RESTORATION OPTIONS FOR ENDODONTICALLY TREATED TEETH – A REVIEW

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ABSTRACT

Coronal restoration, alongside the quality of endodontic treatment, plays a crucial role in the long-term success of the therapy, by preventing micro-leakage in this area and contamination of the endodontic space. Choosing the optimal material and technique consists in a difficult decision making for the clinician. This article aims to present generally accepted criteria for the use of composite restorations, posts, and cuspal coverage restorations on endodontically treated teeth.

INTRODUCTION

After performing thoroughly every step of the endodontic treatment, choosing the optimal coronal restoration for the tooth that is being treated has a strong influence on the long-term success of the therapy. In a review and meta-analysis published in 2011, Gillen *et al.* [1] underlined the importance of the adequate coronal seal, alongside the quality of root canal treatment, for the treatment outcome and healing of apical periodontitis, finding no significant difference between these two factors. Other authors [2] have found of greater influence the quality of the coronal restoration on the long-term success, than quality of endodontic treatment. Even if the existing literature presents contradictory results comparing these two factors, there are no doubts concerning the crucial importance of a correct coronal restoration in order to minimize leakage in this area and, subsequently, failure of endodontic treatment [3].

Most of the authors agree that the optimal timing of the coronal restoration is immediately after endodontic treatment, whenever this is possible [4]. Immediate final restoration prevents micro-leakage in the coronal area, while temporary restorations fail to insure a correct sealing for extended periods of time [5]. When different factors influence decision making and delay the final coronal restoration, placing orifice barriers using composite materials may prevent salivary contamination [6].

There is a considerable range of techniques and materials utilized to achieve coronal sealing in endodontically treated teeth. Choosing the optimal type of coronal restoration is still a subjective decision that

many clinicians make based on their own experience. This article aims to present generally accepted criteria for the use of composite restorations, posts, and cuspal coverage restorations on endodontically treated teeth.

REVIEW OF THE LITERATURE

The influence of coronal restoration on the long-term success of endodontic therapy does not only involve the integrity of periapical tissues, but also the tooth's resistance to fracture. Contrary to the belief that endodontically treated teeth become more brittle, many authors have reported that loss of vitality affects the biomechanical behavior of teeth to a limited extent [5]. Dietschi *et al*. [7] conducted a systematical review of the literature on biomechanical considerations on the endodontically treated teeth, reporting as the main factor reducing resistance to fracture of endodontically treated teeth – coronal tissue loss. Several authors have indicated that the amount and quality of the remaining tooth structure is a key factor not only for the choice of coronal restoration, but also as a predictor of long-term success [8]. Another criteria that influences the choice of coronal restoration is the position of the tooth in the dental arch – anterior teeth are subject to different occlusal forces compared to posterior teeth, and they respond to distinct esthetic requirements [9].

Direct composite restorations

Direct composite restoration represent the most suitable option for anterior or posterior teeth with minimal access cavity, or teeth that also present reduced loss of other coronal tissue [5, 6]. According to several studies, this category of endodontically treated teeth, presenting 3 or 4 remaining coronal walls with adequate thickness (at least 2 mm), shows a good retention for a direct restoration, and using a post should be considered an overtreatment [10-13].

Posts

The initial idea that posts can increase the resistance of the tooth and its strength has been demoted, while the post's role in expanding retention of coronal restoration has been widely reported [14]. When it is decided that using a post is a necessity, usually it will be positioned in the larger and less curved canals, such as distal canals in lower molars, or palatal canals in upper molars [6].The preparation of the space for the post should be as conservative as possible, trying to avoid removal of additional hard tissues of the tooth, and retaining at least 4 mm of root canal filling gutta-percha in the apical direction [3, 6]. A conservative preparation will also influence positively the tooth's resistance to fracture.

Sorensen and Engelman, in 1990, reported the importance of keeping at least 1mm of dental structure, with almost parallel wall preparation [3, 15]. Later articles underlined the necessity of maintaining a minimum of 2 mm height and 1 mm thickness of tooth structure around the cervical area, consisting in a highly desirable condition whenever using a post [6, 16]. This condition, called the ferrule effect,

reduces the chances of vertical fracture of the tooth and minimizes the effects of lateral and rotational forces on the restoration and on the post [17-19].

