

# Critical thinking: The missing link in endodontic education

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After years of teaching endodontic programmes around the country, I can say with strong conviction that the process of critical thinking has not been applied to the mechanics of endodontics. Not for one moment am I critical of a programme's emphasis on diagnosis, histology and pathology. The incorporation of microscopes has vastly improved dentists' abilities to seek out fine structure that can be the difference between success and failure.

perform the entire shaping procedure or to create a glide path for the subsequent use of rotary NiTi files.

If K-files had been chosen as the most appropriate instrument to use after critical analysis, we would expect these instruments at least initially to shape canals more easily than other instruments. We would expect that such problems as loss of length because of the apical impaction of debris, distortion to the outside wall, elbowing and frank perforation would be less inclined to occur because of superior design and method of usage. Yet K-files are associated with all the above problems, whereas their counterpart, K-reamers, is far less likely to produce such issues. In fact, critical thinking was not applied to the choice of instruments. Tradition, inertia and simple prejudice take the place of effective analysis.

Let's examine how critical analysis would prevent this widespread mistake that is perpetrated on our student bodies over the years. Take a look at a photograph of a K-file (Fig. 1). Please note that the shank is composed of 30 flutes along its 16mm of working length. The greater the number of flutes, the more horizontally oriented they are. Compare the 30 flutes on a K-file to the 16 that are present on the shank of a reamer (Fig. 2). Also, please note that with approximately half the flute number, each flute is significantly more vertically oriented along the length of the reamer shank. Fewer flutes lead to less engagement along length. Resistance in apical negotiation is directly related to the reduction in engagement.

A watch-winding motion is the recommended way to use both the reamers and the K-files. Yet, when a watch-winding motion is applied to the more hori-

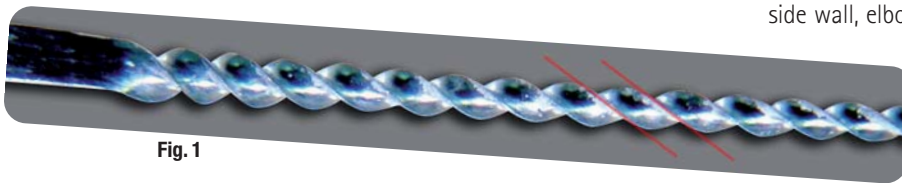


Fig. 1

Fig. 1\_Photograph of a K-file. Note the high number of flutes that are more horizontal in nature.

Where critical thinking is missing is in the selection of the design and utilisation of the instruments used to shape the canals. For the most part, K-files are the instruments recommended for the initial shaping of canals. I have never detected any evidence that the decision to use K-files resulted from an analysis of what works best. It is simply a tool that has been handed down from generation to generation either to

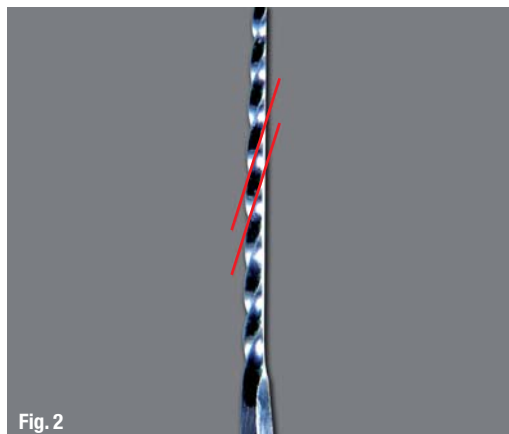


Fig. 2

Fig. 2\_Photograph of a relieved reamer. Note the flat side and the vertical flutes.

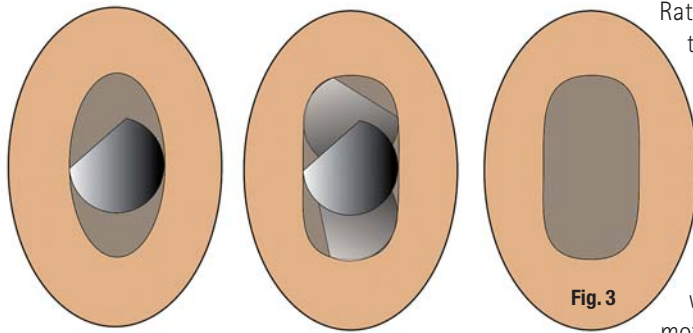


Fig. 3

Rather, he must remove the reamer from the canal, place a 45° bend at the tip and, with a light peck-and-twist motion, attempt to manually negotiate around the obstacle. On the other hand, if tug-back is present from the outset, the dentist knows to continue apical negotiation using either the recommended watch-winding motion or a twist-and-pull motion until the apex is reached.

