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# Comparison of Ba-Hao burn ointment gauze and petrolatum gauze in split graft donor site healing: A randomized, prospective, and self-control study

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## Abstract

**Background and Aims:** To assess patient comfort, wound healing, and scarring at the 6-month follow-up of split-skin graft donor sites treated with Ba-Hao burn ointment (BHBO) gauze, a compound preparation of traditional Chinese medicine since 1970s, compared with petrolatum gauze.

**Methods:** Thirty patients admitted to the Department of Burns of the First Affiliated Hospital of Anhui Medical University between September 2021 and September 2022 participated in this randomized, prospective, self-control clinical study. After harvesting the split skin, donor sites were divided into two parts along the midline. BHBO gauze was applied to half of the donor wounds, and petrolatum gauze was applied to the other half. The wound healing time, pain scores on the postoperative Days 3, 6, and 9, and Vancouver Scar Scale (VSS) score at the 6-month follow-up were assessed.

**Results:** The wound healing time was significantly shorter in the BHBO group than in the control group (10.07 ± 1.48 days vs. 11.50 ± 1.74 days, $p < 0.001$). On postoperative Days 3 and 6, the pain scores quantified by visual analog scores were significantly lower in the BHBO group than in the control group (5.33 ± 1.54 and 4.17 ± 1.51, respectively vs. 7.57 ± 1.41 and 5.20 ± 1.47, respectively). The difference in the visual analog scale score on postoperative Day 9 between the groups was not significant ($p > 0.05$). Microbiological assessment revealed the absence of bacterial contamination in both groups. At the 6-month follow up, the VSS score was significantly lower in the BHBO group (6.67 ± 1.92) than in the control group (9.57 ± 1.55).

**Conclusion:** BHBO resulted in faster donor-site healing, reduced postoperative pain, and improved scar quality at the 6-month follow-up than petrolatum gauze alone.

KEYWORDS

Ba-Hao burn ointment, curative effect analysis, donor site, split-skin graft

Wen-Jing Liu, Han-Ying Qian, and Yuan-Yuan Zhang are equally to this workstudy and are joint first authors.

## 1 | INTRODUCTION

Autologous skin grafting remains the primary choice for treating a diverse array of soft tissue injuries, especially severe burns, and acute and chronic wounds.[1] Autologous skin grafting is a technique in which one skin site of a patient's body is removed from a skin defect. The subtypes of autologous skin grafts based on skin thickness include thin-thickness, split-thickness, and full-thickness skin grafts.

A split-thickness graft comprising both the epidermis and a fraction (1/2–1/3) of the dermis is particularly effective because of its proclivity for success. It has superior abrasion resistance, diminished scar contracture, and more active functionality and aesthetics after healing because of its dermal elements.[2] Consequently, it is often the first choice for autologous skin grafting.

The prevailing standard-of-care protocol for managing donor-site wounds is to apply petrolatum gauze and sterile gauze dressings with compression, followed by semi-exposure dressing until the wound heals. The donor site heals through a process of re-epithelialization that usually takes 7–14 days. However, the skin graft donor site often receives little attention and may be a source of considerable pain and discomfort caused by delayed wound healing. Moreover, patients commonly complain of more severe pain at the donor site than at the surgical site.

Sterile gauze, particularly those with poor hydrophilic properties, can become sclerotic and intractable after water evaporation, intensifying the pain experienced during dressing changes and causing secondary wound trauma.[3] An ideal donor-site dressing should be easy to use, relieve patient discomfort, and promote reepithelization.

Recently, there has been increasing interest in the application of traditional Chinese medicine (TCM) in wound healing. TCM, characterized by abundant pharmacological resources, facile preparation methodologies, cost-effectiveness, and low toxicity profile, has demonstrated considerable promise in expediting wound healing.[4,5] Several domestic clinical investigations corroborated the therapeutic utility of TCM in wound management and have shown significant outcomes.[6,7]

Ba-Hao burn ointment (BHBO) was formulated for treating burns by the Department of Burns at the First Affiliated Hospital of Anhui Medical University in the 1970s. Empirical validation of its effectiveness on burns has been garnered. BHBO is composed of a diverse array of Chinese herbs, including rhubarb, sanguisorba, Chinese gall, borneol, calamine, red halloysite, and sesame oil. The targeted action and effect of BHBO have met special theory of quaternity criteria for TCM prescription: Monarch, Minister, Assistant, and Guide. As a monarch, rhubarb can clear away heat and purge fire. Sanguisorba and Chinese gall can eliminate noxious sores and promote muscle growth, hence their definition as the Minister. Red halloysite, calamine, and Phllodendronamurense are considered to be the Assistant which can astringe dampness and furuncles and can also clear away heat and purge fire. Lastly, calamine was chosen as the Guide, which has the function of reducing fever and relieving pain.

