RESEARCH PAPER

Surgical Excision Alone Versus Excision with Adjuvant Steroid Therapy in Recurrent Keloids: A Comparative Outcome Study

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ABSTRACT

Background: Keloids are challenging fibroproliferative disorders with high recurrence rates following surgical excision. This study compared outcomes of surgical excision alone versus excision with adjuvant intralesional triamcinolone acetonide therapy in recurrent keloids.

Methods: This retrospective study reviewed medical records of 40 patients with recurrent keloids treated between January 2023 and December 2023. Patients were divided into two groups based on treatment received: Group A (n=20) underwent surgical excision alone, while Group B (n=20) received excision with adjuvant intralesional triamcinolone acetonide. Data on Vancouver Scar Scale (VSS), recurrence rates, symptom scores, and patient satisfaction were retrospectively extracted and analyzed over a 12-month follow-up period.

Results: The recurrence rate was significantly lower in Group B (20%) compared to Group A (65%) ($p=0.004$). Group B demonstrated greater VSS improvement (5.8 vs 2.2 points, $p<0.001$), superior symptom relief, and higher patient satisfaction.

Conclusion: Surgical excision combined with adjuvant intralesional triamcinolone acetonide significantly reduces recurrence rates and improves clinical outcomes in recurrent keloids.

Keywords: Keloid, Recurrence, Surgical excision, Triamcinolone acetonide, Adjuvant therapy

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INTRODUCTION

Keloids represent a significant clinical challenge in dermatology and plastic surgery, characterized by aberrant fibroproliferative responses that extend beyond the original wound boundaries [1]. Unlike hypertrophic scars, which remain confined within the wound margins and may spontaneously regress over time, keloids demonstrate persistent growth and exhibit a notorious tendency to recur following treatment [2,3]. The global prevalence of keloids varies substantially across ethnic populations, with higher incidence observed in individuals of African, Asian, and Hispanic descent, where rates may reach 5-15% of wounds compared to less than 1% in Caucasian populations [4,5].

The pathophysiology of keloid formation involves a complex interplay between genetic predisposition, immune dysregulation, and aberrant wound healing mechanisms [6]. At the cellular level, keloid fibroblasts exhibit enhanced proliferative capacity, reduced apoptotic rates, and excessive production of extracellular matrix components, particularly types I and III collagen [7,8]. The transforming growth factor-beta (TGF-β) signaling pathway plays a central role in this process, with keloid fibroblasts demonstrating heightened sensitivity to TGF-β1 and TGF-β2 stimulation, resulting in upregulated collagen synthesis and increased fibronectin production [9,10]. Additional molecular pathways implicated in keloidogenesis include the JAK/STAT, MAPK, and PI3K/Akt/mTOR signaling cascades, all of which contribute to sustained fibroblast activation and matrix deposition [11].

Clinical management of keloids remains challenging due to the high recurrence rates associated with most treatment modalities [12]. Various therapeutic approaches have been employed, including intralesional corticosteroid injections, silicone gel sheets, pressure

therapy, cryotherapy, radiation therapy, laser treatment, and surgical excision [13,14]. Surgical excision as a standalone treatment carries recurrence rates ranging from 45% to 100%, primarily attributed to the inflammatory response triggered by the surgical trauma itself, which may perpetuate the fibrotic cascade [15,16]. This limitation has prompted the development of multimodal treatment strategies combining surgery with adjuvant therapies.

Intralesional corticosteroid injection, particularly with triamcinolone acetonide (TAC), represents the most widely utilized first-line treatment for keloids [17,18]. Corticosteroids exert their therapeutic effects through multiple mechanisms, including suppression of inflammation via inhibition of leukocyte and monocyte migration, potent vasoconstriction that reduces oxygen and nutrient delivery to the wound bed, and direct antimitotic effects on fibroblasts [19,20]. At the molecular level, corticosteroids downregulate TGF-β1 expression, suppress procollagen type I and III mRNA levels, and promote collagen degradation through reduction of collagenase inhibitors [21,22].

When combined with surgical excision, adjuvant corticosteroid injection has been reported to reduce recurrence rates to below 50% in several studies [23,24]. Recent systematic reviews have suggested that postoperative steroid injection may be more effective than pre- or intraoperative administration in preventing keloid recurrence [25]. However, the existing literature presents considerable heterogeneity in study designs, patient populations, treatment protocols, and outcome measures, making direct comparisons difficult [26,27]. Recurrent keloids pose a particularly difficult therapeutic challenge, as they often develop at sites of previous keloid excision and may be more resistant to treatment than primary lesions [28,29]. This retrospective study was conducted to compare the outcomes of surgical excision alone versus surgical excision combined with adjuvant intralesional triamcinolone acetonide therapy in patients with recurrent keloids, with the primary objective of evaluating recurrence rates, symptom improvement, and overall treatment response over a 12-month follow-up period [30].

