Direct Restoration of Endodontically Treated Premolar by Glass Fiber Post and Fiber-reinforced Composite

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Abstract

The article provides a review of the efficacy of Fiber-reinforced composite and glass fiber post-treatments, as well as clinical advice and a resource for treatment decisions.

To evaluate the outcomes of direct restoration of endodontically treated premolars by glass fiber post and fiber-reinforced composite.

A cross-sectional descriptive analysis of 56 endodontically treated premolars with one or two proximal and/or distal wall losses. Using a description of statistical analysis to describe clinical characteristics and treatment outcomes. Compare the association between restoration result factors, clinical characteristics, and variables relating to restoration colour using Chi-squared or Fisher's Exact, with a significance level ($p<0.05$).

After 3 months of the direct restoration of endodontic premolars, the success rate of the fiber post was 100%, the success rate of the overall restoration was 92.9%, and the success rate (no need to repeat) of restoration was 100%. After 6 months of the direct restoration of endodontic premolars, the success rate of the fiber post was 100%, the success rate of the overall restoration was 82.1%, and the success rate of recovery (no need to repeat) was 94.6%.

Using a glass fiber post and fiber-reinforced composite for direct restoration of an endodontically treated premolar provided significant benefits: high clinical effectiveness, little dental tissue loss, good aesthetics, and patient cost savings compared to indirect restoration.

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Introduction

Direct restoration with pins and fillings is currently a common technique for restoring premolars following endodontic treatment. Its benefit is that patients can save time and money [1, 2]. The amount of tooth tissue that remains present in the tooth after endodontic treatment is a concern, though, and the material that is used in the treatment is also important. In recent years, a wide range of materials has been used to create fasteners, including dental fiber, dental porcelain, gold metal, stainless steel, and titanium. The popularity of fiber posts has recently increased in concert with the high demand for aesthetics, and several studies have been conducted to assess their stability in both direct restorations and indirect restorations [3]. The success of the restoration depends on the integrity of the crown, which is the primary factor that must be taken into consideration when using composite material, in addition to maintaining the integrity of the root in the method of direct restoration of endodontically treated teeth with fiber posts. An increasing number of new materials are being developed and released by the dental materials industry. Fiber-reinforced composites, a kind of crown restorative material that has properties such as elasticity, strength, and reduced contraction upon polymerization, have been developed. They are thought to be particularly suitable for large- and medium-sized posterior teeth restorations, overcoming the disadvantages of traditional composites and

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reducing the dangers of root pin placement [4]. In addition to giving clinicians guidance and a resource for technique selection while using fiber-reinforced composite and glass fiber post-treatments, the article gives an overview of their effectiveness. To evaluate the outcomes of direct restoration of endodontically treated premolars by glass fiber post and fiber-reinforced composite.

Materials and methods

Study subjects and study design

A cross-sectional descriptive study was used in the research. Patients who were at least 18 years old and had one to two mesial and/or distal missing teeth were eligible to be sampled. The patient gave consent to participate in the research, had good oral hygiene, and had never had any direct restorations, pins, posts, single crowns, or bridges. Some of the exclusion criteria were mental illness, epilepsy, the inability to communicate, parafunctional habits including teeth grinding, writing, and threading, many cavities, and rising periodontal disease.

Direct restoration of endodontic premolars using fiber posts and fiber-reinforced composites is the approved treatment method. Based on the assessment criteria of the US public health assessment system, modified and supplemented with USPHS, restoration was evaluated at the time immediately following filling, after 3 months, and after 6 months [5].

Data collection

Step 1: Sample selection, interview, and clinical examination

- Explain clearly the study's aims, methodologies, potential benefits, and implementation procedure, and provide patients with all the information.
- Keep a record of the following administrative data.
- Floss teeth and note oral health condition.
- Variables noted via clinical examination: teeth position, condition of teeth on either side, cavities position.
- Variables noted through measurement: deep cavities size, crown/root ratio on radiographs.

