



## ORIGINAL ARTICLE



# Clinical Performance of Direct Anterior Composite Restorations in Mixed Dentition: A randomized cross-sectional study

Can Özükoç\*

<sup>1</sup>Asistant Professor, Istanbul Medipol University Faculty of Dentistry Department of Pediatric Dentistry, Istanbul, Turkey

### Abstract

**Aim:** Direct anterior composite restoration is the first preferred method for children in the mixed dentition stage to replace dental tissue lost to caries, trauma or similar reasons. This study aimed to evaluate the effect of cavity type and treating institution on clinical longevity of direct anterior composite restorations in children in the mixed dentition stage.

**Material method:** The data obtained from 114 direct anterior composite restorations performed in different institutions using the Modified USPHS criteria were evaluated according to cavity types and types of institutions where restorations were performed.

**Results:** It was found that the mean values of retention, marginal adaptation and postoperative sensitivity were higher in class IV restorations, the highest values were obtained from the restorations performed at the Public Oral Health Center, and there was a statistically significant difference. ( $p < 0.05$ )

**Conclusion:** Although it has been shown that the clinical longevity of class IV composite restorations is shorter than other types of restoration in children in the mixed dentition stage, restorations performed at the University Dental Clinic have been found to be more successful.

**Keywords:** Anterior restoration, Composite restoration, Direct composites, Pediatric dentistry, USPHS

## 1 | INTRODUCTION

Due to the development of composite and adhesive systems over the years and the increased interest of individuals in dental aesthetics, aesthetic restorations in both anterior and posterior regions have been performed very commonly in dentistry.(1) Direct anterior composite restorations are still the first-line treatment of dental

diseases in this region, and therefore the factors affecting the clinical performance of these restorations should be evaluated to prolong the longevity of restoration. Today, there are many prospective and retrospective studies evaluating the clinical longevity and efficacy of direct restorations.(2-4) The vast majority of studies are limited to periods up to 3 years and a follow-up period of more than 10 years is rarely reported.(5)

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Different results were obtained in these studies, and it has been observed that the clinical performances of restorations are affected by many factors.(6,7) These factors may be related to the material used, teeth, patient or operator. It has been reported that factors such as the material used, cavity localization, the institution where the restoration is performed, and the physician's experience may affect the clinical performance of restorations.(8-11) However, this type of studies should be repeated periodically due to important developments in adhesive techniques and composite resins in recent years. Moreover, there is no similar study in the field of pedodontics evaluating the clinical success of direct anterior composite restorations.

The aim of this cross-sectional study was to evaluate the effects of restoration type and treating institution on the clinical performance of anterior composite restorations in children in the mixed dentition stage. From this point of view, the hypothesis of this study was that cavity type and treating institution affect the clinical performance of direct anterior composite restorations in children in the mixed dentition stage.

## 2 | MATERIAL AND METHOD

### Study characteristics, participants and design

Calculating the sample size before starting the study, the standard effect size was determined to be 1.01 with a margin of error of  $\alpha=5\%$  and a power of  $\beta=80\%$ , and 95 restorations were calculated to be sufficient for the study.(G power 3.1 for Macintosh; Universitat Dusseldorf, Dusseldorf, Germany) After creating the randomized cross-sectional clinical study protocol in accordance with the CONSORT

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**Corresponding Author:** *Can Özükoç*  
*Asistant Professor, Istanbul Medipol University Faculty of Dentistry Department of Pediatric Dentistry, Istanbul, Turkey*  
*Email: [cozukoc@medipol.edu.tr](mailto:cozukoc@medipol.edu.tr)*

(Consolidated Standards of Reporting Trials) criteria, it was approved by the Ethics Committee of Istanbul Medipol University.(Approval No: 47)

### Inclusion and exclusion criteria

Among children aged 7-12 years who were admitted to the Pedodontics Clinic of Istanbul Medipol University Faculty of Dentistry for treatment between the dates of 10.01.2019 and 10.03.2020 and who had no systemic disease, children with direct anterior composite resin restorations performed at least 1 year ago were selected. Children who were treated by the researcher, had a history of endodontic treatment in the tooth to be examined or bruxism in the anamnesis, children who were non-cooperative, mentally retarded or had a systemic disease, and patients who did not want to participate in the study and who did not give written consent were not included in the study.

