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# Root Canal Retreatment*

**Abstract:** Root canal therapy is not always successful and an increasing number of patients are requesting retreatment to address intra-radicular infection. The armamentarium available to assist the dentist, some of which is described in this article, has never been greater.

**Clinical Relevance:** This paper discusses the causes of failure and reviews many of the techniques available to the practitioner to tackle the problem.

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Increasingly, patients are becoming reluctant to lose teeth, which has led to the practitioner being faced with requests for retreatment of failing root canal treatment. Emphasis is frequently placed on mechanical problems that may have contributed to failure. However, as the principal aetiology is usually biological, with the common factor being micro-organisms, it is important to understand their role in endodontic disease.

Reasons for failure of root canal therapy can be summarized as follows.

Frequent intraradicular causes include:

- Necrotic material remaining in the root canal either through failure to identify all canals or treating canals short;
- Untreated or undertreated canals;
- Contamination of an initially sterile root canal during treatment;
- Persistent infection of a root canal after treatment;
- Bacteria left in accessory or lateral canals;
- Loss of coronal seal; and
- Re-infection of a disinfected and sealed canal system.

Extraradicular causes of failure include:

- Persistent periradicular infection;
- Radicular cysts; and
- Vertical root fractures.

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**Figure 1**. Photograph of the Metalift system. A small hole is drilled in the occlusal surface of the restoration prior to the introduction of a self-threading screw which pushes against the dentine/core and elevates the crown, thus breaking the cement seal.

Further causes of failure may be iatrogenic in nature, in particular, when post space has been created without consideration being given to the internal and external root anatomy, with resultant perforation or root fracture.

Signs and symptoms of failure include:

- A discharging sinus;
- Pulpal pain; or
- Tenderness on biting.

Frequently, however, symptoms may be absent, with retreatment decisions being taken on incidental radiographic findings, for example, the appearance of a periradicular radiolucency or an increase in its size following root canal therapy, or restorative treatment being proposed on a tooth without a lesion but with an apparently incompletely obturated root canal.

Failure, depending on its aetiology, is normally treated in one of three ways:

- Root canal retreatment;
- Periradicular surgery; or
- Extraction.

Extraction is usually indicated for single-rooted teeth with root fractures, unrestorable teeth and those with a hopeless periodontal prognosis. In multi-rooted teeth, it may be possible to resect a fractured or periodontally involved root, or to perform crown lengthening when gross caries is present, in order to make isolation and future restoration possible.

Recent developments in periradicular surgery are resulting in improved outcomes.[1] However, root canal retreatment is still normally considered preferable to surgical intervention, as the latter may seal over uncleaned canal space which could

**Figure 2**. Photograph of tooth restored with copper ring and amalgam prior to re-root treatment; composite or resin re-enforced glass ionomer or orthodontic bands may also be used.

eventually leak. Further problems with a surgical approach include the effects of compromising root length and bone support on prosthetic or periodontal grounds. If, however, it is considered that access to the root canals cannot be gained without the risk of compromising the tooth's prognosis, or the financial implications of disassembly are prohibitive, then surgery is indicated.

## Root canal retreatment procedures

When infection is present, the aim of root canal retreatment is to eliminate micro-organisms that have either survived previous treatment or have re-entered the root canal system. The feasibility of retreatment depends on the operator's ability to gain access to the root canal system, in particular the apical third. Careful assessment of the pre-operative radiograph should be made with regard to whether or not a post has been used, what type it is, the type of root filling material (paste, gutta-percha, silver point), and potential problems such as curves, perforations or ledges. The stages of root canal retreatment are:

- Coronal access;
- Radicular access;
- Removal of root filling materials;
- Negotiation of blocked or ledged canals, regaining canal patency;
- Preparation of the canal;
- Antimicrobial management;
- Obturation and restoration.

Access to the pulp chamber and root canal system is usually complicated by the presence of coronal restorations, retentive devices and obturation materials. The use of additional magnification and lighting is especially useful in re-root treatment procedures. Loupes and a headlamp will provide good visibility of the pulp chamber floor and canal orifices. However, working in the middle and apical thirds of the root canal requires the use of an operating microscope[2] to allow clear vision.

## Coronal access

Careful consideration should be given to the quality of the coronal restoration prior to access. Where the coronal restoration is satisfactory, it should be retained and access made through it, with due care and attention given to the angulation of the bur, as the original coronal landmarks of the tooth may have been lost. The presence of an integral post and core or evidence of leakage around the restoration margins usually indicates that it should be removed prior to performing root canal retreatment.

Sectioning and removal of crowns or bridges, with careful consideration being given as to the method of temporization, is preferred to tapping them off with a crown remover. The latter method is uncontrolled and may result in unnecessary fracture of tooth tissue, with subsequent restorative complications. It is advisable to initiate sectioning with a diamond bur if porcelain is involved, otherwise the transmetal bur provides an excellent means of cutting through metal crowns. A recent device, the Metalift (Figure 1) has been introduced, which allows crowns to be removed intact. The procedure involves drilling a small hole in the occlusal surface of the restoration prior to the introduction of a self threading screw which pushes against the dentine/core and elevates the crown, thus breaking the cement seal.

On occasions, it may be possible to seal leaking restorations internally as a temporary measure to exclude bacteria and prevent leakage of irrigation solutions. Removal of the restoration, however, has the following advantages:

- Ensuring removal of all caries;
- Allowing a thorough check to be made for cracks; and
- Providing excellent access for identifying previously untreated canals.

