

**Evaluation of shaping, centric ability and  
appearance of root canal walls after preparation  
with Ni-Ti Rotary instrument  
(An in vitro study)**

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By

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# **Dedication**

To my Supporting father, my caring mother for giving me love and support throughout life and last but not least, my family.

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## **INTRODUCTION**

One of the main goals of root canal therapy is to eliminate microorganisms, and to shape the root canal system while maintaining the original configuration to facilitate irrigation and placement of the obturating material. However, it is a challenge to achieve optimum cleaning and shaping, especially in curved canals.

In the past, root canals were prepared using files and reamers that were manufactured from stainless steel. The relatively high modulus of elasticity of this material made it difficult to negotiate small-curved canals that resulted in undesirable aberrations such as zips, elbows, ledges and perforations, in addition to creating dentine debris and a smear layer as a consequence of their action on root canal walls.

It is important that endodontic instruments remove dentine and pulpal debris from the entire root canal wall and create a canal free from debris and bacteria. These problems have resulted in a wide search for innovative materials, instruments, and techniques to obtain a clean, disinfected root canal walls.

Recently, various types of endodontic rotary instruments made of nickel titanium (Ni-Ti) alloy have been developed in an attempt to overcome these drawbacks of conventional stainless steel instruments.

Numerous studies have shown the ability of several rotary (Ni-Ti) systems to maintain original canal shape, remain better centered and get rid of debris outside the canal. Most of these studies have concluded that none of the automated devices have completely prevented canal transportation or maintained canal centering even with the recent design features of the instruments cutting edges.

HeroShaper rotary (Ni-Ti) system has a triple helix cross-section with a modified helix pitch and the helix angle. The handle has been shortened to improve access. One of the key modifications is that the helical angle increases from the tip to shank to reduce threading. The other modification is the pitch of blade, which varies depending on the taper. By modifying these parameters, it is claimed to increase the efficiency, the flexibility, and the strength of the instruments.

More recently, Revo-S rotary (Ni-Ti) systems have been introduced into the market. The manufacturer claims that the asymmetrical cross section design of this system allows for better centering of the instrument inside the root canal in addition to better cleaning and shaping ability.

Therefore, it is important to shed a light on the ability of HeroShaper, Revo-S system to maintain the main course of the canal and their ability to get rid of debris.

## **REVIEW OF LITERATURE**

Cleaning and shaping of root canal system is the most difficult and time consuming step especially in narrow curved root canals. Stainless steel instruments often fail to achieve the desired root canal shape, resulting in procedural errors such as zipping, ledges, transportation, and perforations.

Many efforts have been done to minimize the incidence of procedural errors as such as modification in root canal instruments as well as alteration in instrumentation techniques, such modifications have been done in terms of modifying the cross-sectional design, modifying the tip design and advancement in the metal alloy (Ni-Ti).

For clarification of review it is classified in to the following:

- A. Shaping and centric ability of the instrument.
- B. Appearance (surface irregularities) of the root canal.
- C. Methods of evaluation.

### **A. Shaping and centric ability of rotary (Ni-Ti) instruments:**

Shaping of root canals is one of the strategic cornerstones in the foundation of endodontic success where it influences the outcome of all subsequent procedures. Shaping facilitates cleaning by removing restrictive dentin, which allow an effective volume of irrigant to work more deeply and to reach into all aspect of the root canal system. A

continuously tapered preparation with increasing diameter from the apical direction to the orifice thus allowing the gutta-percha and sealer to be moved into all aspects of the prepared root canal system.

Numerous studies have shown the ability of several rotary nickel titanium systems to maintain original canal shape and remain better centered. Most of these studies have concluded that none of the automated devices have completely prevented canal transportation or maintained canal centring even with the last design features of the instruments cutting edges.

