Endodontic 2010/2020

lec.3+4 Endodontic instruments, equipment, and material

a- Extracanal instruments.
b- Intracanal instruments.

Extracanal instruments

A- Endodontic explorer: This is subdivided into:
i- Straight: To locate the root canal orifice
ii- L-shaped: To detect the unremoved parts of the pulp chamber roof.

B-Plastic instruments: They are used to manipulate a plastic material and it has two types
i- One with a blade: This is used to carry temporary filling.
ii- Plugger: This is used to condense cement and base in the root canal.

C- Endo excavator: It is larger than spoon excavator which is used to excavate pulp chamber and curettage of periapical lesions during apicectomy.

D- Endodontic locking pliers (Tweezers): it has a lock that allows the material to be hold the material without continuous pressure; also it has a groove to facilitate holding gutta percha and absorbing points.

E- Endodontic ruler: A metal ruler of 0.5 mm division.

F- Endodontic syringe: This is subdivided into:
i- One with a flat tip to prevent penetration into small canals.
ii- groove to permit the irrigant to flow coronally rather than apically, thus reducing post-operative pain.

G- Instrument organizer (endo. Kit): Used to arrange intra-canal instruments.

H- Transfer sponge: saturated with a disinfectant solution and also used to arrange intra-canal instruments after being used.

I- Instrument stopper: these indicate the working length and some have a notch to indicate the direction of curvature.

Intracanal instruments

ISO Grouping of Instruments

In due time, the ISO committee grouped intracanal root canal instruments according to their method of use:

Group I: Hand use only—files, both **K** type (Kerr) and **H** type (Hedstroem); **reamers, K** type and **U** type; and broaches, pluggers, and spreaders.

• **Group II: Engine-driven** latch type—same design as Group I but made to be attached to a handpiece. Also included are paste fillers.

• **Group III: Engine-driven** latch type—**drills** or reamers such as Gates-Glidden (**G** type). Peeso (**P** type), and a host of others.

• **Group IV: Root canal points—**gutta-percha, silver, paper.

Group I

I- Broaches: These are either smooth for exploring or barbed for extirpation and to remove cotton and paper point from the canal, it is used in the coronal 2/3 of the root using the suitable size and should be inserted freely.

II- Reamers: They are manufactured by twisting triangular stainless-steel bar to produce 0.5-1 flute/mm and they are more flexible than file but used mainly with reaming action.

III- Files: The main types of files are:

a- K-type files: They are manufactured by twisting a square stainless-steel bar to produce 1.5-2.25 flute/mm. either a reaming or a filing action may be used. Although most K-type files were originally used with a in-out. circumferential filing technique, the balanced-force technique.

Reamer	
1. More flexible	Less flexible.
2. Less no. of cutting	More no. of cutting flutes
3. Used mainly in reaming action	Used mainly in filing action.
4. Less effective in filing action	Rotation Can be used in reaming action. less no. of flutes. less no. of flutes.
5. cutting motion is rotation and retraction	Push Pull
6. Cross section is Triangular	Square
7. Round preparation shape	Ovoid

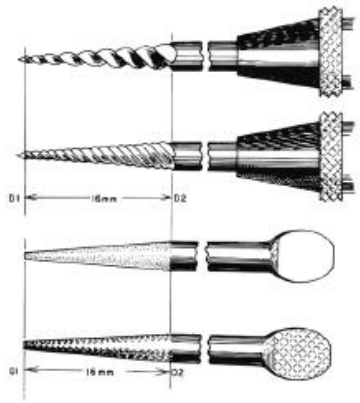
b- K-flex files: They are manufactured by twisting a rhomboid (diamond) shape stainless steel bar so alternating blades with an acute and obtuse angle that will cause an increase in its sharpness and cutting efficiency, the alternating low flutes formed by obtuse angles of rhombus provide more area for debris removal. it is more flexible than K-files but it becomes blunt more quickly.

c- Hedstroem files (H-type): They are made by machining a continuous groove in a triangular metal bar and it is more aggressive than K-files and they are more

effective in pulling action but must not be used with rotary action because they are liable to fracture. It is impossible to ream or drill with this instrument. To do so locks the flutes into the dentin much as a screw is locked in wood. The file is impossible to withdraw once it is locked in the dentin and can be withdrawn only by backing off until the flutes are free.

d- NiTi files: It is much more flexible but fracture without a warning sign and it is difficult to be used in the circumferential filling.

