Dermatological Health, 2025, Volume 3, Issue 4
http://ojs.bbwpublisher.com/index.php/DH
Online ISSN: 2981-8206
Print ISSN: 3083-4775

Postoperative 3D-Printed Scar Device Aids in "Restoring the Ear to Its Original Appearance"

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Abstract: *Background:* To investigate the efficacy of a postoperative 3D-printed scar device in the treatment of ear scars. *Methods:* The clinical data of six patients with ear keloids admitted to the Outpatient Department of Dermatology at the Fourth Affiliated Hospital of Harbin Medical University from August 2025 to September 2025 were selected. Following ear scar excision, a 3D-printed scar device was applied for 3 months to assess its therapeutic effect on patients' ear keloids. *Results:* The keloids of the patients in the treatment group were significantly reduced compared to before treatment. *Conclusion:* The postoperative 3D-printed scar device is an effective method for treating ear keloids, and it significantly improves the precision, comfort, and efficacy of keloid treatment.

Keywords: 3D printing; Scar device; Ear keloid

Online publication: December 31, 2025

1. Background

Auricular keloids are a common clinical complication following ear piercing [1]. Although patients are initially motivated by aesthetic concerns, the formation of scars leads to adverse aesthetic outcomes. Consequently, this often exacerbates psychological burdens and leads to new issues. Due to the unique and complex three-dimensional anatomical structure of the auricle, treating ear scars is a significant challenge. Clinical treatment modalities for auricular scars include radiotherapy [2], silicone sheeting [3], corticosteroid injections [4], surgical repair [5], pressure earrings [6,7], or combined therapies [8]. To date, these methods have been associated with limitations such as uneven pressure application, difficulty in fixation, the need for frequent treatments, and an inability to adapt to individual anatomy, thereby compromising therapeutic outcomes. Recently, 3D printing technology, with its capabilities for customization and the manufacturing of complex structures, has provided new approaches to addressing the aforementioned problems [9,10]. By integrating CT and 3D scanning to acquire high-precision 1geometric data and using computer-aided technology to generate three-dimensional models, it

is possible to fabricate scar devices that closely conform to the patient's auricular anatomy. Furthermore, the pressure can be adjusted based on the scar's condition to achieve a uniform pressure distribution. Additionally, due to their characteristics of comfort, aesthetics, and concealment, these devices are more readily accepted by patients, thereby improving treatment compliance. This study investigates the therapeutic effects of 3D-printed scar devices on patients with postoperative auricular scars by analyzing clinical data.

2. Methods

Patient information and clinical data were collected from the Outpatient Department of Dermatology at the Fourth Affiliated Hospital of Harbin Medical University between August 2025 and September 2025. Six patients aged 18–70 years who had undergone auricular scar excision within one week were selected. Exclusion criteria included patients with allergies to materials such as resin, patients with poor wound healing, and patients with severe systemic diseases or mobility impairments. Patients were also required to accept this treatment modality, strictly follow medical advice, and undergo regular follow-ups. Before the study, all patients signed informed consent forms. All experiments were evaluated and approved by the Ethics Committee of Fourth Affiliated Hospital of Harbin Medical University.

CT imaging and three-dimensional scanning were used to image the affected ear and acquire detailed anatomical data. The collected data were imported into 3D modeling software for three-dimensional reconstruction. Subsequently, the reconstructed models were printed using medical-grade photosensitive resin. Following procedures such as polishing, curing, and disinfection, a finished lake-gray scar device comprising three components was obtained (**Figures 1–4**). The resin material enables precise replication of the complex, curved surfaces and minute anatomical structures of the auricle, facilitating "customization for the ear" for each patient. Most importantly, it achieves a uniform pressure distribution. The dark-colored design facilitates easier observation of the scar condition. Furthermore, the three screws incorporated into the scar device allow for pressure matched to the specific condition of the scar, thereby ensuring optimal therapeutic efficacy.

