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## Post and core: a new clinical perspective – myths and facts

*Retentores intrarradiculares: uma nova perspectiva clínica – mitos e verdades*

*Pernos intrarradiculares: una nueva perspectiva clínica - mitos y verdades*

Jefferson David Melo de **MATOS**<sup>1</sup>  
Leonardo Jiro Nomura **NAKANO**<sup>1</sup>  
Guilherme da Rocha Scalzer **LOPES**<sup>1</sup>  
Jhenifer Rodrigues **SILVA**<sup>2</sup>  
Mateus Favero Barra **GRANDE**<sup>2</sup>  
Ana Carolina **MARQUES**<sup>2</sup>  
Nathália de Carvalho **RAMOS**<sup>3</sup>  
John Eversong Lucena de **VASCONCELOS**<sup>4</sup>  
Valdir Cabral **ANDRADE**<sup>5</sup>  
Marco Antonio **BOTTINO**<sup>6</sup>  
Renato Sussumu **NISHIOKA**<sup>6</sup>

<sup>1</sup>Post Graduate Student - Ph.D Program, Department of Dental Materials and Prosthodontics, São Paulo State University (Unesp), Institute of Science and Technology, São José dos Campos - SP, Brazil

<sup>2</sup>Post Graduate Student - Master Degree Program, Department of Dental Materials and Prosthodontics, São Paulo State University (Unesp), Institute of Science and Technology, São José dos Campos - SP, Brazil

<sup>3</sup>Professor of Prosthodontics, Department of Dentistry, Universidade São Francisco USF, Bragança Paulista - SP, Brazil

<sup>4</sup>Professor of Implantology and Prosthodontics, Department of Dentistry, Faculdade CECAPE, Juazeiro do Norte - CE, Brazil

<sup>5</sup>Professor Adjunct, Department of Dentistry and Maxillofacial Surgery, Universidade Federal de Juiz de Fora UFJF, Governador Valadares - MG, Brazil

<sup>6</sup>Professor of Post Graduate Program in Restorative Dentistry, Department of Dental Materials and Prosthodontics, São Paulo State University (Unesp), Institute of Science and Technology, São José dos Campos - SP, Brazil

### Abstract

**Objective:** The present study aims to describe a literature review on post and core restorations from a new clinical perspective in dentistry. Also, to define the best choice regarding the intraradicular retainer, material used, confection techniques and their possible failures, explaining the myths and the truths about them. **Methodology:** This literature review was conducted by leading health databases: Pubmed (<https://www.ncbi.nlm.nih.gov/pubmed>), SCIELO ([www.scielo.org](http://www.scielo.org)) e Google Scholar (<https://scholar.google.com.br>). The keywords for the textual search were: Denture, Partial, Fixed; Post and Core Technique; Dental Research; Dentistry. **Inclusion criteria** were: literature on the subject under study, literature of recent years, english and portuguese languages, laboratory and clinical studies, and systematic reviews. **Literature Review:** Post and core are defined as prosthetic elements that seek intraradicular retention to support prosthetic crowns or unitary restorations. The ideal shape of the intraradicular retainer should supplement the dental remnant, allowing the shape of a prepared tooth to receive a prosthetic crown. In conjunction of the dental remnant, they are responsible for dissipating and absorbing the forces developed during the chewing cycles, without deformation or damaging the minimal cement layer. **Conclusion:** The evolution of endodontic therapy enables a restoration with greater safety of treated teeth. However, it is necessary to consider the remaining dental structure, mainly because the posts do not provide reinforcement, only retention and resistance to the prosthetic crown.

