

Management of inflammatory complications in third molar surgery: A review of the literature

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Abstract

Background: Pain, swelling and trismus are common complications associated with third molar surgery. These complications have been reported to have an adverse effect on the quality of life of patients undergoing third molar surgery.

Objective: To review the different modalities of minimizing inflammatory complications in third molar surgery.

Methods: A medline literature search was performed to identify articles on management of inflammatory complications in third molar surgery. Standard textbooks of Oral and Maxillofacial Surgery were also consulted and some local scientific publications on the subject were reviewed.

Results: Methods ranges from surgical closure techniques, use of drains, physical therapy and pharmacological means. Studies reviewed have shown that no single modality effectively minimizes postoperative pain, swelling and trismus without undesirable effects.

Conclusion: Inflammatory complications after third molar surgery still remains an important factor in quality of life of patients at the early postoperative periods. Oral surgeons should be aware of the different modalities of alleviation of these complications to make postoperative recovery more comfortable for patients.

Keywords: management, inflammatory complications, third molar surgery, review

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Introduction

The extraction of the impacted mandibular third molar is a common oral surgical procedure¹; and it is often attended by complications, which are distressing to patients². Pain, trismus and swelling are common complications reported³, and they are thought to arise from inflammatory response which is a direct and immediate consequence of the surgical procedure⁴. The adverse effects of the third molar surgery on the quality of life have been reported to show a three-fold increase in patients who experience pain, swelling and trismus alone or in combination, compared to those who were asymptomatic⁴. Many clinicians have thus emphasized the necessity for better pain, swelling and trismus control in patients who undergo third molar surgery⁵.

Several methods of controlling the immediate inflammatory response associated with the third molar surgery abound in the literature. These

include different surgical closure techniques with or without incorporation of drains,^{6,7} use of drugs such as analgesics,⁸ corticosteroids^{9,10} and antibiotics^{11,12}. Other reported modalities include physical therapeutic methods such as cryotherapy¹³ and laser application¹⁴. This article is aimed at reviewing these modalities with particular emphasis on their merits and demerits.

Closure techniques

The closure technique is an operative factor that has been linked to the intensity of postoperative pain and swelling.^{6,7} Primary closure is the complete re-apposition of the third molar flaps post surgery using sutures such that healing is by primary intention, while in secondary closure the socket remains in communication with the oral cavity and healing is by secondary intention.¹⁵ Different terminologies have been used by different authors to describe primary or secondary closure. Dubois et al.⁶ equated primary closure with 'primary healing while Holland and Hindle⁷ used the terms 'closed healing' (complete closure) and 'open healing' (partial closure) to refer to primary and secondary closure respectively. Pasqualini et al.¹⁵ described primary closure as

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complete closure or primary healing and secondary closure as open healing or secondary healing. A review of the literature shows that some authors^{6,7,15} favour secondary closure technique because it is believed to result in less postoperative pain, swelling and trismus after third molar surgery.

Different methods of achieving secondary closure have been described in published reports on closure techniques. These include creating a 'window' by excising the mucosa immediately distal to the second molar,^{6,16} incorporation of drains which may be in form of gauze or rubber,^{17, 18} combining mucosa excision with use of drains¹⁹, placing a single suture²⁰ and the use of 'suture-less' technique where no form of suturing is done.²¹

Mucosa Excision

In a study on 56 patients, Dubois et al⁶ extracted both mandibular third molars simultaneously. The closure was primary on the left; while on the right a window of approximately 6mm diameter was created via the excision of the mucosa distal to the second molar and the socket was left open to heal by secondary intention. Secondary closure was found to minimise swelling and pain in the immediate postoperative period, thus reducing patients' discomfort.

In another study, Pasqualini et al¹⁵ compared primary and secondary closure, using two hundred (200) patients randomly divided into two groups, 1 and 2. In the first group, the mucosa was hermetically sutured to have a primary healing. In the second group, a 5-6mm wedge of mucosa adjacent to the second molar was removed to obtain secondary healing. At 24 hours postoperative review, the difference between the mean pain score in both groups was 0.57cm, on a 0-5 cm visual analogue scale. This difference was statistically significant. Similarly a statistical significant difference was found between both groups in terms of facial swelling with a mean difference of 0.49 cm at 24 hours postoperative review.

