

## A radiographic study regarding post retained restorations

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### Abstract

The aim of this study was to evaluate the incidence of intraradicular retention and the prevalence of different types of posts used for the restoration of endodontically treated teeth, in clinical practice. *Materials and Methods:* The study was performed on 94 digital panoramic radiographies that allowed a comprehensive appreciation. Root canal fillings and the posts were identified on these radiographies and their correctness and quality were assessed by measurements according to the data provided by the specialized literature references. Morphologic parameters investigated were: length, diameter and configuration. *Results:* 474 teeth with endodontic treatment were identified, of which 224 were post restored: 156 (69.6%) using cast posts, 55 (24.6%) using prefabricated non-metallic posts and 13 (5.8%) using threaded prefabricated metallic posts. Regardless the type, we have noticed a great number of errors (84.37%) concerning the manufacturing, the selection, or the application of the post. The errors resulted from disregarding at least one of the investigated morphologic parameters. Intraradicular retention is indicated in clinical situations where dental tissue destruction does not allow placement of crown fillings. *Conclusions:* The improvement of endodontically treated teeth restorations retention with posts is appropriate as long as post preparation does not undermine the remaining tooth structure. Scientific debates still exist regarding the safest modality to restore a non-vital tooth.

**Keywords:** endodontically treated teeth, radicular morphology, panoramic radiography, morphologic parameters, dental tissue loss.

### Introduction

Decay is a destructive chronic disease with multifactorial etiopathogeny that determines dental hard tissue loss, going up to dental pulp injury. Untreated, it invasively evolves to dental pulp necrosis and periapical pathology, which in turn, are accompanied by different degrees of hard tissue destruction. The decision to maintain and restore and particularly to use an endodontically treated tooth as abutment depends mainly on the amount of remaining tooth structure, radicular morphology and its periodontal health [1, 2].

Under these circumstances, the chances to achieve long-lasting restorations are well defined. The outcome of the prosthetic treatment plan depends on the success of each treatment phase, so that radiographic assessment must be performed in different stages: before post placement, in order to check the root canal system seal, after post insertion to evaluate the treatment method according to the data provided by the specialized literature references and during follow-up, when teeth are exposed to masticatory loading forces and we look for the outcome maintenance [1-3].

The above considerations represent the background of this study based on radiographic criteria for quantitative and qualitative assessment of the possibilities of intraradicular retention used for the restoration of endodontically treated teeth.

### Materials and Methods

The study was performed on 94 digital panoramic radiographies acquired in a dental clinic with private practice in Bucharest, Romania, during a three years period (2009-2012).

#### The study protocol

Written informed consent was obtained from all the patients whose radiographies were selected in the study. Root canal fillings and the posts were identified on these radiographies and their correctness and quality were assessed by measurements according to the data provided by the specialized literature references. The investigated morphologic parameters were: length, diameter and configuration.

The main objectives of the study were to determine the incidence of post retained restorations, the distribution of posts use according to the teeth types, the ratio between the different types of posts, as they were radiographically identified and to assess the fairness of the method, regardless the type of post used.

Teeth were distributed by category taking into account topographical considerations and each category was assigned a code number, as follows: 1 – maxillary incisors, 2 – maxillary canines, 3 – maxillary premolars, 4 – maxillary molars, 5 – mandibular incisors, 6 – mandibular canines, 7 – mandibular premolars, and 8 –

mandibular molars. For each dental category, the presence of root canal fillings and their quality, the presence of posts, their type, their length and width and their configuration with regard the numbers of canals in multi-rooted teeth were noticed and registered. The length of the posts was appreciated from the cemento–enamel junction to the end portion (tip) and their width was calculated at the junction between the crown and the root canal for tapered types, while the length/width ratio was considered at the level of the apical third of the posts for parallel-sided shapes. Each type of post was identified grace to its radiopacity and shape (*i.e.*, parallel *vs.* tapered, smooth *vs.* threaded) differences noticed on the radiographic image.

**Results**

After the evaluation of the 94 panoramic radiographies, we have found 474 teeth with radiological signs of endodontic fillings (both correctly and incorrectly performed regarding their length and uniformity); 224 of them were restored with post retained restorations (correct and incorrect in terms of dimensional and/or morphologically parameters).

Sharing the figures resulted by radiological counting at the eight dental classes mentioned above, a percentage distribution was obtained, which is shown in the chart below (Figure 1).

