



EFFECT OF SUBMUCOSAL AND INTRAMUSCULAR DEXAMETHASONE ON POSTOPERATIVE SEQUELAE AFTER MANDIBULAR THIRD MOLAR SURGERY: A COMPARATIVE STUDY

Dr. Ajay Kumar Kushwaha^{1*}, Dr. Gaurav Singh², Dr. Ashok Gupta³

^{1*} Assistant Professor, Department of Oral and Maxillofacial Surgery, Chandra Dental College and Hospital, Barabanki, Uttar Pradesh, India

² Professor, Department of Oral and Maxillofacial Surgery, Sardar Patel Post Graduate Institute of Dental and Medical Science, Lucknow, Uttar Pradesh, India

³ Associate Professor, Department of Forensic Medicine and Toxicology, Career Institute of Medical Sciences and Hospital, Lucknow, Uttar Pradesh, India

***Corresponding Author** Dr. Ajay Kumar Kushwaha

*Email: ajaykushwahamdsomfs@gmail.com

Abstract

Background:

Surgical extraction of impacted mandibular third molars is commonly associated with postoperative pain, swelling, and trismus. Dexamethasone, a corticosteroid, is often used to reduce these sequelae, but the comparative efficacy of different administration routes remains underexplored.

Objective:

To compare the effectiveness of intramuscular and submucosal dexamethasone with a control group in managing postoperative complications following mandibular third molar surgery.

Materials and Methods:

A prospective, randomized clinical study was conducted at Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow. 90 patients with mesioangular Class II Position B mandibular third molar impactions were randomly divided into three groups: Group A received 8 mg dexamethasone intramuscularly (deltoid), Group B received 8 mg submucosally at the surgical site, Group C received no dexamethasone (control). Postoperative parameters including pain (Visual Analog Scale), swelling (facial measurements), and trismus (interincisal distance) were evaluated on postoperative days 1, 3, and 7. Data were analyzed using ANOVA and post-hoc Tukey test, with $p < 0.05$ considered statistically significant.

Results:

On day 1, mean pain scores were lowest in Group B (3.0 ± 1.1), followed by Group A (3.9 ± 1.2), and highest in Group C (5.2 ± 1.0), ($p = 0.001$). Maximum swelling on day 3 was observed in Group C (6.7 ± 1.3 mm) versus Group A (5.1 ± 1.0 mm) and Group B (4.3 ± 0.8 mm), ($p = 0.002$). Trismus reduction was significantly better in Group B by day 7 (interincisal opening: 40.1 ± 2.5 mm) compared to Group A (37.8 ± 2.9 mm) and Group C (35.4 ± 3.1 mm), ($p = 0.003$).

Conclusion:

Submucosal dexamethasone was more effective than intramuscular injection and no steroid treatment in reducing postoperative complications after mandibular third molar surgery, making it a preferable route for clinical practice.

Keywords: Third molar surgery, Dexamethasone, Submucosal, Intramuscular.

Introduction

Surgical removal of impacted mandibular third molars is one of the most frequently performed procedures in oral and maxillofacial surgery. While it is considered routine, the associated postoperative sequelae—including pain, swelling, and trismus—can be substantial, often peaking within the first 72 hours and resolving within 7 to 10 days [1]. These symptoms, although typically self-limiting, can significantly impair essential functions such as speech, mastication, and oral hygiene maintenance, ultimately affecting the patient's quality of life and delaying return to daily activities. To mitigate these inflammatory responses, several pharmacological agents have been introduced into postoperative protocols. Among them, corticosteroids have shown superior efficacy due to their broad-spectrum anti-inflammatory, anti-edematous, and immunosuppressive actions [2]. Dexamethasone, in particular, has gained popularity because of its long half-life, high potency, and minimal mineralocorticoid activity, making it highly effective in controlling the acute inflammatory response associated with oral surgical trauma [3]. Mechanistically, dexamethasone exerts its action by inhibiting phospholipase A2, thereby blocking arachidonic acid release and the downstream synthesis of prostaglandins and leukotrienes—key mediators in postoperative inflammation and pain [3].