In cases of extensive breakdown, it may be necessary to place a copper ring (Figure 2) or orthodontic band and build a restoration, prior to embarking on treatment, in order to ensure a seal around the margins of the rubber dam, avoid compromising

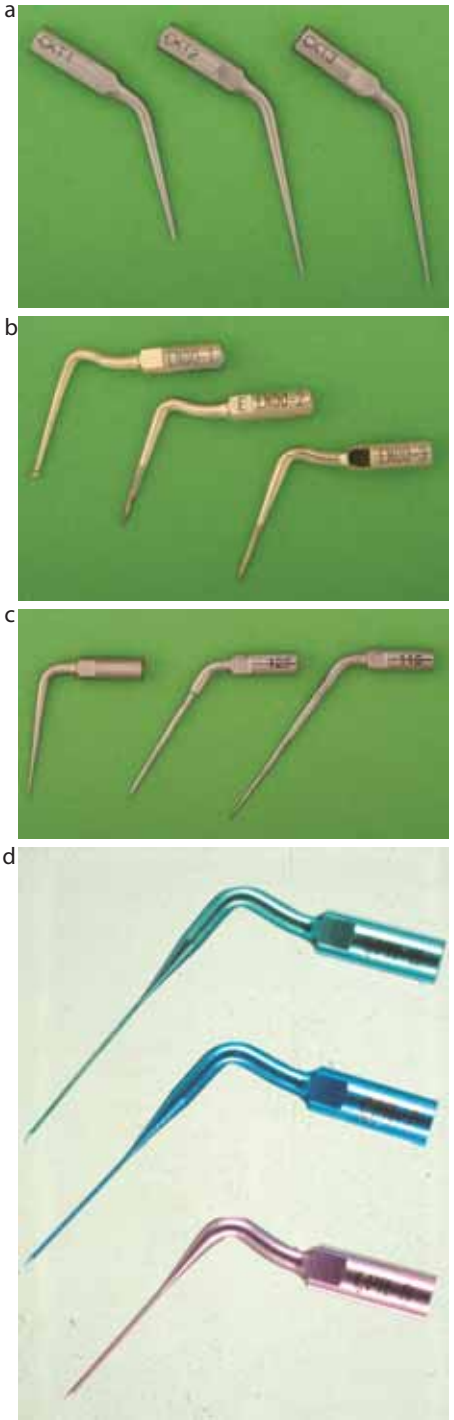
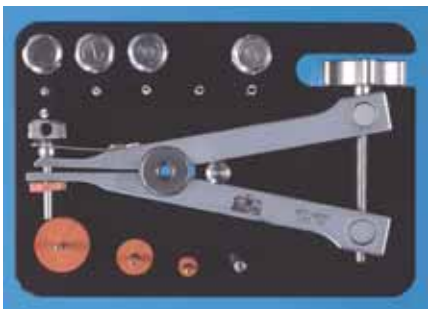


**Figure 3.** A selection of ultrasonic tips suitable for use in retreatment: **(a, b)** large robust tips for disturbing deeply placed restorative materials; **(c, d)** smaller tips used deeper in the canal system.

a



b

**Figure 4. (a)** The Ruddle Post Removal System including the extractor. **(b)** A domer bur, trepan and tap which are used to modify and engage the post.

asepsis and providing a four-walled access cavity for containing irrigant solutions.

## Radicular access, removal of restorative materials

Once coronal access has been gained, attention should be addressed towards radicular access. Core materials will either be tooth or non-tooth-coloured materials or cast metal. The most common non-tooth-coloured material is amalgam, which can be removed superficially using surgical length, round tungsten carbide burs in the high speed handpiece, followed by long neck burs used at slow speed deeper in the access cavity. When the floor of the pulp chamber is approached, ultrasonic tips (Figure 3) offer a safer alternative, compared to burs, for dispersing any material remaining over furcal areas and in the orifices of root canals. Tooth-coloured cores may be more difficult to distinguish from dentine and careful observation of the dried access cavity floor, to differentiate between dentine and restorative material, is important, as is tactile exploration with an endodontic explorer. The access cavity should be re-evaluated at this stage, in regard to its extent, to look for previously untreated canals and ensure that files may pass into the canal without touching the walls. Such interferences may result in small amalgam filings being created which can pass apically and block the canal.

## Radicular access, removal of post and cores

Post and core build-ups may be all in one casting or a combination of preformed posts and plastic core materials. In the latter cases, the core should be dissected away in order to expose the individual posts.

The removal of a post should not be attempted if the force to remove it might result in root fracture. Ultrasonic vibration may be used initially in an attempt to break the cement seal. The vibrations should be directed in a coronal direction, which necessitates the cutting of a notch on the side of the core. If a specialized tip is not available, then a standard ultrasonic scaler may be used. Care must be taken with ultrasonic vibration, as heat is produced which can cause local bone necrosis. It is therefore important to use coolant water spray, intermittent application and moderate power, as high settings may initiate microcracks in the root. In some situations, ultrasonic vibrations may result in the post becoming free within the canal, however, if it does not, then it is necessary to use a device to extract the post and core. This can usually be accomplished in anterior teeth using the Ruddle Post Removal System (Figures 4 a, b), which consists of a series of trepans to mill the post, tubular taps to engage the post and extraction pliers to provide the elevation force.

Recent developments have seen changes in post technology, in particular the use of cements to bond posts into place and those fabricated out of alternative materials, such as composite or fibre posts, whose radio-opacity may resemble gutta-percha. Metal posts cemented with composite cements can be extremely difficult to remove, especially if they are of sound design. Such difficulties are likely to increase in the future and may see an increase in periradicular surgery. Composite or fibre posts normally pose less of a challenge and can frequently be removed using ultrasonic vibration or drilling. It is important to make a note of the type of post and cement used in the patient record, as such information is then available to inform decision-making in the future.

**Figure 5.** Photograph of an LN bur and small ultrasonic tip showing comparison in size.

The fracture of a post within a root canal may pose a major problem and care should be taken to try not to weaken, fracture or perforate the root further. Such situations should first be tackled by troughing around the post to remove the luting cement, using a small long neck bur or thin ultrasonic tip (Figure 5).

