

An Investigation of Reasons for the Removal of Tooth-Supported Fixed Prosthetic Restorations

Diş Destekli Sabit Protezlerin Söküm Nedenlerinin Araştırılması

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ABSTRACT Objective: The aim of this study is to determine the reasons for the removal of tooth-supported fixed prosthetic restorations, and to investigate the relationship between the service length of a fixed prosthesis and the reason for its removal indicated by the clinician, the fabrication place, and the type of materials used in the fabrication of the prosthesis. **Material and Methods:** A questionnaire was prepared, and clinical examination was conducted, pertaining to the type of the fixed prosthesis, the service length of the fixed prosthesis, the reason for its removal indicated by the clinician, the number of units involved, the fabrication place, and the type of materials used in the fabrication of the prosthesis. Descriptive statistics, the chi-squared test, the Mann-Whitney U and the Kruskal-Wallis H tests, and the Spearman's rho correlation coefficient were used for statistical analysis. Statistical significance was assumed for $p < 0.05$. **Results:** The mean service length of fixed prosthesis was $9,28 \pm 5,92$ years, and the leading reasons for the removal of fixed prosthetic restorations were: renewal (29,7%), multiple reasons (23,2%), tooth extraction (11,6%), and apical pathology (8,4%), respectively. A statistical relationship was not found between the reasons for removal and the length of service of the fixed prosthesis ($p > 0.05$). However, there was a statistically significant relationship between the length of service and the fabrication place and type of materials used in fabrication ($p < 0.05$). **Conclusion:** The fabrication place and the type of materials used in fabrication are important parameters that determine the service length of the prosthesis.

Keywords: Fixed prosthetic restoration; removal reason; failure

ÖZET Amaç: Bu çalışmanın amacı, sabit protetik restorasyonların söküm nedenlerini belirlemek ve sabit protezin hizmet süresi ile protez söküm nedeni, protezin yapıldığı yer ve protez materyali arasındaki ilişkiyi araştırmaktır. **Gereç ve Yöntemler:** Çalışma için sabit protezin tipi (kron veya köprü), sabit protezin hizmet süresi, klinisyen tarafından belirtilen söküm nedeni, üye sayısı, protezin yapıldığı yer (özel muayenehane, kamu hastanesi) ve protez materyaline ilişkin bilgileri kaydetmek üzere anket hazırlandı. Katılımcıların sosyo-demografik verileri ve oral hijyen alışkanlıkları da kaydedildi. Verilerin analizinde tanımlayıcı istatistikler, ki-kare, Mann-Whitney U, Kruskal Wallis H ve Spearman rho testleri uygulandı. $p < 0,05$ seviyesinde anlamlı kabul edildi. **Bulgular:** Sabit protezin ortalama hizmet süresi $9,28 \pm 5,92$ yıldır ve sabit protez restorasyonların söküm nedenlerini sırasıyla: yenileme (%29,7), çoklu nedenler (%23,2), diş çekimi (11,6) ve apikal patoloji (%8,4) oluşturmaktaydı. Sabit protezin hizmet süresi ile söküm nedeni arasında istatistiksel olarak anlamlı ilişki bulunmazken ($p > 0.05$), protezin yapıldığı yer ve protez materyali ile ilişki bulunmaktaydı ($p < 0,05$). **Sonuç:** Sabit protezin yapıldığı yer ve yapımda kullanılan materyal protezin hizmet süresini belirleyen önemli parametrelerdir.

Anahtar Kelimeler: Sabit protetik restorasyon; söküm nedeni; başarısızlık

The demand to replace lost or missing teeth by means of a fixed dental prosthesis is on the rise and it is reported that 37% of adults have one crown or more, while 7% of adults have a bridge.^{1,2} Fixed prostheses are more frequently preferred to removable prostheses in the treat-

ment of tooth deficiencies, because of the patient's social and psychological comfort, ease of use, and the fact that they take up less space in the mouth.³ In addition to restoring lost functions to the patient, these prostheses also assist in maintaining the health of the surrounding tissues. However, over time, some problems with the prostheses may arise, making the removal of the restorations necessary to overcome them. There are many possible ways to classify these failures. Sharma et al. classified these failures as:⁴ biological failures (caries, need for endodontic treatment, renewal of endodontic treatment, periodontal problems, occlusion problems, and metal allergies), mechanical failures (cementation errors, defects on the edge of restoration, post-core errors, and fractures on porcelain surface), and aesthetic failures (color and contour errors).