Step 2: Direct Restoration

Before starting the restoration, the patient was clean of dental plaque. Each material is used following the manufacturer's specifications. The finished fillings must be smooth, get a form that is similar to the opposing tooth, make excellent contact with the two nearby teeth, and restore a functional occlusal.

Direct Restoration of Endodontically Treated Premolar by Glass Fiber Post and Fiber-reinforced Composite (Fig 1):

- Cavity preparation
- Preparation of root canals: After removing the root canal sealant and preparing the canal with post drills of increasingly larger sizes, insert the fiber post (Overfibers Hi-rem Endodontic Post) into the prepared canal, check in the periapical film, and leave about 4mm of gutta-percha at the apex.
- Clean with water, blow dry the surface moderately, and dry the canal with paper points.
- Isolate the teeth with cotton rolls.
- Insert the prepared fiber post (Overfibers Hi-rem Endodontic Post) into the canal after placing the post compound (3M Espe Rely X U200) by using lentulo. For 40 seconds, apply the light along the length of the crown.
- Erosion of the cavity of the filling with 35% phosphoric acid for 15 seconds, followed by a thorough clean-water wash and blow-dry.
- Isolate the filling cavity, apply Rubber Dam Clamps, and extract saliva. Apply the bond evenly throughout the cavity, carefully blow it for 10 seconds, and then turn on the light for 20 seconds.
- Insert a fiber-reinforced composite (everX Posterior, GC, Tokyo, Japan) into the cavity for the filling and irradiate it for 10 to 20 seconds.
- Complete with Composite layer (G-aenial Posterior, GC, Tokyo, Japan), end lighting for 20 seconds.
- Use articulating paper to check the occlusal. The fillings should be polished and reshaped.
- Finish the filling with polish.

Step 3: Restoration Review (Fig 2)

- Following recovery, an evaluation was conducted using the indicated evaluation criteria in comparison to the USPHS single-recovery evaluation criteria. A periapical film was taken. The assessment standards contain:
  + Color compatibility
  + Surface of restoration
  + The form of restoration
  + Tightness of restoration
  + Contact
  + Periapical film
- At the 3- and 6-month appointments, all of the aforementioned criteria are assessed by clinical

observation (natural light), at a distance of 60-100 cm, using an examination mirror and probe. Among the six requirements are:

+ Retention of restoration
+ Recurrent caries
+ Results of restoration

Figure 1. The procedure for implementing direct restoration. A. Tooth 25 before restorative filling, B. After setting Glass fiber post, C. Etching cavity, D. Bonding, and lighting 20s, E. Place everX Posterior, F. Finishing the filling, G. 3month follow-up, H. 6month follow-up.

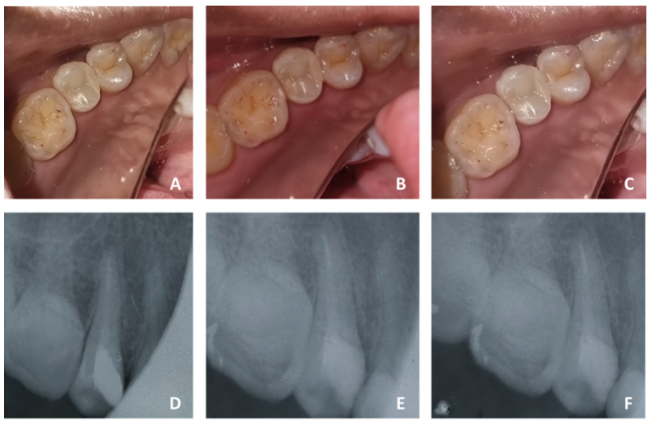

Figure 2. Result of direct restoration. A. Intraoral photos - Finishing the filling, B. Intraoral photos - 3month follow-up, C. Intraoral photos - 6month follow-up, D. Periapical film - Finishing the filling, E. Periapical film - 3month follow-up, F. Periapical film - 6month follow-up.

Statistical analysis

Excel and SPSS 26.0 software were used to record, input, synthesize, and process the data. Using descriptive data to describe clinical characteristics and treatment results. Using Chi-squared or Fisher's Exact, a significance level of 0.05, compare the correlation between restoration outcome variables and clinical characteristics, and restoration color variables.

