Current Practice in Endodontics: 5. Obturation

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Abstract: **The aim of this series of six articles is to improve the quality of endodontic treatment in general dental practice by considering what is currently being taught in dental schools. This article first considers the possible reasons for persisting symptoms following preparation of the root canals. It then reviews the many and varied methods of obturating the prepared root canal system that are available to the general dental practitioner. By considering the objectives of their treatment, and their own level of expertise, readers may decide that one or more new techniques may benefit their practice.**

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Clinical Relevance: **The demand for endodontic treatment increases every year, particularly as an ageing population retains more and more teeth. Through these articles general practitioners may better assess the quality of treatment, and improve their techniques where necessary.**

At the close of the last article in this series a calcium hydroxide inter-visit dressing had been placed in the cleaned and shaped root canal. As discussed at that time, Sjögren *et al*. have shown that the prognosis when treating infected root canals is significantly enhanced when such a dressing is used.[1] The patient had also been cautioned about the probability of inflammatory pain, which would be expected to settle down after a few days, and also what to do in an emergency.

PERSISTENT PROBLEMS

If such an event has occurred, and the patient has returned complaining of severe and persistent pain, a differential diagnosis will have to be made quickly. The most common cause of such a problem is a high temporary restoration, and the patient will report immediate relief of symptoms following adjustment of the occlusion. If this is not the case then the following may be considered and appropriate treatment instituted.

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The Phoenix Abscess

Most practitioners will be familiar with the phoenix abscess, where a long-standing chronic lesion, which has been symptomless for many years, flares up following root canal treatment. The patient is usually astounded that it is possible to suffer so much pain and swelling so rapidly! If the root canals have been correctly cleaned and shaped, the natural immune response should deal with the apical inflammation quite quickly. However, in these circumstances it is prudent to replace the calcium hydroxide dressing before proceeding to obturation. Sadly, the patient will sometimes request extraction rather than continuing with the treatment. Although practitioners may find this disappointing, it is often wise to accede to the patient's wishes.

Residual Infection

Another cause of postoperative pain may be residual infection in the root canals, although this is unlikely if thorough cleaning and shaping was carried out using appropriate techniques. One is usually aware that either the treatment was correctly executed to the best of one's ability, in which case the symptoms should resolve, or, perhaps for reasons of time or technical problems, it was not. In this case the only treatment would be to return to the canals and complete the cleaning and shaping, with the old adage 'if you do not have time to do the job correctly now, then you will have to find the time to do it again!' firmly in mind. A root canal may have been missed, particularly in molars or lower incisors; there may be a vertical root fracture; a different or a second tooth may be endodontically involved; there could even be a completely new cause of the patient's pain. Correct diagnosis is essential, and unless it has been made the prescription of antibiotics is not good clinical practice. It will probably only make the prescriber feel better!

OBTURATION

If a careful clinical technique has been followed during preparation of the canals and placement of the inter-visit dressing, the painful occurrences described above are rare. The usual situation is that the patient returns with a symptomless tooth ready for obturation,

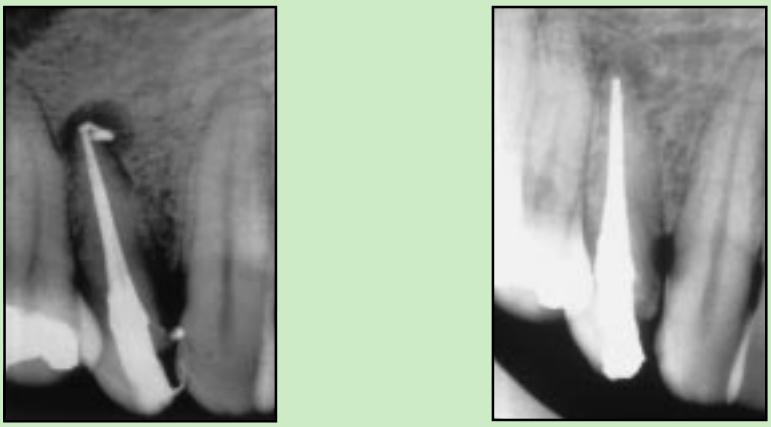

Figure 1. *Sealer, extruded through the apical foramen, will quickly be removed by the tissue fluids. The process will continue, albeit more slowly, into the canal.*

although it is also my experience that they frequently express gratitude for the caution about the immediate post-treatment pain, which lasted a few days. Rubber dam may now be applied, the canals accessed and irrigated with EDTA solution to flush out the water-soluble calcium hydroxide, the canals are dried, and we may now consider the techniques available for obturation. (Of course, if the tooth is tender to percussion then it would be wise not to obturate but to repeat the cleaning and redress the canal system.)