**Descriptors:** Denture, Partial, Fixed; Post and Core Technique; Dental Research; Dentistry.

### Resumo

**Objetivo:** O presente estudo tem por objetivo descrever uma revisão de literatura sobre os retentores intrarradiculares, diante de uma nova perspectiva clínica na odontologia. Além disso, definir a melhor escolha quanto ao retentor intrarradicular, material utilizado, técnicas de confecção e suas possíveis falhas, explanando os mitos e as verdades impostas sobre os mesmos. **Metodologia:** Esta revisão de literatura foi conduzida pelos principais bancos de dados de saúde: Pubmed (<https://www.ncbi.nlm.nih.gov/pubmed>), SCIELO ([www.scielo.org](http://www.scielo.org)) e Google Scholar (<https://scholar.google.com.br>). As palavras-chave para a busca textual foram: Prótese Parcial Fixa, Técnica para Retentor Intrarradicular, Pesquisa em Odontologia, Odontologia. Já os critérios de inclusão foram: literatura que aborde a temática em estudo, literatura dos últimos anos, idioma em inglês e português, estudos laboratoriais, clínicos e revisões sistemáticas. **Revisão de Literatura:** Os retentores intrarradiculares são definidos como elementos protéticos que buscam retenção intrarradicular para suportar coroas protéticas ou restaurações unitárias. O formato ideal do retentor intrarradicular deve complementar o remanescente dentário, permitindo a obtenção da forma de um dente preparado para receber uma coroa protética. Em conjunto com o remanescente dentário, onde os mesmos são responsáveis por dissipar e absorver as forças desenvolvidas durante os ciclos mastigatórios, sem sofrerem deformações ou permitirem o comprometimento da mínima camada cimentante. **Conclusão:** A evolução da terapia endodôntica possibilita uma restauração com uma maior segurança dos dentes tratados. Entretanto, deve-se ter uma atenção ao considerar a estrutura remanescente dental, principalmente no que diz respeito que os pinos não fornecem reforço, somente forma de retenção e resistência à coroa protética.

**Descritores:** Prótese Parcial Fixa; Técnica para Retentor Intrarradicular; Pesquisa em Odontologia; Odontologia.

### Resumen

**Objetivo:** El presente estudio tiene como objetivo describir una revisión de la literatura sobre los pernos intrarradiculares, frente a una nueva perspectiva clínica en odontología. Además, definir la mejor opción con respecto a los pernos intrarradiculares, el material utilizado, las técnicas de confección y sus posibles fallas, explicando los mitos y las verdades que se les imponen. **Metodología:** Esta revisión de la literatura fue realizada por las principales bases de datos de salud: Pubmed (<https://www.ncbi.nlm.nih.gov/pubmed>), SCIELO ([www.scielo.org](http://www.scielo.org)) y Google Scholar (<https://scholar.google.com>). Las palabras clave para la búsqueda textual fueron: Dentadura Parcial Fija, Técnica de Perno Muñón, Investigación Dental, Odontología. Los criterios de inclusión fueron: literatura que aborda el tema en estudio, literatura de los últimos años, idioma en inglés y portugués, estudios de laboratorio, clínicos y revisiones sistemáticas. **Revisión de Literatura:** Los pernos intrarradiculares se definen como elementos protéticos que buscan retención intraradicular para sostener coronas protéticas o restauraciones unitarias. La forma ideal del perno intrarradicular debe complementar el remanente dental, permitiendo la forma de un diente preparado para recibir una corona protética. Junto con los remanentes dentales, donde son responsables de disipar y absorber las fuerzas desarrolladas durante los ciclos de masticación, sin sufrir deformación ni permitir que la capa de cementación mínima se vea comprometida. **Conclusión:** La evolución de la terapia endodóntica permite una restauración más segura de los dientes tratados. Sin embargo, se debe tener cuidado al considerar los remanentes dentales, especialmente porque los pernos no proporcionan refuerzo, solo retención y resistencia a la corona protética.

**Descriptor:** Dentadura Parcial Fija; Técnica de Perno Muñón; Investigación Dental; Odontología.

## INTRODUCTION

Loss of tooth structure due to carious injuries, dental trauma, restorative procedures

and endodontic procedures results in loss of dental support<sup>1</sup>. The longevity of these dental elements has been prolonged due to the continuous development of endodontic therapy and restorative procedures<sup>2</sup>. In order to restore the shape and function of the treated teeth, depending on the clinical situation, just a core build-up may be sufficient to provide retention to the dental crown, but the considerable loss of dental structure precludes this type of procedure, being necessary an intraradicular anchorage<sup>3</sup>.

