Recent Root Canal Instruments and Techniques: A Review

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Abstract

In this article the properties and advantages of NITI alloy were presented with the development of new types of endodontic files and instrumentation techniques. Each new one was designed to solve disadvantages present in older one. NITI files always considered suitable for negotiation of curved canals, this automatically will reduce any possibility of some problems like transportation, ledge formation and zipping within the canal. Cleaning and shaping of the root canal space is the most important to create a sterile area, organisms free. In order to reach this goal (sufficient information of current development of instruments and instrumentation techniques is needed). With the new versions which are rapidly becoming available, the Dentist may find it a little bit difficult to choose the most suitable file and technique for an individual case. Practitioners must always keep in mind that benefits and weaknesses is present in most file systems. In other hand clinical experience, usage safety, handling properties and outcomes of the case, should decide a particular design fate.

Conclusion: Endodontic treatment files and techniques are very rapidly developed and this is the most important point,since each new design or technique will supply advantages which improve the endodontic treatment work and prognosis.

Keywords: *NITI,instrumentation technique, health; canal; roots.*

Introduction

IN the 19th and early part of the 20th century, hand Instruments were the only choice. The first endodontic (handpiece) for automated root canal preparation was developed in1889 by William Rollins. This automated handpiece used full rotation and to lessen instrument breakage, the rotational speed was limited to 100 rpm. The next improvement appeared in **1928** when the Austrian company W & H (Burmoos, Austria) brought out the ―Cursor filing contra-angle. This handpiece used a combined rotational and vertical motion of the file. Eventually, endodontic handpieces became popular in Europe with the marketing of the Racer handpiece (W & H) in **1958** and the Giromatic (Micro-Mega) in **1964**. The Racer handpiece worked with a vertical motion, the Giromatic with an equal reciprocal 90° rotation**(1)**

In the 1980s, sonic and ultrasonic hand pieces were introduced to the dental marketplace and are still being used in various degrees today. The late 1980s to the early 1990s saw the introduction of the first rotary Ni-Ti files and corresponding hand pieces to drive them.

Generally, Ni–Ti instruments have:

1. Effective cleaning ability.
2. Can preserve the root canal anatomy (shape).

To prevent the breakage that may happen to the rotary instruments due to fatigue and appropriate speeds, continuous pecking motion in most canals is recommended [(2)]

Techniques using stainless steel hand file always require:

1. Numerous files.
2. More time.
3. More procedure error.
4. Limited flexibility ➔ canal transportation
5. Permanent plastic deformation (file breakage).

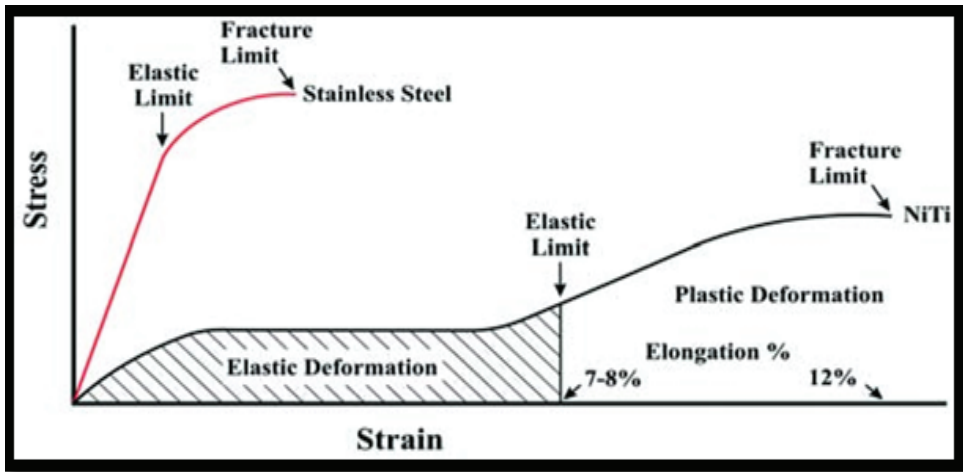

Figure 1: Stress-strain relationship between stainless steel and NiTi.

