DOI: https://doi.org/10.54393/pjhs.v6i4.2807

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 04 (April 2025)

Original Article

OPEN ACCESS

Role of Dexamethasone at the Surgical Site in The Control of Pain and Oedema in Management of Bilateral Mandibular Fractures Osteosynthesis Using the Split-Mouth Technique

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ARTICLE INFO

Keywords:
Dexamethasone, Edema, Mandibular Fracture, Osteosynthesis

How to Cite:
Pervaiz , B., Ashraf, R., Ain, N. U., Shar, M. K., Uddin, H., & Farooq, M. U. (2025). Role of Dexamethasone at the Surgical Site in The Control of Pain and Oedema in Management of Bilateral Mandibular Fractures Osteosynthesis Using the Split-Mouth Technique: Dexamethasone and Oedema in Bilateral Mandibular Fractures Osteosynthesis. Pakistan Journal of Health Sciences, 6(4), 254-253. https://doi.org/10.54393/ pjhs.v6i4.2807

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Received date: 24th January, 2025
Revised date: 20th April, 2025
Acceptance date: 26th April, 2025
Published date: 30th April, 2025

ABSTRACT

Osteosynthesis is a widely used technique for the treatment of fractures, ensuring stability in the healing process. This might cause postoperative pain, edema, trismus, infection, and reduced jaw mobility. **Objectives:** To assess the effectiveness of Dexamethasone in alleviating pain and oedema at the surgical site in patients undergoing bilateral mandibular fracture osteosynthesis using the split-mouth technique. **Methods:** A quasi-experimental study was conducted at the Pakistan Institute of Medical Sciences from 11th October 2023 to 10th August 2024, enrolling 30 participants with bilateral mandibular fractures.They were divided into two groups using the split-mouth technique, with 30 surgical sites in each group. Using a table of random numbers, surgical sites were assigned to Group A (study group), in which submucosal dexamethasone was administered after closure of the incision site, and Group B (control group), which did not receive submucosal dexamethasone. Postoperative pain and edema were evaluated at 24 hours, 72 hours, and one week postoperatively. **Results:** The mean age of the participants was 25.77 ± 8.274, with 73.3% being male. Group A experienced slightly reduced pain than group B (p s 0.005). After 24 hours and 1 week postoperatively, there were statistically significant differences in postoperative oedema among the two groups (p≤0.05), but not at 72 hours (p>0.05). **Conclusions:** It was concluded that dexamethasone can be used as an adjunct to improve postoperative outcomes in patients with mandibular fractures by decreasing pain and oedema.

INTRODUCTION

Once properly aligned, two or more bone fragments can be combined by a routine surgical process called osteosynthesis. It is important to use this technique to fix fractures and keep them stable while they recover [1]. Common osteosynthesis methods consist of metal plates and screws, intramedullary rods, and external fixation devices. Postoperative care is vital because patients often have pain, oedema, trismus, infection, and reduced jaw movements at the surgery site [2]. Clinicians have used a diversity of therapeutic methods, such as corticosteroids, acupuncture, cold therapy, low-level laser therapy, opioids, and nonsteroidal anti-inflammatory medications (NSAIDs) [3]. Predominantly, corticosteroids have gained notice for their capacity minimize problems and postoperative aftereffects in oral surgery [4, 5].According to the literature, these elements effectively decrease inflammation by interfering with several biological processes, such as leukocyte relocation, capillary dilatation, fibrin deposition, and edema [6].This action is best demonstrated by the synthetic cortisol complement dexamethasone, which has strong immunosuppressive and antiallergic properties.It is an important means in the

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postoperative care of patients having complex surgical procedures because of its ability to regulate inflammatory responses [7, 8]. Moreover, Dongol et al demonstrated the Dexamethasone group's oedema assessments were significantly lower (0.05 ± 1.2) than those of the control group (2.0 ± 0.85).3. 72 hours after surgery, the Dexamethasone group described significantly less pain and oedema as compared to the control group [2]. Additional study by Kishore *et al.*, reported that postoperative edema was much lower in the Dexamethasone group on the first day subsequently surgery, and 60–72% of cases had no swelling between the 4th and 7th days after surgery.On the other hand, all patients in the control group experienced edema, which generally went away in 9-12 days [9].The little information on Dexamethasone's effectiveness in lowering pain and swelling at surgical sites, especially in patients undergoing bilateral mandibular fracture osteosynthesis, supports the need to conduct this study in our local community in light of these positive findings.Despite the prevalence of osteosynthesis as a common surgical technique, there is a notable lack of comprehensive research addressing optimal management strategies for postoperative complications.Our study intends to close this knowledge gap and offer insightful information about the possible advantages of dexamethasone by examining its function in this particular setting.

