

The contemporary management of third molars

DM Hyam†‡

†The Canberra Hospital, Canberra, Australian Capital Territory, Australia.

‡Australian National University, Canberra, Australian Capital Territory, Australia.

ABSTRACT

The management of third molars requires a significant assessment and decision process both for the patient and the clinician. The clinician must always identify the indication for third molar surgery, assess the risks of the proposed procedure, and then modify their plan to account for the patient's current and future health, their social and financial setting, and the patient's tolerance of risk. In doing this, the clinician can tailor a solution to meet the individual patient's needs. This decision to remove a third molar is made in the fluid setting of the patient's quality of life and requires regular review. This article gives the clinician the tools, the matrix, and the confidence to guide patients through this process, and outlines some of the pitfalls and common points of bias within the process.

Keywords: Analysis, decision making, third molars, wisdom teeth.

Abbreviations and acronyms: WHARFE System = W – Winter lines, H – Height of mandible, A- Angulation, R – Root form, F – Size follicular sac, E – Exit pathway of tooth; IAN = inferior alveolar nerve; OPG = orthopantomogram.

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INTRODUCTION

The decision to commit a patient to the removal of a third molar can be complex and challenging. No clinician wishes to expose the patient to surgical risk, pain and discomfort during recovery, and the financial burden of surgery, unless there is an identifiable benefit to the patient. Every Oral & Maxillofacial Surgeon faces this dilemma on a daily basis. The clinician faces the challenge of deciding if and when an intervention is required, along with the duty to minimise morbidity and risk.

It is possible that the issue of third molars and their removal is becoming an increasingly important question for teenagers and young adults. Previously, many people had had extractions by the time they reached late puberty, and this may have facilitated the late eruption of third molars into the dental arch in a functional position. As oral hygiene around the world has improved, and as orthodontists increasingly utilize a non-extraction treatment plan, the prevalence of impacted third molars may rise in the future. Research¹ has shown that at least 96% of the population has a third molar. Up to 36% of young people may have an impacted third molar.² When more than a third of the population faces a decision about how best to manage impacted teeth, this places a significant burden on the healthcare sector.

Much time and effort has previously been given to reviewing literature in order to determine what evidence is available and what quality evidence can be utilized in the decision making process. A Cochrane review³ published in 2012 found 'there is no evidence from randomized controlled trials, that prophylactic removal of asymptomatic third molars prevents painful and/or infection complications arising from the retention of these third molars.' The review also found that there was only a single randomized controlled trial which could be classified as being of sufficient rigor to provide evidence in this issue. This trial showed no evidence of a difference in retention or removal. The Cochrane review summarized its findings by 'asking clinician's to rely on clinical experience and patient values and preferences in order to make decisions concerning the treatment of individuals in their care.' Given the lack of strong evidence, a decision making matrix is necessary which allows clinicians to identify and assess the clinical and patient factors of relevance.

CLASSIFICATION OF THIRD MOLARS

The concept of classification of third molars has matured over the last 10 years. Third molars were originally classified as either being symptomatic or asymptomatic, impacted or non-impacted, erupted,

partially erupted, or un-erupted. A more suitable classification system has developed in the recent literature.⁴ This classification describes third molars as being symptomatic or asymptomatic and disease free or disease positive (Table 1). Clinical indications and their relationship to this classification are shown in Table 2. It can also classify third molars as being visible but not at the line of occlusion (i.e. functioning), visible but not at the line of occlusion (i.e. non-functional), or not visible (unerupted).

The decision to remove a symptom positive/disease positive third molar is straight forward. This decision would only be modified by a significant patient contraindication.

