EDITORIAL

Investigation on Nickel-Titanium Rotary Instruments in Endodontics

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Before the introduction of the nickel-titanium (Ni-Ti) alloy for the production of rotary instruments,[1] root canal treatments (RCTs), were used to be performed only by using manual stainless steel (SS) files with longer times of intervention, multiple appointments, and other difficulties often experienced also by expert clinicians.[2] Canal transportations and root perforations, especially in curved canals, were the most drawbacks encountered during RCTs performed with non-superelastic instruments. Moreover, it was necessary to follow longer and complex instrumentation protocols that were more difficult to perform.[3]

Ni-Ti rotary (NTR) instruments allowed clinicians to approach root canal instrumentation in a reproducible and standardized way, with less risk of iatrogenic errors during intracanal instrumentation.[4]

Many generations of Ni-Ti files have been produced in the last decades, passing from simpler designs, to increasingly complex cross-sections to improve cutting efficacy and resistance to fracture even in most challenging narrow, curved root canals.[5,6]

The use of Ni-Ti instruments simplified the shaping procedures of the root canal, making the removal of pulp tissue and infected dentin more efficient than the SS manual files. Furthermore, the increased efficacy in shaping founds its major impact in cleaning and filling procedures.[7] The particular design of many instruments, with a variable taper and peculiar cross-sections, could permit the irrigants to flow through the apical portion of the root canal, with the possibility of sonic or ultrasonic activation performed by many different devices: this could lead to proper disinfection of the root canal system, ensuring the goal of the treatment.[8] However, the prolonged use of these instruments may present some drawbacks: the influence of flexural and torsional stresses to the alloy may alter the characteristics of the crystalline structure of the alloy and leads the instrument to intracanal separation.[9,10] Hence, in literature, many authors investigated the main reasons for failure during instrumentation: torsional failure could happen when the instrument continues to rotate while the tip is taper locked.[6,11] Cyclic fatigue failure is the result of continuative compressive and tensile stresses that concentrates themselves at the maximum curvature point of the instrument.[12] It is clear that these two stresses are the most representative cause of NTR fracture, and both could occur alone or combined.

In the last years, manufacturers have focused their attention to develop Ni-Ti instruments with improved resistance to both types of fracture: thermal treatments demonstrated that they can enhance both cyclic and torsional resistance by improving the quality of the microcrystalline pattern of the alloy.[13] Recently developed instruments have been designed to be used as a single file system and thermal treatments are considered a helpful way to maintain the file's flexibility, centering ability, and resistance to flexural and torsional fracture.[14] In conclusion, it is clear that the aim of the development of new generation NTR instruments should permit a minimal invasive endodontic treatment and reduce the major drawbacks during intracanal instrumentation, such as, root perforation, zips, and ledge. New generation instrument should ensure the most efficient irrigation technique and keep long-lasting characteristic and fracture resistance due to avoid the most possible, intraoperational complications.

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