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Posts – When It All Goes Wrong!

Part 2: Post Removal Techniques

Abstract: Many different techniques for the removal of posts have been proposed over the years, including the development of a number of different instruments and systems. This article discusses a number of the more common techniques, systems and their indications.

Clinical Relevance: Dentists should be aware of the techniques available for the removal of posts and understand which techniques are appropriate for individual cases.

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The previous article in this series discussed the variety of post systems that are available on the dental market and the incidence and reasons for failure of teeth that have been restored with posts. It also discussed the treatment options available for the management of such failures and highlighted the importance of carrying out a thorough assessment to aid with treatment planning. Post removal is often indicated, and this article will describe the various techniques and systems available and their indications.

Preparation prior to post removal

The preparation required prior to

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post removal will vary depending on what type of post is present and what technique for removal is going to be used. The tooth should be isolated (preferably with rubber dam) to prevent the inhalation or ingestion of post fragments or instruments during the procedure and to maintain an aseptic working environment.

Informed consent must be obtained from the patient and other possible treatment options discussed. In cases of endodontic failure, these may include periradicular surgery, extraction, or monitoring of a radiographic lesion, and the advantages and disadvantages of each approach must be discussed. If post removal is necessary because of a fractured post, the alternatives are limited to keeping the root as an overdenture abutment, retaining a core with dentine pins (a compromise with a poor long term outcome) or extraction.

Many different techniques for the removal of posts have been proposed over the years, including the development of a number of different instruments and systems. Not all techniques may be appropriate for every case and often the use of multiple approaches is necessary. Although individual techniques may vary, all should aim to meet the same objectives in that: the techniques and systems are simple, efficient and, most importantly, that the removal of the post is achieved without compromising the remaining tooth structure or causing iatrogenic damage.

Techniques to remove a post

Drilling out the post

Metal and zirconia posts

Drilling out metal posts carries with it a high risk of iatrogenic damage in the form of a root perforation as the bur tip tends to 'skid off' the relatively hard post into the surrounding softer tooth tissue. Even if post removal is successful without perforation, often a substantial amount of dentine is lost, weakening the tooth further (predisposing it to root fracture), and an irregular-shaped post space is produced which may complicate further restorative procedures. There is also the risk that the bur itself may fracture and, as such, this technique is rarely used. Attempting to remove zirconia posts by drilling them out shares the same dangers and difficulties as metal posts. There is a variety of more suitable techniques available for the removal of metal and zirconia posts, which will be discussed.

Fibre posts

Unlike metal and zirconia posts, fibre posts can be removed with drills. This technique is theoretically relatively quick and simple and is best completed using a fibre post removal kit. Owing to the material properties of fibre posts, this procedure does not carry the inherent risks and dangers that are associated with drilling out metal and zirconia posts. Fibre posts are constructed using stretched,

parallel fibres that run longitudinally along the length of the post and which are embedded in a resin matrix. These act to guide the removal drills and keep them within the confines of the post, reducing the tendency for the bur to stray off the post into the surrounding tooth tissue. This therefore reduces the risk of perforation or weakening the tooth to such an extent that predisposes it to root fracture.

Fibre post removal kits usually consist of a pilot drill and a series of post removal drills (which are customized to be used with specific post systems), such as the DT Light-Post® Removal Kit (Figure 1) produced by RTD (Recherches Techniques Dentaires, France). The generic procedure for the removal of a fibre post is outlined in Table 1. If there is a large cement 'plug' apical to the post,



Figure 1. DT Light-Post® Removal Kit (RTD, France) – comprising pilot drill (right) and post removal drill (left). (Picture courtesy of RTD, France.)

this can complicate access to the root filling to allow removal, however, it is possible to use ultrasonic energy under magnification to remove the residual cement 'plug'.

Where fibre posts are concerned, it can sometimes be difficult to differentiate between tooth tissue and post material owing to the colour match of many of these fibre posts. The DT Light Post™ Illusion™ (RTD, France) potentially overcomes this problem as these fibre posts change colour when cooled with the water spray from a dental drill or 3 in 1 syringe (Figure 2).