Table 1. Classification systems

	Disease Positive	Disease Negative
Symptom Positive	S+/D+	S+/D-
Symptom Negative	S-/D+	S-/D-

Table 2. Indication for the removal of third molars grouped according to symptom and disease status

Classification	Disease	Treatment
Symptom Positive & Disease Positive	<ul style="list-style-type: none"> Unrestorable Caries Periapical Pathology Pericoronitis Odontogenic Infection 	Timeframe: Treat Immediately Treatment Options: 1. Surgically Remove 2. Coronectomy (only if necessary) 3. Oral Hygiene Instruction
Symptom Negative & Disease Positive	<ul style="list-style-type: none"> Periodontitis Pathology Food Trapping Root Resorption 	
Symptom Negative & Disease Negative	<ul style="list-style-type: none"> In a fracture line Un-restorable / fractured Associated with orthognathic surgery Pre-orthodontics Prosthetic inhibitor As part of a tumour resection To allow access and maintenance of adjacent teeth 	
	<ul style="list-style-type: none"> Post orthodontics In conjunction with other oral surgery Elite athletes Military and scientific personnel Premedication assessments Pre geriatric assessments Persistent bacteraemia Mild periodontal disease 	Timeframe: Utilise the third molar decision matrix

The decision to remove a symptom positive/disease negative tooth is generally received favourably by both the surgical community and patient’s alike.

Surgeons are often asked to assess and manage the symptom free third molar. This may be at the same surgery as another tooth is being removed, or as a stand-alone procedure. Over recent years the indications to remove third molars have expanded as our understanding of periodontal disease and the systemic effects of transient oral bacteraemia have increased. There is now considerable evidence to support the removal of symptom free/disease positive third molars in young adults.

This article will also discuss whether there are indications for the removal of the disease free/symptom free third molar. This can be a challenging decision for patients, especially when the third molar is symptom free and disease free and either not at the line of occlusion, or not visible. This is the intervention dilemma which causes clinician’s the most angst. The third molar decision matrix (Table 3) assists clinicians to identify the thought processes, patient factors, indications, contraindications, and financial factors, that all combine to influence the decision to remove a third molar.

When should third molars be assessed?

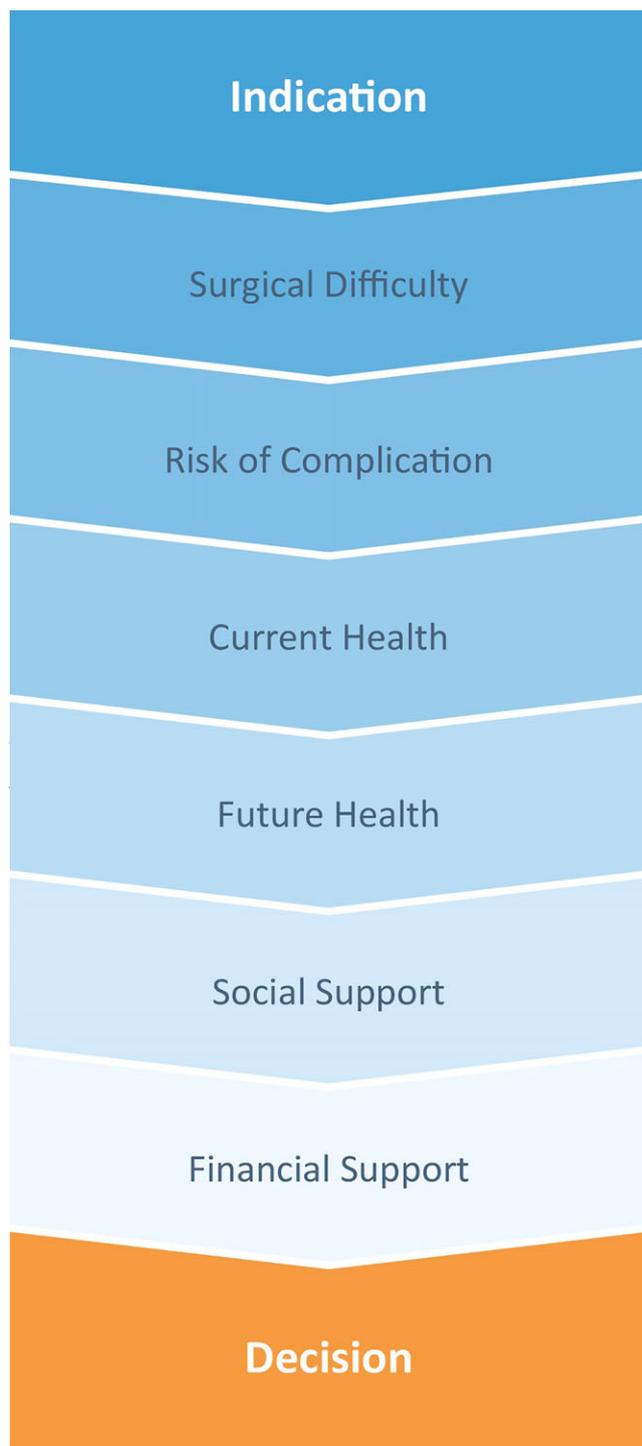
There is no consensus within the literature regarding when third molars should be assessed. Timing might be defined according to the chronological age of the patient or could be defined according to tooth development, particularly regarding whether the crown formation is complete or the root formation is complete. Another option for the definition of timing would be whether the tooth has developed symptoms or disease.

