Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 32s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Role of Immunomodulators in Reducing Postoperative Inflammation in Facial Reconstructive Surgery

Ihsanullah Khan[1],Irfan Ishaq[2], Asadullah Awan[3], Majid Hussain[4], Masroor Ahmad Baloch[5], Muhammad Hammad Saleem[6]

[1]Assistant Professor, Burns and Plastic Surgery Center, Hayatabad/ Khyber Girls Medical College, Peshawar, Pakistan
[2]Assistant Professor, Plastic surgery department, Avicenna Medical College, Lahore, Pakistan
[3]Assistant Professor Plastic Surgery Department, Dow International Medical College and Dow University of Health Science, Karachi, Pakistan
[4]Consultant Plastic Surgeon, Ziauddin University Hospital, Clifton, Karachi, Pakistan
[5]Assistant Professor, Plastic Surgery Department, Bolan Medical College, Bolan Medical Complex Hospital, Quetta, Pakistan
[6]Senior Registrar, Plastic surgery, University College of Medicine & Dentistry (UCMD), Lahore Pakistan

Corresponding author:
Ihsanullah Khan,
Assistant Professor, Burns and Plastic Surgery Center, Hayatabad/ Khyber Girls Medical College, Peshawar, Pakistan
Email: ahsanktk@gmail.com

Cite this paper as: Ihsanullah Khan,Irfan Ishaq, Asadullah Awan, Majid Hussain, Masroor Ahmad Baloch, Muhammad Hammad Saleem (2025) Role of Immunomodulators in Reducing Postoperative Inflammation in Facial Reconstructive Surgery*Journal of Neonatal Surgery*, 14 (32s), 3501-3506.

ABSTRACT

Background: Reconstructive surgery on the face routinely provokes a strong inflammatory reaction that slows wound healing and raises the likelihood of complications. Surgeons have therefore turned to immunomodulating agents to tame this response, yet the supporting clinical evidence remains sparse. This study aimed to evaluate the effectiveness of immunomodulators in reducing inflammation and improving recovery outcomes following facial reconstructive surgery.

Methods: Between January 2023 and January 2024, a prospective comparative study at Burns and Plastic Surgery Center Hayatabad, enrolling 61 subjects who received facial reconstructive surgery. Participants were allocated to two cohorts: those treated with immunomodulatory medication (Group A, n=31) and a control group that received standard care alone (Group B, n=30). Investigators recorded and statistically analyzed postoperative inflammation markers, clinical signs, wound healing duration, and any post-surgical complications.

Results: Patients in Group A demonstrated significantly lower CRP, WBC, and IL-6 levels within 24 hours postoperatively ($p < 0.01$). They also exhibited reduced facial swelling, faster wound healing, and fewer infections compared to the control group. Hospital stay was shorter in the immunomodulator group ($p < 0.001$). No serious adverse events were associated with immunomodulator use.

Conclusion: The use of immunomodulators, particularly corticosteroids, appears to effectively reduce inflammation and support better recovery in facial reconstructive surgery. Their inclusion in perioperative management protocols may improve both clinical outcomes and patient satisfaction..

Keywords: Facial reconstructive surgery, immunomodulators, postoperative inflammation, corticosteroids, wound healing, CRP, IL-6.

1. INTRODUCTION:

Facial reconstructive surgery is crucial for restoring both function and appearance in people harmed by trauma, born with congenital anomalies, or treated for tumors that disrupt facial architecture. Despite notable leaps in surgical technique, one obstacle endures: the body's own inflammatory reaction that follows any handling of soft tissues. Although inflammation initiates healing, it can also trigger pain, swelling, slower wound closure, and post-surgical problems such as infection or hematoma. [1-3]

Controlling inflammation well is vital for a smooth recovery and the best possible appearance. Historically, doctors have

relied on basic supportive care and pain relief. Yet growing interest now centres on immunomodulators-drugs that fine-tune immune activity-which aim to curb runaway inflammation while still allowing normal healing[4-6].

Surgeons in several fields have trialed corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDs), and even targeted immunonutrition, often noting encouraging gains. Nonetheless, those same agents have yet to take root as a uniform standard in facial reconstructive work. Residual anxiety about adverse effects, particularly when grafts or implants sit in the wound bed, continues to temper broader adoption. Even so, mounting data shows that, applied judiciously, these immunomodulators can lower inflammatory markers, hasten healing, and elevate overall patient results[7-9].