Several factors directly influence the survival rate of restorative procedures in endodontically treated teeth, including: biological, mechanical and aesthetic, emphasizing that the intraradicular retainer must comply and optimize these factors. For this reason, the choice of system influences prognosis and treatment duration<sup>4</sup>.

Intraradicular devices have been used for several years to increase retention, provide stability for the final restoration and reestablish dental element function. Such devices range from a cast metal post to prefabricated post that aim to reduce clinical deficiencies and fulfill functional and aesthetic requirements<sup>5</sup>.

The indication of the post will depend on the degree of crown destruction, the involved tooth, the bone support, the type of prosthesis and the type of affecting forces to. Some materials can be used as intraradicular retainers, including cast metal posts, prefabricated metal post and prefabricated non-metallic post, such as glass fiber post<sup>6</sup>.

The professional may choose to use cast metal retainer or prefabricated post. The cast metal retainer can be obtained by the direct/modeling or indirect/impression technique, understanding that the direct technique is indicated in cases with parallel teeth or converging roots and in situations that require retainer in a few teeth. The indirect technique is necessary in cases of divergent root canals and when there is a need for retainer on several teeth. Considering that the custom retainer is cast to fit the root canal and the post and core are fused together, while in the case of the prefabricated post, the post is selected and the core build-up is constructed of a material applied directly over the retainer-remaining tooth<sup>7</sup>.

The cast metal post have shown satisfactory performance in long-term clinical studies, in addition to adapting to the

configuration and angulation of the root canal and the ideal connection between core and post, making it impossible to separate them<sup>8,9</sup>. In recent years, the demand for aesthetics has led to the development of materials with this aspect, especially zirconia or glass fiber. To ensure a satisfactory result, the system must have the same color and reflect and transmit similar light to the natural tooth, especially in anterior teeth, returning the harmony of the smile<sup>10</sup>. The glass fiber post has aesthetics and the ability to have a modulus of elasticity similar to the dental structure when compared to cast metal post, allowing the formation of restoration that dissipates stress similarly to the natural tooth<sup>11</sup>.

It is important to emphasize the dental remnant directly influences the choice of retainer used. In cases with extensive crown and root destruction, cast metal posts are considered the first choice, demonstrating a high long-term success rate<sup>12</sup>. Besides those already mentioned, another important factor that directs the choice of retainer is the root anatomy, because each tooth exhibits its anatomical characteristics, such as: root curvature, mesiodistal width and buccolingual dimension. Thus, the root anatomy defines the selection of the intraradicular retainer<sup>13</sup>.

The present study aims to describe a literature review on post and core restorations, facing a new perspective in dentistry. Also, to define the best choice regarding the intraradicular retainer, material used, confection techniques and their possible failures, explaining the myths and the truths about them.

## MATERIAL AND METHOD

A bibliographic search was performed in the main health databases: PUBMED (<https://www.ncbi.nlm.nih.gov/pubmed>), SCIELO ([www.scielo.org](http://www.scielo.org)) and Scholar Google (<https://scholar.google.com.br>), which collected articles that were published from 1989 to 2019. Inclusion criteria were literature on the subject under study, literature of recent years, english and portuguese languages, laboratory and clinical studies, systematic and literature reviews and case reports. The exclusion criteria were: articles with different subjects from fixed partial denture, post and core technique, dental research and dentistry.

Through the bibliographic search were selected 40 articles, which were extracted 20 articles from PUBMED (<https://www.ncbi.nlm.nih.gov/pubmed>), 13 SCIELO ([www.scielo.org](http://www.scielo.org)) and 7 Scholar Google (<https://scholar.google.com.br>). The following specific medical subject titles and keywords were used: Denture, Partial, Fixed (DeCS / MeSH Terms), Post and Core Technique

(DeCS / MeSH Terms), Dental Research (DeCS / MeSH Terms), Dentistry (DeCS / MeSH Terms) (Figure 1).

