CLINICAL ARTICLE

The standardized-taper root canal preparation – Part 6. GT file technique in abruptly curved canals

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Abstract

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Aim To describe the application of GT files in roots with abrupt curvatures.

Summary Most dentists interpret obstructions to instrument progress as calcification, rather than abrupt curvature. Basically, there are not any apically calcified canals, only clinicians who are not clever enough or patient enough to sneak to patency. Dentists should be on their guard and sensitive to the 'rubber band' sensation of residual pulp tissue, and the 'loose resistance' sensation of the curved or ledged canal. Residual pulp tissue should be removed and the canal lubricated. The ledged or curved canal will only be helped by file bending. The size 10 file test is the key to identify canals requiring pre-bent instruments.

The canal should first be flared short of the obstruction, before shaping the canal after it with regular, pre-bent K-files. Pre-bent GT hand-files can then be used with care to blend the apical and more coronal regions for final shape. Cone-fit may then require chilling and pre-bending GP cones (pre-bend more than one), before packing the canal.

Key learning points

- Root canals do not calcify apically.
- File progress is prevented by pulp tissue, abrupt curvatures or ledging.
- Loose resistance to the passage of a size 10 file shows the canals that require instrument pre-bending. This test should be repeated at intervals during the preparation.
- Even NiTi GT files can be pre-bent for use in abrupt curves.
- Gutta percha cones can be pre-bent after chilling.

Keywords: curved canals, GT files, root canal preparation.

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Introduction

I was teaching one of our Fast-Track courses in a dental school clinical skills laboratory, when I met a young endodontist. We talked about this and that whilst he negotiated his

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first root canal of the course, a maxillary canine about 29 mm long. After about two minutes of effort, he interrupted the flow of our conversation to say,

'But just between you and me, don't you find a lot of canals just can't be negotiated to patency? Like this one, don't you think a lot of them are calcified?'

I dread this question because the answer sounds so arrogant. I said,

'Actually, no. Could I have a look at that tooth?'

Moving the #15 file in the canal revealed a tactile sense of *loose resistance to apical file placement*. Huh. A curved or ledged canal.

I retrieved the file, used an Analytic Endobender Plier (Analytic Endodontics, Orange, CA, USA) to smoothly bend the last 2 mm of the file, adjusted the tear-dropped stop to point at the file bend, and headed back in. Watch-winding the file apically caused the file tip to meet the impediment in the first three directions I explored. I pulled the file out, rebent its tip, and got patent in the next vector I tried.

Throughout the history of clinical endodontics, abruptly curved canals have been misunderstood, usually being described as *apically calcified* canals. This is surprising, keeping in mind that throughout this same history, from the 1930s and earlier, histologists have declared in no uncertain terms that canals are not calcified apically. This also reflects my clinical experience in over 20 years of practice. Basically, there are not any apically calcified canals, only clinicians who are not clever enough or patient enough to sneak to patency.

Touchy feely stuff

The big tip-off is the attendant tactile sensation. Clinicians must be on guard for two common, but very problematic tactile sensations: the 'rubber band', and 'loose resistance to apical file placement' (Buchanan 1991).

The rubber band sensation means there are still pulpal remnants in the canal. Warning! You are within seconds of blocking the canal if there is no lubricant on the file. If this is the case, remove the file, *fill the access cavity with a lubricating solution*, and re-enter with a smaller file. If a #15 file moves to patency but the rubber band is still felt, bend a broach (purple or white for small roots, red or black for large roots) and spin it through the canal.

Loose resistance to apical file placement is a whole different matter. It could be caused by pulp tissue blockage, very common in retreat cases, but this sensation is more likely due to an impediment in the canal or canal wall. Non-blockage impediments come in two versions: the natural and the unnatural impediments. Natural impediments are the abruptly curved canal, the most common, and the relatively unusual lateral canal on the outside of a canal curvature. Unnatural impediments are iatrogenic dings and ledgeforms. Often, mishandled natural impediments become unnatural impediments.

Again, the tip-off that there is an impediment is that a file moving through the canal stops without a catch or a bind on its way out, it is loose in the canal. Tight resistance to apical file placement means the file is binding the canal walls laterally, and a smaller file will usually advance further into the canal. *Loose resistance to apical file placement* usually means that the file tip is engaging an irregular wall in a curved canal, and nothing but file bending will help.