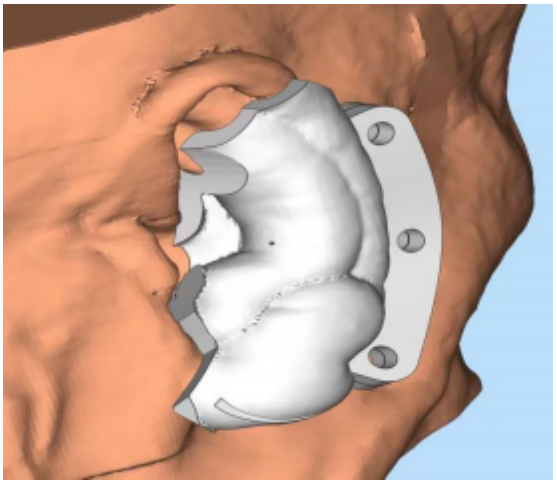

Figure 1. Front view of the 3D model

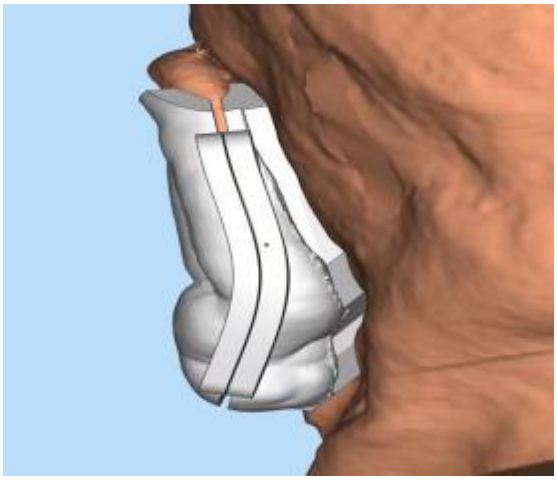

Figure 2. Back view of the 3D model

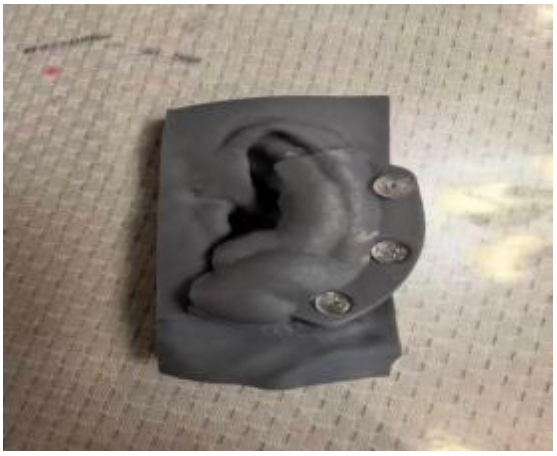

Figure 3. Finished scar device

Figure 4. Finished device components

Patients began wearing the device after suture removal (typically around 14 days post-operation). For the first two days, the device was worn for two hours daily. During this period, skin color and temperature were monitored to prevent excessive pressure. Appropriate pressure was defined as a palpable sense of tightness and sustained pressure without causing pain. After two days, the duration of wear and the pressure gradually increased until a daily duration of 10 hours was achieved. If daytime wear caused significant inconvenience, patients were permitted to wear the device at night. Patients were required to wear the device for three months, with a minimum of 10 effective hours per day. During this period, patients were instructed to maintain a daily log of their sensations and any issues, providing timely feedback to the clinicians. Monthly follow-up visits were conducted at the outpatient clinic. A professional medical team not involved in the treatment assessed the scars using the Vancouver Scar Scale (VSS), evaluating parameters including pliability, vascularity, height, and pigmentation. If changes in scar thickness were observed during assessment, the device was adjusted, or new geometric data were acquired to fabricate a replacement device, thereby ensuring continuous and practical pressure application. Finally, the primary outcome was to evaluate differences in the degree of keloid reduction by patient age characteristics and lifestyle variables to identify risk factors influencing the effectiveness of the scar device. Secondary outcomes included device breathability, side effects, and patient satisfaction with treatment results.

3. Therapeutic outcomes

Patient: A 70-year-old female presented to the Outpatient Department of Dermatology at the Fourth Affiliated Hospital of Harbin Medical University with a history of "keloids on the left earlobe for over 20 years." She had a history of recurrence following previous surgical excision. Specialist examination: Two hemispherical keloids were observed on the left earlobe, involving the earlobe margin. The surface appeared pink, with no telangiectasia, ulceration, or exudation observed. The external auditory canal and hearing were unaffected. VSS: Pigmentation 1, vascularity 0, height 3, pliability 4; total score 8. Diagnosis: Auricular keloid. Treatment: Two weeks after surgical excision, the patient wore the 3D-printed scar device for 3 months, for at least 10 hours per day (**Figures 5–10**).