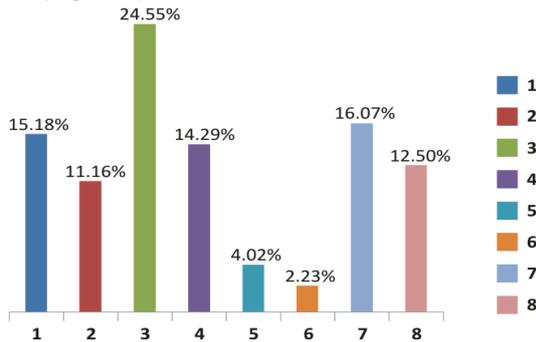


Figure 1 – Distribution of intraradicular retention restorations according to dental classes.

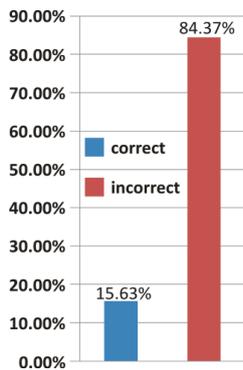


Figure 3 – The correctness of the post retained restorations.

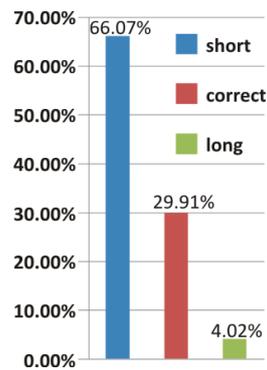


Figure 4 – Results for the length parameter.

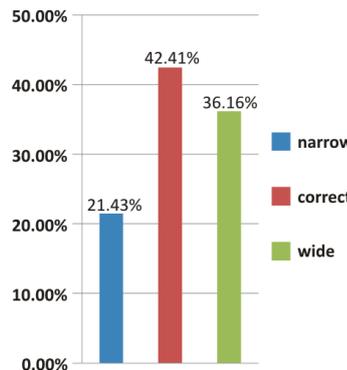


Figure 5 – Results for the width parameter.

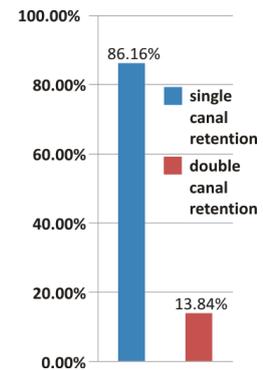


Figure 6 – Prevalence of posts regarding the number of canals used for retention.

**Discussion**

Many restorative options can be used to reconstruct endodontically treated teeth, from direct restorations to coronal coverage. The main factor in decision-making is the amount of remaining tooth structure [4, 5].

In parallel, the 224 teeth with post retained restorations were subjected to a visual examination in order to group them according to shape, configuration and material used.

The result may be presented as a sequence of values, thus: 156 teeth (69.6%) were restored with cast posts, 55 teeth (24.6%) with prefabricated non-metallic posts, and 13 teeth (5.8%) with prefabricated metallic posts (Figure 2).

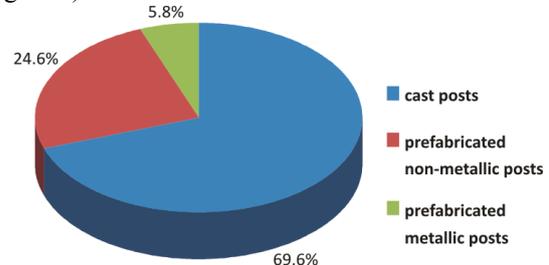


Figure 2 – Prevalence of post retained restorations.

Stands out the highest frequency of cast posts, applied to all categories of teeth, in particular to the premolars and molars. In order of frequency, it follows the non-metallic prefabricated posts with physical properties similar to those of the natural dental tissues and then the metallic prefabricated posts.

We also found that regardless of the type of tooth restoration, or tooth topography, the measured values of these devices do not coincide with standard dimensional array parameters (length, diameter, configuration) than in a small percentage of cases, comprising 35 teeth (15.63%). The remaining 189 teeth (84.37%) have at least one parameter that does not correspond to the standards. In this final category, we also included clinical situations with poor device location (on the improper, eccentric roots, etc.) or those that presented a different morphology of the recommended ones.

The results of the research on criterion watched (fairness of the restorative method, the length, diameter and configuration of the posts), are found in the graphs below (Figures 3–6).