MATERIALS AND METHODS

Study Design and Setting

This retrospective comparative study was conducted at Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam. Medical records of patients who underwent keloid excision between January 2023 and December 2023 were retrospectively reviewed. The study protocol was approved by the Institutional Ethics Committee ref. no. IHEC-I/080/01/2026 and conducted in accordance with the principles of the Declaration of Helsinki [31]. Due to the retrospective nature of the study, the requirement for written informed consent was waived, though patient confidentiality was strictly maintained throughout the research process. Data were extracted from electronic medical records, operative notes, outpatient follow-up records, and clinical photographs using a standardized data collection form.

Patient Selection

A retrospective chart review identified 40 patients with recurrent keloids who underwent treatment during the study period and met the inclusion criteria. Patients were categorized into two groups based on the treatment modality documented in their medical records: Group A (n=20) comprised patients who had undergone surgical excision alone, while Group B (n=20) included patients who had received surgical excision combined with adjuvant intralesional triamcinolone acetonide (TAC) injection. Treatment allocation had been determined at the time of initial consultation based on patient preference and surgeon recommendation after counseling regarding treatment options.

Inclusion criteria: age between 18 and 60 years; clinically diagnosed recurrent keloid, defined as keloid recurrence at a site of previous keloid excision; keloid size amenable to complete surgical excision; minimum follow-up duration of 12 months; and complete medical records available for review [32]. Exclusion criteria: primary keloids without history of previous excision; concurrent use of other keloid treatments during the study period; history of keloid radiation therapy within the past 12 months; pregnancy or lactation; known hypersensitivity to triamcinolone acetonide; active infection at the keloid site; systemic connective tissue disorders; or immunocompromised states [33].

Preoperative Assessment

Preoperative data were retrospectively extracted from medical records, which documented comprehensive evaluations including detailed medical history, physical examination findings, and photographic documentation. Keloid characteristics recorded in the charts included anatomical location, maximum diameter measured in two perpendicular planes, surface area calculated using digital planimetry, duration since recurrence, number of

previous excisions, and previous treatments received [34]. The Vancouver Scar Scale (VSS) scores documented at each visit were extracted, which evaluated four parameters: vascularity (0-3), pigmentation (0-3), pliability (0-5), and height (0-3), with total scores ranging from 0 to 14 [35]. Subjective symptom scores including pain, pruritus, and functional limitation assessed using a visual analog scale (VAS) ranging from 0 to 10 were also extracted from the records [36].

Surgical Technique

As documented in operative records, all surgical procedures had been performed under local anesthesia (2% lignocaine with 1:200,000 adrenaline) by a single experienced surgeon, which minimized operator variability [37]. The keloid was excised using an intramarginal technique, removing the keloid tissue while preserving a minimal rim of normal-appearing scar tissue at the wound margins. This approach was employed based on evidence suggesting that leaving a small remnant of scar tissue may reduce recurrence rates compared to complete extramarginal excision [38]. Hemostasis was achieved using bipolar electrocautery, and wounds were closed primarily in layers using absorbable 4-0 polyglactin sutures for the dermal layer and non-absorbable 5-0 polypropylene sutures for the epidermis. Wound closure was performed with meticulous attention to minimizing tension, with undermining and advancement flaps utilized when necessary [39]. Sutures were removed at 10-14 days postoperatively based on wound healing assessment. Patients were advised to avoid strenuous physical activity for four weeks postoperatively.

Adjuvant Steroid Protocol

According to treatment records, Group B patients had received TAC injections (10-40 mg/mL) starting two weeks postoperatively, then at four-week intervals for five sessions [40-43]. Injection volume documented ranged from 0.1-0.5 mL per linear centimeter, not exceeding 40 mg per session.

Outcomes

Primary outcome was keloid recurrence at 12 months post-surgery, retrospectively determined from follow-up records and defined as scar extension beyond wound margins, VSS height ≥3, or increased VSS from 3-month assessment [45]. Secondary outcomes extracted from medical records included VSS improvement, symptom relief scores, patient satisfaction ratings (5-point Likert scale), and documented complications [46].