Clinicians are often inclined to intervene “early” (before symptoms or disease are present) for a patient with the belief that this may:

- (1) Reduce post-operative pain and suffering;⁵
- (2) May increase the patient’s quality of life;⁶
- (3) May reduce the financial burden;
- (4) May maximize oral health;
- (5) May prevent the complications of long term retention of non-functional third molars.

OTHER MANAGEMENT STRATEGIES

This paper confines its discussion regarding intervention to the surgical removal of teeth. There are other alternative treatments such as medications, oral hygiene adjuncts and operculectomy. Coronectomy is considered under Case Study 3. These adjuncts are useful, particularly when the decision matrix identifies that the risks of surgery outweigh the benefits. But if

Table 3. Third molar decision matrix

the third molar is symptomatic it requires some form of intervention.

THE THIRD MOLAR DECISION MATRIX

The decision matrix (Table 3) for the removal of the third molars should always begin with an indication. Indications for removal of third molars are

summarized (Table 2) according to disease status and symptom status. Once an indication has been identified, the decision to proceed to surgery will be modified by the surgical difficulty along with the procedural risk of a permanent complication. The patient's current health and future health will then modify the decision further. The final modifying factors should include the patient's social support mechanisms and financial capacities.

INDICATIONS FOR REMOVAL

The indications for removal of third molars where the patient is both symptom positive and disease positive are relatively straight forward and will not be considered further (Table 1). The indications where the patient is symptom free but disease positive are worth further examination. There are also indications where the patient is both symptom negative and disease negative, i.e. prophylactic removal.

Recent research has identified periodontitis associated with third molars as a key contributor to reductions in oral health.^{7,8} The key concepts regarding periodontal pathogenesis and third molars are:

- (1) A potential periodontal reservoir;
- (2) Local periodontal progression;
- (3) The systemic effects of periodontal disease.

The reservoir theory has been confirmed by research which shows that a third molar which has a periodontal probing depth of 4 mm or greater is likely to experience an increase in that probing depth over time. That patient is also likely to develop clinically significant periodontal probing depths in the anterior dental arch if they have a pre existing periodontal defect at a third molar.

The local progression theory of periodontitis identifies that 38% of people with periodontal disease around a third molar have disease progression within 2 years.

The systemic effects of periodontal disease have been associated with periodontal disease progression during pregnancy and pre-term birth. The associations between periodontal disease and transient bacteraemia are proving harder to quantify for researchers.

The role of prophylactic removal of third molars to prevent the development of pathology such as dental cysts seems limited. Whilst it is agreed that pathology can form,^{9,10} the number needed to treat to achieve a meaningful benefit may be high.

Food trapping around a third molar is an obvious clinical indicator of reduced or deficient oral hygiene. Very little research exists as to what risk ratios food trapping around a third molar confers in terms of caries experience in the upcoming years. Most clinician's would agree that a third molar that has issues with

oral hygiene and maintenance is at high risk of developing caries in the short term.

