Common Misconceptions about Carrier-Based Obturation

by L. Stephen Buchanan, DDS, FICD, FACD

Myth

Despite the fact that many endodontists consider carrier-based obturation (also known as Thermafil, GT, GTX Obturators) to be a inappropriate method of filling root canals, I have become more impressed with it the longer I have used it in my cases and taught it in my courses. Furthermore, many of the most outstanding endodontists in Europe use this method to great effect (Fig. 1). Meanwhile, too many endodontists in the US still fear or dislike the carrier. What explains this severe disparity in opinions?

The primary reasons I have heard endodontic specialists offer about why they don't want general dentists to use carriers and would never consider using them in their own practices are:

- They fail more often than conventional filling techniques
- The carrier will be wiped of gutta percha and sealer so the carrier will get to the end of the canal naked
- They are difficult or impossible to control—carrier-based filling is not as accurate as conefit techniques
- They are difficult or impossible to remove when a retreatment is needed

Are these statements true or untrue? They are definitely true for generalists and specialists who lack the necessary concepts and techniques for use, but they are not true for those who are well versed in this filling technique. The irony of carrier-based filling is that it is a simple technique but it is actually quite technique sensitive if the treatment objective is to achieve state-of-the-art fills.[1] What this means is that while the technique steps are simple and few, they must be done *exactly* as recommended. Beyond these issues, the endodontist's viewpoint is typically influenced by their experiences in practice. What are some of those experiences?

Endodontists will undoubtedly see carrier-based failures in their practices (Fig. 2), but paradoxically cannot actually identify carrier-based successes. An endodontic treatment result that was well shaped, cleaned, and filled with obturators is literally indistinguishable from a conefit-filled case. It looks the same and it is working well so an endodontist won't have a clue that it is a carrier case if they see it next to a tooth with a failing conefit root canal treatment.

Conversely, carrier cases that fail are identified as such either pre-operatively from the poor appearance of the fill (a stripped carrier at the end of the canal) or the dentist finds out when the tooth is accessed to retreat the case and a carrier is seen in the center of the gutta percha. It's ironic to me that they would then be incensed about a carrier failure. I have never heard of or had the experience myself of accessing

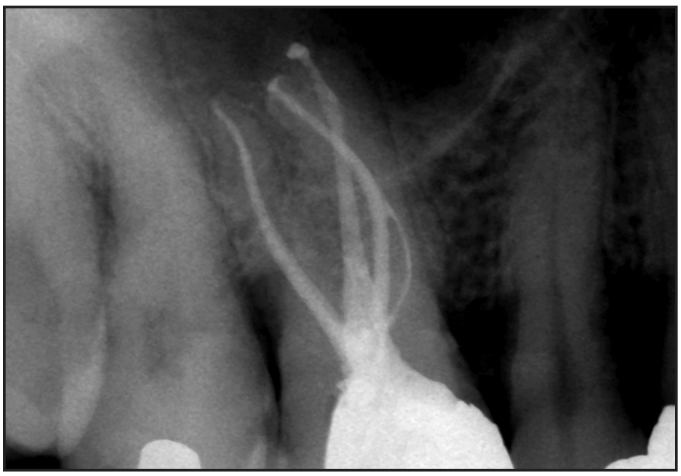

Figure 1. Maxillary molar obturated with Thermafil Obturators. Note the apical accuracy and the filling of accessory canals despite the conservative coronal shape. (courtesy of Dr. Guissepe Cantatore).

