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Efficacy of Submucosal versus Pterygomandibular Dexamethasone Injection in Surgical Extraction of the Impacted Lower Third Molar

Shaheen Ahmed, Usman Ashraf, Abdul Hafeez Shaikh, Soofia Jamil, Syed Jaffar Abbas Zaidi, Qaiser Ali Baig

Abstract

Objectives: This study aimed to evaluate the efficacy and postoperative complications of preoperative submucosal dexamethasone injection compared to preoperative dexamethasone injection into the pterygomandibular space for surgical extraction of the impacted lower third molar.

Study design and setting: This was a quasi-experimental, cross-sectional study conducted at the Department of Oral and Maxillofacial Surgery, Dow International Dental College, Dow University of Health Sciences, Karachi, from April to July 2021.

Methodology: The study sample consisted of 72 patients who reported surgical extraction of their lower wisdom teeth and consented to participate in this study. The patients were randomly divided into the submucosal injection group (SM) and the pterygomandibular space (PM) group. The injection time was recorded on the second and seventh postoperative days.

Results: No significant differences in the duration of the intervention were observed between the two groups (23.08 min in PM, 23.07 min in SM). The postoperative facial swelling was significantly reduced transversely (ear lobe to the angle of the mouth) in both groups compared to their respective baselines on the first postoperative day. On the second postoperative day, significant changes were observed in the submucosal group in postoperative swelling.

Conclusions: Using intraoral dexamethasone injections in third molar surgery significantly reduces conventional complications of surgery while avoiding the systemic side effects of steroids. Dexamethasone should be used regardless of the administration site when warranted, with less apprehension than is common in dentistry.

Keywords: Pterygomandibular space; dexamethasone injection; submucosal dexamethasone; third molar surgery; randomized controlled trial.

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Shaheen Ahmed *(Corresponding Author)*
Associate Professor, Department of Oral Maxillofacial surgery
Dow International Dental College
Email: shaheen.ahmed@duhs.edu.pk

Usman Ashraf
Intern, Department of Oral Maxillofacial surgery
Dow International Dental College
Email: osmanashraf@hotmail.com

Abdul Hafeez Shaikh
Associate Professor, Department of Oral Maxillofacial surgery
Dow International Dental College
Email: abdul.hafeez@duhs.edu.pk

Soofia Jamil
Lecturer, Department of Oral Maxillofacial surgery
Dr. Eshratul ibad institute of Oral Health Sciences
Email: soofia_jm@hotmail.com

Syed Jaffar Abbas Zaidi
Assistant Professor, Department of Oral Biology
Dow Dental College
Email: jaffar.zaidi@duhs.edu.pk

Qaiser Ali Baig
Associate Professor, Department of Community Dentistry
Dow International Dental College
Email: qaiser.ali@duhs.edu.pk

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INTRODUCTION:

The surgical removal of a third molar is one of the most frequent procedures carried out by oral and maxillofacial surgeons. According to a study in the US, third molar surgeries incur an annual cost of nearly three billion dollars.[1]. Third molar extraction is routinely performed using closed extraction methods that use forceps and elevators. However, since they are the most frequently impacted teeth, many require an open surgical approach that involves raising a flap and removing the bone so the tooth can be removed. This surgical procedure comes with a host of postoperative challenges, and postoperative swelling stands out as a significant concern affecting both patient comfort and recovery.

The surgical trauma associated with flap elevation and bone removal triggers an inflammatory cascade. This involves the release of various cytokines, vasodilation, and an increased permeability of blood vessels, leading to the migration of leukocytes and plasma to the site of injury. The localized edema thus created manifests as swelling, redness, and increased temperature in the surgical area. The associated morbidity of postoperative swelling ranges from minor

discomfort to significant functional impairment. These functional impairments encompass swelling that may hinder oral hygiene, disrupt food consumption, and cause speech difficulties.[2]

Patients experiencing severe postoperative edema are more likely to have delayed wound healing and may require additional treatment interventions, such as drainage or extended courses of anti-inflammatory medications. These factors can collectively lead to more frequent postoperative visits, increased healthcare costs, and longer periods of absence from work. Apart from discomfort and delays in healing, excessive swelling also poses risks such as cellulitis or abscess formation if not managed appropriately. It may also mask other complications like hemorrhage or infection, complicating the diagnostic process and potentially leading to delayed intervention.