Each instrument has a number which refers to the size of its tip D_0 and D_{16}= D_0 =0.32mm, the distant between D_0 to D_{16}=16mm, but the total length vary (length=31 mm for anterior, medium=25mm, or short=21mm for posterior)
E.g. Reamer size 30 ------ D_0 =0.3mm
70 ------ D_0 =0.7mm



Original recommendation for standardized instruments.Cutting blades 16 mm in length are the same size and numbers as standardized filling points. The number of the instrument is determined by diameter size at D1 in hundredths of millimeters.Diameter 2 (D2) is uniformly 0.32 mm greater than D1.

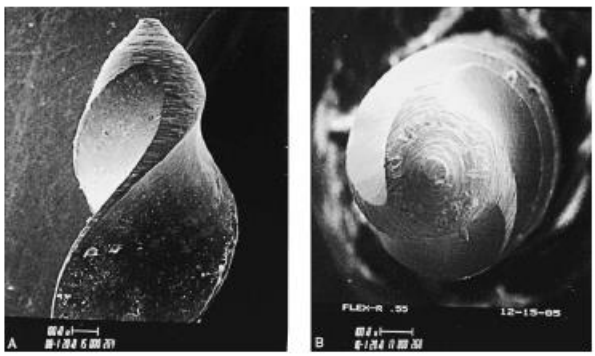
All intracanal instruments are color coded and each color represents a size

Table 10-1 Dimensions in Millimeters. Revision of ADA Specification No. 28 Added Instrument Sizes 08 and 110 to 150 to the Original Specification

Size	Diameter (Tolerance ± 0.02 mm)			Handle Color Code
	D_1 mm	D_2 mm	D_3 mm	
08	0.08	0.40	0.14	Gray
10	0.10	0.42	0.16	Purple
15	0.15	0.47	0.21	White
20	0.20	0.52	0.26	Yellow
25	0.25	0.57	0.31	Red
30	0.30	0.62	0.36	Blue
35	0.35	0.67	0.41	Green
40	0.40	0.72	0.46	Black
45	0.45	0.77	0.51	White
50	0.50	0.82	0.56	Yellow
55	0.55	0.87	0.61	Red
60	0.60	0.92	0.66	Blue
70	0.70	1.02	0.76	Green
80	0.80	1.12	0.86	Black
90	0.90	1.22	0.96	White
100	1.00	1.32	1.06	Yellow
110	1.10	1.42	1.16	Red
120	1.20	1.52	1.26	Blue
130	1.30	1.62	1.36	Green
140	1.40	1.72	1.46	Black
150	1.50	1.82	1.56	White

*New diameter measurement point (D_3) was added 3 mm from the tip of the cutting end of the instrument. Handle color coding is official.

Tip Modification. Modification of the sharpness of the instrument tip by grinding to remove the transition angle between the tip and first blade (blunt tip).This modification will make less ledging and/or transportation (machining the preparation away from the natural canal anatomy) and the file remains centered within the original canal.



Flex-R-file with noncutting tip. A, Note rounded tip. B, "Nose" view of a noncutting tip ensures less gouging of the external wall and reduced cavity transport.

IV-Spiral root fillers: May be used for posting paste within the canal but are liable to fracture, the alternative is to coat a file with paste and spin it in an anticlockwise direction.

V- Spreader: Long tapered and pointed end instrument to compress gutta-percha laterally and apically and leaving space for auxiliary cones. There is also a finger type which smaller and shorter, so can be used in posterior teeth.

VI-Plugger: Similar to spreader but with blunt flat tip used for vertical condensation and in the termination of all obturation condensation.

The mode of action of intra-canal instruments

I- Reaming action (used with a reamer): It is a repeated clockwise rotation which gives round preparation in cross section.

II- Filling action (used with the file): A push-pull action which gives irregular general oval cross section.

III- Quarter-turn filing (used with file and reamer): A push and 1/4 clockwise and pull action that gives oval cross section.

IV- Circumferential filing: A push and 1/4 clockwise and pull action each time from a different site from the coronal cavity to give an oval cross section which is highly flared cervically.

Nickel – Titanium endodontic Instrument

A new generation of an endodontic instrument made from remarkable alloy, Nickel – titanium has added a striking new dimension to the practice of endodontic. The super elasticity of Ni-Ti differentiates it from other metals such as stainless steel that sustain deformation and retain permanent change shape. These properties make nickel-titanium endodontic files more flexible and better able to conform to canal curvature, resist fracture, and wear less than stainless steel files.