Properties of (NiTi) files:

- Flexibility, shape memory
- Also have a low modulus of elasticity (about 1/4 to 1/5 that of stainless steel files),
- Higher strength.

NiTi files always considered suitable for negotiating curved canals and reduce the risk of transportation, zipping and ledge formation within the canal[3]. Highincidence of unexpected failure of rotary nickel–titanium instruments during use represents some limitations. These instruments frequently may fracture and may be lodged in narrow and canals with apical curvature[4,5]. Nowadays, greatest numbers of commercially available Ni-Ti files utilized to shape root canals are driven ina (continuous rotation).Any repetitive back-and-forth motion can be defined as reciprocation which used with stainless steel files in the past. From inception, most hand piecesused equal to 90° reciprocation both clockwise and counterclockwise. Throughout time, most reciprocating systems have reduced the envelope of motion to 30° arcs of reciprocation. Now a days, the M4, Endo-Eze AET and the Endo-Express use small, equal, 30° angles of clockwise and counterclockwise reciprocation[1].

Metallurgy of rotary instruments:

Nickel-titanium alloy:

1. Corrosion resistance is high,
2. Super elasticity,
3. Shape memory. This is because of the arrangement of the atoms in steel can move against each other by a small specific amount before the occurrence of plastic deformation [6].

Electro polishing: The purpose of this process is to reduce irregularities in the file surfaces such as flash and milling marks, this also improve properties of the material, specifically fatigue and corrosion resistance. The resulting instruments appear to have better cutting efficiency and corrosion resistance. Changes in the alloy material have been introduced in order to make it with more resistance to cyclic fatigue. In manufacturing endodontic instruments the alloy:

1. Composed of 56 % (wt.) nickel, 44 % (wt.) titanium and is generically known as 55-Nitinol [7].
2. In addition to the fact that it possesses higher amount of flexibility and highly resistant to fracture [8].
3. NiTi has inherent ability of shape memory (SM) and superelasticity (SE) also called pseudoelasticity, (PE); the transition between the —austenitic and — martensitic phases in the NiTi alloy is a function of temperature andstress[7].

Super elasticity (SE): The austenitic phase transforms into the martensitic phase when subjected to stress.

Shape memory (SM*):* The shape-memory undergo transformation whencooled from the high temperature (austenite) to the low temperature (martensitic)[9].

Blue treatment:"Vortex Blue and ProTaper Gold rotary files"; are new modalities of instruments they can undergo a complex heating-cooling property treatment

that results in the formation of a visible titanium oxide layer in the surface of the instrument whichkeep a shape memory alloy by controlling transition temperatures[10].

Glide path: The root canal system should first be explored with a small, pre-curved stainless steel files then enlarged by a larger hand files so we get glide path before introducing the first crown-down rotary instrument. PathFile Root Canal Drills, G-FilesTM, ScoutRace files are examples of new rotary systems used specially in severely curved canals to get the glide path[11].

Path FileTM: In order to create a glide path rapidly and safely this new rotary instrument was designed. It comes in 3 sizes and made up of NiTi alloy with a very slight taper of .02 so it can resist the cyclic fatigue[12].

Scout Race: To mechanically prepare root canals that are with sever curvature this new design appeared with3 different lengths. They have rounded safety tips to guide and cutting edges to eliminate screwing [12].

ProTaper Universal: ProTaper rotary instruments have been shown to create more regular canal diameters when compared with FlexMaster, HERO and 25 Race file systems. They have a continues ability to change helical angle and pitch over the cutting area that will prevent it from being screwed through the root canal space.

ProTaper Gold: Have the identical geometry of PTU instruments but are manufactured from a proprietary heat treated NiTi alloy. It still produces the same PTU shapes, but they are considered to be with better safety and actually better. The shapes will be more precisely replicate the original root canal system flow. The gold technology will provide better canal shapes, safer and greater efficiency.