Figure 2. Mandibular molar with failing RCT. The canals were grossly undertreated and then, coincidentally, carrier-based obturation was used to fill the under-negotiated and uncleaned canals. This was an endodontic treatment failure, not an obturator failure.

a failing conefit RCT case, seeing just gutta percha in the canal, and saying, "Oh no, it's gutta percha, I hate that material because it fails so often!" We should remember that the most important factor to be considered is the long-term outcome, regardless of the obturation technique. In this regard, studies have shown no difference between carrier-based techniques and traditional techniques.[2,3]

Granted, any endodontist who does not know an effective removal technique for carriers will be very frustrated in retreating those cases. I can understand why they would be resentful in that situation. However, as I tell my students, just because an endodontist in your area can't get carriers out, that doesn't mean you can't. With the techniques I use to remove carriers, it usually takes me less time to retreat carrier cases than those filled with just gutta percha (more on this later). My findings are well correlated with the ones reported in the literature.[4,5]

As to seeing carriers stripped of gutta percha and sealer in the apical half or third, that's not a carrier failure, that's an iatrogenic failure. Those same cases—typically negotiated, shaped, and cleaned poorly—would have failed no matter how they were filled. As with all obturation techniques, the outcomes of carrier-based filling procedures are totally dependent upon the quality and thoroughness of all of the procedures that precede this step.[6,7,8]

Cases where the gutta percha and sealer have been wiped off the end of the carrier are most often under-shaped. Historically, like silver point obturation, some clinicians like using carriers because they are easier to push through under-shaped canals than gutta percha cones (these are, for the most part, the only dentists who still use metal carriers). If a canal has been well shaped and cleaned (adequately irrigated), the only way that gutta percha can be stripped from the end of the carrier is when inadequate amounts of sealer have been placed into the canal prior to carrier insertion.

In fact, the placement of sealer is perhaps the most technique sensitive part of carrier technique. Too much and you will have a large amount of sealer unnecessarily exit the terminus of the canal. Too little and you will end up with a naked carrier in the apical third. The first outcome is unaesthetic, but will rarely cause failure. When too much sealer is placed in the canal, the heated obturator—with its softened gutta percha conforming to the diameter of the orifice immediately upon entering the canal space—pushes all surplus sealer out the end of the canal.

If too little sealer is placed, the obturation outcome may look better, but there will be a greater chance of the RCT failing in infected canals. Sealer, in centered condensation techniques, not only accomplishes the seal against the canal wall (gutta percha by itself cannot effectively seal a canal), it also acts as a lubricant so that the heated gutta percha can slip and slide down the canal and into lateral irregularities.

Reality

The best way to describe centered condensation filling methods (Continuous Wave and carrier-based obturation) is that these techniques are actually the inverse of our impression tray technology. The carrier or electric heat plugger is like the tray, the gutta percha (or synthetic GP) is like the heavy-bodied material, and the sealer behaves like the light bodied material. Not only does this analogy explain the very three dimensional fill that occurs in seconds, it is very instructive as to how centered condensation obturation is best done.

The impression tray may lightly touch a tooth cusp here or there, but it is not intended to closely fit the dental arch of teeth. Neither is the electric heat plugger or the carrier supposed to fit the canal like a master cone. These devices are intended to move the heavy-bodied GP through the canal and that thermoplastic material is intended to slide on and distribute the light-bodied sealer. This viscodynamic process, and

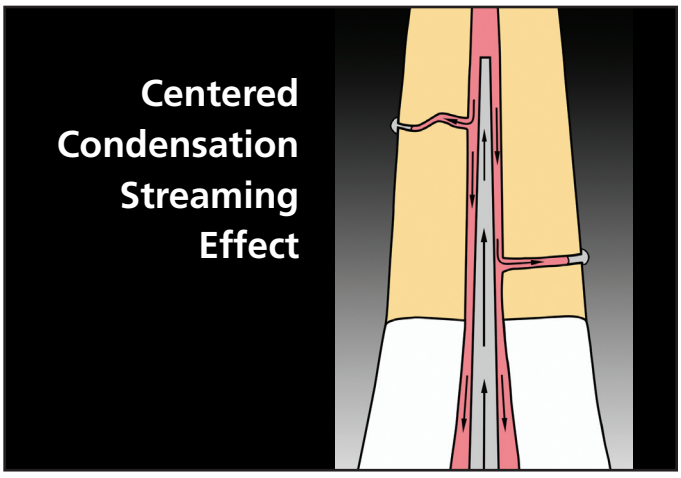

Figure 3. Illustration of Centered Condensation streaming effect that is driven by the carrier or elelctric heat plugger displacing the gutta percha and sealer from the canal as these three components move toward the terminus. This explains how a 2.5-4 second downpack or carrier placement is able to so effectively fill all cleaned lateral canal anatomy. This result occurs in no less time than the placement of an impression tray loaded with heavy and light-bodied material.

