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Comparative Evaluation of Intralesional Corticosteroid Injection and Surgical Excision in Hypertrophic Scar Treatment

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Abstract:

Background: Hypertrophic scars are a common sequela of cutaneous injury and can cause significant functional and psychosocial morbidity. Although surgical excision offers rapid removal of scar tissue, recurrence rates remain high if not combined with adjuvant therapy. Intralesional corticosteroids, particularly triamcinolone acetonide, have been widely used due to their ability to inhibit fibroblast proliferation and collagen deposition. This study aimed to compare the efficacy, recurrence rates, patient-reported outcomes, and safety profile of intralesional triamcinolone versus surgical excision in the management of hypertrophic scars.

Methods: A prospective, comparative study was conducted on 136 patients with hypertrophic scars, randomized into two groups: Group A (n = 68) received intralesional triamcinolone (40 mg/mL) every 3 weeks for 12 weeks, and Group B (n = 68) underwent surgical excision with primary closure. Baseline demographic and clinical parameters were recorded. Outcomes were assessed at baseline and 12 weeks using the Vancouver Scar Scale (VSS), visual analog scale (VAS) for pain and pruritus, recurrence rates, adverse events, and patient-reported global response and satisfaction. Statistical analysis was performed using independent t-tests and chi-square tests, with $p < 0.05$ considered significant.

Results: Baseline characteristics, including mean age (32.4 ± 9.8 vs. 33.1 ± 10.2 years) and mean VSS scores (8.0 ± 1.8 vs. 8.0 ± 1.9), were comparable between groups. At 12 weeks, Group A demonstrated significantly lower mean total VSS scores than Group B (3.2 ± 1.5 vs. 3.8 ± 1.7, $p = 0.031$), with greater improvement in pigmentation and pliability. Pruritus relief was significantly better with triamcinolone (VAS 1.2 ± 0.8 vs. 1.8 ± 1.0, $p = 0.002$). Recurrence was significantly lower in Group A (10.3%) compared to Group B (20.6%, $p = 0.048$). Skin atrophy occurred in 11.8% of patients receiving triamcinolone, whereas surgical patients experienced more wound-related complications. Patient satisfaction was higher in the triamcinolone group (70.6% vs. 63.2%), though not statistically significant.

Conclusion: Intralesional triamcinolone provides superior overall scar remodeling, lower recurrence rates, and better pruritus relief compared with surgical excision, with manageable local adverse effects. It represents an effective, minimally invasive, office-based treatment for hypertrophic scars and should be considered as a first-line option, especially for non-refractory lesions.

Keywords:

Hypertrophic scar, intralesional corticosteroid, triamcinolone acetonide, surgical excision, Vancouver Scar Scale

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Introduction

Hypertrophic scars are pathological cutaneous responses characterized by excessive collagen deposition within the dermis, resulting in raised, erythematous, and often pruritic or painful lesions. They commonly develop following trauma, burns, surgery, or inflammatory skin conditions, with incidence rates ranging from 40% to 70% in surgical wounds and up to 90% in deep burn injuries [1,2]. Unlike keloids, hypertrophic scars remain confined within the original wound margins, but they can cause significant cosmetic disfigurement, functional impairment, and psychosocial distress, thereby impacting quality of life [3].

The pathogenesis of hypertrophic scar formation is complex and involves an imbalance between collagen synthesis and degradation, persistent inflammation, and dysregulated fibroblast activity. Elevated levels of transforming growth factor-beta (TGF-β), increased fibroblast proliferation, and prolonged myofibroblast activity have been implicated in the exaggerated wound healing response [4,5]. These molecular changes lead to excessive deposition of type III collagen and thickened dermal architecture.

Management of hypertrophic scars remains challenging, with no universally accepted gold-standard therapy. Current treatment modalities include intralesional corticosteroids, surgical excision, pressure therapy, silicone gel sheets, cryotherapy, laser treatment, and newer options such as intralesional 5-fluorouracil, bleomycin, or verapamil [6]. Among these, intralesional corticosteroids—most commonly triamcinolone acetonide—are considered the first-line therapy due to their anti-inflammatory, vasoconstrictive, and collagen synthesis-inhibiting effects [7]. Triamcinolone acts by suppressing fibroblast proliferation, reducing glycosaminoglycan synthesis, and decreasing TGF-β expression, resulting in scar flattening and symptomatic improvement [8].

Surgical excision is another frequently employed modality, particularly for large or functionally limiting scars. However, excision alone carries a recurrence rate as high as 50–100%, attributable to the reactivation of the same pathological wound healing pathways [9]. To overcome this limitation, surgical excision is often combined with adjunctive therapies such as intralesional corticosteroid injection, pressure therapy, or radiotherapy to reduce recurrence rates [10].

