

Treatment planning the endodontic case

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Abstract

Following a definitive diagnosis of the need for root canal treatment, the treatment planning stage should be straightforward if a logical sequence of decision-making is followed. Very few contra-indications exist for providing root canal treatment, but the planning must include several aspects. Firstly, is root canal treatment best for the patient to maintain a functional dentition long term? Secondly, who should provide the treatment? Thirdly, what are the restorative options that will ensure the best long-term prognosis? The sequencing of root canal treatment generally occurs early in a typical treatment plan, and prompt restoration after treatment is crucial to long-term survival of the tooth.

Key words: Treatment planning, endodontics.

INTRODUCTION

The goal of endodontic treatment is to preserve the tooth as a functional unit within a functioning dentition. As such the endodontic treatment must be integrated into a comprehensive treatment plan that includes restorative and periodontal management. Clinical management begins with an accurate diagnosis of the cause of endodontic pathology.¹ Sometimes, it is necessary to deal with acute pain and swelling associated with a tooth that requires endodontic treatment before being able to offer a definitive treatment plan.² The proposed endodontic treatment should be part of an agreed, comprehensive treatment plan that includes the patient's participation in the treatment decisions. In order to give good advice, the dentist will need to exercise clinical judgement that is based on rational treatment principles. It is the skill and care with which these judgements are made that distinguish the really good dentist from the merely good dentist.³

General overview of endodontic treatment planning

The selection of cases for endodontic therapy should take into consideration the prognosis of the

endodontic, restorative and periodontal procedures.⁴ The flow chart (Fig 1) provides a diagrammatic outline of the decision-making process for treatment planning in endodontics. Once appropriate diagnostic tests have confirmed the pulpal and periradicular diagnosis, immediate treatment of the tooth may be required if relief of painful symptoms is needed. For a patient in pain, the dominating concern by the dentist is whether endodontic treatment will rapidly and predictably eliminate the patient's pain and discomfort.⁵ Following stabilization of the tooth, the dentist should exercise caution in deciding whether the tooth concerned has a good or poor prognosis. Issues to consider when making this judgement include: (1) strategic value of the tooth; (2) periodontal factors; (3) patient factors; and (4) whether the tooth can be restored or are there alternative replacement options. Although certain teeth are endodontically treatable, the amount of tooth structure remaining may not be readily restorable, and a durable coronal restoration is not achievable.⁶ Of equal importance, the periodontal condition of the tooth must be assessed prior to endodontic therapy because optimal periodontal health is critical to the long-term success of teeth that are endodontically treated.⁷ It is essential to consider the patient's needs, attitude and willingness to accept treatment.⁸ The clinician should also take into account the patient's medical condition and motivation to maintain oral health.⁹

The above considerations will aid the dentist in determining whether a tooth can be preserved via endodontic therapy or whether it is in the best interests of the patient to consider extraction and possibly a prosthetic replacement.¹⁰ Both the dentist and patient must agree on the definitive plan. If the tooth is extracted, replacement options such as removable dentures and conventional bridgework are well known to the profession. Developments in the field of implantology and adhesive dentistry have also increased the options available for patients.¹¹ If the dentist and patient agree to retain the tooth, the next question is to decide whether to refer the patient to an endodontist.⁶ The dentist should consider whether he or she possesses the necessary skills and knowledge to perform endodontic treatment for this particular tooth to a high standard. The components of the treatment planning flow chart (Fig 1) will be considered individually in greater detail.

