

# RESTORATION OF TEETH AFTER ENDODONTIC TREATMENT WITH APPLICATION OF STANDARD FIBRE-REINFORCED COMPOSITE (FRC) CROWN-ROOT POST – SELECTED ASPECTS

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## Abstract

**Introduction.** Changes in the physicochemical properties of tooth hard tissues after endodontic treatment result from a significant loss of structure not only at the level of the clinical crown, but also at the level of the root. Reconstruction of lost tissues is a difficult procedure due to the lack of materials and technologies that perfectly reflect the properties of the reconstructed tissues. Currently, the most frequently recommended solution in the conservative-prosthetic approach in the aspect of the performed reconstruction is adhesion management. Such a procedure may include standard fiberglass-based crown-root inlays (FRC – fiber resin composites), which are the base for the reconstruction of composite clinical crowns.

**Aim.** The aim of the study was to present selected aspects of the reconstruction of teeth after endodontic treatment with the use of standard glass fibre-based crown-root posts.

**Material and methods.** The literature from PubMed and Research Gate databases from 2000-2018 has been reviewed using keywords: FRC, composite reconstruction, fiber post, tooth reconstruction after endodontic treatment. The available articles were used for direct method of composite restorations based on the standard posts.

**Results.** A review of the literature shows that the method of clinical crown reconstruction with fiberglass-based composite posts is now widely used. The most important aspect is the proper qualification of the tooth after endodontic treatment for this clinical procedure.

**Conclusions.** Composite reconstructions of clinical crowns based on a standard fiberglass-based posts are a recommendable alternative to permanent restorations. It should be remembered that in every case, as well as at every stage, there may be failures and complications resulting from material imperfections and weakening of natural tooth tissues.

**Keywords:** FRC, composite reconstruction, fiber post, tooth reconstruction.

## Introduction

During endodontic treatment, the natural tissues of the tooth are weakened. To prevent complications associated with tooth fracture, therapeutic treatment should be carefully planned in the form of a properly selected method of the clinical crown restoration. The implementation of composite tooth crown reconstruction using

a standard fiber-reinforced crown-root post is currently one of the modern and recommended methods for the treatment of teeth after endodontic treatment. The main goal of the clinical procedure is to replace the lost tooth structure with conservative methods and to ensure proper maintenance of the clinical crown reconstruction [1].

There are many factors affecting the correct bonding of the FRC post in the root canal and having a decisive impact on the long-term maintenance of restoration in oral cavity. These include: proper root canal preparation, the amount of tooth crown tissue left, the right choice of material and knowledge of its physical properties, as well as appropriate clinical management.

## **Aim**

The paper aims at characterizing the most important factors in the tooth restoration process after endodontic treatment using a standard fiber-reinforced composite crown-root post.

## **Material and methods**

The literature review was made using the PubMed and Research Gate database throughout 2000-2018 using key words: FRC, composite reconstruction, fiber post, tooth reconstruction after endodontic treatment. From among the available articles there were selected those that related to the implementation of composite restorations using the direct method based on the standard post and their application in both the lateral and anterior dental arch.

## **Results**

### **Influence of rinsing agents used during chemomechanical treatment of root canal on binding forces of FRC posts**

The treatment of the root canal using both rotary and manual endodontic tools inevitably leads to the formation of a smear layer on the walls of the canal. The layer produced is of a slightly grainy and amorphous nature. Its removal determines the long-term success of endodontic treatment [2]. For cleaning of the needed surface, the chemical cleaning procedures of the canal walls are used, which most often involve the synergy of several cleaning agents/methods. They modify the walls of the root canal, additionally indirectly affecting the subsequent procedures, which are used in the treated space, including the filling or inserting of the crown-root post [3].

Sodium hypochlorite is a widely used agent when rinsing root canals. It favors cleaning, moisturizing, removing the collagen layer, above all has a broad spectrum of antibacterial properties, perfectly dissolves the tissue. Sodium edetate (EDTA) by chelating calcium compounds causes demineralization and cleaning of root dentin walls. Both compounds, acting alternately, synergistically remove the smear layer formed in the root canal during the mechanical processing of its walls [2,3].

However, it should not be forgotten that long-term exposure of dentine to the effects of high concentrations of NaOCl leads inevitably to a decrease in its elasticity

and resistance to bonding, while the susceptibility to fractures increases [4]. In addition, it negatively affects the resin cement/dentin interface bonding [2,5].

### **The process of removing the smear layer from the space prepared for inserting the standard fiber-reinforced (FRC) crown-root post**

One of the basic steps leading to the positive effect of using FRC posts is to obtain a cleaned surface of canal dentin after preparation of the lodge. A proper dentin/post/cement interface bonding is not possible if the surface of natural tissues is not properly prepared [5]. The preparation of root canal lumen consists of:

- removing the canal filling at the appropriate depth
- removal of the surface layer of root canal dentin
- removing the smear layer formed during previous treatments.

The most important thing in obtaining optimal retention and adhesion is the proper treatment of the smear layer. In the case of cements with self-etching components, it is assumed that the smear layer will be reorganized by them in a way that will allow the creation of a hybrid film at a minimum depth of 1/3 of the crown canal. However, acid monomers have little predictable effect in the case of a thick smear layer. In addition, in the hybrid film, there are irregularly positioned collagen fibers, which degrade over time, inevitably leading to a lower retentive strength [6].

In turn, conditioning of dentin with phosphoric acid may generate problems in the periapical area, or in very narrow or deep canals, where it is difficult to control its optimum and safe penetration [7].

Rinsing with chemicals can be aided by ultrasound, especially when removing a thick smear layer, but it should be done carefully, as combination of NaOCl with EDTA can lead to significant erosion of tissue within the canal.

