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Gurskaya, Narmina Azad

Azerbaijan Medical University, Baku, Azerbaijan

The Use of Fiberglass Posts in the Restoration of a Destroyed Coronal Part of the Tooth

▷ **Abstract.** The modern development of dentistry is marked by the emergence of new technologies and filling materials for the restoration of hard tooth tissues, which makes it possible to achieve optimal results in the rehabilitation of teeth with a deficiency of hard tissues. When restoring devitalized teeth after endodontic treatment, either direct or indirect restoration of their coronal part is performed.

The aim of the study is to evaluate the quality of coronal restoration in devitalized teeth using fiberglass post systems fixed with flowable light-cured composite, as well as to determine the depth of polymerization of the flowable filling material in the root canal when cured with fiber-optic light guides with a focused beam.

Materials and methods. The material for the study consisted of maxillary incisors from both male and female individuals aged 20-40 years, extracted due to periodontal disease.

After extraction, the teeth were immediately rinsed in a saline solution and disinfected in a 6% hydrogen peroxide solution [3]. The crowns of the teeth were trepanned, creating access to the root canals. The root canals were mechanically prepared using reamers, and a post was fitted into each root canal. The post was then fixed with a flowable composite material.

The post-endodontically treated teeth were sectioned with a diamond disc to create halves of the teeth. The internal surfaces of the tooth tissues were polished to achieve a smooth finish.

Conclusions. The method of restoring tooth crowns using fiberglass posts with fixation in flowable light-cured composite material is recommended for widespread use.

The use of this method reduces the risk of cracks forming in the root canal, thereby increasing the load-bearing capacity of the restored tooth.

Keywords: *devitalized teeth, destroyed tooth crown, fiberglass post, flowable composite.*

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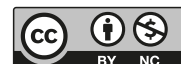

The choice of treatment method for restoring severely damaged teeth remains challenging for dentists.

Most authors believe that to preserve a tooth after devitalization for a long period, high-quality treatment and root canal obturation are necessary, as is successfully carrying out post-endodontic restoration [4, 7, 9].

Restoring the coronal part of the tooth using intracanal fiberglass posts has become widespread. The elastic modulus of these posts is close to that of dentin in the tooth root [10]. The success of such treatment directly depends on the accuracy of the post's fit to the root canal walls, the thickness of the cement layer used for fixation, and the quality of adhesion between the post, cement, and tooth tissues.

Over the past decade, new technologies and materials have emerged, expanding the technical capabilities of coronal tooth restoration and enhancing its functional efficiency [6]. Using endocanal posts is a promising and durable method for ensuring the retention of filling material in endodontically treated teeth.

An analysis of numerous literature sources has indicated that practitioners have recently become increasingly interested in fiberglass posts. This type of post has high strength and acts as a shock absorber, distributing most of the load exerted on the final restoration while transferring only a small portion of it to the walls of the tooth cavity. Fiberglass posts adhere well to tooth structures and composite cements. They can easily fit into the root canal and be placed in a single visit. At the same time, if necessary, they can be removed from the canal.

Most fiberglass posts have a color and light transmission similar to natural tooth tissues, providing excellent opportunities for aesthetic restorations [1, 3, 7].

After endodontic treatment, the loss of hard tooth tissues and irreversible biochemical and biomechanical changes that contribute to increased tooth fragility, root reinforcement, and the restoration of the destroyed coronal part are carried out using root posts. Root posts are classified based on the material from which they are made (flexible and non-flexible) and their fixation method.

Non-flexible (active and passive) metal posts are still used but have several disadvantages, including metal corrosion, weak bonding at the metal-dentin-cement interface, and poor aesthetics in anterior teeth restorations. Flexible root posts include fiberglass and carbon fiber posts. Fiberglass posts have several advantages over carbon fiber posts. Their physical and mechanical properties, particularly their elastic modulus, are very similar to those of dentin, and the restorative components form a single morphofunctional unit with the tooth tissues.

The use of fiberglass posts has significantly changed the criteria for post-endodontic restoration. The tooth tissues and the fiberglass post form a unified structure capable of withstanding both vertical and lateral loads due to the elasticity of the fiberglass, which is close to that of dentin. This creates a mechanically homogeneous complex that facilitates the distribution of masticatory loads along the root axis. Fiberglass posts reduce stress transmission to the root walls, decreasing the risk of root fracture.