Ultrasonic energy

Ultrasonic energy can be used to cause microscopic vibration of the post which shatters the cement lute, loosening the post with minimal damage to the remaining tooth tissue. This having been said, Altshul *et al* identified a statistically significant increase in the number of dentinal cracks present following the use of ultrasonic energy to attempt to remove posts, compared to teeth where no attempt had been made to remove the post.¹ Ultrasonic energy can either be used on its own or in combination with other techniques.² In addition, if there is limited inter-arch space (eg posteriorly) it can be used where other post removal techniques cannot.³ A protocol for the use of ultrasonic energy is shown in Table 2.



Figure 2. DT Light Post™ Illusion™ (RTD, France) – these fibre posts change colour when cooled with the water spray from a dental drill or 3 in 1 syringe which allows easier differentiation between tooth and post material when attempting removal.

How long should it take?

It is generally accepted that ultrasonic energy is of benefit when trying to remove posts from root canals.^{5–10} Two to five minutes of ultrasonic energy reduces the amount of force required to remove a post, however, as a general rule, one minute of ultrasonic time is required per millimetre of cemented post length.^{5,10} Ultrasonic energy should be able to remove a standard length post in under 10 minutes and, if this has not been achieved, alternative techniques should be considered.^{6,8} However, in the authors' experience, perseverance beyond this time limit is often rewarded.

The post material, type of luting cement and post design used may also influence the effectiveness of ultrasonic energy for post removal.

Influence of post material

It is known that the conductance of vibratory forces within a post is proportional to the square root of the modulus of elasticity of the material the post is made from.¹¹ Posts made from softer metals (such as cast posts) do not respond as well to ultrasonic energy compared to harder, prefabricated posts.¹² It is for this reason that ultrasonic energy is not very effective when attempting to remove a fibre post.

Influence of luting cement

Cement type influences the effectiveness of ultrasonic energy during post removal. Posts cemented with adhesive resin luting cements (eg *Panavia 21*, Kuraray, USA) have been shown not to be influenced by a 10 minute application of ultrasonic energy, unlike those cemented with zinc phosphate or glass ionomer cement.⁷ However, one endodontic textbook reports that composite is one of the easiest materials to loosen via the use of ultrasonic energy due to the difficulties in bonding to intra-radicular dentine.¹³ There is no consensus as yet in this area and the outcome is most likely influenced by degradation of the radicular dentine bond over time.¹⁴ It is the authors' experience that any