While metallic posts add time and fees to the normal procedures, fiber posts present a modulus of elasticity similar to dentin [6] and may be used without involving laboratory procedures and temporization of treatment. Other materials, such as ceramic or zirconium posts are also available, presenting aesthetic advantages for the anterior teeth.

In a prospective clinical study published in 2012, Naumann *et al.* [20] concluded that decision making regarding the use of fiber posts should take into consideration 2 main factors – tooth type and the number of the remaining coronal walls. Studies realized on anterior teeth report contradictory conclusions regarding the use of posts to increase resistance to fracture [21-26], while taking into consideration that these are in vitro studies with limited size of study groups [13].

According to Mangold and Kern [27], using a post on a premolar with 2 or 3 remaining coronal walls determined no significant difference on the fracture resistance of the tooth, while it greatly influenced the resistance when the tooth presented less than 2 remaining coronal walls. Scotti *et al.* indicates that in premolars with remaining walls' thickness > 2 mm, fiber post and a direct intracuspal composite restoration provides sufficient fracture resistance [28].

Papalexopoulos *et al.*, in a review published in 2019, reported a simplified "restorative algorithm" for posterior teeth, by making reference to the number and width of the remaining coronal walls [13, 18, 27]. According to this algorithm, post and crown are indicated in molars presenting 1-2 dentinal walls (with more than 50% of remaining coronal structure), or molars presenting 3 dentinal walls, from which two or three walls with thickness less than 2 mm [13].

Cuspal coverage

According to the American Association of Endodontists [6], all posterior teeth that have been endodontically treated should also receive cuspal coverage restorations, in order to preserve the tooth's integrity against occlusal forces [29]. Creation of the access cavity in teeth subjected to endodontic treatment, together with loss of coronal structure due to carious lesions frequently present in these teeth, has been proven to increase the cuspal deflection, possible cause for fracture [30]. Nevertheless, the procentage of endodontically treated teeth that receive cuspal coverage appears to be low [9]. Therapeutic options for the restoration of posterior endodontically treated teeth include direct composite restorations, indirect restorations (onlay/overlay) using composite resin, ceramic, or even gold, and full crowns such as metal-ceramic, full ceramic, zirconia-ceramic, monolithic zirconia, or even gold crowns [31].

Scotti *et al.* indicates for endodontically treated premolars with remaining walls' thickness < 2 mm, total cuspal coverage through composite adhesive restoration, with or without fiber post, as an

option that provides satisfactory fracture resistance [28].

Papalexopoulos *et al*. proposes an indirect adhesive restoration (onlay/overlay) for molars presenting 3 remaining coronal walls, with either one wall being less than 2 mm thick, or 2-3 walls with thickness < 2 mm, with the condition that these teeth do not represent an abutment for fixed or removable prosthesis [13].

Complete crowns are indicated in posterior teeth with more than 50% of coronal structure loss [13]. The ferrule effect is also important when a complete crown is chosen to restore the tooth, and it has been reported that in endodontically treated teeth restored with prefabricated post, composite core, and complete crown, a 2 mm height of the axial wall increased their fracture resistance [9, 10, 19]. Several studies have shown a better survival rate of endodontically treated teeth when a full crown was used [5, 32, 33].

Bindl and Mormann introduced in 1999 the term of "endocrown", describing them as adhesive computer-generated ceramic corono-radicular restorations, anchored on the cavity margins and on the entire pulp chamber, presenting increased resistance to fracture [13, 34, 35]. Their main advantage is the fact that both crown and core act as a single unit, and are indicated in posterior teeth with excessive loss of dental structure, inadequate ferrule, and limited free-way space [13, 36, 37].

Conclusions

Coronal restoration of endodontically treated teeth remains a controversial subject. Nevertheless, a conservative approach is highly recommended, taking into consideration the amount and quality of the remaining coronal structure, biomechanical properties and clinical performance of materials and techniques, in order to increase the tooth's resistance to fracture and to preserve a good prognosis.

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