As most of the teeth that require endodontic treatment are weakened by caries, old fillings and endodontic access, they will need a crown. In this case, the remaining dentin will be insufficient to support the final restorations, so a post retained core is necessary to provide crown retention [6–8]. From the 474 endodontically

treated teeth found in our study, only 224 (47.25%) were post restored. Peroz I *et al.* [9] proposed a classification regarding restoration of endodontically treated teeth, according to the amount of remaining tooth structure:

- Class I: Four remaining cavity walls (only the access cavity is present) – filling of the access cavity is the definitive restorative treatment.

- Class II and III: Two or three remaining cavity walls. Adhesive restorations are recommended.

- Class IV: One remaining cavity wall – a post retained core is suggested. If the tooth will be used as an abutment for fixed or removable partial dentures, using of a post retained restoration is mandatory.

- Class V: No remaining cavity wall – insertion of posts is necessary. In these situations, it is of great importance that the final restoration will provide the so-called “ferrule effect”. The ferrule is “the circumferential ring of sound tooth structure that is enveloped by the cervical portion of the crown restoration” [10].

The need for a post retained restoration depends also on the size and position of the tooth in the dental arch. Molars have a big pulp chamber that offers enough retention for a direct restoration. When significant loss of tooth structure has occurred, a post is necessary [10]. The investigated upper molars were post restored in a percentage of 14.29% and the lower molars in a percentage of 12.5% (Figure 1). Premolars have smaller pulp chambers and less tooth structure, so that they often require a post [10, 11]. In the present study, a significant rate of post retained restorations was registered on premolars (24.55% upper premolars and 16.07% lower premolars as shown in Figure 1). Anterior teeth that present a little loss of hard tissue do not require posts placement. If the tooth need a crown a post retained foundation is necessary [10]. The investigated upper incisors were post restored in a percentage of 15.18%, the upper canines in a percentage of 11.16%, while the lower ones in a percentage of 4.02% and 2.23% respectively (Figure 1). The lowest percentage of post retained restoration was registered in anterior mandibular teeth. This type of restorations needs special considerations for the anterior mandibular teeth, as post space preparation is difficult due to thin and mesio-distal flattened canals.

Once the decision to use a post has been taken, we must choose the type of post. Two categories exist: the custom made posts, laboratory fabricated (cast posts) and the prefabricated ones, the latter available in two variants: metallic and non-metallic. The selection of the devices is based on the following [2, 4, 12–14]:

- The amount of tissue loss: the greater the hard tissue destruction, the more cast posts will be preferred.

- Root canal morphology: due to their greater adaptability cast posts are indicated in canals with a noncircular cross-section and in extreme tapered or flattened canals. Enlarging such canals to conform to a prefabricated post could be excessive and may lead to perforations. In addition a thin, uniform layer of cement will fill the endodontic space in cases of custom made posts, while in cases of prefabricated posts, due to their poor fit the cement will be very thick [14]. This is the

reason why in this study the thickness of parallel-sided shapes was assessed at the level of the end of the post.

An abandonment of the old concept of double canal retention was noticed in our study (Figure 6). The double canal retention was used in the past to supplement retention and anti-rotational resistance in multi-rooted teeth. Nowadays, it is considered that canals with a noncircular cross-section in which a cast post is well fitted offer enough resistance to rotational forces. The rotation is also prevented by remaining vertical coronal walls [14]. The distal canal of mandibular molars and the palatal canal of maxillary molars are usually used for post placement, as their specific morphology (large and straight canals) offers the best conditions for post space preparation [11].

The anti-rotational resistance of prefabricated post is questionable due to their round cross-section shape [14].

A standard regarding restoration of the endodontically treated teeth does not exist as specific factors for the individual tooth and clinical situation dictate the therapeutically approach [10, 15]. A balance between retention and fracture resistance must be always considered. Metal devices were the first used. Historically, it was appreciated that their superior physical properties were a guarantee for success of the restoration and longevity of the tooth. Today, it is considered that their rigidity may pose a risk for root fracture. With recent insight into biomechanics, with demands for esthetics and technological advances, prefabricated non-metallic posts were introduced, with a closer elastic modulus to that of dentine: fiber-reinforced composite posts (fibers embedded in a polymer matrix). This characteristic is very important for the distribution of the occlusal forces evenly along the length of the root, thus decreasing, even eliminating the possibilities of root fracture [16, 17] and represents the reason why many authors prefer the use of non-metallic prefabricated posts. Reduced risk fracture of the root is registered with these types of posts. Instead, failure occurs by cervical leakage, cement breakdown and loss of the artificial crown [10, 18].