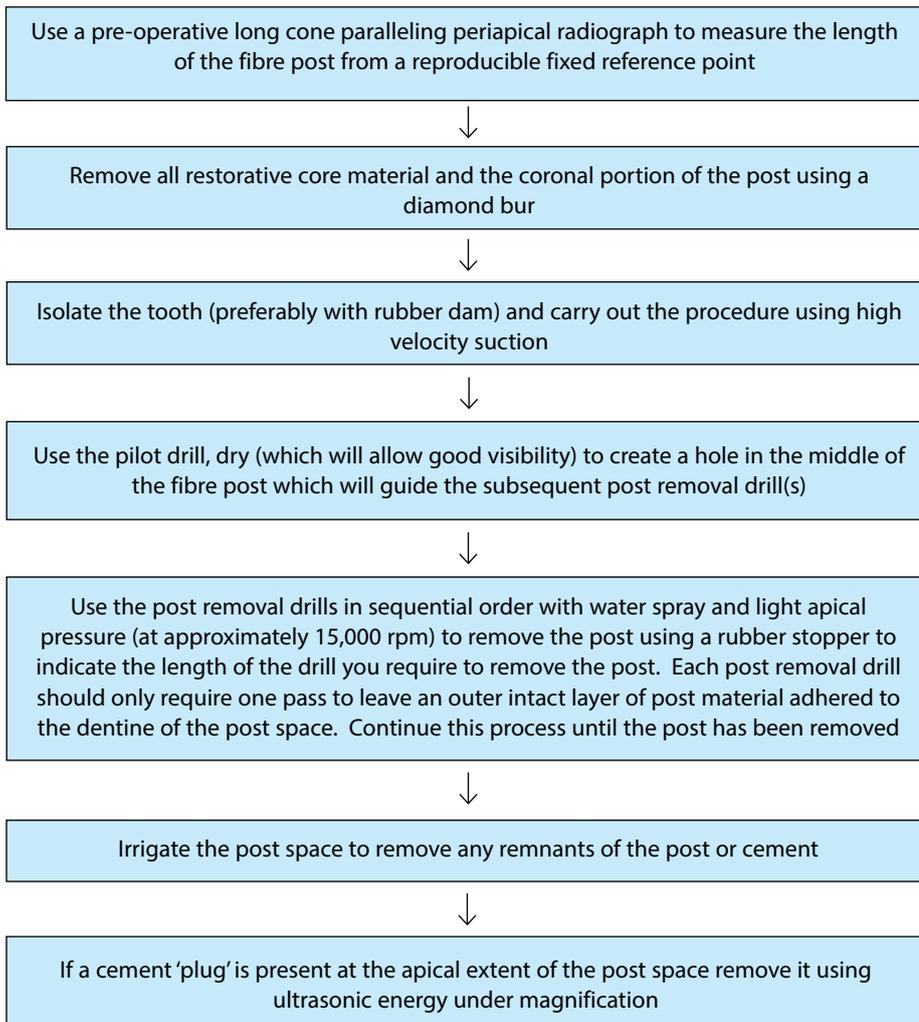


Table 1. Generic procedure used to remove a fibre post.

indirect metal restoration cemented with an adhesive resin luting cement is more difficult to remove.

Influence of post design

The design of post may also influence the effectiveness of ultrasonic energy for post removal. Passive, prefabricated, parallel-sided posts are arguably the easiest to remove as it is unlikely that they are well adapted to the coronal third of the post space, resulting in a thicker layer of luting cement which is easier to break down. Once disrupted, the cement can sequentially be broken down along the length of the post as the fulcrum point of the post moves apically. It is thought that ultrasonic energy has a

two-fold effect via the transmission of energy to the post and the movement of the post within the post space, once the cement layer has been removed coronally.

There is a wide range of different ultrasonic units and tips on the market, some specifically designed to remove canal obstructions, such as the ProUltra® ENDO Tips (Dentsply/Maillefer, Tulsa Dental, OK). Ultrasonic tips should be used with a very light brushing motion and there is considerable debate whether or not they should be used dry or with irrigation (eg sodium hypochlorite, chlorhexidine, saline or distilled water). Some dentists report that they should be used dry with the

dental nurse blowing a constant stream of air from the 3 in 1 syringe to remove debris and dust and to cool the tooth. *In vitro* evidence has shown a rapid increase in the temperature of the root surface and therefore possible damage to periodontal ligament cells, even if an ultrasonic tip is used with maximal water spray.⁴ Care should therefore be exercised when trying to remove a post in this way.

Threaded posts

Threaded posts are classified as active posts and can often be the easiest type of post to remove. The ease of removal depends on whether or not the coronal aspect of the post is damaged, if it is accessible and what material has been used to cement it *in situ*. One very important point to note is that post pullers should never be used to remove active posts as their use will generate excess forces which could easily cause a root fracture.

If the head of the post is accessible, not damaged and a non-adhesive resin luting cement has been used to cement it, removal is usually a simple case of unscrewing it in an anti-clockwise direction. Some systems, such as those manufactured by Dentatus AB (Sweden), have a matched hand wrench which can be inserted into or onto the post head to facilitate this. Even if the head of the post is damaged or the post has fractured, as long as the coronal portion of the post is accessible, it can still usually be unscrewed using haemostats or similar forceps (Figure 3). When unscrewing an active post, it is essential not to apply any lateral forces as this could cause a root fracture. If the post has fractured flush with the tooth tissue, it can sometimes still be unscrewed by cutting a narrow groove in the exposed surface of the post and attempting to unscrew it with an instrument resembling a screwdriver head.

Ultrasonic energy can be used in combination with the above technique in an attempt to break the cement lute, as has been discussed. If these attempts fail, a Masserann Kit (Micromega, Besancon, France) (or a



Figure 3. Removal of an active threaded post using artery forceps. **(a)** Pre-operative long cone paralleling periapical radiograph. UL1, 2 both require repeat orthograde root canal treatment. UL1 has been restored with an active threaded post and crown and UL2 with a passive, parallel-sided, smooth post and crown. **(b)** UL1 following removal of the coronal restoration (the restoration and post have already been successfully removed from UL2). **(c)** Use of artery forceps to unscrew the post in an anti-clockwise direction ensuring no lateral or apical forces are applied which could result in the formation of dentine cracks or a root fracture. **(d)** The successfully removed active threaded post.

similar post removal system) may need to be used.