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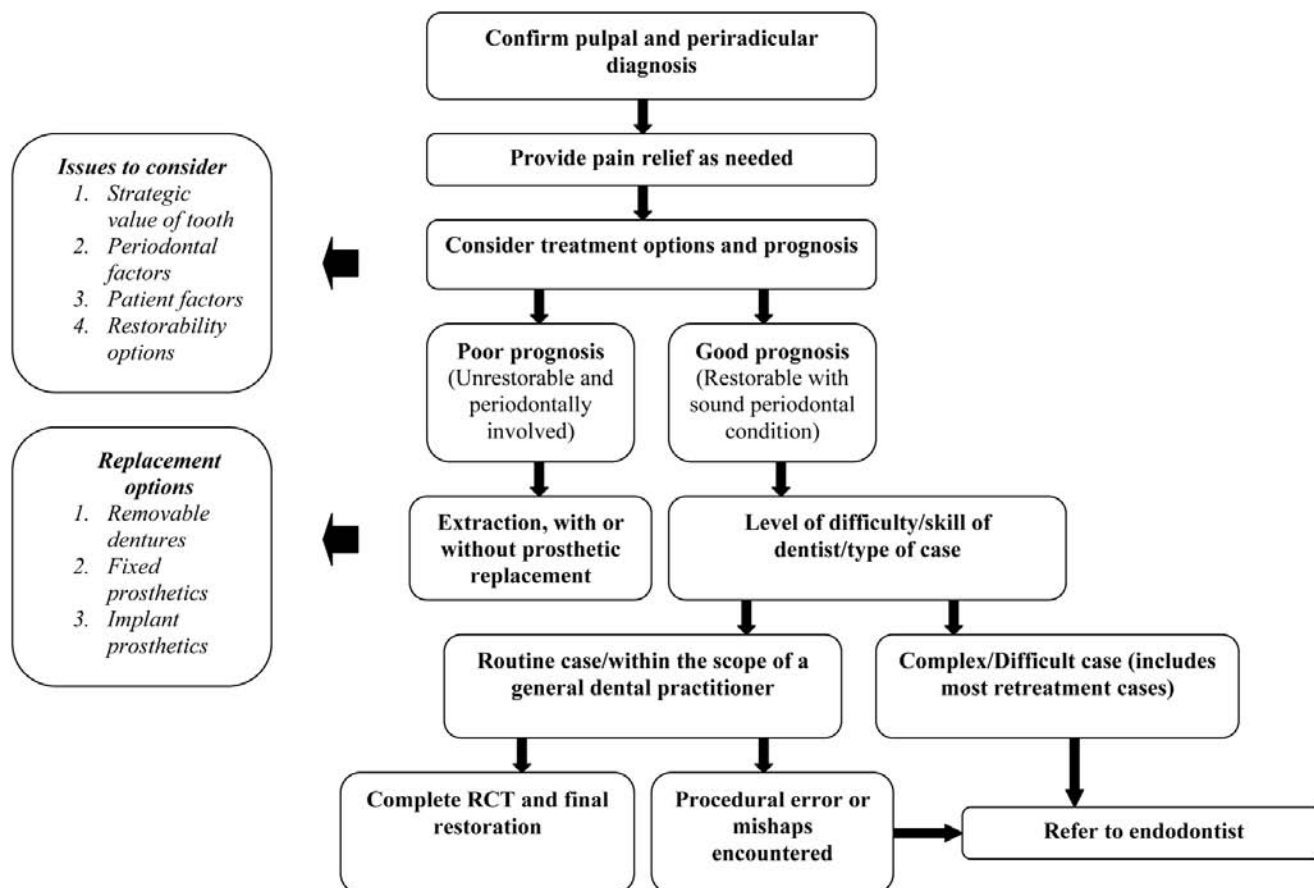


Fig 1. Treatment planning flow chart.

Strategic value of the tooth

The primary concern is the long-term preservation of a healthy functional dentition. The concept of treating the dentition as a functioning unit is in conflict with traditional dental practice in which the tooth, rather than the dentition, is often the focus of concern.¹² The dentist should consider the strategic value of the tooth to be endodontically treated in relation to the overall function of the dentition. For example, a 2nd molar or

3rd molar (Fig 2) is generally considered to be of little strategic value, unless it is required to support a prosthesis. This is because a denture is more stable if it has a posterior abutment tooth to retain and support it.³ Other strategic considerations may include the structural integrity, remaining sound tooth structure, morphology and dimensions of the root, the level of surrounding bone, amount of periodontal support, and whether the tooth is in the aesthetic zone.¹⁰

