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Original Article

Combination of keloid core excision and triamcinolone acetonide local injection shows significant clinical efficacy in treating auricular keloid

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Abstract: Objectives: To investigate the clinical efficacy of keloid core excision combined with triamcinolone acetonide (TA) local injection for the treatment of auricular keloids. Methods: From May 2019 to November 2021, 86 patients with auricular keloid who met the inclusion criteria were enrolled. Based on treatment modality, they were divided into two groups: a research group (n=43) receiving keloid core excision combined with TA local injection and a control group (n=43) undergoing keloid core excision alone. The clinical efficacy, postoperative adverse reactions, Vancouver Scar Scale (VSS) score 12-Item Pruritus Severity Scale (12-PSS) score, sleep quality, serological indicators, Self-Rating Anxiety Scale (SAS) score, Self-Rating Depression Scale (SDS) score, Short-Form 36-Item Health Survey (SF-36) scores, recurrence rate, and treatment satisfaction were compared between the two groups. Results: The research group showed superior overall clinical efficacy, higher SF-36 scores, fewer total adverse reactions, and better sleep quality compared to the control group. Additionally, the research group had lower VSS, 12-PSS, SAS, and SDS scores, more significant reductions in serological indicators, and a reduced recurrence rate. Conclusions: Keloid core excision combined with TA local injection was more effective than keloid core excision alone in treating auricular keloids, with significantly better clinical efficacy.

Keywords: Keloid core excision, local injection of triamcinolone acetonide, auricular keloids, clinical efficacy, prognosis

Introduction

Auricular keloids are a localized fibrous tissue proliferative disorder of the skin, commonly found in the auricle area. They can be caused by various factors, such as infection during ear piercing, trauma, and surgery [1]. Patients often experience itching, pain, and significant distress, as the disease can severely affect facial appearance and mental health [2]. Due to the absence of a unified and standardized treatment, auricular keloids are usually managed through surgical resection, laser therapy, and local drug injection [3]. Surgical excision is a common treatment that involves the complete removal of keloid tissue; however, it may lead to the formation of new scar or recurrence. Laser therapy targets the keloid tissue more accurately, reducing damage to the surrounding normal tissue, but multiple treatments are often required to achieve the desired effect. Topical injection helps relieve symptoms by directly acting on the keloid tissue, but its efficacy is affected by drug selection and medication methods [4]. Therefore, it is often difficult to achieve the expected therapeutic effect with a single treatment type. To improve the therapeutic efficacy and reduce the risk of recurrence, a combination of multiple treatment methods is often used in clinical practice. Keloid core excision has been shown to reduce wound tension and produce favorable aesthetic results, and its combination with adjuvant therapy has been found to lower the recurrence rate of keloids [5]. Therefore, ongoing exploration and optimization of auricular keloid treatments are crucial for improving efficacy and outcomes.

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Keloid core excision is a surgical treatment to improve the appearance and texture of scars. During the procedure, the central part of the keloid tissue is removed under local anesthesia, aiming at reducing the thickness and hardness of the scar, making it flatter and softer. After the excision, the wound is sutured to promote wound healing and tissue repair. Despite its high efficacy, the recurrence rate is quite high, ranging from 45% to 100%. Intralesional hormone injections remain an effective treatment [1]. Triamcinolone acetonide (TA) is an intermediate-acting glucocorticoid that inhibits inflammatory responses [6]. In response to skin irritation or infection, the body releases a variety of inflammatory mediators that trigger local inflammation. TA inhibits the synthesis and release of these inflammatory mediators, thus alleviating symptoms such as redness, swelling, and itching [7]. Postoperative auricular keloids are often accompanied by abnormal skin hyperplasia, while TA can help reduce the thickness and stiffness of scars, inhibiting excessive skin cell proliferation and preventing excessive scar tissue formation [8]. A mouse model demonstrated a significant reduction in scarring in hypertrophic scars following TA injection, suggesting its potential in scar repair [9].

This study included 86 cases of auricular keloid and analyzed the clinical efficacy of keloid core excision combined with TA local injection in the treatment of auricular keloids to verify the clinical advantages of this combined therapy. To date, there has been a paucity of comparative studies evaluating the clinical outcomes of this combined modality against keloid core excision alone in patients with auricular keloids, highlighting the novelty of this investigation. This study aims to provide a comprehensive analysis, possiblyrefining treatment protocols for auricular keloid patients undergoing keloid core excision. Furthermore, it seeks to establish a robust clinical reference for the efficacy of TA local injection as an adjunctive therapy.

Patients and methods

General data

This retrospective study was approved by the Ethics Committee of The First School of Clinical Medicine, Southern Medical University. A total of 86 patients with auricular keloid admitted to our hospital between May 2019 and November 2021 were included, including 43 cases in the control group receiving keloid core excision alone and 43 cases in the research group receiving keloid core excision with local TA injection.