External root resorption is a common concern amongst patients, family members, and clinicians. Research has confirmed that up to 7.5% of 21–30 year olds have evidence of external root resorption in at least one site in the dental arch.¹¹ This appears to have a 3:1 male preponderance. Interestingly, once root formation appears to be complete and the patient has reached 30 years of age, the root resorption does not seem to continue. This would seem to confer some protection against root resorption by the removal of impacted third molars up until the age of 30 but very little benefit after this point.

One of the most contentious areas in the decision making process for the removal of third molars is the issue of post orthodontic stability. There is limited evidence of clinical use in this area.^{12–15} The one paper which met the eligibility criteria for the Cochrane review had a relatively small sample size and was vulnerable to bias.¹⁵ This paper still found no difference between the retention and removal of third molars in the orthodontic patient, regarding lower anterior crowing. There are several concepts worth considering which currently have little to no suitable evidence available for discussion. Some of the previous research regarding this topic was conducted on patients who had had pre-molar extractions as a component of their orthodontic plans. Significant numbers of modern orthodontic patients are having non extraction orthodontics and this may be increasing the rate of impaction of lower molars. Another important concept is that a vertically impacted third molar can still impart horizontal force vectors during its eruption phase. Also of importance in managing the post orthodontic patient is the assessment of the third molar and its current stage of root formation.

The decision to prophylactically remove third molars in the post orthodontic patient remains a purely clinical and patient preference derived decision. The evidence one way or another is lacking and unclear. Many parents in western countries who have access to quality healthcare consider it a reasonable risk to remove the potentially impacted lower third molars both to help ensure against orthodontic relapse and protect the long term prognosis for the lower second molar against external resorption and distal root caries. This currently remains a personal preference decision for patients, their families, and their clinicians.

The prophylactic removal of third molars can be divided into six main groups. These include;

- (1) Sport or military patients:
 - (i) Contact sports¹⁶
 - (ii) Peak performance patients

- (2) Reduced physical dexterity:
 - (i) Tremors
 - (ii) Neuromuscular disease
- (3) Altered mental capacity:
 - (i) Dementia
 - (ii) Cognitive development
- (4) Pre medication:
 - (i) Bisphosphonates
 - (ii) Anti coagulants
- (5) Pre treatment:
 - (i) Radiotherapy
 - (ii) Chemotherapy
- (6) Immunomodifier therapy:
 - (i) Bacteraemia
 - (ii) Tissue transfer patients

In the patients where prophylactic removal is being considered the clinician must attempt to judge the likelihood that this tooth will need removal or acquire disease or symptoms within a particular future period. They must then balance this risk against the risks of surgical removal. The clinician must feel that the patient will be better for having had surgery at this time versus surgery at a later time where the procedure may be more complex the recovery more tenuous and the complication rate may be higher.

SURGICAL ASSESSMENT

Once the clinician has decided that there is an indication for the removal of a tooth, they must then assess the surgical risk of the procedure.

Classically, third molars have been considered with various classifications to describe the difficulty and risk associated with their surgical extraction. Classifications such as Pell and Gregory^{17,18} or Winter's classification¹⁹ have largely fallen into disuse. A more common system for examining and predicting the difficulty of removal of third molars is the WHARFE system.²⁰ This considers:

- (1) W – Winter's lines;
- (2) H – Height of mandible;
- (3) A – Angulation;
- (4) R – Root form;
- (5) F – Size of follicular sec;
- (6) E – Exit pathway of tooth.

This schematic allows for a more thorough examination of the tooth and its radiology prior to its removal.

SURGEON CAPACITY

An additional assessment is whether the surgeon is capable of providing the surgery. This is a potential source of bias in the process and should always be insightfully assessed. If a surgeon is incapable of providing the procedure, they should refer the patient for assessment to someone who can perform the surgery, so that there is

no bias in the decision pathway, especially when conservative management is recommended.

RISK OF COMPLICATION

Post-surgery complications remain a significant deterrent for patients and clinicians alike. When the patient is disease or symptom positive, the benefits of surgery are seen to outweigh the risks and surgery ensues. When the patient is asymptomatic, the equation becomes more difficult.