In a recent study on the influence of primary and secondary closure (achieved by mucosa excision) techniques on postoperative pain and swelling, Dander et al¹⁶ recorded overall mean differences of 0.27cm and 0.54 cm (on a 0-5cm visual analogue scale) for pain and swelling respectively at 1 week postoperative evaluation. These differences were significant for both parameters of pain and swelling ($p < 0.05$).

Surgical excision of a normal tissue in order to create a 'window' for evacuation of inflammatory

exudates needs a second thought. In surgical practice, it is quite unusual to excise normal tissues without associated pathology except in few occasions such as excision of malignant conditions or benign lesions with high recurrent potentials, where some margin of normal tissue is taken along with the lesion to ensure adequate clearance. Thus, excision of normal mucosa as a means of evacuating inflammatory exudates appears to deviate from good surgical principles and should be discouraged. In addition, the process of tissue excision may add to the surgical trauma and may presumably result in prolonged operation time and delayed healing^{6,15}. Thus, there is a need to consider other less traumatic techniques of minimizing the inflammatory complications associated with third molar surgery.

Use of Drains

Holland and Hindle⁷ compared the influence of complete closure of post extraction sockets (closed healing) and sockets maintained partially opened with bismuth iodoparaffin paste (BIPP) dressing (open healing) on postoperative pain, swelling and healing in seventy (70) patients undergoing bilateral third molar surgery. They found that post-operative pain and swelling were more marked in the 'closed' than in the 'open healing group. The mean differences between the postoperative pain and swelling in the two surgical techniques were not stated. Healing was however said to be better with the 'closed' healing than the 'open' healing techniques at 1 month postoperative review. The presence of the BIPP dressing probably interfered with proper apposition of the flaps and thus resulted in delayed healing.

Rakprasitkul and Pairuchvej¹⁷ in a similar study, compared primary healing associated with the insertion of a small drainage tube, removed on day 3, with primary healing alone. They found a mean difference of 0.3cm for pain (on a 0-10cm visual analogue scale) and 4.4 percent for facial swelling between the group with drain and without drain. The difference was not significant for pain but was significant for swelling at 72 hours postoperative review. They recommended the use of a small tube drain when primary closure technique is employed following third molar surgery.

Cerqueira et al¹⁸ in a comparative study of the effect of a tube drain in impacted lower third molar surgery, recorded a difference of 0.26cm (on the visual analogue scale) in facial swelling between drain and no drain groups at 24 hours postoperative review. This difference was significant ($p < 0.001$) but had no significant effect on pain and trismus.

Chukwunke et al²² in a comparative study of the effect of a tube drain on postoperative discomfort following third molar surgery found that incorporation of a drain resulted in less swelling and trismus without any effect on pain. They recorded a mean difference of 5.4% ($t=5.8$, $p<0.05$) and -0.39% ($t= -11.7$, $p<0.05$) for facial swelling and restriction in mouth opening respectively between the drain and no drain groups at 24hours postoperative evaluation. They also observed a transient increase in the pain score in the group with the rubber drain probably due to the irritating effect of the rubber. However, there was a sharp decline in the level of pain perceived when the rubber drain was removed after 72 hours.

The presence of an intra oral drain requires additional home care, in the form of toileting of the socket, by the patient and this may result in delayed healing in some cases.⁷ The insertion of a surgical drain whether in the form of a rubber tube or gauze may add to the surgical time and may result in more trauma for the patient. Rakprasitkul and Pairuchvej¹⁷ reported a 4-minute difference in the surgical time between patients who had primary closure alone and those who had primary closure plus insertion of a rubber tube drain.

In addition, the presence of a rubber tube or gauze inside the mouth for a period of about 48-72 hours may not be tolerated by some patients due to its irritating effect.¹⁷ Chukwunke et al²² reported a higher pain score in patients due probably to the irritating effect of a rubber drain. Although the authors did not specify whether the drains were removed with or without any form of anaesthesia or analgesia, it is likely that the process of drain removal will also add to the overall patient morbidity. Patients with drains will require additional postoperative review period to remove the drain. In the study described by Cerqueira et al¹⁸, the drain group had 1 more visit because of the need to remove drain. This may add to the overall cost of surgery in terms of the extra time needed for review, the cost of transportation to and from the hospital and the cost of purchase of rubber drains. In addition, drains may act as a source of infection and could be aspirated or swallowed if not properly secured.