the streaming effect of the surplus gutta percha and sealer escaping coronally during placement of the plugger or carrier, is how every lateral canal, fin, or isthmus that has been cleaned can be filled in 2.5-4 seconds[9] (Fig. 3).

When there is a paucity of sealer in the canal prior to inserting an obturator, the carrier and the gutta percha around it move down the canal together, pushing sealer ahead of the gutta percha, thereby coating the canal walls until the sealer runs out. The gutta percha then makes contact with the un-lubricated canal wall, and instead of smoothly moving down the canal, the gutta percha sticks to the dentin and stops, after which the carrier proceeds to length by itself.

This outcome occurs when dentists only apply a ring or sealer around the orifice of the canal to be filled, or when they over-blot, with paper points, sealer placed to full length. The solution to this problem is not difficult, it's just technique sensitive.

As to the issue of apical accuracy of filling with carriers, my experience is that they can be just as accurate as conefit techniques if done in a clever manner. By clever, I mean that the canal must be ideally shaped with apical continuity of taper being confirmed, and the sealer and carrier placement techniques have been done exactly right. Not difficult but technique sensitive.

Case selection

Dentists whom I teach both of the centered condensation filling methods will usually ask me how I decide whether to use the Continuous Wave conefit filling technique or carrier-based filling—with their concern mainly revolving around the question of which cases cannot be filled with carriers. Ironically, the range of anatomy that is ideally filled with carriers is broader than for conefit filling. I would always choose carrier filling for canals with impediments that I have been able to shape to length but do not allow me to fit a cone to length (Fig. 4).

Also, I prefer carrier-based filling in long, narrow, severely curved canals (Figs 5, 6). Even with the relatively new 30-.04 System B electric heat plugger—smaller tip size and much more flexible than the larger sizes—I know I will be able to create condensation of the softened gutta percha all the way

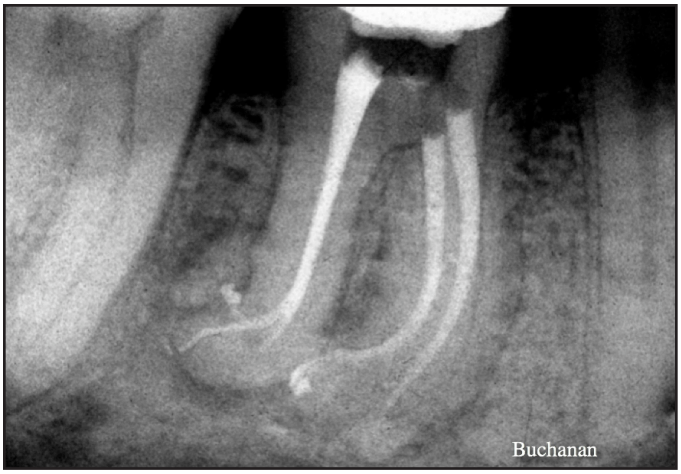

Figure 4. Mandibular molar with apical impediment in distal root 4-5 mm's short of the primary terminus, but with 7-10 mm's of branching canal space beyond that impediment. Gutta Percha conefit to length was not possible despite the shape being accomplished beyond the impediment.