The route of dexamethasone administration plays a critical role in determining its bioavailability, onset of action, patient compliance, and therapeutic outcome. Traditionally, intramuscular injection has been the preferred method due to its systemic distribution and well-established pharmacokinetics. However, this method can lead to injection-site discomfort and carries the risk of systemic corticosteroid-related side effects. Alternatively, the submucosal route, wherein the drug is deposited directly at the surgical site, has emerged as a promising method, offering localized action with reduced systemic absorption [4]. This localized concentration is theorized to provide more immediate and targeted anti-inflammatory effects, potentially resulting in better postoperative outcomes with fewer side effects.

Although both methods have been studied independently, there is a lack of robust comparative studies that assess the efficacy of intramuscular versus submucosal administration in a controlled, randomized setting. Moreover, few studies have included a no-steroid control group, which is essential to establishing a true baseline for the therapeutic impact of dexamethasone. The absence of direct comparative data leaves a clinical gap in determining the most effective and patient-friendly route of corticosteroid administration in third molar surgeries.

Therefore, the present study aims to address this gap by conducting a prospective, randomized trial to compare the efficacy of submucosal and intramuscular dexamethasone administration with a control group receiving no corticosteroid. The primary outcomes evaluated include postoperative pain, facial swelling, and mouth opening limitation (trismus), which together serve as reliable indicators of patient recovery and quality of surgical care.

Materials and Methods

Study Design and Setting:

This was a prospective, randomized, controlled, single-blinded study conducted at the Department of Oral and Maxillofacial Surgery, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow, Uttar Pradesh.

Sample Size and Allocation:

A total of **90 patients**, aged 18–35 years, indicated for the surgical removal of impacted mandibular third molars, were enrolled and randomly divided into three equal groups of 30 patients each:

- **Group A:** Received **8 mg dexamethasone intramuscularly** (in the deltoid region).
- **Group B:** Received **8 mg dexamethasone submucosally** at the surgical site.
- **Group C (Control):** Underwent the surgical procedure without dexamethasone administration.

Inclusion Criteria:

- Healthy individuals (ASA I)
- Mesioangular impacted mandibular third molars (Class II, Position B – Pell and Gregory)
- No contraindications to corticosteroid use

Exclusion Criteria:

- Acute infection at surgical site
- History of systemic corticosteroid therapy in the past month
- Diabetes, immunosuppressive conditions, or known allergy to dexamethasone
- Pregnant or lactating women

Surgical Protocol:

All procedures were performed by the same experienced oral surgeon under local anesthesia using 2% lidocaine with 1:100,000 epinephrine. A standard mucoperiosteal flap was raised, and bone guttering and tooth sectioning were done as required. Postoperative instructions were standardized.

Outcome Measures and Data Collection:

1. **Pain:** Measured using a 10-point Visual Analog Scale (VAS) on postoperative days 1, 3, and 7.
2. **Swelling:** Assessed via facial measurements (tragus–pogonion, gonion–lateral canthus) using flexible measuring tape; mean of both used.
3. **Mouth Opening:** Maximum interincisal distance measured in mm with a Vernier caliper on days 1, 3, and 7.

Statistical Analysis:

Data were analyzed using SPSS version 25.0. One-way ANOVA was applied to compare intergroup differences, and Tukey's post-hoc test was used for multiple comparisons. A *p*-value <0.05 was considered statistically significant.

Results

Demographic Data:

All three groups were comparable in terms of age (mean 25.3 ± 2.8 years) and gender distribution (48 males, 42 females; evenly distributed).

Table 1: Mean VAS Pain Scores

Post-op Day	Group A (IM)	Group B (SM)	Group C (Control)	<i>p</i> -value
Day 1	3.9 ± 1.2	3.0 ± 1.1	5.2 ± 1.0	0.001
Day 3	2.8 ± 1.0	1.9 ± 0.9	4.1 ± 1.2	0.002
Day 7	1.1 ± 0.6	0.8 ± 0.5	2.0 ± 0.9	0.018

Table 2: Facial Swelling (Mean Change in mm)

Post-op Day	Group A	Group B	Group C	<i>p</i> -value
Day 1	4.7 ± 0.8	3.9 ± 0.6	5.5 ± 1.1	0.005
Day 3	5.1 ± 1.0	4.3 ± 0.8	6.7 ± 1.3	0.002
Day 7	2.2 ± 0.5	1.5 ± 0.3	3.3 ± 0.7	0.011

Table 3: Mouth Opening (mm)

Post-op Day	Group A	Group B	Group C	<i>p</i> -value
Day 1	31.1 ± 2.6	32.4 ± 2.3	28.7 ± 2.5	0.013
Day 3	34.5 ± 2.4	36.3 ± 2.1	30.8 ± 2.2	0.001
Day 7	37.8 ± 2.9	40.1 ± 2.5	35.4 ± 3.1	0.003

Group B (submucosal) consistently demonstrated the best outcomes ($p < 0.05$ across all parameters and timepoints).