Eligibility and exclusion criteria

All patients were diagnosed with auricular keloids based on clinical examination and met the diagnostic criteria for keloid [10]. Inclusion criteria: skin damage lasting for more than six months, with persistent hyperplasia, scar redness, congestion, itching, and pain; skin surface showing tumor-like hyperplasia extending beyond the initial lesion and involving surrounding normal skin, exhibiting a tendency to evert and predilection for specific areas; no previous treatment for auricular keloids; with complete medical records and normal communication and cognitive abilities.

Exclusion criteria: patients with wasting diseases such as cancer, tuberculosis, and immunodeficiency; those who did not follow medical advice; and women in lactation, pregnancy, or with a plan to conceive in the short term.

Treatment methods

The control group underwent keloid core excision. Upon admission, each patient underwent a comprehensive examination, including Vancouver Scar Scale (VSS) scoring to evaluate the condition of the keloid. Preoperative analgesia and surgical planning were then tailored to the severity of the patient's condition. All procedures were performed by the same team of physicians and anesthesiologists to ensure consistency and professionalism. Local anesthesia was administered during the operation, with treatment strategies based on the keloid size. For scars greater than or equal to 1 cm in diameter, the inner core was first excised, and a C-shaped incision was made to match the natural anatomy of the ear. After excising the core through the incision, the inner layer was sutured, and the scar flap was moderately preserved, followed by tension-free suture. For scars less than 1 cm in diameter, the inner core was directly removed, and the wound was sutured without the need for a C-shaped incision. Similarly, the scar flap was preserved appropriately, and tension-free suturing was

performed to ensure postoperative healing and aesthetic appearance.

The research group was subjected to TA local injection in addition to the above treatment. TA (Beijing Yita Biotechnology Co., Ltd., YT67122) was injected into the scar site on the third day after suture removal. During injection, the needle was inserted at the junction between the scar and normal skin, with the depth controlled within the dermis layer. The injection was stopped once the scar was slightly raised and the skin color became lighter. Care was taken to avoid injecting the normal skin to prevent potential adverse effects such as skin tissue atrophy and blood vessel dilation. For the keloid size up to 1 cm in diameter, a single-point injection was given, and diagonal injections were given for those between 1.0 cm and 2.0 cm in diameter. The dose of each TA injection was 20-40 milligrams, administered once every 2 weeks, for a total of 4 treatments.

Analysis indexes

(1) Treatment effectiveness was evaluated based on the following criteria: Cured: Pain and itching disappeared, the scar became completely softened and flat, with no induration or protrusion, and no recurrence observed during a 12-month follow-up period after treatment. Markedly effective: Pain and itching disappeared or were obviously alleviated, and the scar area softened and flattened by 60% to 70%; the scar improved from severe to moderate or mild, with no reversal within the 12-month follow-up. Ineffective: Symptoms and signs such as pain, itching, and discoloration persisted without significant improvement, and the texture and size of the scar changed barely or only slightly; Recurrence happened within 12 months after the treatment, although the criteria for cure or marked effectiveness were met during treatment. The total effective rate was the sum of the percentage of cured and markedly effective cases.

(2) Adverse reactions: The complications in both groups during treatment were observed and recorded, mainly including pigmentation, persistent pain, itching, and infection.

(3) Scar recovery: The scars were assessed before and 6 months after surgery using the VSS. The scale contains four dimensions, namely, thickness of the hypertrophic scar (0-4 points), color (0-3 points), vascularity (0-3 points), and pliability (0-5 points), with a total of 15 points. The higher the score, the more serious the scar.

(4) Itching assessment: To evaluate itching, the 12-Item Pruritus Severity Scale (12-PSS) was used before and 6 months after the operation. The scale contains 12 items, with total score ranging from 3 to 22. The score is proportional to the patient's itching degree.

(5) Sleep quality: The sleep duration and frequency of awakenings were recorded for both groups.

(6) Serological indicators: Serum specimens were collected from both patient groups before and after surgery. The concentrations of matrix metalloproteinase 9 (MMP-9) and transforming growth factor-β1 (TGF-β1) were measured using enzyme-linked immunosorbent assay (ELISA), with kits purchased from Hangzhou Multi-Sciences Biotech Co., Ltd. (EK1M09, EK981).

(7) Negative emotions and quality of life: Anxiety and depressive states were assessed using the Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS) before and after surgery. Both scales have a scoring range of 20 to 80 points, with higher scores indicating more severe anxiety or depression. Additionally, quality of life was evaluated using the Short-Form 36-item Health Survey (SF-36), with scores ranging from 0 to 100. Higher scores indicate better quality of life.

(8) Prognostic recurrence rate: Telephone follow-up and outpatient reviews were conducted for 12 months after the end of treatment. Recurrence was defined as the continuous expansion of keloid tissue compared to the condition at the end of treatment, along with worsening self-perceived symptoms such as ear pain and itching. The 12-month recurrence rate in both groups was statistically analyzed.