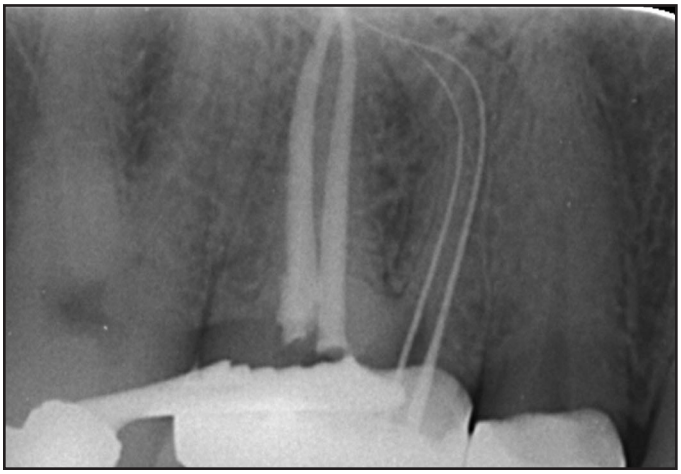

Figure 5. Maxillary molar with long, narrow, severely curving canals. The MB1 and MB2 canals were 25 mm's long, had abrupt, midroot curvature to the distal and the MB2 canal had an apical rebend inthe opposite direction. Both canals were shaped to a 20-.06 GTX File shape.

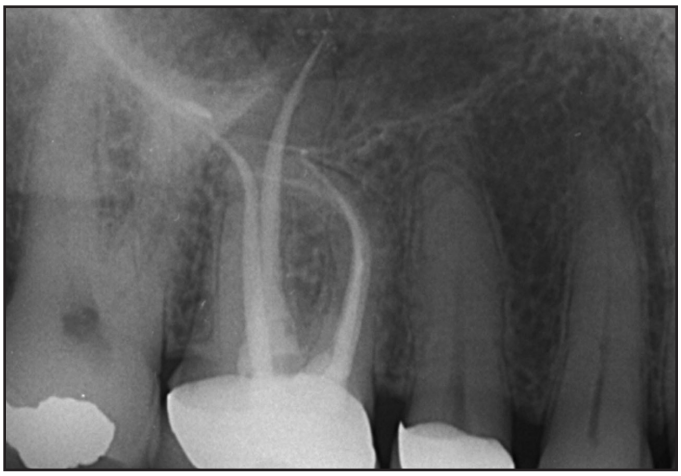

Figure 6. All canals were filled with GTX Obturators. Note the dense fills and the apical accuracy despite the conservative coronal shapes. This type of anatomic challenge presents the ideal indication for carrier use by specialists.

to the last 1 mm of the canal when I take a carrier to length, whereas I may be 6-8 mm back with an electric heat plugger.

On the other hand, I think the canal that is treated more simply with a Continuous Wave Technique is one that I anticipate placing a post in. For well-trained GDP's and endodontists who fill with both techniques, it is always easier to fit a cone, downpack through it with a System B plugger, do the separation burst of heat, remove the plugger and surplus gutta percha out of the canal, condense the apical mass with a hand plugger, and immediately drop a post drill into that vacant coronal space.

It is my recommendation that post space be prepared in carrier-filled canals on a second appointment, as cutting through the carrier immediately after it's placement—before the sealer has set—could cause rotational movement of the carrier and thereby disturb the integrity of the gutta percha and sealer against the canal wall. I have heard of increased levels of failure with this treatment regime.

For those who only use carriers, my favorite method for cutting carriers down to rough out a post space prior to using the post drill is to use a round-ended ultrasonic tip such as a BUC-1 (Spartan). In about 1.5 seconds that tip will safely drop through the coronal third or half of the canal, heating and removing the carrier and most of the gutta percha, making it very easy to follow with a post drill. Beware of sharp-ended ultrasonic tips, they will ledge curved canals. The other safe methods of cutting out carriers for post spaces is to use a System-B at 360^0 C, or an LAX stainless steel drill (with a pilot tip for safety/ SybronEndo) at 5K-10K rpm.

Finally, beware of manufacturer's recommendation that their post drill (especially the one with an asymmetric tip) is safe to cut out carriers as they make the post space. I know several talented dentists who have used this method and have inadvertantly caused a lateral root perforation with one of these drills.