Although disputed, cast posts provided excellent clinical services. Two studies comparing opinions with regard the restoration of endodontically treated teeth between board-certified prosthodontists and general dental practitioners showed that prosthodontists preferred the use of cast posts [19, 20]. In both investigated groups, this kind of posts was the one more commonly used [20]. In our study, the greatest percentage (69.6%) of the restorations with radicular retention were represented by cast posts retained crowns. This finding sustains the idea that, even if cast posts are considered obsolete, we still face many clinical situations that require their use. Failures with regard root fracture were not registered in our study because the fracture lines could not be accurately evaluated on panoramic radiographies.

24.6% of the restorations with radicular retention found in our study were represented by prefabricated non-metallic posts in association with a core build up.

The smallest percentage of the restorations with radicular retention was represented by prefabricated metallic posts (5.8%) in this research. This is in accordance with the opinion that today the competition is

held between cast posts and prefabricated non-metallic posts [5]. Morgano SM and Brackett SE postulated that a direct restoration using two pieces: a prefabricated metallic post and a core build up is a less predictable therapeutically approach than a cast post, which is a one-piece restoration [21]. The weakest link of the former system is represented by the metal-core build up material interface. All prefabricated metallic posts found were threaded. Their engagement into dentin offers a superior retention but also is accompanied by increased stress formation within the root and thus by an increased risk of root fracture [22].

Regarding the two investigated parameters, length and diameter of the posts, their fairness was assessed according to the data provided by the specialized literature references. Post length within the root canal must be at least equal with the crown high [23, 24]. It is also essential to maintain the integrity of the apical seal [10, 25]. Sorensen JA and Martinoff JT investigated 1273 endodontically treated teeth used as abutments for crowns or primary support for fixed and removable partial dentures, regarding the rate and manner of failure and found that where post length in the canal was equal to or greater than the length of the crown, the success rate was 97.5%, regardless of post design [25]. Unfortunately, a high percent of short posts (66.07%) was registered in our study, followed by 29.91% of correct length posts and a small percent (4.02%) of to long posts.

The width of the post is appreciated as correct if it does not exceed one-half the width of the root [26]. In teeth investigated in this study 42.41% of the posts had a correct width, while 21.43% were too thin and 36.16% were too thick in relation with the width of the root.

Post space preparation requires good understanding and knowledge of radicular internal morphology to avoid unnecessary mishaps [27]. The close relation between root canals morphology and post selection and configuration was emphasized by Goodacre CZ and Baba NZ [28] who showed that: "The individual who completed the endodontic treatment is ideally suited to perform the post space preparation, being the one that is most knowledgeable regarding root curvatures and areas where no further root preparations should be performed because it will result in areas of thin residual dentin."

In terms of dimensional measurements, the method used in this study is relative, because the distances on the radiography do not correspond with the actual distances, due to the different angles formed by the anatomical elements with the incident X-ray beam.

## ☒ Conclusions

Our study shows that despite the progresses in caries prevention and therapy, many teeth still need endodontic treatment. The restorative approach plays a decisive role in the long-term prognosis of a non-vital tooth. Specific clinical situations and individual teeth require particular consideration. Cast posts were the most prevalent, demonstrating again their long-term clinical service, followed by prefabricated non-metallic posts, appreciated

for superior biomechanical behavior. Based on our study results, some theoretical rules are disregarded in the daily practice.

## Acknowledgments

This study was a part of the thesis of the second author to fulfill the requirement of the PhD degree in Medical Sciences at "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania.