Removal of passive posts with haemostats or similar forceps

Haemostats can be used to remove passive, prefabricated cylindrical posts in addition to active threaded posts (as has previously been discussed), however, they can only be used if the head of the post can be grasped. A

variety of different shapes and angles of instruments is available. Kleier and Mendoza suggested that there is a significant advantage in using tungsten carbide needle holders (such as Perma-Sharp™ needle holders manufactured by Hu-Friedy, Chicago, IL) as opposed to the stainless steel instruments mentioned previously, as a high friction grip cannot be achieved with instruments that have a similar metal hardness to the posts. They reported that tungsten carbide bites into softer stainless steel which creates a

more positive frictional grip.¹⁵

Initially, all restorative material should be removed to allow access to the post head and, as has previously been stated, it is important when using haemostats to ensure that no lateral or apical force is applied, as this could result in the formation of dentine cracks or root fracture.

Prefabricated posts are circular in cross-section and are often only well adapted to the apical part of the post space due to the shape of root canals. With this in mind, it is possible to apply slight rotational forces to attempt to break the cement seal, in combination with a very gentle coronally directed force, to try to remove the post from the canal. The use of ultrasonic energy can also be used in combination with haemostats to try to remove as much of the cement lute, directly in the coronal aspect of the post space and indirectly by trying to break the cement lute by transmitting energy through the post.

Custom-made posts (made as cast post and cores), on the other hand, are usually very well adapted to the entire post space and are not circular in cross-section. It is therefore essential not to apply any rotational forces to them as this could cause a root fracture. Instead, ultrasonic energy should be used in combination with gentle coronally directed forces to try to remove the post.

It has, however, been reported that the use of haemostats is prone to complications and is more dangerous than using post pullers, which will be discussed later.^{12,16}



Figure 4. Masserann Kit (Micromega, Besancon, France).