Carrier-based Obturation Techniques

After drying, apply sealer to the canal walls with a coated paper point that is moved circumferentially around the canal starting at the orifice level and then is moved apically. Surplus sealer is blotted with successive paper points taken to length, removed, and examined as to whether they are coated or spotted with sealer. A "coated" paper point means that sealer is filling the lumen of the canal—the most common cause of apical surplus. A "spotted" paper point indicates that the sealer is only on the canal walls—this is ideal.

There are three methods of filling multi-canaled teeth:

- Place paper points in canals not being filled, place the obturator into the first canal, cut it at the orifice level with a Preppi bur or System-B electric heat plugger, remove one paper point and repeat until all canals are filled.

- Place the first obturator, place a fingertip atop the handle, use cotton pliers to pull the stop up the handle, then, grasping the shank of the carrier with the pliers, break the handle off the carrier, pull the stop off the shank of the carrier and push slightly on the carrier to ensure that it was not displaced during handle and stop removal. This will allow space for the next carrier to be easily placed.

- Prepare the carrier by first adjusting the stop to the correct length. Then, use a tapered diamond bur to cut halfway through the carrier shank 2-5 mm's below the stop, bend the carrier carefully until a "greenstick fracture" is felt, straighten the carrier shank and put the carrier in the oven. Immediately after inserting the carrier to length, bend the handle and shank, rotate it until it comes off, and the way is now clear to place the other carriers. After all carriers are inserted, they are all cut at the orifice levels with a Preppi bur and water spray (to set the warm sticky gutta percha for easier removal).

When filling molars with obturators, rather than putting them into the canals by hand, it is much easier to grasp the shank of the carrier with a hemostat and break the handle off the carrier shank. This will provide much more clearance during placement in these tighter interocclusal spaces.

Measure the carrier (the plastic part) 1mm short of the full canal length. When the technique described is being adhered to, the canal is filled ideally to length when the carrier is 1 mm from that length. This has the advantage of revealing placement

failures due to inadequate sealer and gutta percha short of the canal terminus as the short fill is more apparent than if the naked carrier is taken to length.

Different styles of obturators want different rate of insertion. Narrower carriers, such as Thermafil, are placed in 3-4 seconds. Carriers with more shape, such as GT and GTX Obturators, are inserted in 6-8 seconds, the only exception being when filling canals with impediments more than 1mm from the apical terminus, where faster insertion is warranted to push more filling material ahead of the carrier than is usually desired in non-impediment cases. GT and GTX Obturators are always heated on the longest heating cycle.

The advantage of system-based obturators, such as GT and GTX Obturators, is that the last file used acts as the size verifier. When Thermafil carriers are used in canals shaped without system-based rotary files (any that are used with GGB's or step-back preparations) a size verifier is needed to confirm the fit of the carrier in whatever shape was created.

Carrier Removal Prior to Retreatment of Endodontic Failures

There are several straightforward methods of carrier removal. Like carrier placement, these are simple techniques but these are all technique sensitive. Doing them incorrectly will result in great frustration and in erroneous statements by clinicians about the difficulties of retreating carrier-filled canals. Carrier removal in three easy steps:

1. Enter the canal with:
    a. Chloroform and a #15 file
    b. A System-B electric heart plugger
    c. A round-ended ultrasonic tip such as the Buc-1
    d. A 20-.04 GT or GTX Rotary File at 500 rpm
2. Immediately and carefully thread a Hedstrom file along side the carrier (a #15H if a, b, or c method of entry is used, a #25H if d method is used) half to two-thirds down the canal length.
3. Remove the Hedstrom file and carrier by levering the file out with a curved hemostat clipped under the handle and fulcrum the beaks off a mesially-adjacent tooth that is padded with a folded 2X2 gauze.
4. Use the heating methods, b or c, if the carrier has been tightly placed in an undershaped canal. If you are quick with the #15 Hedstrom file it can be threaded *through* the softened plastic and removed.

