IN BRIEF

- Before any dental treatment is provided it is essential that the patient's symptoms have been correctly diagnosed.
- Conditions causing dental pain on first presentation may include pulpitis (reversible or irreversible), periapical periodontitis, dental abscess, as well as cracked tooth syndrome and other oro-facial pain disorders.
- Conditions arising during treatment may include high restorations, (probably the most common), root or crown fractures, problems with root canal instrumentation and infection.
- Following treatment pain may be due to any of the above, or failure of the root canal treatment. However, patients should always be cautioned to expect a certain amount of post-treatment discomfort.

VERIFIABLE CPD PAPER

Endodontics: Part 3
Treatment of endodontic emergencies

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The swift and correct diagnosis of emergency problems is essential when providing treatment, especially in a busy dental practice. A diagnosis must be made and appropriate treatment provided in usually just a few minutes. The sequence considered here encompasses problems presenting before, during and after dental treatment. Various diagnostic aids are considered, and some unusual presenting conditions discussed.

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Refereed Paper
doi:10.1038/sj.bdj.4811641
© British Dental Journal 2004; 197: 299–305

The aim of emergency endodontic treatment is to relieve pain and control any inflammation or infection that may be present. Although insufficient time may prevent ideal treatment from being carried out, the procedures followed should not prejudice any final treatment plan. It has been reported that nearly 90% of patients seeking emergency dental treatment have symptoms of pulpal or periapical disease.[1,2]

Patients who present as endodontic emergencies can be divided into three main groups.

Before treatment:

1. Pulpal pain
   a) Reversible pulpitis
   b) Irreversible pulpitis
2. Acute periapical abscess
3. Cracked tooth syndrome

Patients under treatment:

1. Recent restorative treatment
2. Periodontal treatment
3. Exposure of the pulp
4. Fracture of the root or crown
5. Pain as a result of instrumentation
   a) acute apical periodontitis
   b) Phoenix abscess

Post-endodontic treatment:

1. High restoration
2. Overfilling
3. Root filling
4. Root fracture

BEFORE TREATMENT

Details of the patient's complaint should be considered together with the medical history. The following points are particularly relevant and are covered more fully in Part 2.

1. Where is the pain?
2. When was the pain first noticed?
3. Description of the pain.
4. Under what circumstances does the pain occur?
5. Does anything relieve it?
6. Any associated tenderness or swelling.
7. Previous dental history:
   a) recent treatment;
   b) periodontal treatment;
   c) any history of trauma to the teeth.

Particular note should be made of any disorders which may affect the differential diagnosis of dental pain, such as myofascial pain dysfunction syndrome (MPD), neurological disorders such as trigeminal neuralgia, vascular pain syndromes and maxillary sinus disorders.

Diagnostic aids

- Periapical radiographs taken with a paralleling technique.
- Electric pulp tester for testing pulpal responses.
- Ice sticks, hot gutta-percha, cold spray and hot water for testing thermal responses.[3]
- Periodontal probe.

Pulpal pain

The histological state of the pulp cannot be assessed clinically.[4,5] Nevertheless, the signs and symptoms associated with progressive pulpal

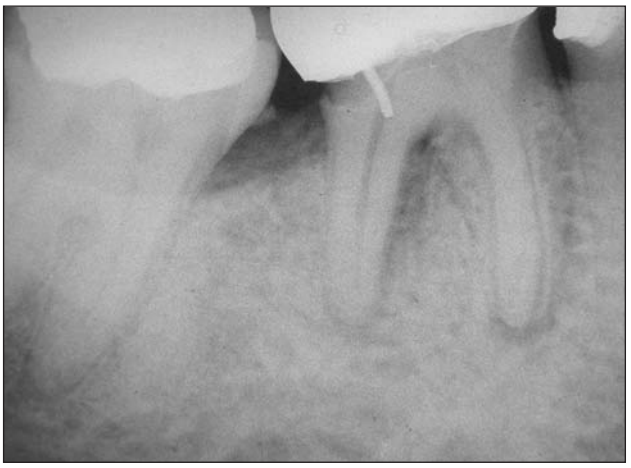

Fig. 1 Initial radiographic assessment. Radiographs should be checked for any relevant information such as deep caries, pinned restorations, and the appearance of the periodontal ligament space.

and periapical disease can give a reasonable indication of the likely state of an inflamed pulp, that is whether it is reversibly or irreversibly damaged.[6]

Irritation of the pulp causes inflammation, and the level of response will depend on the severity of the irritant. If it is mild, the inflammatory process may resolve in a similar fashion to that of other connective tissues; a layer of reparative dentine may be formed as protection from further injury. However, if the irritation is more severe, with extensive cellular destruction, further inflammatory changes involving the rest of the pulp will take place, which could eventually lead to total pulp necrosis.