This study aimed to assess how well dexamethasone works as an adjuvant medication to lessen postoperative pain and edema subsequent oral and maxillofacial operations. The ultimate goal of this study is to support better clinical practices with evidence, which will improve patient outcomes and satisfaction.

METHODS

A quasi-experimental study was conducted at the Department of Oral and Maxillofacial Surgery (OMFS) at the Pakistan Institute of Medical Sciences (PIMS) in Islamabad from October 11, 2023, to August 10, 2024, following approval by the Shaheed Zulfiqar Ali Bhutto Medical University ethical review board (No. F.1-1/2015/ERB/SZ ABMU/1064).The WHO sample calculator was used to calculate sample size with a significance level of 5% and a power of the test set at 90%. The anticipated population standard deviation is 1.025, and the expected mean difference between the groups is 2.0, with an anticipated population mean of 0.05 [3]. The sample size turned out to be 60 surgical sites, with 30 participants. This study used a split-mouth design, where individually participant's face was divided into two sections: the study side and the control side.The control group received conventional standard care, while the study side received the intervention that was being tested, as the injection of submucosal dexamethasone.This method successfully used each participant as their control, permitting the results of the two sides to be compared within the same individual. This concentrated variability improved the reliability of the results by enabling the study to account for individual factors that might affect the outcomes. The non-probability consecutive sampling technique was used to take in these patients, who ranged in age from 18 to 50 years and were of either gender and reported with bilateral mandibular fractures only. Individuals who were regarded as ASA II or ASA III and had accompanying fractures other than mandibular bone fractures that would have delayed their healing or surgical treatment were excluded from the study. By meeting these standards, the study population was sufficiently homogeneous to allow for the drawing of reliable findings about the effectiveness of treatment for bilateral mandibular fractures. Every patient who was hospitalized in the indoor facility to be operated through open reduction and internal fixation (ORIF) under general anesthesia was informed about the study participation before being the in the study, and their informed written agreement was obtained. A standardized form was used to collect demographic information such as age, gender, trauma source, trauma site, and trauma duration. A total of 30 Patients with bilateral mandibular fractures were divided using a table of random numbers into two groups, with 30 surgical sites in each group. Surgical sites were assigned Group A, in which submucosal Dexamethasone was administered after ORIF and closure of the incision site, and Group B, which did not receive submucosal dexamethasone.All patients underwent surgery performed by a single surgical team, following standard operating procedures. Group A patients received 8 mg of Dexamethasone [3] by submucosal infiltration at the surgical site following open reduction and internal fixation (ORIF) and primary closure of the incision site, whereas group B patients did not receive submucosal dexamethasone. Additionally, the duration of the operation (time from 1st incision to the last suture placed) and the period between trauma and surgery were recorded.The Visual Analogue Scale (VAS) is a well-validated, reliable, and widely used tool for assessing pain intensity.Studies confirm its validity and reliability in both acute and chronic pain settings, such as Delgado *et al.*, and Crossley KM *et al.*, reported excellent test-retest reliability with an intraclass correlation coefficient (ICC) of 0.49, and a validity score of 0.72, indicating consistent measurement over time [10, 11]. VAS is a 10-cm stripe with one side fixed, which was used to measure postoperative pain. A score of 0 denotes no pain, 1–3 mild, 4–6 moderate, 7–9 severe, and 10 the worst possible pain [12].To determine which side of the procedure caused more pain, patients were asked to record their possible experience level of pain on a line. Pain assessments were conducted postoperatively after 24 hours, 72 hours, and one week of surgery. The linear tape measurement method for assessing facial edema is a reliable and valid instrument, widely utilized in clinical research for postoperative swelling.Studies have indicated that tape measures of lengths between fixed facial

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landmarks yield good to outstanding reliability, with intraclass correlation coefficients (ICC) ranging from 0.66 to 0.95 depending on the anatomical site and evaluator consistency as reported by Chotipanich and Kongpit [12]. This point-to-point facial measurements demonstrated respectable precision and reproducibility, while neck circumference measures had ICCs ranging from 0.90 to 0.95, indicating strong reliability. In a similar vein, Dongol et al., objectively assessed postoperative edema using nine standardized facial lines measured in millimeters using a flexible tape, demonstrating the method's viability and sensitivity for identifying swelling changes [2], as shown in Figure 1.