Although both intralesional triamcinolone and surgical excision are widely used, there remains limited high-quality comparative data on their relative efficacy and safety as monotherapies [8]. Understanding which modality offers superior outcomes in terms of scar flattening, symptom relief, recurrence prevention, and adverse effect profile is essential for guiding clinical decision-making [10].
Hence, the present study was aimed to comparatively evaluate the effectiveness and safety of intralesional triamcinolone injection versus surgical excision in the treatment of hypertrophic scars.

Material and methods

Study Design and Setting

This prospective comparative interventional study was conducted in the Department of General Surgery at a tertiary care centre in North India, over a period of 2 years between January 2020 and January 2022. Approval for the study protocol was obtained from the Institutional Ethics Committee prior to commencement, and the study adhered to the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants after providing detailed information regarding the procedures, risks, and benefits.

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Study Population

Patients presenting to the surgical outpatient department with clinically diagnosed hypertrophic scars were screened for eligibility. A hypertrophic scar was defined as a raised, erythematous, firm scar confined to the original wound margins and present for at least three months. Patients of either sex, aged between [18–60 years], with symptomatic scars following surgery, trauma, or burns were included. Exclusion criteria comprised keloids (scar extending beyond wound margins), uncontrolled diabetes mellitus, immunodeficiency, bleeding disorders, active local infection, history of scar treatment in the past six months, and pregnancy or lactation.

Sample Size and Randomization

A total of 136 patients meeting inclusion criteria were enrolled. They were randomly allocated into two groups (68 patients in each group) using computer-generated random numbers. Allocation concealment was achieved through the use of sealed opaque envelopes, which were opened just before initiating the intervention.

Intervention Protocol

Group A: Intralesional Triamcinolone Injection

Patients received intralesional triamcinolone acetonide (40 mg/mL). After aseptic preparation of the area, the drug was injected intradermally using a 26-gauge needle at a dose of approximately 0.1–0.2 mL per cm^2 of scar tissue, with uniform distribution throughout the lesion. The total volume did not exceed 2 mL per session. Injections were repeated every three weeks for up to three sessions or until satisfactory flattening of the scar was achieved.

Group B: Surgical Excision

Patients underwent surgical excision under local or regional anesthesia depending on scar size and site. The scar was excised using an elliptical incision with minimal undermining to avoid wound tension. Primary closure was achieved with interrupted or subcuticular sutures for optimal cosmesis. Aseptic dressings were applied, and postoperative care was provided. Sutures were removed on the 7th–10th postoperative day based on healing status.

Follow-up and Outcome Measures

All patients were evaluated at baseline and at 4, 8, and 12 weeks post-intervention. Objective scar assessment was performed using the Vancouver Scar Scale (VSS), which evaluates vascularity, pigmentation, pliability, and height. Patient-reported outcomes, including pain and pruritus, were measured using a 10-point Visual Analog Scale (VAS). Recurrence was defined as reappearance of scar elevation >2 mm compared to surrounding skin. Adverse effects such as skin atrophy, hypopigmentation, infection, telangiectasia, or delayed wound healing were documented.

Statistical Analysis

Data were compiled in Microsoft Excel and analyzed using SPSS version 20.0. Quantitative variables were expressed as mean ± standard deviation and compared between groups using unpaired Student's t-test, while intragroup pre- and post-treatment comparisons were made using paired t-test. Categorical data, such as recurrence rates and adverse events, were compared using Chi-square or Fisher's exact test as appropriate. A p-value < 0.05 was considered statistically significant.

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Results

A total of 136 patients were enrolled, with 68 in each treatment group. The mean age of patients was comparable between the groups (32.4 ± 9.8 years in the triamcinolone group vs. 33.1 ± 10.2 years in the surgical group, p = 0.622). The male-to-female distribution was also similar (58.8% males in Group A vs. 61.8% in Group B, p = 0.693). The mean duration of scars was 6.2 ± 3.1 months in the triamcinolone group and 6.0 ± 2.9 months in the surgical group (p = 0.745). Etiology distribution (surgery, trauma, burns) and scar site distribution (face/neck, trunk, extremities) did not differ significantly between the groups. The baseline mean total Vancouver Scar Scale (VSS) score was identical in both groups (8.0 ± 1.8 vs. 8.0 ± 1.9, p = 0.988), confirming comparability at baseline (Table 1).

Table 1. Baseline demographic and clinical characteristics.

