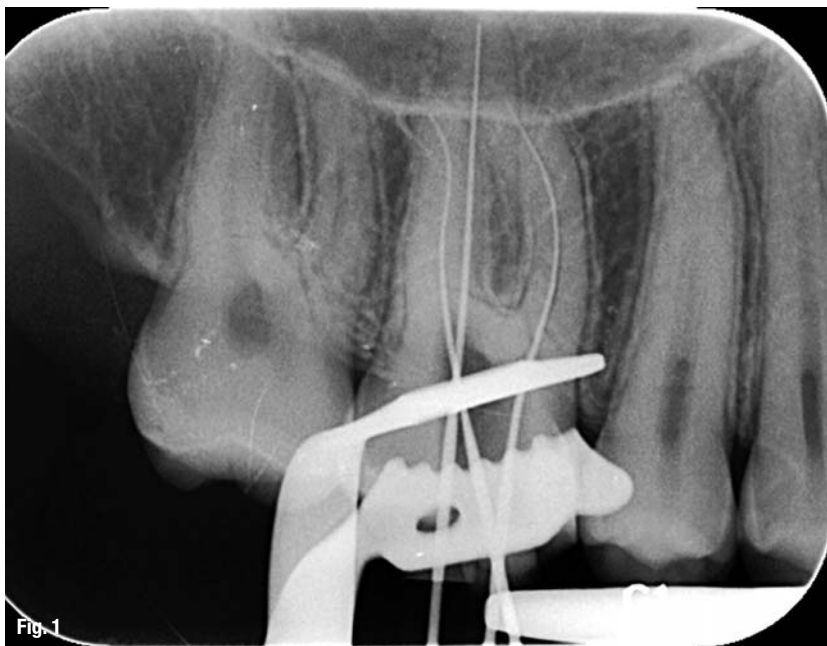


# The X-Files: four case reports

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**Fig. 1** \_Maxillary molar with files in each root to lengths determined by Root ZX (J. Morita); note the curvatures in the MB and DB canals, as well as the lengths in the palatal and DB canals that are short of the radiographic root apices but at the termini of those canals.

\_In his book *Innovation and Entrepreneurship*, business guru Peter Drucker stated that a new technology is not widely taken up by users unless it provides a 10x improvement over their current methods of work. This is certainly true in dentistry. Incorporating a new concept, technique, or instrument into a fully scheduled day is a huge stressor. It also entails significant training costs for the dentist and staff, as well as high costs for the new inventory needed. Because of this, the most financially successful dentists watch carefully for the point in time at which the benefits of the new technology outstrip the costs of taking it on. Only early adopters, who are driven by wanting to be on the cutting edge of technology, will jump in sooner.

When the 10x factor of improved results becomes a reality, clinicians who recognise these advantages can accomplish the treatment in less time, with fewer steps and greater confidence in

the outcome. The new GTX Rotary File with M-Wire metallurgy satisfies these requirements. This new file has the attributes of much greater resistance to cyclic fatigue failure—the major cause of instrument separation. In addition, fewer files and procedural steps are needed to create ideal shapes in root canals. As an improvement to the GT File series, the GTX Files have landed cutting blades for prevention of transportation, although the radial lands have been optimised. This has been accomplished by varying the land widths along the file length to increase cutting efficiency without losing their resistance to straightening curved canal paths. Furthermore, the blade angles have been opened up (fewer twists), which not only increases cutting speeds, but also increases their flexibilities and the size of their chip spaces between the flutes.

All of these changes in efficiency were accomplished without forsaking one of the unique features of the GT File series: the 1 mm maximum flute diameter (MFD) limitation, which prevents over-enlargement of the coronal region of the root canal. This is a key factor in reducing the loss of structural integrity of the tooth after endodontic treatment. So, with the pre-existing safety features of landed cutting blades and limited MFDs, and the newly enhanced safety of R-Phase NiTi metallurgy, the only thing that could be better would be to reduce the number of files and procedural steps needed to accomplish shaping procedures in canals.