Many factors are considered to present a reason for the removal of fixed prosthetic restorations.⁵ Tooth caries are discussed as a major reason for the failure of fixed prosthetic restorations by most researchers.^{1,2,6,7} Other common reasons reported for failures which resulted in the dismantling of fixed prosthetic restorations are as follows: loss of retention, periodontitis, root fractures, endodontic problems, and porcelain fractures.⁸ Each researcher evaluated fixed prostheses based on different definition criteria in terms of what constitutes a failure and for this reason the results cannot be generalized.^{9,10}

Knowledge of the failures that can occur with fixed prostheses enhances the clinician's ability to diagnose and develop the most appropriate treatment plan.¹¹ Additionally, patients and insurance systems are interested in the quality of fixed prosthetic restorations and they want to be informed about the predictable life span of these treatments.¹² The aim of this study is to determine the reasons for the removal of fixed prosthetic restorations and to investigate the relationship between the service length of a fixed prosthesis and the reason for its removal indicated by the clinician, its fabrication place (private practice, public hospital, university hospital), and the type of materials used in its fabrication.

MATERIAL AND METHODS

This study was performed with the approval of the Necmettin Erbakan University Faculty of Dentistry Research Ethics Committee in accordance with the stipulations laid out by the Declaration of Helsinki (decision no: 2017/11). The study was conducted using 100 randomly selected patients seeking consultation regarding complaints related to fixed prostheses. The age of the patients ranged from 29–77 years, with a mean age of $50,83 \pm 10,92$ years (63 women and 37 men), and they were all patients who had visited the Faculty of Dentistry at the Necmettin Erbakan University for a dental check-up in 2017. An informed consent was obtained from each individual prior to participation.

A questionnaire was prepared, and clinical examination was conducted pertaining to the type of the fixed prosthesis (crown or bridge), the service length of the fixed prosthesis, the reason for its removal indicated by clinician, the number of units involved, its fabrication place (private practice, public hospital, university hospital), and the type of materials used in its fabrication (full metal or metal-ceramic restoration). Additionally, socio-demographic data (age, gender, education, and place of residence), smoking, and tooth brushing habits of the participants were recorded.

All statistical analysis was performed using the SPSS software (Ver. 21; SPSS Inc., Chicago, IL, USA). Normal distribution of continuous numerical variables was analyzed using the Shapiro-Wilk test. The normality was violated, and the differences were analyzed by the Mann-Whitney U and Kruskal-Wallis H tests. Mean and standard deviations were calculated with descriptive statistics, and the chi-squared test was used for categorical variables. Spearman's rho correlation coefficient was used for the correlation of the service length and member number of the fixed prosthesis. Statistical significance was assumed for $p < 0.05$.

RESULTS

The mean age of the patient sample was $50,83 \pm 10,92$ years. Spearman's rho correlation coefficient

showed that the service length of the fixed prosthesis did not correlate to the patient’s age ($r=-0.101$, $p=0.213$, $p>0.05$). Of the 100 participants in the study, 63 were women and 37 were men, and the average service length of the fixed prosthesis did not show a significant difference in relation to gender (Mann-Whitney U, $p=0.250$, $p>0.05$).