Retreatment with ProTaper: ProTaper D1 - for coronal filling removal, ProTaper D2 - for middle filling removal, ProTaper D3 - for apical filling removal. By using very slight apical pressure during file penetration within the canal also withdraw the file frequently, inspection done for the file then cleaning from the debris, we can use a hand file to overcome if there is any resistance and confirm the canal permeability.

ProTaper NEXT: It comes as 5 instruments but mostly we can prepare by the first two. The Protaper Next X1, the Protaper Next X2 which can be considered as the first finishing instrument for optimal irrigation and root canal obturation. Protaper Next X3,Protaper Next X4 and the Protaper Next X5 .Those will be used to create tapering in the root canal or to prepare wide and large root canal systems [13].

Figure 2: PROTAPER NEXT, complete system with five instruments.

This system has several properties which include flexibility, safety and because of its bilateral symmetrical rectangular cross section it will create asymmetric rotary motion[13,14].

Twisted Files (TF): It has a raised flexibility, fracture resistance and slower crack initiation and propagation. Special surface conditioning and twisting is used during the manufacturing process which will lead to increase in the resistance of the instrument to cyclic fatigue and flexibility [15].

TF Adaptive: Most clinical cases will be easy to be treated effectively and safely by the sefiles. This file when it is used without stress it can allow better cutting efficiency and caries removal because it works in a continuous rotation movement. This will allow better brushing or circumferential filing for better debris removal in oval canals and reducing the tendency of screwing that minimizes errors that is commonly seen with other NiTi instruments of great taper and used in continuous rotation. The angles depending on the anatomical variations and intracanal stresses forced on the instrument so they vary according to these . Therefore there is reduction in the risk of intracanal failure but not affecting performance of the work[16].

Hyflex CM and Hyflex EDM:

This new instrument has: Improved flexibility,resistance to cyclic fatigue and good adaptation to the canal space anatomy reducing the risk of ledging, transportation, or perforation. This file appears to regain its shape after sterilization and can be reused, if not returned back to their original shape then they should be should be discarded[9].

Reciprocr: These files are currently designed to allow root canal preparation without glidepath preparation,not like above mentioned systems. In order not to get root canal straightening, preparation faults and preparation time mechanical root canal preparation systems are better compared to hand instrumentation . This system is very comfortable to the dentist and the patient. Reciproc system also includes three instruments (R25, R40 and R50) and is driven by the VDW Silver Reciproc Motor (VDW) or the X- Smart Plus motor (Dentsply/Maillefer). When it rotates in the cutting direction it will advance and engage dentine to cut it before the instrument will rotate in the opposite direction to ensure disengagement [17].

Reciproc Blue: It is a single instrument required to prepare a root canal. Simple, but effective, it has enhanced safety in root canal preparation and retreatment for patients. Made from Nickel- Titanium (NiTi) undergoes innovative heat treatment, increased resistance to cyclic fatigue and additional flexibility and blue color. It provides more effective irrigation and obturation. This instrument designed specifically to be used in reciprocation. It has better properties because of specific s-shaped cross-section, the taper, the cutting angles and the thermally improved raw material.