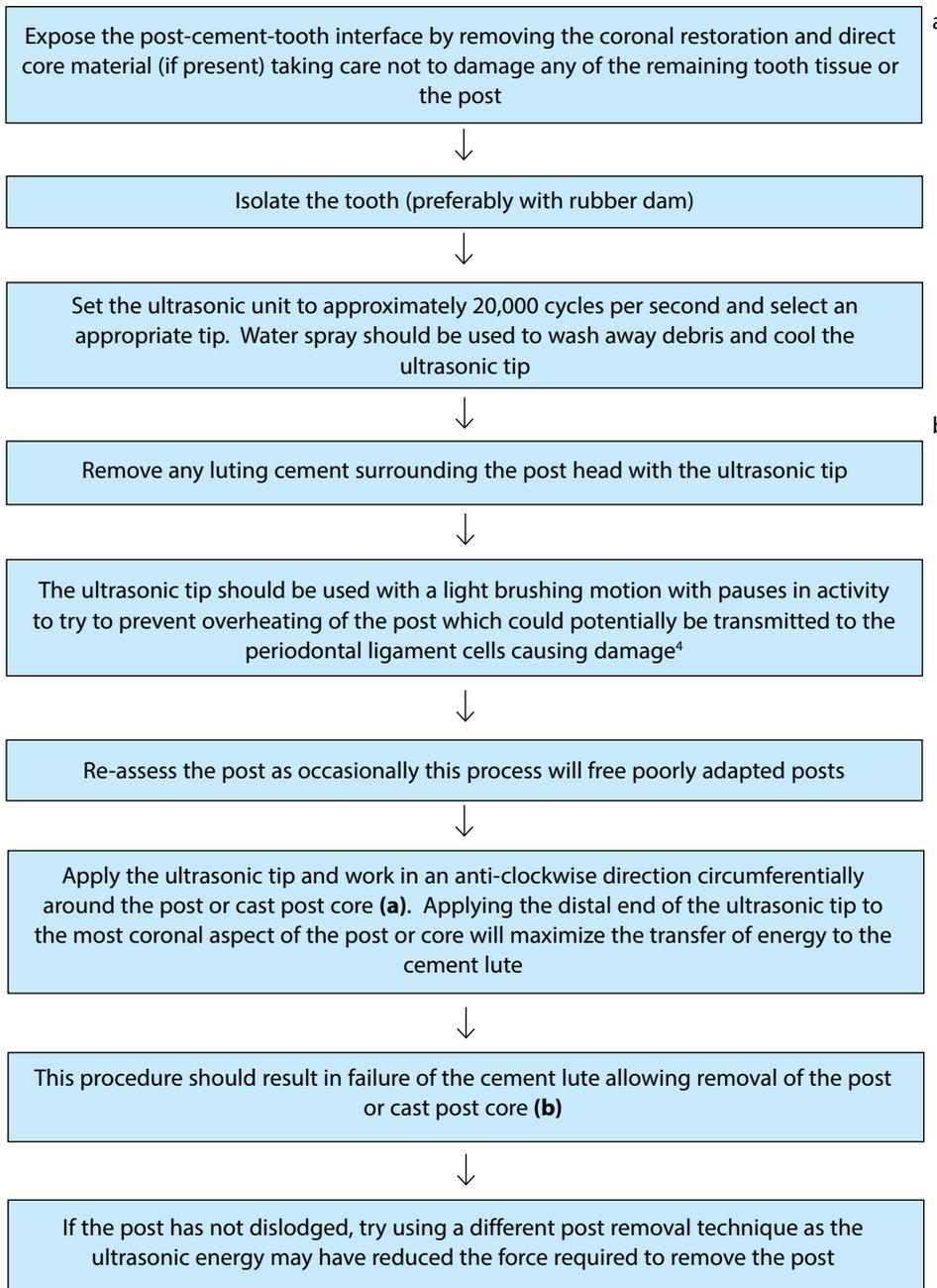


Table 2. Protocol for the use of ultrasonic energy.

Trephines

Masserann Kit (Micromega, Besancon, France)

The Masserann Kit (Figure 4) comprises a variety of trepan burs which are end-cutting tubes with two saw teeth of differing diameters and lengths which can be attached to a handle (Figure 5). The trepan burs are used to remove

cement and dentine from around the periphery of the post, which then allows the post to be removed. The use of the Masserann Kit is specifically indicated where there is little or no coronal post material accessible, which contraindicates the use of a number of other techniques. The Masserann Kit can be used in combination with ultrasonic energy, and it has been claimed that

this is the most efficient method when removing a fractured post.¹⁷

The advantages of the Masserann Kit are that it is simple to use, little heat is generated during its use and it has been stated that, if used correctly, excessive forces are avoided, reducing the likelihood of causing a root fracture or perforation during removal.¹⁸ However, if used incorrectly, they do have

a tendency to remove excess tooth tissue and increase the risk of perforation.¹⁹

The technique for the use of the Masserann Kit is described in Table 3. As previously mentioned, it is advisable to use ultrasonic energy during the procedure to aid with breaking of the cement lute, either directly or indirectly, via application on the post tip.

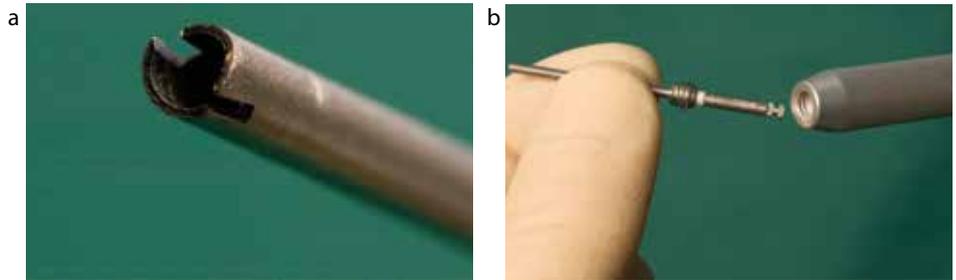


Figure 5. Trepan burs – end-cutting tubes with two saw teeth of differing diameters (a) which can be attached to a handle (b).