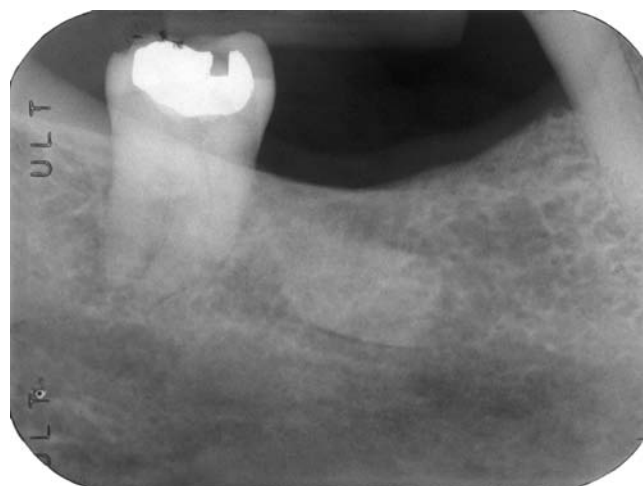


Fig 2. Tooth 48 has strategic importance to the overall treatment plan because it is the most distal tooth in a quadrant supporting a partial removable prosthesis. Otherwise a third molar would not generally be considered a worthwhile candidate for endodontic treatment.

Periodontal factors

The health of the periodontium needs to be assessed because in a compromised dentition, the long-term prognosis for retaining a single tooth may be poor.¹ Approximately one-third of endodontically treated teeth requiring extraction are lost because of periodontal problems.¹³ Insufficient periodontal support (Fig 3) may thus be viewed as a contraindication to root canal treatment. Periodontal management of patients is important to the long-term success of any treatment plan,¹⁴ but this area of discussion is beyond the scope of this article.

Patient factors

The dentist should be aware that some patients will opt to have an extraction of a tooth on the grounds of time involved in treatment, fear of treatment, lack of confidence that root canal treatment is likely to be



Fig 3. Tooth 11 presented with extensive periodontal probing and mobility. The tooth was planned for extraction because of poor periodontal prognosis, despite the probability of a favourable endodontic prognosis.

successful or the total cost involved.³ Although medical conditions (e.g., diabetes, or habitual tobacco smoking) may complicate or delay healing, in general, medical reasons are not a contra-indication to root canal therapy. However, conditions which limit a patient's ability to lie supine (e.g., spinal arthritis), to open the mouth wide (e.g., rheumatoid arthritis), or to tolerate rubber dam (e.g., anxiety disorders),¹ may make endodontic treatment more difficult but not impossible.

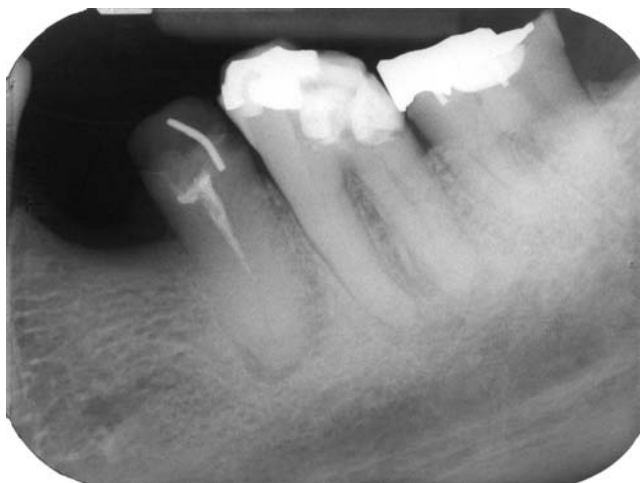


Fig 4. Extensive loss of tooth structure from both teeth (35 and 36) raises the issue of the type of restoration to preserve these teeth as functional units long-term. The question of whether tooth 36 has sufficient tooth structure will determine whether this tooth is to be restored with an amalgam cuspal overlay, restored with a crown or extracted.



Fig 5. Tooth 36 presented with calcification of the mesial root canals and a perforation near the furcation area, both of which complicate treatment and alter the prognosis for this tooth. Due to the complexity of the case, the dentist should consider referral to an endodontist for repair of the perforation site and exploration of the calcified canals.

Following appropriate explanation of what is planned, the dentist should take into consideration the following questions that may influence the overall treatment plan and management:³ (1) Is endodontic treatment in the patient's best interest? (2) What are the patient's expectations? (3) Will the patient be able to tolerate the treatment planned? (4) Will the patient be able to afford the treatment planned?

