



Modern Approaches to Pain and Inflammation Control in Oral Surgery

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Abstract:

The following postoperative complications are related to surgical trauma and inflammation: pain, edema and trismus. They are managed with an analgetic foundational drug, a suitable anti-inflammatory (adjuvant) and attention to functional recovery. A clinical guideline, systematic reviews and evidence mapping were used to synthesize ten sources of literature, focusing on mandibular third molar surgery. NSAID (s) with or without acetaminophen is recommended as primary analgesics following extraction and routine opioid prescribing is discouraged. The results for preemptive dosing, corticosteroid, combined, cryotherapy and photobiomodulation are more variable and sometimes less certain due to the use of less consistent and less reliable methods and studies. The intensity of pain, facial swelling and opening of the mouth should be assessed separately. Patient-specific factors should take into account contraindications, procedure complexity, timing of treatment and the clinical distinction between expected inflammatory reaction and a postoperative complication.

Keywords: Oral surgery; post-surgical pain; inflammation; Non-Steroidal Anti-inflammatory Drugs; Corticosteroids; Cryotherapy; Photobiomodulation.

Introduction

The extraction, flap elevation, bone removal and soft-tissue manipulation induce an acutely inflammatory response. In the early days after surgery, pain, swelling and limited mouth opening may make eating and oral hygiene difficult and may affect sleep. The intensity and/or duration of these reactions varies with patient and operation, and an intervention that is effective for reducing pain may not decrease swelling or trismus. An evidence-based clinical guideline covers acute pain following both simple and surgical tooth extraction and places pharmacologic treatment in the context of benefit, harm and feasibility [1]. Evidence for oral surgery is overwhelmingly constituted by the case of mandibular third molar extraction, which is a valuable, but imperfect model, for other procedures. Medications and physical interventions are described in a systematic review of nine RCTs of oral and maxillofacial surgery, but the interventions and surgeries are too multifaceted to create a universally applicable protocol [2]. Ten selected publications are reviewed and first line analgesics differ from those used as adjuncts to reduce swelling,

or trismus or promote healing. It also assesses the level of support for each claimed benefit, and does not claim that every statistically significant endpoint is a clinical recommendation.

The clinical evaluation and treatment objectives

A postoperative assessment should document the baseline risk, complexity of the procedure, onset of symptoms, reported pain intensity, medication given for pain, facial swelling and maximal mouth opening (if applicable). The main goals are pain control sufficient enough but with a tolerable side effect profile, restore function and have an awareness of the atypical course. When pain worsens after initial improvement, new fever or discharge, and disproportionate swelling all indicate complications that need to be assessed and not just by increasing the dose of the analgesics. The studies of 3rd molars are frequently performed on visual analog or numeric pain scale, facial dimensions and interincisal distance, which are not a comprehensive reflection of the whole patient experience [2].

Individual should be considered prior to the selection of a drug. The use of a nonsteroidal anti-inflammatory drug (NSAID) is modified if the patient has a history of gastrointestinal bleeding, kidney disease, allergy, interacting anticoagulants or other contraindications. The acute-pain guideline outlines other options in the event that NSAIDs are not suitable and restricts opioid use when other first-line drugs are not effective or contraindicated [1]. Selection should also consider the possibility of surgical trauma and rescue medication as well as the possibility of a “just in case” prescription of an opioid for each patient. These are guidelines for dosage and not a dose for a specific age and history.

The simple analgesics are NSAIDs + acetaminophen.

The 2024 CPG recommends that nonopioids be the initial treatment for acute pain after a tooth extraction. Combination products that include non-steroidal anti-inflammatory drugs (NSAIDs) typically are safer and more effective in terms of relief and side effects than opioid analgesics.

Opioids are not recommended as first-line treatment and are only considered when first-line treatment has failed, or where NSAIDs are contraindicated; The guideline strongly advises against routine advance prescribing of opioids for adolescents and young adults [1].

This guidance directly concerns extraction-related pain, and helps to form a basis for other oral surgery planning, although clinical judgment must be exercised for other procedures. The 2024 systematic review and meta-analysis of NSAIDs in oral surgery indicated that there were differences between the drugs and the schedules in terms of pain, swelling and trismus (difficulty opening the jaw). The certainty was rated as low to very low and the comparisons between the drugs of the drug class, timing and duration were indirect and heterogeneous [3]. The detailed ranking, therefore, is intended to be a red flag, rather than proof that one NSAID is better than others. In the original studies, an NSAID was frequently used, but it is important to determine whether an NSAID is warranted in the patient, and whether pain can be managed without resulting in unintended drug effects [1,3].

