Tactile perception in endodontics

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_When it comes to tactile perception, most dentists doing root canal therapy would agree—more is better. But, what exactly do we mean when we talk about tactile perception? To me, tactile perception is a measure of the degree to which we can determine what the tip of the negotiating endodontic instrument is encountering. Is it encountering an impediment like a solid wall or is it lodged in a tight canal? Or is the canal that the tip of the instrument is entering round or oval?

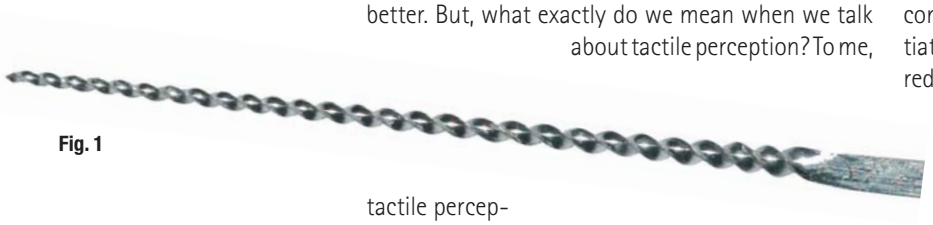

Fig. 1

Superior tactile perception is a direct result of the instrument's design and the way it is used. Assuming that tactile perception is exactly as I define it, a reasonable analytic task is to determine what endodontic instrument designs and techniques of use enhance tactile perception. One basic insight is that the information conveyed from the tip of the instrument will become increasingly clear as the engagement along length is reduced. If there is a great deal of engagement along length, exactly what the tip of the instrument is encountering becomes murky.

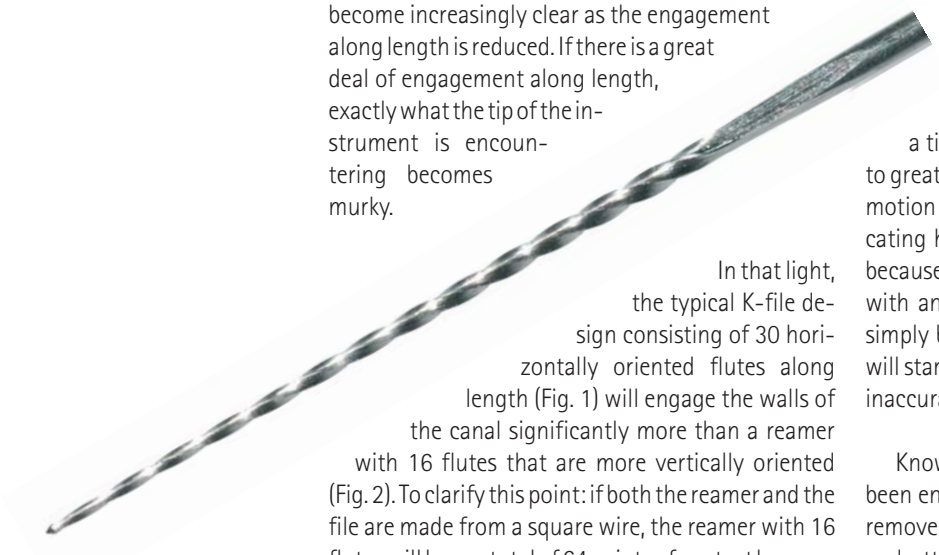

Fig. 2

In that light, the typical K-file design consisting of 30 horizontally oriented flutes along length (Fig. 1) will engage the walls of the canal significantly more than a reamer with 16 flutes that are more vertically oriented (Fig. 2). To clarify this point: if both the reamer and the file are made from a square wire, the reamer with 16 flutes will have a total of 64 points of contact because each flute alone has 4 contact points (fabricated from a twisted square wire), while the file with 30 flutes will have a 120 contact points. The greater the number of contact points, the greater the engagement and the consequent increase in resistance to apical negotiation. In short, increasing resistance along length reduces the tactile perception of what the tip of the instrument is engaging. An increase in the number of flutes increases engagement and reduces tactile perception, while the more horizontal orientation of the flutes engages the dentine rather than cutting it when used with the recommended watch-winding motion. The file design is similar to that of a screw and tactile perception at the tip is secondary to engagement along length. While the goal of a screw is engagement, that is not the goal of an endodontic shaping instrument and the more horizontally oriented flutes along the length of a file are counterproductive to the goals the dentist wishes to achieve.

Ideal tactile perception tells the dentist when a solid wall has been encountered. The dentist differentiates this type of engagement from being in a tight canal by the degree of tug-back present when he/she pulls the instrument back. No immediate tug-back means the dentist is encountering a solid wall. Immediate tug-back means the dentist is most likely in a tight canal that will allow him/her to progress to greater depths either using a tight watch-winding motion or via the instrument's use in the 30° reciprocating handpiece. I emphasise the word *immediate* because a solid wall continuously being pecked at with an instrument will start to produce tug-back simply because the repeated pecks into a solid wall will start to establish its own man-made pathway, an inaccuracy a dentist wants to avoid from the start.