Use of ultrasonic tips will remove many fractured posts without having to resort to additional means, such as the Masserann kit (Figures 6 a, b). The Masserann system is preferred to the Ruddle for removal

a

b

**Figure 6. (a)** Photograph of the Masserann kit**. (b)** Close up of a Masserann trepan.

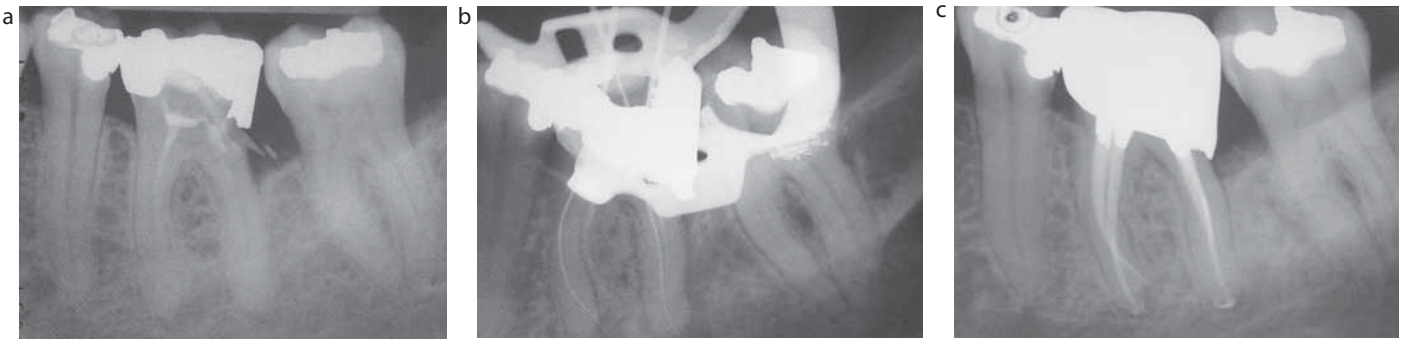


**Figure 7.** Series of radiographs showing a badly broken down lower first molar **(a)** which was restored with amalgam supported by a copper band prior to attempting removal of the hard paste. **(b)** Intermediate length determination radiograph showing hard paste still remaining deep within two of the canals. This was removed using an LN bur and ultrasonics. **(c)** Amalgam core and coronal restoration in place.

of fractured posts, as the metal trepans are thinner and therefore more conservative of tooth tissue. A suitably sized trepan is directed along the side of the post in the space created by the ultrasonic tips. A smaller trepan may then be used to grip and remove the fractured portion (additional ultrasonic vibration applied to the trepan may be useful at this point). If the post is of the screw-in type, then it may be unscrewed after the use of ultrasound to weaken the cement seal, either by placing a groove in its end or grasping it with a tight-fitting trepan. If this is unsuccessful, then a trepan should be selected which will cut along the threads of the post, as this will minimize the amount of dentine removed while easing the cutting of the metal. In exceptional cases, fractured posts may be drilled out using an end cutting bur. This procedure, however, is rarely necessary in view of the recent developments in ultrasonic tip design and improved magnification and lighting.

## Access to the apical third

Access to the apical third of the root is usually restricted by the presence of materials used to obturate the canal, those most frequently used including:

- Pastes, soft or hard;
- Gutta-percha;
- Silver points full length or sectional;
- Carrier-based materials.

A thorough evaluation of the access cavity should be performed, modifying it as necessary to give straight line access to the root canals prior to attempting removal of the obturation materials.

## Removal of pastes

Soft pastes can usually be easily penetrated using short sharp hand files and copious irrigation. The use of an ultrasonically powered file, with accompanying irrigation, can be helpful in these situations, especially for removing remnants of paste from root canal walls, which may remain despite careful hand instrumentation. It is important to remove such remnants, as they block tubules and fins, etc, preventing the dentine surface from being exposed to irrigating solutions. Rotary nickel titanium instruments may also be used to help in removal, but only after a smooth glide path has been established with hand files.

Hard pastes can be particularly difficult to remove and usually need to be drilled out with a small long neck bur, or chipped out using an ultrasonic insert, as described previously. These procedures can only be used in the straight part of the canal and it is important to use magnification and lighting, as they are high risk and may lead to going off line and perforation. Irrigation with EDTA and sodium hypochlorite should be employed, together with frequent drying, to ensure good visibility, especially deep within the canal. Small files may also be used and penetration can sometimes be achieved, as paste root fillings tend to be denser coronally and do not always set fully in the apical part of the root canal (Figures 7 a–c). Mixed results may be obtained with solvents such as chloroform Endosolve E or R.

## Removal of gutta-percha

Gutta-percha root fillings, which have been inadequately laterally condensed, may be removed by rotating one or two small Hedstrom files around or between the root canal filling points, pulling and elevating the points intact. An attempt should always be made to remove over extended points intact as, once solvents are used, it becomes more difficult to grasp the point and remove overextended material. If this is unsuccessful, then removal of the root canal filling should be considered in stages, removing first the coronal, followed by the middle and apical thirds. Gates-Glidden burs may be used coronally in the straight part of appropriately sized canals. These are available in a range of sizes and have a safe cutting tip that reduces the risk of perforation, provided that too large a size is not used. Care should be taken during their use as, if too fast a speed is used, then they may inadvertently screw into the canal and cause considerable damage; a suitable speed being 1000–1500 rpm. Other rotary instruments that may be used for the removal of gutta-percha include those made from nickel titanium (eg ProFiles or Orifice Shapers). These instruments are useful for removing coronal gutta-percha from large canals and around curves, provided a glide path has been confirmed. They are used at a higher speed (up to 500 rpm, in the straight part of the canal, to soften and elevate gutta-percha) than for canal preparation. Care is needed, however, when advancing around curves or into the apical region, when the speed should be reduced to 300 rpm.