NSAID selection is different than acetaminophen combination therapy. The two act in different ways and may be a good combination of drugs to give good analgesia without the regular use of an opioid drug as outlined in the guideline [1]. But, taking the two together doesn't negate the need to evaluate each one individually: Total daily dose of acetaminophen, liver disease if applicable, bleeding, gastrointestinal, renal or cardiovascular issues for NSAIDs still are important. None of these groups could be differentiated in terms of postoperative pain. If a patient complains about inadequate pain control, the

medication should be reviewed and the surgery site checked for the last time before switching medications up [1,3].

The positive aspect of the guideline is that it considers benefits and harms for individuals affected by the trial, rather than the maximum number of people benefiting from the trial. For example, a drug that is effective for the first few hours after extraction, may not be suitable as a routine drug as it can have disproportionate side effects and/or a rescue drug may need to be given soon after extraction [1]. Each of the subgroups in the NSAID review consists of different procedures and different perioperative schedules and thus cannot define an optimum regimen for each procedure [3]. An accountable treatment plan records the patient's likely response to the primary treatment medication, may include a plan for repeated doses of the unsupervised medication if this is likely to be needed, and may include a plan for a review of the medication to be given if the patient complains of pain that is so severe that repeated doses of the primary treatment medication are not indicated.

Corticosteroids and the distinction between outcomes

Inflammatory mechanisms are employed to control inflammatory processes, not to provide much analgesia, and therefore, Corticosteroids are used to help reduce inflammation. The effect of corticosteroid (vs placebo) was negligible at 6 hours and 24 hours after removal of third molars from the mandible in a systematic review and meta-analysis of 40 RCTs, and was rated as low or very low certainty. It did not reveal a significant difference in the postoperative infection or in alveolar osteitis, whereas there was some doubts for these outcomes [4]. The results do not imply that there is no benefit from swelling or trismus, but do caution that the utilization of steroids is not a primary method of pain management for all.

There were seven randomized studies comparing preemptive dexamethasone to methylprednisolone, and these studies yielded widely similar results for pain, need for rescue analgesics, and swelling. Dexamethasone was associated with less early trismus; methodological heterogeneity and low to moderate certainty of evidence limit confidence in a drug preference [5]. Such comparisons are clinically appropriate when the issue of mouth opening is important, but are not to be interpreted as a meaningful pain superiority claim. When comparing steroid regimens, route, timing, dose and duration must be taken into account, as well as patient contraindications [4,5].

Nine studies were included in a 2025 systematic review of postoperative methylprednisolone; five of those were quantitatively analyzed. The pooled pain comparisons at 24 hours and 7 days were not significantly different, but the authors suggested that benefits may be seen on other inflammatory results [6]. Some of the statements included in that review regarding interincisal reduction and relative trismus effects are hard to reconcile with the overall conclusions of that review. Methylprednisolone probably affects certain recovery measures, and does not seem to be beneficial for pain. Review must be interpreted with the larger, placebo-controlled analysis and the direct comparison to dexamethasone, and not stand alone as a basis for prescribing a specific steroid [4–6].

Preventative treatment and multidrug therapy.

Preemptive treatment involves the administration of an analgesic or anti-inflammatory prior to tissue injury, to prevent initial nociceptive and inflammatory responses. The nineteen systematic reviews reviewed related to preemptive NSAIDs and corticosteroids in oral-surgery procedures, primarily

involving third-molar surgery. Reporting of adverse events, reported doses, adverse-event reporting, and method of administration were also highly variable and there were at least two major methodological flaws in every review included (except for doses) [7].

These limitations make it difficult to reach a definite conclusion that the use of a preoperative administration is always superior to a judicious postoperative administration. While there may be a specific time window, the gain should be evaluated based on the specific outcome and patient. Meanwhile, a smaller systematic review of five studies involving 436 third-molars in 420 patients was performed for the combined use of dexamethasone and diclofenac for pre-operation. Some comparisons of the combination with diclofenac alone showed a decrease in pain and facial swelling, while trismus did not consistently show a benefit [8]. The analysis does not support routine dual therapy of any sort, but rather a potential worthwhile adjunctive approach, which should only be considered when considering the risks of NSAID and steroid use. Especially, it is necessary to consider the study designs, regimen differences, and limited data on adverse effects of a positive pooled result for a short-term endpoint [7,8].

These sources are therefore 'supplemental' to each other: the guideline sets the stage for an effective first-line nonopioid analgesic approach [1]; the NSAID synthesis explores variation on that approach [3]; the corticosteroid trials ask whether an additional effect makes any difference in the size and certainty of that effect [4–6]; and the preemptive and combination reviews ask whether combining or timing can enhance selected outcomes [7,8]. This may help to avoid the wrong-headed impression that a successful outcome from one intervention necessitates the use of all available interventions. Even if a patient is given rescue analgesia preoperatively, the plan should include follow-up.