Beyond the challenges of negotiating these tortuous passageways, is the question of whether to use rotary shaping instruments. The answer is yes, but only coronal to the impediment. The following is the logical progression of tests and procedural subroutines needed for creating predefined shapes in these canal forms with GT files, both rotary as well as hand versions (Figs 1 and 2).

Figure 1 Rotary GT files in the standard series.

Figure 2 Hand GT files in the standard series.

Figure 3 A #10 K-file meeting loose resistance to apical file placement, indicating the presence of an impediment.

Figure 4 The stop is shortened to this length, indicating the distance to the impediment.

The #10 file test

The #10 file test is a simple but effective way to identify canal forms too curved or irregular to shape without bent files. A common outcome in cases where initial negotiation files must be bent to reach patency is that after a pre-bent #15 file is worked to length, files do not need to be pre-bent thereafter. In other words, after pre-bent #08, 10, and 15 K-files are worked to length, the irregular canal path has been smoothed such that an unbent #10 K-file can now traverse the canal to its terminus.

Unfortunately, most of the time, when initial negotiation files must be pre-bent, shaping files must also be pre-bent. The test, again, is the #10 file test. Whenever a canal fails the #10 file test, files must be pre-bent to advance the shape. After each shaping subroutine, the #10 file test can be tried again. Be optimistic, coronal-to-apical shaping increases the odds of passing the #10 file test, but accept bad news gracefully.

When the #10 file meets loose resistance to apical file placement, just shorten the stop to the reference point (Figs 3 and 4), and do crown-down shaping with rotary files short of that depth. Do the #10 file test again. Sometimes just smoothing the approach allows the #10 file to translate the curvature. Often it does not.

Figure 5 A rotary 0.10 GT file, measured short of the impediment length, starts the crown-down shaping procedure.

Figure 6 A rotary 0.08 GT file continues the crown-down development of shape after the 0.10 stalls out.

Figure 7 A rotary 0.06 GT file extends the shape just short of the impediment.

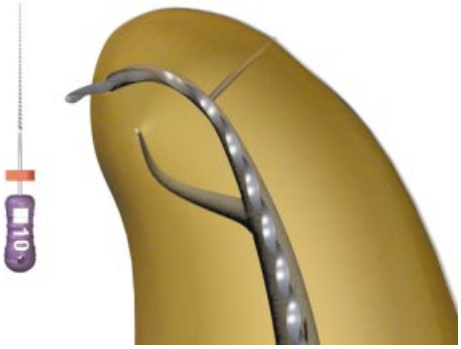

Figure 8 A #10 K-file test is applied. In some cases early crown-down shaping allows a pass on this test.

Crown-down shape

Set the stops at least 0.5 mm short of the impediment and cut shape to that point (Figs 5–7). This will take between one and three rotary GT files in the standard series. Start with the 0.10 GT file and drop in taper size as necessary to drop the shape near the impediment. Once this initial enlargement is completed the #10 file test should be attempted again (Fig. 8).

Figure 9 Recapitulation with the 0.08 GT file advances the shape.

Figure 10 In a case that passes the #10 file test after initial crown-down enlargement, an 0.06 GT or 0.04 Profile can be taken to length completing the shape.

Figure 11 Most often in cases that evidence early loose resistance to apical file placement, initial crown-down shaping will not achieve a pass of the #10 file test, as the file still engages the same apical impediment.

Figure 12 A pre-bent #20 K-file starts the apical shaping beyond the impediment, used with watch-wind-pull motions (no quarter-turn-pull).

If it passes, just finish the crown-down shape to the terminus (Figs 9 and 10). If it fails (Fig. 11), pull out your stainless steel K-files and Endobender pliers.

Apical stepback with hand K-files

Pre-bend K-file sizes #20–35 after measuring them to full length. Use these in a watch-wind-pull motion, in series from small to large. After two or three recapitulations through this series of files, they should fit within 0.5–0.25 mm increments (Figs 12–15). Do the #10 file test again. Sometimes cutting the apical preparation with the hand files smoothes the path enough for the unbent file tip to glide around the impediment to patency (Figs 16 and 17). Often it fails (Fig. 18).

