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The Status of Vital Abutment Teeth Three Years after Prosthodontic Treatment

Vital Abutman Dişlerin Protetik Tedavinin Tamamlanmasından Üç Yıl Sonraki Durumlarının Değerlendirilmesi

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Abstract

Objective: The aim of this study was to radiographically evaluate the periapical status of vital teeth that serve as abutments to fixed metal ceramic dental prostheses (FDP) three years after undergraduate dental students performed the treatment.

Material-Method: The study sample consisted of 395 vital and intact teeth prior to the permanent cementation of FDP of 44 female and 23 male patients with a mean age of 50.8±11.8 years. The type of FDP and the type of teeth, as well as the age and gender of the patients, were recorded. Patient satisfaction with the treatment was also determined. Each tooth was examined on periapical radiographs and scored using the periapical index (PAI) to determine the periapical status.

Results: Interobserver agreement between readings was 0.87. Fifty-six patients (83.5%) were satisfied with their treatment. The percentage of apical periodontitis was found to be the least in mandibular incisors (3.4%, $p<0.05$). Apical periodontitis was more frequently observed in maxillary teeth than in mandibular teeth (20% and 10.6%, respectively; $p<0.05$).

Conclusions: Although patients were generally satisfied with the treatment they received, and FDP treatment performed by undergraduate students appears to be satisfactory, more emphasis must be placed on the supervision of students to obtain better results.

Keywords: Fixed Dental Prostheses, Intraoral Radiography, Periapical Index, Undergraduate Dental Education

Özet

Amaç: Bu çalışmada amaç, diş hekimliği öğrencileri tarafından yapılan sabit protezlere destek olarak kullanılan vital abutman dişlerin, tedavi bitiminden üç yıl sonraki periapikal durumlarının radyografik olarak değerlendirilmesidir.

Materyal-Method: Çalışmaya sabit protezin kalıcı simantasyonu esnasında vital ve sağlam durumda olan 67 hastaya (44 kadın, 23 erkek) ait 395 diş dahil edilmiştir. Hastaların ortalama yaşı 50,8±11,8 olarak bulunmuştur. Sabit protezin tipi, abutman dişlerin türü,ve hastaların tedavi ile ilgili memnuniyet durumları kaydedilmiştir. Abutman dişler periapikal radyografiler üzerinde iki okuyucu tarafından değerlendirilmiş ve dişlerin periapikal durumları Periapikal İndeks Skalası'na (PAI) göre skorlanmıştır.

Bulgular: Okuyucular tarafından yapılan okumalar arasındaki uyum 0,87 olarak bulunmuştur. Hastaların 56'sı (%83,5) yapılan tedaviden memnun olduklarını belirtmişlerdir. Apikal periodontitis görülme yüzdesinin en düşük olduğu diş türü mandibular kesici dişlerdir (%3,4, $p<0,05$). Maksiller dişlerde (%20) apikal periodontitis görülme yüzdesi mandibular dişlerden (%10,6) daha yüksek bulunmuştur ($p<0,05$).

Sonuç: Hastaların büyük çoğunluğunun yapılan sabit protezlerden memnun olmalarına rağmen, klinik olarak daha iyi bir sonuç alınabilmesi için tedavi esnasında diş hekimliği öğrencilerinin denetlenmesine daha çok önem verilmelidir.

Anahtar Kelimeler: Sabit Protez, İntraoral Radyografi, Periapikal İndeks, Diş Hekimliği Eğitimi

Introduction

Fixed metal ceramic dental prostheses (FDP) have long been used to restore heavily damaged and missing teeth in a way that satisfies the patient's aesthetic, functional and biological demands (1). Tooth preparation involves removing enamel and dentin and cutting odontoblasts, during which the pulp can be subjected to desiccation. Impression techniques necessitate drying the surface of the cut dentin, which also may desiccate the dentin (2). The polymerization of resin materials, which are used for the fabrication of provisional crowns, is associated with an exothermic reaction and can cause iatrogenic thermal trauma to the pulp (3). Each step in the fabrication of FDP is a source of potential pulp damage and it may take some time before infection and pulp destruction are detected (1, 2-6). Most pulp deteriorations are recorded two to seven years after treatment because damaged or non-vital pulp tissue may became infected years later.

In dental clinical education, evaluating FDP treatments

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performed by dental students has an important role in identifying problems related to clinical performance. Lack of symptoms does not necessarily indicate a healthy periapex. A radiographic examination is necessary to determine pulp status at recall because pulp sensibility tests are not possible in most instances following crown placement.

The objective of this study was to radiographically evaluate the apical status of teeth that serve as abutments to FDP three years after treatment by undergraduate dental students.

