

Effects of the intramuscular administration of dexamethasone after the surgical extraction of impacted teeth

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Abstract

Background: Dexamethasone is frequently used for controlling oedema, trismus, and pain following oral surgical procedures and is one of the most researched corticosteroids in oral and maxillofacial surgery.

Objectives: To evaluate the efficacy of a post-operative intramuscular injection of dexamethasone (4 mg) in reducing pain, swelling, and trismus following tooth extraction.

Methods: A non-randomised trial was conducted from 2022 June to 2023 September by department of Oral and Maxillofacial Surgery, Kathmandu Medical College after institutional ethical approval. The participants with no known systemic diseases or drug allergies with age 18-40 years (40 males and 18 females) were enrolled by convenience sampling. Participants were explained about study details and assigned to either a control group or a study group after obtaining informed consent. The control group received an intramuscular 1 ml injection of normal saline solution, while the study group received 1 ml of dexamethasone (4 mg) administered into the deltoid muscle post-operatively. Post-operative pain, swelling, and trismus were assessed and compared between two groups using the Mann-Whitney U test.

Results: Dexamethasone significantly reduced post-operative facial swelling compared to the control group. The reduction in swelling was statistically significant immediately after extraction and continued to show significant differences through Day 2. On Day 7, the difference in swelling between the two groups remained mild but notable. Additionally, dexamethasone was effective in decreasing pain and improving mouth opening.

Conclusion: Intramuscular injection of dexamethasone into the deltoid muscle post-operatively is effective in reducing pain, swelling, and trismus following mandibular third molar extraction.

Key words: Dexamethasone; Intramuscular Injection; Pain; Post-operative swelling; Surgical extraction.

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INTRODUCTION

Surgical removal of impacted mandibular third molars is one of the most common dental procedures. Although a minor surgical procedure, complications like pain, swelling, and trismus are common. This could be due to tissue inflammatory process, with cardinal signs of inflammation that include pain, heat, redness, swelling, and loss of function.¹

Corticosteroids reduce inflammation via inhibition of phospholipase A2, which is the first enzyme involved

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in conversion of phospholipids into arachidonic acid, therefore blocking synthesis of other products such as prostaglandins, leukotrienes, and substances related to thromboxane A₂.² In essence, corticosteroids stop the formation of these end products which are a broth of potent inflammatory mediators that cause signs and symptoms. They also have the ability to stabilise lysozyme membranes, decrease the release of inflammation-causing lysozymes, and decrease the permeability of capillary thereby preventing diapedesis, the initial leakage of fluids from the capillaries and loss of plasma protein into tissue space. There is also a decrease in the formation of bradykinin, a powerful vasodilating substance.

Dexamethasone was first tested in 1965 to control oedema and to decrease trismus and pain after oral surgical procedures.³ Since then, there has been a surge in popularity for its use in oral surgical procedures, thereby making it the most frequently studied and used corticosteroids in oral and maxillofacial surgery.⁴ The surgical extraction of impacted mandibular third molars usually causes complications such as dysaesthesia, severe infection, bone fracture, and dry socket. It may also cause facial swelling and severe pain that may seem more important to patients.⁵ The aim of this study was to assess the effectiveness of post-operative intramuscular administration of four milligram dexamethasone after surgical extractions.

METHODOLOGY

A non-randomised trial was conducted among 58 patients (40 males and 18 females) with impacted lower third molars, who were treated at the department of Oral and Maxillofacial Surgery, Dental Programme, Kathmandu Medical College, Duwakot, Bhaktapur, Nepal. The data collection was done from 2022 June to 2023 September after ethical approval from the Institutional Review Committee of Kathmandu Medical College (Ref. 0106202101). Study details were explained to the participants and written informed consent was obtained from all patients for their participation and presentation of the study findings. Sample size was calculated using the following formula based upon study of Klongnoi et al.:⁶

$$\text{Sample size (n)} = \frac{2(Z_{\alpha} + Z_{\beta})^2 S^2}{d^2}$$

Where, Z_{α} = Z deviate corresponding to the α error rate = 1.96 for 95% reliability, Z_{β} = Z deviate corresponding to the β error rate = 0.84 at 80% power, S = standard deviation = $(S_1 + S_2)/2 = (0.84 + 2.36)/2 = 1.6$, d = mean difference between dexamethasone and control group

= $(0.41 - 1.64) = -1.23$, n = sample size required per group = 26.53. Adding 8% of attrition rate, final sample size = $28.65 \approx 29$ per group (58 in total).