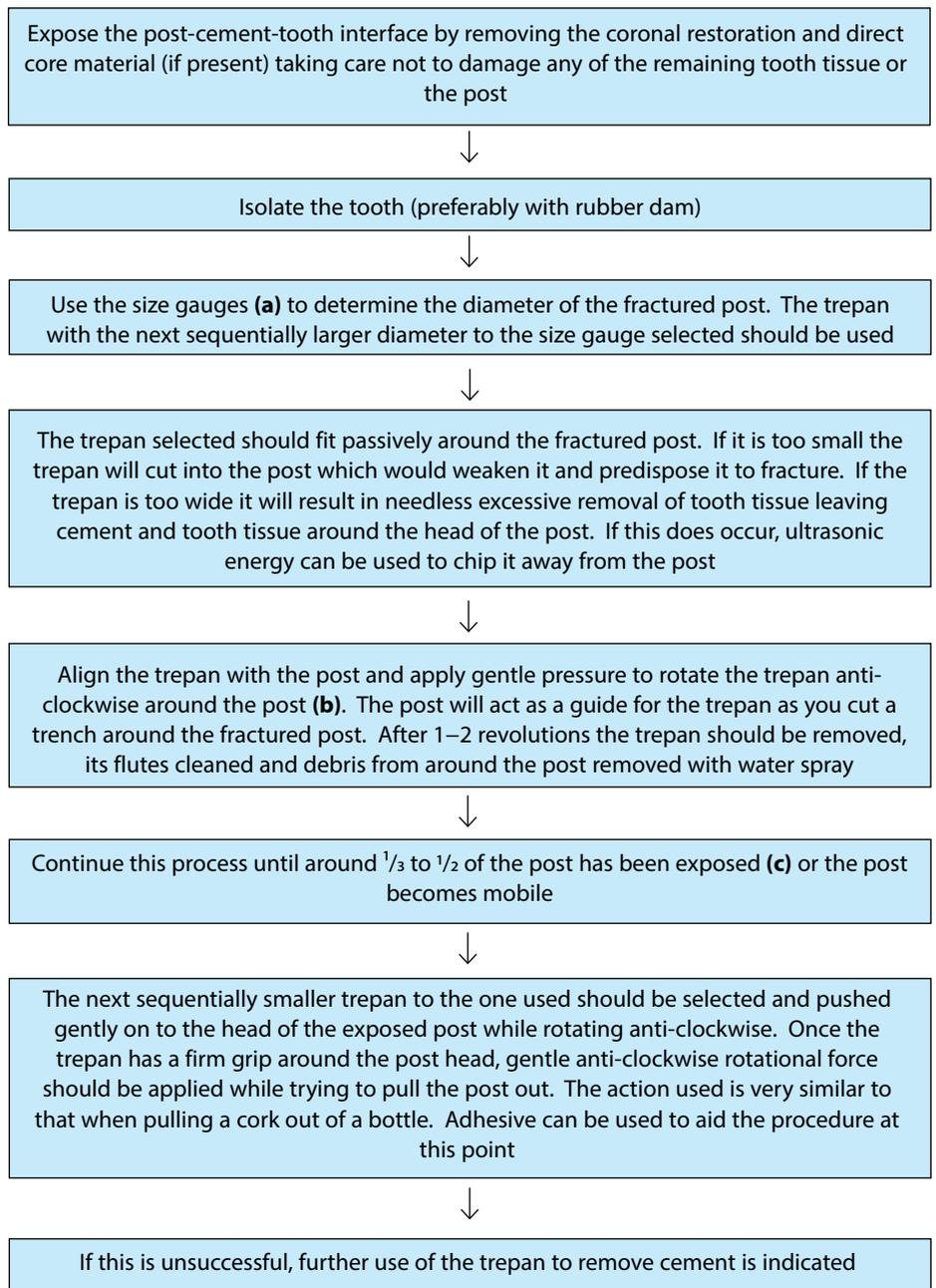


Table 3. Procedure for use of the Masserann Kit (Micromega, Besancon, France).

Post pullers

There is a wide variety of different systems on the market and, although they may differ in design, their action is all modelled on the same principle: create enough force to break the cement bond and 'pull' the post out of the root canal. Owing to their mode of action, post pullers should therefore only be used with passive posts and never used with active posts, as this is likely to cause a root fracture. Post pullers are most commonly used for anterior teeth as sufficient inter-arch distance is required for their use. Post pullers have been reported to be highly efficient and the advantages of using them include conservation of remaining tooth structure, reduced risk of root fracture, reduced risk of root perforation and reduced risk of torque forces being placed on the root.¹⁹

Ruddle Post Removal System (Analytic Endodontics, SybronEndo, Orange, CA, USA)

This system works in a similar



Figure 6. Ruddle Post Removal System (Analytic Endodontics, SybronEndo, Orange, CA, USA) – comprising an extracting plier, a transmetal domer bur, five trephines of varying internal diameters, five corresponding tubular taps and rubber bumpers of varying diameter.

way to the Gonon Post Remover (Ron Chige Inc, Boca Raton, FL, USA) and the Thomas Universal Post Remover (FFDM Pneumat, Bourges, France). The Ruddle Post Removal System comprises an extracting plier, a transmetal domer bur, five trephines of varying internal diameters, five corresponding tubular taps and rubber bumpers of varying diameter (Figure 6). Table 4 outlines the procedure for the use of this system to remove passive posts (but the same basic principles and operational techniques apply to the Gonon Post Remover and Thomas Universal Post Remover).

