

Frequency of Direct Composite Restorations to Anterior Teeth After Orthodontic Treatment: A Retrospective Study

Ortodontik Tedavi Sonrası Anterior Dişlere Direkt Kompozit Restorasyon Uygulama Sıklığı: Retrospektif Bir Çalışma

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ABSTRACT

Objective: The aim of this study was to evaluate the frequency rate of applied direct composite restorations to the upper anterior teeth of patients to improve the aesthetic appearance after orthodontic treatment.

Methods: Records of 1080 patients whose orthodontic treatment was completed in the last 5 years were examined. In total, 104 patients with direct composite restorations of their upper anterior teeth because of a tooth-size discrepancy, tooth-shape malformation, missing lateral incisors, missing central incisors, black triangles, and transposition after orthodontic treatment were identified. Information such as gender, age, Angle classification, and which tooth or teeth were restored and for what reason were recorded. Mean \pm standard deviation or n (%) was used for the descriptive variables and the chi-square test was used for the categorical variables. Statistical significance was accepted as $P < .05$.

Results: In the present study, the frequency rate of direct composite restoration to the upper anterior teeth was found to be 9.6% among all patients whose orthodontic treatment was completed. When the reasons for restoration were evaluated, the most common reasons were determined as tooth-size discrepancy (60.6%), malformation (18.3%), and missing lateral incisors (14.4%). In patients with direct composite restorations, the most common reason for restoration in the right (65.2%) and left canine (66.7%) teeth were missing lateral incisors; in the right (80.6%) and left (74.3%) central and right (77.8%) and left (78.7%) lateral teeth, the tooth-size discrepancy was detected.

Conclusion: In some orthodontic cases, direct composite restorations are needed for an appropriate aesthetic appearance.

Keywords: Anterior diastema, direct composite restoration, orthodontic treatment

ÖZ

Amaç: Bu çalışmanın amacı, ortodontik tedavi sonrası estetik görünümü iyileştirmek için hastaların üst ön dişlerine uygulanan direkt kompozit restorasyonların sıklığını değerlendirmektir.

Yöntemler: Son beş yıl içinde ortodontik tedavisi tamamlanan 1080 hastanın tüm kayıtları incelendi. Ortodontik tedavi sonrası diş-boyut uyumsuzluğu, diş-şekil bozukluğu, lateral diş eksikliği, santral diş eksikliği, siyah üçgen oluşumu ve transpozisyon nedeniyle üst anterior dişlerine direkt kompozit restorasyon yapılan 104 hasta tespit edildi. Cinsiyet, yaş, Angle sınıflandırması, hangi diş veya dişlerin ne sebeple restore edildiği gibi bilgiler kaydedildi. Tanımlayıcı değişkenler için ortalama \pm standart sapma veya n (%), kategorik değişkenler için ki-kare testi kullanıldı. İstatistiksel anlamlılık $P < ,05$ olarak kabul edildi.

Bulgular: Bu çalışmada ortodontik tedavisi tamamlanan tüm hastalar arasında, üst ön dişlerine direkt kompozit restorasyon yapılma sıklığı %9,6 olarak bulundu. Restorasyon nedenleri değerlendirildiğinde, en sık olarak diş-boyut uyumsuzluğu (%60,6), diş-şekil bozukluğu (%18,3) ve lateral diş

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eksikliği (%14,4) belirlendi. Direkt kompozit restorasyon yapılan hastalarda, sağ (%65,2) ve sol kanin (%66,7) dişlerde en sık restorasyon uygulama sebebi lateral diş eksikliği; sağ (%80,6) – sol (%74,3) santral ve sağ (%77,8) – sol (%78,7) lateral dişlerde ise diş – boyut uyumsuzluğu tespit edildi.