(9) Treatment satisfaction: Treatment satisfaction was assessed by patient self-report. The evaluation results were classified into three categories: highly satisfied, satisfied, and dissatisfied. The treatment satisfaction rate was calculated as the percentage of patients who were either highly satisfied or satisfied, using the following formula: treatment satisfaction rate = (number of highly satisfied + number of satisfied)/Total number of patients ×100%.

Table 1. Comparison of baseline data between the two groups

Indicator	Research group (n=43)	Control group (n=43)	χ^2/t	P
Age (years)	30.58±3.61	30.72±3.33	0.187	0.852
Disease course (years)	2.34±0.89	2.67±1.02	1.599	0.114
Body mass (kg)	60.75±6.49	60.09±7.01	0.453	0.652
Keloid diameter (cm)	2.35±0.61	2.44±0.59	0.695	0.489
Cause of keloid formation			1.412	0.494
Ear piercing	24 (55.81)	21 (48.84)		
Burns	8 (18.60)	6 (13.95)		
Infection	11 (25.58)	16 (37.21)		
Keloid position			0.221	0.639
Earlobe	29 (67.44)	31 (72.09)		
Helix	14 (32.56)	12 (27.91)		

Table 2. Comparison of clinical efficacy between the two groups

Indicator	Research group (n=43)	Control group (n=43)	χ^2	P
Cured	32 (74.42)	12 (27.91)		
Markedly effective	9 (20.93)	21 (48.84)		
Ineffective	2 (4.65)	10 (23.26)		
Total effective rate	41 (95.35)	33 (76.74)	6.198	0.013

Statistical processing

Quantitative data were expressed as (Mean ± Standard Error of the Mean (SEM)). Comparisons between the two groups of continuous data were made using an independent-samples t-test, and comparisons before and after treatment were made using a paired t-test. Categorical data were expressed as percentages, and the χ^2 test was used to assess differences between the two groups. All statistical analyses were performed using SPSS 22.0 software. A *P*-value of <0.05 was considered significant.

Results

Comparative analysis of patients' general data

No notable differences were observed between the two patient cohorts in general information, indicating comparability. Specifically, the research and control groups were similar in age, disease course, body weight, and keloid characteristics (e.g., diameter, cause, and location) (all P>0.05, **Table 1**).

Comparative analysis of clinical efficacy

The total effective rate was 76.74% in the control group and 95.35% in the research group, showing markedly higher clinical efficacy in the research group (P<0.05, **Table 2**).

Comparative analysis of postoperative adverse reactions

Postoperative adverse reactions, including pigmentation, persistent pain, itching, and infection, were recorded for both groups. The overall incidence of adverse reactions was 2.33% in the research group, significantly lower than the 25.58% observed in the control group (P<0.05, **Table 3**).

Comparative analysis of VSS scores before and 6 months after the operation

The VSS score was similar between the research and control groups before operation (P>0.05), but it significantly decreased 6 months post-surgery (P<0.05), with a significantly lower score in the research group compared with the control group (P<0.05, **Figure 1**).

Comparative analysis of 12-PSS scores before and 6 months after the operation

Pre-treatment 12-PSS scores were similar between the two groups (P>0.05). However, the 12-PSS score decreased significantly six months after surgery (P<0.05), with a more pro-

Table 3. Comparison of postoperative adverse reactions between the two groups

Indicator	Research group (n=43)	Control group (n=43)	χ^2	P
Pigmentation	1 (2.33)	2 (4.65)		
Persistent pain	0 (0.00)	2 (4.65)		
Itching	0 (0.00)	4 (9.30)		
Infection	0 (0.00)	3 (6.98)		
Total	1 (2.33)	11 (25.58)	9.685	0.002

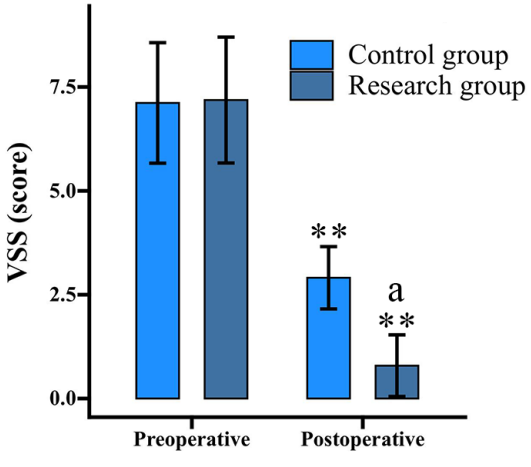

Figure 1. Comparison of VSS scores between the two groups before and after treatment. Note: VSS, Vancouver Scar Scale; **P<0.01 *vs.* before treatment; [a]P<0.05 *vs.* control.