This article is intended to describe how these files are able to cut the shapes that are needed in most root canals, using one or two instruments with four to five procedural steps. I will detail the shaping procedures used in molars with moderate-to-severe canal curvatures by me and two of my esteemed endodontic colleagues.

## Case 1: Maxillary molar treatment

This case was treated as a live demonstration at the California Dental Association meeting in Anaheim in USA on 3 May 2008. Figure 1 is a radiograph showing the final negotiating files in each canal. I do not consider this a means of length determination because they are not as accurate as my J. Morita apex locator for this purpose. This image was taken to demonstrate for my audience the curvatures of the different canals in this tooth. The mesio-buccal (MB) and disto-buccal (DB) canals have obvious, significant curvatures. The palatal canal appears to be straight in this X-ray angle but could be curved in the buccal or lingual planes, a possibility that will be discovered during the shaping of the canal. This image shows the negotiating prerequisite to shaping with GTX Files: a #15 K-file (or larger) to the terminus of all canals.

The shaping objective for GTX File use has been changed (streamlined) from that suggested for GT File shaping. Notably, the small-canal shaping objective is now limited to a .06 shape and the shaping objective for medium-large canals is typically limited to a .08 shape. This is with the understanding that some medium and large canals may occasionally need a .10 or even a .12 shape, if their apical canal form is large. So, the MB and DB canals will be shaped to a .06 taper and the palatal canal to a .08 taper, with the final apical diameters to be determined by apical gauging procedures followed after the initial shape has been cut.

This tooth had two MB canals that were apically confluent. GTX File shaping is achieved in the presence of 6 % NaOCl, and the shaping routine in small canals is always begun with the 20/.06 GTX File used at 300 rpm with a torque limit of around 250 gm/cm. The 20/.06 GTX File is spun up and introduced into the canal with a light but steady apical movement. This is where the biggest difference between GT File and GTX File function becomes apparent. The GT Files (with their smaller chip space) typically cut for about four to six seconds before stalling in their apical progress, owing to the cut debris filling the chip spaces; whereas the GTX Files (having twice the chip space) will cut for ten to twelve seconds before stalling. I usually let the file continue its apical progress without any interruption. However, many of my colleagues cut with the file for three to four seconds, withdraw by 0.5 mm, and then continue further apical progress until the file stalls.



Fig. 2

The main issue is that landed blade files do not cut effectively when used with an in-and-out pecking motion; they require the blades to be set against the canal walls for cutting to occur. While this is sometimes perceived as a less effective cutting event than the bite of non-landed blades, the time to completion of shape belies that perception. Obviously, when the GTX File finally stalls, it is retrieved, the blades are cleaned with alcohol gauze, and then the file is re-introduced for further cutting. When the same GTX File starts to stall again, it is time to drop down in size to a 20/.04 GTX File so that initial shaping in small canals can continue safely. In this case, the 20/.06 GTX File cut all the way to length in the MB1 and MB2 canals in two or three cutting cycles, but in the DB canal a 20/.04 GTX File was needed to achieve length. This is typical in maxillary molars.

**Fig. 2** Post-op radiograph showing conservative coronal shapes, apically accurate fills, and an ideally cut access cavity with the mesial and distal access walls parallel to the mesial surface of the tooth.

One of the new technique strategies taught for GTX File use is visual gauging at the end of initial shaping, looking at the first 20 Series GTX File that cuts to length to determine whether there is dentine debris in the tip flutes. When the first GTX File to length has debris packing the last flute space, there is a good chance that the terminus is no larger than the tip diameter of that file. When that file is devoid of chips at its tip, it is most likely that the terminal diameter of the canal is larger.

This is a time saver, as it eliminates the need to introduce NiTi K-files (tactile gauging) to determine whether a larger apical size will be needed to create apical continuity of taper—confirmation that the taper in the preparation extends all the way to the apical terminus.