**Fig. 3** Illustration of an asymmetrical instrument's ability to distinguish and clean an oval-shaped canal.

zontally oriented flutes of a K-file, the threads tend to embed themselves into the canal walls without shaving any of the dentine away in the process. Increasing the amount of engagement does not help in shaping the canal. Compare the action of these flutes with the more vertical orientation of the flutes on the reamer. Using the same watch-winding stroke applied to the K-files, the blades being more at right angles to the plane of motion will immediately start shaving dentine from the walls of the canal, further reducing the degree of engagement and the subsequent resistance encountered as the reamers negotiate apically.

Clinically, the dentist encounters less resistance when using reamers because there is less engagement along length, resulting from fewer flutes to begin with and their greater ability to shave dentine rather than embed into it. Embedment leads to increased resistance. Shaving dentine further reduces the smaller amount of engagement that was already present. The design and utilisation of the K-file works against the very goals it wants to attain. Reamers are designed and utilised in a way that is compatible with their goals. Critical thinking would make these basic points obvious. Controlled clinical testing of both designs would immediately demonstrate the superiority of reamers to K-files.

The comparison could easily stop at this point, and reamers would be the unquestioned winner, but there are other advantages that accrue to the user as well. With less engagement along length, a cutting blade more or less at right angles to the plane of motion that removes dentine rather than embeds into it, a more flexible instrument that is a consequence of fewer twists along the length of the shank, the reamer gives the dentist a superior tactile perception, giving him the ability to differentiate between the tip of the instrument hitting a solid wall or engaging within a tight canal. Both situations will either stop or slow down apical progress.

However, if the tip of the instrument is hitting a wall, there will be no tug-back when the reamer is withdrawn, telling the dentist that he must not attempt to proceed further.

A K-file that is already so heavily engaged along length cannot make the distinction between a solid wall and a tight canal. The resistance along length obscures what the tip of the instrument is encountering. Using a K-file, all a dentist may know is that he is short of length. Using an aggressive twist-and-pull motion, the proper length can be regained even when employing a K-file with a non-cutting tip. However, too often the dentist will discover that the original anatomy has been lost with the apical third transported to the outside wall of a curved canal. This is the effect when a solid wall or impacted debris is encountered, but not recognised as such because of the excessive engagement of the K-file along length.

The absence of critical thinking is recapitulated by maintaining the continued use of K-files. First, we abdicate the use of reamers without making any comparisons. Worse, while not learning the benefits of reamers, we also lose our evolutionary potential to improve upon a tool that in its present state is superior to K-files.

Critical thinking demonstrates that reamers are superior to K-files for several reasons, one of the main reasons being reduced engagement along length. By placing a flat along the entire working length of the reamer, we now have a reamer that has even less engagement along its working length. The result is an

