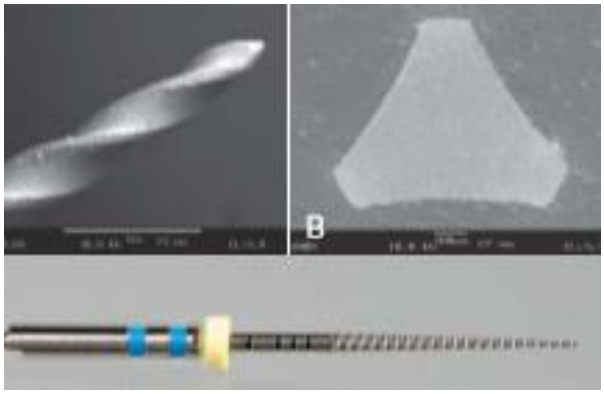
Endodontics

Lecture 5 أ.د.حسين فيصل الحويزي

Intracanal Instruments

Rotary Instrumentation systems using Nickel Titanium

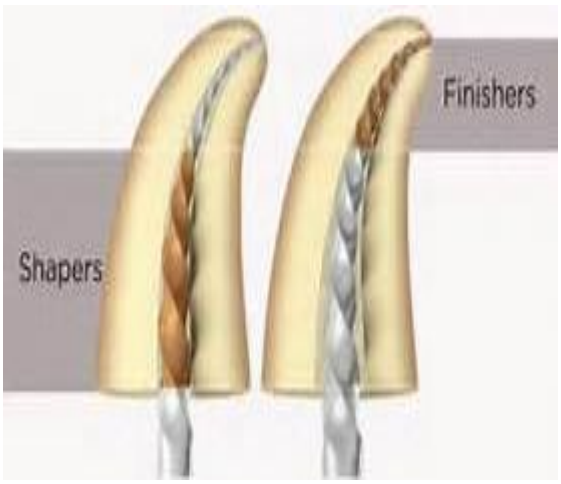
ProFile system



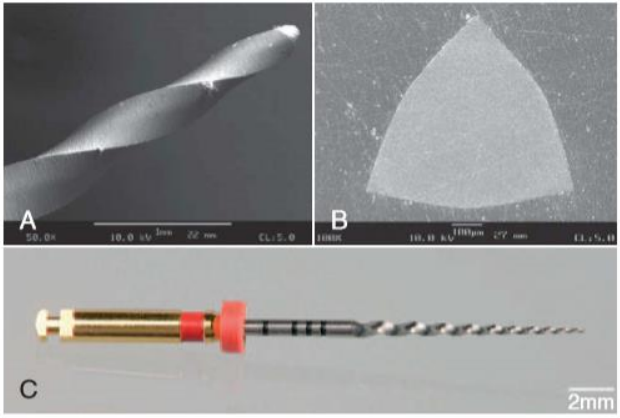
The ProFile system was introduced in 1994. ProFile instruments have increased tapers compared with conventional hand instruments. The tips of the ProFile Series 29 rotary instruments had a constant proportion of diameter increments (29%). Cross section of a ProFile instrument has a U-shape design with radial lands. Lateral views show a 20-degree helix angle, a constant pitch, noncutting tips and with a neutral or slightly negative rake angle. This configuration facilitates a reaming action. The preferred speed is 275-325 rpm.

ProTaper Universal system.

The ProTaper system is based on another concept and composed of six instruments:
1- Three shaping files.
2- Three finishing files.
This set is increased by two larger finishing files and a set designed for retreatment procedures. In cross section, ProTaper shows a modified K-type file with sharp cutting edges and no radial lands; this creates a stable core and sufficient flexibility for the smaller files. The cross section of finishing files F3, F4, and F5 is slightly relieved for increased flexibility. The difference in design of this system is the varying tapers along the instruments' long axes. The three shaping files have tapers that increase coronally, and the reverse pattern is seen in the five finishing files.



Shaping files #1 and #2 have tip diameters of 0.185 mm and 0.2 mm, respectively, 14-mm-long cutting blades. The diameters of these files at D14 are 1.2 and 1.1 mm, respectively. They are used in the coronal and middle third of the root canal.
The finishing files (F1-F5) have tip diameters of 0.2, 0.25, 0.3, 0.4, and 0.5 mm, respectively, between D0 and D3, and the apical tapers are .07, .08, .09, .05, and .04, respectively. The finishing files have rounded noncutting tips. They are used in the apical third of the root canal.