Material-Methods

A random sample of 67 patients who received FDP treatment from dental students between 2011 and 2012 was recalled after three years. The study was formally reviewed and approved by the Institutional Review Board of the faculty (no: 2014/40) and the procedures were followed in accordance with the Helsinki Declaration. Written informed consent was received from all the participating patients. The study sample consisted of 395 intact teeth without caries, restorations, existing crowns, history of previous trauma, clinical signs and symptoms, or periodontal probing depth with mobility within normal limits. The teeth also had vital healthy pulp that was confirmed with electric pulp testing prior to permanent cementation of the FDP.

The samples were divided according to tooth type (maxillary anterior, premolar, and molar teeth, mandibular anterior, premolar, and molar teeth) and according to the type of FDP restoration: (1) Single crown; (2) Single crown-p: Crown supporting a partial denture; (3) Simple bridge: two abutments with one pontic inbetween; (4) Complex bridge: a bridge with more than one pontic; and (5) Cantilever bridge: with a pontic which is not between abutments.

The work was performed by undergraduate students under the supervision of the teaching faculty in a 2-hour session. The crown preparations were completed using high-speed diamond burs with a combination of air and water coolants. Restorations were fabricated by the same commercial dental laboratory. Asymptomatic teeth with optimum gingival adjustment, occlusal adjustment, contact and color match were approved for cementation.

Digital periapical images were obtained with photostimulable phosphor plates with Di¬gora Optime (Soredex, Milwaukee, WI). For each tooth, periapical radiographs were examined to identify the periapical status three years after FDP treatment (follow-up radiograph). A dentomaxillofacial radiologist cropped the digital radiographic images to indicate the apices of the corresponding teeth. Apical status of the abutment teeth was ex¬amined on the periapical radiographs and assessed by the periapical index (PAI) proposed by Ørstavik et al. as follows: 1=normal periapical structures; 2=small changes in bone structure; 3=changes in bone structure with little mineral loss; 4=periodontitis with a well-defined radiolucent area; and 5=severe periodontitis with exacerbating features (7). PAI scores of 1 and 2 signified a healthy periapex, and PAI scores of 3, 4 and 5 signified the presence of apical radiolucency and were classified as apical periodontitis. For multirooted teeth, the highest score obtained among the roots was taken as the final PAI score.

Patient satisfaction was determined by asking patients if they were satisfied with the treatment, with the response options being highly satisfied, satisfied or not satisfied.

IBM SPSS (Statistical Package for Social Sciences) Statistics 22 was used for the statistical analysis. In addition to descriptive statistical methods, qualitative data were evalu¬ated using the Chi-square test. Inter-observer agreement of the readings was evaluated with weighted Kappa. Significance was set at $p<0.05$.

Results

The study group consisted of 44 female (65.7%) and 23 male (34.3%) patients between 28 and 81 years of age (mean age: 50.8±11.8 years). The inter-observer agreement between readings was 0.87 (Kappa; 95% CI: 0.7153-0.9381; $p<0.01$). Table 1 shows the distribution of the teeth according to tooth group, apical status and type of FDP. Of the 395 teeth that were asymptomatic at the recall examination three years after FDP treatment, 62 (15.7%) presented with apical periodontitis according to the PAI index. The percentage of apical periodontitis was lower in mandibular incisors than in other tooth types (3.4%, $p<0.05$; Table 2). Apical periodontitis was more frequently observed in maxillary teeth than in mandibular teeth (20% and 10.6%, respectively; $p<0.05$). Interestingly, there was no statistically significant difference in the percentages of teeth with apical periodontitis in different types of FDP ($p>0.05$). Among all patients, 34 (50.7%) were highly satisfied and 22 (32.8%) were satisfied with their treatment, while 11 (16.4%) were not satisfied.

Table 1. The distribution of teeth according to tooth group, apical status and type of FDP during follow-up

		n	%
Type of tooth	Maxillary molar	51	12.9
	Maxillary premolar	75	19.0
	Maxillary anterior	89	22.5
	Mandibular molar	73	18.5
	Mandibular premolar	78	19.7
	Mandibular anterior	29	7.4
Apical status	Healthy periapex	333	84.3
	Apical periodontitis	62	15.7
Fixed prosthetic restoration type	Single crown	13	3.3
	Single crown-p	21	5.3
	Simple bridge	123	31.1
	Complex bridge	196	49.6
	Cantilever bridge	42	10.7

Discussion

The main purpose of the present study was to use radiography and the periapical index to evaluate the apical status of intact teeth that serve as abutments to FDP three years after treatment was performed by undergraduate dental students.

Previous studies that evaluated early endodontic complications

during the preparation phase or immediately after the completion of metal ceramic FDP of teeth crowned in a vital condition found that the prevalence of apical periodontitis was lower than in our study (5.3%-6.1%) (1, 5, 8, 9). Kontakiotis et al. reported that the incidence of asymptomatic pulp necrosis of the teeth following crown preparation was 9.1%, which decreased to 5.3% when only intact teeth were evaluated and increased to 12.5% in teeth with preoperative caries, restorations or crowns (1). In addition, studies that evaluated the prognosis of FDP treatment found that the rate of apical periodontitis of vital abutments supporting conventional FDP ranged from 3% to 38%, which is in accordance with this study (5, 6, 8-14). Cheung et al. found that 33% of vital abutment teeth developed signs of endodontic complications at some point after cementation of the final restorations during a follow-up period of up to 15 years (15). The differences among studies may be due to the length of the follow-up period, the sample size, the technique used for the evaluation, and the preoperative status of the teeth.