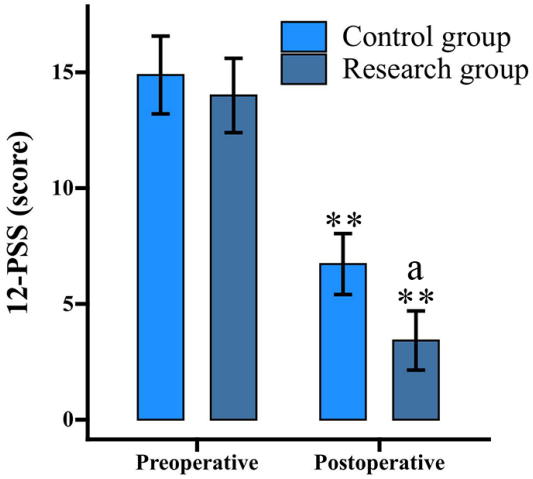

Figure 2. Comparison of 12-PSS scores between the two groups before and after treatment. Note: 12-PSS, 12-Item Pruritus Severity Scale; **P<0.01 *vs.* before treatment; [a]P<0.05 *vs.* control.

nounced reduction observed in the research group (P<0.05, **Figure 2**).

Comparative analysis of sleep quality

Sleep quality was evaluated by assessing sleep duration and frequency of awakenings before and after treatment. No significant inter-group differences were observed in either sleep duration or frequency of awakenings before treatment (P>0.05). Both groups showed prolonged sleep duration and reduced awakenings after treatment. The research group had a significantly longer sleep duration and fewer awakenings compared to the control group (P<0.05, **Figure 3**).

Comparative analysis of serological indicators

Serological markers, specifically MMP-9 and TGF-β1, were assessed in both groups before and after treatment. Prior to treatment, no significant differences in MMP-9 and TGF-β1 levels were observed between the two groups (P>0.05). After treatment, a significant downward trend in the levels of both MMP-9 and TGF-β1 was evident in both groups (P<0.05). Notably, when compared to the control group, the research group exhibited lower levels of MMP-9 and TGF-β1 (P<0.05), as shown in **Table 4**.

Comparative analysis of negative emotions and quality of life

The SDS, SAS, and SF-36 scales were used to assess the negative emotions and quality of life of the two groups before and after treatment. Before surgery, no significant discrepancies were observed in the SDS, SAS, or SF-6 scores between the two groups (P>0.05). Postoperatively, both groups showed a notable decrease in the SDS and SAS scores, along with a significant increase in the SF-36 scores (P<0.05). Furthermore, when compared to the control group, the research group demonstrated significantly lower SDS and SAS scores and a statistically higher SF-36 score than the control group (P<0.05), as shown in **Table 5**.

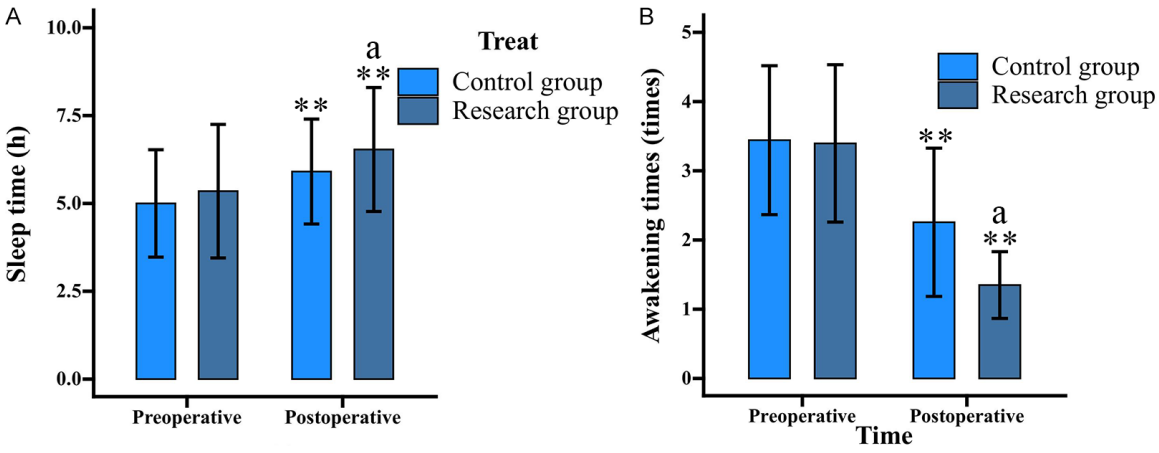

Figure 3. Comparison of the sleep duration and awakenings from sleep between the two groups before and after treatment. A. Sleep duration before and after treatment. B. Frequency of awakenings from sleep before and after treatment. Note: **P<0.01 *vs.* before treatment; aP<0.05 *vs.* control.