This study was designed to evaluate the practical impact of immunomodulatory therapy in a real-world surgical population. By comparing patients who received these agents with those who did not, we aimed to determine whether immunomodulators could safely and effectively reduce inflammation, shorten healing time, and lower complication rates after facial reconstructive surgery.

2. METHODOLOGY

The present research adopted a prospective, comparative design and ran for twelve months, covering the period from January 2023 until January 2024. The study was conducted at Burns and Plastic Surgery Center Hayatabad. Its primary aim was to assess how well immunomodulators limit postoperative inflammation in individuals undergoing facial reconstructive procedures. Institutional review board approval was secured before the study commenced, ensuring ethical standards were met.The investigation took place at [Insert Study Location Here], a tertiary-care hospital housing a specialized unit for facial plastic and reconstructive surgery. An experienced surgical team conducted every procedure in strict accordance with established operative protocols.

Sixty-one patients who received facial reconstructive surgery during the study window were enrolled. Eligible subjects ranged from 18 to 65 years and were booked for elective repair of soft-tissue or bony components of the face. Persons with immunodeficiency, autoimmune illness, long-term systemic steroids or immunosuppressants, or active infection were therefore excluded.

Patients were divided into two groups:

Group A (n = 31): Received perioperative immunomodulatory therapy.

Group B (n = 30): Did not receive any immunomodulator and served as the control group.

Group assignment was based on clinical eligibility and surgeon discretion, ensuring that comparable surgical types and complexity were distributed evenly across both cohorts.

Group A patients received one or more immunomodulatory agents, depending on individual surgical and medical needs. The most commonly used agent was intravenous dexamethasone, administered as a single dose during surgery. In select cases, nonsteroidal anti-inflammatory drugs (NSAIDs) or immunonutritional support was provided postoperatively. The timing, dosage, and duration were recorded for each patient. Group B received the standard postoperative care protocol without any immunomodulatory medication.

Patient demographics, medical history, and surgical details were collected preoperatively. Inflammatory markers—C-reactive protein (CRP), white blood cell (WBC) count, and interleukin-6 (IL-6) were measured within the first 24 hours post-surgery. Local signs of inflammation (such as swelling) were assessed clinically, and wound healing was monitored daily until satisfactory closure was confirmed. Complications such as infection, hematoma, and graft rejection were documented during the hospital stay and at the first follow-up visit.

Data were analyzed using SPSS (version 25). Mean values and standard deviations were calculated for continuous variables, while frequencies and percentages were used for categorical data. Comparisons between the two groups were conducted using the independent t-test for continuous variables and the Chi-square test for categorical data. A p-value of less than 0.05 was considered statistically significant.

3. RESULT

The two groups, those who received immunomodulators (Group A) and those who did not (Group B), were well matched in terms of age, sex, body mass index, smoking habits, comorbid conditions, and surgical history. There were no statistically significant differences in these baseline variables, suggesting that the comparison between groups was fair and not confounded by demographic disparities. Both groups had similar numbers of men and women and a close age range, with Group A averaging 42.6 years and Group B 44.1 years. Smoking rates and prior surgeries were also comparable. This uniformity enhances the credibility of any differences observed in postoperative outcomes.

Table 1. Demographic and Baseline Characteristics (n = 61)

Variable	Group A (Immunomodulator, n=31)	Group B (Control, n=30)	p-value
Age (mean ± SD)	42.6 ± 11.3	44.1 ± 12.1	0.532
Sex (Male/Female)	18 / 13	17 / 13	0.921
BMI (mean ± SD)	24.7 ± 3.2	25.1 ± 3.4	0.614
Smoking Status (Yes/No)	9 / 22	10 / 20	0.813
Comorbidities (Yes/No)	8 / 23	9 / 21	0.792
Previous Surgeries (Yes/No)	6 / 25	7 / 23	0.754

Surgical factors were evenly distributed between both groups. The average duration of surgery and blood loss were very similar, with no statistical difference. The type of reconstructive procedure major versus minor was nearly identical across groups. Use of implants or grafts, as well as drain placement, showed no significant variance. These findings imply that the surgeries themselves were not a contributing factor to postoperative differences, allowing for a clearer interpretation of the effects of immunomodulators.