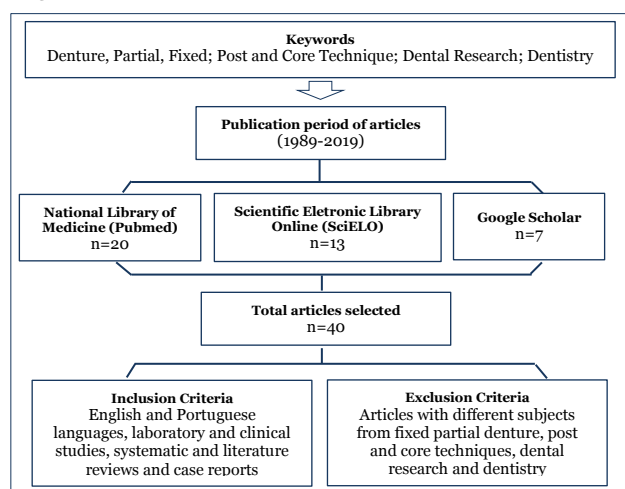


Figure 1: Articles selection flowchart.

## RESULTS

### ○ Literature Review

Post and core are defined as prosthetic elements that seek intraradicular retention to support prosthetic crowns or unitary restorations<sup>14</sup>. The ideal shape of the intraradicular retainer should supplement the dental remnant, allowing the shape of a prepared tooth to receive a prosthetic crown. In conjunction of the dental remnant, they are responsible for dissipating and absorbing the forces developed during the chewing cycles, without deformation or damaging the minimal cement layer<sup>15</sup>.

### ○ Indications

Post and core are indicated for endodontically treated teeth, when significant reduction of their dental structures occurs and may affect fracture resistance due to the compromise of important elements, especially reinforcement, such as marginal ridges, oblique ridge and root of pulp chamber<sup>16</sup>. The selection of the post will depend on the location of the tooth in the arch and especially on the amount of dental remnant<sup>17</sup>.

### ○ Cast metal post

Cast metal post are indicated for teeth with little remnant in the crown portion, especially at the height of the cervical region. In the region of the ferrule effect, the margin volume should be at least 0.5mm<sup>18</sup>.

There are some classic indications for cast metal post, such as the change in root/crown angle, for example in case of the buccal root where the crown needs to be lingualized to positionally harmonize with other teeth; in excessively tapered or elliptical root canals, where the prefabricated post do not adjust the root canal walls and would require a

thicker cement layer; teeth with total crown destruction, where practically only the root remained, in which the core material would be exclusively dependent on intracanal anchorage<sup>19</sup>.

### ○ Glass fiber post

Glass fiber post are indicated in cases with an intact clinical crown region, at least 2.0 mm of supra-gingival tooth structure, to favor the largest contact area available for adhesion and provide correct stress distribution<sup>20</sup>. Featuring the following advantages: single clinical session, no laboratory procedure, lower cost, less dentin removal, aesthetics, ease of removal, elastic modulus similar to dentin and better fracture prognosis. Regarding the disadvantages, they have little or no individualization, they are not used in any situation of tooth destruction and root canal anatomy, limited adaptation, larger cement film and limited radiopacity.

### ○ Choice of Intraradicular Retainer (Advantages and disadvantages)

Endodontically treated teeth have a much higher failure rate than vitalized teeth. These failures can be classified according to their cause into biological and mechanical failures<sup>21</sup>.

The biological ones are related to tooth recontamination, which can happen by bacterial infiltration through the root apex, crown portion or contamination in the process of restorative procedures. Mechanical factors are mainly related to fractures or retention losses of the prosthetic part. In relation to cast metal post, failure occurs due to tooth fracture, whereas in the glass fiber post it promotes decementation<sup>22</sup>.

### ○ Cast metal post

Cast metal post have the advantages of better adaptation, high structural stiffness of the retainer, radiopacity, smaller cement film, individualization, use in any situation of crown destruction and root canal anatomy. Among the disadvantages, they need a greater number of clinical sessions, laboratory procedures, higher cost, require additional dentin removal, unfavorable aesthetics, more invasive technique, difficulty of removal, high modulus of elasticity, with its consequences can cause root fracture<sup>23</sup>.