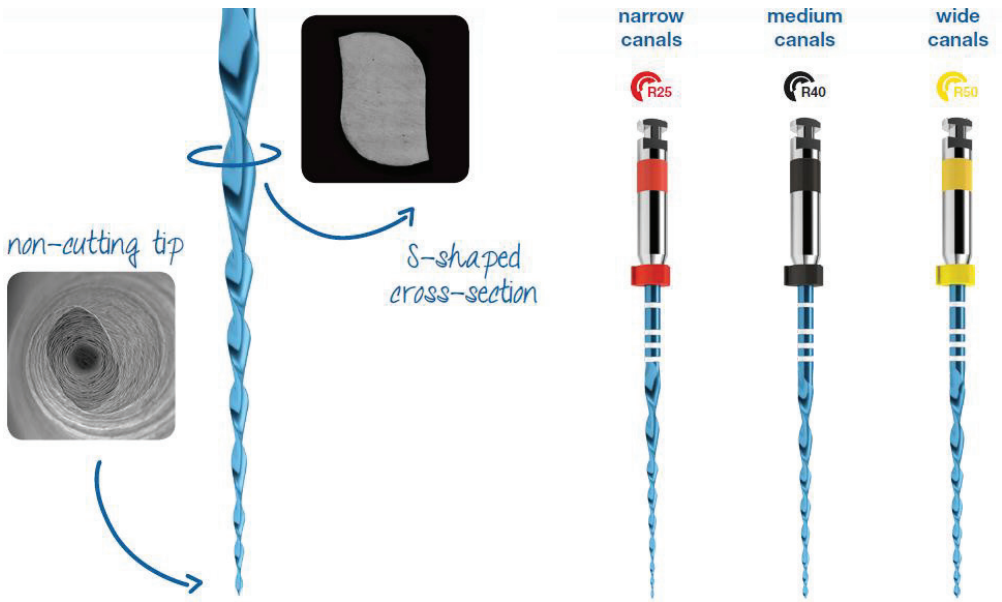

Figure 3: Reciproc blue,This instrument designed specifically to be used in reciprocation.

One Shape: It is also asingle file instrument which made of austenite NiTi alloy. Tip size of 25 and a constant taper of 0.06, it have different cross sectional designs over the length of the working part. It has a very good advantage of faster treatment than conventional techniques.

2Shape: It has:

1. Better cyclic fatigue resistance.
2. Better and more flexibility.
3. We insert the rotating instrument into the canal until feel resistance.
4. When the file is Removed from the canal, it must be cleaned by cleaning the grooves and do irrigation through the canal, after that continuous progressive downward movement.
5. To reach the working length two to three cycles are usually sufficient. This file is suitable for about all different treatments**.**

Self Adjusting File (SAF): It adapts itself to the three dimensional anatomy of root canals will lead to removal of dentin uniformly, remaining wall thickness and prevention of canal transportation**[18].**

Properties:[19,20]:

- This file has the ability to be Adapted to the root canal with three Dimensional Anatomy.
- Uniform thickness of Dentin and Remaining Wall Thickness can be removed.
- Canal Transportation prevention.
- Durable
- Irrigate the canal with Sodium Hypochloritein continuous manner.
- In the Apical Part of the Canal Removal of the Smear Layer.

Wave One: It is a single-file system to shape the root canal completely from start to finish. One hand file only required in this technique followed by one single Wave one file to shape the canal completely. In fine canals the Wave One Small file is used. These files are designed in a manner so it works with a reverse cutting action**[21].**

How we can select the suitable file?:

1. We Use Wave One Small file,If size 10 K-file is very resistant to movement.
2. We use Wave One Primary file, if size 10 K-file moves to length easily loosely.
3. We use Wave One Large file,if size 20 hand file or larger goes to length.

WaveOne GOLD: The ground NiTi files are heat-treated and slowly cooled and this has a positive effect on the instrument properties and gives the file its distinctive gold finish, improves its strength and flexibility far in excess of its predecessor.

The followings have been shown:

1. Cyclic fatigue resistance of this type of files 50% greater than WaveOnePrimary.

2. The flexibility of this type of files Primary is 80% greater than that of WaveOnePrimary**.**

This single- file reciprocating system has four tip sizes Small, Primary, Medium and Large, in lengths of 21, 25 and 31mm lengths. Preparation of the canal is ideal for the irrigant exchange and removal of debris. A design feature present in this file result in a reciprocating movement that is very smooth, eliminating the need to push on the file promotes safety and improves cutting efficiency**[21].**

Gentile file: This file is made from SS. The single-use files, It enlarge the canal walls by gently scraping the dentinal walls since that it has a rough surface after undergoing particle blasting. They are operated by a special fully automated handpiece at a maximum speed of 6500 rpm. The GF system consists of files, an orifice opener 18 mm long and 5 preparation files 25 mm long. canals should be prepared by using 2 to 3 files According to manufacturer‘s instructions . This will allow the dentist to choose the most appropriate file combination according to the canal anatomy**[22]** single file rotary and reciprocating systems also ensure ease of use and reduced preparation time.[23].

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Conflict of Interest: Non

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