Combination of Mucosa Excision and Drain

A combined technique of mucosa excision and insertion of a drain to keep the socket open for drainage has been described by de Brabander and

Cattaneo.¹⁹ The authors evaluated two different types of wound closure after removing impacted mandibular third molars. In the test group, a portion of the mucosa distal to the second molar was removed and a drain, in the form of vaselined gauze, was inserted into the socket to ensure secondary closure of the surgical wound. In the control group they used the same surgical procedure but without drainage. Secondary closure was found to be preferable because it reduces pain and swelling post-surgery but insertion of a vaselined gauze drain did not influence these parameters. A critical appraisal of the use of drains and mucosa excision with the likely associated problems has been presented in the preceding paragraphs.

Suture-less and Single Suture Techniques

A technique in which no form of suturing is done has been described by Waite and Cherala.²¹ The authors reported the outcome of surgical extraction of 1,280 impacted third molars in 366 patients without placement of sutures (secondary healing). They reported less pain because the technique allowed for open drainage of the extraction sockets. This study was however retrospective and the actual differences were not quantified. A suture-less technique have the advantages of reducing the operation time and less tissue manipulation with consequent reduction in the inflammatory response²¹. The technique might however be limited to cases in which minimal incisions are used for third molar surgery^{21,23,24}.

Recently, Osunde et al²⁰ compared the influence of partial and complete closure techniques, achieved by placement of single suture and multiple sutures respectively, on inflammatory complications after third molar surgery. The authors found less pain, swelling and trismus in the single suture group within the first 72 hours of review. Pain was subjectively evaluated using a 10cm visual analogue scale while swelling and trismus were evaluated using a flexible centimetre tape and vernier callipers respectively. They reported slight but statistically significant differences of 0.5cm, 0.2cm and 0.1cm for pain, swelling and trismus respectively at 24hours post surgery. Partial closure using single suture appears promising as it is a simple, an economical and a less traumatic method of alleviating inflammatory complications in third molar surgery.²⁰ In addition, it is free of the irritating effect of a foreign body which may be in the form of a rubber drain or gauze. A single suture in third molar surgery may

however be contraindicated in cases of ectopically located teeth where incisions may be extended for adequate access.

A summary of the mean differences in postoperative pain and swelling between the different closure techniques obtained from some of the studies reviewed is presented in Table 1. The values of the mean differences in terms of pain and swelling obtained from the different comparative studies were essentially the same irrespective of the surgical

closure technique employed. Based on the studies reviewed it appears that a technique that allows for evacuation or drainage of inflammatory exudates essentially results in less postoperative pain and swelling. This could be achieved by mucosa excision, the incorporation of drains or the use of a single suture. The latter is preferable because the technique is simple to carry out, is less traumatic and is most economical when compared with mucosa excision or the incorporation of drains.

Table1. Mean differences between postoperative pain and swelling in the secondary closure groups and controls. Data in centimeter except otherwise stated

Authors	Year	Surgical Technique	Mean Difference	
			Pain	Swelling
Repraksitkul and Pairuchvej	1997	drain	0.30	4.4%
Cerqueira et al.	2004	drain	-	0.26
Pasqualini et al.	2005	mucosa excision	0.57	0.49
Chukwunke et al.	2008	drain (rubber)	-	5.4%
Dander et al.	2010	mucosa excision	0.27	0.54
Osunde et al.	2011	single suture	0.50	0.20

Drugs and physical therapy

Different therapeutic approaches geared towards alleviation of the postoperative morbidity associated with inflammatory response following third molar surgery have been documented in the literature. These include use of drugs, application of ice packs and low-power laser. The drugs commonly used to minimise the postoperative pain, swelling and trismus are analgesics and corticosteroids.

Analgesics

Analgesics are used to control postoperative pain after oral surgical procedure. Postoperative dental pains are usually moderate and of short duration and analgesics are often required for the first 24-48 hours⁸. The most commonly used analgesics after third molar surgery are paracetamol and the non-steroidal anti-inflammatory drugs (NSAIDS) either alone or in combination with opioids or steroids^{8,25}. The NSAIDS are particularly useful as they are thought to possess anti-inflammatory properties and thus able to ameliorate the pain, trismus and swelling associated with third molar surgery.