Fig. 3

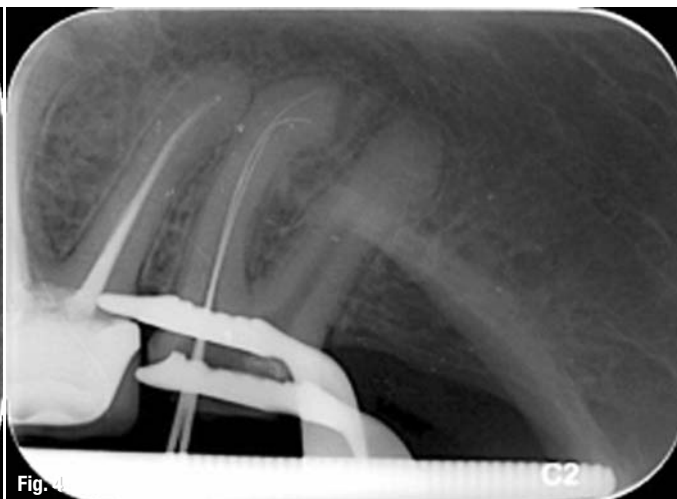


Fig. 4

**Fig. 3\_** Mandibular molar with failing endodontic therapy due to apically inadequate treatment in all canals.

**Fig. 4\_** Negotiation files in mesial canals after removal of filling material and advancement through apical blockage; note the severe curvatures.

**Fig. 5\_** Post-op radiograph showing apical confluence of mesial canal shapes and the second apical portal of exit branching off the point of confluence; note the apical ledge at the curvature in the distal canal, bypassed with bent stainless-steel K-files and finished with a pre-bent GTX Rotary File.

Apical continuity of the taper is what gives us the greatest chance of having apical accuracy when we fill the canal, so this is a critical element of the GT and GTX File technique. Visual gauging allows a quick decision to be made on the likely final shape, and in this clinical case the 20/.06 GTX File had no tip debris after reaching the terminus of the MB1 and MB2 canals, indicating that a 30/.06 GTX File should then be used. In the DB canal, the first file to length (the 20/.04 size) showed tip flutes packed with debris, indicating that a 20 Series GTX File would probably suffice to complete the shape in that canal. And in fact, when the 20/.06 file was cut to length and tactile gauging was achieved, this proved to be the case.

This technique shows the clinician which tip size of a .02 tapered K-file binds at length, indirectly revealing the apical diameter of the

canal. Tactile gauging is achieved with NiTi K-files to increase the accuracy of the test because the more rigid stainless-steel K-files can cause misreadings of apical diameters. Tactile gauging is achieved in the presence of 17 % aqueous EDTA, so that the smear layer is removed at the same time that shaping is completed (in visual gauging dentists will still place EDTA in the canal for a minute to remove the smear layer before reintroducing NaOCl), and it is absolutely critical that the NiTi gauging files are used with a straight-in, straight-out motion—not even a wiggle can occur or the apical constricture will be cut open and further shaping will be required to recreate apical continuity of taper.

Shaping of the palatal canal (a medium-size canal) was begun with a 30/.08 GTX File and it easily cut to length, showing no chips at the tip of the file. A 40/.08 GTX File was then cut to length with visual gauging, indicating that shape might then be complete—a fact that was confirmed by tactile gauging. Each canal was shaped with just two GTX Files, and the post-operative radiograph shows very conservative coronal shapes and excellent apical accuracy in the obturation (Fig. 2).

### **Case 2: Mandibular molar re-treatment**

Figure 3 shows a previously treated tooth that was sensitive to percussion and biting pressure. It had an overt apical lesion on the mesial root apex due to the inadequacy of apical treatment. After removal of the gutta-percha, lubricant and small K-files were used to bypass the apical blockage in the mesial canals (Fig. 4) and the ledge in the distal canal. The mesial canals had separate apical openings that were each negotiated. However, they were also confluent