**Thompson and Dummer(2000)<sup>(1)</sup>** Assessed the general efficacy and shaping ability of Hero 642 rotary instruments. Images of pre and post-operative canals were taken in a standardized manner and analyzed using image analysis software. An assessment was made for the presence and position of apical zip, elbows, ledges and perforations. Also canal width was assessed in eleven points along the canal length. **They found that,** four zips and elbows were created in canals with 40, where no perforations or danger zones created. Eight instruments deformed and two fractured in size 20. Highly significant differences were apparent between the canal shapes in total canal width at the apex and beginning of the curve. Canal transportation was most directed towards the outer aspect of the curve.

**Bertrand et al (2001)<sup>(2)</sup>** Analyzed canal transportation on 24 mandibular molars using Hero 642 system. Roots were embedded in clear resin using a plaster mold and cross-sectional cut in the apical, middle and coronal thirds. Group 1 of 12 root canals used as control was instrumented with stainless steel FlexoFiles using the step-back technique. Group 2 of 12 root canals were instrumented with Hero 642 system according to the

manufacturer instructions. For each sectioned level the amount of dentine removed, change of shape factor and the canal Centre displacement were calculated using a digital image analysis system. **They results showed** that, no significant difference occurred in the amount of dentine removed, change of shape factor and canal center displacement in the coronal and middle thirds. In the apical third transportation was significantly higher with FlexoFiles than with the Hero system.

**Versümer et al (2002)<sup>(3)</sup>** Compared preparation of curved root canals using Profile .04 and Lightspeed rotary instruments. Fifty mandibular molars with curvatures ranging from 20°-40° embedded in a muffle system were used and divided into 2 groups. The Lightspeed system was used in a step-back technique while Profile .04 was used in a crown-down technique. Both were irrigated with 3% NaOCl and RC-Prep was used as a chelating agent. Straightening of root canal curvature and postoperative root canal diameter were evaluated. Both NiTi instruments maintained curvature well; the mean degree of straightening was less than 1° for both systems with no statistical difference. Most procedural errors occurred with Profile .04 instruments. Following preparation 64% of root canals prepared with Profile .04 showed a round diameter, 30.7% oval and 5.3% were irregular in diameter. In case of Lightspeed 41% were round, 45% oval and 13% irregular in diameter, with no statistical difference between both systems. Lightspeed instruments enlarged the root canals more uniformly than Profile .04, with a statistical difference only for the coronal thirds of the root canals.

**Yun and kim (2003)<sup>(4)</sup>** Compared the root canal shaping abilities of 4 NiTi rotary instruments (ProFile, GT Rotary, Quantec, and ProTaper) using simulated curved root canals in plastic blocks with the crown-down

technique. The instrumentation time, changes of canal dimension and curvature, canal aberration, and instrument deformation were evaluated. They found that, ProTaper took significantly less instrumentation time, removed more canal wall (especially at the inner side of the canal curve), lessened the canal curvature, and induced more instrument deformation than did the other instruments.

**Vanni et al (2004)<sup>(5)</sup>** Compared the apical displacement produced by four different rotary Ni Ti instruments. The specimens were divided into 5 groups: Group 1, Quantec 2000 system; group 2, Pro-File 0.04 taper; group 3, Pro-File series 29 0.04 taper; group 4, Pow-R 0.02 taper and group 5, Flexofile stainless steel hand files. The irrigant used was 1% sodium hypochlorite, with a volume of 10 ml for each specimen. The apical displacements produced by the endodontic instrument were measured superimposing the odontometry and final preparation radiographs, which were projected with a 20X magnification on a white paper. The results show that, the lowest mean apical displacement value was found for the Pow-R system (Group 4), and the highest value was found for the hand system. The highest transformed coefficient of variation was 21.99%, for Group 4, also showed statistically significant differences between all group mean values ( $p < 0.001$ ), except between groups 2 and 3. The manually prepared group 5 exhibited higher mean apical displacement values than all other groups.

**Miglani et al (2004)<sup>(6)</sup>** Compared the canal centering ability of two rotary Nickel Titanium instruments (Hero 642, Profile 0.04 and 0.06 series) with stainless steel K-file using Kuttler's endodontic cube method. Forty-five extracted human first mandibular premolars were selected and divided randomly into 3 groups group I was prepared by hand instrumentation