsen (8).

Statistical Analysis

Statistical analyses were performed using SPSS 20.1 and Microsoft Excel software program. Percentage data between two groups were compared with the Mann-Whitney U test. Categorical data were analyzed with the chi-square test. Significance level used was $p<0.05$. Graphs of the results was performed using by Microsoft Excel program.

Results

The present study comprised a convenience sample of 380 patients (166 women and 214 men) with an age range of 25 to 83 years old (46.0+- 11.1 years for men and 49,4+-11,0 years for women). While the amount of restoration was highest in the upper jaw with 56%, it was observed that the least restorations were in the lower anterior region with 8%. The most commonly used abutment tooth were lower right second premolar teeth with 5.4%.

Third molar teeth were the most missing teeth and the least teeth used as abutment. Least used abutment third molar was upper right third molar teeth with the 0,5% (Fig. 2,3).

10.2% of restorations didn't meet the requirements of Ante's law. No significant relationship was observed between periapical lesion formation and compliance with Ante's law ($p>0,05$ $p=0,839$). Periapical lesion was observed among the 28,2% of restorations which meet the requirements of Ante's law and 26,7% of restorations which doesn't meet the requirements Ante's law. More caries were observed among the restorations which doesn't meet the requirements of Ante's law ($p<0,05$ $=0.01$) (Table 1). No relationship was detected between gender and number or type of restoration.

21% of patients had cantilever on their FPDs. Cantilevers were mostly used on the lower and upper first molar teeth region. The number of cantilevers used on first molar teeth was 46,2% of all cantilevers (Fig. 4).

Caries formation on abutment teeth was observed in 40.5% of patients. No relationship was observed between gender and caries formation ($p>0.05$) (Table

2). The results of the statistical analysis showed that there wasn't any significant relationship between restoration type (crown, bridge, crown and bridge) and caries formation. (p>0,05)

Periapical lesion on abutment teeth was observed in 26,2% of patients. The significant relationship was found between gender and periapical lesion (p=0,038). While the abutment teeth with periapical lesion was 22,4% among female, it was 31,9% for male. Table 3. shows the lesion distribution among genders. No relationship was observed between restoration type and periapical lesion existence. (p>0,05)

12% of abutments had endodontic treatment. Periapical lesions were observed on 16.5% of endodontically treated teeth. Distribution of periapical lesions was found 23% class III, 1.8% class IV, 1.3% class V according to PAI (Fig. 5).

Discussion

In the dental literature there are many of studies on the survival and success of fixed partial dentures defining the survival of the restorations including the definition "crown not removed" (9-17).

Table 1 Relationship between decay and Ante's law

		Ante's Law		
Decay		**Not Comply**	**Comply**	**Total**
Not Exist	(n)	16	209	225
	(percent)	7,1%	92,9%	59,2%
Exist	(n)	23	132	155
	(percent)	14,8%	85,2%	40,8%
Total	**Count**	**39**	**341**	**380**
		10,3%	**89,7%**	**100%**

Table 2 Relationship between decay and sex

		Sex		
Decay		**Women**	**Men**	**Total**
Not Exist	(n)	94	131	225
	(percent)	41,8%	58,2%	59,2%
Exist	(n)	73	82	155
	(percent)	47,1%	52,9%	40,8%
Total		**167**	**213**	**380**
		43,8%	**56,2%**	**100%**

Table 3 Relationship between periapical lesion and sex

		Sex		
Periapical lesion		**Women**	**Men**	**Total**
Not Exist	(n)	113	166	279
	(percent)	40,5%	59,5%	73,4%
Exist	(n)	53	48	101
	(percent)	52,4%	47,6%	26,6%
Total		**166**	**214**	**380**
		43,7%	**56,3%**	**100%**

In the decision -making process for fixed partial dentures and their abutment teeth evidence-based clinical complications and data have a great importance. In addition to this, metal-ceramic FPDs have been gold standard in fixed prosthodontics for a long time. In contemporary dental literature, most of the studies about the survival and success of the fixed partial denture are focused on to dental implants and in the current dental literature research studies on the tooth supported metal-ceramic FPDs are limited (2). Thus, the results of the present study may be useful regarding to treatment planning for tooth supported FPDs. According to the results of the present study mandibular anterior region is the least FPD applied region in the oral cavity. It was determined that the most used abutment tooth for FPDs were second premolars and the percentage was 17,4%. The most observed tooth loss was third molars with the percentage of 26.3%. The reason may be originated from the eruption problems and ignorance of restorative requirements of third molars that finally result with extraction of third molars. Following third molars, most observed tooth loss was first molars with a percentage of 23,6%. The reason may be originated from the early loss of mandibular first molars since first molars were the first teeth erupted in the oral cavity. This finding might be taken into consideration during the restorative operations such as orthodontic extractions, filling, root-canal treatment etc. on the mandibular premolars.