Figure 13 A pre-bent #25 K-file cuts 0.5 mm short of the #20 file.

Figure 14 A pre-bent #30 K-file is watch-wound to about 1 mm short of terminal length.

Figure 15 A pre-bent #35 K-file ends the sequence, again, short of the preceding files.

Figure 16 The #10 file test is used again. Sometimes, after apical shaping is accomplished with hand files, the unbent #10 file will then translate around the canal curvature.

Figure 17 In that case a rotary 0.04 Profile or 0.06 GT file is brought in to complete the shape.

Figure 18 Often the #10 file test fails at this point, indicating that rotary files still cannot be taken to the impediment without grave risk of apical laceration of the canal.

Completing the shape with a GT hand file

At this point the canal is shaped coronally and apically, but there is discontinuity of shape centred at the impediment. Obviously, if the canal passes the #10 file test, the shape is finished with one or more rotary GT files (Fig. 17). If the #10 file still hangs up (Fig. 18), you will need to pull out GT hand files.

Figure 19 A GT hand file of the Shaping Objective taper (0.08 in this case) is brought to bear at this point as pre-bending and directed introduction is possible where it is not possible with rotary files. Because of nickel titanium's shape memory the file must be dramatically overbent, at least 180–270°. The Endobender Plier by Analytic Endodontics is an effective tool for this job.

Figure 20 When bent far enough, even a NiTi file will hold a residual 35–45° bend.

Figure 21 The pre-bent GT hand file, used with a directional stop pointing toward the file bend, will in most cases, then traverse the impediment.

Figure 22 The GT hand file is first rotated in a counter-clockwise direction with no apical pressure, pulling the instrument into the canal. This sets the file blades into the canal wall, similar to tapping a screw thread in a hole.

Nothing but a pre-bent file will traverse the impediment, and a pre-bent rotary file is useless as it is difficult to move to place with no rotation and the first rotation straightens any bend placed into the file. Therefore, the GT hand file size matching the Shaping Objective for that canal is measured, setting the tear-drop stop at full length.

There is a myth that nickel titanium, because of its remarkable shape memory, cannot be effectively pre-bent. The material can hold some 35–45° of bend, if the file is over-bent by 180–720° (Figs 19 and 20). Sometimes it will take four or five attempts before the bend will remain. Align the point of the stop toward the file bend and you are ready.

Direct the bent tip around the impediment with a careful watch-winding motion. Once the file tip is past the impediment, the hard work is over (Fig. 21). Because apical step-back preparation preceded this final step, the tip of the GT hand file is actually acting as a passive pilot guide, pulling the rest of the file past the impediment.

These files have reverse-cut flutes, so start by spinning the file counter-clockwise (CCW; Fig. 22). This will feed the file into the canal. When resistance is met, firmly continue the CCW rotation until the file will not rotate further. You have just tapped a bit of a screw thread into the canal walls.

Figure 23 Then, after applying significant apical pressure, the GT file is rotated in a clock-wise direction at least 180–720°, or until the clicking sound of blades snapping past the screw threads stops. Do not pull the file out yet.

Figure 25 With apical pressure applied, the clockwise cutting stroke is accomplished.

Figure 27 The final cut. After the clicking smoothes out, counter-rotate the file as it is withdrawn to capture all cut dentine in the flute spaces.

Figure 24 The GT file is counter-rotated again to seat the blades into the dentine.

Figure 26 The GT file is moved to final length with another CCW rotation.

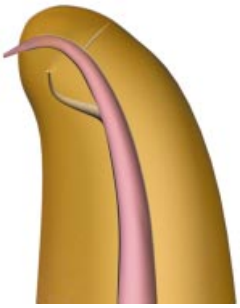

Figure 28 A 0.08 taper feather-tipped Autofit gutta percha cone (Analytic Endodontics) at its ideal binding position in the canal. It may be necessary to chill and pre-bend the gutta percha cone to get its tip to traverse around the impediment during cone-fit.

Apply apical pressure to the file so it cannot back out of the canal, and rotate it in a clockwise (CW) direction (Fig. 23). You will hear and feel the file 'click' as the blades snap past the previously cut screw threads. After two or three clicks, it is usually smooth. Do not remove the file here!