Heat may be used to soften and remove gutta-percha in narrow canals conveniently, followed by files and solvent. Once a curvature is approached, then it is important to use a solvent such as chloroform,

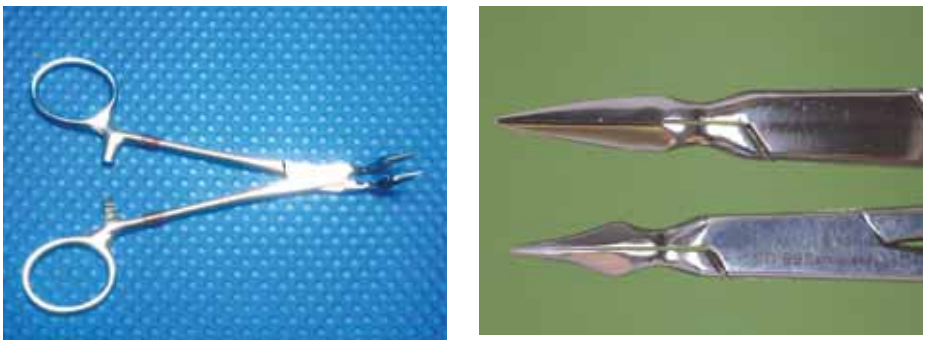


**Figure 8.** Steiglitz forceps before and after modification on a prosthetics lathe.

oil of cajaput or oil of turpentine to soften the gutta-percha, aid mechanical removal and reduce the chance of transporting the main axis of the canal. Chloroform is the most effective solvent for dissolving gutta-percha.[3,4] A small drop placed in the canal is all that is required, as it only softens the coronal end of the gutta-percha, which is then removed with hand files. The chloroform is replaced frequently as softened gutta-percha is removed and progress made to the terminus of the canal. Gutta-percha, softened with chloroform, tends to smear the canal walls, which may be removed by paper point wicking. However, chloroform itself, like all solvents, has a potentially toxic effect, so it is important to use it sparingly.

## Removal of silver points

Silver points are round in cross-section and therefore rarely seal canals adequately. Leakage occurs when sealer washes out, with subsequent corrosion leading to failure of the root canal filling. The approach to removal depends on whether the point extends and can be seen to extrude within the pulp chamber. In such situations, silver point snugness should be assessed by grasping with Steiglitz forceps (Figure 8) and levering gently, using the coronal aspect of the tooth as a fulcrum. Loose points will be easily removed in this manner and gentle manipulation is unlikely to remove valuable coronal silver point, which may be required for future grasping and extraction attempts. If the points cannot be removed easily, then ultrasonic vibrations can be applied to the forceps holding the point.

If the silver point has been cut off at the canal orifice, then it is generally not possible to grip it. In such situations, an ultrasonic tip may be used to cut a trough around the point. Care needs to be taken not to touch the point, as the silver is much softer than the steel used for manufacture of the ultrasonic tip, and preferential removal of the point will occur. A variety of removal techniques may be employed to grip the point and remove it once a trough approximately 2 mm deep has been prepared, such as a Masserann extractor (Figure 9a), Ruddle IRS (Figure 9b) or tube and glue/composite (see fractured instrument removal section). A silver point retreatment case is illustrated in Figures 9 c–e. On occasions it may be necessary to work a size 15 ultrasonic file down the side of a point placed deep in a root canal. Removal in these situations may be facilitated by placing a Hedstrom file alongside the point to aid elevation, with or without ultrasonic vibration.

## Removal of carriers

Carrier obturation techniques consist of a core surrounded by gutta-percha, and a combination of techniques used for the removal of gutta-percha and silver points is frequently indicated. Initial exploration along the side of the carrier with a solvent will