The convex triangular cross section of ProTaper instruments reduces the contact areas between the file and the dentin. The greater cutting efficiency of this design has been improved by balancing the pitch and helix angle, preventing the instruments from threading into the canal. ProTaper instruments can be used with 250 to 300 rpm.

Two usage characteristics are recommended for the ProTaper system:

1-The preparation of a glide path.

2- The use of a more lateral "brushing" working stroke. Such a stroke allows the clinician to direct larger files coronally away from danger zones and counteract any "threading-in" effect.

No. of instruments/ set	Tip sizes	Size increments	r.p.m. (recommended)	Lengths
6 (3 shaping files; SX, S1, S2; 3 finishing files; F1, F2, F3)	19-30	Vary along the working part of an individual instrument	150 to 350 minimal axial force, low to medium torque to fracture, varying working torque	19, 21, 25 mm

ProTaper Next

This system is composed of 5 files, namely X1, X2, X3, X4 and X5. These files correspond to sizes 17/04, 25/06, 30/07.5, 40/06.5 and 50/06 respectively.

The X1 and X2 have variable tapered design whereas X3-X5 files have a fixed taper from D1-D3 then a decreasing percentage tapered design over the rest of their active portions.

This system has a rectangular cross section that is of centered which allows 2 points contact with the dentin wall and the rest of the space free for storing debris which will be removed by the file swaggering motion.

Wave One single file reciprocating system

This system is a single-use, single file system to shape the root canal. In most cases, the technique only requires one hand file followed by one single Wave One file to shape the canal completely using the reciprocation motion that engages and cut dentine in a 150-degree counter-clockwise (CCW) direction and then, before the instrument has a chance to taper lock, disengages 30 degrees in a clockwise (CW) direction. The net file movement is a cutting cycle of 120 degrees and therefore after three cycles the file will have made a reverse rotation of 360 degrees.

The file is made with M-wire technology which improves strength and resistance to cyclic fatigue about four times the traditional rotary NiTi files. The system is composed of:

- The Wave One small file. It is used in narrow canals. The tip has an ISO of 20 with a continuous taper of 6%.
- The Wave One primary file. It is used in the majority of canals. The tip has an ISO of 25 with an apical taper of 8% that reduces towards the coronal end.
- The Wave One large file. It is used in wide canals. The tip has an ISO of 40 with an apical taper of 8% that reduces towards the coronal end.

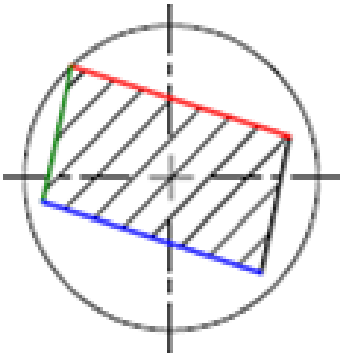
The instruments are designed to work with a reverse cutting action. All instruments have a modified convex triangular cross section at the tip end and a convex triangular cross section at the coronal end. This design improves instrument flexibility. The variable pitch flutes along the length of the instrument improve safety.

Wave One Gold

To improve the Wave One system the Wave One Gold system was introduced. It is composed of four tip sizes:
Small (20.07, yellow)
Primary (25.07, red)
Medium (35.06, green)
Large (45.05, white)

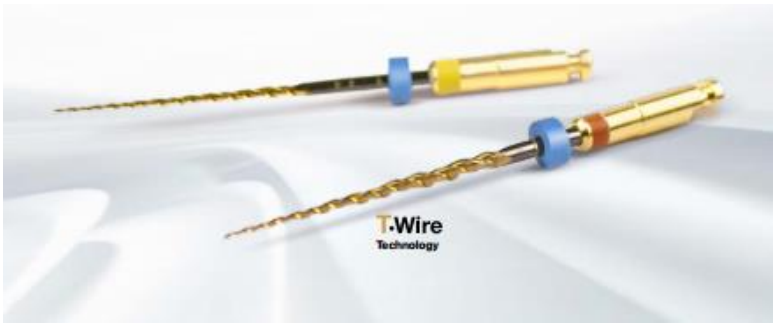
		Tip diameter	Taper at tip
Small		020	7%
Primary		025	7%
Medium		035	6%
Large		045	5%

The various tip sizes and tapers afford the clinician the ability to clinically prepare a wider range of apical diameters and endodontic anatomy.
The cross-section of WaveOne GOLD is a parallelogram with two 85-degree cutting edges in contact with the canal wall, alternating with off-centred cross-section where only one cutting edge is in contact with the canal wall.