When there is a reported reduction in pain at one time point, it should be differentiated from the entire postoperative period. Few of the experiences measured are identical: early scores measure early scores; cumulative rescue medication measures cumulative rescue medication; swelling over several days measures swelling over several days; mouth opening at follow-up measures mouth opening at follow-up. For example, the dexamethasone versus methylprednisolone review did not demonstrate a clear superiority in regard to pain, even though there was a difference with regard to early trismus [5]. The effects on trismus improvement were not as consistent, with the combination review suggesting effects on pain/edema. The following examples highlight this further and emphasize the importance of keeping the comparator, assessment day, and measured outcome in the narrative with every result rather than generalizing an entire regimen as more effective [5,8].

Nonpharmacological approaches

Cryotherapy – low cost, easy to use, effective for early swelling and pain. In a systematic review (2025) it was categorized as probably beneficial in the first 72 hrs after surgery for extraction of 3rd molars for pain and swelling. It also concluded that the overwhelming number of underlying reviews were methodologically rated in the "critically low" category and none of the reviews actually addressed the quality of life [9]. So, in early signs alone, there is some evidence to look at to consider use of cold application as an adjunct, but there is no clear evidence that this would be beneficial, and no specific schedule or duration decided. Also, secondary wound closure and chlorhexidine has been studied in the same source, but with different results [9].

However, PBM therapy uses low level intensities to affect tissue response and there are variations in clinical protocols through the use of various wavelengths, energy, application site and timing. A systematic review and meta-analysis of the effects of surgical removal of third molars on wound healing conducted in 2024 revealed the presence of a great deal of variety and that the wound healing assessment of alveolar socket and mucosa were the most frequently used outcome measures, while the bone related outcome measures were also assessed [10]. Does not set down a standard postoperative analytics regime. A recent 2023 broader review mentions laser therapy as a possible therapeutic approach for post oral and maxillofacial surgery discomforts, however only nine trials were mentioned in a list of different therapies [2]. It is, therefore, possible to talk about the use of Photobiomodulation as an emerging adjunct, and to differentiate the healing endpoints from direct evidence of pain relief [2,10].

Nonpharmacological is another means of communication! Patients can be informed of the expected improvement of the symptom in the first few days, what the intervention will help with (pain or swelling), and when they expect their symptoms to get worse that they should investigate. Evidence for early recovery of third molars is in favor of cryotherapy while for the other recovery protocols the results are dependent on the delivery of these protocols [9,10]. These should not be considered as alternatives to the treatment of wound complications for either. All of the drugs and physical interventions are shown to have no additional clinical benefit in the larger intervention review (2) but the review does include both physical and drug interventions.

limitations of evidence and practical synthesis.

There are some methodological problems that are repeated in the ten sources. There are various types of operations, pain planning, baseline pain scores, windows of follow-up and swelling and/or trismus definitions used in studies.

The preemptive overview detected problems with all nineteen reviews included and the evidence map detected critical low methodological quality in the majority of reviews on physical or local measures. Hence, the use of the guideline as first-line pain treatment is more appropriate and should be relied on more than it can be used to rank doses from different trials, and is therefore more trustworthy than a guideline without the structured evidence appraisal. However, its pain guidelines for extraction can not be used in every maxillofacial operation.

Another potential issue of counting the same randomized trials more than once would be the multiple reviews of the same third molar interventions. The selected publications are not 10 independent clinical trials, but are reviews of reviews, meta-analyses and a small broad review (most are a combination of the three) [1-10] plus a guideline. Such agreement in multiple papers might be attributable to the same patients. This guideline is the most direct source of information on the choice of analgesics, and other syntheses are used to explore some specific adjuncts, in this review, without attempting to add sample sizes and effect estimates as if they were populations that did not overlap [1,4,7,9].

Clinical application is most often considered in terms of specific questions. If appropriate use the guideline-supported nonopioid foundation for immediate pain relief after extraction [1]. In case of prominent edema or limited mouth opening, discuss the use of a corticosteroid or local supportive measure; consider weak or outcome-specific action [4–6,9]. If the patient requests an advanced technology such as photobiomodulation, remind him/her that there is no reliable research that demonstrates healing properties for the same. [10] Re-evaluate the site of the operation if the pain

suddenly gets worse rather than give more and more painkillers and treat a complication. This approach matches the functional concern with the type of certainty of evidence [1-10] and treatment.

Conclusion

Oral pain and inflammation in the modern management of postoperative oral surgery starts with the assessment of the patient and nonopioid postoperative pain management. There are clear guidelines endorsing the use of NSAIDs (with or without acetaminophen) for extraction pain, and there is a limited indication for the use of opioids. Selected outcomes may benefit from treatment with corticosteroid, preemptive combinations, cryotherapy or photobiomodulation, but with limited, uncertain or protocol specific efficacy. Reporting of pain, swelling, trismus and wound healing should be separate/specific and generalizations based on studies of third molars should be applied with caution in other oral surgery procedures [1-10].

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