

Pre- and postoperative management techniques. Before and after. Part 2: the removal of third molars

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IN BRIEF

- Discusses the factors influencing complications during third molar surgery.
- Provides an overview on the use of antibiotics to prevent infection following third molar surgery.
- Describes methods used to minimise or prevent postoperative pain and swelling following wisdom teeth removal.
- Highlights the use and benefits of cone beam computed tomography (CBCT) for third molar surgery.

This article aims to highlight the strengths and weaknesses within the selected evidence to aid readers in clinical decision-making when managing patients before and after third molar surgery. Preoperative methods to prevent nerve damage, including the use of computed tomography (CT), are discussed. Preoperative considerations are also summarised, including risk factors such as increasing the occurrence of nerve deficit, weakness and damage, and the role of cone beam CT and when this should be used. The postoperative complications pain, swelling and infection are considered and the available evidence for the use of different protocols, regimes and combinations of therapies summarised.

INTRODUCTION

In the second of this short series of articles covering pre- and postoperative management techniques, we will take a closer look at some of the existing protocols, advice and instructions that are used (or considered) within one particularly common oral surgery procedure carried out by operators all over the world, namely the removal of third molar teeth. Considering the advent of new pre- and postoperative techniques, we will discuss management methods and materials, and the current evidence to support or refute these approaches.

Surgeons must remain careful to use methods to avoid complications during third molar surgery, and this prudence must begin before any procedure. This is particularly true for those complications that will significantly affect the patient's quality of life. It is important to recognise and eliminate as many as possible of the risk factors that would increase the possibility of developing problems such as nerve damage, pain, swelling and infection.

PREOPERATIVE

Prevention of nerve damage

The fundamental decision for considering or requesting further investigation rests with the clinician. The justifications often relate to the

risks, which should be clearly outlined on the consent form. Some of these investigations may be dependent on risk factors or may highlight specific risk factors. A large scale study, including over 3,000 patients, investigating the main risk factors for developing permanent sensory dysfunction in the inferior alveolar nerve (IAN) was performed in 2010.¹ In this study, the main risk factors were found to be: the skills and experience of the operator, the type of impaction and the radiographic proximity of the tooth to the IAN.¹

Kim *et al.* discussed these risk factors in a recent case-control study in which a large sample size was used to identify patients who demonstrated signs of sensory deficit of the IAN. The results of this study suggest that significant risk factors include increased patient age, deeper impaction and particular radiographic signs (such as darkening, deflection and narrowing of the third molar teeth roots and narrowing of the IAN canal). These radiographic signs have been investigated previously, beginning with Rood and Shehab in 1990³ who identified seven radiographic signs of increased IAN injury, three of which were 'significant'. Since then, various other studies have yielded similar results⁴⁻⁹ and the evidence suggests that clinicians should take note of these 'significant' signs, but remain wary that the other signs identified by these studies may occasionally lead to a close association between teeth roots and IAN.

Trigeminal nerve injury carries a high morbidity in dental surgical procedures with potentially serious medico-legal repercussions.¹⁰ For the patient, these injuries carry the burdens of reduced function, self-esteem

and quality of life.¹¹ Recently, there has been much interest in less invasive and preventive measures as alternatives to full third molar teeth surgery, in particular the coronectomy procedure.¹²⁻²¹ The most recent and comprehensive evaluation of this technique comes from a recent Cochrane systematic review,²² which evaluates different surgical techniques for the removal of third molars. The authors of this review were reluctant to recommend any changes to current surgical practice and did not openly recommend the coronectomy procedure.²² Some of the problems in relation to coronectomy include the lack of long-term follow-up, and hence unpredictability with regard to the outcome of the roots left *in situ* and any long-term complications. In one particular randomised controlled trial, 38% of coronectomy procedures were described as 'failed', but with no mention as to how/why this occurred. Despite these flaws, the evidence did consistently demonstrate a reduced rate in symptoms indicating IAN damage in patients who had undergone the coronectomy procedure when compared to normal third molar surgery.