Variable	Group A: Triamcinolone (n = 68)	Group B: Surgical Excision (n = 68)	p-value
	Frequency (%)/mean ± SD		
Age (years)	32.4 ± 9.8	33.1 ± 10.2	0.622
Gender			
Male	40 (58.8%)	42 (61.8%)	0.693
Female	28 (41.2%)	26 (38.2%)	
Duration of scar (months)	6.2 ± 3.1	6.0 ± 2.9	0.745
Etiology			
Surgery	36 (52.9%)	34 (50.0%)	0.801
Trauma	20 (29.4%)	22 (32.4%)	
Burns	12 (17.6%)	12 (17.6%)	
Scar site			
Face/Neck	18 (26.5%)	16 (23.5%)	0.717
Trunk	20 (29.4%)	22 (32.4%)	
Extremity	30 (44.1%)	30 (44.1%)	
Baseline total VSS	8.0 ± 1.8	8.0 ± 1.9	0.988

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Both groups demonstrated significant improvement in individual VSS parameters from baseline to 12 weeks, with greater absolute reduction seen in the triamcinolone group. Mean vascularity scores decreased from 2.0 ± 0.6 to 0.8 ± 0.7 in Group A and to 0.9 ± 0.8 in Group B (p = 0.344 between groups). Similar trends were noted for pliability and height parameters, with between-group differences not reaching statistical significance. Pigmentation showed slightly better improvement with triamcinolone (0.8 ± 0.7 vs. 1.0 ± 0.8, p = 0.078). Importantly, the mean total VSS score was significantly lower at 12 weeks in Group A compared with Group B (3.2 ± 1.5 vs. 3.8 ± 1.7, p = 0.031), indicating superior overall scar remodeling with intralesional triamcinolone (Table 2).

Table 2. Vancouver Scar Scale (VSS) — component scores and total (Baseline vs 12 weeks).

VSS parameter	Timepoint	Group A: Triamcinolone (n = 68)	Group B: Surgical Excision (n = 68)	p-value
		mean ± SD		
Vascularity	Baseline	2.0 ± 0.6	2.0 ± 0.6	0.995
	12 weeks	0.8 ± 0.7	0.9 ± 0.8	0.344
Pliability	Baseline	2.0 ± 0.6	2.0 ± 0.6	0.999
	12 weeks	0.6 ± 0.6	0.7 ± 0.7	0.214
Height	Baseline	2.5 ± 0.8	2.5 ± 0.9	0.858
	12 weeks	1.0 ± 0.9	1.2 ± 1.0	0.106
Pigmentation	Baseline	1.5 ± 0.6	1.5 ± 0.6	0.909
	12 weeks	0.8 ± 0.7	1.0 ± 0.8	0.078
Total VSS	Baseline	8.0 ± 1.8	8.0 ± 1.9	0.988
	12 weeks	3.2 ± 1.5	3.8 ± 1.7	0.031

Both treatment modalities resulted in substantial reduction in pain scores on the VAS by 12 weeks (from 3.1 ± 1.2 to 1.0 ± 0.6 in Group A and from 3.0 ± 1.3 to 1.1 ± 0.7 in Group B), with no significant intergroup difference (p = 0.475). Pruritus scores improved in both groups but the reduction was significantly greater in the triamcinolone group (1.2 ± 0.8 vs. 1.8 ± 1.0, p = 0.002), reflecting better symptomatic relief (Table 3).

Table 3. Patient-reported outcomes (VAS for pain and pruritus).

Symptom (VAS 0–10)	Timepoint	Group A: Triamcinolone (n = 68)	Group B: Surgical Excision (n = 68)	p-value
		mean ± SD		
Pain	Baseline	3.1 ± 1.2	3.0 ± 1.3	0.761
	12 weeks	1.0 ± 0.6	1.1 ± 0.7	0.475
Pruritus	Baseline	4.0 ± 1.5	4.0 ± 1.6	0.989
	12 weeks	1.2 ± 0.8	1.8 ± 1.0	0.002

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During 12-week follow-up, recurrence was observed in 10.3% of patients in the triamcinolone group compared with 20.6% in the surgical excision group, a statistically significant difference (p = 0.048). Overall adverse events were slightly more frequent in the triamcinolone group (22.1% vs. 16.2%, p = 0.343), driven primarily by steroid-related skin atrophy (11.8% vs. 0%, p = 0.002). Hypopigmentation and telangiectasia were also seen more often with triamcinolone, although not statistically significant. Conversely, wound-related complications such as infection (5.9%) and dehiscence (4.4%) were noted only in the surgical group (Table 4).

Table 4. Recurrence and adverse events or complications during follow-up (observed up to 12 weeks).

Outcome	Group A: Triamcinolone (n = 68)	Group B: Surgical Excision (n = 68)	p-value
	Frequency (%)		
Recurrence			
Yes	7 (10.3%)	14 (20.6%)	0.048
No	61 (89.7%)	54 (79.4%)	
Any adverse event	15 (22.1%)	11 (16.2%)	0.343
Skin atrophy	8 (11.8%)	0 (0.0%)	0.002
Hypopigmentation	6 (8.8%)	4 (5.9%)	0.501
Telangiectasia	2 (2.9%)	0 (0.0%)	0.115
Infection	1 (1.5%)	4 (5.9%)	0.128
Wound dehiscence	0 (0.0%)	3 (4.4%)	0.078

An excellent or good overall response was achieved in 75.0% of patients treated with triamcinolone compared with 67.6% in the surgical group, though this difference was not statistically significant (p = 0.218). Patient satisfaction was numerically higher in Group A (70.6%) than in Group B (63.2%), but again without statistical significance (p = 0.209) (Table 5).

