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NON-TITANIUM RECIPROCANT SYSTEM AND INSTRUMENTS: *LITERATURE REVIEW*

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ABSTRACT

Endodontic therapy aims at cleaning and shaping the root canal, minimizing the amount of bacteria and their by-products present, as well as allowing an efficient sealing of the system, thus eliminating infection, preventing or curing apical periodontitis. The success of endodontic treatment depends on several factors, and root canal preparation is extremely important, as the conical shape given to the canal during instrumentation will help in the effectiveness of other procedures, such as facilitating irrigation and aspiration and three-dimensional obturation. root canal system. The aim of this study is to analyze the reciprocating systems in endodontics and which conducts are most used and appropriate. A search was performed in the PubMed database to identify available investigations from 2009 to 2019. The following keywords were used in the search: *" Reciprocating " OR " Reciprocation. "* The research was limited to dental publications written in English and Portuguese. An additional hand search was extensively performed in the *Journal of Endodontics*; International Journal of Endodontics; Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and *Endodontology; Australian Endodontic Journal; British Dental Journal; and Journal of American Dental Association*, specializing in the subject by citing selected studies and review articles available. The success of endodontic treatment depends on several factors, and root canal preparation is extremely important, as the conical shape given to the canal during instrumentation will help in the effectiveness of other procedures, such as facilitating irrigation and aspiration and three-dimensional obturation. root canal system. However, when bacteria are present inside the root canal, they are also found in the dental tubules, so it is recommended to remove part of the infected dentin by instrumentation.

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INTRODUCTION

Endodontic therapy aims to clean and shape the root canal. minimizing the amount of bacteria and their by-products present, as well as allowing efficient sealing of the system and thus eliminating infection by preventing or curing apical periodontitis. Root canal preparation is an extremely important phase for the following steps to be taken. properly performed and most likely to succeed (Alcalde *et al*., 2015; Plotino *et al*., 2012). The success of endodontic treatment depends on several factors, and root canal preparation is extremely important, as the conical shape given to the canal during instrumentation will help in the effectiveness of other procedures, such as facilitating irrigation and aspiration and three-dimensional obturation. of the root canal system (Pereira *et al*., 2013). However, when bacteria are present inside the root canal, they are also found in the dental tubules, so it is recommended to remove part of the infected dentin through instrumentation (Cavalli, 2016). To this day, root canal instrumentation is so widely discussed and different instrumentation methods and systems are described in the literature. Initially, root canal instrumentation was performed using stainless steel files, but due to their low flexibility power and their ability to rectify curvilinear parts, they lose room for more flexible technologies (Martinho *et al*., 2015; Nascimento and Almeida, 2017). Pereira *et al*., 2017; Rubio *et al*., 2017). Having more flexible

files and aiming to make endodontic treatment more agile and efficient, the aim of this review is to analyze the reciprocating systems in endodontics and which conducts are most used and appropriate.

METHODOLOGY

A search was performed in the PubMed database to identify available investigations from 2009 to 2019. The following keywords were used in the search: " *Reciprocating* " OR " *Reciprocation*. ". The research was limited to dental publications written in English and Portuguese. An additional manual search was extensively performed in the *Journal of Endodontics*; International Journal of Endodontics; Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology; *Australian Endodontic Journal; British Dental Journal; and Journal of American Dental Association*, specializing in the subject by citing selected studies and review articles available. After removing duplicate articles, reviewing the title, and selecting by reading the abstracts, full-text articles were used to verify that the topic was pertinent. We found 54 articles, after identifying duplicates 4 articles were removed. Only 24 articles were selected after reading the title, and after reading the abstracts, 10 more articles were excluded because they did not fit the search terms. 14 articles were used as a basis for the construction of this literature review. Other articles were added to compose the body of the review.

Literature Review

Root Channels Root: Canal modeling is one of the most important steps in root canal treatment. It is essential in determining the effectiveness of all subsequent procedures, including chemical disinfection and root canal obturation. However, even though this stage is adversely influenced by the highly variable root canal anatomy, it aims at the complete removal of vital or necrotic tissue to create sufficient space for irrigation. In addition, modeling tends to preserve the integrity and location of the canal and apical anatomy in preparation for proper filling (Castellucci *et al*., 2011; Plotino *et al*., 2012; Webber, 2015). Avoiding iatrogenic damage to the root canal structure and additional irritation of the periradicular tissue is demanding for all the latest instrumentation techniques. Maintaining the original canal shape using a less invasive approach is associated with better endodontic outcomes. Nickel-titanium rotary instruments have been shown to be efficient in obtaining optimal root canal modeling, with less straightened and better centralized curved root canal preparations (Webber, 2015). The super elasticity of rotating materials may allow less lateral forces to be exerted against the channel walls, especially in severely curved channels, reducing the risk of channel aberrations and better maintaining the original channel shape (De Azevêdo Rios *et al*. 2014; McLellan *et al*., 2002; Plotino *et al*., 2012). However, in clinical practice, these instruments may undergo fracture, mainly due to flexion (fatigue fracture) and torsional (shear failure) efforts. Torsional stresses can be increased with a wide contact area between the channel walls and the cutting edge of the instrument. To reduce such stresses there is the union of multiple progressive cones, properly maintaining the curvature of the original canal (Grande *et al*., 2015).

