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A Novel Criterion to Evaluate Mechanical Properties of Nickel-Titanium Rotary Instruments: The Operative Torque

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EDITORIAL

Since the introduction of NiTi endodontic rotary instruments in the clinical practice, instrumentation procedures have become easier, faster, and safer. These improvements are related to their stress resistance characteristics, which allow avoiding their intracanal separation, because of excessive cyclic fatigue or torsional stress [1]. An accurate radiographic three-dimensional analysis, with CBCT, allows clinicians to choose the most suitable instruments and reduce the risk of iatrogenic errors [2]. In order to achieve excellent results, clinicians can use some strategies to improve NiTi instrument efficiency and reduce the probability of intracanal separation, such as different instrumentation technique, motion used (continues or reciprocating motion) or the use of lubricants [3-5]. However, the choice of the most suitable instrument is crucial in many cases.

Nevertheless, the marketplace offers to clinicians a wide selection of NiTi endodontic rotary instruments and it is not easy to navigate the choice.

Nowadays, there are several tests to evaluate and compare NiTi instruments, divided into static and dynamic ones [6]. The static ones are cyclic fatigue tests, torsional resistance tests and flexibility tests. These are the most used to assess metallurgical properties of NiTi endodontic rotary instruments and they are described by the International Organization for Standardization (ISO) 3630-1. The torque values at failure, obtained from ISO tests, are used to determine torque settings in torque-control motors in order to establish a risk threshold value, that should not be overcame during instrumentation [7]. Despite this, these setting values could not reflect the real torsional stress distribution along the instrument, since torque-control motors calculates torsional load as a sum of torsional stresses generated from the contact between whole instrument surface and dentine, while static tests measure torsional load at a specific level.

For the above-mentioned reasons, dynamic tests have been introduced to better simulate the usage of NiTi rotary instruments during clinical practice. They allow to simultaneously take into account different parameters, such as the reciprocal influence between torsional and flexural stresses, dentin hardness, root canal anatomy, and instrumentation technique [5,8]. To better consider all variables that influence torsional stress generation a new evaluation parameter was introduced: the operative torque [9,10].

The operative torque can be defined as the amount of torque needed by instruments to progress inside the canal and complete its dentin cutting action and debris removal. This dynamic measurement also depends on time needed to complete root canal shaping, so it considers the ability of an instrument to progress to the working length during instrumentation. Due to the different morphological characteristics of the canals, in terms of diameters, curvatures, bifurcation and apical conformation, the operative torque changes continuously.

The value of the Operative Torque is influenced by all parameters that generate torsional load during shaping procedure and it allows comparing the real-time evaluation of the performance of NiTi rotary instruments, also in vivo [3].

Each clinician, who in any case uses the instruments according to the manufacturer's instructions, applies different apical forces, performs different amplitudes movements, and uses a different instrumentation technique, such as pecking motion or brushing motion [11,12]. Hence, all these factors cause an important accumulation of stress on the instrument, which cannot be evaluated with the aforementioned static, tests [13].

Therefore, operative torque should be used by clinicians as a criterion for select the most suitable NiTi rotary instrument for the specific case. The choice should be directed toward a NiTi rotary instrument that generates low operative torque values and exhibits high torque values at fracture.

In daily clinical practice, the wider is the range between these values, the safer and more effective is the intracanal instrumentation. This concept is known as “torque range”, and it comprehends both operative torque and resistance to torsional stress, allowing the evaluation of the most suitable NiTi rotary instrument to choose [14].

In conclusion, operative torque should be considered as a selection criterion that allows clinicians select in a conscious way the NiTi instrument that best suit the specific case, having evaluated the instrument in a more realistic way, a not just with ideal tests.

CONFLICT OF INTEREST

All authors declare that there is no conflict of interest.

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