Mechanistically, this ointment can detoxify and promote blood circulation to clean necrotic tissue, achieve hemostasis with astringents, and facilitate regeneration at the wound or sore site. Various clinical studies have substantiated the ointment's potential to accelerate burn wound healing.[8,9]

**Key points**

- Explore the different clinical effect of Ba-Hao burn ointment (BHBO) and petrolatum gauzes in donor site.
- BHBO can shorten donor site wound healing time and dull pain.
- BHBO can improve scare quality.

The Chinese herbal medicine mentioned above is ground into a powder and then incorporated into melted beeswax and sesame oil to obtain the ointment. Once the ointment cools down, it is smeared evenly onto an 80*225 mm gauze and used in clinical settings after a sterilization process. And 30 mL BHBO can produce eight pieces of BHBO gauze.

However, little information is available regarding the use of BHBO in donor-site wounds and we aimed to assess patient comfort, wound healing, and scarring between BHBO gauze and petrolatum gauze at the 6-month follow-up of split-skin graft donor sites.

## 2 | MATERIAL AND METHODS

### 2.1 | Study design and patients

This single-center study was conducted at the Department of Burns of the First Affiliated Hospital of Anhui Medical University. It was approved by the Medical Ethics Committee of First Affiliated Hospital of Anhui Medical University and performed in accordance with the 1964 Declaration of Helsinki and its later amendments. And all patients had signed informed consent.

Patients (Table 1) aged > 18 years in whom split-thickness skin grafting was indicated for wound repair were identified for potential inclusion and observation. Patients with a total donor-site area of at least 50 $cm^2$ without infection or scars were analyzed. There was no upper limit for the donor-site size. The exclusion criteria included females with pregnancy, menstruation, or lactation; patients with a severe medical condition involving hepatic dysfunction; or patients with an allergy or sensitivity to BHBO or petrolatum gauze.

### 2.2 | Treatment methods

For all patients, the skin was aseptically harvested. A handheld dermatome (Zimmer Inc.) was used to harvest the skin (5–6 cm wide at a depth range of 0.3–0.45 mm). The skin strips varied in length and width depending on the amount of skin used to cover the wounds. Donor-site bleeding was controlled by the application of sterile gauze, which was removed once hemostasis was successfully achieved. The donor sites were divided equally into two parts (left and right) along the midline to receive different treatments with the BHBO or petrolatum gauze. Each patient received both types of

**TABLE 1** Patient characteristics.

| Patient characteristics ($n = 30$) | |
|---|---|
| Demographics | |
| Mean age (SD), years | 47.07 (16.18) |
| gender (male/female) | 12/18 |
| Skin grafts site | |
| Right upper limb | 4 |
| Left upper limb | 1 |
| Right lower limb | 7 |
| Left lower limb | 15 |
| Trunk | 3 |
| Graft skin area | |
| 1% | 21 |
| 2% | 3 |
| 3% | 4 |
| 4% | 2 |

Abbreviation: SD, standard deviation.

dressings, and both dressings were bandaged using multilayered sterile gauze and compression.

On postoperative Days 3, 6, and 9, two burn surgeons only changed the outer dressings and the inner dressings were left in place. When the wound was healed, the inner gauze would automatically fall off. While we changed the dressing, the main observation was whether the inner layer dressing was dry and falling off to determine the degree of healing in the donor area. And photographed the wound at a fixed focal length on postoperative Day 3, 6, and 9. All procedures were performed under strictly aseptic conditions. All outer dressings were removed 9 days postoperatively while retaining the BHBO and petrolatum gauze. The donor areas were covered with two different gauze dressings until complete epithelialization occurred. After complete epithelialization, the time was recorded.

Pain was measured using the visual analog scale (VAS).[10] The VAS consists of a 10-cm line, with the left side representing the absence of pain and the right side indicating great pain. Participants were asked to indicate their current level of pain on the scale, with higher values indicating more intense pain.

The scars were assessed using the Vancouver Scar Scale (VSS)[11] at the 6-month postoperative follow-up. The VSS, which is composed of four variables, pigmentation, vascularity, pliability, and height, was used for wound assessment by two surgeons during the follow-up visits.