The object of this phase of treatment is to seal the canal completely in three dimensions, to incarcerate the small number of micro-organisms that may remain in the canal, and to prevent the passage of further infection from the oral cavity to the periapical tissues. Thus the coronal seal is just as important as the apical seal.[2] Single-point techniques, in particular silver points, have no place in modern endodontics. If it proves impossible to place a gutta-percha point to the same working length as the master file, and the size of the gutta-percha point has been verified as described later, then the canal preparation is faulty and must be re-visited.

Some practitioners object to the term 'three-dimensional seal', claiming it to be tautology. In fact the three dimensions referred to are those of the root canal, not the sealing medium, and it is essential that the root canal is obturated over its entire length, breadth and width.

However carefully gutta-percha is condensed into the canal, by whatever technique, slight voids will always remain. Root canal sealer may be used to fill these voids but as sealers may resorb in time this proves a weakness in the obturation, as illustrated in Figure 1. Minimal amounts of sealer should be used. Many commercial root canal sealers are available, and individuals will have their own personal favourites. Most are based on a zinc oxide/eugenol formula, with various additives. The formula for Grossman's sealer is shown in Table 1, and certain chemists are able to make this up to prescription. Similar sealers are commercially available. The author finds that the main advantage of this type of sealer is the extended working time, even in the presence of moisture or heat, either of which can make some sealers set before obturation is completed. Whichever sealer is chosen, it should be applied sparingly to the canal walls, for example by placing a small amount onto a file and evenly coating the walls by slight counter-rotation of the file in the canal.

Powder:	
Zinc oxide	42 parts
Staybelite resin	27 parts
Bismuth subcarbonate	15 parts
Barium sulphate	15 parts
Sodium borate anhydrous	1 part
Liquid:	
Eugenol	

Table 1. *The formula for Grossman's sealer.*

The obturation technique most widely taught to undergraduates is cold lateral condensation of gutta-percha. A master point is selected to match the master apical file, and tried in the canal. It is important to remember that the sizing may not be accurate, and a measuring gauge such as the one shown in Figure 2 can be useful. If the gutta-percha point does not fit snugly into the correct-sized hole it is too large, and should be discarded. Alternatively, if the tip protrudes through the hole then it may be cut off to give an exact ISO size, which, when placed in the canal, should fit snugly to working length, exhibiting a slight resistance to withdrawal, or 'tug-back'.

The finest finger spreader is now selected which will fit close to the working length, and the master point is compressed, leaving a void into which is placed the first matching accessory point. This technique is easier to perform in the mouth than when practising with a hand-held tooth in a laboratory because the patient is 'holding' the tooth, leaving both of the operator's hands free. The finger spreader is placed in the canal and left there. The operator picks up an accessory point with tweezers and holds this over the canal. The finger spreader is now grasped with the other hand, gently twisted and removed. Immediately the accessory point may be inserted, before

Figure 2. *A device for accurately matching gutta-percha points to ISO sizes.*

Figure 3. *A range of different-sized endodontic heat carriers.*

the compressed gutta-percha has the chance to recoil into the space created. Larger finger spreaders and matching accessory points may be used until the canal is fully filled.

Practitioners sometimes report that gutta-percha points, even when correctly sized, do not always fit easily into the canal. One reason for this may be that the dental nurse has placed the tips of the points into the sealer, to offer them neatly to the dentist. Gutta-percha points contain about 30% zinc oxide, which will react with eugenol in some sealers and soften the tip, which may then distort in the root canal. The points should be dipped in sealer only at the moment before they are inserted into the canal.

Laboratory studies have demonstrated the leakage potential of teeth obturated with cold lateral condensation[3,4] and many endodontists have described ways of creating a better seal,[5–7] almost all of which involve some form of heat to soften the gutta-percha. Most, unfortunately, involve the purchase of specialized equipment, an expense that may not appeal to all practitioners. Before considering these, however, two cheaper alternative methods may be worth mentioning.

The first merely involves turning cold lateral condensation into warm lateral condensation by the use of heat carriers. Attempting to heat a standard finger spreader will be unsuccessful, as these instruments have not been designed to retain heat. Heat carriers such as those shown in Figure 3, however, will condense the gutta-percha with far greater efficiency, create a larger void for accessory points, and give a smoother, more homogeneous obturation, with very little extra effort or expense.

The second is a variation of a method first presented by McSpadden in 1980.[8] He described the use of a 'compactor', which was, in effect, a reverse Hedström file. This is rotated at medium speed in a conventional slow-speed hand-piece, and introduced into the canal beside a well fitting master point. The theory is that the gutta-percha becomes plasticized and is forced down the canal, building up pressure which gradually extrudes the compactor. When the technique was successful the results were excellent, but it had severe weaknesses, the prime one being lack of control of the apical stop. Soft gutta-percha was frequently extruded into the trabecular bone around the apex. The condensers themselves were prone to fracture, leaving an incomplete obturation with a broken instrument.