There has been much interest in the incidence of both temporary and permanent damage to the trigeminal nerve (in particular, the lingual nerve and the IAN) postoperatively,²³⁻⁴⁰ including risk factors which relate to these sensory deficits.³¹ A 1992 study by Carmichael and McGowan reported a post-extraction analysis of 1,339 third molar teeth from 825 patients in West Scotland. They reviewed patients for a year and the study yielded some interesting results (see Table 1). In fact, one in four of the participants exhibited some form of temporary sensory deficit,²⁶

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however, the technique used during third molar removal (that is, whether a 'lingual flap' was raised), was not specifically discussed. The recommendations in this study were to provide meticulous and thorough information to patients regarding the complication of trigeminal nerve injury. Robert *et al.* submitted results of a state survey in California in which operators in oral/maxillo-facial surgery units reported their own experiences in relation to temporary/permanent damage to the lingual nerve and IAN following mandibular third molar extractions. The overall estimated rates were 1 in 1,000 cases of lingual nerve damage (both temporary and permanent) and 4 in 1,000 cases of IAN damage (both temporary and permanent).³² Again, tooth removal techniques were not disclosed. Further statistics have been derived and estimate short-term lingual nerve sensory deficit at 0.4–1.5% (without the use of a 'lingual flap'), with persistent insufficiency at 0.5–20% (with the use of a 'lingual flap'),^{33–35} but can be as low as 0.0% (without the use of a 'lingual flap').³³ Elsewhere in the literature, Hillerup and Stolze report the incidence of temporary injury at 1–20% and permanent injury at 0–2%.³⁶ The figures for IAN disruption would suggest temporary deficiency rates in 1–5% of cases and permanent deficiency in 0–0.9% of cases,^{35,37} with a mean figure of 0.3% from all studies.³⁸ Alternative aetiology and the management of such neurological damage and injury has been discussed in other texts.^{35,38–40}

There continues to be vast interest in the topic of nerve insufficiency following dental surgery. As discussed briefly above, many studies with varying methodologies have been conducted to provide useful statistics which should not be ignored by clinicians. The evidence considered above contains studies with large sample sizes, but there is no specific focus on one single surgical technique or experience of the operator carrying out the procedure. There are a large number of variables that can have an effect on both lingual and IAN deficit/damage/injury, none of which have been completely standardised in any single trial or study. The range in the statistics (see Tables 1 and 2) may be a reflection of this. It is the view of the author that when consenting the patient for this surgical procedure (removal of third molar teeth), it is of benefit for the clinician to be aware of the evidence to help provide patients with accurate information. It should, however, also be recognised that these statistics will vary from patient to patient and should not be used blindly without the clinician's own judgement.

Regarding the use of computed tomography imaging for removal of third molar teeth, the risk considered is most commonly

Table 1 'Temporary' and 'permanent' nerve damage to the lingual nerve and IAN following removal of wisdom teeth*, Carmichael and McGowan (1992)

	Lingual nerve	IAN
6–24 hours	15%	5.5%
7–10 days	10.7%	3.9%
1 year	0.6%	0.9%

*No specific or single technique stated for mandibular third molar removal

Table 2 Observations in the recovery of sensory deficit of the lingual nerve (including techniques such as raising a 'lingual flap') and IAN following removal of wisdom teeth*, Hillerup and Stolze (2007) and Hillerup (2008)

	Lingual nerve	IAN
Short-term deficit	1–20%	1–5%
Long-term deficit	0–2%	0–0.9%

*No specific or single technique stated for mandibular third molar removal

potential temporary/permanent damage to either the lingual nerve, or the IAN. The increasing availability of this computed tomography imaging should prompt practitioners to consider its use. Thus, it is beneficial to be aware of the current evidence relating to its use.

The use of computed tomography (CT) in the management of impacted mandibular third molars

There is continuing debate as to whether a small portion of patients, a majority of patients or all patients should be examined using cone beam CT (CBCT) when presenting to the clinician with impacted mandibular third molars. The author's view is that readers can be sure that this debate will continue well beyond the publication of this article.

One of the early published articles on this topic revealed that the use of CT actually resulted in a decrease in the number of patients who initially presented as 'high-risk' in relation to proximity of the IAN following their referral using panoramic radiography. Many other studies have since investigated the use of CT, eg White described the many uses of CBCT in dentistry,⁴² confirming its application for impacted third molars (see Figures 1–5 relating to the same tooth and patient). A subsequent paper in 2011⁴³ also confirmed the efficacy of CBCT and builds on the evidence from the initial 2007 publication.⁴¹ This study reported a similar conclusion when comparing CBCT to panoramic imaging, namely that significantly more of the patients involved in the study were reclassified to a lower risk of IAN injury when compared with panoramic assessment. The authors of that particular article went on to comment that CBCT contributes to an

'optimal' risk assessment and superior surgical planning compared to plain panoramic radiography.⁴³ Overall, the literature does not conclude that CBCT radiography should be made obligatory in relation to management of impacted mandibular third molars, but does encourage the use of this radiography when it is warranted and confirms its efficacy.^{46–48} Figures 1–5 demonstrate how useful CBCT can be to aid treatment plans and how/when it may best be utilised.