The relevance of post-surgery complication decreases with surgeon experience.²¹ The more experienced the surgeon, the less likely a significant complication. This would suggest that for patients considering prophylactic surgery for asymptomatic teeth, the surgeon's experience is a factor of importance.

The risk of Inferior Alveolar Nerve (IAN) damage is relatively low (0.68%)²¹. The reduction of quality of life for patients who have a post-operative IAN injury is also low. The risk of post-operative nerve damage also increases with patient age²¹. These factors combined would suggest that the removal of an asymptomatic tooth by an experienced surgeon in a young patient, is unlikely to result in a significant reduction in quality of life, even if the IAN is damaged.

Damage to the Lingual nerve is also a rare complication, but one which is keenly avoided. The reported occurrence is 0.15%²¹ but anecdotally seems to be less when surgery is performed by a more experienced practitioner, and when lingual retractors are not used.

Post-operative surgical morbidity such as infection, alveolar osteitis (dry socket), bruising, and pain result in a defined period of reduction in quality of life. This period is usually less in intensity and duration than the aggregate of recurrent third molar symptoms throughout a lifetime.

CURRENT HEALTH MODIFIERS

Current health modifiers for patients include things such as cardiac state, immunocompromise, coagulation function, medications such as bisphosphonates and denosumab, respiratory function, the patient's fitness for anaesthetic/sedation/local anaesthesia, and the patient's pregnancy status. If any of these conditions are present in a significant manner it is likely that the decision to remove the third molar will be given both more consideration and will require a higher potential health benefit to proceed.

FUTURE HEALTH MODIFIERS

Future health modifiers are difficult in some instances for clinicians to predict. In other instances patients can specifically attend for an examination of their third

molars because they are aware that they are about to commence medication, have a tissue transfer procedure, or become pregnant. In these situations the clinician must try to predict the likelihood of the third molar acquiring either symptoms or disease within a specified period and balance this against the potential for morbidity following the surgical removal of the tooth.

SOCIAL MODIFIERS

Social modifiers of note for patients include access to care and support post surgery. The patient's level of understanding and capacity to communicate along with their manual dexterity must also be considered. Many patients have specific personal desires and this can be intimately tied in with their mental health and their religious background. Issues such as transport and home help can also be major modifiers in the decision to proceed to surgery.

FINANCIAL MODIFIERS

For many patients in western culture financial modifiers are also an important component of the health care decision. When patients have access to insurance plans for specific periods whilst in employment, or are under family access plans, they will often be more inclined to remove third molars at an earlier stage. Also of importance to many young people is the potential to limit the loss of income due to the retention of third molars (from time lost from work through pain) versus a specified period of loss of income during a relatively short period of recovery following surgery. Another example of a financial modifier might be the decision to remove one symptomatic third molar along with three asymptomatic third molars for patients who only wish to undergo one period of recovery rather than four separate episodes of recovery in the future.

WHAT TO DO IF SURGERY HAS NOT BEEN RECOMMENDED?

If the surgical matrix has been followed and there are significant reasons to avoid or delay surgery, the patient should not be discharged from care. Patients with known third molars should have regular review and be considered for reasonable regular radiological assessment. The degree of symptomatology and the type of contraindication to surgery should be considered when deciding between a 2, 5, or 10 year review OPG interval.

INTERNATIONAL VIEWS

The international experience regarding the decision making process for the removal of third molars is

interesting. In the United Kingdom's National Health Service (NHS), the National Institute for Clinical Excellence (NICE) has recommended that impacted third molars that are free from disease should not be removed.²² They have recommended that patients who have impacted third molars that are asymptomatic should visit their dentist for their usual check-ups and that only patients who have diseased third molars or other problems with their mouth should have their third molars removed. This guideline essentially excludes the third, fourth, and fifth (current health modifiers, current future modifiers, and social and financial modifiers) elements from the decision matrix. This may be because the guidelines were produced before the onset of significant events such as bisphosphonate related osteonecrosis of the jaw, or because the NHS funds the majority of third molars surgery so that financial decisions are less of a factor in treatment planning.