## 2.3 | Statistical analysis

All statistical analyses were performed using SPSS (version 25.0; IBM Corp.) and tests were in 2-sided. Data were expressed as Mean ± SD. A paired *t*-test was used to analyze the mean wound healing time and total VSS. One-way analysis of variance was applied to the VAS score. Each VSS variable was analyzed using the Wilcoxon signed-rank test. The *p* Value was adjusted using the Bonferroni method for the correction of five multiple comparisons so that $p < 0.05$ was considered statistically significant.

# 3 | RESULTS

Thirty patients were observed and analyzed, and all completed the observation without any adverse events. We found a significant difference between the two dressings regarding pain score and healing endpoints.

## 3.1 | Wound healing time

The healing times of the two dressings in the donor are shown in Figure 1. A significantly shortened healing time of the donor site was observed in the BHBO gauze group (10.07 ± 1.48 days) than in the petrolatum gauze group (control group) (11.50 ± 1.74 days, $p < 0.001$). The donor sites of these two groups were examined and showed no evidence of infection at the time of dressing removal.

## 3.2 | Pain scores

The pain scores for a total of 30 patients were obtained. Patients in the BHBO group had significantly lower pain intensity scores for the donor site on postoperative Days 3 and 6 (5.33 ± 1.54 and 4.17 ± 1.51, respectively $p < 0.001$, and $p = 0.006$ the value to the nearest thousandth) than those in the control group (7.57 ± 1.41 and 5.20 ± 1.47, respectively,). However, by postoperative Day 9, no significant difference in

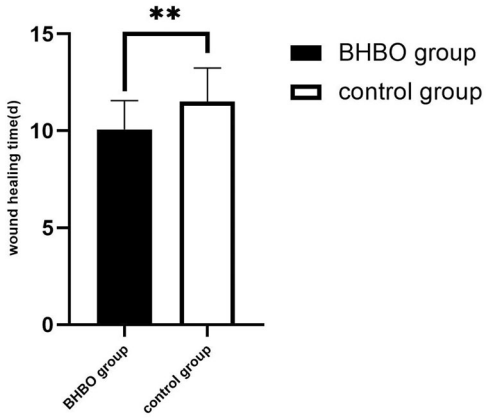


**FIGURE 1** Comparison of wound healing time between the two groups. The wound healing time for patients treated with BHBO gauze is shorter than that for those treated with petrolatum gauze ($p < 0.01$) BHBO, Ba-Hao burn ointment; BHBO group, the donor site was treated with Ba-Hao burn ointment gauze; control group, donor site was treated with petrolatum gauze. **$p < 0.01$.

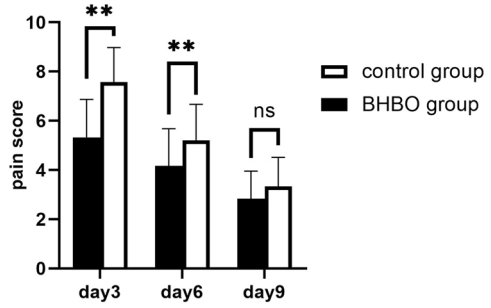


**FIGURE 2** Comparison of wound pain scores between the two groups. The pain at the donor site where BHBO was applied is improved compared with that where petrolatum gauze was applied on postoperative Days 3 and 6 ($p < 0.01$). BHBO, Ba-Hao burn ointment; BHBO group, the donor site was treated with Ba-Hao burn ointment gauze; control group, the donor site was treated with petrolatum gauze; ns, not significant. $^{**}p < 0.01$.

donor-site pain was noted between the groups (2.83 ± 1.12 and 3.33 ± 1.18, respectively, $p = 0.105$) (Figure 2).

### 3.3 | VSS score

Each donor site was assessed using VSS parameters at 6 months after wound healing (Figure 3A–E). Regarding wound scar score (Figure 3A), the mean VSS score in the BHBO group was significantly lower than that in the control group (6.67 ± 1.92 vs. 9.57 ± 1.55, $p < 0.001$). The BHBO group had lower scores for every parameter of the VSS than the control group at 6 months postoperatively. Both dressing types shared a mean scar pigmentation of 1 point ($Z = -1.292$ and $-1.213$, respectively) The mean cicatricial vascular distribution scores in the BHBO and control groups were 1 and 2 points, respectively ($Z = -1.213$) The scar pigmentation and cicatricial vascular distribution scores were not significantly different at 6 months postoperatively ($p = 0.196$ and 0.225,