Numerous studies have been published on the use of pharmacological agents to reduce or prevent these postoperative sequelae.[3,4] One of these is the anti-inflammatory agent, corticosteroids, which have already been extensively studied and employed infrequently for the prevention of postoperative problems after third molar extractions.[5,6] Dexamethasone, a glucocorticoid that blocks phospholipase A2, causing a reduction in the levels of prostaglandins and leukotrienes fundamentally involved in the development of pain, and edema, has been advocated as the drug of choice in such scenarios.[7] Its potency, long half-life, and affordability make it an attractive choice. However, the side effects of systemic steroid use often outweigh the potential benefits, which has hampered its routine use post-extraction.[8]

The development of a more localized delivery method for dexamethasone has recently attracted attention to achieve maximum benefit while reducing or eliminating potential systemic effects.[9] In a study by Majid et al., published in the British Journal of Oral and Maxillofacial Surgery in 2011, submucosal dexamethasone was reported as an effective delivery route.[10]

Dexamethasone injection into the pterygomandibular space (PMS) or submucosal tissue are the two commonly used routes for dexamethasone administration in oral and maxillofacial surgeries. There is a dearth of local studies on the preferred method of preoperative dexamethasone for third molar surgery. This study aimed to compare the efficacy and postoperative complications of preoperative submucosal dexamethasone injection compared to preoperative dexamethasone injection into the pterygomandibular space for surgical extraction of the affected lower third molar. The findings of this study will contribute to the existing literature and facilitate better-informed clinical decisions in the field of oral and maxillofacial surgery.

METHODOLOGY:

This research was approved by the Institutional Review Board (IRB) of Dow University of Health Sciences Ref. No. IRB-1801/DUHS/Approval/2021 dated 03-02-2021. This pseudo-experimental cross-sectional study was conducted at the Department of Oral and Maxillofacial Surgery, Dow International Dental College, from April to July 2021. This study employed convenience sampling. The study sample consisted of 72 patients who reported for extraction of their lower wisdom teeth and consented to participate in the study. All extractions were performed under local anesthesia and patients were randomly divided into two groups.

Group 1 received submucosal dexamethasone (SM), while Group 2 was administered dexamethasone in the pterygomandibular space (PM). Only those patients with their teeth extracted through an open surgical approach and those with at least 2/3 of the lower molar root formed were included. Patients were excluded if they had uncontrolled systemic medical problems or a history of long-term drug use. Similarly, pregnant, lactating women and patients with documented adverse effects of steroid use were excluded from the current study.

The procedure was preceded by a complete medical history, an oral examination, and a radiographic evaluation. Informed consent was obtained from each patient. Each patient was blinded to the route of delivery of the drug. All extractions were performed by the same dental surgeon. Local anesthesia, lignocaine with epinephrine 1:100,000, was used for inferior alveolar and buccal nerve block. An average of 2-4 cartridges were used on each patient. As soon as profound anesthesia was achieved, dexamethasone 8 mg was administered.

Surgical access was gained through Ward's incision and a full thickness mucoperiosteal flap was raised. The bone was drilled, and the tooth sectioning was performed accordingly. The extraction socket was evaluated and closed using 3-0 silk. Regular postoperative instructions were given to each patient. Augmentin 625 mg (GSK, Pakistan) and Flagyl 400 mg (Sanofi Aventis (Pakistan) Ltd.) were prescribed for five days. Synflex 550 mg (Martin Dow Pharmaceuticals (Pak) Ltd.) was prescribed for pain relief.

Facial swelling was assessed before the procedure (baseline) the on the second and seventh postoperative day. The swelling was measured with the help of a measuring tape and readings were recorded from two specific sites. All measurements were performed in millimeters. These sites were from the earlobe to the ipsilateral angle of the mouth. The other site was the lateral canthus of the eye to the ipsilateral angle of the mandible (soft tissue gonion, measured as the posterior and inferior most point at the angle of the mandible). Trismus was assessed by analyzing the interincisal distance with the help of Vernier calipers.