The American Association of Maxillofacial Surgeon's (AAOMS) recommends that 'treatment decisions regarding why, when, or how, to treat third molar teeth are extremely complex'. There is no pat answer, cookbook recipe, or flow chart that is universally accepted regarding the decision making process.²³ The American Association clearly identifies the need to tailor the decision matrix to the needs and desires of the individual.

Australia has neither such guidelines nor clinical recommendations. The majority of Australian surgeons would use a model similar to this decision matrix to decide for each patient. The risk of post surgical morbidity, long term neurosensory complication, pain and suffering due to retention of third molars, and the social and financial implications of both retention and removal of third molars would typically be a factor in most Australian surgeons' decision making process. Hopefully, this decision matrix illustrates a repeatable consideration process for clinicians. There is insufficient evidence for specific indications such as post orthodontic stability or prophylactic removal to assist the new clinician in this decision making process. Many of these decisions are made based on previous experience and patient desire. This continues to be a reasonable method provided consideration is made across the broad concepts outlined in this article.

CASE STUDIES

Case Study 1 (Fig. 1)

Figure four shows a case study of a 17 year old male who has fragile X syndrome and lives in institutional care. He has limited support from his elderly mother and is engaged within her health plan for another



Fig. 1 Radiograph of Case 1.

year until he turns 18. The patient has presented with the tooth 38 partially erupted but symptom free. There is a 3mm periodontal pocket at the mesial aspect.

The decision matrix shows that this is a symptom negative and disease negative tooth. The procedural risk for the removal of this tooth is relatively low. The patient's current health modifiers may make the surgeon less likely to remove the tooth given the patient's poor understanding and capacity to consent to the procedure. The patient's future health modifiers may increase the inclination towards surgery, a trend multiplied by the patient's relatively poor oral hygiene which is not likely to improve in the future. The patient's social modifiers may also increase your inclination towards surgery given that the patient has current access to social, family, and financial support. The decision to remove this asymptomatic and disease free third molar may end up being made for largely non-clinical but very significant social and financial factors. This is a common example of why the decision to remove a third molar remains a highly tailored process where the individual's desires and needs are considered on a case by case basis.

Case Study 2 (Fig. 2)

An 18 year old female who has had non-extraction orthodontics presents with mesially impacted third molars. There is insufficient space distal to the second molars and a lack of keratinized gingiva. She is otherwise fit and healthy. Her mother is keen for surgery whilst she is on a gap year and before she leaves home for university.

These lower third molars are disease free and symptom free. The indication for surgery is the potential for damage to the adjacent second molar, and the potential for periodontal disease in the future. The



Fig. 2 Radiograph of Case 2.

teeth are relatively low risk in terms of surgical complication and the surgeon is experienced and competent to perform the procedure. There are no modifying health factors and the patient has good social and financial support, which will decrease in the following year. Here it is likely that this is a sensible, low-risk, and convenient time for this patient to have their third molars addressed and surgically removed.

Case Study 3 (Fig. 3)

A 21 year old male who has pericoronitis associated with the lower third molar requiring 3 courses of oral antibiotics in the last twelve months. He has a mild phobia and requires a general anaesthetic to remove the tooth. His mother has requested that he have the upper third molars removed at the same operation. This is reasonable given that the likelihood of plaque retention and difficulties with the retained upper non-