### Evaluation procedures

After obtaining the consent form from the children and their parents who wanted to participate in the study, anterior composite restorations performed in different centers were classified by the researcher according to the Black classification (class III, class IV and class V) and the evaluation form that was created using the Modified USPHS Criteria in Table 1 in terms of retention, color match, marginal adaptation, marginal discoloration, secondary caries formation, and postoperative sensitivity was filled in. The restorations were scored as Alpha, Bravo, and Charlie. While Alpha represented excellent condition, Bravo showed an acceptable deterioration, and Charlie represented that the restoration should be replaced. In order to perform a statistical evaluation, the numerical values were given to the restorations with 1 to Alpha score, 2 to Bravo score, and 3 to Charlie score.

### Statistical analysis

The data obtained from the study were analyzed using the "Statistical Package for the Social Sciences" (SPSS 22 for Windows, SPSS Inc., Chicago, Illinois, USA) software. In the statistical evaluation of the results, the Mann-Whitney u test was used for binary comparisons and the Kruskal-Wallis test was used for multiple comparisons, and the level of significance was set at p 0.05 for tests.

**TABLE 1: Modified USPHS criteria**

Retention	
Alfa	Without loss of dental material
Charlie	With loss of dental material
Marginal Discoloration	
Alfa	There is no discoloration between the restoration and tooth
Bravo	There is discoloration on less than half of the circumferential margin
Charlie	There is discoloration on more than half the circumferential margin
Marginal Adaptation	
Alfa	Explorer does not catch or has oneway catch when drawn across the restoration/tooth interface
Bravo	Explorer falls into crevice when drawn across the restoration/tooth interface
Charlie	Dentin or base is exposed along the margin
Color Match	
Alfa	The restoration matches in color and translucency to adjacent tooth structure
Bravo	The mismatch in color and translucency is within the acceptable range of tooth color and translucency
Charlie	The mismatch is outside the acceptable range of color and translucency
Recurrent Caries	
Alfa	There is no clinical diagnosis of caries
Charlie	There is clinical diagnosis of caries
Postoperative Sensitivity	
Alfa	Absence of the dentinal hypersensitivity
Bravo	Presence of mild and transient hypersensitivity
Charlie	Presence of strong and intolerable hypersensitivity

### 3 | RESULTS

After obtaining the consent form from the children and their parents who wanted to participate in the study, of 85 (125 teeth) participants, 4 (8 teeth) children were excluded from the study since they wanted to leave the study and 2 (3 teeth) patients were not analyzed due to incomplete filling of the evaluation form. The flow diagram showing the study protocol is shown in Table 2.

**Table 2: Study protocol flow diagram**

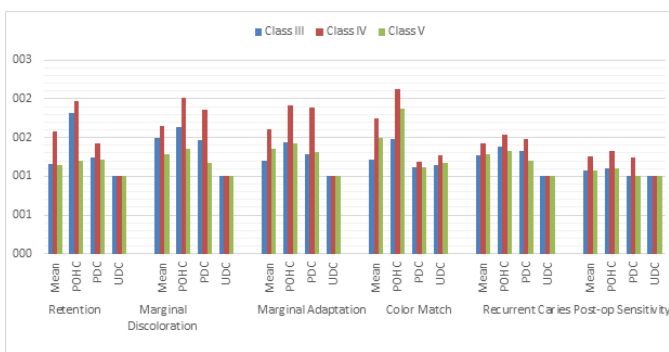


A total of 114 anterior composite restorations of 79 patients performed in different centers were analyzed. It was determined that all restorations have been in the mouth for less than 5 years, and of the restorations, 63 were performed 1 year ago, 27 were performed 2 years ago, 18 were performed 3 years ago, and 6 were performed 4 years ago. It was found that of the restorations, 25 were performed at the Public Oral Health Center (POHC), 43 were performed at the Private Dental Clinic (PDC), and 46 were performed at the University Dental Clinic (UDC), and 59 (51.75%) were class III, 41 (35.96%) were Class IV, and 14 (12.28%) were Class V. When the mean values of the restorations were analyzed, it was found that the mean values of retention ( $1.58 \pm 0.52$ ), marginal adaptation ( $1.60 \pm 0.64$ ) and post-op sensitivity ( $1.26 \pm 0.73$ ) were higher in class IV restorations and there was a statistically significant difference. ( $p < 0.05$ ) Although all the values of the restorations performed at the UDC were below the mean values, the highest values were obtained

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from the restorations performed at the POHC. It was found that the color match value ( $2.13 \pm 0.37$ ) of the class IV restorations performed at the POHC was higher than the mean value ( $1.75 \pm 0.44$ ) and the PDC ( $1.19 \pm 0.27$ ) and UDC ( $1.27 \pm 0.1$ ) values and there was a statistical difference. ( $p < 0.05$ ) The chart showing the correlation between the institution where the analyzed restorations were performed and their mean values is given in Table 3.