Advantages

1- NiTi files are more flexible than the stainless-steel files (low modulus of elasticity).

2- Superior resistance to fracture in a clockwise or counter-clockwise reaming motion.

3- They are biocompatible and appear to have excellent anticorrosive properties.

4- These instruments maintain the original shape of the curved canal and remain centered in the canal and cause the least amount of apical transportation, zipping, elbow, and ledging.

5- They have good resistance to untwisting, rounding of edges and tip alternation.

6- They are significantly faster than other instruments.

7- Concerning cutting efficiency as well as instrumentation of curved canals Ni-Ti instrument were clearly superior to all another instrument.

Disadvantages

1- Their high expense.
2- The penetration ability of Ni-Ti instruments seems to be less than that of stainless steel instruments.
3- Ni-Ti instruments have an inability to bypass or remove ledge.
4- These instruments break without any previous sign of their fracture such as untwisting of the file, unlike stainless steel instruments which allow discarding the instrument before fracture.

ISO Group II and III: Engine – driven instruments can be used in three types of contra angle handpieces:

1- Rotary contra angle handpiece: The instrumentation with a full rotary handpiece is by straight line drilling full rotary contra angles are used primarily to develop coronal access to the canal orifices. In addition, special drills or reamers, listed under ISO Group II, may be used to funnel out orifices for easier access, to widen as much 2/3 of the canal, or to prepare post canals for final restriction of the tooth.

Since most of these instruments do not bend, they should primarily be used in straight canals because they are often misdirected or forced beyond their limits. They will cause perforations or break in the hands of the instruments. Lack of tactile sense is a real problem, and the slower handpiece improves this.

An entirely new 'wrinkle' in rotary handpieces is the **Morita Tri Auto – ZX**, a cordless, battery – powered, endodontic slow speed (280 rpm) handpiece with a built – in apex locator.

It uses rotary nickel-titanium instruments held by a push button chuck. The Tri **Auto – ZX** has three automatic functions. The handpiece automatically starts when the file enters the canal and stops when the file is removed, if too much pressure is applied, the handpiece automatically stops and reverse rotation. It also automatically stops and reverses rotation when the file tip reaches the apical stop, as determined by the build in apex locator. The Tri Auto ZX will work in a moist canal.

2- Reciprocating Handpiece: To overcome the inflexibility of conventional endodontic hand instrument, the Giromatic (quart turn endodontic handpiece) was introduced in 1964. This handpiece operates by rotary-reciprocal action through a 90 – degree are, which delivered 3000 times per minutes.

Rotary instruments:

1-Gates-Glidden drills.
2-Pesso reamers.

- Ultrasonic Handpieces.
- Sonic handpieces.

1- Gates – Glidden drills: These are an integral part of new instrument techniques which have many uses:
1. To open the canal orifice.
2. To achieve straight line access by removing the dentin shelf.
3. To flare the coronal and middle third of the canal rapidly

The Gates-Glidden drills are steel instruments for the contra-angled handpiece characterized by a long shank and an elliptical extremity which is flame shaped with a "guiding" non-cutting tip The Gates-Glidden drills are available in six sizes and marked with circular notches on the part that attaches to the contra-angled handpiece; The Gates-Glidden drills are designed with the weakest point at the start of the shank, so that they are easier to remove in case they fracture inside the root canal The Gates drills must be used passively on withdrawal from the canal with a brush like circumferential movement and their use must always be preceded by preflaring of the canal using hand instruments. An active use of the Gates Glidden drills is not recommended because they can lead to the formation of ledges and dangerous structural weakening that in the curved and thin canals can cause stripping. The blades of the Gates-Glidden drills do not have angles but flat cutting planes to reduce the aggressiveness and the tendency to screw in; they could be considered as the first example of the "radial lands" type of blades.
Used at slow speed for preparing the coronal 2/3 of the canal. It is used in withdraw the motion to remove tooth structure. They come in the following sizes:
Number 1 equal to ISO 50
Number 2 equal to ISO 70
Number 3 equal to ISO 90
Number 4 equal to ISO 110
Number 5 equal to ISO 130
Number 6 equal to ISO 150

2- Pesso reamers:
Peeso Reamers are steel instruments for the contra-angled handpiece similar to the Gates-Glidden drills, from which they differ in that the blades are spread over a wider surface and the shape that is cylindrical. The design of the blade (radial lands type) and the non-cutting tip is, in fact, identical to that of the Gates drills. On the contrary, the Peeso drills are very useful in the preparation of the dowel space (post space) in

canals already enlarged or in retreatments to speed up the removal of the obturation material.