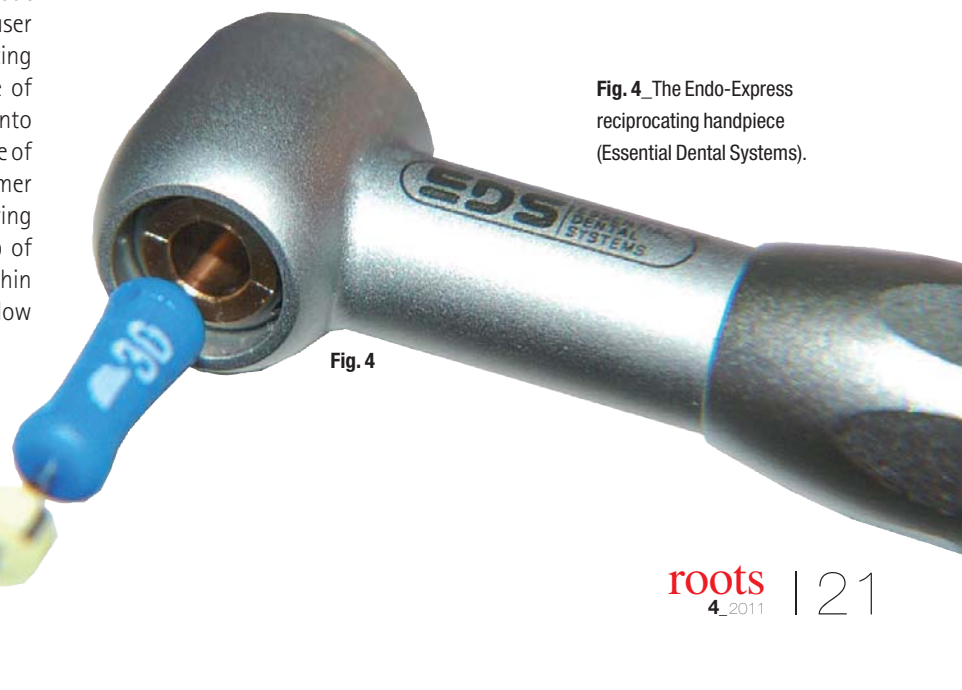


Fig. 4

**Fig. 4** The Endo-Express reciprocating handpiece (Essential Dental Systems).

**Figs. 5–7** Radiographs showing clinical results achieved with relieved reamers in a reciprocating handpiece.



**Fig. 5**



**Fig. 6**



**Fig. 7**

instrument that is even more flexible because it is thinner in cross-section, includes two vertical columns of chisels that cut equally effectively in both the clockwise and counter-clockwise direction and is asymmetrical in cross-section, giving it the ability to differentiate between a round and oval canal. No symmetric instrument can differentiate between a round and oval canal.

The ability to make this distinction tells the dentist when to widen the canals to greater dimensions for superior mechanical cleansing and better chemical debridement via the irrigants (Fig. 3).

Without critical thinking, no one knows that a reamer is superior to a K-file and without that knowledge, no one knows that a reamer can be modified to further improve its functionality. Perhaps, most importantly, without the benefit of critical thinking, those designing instruments to eliminate the shortcomings of K-files do not eliminate them. They merely reduce them, still incorporating their use in the creation of the glide path<sup>1</sup>, and then proceed to introduce rotary NiTi systems that, while overcoming the limitations of K-files, introduce significant new problems that add cost, anxiety and unpredictability to canal shaping.

In the meantime, critical thinking would clearly demonstrate that relieved reamers (Fig. 3) are not only good for glide path creation but work far more safely when used for the entire shaping procedure. Stainless-steel relieved reamers are quite effective at recording the curvatures of a canal.<sup>2</sup> Unlike NiTi, they do not snap back to the straight position, a property that increasingly distorts the apical end of curved canals as the tip size and taper of the instruments increase.

The greater stiffness of stainless steel is compensated for by the relieved reamer design, never exceeding a .02 taper and routinely straightening the coronal curve prior to the use of larger-tipped instruments. Used either in a tight watch-winding stroke or in a

30° reciprocating handpiece (Fig. 4), the tip of the instrument confined to such a short arc of motion always stays centred in the canal. As long as patency is maintained, these relieved reamers will not deviate from the original pathway. Patency<sup>3</sup> is maintained by going 0.5 mm beyond the constriction through a 25 relieved reamer, a technique that is easy to master and is completely predictable in its results.

Unless one is exposed to the critical thinking needed to open one's mind to better working alternatives, the entire cascade of learning is stopped before it starts.

Without critical thinking, one will never learn that reamers are safer, more efficient and more effective than K-files. Without learning the superiority of reamers, one will never learn that relieved reamers are superior to non-relieved reamers. If one does not use reamers, one will not be exposed to the advantages of non-distorted shaping using a 30° reciprocating handpiece. Without the exposure to a 30° reciprocating handpiece, one will never appreciate the absence of torsional stress and cyclic fatigue<sup>4</sup> that plagues rotary NiTi, leading to unpredictable separation. And, without the appreciation that instruments will simply not break, one will not confidently shape canals to the larger dimensions that are often required to ensure proper debridement and irrigation. Examples of cases done with relieved reamers in a reciprocating handpiece are shown in Figures 5–7.

We have been indoctrinating our students for too long. It is about time that we educate them. Critical thinking is the way for students to make rational decisions. They will become better dentists and serve the needs of their patients better when these skills are honed. There may be those out there who dispute the conclusions that critical thinking will produce, but I defy anyone who says this is not the proper way to educate.

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

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