Their transparency and aesthetic properties allow them to be effectively used in anterior teeth, while their biocompatibility and elasticity eliminate the risk of corrosion. Additionally, fiberglass posts are passively fixed in the canal using composite cement. This results in a structure entirely based on a resin matrix with strong chemical bonding between its components: the post, composed of fibers in an organic matrix, the composite cement for fixation, and the composite material for coronal restoration.

It is crucial that the mechanical and physical properties, including the elastic modulus, are similar between the post and dentin and between the cement used for fixation and the composite material used for coronal restoration.

Indications for the Use of Fiberglass Posts:

1. Strengthening the tooth core after endodontic treatment and in the presence of a supragingival defect in one of the tooth walls.

2. Enhancing composite restorations in cases of partial supragingival wall defects.

3. Patients with metal allergies or signs of galvanism in the oral cavity.

Contraindications for the Use of Fiberglass Posts:

1. Subgingival hard tissue defects, as adhesive techniques would be challenging.

2. Using the root to support the fixation of overlaying prostheses.

Using fiberglass posts contributes to excellent aesthetic restoration results and ensures sufficient strength for the restored tooth. When restoring the structure and function of such teeth, selecting the appropriate post system is essential. Metal posts are often used, but they have many disadvantages. The main drawback is excessive pressure on the root, which leads to cracks and tooth fractures. In modern dentistry, fiberglass posts and adhesive techniques have become preferred.

Fiberglass is elastic, resilient, and has greater flexural strength than metal. The use of fiberglass posts as a system for filling the root canal has demonstrated higher fracture resistance than metal posts. Fiberglass posts have a lower elastic modulus than dentin, which promotes optimal load distribution within the root canal and reduces the risk of root fractures compared to metal post systems [5, 6, 8].

A crucial factor for successful tooth restoration is the correct selection of the material used to fix the fiberglass post in the root canal. The material must possess high elastic, resilient, and strong properties corresponding to the biomechanical characteristics of the tooth's hard tissues.

Due to its high volumetric application of up to 4 ml, the flowable composite material allows for the rapid filling of deep cavities. This material exhibits minimal polymerization shrinkage, which prevents polymerization stress that can lead to material detachment, postoperative sensitivity, and marginal delamination [2].

The study aims to evaluate the quality of coronal restoration in devitalized teeth using fiberglass post systems fixed with flowable light-cured composite and to determine the depth of polymerization of the flowable filling material in the root canal when cured with fiber-optic light guides with a focused beam.

Materials and Methods

The study material consisted of maxillary incisors from both male and female individuals aged 20–40 who had been extracted due to periodontal disease.

After extraction, the teeth were immediately rinsed in saline and disinfected in a 6% hydrogen peroxide solution [3]. The crowns of the teeth were trepanned, creating access to the root canals. The root canals were mechanically prepared using reamers, and a post was fitted into each root canal. The post was then fixed with a flowable composite material.

The post-endodontically treated teeth were sectioned with a diamond disc to create halves of the

teeth. The internal surfaces of the tooth tissues were polished to achieve a smooth finish.

The polished surfaces were stained with a 1% methylene blue solution for 60 minutes.

The teeth were divided into groups:

1 — Control group (n = 5): These are teeth restored using fiberglass posts and flowable composite material, with polymerization carried out using a standard light guide ($d = 8$ mm).

2 — Experimental group (n = 5): These are teeth restored using fiberglass posts and flowable composite material, with polymerization carried out using a modified funnel-shaped light guide ($d = 3.5$ mm), which allows focusing the light into a thin beam.

Before fixation in the root canal, the fiberglass posts were degreased in 96% alcohol for 3 min, then dried and treated with a 5th-generation adhesive, followed by photopolymerization of the adhesive on the post. The dentin surface of the root canal and the hard tissues of the coronal part of the teeth were treated with 37% orthophosphoric acid before the fiberglass post was fixed. The dentin surface of the root canal and the hard tissues of the coronal part of the tooth were also treated with adhesive.

The fiberglass post was fixed in the root canal to a depth of 6–8 mm, as this length ensures minimal stress concentration in the tooth and physiologically appropriate load transmission during chewing [4]. Fixation was performed using flowable light-cured composite material with a photopolymerization lamp, with light intensity ranging from 500–550 mW/cm^2, for 30 seconds.

Upon examining the stained tooth slices, it was found that when polymerization was performed with a photopolymerization lamp using the standard light guide, the upper third of the slice was uniformly stained with methylene blue, indicating complete polymerization of the photopolymer. However, uneven staining was observed in the middle third, with isolated intensely colored areas, suggesting incomplete polymerization in those regions. In the lower third of the slice, polymerization did not occur at all.