There are features of pulpitis which can make the borderline between reversible and irreversible pulpitis difficult to determine clinically. In general, if the responses to several tests are exaggerated, then an irreversible state is possible.

The essential feature of a reversible pulpitis is that pain ceases as soon as the stimulus is removed, whether it is caused by hot or cold fluids, or sweet food. The teeth are not tender to percussion, except when occlusal trauma is a factor. Initially, one of the following treatment may be all that is necessary:

- Check the occlusion and remove non-working facets.
- Place a sedative dressing in a cavity after removal of deep caries.
- Apply a fluoride varnish or a dentine bonding resin to sensitive dentine and prescribe a desensitizing toothpaste.

Should the symptoms persist and the level of pain increase in duration and intensity, then the pulpitis is likely to be irreversible. The patient may be unable to decide which tooth is causing the problem, since the pain is often referred to teeth in both the upper and lower jaw on the same side. In the early stages, the tooth may exhibit a prolonged reaction to both hot and cold fluids, but is not necessarily tender to percussion. When testing for sensitivity to percussion it is not necessary to tap the tooth with the handle of dental instrument. Gentle finger pressure will be more than sufficient to elicit a response, and much kinder to your patient.

Only when the inflammation has spread throughout the pulp and has involved the periodontal ligament, will the tooth become tender to bite on. In these circumstances, the application of heat will cause prolonged pain which may be relieved by cold. Both hot and cold can precipitate a severe bout of pain, but as a rule heat tends to be more significant.

Pain from an irreversibly damaged pulp can be spontaneous and may last from a few seconds to several hours. A characteristic feature of an irreversible pulpitis is when a patient is woken at night by toothache. Even so, if untreated a symptomatic pulpitis may become symptomless and pulp tests may give equivocal results. In time, total pulp necrosis may ensue, without the development of further symptoms and the first indication of an irreversibly damaged pulp may be seen as a periapical rarefaction on a radiograph, or the patient may present with an acute periapical abscess.

To summarize, therefore, in reversible pulpitis:

- The pain is of very short duration and does not linger after the stimulus has been removed.
- The tooth is not tender to percussion.
- The pain may be difficult to localize.
- The tooth may give an exaggerated response to vitality tests.
- The radiographs present with a normal appearance, and there is no apparent widening of the periodontal ligaments.

In irreversible pulpitis:

- There is often a history of spontaneous bouts of pain which may last from a few seconds up to several hours.
- When hot or cold fluids are applied, the pain elicited will be prolonged. In the later stages, heat will be more significant; cold may relieve the pain.
- Pain may radiate initially, but once the periodontal ligament has become involved, the patient will be able to locate the tooth.
- The tooth becomes tender to percussion once inflammation has spread to the periodontal ligament.
- A widened periodontal ligament may be seen on the radiographs in the later stages.

Careful evaluation of a patient's dental history and of each test is important. Any one test on its own is an insufficient basis on which to make a diagnosis. Records and radiographs should first be checked for any relevant information such as deep caries, pinned restorations, and the appearance of the periodontal ligament space (Fig. 1). Vitality tests can be misleading, as various factors have to be taken into account. For example, the response in an older person may differ from that in someone younger due to secondary dentine deposition and other atrophic changes in the pulp tissue. Electric pulp testing is simply an indication of the presence of vital nerve tissue in the root canal system only and not an indication of the state of health of the pulp tissue.

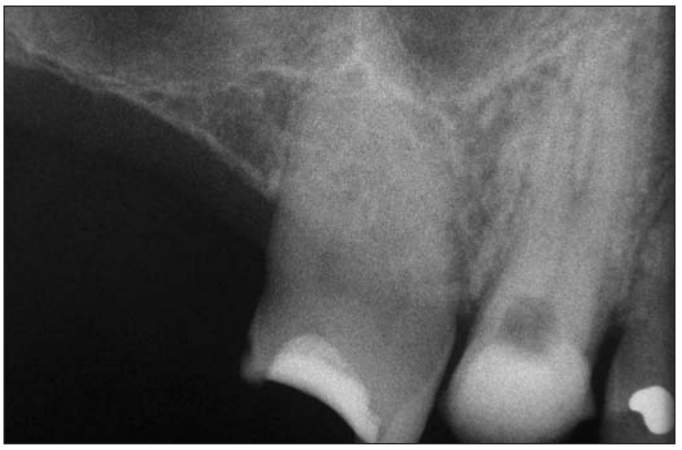

Fig. 2 Radiographic changes range from a widening of the periodontal ligament space (note that this upper first premolar has two separate buccal roots)...