Statistical Analysis

Analysis used SPSS version 25.0. Continuous variables: mean ± SD; categorical: frequencies/percentages. Between-group comparisons: independent t-test or Mann-Whitney U test; categorical: chi-square or Fisher's exact test. $P<0.05$ was significant [47,48].

RESULTS

Baseline Characteristics

Medical records of forty patients meeting inclusion criteria were analyzed (20 per group). Mean age at the time of surgery was 32.4±8.7 years in Group A and 30.8±9.2 years in Group B (p=0.572). Females comprised 65% of Group A and 60% of Group B (p=0.744). No significant baseline differences were observed between groups.

Table 1: Baseline Characteristics

Parameter	Group A (n=20)	Group B (n=20)	p-value
Age (years)	32.4 ± 8.7	30.8 ± 9.2	0.572
Female, n (%)	13 (65%)	12 (60%)	0.744
Keloid size (cm²)	4.2 ± 2.8	4.6 ± 3.1	0.664
Earlobe location, n (%)	7 (35%)	8 (40%)	0.823
Baseline VSS	9.3 ± 2.1	9.6 ± 2.3	0.668

VSS: Vancouver Scar Scale

Primary Outcome: Recurrence

Recurrence at 12 months: Group A 65% (n=13), Group B 20% (n=4) (p=0.004). Relative risk 3.25 (95% CI: 1.31-8.07).

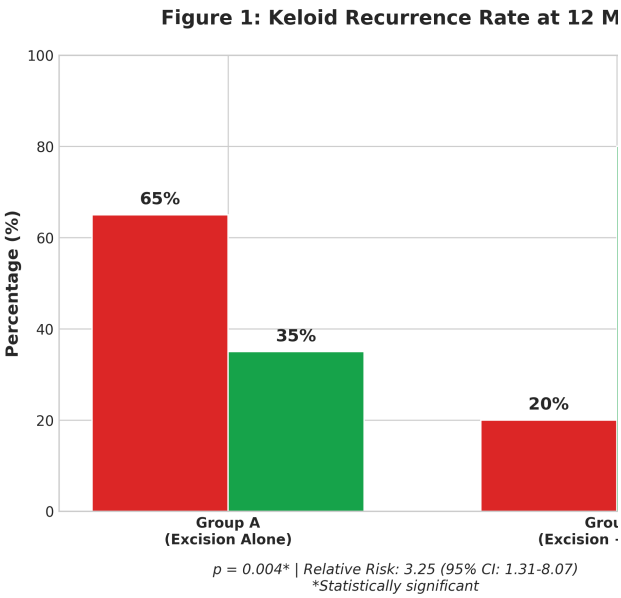

Figure 1 - Bar chart comparing recurrence rates

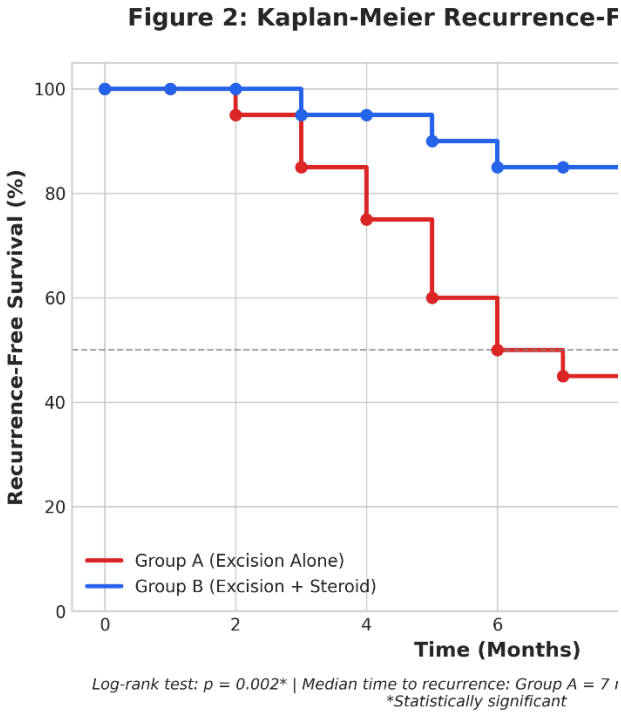

Figure 2 - Kaplan-Meier curve

Table 2: Recurrence at 12 Months

Outcome	Group A	Group B	p-value
Recurrence, n (%)	13 (65%)	4 (20%)	0.004*
No recurrence, n (%)	7 (35%)	16 (80%)	-

**Statistically significant*

Secondary Outcomes

VSS reduction at 12 months: Group A 2.2±1.5, Group B 5.8±1.8 (p<0.001). Pain VAS reduction: Group A 1.9±1.4, Group B 3.9±1.7 (p<0.001). Patient satisfaction: Group B 3.9±0.9, Group A 2.6±1.2 (p<0.001); 70% satisfied in Group B vs 25% in Group A.