The total number of examined fixed prostheses was 155, consisting of 130 bridges and 25 crowns, with 650 units evaluated in total. The average service length of the fixed prosthesis was 9.28 ± 5.92 years. No statistical difference was found between crowns and bridges in terms of the mean service length in the mouth (Mann-Whitney U, $p=0.966$, $p>0.05$). Fixed prostheses were categorized into three subgroups according to member number (1-5 members, 6-10 members, and 11-15 members) and no statistical difference was found between these groups in terms of the service length

(Kruskal-Wallis H, $p=0.816$, $p>0.05$) (Table 1). However, Spearman’s rho correlation coefficient showed that the service length and member number of the fixed prosthesis negatively correlated to each other ($r=0.892$, $p=-0.011$, $p<0.05$). The service length shortened when the member of the fixed prosthesis increased.

These reasons for removal, the number of the fixed prosthesis and the mean service length, are categorized in Table 2. A statistical relationship was not found between the reasons for removal and the length of service of the fixed prosthesis (Kruskal-Wallis H, $p=0.063$, $p>0.05$). The mean service lengths of the fixed prosthesis in relation to its fabrication place and the material used in its fabrication are given in Tables 3 and Table 4. The service length of the fixed prosthesis fabricated in public hospitals showed the lowest values when compared other places (Kruskal-Wallis H, $p=0.000$, $p<0.01$). The average service length of full metal prosthesis

TABLE 1: The member number of prosthesis and mean service length.

Member number of prosthesis	Number of Prosthesis	Percent (%)	Mean length of service (year)
1-5	119	76.7	9.40±6.23
6-10	27	17.4	9.07±4.85
11-15	8	5.9	7.75±4.95
Total	155	100.0	9.28±5.92

Kruskal Wallis H, p=0.816, p>0.05

TABLE 2: The reasons for removal, number of fixed prosthesis and mean length of service of the fixed prosthesis.

Reasons for Removal of Fixed Prosthetic Restorations	Number of Prosthesis	Percent (%)	Mean length of service (year)
Replacement	46	29.7	9.09±5.31
Porcelain fracture	5	3.2	10.00±3.80
Pain	10	6.5	11.90±6.26
Tooth extraction	18	11.6	6.61±2.81
Apical pathology	13	8.4	8.46±6.21
Periodontal disease	6	3.9	4.00±1.78
Defective margins	8	5.2	7.25±3.88
De-cementation	1	0.6	17
Caries	12	7.7	11.50±10.25
Multiple	36	23.2	10.69±5.96
Total	155	100.0	9.28±5.92

Kruskal Wallis H, p=0.063, p>0.05

TABLE 3: The reasons for removal, number of fixed prosthesis and mean length of service of the fixed prosthesis.

Fabrication place of prosthesis	Number of Prosthesis	Percent (%)	Mean length of service (year)
Private practice	77	49.7	11.47±6.33
Public hospital	68	43.9	6.69±3.79
University hospital	10	6.5	10.00±7.90
Total	155	100.0	9.28±5.92

Kruskal Wallis H, p=0.000, p<0.01

TABLE 4: The material used in fabrication and mean service length.

Material used in fabrication of prosthesis	Number of Prosthesis	Percent (%)	Mean length of service (year)
Full metal	11	7.1	20.29±10.98
Metal-ceramic	144	92.9	8.65±5.05
Total	155	100.0	9.28±5.92

Mann Whitney U, p=0.005, p<0.05

was significantly higher than metal-ceramic prosthesis (Mann-Whitney U, $p=0.005$, $p<0.05$).

The distribution of fixed prostheses according to their location in the mouth and mean service length are given in Table 5. There was a statistically significant relationship found between the length of service and the region in which the fixed prosthesis is located in the mouth (Kruskal-Wallis H, $p=0.026$, $p<0.05$). Fixed prostheses in the maxillary anterior region had a higher life span than those in other locations.

The education levels of the patients were as follows: 61% primary school, 4% secondary school, 13% high school, and 22% university graduate. The

relationship between the reason for prosthesis removal and other parameters (i.e. gender, education, place of residence, and so on) were not considered to be significant (Chi-square, $p>0,05$) (Table 6). Urban population constituted 90% of the participants. An evaluation of the oral hygiene habits of the patients found no relationship between the two genders (Chi-square, $p=0,760$, $p>0,05$). Smoking habits were present in 20% of the patients. Halitosis related to fixed prosthesis was reported by 38% of the patients. Tooth brushing habits of the participants were as follows: 8% never brushing, 38% once a day, 26% twice a day, 20% twice a week, and 8% once a week.