Table 4. Comparison of serological indicators between the two groups

Indicator	Research group (n=43)	Control group (n=43)	t	P
MMP-9 (ng/mL)				
Before surgery	67.67±11.35	68.49±10.21	0.352	0.726
After surgery	30.93±7.85**	39.02±8.03**	4.724	<0.001
TGF-β1 (ng/L)				
Before surgery	420.44±37.39	422.95±29.81	0.344	0.732
After surgery	298.07±23.46**	346.93±20.89**	10.200	<0.001

Note: MMP-9, matrix metalloproteinase 9; TGF-β1, transforming growth factor-β1. **P<0.01 *vs.* before treatment.

Table 5. Comparison of negative emotions and quality of life between the two groups

Indicator	Control group (n=43)	Control group (n=43)	t	P
SDS (points)				
Before surgery	56.30±6.46	55.67±8.09	0.399	0.691
After surgery	43.84±7.80**	50.40±6.12**	4.339	<0.001
SAS (points)				
Before surgery	57.00±8.36	57.40±8.90	0.215	0.830
After surgery	45.21±6.66**	52.95±8.15**	4.822	<0.001
SF-36 (points)				
Before surgery	49.65±9.31	51.00±7.84	0.727	0.469
After surgery	67.21±7.19**	62.56±6.35**	3.179	0.002

Note: SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale; SF-36, Short-Form 36-item Health Survey. **P<0.01 *vs.* before treatment.

Comparative analysis of prognostic recurrence

Both groups of patients were followed up for 12 months to assess the recurrence rate, revealing a recurrence rate of 2.33% in the research group and 20.93% in the control group (P<0.05), as shown in **Table 6**.

Comparative analysis of treatment satisfaction

The overall treatment satisfaction rate was 90.70% in the research group, significantly higher than the 74.42% in the control group (P<0.05, **Table 7**).

Discussion

Auricular keloids are a common clinical condition that usually results from perforated ear injuries (e.g., piercings) that have not been properly disinfected or other improperly treated injuries [11]. Current treatment guidelines recommend surgical excision in combination with intralesional injections or radiation therapy to manage keloids [12]. However, due to the small area and unique location of auricular keloids, there are certain risks associated with radiation therapy [13]. Therefore, a combination of surgery and medical therapy is increasingly used in clinical practice to manage auricular keloids [14]. This study aims to explore the

Table 6. Comparison of prognostic recurrence rate between the two groups

Indicator	Research group (n=43)	Control group (n=43)	χ^2	P
Recurrence	1 (2.33)	9 (20.93)		
No recurrence	42 (97.67)	34 (79.07)		
Recurrence rate (%)	2.33%	20.93%	7.242	0.007

Table 7. Comparison of treatment satisfaction between the two groups

Indicator	Research group (n=43)	Control group (n=43)	χ^2	P
Highly satisfied	30 (69.77)	20 (46.51)		
Satisfied	9 (20.93)	12 (27.91)		
Dissatisfied	4 (9.30)	11 (25.58)		
Satisfaction	39 (90.70)	32 (74.42)	3.957	0.047

advantages of combining keloid core excision with TA local injection, providing valuable clinical evidence for this treatment approach.

Surgery remains one of the primary treatments for keloids, focusing on removing scar tissue as completely as possible without affecting the shape or size of the ear and preventing re-hyperplasia [15]. However, post-surgical wound coverage and repair are challenging, as improper repair may lead to deformation of the pinna and earlobes [16]. In clinical practice, it is often difficult to achieve ideal results with a single surgical treatment, necessitating the use of additional treatment methods [17]. TA, a synthetic glucocorticoid, suppresses fibroblast proliferation, reduces collagenase inhibitors, increases collagenase activity, and promotes collagen degradation by lowering platelet-derived growth factor genes. Additionally, TA inhibits procollagen gene expression and protein synthesis, resulting in softening and flattening of scars [18]. TA is a well-known long-term therapy for keloids, which can be used as a monotherapy immediately after surgery to reduce the likelihood of keloid recurrence [19]. Given the challenges in wound coverage and repair following keloid excision, this study hypothesized that adjunctive TA treatment after keloid excision can optimize therapeutic outcomes for patients with auricular keloids.

In our study, the total effective rate of the research group was 95.35%, significantly higher than the 76.74% observed in the control group. This demonstrates a substantial advantage of combining keloid core excision with TA local injection in enhancing therapeutic efficacy. In a study by Sun Q et al. [20], a combination of individualized surgery, radiotherapy, and TA injection yielded a success rate of 87.61% in treating auricular keloids, suggesting that the therapeutic efficacy observed in our study may offer even greater clinical benefits.

Previous research has shown that TA can effectively improve the color and texture of scars and reduce scar thickness in patients with burn hypertrophic scars [21]. TA has also been shown to inhibit the proliferation of hypertrophic scar fibroblasts, promote their apoptosis, and reduce the degree of dermal fibrosis, thus effectively preventing excessive scar hyperplasia [22]. These findings may help explain the potential mechanism of surgery combined with TA local injection in inhibiting fibroblast proliferation and delaying granulation tissue generation [23].