## References

- [1] Cherlea V, *Tratamentul endodontic*, Ed. Național, București, 2000, 24, 25, 216, 258–260.
- [2] Bratu D, Nussbaum R, *Bazele clinice și tehnice ale protezărilor fixe*, Ed. Signata, Timișoara, 2001, 183, 184, 294–305, 439, 440.
- [3] Hartly FJ, *Endodontics in clinical practice*, University Press, Cambridge, 1990, 128–202.
- [4] Oltean D, Nimigean VR, Oltean AM, *Reabilitare orală*, Ed. Universitară "Carol Davila", București, 2007, 121–137.
- [5] Nimigean VR, Buțincu L, Ioniță S, Nimigean V, Truță RI, Bencze MA, *Corelații dintre restaurarea dinților tratați endodontic și soluția de protezare ulterioară – retrospectivă a literaturii de specialitate*, Romanian Journal of Stomatology, 2011, LVII(3):209–215.
- [6] Goodacre CJ, Spolnik KJ, *The prosthodontic management of endodontically treated teeth: a literature review. Part I. Success and failure data, treatment concepts*, J Prosthodont, 1994, 3(4):243–250.
- [7] Fernandes AS, Dessai GS, *Factors affecting the fracture resistance of post-core reconstructed teeth: a review*, Int J Prosthodont, 2001, 14(4):355–363.
- [8] Ozkurt Z, Işeri U, Kazazoğlu E, *Zirconia ceramic post systems: a literature review and a case report*, Dent Mater J, 2010, 29(3):233–245.
- [9] Peroz I, Blankenstein F, Lange KP, Naumann M, *Restoring endodontically treated teeth with posts and cores – a review*, Quintessence Int, 2005, 36(9):737–746.
- [10] McComb D, *Restoration of the endodontically treated tooth*, <http://www.rcdso.org/dispatch/PeakFM2008.pdf>.
- [11] Cheung W, *A review of the management of endodontically treated teeth. Post, core and the final restoration*, J Am Dent Assoc, 2005, 136(5):611–619.
- [12] Hunter AJ, Feiglin B, Williams JF, *Effects of post placement on endodontically treated teeth*, J Prosthet Dent, 1989, 62(2): 166–172.
- [13] Fernandes AS, Shetty S, Coutinho I, *Factors determining posts selection: a literature review*, J Prost Dent, 2003, 90(6):556–562.
- [14] Rosenstiel SF, Land ME, Fujimoto J, *Restoration of the endodontically treated tooth*. In: Rosenstiel SF, Land ME, Fujimoto J, *Contemporary fixed prosthodontics*, Mosby, St. Louis, 2006, 336–378.
- [15] Stockton L, *Factors affecting retention of post systems: a literature review*, J Prosthet Dent, 1999, 81(4):380–385.
- [16] Lassila LV, Tanner J, Le Bell AM, Narva K, Vallittu PK, *Flexural properties of fiber reinforced root canal posts*, Dent Mater, 2004, 20(1):29–36.
- [17] Boksmann L, Hepburn AB, Kogan E, Friedman M, de Rijk W, *Fiber post techniques for anatomical root variations*, Dent Today, 2011, 30(5):104, 106–111.
- [18] Spear F, *When to restore, when to remove*, Insight Innovation, 2001, 29–37.
- [19] Morgano SM, Hashem AF, Fotoohi K, Rose L, *A nationwide survey of contemporary philosophies and techniques of restoring endodontically treated teeth*, J Prosthet Dent, 1994, 72(3):259–267.
- [20] Eckerbom M, Magnusson T, *Restoring endodontically treated teeth: a survey of current opinions among board-certified prosthodontists and general dental practitioners in Sweden*, Int J Prosthodont, 2001, 14(3):245–249.
- [21] Morgano SM, Brackett SE, *Foundation restorations in fixed prosthodontics: current knowledge and future needs*, J Prosthet Dent, 1999, 82(6):643–657.

- [22] Peutzfeldt A, Sahafi A, Asmussen E, *A survey of failed post-retained restorations*, Clin Oral Investig, 2008, 12(1): 37–44.
- [23] McLean A, *Criteria for the predictably restorable endodontically treated tooth*, J Can Dent Assoc, 1998, 64(9):652–656.
- [24] McLean A, *Predictably restoring endodontically treated teeth*, J Can Dent Assoc, 1998, 64(11):782–787.
- [25] Sorensen JA, Martinoff JT, *Endodontically treated teeth as abutments*, J Prosthet Dent, 1985, 53(5):631–636.
- [26] Morgano SM, *Restoration of pulpless teeth: application of traditional principles in present and future contexts*, J Prosthet Dent, 1996, 75(4):375–380.
- [27] Gogna R, Jagadish S, Shashikala K, Keshava Prasad B, *Restoration of badly broken, endodontically treated posterior teeth*, J Conserv Dent, 2009, 12(3):123-8.
- [28] Goodacre CJ, Baba NZ, Restoration of endodontically treated teeth. In: Ingle JI, Bakland LK, Baumgartner JC, *Endodontics*, 6<sup>th</sup> edition, BC Decker Inc., Hamilton, Ontario, 2008, 1431–1471.

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*Received: June 25<sup>th</sup>, 2012*

*Accepted: October 25<sup>th</sup>, 2012*