Sonuç: Bazı ortodontik vakalarda, uygun estetik görünümü sağlamak için direkt kompozit restorasyonlara ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Anterior diastema, direkt kompozit restorasyon, ortodontik tedavi

INTRODUCTION

The main purpose of orthodontic treatment is to restore the health of teeth and periodontium by eliminating malocclusion and improving the dentofacial appearance.¹ To eliminate malocclusion and to provide an ideal occlusion, it is necessary to restore the tubercle–fissure relationship and overjet–overbite of the dental arches. To accomplish this, the mesiodistal size discrepancies of teeth between the lower and upper dental arches should also be eliminated. This tooth-size discrepancies are determined with conventional and digital calipers or digital scanning of 3-dimensional models of the mesiodistal widths of the teeth.² To achieve the goals of orthodontic treatments in patients with tooth-size discrepancies, either removing material from the teeth in the same arch (interdental stripping) or adding material (composite restorations or porcelain veneers) to the teeth in the opposite arch may be required.

Due to tooth size/shape anomalies, tight contact between the front teeth cannot always be achieved after orthodontic treatments. When such situations are detected, a restorative intervention may be required to optimize results.³ In minor intervention, direct composite restorations are often preferred because of the high success rate. In a recent study,⁴ the annual failure rate of anterior direct composite restorations applied after orthodontic treatment was found to be 2.59%. Material chipping and wear were the most common reasons for failure and most of them were classified as repairable. Direct composite restorations are simple, fast, and cost-effective and do not require extensive preparations that could damage healthy tooth structures.⁵

A multidisciplinary approach should be followed to correct the malformation in the anterior region after orthodontic treatment. For best results, it is important to include a restorative dentist on the team.⁶ However, it is not known to what extent patients need treatment with a multidisciplinary approach with a restorative dentist. To know this, it is important to know the frequency of direct composite application in an orthodontic clinic.

Guidelines for obtaining informed consent for orthodontic treatment require patients to obtain adequate information about the proposed treatment.⁷ As part of the process, patients should be informed of the need for restorative treatment and the potential risks/benefits of treatment. Therefore, knowing the reasons for direct composite application in the orthodontic clinic after the treatment is also important to inform patients.

Although case series and success rates have been evaluated in the studies, no study on the frequency rate of direct composite application has been found in the literature. Determining the need for restorative treatment after orthodontic treatments provides guidance to the clinician in planning the final stage of orthodontic treatment. The aim of this study was to evaluate

the frequency rate of direct composite restorations applied to the upper anterior teeth of patients to improve the aesthetic appearance after orthodontic treatment. Determining the applied reasons for the restorations was a secondary purpose. The null hypothesis was that there is no requirement for orthodontics and restorative dentistry collaboration in orthodontic treatment management.

MATERIAL AND METHODS

Photographs and panoramic x-rays of 1080 patients, whose orthodontic treatment was completed in the last 5 years (between January 2015 and January 2020) in the Orthodontic Clinic of the Çukurova University, Faculty of Dentistry, were examined. Ethical approval of the study was obtained from Çukurova University Faculty of Medicine Clinical Research Ethics Committee (Date: 10.01.2020, Number: 95th Meeting, 44th Decision). The present study was a retrospective archive study. The files of the patients whose orthodontic treatment was completed but who were referred to restorative dental treatment to achieve the appropriate esthetic appearance were selected from the archive. Of these patients, those with direct composite restorations to their upper anterior teeth were determined. The exclusion criteria from this study were as follows:

- Patients with cleft lip and palate,
- Patients with craniofacial anomalies,
- Patients with oligodontia.

As a result, 104 patients out of 1080 patients were included in the present study. Reasons for applied direct composite restorations were determined as follows (Figure 1):

- Tooth-size discrepancy (Fig. 1A)
- Tooth-shape malformation (Fig. 1B)
- Missing lateral incisors (Fig. 1C)
- Missing central incisors (Fig. 1D)
- Black triangle formation (Fig. 1E)
- Transposition (Fig. 1F)

The gender, age, Angle classification (Class I, II, III), which teeth from the anterior 6 teeth were filled, the reason for filling, and who the patient's orthodontist was were recorded.