Figure 5. Preoperative

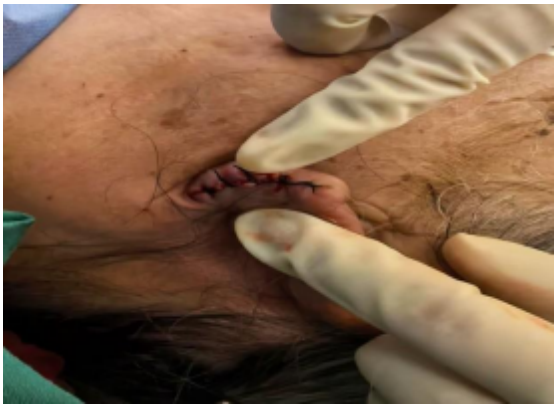

Figure 6. Postoperative

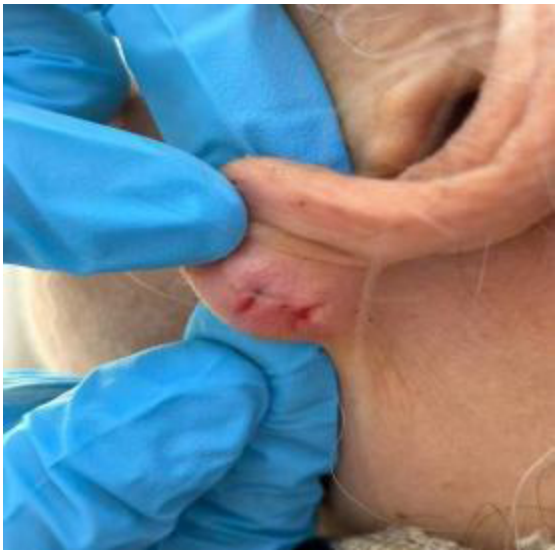

Figure 7. Following suture removal

Figure 8. Wearing the device

Figure 9. Front view of the ear after 3 months

Figure 10. Back view of the ear after 3 months

Initial treatment phase: The patient began wearing the scar device immediately following suture removal. The patient reported sensations of tightness and constriction but experienced no pain. No skin blanching or allergic reactions were observed, and no discomfort was reported.

Three months post-treatment: VSS: Pigmentation 0, vascularity 0, height 1, pliability 1; total score 2. This represented a significant reduction compared to the pre-treatment score of 8. Physical examination revealed that the scar tissue was essentially flat, with color approximating normal skin tone, and was soft and elastic to the touch. The patient's auricular structure was restored to a near-normal anatomical appearance. Her daily life was more convenient than before, and she was psychologically more relaxed. The patient expressed high satisfaction with the treatment, finding the scar device comfortable and aesthetically pleasing, without interfering with daily life or causing adverse reactions.

The postoperative use of 3D-printed scar devices demonstrates significant efficacy in treating auricular scars. Furthermore, its comfort and breathability enhance patient compliance, providing a novel approach to treating scars in complex, curved anatomical regions.

4. Results

The treatment group consisted of three females and three males, with three patients aged 18–30 years and three patients aged 55–70 years. All six patients strictly adhered to the protocol by wearing the scar device for 3 months, commencing approximately 14 days after auricular scar excision.

Follow-up revealed that therapeutic outcomes in the older age group were superior to those in the younger age group. Among the six patients, one patient experienced prolonged depressed mood and frequent insomnia due to work-related stress; the therapeutic outcome for this patient was suboptimal compared to the other patients.

The postoperative 3D-printed custom scar device demonstrated significant therapeutic efficacy for patients with auricular scars. In all six patients, the keloids were significantly reduced compared to the preoperative status.

5. Discussion

Auricular scars result from the abnormal proliferative repair of fibrous connective tissue following damage to the dermis caused by trauma to the auricular skin. While generally asymptomatic, severe cases can lead to cicatricial stenosis of the external auditory canal, auricular deformity, and secondary infection. These complications compromise hearing and aesthetics, exacerbate patients' feelings of inferiority and anxiety, and severely impact their quality of life.