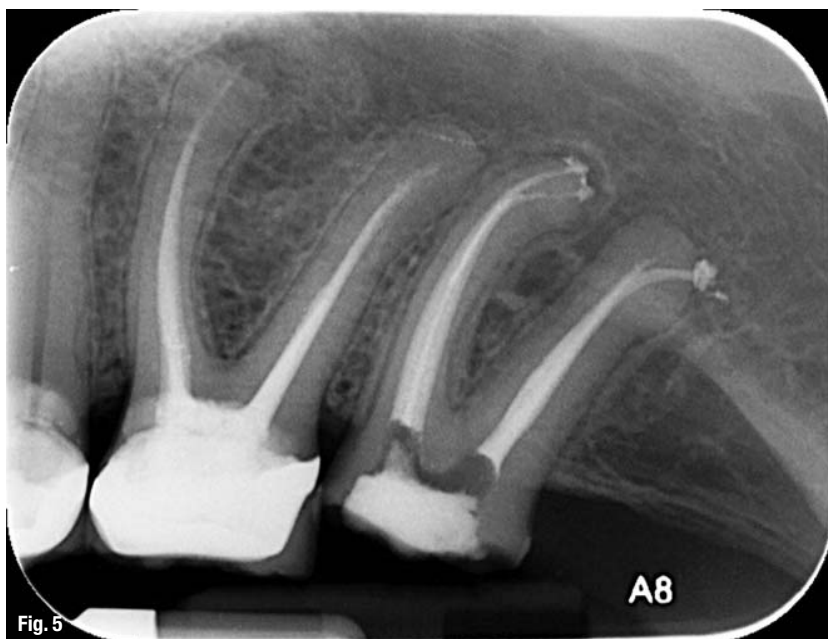


Fig. 5

and my shaping files working through those canals cut into a common terminal opening. The second apical portal of exit in the root was kept patent with a #15 K-file, the gutta-percha points were fitted into the confluence, and the second opening was filled during the Continuous Wave of Condensation Downpack. The canals were initially shaped with a single 20/.06 in three cutting cycles, followed by a 30/.06 GTX File to finish as the 20/.06 had no tip flute debris upon reaching length.

The distal canal was more difficult because it had a sharply bent canal with a ledge at the apex of the curve (created by the previous dentist who treated the patient). Pre-bent, stainless-steel K-files were used to bypass the ledge impediment and a series of files (sizes 15 to 30) were used in a light serial step-back technique to rough out the apical shape. I had used this technique to cut tapered-preparation shapes in root canals for about ten years, and although it was the only method we had prior to variably tapered NiTi shaping instruments, it was slow and tedious, and created less-than-perfect tapers in canals. So in this case, although it was necessary to cut an initial shape with this method, I wanted an apical taper that would improve the apical accuracy of obturation in the canal.

The technique taught to me by Dr David Rosenberg, (a dear friend) who tragically passed away earlier this year and will always be an inspiration, in these situations is to pre-bend the NiTi shaping files with Endo-Bender pliers. While NiTi (even with its shape memory) is commonly thought to be impervious to bending, it actually requires greater flexure—about a 180 degree bend—to achieve a residual bend of approximately 30 to 45 degrees. This can be done to GT Hand Files or to GTX Rotary Files (I prefer using

handpiece-driven files for this procedure). After a 30/.08 GTX File was bent and the directional indicator on the stop was aligned with the bend, I tapped the foot pedal until the bend on the file in the handpiece was in a distal direction, dropped it past the ledge impediment, and depressed the foot pedal. The file quickly cut to length and the canal was tactilely gauged at a 30 K-file size.

However, the ledge was so large that it was virtually impossible to fit a gutta-percha cone beyond it, so this canal was filled with a GTX Obturator. These filling devices always move the sealer and gutta-percha ahead of the carrier. So, in this case I filled beyond the impediment by inserting the obturator to the ledge point in four seconds, thereby accelerating the apical movement of filling material ahead of the carrier by 3 to 4 mm. This was instead of the usual six- to eight-second insertion time, described in my typical GTX Obturator technique, necessary to limit the filling material to only end up 1 mm ahead of the carrier—which is obviously the goal when the carrier can be placed to a length 1 mm short of the terminus.