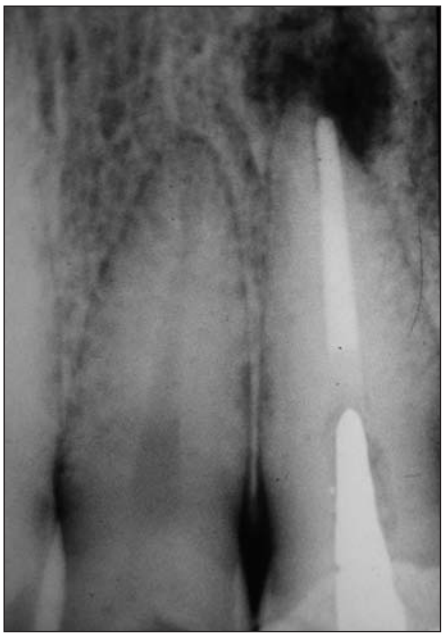

Fig. 3 ... to a large, well-defined area of radiolucency.

Once pulpal inflammation has spread to the periodontal ligament, the resulting inflammatory exudate may cause extrusion of the tooth, making it tender to bite on. This particular symptom, acute apical periodontitis, may be a consequence of occlusal trauma; the occlusion must therefore always be checked.

Ideally, the treatment for irreversible pulpitis is pulp extirpation followed by cleaning and preparation of the root canal system. If time does not permit this, then removal of pulp tissue from the pulp chamber and from the coronal part of the root canal is often effective. Irrigation of the pulp chamber using a solution of sodium hypochlorite before carrying out any instrumentation is important. (Sodium hypochlorite is usually sold as a 5% solution. This may be diluted with purified water BP to the operator's preference.) Sodium hypochlorite solution has proved to be one of the most effective disinfecting agents used in root canal treatment,[7,8] with different authors recommending strengths between 0.5 and 5.0%. The pulp chamber and root canals are dried, and a dry sterile cotton wool pledget placed in the pulp chamber with a temporary filling to seal the access cavity. Antiseptic solutions such as phenolic solutions or corticosteroid/ antibiotic preparations on cotton wool pledgets have been advocated, but their effectiveness is of doubtful value. Corticosteroid dressings should be used sparingly as there is evidence that suppression of an inflammatory response by steroids allows bacteria to enter the bloodstream with ease.[9] This is a particularly undesirable effect in patients who, for example, have a history of rheumatic fever. Studies have shown that provided the pulp chamber and the root canals have been cleansed and dried, medication of the pulp chamber and root canals is of little practical benefit. Paper points are used to dry the canals and under no circumstances should they be left in the canal, otherwise any fluid that enters the canal system will be absorbed and so provide an effective culture medium for any residual bacteria.

Difficulty with local analgesia is a common problem with an acutely inflamed pulp. In addition to standard techniques, supplementary analgesia can be obtained with the following:

1 Additional infiltration anaesthesia, such as long-buccal, lingual and palatal.
2 Intraligamental (intra-osseous) injection.
3 True intra-osseous injection.
4 Intrapulpal analgesia.
5 Inhalational sedation with local analgesia.

Should these techniques give only moderate success, it is advisable to dress the pulp to allow the inflammation to subside and to postpone pulp extirpation. A corticosteroid/antibiotic preparation with a zinc oxide/eugenol temporary restoration will provide an effective, short-term dressing.

Continuation of pain following pulp extirpation may be due to one of the following causes.

1 The temporary filling is high.
2 Infected pulp tissue is present in the canal.
3 Some of the canal contents have been extruded through the apex.
4 Overinstrumentation of the apex or perforation of the canal wall.
5 An extra canal may be present which has not been cleaned.

If the problem is not found to be occlusal, whatever the cause the remedy is to irrigate the pulp chamber and root canal system again with sodium hypochlorite solution and perhaps gently instrument, then dry and redress the tooth as before.