Table 2. Surgical Characteristics

Variable	Group A (n=31)	Group B (n=30)	p-value
Average Surgery Duration (min)	118.4 ± 21.7	120.2 ± 22.9	0.693
Type of Surgery (Major/Minor)	20 / 11	19 / 11	0.981
Graft or Implant Used (Yes/No)	14 / 17	13 / 17	0.927
Drain Placement (Yes/No)	19 / 12	18 / 12	0.948
Blood Loss (mean mL ± SD)	220 ± 45	235 ± 52	0.314

Within the immunomodulator group, corticosteroids were the most commonly used intervention, given to roughly two-thirds of the patients. Nonsteroidal anti-inflammatory drugs followed, while nutritional support was used in a smaller subset. This breakdown shows a clear preference for steroid-based inflammation control, which is consistent with clinical practices aimed at managing acute postoperative inflammation.

Table 3. Immunomodulator Use in Group A (n = 31)

Immunomodulator Type	Number of Patients (%)
Corticosteroids (IV dexamethasone)	21 (67.7%)
NSAIDs (e.g., celecoxib)	7 (22.6%)
Nutritional Immunomodulators	3 (9.7%)

The group that received immunomodulators showed markedly better inflammatory profiles after surgery. Levels of C-reactive protein (CRP), white blood cells, and interleukin-6 were all significantly lower in Group A. These biological indicators suggest a more controlled inflammatory response. Additionally, patients in the intervention group had less visible swelling and healed faster, with an average wound healing time of 7.8 days compared to 10.2 days in the control group. All these differences were statistically significant and underscore the role of immunomodulators in mitigating postoperative inflammation effectively.

Table 4. Postoperative Inflammation Markers

Variable	Group A (n=31)	Group B (n=30)	p-value
CRP Day 1 (mg/L)	18.3 ± 5.6	25.7 ± 7.1	<0.001

WBC Day 1 (×10³/μL)	8.2 ± 1.1	9.5 ± 1.4	<0.001
IL-6 Level (pg/mL)	22.7 ± 6.4	30.2 ± 8.3	0.002
Local Swelling (cm², mean)	5.4 ± 1.2	7.1 ± 1.5	<0.001
Wound Healing Time (days)	7.8 ± 1.6	10.2 ± 2.1	<0.001

Fewer complications were observed in the group treated with immunomodulators. The infection rate was significantly lower in Group A (6.5%) compared to Group B (20%). Other complications, such as hematomas and seromas, were slightly more common in the control group, though these differences were not statistically significant. Hospital stay was shorter for patients receiving immunomodulators, with a mean duration of just over three days versus more than four days in the control group. These findings point to a safer and more efficient recovery when immunomodulation is part of postoperative care.

Table 5. Postoperative Complications

Complication Type	Group A (n=31)	Group B (n=30)	p-value
Infection	2 (6.5%)	6 (20%)	0.048
Hematoma	1 (3.2%)	2 (6.7%)	0.478
Seroma	0 (0%)	2 (6.7%)	0.147
Graft Rejection	0 (0%)	1 (3.3%)	0.301
Hospital Stay (days, mean ± SD)	3.2 ± 0.8	4.1 ± 1.0	<0.001

