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Review Article

HyFlex Instrument: Literature Review

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Abstract:

The With the emergence of various rotary instruments Nickel-titanium alloy, the Coltene launched a rotary instrument of a NiTi alloy wire with controlled memory, with martensitic structure, which, after being induced to a high thermodynamic temperature returns to its original shape, with unique flexibility and resistance differentiated from other files. Several comparative studies with this innovative rotary instrument and other instruments of NiTi alloy were performed. The manufacturer promises that this instrument Hyflex, reduces fatigue, ledging and perforation. Were analyzed alloy Niti, and their integration into the manufacturing process Hyflex. And it is concluded that the Hyflex has a unique flexibility, greater resistance to fatigue, perforation and ledging, extrusion weak and monitors the internal anatomy of the root canal due to its Niti alloy wire controlled memory that retuns to their state original when the heat induced heat at a high temperature, freshly brewed, and differing from the other driven endodontic instruments will Niti alloy engine. These and other properties of the rotating device called Hyflex were reviewed by authors of scientific articles compared to other rotary instruments fatigue fracture, fracture by cyclic fatigue, tension, and extrusion of weak and flexibility. This literature review is based on scientific articles that evaluate the mechanical properties of Hyflex.

***Keywords:** Alloy NiTi instruments, Rotary, Hyflex.*

1. Introduction

The introduction of nickel-titanium alloy (NiTi) in the manufacture of endodontic instruments is one of the main innovations in endodontics. This alloy is superelastic, thus providing the development of instruments with greater flexibility. This flexibility allows the instruments to follow the original path of the root canal (TESTARELLI et al. 2011). However, despite the good mechanical properties of NiTi alloy, fracture of these instruments is still a major concern.

The mechanical properties of NiTi alloys are dependent on the proportion of nickel and titanium in the alloy, as well as on the type of heat treatment these alloys receive (TESTARELLIet al.2011).

In the search for instruments with greater fracture resistance and flexibility, companies have developed new rotary instruments with different types of alloys, which are obtained through various heat treatments, which are normally not disclosed, as they are patented. In addition, some manufacturers have also changed the Ni/Ti ratio (TESTARELLIet al.2011; PONGIONE et al. 2012).

In 2010, a new type of NiTi alloy emerged, the controlled memory (CM) alloy, which has high fracture strength and good flexibility. Hyflex CM (ColteneWhaledent, Cuyahoga Falls, Ohio, USA) is made from this alloy (SHEN et al. 2013). Hyflex deforms when induced in the root canal anatomy, but when subjected to autoclave sterilization it returns to its original shape. (Coltene). The NiTi alloy was developed by Buelheret al. in 1963 at the Naval OrdnanceLaboratory (NOL) in Maryland, United States. As a tribute to the place where it was created, it was named Nitinol. This alloy presents equal percentages of Ni and Ti (LOPES & SIQUEIRA 2013).

The present study aims to carry out a literature review on the main characteristics of the Hyflex instrument.

2. Systematic Review

2.1 Nickel-Titanium Alloy

The NiTi alloy has two crystalline phases: Austeunite and Martensite. Austenite is the body-centered cubic phase with less elasticity than martensite. Martensite is monocyclic, and can form by tension or cooling (LOPES & SIQUEIRA 2013).

Most endodontic instruments available on the market have, by weight, 56% Ni and 44% Ti (SHEN et al. 2013).

Hyflex instruments, manufactured from wire with controlled memory, have Ni levels around 52% of the weight percentage (TESTARELLIet al.2011;SHEN et al. 2013; BŰRKLEIN et al. 2014).

2.2 Fracture Resistance

2.2.1) Torsion Fracture

Torsion fracture occurs when the endodontic instrument has one of its ends immobilized and a torque greater than the torsional fracture resistance limit is applied to the other (LOPES & SIQUEIRA 2013).

Peterset al. (2012) tested the torsional strength of Hyflex. Based on the results obtained, they concluded that these instruments have similar torsional properties when compared to traditional instruments made of NiTi.

2.2.2) Fracture due to Cyclic Fatigue

Cyclic fatigue fracture is caused when an endodontic instrument rotates, being induced by repeated alternating, tensile and compressive stresses inside a curved canal, when it remains within the elastic limit of the material (LOPES & SIQUEIRA 2013).