Data were compiled and tabulated with the help of SPSS version 22. Descriptive statistical parameters (mean, standard deviation, and independent-sample*t*-test) were used to assess

Table 1: Baseline characteristics of study participants (n=72)

	Site Pterygomandibular (PM)	Submucosal (SM)	p-value*
Age (years)			
Mean ± SD	30.58 ± 7.72	30.47 ± 8.02	0.952
Duration of operation (min)			
Mean ± SD	23.08 ± 5.82	23.07 ± 4.79	0.975
	n (%)	**n (%)**	**p-value***
Gender			
Male	21 (58.3)	22 (61.1)	0.810
Female	15 (41.7)	14 (38.9)	
Impaction			
Mesioangular	18 (50.0)	19 (52.8)	0.994
Vertical	10 (27.8)	9 (25.0)	
Horizontal	5 (13.9)	5 (13.9)	
Distoangular	3 (8.3)	3 (8.3)	

*p-value calculated using independent t-test

**p-value calculated using Chi-square test

Table 3: Trismus measurement among study participants (n=72)

Trismus	Site		p-value
	Pterygomandibular	Submucosal	
	Mean ± SD	Mean ± SD	
Interincisal distance			
Baseline	47.30 ± 5.22	46.07 ± 5.08	0.318
Postoperative 2nd day	36.76 ± 4.41	35.79 ± 4.08	0.338
Postoperative 7th day	43.00 ± 4.90	41.91 ± 4.92	0.353
Differences			
Baseline - 2nd day	10.53 ± 2.07	10.28 ± 1.99	0.596
Baseline - 7th day	4.30 ± 2.13	4.16 ± 2.55	0.803

p-value calculated using an independent t-test

Table 2: Measurements of swelling among study participants (n=72)

Swelling	Site		p-value
	Pterygomandibular	Submucosal	
	Mean ± SD	Mean ± SD	
Earlobe to angle of mouth (mm)			
Baseline	115.78 ± 0.77	116.05 ± 0.84	0.160
Postoperative 2nd day	118.29 ± 1.20	117.99 ± 1.26	0.298
Postoperative 7th day	117.00 ± 0.95	116.99 ± 0.92	0.940
Differences			
2nd day - baseline	2.51 ± 0.87	1.93 ± 1.36	0.036
7th day - baseline	1.22 ± 0.57	0.93 ± 1.15	0.186
Canthus of the eye to angle of mandible (mm)			
Baseline	106.23 ± 0.70	106.08 ± 0.83	0.396
Postoperative 2nd day	110.36 ± 0.91	110.40 ± 0.99	0.893
Postoperative 7th day	108.43 ± 0.88	108.35 ± 0.89	0.692
Differences			
2nd day - baseline	4.13 ±0.52	4.31 ± 0.97	0.316
7th day - baseline	2.19 ± 0.53	2.26 ± 0.94	0.692

p-value calculated using an independent t-test

the significance of difference. The value of $p < 0.05$ was considered significant.

RESULTS:

The study sample consisted of 72 patients who reported for extraction of their lower wisdom teeth. The patients were then divided into two groups, the SM and the PM. Table 1 summarizes the characteristics of the patients involved in our study. No significant differences in the duration of the intervention were observed between the two groups (23.08 min in the PM, 23.07 min in the SM group). The swelling was significantly different between the two groups compared to their respective baselines on the second postoperative day (Table 2), while no significant differences were observed in mouth opening (Table 3).

DISCUSSION:

The third mandibular molar is located in the retromolar region, a highly vascularized area with a lot of loose connective tissue. Various mediators are released due to this, leading to subsequent events such as pain, swelling, and trismus. The intensity and extent of the sequel of events

can be controlled and reduced pharmacologically. One of the pharmacological methods that has been used since its introduction in the 1960s is corticosteroids.[5,6] In recent years, dexamethasone has become the corticosteroid of choice.[7,10]

A comprehensive search was performed using the MEDLINE, Cochrane Library, and PubMed databases for relevant studies published from January 2015 to September 2021. Keywords used for the search were "submucosal dexamethasone," "dexamethasone injection", "pteroygomandibular space," "oral surgery", "postoperative pain," and "randomized controlled trial." The search was restricted to English-language publications.

A total of 10 randomized controlled trials (RCTs) were identified, which compared the efficacy of submucosal dexamethasone injection versus dexamethasone injection into the pterygomandibular space. Of these, six studies reported a statistically significant reduction in postoperative pain with submucosal dexamethasone injection, while four studies found no significant difference between the two techniques.[11-13] In a meta-analysis of the data from these studies, submucosal dexamethasone injection was found to be more effective than dexamethasone injection into the PMS in reducing postoperative pain ($p < 0.05$).[14]

The use of dexamethasone for routine extractions is neither indicated nor justifiable and its use is limited to complicated surgical procedures.[13] As part of our study, only cases expected to undergo extensive bone guttering and tooth sectioning were selected as shown in Table 1.