This process usually takes me less than 60 seconds, with the exception of ovoid canals (canines, distal canals of lower molars). In ovoid canals it may be necessary to thread a Hedstrom file along both sides of the carrier so the carrier cannot move away from and disengage from the Hedstrom flutes. In these cases I will try two #15's first, then two #25's, and if the carrier has not come out yet I will thread two #35 Hedstrom files along side. (I always have two files of each of these sizes ready to go).

Removing a carrier with pliers is difficult or impossible and requires overcutting the access cavity. Using a rotary file with a bigger tip or taper may cut off the carrier deep in the canal, making removal much more difficult. Using a K-file rather than a Hedstrom file won't work. Using a System-B or ultrasonic tip to heat and cut through the carrier, but not having a #15 Hedstrom file ready so that it may be immediately threaded through the still-warm plastic won't work.

I have yet to fail at removing a carrier (jinx). The longest I have ever spent was 3 minutes. Simple technique, but technique sensitive. For video clips of these techniques see my web page www.endobuchanan.com (click on 'expert advice', then 'endo updates').

Conclusion

Testament to the efficacy of well-placed obturators is the introduction of them to undergraduate endodontic programs such as University of the Pacific (Alan Gluskin, Chair) and Baylor University (Jerry Glickman, Chair and president of the AAE) and Nova Southeastern Unersity (Sergio Kuttler). The realization these progressive educators came to was that a large percentage of their graduates will use carrier based obturation after leaving dental school so denying them credible instruction in that filling method was in essence dereliction of duty.

Thermafil has been around for more than 20 years, and during that time great numbers of research studies have been done at universities with the vast majority

of them showing equal or better filling results than with cold lateral condensation methods—still the most commonly taught in undergraduate programs. Many of these researchers began the study very skeptical of carrier-based obturation but ended up believers after seeing the very dense, three dimensional results.

Since then, carrier-based obturation has become a system-based procedure with the GT and GTX Files, thereby eliminating the need for size verifiers and improving the viscodynamics of their function due to better fitting carriers. Recently, SybronEndo has introduced an obturator with their Real Seal synthetic gutta percha material, making the claim that they have better resistance to coronal leakage with that material. No one, as far as I know, is questioning the efficacy of delivering it on a carrier.

If you are an endodontist and you just do not want to use this filling method, that's fine—the rest of us will be drinking coffee while you are still working away—but remember what Thumper's mom said, "If you don't have anything good to say, don't say anything at all." If you badmouth it, and a general dentist learns how to use it successfully, you will look like an insecure, disingenuous clinician—not a go-to specialist. Even worse, if you bad-mouth a general dentist when their carrier-filled case fails, the next time he or she is in that situation the patient will be sent to an implant surgeon who will say that endodontic treatment is a space maintainer for an implant—thus giving the general dentist a "get-out-of-jail-card" for free.

On the positive side of this issue, can you imagine what it would be like in difficult cases to finish the case in one visit because you used the less time-consuming carrier method? Can you imagine what it would be like to never see another backfilling void? Can you imagine how effectively a carrier—moving to within 1 mm of the terminus—can plastically deform gutta percha and sealer in the apical third of a really narrow, really long, and really curved canal?

Rather than calling it by its perjorative description, "gutta percha on a stick", clinicians who are open-minded are finding carrier-based obturation to be a simple, yet exceptional method of obturation (Figs. 7A, 7B).

References

1. Gound TG, Sather JP, Kong TS, Makkawy HA, Marx DB (2009) Graduating dental students' ability to produce quality root canal fillings usin single-or multiple-cone obturation techniques. *J Dent Educ* **73(6)**: 696-705

2. Chu CH, Lo EC, Cheung GS (2005) Outcome of root canal treatment using Thermafil and cold lateral condensation filling techniques. *Int Endod J* **638(3)**:179-85