Furthermore, we found a lower rate of total adverse reactions in the research group compared to the control group (2.33% vs. 25.58%), indicating that TA local injection may help reduce inflammatory cell aggregation in scar tissue, reduce inflammatory stimulation, and inhibit fibroblast proliferation and collagen synthase activity. These effects contribute to a reduction in adverse reactions such as pigmentation, persistent pain, itching, and infection in patients with auricular keloids after surgery. Ultimately, this enhances the quality of postoperative scar healing, alleviates patient discomfort, and improves treatment effectiveness.

To better identify the risk factors for keloid development and evaluate treatment effectiveness, we used the VSS scale, which provides an objective reflection of the thickness, soft-

ness, color and vascularity. This scoring system is known for its high reliability and validity, making it a widely used tool in clinical practice. It is easy to apply, allowing doctors to objectively evaluate the condition of scars through simple observation [24]. The VSS score showed a significant decrease 6 months after surgery, with the research group demonstrating even lower scores than the control group, indicating that TA local injection after keloid core excision can effectively promote scar resolution, mitigate clinical symptoms, and effectively reduce scar thickness. Six months after surgery, both groups showed a marked decrease in 12-PSS score, especially in the research group, indicating that TA local injection following surgery helps to prevent the inflammatory response, thereby reducing itching at the wound site. These findings collectively underscore the beneficial role of local TA injection after keloid core excision in promoting symptom relief and improving patient outcome.

Wound itching can negatively affect patients' quality of life, leading to disrupted sleep and increasing anxiety and depression [25]. Sleep quality results indicated that both groups experienced longer sleep duration and fewer awakenings after intervention, with even longer sleep duration and fewer awakenings in the research group. This suggests that additional TA injection effectively reduced postoperative adverse reactions and improved sleep quality, which may aid in scar recovery. Supporting this, Mintz et al. [26] reported that TA significantly enhanced sleep quality in patients with nocturnal rhinitis, which aligns with our observations.

Furthermore, local injection of TA following keloid core excision effectively downregulated the abnormally elevated serological markers such as MMP-9 and TGF-β1. This finding may give insight into the therapeutic mechanism of TA in treating keloids. Specifically, TA suppresses the synthesis of type I and type III collagens and the proliferation of keloid fibroblasts by effectively curtailing the release of MMP-9 and TGF-β1, both of which mediate the pathophysiologic processes of keloids. This suppression aids in collagen degradation and promotes fibroblast degeneration and necrosis within keloids [27, 28]. Furthermore, prior research has demonstrated that TA may modulate TGF-β signaling in fibrosis associated with idiopathic carpal tunnel syndrome and significantly reduce plasma MMP-9 levels in diabetic patients [29]. Additionally, an *in vivo* study corroborated these findings, showing that TA effectively suppresses MMP-9 gene expression in human retinal pigment epithelial cells [30].

Moreover, our findings indicate that the combination of keloid core excision and local TA injection for auricular keloids can markedly alleviate patients' anxiety and depression while significantly enhancing their quality of life. Similarly, Karaulov et al. [31] documented that TA significantly improved overall quality of life in patients with allergic rhinitis, aligning with the positive outcomes observed in our study. This may be ascribed to the pronounced efficacy of this therapeutic approach. Following the adoption of this treatment modality, patients experience a notable alleviation of clinical symptoms, including milder scarring, reduced itching, and enhanced sleep quality. These multifaceted improvements contribute to a reduction of the psychological burden associated with the disease and ultimately enhance the patients' overall quality of life.

Excessive keloid area is one of the key factors for recurrence, as the incision area from surgical sutures also increases accordingly [32]. Research has shown that local injection of TA can reduce intercellular adhesion, inhibit scar contracture, and eliminate the possibility of scar re-hyperplasia and recurrence by cleaving the wound matrix [33]. This is similar to the findings of our study, which revealed a lower recurrence rate in the research group compared to the control group during the 12-month follow-up. Through in-depth analysis, we observed that TA local injection after surgery effectively reduced scarring, improved scar elasticity, and reduced scar thickness, erythema, and pigmentation during treatment [34]. By stabilizing the granular membrane of mast cells, TA prevents the release of histamine and other stimulants, thus reducing tissue congestion, cellular reactions, and fluid exudation. This inhibition helps prevent the formation of granulation tissue and excessive scar growth during the healing process. In addition, TA is absorbed slowly after local injection, with a long duration of action, which further reduces the risk of postoperative recurrence [35]. A meta-analysis by Shin et al. [17] reported a recurrence rate of 15.4% for auricular keloids treated with TA

combined with surgical excision, which is higher than the recurrence rate observed in our study. This further highlights the benefits of our combined approach.

Finally, our findings indicated that the combination of keloid core excision and local TA injection for auricular keloids can markedly elevate patients' treatment satisfaction. This can be attributed to the pronounced clinical superiority of this combined approach.