This case was shaped with just two GTX Files in the reasonable curvature of the mesial canals. However, as is typical with difficult canals, the distal canal required four K-files and a single GTX File (Fig. 5).

### **\_Cases 3 and 4**

The two cases shown in Figures 6 and 7 were treated by my good friend Dr Giuseppe Cantatore. As is typical of his GTX technique for virtually all canals, he negotiated each canal up to a K-file size 20, cut a 20/.06 GTX File to length, then cut a 30/.04 GTX File to length, and finished with a 30/.06 GTX File. Dr Cantatore is known for

**Figs. 6 & 7** \_Maxillary molars with S-shaped curves in the DB canals; note the MB root structure in Figure 6 with its narrow width and remarkable curvature. No anti-curvature brushing motion was needed because of the GTX File lands and their limited MFDs. These cases were filled with carrier-based obturation. (Courtesy of Dr Giuseppe Cantatore)



OOL



**Fig. 8** A mandibular molar shaped with two GTX Files in the mesial canals and a single 30/.08 GTX File in the distal canal; note the excellent 3-D cleaning and filling of lateral canals.

(Courtesy of Dr David Rosenberg)

**Fig. 9** Maxillary molar with severe curvature in all four canals; note the conservative coronal shapes, the excellent apical control, and the multiple lateral canals cleaned and filled. This is an excellent clinical result requiring only two GTX Files per canal.

(Courtesy of Dr David Rosenberg)

his very conservative coronal shapes through which he uses carrier-based obturation to fill with excellent apical results.

The final two cases (Figs. 8 & 9) were treated by Dr Rosenberg. In his case notes, he stressed that he spent much time creating ideal access cavity preparations prior to instrumentation, with special emphasis on creating straight-line glide paths for files, so that they do not accumulate cyclic fatigue stresses in the coronal third. He assured me that he no longer uses Gates–Glidden Burs for his approach and instead uses ultrasonic tips and an LAX diamond bur (SybronEndo), where it fits without over-enlargement of orifices.

Dr Rosenberg also instruments to a #20 K-file size in small canals before cutting GTX Files to length (more handwork than I do), but as a result he usually gets the 20/.06 GTX File to length without using a 20/.04 GTX File. If he has difficulty working a #20 K-file to length in a tightly curved canal, he cuts to shape in the coronal third with a 20/.06 GTX File and then with the

#20 cuts to length with less effort. Occasionally, he will use a 20/.04 GTX File when a 20/.06 GTX File resists placement. In medium or large canals, he works progressively larger K-files to length until the first one binds at length (usually a #30 or #40), and then cuts to shape with a 30/.08 or 40/.08, respectively.

Like me, both of these clinicians use rotary files only in a single tooth before they are discarded. We know that the cost of tracking previous file use, or worse a file separation, is never worth the cost of a new file being brought into the case.

## Conclusion

What is seen in all of these cases instrumented using just one to three GTX Files per canal is ideal apical management, both in terms of fidelity to the original canal path and in terms of apical accuracy and three-dimensionality of obturation. We see shapes that are confluent with the original curvature of the canals with teeth with their structural integrity intact after endodontic therapy for the best chance of an excellent long-term prognosis.

In my opinion, the shaping results with GTX Files shown here are a 10x improvement over shaping file systems requiring four to six instruments, twice the number of procedural steps, laborious anti-curvature brushing motions to make up for large MFD sizing, and less than predictable avoidance of transportation. The state-of-the-art endodontic shaping is now a two-file reality, allowing more time for things like negotiating all canals to their termini and effective irrigation.

*This article is dedicated to the memory of Dr David Rosenberg, a friend, colleague, devoted husband and loving father.*

## \_about the author

roots



**Dr L. Stephen Buchanan** is a Diplomate of the American Board of Endodontics and a Fellow of both the International College of Dentists and American College of Dentists. Clinicians interested in his DVD series, *The Art of Endodontics*, and his hands-on laboratory workshops in Santa Barbara, USA, can call +1 800 528 1590.

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