Results

Results immediately after the direct restoration of endodontically treated premolar.

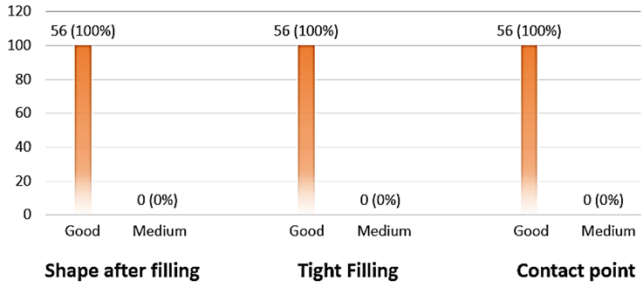

Figure 3. Shape after filling, tight filling, and contact point immediately after the direct restoration of endodontically treated premolar.

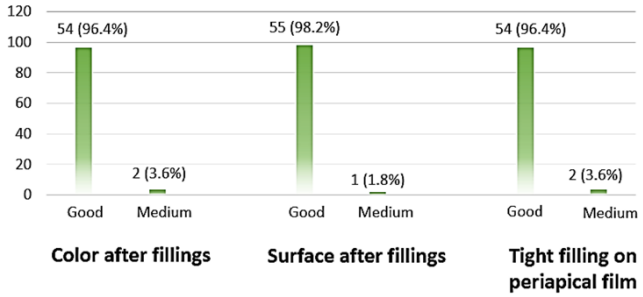

Figure 4. Color after filling, the surface after filling, and tight filling on the periapical film immediately after the direct restoration of endodontically treated premolar.

The filling's shape, tightness, and contact points were all 100% following restoration (Fig 3). On radiographs, the majority of regular restorations following fillings receive favorable ratings for color, surface finish, and fit (Fig 4).

Results after 3-month and 6-month follow-up direct restoration of endodontically treated premolar

		Color after filling		Total n (%)	Surface after filling		Total n (%)
		Good n (%)	Medium n (%)		Good n (%)	Medium n (%)	
Follow up time	3months follow up	53 (94.6)	3 (5.4)	56 (100)	53 (94.6)	3 (5.4)	56 (100)
	6 months follow up	48 (85.7)	8 (14.3)	56 (100)	51 (91.1)	5 (8.9)	56 (100)

Table 1. Color after filling and surface after filling after 3-month and 6-month follow-up direct restoration of endodontically treated premolar.

94.6% of fillings were assessed as good after three months of color restoration, whereas 8.9% were graded as the medium. There 85.7% of fillings were rated good after six months of

color restoration and 14.3% were rated medium. Following three and six months of restoration, no samples were recorded as low (Table 1).

After 3 months of filling, the filling surface was recovered, with 94.6% of the fillings graded as good and 5.4% as the medium. 91.1% of the fillings were regarded as good after 6 months, while 8.9% were classified as medium. After three and six months of restoration, no samples were identified as having a low grade (Table 1).

		Color after filling		Total n (%)	P*
		Good n (%)	Medium n (%)		
The habit of using tea/coffee	Yes	11 (61.1)	7 (38.9)	18 (100)	0,001
	No	37 (97.4)	1 (2.6)	38 (100)	
Total (n, %)		48 (85.7)	8 (14.3)	56 (100)	

Table 2. Color after filling after 6-month follow-up direct restoration of endodontically treated premolar and habit of using tea/coffee.
(*Fisher's Exact test)

Seven of the 18 samples—representing 38.9%—that had the daily habit of drinking tea or coffee observed color changes. The rate of discolored fillings was 2.6% in the group of those who didn't often consume tea or coffee. After six months, the filling color changed in a correlation (p=0.001) with the frequency of daily tea/coffee drinking (Table 2).