Whether the tooth can be restored and its replacement options

Extraction of the tooth is a valid treatment if endodontic therapy is not applicable or where endodontics would succeed, but successful completion of the treatment plan is impossible because of periodontal or restorative issues.⁷ The tooth concerned must be assessed for any restorative challenges that would deem the tooth as unrestorable following root canal treatment. Figure 4 shows a radiograph of a patient with a severe restorative problem of tooth 36 because of the extensive subgingival restoration.

Removable partial dentures are often a simple and relatively inexpensive tooth replacement option, but these prostheses tend not to be well tolerated.¹⁵ Conventional bridges can provide an excellent option for tooth replacement, especially when the potential abutment teeth will benefit with full coronal coverage restorations,¹⁵ but the patient's oral hygiene must be excellent.¹⁰ Certain patients may benefit from an implant-supported prosthesis, but it is not the treatment of choice in all situations.¹⁵ The patients must be carefully selected both on clinical grounds and the patients' wishes after they have been fully informed of the procedure and are able to make an informed decision.¹²

Prognosis of endodontic treatment

The prognosis for endodontic treatment of the tooth or teeth in question must be taken into account in the



a



b

Figs 6a and 6b. This complicated case exhibits a number of problems and root canal retreatment for both teeth (11 and 21) is technically challenging because of the existing crown, post, and composite resin restoration. The need to remove existing restorations in order to retreat these teeth makes this case complex. It is important to assess for cracks, perforation, caries and whether these teeth can be suitably restored again prior to committing the patient to prolonged and expensive treatment.

treatment planning. Data regarding the outcome of endodontic treatment should be interpreted with caution because different studies lack standardization and vary in material composition, treatment procedures and methodology, i.e., prospective or retrospective in the study design.¹⁶ The main reason for the variability of quoted success rates is because of inconsistent definition.¹⁷ Clearly, a more lenient definition increases the success rate in comparison with a more stringent one.⁴ Although dentists would like to give the patient as accurate a prognosis as possible before endodontic treatment is performed, a less than ideal technical standard provided, or procedural errors and/or an inadequate coronal restoration will lead to a reduced prognosis for the tooth.⁹ Dentists should be reminded that studies reporting an overall healing frequency (success rate) do not necessarily imply that this particular tooth has the same chance of healing. Quoting a figure or even a range (e.g., 60 per cent or 50–70 per cent chance of healing for a re-treatment case) can be very misleading.

When to refer and when to perform endodontic retreatment

Dentists should be able to assess when the difficulty of the treatment exceeds their skill and be able to refer the patient to an endodontist as necessary.¹⁰ Sometimes, diagnosis and the decision to treat endodontically are easily achieved, but the technical difficulty of the case



Fig 7. Tooth 21 presents with an uncomplicated single-rooted, infected root canal with a periapical area. Clinically, the margin of the composite resin restoration is not ideal but this case is reasonably straightforward with regards to endodontic and restorative management of tooth 21.



Fig 8. The mandibular molars (36 and 37) were referred for endodontic assessment before placing crowns on these teeth. Radiographically, there were periapical radiolucencies associated with both teeth, and the root filling for tooth 37 was technically deficient. The existing coronal restoration for both teeth was less than ideal, presenting with caries and open margins. It is important to determine if tooth 37 is restorable before endodontic retreatment is performed and to treatment plan the definitive coronal restoration for tooth 36.

dictates that the patient be referred to an endodontist for management.⁹ Other factors that may complicate and increase the difficulty of an endodontic case include:⁶ (1) calcifications; (2) inability to isolate the tooth with a rubber dam; (3) resorptive defects; (4) extra roots and canals; (5) retreatment cases; (6) presence of a post; and (7) ledges and perforations. Dentists should recognize these potential problems and include them in the decision-making process. Referring the patient before commencement of endodontic treatment is better than after a procedural problem has been created (Fig 5) because the procedural error will compromise the prognosis of the tooth.⁹ After careful consideration of issues such as strategic value of the tooth, periodontal factors, patient factors and whether the tooth can be restored, referring the patient to a specialist endodontist may be in the best interest of the patient. Retreatment is warranted after an acceptable observation period with no signs of radiographic improvement. Unlike initial treatment of an infected root canal system, retreatment cases are technically more difficult to manage (Figs 6a and 6b). In cases where extraradicular infection is the source of ongoing disease, apical surgery is considered the treatment of choice.¹⁷ Dentists must be aware of their level of clinical skill, knowledge and experience when they encounter a case beyond their abilities and such cases should be referred to an endodontist.¹⁸

