Using hand files to their full capabilities: A new look at an old yet emerging technology

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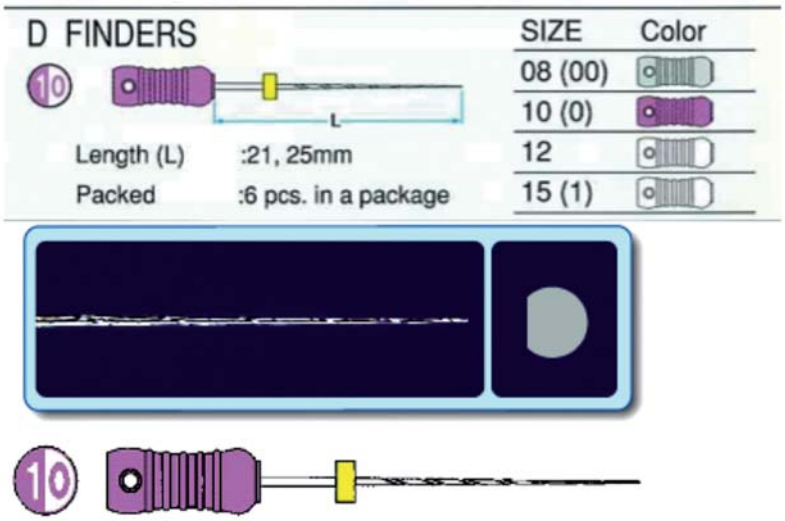

Fig. 1

Fig. 1_Mani D Finders.
(Images provided by Dr Rich Mounce)

_Despite wide global acceptance of rotary nickel titanium (RNT) canal enlargement, hand files remain central to endodontic practice. It can be argued persuasively that proper canal negotiation and glide path creation are key ingredients to successful long-term treatment, along with adequate and appropriate irrigation, canal preparation, coronal seal, etc. Simply stated, after the preparatory steps of straight-line access and removal of the cervical dentinal triangle with orifice openers, if the canal is not properly negotiated and a glide path prepared prior to RNT enlargement, cleaning and shaping procedures cannot be optimal.

This article was written primarily for the general dentist. It describes stainless steel (and, to a lesser degree, nickel titanium) hand files, reciprocation and their clinical application. This article is intended to be a clinical "how to" article, not a literature review, hence a lack of extensive references. The endodontist is encouraged to compare their treatment methods with those described here. The Mani product line of files is described primarily because these files are used daily by the author. Examples of equivalent files are provided alongside of Mani products throughout the article for comparison.

There are myriad hand file designs, applications, materials and manufacturing methods. In recent years, multi axis grinding machines have provided advancements of true clinical consequence, especially with regard to file flexibility and cutting ability. Given the wide diversity of available designs and features, it is impossible to discuss the design, clinical use or precautions required for every hand file on the market. Neither barbed broaches nor balanced force technique will be discussed.[1]

_Introduction: Appreciating the unseen dimension

Hand files allow the clinician to manually "feel" the unseen dimension in canal anatomy beyond what radiographs alone can illustrate. Specifically, by virtue of hand file resistance to apical advancement, the clinician can, by tactile feel, determine the curvature, calcification, length, the anatomy of the MC, and if iatrogenic events may have occurred. Only cone beam technology comes close to providing the tactile information provided by hand files (Planmeca).

Such tactile information helps determine treatment strategies prior to shaping. Astute RNT use has, as its foundation, intimate canal knowledge first by hand files. Forcing RNT files to length without adequate hand file negotiation and a glide path is the harbinger of file fracture, canal transportation and inadequate cleaning and shaping.

Fig. 2

Fig. 2_Mani K and H Files, and Mani Reamers.