Decreasing the contact area between the file and the canal wall reduces binding (taper lock) and, in conjunction with a constant helical angle of 24 degrees along the active length of the instrument, ensures little or no screwing in. The additional space around the instrument also ensures additional space for improved debris removal.
The tip of WaveOne GOLD is roundly tapered and semi-active, modified to improve its smooth and reproducible penetration into the canal.

Two shape



This system consists of two files which are:
1- TS1: The tip is #25 and a taper of 04.
2- TS2: The tip is #25 and a taper of 06.
3- Apical finishing files (if needed in larger canals:
a) F35: The tip is #35 and a taper of 06.
b) F40: The tip is #40 and a taper of 04.

The TS1 file enters the canal to widen it to apical diameter of size 25 and taper 04 (double taper of iso K-file). The TS2 widen the canal to 06 (three times the taper of iso K-file). This makes a funnel shaped canal with a wide orifice and an apex of width of size 25.

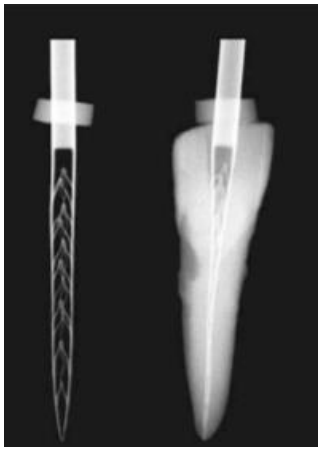
XP Endo shaper

It is rotary file system made with MaxWire alloy which offers better:
1- Flexibility
2- Fatigue resistance

3- Ability to progress within the canals with ease, expanding or contracting according to the canal morphology.
4- Shape memory principles enabling the instrument to take on a predefined shape at 35°C.

The instrument has the Booster Tip which has the following properties:
1- Six cutting edges for optimal guidance.
2- Starts shaping at minimum ISO diameter 15 to achieve a final diameter of ISO 30 with only one instrument. It increases the taper from .01 to at least .04. It allows to reach a final canal preparation of minimum 30/.04 with only one instrument.

Group IV: Engine-Driven Three-Dimensionally Adjusting Files (Self-adjusting file)



The self-adjusting file (SAF) represents a new approach in file design and mode of operation.
The file is a hollow device, designed as a cylinder of thin-walled, delicate NiTi lattice with a lightly abrasive surface. An initial glidepath is established with a #20 K-file to allow the insertion of the SAF file. The file compresses from its 1.5 mm diameter into dimensions equivalent to those of a #25 K-file. The handpiece generates in-and-out vibrations with 5000 vibrations per minute and 0.4 mm amplitude. The compressed file will adapt itself to the root canal walls, applying a uniform cutting action gradually removing a uniform dentin layer from the canal walls. There a continuous flow of irrigant which removes the tissue debris and the dentin powder generated by the file.

Group V: Engine-Driven Reciprocating Instruments:

The Giromatic handpiece, a rotary instrument in use since 1969, delivers 3000 quarter-turn reciprocating movements per minute. Rasps and barbed broaches are most often used in Giromatic handpieces, but K-type and H-type instruments also can be used.

Group VI: Sonic and Ultrasonic Instruments

Files or ultrasonic tips can be activated by electromagnetic ultrasonic energy. This energy activates an oscillating sinusoidal wave in the file with a frequency of upto 30 kHz.
There are two types of such energy:

1- Ultrasonic: Devices which operate at 25 to 30 kHz, include the magnetostrictive and the piezoelectric. Ultrasonic devices use regular types of instruments (e.g., K-files),
2- Sonic: Devices which operate at 2 to 3 kHz which may use metal files or plastic tips as Endoactivator.

Although similar in function, piezoelectric units have some advantages over the magnetostrictive systems. For example, piezoelectric devices generate little heat, so no cooling is needed for the electric handpiece. The magnetostrictive system generates excessive heat, and a special cooling system is needed in addition to the irrigation system for the root canal.
The file in an ultrasonic device vibrates in a sinus wave–like fashion. A standing wave has areas with maximal displacement (i.e., antinodes) and areas with no displacement (i.e., nodes). The tip of the instrument exhibits an antinode. Ultrasonic devices proved very efficient for irrigating root canal systems.

During free ultrasonic vibration in a fluid, two effective physical effects are formed:
1- Cavitation. During oscillation in a fluid, a positive pressure is followed by a negative pressure causing implosion.
2- Acoustic streaming. This is small, intense, circular fluid movement around the instruments.