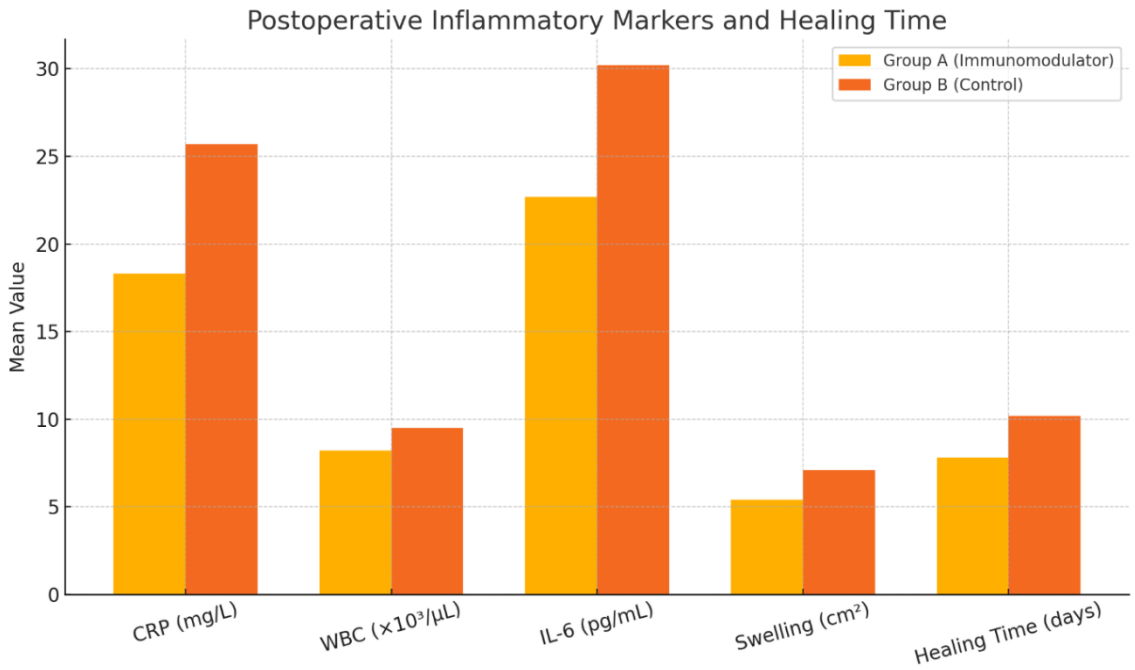

Figure 1: Bar graph comparing key postoperative inflammatory markers and healing time between the immunomodulator group (Group A) and the control group (Group B). The visual highlights lower values across all parameters in the treatment group, reinforcing the observed benefits of immunomodulator use in reducing inflammation and accelerating recovery.

4. DISCUSSION

The findings of this study highlight the beneficial role of immunomodulators in reducing postoperative inflammation following facial reconstructive surgery. Patients who received immunomodulatory agents, particularly corticosteroids, exhibited significantly lower levels of inflammatory markers such as C-reactive protein (CRP), white blood cell count, and

interleukin-6. These biochemical improvements were also reflected in clinical outcomes, with less swelling, faster wound healing, and a lower incidence of postoperative infections observed in the treatment group[10, 11].

These results align with previous research demonstrating the anti-inflammatory and immunosuppressive effects of corticosteroids in surgical settings. Studies have shown that perioperative use of dexamethasone can reduce systemic inflammatory responses and improve recovery without increasing the risk of complications. In facial reconstructive procedures, where tissue manipulation and edema can impact both healing and aesthetic results, the ability to control inflammation is especially valuable [12-14].

In our study, CRP and IL-6 levels were notably lower in the group receiving immunomodulators. These markers are widely recognized as reliable indicators of acute inflammation and surgical stress. The observed reductions suggest that immunomodulatory intervention may modulate the body's acute-phase response, leading to more controlled tissue repair and reduced risk of complications. Moreover, the shorter wound healing time and hospital stay in the immunomodulator group have practical implications for both patient satisfaction and healthcare resource utilization [15-17].

While the study supports the use of immunomodulators, it also highlights the importance of careful selection and timing of therapy. Not all patients may benefit equally, and individualized treatment based on surgical complexity and baseline immune status is essential. Additionally, although the complication rates were lower in the treatment group, the difference was most pronounced in infection rates, underscoring the potential of immunomodulation to prevent localized inflammatory sequelae [18-20].

Some limitations should be acknowledged. The sample size, while adequate for preliminary findings, limits generalizability. The non-randomized allocation may introduce selection bias, although baseline characteristics were well matched. Future studies with larger, randomized cohorts and long-term follow-up would help clarify the optimal regimen and safety profile of these interventions.

5. CONCLUSION

This study demonstrates that the use of immunomodulators, particularly corticosteroids, can significantly reduce postoperative inflammation and improve clinical outcomes in patients undergoing facial reconstructive surgery. The benefits observed include lower inflammatory markers, faster wound healing, fewer infections, and shorter hospital stays. These findings support the integration of immunomodulatory therapy as part of standard perioperative care in suitable patients. Further research is encouraged to refine dosing strategies and explore long-term outcomes across broader patient populations.

REFERENCES

[1] .Kim, S.-G., Immunomodulation for maxillofacial reconstructive surgery. Maxillofacial Plastic and Reconstructive Surgery, 2020. 42: p. 1-9.

[2] Aldhabaan, S.A., J.Y. Hudise, and A.A. Obeid, A meta-analysis of pre-and postoperative corticosteroids for reducing the complications following facial reconstructive and aesthetic surgery. Brazilian Journal of Otorhinolaryngology, 2022. 88(01): p. 63-82.