Participants of age 18-40 years, with no underlying diseases, no history of drug allergies, who had impacted third molars with similar difficulty indices requiring surgical extraction with bone removal. Patients were selected by convenience sampling technique and alternately assigned to either the study or control group. In this study group, 4 mg of Dexamethasone in 1 ml was injected intramuscularly into the deltoid muscle immediately after surgical extraction. The control group received 1 ml of normal saline. The procedures were performed by the same surgeon.

Facial swelling was measured using three reference points: Line 1 from the lateral canthus of the eye to the soft tissue gonion, Line 2 from the corner of the mouth to the tragus of the ear, and Line 3 from the tragus of the ear to the soft tissue pogonion. Pain levels were assessed using a visual analogue scale (VAS), and trismus was measured by the maximum interincisal distance. Surgery was performed under local anaesthesia with a triangular flap elevation, buccal bone removal, tooth division, and wound closure using interrupted sutures.

Post-operative medication for both groups included 500 mg of amoxicillin three times daily for five days and 400 mg of ibuprofen every six hours for three days. Facial swelling, pain levels, and interincisal distance were recorded immediately after surgery, and on post-operative days 2 and 7. Data were analysed using IBM SPSS Statistics for Windows, version 24 (IBM Corp., Armonk, N.Y., USA), employing Mann-Whitney U test for inferential statistics, with significance set at $p < 0.05$.

RESULTS

Dexamethasone significantly reduced post-operative pain and facial swelling following surgical extraction (Table 1). Dexamethasone also showed good result than control groups regarding the maximum interincisal distance immediately after surgery, and on post-operative Days 2 and 7 (Table 2). Although the difference in facial swelling was not significant immediately after the extraction, a significant reduction was observed on post-operative Day 2 between the dexamethasone and control groups. A mild but significant difference ($p < 0.001$) in swelling was noted on post-operative Day 7 (Table 3). Pain, assessed using the Visual Analogue Scale, did not show a significant difference between the groups immediately after surgery. However, Dexamethasone demonstrated a significant reduction ($p < 0.001$) in pain

on post-operative Days 2 and 7 (Table 1). In summary, the post-operative intramuscular injection of 4 mg Dexamethasone significantly reduced post-operative facial swelling and pain and trismus.

DISCUSSION

The extraction of impacted mandibular third molars often involve complications such as nerve damage, tooth or root displacement, mandibular fracture, facial swelling, trismus, and pain. While the incidence of these complications is relatively low, they can be minimised with comprehensive preoperative evaluation, thorough treatment planning, and adherence to surgical principles.

Transalveolar extraction of the mandibular third molar is a common oral surgical procedure, and managing post-operative pain is a critical consideration. Many studies have focussed on mitigating post-operative

pain.⁷⁻¹¹ While the inflammatory response is crucial for wound healing, an excessive response can lead to complications. To manage post-operative pain, clinicians commonly prescribe non-steroidal anti-inflammatory drugs (NSAIDs), opioids, or their combination. However, corticosteroids, particularly dexamethasone, are known for their efficacy in reducing post-operative pain, facial swelling, and trismus.⁶⁻¹¹ In current study, 4 mg of dexamethasone was administered immediately after the removal of a lower third molar, while the control group received 1 ml of normal saline.