### ○ Glass fiber post

The glass fiber posts are composed of epoxy resin and fibers, these composites present in fiberglass posts have adequate compressive and fracture strength<sup>24</sup>. Another advantage is that it does not require the laboratory procedure and requires less removal of intraradicular dentin, reducing the susceptibility to root fracture. In addition, it

provides greater ease of technique, low stiffness, modulus of elasticity similar to dentin, ease of application, low cost when compared to ceramic. Regarding the disadvantages of glass fiber post, they have lower mechanical properties, limited radiopacity, making adaptation assessment difficult<sup>25</sup>.

#### ○ *Cementation*

The purpose of cementation is to seal the area between the prosthetic part and the dental structure, protecting from irritating products of physical, chemical and bacterial nature, preventing recurrence of caries. The desirable properties for ideal cement are adhesion, high polymerization, low viscosity, compatible mechanical properties, fluoride release and radiopacity<sup>26</sup>. Correct cementation ensures good retention and stability of the part. The lower the cement thickness, the better its cementing action, thus, it is desirable that the cement absorbs and dissipates the loads generated by chewing, in addition to having a modulus of elasticity similar to dentin<sup>27</sup>.

Zinc phosphate cement is extremely satisfactory and is the most widely used agent in the cementation of cast metal post. Despite its lack of adhesion to dental structure or restorations, it is the reference for comparison with new systems<sup>28</sup>.

The choice of zinc phosphate as a cementing agent is due to the fact that it is a material that has cohesive strength, is radiopaque, has good compressive strength, adequate working time, and excellent handling characteristics and low cost. However, it presents solubility to oral fluids, to minimize such problem, it is ideal that there is an adaptation of the cast metal post to the root canal and the metal ceramic crown to the core, so that the cement film is reduced. Resin cements have polymerization depth limitation and are not indicated for cementation of metallic restorations and metal posts<sup>29</sup>.

Root stress after retainer cementation depends on variables such as its diameter, length and received load. During mechanical preparation of the canal to receive the intraradicular retainer, part of the obturating material and dental structure is removed, providing strength and retention to the post, being careful to avoid lateral perforations, loss of apical integrity and root resistance<sup>30</sup>.

#### ○ *Failures*

Intraradicular retainer failures are usually not related to the post type, but to other factors such as patient age, retainer location, abutment type, and cementation. In elderly patients, the very weak dentin and the increase in the number

of repeated restorations result in great loss of dental structure<sup>31</sup>.

The success of the final restoration associated with a post and core is in most cases related to radicular preparation and cementation, which if properly followed, enable a high success rate<sup>32</sup>.

The inefficiency of a post by not reinforcing the weakened tooth structure can be mechanically explained<sup>33</sup>. In the case of upper teeth, as the load is applied to the palatal surface, the support used is directly related to the buccal alveolar crest<sup>34</sup>. This generates concentration of compressive stress on the buccal side of the tooth, and on the opposite side tensile forces are developed in the palatine direction. These opposing forces lie at the longitudinal center of the tooth exactly where the post is cemented. Near the tooth surface, the magnitude of this pressure is higher, which demonstrates the need for peripheral rather than central reinforcement<sup>35</sup>.

When the load applied to the tooth exceeds the proportional limit, a fracture begins in the palatal region, where the enamel is under tensile strength<sup>36</sup>. This fracture line may propagate transversely from where the load is being applied to the support above the bone crest<sup>37</sup>. This fracture pattern can be modified when the post is cemented into the root canal. When the fracture line reaches the region where the retainer is cemented, it dissipates part of the stress with its own structure, guiding the failure to the longitudinal direction of the root<sup>38</sup>. In addition, Lopes et al.<sup>10</sup> report the existence of variation in stress concentration around a prefabricated post, as well as a higher possibility of root fracture, thus the retainer for more complex cases is the cast metal post.