		Color after filling		Total n (%)	P*
		Good n (%)	Medium n (%)		
Surface after filling	Good n (%)	48 (94.1)	3 (5.9)	18 (100)	<0,001
	Medium n (%)	0 (0)	5 (100)	38 (100)	
Total n (%)		48 (85.7)	8 (14.3)	56 (100)	

Table 3. Color after filling and surface after filling after 6-month follow-up direct restoration of endodontically treated premolar.
(*Fisher's Exact test)

At the 6-month follow-up, all samples with medium-rated filling surfaces and color matching between the filling and natural tooth tissue received this rating. 94.1% of the color-matching samples in the group of restoration surfaces with good reviews were noted as good. After 6 months, there was a correlation between the filling's surface and the tooth tissue's color compatibility (p<0,001) (Table 3).

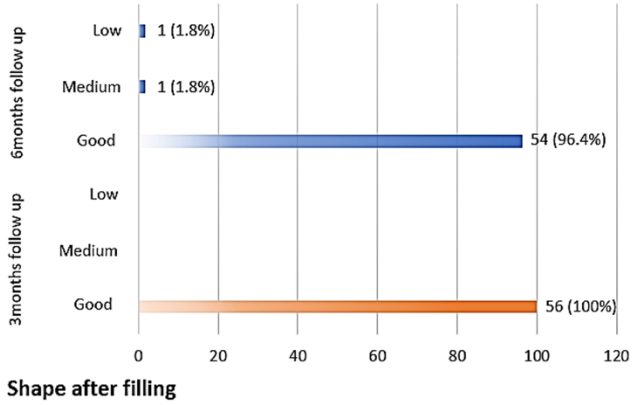

Figure 5. Shape after filling after 3-month and 6-month follow-up direct restoration of endodontically treated premolar.

After 3 months of restoration, the filling's shape was in excellent shape. After 6 months, 1.8% of the restoration was medium, 96.4% of the restoration had a graded aesthetic, and 1.8% needed to be replaced (Fig 5).

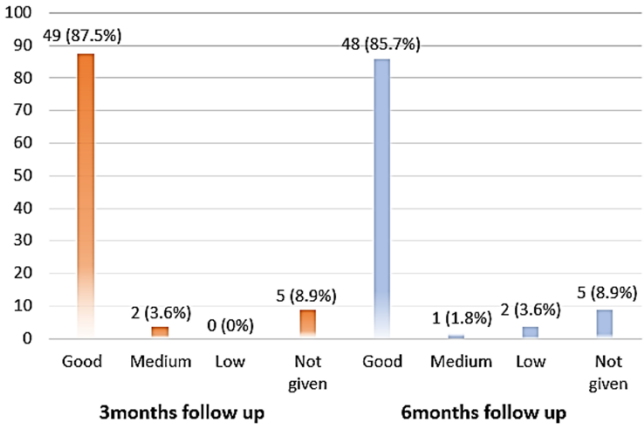

Figure 6. Contact point after 3-month and 6-month follow-up direct restoration of endodontically treated premolar.

		Size of cavity			Total	p*
		Small n (%)	Medium n (%)	Large n (%)		
Contact point after 6 months follow up	Good n (%)	2 (4.2)	39 (81.3)	7 (14.6)	48 (100)	0.067
	Medium n (%)	0 (0)	1 (100)	0 (0)	1 (100)	
	Low n (%)	0 (0)	0 (0)	2 (100)	2 (100)	
Total		2 (3.9)	40 (78.4)	9 (17.6)	51 (100)	
Tight filling on periapical film after 6 months follow up	Good n (%)	2 (100)	41 (93.2)	8 (80)	51 (91.1)	0.267
	Medium n (%)	0 (0)	3 (6.8)	1 (10)	4 (7.1)	
	Low n (%)	0 (0)	0 (0)	1 (10)	1 (1.8)	
Total		2 (100)	44 (100)	10 (100)	56 (100)	

Table 4. Contact point, tight filling on periapical after 6 months follow up direct restoration of endodontically treated premolar and size of the cavity. (*Fisher-Freeman-Halton test)

Following a 3-month follow-up, 87.5% of patients had restoration with good contact points, 3.6% had medium contact points, and 0.5% had low contact points. Following up after 6 months, 3.6% had poor contact points, 1.8% had medium contact points, and 85.7% of restorations had good contact points (Fig 6).