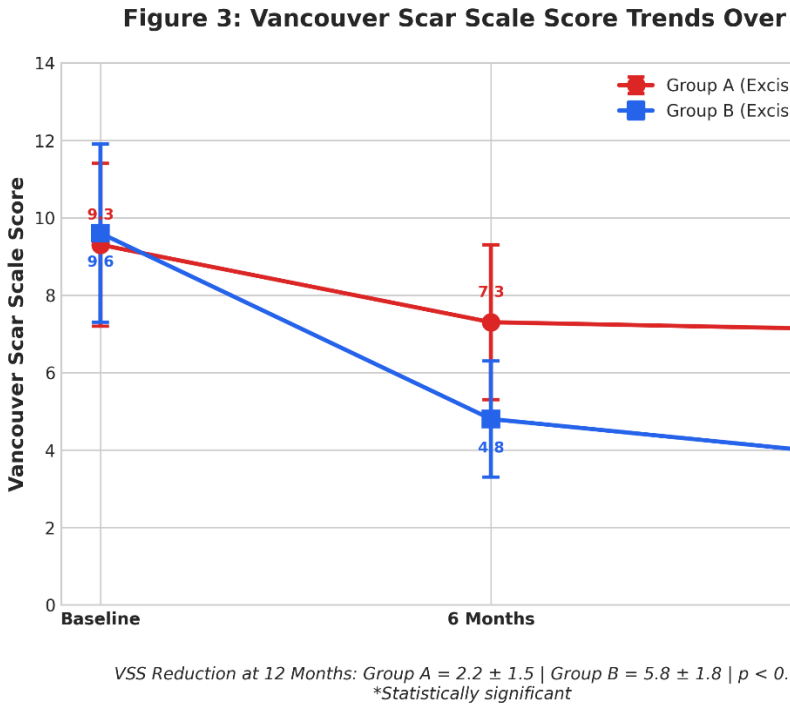

Figure 3 - Line graph of VSS trends

Table 3: VSS Scores During Follow-up

Parameter	Group A	Group B	p-value
VSS at 6 months	7.3 ± 2.0	4.8 ± 1.5	<0.001*
VSS at 12 months	7.1 ± 2.4	3.8 ± 1.3	<0.001*
VSS reduction	2.2 ± 1.5	5.8 ± 1.8	<0.001*

**Statistically significant*

Complications

Overall complications: Group A 15%, Group B 45% (p=0.038). Group B complications were primarily steroid-related: hypopigmentation 15%, skin atrophy 10%, telangiectasia 10%—all mild and self-limiting. Surgical complications were comparable between groups.

Table 4: Complications

Complication	Group A	Group B	p-value

Wound dehiscence	2 (10%)	1 (5%)	1.000
Hypopigmentation	0 (0%)	3 (15%)	0.231
Skin atrophy	0 (0%)	2 (10%)	0.487
Total	3 (15%)	9 (45%)	0.038*

**Statistically significant*

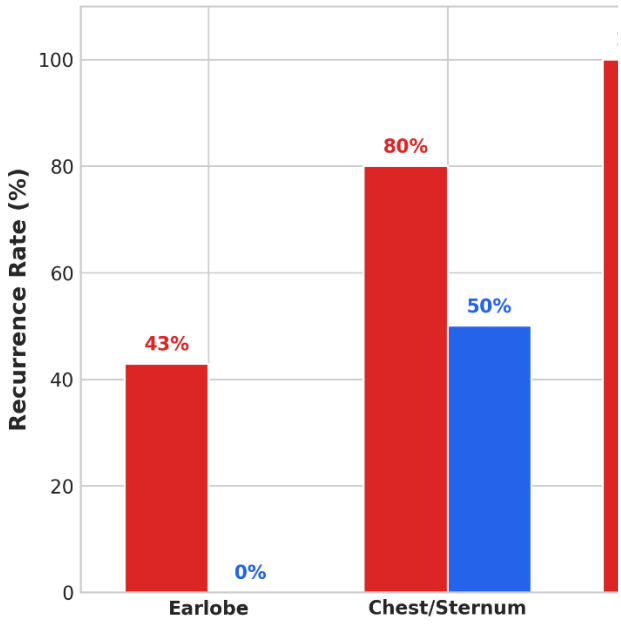

Figure 4: Keloid Recurrence Rate by Anatomical Location

DISCUSSION

This retrospective comparative study demonstrates significantly superior outcomes with surgical excision combined with adjuvant triamcinolone acetonide compared to surgical excision alone for recurrent keloids. Our findings revealed a recurrence rate of 65% in patients treated with surgical excision alone, which aligns closely with previously published literature reporting recurrence rates between 45% and 100% following surgical monotherapy [15,16]. This high recurrence rate underscores the well-established principle that surgical trauma itself can serve as a trigger for keloid formation, initiating the inflammatory cascade that perpetuates fibroblast activation and excessive collagen deposition [49].