Several issues can arise during the use of this system:

- The tubular tap should be screwed down by 3mm, if it is less than 3mm it may dislodge, which could strip the threads created off the post. If the tubular tap is screwed down more than 3mm, it may split or snap the head of the post.
- If increasing resistance is felt as the knob is turned you should use ultrasonic energy to break the cement bond and then repeat the procedure. This combination promotes failure of the cement bond and allows post removal.¹
- In the event that the threads are stripped from the post, if sufficient vertical height of the post remains, you can simply trephine down further and repeat the procedure. If insufficient vertical height remains, select the next smallest trephine and tubular tap to prepare the post, however, this will be less retentive.⁸
- If the head of the post shears off during the procedure and there is not enough coronal post material remaining to repeat the procedure, you may have to use a trephine technique such as the Masserann Kit to remove the post. The risk of shearing off the post head can be minimized by using a lubricant when attaching the tubular tap to the post and by screwing the tubular tap on 60–90° anti-clockwise, initially, then reversing 30° clockwise.⁸

The Ruddle Post Removal System can also be used to remove active threaded posts, but it is essential that the extracting pliers are not used. The tubular tap should be attached as described in Table 4 and rotated in an anti-clockwise direction with finger pressure. A torque bar can be used to increase leverage and ultrasonic energy may also facilitate post

removal.⁸

When using the Ruddle Post Removal System to remove a post from an anterior tooth with intact, adjacent teeth which have a level incisal plane, the removal loads can be spread over these teeth by placing wooden spatulas across the adjacent teeth and securing them with any restorative material. The arm of the extracting plier is then positioned to brace against this platform and activated. It is important, if this approach is adopted, that you ensure you are not elevating the tooth out of its socket as tooth extraction could occur!⁸



Figure 7. Egglar Post Remover (Automaton-Vertriebs-Gesellschaft, Germany).

Expose the post-cement-tooth interface **(a)** by removing the coronal restoration and direct core material (if present), taking care not to damage any of the remaining tooth tissue or the post. Gain straight line access to the post with complete circumferential access to at least 4mm of the post head **(b)**. Occasionally, this process will loosen poorly adapted posts⁸



Round off the coronal aspect of the post using the domer drill to facilitate the positioning and location of the trephine **(c)**



Select the largest trephine that engages the post. If the trephine only fits passively, then select the sequentially smaller trephine. Using a pecking action, drill down 2–3mm with the trephine in a high torque, slow-speed hand piece, rotating clockwise at approximately 15,000rpm **(d)**. A chelating agent eg Glyde™ File Prep (Dentsply/ Maillefer, Tulsa, OK) can facilitate this machining process.⁸ A perfectly round post head is created



Screw the corresponding tubular tap down approximately 3mm using firm pressure in an anti-clockwise direction. Rubber bumpers should be placed over the tubular tap to protect the root face during post removal as these will evenly distribute pressure over the root face **(e)**



Attach the extracting plier **(f)** to the tubular tap and open its jaws by turning the knob anti-clockwise. As the jaws of the pliers move apart, the post will be lifted out from the tooth **(g)**. Ensure you remove the post along the long axis of the post space/tooth to decrease the likelihood of a root or post fracture. As the jaws move further apart, the force shifts away from the long axis of the post space/tooth and, therefore, additional rubber bumpers should be added to redirect the forces along the long axis⁸



Once the post has been safely removed **(h)** the tubular tap can be rotated clockwise to disengage it from the post **(i)**

