Endodontics

د. بلند محمد سليم

Lec:3

Hand instruments

Hand instruments are grouped according to usage by the **International Organization for Standardization (ISO)**, working alongside the **American National Standards Institute (ANSI).** These organizations have defined terminology, dimensions, physical properties, measuring systems and quality control of endodontic instruments and materials.

Standardization:-

The development of world wide standards for endodontic instruments and materials has occurred since the 1950s, when it was realized that a considerable amount of variation existed between root canal instruments of different manufacturers. At that time proposals for standardizing instruments were produced and covered the following:-

1) The diameter and taper of each instrument and filling point.
2) The graduated increase in size from one instrument to the next.
3) An instrument- numbering system based on the diameter of the instrument.

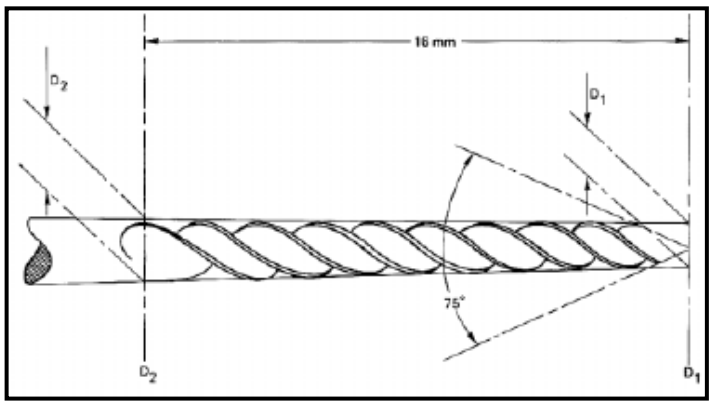
These proposals have been widely accepted, and endodontic hand instruments, (files, reamers and barbed broaches) are standardized in relation to size, color coding and physical properties.

The guidelines for instruments are:

1-Instruments are numbered from 06-150.Each number represent diameter of instrument in 100th of millimeter at the tip.

2-Working blade begins at tip (D_1) and extends 16 mm up the shaft (D_2). D_1 represents the diameter of the projection of the working part at the **tip end**, and is its nominal size. (D_2) is 0.32

mm greater than D_1, ensuring that there is constant increase in taper, i.e 0.02mm per mm of instrument.



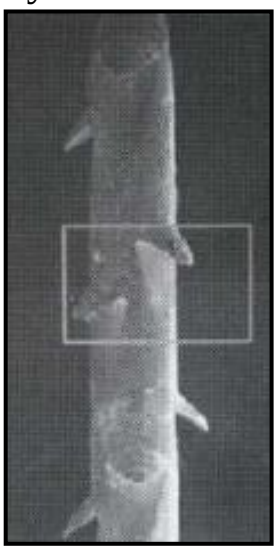
3-Tip angle of instrument varies as 75+_ 15^0.

4-Instrument handles are color coded for their easier recognition (yellow, red).

5-Instrument available in length 21, 25, 28, and 30mm are used for root canal therapy.

Barbed broaches:-

These are made from soft steel wire. The barbs are formed by cutting into the metal and forcing the cut portion away from the shaft, so that the tip of the barb points towards the handle. The cuts are made eccentrically around the shaft so that it's not weakened excessively at any one point. Barbed broaches are mainly used for the removal of pulp tissue from root canals, but also for removal of cotton- wool dressings.



Provided the instrument is loose within the canal and the barb is used to engage soft tissue only, the risk of fracture is minimal. However, as soon as the barbed broach is wedged against the wall of the canal, the barbs are flattened against the shaft. When an attempt is made to remove the instrument from the canal, the sharp barb tips dig into the canal wall and resist its withdrawal. Considerable force may be necessary to free the jammed instrument and there is a risk of either fracturing the shaft of the instrument or at least some of the individual delicate barbs. For this reason, the instrument should never be used to shape canal walls.

Reamers:-

Reamers are usually made from stainless steel by twisting tapered lengths of wire which have a triangular or square cross-section, to form an instrument with sharp cutting edges along the spiral. Although cross-section is a manufacturer's prerogative, the smaller sizes (15-50) are usually manufactured from a square blank, while the larger sizes are manufactured form a triangular blank. Reamers are used to enlarge and shape an irregularly shaped root canal into a cavity of round cross- section. The basic action is a half- turn twist and pull which shaves the canal, removing dentine chips from the root canal. However, anatomically, no root canal is round in cross- section and none can be prepared. Reamers are widely used in cleaning and shaping procedures, and during the method of canal preparation.