In contrast, the addition of postoperative intralesional triamcinolone acetonide significantly reduced the recurrence rate to 20%, representing a relative risk reduction of approximately 69%. This finding is consistent with systematic reviews and meta-analyses demonstrating the superiority of combination therapy over surgical excision alone [50,51]. The mechanism by which adjuvant corticosteroid therapy prevents keloid recurrence involves multiple synergistic pathways. Triamcinolone acetonide exerts potent anti-inflammatory effects by suppressing the migration and phagocytic activity of leukocytes and monocytes, thereby attenuating the inflammatory phase of wound healing critical in keloid pathogenesis [19,20].

Additionally, corticosteroids function as powerful vasoconstrictors, reducing blood flow to the wound bed and limiting the delivery of oxygen and nutrients that support fibroblast proliferation [52]. At the molecular level, triamcinolone acetonide has been shown to downregulate transforming growth factor-beta (TGF-β) signaling, which is recognized as a central driver of keloid formation through its effects on fibroblast proliferation and collagen synthesis [21,22]. The antimitotic effects of corticosteroids directly inhibit fibroblast proliferation and promote apoptosis, while the reduction of collagenase inhibitors facilitates collagen degradation [53].

The timing of postoperative steroid administration appears to be a critical factor in treatment success. In our protocol, the first injection was administered two weeks postoperatively following suture removal, which allowed adequate initial wound healing while intervening early enough to modulate the inflammatory response before excessive scar tissue formation. This approach is supported by recent systematic reviews showing postoperative injection superiority over pre- or intraoperative administration [25].

The significantly greater improvement in Vancouver Scar Scale scores observed in the combination therapy group reflects the multifaceted effects of corticosteroids on scar characteristics. The improvements in vascularity and pigmentation can be attributed to vasoconstriction and anti-inflammatory properties, while enhanced pliability and height reduction result from decreased collagen synthesis and increased collagen breakdown [54]. The mean VSS reduction of 5.8 points in Group B compared to 2.2 points in Group A represents both statistically and clinically meaningful improvement.

Anatomical location influenced outcomes, with earlobe keloids showing the most favorable response (0% recurrence in Group B). This finding is consistent with reports suggesting that earlobe keloids are generally

more amenable to treatment [57,58]. The relatively low mechanical tension on earlobe wounds may contribute to these favorable outcomes. In contrast, chest, sternum, and shoulder keloids showed higher recurrence, attributable to increased mechanical stress at these sites [59].

The higher overall complication rate in the combination therapy group (45% vs 15%) was primarily due to localized, self-limiting steroid-related effects including hypopigmentation, skin atrophy, and telangiectasia. These complications can be minimized through careful injection technique and appropriate dosing [60,61]. Importantly, surgical complication rates were comparable between groups, indicating adjuvant steroid therapy does not compromise wound healing when administered after initial wound closure [62].

This study has several limitations inherent to its retrospective design. Selection bias may have influenced treatment group allocation, as patients were not randomly assigned to treatment arms. Information bias is possible due to reliance on pre-existing medical records, which may have incomplete or inconsistent documentation. The small sample size (n=40) limits statistical power and generalizability. The single-center setting may affect external validity. Additionally, the 12-month follow-up period may not capture late recurrences that can occur years after treatment. The lack of blinding in outcome assessment introduces potential observer bias. Future prospective randomized controlled trials with larger samples, multicenter design, longer follow-up periods, blinded outcome assessment, and standardized objective measurement tools are warranted to confirm these findings [66-69].

CONCLUSION

Surgical excision combined with adjuvant intralesional triamcinolone acetonide yields significantly superior outcomes compared to excision alone in recurrent keloids. The combination therapy demonstrated lower recurrence (20% vs 65%), greater VSS improvement, better symptom control, and higher patient satisfaction over 12 months. Despite higher minor steroid-related complications, the overall therapeutic benefit supports integrating adjuvant corticosteroid injection into standard keloid management protocols.

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