Rotate the GT file CCW to feed it back in, push on it, and cut in a CW direction (Figs 24–27). After three to five of these cutting cycles, the file will not advance in CCW

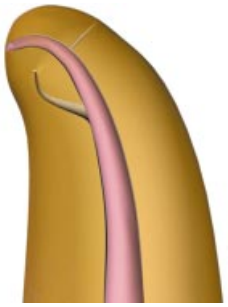

Figure 29 That cone measured and cut to length in preparation for the cone-fit film. After confirmation that the cone is at length, it is cut back a further 0.5 mm to allow for the slight apical movement during the down-pack condensation stroke.

Figure 30 Mandibular second molar with abrupt curvature of the distal canal, treated exactly as shown in the illustrations. Note the apical control despite the conservative coronal enlargement.

rotation, the flutes are full of debris. Rotate the file CCW as it is retrieved from the canal to keep the debris loaded on the file flutes.

Apical gauging finale

Apical gauging is then done to confirm apical continuity of shape. Remember, apical gauging is *not* apical preparation. The GT files will cut the apical preparation (creating a predefined taper), the gauging files are only to measure diameters of the canal in apical regions. In small root canals, the #20 K-file will usually bind at length, with each larger file fitting further from the terminus. In large root canals the terminal diameter of the canal may be larger. In that case the best technique strategy is to take the GT hand file long (Buchanan 2001). As radical as it may seem, it is totally safe (Torabinejad *et al*. 1988) and it is the quickest and most predictable way I have ever cut shape to the terminus of a canal with a large apical diameter or shaped out a ledgeform in a curved canal.

Cone-fitting around the abrupt apical curvature

It is not a bad idea to do the #10 file test one more time here. The best chance of passing the #10 file test is after the GT hand file has been cut to length. If a #10 file translates around an abrupt apical curvature or the previous site of a ledge-form, cone-fit will probably take about 20 s. If a small file must be pre-bent to reach the canal terminus it may be necessary to pre-bend the gutta percha cone as well.

The only way gutta percha will hold a bend is to chill it. There are three methods I know now:

(1) quenching the cone with an alcohol gauze that has been waved through the air, chilling it by evaporation of the alcohol,

(2) spraying the cone with a refrigerant such as ethyl chloride, or

(3) dipping the cone in a glass of ice water Once chilled, the cone is bent between gloved fingernails (Figs 28 and 29).

If you have to bend a gutta percha cone to get it to length, it is best to fit three cones prior to the drying and cementation procedures. Invariably one or two, but seldom three, cones hang up so it is nice to have a plan B and C.

Conclusions

Shaping root canals, for the experienced, discriminating dentist, has traditionally taken 30–45 min per canal, depending on the canal and the clinician. Variably tapered nickel titanium rotary GT files have absolutely revolutionized that process, and because this system is a more than 10X improvement over previous methods, it is here to stay (Fig. 30).

GT files, in the hands of dental students in their first experience with the instruments cut ideal preparation shapes in every case. It took them an average of 22 min to create an inconsistently tapered preparation with K-files and Gates-Glidden burs. It took an average of 4 min to create consistently ideal root canal preparations with rotary GT files (Buchanan 2000). In addition, they are a system of files designed specifically (for the first time) to address every anatomic challenge presented to the practising clinician.

Canals with small apical diameters, canals with large apical diameters (just shy of the blunderbuss apex), canals with apically accelerating and multiplanar curvatures, and root canal pathways with abrupt apical curvatures or ledgeforms. All of these can be ideally shaped with one to four GT files in less than 5 min. But this is specifically not a statement that, 'Any molar can be treated in a half-hour'. That would be ethically and morally bankrupt.

I would suggest a different take here. You cannot afford to provide quality endodontic care to your patients unless you are efficient. These instruments will not make endodontic therapy easy, they will make one small part easier. I most appreciate them when it has taken me two hours to find and negotiate all the canals in a dreadful molar. I am then very glad to know that I am only about 10–15 min away from perfect shape and cone-fit. Of course, even better is when a simple canal is ideally shaped in 2 min with one file.

Be careful. You must practice this technique on extracted teeth before using it on patients. If you exactly follow the technique described in this series of articles and keep a light hand, you are going to have a lot of fun. Now you will have time to negotiate, shape, clean, and three-dimensionally fill root canals to their terminal points. Enjoy.

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