Knowing that a solid wall, as an impediment, has been encountered tells the dentist that he/she must remove the instrument, place a small bend at the tip and attempt to negotiate around the impediment manually. Once around, the dentist leaves the instrument at the newly negotiated depth and reattaches it

to the reciprocating handpiece for what is generally a smooth and rapid negotiation to the apex. As is clear, fewer more vertically oriented flutes increase tactile perception. Fewer flutes also make the instrument less work-hardened, which in turn makes the instrument more flexible, another feature that enhances tactile perception.

Placing a flat along the entire working length further improves tactile perception by further reducing engagement along length, while making the instrument even more flexible. Those 64 contact points are now reduced to 48 (Fig. 3). A cutting tip is an additional feature that can be added to improve tactile perception. Unlike a non-cutting tip that has the potential to impact pulp tissue, a cutting tip tends to pierce it. There is no concern about a cutting tip creating its own pathway because the degree of motion is limited to either a tight watch-winding stroke or the 30° arc generated by the reciprocating handpiece.

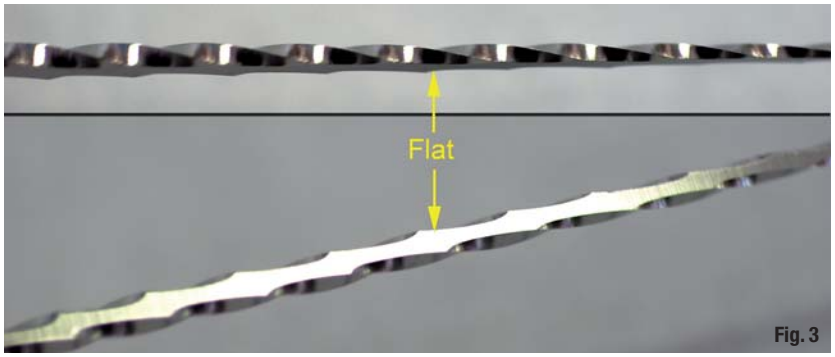

Fig. 3

If a system of instruments with these design features is used according to the prescribed method for the entire shaping procedure, tactile perception will not be compromised at any point during the instrumentation procedure. Compare this approach to the use of K-files and the subsequent use of rotary NiTi files. The K-files are poorly designed to enhance tactile perception because they engage excessive amounts of tooth structure along length. Their horizontally oriented flutes are designed to engage, not cut, and the great number of flutes resulting from twisting the wire more times produces a stiffer instrument incompatible with superior tactile perception. Rotary NiTi is now used in a crown-down fashion, where the goal is to determine when excessive resistance is encountered along length, not at the tip. In fact, the tips of these rotary NiTi instruments do not engage apically until the shaping procedure is almost completed and then rarely exceed a diameter of apical preparation beyond what was established by the K-files. When rotary NiTi files prepare apical preparations beyond the dimensions produced with K-files in curved roots, the likelihood of separation due to excessive torsional stress and cyclic fatigue increases.

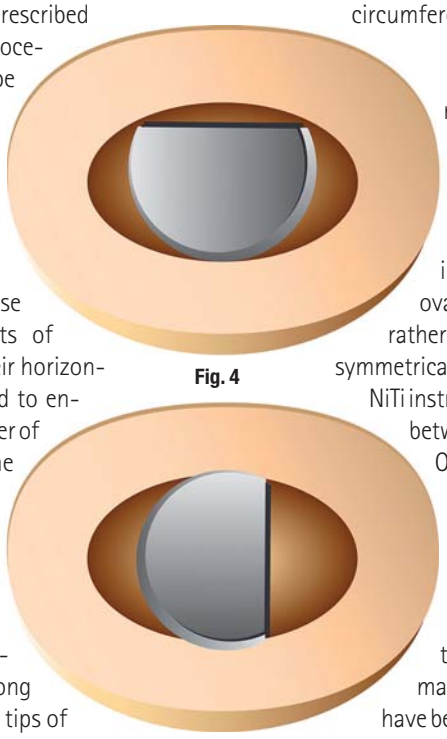
Fig. 4

Relieved reamers not only supply more accurate information regarding differentiating a solid impediment from a tight canal, but can also differentiate between a round and oval canal. Some advocates of rotary NiTi have gone to great lengths to explain the extent to which the apical end of a canal should be prepared, using such terms as *tuning* and *gauging*, where the apical preparation is determined by the presence of clean dentine filings on the flutes of the rotary instruments. Tuning is to first see filings. Gauging is to take the diameter up to the point where the filings are clean. If clean filings are present, rotary NiTi advocates take this as clear evidence that the canals have been shaped adequately to assure clean walls circumferentially.