Table 5. Global response and patient satisfaction.

Outcome	Group A: Triamcinolone (n = 68)	Group B: Surgical Excision (n = 68)	p-value
	Frequency (%)		
Global Response			
Excellent/Good	51 (75.0%)	46 (67.6%)	0.218
Fair/Poor	17 (25.0%)	22 (32.4%)	
Patient satisfied	48 (70.6%)	43 (63.2%)	0.209

Discussion

In this comparative study of intralesional triamcinolone versus surgical excision for hypertrophic scars, both treatment modalities resulted in significant clinical improvement over 12 weeks; however, intralesional triamcinolone demonstrated a trend toward superior overall scar remodeling, lower recurrence rates, and better patient-reported outcomes, with an acceptable adverse event profile.

Baseline demographic and clinical characteristics were comparable between the two groups,

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minimizing selection bias and allowing for meaningful interpretation of outcome differences. The mean age, gender distribution, duration, etiology, and anatomical site of scars were statistically similar, consistent with previous studies by Trisliana Perdanasari et al., and Zhuang et al., that have highlighted the importance of homogenous baseline characteristics in scar outcome research [11,12]. The identical baseline VSS scores (8.0 ± 1.8 vs. 8.0 ± 1.9) further strengthen the internal validity of the study.

Our results showed a statistically significant greater reduction in total VSS score with intralesional triamcinolone at 12 weeks (3.2 ± 1.5 vs. 3.8 ± 1.7, p = 0.031), suggesting superior overall scar remodeling. Similar findings have been reported in Indian cohorts by Augustine et al., and Srivastava et al., who observed 40–60% VSS reduction following 6–12 weeks of intralesional steroid therapy, attributed to inhibition of fibroblast proliferation and collagen synthesis [13,14]. Surgical excision, though effective in reducing scar height and improving pliability, carries a well-documented risk of recurrence due to persistent abnormal fibroblast activity at wound edges [15]. The marginally better pigmentation improvement seen in the triamcinolone group (0.8 ± 0.7 vs. 1.0 ± 0.8, p = 0.078) may reflect corticosteroid-induced melanocyte suppression, as noted in prior study by Ledon et al., [16].

Patient-reported outcomes mirrored objective improvements. Both modalities significantly reduced pain and pruritus scores, but the improvement in pruritus was significantly greater with triamcinolone (VAS 1.2 ± 0.8 vs. 1.8 ± 1.0, p = 0.002). These results are in line with reports from Murakami et al., and Rimmer et al., who emphasized the anti-inflammatory action of corticosteroids leading to rapid symptomatic relief, particularly pruritus, which is mediated by mast cell degranulation and neuropeptide activity within scar tissue [17,18].

An important finding was the significantly lower recurrence rate in the triamcinolone group (10.3% vs. 20.6%, p = 0.048). This observation corroborates earlier studies by Sheng et al., and Sun et al., suggesting that intralesional corticosteroids not only flatten scars but also suppress fibroblast hyperactivity and TGF-β expression, reducing the likelihood of regrowth [19,20]. In contrast, recurrence after surgical excision remains high, often exceeding 45–50% in some series, unless combined with adjuvant therapy such as postoperative steroid injection, pressure therapy, or radiotherapy [21].

The adverse event profile was consistent with the known pharmacological effects of corticosteroids. Skin atrophy occurred exclusively in the triamcinolone group (11.8%, p = 0.002), a rate comparable to previously reported figures of 8–15% [22]. Hypopigmentation and telangiectasia were observed but did not reach statistical significance. On the other hand, wound-related complications such as infection (5.9%) and dehiscence (4.4%) were unique to the surgical group, reflecting the inherent risks of operative intervention.

Finally, although the difference did not achieve statistical significance, a greater proportion of patients in the triamcinolone group reported an excellent or good global response (75.0% vs. 67.6%) and higher satisfaction rates (70.6% vs. 63.2%). Patient-reported satisfaction is an important outcome measure in scar management, as psychosocial distress from visible scarring can significantly impact quality of life [23,24].

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Conclusion

Taken together, our findings support intralesional triamcinolone as an effective, minimally invasive, office-based treatment with superior scar remodeling, lower recurrence, and better symptomatic relief compared to surgical excision. However, its use should be balanced against the risk of local steroid-related adverse effects, which can be minimized by appropriate dosing, spacing of injections, and patient counseling.

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