_Hand file applications, differentiation and general use principles

Hand files differ based on the following (among other attributes):

1. Material of manufacture (carbon steel, stainless steel, nickel titanium, among several other less common materials).
2. Taper (0.02 tapered, variable tapered, greater tapered).
3. Initial cross sectional design before manufacture (triangular, square, rhomboid, among other initial shapes).
4. Final cross sectional design.
5. Corrosion resistance.
6. Handle design and material used for the hand file.
7. Tip sizes (of the individual instrument).
8. Progression of tip sizes across the spectrum of a given set of instruments.
9. How the cutting flutes are produced (twisting, grinding, among other manufacturing methods).
10. Tip design (active, non cutting, partially cutting).
11. Whether the file is reciprocated, watch-wound (K files), rotated (K reamers), or used with a pull stroke (H files).
12. Helix angle, rake angle, cutting angle (if different from the rake angle) number of flutes (as well as flute width, depth and number).
13. Possible variability of the cutting angle along the length of the file.
14. Linear length of the cutting flutes.
15. In addition to the attributes above, hand files are designed to be stiff versus flexible, aggressive cutting versus less aggressive, finishing files versus bulk shaping files, among other general classifications.

_Principles for maximizing hand file effectiveness

The use of hand files is based on several universal assumptions. These assumptions are:

a) Optimal visualization of the access preparation, ideally through the surgical microscope (Zeiss, Global Surgical).

b) Optimal radiographic evaluation of the tooth prior to access preparation including where necessary, cone beam visualization. For those without CBCT technology, having two or optimally three different pre-operative radiographic angles will provide the best possible visualization of canal anatomy short of a CBCT scan.

c) Straight line access.

d) Removal of the cervical dentinal triangle prior to hand file exploration.

e) Copious irrigation at every stage in the procedure, especially rinsing debris from the access preparation before hand files are inserted.

f) Pre-operative evaluation of the estimated and expected true working length, final taper and master apical diameter.

g) Curved files negotiate curved canals more effectively than straight ones. The EndoBender pliers (Axis/Sybron) are an effective instrument to place the needed curvature onto hand files. Generally, in canals that have been ledged or transported, placing an acute, 3- to 5-mm curve onto the apical portion of the hand file is beneficial. Multiple insertions of curved hand files to bypass blocked and transported canals (especially ledges) are the rule, not the exception. Alternatively, if no transportation has occurred (the canal is untouched or easily

Fig. 3_Mani Flexile Files.

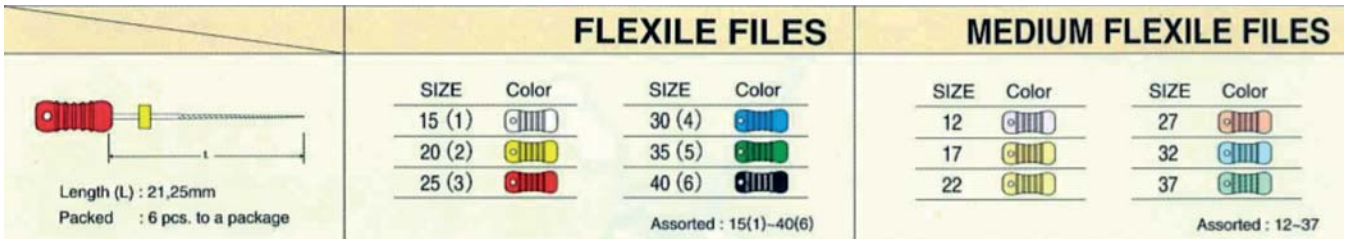

Fig. 3

Fig. 4

Fig. 4_Mani RT Files.

negotiable) the clinician can curve the file in their fingers without an EndoBender.

h) Canals should always be negotiated with hand files prior to using RNT files. Even if the clinician uses a RNT glide path creator (PathFile, DENTSPLY Tulsa or PreShapers, SpecializedEndo), the canal should be first negotiated by hand to assure patency. Clinician preference dictates whether a glide path should be created by hand files or RNT files.

i) In the view of the author, hand files are single use disposable instruments as they dull rapidly during clinical function.

j) The use of nickel titanium hand files is a matter of personal preference. While some clinicians desire the flexibility and shape memory of nickel titanium hand files, others do not. It should be noted that nickel titanium hand files are available with controlled memory, a proprietary thermo mechanical process in which nickel titanium hand files lose their shape memory yet retain their flexibility.[2-4]

k) The principles of canal preparation must be observed, irrespective of the methods utilized to achieve these principles (i.e., hand file canal enlargement and/or RNT enlargement or a combination of these methods). These principles are to:

_leave the canal in its original position (simply enlarge it as described here);

_leave the minor constriction (MC) of the apical foramen at its original position and size;

_create a tapering funnel with narrowing cross sectional diameters from orifice to apex;

_create a master apical taper that optimizes irrigation and obturation hydraulics, and yet causes no iatrogenic events (strip perforation, canal transportation unnecessary dentin removal—and does not leave the tooth at risk of long term vertical fracture).