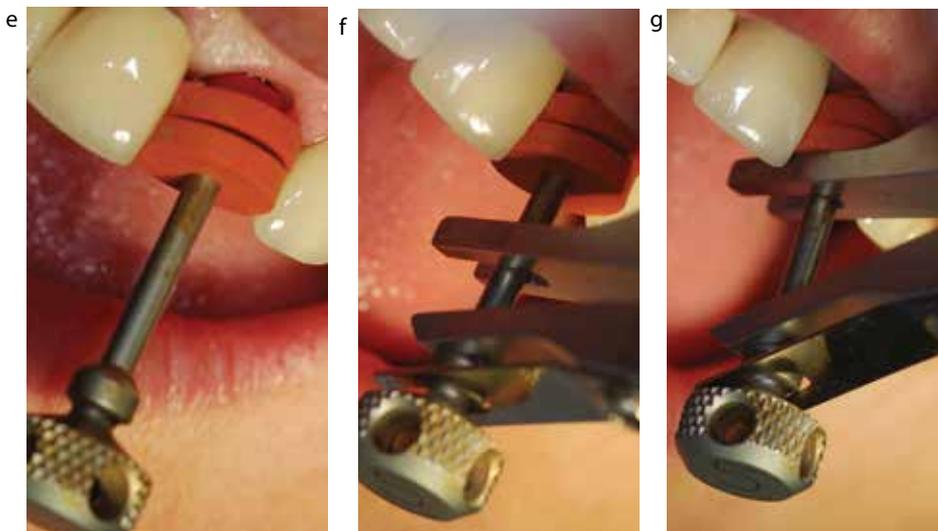


Table 4. Procedure for use of the Ruddle Post Removal System (Analytic Endodontics, SybronEndo, Orange, CA, USA).

Use a flat-ended diamond bur to make the mesial and distal root faces the same height **(a)**. This creates a flat surface for the repelling arms of the Egglar Post Remover in line with the long axis of the root. Do not use the Egglar Post Remover if there is a difference in the levels of the root face on the mesial and distal aspects



Reduce and shape the core to accommodate the stabilizing and repelling arms **(b)**



Position the Egglar Post Remover **(c)** over the core with the stabilizing arms on the labial and palatal aspects. Turn the large knob clockwise to bring the stabilizing arms together until the Egglar Post Remover has a firm and stable grip of the core **(d)**



Turn the smaller thumbscrew clockwise to activate the repeller arms. It is important to ensure that the Egglar Post Remover is positioned along the long axis of the root and the repeller arms contact the root face simultaneously and uniformly as they lower onto the mesial and distal root surfaces **(e)**



The post will be withdrawn coronally along the long axis of the root as the stabilizing arms holding the core move away from the root face **(f)**. The position of the repeller arms should be monitored throughout the procedure as they can splay and cause dentine fractures



The post **(g)** will eventually be removed completely from the root **(h)**



Table 5. Procedure for use of the Egglar Post Remover (Automaton-Vertriebs-Gesellschaft, Germany).

Egglar Post Remover (Automaton-Vertriebs-Gesellschaft, Germany)

To the authors' knowledge, the Egglar Post Remover (Figure 7) is no longer commercially available, however, sufficient numbers should be in circulation and use to justify its description here for completeness. The Egglar Post Remover is effective and simple to use and is most suited for the removal of passive cast post cores, and it is hoped that its description might inspire its re-introduction by a manufacturer in the future. Its use is contra-indicated in cases where there is insufficient core material present, or if there is a lack of inter-arch space. This means that it is mainly used in anterior and premolar regions. The use of the Egglar Post Remover involves very little removal of the remaining tooth structure, and the risk of causing a root fracture or root perforation is minimal as posts are withdrawn along the long axis of the tooth, eliminating root torquing forces.²⁰ The procedure for the use of the Egglar Post Remover for the removal of passive cast post cores is described in Table 5.

The Egglar Post Remover may not be appropriate for use to remove posts from teeth which have very narrow roots, or roots with very thin dentine walls, owing to the risk of root fracture occurring when the repeller arms engage these root surfaces.²⁰ As with all post pullers, the Egglar Post Remover should only be used to remove passive posts and should not be used to remove active posts. Care should be taken when using the Egglar Post Remover if the post has been placed at a significantly different angle from that of the long axis of the root. A study demonstrated that, if the Egglar Post Remover is used at a 10° angle to the long axis of the root for post removal, 20% of the teeth suffered damage compared to 0% if it was positioned correctly (parallel to the long axis of the root). However, only one of the 20% of damaged cases rendered the tooth unrestorable.²⁰

Following post removal

Following the removal of the post from the root, it is essential that the remaining root is examined for

cracks. If indicated, repeat orthograde root canal treatment should be completed prior to definitive restoration. The options for restoration of a root would usually include either the placement of a new post-retained restoration or the use of the root as an overdenture abutment (possibly incorporating precision attachments). If a post required removal due to fracture, it is essential to assess the reasons why this occurred so that these can be addressed in any future restoration, hopefully reducing the likelihood of repeated failure and post fracture.

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