Due to the ear's complex curved surfaces and minute anatomical structures, traditional pressure therapies fail to apply uniform, sustained pressure to the scar. This often results in suboptimal therapeutic outcomes. In recent years, 3D printing technology has been widely used in the medical field, providing alternative solutions to numerous medical challenges. By reconstructing a three-dimensional model of the patient's ear, highly personalized and customized scar devices can be fabricated. This ensures not only a morphological fit but also, more importantly, a uniform distribution of pressure. The printing material used in this study was a photosensitive resin, which, compared with traditional silicone sheets, offers superior dimensional stability and pliability. It allows for timely pressure adjustments based on specific conditions to achieve optimal therapeutic

effects.

The process from data scanning to the clinical application of the 3D-printed scar device requires approximately one week. Patients can begin using the device immediately after suture removal, thereby capturing the critical window to prevent scar recurrence. The patient's three-dimensional geometric data of the auricle can be retrieved at any time; should the scar device be damaged or lost, it can be rapidly reproduced. Additionally, the 3D model data can be utilized for pre- and post-treatment comparisons, providing a valuable reference for subsequent treatments.

As an exploratory study, this research has certain limitations, including a small sample size and a relatively short duration of device usage. Future studies with more comprehensive protocols and longer-term follow-up are required. This study primarily investigated the combined therapy of surgery and pressure therapy using scar devices. Future research may explore additional combined modalities, such as integrating radiotherapy or pharmacological agents with scar devices, which remain to be investigated.

6. Conclusion

The postoperative 3D-printed scar device enables individualized design and high adaptation to the patient's auricular anatomy, resulting in uniform pressure distribution. It also effectively controls postoperative scar growth and improves patient compliance, representing an effective treatment modality that combines precision with comfort.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Fijałkowska M, Kasielska A, Antoszewski B, 2014, Variety of Complications After Auricle Piercing. Int J Dermatol, 53(8): 952–955.

[2] Mohamed R, Elawadi AA, Al-Gendi R, et al., 2022, The Outcome of Postoperative Radiation Therapy Following Plastic Surgical Resection of Recurrent Ear Keloid: A Single Institution Experience. Journal of the Egyptian National Cancer Institute, 34(1): 4.

[3] Lim DZJ, Chun YY, Montero AY, et al., 2024, Silencing SiRNA Microneedle Patches Versus Silicone Sheets in Reducing Post-Surgical Scars: A Randomized Single-Blinded Intra-Individually Controlled Clinical Trial. Br J Dermatol, 1–8.

[4] Yin Q, Niessen FB, Gibbs S, et al., 2023, Intralesional Corticosteroid Administration in the Treatment of Keloids: A Survey Among Dutch Dermatologists and Plastic Surgeons. J Dermatolog Treat, 34: 2159308.

[5] Park TH, Rah DK, 2022, Successful Eradication of Helical Rim Keloids with Surgical Excision Followed by Surgical Resection of Recurrent Ear Keloid: A Single Institution Experience. J Egypt Natl Canc Inst, 34: 4.

[6] Li H, Song T, 2020, 3D Printed Custom-Made Pressure Clips for Ear Keloid Treatment After Surgical Excision. Am J Otolaryngol, 41(4): 102516.

[7] Chugh A, Hooda A, Bishnoi P, 2013, Custom-Made Different Designs of Pressure Clips for the Management of Ear Lobe Keloids. Dent Hypotheses, 4: 135.

[8] Aköz T, Gideroğlu K, Akan M, 2002, Combination of Different Techniques for the Treatment of Earlobe Keloids. Aesthetic Plast Surg, 26(3): 184–188.

[9] Yigit B, Yazar M, Alyanak A, et al., 2009, A Custom-Made Silicon Mold for Pressure Therapy to Ear Keloids. Aesthetic Plast Surg, 33: 849–851.

[10] Nejat AH, Hamdan S, Abrego I, et al., 2022, Fully Digital Workflow for Fabrication of A 3D Printed Ear Stent for Auricular Keloids: A Technique Article. J Prosthodont, 31(3): 266–270.