However, two factors make me hesitate in accepting 'tuning' and 'gauging' as effective and predictable procedures. First, the literature clearly demonstrates a high incidence of canals that are oval in their apical anatomy rather than round.[1-3] Second, a symmetrical instrument, like all rotary NiTi instruments, cannot differentiate between a round and oval canal. Only an asymmetrical instrument, one with a flat along its length can make that determination (Fig. 4). When a symmetrical instrument produces dentinal filings at the tip of the instrument, it may only mean that the filings have been removed from the smaller diameter of an oval canal, producing no information about the wider diameter of the oval canal. The literature has reported that the wider portion of an oval canal may be three to five times that of the smaller diameter.[3] Those using rotary NiTi instruments will not know this and will not have taken appropriate steps to adapt to this situation.

Given the increased vulnerability of rotary NiTi files to breakage as the tip size and taper of the instruments increase, it is comforting to consider small preparations as adequate for cleansing and irrigational purposes, even though there is much evidence to counter


Fig. 5


Fig. 6

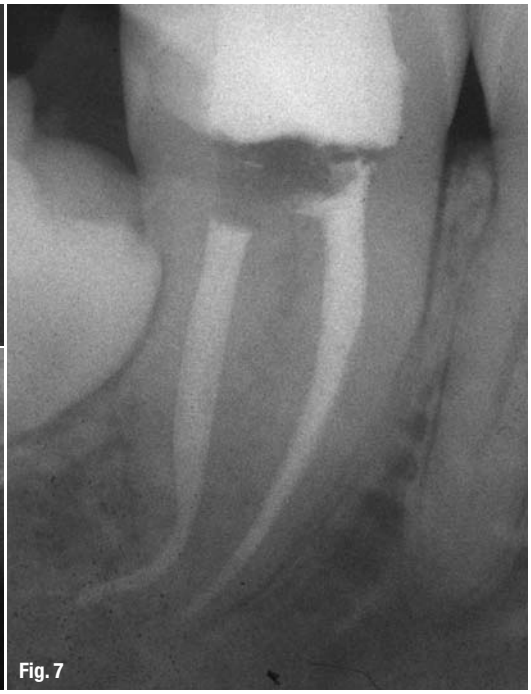
Fig. 7

these perceptions. From a practical point of view, the smallest apical preparation that allows for effective irrigation is a size 30, with a size 35 apical preparation strongly recommended. There are a number of articles that closely correlate the degree of apical preparation with reduced bacterial count; reduced bacterial count is closely associated with higher success rates.[4,5]

From the above discussion, it is evident that superior tactile perception offers the dentist the tools to differentiate between encountering a solid impediment and negotiating a tight canal. The former situation produces no immediate tug-back on the instrument, while the latter does. No tug-back indicates that the dentist should remove the instrument from the canal immediately, pre-bend it at the tip and seek to negotiate around the present impediment manually. This differentiation is essential to avoid deviating from the correct canal path by the dentist making his/her own canal in error. The cutting tip of relieved reamers confined to a tight manual watch-winding motion or the 30° reciprocating handpiece easily negotiates to the constriction and then 0.5 mm beyond to assure patency throughout the shaping procedure, which in turn keeps the instruments centred, minimising the chances of canal transportation.[6] By instrumenting 0.5 mm beyond the constriction using a size 25, the canals can be predictably opened to the constriction to a minimum of size 35, size 40 1 mm back, and then overlayed with a size 25/06 taper without distortion, assuring a space that is sufficiently large to be well irrigated with NaOCl, digesting chemically any organic debris that may have been missed mechanically. Non-distortion is a result of the modified balanced force that is generated when a tight watch-winding motion is employed. In the same way, the 30° reciprocating handpiece mimics this tried-and-proven manual motion in keeping the tips of the instruments well centred while negotiating curved canals.

Rotary NiTi files use a motion that can never provide new information about what is occurring at the tip of the instrument. When using rotary NiTi, any information on the apical anatomy of a canal is first attained by employing K-files, instruments that are designed and used in ways that—as this discussion has attempted to address—are incompatible with shaping the canals without distortion and assessing their apical anatomy accurately, at times erroneously giving the dentist the impression that the canals are narrower than they may be.

Relieved reamers are used in a way that assures long life, virtually eliminating separation and giving the dentist more accurate information to determine the width to which the canals should be shaped, with the flexibility to be used both manually and in the reciprocating handpiece. Their use in this manner is supported by a growing body of research that clearly demonstrates that superior results are attainable, while reducing costs per use by 90% compared to rotary NiTi. It is thus no surprise that this alternative approach is garnering increasingly more enthusiastic attention. Clinical examples are shown in Figures 5 to 7.

For more information regarding this highly effective and safe approach, please contact me at my free online forum www.endomailmessageboard.com._

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

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