A thorough disinfection is the final stage of preparing the root canal for starting the adhesive/cementing procedure. The role of chlorhexidine in this process is often emphasized, which in addition to disinfecting properties, acts directly as an inhibitor of metalloproteinases (MMPs) [8].

### **Choice of luting agent for cementing the FRC post in the root canal**

The use of crown-root FRC posts has influenced the development of materials technology in terms of their cementing in the intracanal space. Luting cements used in the adhesive cementation technique of fiber-reinforced composite posts are often called active cements. This term, unlike passive conventional cements, comes from the fact that they actively produce bonds with dentine through the hybrid film, and are chemically bonded to the filling material. Composite cements can be divided into [9,10]:

- conventional cements
- self-etching cements
- self-adhesive cements.

Besides, the cements of choice are materials with a double bonding system, because on the one hand they provide relatively fast polymerization in regions where the light

from the polymerization lamp reaches, on the other hand, in places that are outside the area of the light polymerization, there is chemical bonding. It is assumed that a fiber-reinforced post perfectly conducts a beam of polymerizing light, however, it should not be forgotten that with the increase in depth, the amount of transported light decreases, which results, inter alia, in the loss of energy and mass in unit of time [11,12]. Bearing in mind the above fact, it is important to provide the right amount and quality of light energy. Improperly polymerized monomers can have a cytotoxic effect on surrounding tissues [13].

### **Procedures after cementing a standard fiber-reinforced root canal post in the root canal**

The clinical procedure following the correct endodontic treatment of the tooth can be called postendodontic treatment. The way chosen by the clinician will determine the longevity of the tooth to perform full-featured functions in the Stomatognathic System. Studies show that the success of endodontic treatment depends to the greatest extent on a properly restored clinical crown of the tooth, while even well-performed treatment of the root canal system may fail in the case of neglect at the postendodontic stage [14].

It is often emphasized that it is necessary to close the treated canal space as soon as possible with the final restoration due to the risk of developing reinfection [15,16]. Therefore, it should be emphasized that the purpose of supplying natural tooth tissues with a prosthetic restoration or direct reconstruction is not only restoration of the function and protection against fractures, but above all, sealed closing of the access to the canal system [16]. In this respect, it is important to choose such a restorative method, which, in opposition to occlusion forces, will protect the remaining tissues from destruction.

It is repeatedly pointed out that the teeth lacking pulp circulation change their physical properties and become more fragile. Histochemical studies show that the amount of water structurally bound by collagen in dentin after endodontic treatment drops by only 10% [17], hence it is believed that there is no basis for assessing these tissues as less valuable. What matters, is the fact that there is a loss of structure, resulting mainly from the extent of the possible carious process or the methodology of making access to the root canal system. The preparation of the MOD cavity leads to the loss of up to 65% of the hard structure, while the removal of pulp chamber roof and chemomechanical processing of the canals – only up to 6% loss of natural tooth tissues [17,18].

Due to the fact that the risk of breaking of the endodontically treated tooth pillar depends directly on the remaining structure of natural tooth tissues, there are distinguished five classes, with regard to the extent of the endodontic cavity (Table 1). It should be remembered that qualification of dentin walls presence is made on the basis of their thickness measurement, if it does not exceed 1 mm, it is assumed that this wall does not exist [19,20].

After careful analysis of the individual clinical situation of the patient, the appropriate type of restoration can be selected. It is necessary to take into account not only

**Table 1.** Classification of endodontic lesions with regard to the extent of natural tooth walls left

Class of lesion	Number of missing/reduced walls	Recommended algorithm	Type of recommended filling/restoration
<b>I</b>	-	Adhesive procedure: direct method	<ul style="list-style-type: none"> <li>• Direct composite restoration of clinical crown</li> </ul>
<b>II</b>	1	Adhesive procedure: direct method	<ul style="list-style-type: none"> <li>• Direct composite restoration of clinical crown</li> </ul>
<b>III</b>	2	Adhesive procedure: direct or indirect method	<ul style="list-style-type: none"> <li>• Direct composite restoration of clinical crown</li> <li>• Indirect restoration in the form of inlay, onlay, overlay</li> <li>• Prosthetic crown</li> </ul>
<b>IV</b>	3	Adhesive procedure: direct or indirect method + additional retention element in the form of root-crown post	<ul style="list-style-type: none"> <li>• Direct composite restoration of clinical crown on root-crown post</li> <li>• Direct composite restoration of the clinical crown on root-crown post prepared for inlay, onlay, overlay</li> <li>• Direct composite restoration of the clinical crown on root-crown post prepared for prosthetic crown</li> </ul>
<b>V</b>	4	Adhesive procedure: direct or indirect method + additional retention element in the form of root-crown post + prosthetic crown	<ul style="list-style-type: none"> <li>• Direct composite restoration of the clinical crown on root-crown post prepared for prosthetic crown</li> </ul>

the physical properties and aesthetics, but also the patient's personal preferences. It is also absolutely necessary to inform the patient about the advantages and disadvantages of each method of tooth restoration. Laboratory and clinical tests often prove that in most cases it is possible to achieve the goals set by adhesive dentistry. Due to the adhesion to hard tissues, it has become possible to more economically develop natural structures, obtain better marginal integrity and better distribution of forces during occlusion [21].

## Conclusions

Composite restorations of clinical crowns supported by standard fibre-reinforced composite (FRC) crown-root posts are a recommendable alternative to permanent restorations. It should be remembered that in each case, as well as at any stage, there may be failures and complications resulting from material imperfections and weakening of natural tooth tissues.

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