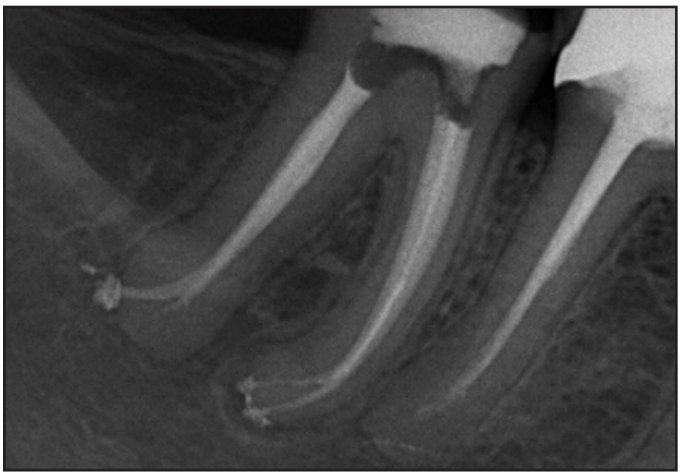

Figure 7A. Mandibular molar seen in Figure 2 after retreatment was done. After carriers were removed (2 minutes for all 3), the canals were negotiated to their terminal points, shaped, cleaned, and then refilled with carrier-based obturation (GTX Obturators). Note the complex anatomy in the apical third of the mesial root, and the ideal fill in the distal root in spite of the severe apical curvature and the ledge impediment.

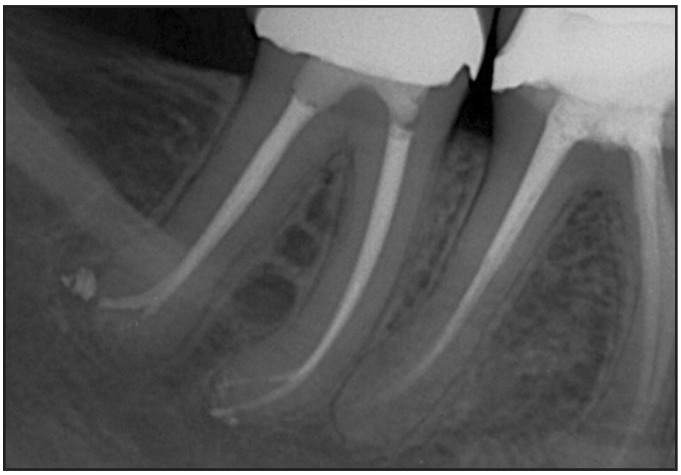

Figure 7B. 6 month recall with completed healing.

3. Gagliani MA, Cerutti A, Bondesan A, Colombo M, Godio E, Giacomelli G (2004) A 24-month survey on root canal treatment performed by NiTi engine driven files and warm gutta-percha filling associated system. *Minerva Stomatol* **53(10)**: 543-54

4. Frajlich SR, Goldberg F, Massone EJ, Cantarini C, Artaza LP (1998) Comparative study of retreatment of Thermafil and lateral condensation endodontic fillings. *Int Endod J* **31(5)**: 354-7

5. Royzenblat A, Goodell GG (2007) Comparison of removal times of Thermafil plastic obturators using ProFile rotary instruments at different rotational speeds in moderately curved canals. *J Endod* **33(3)**: 256-8

6. Hugh CL, Walton RE, Facer SR (2005) Evaluation of intracanal sealer distribution with 5 different obturation techniques. *Quintessence Int* **36(9)**: 721-9

7. Schafer E, Olthoff G (2002) Effect of three different sealers on the sealing abiity of both thermafil obturators and cold laterally compacted Gutta-Percha. *J Endod* **28(9)**: 638-42

8. Abarca AM, Bustos A, Navia M (2001) A comparison of apical sealing and extrusion between Thermafil and lateral condensation techniques. *J Endod* **27(11)**: 670-2

9. De-Deus G, Gurgel-Filho ED, Magalhaes KM, Coutinho-Filho T (2006) A comparison of apical sealing and extrusion between Thermafil and lateral condensation techniques. *J Endod* **27(11)**: 670-2