EDITORIAL

NiTi Rotary Instruments: New Investigations of Patterns of Fracture

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Along with the introduction of nickel–titanium, endodontics has deeply changed. The switch from manual stainless-steel instruments to NiTi rotary instruments has influenced not only operative times but also shaping procedures, irrigant penetration, and obturation techniques.[1] However, if some major improvements were introduced, different kinds of drawbacks appeared to happen more frequently. While SS instruments are less efficient than NiTi rotary instruments, they usually happen to separate inside the canal less often than the former ones.[2] One of the main issues regarding SS files was the possibility to create a perforation inside the root. The fracture could happen because this type of file presents an active tip that, if pushed too hard over the dentinal wall of a root, can create a different path, eventually leading to perforation. On the other hand, regarding this topic, NiTi rotary instruments are overall safer since they present a noncutting tip. This is mainly because the transition angle of the file tip is designed to be non-active and therefore much safer than SS files.[3] However, as previously mentioned, also NiTi instruments present some important drawbacks that have to be considered due to prevent the development of excessive stresses that are not supported by the chosen instrument. Indeed, to exalt the properties of the NiTi instrument, it is important to know the characteristics of the chosen NiTi file, not only their breakage resistance in traditional static conditions but also their behavior during clinical procedures.

Up to date, literature has individuated and deeply evaluated the flexural and torsional behavior of NiTi rotary instruments. Precisely, the cyclic fatigue stress is a mechanism that happens for every kind of metal, freely rotating inside a curvature. It is nothing less than the weakening of a material caused by cyclic loading that eventually results in progressive and localized structural damage. This continual tension and compression on the area of maximum curvature will lead to the formation of cracks that, once initiated, will not stop their progression.[4]

On the other hand, torsional stress occurs when the tip of the instrument binds inside the canal, while the upper part continues to rotate: this free rotation of the coronal part of the instrument will lead to separation. The instrument is often submitted to this kind of stress while advancing toward the apex.[5,6]

Literature is now trying to find more peculiar ways to investigate NiTi rotary file properties. Indeed, while some researchers tried to measure the amount of stress generated during root canal treatment (RCT), others have tried to investigate, in a static condition, different and more up-to-date properties of endodontic instruments.[7]

The measurement of operative torque is nowadays the most representative method for the evaluation of stresses during root canal treatment.[8,9] Despite that, authors have still not found a consensus on this kind of evaluation process: it is still unclear if the separation is a representation of only torsional stresses or a sum up of both torsional and flexural fatigue and, it is unclear the importance of clinical technique and clinician skill on operative torque. Measuring the operative torque can be obtained in different ways, with the introduction of two different values: mean torque and average peak torque.[10] Therefore, it is still to standardize the measurement of this new parameter.

The bending resistance has been tested on a different portion of the instrument compared to ISO standard: this kind of approach is more representative of recently developed clinical approaches, such as less invasive access cavity which appears to be one of the main goals for minimal invasive endodontics. Indeed, a conservative access cavity would force the instrument to enter tilted into the canal and therefore it is logical that the whole instrument would develop flexural stresses.[11]

Overall, these patterns of fracture have a historical background of several studies, evaluating flexural or torsional resistance using a static methodology validated by ISO. However, nowadays these static evaluations must be considered obsolete and therefore, present literature is trying to move toward a dynamic evaluation of these stresses with the aim of overcome some difficulties in performing these tests and creating a large consensus among researchers.

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