### **DISCUSSION**

Post and cores are conventionally used in restorative dentistry. They are presented as the most versatile in adaptation, since they allow to reproduce the root canal in different ways, providing a better adaptation; distribution of forces at the root, restoration of shape and function, reintegrating the tooth into the stomatognathic system and with respect to the anterior elements, restoring smile harmony<sup>39</sup>.

The cast metal post have as their main property their stiffness and high mechanical strength that must be taken into consideration when selecting metallic retainers, since the post fixed in the root canal aims to retain and stabilize a coronal component. Therefore they are indicated in cases of extensive rehabilitation, dental realignment and in cases with elliptical or excessively tapered canals where the

prefabricated post does not fit tightly to the canal walls, resulting in higher cement thickness. Their use is also justified by the claims that cast metal posts have a versatility of indication, thus allowing their use in almost all cases. Through these retainers it is possible to reconstruct the coronal portion, restoring biomechanical conditions to the tooth to maintain its perfect functioning<sup>40</sup>.

The advantages of cast retainers are related to their high stiffness and better adaptation to the canal, which favors anti-rotational characteristics. Its disadvantages are related to an additional dentin reduction and the need of laboratory procedures<sup>30</sup>.

The post and core presents itself as a segment of the reconstruction inserted in the root canal to stabilize a coronal component<sup>33</sup>. The retainer function is more than coronal segment retention, it also helps to prevent tooth fracture after endodontic therapy by providing support and internal strength<sup>34</sup>.

The retention of cemented post can be affected by a number of variables including length, diameter, wall inclination, surface roughness of retainer and conduit, cementing agent, and cementation technique<sup>28</sup>. Any factor that causes decreased retention may produce the retainer vulnerable to the action of forces leading to fracture<sup>36</sup>.

The purpose of cementation is to seal the area between the post and core and the dental structure, protecting it from irritating products of physical, chemical and bacterial nature, preventing caries recurrence<sup>37</sup>.

Some criteria must be followed to increase the success rate with intraradicular retainers:

- ✓ The apical sealing must not be violated;
- ✓ Parallel retainers are more retentive than tapered retainers;
- ✓ Long retainers have a larger surface area and are more retentive than short ones;
- ✓ Retainer material should be corrosion resistant, non-toxic and cannot react adversely with other material that was used adjacent to it;
- ✓ Retainers should be adapted and passively cemented.

The use of retainers represents a last attempt to preserve a compromised tooth<sup>10</sup>. Post and core failure always results in less tooth structure and often needs a careful review of the treatment plan. Therefore, it is essential the prevention of post and core failures.

#### FINAL CONSIDERATIONS

It can be concluded from this study that in Dentistry, several options and methods for the use of intraradicular retainers can be found. In

this context, the evolution of endodontic therapy enables a safer restoration of the treated teeth.

However, care should be taken when considering the remaining dental structure, especially as the post do not provide reinforcement, only retention and resistance to the prosthetic crown, and are necessary when retention is required for the coronal restoration.

The use of post and core restorations should be mainly conducted by the clinical setting and rehabilitative method, respecting their appropriate indications. Possible failures occur due to mistaken indication of an intraradicular retainer or possible errors performing the technique. Preservation of remaining dentin is a determining factor for the longevity of endodontically treated teeth requiring post and core restorations. The length, diameter, shape of the post are factors that influence both its retention and the resistance of devitalized teeth to fracture. The stiffness of the post material may increase the susceptibility of root fracture. The anatomy and location of the tooth in the arch should be considered when planning post and core restorations. However, further studies are needed regarding the conduct to be taken in the dental surgeon's clinical routine.

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#### CONFLICTS OF INTERESTS

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The authors declare no conflicts of interests.

#### CORRESPONDING AUTHOR

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**Jefferson David Melo de Matos**

Department of Dental Materials and Prosthodontics,  
São Paulo State University (Unesp),  
Institute of Science and Technology,  
São José dos Campos – SP, Brasil  
Av. Eng. Francisco José Longo, 777/778, Jardim São  
Dimas 12245-000 São José dos Campos - SP, Brasil  
e-mail: matosjefferson19@gmail.com

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