The facial region's rich vascularisation results in a pronounced inflammatory response.^{12,13} Factors such as individual physiological response, tissue trauma, surgical duration, and manipulation contribute to the severity of post-operative sequelae.¹⁴ Corticosteroids are effective adjuvants in reducing inflammatory mediators

Table 1: Comparison of pain perception in between two groups using VAS score (n = 29 in each group)

Time of pain measurement VAS (mm)	Dexamethasone group		Normal saline group		p-value
	Median (IQR)	Mean rank	Median (IQR)	Mean rank	
Day 1	6.0 (6.0-7.0)	16.81	8.0 (8.0-9.0)	42.19	<0.001
Day 2	5.0 (4.0-5.0)	16.31	7.0 (7.0-7.50)	42.69	<0.001
Day 3	4.0 (3.50-4.0)	15.0	6.0 (6.0-7.0)	44.0	<0.001

Mann-Whitney U test

Table 2: Comparison of mouth opening in mm between two groups (n = 29 in each group)

Mouth opening (mm)	Dexamethasone group		Normal saline group		p-value
	Median (IQR)	Mean rank	Median (IQR)	Mean rank	
Day 1	33.00 (32.50-33.50)	43.93	30.50 (30.15-31.10)	15.07	<0.001
Day 3	34.0 (33.50-34.50)	43.86	32.50 (32.50-32.80)	15.14	<0.001
Day 7	38.10 (38.0-38.50)	34.14	37.70 (37.50-38.25)	24.86	0.035

Mann-Whitney U test

Table 3: Comparison of line A, B, and C in mm between two groups (n = 29 in each group)

Facial swelling	Days	Dexamethasone group		Normal saline group		p-value
		Median (IQR)	Mean rank	Median (IQR)	Mean rank	
Line A	Day 1	11.0 (10.50-11.20)	19.38	11.50 (11.50-11.70)	39.62	<0.001
	Day 3	9.90 (9.50-10.0)	15.55	10.80 (10.80-11.0)	43.45	<0.001
	Day 7	9.60 (9.40-9.70)	15.71	10.30 (10.20-10.50)	43.29	<0.001
Line B	Day 1	13.50 (13.30-13.60)	43.79	12.30 (12.0-12.80)	15.21	<0.001
	Day 3	12.40 (11.90-13.0)	44.0	10.40 (10.30-11.20)	15.0	<0.001
	Day 7	11.90 (11.50-12.0)	44.0	9.50 (9.50-9.80)	15.0	<0.001
Line C	Day 1	15.20 (15.0-15.40)	15.0	16.10 (16.05-16.50)	44.0	<0.001
	Day 3	14.0 (13.85-14.10)	15.0	15.20 (15.20-15.50)	44.0	<0.001
	Day 7	13.70 (13.60-13.80)	16.16	14.30 (14.0-14.50)	42.84	<0.001

Mann-Whitney U test

after surgery. Dexamethasone, a potent synthetic corticosteroid, has significant anti-inflammatory properties. It is approximately 25 times more potent than hydrocortisone, six times more potent than prednisone and methylprednisolone, and equal in strength to betamethasone.^{15,16}

In this non-randomised trial, we administered intramuscular dexamethasone and found it significantly reduced post-operative discomfort, consistent with studies where dexamethasone was injected submucosally.¹⁷ The results from this study showed a significant difference in mouth opening between the study and control groups, which contrasts with Klongnoi et al.'s study that reported no significant difference.⁶ On the first post-operative day, the mean VAS pain score was 6.0 for the dexamethasone group and 8.0 for the saline group, indicating that the dexamethasone group experienced less pain.

Overall, this study underscores the effectiveness of intramuscular dexamethasone in reducing post-operative pain and swelling following mandibular third

molar extraction, highlighting its value in enhancing patient recovery. This study comprises of small sample size and is done in single centre thus, the findings cannot be generalised.

CONCLUSION

Intramuscular dexamethasone (4 mg) significantly reduces post-operative pain and facial swelling after extracting impacted lower third molars. Swelling were noticeable by Day 2 and continued through Day 7. There was significant change in maximum inter-incisal distance in Days 1 and 3 with dexamethasone effectively reducing overall post-operative discomfort. Based on these results, administering a single 4 mg dose of intramuscular dexamethasone immediately after surgery is recommended to improve patient comfort and accelerate recovery. Future research should focus on optimising dosage and examining long-term effects to enhance post-operative care.

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