After 6 months, 100% of the samples with poor contact points had large cavities restored. One of every 2 samples had a medium-sized cavity out of all samples with medium contact points. In contrast, 81.3% of samples with medium-sized cavities in samples with good contact points were still restored. The difference was not statistically significant (p=0.067) (Table 4).

All small cavities with close fits were radiographically assessed as good at the 6-month follow-up. Radiographs showed a good fit in 93.2% of the medium-sized patients. In terms of the statistics, the difference was not significant (p=0,267) (Table 4).

	The result after direct restoration			Total n (%)
	Good n (%)	Medium n (%)	Low n (%)	
3months follow up	52 (92.9)	4 (7.1)	0 (0)	56 (100)
6months follow up	46 (82.1)	7 (12.5)	3 (5.4)	56 (100)

Table 5. Results after 3-month and 6-month follow-up direct restoration of endodontically treated premolar.

Following the three-month duration of the study, the rate of good restoration accounted for 92.9% of cases, while the rate of medium restoration accounted for 7.1%. Following a 6-month examination, 82.1% of the restored samples had a good grade, whereas 2.4% of the samples failed and needed restoration. 94.6% of the restorations were rated as good or medium and were considered acceptable. No failed samples need to be extracted (Table 5).

Discussion

In our investigation, the work area was isolated using cotton balls and saliva straws. Rubber dams were the most effective means to keep humidity under control. The rubber dam was not used in our investigation due to financial and logistical limitations. Referring to the literature, however, several investigations demonstrate that the use of rubber dam had no effect on the material's performance and that adequate isolation using cotton rolls produced results in retention and recovery that were comparable to those of rubber dam [6, 7].

Results immediately after the direct restoration of endodontically treated premolar

In our research, G-aenial Posterior Composite was used as the aesthetic layer of the whole restoration. The color selection procedure was carried out in daylight, with several shades of composite being applied to tooth tissue and illuminated by lights to determine which shade was most complimentary. However, immediately after the following filling, it was still noted that 2 samples (3.6%) showed moderate color compatibility, i.e., there was a little color difference between fillings and natural tooth tissue that could be observed during filling inspection and no need to replace fillings. Various factors, such as old age color changes, dead pulp, external stains, light sources, the patient's clothing, and skin tone, and the dark fillings left behind after the irradiation procedure, may include an impact on the contrast between fillings and natural teeth [8, 9].

Results after 3-month and 6-month follow-up direct restoration of endodontically treated premolar

54 of the samples in our research had filling colors that were compatible with tooth tissue after 3 months. However, there was one more sample that showed a slight change in filling colors compared to tooth tissue. An excellent color match rate for fillings was 94.6%, while a slight color change rate for fillings was 5.4%. Six samples in all had changed color for six months compared to the original (Table 1). There was a statistically significant relationship between the habit of drinking colored drinks and color changes in fillings, with 14.3% of fillings showing a slight color difference from the original tooth tissue. The color change also correlates with the habit of drinking tea and coffee. According to in vitro research by Assaf et al. (2020), the G-aenial composite had a color change, more specifically a darkening, after being steeped in coffee for 75 days [10]. According to research by Dinc Ata et al. (2017), the usage of tea could harm the color of composites, Dinc Ata recommended that clinicians should warn patients that the use of certain teas may darken the filling's color [11]. Regular tea and coffee use