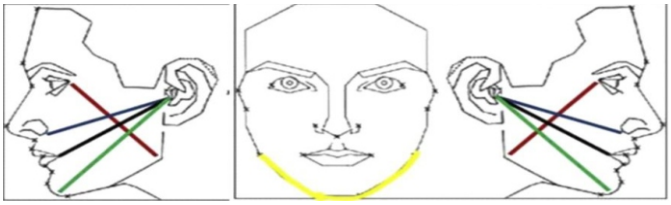

Figure 1: Linear Measurements of Postoperative Edema

Line 1 (Red): Beginning from the right lateral canthus to the right gonion.Line 2 (Blue): Beginning from the left lateral canthus to the left gonion. Line 3 (Green): Beginning from the right commissure of the lips to the right tragus. Line 4 (Purple): Beginning from the left commissure of the lips to the left tragus. Line 5 (Orange): Beginning from the midline of the chin to the right tragus. Line 6 (Yellow):Beginning from the midline of the chin to the left tragus.Line 7 (Cyan): Beginning from the right ala to the right tragus.Line 8 (Magenta): Beginning from the left ala to the left tragus. Line 9 (Black): Beginning from the left gonion to the right gonion.Three separate time intermissions were used to determine the level of postoperative oedema at 24 hours, 72 hours, and one week after surgery.The mean values gained from these assessments were computed.A thorough evaluation of surgical recovery is simplified by measuring each line, which offers important insights into how oedema evolves as per guidelines for measurement validated and published by Dongol A *et al.*, [2].The purpose of this comprehensive calculation is to offer valuable data concerning the effectiveness of dexamethasone in decreasing postoperative pain and oedema in individuals who have been reported with mandibular fractures bilaterally.The data were collected and interpreted using SPSS Version 27.0. Categorical variables like gender and pain level were shown via frequencies and percentages. Age, VAS pain scores, and postoperative oedema were amongst the numerical variables whose means and standard deviations were calculated.The study group was used to stratify the data.To assess the normality of quantitative data and confirm that the t-test was adequate, histograms, Q-Q plots, and the Shapiro-Wilk test were employed.The mean pain and oedema scores of two separate groups were compared using an independent sample t-test.A statistically significant p value of ≤0.05 proposed that there were significant differences between the two groups.This analysis provided insights into the effectiveness of Dexamethasone in managing postoperative complications like pain and edema in patients with bilateral mandibular fractures.

RESULTS

The data shows that majority of the patients reported in the department of OMFS were male (73.3%) with a mean age of 25.77 ± 8.274. The gender distribution is shown in Figure 2.

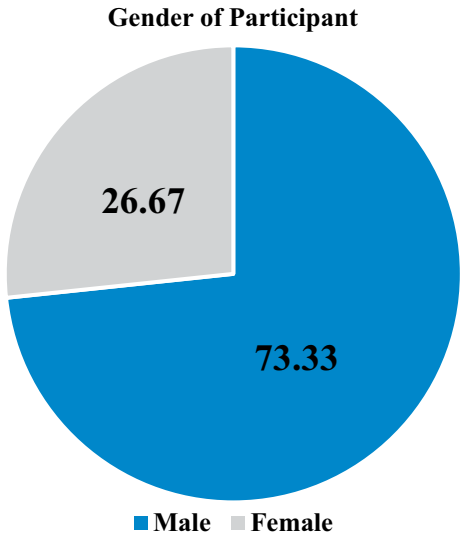

Figure 2: Gender Distribution of Study

The study represents the frequency and percentage of the Pain category based on the VAS score in either group after 24 hours, 72 hours, and one week postoperatively. There is slightly reduced post op pain among the patients in which dexamethasone was used compared to the control group B. The descriptive statistics of the study are shown in Table 1.