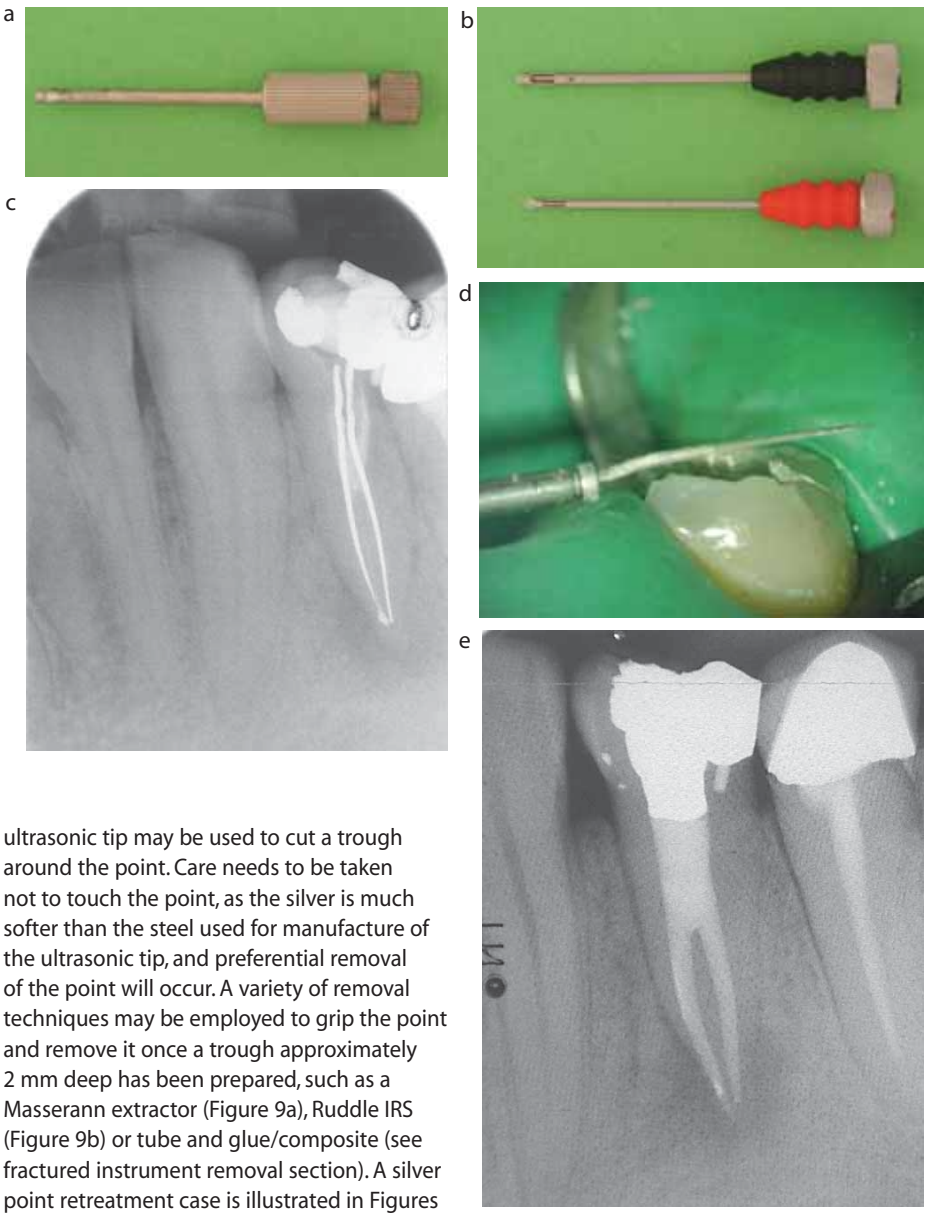



**Figure 9.** Photograph of **(a)** a Masserann extractor and **(b)** a Ruddle IRS. **(c, d, e)** A silver point retreat case in which the Masserann extractor was used to remove the points.

a

b

c

**Figure 10.** A carrier retreatment case where the carrier was bypassed, solvents and files prior to the use of a rotary NiTi file, and Steigitz forceps were used to remove the carrier: **(a)** pre-operative radiograph; **(b)** photograph following removal showing lingual fin/canal; **(c)** postoperative radiograph.

remove gutta-percha, create space in larger canals and may locate a groove on the side of the carrier to pass a rotary NiTi file alongside and frequently elevate the point. If this is not successful, then grasping or elevation techniques, as described in the silver point section, may be employed (Figures 10a–c).

## Management of fractured instruments

Instrument fracture can occur during root canal preparation but is not considered to be a negligent act. However, not informing the patient of such an event would constitute negligence.

Key factors in minimizing instrument fracture are as follows:

- Considering files as disposable items, discarding damaged instruments during treatment;
- Not forcing instruments;
- Using instruments in the correct sequence, alternating sizes and tapers as appropriate;
- Not rotating stainless steel instruments more than a quarter turn clockwise;
- Confirming a glide path to size 20 with hand files prior to using rotary NiTi instruments;
- Taking care with certain canal anatomy when using nickel titanium, canals that merge, divide or are dilacerated;
- Ensuring straight line access before preparing the canals, thereby reducing stress on the instruments.

The first thing to do in the event of a fractured instrument is to stop and evaluate the situation, as fractured instruments themselves are not a direct cause of failure, rather it is the indirect effects they may have, such as interfering with complete cleaning and disinfection of the canal. If the instrument has broken at length after thorough cleaning, then it may be preferable to leave the instrument *in situ* rather than risk removing excessive amounts of tooth structure or perforating the root in a vain attempt at removal. It is also pertinent to put things into context as to the effect this unfortunate incident will have on the outcome of treatment, for example, if the instrument broke near the end of canal preparation in an uninfected case, then it is unlikely to affect the outcome. On the other hand, instruments that fracture early in the preparation of infected root canals will prevent thorough debridement and are therefore more likely to be associated with problems.

A thorough evaluation of the root containing a fractured instrument should be undertaken, including multiple radiographic angles. Key information includes the following:

- The width and length of the fragment and whether it is stainless steel or nickel titanium (nickel titanium is more brittle than stainless steel and may fracture on contact with ultrasound);
- Location of the instrument – coronal, middle or apical third of the root;
- The anatomical cross-section of the canal, round or oval, the position of any curvature/recurvature and the portion of the fragment within this curvature;
- Presence or absence of apical periodontitis radiographically or clinical symptoms.

Key considerations in assessing fractured instruments include:

- Did the instrument break at the start or end of preparation;
- Multiple radiographic angles;
- Width and length of the fragment;
- Type of metal, stainless steel or nickel titanium;
- Location of instrument, coronal, middle or apical third;
- Anatomical cross-section of the canal, round or oval;
- Position of any curvature/recurvature, and portion of fragment within this curvature;
- Presence or absence of apical periodontitis.

Consideration of the above factors will influence choice of approach: orthograde, surgery or monitoring of the situation. Normally, an orthograde approach would be considered the one of choice for easily accessible instruments in the straight part of the canal. Discretion is advised as one moves further apically, especially in curvatures, as removal attempts of more deeply placed instruments may weaken or perforate the root. In such situations, surgery should be considered if treatment is required.