The current study contributes valuable insights into the use of intraoral dexamethasone injections for patients undergoing surgical extraction of impacted lower third molars. Specifically, our findings affirm that both submucosal and pterygomandibular injections are effective in reducing postoperative complications like facial swelling.[15] This study concurs with previous literature on the efficacy of dexamethasone in reducing postoperative swelling following third molar surgery.[16,17] The unique aspect of our study is that it compares the effectiveness of two different administration sites: submucosal and pterygomandibular. The findings challenge the marginal preference for pterygomandibular injections seen in prior studies, such as the work by Laureano Filho et al.[18], by showing no significant difference in the duration of the intervention between the two sites.

Despite no significant differences in the duration of the procedure between the two groups, the submucosal group showed significant improvement in postoperative swelling on the second day as shown in Table 2. This result requires further investigation. Factors such as tissue proximity and pharmacokinetics might offer an explanation, though existing research is inconclusive.[19]

Considering the 2008 study by Filho et al., which indicated that 8 mg of dexamethasone was more effective for reducing swelling and trismus than 4 mg, 8mg was selected as the standard dose for all our patients.[20,21] Numerous studies have been conducted on steroid administration routes, including peroral, intravenous, intramuscular (masseteric, gluteal, or deltoid), submucosal, and delivery into potential space.[4,10,22] We evaluated the pterygomandibular space as a site of dexamethasone administration owing to its high vascularity facilitating drug absorption, its unique accessibility to the oral surgeon administering the inferior alveolar nerve block, and the added benefit of augmenting and prolonging analgesia.[23,24] We then compared this procedure to a submucosal injection of dexamethasone, a method being increasingly employed lately.[25] In both groups, injection time did not differ significantly with similarly impacted lower third molars removed by the same surgeon as shown in Table 3. Therefore, neither method was more efficient in terms of time.

Postoperative facial swelling, evaluated noninvasively and cost-effectively by measuring the distance from the lateral canthus to the ipsilateral mandibular angle and the earlobe to the ipsilateral angle of the mouth, showed a significant difference in both groups. The postoperative swelling was significantly reduced transversely (ear lobe to the angle of the mouth) in the submucosal injection group on the second postoperative day ($p < 0.05$) as shown in Table 2. This difference could be attributable to the proximity to the surgical site in the submucosal injection group or the added trauma of a second injection at the same site in the pterygomandibular group. This difference in postoperative swelling ceased to be significant on the seventh postoperative day.

It was postulated that the pterygomandibular group would undergo more profound pain relief than the submucosal group; however, since no participant from either group reported any significant pain postoperatively, we might infer that dexamethasone augments pain relief when administered with local anesthesia regardless of the site of injection. This is in accordance with previous studies on this subject.[22] The benefits of dexamethasone injection for reducing postoperative sequelae after third molar extraction were demonstrated in our study regardless of the injection site. A transient benefit was noted with the submucosal injection at 1-week post-surgery.

The current study is not without its limitations. The quasi-experimental design and the moderate sample size of 72 participants could affect the generalizability of the findings. For more robust data, future studies could incorporate a randomized controlled trial and larger sample sizes. Investigating the pharmacokinetics of dexamethasone in different administration sites may also provide further insights.

CONCLUSIONS:

The use of intraoral dexamethasone injections should be considered a viable option in third molar surgeries, given their effectiveness in reducing postoperative complications without extending the surgical duration. Using intraoral dexamethasone injections in third molar surgery significantly reduces the conventional complications of surgery while avoiding the systemic side effects of steroids. There were no significant differences in postoperative sequelae after third molar extraction based on the dexamethasone administration site. The findings of the study mitigates concerns about the systemic side effects of corticosteroids and promotes the broader adoption of dexamethasone as a treatment modality.

Authors Contribution:
Shaheen Ahmed: Drafted the work and performed surgical extractions
Usman Ashraf: Drafted the work and finally approved it to be published.
Abdul Hafeez Shaikh: Injected dexamethasone and worked on the manuscript
Soofia Jamil: Drafted the work and performed surgeries
Syed Jaffar Abbas Zaidi: Copyedited and proofread the manuscript.
Qaiser Ali Baig: Performed Statistical analyses

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