Caries has been observed radiographically in 40.5% of patients at least one of the abutment teeth, and this is a significant proportion. This finding is similar with findings of other studies (4, 17-20). This suggests that patients with high risk caries who will be treated with fixed partial dentures should take anti-caries measures such as special diets and better oral care.

The frequency of teeth with periapical lesion varies from 0.6% to 9.8% in other studies (21-23). In this study %6.3 of abutment teeth had periapical lesion. Less periapical lesions were exist on females but it was not statistically significant (p=0,038). Any information wasn't founded about existing less periapical lesions on female patients in the dental literature. The most used cantilevers were first molars with the percentage of 46,2%. Hence, protecting the second premolars is important during the dental treatments.

Pak et al.(24) examined 300,861 teeth with a review study. They reported that 10% of the teeth had endodontic treatment and 36% of the endodontically treated teeth had periapical radiolucency. In the present study, periapical lesions were observed in the 16.5% of endodontically treated abutment teeth. Also, 12% of the abutment teeth had root-canal treatment. In comparison the result of the present study with report of Pak et al. (24); it can be criticized that less lesions are observed on endodontically treated teeth with

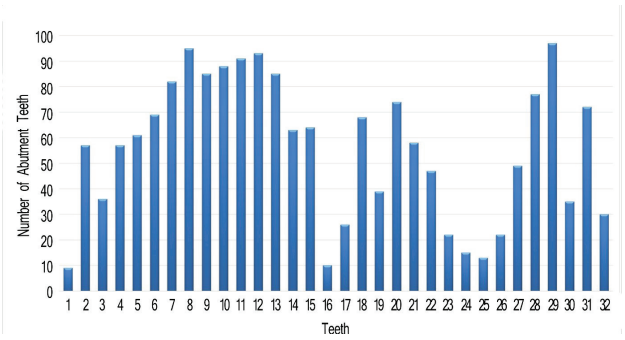

Figure 2. Distribution of abutment teeth in the present study

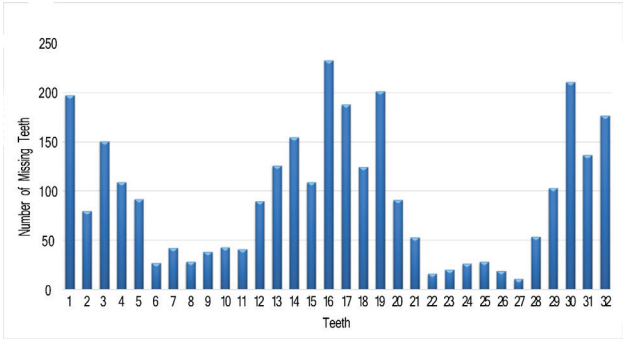

Figure 3. Distribution of missing teeth in the present study

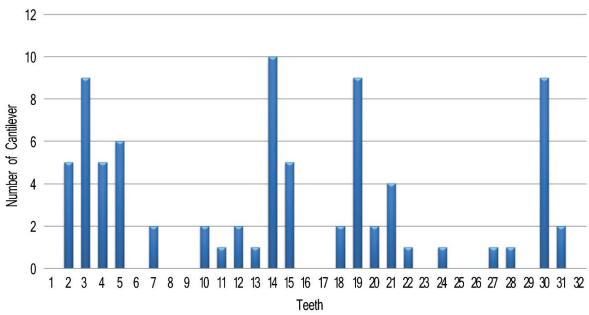

Figure 4. Figure 4. Distribution of cantilevers in the present study

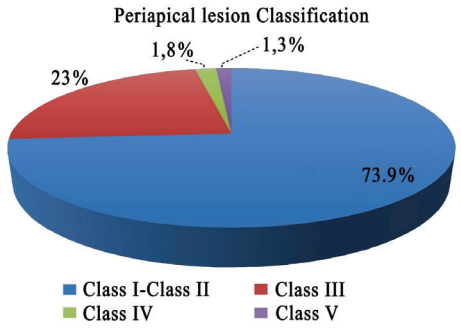

Figure 5. Distribution of periapical lesions according to periapical index

FPD compared teeth without FPD treatment.