Files:-

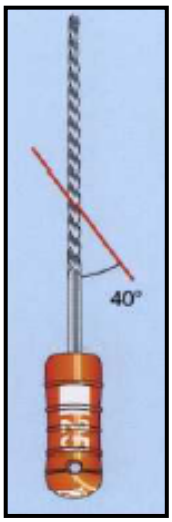
There are various types of root canal file, and they are usually made from stainless steel. The followings are the main types:-

1)K-file. 2) K-flex. 3) Flexofile. 4) Flex-R. 5) Hedstrom and Safety Hedstrom. 6) S-file.

Files are predominantly used with a filing or rasping action, in which there is little or no rotation of the instrument in the root canal, except for the Flex-R instrument.

K-file:-

This instrument is manufactured from stainless-steel wire which is ground into square or triangular cross-section. The blank is twisted into a tighter series of spirals than a reamer to produce from **0.9 to 1.9** cutting edges per millimeter length; some K-files are ground. When a K-file is manufactured from a



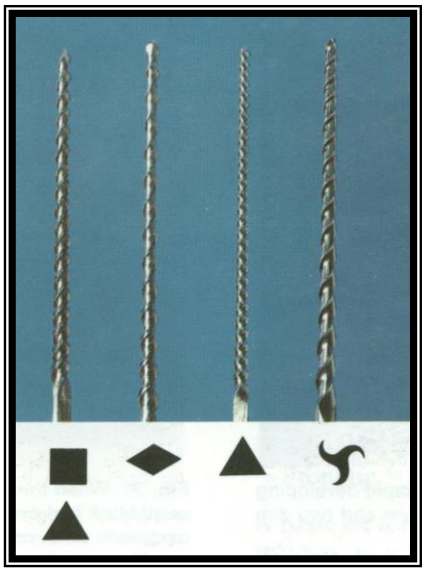
triangular cross-section it demonstrates **superior cutting efficiency,** and as a result of its increased **flexibility** is more likely to follow canal curvature than a file with a square cross-section.

K-flex file:-

The K-flex file has a cross-section that is **rhomboid-shaped** and the twisted instrument has a series of cutting flutes with alternate sharp (< 60°) cutting edges and obtuse non-cutting edges. The cutting efficiency of the K-flex file is **greater** than many brands of K-file; due to its increased flexibility and ability to remove debris as its alternating blades provide a **reservoir** for debris, also the decrease in contact of instrument with canal walls provides more space for irrigation. A disadvantage of this file is its quicker loss of cutting efficiency.

Flexofile:-

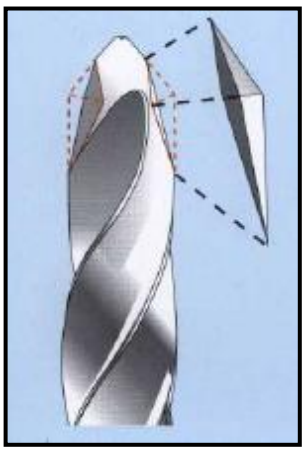
This instrument is manufactured by maillefer in the same manner as the K-file but it has a **triangular cross-section** that gives sharper cutting blades and more room for debris than the conventional K-file. The stainless steel is extremely flexible and the instrument resists fracture. The **file tip is non-cutting (Butt).**



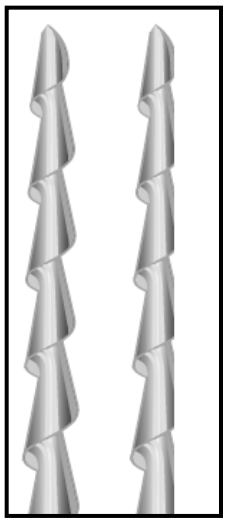
A- K-file B- K-Flex file C- Flex-o-file

Flex-R file:-

Most root canal instruments have a sharp tip. Removal of the sharp cutting edges form the tip of the instrument helps to prevent undesirable ledge formation. The flex-R design eliminates the possibility of ledge formation by **removing the cutting surfaces at the tip's leading edge.** This enables the tip to ride along the canal rather than gouge into it. At the same time, the **triangular cross-sectional** area of the flex-R provides flexibility to negotiate severely curved canals.



Hedstrom and Safety Hedstrom:-



The hedstrom file is made by machining a steel blank of round cross-section to produce elevated cutting edges. The tapering effect appears to form a series of intersecting cones. Although the design leads to a flexible instrument, the instrument is inherently weak due to the small shaft diameter and is therefore prone to **breakage**. The hedstrom file has been reported to have a low cutting efficiency compared with other files as it only cuts on the withdrawal stroke, never the less it can be used to flare canal orifices and remove broken instruments, gutta-percha and silver points.