Table 1: Descriptive Statistics of Pain Category Based on VAS Score

Variables		Group-A Frequency (%)	Group B Frequency (%)	p-Value
VAS Pain After 24H Post-op	No Pain	0 (0.0%)	0 (0.0%)	<0.001*
	Mild Pain	0 (0.0%)	0 (0.0%)	
	Moderate Pain	0 (0.0%)	0 (0.0%)	
	Sever Pain	30 (100.0%)	15 (50.0%)	
	Worst Possible Pain	0 (0.0%)	15 (50.0%)	
	Total	30 (100.0%)	30 (100.0%)	
VAS Pain After 72H Post-op	No Pain	0 (0.0%)	0 (0.0%)	0.001*
	Mild Pain	09 (30.0%)	0 (0.0%)	
	Moderate Pain	16 (53.3%)	16 (53.3%)	
	Sever Pain	05 (16.7%)	14 (46.7%)	
	Worst Possible Pain	0 (0.0%)	0 (0.0%)	
	Total	30 (100.0%)	30 (100.0%)	

DOI: https://doi.org/10.54393/pjhs.v6i4.2807

VAS Pain After 1 Week Post-op	No Pain	18 (60.0%)	03 (10.0%)	<0.001*
	Mild Pain	11 (36.7%)	27 (90.0%)	
	Moderate Pain	01 (3.3%)	0 (0.0%)	
	Sever Pain	0 (0.0%)	0 (0.0%)	
	Worst Possible Pain	0 (0.0%)	0 (0.0%)	
	Total	30 (100.0%)	30 (100.0%)	

*Statistically significant

The study presents the mean and standard deviation of pain score and oedema with p-value after 24 hours, 72 hours, and one week postoperatively. The mean postoperative pain of the patients in group A was recorded as 7.90 ± 0.803, 4.80 ± 1.584, and 1.17 ± 1.020 after 24 hours, 72 hours, and after one week. Similarly, in group B mean postoperative pain was 9.90 ± 2.604, 6.34 ± 0.928, and 2.27 ± 0.907 after 24 hours, 72 hours, and one week postoperatively. Post stratification of the study outcome measured through independent sample t test shows a significant difference as p-value was <0.001*. The mean postoperative oedema of the patients in group A was recorded as 13.219 ± 1.042, 13.109 ± 0.905, and 11.466 ± 0.546 after 24 hours, 72 hours, and one week. Similarly, in group B mean postoperative oedema was 14.296 ± 1.094, 13.392 ± 1.005, and 11.851 ± 0.742 after 24 h, 72 h, and one week postoperatively. Post-stratification of the study outcome measured through independent sample t test shows a significant difference as p-value was <0.001* after 24h and 0.026* one week postoperatively, but this association was not significant after 72h postoperatively as p-value was 0.256, as given in Table 2.

Table 2: Descriptive Statistics of Independent Sample Test of the Study Outcomes Postoperatively

Variables		Group A	Group B	p-Value	Age of the Study Population
		Mean ± SD			
Vision Analog Scale Pain Score	Pain After 24H	7.90 ± 0.803	9.90 ± 2.604	<0.001*	25.77 ± 8.274
	Pain After 72H	4.80 ± 1.584	6.34 ± 0.928	<0.001*	
	Pain After 1 Week	1.17 ± 1.020	2.27 ± 0.907	<0.001*	
Oedema	Oedema After 24H	13.219 ± 1.042	14.296 ± 1.094	<0.001*	
	Oedema After 72H	13.109 ± 0.905	13.392 ± 1.005	0.256	
	Oedema After 1 Week	11.466 ± 0.546	11.851 ± 0.742	0.026*	