Acute periapical abscess

This condition develops from an acute periapical periodontitis. In the early stages, the difference between the two is not always clear. Radiographic changes range from a widening of the periodontal ligament space (Fig. 2), to a well-defined area (Fig. 3). The typical symptoms of an acute periapical abscess are a pronounced

Fig. 4 A pronounced swelling may be present adjacent to the abscessed tooth.

Fig. 5 Immediate relief is obtained as pus drains feely from an access cavity.

soft-tissue swelling (Fig. 4) and an exquisitely tender tooth. Extrusion from the socket will often cause the tooth to be mobile. Differential diagnosis of a suspected periapical swelling is important in case the cause is a lateral periodontal abscess. The diagnosis can be made by testing the vitality of the tooth. If it is vital, then the cause may well be periodontal in origin.

The immediate task is to relieve pressure by establishing drainage, and in the majority of cases this can be achieved by first opening up the pulp chamber, as seen in Figure 5. Initially, gaining access can be difficult because the tooth is often extremely tender. Gently grip the tooth and use a small, round, diamond bur in a turbine to reduce the trauma of the operation. Regional analgesia may be necessary, and inhalation sedation can prove invaluable. If drainage is not immediate it is permissible to explore the apical foramen with a very fine (size 08 or 10) file. The foramen should not be instrumented or enlarged, and if drainage does not result the procedure should not be persevered. As discussed in Part 7, the use of ultrasonically activated endodontic files may be particularly helpful in this situation for effectively flushing infected debris from the root canal system.

If a soft-tissue swelling is present and pointing intra-orally, then it may be incised to establish drainage as well. The presence of a cellulitis may result in little or no drainage. If a cellulitis is present, medical advice should be sought before any treatment is carried out (Fig. 6).

Incision to establish drainage

Incision to establish drainage is the only surgical endodontic procedure which may be undertaken when acute inflammation is present. The principal indication is the presence of a collection of pus which points from a fluctuant abscess in the soft tissues. Establishing drainage to help bring the infection under control is essential, and should always be obtained through the root canal and soft tissues in preference to administering antibiotics alone. The soft-tissue swelling should be examined to see if it is fluctuant. Where the swelling is pointing intra-orally, copious amounts of surface analgesia should be applied, for example ethyl chloride or topical lignocaine ointment. Regional anaesthesia may not be effective due to the presence of pus, and the administration of a local analgesic solution may spread the infection further into the tissues.

Incise the swelling with a Bard–Parker No. 11 or 15 scalpel blade, or aspirate, using a wide-bore needle and disposable syringe. It may be possible to aspirate the abscess via the root canal as well. The advantage of this technique is that the sample can be sent for bacteriological examination if required. It is not usually necessary to insert a drain, but if it is thought necessary then a piece of quarter-inch or half-inch selvedge gauze may be used. The same criteria apply when extra-oral drainage is indicated, and it may be possible to use the same technique of aspiration with a wide-bore needle and disposable syringe. However, if an extra-oral incision is considered necessary, as in Figure 7, it is wise to refer the patient to an oral surgeon for this particular procedure.

Root canal treatment

Once access and initial drainage have been achieved, a rubber dam should be applied to the tooth to complete the operation. Before any further instrumentation is carried out, the pulp chamber should be thoroughly irrigated with a solution of sodium hypochlorite to remove as much superficial organic and inorganic debris as possible. This in itself may bring considerable pain relief and will make subsequent instrumentation easier. Having debrided the canals to the best possible extent with frequent changes of irrigant, the canals should be dried with paper points and a dry sterile cotton wool pledget placed in the pulp chamber to prevent ingress of the temporary dressing. The access cavity is then sealed to prevent re-infection of the canals from the oral cavity. If complete debridement was not possible the patient must

Fig. 6 A teenage patient who had a large periapical lesion of a lower incisor is developing a cellulitis.

be recalled within 48 hours. At this time it will usually be possible to complete instrumentation and place a calcium hydroxide dressing in the canals.

The temptation to leave the tooth open to drain must be resisted at all costs.[10] The microbial flora of the canal will be changed, making treatment more difficult and lowering the long-term prognosis. Furthermore, this treatment contravenes the prime objective of treatment: to disinfect the root canal. If the clinician does not have sufficient time to carry out adequate treatment when opening the tooth, good clinical practice would suggest re-appointing the patient to the end of the treatment session when time is available.