Endodontic treatment sequence

General overview

The treatment sequence may be planned into a number of stages including: (1) initial cause-related therapy, e.g., emergency pulp extirpation; (2) re-examination, e.g., response to initial endodontic treatment; (3) corrective treatments, e.g., complete root canal treatment and restorative treatment; and

(4) maintenance, e.g., measures to prevent the disease recurrence.¹

Treatment plans can conveniently be divided into “simple” and “complex”. The treatment plan may be simple if only one tooth is involved and the overall status of the dentition is acceptable,⁹ especially for regularly attending patients with a well-maintained dentition (Fig 7). A more complex treatment plan is often required for patients who have not attended for some time or where there is a need for a major reassessment of a declining state of dental health³ (Fig 8). If the patient requires an extensive treatment plan, it is important to manage the acute pain and swelling associated with a tooth that requires root canal treatment before offering a definitive treatment plan.

Prior to endodontic treatment, the existing restoration should be removed completely because visual clinical examination is an unreliable indicator of the presence of marginal breakdown, caries, cracks and fractures in teeth with pulp and/or periapical disease.¹⁹ It may be necessary to defer the final decision to undertake root canal treatment until after the restoration has been removed and the remaining tooth structure can be assessed more thoroughly.

Post-endodontic restoration and long-term outcome

The final coronal restoration could influence the outcome of endodontic treatment. The restoration should provide adequate coverage to protect the endodontically treated tooth against fracture, which could ultimately lead to extraction.⁹ Other potential problems associated with the final restoration playing a role in the breakdown of root canal treatment include a permanent restoration with marginal breakdown, or bacterial penetration due to restorative procedures such as post space preparation.²⁰ Both will result in micro-organisms invading the filled root canal space after treatment.

The relationship between the quality of the coronal restoration and the periapical status has been investigated in several studies.²¹⁻²⁵ It has been suggested that both root canal filling and the coronal restoration serve as a barrier against fluid and bacterial penetration into the periapical area.²⁶ A number of studies have shown that inadequate root filling and coronal restorations were associated with an increased incidence of apical periodontitis,^{21,24} but the technical quality of the endodontic treatment (as assessed radiographically) had a more substantial impact on the outcome of treatment than the technical quality of the coronal restoration.²⁵ In reality, there are no available materials or obturation techniques that can confidently assure an impervious seal of the complex root canal system.²⁷ Ricucci and Bergenholtz^{28,29} suggest that the problem of coronal bacterial penetration may not be of such great clinical importance, provided ideal instrumentation and high technical quality root canal fillings are achieved, and their findings challenged the significance of coronal microleakage and numerous *in vitro* findings.

Fractures of endodontically treated teeth could lead to infection of the root canal system or extraction of the tooth. Vire *et al.*¹³ observed that close to half of the failures seen in the study were due to crown fractures. Linn and Messer³⁰ in a laboratory study showed that full coronal coverage of an endodontically treated molar resulted in an increase in cuspal stiffness, and this finding reinforces the importance of cuspal coverage to protect against fracture. Also, cuspal coverage will reduce cuspal deflection and minimize marginal breakdown.³¹ Aquilino *et al.*³² in a retrospective cohort study observed a strong association between crowns as a coronal restoration and long-term survival of root canal treated teeth.

CONCLUSION

The difficulty of a case should be balanced with the skill and experience of the dentist in deciding whether to manage the case in general practice or to refer the patient to an endodontist.⁹ The dentist must determine whether the needs are best served by providing endodontic treatment or advising extraction.⁶ Should endodontic treatment be undertaken, the prognosis depends not only on the endodontic treatment but other factors such as whether the tooth can be suitably restored and the periodontal status.⁹ The overall treatment planning in endodontics should be in agreement with the overall dental management of the patient.

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