The stages in fractured instrument removal begin with the aim to improve radicular access and ensure good visibility to obtain a clear view of the instrument, using Gates-Glidden and modified belly Gates-Gliddens (Figure 11). The use of these instruments creates debris and copious irrigation using NaOCl, EDTA and alcohol is required to help improve vision after drying and assess the position of the instrument. Bypass should be attempted in the first instance, prior to attempting removal, as this

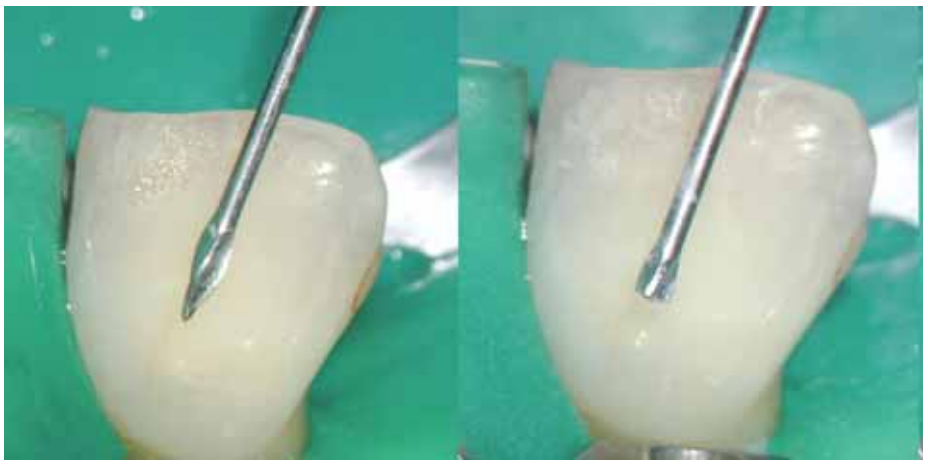


**Figure 11.** Photograph of unmodified and modified belly Gates-Glidden drills.

gives an early indication of the anatomy of the canal. Care must be taken not to force instruments, however, as the broken fragment may direct the 'bypassing' file off line, with the danger of perforation. Bypassing instruments becomes more difficult in the apical third, as canals are normally rounder in cross-section in this area. If it is possible to bypass the instrument, then cleaning and shaping procedures should be completed. Frequently, the instrument will be removed as part of the process, especially if a small ultrasonic file can be placed next to the instrument to flush it out, using a combination of gentle vibration and irrigation. If the fragment is not removed, then the canal should be shaped, irrigated and obturated to include the fractured instrument as part of the root filling; as in many situations success rate will not be affected.[5]

An operating microscope is required to aid visibility for removal of anything other than superficially placed instruments. Space may be created around the instrument using a small ultrasonic tip at low power, taking care to work in an anti-clockwise manner around the fragment. This lateral trough should be continued to a depth of 2 mm, if possible, prior to applying vibration laterally against the instrument, which may then unscrew. Superficially placed fractured instruments may be grasped by the Masserann extractor or Ruddle IRS in a similar way to silver points (Figures 12a–c). Alternative removal methods include placing a small amount of chemically cured composite inside a spinal needle, or a small amount of superglue or composite inside a close-fitting Cancellier tube (Figure 13) and placing the needle/tube over and around the exposed fractured instrument. The speed of set of the superglue can be accelerated by using a few drops of monomer, whilst the composite should be left for about five minutes before attempting manipulation of the fragment. Once set, the tube is rotated gently, with an emphasis on anticlockwise movement in order to attempt delivery of the fractured instrument (Figures 14 a–c).

Visibility decreases deeper in the canal and, in the case of an instrument that is completely placed in a curve, it may not be possible to see it at all. Ultrasound should be used at low power deep in the canal for dentine removal and file loosening. This will help avoid inadvertent dentine removal and disintegration of the only exposed part of an instrument that is slightly engaged in a curve. Delivery of the instrument may be complicated by it impacting against the outer canal wall as it is elevated, a situation that becomes more likely the longer the instrument. In such situations, space should be created laterally for the instrument to move in to. File straightening can be especially problematic with nickel titanium fragments, as these straighten on release from curvatures, thereby continuing to lie tight against the canal wall and resisting attempts to place retrieval instruments around them. In such situations it may be possible to tease the fragment out with a series of precurved small stainless steel files, but this is unpredictable.

## Regaining canal patency

Frequently, after removal of filling materials or broken instruments, blockage or a ledge will be noted, which prevents further progress down the canal and completion of cleaning and shaping. The first stage is to refine the coronal and radicular access, as this creates space for thorough irrigation with NaOCl/EDTA, placement of a lubricant

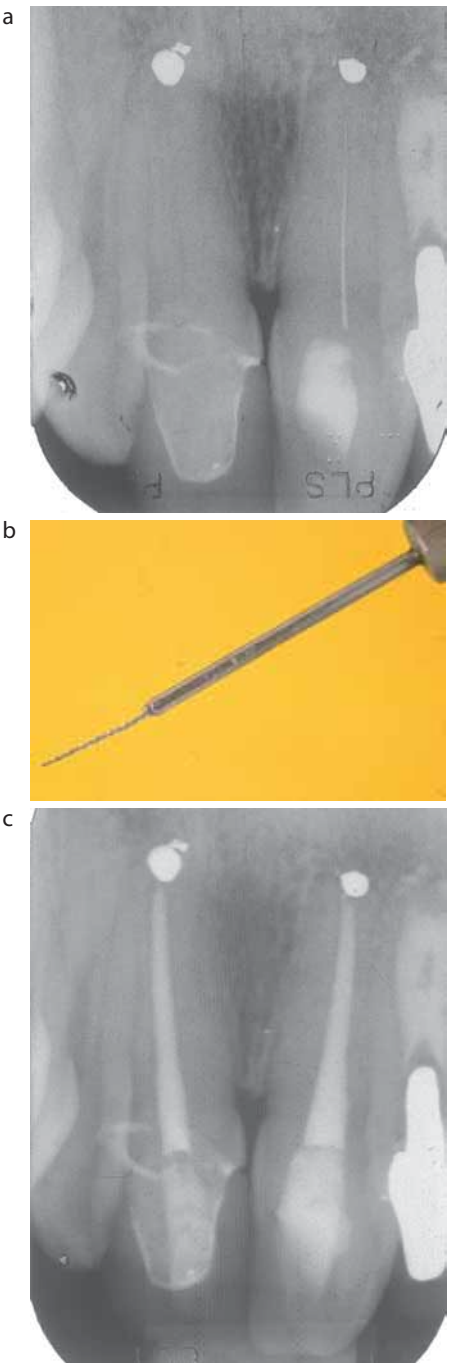


**Figure 12.** Superficially placed fractured instrument **(a)** removed with a Masserann extractor following troughing **(b, c).**