Periapical lesion status and size of the periapical bone destruction were evaluated using by the PAI in the present study. Actually, periapical index was described for periapical radiographs firstly, but several studies have used panoramic radiographs in the dental literature (25-28). The percentage of Class III lesions were 23% and this percentage was the highest percentage between visible lesion classes on radiographs. This finding is similar to the findings of the Ridao-Sacie et al. (28).

Ante's law (29) defined as "The total periodontal membrane area of the abutment teeth must equal or exceed that of the teeth to be replaced" by Ante in 1926. Validity of Ante's law has been discussed until today (30), but there is no any other index that evaluates abutment teeth and its relationship with the missing tooth or pontic. Leempoel et al observed that 14,90 % and 13 % of restorations were not meet with Ante's law respectively in their two studies about the restorations' compliance with Ante's law (31, 32). In the present study, 10.2% of restorations with abutment teeth were not meet the requirements of Ante's law, according to radiographic data. Walton's et al accepted that the restorations which have 4 or more pontics are not comply with Ante's Law in their study about the comparison of implant and abutment teeth (33). Most of the FPDs which were not meet the requirements of Ante's law also had 4 or more pontics with two abutments in the present study.

Balevi (30) claimed that Ante's law is not evidence based. Nyman and Ericsson (34) monitored the restorations which didn't meet the requirements of Ante's Law about 8-11 years and they observed that there were not periodontal problem or bone loss. 167 bridge were assessed for their compliance to Ante's law by Leempoel et al (35). They stated that the bridges which didn't meet the requirements of Ante's law had shorter survival rate. Although Balevi et al. claimed that Ante's law is not "evidence based", the authors of the present study did not found an objective rule that helps decision of treatment planning and also selection of abutment teeth objectively to young and new graduated dentists other than Ante's Law in the dental literature. Periapical status, secondary caries presence and their relationship with Ante's law were assessed in our study since the long span bridges bend much more than short. Bending of bridge restorations may cause degeneration of marginal integrity of the long-span bridges. According to the results of the present study it was observed that the presence of secondary caries on the abutments which didn't meet Ante's law were higher than the others and it was statistically significant (p=0,02).

Caries formation may be increased because of periodontal changes on abutment teeth which received excessive occlusal loading. This finding support's Ante's law contrary to Balevi (30) and Nyman's (34) findings. Perhaps the most important limitation of the present study was that there were no any clinical or radiographical information about condition of abutment teeth and periodontal tissues prior to FPD treatment. Another limitation of the present study is the lifetime of the restorations did not investigated in the present study since the study was retrospective and performed only on the dental radiograph. In the dental literature, there are a lot of study investigating the lifetime of FPDs, success and failures. However, the results of the present study are worthwhile regarding the relationship between Ante's law, secondary caries and periapical lesions in the present study.

Dikbaş et al. (3) investigated the reasons of extractions with crowned teeth in their study. Although the study design was different from the present study, their study investigated the failures of crowned teeth in their study. Dikbaş et al. showed that caries was the most observed extraction reason for crowned teeth after periodontal disease and the percentage of caries for extraction was 26.9%. In the present study, the secondary caries percentage was 40.5%. The extraction because of periapical lesion and endodontic lesion had 12% totally in the extraction reasons. In the present study, the periapical lesion ratio in FPDs was 26.1%. The results of the periapical lesion and caries were higher than Dikbaş et al.'s study since they were investigated only the extraction reason with crowned in their study.

In the perspective of the present study, it is important to discuss the superiority of the dental implant therapy to the FPD. Mostly, a FPD needs tooth preparation that causes extensive removal of enamel and dentin. Although the tooth preparation is performed by a highly talented and good educated clinician, the biological and living nature of the tooth structure and some of the dental materials such as luting cements, poorly adapted temporary crowns etc. may cause the undesired the effects of FPDs such as pulp necrosis and secondary caries. Preventing tooth preparation may cause protection of the vitality and unity of natural tooth structure from the undesired effects of FPDs. Thus, dental implant therapy is the key for protecting the unity of the natural tooth structure in the rehabilitation of tooth loss

Conclusion

According to the results of the present study, the rehabilitation of patients with conventional FPDs may cause different periapical pathologies and caries. Careful evaluation of the abutments, periapical status and ideal planning of FPDs may decrease the complications would be observed. Considering to Ante's law in the planning stage of FPDs may cause better prognosis of abutment teeth regarding to secondary caries prevention. Follow up appointments may be a critical point in evaluation of abutments both clinically and radiographically. Finally, the advantages of dental implants are obvious according to the results of the present study.

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