_General classes of hand files

Files primarily designed for canal negotiation

In calcified canals, hand file stiffness is an attribute. Mani D Finder files are representative of this class and are especially useful for early negotiation of calcified canals. The D finders have a D shaped cross section. Some files utilize carbon steel in manufacture and/or possess atypical tip sizes to facilitate negotiation. Stiffness can be attributed to either the files design (Mani D Finders) or the use of carbon steel and/or a combination of carbon steel and a modified design (Pathfinder CS, Axis/SybronEndo) (Fig. 1).

K files

Generally, K files have a three or four-sided configuration with more spirals than a K reamer. Mani K Files are four-sided. Overall, K files are the most "universal" hand files covering the greatest number of clinical indications.

K files are not as flexible as hand files designed specifically for flexibility (such as the Mani Flexile files discussed below) or nickel titanium hand files. K files are used with a watch-winding hand motion and can be reciprocated (as described below). The angle between the cutting flutes and long axis of a K file is generally in the 25- to 40-degree range.[5] Lexicon K Files are an additional example of another commercially available K file (DENTSPLY Tulsa).

K Reamers

Mani K Reamers are three-sided and contain fewer spirals than K files. Smaller reamers are generally square

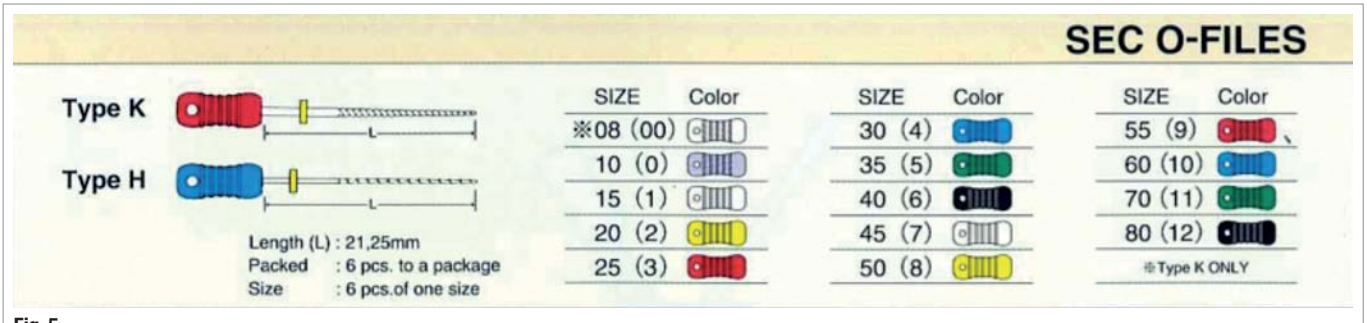

Fig. 5

Fig. 5_Mani SEC O K and H Files.

in cross section. Larger reamer sizes are generally triangular. The angle between the cutting flutes and long axis of a reamer is most often in the 10- to 30-degree range.[5]

Reamers are used in rotation, unlike K files. Hand file rotation is associated with less canal transportation than K file watch winding.

The use of K reamers versus K files is a matter of personal preference. K type instruments of both types (reamers versus K files) should be manipulated carefully when used counterclockwise due to the risk of instrument fracture. Lexicon K Reamers are an additional example of a commercially available K reamer (DENTSPLY Tulsa)—these are triangular in cross section.

H files

H files (Mani H Files as well) have conical spirals ground into them. They are used on the pull stroke for gross removal of canal contents in the coronal third and in retreatment. H files should not be rotated due to fracture risk inherent in their design. The angle between the cutting flutes and long axis of an H file is generally in the 60- to 65-degree range.[5]

It is not advisable to use H files near the MC. The MC can be transported easily if H files are used at or beyond the MC. Clinically, aside from transportation, such an action lead to significant apical bleeding (Fig. 2).