The design faults in the original McSpadden instruments have been overcome in the Maillefer (Ballaigues) 'Gutta Condensors', which are far less likely to fracture. The thermomechanical compaction obturation technique was greatly improved with modification by Tagger and co-workers,[9] who described how the condensers plasticize the gutta-percha only 2–3 mm ahead of their tip. If, therefore, an apical seal is created using a master point, finger spreaders and two or three accessory points, the gutta condenser may be introduced only part way into the canal, stopping 4–5 mm short of the working length. Thus the coronal part is back-filled quickly and efficiently. Many practitioners use these devices routinely, having taken the time to perfect the technique, with extremely good results.

Several manufacturers now produce obturation devices similar to those originally marketed in this country as Thermafil (Deproco UK Ltd., Dorking, Surrey). These are a range of ISO-sized plastic carriers, coated with alpha-phase gutta-percha. A series of sized verification blanks are available to ensure an accurate fit of the individual ISO-sized obturating device selected. The device is heated in an oven to soften the alpha-phase gutta-percha, and smoothly introduced to the prepared canal. When practised and perfected, the technique is swift and effective and, although the devices may cost a few pounds each, the time saved by this rapid technique may more than compensate. It is essential that a minimal amount of sealer is used, or it will be expressed through the apex under pressure. Even with local anaesthesia, the patient may register a 'puff' of pain, and there may be considerable postoperative sensitivity.

A range of gadgets utilizing the features of gutta condensers and alpha-phase gutta-percha was marketed, but the same criticisms about control and consistency of results made earlier in relation to the original thermomechanical compaction technique apply to these gadgets.

Two further methods of obturation must be mentioned but, as with any new technique, even if the expensive equipment is purchased, a hands-on course is essential to perfect the technique. The first, and probably the most popular method of obturation amongst specialist endodontic practitioners at present, is System B® (Analytic Technology, California, USA). The 'B' stands for the designer and developer, Steve Buchanan. This is a precise and accurate method of delivering immediate, controlled heat to soften the gutta-percha in the root canal. The softened GP can then be vertically condensed into the confines of the canal, and a range of pluggers have been designed by Steve Buchanan to complement the System B. His technique is termed the 'continuous wave of condensation', and in

Figure 4. *Probably the only 'perfect' seal!*

experienced hands produces superb results.

The second, the Obtura® (Obtura Corporation, Missouri, USA), is a device for injecting heated gutta-percha directly into the canal. A digital read-out displays the exact temperature of the gutta-percha, although this does fall as the material extrudes through the disposable silver needle. Viscosity and flow rate can be controlled precisely, and the warm gutta-percha is then vertically compacted into the canal, obturating lateral and accessory canals as well. The Obtura is usually used either for incremental filling of wide canals or for completing the obturation of the coronal part of the canal once an apical seal has been achieved. Again, as with all the techniques described in this series, hands-on courses and extensive *in vitro* practice are mandatory before attempting these procedures on a patient.

CORONAL LEAKAGE

It was shown recently that any gutta-percha obturation will allow the passage of micro-organisms from the crown to the apex within 26 days if it becomes exposed to the oral cavity.[10] Reference was made earlier to the fact that, if a case becomes re-infected and fails, it will do so far more frequently from the coronal end of the canal than the apical. The final part of the obturation, therefore (unless a post crown is to be fitted) is the placement of a glass ionomer lining over the entire floor of the pulp chamber to seal the canals from bacterial ingress should the coronal restoration fail.

CONCLUSION

As has been stated frequently in this series, the prime objective of treatment is removal of infected material from the entire canal system. If this has not been achieved then, whatever method of obturation has been used, the case will eventually fail. The illustration in Figure 4 is probably the closest we will ever get to the perfect seal!

It is hoped that the reader now understands the principles of endodontic practice, and has chosen to learn more about any new techniques that have appealed during the series, and to practice and improve their clinical skills. There is no substitute for careful preparation before trying new techniques clinically. Indeed, purchasing a new system and using it on a patient without such practice may be considered serious professional misconduct. Were something to go wrong, and a complaint made, evidence of attendance on appropriate training programmes would be required. On the other hand, now that compulsory continuing professional education is with us, and credits must be totalled annually, it does seem to make sense to go on a course that you would enjoy. And I can assure you that, with practice, endodontics can be very enjoyable!

The final article in this series will consider what can go wrong, offer hints to help with re-treatments, and consider when periradicular surgery may be appropriate.

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LETTERS

Dental Update would like to devote more space to airing the views and experiences of its readers. If you have a comment or opinion on an article *Dental Update* has published or an interesting case to share with other readers, please send your letter (double-spaced, signed and with an indication that it is for publication, together with any photographs) to:

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1. A, B, C	6. A, B, D
2. A, C, D	7. A, B
3. B	8. B, C
4. C	9. A, B, D
5. B, D	10. B