Statistical Analysis

The IBM Statistical Package for the Social Sciences 22.0 software package (IBM Corp.; Armonk, NY, USA) was used for data analysis. Age was presented as mean \pm standard deviation and statistics of descriptive variables as n (%). The chi-square test was used to analyze categorical variables. Statistical significance for all analyses was accepted as $P < .05$.

RESULTS

All post-treatment records of the 1080 patients, whose orthodontic treatment was completed, were examined. It was observed



Figure 1. Reasons for direct composite restoration after orthodontic treatment. Intraoral view before orthodontic treatment on the left, during orthodontic treatment in the middle, and after composite restorations on the right. Why direct composite restoration was performed in each patient was explained: (A) Tooth-size discrepancy; because of diastema in the upper lateral and central teeth after orthodontic treatment. (B) Tooth-shape malformation; due to upper lateral teeth with narrow mesiodistal width. (C) Missing lateral incisor; due to congenital upper lateral tooth deficiency. (D) Missing central incisor. (E) Black triangle formation; due to loss of papillae between the upper central teeth. (F) Transposition; due to the transposition of the left canine and lateral.

that 104 patients (9.6%) had direct composite restorations done to their upper anterior teeth. Of these patients, 66 (63.5%) were female and 38 (36.5%) were male. The mean age of these patients was 20.4 ± 4.6 years. It was observed that 20 (19.2%) patients were under the age of 18.79 (76.0%) patients were aged 18-28, and 5 (4.8%) patients had the age of 29 and above. Table 1 presents the reasons for the direct composite restorations.

The evaluation in terms of gender showed that the Angle classification and the reasons for restoration were similar for men and women (Table 2). There was no gender difference regarding the teeth (Table 3).

	n	%
Tooth-size discrepancy	63	60.6
Tooth-shape malformation	19	18.3
Missing lateral incisor	15	14.4
Missing central incisor	3	2.9
Black triangle formation	2	1.9
Transposition	2	1.9

Restorations regarding tooth-size discrepancies were similar ($P = .402$) for all Angle classifications (Class I, II, III); 66% for Angle Class I, 54% for Class II, and 71.4% for Class III. Missing lateral incisors were the only statistically significant reason for the

	Female		Male		P
	n	%	n	%	
Age groups					
Below 18	12	18.2	8	21.1	.707
From 18 to 28	50	75.8	29	76.3	
Above 28	4	6.1	1	2.6	
Angle classification					
Class I	30	45.5	17	44.7	.937
Class II	32	48.5	18	47.4	
Class III	4	6.1	3	7.9	
Tooth-size discrepancy	38	57.6	25	65.8	.409
Tooth-shape malformation	12	18.2	7	18.4	.976
Missing lateral incisor	11	16.7	4	10.5	.391
Missing central incisor	2	3.0	1	2.6	.907
Black triangle formation	2	3.0	0	0.0	.279
Transposition	1	1.5	1	2.6	.690

Table 3. Distribution of Teeth with Direct Composite Restoration by Gender

	Female		Male		P
	n	%	n	%	
Right canine	16	24.2	7	18.4	.491
Right lateral	38	57.6	25	65.8	.409
Right central	21	31.8	10	26.3	.555
Left central	24	36.4	11	28.9	.441
Left lateral	36	54.5	25	65.8	.262
Left canine	15	22.7	6	15.8	.396

composite restoration. In addition, it was observed that the percentage of composite restorations was higher in Angle Class II patients (24.0%) compared to Class I (4.3%), due to missing lateral incisors ($P = .022$).

The number of direct composite restorations after orthodontic treatment was similar ($P = .951$) among clinicians (13 different clinicians in total). In addition, the medians of the number of teeth were equal (a maximum of 2 teeth out of 6 in 1 patient).