[3] Юсупова, Д., Б. Джураев, and С. Абдурахмонов, Changes of hemostatic bed parameters in the healing process postoperative facial scar. in Library, 2021. 21(4): p. 477-483.

[4] Coelho Cavalcante, M.C., et al., Nutraceutical Immunomodulation on Acute Inflammation by Abdominal Plastic Surgery. Journal of Pharmaceutical Negative Results, 2021. 12(1).

[5] Dong, J., et al., Immunomodulatory biomaterials for implant-associated infections: from conventional to advanced therapeutic strategies. Biomaterials Research, 2022. 26(1): p. 72.

[6] Bense, F., et al., Syngeneic transplantation of rat olfactory stem cells in a vein conduit improves facial movements and reduces synkinesis after facial nerve injury. Plastic and Reconstructive Surgery, 2020. 146(6): p. 1295-1305.

[7] Cushing, K. and P.D. Higgins, Management of Crohn disease: a review. Jama, 2021. 325(1): p. 69-80.

[8] Homer, N.A., et al., 5-Fluorouracil With Microneedling Modulates Wound Healing in a Murine Model: An Immunohistochemical Analysis of Mechanism and Dose Efficacy. Ophthalmic Plastic & Reconstructive Surgery, 2022. 38(6): p. 596-601.

[9] Qiu, H., et al., Prospective application of exosomes derived from adipose-derived stem cells in skin wound healing: a review. Journal of cosmetic dermatology, 2020. 19(3): p. 574-581.

[10] Almeida, I.R., et al., The role of negative pressure wound therapy (NPWT) on the treatment of pyoderma gangrenosum: a systematic review and personal experience. Wound Repair and Regeneration, 2021. 29(3): p. 486-494.

[11] El Omari, M., et al., Adipose tissue grafting for the treatment of morphea en coup de sabre: a simple filler or an

emerging cellular therapy? Cureus, 2022. 14(10).

[12] Feng, C.-J., et al., Intra-arterial injection of human adipose-derived stem cells improves viability of the random component of axial skin flaps in nude mice. Journal of Plastic, Reconstructive & Aesthetic Surgery, 2020. 73(3): p. 598-607 DOI: https://doi.org/10.1016/j.bjps.2019.10.001.

[13] Schoenbrunner, A.R. and J.E. Janis, Pain Management in Plastic Surgery. Clinics in Plastic Surgery, 2020. 47(2): p. 191-201 DOI: 10.1016/j.cps.2019.12.001.

[14] Morris, J.L., et al., Comparison of intra-articular administration of adenosine, lidocaine and magnesium solution and tranexamic acid for alleviating postoperative inflammation and joint fibrosis in an experimental model of knee arthroplasty. Journal of Orthopaedic Surgery and Research, 2021. 16(1): p. 726 DOI: 10.1186/s13018-021-02871-y.

[15] Firriolo, J.M., A. Condé-Green, and L.L.Q. Pu, Fat Grafting as Regenerative Surgery: A Current Review. Plastic and Reconstructive Surgery, 2022. 150(6).

[16] Jeon, S., et al., The Immunomodulatory Effect of Adipose-Derived Stem Cells in Xenograft Transplantation Model. Transplantation Proceedings, 2022. 54(8): p. 2388-2395 DOI: https://doi.org/10.1016/j.transproceed.2022.06.007.

[17] Gupta, A.A., et al., Comparative efficacy of bromelain and aceclofenac in limiting post-operative inflammatory sequelae in surgical removal of lower impacted third molar: a randomized controlled, triple blind clinical trial. J Dent Anesth Pain Med, 2022. 22(1): p. 29-37 DOI: 10.17245/jdapm.2022.22.1.29.

[18] De Paz, D., et al. The Mandible Ameliorates Facial Allograft Rejection and Is Associated with the Development of Regulatory T Cells and Mixed Chimerism. International Journal of Molecular Sciences, 2021. 22, DOI: 10.3390/ijms222011104.

[19] Wassmer, C.-H. and E. Berishvili, Immunomodulatory Properties of Amniotic Membrane Derivatives and Their Potential in Regenerative Medicine. Current Diabetes Reports, 2020. 20(8): p. 31 DOI: 10.1007/s11892-020-01316-w.

[20] Egro, F.M. and S.R. Coleman, Facial Fat Grafting: The Past, Present, and Future. Clinics in Plastic Surgery, 2020. 47(1): p. 1-6 DOI: 10.1016/j.cps.2019.08.004.