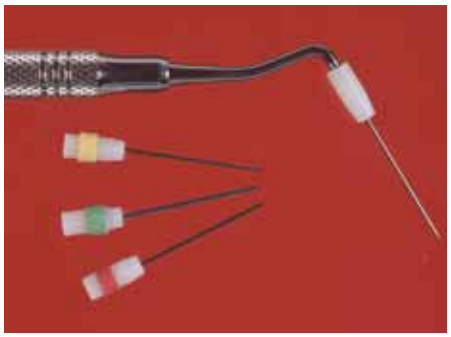


**Figure 13.** Photograph of Cancellier tubes which may be used with superglue to help remove fractured instruments.


**Figure 14.** Case demonstrating **(a)** fractured instrument, **(b)** ultrasonic troughing prior to engagement using tube and chemically cured composite and **(c)** postoperative radiograph following cleaning, shaping and obturation.

**Figure 15.** Buchanan file bender which may be used to place a small bend on the end of a file to help negotiate ledged canals.

and introduction of a small file with a curve, placed in its apical few millimetres, using a file bender (Figure 15). This instrument is directed towards the curvature and used to pick and probe the depths of the canal until a catch or bite is sensed. If this is not initially successful, then the file is removed and recurved or, alternatively, a new file substituted. Blockage and ledge negotiation may result in many small files being discarded. Once a bite is felt, then the file is moved in and out in small increments to smooth the path and advance apically. A very light watchwinding movement may also be employed with care. Files are advanced in this manner to the end of the canal, up to size 20, and the preparation may be smoothed using precurved 06 (white) and 08 (yellow) Hand GT files in reverse balanced force.

## Perforations

Perforations of the root canal may occur during root canal treatment. Breach of the pulp chamber floor in multi-rooted teeth during access, or labial perforation during access through crowned anterior teeth, are two of the more frequently encountered problems (Figures 16 a, b, 17 a, b), especially if there is limited visibility due to inflamed pulp tissue, or the canals are calcified. Several materials have been advocated for the management of perforations, with the current one of choice being Mineral Trioxide Aggregate (MTA) in view of its tolerance of moisture and sealing ability. However, this material requires a two-stage procedure and other single step techniques using barrier techniques may still be used on occasions.

The first stage of perforation management involves length determination using an apex locator and paper points, debriding/irrigating the area carefully to preclude a hypochlorite accident and then repair of the perforation. MTA is mixed to a stiff slurry, introduced to the site with a plastic instrument or suitable carrier, such as the Dovgan or Dentsply models and tamped gently into place with a plugger. A damp pledget of cotton wool is then placed over the MTA, the access sealed, and patient reappointed. At the next appointment, the MTA is evaluated by dragging a probe over its surface to ensure its set, and the root canal is then obturated (Figures 16 c, d). If it is desired to complete all treatment in one visit, then a barrier, such as calcium sulphate (*Calacept*) may be placed in the periradicular tissues up to the root edge, and *Super EBA* or glass ionomer inserted once moisture control is assured (Figures 17 c, d). The success of perforation repairs is related to the length of time they have been present, degree of infection, their size and relationship to the gingival margin. Perforations should be sealed as soon as possible, and the smaller they are the easier they are to deal with. Those closer to the cervical area are more likely to be associated with periodontal breakdown, whilst perforations in the apical third are frequently best managed surgically, as it may not be possible to renegotiate and obturate the apical few millimetres past the perforation.

## Antimicrobial management

Retreatment of teeth with apical periodontitis has a poorer prognosis than initial therapy, with infection at the time of treatment and the size of the lesion both influencing the outcome. The clinical ability to control infection in retreatment cases may be due to several factors. Bacteria lying in

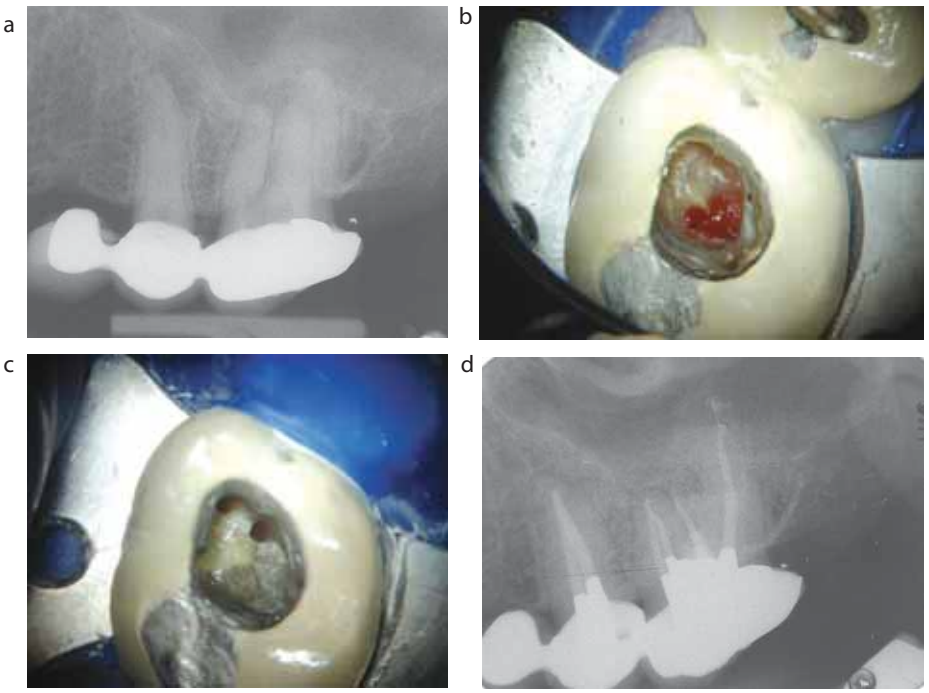



**Figure 16.** Case showing furcal repair using grey MTA: **(a)** pre-operative radiograph; **(b)** photograph of perforation site; **(c)** MTA repair; **(d)** postoperative radiograph. No barrier was used in this case and some furcal extrusion can be seen; this was uneventful.