Neves *et al.* looked specifically at signs of close proximity of the tooth to the IAN canal and concluded that darkening of the roots and loss of corticated margins of the IAN canal (in isolation and combination) were effective at determining a risk relationship between the tooth and the IAN canal further warranting 3D investigation.⁴⁴ This view was shared by Shahidi⁴⁵ the following year. Matzen *et al.* launched an ambitious trial in 2013 which studied whether subsequent CBCT (following panoramic radiography and a stereo-scanogram) influenced the treatment plan.⁴⁶ They found that CBCT imaging only changed 12% of treatment plans.

Ironically, the use of CBCT has been to predict postoperative outcomes. The evidence discussed so far relates to 'high-risk' third molar teeth. Guerrero *et al.* concluded that the use of CBCT was no better than panoramic radiography for predicting postoperative complications in 'moderate-risk' cases relating to impacted mandibular third molars.⁴⁷ This particular study confirmed that careful planning and good surgical technique can provide a desirable result, irrespective of the imaging used.⁴⁴ It would appear from all of the evidence considered that risk assessment is an important factor in



Fig. 1 A DPT radiograph taken on a patient referred for removal of the lower mandibular third molar (48)

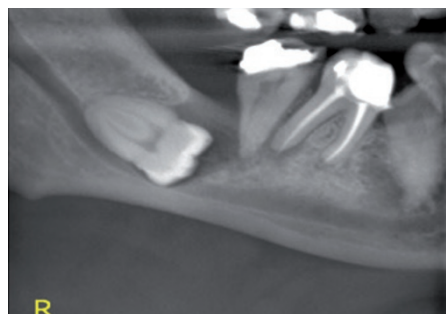


Fig. 2 A magnified view of the DPT showing potential dentigerous cyst formation associated with 48

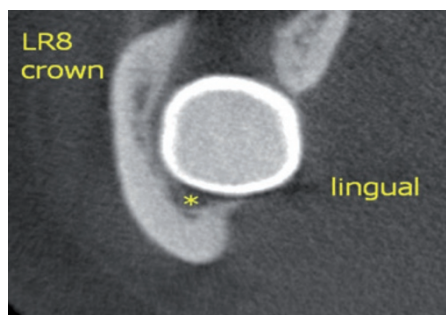


Fig. 3 CBCT – Sagittal view of the mandible, illustrating the crown of the same 48 tooth, and its relationship to the IAN-canal (*). These images can be used to predict potential risks of nerve damage when performing surgery

determining whether further special investigation (such as CBCT) is beneficial. From the studies discussed, it is clear that panoramic imaging still plays a pivotal role in the management of third molar teeth; as indications from these radiographs form part of the risk assessment.

There continues to be ongoing worldwide research on the topic in order to provide more accurate, specific advice for clinicians and operators to use when communicating with patients and within surgery. In 2009, the SEDENTEXCT project produced provisional guidelines on the use of CBCT in dental and maxillofacial radiography.⁴⁹ In the same year national guidelines were produced.⁵⁰ These documents are comprehensive, readily available and the author would recommend that clinicians regularly using CBCT be familiar with them.

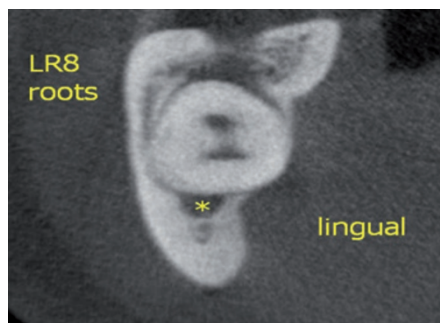


Fig. 4 Sagittal view of the mandible, illustrating a section through the 48 tooth, and its position relative to the IAN-canal



Fig. 5 Sagittal view of the mandible, illustrating the roots of the 48 tooth, and their association with the IAN-canal