Hand files of accentuated and variable taper

Mani Flare Files are more tapered than standard hand files—0.05 taper compared to 0.02 taper. They are used to prepare tapered canals for doctors who hand file the entire preparation among other more specialized uses such as verifying taper before cone fit.

Accentuated taper is also available with nickel titanium GT Hand Files. ProFile 0.04 Hand Files are 0.04 tapered and come in a variety of tip sizes, again in nickel titanium. ProTaper Universal Hand Files feature the ProTaper variable taper design in shaping and finishing files in various lengths (all of the above are manufactured by DENTSPLY Tulsa).

Flexible Files

Mani Flexible Files are triangular in cross section. Files with a triangular cross section are more flexible

than those with square cross sections. Flexible stainless steel hand files are generally used in easily negotiated canals. Clinician preference dictates whether to use flexible stainless steel files relative to nickel titanium hand instruments (Fig. 3).

Additional files in this class are Lexicon FlexSSK Files (DENTSPLY Tulsa). These files are also available in medium sizes (12, 17, 22, etc.).

Aggressive cutting files

Mani RT files (possessing a parallelogram cross-section) and a 71-degree cutting angle, making them more aggressive relative to many of the other files included here. RT files would be used primarily by doctors who are hand filing the entire canal in conjunction with other hand files (Fig. 4).

Nickel titanium files

GT Hand Files (made of nickel titanium) are available in various tapers and tip sizes (DENTSPLY Tulsa). Lexicon FlexNTK Files are made of nickel titanium and come in various tip sizes while maintaining a constant taper. As mentioned above, clinician preference dictates whether a flexible stainless steel file is more desirable than a nickel titanium hand file.

Medium sizes, K, H and reamers

Mani provides K Files, H Files and stainless-steel reamers in medium sizes (12, 17, 22, 27, etc.). ProFile Series 29 Stainless Steel 0.02 Hand Files have a constant 29 per cent increase in tip size in 0.02 taper. Use of medium sizes avoids the dramatic increase in tip diameter with increasing tip sizes, especially between a #10 an #15 hand file (a 50 per cent increase in size of the #15 relative to the #10 hand file).

Safe-ended hand files and reciprocation

Mani SEC O files are available in an H and K file variety. Both are "safe-ended," as they do not cut on their tips. The Mani SEC O K File is ideal for reciprocation. SEC O H files (and H files in general) are not reciprocated (Figs. 5 & 6).

Reciprocation is a very safe technique, whereby the clinician can use a reciprocating hand piece attachment to replicate manual hand file watch winding. Clinically, reciprocation is used after the canal has been negotiated to the TWL and reciprocation proceeds with the first file that binds at TWL. In this article, the terms TWL and MC are synonymous. The purpose of reciprocation is to save time, reduce hand fatigue and prepare a space into which RNT files can subsequently be inserted with minimal torque stresses (prepare a glide path).

Reciprocation is inherently safe. It is difficult to fracture hand files when this technique is used appropriately. Fracture or iatrogenic misadventure generally occurs when the files are inappropriately placed (well beyond the MC), the wrong type of hand file is reciprocated (H) and/or the speed is grossly exaggerated above the recommended levels.

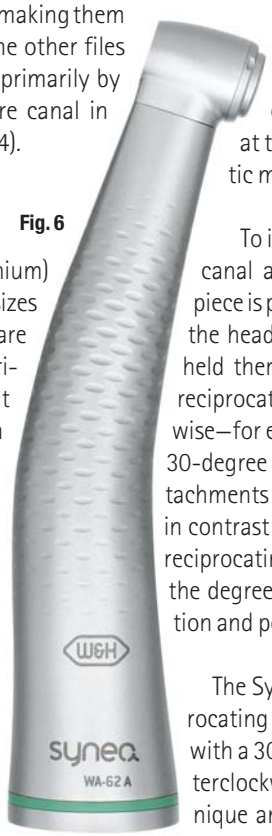

Fig. 6

Fig. 6_The Synea W&H WA-62. A reciprocating hand piece attachment.

