



Comparative Evaluation of Root Canal Preparation Using Two Single File Systems (Clinical and Experimental study)

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BY

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

أَوَّلُ آيَاتِكَ

"اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ {1} خَلَقَ الْإِنْسَانَ مِنْ
عَلَقٍ {2} اقْرَأْ وَرَبُّكَ الْأَكْرَمُ {3} الَّذِي عَلَّمَ بِالْقَلَمِ {4}
عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ {5}"

سورة العلق

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DEDICATION

***To my precious family especially my
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The main objective of endodontic therapy is to treat pulpal and periradicular tissues in order to retain the natural dentition preserving normal form, function, and esthetics. This is greatly achieved by removal of root canal contents and disinfection of the colonizing microorganisms through shaping and cleaning processes.

Ideally, shaped canal should have a continuously tapering funnel that preserves the original anatomy. Many endodontic instruments have been developed in the hope that they can effectively achieve the ideal funnel form without creating aberrations, which may affect the clinical outcome of root canal treatment.

During the last years, a huge development and clinical improvements in endodontic treatment had been developed. One of these improvements is in instrumenting root canals.

A new concept for NiTi files has recently been introduced in which different working motions is used to finish root canal shaping with only a single file. An example of that is WaveOne (WO) file that is used in a reciprocating motion and made of a special NiTi alloy (M-Wire) which increases flexibility and prolonged fatigue life. The reciprocating motion involves an initial rotation of the instrument in a counterclockwise direction, during which the instrument penetrates and cuts the dentin, and then a rotation in the opposite direction, during which the instrument is released.

Another single file system is OneShape (OS) file that is used in a traditional, continuous, rotational motion and has an asymmetric cross-sectional geometry that generates traveling waves of motion along the active part of the file.

In clinical practice the NiTi files are associated with an increased risk of fracture, mainly because of bending stresses (failure by fatigue) and torsional shear stresses (failure by torque). Failure by torque might occur in case of torsional shear stresses exceeding the elastic limit of the alloy, producing plastic deformation and eventually fracture. Various aspects might contribute to increase these stresses; such as excessive pressure on the handpiece, wide area of contact between the canal walls and the cutting edge of the instrument, or if the canal section is smaller than the dimension of the tip of the instrument. The latter case might lead to a taper lock, especially with regularly tapered instruments. The risk of taper lock might be reduced by creating a glide path before using NiTi rotary instrumentation either manually or mechanically.

Cleaning and shaping of the root canal is the single most important phase of endodontic therapy. The goal of root canal instrumentation is to obtain a continuous tapering funnel flowing with the shape of the original canal from the coronal access to the apex. The endodontic Glide path is a smooth radicular tunnel from canal orifice to physiologic terminus (foraminal constriction). It is the starting point of radicular preparations. Without it, cleaning and shaping becomes unpredictable or impossible because there is no guide for endodontic mechanics. A glide path helps prevent torque failure and cyclic fatigue. Initially, when rotary files were introduced there was no recommendation for glide path creation. Subsequently, instrument fracture became a significant issue. The glide path assures the operator that the tip of the file will not become locked as it moves apically and that the canal is free and clear of significant debris and blockage, could lead to iatrogenic events.

The efficacy of different root canal treatment techniques has been widely discussed in terms of clinical outcomes and tooth retention. However, the

evaluation of clinical outcomes does not consider the patient's perspective thus focusing on post-operative pain as an outcome of the endodontic treatment.

Postoperative pain is defined as the sensation of discomfort after endodontic intervention. Dentinal debris, pulp tissue, microorganisms, and irrigants can be conveyed to the periradicular tissues during root canal preparation, and such extrusion of debris can lead to postoperative complications, such as flare-ups.

Studying shaping ability of these new NiTi systems with different design features, and kinematics are important for understanding how the differences affect their performance; Thus, we aimed to evaluate and compare outcomes of using the two file systems as regarding apical debris extrusion, the canal transportation, and canal centering ability in extracted human teeth using CBCT scanning. The clinical outcome of the study will evaluate and compare different groups as regarding post-operative pain.

The major goals of endodontic treatment is to preserve the functional teeth, by removing irritants from the root canal system; obturate the cleaned and shaped system; and prevent future recontamination of sealed root canals [1].

A proper access cavity preparation will allow the clinician to remove all coronal pulp tissue and locate all root canal orifices. Once the root canals have been found they are carefully scouted with a small instrument capable of reaching the apical extent of each root canal. The desired working length is determined and “a smooth radicular tunnel from canal orifice to physiologic terminus”, or glide path, must be confirmed or established.

Mechanical instrumentation is quite effective at reducing the numbers of bacteria in the canal. There are three main areas in which engine driven instrumentation has been modified over the years as more and more file systems are introduced to the market. Most early advances in rotary instrumentation dealt with changes in cross-sectional design. Later, alloys modified through heat treatment and other manufacturing methods were introduced. While improvements in these areas continue to be made, there has been particular interest in recent years surrounding the method of rotation itself. The vast majority of instrument systems employ continuous rotation in a clockwise direction. The instrument simply spins in one direction at a constant speed. However, there have been a few systems released which function via reciprocating motion.

Reciprocating motion is the combined movement of rotation in one direction alternated with rotation in the other direction. The magnitude of rotation in each direction corresponds to the angle of the arc traveled by each point of the file in a

circle. The difference between the two angles determines the net amount a file actually travels rotationally per cycle. Alternating the direction of movement reduces torsional stress by minimizing instrument binding as it advances down a narrow canal. While only a few reciprocating systems are available on the market today, there are an infinite number of possible combinations of angles in each direction, thus reciprocating motion can refer to an unlimited amount of different overall and net movements.

I. Instrumentation kinematics of engine-driven nickel titanium instruments

Endodontic machine-assisted instrumentation can be classified into five groups according to the instrumentation kinematics as follows: rotary motion, rotational reciprocating motion, vertical vibration plus rotational reciprocating motion, vertical vibration and rotary motion plus rotational reciprocating motion (adaptive).^[2]

a. Rotary instrumentation

According to *Hulsmann et al*^[3] the first reference to rotary instrumentation was made by *Oltramare*^[4], who used fine needles with rectangular cross sections that could be attached to a dental handpiece. *Rollins (1899)* developed the first endodontic hand-piece for root canal instrumentation that was used with specially designed needles at 100 rpm^[5] After the introduction of NiTi endodontic hand instruments by *Walia et al*^[6] many rotary NiTi instruments have been marketed. Recently, a new type of rotary motion, asymmetrical rotary motion, has been