POSTOPERATIVE

Analgesia and swelling

Perhaps one of the most important priorities for the dental patient visiting clinicians is that they have a pain-free experience. This is well recognised by operators and the use of modern local anaesthetics has assisted greatly in providing an environment which is more comfortable for the patient. What may elude some operators is that this concept of pain management should continue postoperatively – even beyond the patient's stay within the operating environment. The World Health Organisation (WHO) has confirmed that this is *a priori* and the responsibility of the clinician.⁵¹

Much of the research surrounding pain relief following third molar tooth removal is relatively recent.^{52–54} However, the early work carried out by Frame *et al.* is still clinically beneficial and relevant today.⁵⁵ This study was published over 20 years ago and confirms the benefits of the use of ibuprofen as a postoperative measure following third molar tooth removal; and its superiority over dihydrocodeine.

Corticosteroids are popular with many surgeons and are recognised for their ability to reduce discomfort to patients following third molar removal,⁵⁶ and their mechanism of action is well-known.^{57–60} In 1993, one study used methylprednisolone (16 mg orally – 12 hours prior, 20 mg intravenous [IV] – immediately prior) against a placebo

tablet (orally – 12 hours prior) and obtained good results.⁶¹ They also suggested continuing the IV administration three days postoperatively. Tiwana *et al.* studied patients who were undergoing surgery on four impacted third molar teeth.⁶² The patients were divided into two groups, one receiving different corticosteroid regimes against an untreated control group. They concluded that those who'd received the preoperative IV infusion of corticosteroid had better outcomes postoperatively. There has been a great deal further research into the use of corticosteroids in different combinations (with antibiotics), in different sites and at different times of administration, which mainly concentrate on postoperative swelling as the main outcome.^{63–71} Beirne and Hollander asked patients how many pain pills they used postoperatively following their third molar extractions and noted significantly reduced pain postoperatively in those that had received 125 mg methylprednisolone IV, when compared to the control group.⁷² Nearly ten years later, a German study concluded that a combination of methylprednisolone (both before and after surgery) and ibuprofen (on the day of surgery and after surgery) were effective in providing postoperative analgesia.⁷³ Graziani and co-authors used an alternative approach to the other studies mentioned – utilising dexamethasone perioperatively to either inject submucosally or as endo-alveolar powder. It was concluded that these medicaments were effective at reducing postoperative pain, trismus and facial oedema.⁵² Much of the research using corticosteroids focuses on interventions that require administration by the clinician and are unlikely to be readily available or accessible to patients. Consequently, many of the combinations tested may be more suited to a secondary care setting or specialist clinics when used in primary care. Despite this, when interventions are obtainable and where clinicians have suitable, sufficient and adequate training, these corticosteroid regimes should be considered for use.

In 2008, a large Cochrane review concentrated on the use of acetaminophen (paracetamol) – in particular the optimum dosage and the best time to utilise the drug postoperatively.⁵³ The authors concluded that paracetamol is safe and effective postoperatively when used for treatment of postoperative pain relating to third molar removal, having the benefit of reducing pain intensity at both 4 and 6 hours.⁵³

In 2011, some authors tried a different approach using a 'food product', which contained palmitoylethanolamide as the active ingredient. This was used for postoperative pain control following surgery

on impacted third molars. The study demonstrated statistically significant results for postoperative pain control with the use of palmitolyethanolamide.⁷⁴ However, when looking closely at the results of this trial, supplementary analgesics were also used in the first week post-surgery, and it is unclear whether these contributed or were even directly responsible for the pain control following the procedure. The latest and most-recent research is a Cochrane systematic review, which has been published as recently as 2014.⁵⁴ The review looks at the beneficial and harmful effects of ibuprofen and/or paracetamol for pain relief after lower third molar surgery. It confirms high-quality evidence is present to indicate that ibuprofen is superior to paracetamol in providing pain relief following this procedure, but also suggests that a combination drug has superior effects at 8 hours, demonstrating encouraging results.⁵⁴

The use of ice has yielded positive results^{75–78} and has the additional benefits of reducing the discomfort experienced with postoperative swelling. Physiologically, reduced local temperature and reduced cellular metabolism are partially responsible for the efficacy as a therapeutic aid postoperatively.⁷⁸ In 2005, contrasting evidence was published by Van der Westhuijzen *et al.*, who concluded that no significant difference was noted in patients who had applied ice continuously for 24 hours postoperatively following removal of third molars in comparison to the control group (who did not apply ice).⁷⁹ Despite contrasting evidence, many clinicians advocate the use of ice postoperatively, and it has also been recommended following procedures such as endodontic surgery.