Nickel-titanium (NiTi) rotary instruments: A sliding path is defined as a smooth root tunnel from the canal orifice to the physiological termination of the root canal. It has been reported that when a slide path was created using rotating NiTi files, the original channel morphology was maintained better than when the slide path is created using stainless steel manual files. In addition, the preparation time was reduced and postoperative pain decreased by preparation of the sliding path (Yılmaz *et al*., 2018). NiTi rotary instruments are commonly used for endodontic practice. These instruments offer many advantages, including flexibility over conventional stainless steel instruments. Despite their undeniably favorable qualities, there is a potential risk of unexpected fracture, as many variables may contribute to file separation, but the two main causes are cyclic fatigue and torsional stress (Pedullà *et al*., 2019). Recent attempts have used heat treatments to modify phase transition temperatures and thus improve the mechanical properties of the files. In addition, file manufacturers have attempted to develop new designs, manufacturing processes, and kinematics to minimize fracture occurrence (Eugenio Pedullà *et al*., 2018; van der Vyver *et al*., 2019). In addition, the use of reciprocal motion has been shown to prolong the life of NiTi instruments and thus fatigue strength compared to continuous rotation. Reciproc R25 (Rec) (VDW, Munich, Germany) and Primary WaveOne (WO) Sirona Maillefer, Ballaigues, Switzerland) are two well-known reciprocal single archive instruments. Rec and WO have the same size (tip size 25 with 0.08 taper) (Prati *et al*., 2013). The cone is constant at the apical 3 mm of the instruments, but is reduced in the middle and coronal portion of the instrument's working part (Ebihara *et al*., 2018; Prati *et al*., 2013; Yılmaz *et al*., 2018). The recording instruments have a constant S-shaped cross section with two cutting blades; WO instruments have a modified convex triangular cross-section at the tip and a convex triangular cross-section at the middle and coronal portion of the instrument (EBIHARA *et al*., 2018; Yared, 2015; Yılmaz *et al*., 2018).

Root Channels and Modeling with NiTi: Instrumentation Root canal modeling instruments have evolved considerably over the last twenty years and it has been shown that the use of nickel-titanium endodontic instruments can have several advantages compared to stainless steel instruments, resulting in fewer procedural errors and complications. In addition, NiTi instruments are more flexible than stainless steel instruments. The impact of different file systems on channel modeling quality has been investigated in many studies, showing that the use of machined NiTi files leads to better channel modeling results than stainless steel manual files (Jungnickel *et al*., 2018; Rossi-Fedele and Ahmed, 2017). During root canal treatment, the main objective of mechanical instrumentation is to enlarge the root canal and, along with irrigation protocols, remove pulp tissue, infected dentin layers and biofilms attached to the root canal surface. However, the anatomical complexities of the teeth prevent instruments and irrigating solutions from reaching the entire canal surface, which may influence the root canal treatment outcome (Ordinola-Zapata *et al*., 2016; Özyürek and Demiryürek, 2016). Effective cleaning and shaping of the root canal system is essential to achieve the biological and mechanical goals of root canal treatment. Root canal modeling can be achieved by the manual use of stainless steel files or NiTi file-driven rotary motion (Jin *et al*., 2013). A much investigated parameter was the time of treatment; Machine-driven instruments have been shown to provide a faster root canal shape compared to manual techniques. However, the time spent on root canal preparation is only part of the total endodontic treatment time, which can be divided into access preparation, root canal biomechanical preparation

and filling time (Özyürek and Demiryürek, 2016). It has not been previously estimated how a decrease in setup time would affect the total operating time. Inexperienced users have been shown to benefit from the use of machine-driven NITi file systems, gaining more confidence in performing endodontic treatment and a better sense of security (Özyürek and Demiryürek, 2016; E. Pedullà *et al*., 2018; Tokita *et al*., 2017). The use of reciprocal motion has been shown to prolong the durability of a NiTi rotary instrument and increase its fatigue strength compared to continuous rotation. With the benefits of reciprocal motion, a new technique to complete channel modeling with just one file has been suggested. It seems that the concept of unique NiTi instrumentation technique using reciprocal movement is more cost-effective and can ease many practitioner tensions in learning a new technique (Kim *et al*., 2013; Lee *et al*., 2013).

Conclusion

The success of endodontic treatment depends on several factors, and root canal preparation is extremely important, as the conical shape given to the canal during instrumentation will help in the effectiveness of other procedures, such as facilitating irrigation and aspiration and three-dimensional obturation. root canal system. However, when bacteria are present inside the root canal, they are also found in the dental tubules, so it is recommended to remove part of the infected dentin by instrumentation.

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