Al-Khreisat reported that mandibular anteriors with symptoms of endodontic complications (6.7%) had a higher score of apical periodontitis (5). Kontakiotis et al. observed the highest incidence of pulp necrosis in mandibular anterior teeth (11.7%) and the lowest incidence in mandibular posterior teeth (7.1%) (1). They attributed this to the fact that mandibular incisors are the smallest teeth, and removal of enamel and dentin during preparation will lead to thin dentin walls. By contrast, Cheung et al. found that the upper maxillary anterior teeth develop endodontic complications most frequently (54.5%) (15). According to our results, the percentages of apical periodontitis in the mandibular and maxillary anterior teeth were 3.4% and 13.5%, respectively (Table 2), which are lower than the results reported in previous studies. In addition, in our study, mandibular anterior teeth had the lowest incidence of apical periodontitis when compared to the other tooth groups and maxillary teeth were significantly more frequently associated with apical periodontitis than were mandibular teeth. This result might be explained by the fact that maxillary teeth are prepared indirectly without any direct vision, which increases the possibility of operational error.

Table 2. Evaluation of PAI scores according to the type of tooth and FDP during follow-up

		Healthy periapex	Apical periodontitis	p
		n(%)	n(%)	
Type of tooth	Maxillary molar	37 (72.5)	14 (27.5)	0.020*
	Maxillary premolar	58 (77.3)	17 (22.7)	
	Maxillary anterior	77 (86.5)	12 (13.5)	
	Mandibular molar	65 (89.0)	8 (11.0)	
	Mandibular premolar	68 (87.2)	10 (12.8)	
	Mandibular anterior	28 (96.6)	1 (3.4)*	
Fixed prosthetic restoration type	Single crown	11 (84.6)	2 (15.4)	0.077
	Single crown-p	18 (85.7)	3 (14.3)	
	Simple bridge	113 (91.9)	10 (8.1)	
	Complex bridge	158 (80.6)	38 (19.4)	
	Cantilever bridge	33 (78.6)	9 (21.4)	

Chi-square test * $p<0.05$

Previous studies correlated the type of the FDP to the frequency of pulp deterioration in abutment teeth (4, 5). The higher prevalence of pulp complications in large, fixed prostheses may also be due to a more complex alignment of preparations, with possible iatrogenic tissue removal and overtapered abutments (6). Large, fixed prostheses are also difficult to cast with an acceptable fit compared with single crowns. Finally, large, fixed prostheses may also indirectly increase the risk of apical periodontitis due to more difficult cleaning procedures and the development of secondary caries (6). However, in our study, no significant difference was observed in terms of periapical status between different types of FDP. This might be attributed to careful treatment planning with final approval from the clinical supervisor, which could prevent any excessive pressure on the abutment teeth. Treatment is meticulously planned to prevent overload and lessen the possibility of apical periodontium related to excessive load.

Dental student must understand the goals of FDP and the criteria for evaluating the quality of performance. With regard to FDP and survival rates, dental students are expected to meet certain standards upon graduation. In our multidisciplinary dental student clinic, 3rd-year students perform only simple FDP treatments with one pontic between abutments in their second term, while 4th and 5th year students perform more complex FDP in addition to simple procedures. The distribution of patients is determined by the supervisors, who follow and approve each step of the treatment based on year of study and skill. In the present study, the student population consisted of 3rd, 4th and 5th year students, and the successes of students in different years of study were not compared.

No information about patient satisfaction related to FDP treatment by dental students is available in the literature. In this study, the percentage of patient satisfaction with FDP treatment was 83.5%. Although patient satisfaction with the treatment obtain seems high, a systematic recall process should be integrated into the student clinic to monitor FDP survival and the periapical status of the abutments. In our institution, a new recall system is being developed that may increase patient follow-up and provide feedback on the treatments performed in the student clinic.

In the present study, the determination of apical status was based on the radiolucency observed on periapical radiographs. It is possible that the rate of pulpal necrosis could be higher in the present study due to a lack of radiographic change. Although patients were generally satisfied with the treatment they received, and FDP treatments performed by undergraduate students appear satisfactory, more emphasis must be placed on the supervision of the students to obtain better results. A limitation of this study is that it was conducted in only one dental facility. Also, the diagnosis of apical periodontitis was based only on the radiographic evaluation because proper

pulp sensibility tests are not possible after FDP placement. Long-term, multi-center, follow-up studies are needed to evaluate complications related to FDP performed by dental students and determine the overall success rate. In addition, to ensure successful treatment, a further study that defines the suitability of the indications for FDP relative to the year of study and abilities of the students may be needed.

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