**Table 3: Correlation between the institution where the analyzed restorations were performed and their mean values**



Of the Class IV restorations, 10.52% were partially lost, and there was a statistically significant difference. ( $p < 0.05$ ) The Class III and IV restorations were found to have equal (7.01%) marginal discoloration extending to the dentin, whereas the class IV restorations had unacceptable marginal adaptation and color match with 7.89% and 8.77%, respectively, and the restoration was required to be replaced and there was a statistically significant difference compared to other results. ( $p < 0.05$ ) In class IV restorations, moderate and high postoperative sensitivity were observed in 3 (2.63%) and 4 (3.50%) patients, respectively. The distribution of the status of the restorations according to the Modified USPHS criteria is given in Table 4.

### 4 | DISCUSSION

Direct composite restorations are preferred more than indirect composite restorations since they are more affordable, can be finished in a single session, require less tissue loss and have successful long-term clinical performance.(12) Although the evaluation

of the clinical success of direct anterior composite restorations in restorative dentistry has attracted the attention of many researchers(13-19), and has been investigated, there is no study investigating the success of direct anterior composite restorations in pedodontics. Therefore, the success of direct anterior composite restorations in children in the mixed dentition stage was evaluated in this study. As a result of the evaluation, it was found that cavity type and the institution where it was performed directly affected the clinical performance of anterior composite restorations in children in the mixed dentition stage and the hypothesis was confirmed.

In the study, cross-sectional design was preferred using the statistically determined sample size. Randomized clinical studies are considered to be the most reliable methods for evaluating the clinical performance of restorations. In general, better results have been obtained in randomized clinical studies compared to cross-sectional studies.(2) Because this method is used in optimum conditions, by one or more experienced operators on a limited number of well-motivated patient groups.(7) However, although these studies provide important clues about the potential success of the restorative materials used, they do not reflect the actual clinical success of restorations performed by different physicians under different conditions. Therefore, retrospective and cross-sectional studies are also needed to evaluate the clinical performance of materials and the factors affecting the clinical performance. Due to the fact that this study evaluated restorations performed by different physicians in different institutions, learning previous treatment information verbally from the patient and therefore not knowing the brands and types of the materials used in current restorations are the limitations of the study.

In the prospective studies evaluating the clinical longevity of anterior composite restorations, the rate of loss of restoration due to retention within 10 years was 1% -27% for class III, 0% - 5.3% for class V, while the causes of loss have been shown as restorative material, characteristics of the patient, and type of cavity.(20-23) In a retrospective study(24), the rates of loss within 10 years have been reported as 28% for class III, 43.7% for class IV, 31.1% for class V. Heintze et al.(25) reported that Class IV

**TABLE 4:** Distribution of the restorations examined according to the modified USPHS criteria

	Class III n(%)	Class IV n(%)	Class V n(%)	Kruskal-Wallis p
Re Alpha	54(47.36%)	29(25.43%)	13(11.40%)	0.832
Charlie	5(4.38%)	a12(10.52%)	1(0.87%)	0.032
Marginal discoloration Alpha	38(33.33%)	22(19.29%)	11(9.64%)	0.634
Bravo	13(11.40%)	11(9.64%)	2(1.75%)	0.072
Charlie	8(7.01%)	8(7.01%)	1(0.87%)	0.094
Marginal adaptation Alpha	49(42.98)	25(21.92%)	10(8.77%)	0.669
Bravo	8(7.01%)	7(6.14%)	3(2.63%)	0.737
Charlie	2(1.75%)	a9(7.89%)	1(0.87%)	0.039
Color match Alpha	48(42.10%)	20(17.54%)	9(7.89%)	0.054
Bravo	9(7.89%)	11(9.64%)	3(2.63%)	0.077
Charlie	2(1.75%)	a10(8.77%)	2(1.75%)	0.022
Retention Alpha	51(44.73%)	32(28.07%)	12(10.52%)	0.371
Charlie	8(7.01%)	9(7.89%)	2(1.75%)	0.239
Postoperative sensitivity Alpha	56(49.12)	34(29.82%)	13(11.40%)	0.121
Bravo	1(0.87%)	a3(2.63%)	1(0.87%)	0.018
Charlie	2(1.75%)	a4(3.50%)	0(0.0%)	0.043

<sup>a</sup>statistical difference

restorations were lost 2 times more than class III restorations. In this study, a similar loss rate was found and it is proved that the type of cavity has a direct effect.