The efficacy of different analgesic regimen, formulation and routes of administration has received attention from researchers. Hyrkas et al²⁶ compared preoperative administration of diclofenac sodium via the oral route and found no significant difference in terms of analgesic efficacy following third molar surgery. Joshi et al²⁷ compared the effect

of preoperative ibuprofen, diclofenac, paracetamol with codeine and placebo tablets on postoperative dental pain and found no significant difference between the different therapeutic groups but the placebo group had significantly shorter time before taking 'rescue analgesia' (median 17minutes, range 14-19) than diclofenac group (median 32minutes, range 15-180 minutes). Ong and Tan²⁸ compared the efficacy of preoperative intravenous tramadol and ketoralac and found lower pain intensity score, longer time for rescue medication (9 hours versus 7 hours, P=0.007) and less postoperative acetaminophen consumption (P=0.02) in the ketoralac group. They concluded that ketoralac was more effective in prevention of postoperative dental pain. Moller et al²⁹ in similar study compared the onset of acetaminophen analgesia using oral and intravenous routes after third molar surgery and found that the onset of action was shorter for the intravenous route but no significant benefit in terms of analgesic efficacy. Bamgbose et al⁵ compared administration of diclofenac potassium alone and in combination with Dexamethasone and found that the combination therapy was more effective in controlling pain, swelling and trismus following third molar surgery.

Corticosteroids

By pharmacologically controlling the extent of the inflammatory process, the intensity or severity of postoperative sequelae such as pain, swelling and trismus may be reduced³⁰. Corticosteroids have been reported to control these sequelae when given preoperatively³¹. The two most widely used are dexamethasone and methylprednisolone. Biernie and Holland³² compared different dosage regimen of corticosteroids in third molar surgery and concluded that administration of 125mg of methylprednisolone was effective in reduction of postoperative oedema without any significant side effect. Opinions differ among different authors on the efficacy of steroids in alleviation of mouth opening limitations after third molar surgery^{9,10}. While Seward et al⁹ stated that steroids have no significant effect on trismus, Peterson et al¹⁰ advocated the use of corticosteroids to help minimize pain, swelling and trismus. The authors noted that the most effective method of usage was yet to be defined. It was observed that an initial intravenous dose of steroid at the time of surgery had a major clinical impact on swelling and trismus in the early postoperative period. They also observed that this initial early advantage disappears by the second or third postoperative day, if additional doses of corticosteroid were not given. Their findings were also supported by Miles and Desjardins³³ who observed that patients treated with corticosteroids experienced continual facial swelling up to the third postoperative day. They therefore advised the administration of corticosteroids for a minimum of three days post surgery. In conclusion, they stated that for maximal control of facial swelling additional administration of steroids should be given for 1 or 2 days post surgery. Ustun et al³⁴ compared the effects of 1.5mg/kg and 3.0mg/kg of methylprednisolone on pain, swelling and trismus after third molar surgery and found no significant difference between the two doses. They concluded that it was better to use the lower dosage regimen because of the potential side effects of corticosteroids.

Opinion differs among authors concerning the potential side effects of the use of steroids in surgery. Kaldwarf et al³⁵ believe that suppression of adrenal cortex does not occur with high doses of short-term corticosteroids. Montgomery et al³⁶ similarly reported that shortened parenteral use of steroids (immediately preoperative and postoperative) regardless of the dose does not exert an undesirable effect on the adrenal-pituitary

regulation of natural steroid secretion, implicating their safe use for this indication. Garsema and Baker³⁷ stated that the potential complications of perioperative use were adrenal suppression and delayed wound healing which may manifest in prolonged usage. In a comparative study of the effects of methylprednisolone on the sequelae of third molar surgery, Esen et al³⁸ found that administration of 125mg of methylprednisolone does not have any significant effect on postoperative infections, disturbance of wound healing, adrenal suppression and other corticosteroid-related complications.