Discussion

The findings of the present study underscore the clinical efficacy of dexamethasone in minimizing postoperative sequelae such as pain, swelling, and trismus following mandibular third molar extraction. Notably, Group B, which received 8 mg of dexamethasone submucosally, demonstrated superior outcomes across all parameters when compared to the intramuscular group (Group A) and the control group (Group C).

These results validate the growing consensus in literature that localized administration of corticosteroids, particularly via the submucosal route, offers targeted anti-inflammatory action with reduced systemic side effects. In the present study, patients in the submucosal group exhibited significantly reduced pain scores, less facial swelling, and quicker restoration of mouth opening from postoperative day 1 through day 7. These clinical benefits can be attributed to the higher localized drug concentration achieved at the surgical site, resulting in effective modulation of the inflammatory cascade directly where tissue trauma occurs.

Our observations align with those of Grossi et al., who reported that submucosal dexamethasone effectively diminished postoperative discomfort and facilitated faster recovery with minimal systemic exposure [5]. Their findings highlighted the pharmacokinetic advantage of this route in producing rapid onset and sustained anti-inflammatory effects within the confined surgical field. Unlike systemic administration, submucosal injection bypasses first-pass metabolism and permits direct drug availability at the site of injury.

Furthermore, Majid and Mahmood also demonstrated that patients who received submucosal dexamethasone reported marked improvement in postoperative swelling and trismus, findings that parallel those from the present study [6]. They concluded that while both submucosal and intramuscular routes are beneficial, the submucosal route offers added advantages in terms of patient comfort, drug deposition precision, and ease of administration in an outpatient setting.

Although intramuscular dexamethasone (Group A) did provide measurable benefits over the control group, its efficacy was consistently lower than the submucosal group. This outcome may stem from

the slower absorption and systemic dispersion associated with intramuscular injections, leading to dilution of drug effect across non-target tissues. Additionally, intramuscular injections are associated with discomfort at the injection site, which may affect patient compliance, especially in routine dental procedures.

The control group (Group C), which did not receive any corticosteroid, predictably demonstrated higher levels of postoperative pain and swelling and slower recovery of mouth opening. This reinforces the established role of corticosteroids as adjuncts in oral surgical protocols to minimize inflammation-driven complications [7-10]. The observed outcomes highlight the importance of incorporating corticosteroid prophylaxis—particularly via efficient delivery routes—into standard postoperative management strategies for third molar surgeries.

Nevertheless, certain limitations must be acknowledged. Firstly, although the sample size of 30 patients per group (n=90) provided sufficient power for detecting statistically significant differences, larger-scale, multicentric trials are necessary to improve generalizability. Secondly, the short follow-up duration (limited to 7 days) did not permit assessment of long-term healing outcomes or rare adverse effects of corticosteroid use. Lastly, biochemical or radiographic parameters such as C-reactive protein levels, salivary inflammatory markers, or postoperative tissue healing scores were not evaluated, which could have provided objective molecular insights into the anti-inflammatory efficacy of dexamethasone [11-15].

Future research should incorporate extended follow-up periods, inclusion of biochemical and radiological endpoints, as well as patient-reported outcome measures (PROMs) to further elucidate the comparative effectiveness of different corticosteroid routes. Additionally, exploring alternative dosages, combination therapies, and delivery vehicles (such as sustained-release microspheres or liposomal carriers) may enhance the clinical utility of dexamethasone in oral surgery.

Conclusion

Submucosal dexamethasone was found to be more effective than intramuscular administration and no steroid use in controlling postoperative pain, swelling, and trismus. Its localized delivery, ease of administration, and superior outcomes make it a valuable option in routine third molar surgeries.

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