Pongionetal. (2012) compared the resistance to cyclic fatigue of NiTi instruments with similar cross-section and different manufacturing processes: traditional NiTi wire, M-wire, Hyflex. A simulated canal with a curvature of 60 degrees was used and the instruments were driven in continuous rotation until the fracture. Based on the results obtained, the authors concluded that Hyflex was significantly stronger than the other instruments, but there was no difference between traditional NiTi and M-Wire alloys.

Rubiniet al. (2013) compared the cyclic fatigue resistance of Hyflex using different types of movements. Twenty-four Hyflex 40 instruments were used, with 0.04 taper, divided into two groups according to the movement used, continuous and reciprocating rotation, 150 counterclockwise and 30 clockwise. The instruments were driven in channels with a 135 degree curvature, and the time to fracture was calculated. The authors concluded that reciprocating movements significantly increased fatigue life when compared to continuous rotation.

Plotino et al. (2014) evaluated whether reciprocating motion could increase the fatigue life of Hyflex in a cyclic fatigue test over continuous rotation. 24 HyFlex® size 40 taper were used. 04 who were randomly divided into two groups (n = 12 each). All instruments were subjected to a cyclic fatigue test. In the first group, the instruments were used with a continuous rotation, while the second, with a reciprocating movement. The reciprocity movement selected was as follows: 150 degrees counterclockwise and 30 degrees clockwise. In both movements, 300 rpm speed was used. The results indicated that reciprocating movements showed a significant increase in time to fracture when compared with continuous rotation. It concluded that the reciprocating movement increased the resistance to cyclic fatigue of the tested nickel titanium instrument, when compared with continuous rotation.

2.2.3) Bending Resistance

Pongionetal. (2012) compared the flexibility of NiTi instruments with similar cross-section and different manufacturing processes: traditional NiTi wire, M-wire, Hyflex. Flexion was measured when the instrument reached a 45 degree curvature. Based on the results obtained, the authors concluded that Hyflex were the most flexible instruments, and that there was no difference between traditional NiTi and M-Wire alloys.

2.2.4) Debris Extrusion

SuraKanti et al. 2014 compared material extruded apically during root canal treatment using ProTaper, Hyflex, and Waveone. Sixty newly extracted lower human premolar teeth were used, which were sacrificed for orthodontic and periodontal purposes. Inclusion criteria were mandibular premolars with one root and one canal, with apical curvature between 0° and 10°. The teeth were randomly selected and assigned to three experimental groups, with 20 teeth in each group. The average weight of extruded material was calculated for each group. The authors concluded that, under the conditions of this study, Waveone was associated with greater debris extrusion compared to ProTaper and Hyflex.

2.2.5) Channel Transport

Kumaret. (2013) compared canal transport when using TF and Hyflex rotary instruments with stainless steel K-type handheld instruments using computed tomography. 90 newly extracted lower premolars used, randomly divided into three experimental groups containing 30 teeth each. Teeth were CT scans before and after instrumentation. The results obtained indicated that manual instruments promoted greater transport and less centralized preparation when compared with rotary instruments. No significant difference was observed between the Hyflex and TF instruments. The authors concluded that the rotary instruments were able to maintain the curvature of the canal.

2.2.6) Voltage Generated in the Instrument

Medhaetal. (2014) evaluated the tension generated in 3 different instruments in the apical third of the root canal. ProTaper, Revo S and Hyflex CM rotary NiTi instruments were tested. The analysis was performed using finite elements. The lowest voltage generated was observed in RevoS, followed by Hyflex and finally Protaper. And it is concluded that the design of the instrument influences the degree of voltage generated in the instrument.

3. Conclusion

Based on this systematic review, it is concluded that before the Hyflex file, the files that were used broke inside the root canal in the preparation, in order to make the files more effective, Hyflex emerged.

Thus, for presenting greater flexibility when compared to other rotary instruments, Hyflex is used. This instrument reduces the risk of stepping and perforation, and when induced inside the canal follows the internal anatomy of the root canal. In addition, it showed better resistance to cyclic fracture and fatigue fracture.

In cases where the Hyflex deformity occurs, due to the memory control that regenerates the crystal structures, it is enough to place them in hot water, approximately 60ºC, so that the file recovers its original shape, and, or, autoclaved. However, after the above procedure according to the manufacturer's specification, if it does not recover the original shape, the Hyflex must be discarded, due to an irreversible deformity which increases the risk of fracture.

Therefore, the indication for the use of the Hyflex file is to widen the root canal with greater efficiency and safety so that the endodontic procedure can be completed.

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