Review Article

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Advances in Rotary Endodotnics

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Abstract

Rotary endodontics has come into practice almost 20 years back and it has revolutionized the way endodontics has been practiced. Many systems have been introduced, although no system is ideal. Every system has advantages and disadvantages. Thorough understanding of the science behind the rotary file helps us in choosing the best system or use two or more systems together to give the best results. Such a technique is called as hybrid technique.

Keywords: Design; Generations; M-wire; Reciprocation.

Introduction

All rotary endodontic systems are made of Ni-Ti material. Their flexibility and shape memory is very useful in dealing with very severely curved canals with great efficiency and better root canal preparations. More recently M wire technology has been introduced. The rotary systems biggest advantage is better shaping of the canal and reduced operator fatigue [1].

The "governing principles" for NiTi Rotary Preparation [2,3]

1. Gauge case difficulty
2. Gain sufficient access
3. Initial canal preparation with hand files till size #20 before using rotary files
4. Use light touch and low rpm
5. Follow crown-down sequence
6. Discard rotary instruments frequently

Table 1: Summary of basic rules for rotary instrumentation [1,4]

Case selection	Gradual curves, glide path confirmed with straight size no. 20 K-file	acute coronal curves and other anatomical variations
Glide path	Confirm a patent canal to the level the rotary should follow	Unknown canal conditions ahead of the rotary instrument
Speed*	Low (~ 250 rmp)	High (> 350)
Torque	Dependent on file; low for small-diameter taper; governed by motor or tactile feedback Uniformly low or always high;	reliance on torque-controlled motor
Hand movement	Pecking for radial-landed files, brushing for nonlanded files	Forcing the file apically

Table 2: Differences between continuous rotation and reciprocating files [5]

Rotation	Reciprocation
The file continuously rotates in the canal	Similar to hand motion of the file
More chances of separation	Less chances of file separation
The speed and torque affects the efficiency of the file	Degree of reciprocation depends on the material properties of the file
	a reciprocating file that utilizes an equal bidirectional movement requires more inward pressure to progress, will not cut as efficiently as a same-size rotary file, and is more limited in augering debris out of the canal.

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Design Features of Rotary Instruments [2,4,6]

Tip Design

Most of the rotary instruments have a non cutting tip to avoid transportation of the canal. The tip of the file can be cutting, partially cutting or non-cutting.

Taper

1. Constant taper
2. Progressive taper
3. Constantly progressive taper

Rake Angle

Rake angles are also important and affect the cutting efficiency of the instrument.

Helical Angle

The helical angle is the angle that the cutting edge makes with the long axis of the file. (Flute width, flute depth, number of flutes along the working length of the file) Radial Land: A radial land is a surface that projects axially from the central axis, between flutes, as far as the cutting edge. The presence or absence of radial lands and whether the radial lands are relieved

Pitch

Pitch is the number of spirals or threads per unit length.

Cross-sectional design (symmetry or asymmetry, the presence of a positive or negative rake angle and / or cutting angle, triangular and U shaped designs among others, etc.)

Classification of Rotary Files in Endodontics [6,7]

First Generation

Have passive cutting radial lands and fixed tapers of 4% and 6% over the length of their active blades which encouraged a file to stay centered in canal curvatures during work.

Required numerous files to achieve the preparation objectives

Example: GT files

Second Generation

Have active cutting edges and require fewer instruments to fully prepare a canal To discourage taper lock and the resultant screw effect associated with both passive and active fixed tapered Ni-Ti cutting instruments, EndoSequence (Brasseler USA) and BioRaCe (FKG Dentaire) provide file lines with alternating contact points.

Third Generation

Manufacturers began to focus on utilizing heating and cooling methods to reduce cyclic fatigue and improve safety when rotary NiTi instruments work in more curved canals.

The desired phase-transition point between martensite and austenite can be identified to produce a more clinically optimal metal than NiTi, itself. This 3rd generation of NiTi instruments significantly reduces cyclic fatigue and, hence, broken files.

Examples of brand lines that offer heat treatment technology are Twisted File (Axis|SybronEndo); HyFlex (Coltène); and GT, Vortex, and WaveOne (DENTSPLY Tulsa Dental Specialties).

Fourth Generation

Utilizes reciprocation, which may be defined as any repetitive up-and-down or back-and-forth motion

Endo-Express (Essential Dental Systems), and Endo-Eze (Ultradent Products) are examples of systems that use a movement where the clockwise (CW) and counterclockwise (CCW) degrees of rotation is same.

Fifth Generation

Designed such that the center of mass and / or the center of rotation are offset

Files that have an offset design produce a mechanical wave of motion that travels along the active length of the file.

Example: Protaper next

Table 3: Differences in hand instrumentation and rotary files in endodontics [3,8]

	Hand instrumentation	Rotary
1.	Step back	Crown down
2.	Files used are of lesser taper 2%	Greater taper files are used
3.	More debris extrusion beyond the apex	Less debris extrusion beyond the apex
4.	more operator fatigue	Less operator fatigue
5.	lateral condensation during obturation	Single cone obturation

M wire [8,9]

M-Wire is a new nickel titanium alloy that is prepared by a special thermal process that is claimed to increase flexibility and resistance to cyclic fatigue. It is reported that instruments made from M-Wire with a Profile instrument (Dentsply / Maillefer) design exhibit nearly 400% more resistance to cyclic fatique than super elastic wire instruments of the same size.

How to Avoid Separation of Rotary Files [11,12]

1. Understanding torque and cyclic fatigue
2. Landed vs. nonlanded rotary files
3. High RPM vs. low RPM: A higher RPM will allow the file to work more effectively and will give the clinician greater tactile awareness. This is why we do crown preparations with high-speed turbines. The only limitation in using nonlanded files at a higher RPM is the increase in speed decreases the cycles to failure, meaning you can't use the files as often. This is really no problem because we should all get into the habit of single-use, especially after molar endodontics. Moreover, when running a nonlanded file at a greater RPM, you have gained a dramatic increase in tactile awareness as a result of the increased speed.
4. Always keep a file moving
5. Torque control engines
6. Single-use
7. Files should be well lubricated
8. Never force a file
9. Sensible operatory management
10. Difficult anatomy: severely curved canals must be avoided and must be prepared using hand instruments of lesser taper

Conclusion

Despite rotary endodontics are having advantages in canal preparation, it can't be used for all the cases. Proper case selection is very important. Also, once should keep in mind that the taper of rotary files is far too high than the conventional 2% hand files. The technique of canal preparation is crown down, so the amount of debris that goes beyond the apex is less. The clinician should properly judge the case before using rotary files.

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