

Mechanical Characteristics, Testing, and Future Perspective of Nickel–Titanium Rotary Instruments

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The main drawback of several studies is the limited analysis performed for the comparison of nickel–titanium (NiTi) rotary systems. Most often, research articles in this area are focalized on the static characteristics such as static cyclic fatigue, torsional loads, and flexibility, not considering their reciprocal interaction and all dynamic factors.¹ Recent evidence in the literature defines the reciprocal interaction between these parameters as a fundamental element in the study of their mechanical characteristics.² However, static mechanical behavior is fundamental to assess the basic performance of NiTi instruments, but its interpretation during clinical practice is pointless as it does not resemble the real clinical scenario.^{1,3,4} Results arising from static tests, certainly valid as a first approach to the evaluation of an instrument recently introduced on the market, and comparative evaluations, should be considered in a general and more complete view, considering their reciprocal relationships.^{3–6} For these reasons, different types of researches that investigate both static and dynamic performance of NiTi instruments should be strongly recommended in order to give to original research and *in vitro* study an actual clinical significance, certainly much more indicative in view of a subsequent clinical application of NiTi rotary instruments.^{7–9}

Regarding this, we hope that researchers will propose and develop different and novel methodologies that allow a complete comprehension of mechanical and metallurgical behavior in static and dynamic tests of NiTi rotary instruments to achieve significant comparison between different NiTi systems.^{7,10}

The knowledge of the mechanical characteristics of NiTi alloy and the study of dynamic behavior during root canal shaping, are mandatory in order to improve techniques, instrument design, and their clinical use.⁷ The intracanal instrumentation, assisted by disinfection protocols and subsequent activation of the irrigants, is what guarantees an excellent root canal obturation and therefore the outcome of endodontic therapy.¹¹ Intracanal separation of NiTi endodontic rotary instruments is still one of the major concerns of endodontists, even if the success rate of root canal therapy is high. The reduction of the percentage of intracanal separation of the instruments is a future objective, certainly possible by better understanding the distribution of stresses and the mechanical characteristics of NiTi instruments.^{9,10}

Moreover, although the possibility of knowing deeply the anatomy of the endodontic system is always greater, both with three-dimensional radiographic diagnostic examinations and with radiation-free diagnostic examinations, the unexpected obstacle during root canal instrumentation often represents a reason for separation of the instruments, which it can be represented by an unexpected curvature, or an unexpected canal bifurcation.^{12–15} Furthermore, it should be taken into consideration that the

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validation of regenerative endodontic techniques, as well as the use of bioceramic-based sealers, assisted by an adequate root canal system disinfection, results in a lower need for root canal instrumentation, with savings in terms of stress on endodontic NiTi rotary instruments.^{16–20}

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