In patients with direct composite restoration, the most common reason for applications in the right and left canine teeth were missing lateral incisors (Table 4). Composite materials were used for recontouring the teeth.

DISCUSSION

Anterior direct composite treatments are frequently used for tooth enlargement, gap closure, and reshaping of teeth. In this study, the clinical frequency and application indications of patients who were treated with anterior tooth composites after orthodontic treatment were evaluated. According to the results of this study, the null hypothesis was rejected. This study showed that restorative treatment is needed to provide an appropriate esthetic appearance, especially in the maxillary anterior region.

In the present study, patients were classified as cases of tooth-size discrepancy (Bolton discrepancy), tooth-shape malformation (peg-shaped or narrow lateral incisors), missing lateral incisors or central incisor teeth, transposition cases, and cases with a black triangle. The study determined that Bolton discrepancy was a primary reason for composite applications, with 60.6% of the total composite restorations being applied after orthodontic treatment. This is consistent with studies that mention a 5% tooth-size discrepancy in the general population.⁸ Evaluating the 1080 orthodontic treatment patients, it was observed that composite resin was applied to 63 patients, which agrees with the literature. However, it should be noted that composite restoration is not performed in every case of Bolton discrepancy. Other options for Bolton discrepancy in orthodontic practice are interproximal reduction (IPR), tooth extraction decision, angulation-inclination changes in teeth, or maxillary molar rotation.

In various studies, differences in the intermaxillary teeth ratios were investigated in ethnic,^{9,10} gender,^{11,12} and malocclusion groups.¹³⁻¹⁶ Some studies found maxillary tooth material excess

in Class II malocclusions¹³ and mandibular tooth material excess in Class III malocclusions, while other studies found no significant difference.^{17,18} This study also investigated whether there was a relationship between the first Angle classification and tooth-size discrepancy, no significant difference was found.

According to this study, the second reason for the application of direct composite restorations is tooth-shape malformation (18.3%). The peg-shaped lateral tooth is one of the leading tooth-shape malformations. In the present study, this percentage was 1.75% in patients whose treatment was completed. According to a meta-analysis,¹⁹ the prevalence of peg-shaped lateral incisor in the general population is 1.8%, while it was 2.7% in orthodontic treatment patients, and it is 1.35 times more common in women. In our study, peg-shaped lateral incisor rates were also 1.71 times higher in women. It is stated that the percentage of unilateral (0.8%) or bilateral peg-shaped lateral incisor is approximately equal, which is similar to the percentage observed in our study. No relationship was observed between the peg-shaped laterals with the gender or the Angle classification.

In the present study, missing lateral incisors were the third-highest cause for applying direct composite restoration (14.4%). In the case of missing lateral incisors, there are 2 types of treatments in orthodontics: opening or closing the gap.²⁰ If the gap is closed in the case of congenitally missing lateral incisors, repositioning the canines into the lateral incisor space may well produce an esthetical unsatisfactory result, therefore composite restoration is applied.

If the gap of the missing lateral incisor is closed with mesialization of the canine, the posterior teeth are also located mesially, and a Class II relationship is established. Space closure is indicated in cases of the mesial eruption of the canines or mesial drift within the supporting zone. This may be the reason why the percentage of composite restorations due to the lack of lateral incisors is higher in Class II. On the contrary, orthodontic space opening is preferred in cases of Class I malocclusion, where extractions in the lower arch are not indicated, and in patients with Class III malocclusion, retrognathic profile.

Another finding of the study concerns space closure in patients with missing central incisors. Replacing the central incisor with a lateral incisor, to close the gap due to the smaller mesiodistal width, requires the use of composite materials.