canal recesses may be protected by residues of filling material and thereby not exposed to antibacterial agents. Existing ledges, transportation and obstructions may also prevent an optimal level of debridement and root filling.

As stated earlier, the aim of retreatment is to regain access to and treat infection within the root canal, the flora of which can be variable.[6] In cases where much of the root canal system has not been instrumented, then the flora is likely to be polymicrobial in nature, similar to that of a necrotic pulp, and antimicrobial management follows conventional lines; that is, thorough cleaning, disinfection and placement of $Ca(OH)_2$. If the previous root treatment has, however, managed most of the canal system, then the flora may be different, with only a few species being present. One organism that has been associated with such failures is *Enterococcus faecalis*,[7] which is resistant to elimination. Therefore, in such cases, a ten minute soak with 5% IKI, following preparation and smear layer removal, has been advocated,[8] together with adding IKI to the usual $Ca(OH)_2$ intervisit dressing to help eradicate this organism. An alternative is not to use IKI but add Camforated Mono Chloro Phenol to a slurry of $Ca(OH)_2$ and glycerine as an intervisit root canal dressing.[9] Many operators prefer not to use IKI in view of its allergenic potential.

## Conclusion

The success of re-root canal treatment is good (94–98%)[10] when it is being undertaken to achieve a technical improvement in potential failures. When

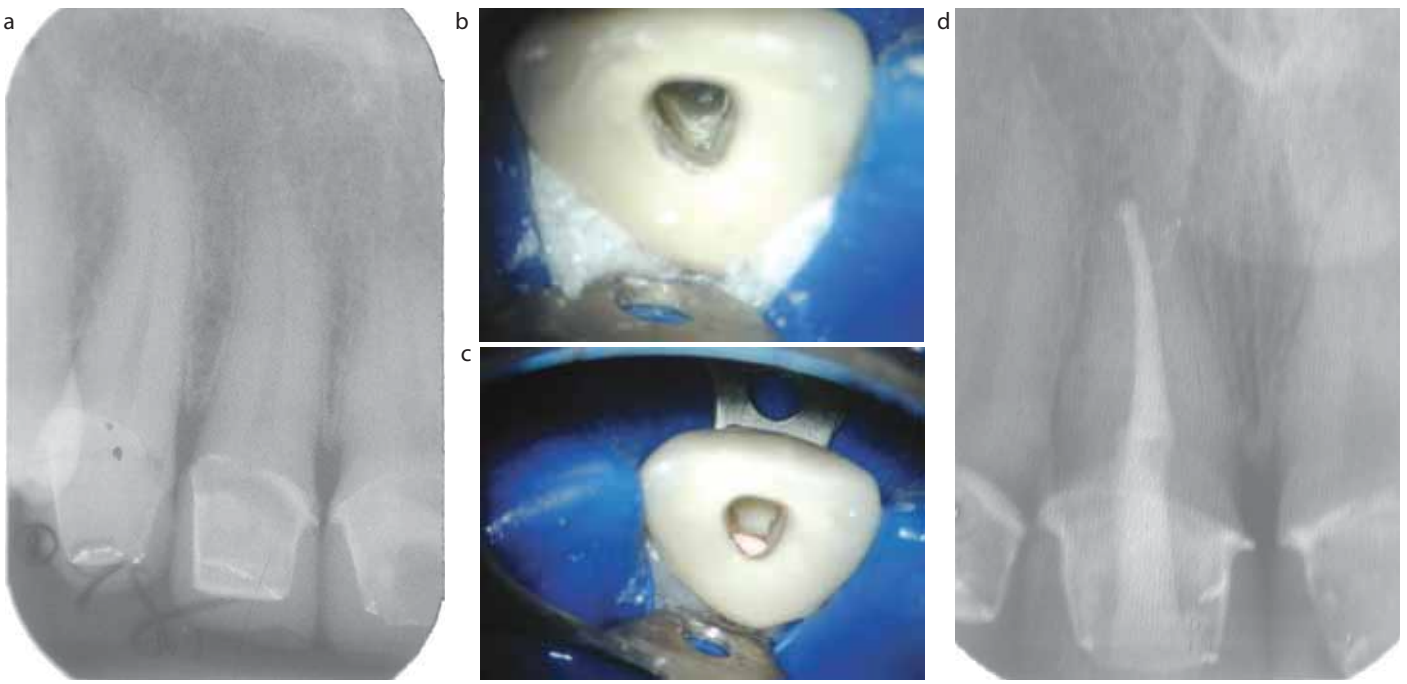



**Figure 17.** Case showing labial perforation: **(a)** pre-operative radiograph; **(b)** labial perforation; **(c)** glass-ionomer repair following placement of a barrier and **(d)** postoperative radiograph.

periradicular pathology is present, the success rate is much lower (62–78%).[11,10] Retreatment itself can bring its own problems:

- Perforation;
- Fractured instruments;
- Compromised, cleaning, disinfection and obturation of the root canal system.

Therefore, it is important that patients are informed of such factors prior to embarking on this procedure.

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