These instruments are available with or without safe tips. Gutta-percha should have previously been removed to post depth with a hot plugger. Pesso resembles The Gates-Glidden drills in sizes.

ProTapers

The ProTaper System is made up of 6 instruments that are divided into 2 groups of 3 instruments each: Shapers with the marking SX, S1 and S2 and Finishers with the marking F1, F2, and F3. The Shapers are instruments for eliminating coronal interferences and to create a smooth pathway for the Finishing instruments while the Finishers are meant for the finalizing of the shape created by the Shapers and for giving a definitive taper and diameter to the canal. The S-X Shaper is an auxiliary instrument used in canals of teeth with shorter roots or to extend and expand the coronal aspects of the preparation, similar to the use of Gates-Glidden drills or orifice openers. Sx has a much quicker rate of taper between D1 and D9 as compared with the other ProTaper Shaping files. Shaping File S-1 is designed to prepare the coronal 1/3 of the canal, whereas Shaping File S-2 enlarges and prepares the middle third in addition to the critical coronal region of the apical third. The important structural characteristics of the ProTapers are

– Robust triangular cross-section with convex sides to increase the metal mass of the central core resistance of the instruments;
– cutting blades with cutting angles (there are no radial lands);
– Variable helical angle to reduce screw in risk;
– Variable pitch (distance between spirals) to reduce the risk of screw in and aid the removal of debris;
– Multiple increases in tapers towards the handle of the shapers (so as to increase the flexibility in the apical third) and decrease towards the handle in the Finishers (so as to enlarge the apical preparation without making the coronal third of the instrument too rigid).

Path Files

Mechanical glide path and Preflaring.

Available in 3 ISO sizes (013, 016 and 019) and 3 lengths (21, 25 and 31mm). Flexible and resistant to cyclic fatigue, they offer many advantages compared to manual solutions

Pathfinder: These are used for negotiation of irregular calcified canal when it is difficult to use 06, 08 and 10 files which may prove to tip fracture, so that to

avoid this problem pathfinder files can be used, these files are available in two sizes K1 (between 06 and 08) and K2 (between 08 and 10). They are made of stainless steel or carbon steel (become more rigid).
The taper of their instruments reduced to give the tip a greater rigidity so that more apical pressure can be applied without the risk of tip bending damage to the tip of the small instrument may be due to a relatively abrupt change in the direction of the canal.

- **Ultrasonic Handpieces:** Instruments used in the hand pieces that move near or faster than the speed of sound range from standard K – type files to special broach like instruments.

Ultrasonic endodontic is based on a system in which sound as an energy source activates an endodontic file resulting in three-dimensional activation of the file in the surrounding medium.

The main debriding action of ultrasonic was initially thought to be by cavitation, a process by which bubbles formed from the action of the file, become unstable, collapse and cause a vacuum like 'explosion'. A combined shock, shear and vacuum action results. Since an irrigation and aspiration system is employed in the endodontic equipment for ultrasonic, the broken cell parts are washed out and then removed from the canal system.

The cleaning efficacy can be enhanced by placing an ultrasonic tip into the irrigated space of the canal. Ultrasonic creates both cavitation and acoustic streaming. The cavitation created is minimal and is restricted to the tip. However, the acoustic streaming effect is significant. These motions allow cleaning and flushing out of areas that files may not be able to negotiate.

- **Sonic handpieces:** The endo MM 1500 (Endo Micro – Mega 1500) was developed as sonic vibratory handpiece (special handpiece) to be attached to the turbine line of a dental unit. The handpiece operates at a frequency of 1500 HZ at a pressure 0.4 Mpa tap water irrigant and coolant is delivered into the preparation from the handpiece.

These instruments have safe ended non cutting tips. 1.5 – 2 mm in length. Those files were particularly ineffective in widening the canal as the previous two instruments. The root canal instrument vibrates in the simpler pattern than ultrasonic files. A continuous flow of water is delivered through the handpiece to the instrument.

The WaveOneTM single file reciprocating system

The new WaveOneTM NiTi file from DENTSPLY Maillefer is a single use, a single file system designed to completely shape the root canal from start to finish.