TABLE 5: The regions of fixed prosthesis and mean service length.

Region of fixed prosthesis	Number of Prosthesis	Percent (%)	Mean length of service (year)
Mandible anterior	10	6.5	9.20±5.55
Mandible posterior	49	31.6	10.55±6.50
Mandible anterior+posterior	21	13.5	8.05±4.76
Maxilla anterior	18	11.6	12.39±6.32
Maxilla posterior	36	23.2	7.69±5.97
Maxilla anterior+posterior	21	13.5	7.62±3.72
Total	155	100.0	9.28±5.92

Kruskal Wallis H, p=0.026, p<0.05

TABLE 6: The relationship between the reason of prosthesis removal and other parameters.

Studied parameters	Chi-square. p
Gender	0.717
Education	0.367
Residence place	0.708
Type of fixed prosthesis	0.385
Region of fixed prosthesis	0.607
Fabrication place of fixed prosthesis	0.836
Material used in fabrication of prosthesis	0.634
Smoking habit	0.627
Tooth brushing habit	0.339

The average service length of the fixed prosthesis did not show a significant difference related to education level ($p=0.180$, $p>0.05$), place of residence ($p=0.468$, $p>0.05$), smoking habits ($p=0.070$, $p>0.05$), and tooth brushing habits ($p=0.976$, $p>0.05$).

DISCUSSION

The service length of fixed prosthetic restorations reported in literature is changing, and several parameters are indicated that relate to the life span of this type of prosthetic treatment. This study was designed to determine the reasons for the removal of fixed prosthetic restorations and to investigate the relationship between the service length of the fixed prosthesis and the reason for its removal indicated by the clinician, its fabrication place (private practice, public hospital, university hospital), and the type of materials used in its fabrication.

The present study shows that the service length of the fixed prosthesis does not correlate to the patient's age. This result is in accordance with most literature studies. In a current meta-analysis study, which is investigating the influence of age on the duration of the fixed prosthesis through 11 articles, it is reported that age is not a risk factor for the survival of the fixed prosthesis.¹³ On the other hand, De Backer et al. indicate that age is associated with the survival of the prosthesis.¹⁴ This can be explained through the stomatognathic system's changes that occur as a result of the ageing process and motor capacity reduction, which lead

to increased difficulty of proper oral hygiene maintenance.¹³

The reported average duration of fixed prosthesis use varies between 4.65 years and 15 years.^{9,10,15-19} Şermet et al. report in their study that the average life span of a two-support three-member bridge is 11 years, the life span of a two-support four-member bridge is 8.6 years, the life span of a two-support five-member bridge is 9.5 years, and the average life span of a two supported six-member bridge is 8 years.²⁰ Reuter and Brose report that the life span of five or more member fixed prosthetic restorations is less than that of short restorations.²¹ In general, a bridge of more than four units is reported to be at high risk.² Napan kangas et al. also claim there are more complications in longer fixed prosthesis.²² Similarly, the current study reveals that the service length of the fixed prosthesis shortens when the member number of the fixed prosthesis increases (Table 1). In a conflicting study, Walton et al. state that there is no significant relationship between the number of members and the life span of the restorations.¹⁶

In studies conducted up to now, it is observed that there are lots of reasons related to the removal of fixed prosthetic restorations. Cheung et al. reports endodontic problems to be the major reason for the removal of metal-ceramic restorations.²³ Similarly, Özdemir et al. report that the first cause for the removal in abutment teeth was pain in 37,4% of cases, and Sağsöz et al. report that apical pathology is the chief reason for the removal of the fixed prosthesis.^{5,15} This study indicates that the leading reasons for the removal of fixed prosthetic restorations are: renewal (29,7%), multiple reasons (23,2%), tooth extraction (11,6%), and apical pathology (8,4%), respectively. Consistent with our study, Şermet et al. report that the most frequent cause for removal is renewal, while Reuter and Brose report periodontal problems and Pawar state it is the lack of retention that are the main causes.^{20,21,24} Apart from those studies, the most common cause for the removal of the fixed prosthesis is caries in abutment teeth.^{11,25,26} None of these reasons can claim to be the only cause for the removal of fixed dentures, because all aforementioned