This study had several limitations that warrant further refinement. First, the factors influencing prognostic recurrence were not explored in-depth, and future research should include supplementary analyses to provide more targeted clinical guidance for recurrence prevention. Second, a comparison between delayed TA injection and immediate postoperative TA injection was not conducted. Addressing this gap may provide valuable insight and more reliable guidance for clinical practice. Third, the lack of long-term follow-up data over 3-5 year limits the ability to assess the long-term prognosis of the two treatment modalities. Incorporating extended follow-up observations would provide a more thorough understanding of their long-term efficacy and clinical outcomes. In future studies, we aim to address these limitations systematically to strengthen the robustness and clinical applicability of our findings.

In summary, keloid core excision combined with local TA injection for auricular keloids demonstrates distinct clinical advantages. Specifically, this approach enhances therapeutic efficacy, prevents adverse reactions, and improves sleep quality, overall quality of life, and overall treatment satisfaction. Moreover, it markedly mitigates negative emotions, lowers MMP-9 and TGF-β1 levels, and reduces the risk of recurrence, highlighting its promising potential for clinical use.

Disclosure of conflict of interest

None.

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References

[1] Zuber TJ and DeWitt DE. Earlobe keloids. Am Fam Physician 1994; 49: 1835-1841.
[2] O'Brien L and Pandit A. Silicon gel sheeting for preventing and treating hypertrophic and keloid scars. Cochrane Database Syst Rev 2006; CD003826.
[3] Cohen AJ, Talasila S, Lazarevic B, Banner L, Gleason L, Malkani K, Uitto J and Nikbakht N. Combination cryotherapy and intralesional corticosteroid versus steroid monotherapy in the treatment of keloids. J Cosmet Dermatol 2023; 22: 932-936.
[4] Yin Q, Niessen FB, Gibbs S, Lapid O, Louter JMI, van Zuijlen PPM and Wolkerstorfer A. Intralesional corticosteroid administration in the treatment of keloids: a survey among Dutch dermatologists and plastic surgeons. J Dermatolog Treat 2023; 34: 2159308.
[5] Kurup S, Travis TE, Shafy RAE, Shupp JW and Carney BC. Treatment of burn hypertrophic scar with fractional ablative laser-assisted drug delivery can decrease levels of hyperpigmentation. Lasers Surg Med 2023; 55: 471-479.
[6] Zhang Z, Cheng L, Wang R, Cen Y and Li Z. Effects and safety of triamcinolone acetonide-controlled common therapy in keloid treatment: a Bayesian network meta-analysis. Ther Clin Risk Manag 2018; 14: 973-980.
[7] Wong TS, Li JZ, Chen S, Chan JY and Gao W. The efficacy of triamcinolone acetonide in keloid treatment: a systematic review and meta-analysis. Front Med (Lausanne) 2016; 3: 71.
[8] Lubov JE, Rohan CA, Travers JB, Hill MJ and Aranda A. Stellate hypopigmentation in a pediatric patient after treatment with intralesionally-injected corticosteroid. Am J Case Rep 2022; 23: e935898.
[9] Wu Z, Huang D, Xie J, Li M, Chen P and Yu Z. Triamcinolone acetonide suppressed scar formation in mice and human hypertrophic scar fibroblasts in a dose-dependent manner. Cell Mol Biol (Noisy-le-grand) 2023; 69: 226-231.
[10] Mankowski P, Kanevsky J, Tomlinson J, Dyachenko A and Luc M. Optimizing radiotherapy for keloids: a meta-analysis systematic review comparing recurrence rates between different radiation modalities. Ann Plast Surg 2017; 78: 403-411.
[11] Guo P, Pan B, Jiang H, Yang Q and Lin L. Burned ear reconstruction using the combination of an expanded postauricular scar skin flap and a postauricular fascial flap. Facial Plast Surg 2021; 37: 354-359.
[12] Watson D and Panuganti B. Treating scars in the auricle region. Facial Plast Surg Clin North Am 2017; 25: 73-81.