In the second group of samples, where photopolymerization was carried out using the modified light guide with a diameter of 3.5 mm, we observed uniform polymerization in both the upper and middle thirds of the slice, as indicated by its even pale blue color. In the lower third, isolated intensely blue areas were seen, suggesting incomplete polymerization of the composite material's organic matrix.

Six patients aged 18–55 were examined and treated. Using the described method, fiberglass posts and flowable composite material restored eight teeth with missing crowns. The material in the root canal was polymerized using the same method as the extracted teeth.

The quality of the restored tooth crowns was assessed immediately after restoration and after a 12-month follow-up period. The evaluation criteria included anatomical form, marginal adaptation, surface roughness, marginal discoloration, secondary caries, post-restoration sensitivity, and the condition of the contact point. The quality of the contact point was checked using floss.

The condition of the restored tooth crowns was graded as excellent, satisfactory, or unsatisfactory.

- *Excellent (A)*: The restored crown met all the criteria.
- *Satisfactory (B)*: The restored crown did not meet the ideal standard and may require replacement.
- *Unsatisfactory (C)*: The restored crown showed defects in one of the evaluated criteria and should be replaced for preventive reasons.

All the restored tooth crowns met the "A" standard in 100% of the cases.

Twelve months after examining the six patients, no secondary caries were observed. A firm contact point was maintained in 76% of the restored teeth, while 24% had a less tight contact. According to the "marginal adaptation" criterion, 5 restored crowns met the "A" standard, one case met the "B" standard, and no crowns showed the "C" grade. No discoloration was observed in 3 cases.

The conducted studies indicated that the restoration of tooth crowns using this method has several positive characteristics:

- Proper distribution of load on the tooth root;
- Both the flowable composite and fiberglass post are robust and simultaneously elastic, without altering the color of the tooth tissue;
- The ability to polymerize flowable composite material in the root canal to a depth of 8 mm.

The process of post-fixation is reliable and straightforward.

Conclusions

The method of restoring tooth crowns using fiberglass posts with fixation in flowable light-cured composite material is recommended for widespread use.

This method reduces the risk of cracks forming in the root canal, thereby increasing the restored tooth's load-bearing capacity.

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Використання склопластикових штифтів при відновленні зруйнованої коронкової частини зуба

Гурська Нарміна Азад

Азербайджанський медичний університет, Баку, Азербайджан

Сучасний розвиток стоматології відзначений появою нових технологій і пломбувальних матеріалів для відновлення твердих тканин зуба, що дозволяє досягти оптимальних результатів у реабілітації зубів з дефіцитом твердих тканин. При відновленні девіталізованих зубів після ендодонтичного лікування проводиться пряме або непряме відновлення їх коронкової частини.

Метою дослідження є оцінка якості коронкової реставрації девіталізованих зубів з використанням скловолоконних штифтових систем, закріплених текучим світлотвердіючим композитом, а також визначення глибини полімеризації текучого пломбувального матеріалу в кореневому каналі при полімеризації волоконно-оптичними світловодами зі сфокусованим променем.

Матеріали та методи. Матеріалом для дослідження були верхньощелепні різці чоловіків та жінок віком 20-40 років, видалені через захворювання пародонту. Після видалення зуби негайно промивали у фізіологічному розчині та дезінфікували у 6% розчині перекису водню [3]. Коронки зубів трепанували, створюючи доступ до кореневих каналів. Кореневі канали механічно підготовлювали за допомогою розширювачів, і в кожен кореневий канал встановлювали штифт. Потім штифт фіксували текучим композитним матеріалом. Зуби після ендодонтичного лікування розсікали алмазним диском для створення половинок зубів. Внутрішні поверхні тканин зуба полірували для досягнення гладкої поверхні.

Висновки. Метод відновлення зубних коронок за допомогою скловолоконних штифтів з фіксацією в текучому світлотвердіючому композитному матеріалі рекомендовано для широкого застосування. Використання цього методу знижує ризик утворення тріщин у кореневому каналі, тим самим збільшуючи несучу здатність відновленого зуба.

Ключові слова: *девіталізовані зуби, зруйнована коронка зуба, склопластиковий штифт, текучий композит.*

Gurskaya Narmina Azad — Doctor of Philosophy in Medicine, Assistant Department of Orthopedic Dentistry, Azerbaijan Medical University, Baku, Azerbaijan.

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