The other indication for composite restorations after orthodontics is black triangles. A black triangle is a gap seen at the cervical embrasure below the contact point of some teeth where the papilla is missing (Figure 1). When teeth are crowded and overlapped, the papilla is not able to grow in the contact area between them. After aligning teeth by orthodontic treatment, this lack of papillae between the teeth becomes visible as a black triangular space. This usually occurs due to root deviation of adjacent teeth either naturally or due to improper orthodontic treatment.^{21,22}

Table 4. Reasons for Application in Teeth with Direct Composite Restoration

	Right Canine	Right Lateral	Right Central	Left Central	Left Lateral	Left Canine
Tooth-size discrepancy	5 (21.7)	49 (77.8)	25 (80.6)	26 (74.3)	48 (78.7)	6 (28.6)
Tooth-shape malformation	0	12 (19.0)	4 (12.9)	6 (17.1)	13 (21.3)	0
Missing lateral incisor	15 (65.2)	0	0	0	0	14 (66.7)
Missing central incisor	2 (8.7)	2 (3.2)	0	1 (2.9)	0	0
Black triangle formation	0	0	2 (6.5)	2 (5.7)	0	0
Transposition	1 (4.3)	0	0	0	0	1 (4.8)
Total	23 (100)	63 (100)	31 (100)	35 (100)	61 (100)	21 (100)

The results are presented as n (%) in the table.

Triangular-shaped incisor crowns²³ and long, narrow teeth²⁴ are all etiological factors for black triangles. In the case where the crowns are triangular-shaped, IPR of enamel between the triangular crowns will broaden the contact area. Changing the contact point gingivally leads to reduced open gingival embrasures. Typically, 0.5-0.75 mm of enamel is removed with IPR to correct black triangles.²⁵

Other low-percentage composite restorations were transposition cases. Tooth transposition is defined as the positional interchange of two adjacent teeth within the same quadrant. Its incidence is approximately 0.4%,²⁶ which is similar to the incidence in our orthodontic population. It occurs more commonly in the maxilla than the mandible.^{26,27} The maxillary permanent canine has been reported as the tooth most frequently involved in transposition.^{26,28}

The evaluation in terms of gender concluded that the reasons for direct composites and Angle classification were similar for men and women. In cases of missing lateral incisors, the percentage of composite restorations is higher in Angle Class II patients compared to Class I. The lack of difference in other groups might be the low number of patients selected for this study. The percentage of clinicians who made a restorative treatment decision after orthodontic treatment was similar. It is seen that different orthodontists in the same clinic provide 9.6% of their patients with composite restorations after orthodontic treatment. The reason for this might be that, because of their interactions in the same clinic, the physicians have a similar opinion regarding the ideal orthodontic treatment, and the opinions of the consulted restorative dentists are also related.

Direct composite restorations made to the anterior teeth require regular control of the patient. There may be breaks, ruptures, discoloration, or complete falls on the edges of the composite fill. However, today, the success of direct composite restorations is increasing at a level that cannot be ignored. This is caused by both the improved adhesive systems and the color and physical properties of composite fillings that better reflect the properties of the teeth. Compared to prosthodontic treatment, the advantage of contemporary dental composites as a minimally invasive procedure for tooth shape corrections is the minimum loss of dental hard tissue.²⁹ In a previous study,³⁰ the failure rate after 5 years of reshaping the anterior teeth and closing diastemas with direct composite restorations was 84.6%. More than 90% of the restorations were clinically categorized as excellent or good. Moreover, failed restorations were successfully repaired, and 100% functional endurance was achieved. Another study³¹ reported that restorations placed after orthodontic treatment showed a 93% success rate after a 4-year follow-up. Therefore, the treatment with direct composite restorations is considered an appropriate alternative to indirect restorations.

The percentage of direct composite restorations in patients whose orthodontic treatment was completed was 9.6%. Direct composite restorations after orthodontic treatment are widely used as an option with minimal invasive effects, providing anterior teeth with an esthetic smile, and achieving the ideal arch size and stability. This reveals the importance of a multidisciplinary approach in orthodontic treatment.

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