over time changes the restoration's color. Other factors that affect the color of fillings include dental hygiene, smoking habits, and the amount of time the filling stays in the mouth. The aesthetic layer of the complete restoration in this study consisted of G-aenial Posterior Composite, a microhybrid composite. There are several explanations for why restorations lose polish over time. One of the elements impacting the restoration surface is the composition of the composite, as well as the form, size, and placement of the restoration molecules that make up. In comparison to Bis-GMA-based composites, UDMA-based composites were softer. It was discovered that monomers like Bis-GMA and TEGDMA had much larger polymerization shrinkage than other monomers. This difference in molecular hardness, final strength, and polymerization rate combination may have led to the change in the surface texture of restorations [12]. Composite with a plastic frame made of Bis-GMA had the lowest surface roughness, whereas composite with a plastic frame made of Ormecer had a greater surface roughness than composite with a UDMA plastic frame [13]. Microhybrid composites were the topic of in vitro research by Lemos et al. (2017) who found that acid and toothpaste brushing were the different chemical parameters that had the greatest impact on the composites' gloss and roughness [14]. The impacts of brushing and the toothpaste's ingredients on the restoration's surface structure over time were then demonstrated. In this research, it was shown that, after 6 months, there was a connection between the restored surface and the staining of the fillings; 100% of the samples with the restored surface after 6 months of reduced shininess recorded a change in color. The relationship between them and biofilm served as one of the foundations for the explanation of the aforementioned relationship. After cleaning, a coating of salivary glycoprotein will operate as a protective layer, covering the tooth surface (most bacteria will not be able to attach to this glycoprotein layer). Some bacterial strains, such as those in the family Streptococci mutans, can connect to receptors on this glycoprotein, adhere to the surface of teeth, and proliferate there over time to create a biofilm. Because they were shielded from the cleaning forces of nature on non-smooth repair surfaces, these bacteria can survive longer there. Additionally, the surface's roughness enhances the bacteria's capacity to cling. Food dyes that are a part of this biofilm stick to the restoration's surface and gradually change the color of the restoration [15].

Along with durability and aesthetics, one of the key factors in determining if a filling was successful overall was the tightness of the repair and recurrence. In this study, 92.9% of the samples were rated as good after 6 months of restoration, 5.4% of the samples were classified as medium, and 1.8% of the samples were rated as poor. Due to repeated caries, the sample with a low grade had exposed tooth tissue and a partial loss of filling. The results of the evaluation of the closeness of this study are similar to the study of Balkaya et al. (2020) there were 6.3% of cases of the exploratory probe after 1 year of filling with Filltek Bulkfill Posterior, the study. by Colak et al (2021) 100% of the recovery had good tightness after 6 months and 97.1% had good tightness after 1 year. The fact that there is a certain percentage of restorations after a period of discontinuity with the tooth tissue can be explained through the adhesive system of the composite [16, 17].

The research authors revealed a connection between the contact points and the location of the missing tooth wall, and there was a discrepancy between those findings and those from the Gomes et al. study (2015) when it came to determining the position of the restoration. If the contact point was good or not, the return had no bearing [18]. Due to the tiny sample size and partial filling loss, the sample was inadequately documented while determining the contact point, which is what caused the disparity. The evaluation of lateral exposure using visualization and exploration following USPHS standards yields subjective conclusions and mostly depends on the study evaluator and the patient's emotions. After three and six months, a survey using radiography to assess tooth root fracture revealed that there had been a complete recovery without pin and root fracture. Apart from the fiber post's elastic modulus, which limited root fractures and was similar to dentin's elastic modulus, this study's findings can be explained by the fact that radiography fracture evaluation is of limited relevance due to the likelihood of overlapping images on 2D films. Detailed analysis of root fractures seen on a CT cone beam. Within the scope of this topic's research, it was evident that the fiber post had a high level of therapeutic success against root fractures six

months after treatment.

Conclusions

Endodontic premolars were directly restored for 3 months, during which time the success rate of the fiber post was 100%, the success rate of the overall restoration was 92.9%, and the success rate of the restoration (no need to repeat) was 100%. After 6 months of endodontic premolar direct restoration, the success rate of the fiber post was 100%, the success rate of the overall restoration was 82.1%, and the success rate of recovery (no need to repeat) was 94.6%. In contrast to indirect restoration, using a glass fiber post and fiber-reinforced composite for direct restoration of an endodontically treated premolar had several advantages, including strong clinical effectiveness, minimal tooth tissue loss, good aesthetics, and lower patient costs.

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Declaration of Interest

The authors have no conflicts of interest to declare.

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