tioned causes are considered to be accompanied with or related to each other. For example, caries is commonly the result of marginal leakage, which is based on a mismatch between the supporting tooth and the margin of the restoration. When the treatment of the existing caries is delayed the problem grows further, and the need for endodontic treatment arises as a cause of apical pathology. Thus, it is believed that the complications that cause the removal of fixed restorations are all directly or indirectly related to each other.²⁰

The results of this study show that a statistical relationship between the reasons for the removal and the length of service of the fixed prosthesis is not found. Periodontal disease and tooth extraction show the shortest duration values for the removal of the fixed prosthesis with $4,00\pm 1,78$ and $6,61\pm 2,81$ years, respectively (Table 2). Therefore, patients should especially be carefully examined with respect to periodontal disease, and teeth require extraction at the planning stage to prevent the early removal of the prosthesis. In contrast to our study, Özdemir et al. report that facet fractures and aesthetic problems cause the shortest period for removal at 4,22 years, followed by loss of retention at 4.85 years, with removal for renewal providing the longest period at 18.15 years.⁵

This study indicates that a fixed prosthesis fabricated in a public hospital shows the lowest service length values when compared other places (Table 3). Public hospitals have excessive patient loads in our country, which probably leads to less time per patient and results in the failure of prosthetic treatment. In this regard, the government needs to produce new health policies to increase the quality of treatments.

In literature, it is reported that the duration of prosthesis use is affected by the preparation of the support tooth, the planning of the prosthesis, the adjustment of teeth and restoration, and the patient's prosthesis care. Some researchers believe that it is not healthy to specify the life span duration for fixed prosthetic restorations, because there are many factors affecting this period. Our results indicate that the materials used in the fabrication of

the fixed prosthesis leads to a change in its life span. The mean service length of a fixed prosthesis is $9,28\pm 5,92$ years, while the average service length of a full metal prosthesis is $20,29\pm 10,98$ and $8,65\pm 5,05$ years for a metal-ceramic prosthesis (Table 4). This may be attributed to the failures related to porcelain. In accordance with this study, Briggs et al. also reports better survival rates for full metal crowns compared to porcelain fused restorations.² Porcelain fused metal restorations are shown to have a lower 10-year survival than full metal restorations.²⁷

This study also indicates that fixed prostheses in the maxillary anterior region have a higher life span than those in other locations (Table 5). The maxillary anterior region has the higher aesthetic importance for patients, and this result can be attributed to minimal food retention and maximum oral hygiene care of the patients in this region.

Even though all these problems can be seen in fixed prosthetic restorations, there are generally no patient complaints. Patients usually accept the removal of a restoration only when they feel pain, and they do not need routine controls for the prosthesis. Our results indicate that the service length of the fixed prosthesis did not show a significant difference according to either sociodemographic (gender, education, place of residence) and oral hygiene parameters (smoking and tooth brushing habits) (Table 6). This may be attributed to the limited sample of this study, and further studies with larger samples are needed. It is advisable for information about the care of the prosthesis to be provided to the patient prior to starting the treatment.²⁰

CONCLUSION

1. As periodontal disease and tooth extraction show the shortest duration values for the removal of the fixed prosthesis, patients should be carefully examined especially in relation to periodontal disease and teeth require extraction at the planning stage to prevent the early removal of the prosthesis.
2. To increase the service length of the fixed prosthesis, the prosthesis member number should be reduced as much as possible.

3. As the service length of the prosthesis can be affected by its fabrication place, the type of materials used in its fabrication, and its location in the mouth, those three parameters should be taken into consideration during the planning stage of a fixed prosthetic restoration.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that

provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

All authors contributed equally while this study preparing.

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