Antibiotics are only required when there is systemic spread of the infection, the patient is unwell and has a raised temperature. Antibiotics are not an alternative to appropriate cleaning and disinfection of the root canal.[11] There is a serious tendency to over prescription of antibiotics in situations where they are not indicated. If, however, there is a clinical reason for their use, amoxycillin is usually the agent of choice, prescribing 250 mg three times a day until the infection is under control and root canal therapy initiated. Metronidazole is a useful alternative where the penicillins are contraindicated.

CRACKED TOOTH SYNDROME (POSTERIOR TEETH)

Crazing of the enamel surface is a common finding on teeth as a consequence of function, but on occasion it may indicate a cracked tooth. If the crack runs deep into dentine and is therefore a fracture, chewing may be painful. Initially, this may not be of sufficient intensity for the patient to seek treatment. However, once the fracture line communicates with the pulp, pulpitis will ensue. A quiescent period of several months may follow before any further symptoms develop. The patient may present with a whole range of bizarre symptoms, many of which are similar to those of irreversible pulpitis:

- Pain on chewing.
- Sensitivity to hot and cold fluids.
- Pain which is difficult to localize.
- Pain referred along to the areas served by the fifth cranial nerve.
- Acute pulpal pain.
- Alveolar abscess.

Fig. 7 External incision may be required, and the patient should preferably be referred to a general surgeon.

Diagnosis can be difficult and much depends on the plane of the fracture line and its site on the tooth. Radiographs are unlikely to reveal a fracture unless it runs in a buccolingual plane. A fibre-optic light is a useful aid as it will often reveal the position of the fracture. One diagnostic test is to ask the patient to bite on a piece of folded rubber dam. Care must be exercised as this test may extend the fracture line. The extent of the fracture line and its site will decide whether the tooth can be saved or not. If it is a vertical fracture, involves the root canal system and extends below the level of the alveolar crest, then the prognosis is poor and extraction is indicated (Fig. 8). However, if the fracture line is horizontal or diagonal and superficial to the alveolar crest, then the prognosis may be better.

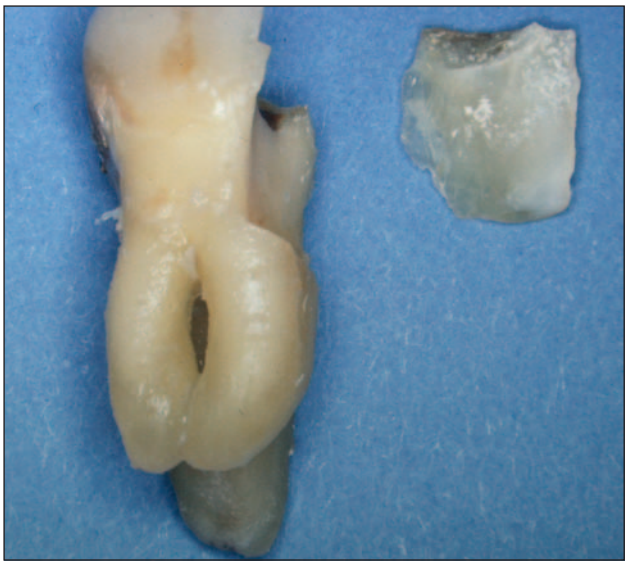

Fig 8 A patient who complained of classic 'cracked-cusp' pain was found to have such a deep subgingival cusp fracture that the tooth was extracted.

PATIENTS UNDER TREATMENT

Following endodontic procedures, patients may sometimes experience pain no matter how carefully the treatment has been given. It would be prudent to warn every patient to expect a certain amount of discomfort following endodontic treatment, advising them that this is caused by an inflammatory response at the tooth apex. They should be advised to take over-the-counter analgesics, preferably NSAIDs. However, if the pain persists for more than two or three days, further treatment is probably required for one of the following reasons.

Recent restorations

Pain may be a result of:

- High filling
- Microleakage
- Micro-exposure of the pulp
- Thermal or mechanical injury during cavity preparation or an inadequate lining under metallic restorations
- Chemical irritation from lining or filling materials
- Electrical effect of dissimilar metals.

It is not always possible to know beforehand whether there is a pre-existing pulpal condition when operative procedures are undertaken. Consequently, a chronic pulpitis may be converted into an acute pulpitis.

Periodontal treatment

There is always a chance that some of the numerous lateral canals that communicate with the periodontal ligament are exposed when periodontal treatment is carried out. This aspect is considered in the section in Part 9 on 'perio-endo lesions'.