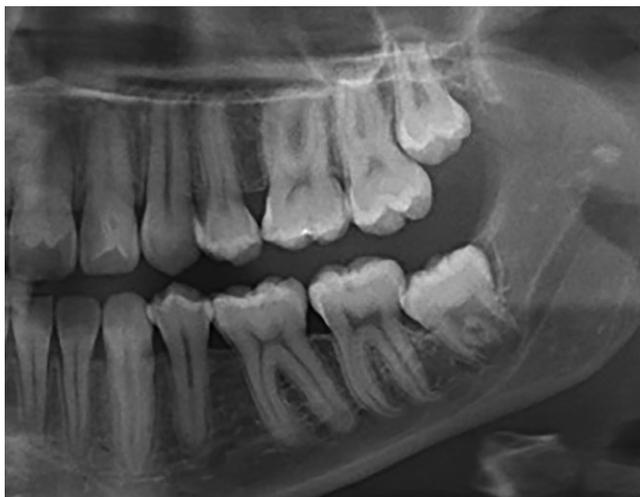


Fig. 3 Radiograph of Case 3.

functional third molars is high. The additional surgery will not prolong his recovery, and there is a cost and social benefit by reducing his treatment episodes to a single period rather than requiring two separate procedures.

Case Study 4

A 24 year old male presents with symptomatic mandibular 3rd molars. He is medically fit & well and plays the Trumpet in the State Symphony Orchestra. The OPG radiograph shows that the inferior alveolar nerve is in close proximity to the tooth roots (Fig. 4).

Management of this case is complex. If you proceed with surgical treatment then there is a risk of nerve injury with potential significant effects on his career. A numb lip will affect his ability to play at a high standard. On the other hand he is in pain which needs to be resolved. Prolonged decision-making can give rise to problems as nerve injuries are more prevalent in older patients with a higher risk of dysaesthesia and slower bone healing.

This patient is best referred to an OMS with experience in management of nerve injuries and in particular the techniques of avoidance. The first step is imaging the precise relationship of the nerve to the tooth by a CT scan (Fig. 5). A surgical plan can then be developed. One technique besides complete extraction is to perform a coronectomy.²⁴ The crown is removed leaving the root undisturbed from the nerve. This avoids



Fig. 4 Radiograph of Case 4.

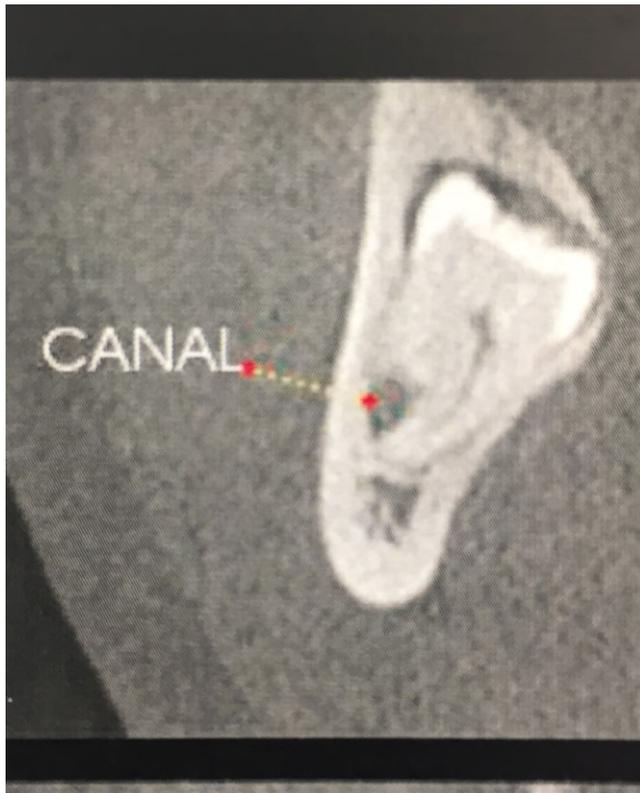


Fig. 5 5 CT of Case 4.

the risk of nerve damage. The residual root either remains in situ & becomes surrounded by bone or over time the roots erupt away from the nerve thus facilitating their safe removal.

CONCLUSION

This paper gives the clinician the tools, the matrix, and the confidence to guide patients through the process of third molar assessment and treatment.

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Address of correspondence:

Dylan Hyam
 Capitol Oral and Facial Surgery
 Suite 2, Level 3
 173 Strickland Crescent
 Deakin, ACT 2600
 Australia
 Email: dylan.hyam@act.gov.au