Reciprocating hand piece attachments fit onto an E-type coupling and can be powered at 900 rpm, for example at the 18:1 setting on an electric endodontic motor.

To initiate reciprocation, the file is left in the canal at the TWL and the reciprocating hand piece is placed over the file (the file is inserted into the head of the reciprocating hand piece and is held there while reciprocating). The attachment reciprocates the file clockwise and counter clockwise—for example, with a 30-degree clockwise and 30-degree counterclockwise movement. These attachments do not rotate the file a full 360 degrees—in contrast to how RNT files are powered. Different reciprocating hand pieces may have variations on the degree of clockwise or counterclockwise rotation and possibly include a vertical amplitude.

The Synea W&H-62A is an example of a reciprocating hand piece (MounceEndo) attachment with a 30-degree clockwise and 30-degree counterclockwise motion. Reciprocation is the technique and file motion utilized in the Wave One canal preparation system (DENTSPLY Tulsa).

Clinically, using the SEC O K File as an example, the SEC O K File is placed to the TWL, the attachment placed over the file and reciprocation commences as described above. The file is reciprocated for 15 to 30 seconds, using a 1- to 3-mm vertical amplitude movement. Clinically, the file will become less tightly bound as the canal is enlarged.

If, for example, a #08 SEC O K file is the first file that binds in the canal at TWL this file is reciprocated. Once the #08 SEC O K File is reciprocated, the canal will now accept a #10 SEC O K File to TWL. The #10 SEC O K File is reciprocated. Once reciprocation is complete, the canal will allow a #15 SEC O K File to reach the TWL. Once the canal is enlarged to approximately the size of a #15 or #20 hand file, the canal is ready for RNT enlargement.

Fig. 7


Fig. 8

Fig. 7_The MounceFile Controlled Memory nickel titanium files.
Fig. 8_Clinical case treated using the reciprocating technique described and the MounceFile in Controlled Memory.

Aside from glide path creation, this technique is especially helpful in early enlargement of calcified canals, especially the MB2 canal of upper molars. Reciprocation is also valuable for rubbing out iatrogenic ledges. Once the hand file can negotiate around the ledge, it is left in place and reciprocated as suggested above.

It is not advised to place a hand file in a reciprocating handpiece attachment and try to move the file apically while powering the file. While such a motion will work some of the time, it can accentuate ledges and other canal transportations and increase the risk of file fracture.

_Integration of the glide path with early RNT shaping

If the clinician is using RNT shaping methods, the decision must be made to move either crown down, step back or possibly use a hybrid of the two strategies. While a comprehensive discussion of such RNT strategies is beyond the scope of this article, it has value to mention that judicious initial removal of restrictive dentin at the point of greatest root curvature (especially in complex cases) is essential to minimize subsequent iatrogenic events. Caution is advised. RNT fracture is a risk when the wrong taper and tip size RNT is inserted into an acute curvature (immediately after glide path creation) with unnecessary force. In essence, a strict crown down sequence may not be indicated.

Anatomically, the aforementioned greatest curvature tends to be in either the middle root third or at the junction of the middle and apical thirds. Clinically, in complex multiplanar curvatures, after glide path preparation, regardless of whether the glide path was made with reciprocation or with a nickel titanium instrument, using a relatively smaller taper and tip size RNT file (for example, a 0.02/20, 0.03/20, or 0.04/20 file such as the MounceFile CM (controlled memory) can minimize the risk of subsequent fracture that may otherwise result in moving directly to a strict crown down approach around such a curvature. Fracture risk is minimized with the removal of restrictive dentin along the curvature through use of the instruments above (Figs. 7 & 8).

Alternatively, instead of using the MounceFile, the clinician can make an equivalent enlargement through the curvature using a 0.04/25 Twisted File (Axis/Sybron) or similarly sized RNT file.

This article, written for the general dentist, has described common attributes of hand files, their clinical use, reciprocation, and integration of glide path preparation with initial shaping procedures. Emphasis has been placed on interpreting tactile feedback and avoidance of iatrogenic events. Your feedback is welcome._

Editorial note: A complete list of references is available from the publisher.

_about the author roots

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