*Statistically significant

DISCUSSION

The anti-inflammatory qualities and proven safety of corticosteroids (also known as glucocorticoids) make them widely used. Cortisone, dexamethasone, prednisolone, and other substances are members of the glucocorticoid class. By blocking the chemotaxis of inflammatory mediators, these substances reduce vascular dilatation, fluid exudation, and cell turnover [14]. Due to its long half-life and rapid action, dexamethasone, a common glucocorticoid, is suggested for the majority of complex surgical operations, such as orthognathic surgery and open reduction internal fixation (ORIF) of facial fractures. Because of its prominence and mobility, the mandible is a common source of damage among facial bone fractures [15]. Oral and maxillofacial surgeons frequently prescribe corticosteroids to treat postoperative pain and edema. When assessing its effects on inflammation, tissue repair, and immunological function, clinical correlation is crucial [16]. The outcomes of this split-mouth randomized comparative study provide valuable information about how dexamethasone affects postoperative pain and oedema in individuals with bilateral mandibular fractures after open reduction and internal fixation. Thirty patients from 60 surgery sites participated in the study, and SPSS version 27.0 was used to analyze the data. The demographic profile of the patients showed that the majority were male (73.3%) with a mean age of 25.77 ±8.274, which is consistent with the typical age group involved in the road traffic accidents, Sports injuries, and physical assaults seeking oral and maxillofacial surgical management. This trend among the population was also reported by Wemambu et al., [17]. The gender distribution highlights the preponderance of male patients in the sample. The descriptive statistics reveal the frequency and percentage of pain categories based on the Visual Analog Scale (VAS) scores recorded at 24 hours, 72 hours, and one week postoperatively. From this, it is evident that patients who received dexamethasone (Group A) reported slightly reduced postoperative pain compared to the control group (Group B). The pain scores in Group A were consistently lower, suggesting that dexamethasone may have a beneficial effect in managing postoperative pain. This observation is further supported by the mean and standard deviation of pain. In Group A, the mean postoperative pain was 7.90 ± 0.803 at 24 hrs, 4.80 ± 1.584 at 72 hrs, and 1.17 ± 1.020 after one week. Conversely, Group B reported higher pain scores, with values of 9.90 ± 2.604, 6.34 ± 0.928, and 2.27 ± 0.907 at the corresponding time points. A significant difference in postoperative pain between the two groups was confirmed by an independent sample t-test; a p-value of ≤0.05 showed that dexamethasone significantly decreased pain in comparison to the control group. Mubeen et al., and Hashim et al., have reported similar reduction in post-operative pain after administration of dexamethasone [16, 18]. In addition to pain, the study also measured

DOI: https://doi.org/10.54393/pjhs.v6i4.2807

postoperative oedema, which is another critical outcome in post-surgical recovery. The mean oedema scores for Group A were 13.219 ± 1.042 at 24 hrs, 13.109 ± 0.905 at 72 hrs, and 11.466 ± 0.546 after one week. For Group B, the mean oedema scores were slightly higher at all time points: 14.296 ± 1.094, 13.392 ± 1.005, and 11.851 ± 0.742, respectively. Table 2 further presents statistical analysis that shows significant differences between the groups at 24 hrs and one week postoperatively, with p-values ≤0.05. However, at 72 hrs, no statistically significant difference was observed in oedema between the two groups (p-value ≥0.05). This proposes that dexamethasone, effectively reduced oedema in the initial postoperative period and remained effective one week after surgery. The role of dexamethasone in reducing oedema postoperatively was also investigated by Hashim *et al.*, Oksa *et al.*, and Genc et al., and they also concluded that it significantly reduces the postoperative oedema [18-20]. In another study reported by Rodrigues VP *et al.*, 100 participants between the ages of 18 and 40 were divided into 2 equal groups [21]. Fifty of these individuals (the Test group) received 4 mg of dexamethasone submucosally at the operating position before surgery. In the control group, however, no submucosal dexamethasone was administered. Both pain and facial edema were assessed, and while edema greatly decreased on the second postoperative day, which is inconsistent with our findings, pain significantly improved, which is in line with our research. Nair RB *et al.*, reported that participants who received dexamethasone 24 hrs and 72 hrs postoperatively experienced less edema [22]. The study also stated reduced pain score on the visual analog scale in dexamethasone group after 24 hours and 72 hours of operation compared to the control group [18]. These findings underscore the potential benefits of dexamethasone in managing postoperative pain and oedema in oral and maxillofacial surgery. The results suggest that dexamethasone can be a useful adjunct in improving patient recovery by reducing pain and swelling, particularly in the first 24 hours and 1 week after the surgery. The observed reduction in pain and oedema supports the use of dexamethasone as a standard adjunctive treatment in these types of surgeries. For confirmation of the long-term properties of dexamethasone and to examine its possible influence on other postoperative results, such as infection rates or functional recovery, more research with a bigger sample size and longer follow-up times would be helpful.

CONCLUSIONS

It was concluded that, based on the findings, dexamethasone is a supportive adjunctive drug for refining post-operative recovery. Its regular use in homologous surgical operations may improve patient outcomes and well-being due to the noticeable decrease in pain and edema. Dexamethasone should be a usual component of post-operative treatment regimens in light of these positive results. Patients may be happier and heal more quickly as a result of this approach.

Authors Contribution

Conceptualization: BP
Methodology: BP, RA, NUA, HU
Formal analysis: BP
Writing review and editing: MKS, MUF
All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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