The safety hedstrom file (Kerr) features a non-cutting safety side along the length of the blade, which reduces the potential for strip perforations. The non-cutting side is oriented to the side

of the canal where cutting is not desired, and is indicated by a flattened side on the handle. The file is used with a traditional filing technique.

S-file (Unifile):-

Originally developed in Sweden, this instrument has an **S-shaped cross-section** which has been produced by grinding. This results in a stiffer instrument than the conventional hedstrom file. A millimeter scale is etched onto the shaft of the instrument to facilitate length control. The instrument has good cutting efficiency in either a filing or reaming action; the instrument therefore could be classified as a hybrid design.

New instrument design and technology:-

Nickel-titanium file:-

In 1988, the properties of a file manufactured from **nickel-titanium (Ni-Ti) alloy** were reported this file demonstrates greater elastic flexibility in bending, and greater resistance to torsional fracture than stainless steel. There are now several commercial versions. Ni-Ti files have a **non-cutting tip**, cannot be precurved, and tend to straighten curved root canals less than stainless steel file.

Golden-mediums:-

Maillefer have produced a series of **intermediate-size** instruments to complement ISO standard-size instruments. The new instruments roughly correspond in size to halfway between standard ISO sizes and are numbered 12, 17, 22, 27, 32, and 37. Whilst this system addresses the problem of two few instruments in the smaller sizes, it does not achieve linear dimensional change at D1. Golden-Mediums are part of the flexo-file range.

MAC files and Double MAC files:-

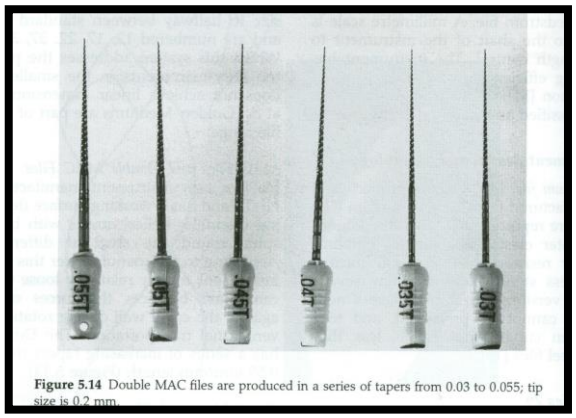
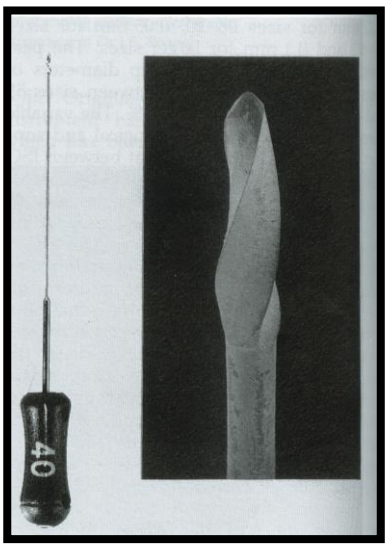


Figure 5.14 Double MAC files are produced in a series of tapers from 0.03 to 0.055; tip size is 0.2 mm.

The MAC file is a new instrument manufactured from Ni-Ti, and has a working surface demonstrating dissimilar helical angles with blades that spiral round the shaft at different rates. According to the manufacturer this allows the instrument to stay relatively **loose** within the canal and balances the forces of the file against the canal wall during rotation to **prevent canal transportation**. The Double MAC has a series of increasing tapers from 0.03 to 0.55 mm/mm length.

Canal Master U:-



The Canal Master U (CMU) hand instrument was developed in the late 1980s. The instrument is used to prepare the **apical third of the canal**, and has a **non-cutting pilot tip**, a 1 mm length cutting blade, and a parallel sided shaft with a smaller diameter than the cutting blade. It's designed to improve debris removal and **reduce apically extruded debris**, further; it has been reported to create a well-centered canal preparation without ledging and transportation. Recently, a Ni-Ti CMU hand instrument has been developed, and it produces a better canal preparation than other files.

Flexogate:-

Similar in design and use to the CMU hand instrument, the flexogate is a logical development of the Gates-Glidden drill. Whereas the latter is used during conventional coronal preparation of the canal, the flexogate's task is enlarging the

apical region of the canal. The flexogate demonstrates a non-cutting guiding tip and debris evacuation zone which helps to maintain root canal configuration during instrumentation.

Whilst the flexogate can fracture more easily during torsion than the CMU, it has a breakage pint approximately 16 mm from the tip, which ensures its retrieval in the event of separation. The bending moment of the flexogate and the CMU are well below standard's specifications for files, leading to considerable flexibility in curved canals.