Exposure of the pulp

If a carious exposure is suspected, then removal of deep caries should be carried out under rubber dam. The decision to extirpate the pulp or carry out either a pulp capping or partial pulpotomy procedure depends on whether the pulp has been irreversibly damaged or not (see Part 9 – calcium hydroxide). If there is insufficient time, or any difficulty is experienced with analgesia, temporary treatment, as recommended for irreversible pulpitis, may be carried out.

Fig. 9 Root or crown fractures can often be avoided by protecting the tooth during endodontic treatment, and providing cuspal coverage following treatment. If the tooth fractures in the vertical plane the prognosis is poor.

Root or crown fractures

Most root or crown fractures can be avoided by adequately protecting the tooth during a course of root canal treatment. If the structure of the tooth is damaged between appointments, pain is likely to occur as a result of salivary and bacterial contamination of the root canal. If the tooth happens to fracture in a vertical plane, the prognosis is poor and the tooth may have to be extracted (Fig. 9). In the case of multirooted teeth, it may be possible to section the tooth and remove one of the roots.

Pain as a result of instrumentation

The two conditions that may require emergency treatment during a course of root canal treatment are:

- acute apical periodontitis;
- Phoenix abscess.

Acute apical periodontitis may arise as a result of over instrumentation, extrusion of the canal contents through the apex, leaving the tooth in traumatic occlusion, or placing too much medicament in the pulp chamber as an inter-appointment dressing.

Irrigation of the canal with sodium hypochlorite and careful drying with paper points is usually sufficient to alleviate the symptoms. The occlusion must be checked, as there is likely to be a certain amount of extrusion of the tooth from its socket.

The term 'Phoenix abscess' relates to the sudden exacerbation of a previously symptomless periradicular lesion. It can be one of the most troublesome conditions to deal with and occurs after initial instrumentation of a tooth with a pre-existing chronic periapical lesion (Fig. 10). The reasons for this phenomenon are not fully understood, but it is thought to be due to an alteration of the internal environment of the root canal space during instrumentation which activates the bacterial flora. Research has shown that the bacteriology of necrotic root canals is more complex than was previously thought, in particular the role played by anaerobic organisms.

Treatment consists of irrigation, debridement of the root canal and establishing drainage. In

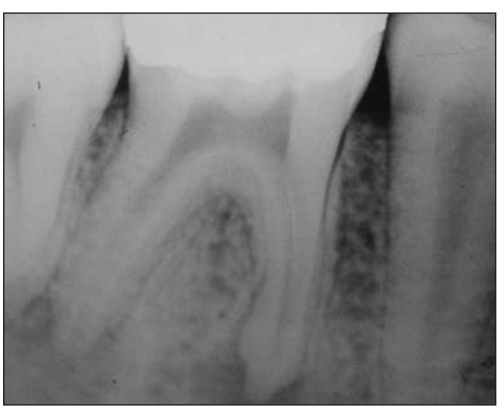

Fig. 10 Phoenix abscess. Endodontic treatment was commenced on this tooth with a chronic periradicular lesion, which had previously been symptomless. The patient returned 2 days later with extreme pain and swelling.

severe cases, it may be necessary to prescribe an antibiotic.

POST-ENDODONTIC TREATMENT

The following factors need to be considered should pain occur following sealing of the root canal system.

- High restoration
- Overfilling
- Underfilling
- Root fracture

Once obturation of the root canal space has been completed, restoration of the rest of the tooth can be carried out. The occlusion must be checked for interferences, to avoid an apical periodontitis, or worse, a fractured tooth.

Root fillings that are apparently overfilled do not as a rule cause more than mild discomfort after completion. The most likely cause of pain following obturation of the root canal space is the presence of infected material in the periapical region. The significance of an underfilled root canal is whether the canal has been properly cleaned and prepared in the first instance, and infected debris is still present in the canal. Post-endodontic pain in these circumstances may well be due to inadequate debridement of the canal.

Removal of an overextended root filling is rarely completely successful and the options left are as follows:

- Prescription of analgesics and, if the pain is more severe and infection is present, antibiotics.
- An attempt at removal of the root filling and repreparation of the root canal.
- Periradicular surgery and apicectomy.

Root fracture

The forces needed to place a satisfactory root filling, using the lateral compaction of gutta-percha technique, should not be excessive; too much pressure increases the risk of root fracture. The most common type of fracture is usually a vertical one and the prognosis is poor. Extraction, or sectioning of the root in the case of a multirooted tooth, is all that can be recommended.

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