The most significant cause of marginal discolorations in restorations is marginal leakage.(26) Marginal leakage may result from the polymerization shrinkage of composite resins. In the literature, there are many in vitro studies reporting that the bond strength values of self-etch adhesives to the unprepared enamel are lower than those of etch-and-rinse adhesives.(27,28) For this reason, etching to the enamel should be performed in anterior restorations. Ramirez et al. (29) found a marginal discoloration rate of 18.2% as a result of the 4-year follow-up of Class IV restorations, which is close to the rate found in this study.

The most important factor that determines retention and marginal adaptation is the excessive masticatory forces on the incisal edge of the teeth with class IV restoration. As a result of this, the restoration loses its marginal adaptation and may be broken in the following period.(30) Due to the large bond interface between the tooth and restoration in Class IV restorations, color match, postoperative sensitivity and sec-

ondary caries are also highly likely to occur.(25) In a study, class IV restorations in patients with bruxism have been shown to be broken due to exposure to excessive stress.(31) Lucarotti et al.(32) reported that the clinical longevity of composite restorations including an incisal edge in the anterior teeth was reduced by half. Similarly, decreased marginal adaptation, retention, color match and more secondary caries were observed in the class IV restorations in this study. It is believed that this is caused by polymerization shrinkage.

The interface-contact relationships of restorations and the polymerization shrinkage that restorations performed with the direct methods undergo cannot be evaluated with the USPHS criteria.(33,34) However, since color match, marginal adaptation, and secondary caries will be observed after polymerization shrinkage, the indirect results of polymerization shrinkage can also be evaluated with the modified USPHS criteria. When the results of the study were analyzed, it was found that color match and marginal adaptation were lost more and secondary caries developed more in class IV restorations due to polymerization shrinkage.



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In many studies(12,13,35), secondary caries have been shown as the major cause of restoration losses or replacements; however, the reason for observing secondary caries only in 19 (16.66%) teeth in this study is thought to be due to the fact that restorations were recently performed.

It is seen that the results obtained in the studies(13,24,31,35) evaluating direct anterior composite restorations in adults after 5 years of use or more are consistent with the results of this study. Although the restorations evaluated in this study were present in the mouth for less than 5 years(17,36), higher scores (Bravo and Charlie) were obtained than the values obtained in the studies investigating direct anterior composite restorations that were present in the mouth for less than 5 years in adults. The reason for this is believed to be more wear in the restorations due to the effect of changing occlusion dynamics in children in the mixed dentition stage.

Although all dental restorations have a lifetime, composite restorations have the chance to be repaired, when necessary. Since repairs are a less invasive procedure, they also contribute to the preservation of the remaining intact dental tissue.(37) Since the studies(37,38) have shown that the repair of composite restorations is a less invasive procedure when necessary and it prolongs the clinical longevity of the restoration, it should be preferred to repair direct anterior composite restorations with Bravo and Charlie scores in children in the mixed dentition stage, instead of replacing them.

This study is important in terms of evaluating restorations performed by different physicians in different institutions. Although the vast majority of the restorations were performed in university clinics, it is seen that the restorations that were considered unsuccessful were mostly performed in public hospitals and private clinics. The reason for this may be shown as excessive clinical workload, insufficient information and equipment. Excessive clinical workload can affect the clinical performance and longevity of the restoration.(39) However, the risk of failure of composite restorations also increases in cases such as insufficient training in the adhesive procedures or lack of equipment required for performing composite restorations with high technical sensitivity.(40)

Therefore, in the face of the rapidly developing adhesive technology nowadays, sufficient training should be received, especially regarding the use of new materials, and restoration should not be started before the required instruments are ready.

## 5 | CONCLUSION

Although it was shown that the clinical longevity of class IV composite restorations were shorter than other types of restoration, marginal adaptation was impaired in a shorter time, and postoperative sensitivity was more common, the restorations performed in university clinics were found to be more successful.

### Conflict of interest

There is no conflict of interest.

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