Administration of steroid following third molar surgery is effective in reducing the postoperative inflammatory response associated with this procedure. However, its use is limited by fear of interference with the normal healing process and needle phobia, since it is usually given parenterally and this may add to the overall surgical trauma. Some patients also detest the use of steroids for fear of not wanting to take extra medication.³⁹

Cryotherapy

Cryotherapy or cold therapy is the local or systemic application of cold for therapeutic purposes and has been in use as early as the time of Hippocrates⁴⁰. Ice therapy has been reported to control inflammation, pain and oedema⁴⁰. Engstrom et al⁴¹ recommended the use of ice packs to reduce postoperative swelling following impacted third molar surgery. He recommended that the ice pack be wrapped in dry cloth and applied at 20 minutes interval for 24 hours postoperatively. The effect of external application of local cold on swelling, trismus, temperature and pain postoperatively in surgical removal of impacted mandibular third molars was studied by Forsgren et al⁴². In a randomized controlled trial of two groups with and without ice pack application, they found no significant differences in swelling, trismus, temperature or postoperative pain between both groups. They concluded that external application of ice pack does not appear to improve postoperative course following third molar surgery. However, they agreed that it has minimal effect on postoperative oedema. Sortino et al¹³ recommended a rational application of ice packs appropriate to the degree of the expected morbidity in each patient as an effective way of minimizing the postoperative discomfort after third molar surgery. On the contrary, Filho et al⁴³ found that ice pack application improved postoperative pain and oedema but does not have any significant effect on

trismus. Van der Westhuijzen et al⁴⁴ in a study of two groups of patients with and without ice pack application did not find any significant difference in terms of pain, swelling and trismus following third molar surgery.

Ice therapy is a simple, cheap, repeatable and safe treatment modality but its use is considered to be contraindicated in patients suffering from cold hypersensitivities and intolerances as in Raynaud's phenomenon, or over regenerating nerves, areas with impaired circulation or peripheral vascular disease⁴⁵.

Laser

The use of laser is a relatively new method of reducing postoperative discomfort, especially oedema, after third molar surgery. It is believed that laser irradiation induces an increase in number and diameter of lymph vessels, with a simultaneous decrease of blood vessel permeability^{46,47}. The effect of laser irradiation on blood vessels is not completely understood. While some authors state that laser induce vasodilatation^{48,49}, others point to its initial vasoconstrictor effect⁵⁰. In addition, laser increases protein absorption by activating macrophages⁴⁶, modifying hydrostatic and capillary pressure, and inducing the absorption of interstitial fluids with consequent reduction in oedema.

A randomized double-blind clinical trial on the effectiveness of helium-neon laser in the prevention of pain, swelling and trismus after removal of third molars was carried out by Carillo et al.⁵¹ In their 100 patients randomly allocated to receive helium-neon laser, ibuprofen or placebo in a prospective parallel clinical trial, they found that trismus was significantly reduced in the helium-neon laser and ibuprofen groups, while pain was significantly less in the ibuprofen group compared with helium-neon laser and placebo groups; but swelling was the same in the three groups. Maskova and Smekal⁵² while highlighting the effect of laser therapy in dentistry were of the opinion that laser irradiation of the alveolus along with the lingual and buccal bony walls after tooth extraction would lead to faster coagulation, less postoperative discomfort and quicker healing. In 1992, Roynesdal⁵³ studied the effect of low-powered laser (LPL) on postoperative pain and swelling and found that the anti-oedematous effect was dose-dependent. They observed that there was no significant anti-oedematous effect of 10 Joule (3 J/cm²) or less (6 J) when administered after impacted lower third molar surgery. Roynesdal et al⁵⁴ investigated the effect

of laser application on postoperative pain and swelling following third molar surgery and found the use of laser therapy helpful in minimizing these postoperative variables. In a recent study, Markovic and Todovic¹⁴ in a comparative study applied higher therapeutic dose (4 J/cm², with constant power density of 50mW, and wavelength of 637nm) on one of the experimental groups and found a significant reduction in postoperative oedema following third molar surgery. The reduction was more marked when the LPL was combined with local intramuscular injection of dexamethasone.

The use of laser in third molar surgery is painless, non-invasive and no adverse effect appears to have been reported in patients. However, its use in developing countries is still limited due to the cost.

Conclusion

This article has presented the different modalities of management of pain, swelling and trismus in third molar surgery. The review showed that no single modality of management effectively prevents the occurrence of these complications without undesirable side effects. Partial closure using single suture technique appears promising because it is simple to carry out, less traumatic, is most economical and is free from the irritating effect of a foreign body which may be in the form of a rubber drain or gauze. In addition there may be no need for additional medications such as the use of steroids.

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