Antibiotics

Current guidelines in primary care dentistry would encourage the cautious and selective use of antibiotics.^{80,81} Alveolar osteitis (dry socket) and osteomyelitis are well-recognised postoperative complications for dental extractions.^{82–86} To help reduce their incidence or prevent these unwanted complications, oral surgeons will often consider the use of antibiotics following removal of third molar teeth.

Some useful initial work on this subject was carried out by Van Gool and authors.⁸⁷ They reviewed complaints and complications following 932 mandibular third molar extractions and looked at the effect of various factors on the prevalence (including the prescription of antibiotics). Their findings suggested a lower prevalence of such complaints and complications in the absence of 'socket packing', tight suturing and avoiding

reflecting the mucoperiosteum. Their study also rejected the requirement for prophylactic administration of antibiotics.⁸⁷

Since this early work, many further studies have been carried out, including literature reviews.^{88–90} The first of these recent reviews was carried out by Ren and Malmstrom in 2007.⁹¹ They performed a meta-analysis of randomised controlled trials on the effectiveness of antibiotic prophylaxis in third molar surgery. From the 16 trials analysed, they concluded that systematic antibiotics administered before surgery are effective at reducing the incidence of dry socket and wound infection postoperatively.⁹¹ Evidence surrounding interventions and medicaments to prevent dry socket has been well-discussed in a superb recent article published in this Journal.⁹² One of the reviews is a Cochrane systematic review, which concentrated on the use of antibiotics after general extractions of teeth.⁹³ Randomised double-blind placebo-controlled trials of antibiotic prophylaxis in patients undergoing dental extractions (for any indication) were analysed for postoperative infectious complications. However, within this review, all trials included were actually those of healthy patients undergoing third molar teeth removal that were often treated by oral surgeons. The authors concluded that some evidence exists to support the use of antibiotics to reduce the risk of postoperative infection, dry socket and pain. The review also commented that it is unclear whether this evidence can be generalised to immunodeficient or immunocompromised patients.⁹³ Oomens and co-authors alluded to this fact in their 2012 review.⁹⁴ This review commented on the strength of the trials that were included – only eight of the 23 trials used were identified as 'high-quality'. The conclusions here indicated that only limited evidence exists to support the use of antibiotics for the prevention of postoperative complications ('infection'). The review also noted the absence of well-designed and well-reported high-quality randomised controlled trials, which would also take known risk factors into account.⁹⁴

Although there appears to be an abundance of evidence surrounding this particular topic, most data appears non-specific and not accurate enough to be able to reach reliable evidence-based conclusions for patients with different medical morbidities. Nevertheless, from the reviews that have been conducted, there would appear to be a useful role for antibiotics in reducing the advent of postoperative infections, particularly dry socket. Unfortunately, there does not seem to be sufficient investigation into antibiotic efficacy relative to patient risk-factors.

SUMMARY

As demonstrated in this summary of the literature; ample research and effort has gone into providing clinicians with diagnostic tools, recommended techniques and medicaments to prevent potential morbidities during third molar teeth surgery, or in the period afterwards.

The operator must make patients aware of the relative risks of complications, such as nerve damage, deficit or injury. Today, the accessibility and availability of CBCT can assist the clinician in identifying and explaining such risks to patients, as well as planning treatment. The use of CBCT, however, should not be routinely used but should be reserved for specific cases and guidelines do exist to specify their role in third molar removal.

Probably the most common postoperative complications are pain, swelling and infection. It is unsurprising that there is a lot of research available related to these problems. Ibuprofen, and its combination with paracetamol should still be the first choice for relieving postoperative pain following third molar tooth removal. Corticosteroids have been investigated preoperatively, perioperatively and postoperatively and remain popular for either preventing, reducing or treating gross swelling. Although many regimens investigated in research studies are combinations or are used at different time-periods within the surgical period and consequently they are effective to varying degrees and for varying lengths of time. With regards to preventing postoperative infection, antibiotics have been thoroughly investigated. Although guidance repeatedly discourages their overuse and there is a high volume of data surrounding the topic, this data is not specific or accurate enough to be conclusive. However, recommendations from some reviews would advocate that they have a role in reducing postoperative infections and dry socket.

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