[13] Mohamed R, Elawadi AA, Al-Gendi R, Al-Mohsen S, Wani S and Wafa A. The outcome of postoperative radiation therapy following plastic surgical resection of recurrent ear keloid: a single institution experience. J Egypt Natl Canc Inst 2022; 34: 4.
[14] Mohammadi AA, Kardeh S, Motazedian GR and Soheil S. Management of ear keloids using surgical excision combined with postoperative steroid injections. World J Plast Surg 2019; 8: 338-344.
[15] Dolivo D, Rodrigues A, Sun L, Hou C, Li Y, Chung E, Leung K, Galiano R, Mustoe T and Hong SJ. Simvastatin cream alleviates dermal fibrosis in a rabbit ear hypertrophic scar model. J Cosmet Dermatol 2023; 22: 534-541.
[16] Shockman S, Paghdal KV and Cohen G. Medical and surgical management of keloids: a review. J Drugs Dermatol 2010; 9: 1249-1257.
[17] Shin JY, Lee JW, Roh SG, Lee NH and Yang KM. A comparison of the effectiveness of triamcinolone and radiation therapy for ear keloids after surgical excision: a systematic review and meta-analysis. Plast Reconstr Surg 2016; 137: 1718-1725.
[18] Shahinfar S and Maibach H. Enigma of intramuscular triamcinolone acetonide (Kenalog®) efficacy. Clin Pharmacokinet 2023; 62: 1189-1199.
[19] Camacho-Martinez FM, Rey ER, Serrano FC and Wagner A. Results of a combination of bleomycin and triamcinolone acetonide in the treatment of keloids and hypertrophic scars. An Bras Dermatol 2013; 88: 387-394.
[20] Sun Q, Yu ET, Zhou Y, Tong S, Zhou KJ and Guo S. Individualized surgery combined with radiotherapy and triamcinolone acetonide injection for the treatment of auricular keloids. BMC Surg 2021; 21: 256.
[21] Ma CM, Cai JL, Niu FY, Zong XL, Chen Y and Liu LB. Skin needle roller importing triamcinolone acetonide into scar to treat hypertrophic scars. Zhonghua Zheng Xing Wai Ke Za Zhi 2012; 28: 185-189.
[22] Qin Z, Chen F, Chen D, Wang Y, Tan Y and Ban J. Transdermal permeability of triamcinolone acetonide lipid nanoparticles. Int J Nanomedicine 2019; 14: 2485-2495.
[23] Cho MY, Song A, Chung KY and Roh MR. A novel method of steroid delivery to improve the efficacy of intralesional injection in keloid treatment. Dermatol Surg 2022; 48: 631-635.
[24] Thompson CM, Sood RF, Honari S, Carrougher GJ and Gibran NS. What score on the Vancouver Scar Scale constitutes a hypertrophic scar? Results from a survey of North American burn-care providers. Burns 2015; 41: 1442-1448.
[25] Jia X, Huang L and Hu J. A rare symptom of secondary infection after facial thread lift and its treatment. J Craniofac Surg 2023; 34: e204-e205.
[26] Mintz M, Garcia J, Diener P, Liao Y, Dupclay L and Georges G. Triamcinolone acetonide aqueous nasal spray improves nocturnal rhinitis-related quality of life in patients treated in a primary care setting: the quality of sleep in allergic rhinitis study. Ann Allergy Asthma Immunol 2004; 92: 255-261.
[27] Bran GM, Goessler UR, Baftiri A, Hormann K, Riedel F and Sadick H. Effect of transforming growth factor-beta1 antisense oligonucleotides on matrix metalloproteinases and their inhibitors in keloid fibroblasts. Otolaryngol Head Neck Surg 2010; 143: 66-71.
[28] Lee DE, Trowbridge RM, Ayoub NT and Agrawal DK. High-mobility group box protein-1, matrix metalloproteinases, and vitamin D in keloids and hypertrophic scars. Plast Reconstr Surg Glob Open 2015; 3: e425.
[29] Yang TH, Gingery A, Thoreson AR, Larson DR, Zhao C and Amadio PC. Triamcinolone acetonide affects TGF-beta signaling regulation of fibrosis in idiopathic carpal tunnel syndrome. BMC Musculoskelet Disord 2018; 19: 342.
[30] Hollborn M, Stathopoulos C, Steffen A, Wiedemann P, Kohen L and Bringmann A. Positive feedback regulation between MMP-9 and VEGF in human RPE cells. Invest Ophthalmol Vis Sci 2007; 48: 4360-4367.
[31] Karaulov AV, Nenasheva N, Smolkin Y, Maslakov A and Lucio L. Triamcinolone acetonide in the treatment of perennial allergic rhinitis: a post hoc analysis of quality of life during a phase III study. Int Arch Allergy Immunol 2022; 183: 160-167.
[32] Domenico P, Giuliana C, Daniele B, Bruno B, Alessandro G, Fabrizio M, Matteo TC and Claudio C. Ear keloids: an innovative 3-steps combined treatment. Skin Res Technol 2023; 29: e13506.
[33] Disphanurat W, Sivapornpan N, Srisantithum B and Leelawattanachai J. Efficacy of a triamcinolone acetonide-loaded dissolving microneedle patch for the treatment of hypertrophic scars and keloids: a randomized, double-blinded, placebo-controlled split-scar study. Arch Dermatol Res 2023; 315: 989-997.
[34] Nedelec B, LaSalle L, de Oliveira A and Correa JA. Within-patient, single-blinded, randomized controlled clinical trial to evaluate the efficacy of triamcinolone acetonide injections for the treatment of hypertrophic scar in adult burn survivors. J Burn Care Res 2020; 41: 761-769.
[35] Anggraini YE, Trisnowati N, Martien R and Danarti R. A randomised clinical trial study assessing the efficacy of 5% losartan potassium loaded in ethosomal gel to treat human keloids: a trial protocol. Trials 2024; 25: 12.