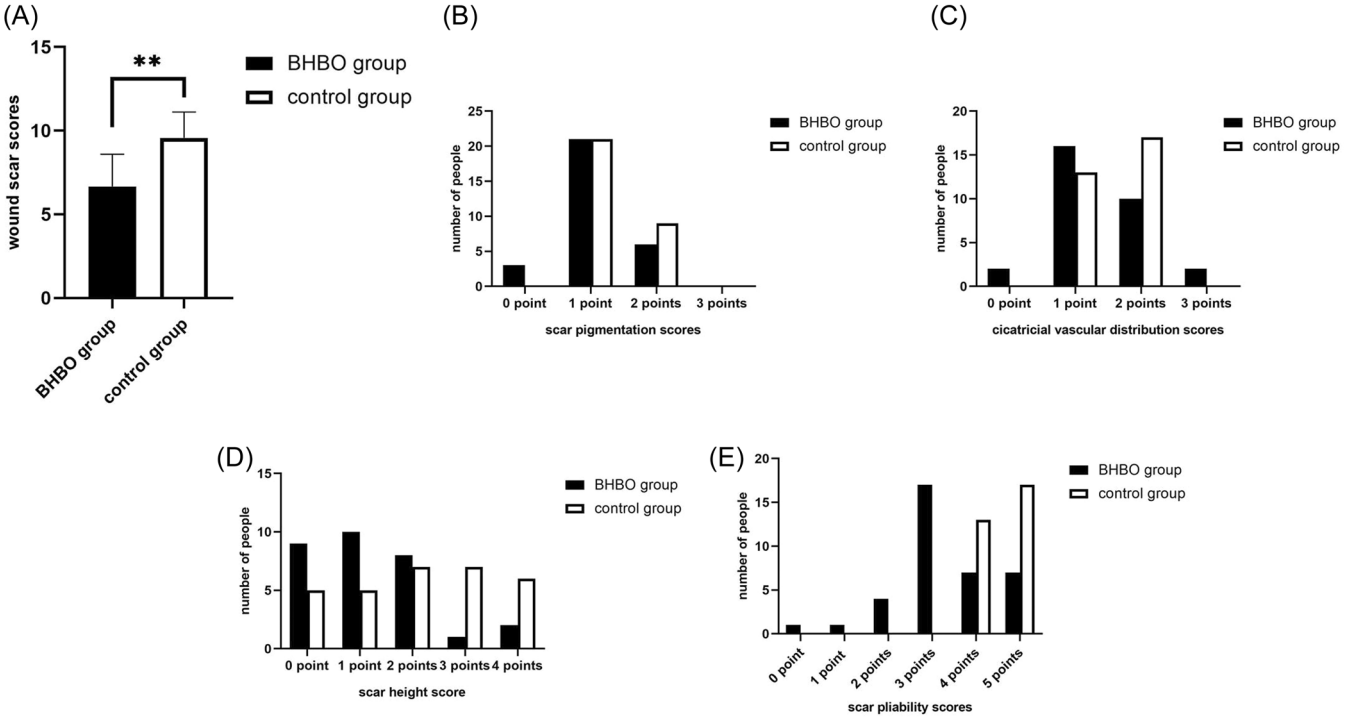


**FIGURE 3** VSS parameters at 6 months after wound healing. (A) Comparison of wound scar scores between the two groups. The wound scar scores for patients treated with BHBO gauze are lower than those of patients treated with petrolatum gauze ($p < 0.001$). (B) Comparison of scar pigmentation scores between the two groups. The figure shows the number of patients by each scar pigmentation score for the donor sites treated with BHBO gauze and the donor sites treated with petrolatum gauze, respectively. (C) Comparison of cicatricial vascular distribution scores between the two groups. The figure shows the number of patients by each cicatricial vascular distribution score for the donor sites treated with BHBO gauze and the donor sites treated with petrolatum gauze, respectively. (D) Comparison of scar height scores between the two groups. The figure shows the number of patients by each scar height score for the donor sites treated with BHBO gauze and the donor sites treated with petrolatum gauze, respectively. (E) Comparison of scar pliability scores between the two groups. The figure shows the number of patients by each scar pliability score for the donor sites treated with BHBO gauze and the donor sites treated with petrolatum gauze, respectively. BHBO, Ba-Hao burn ointment; BHBO group, the donor site was treated with Ba-Hao burn ointment gauze; control group, the donor site was treated with petrolatum gauze. $^{**}p < 0.001$.

respectively) (Figure 3B,C). The scar height and pliability scores ($Z = -2.488$ and $-4.626$, respectively) were significantly lower in the BHBO group than in the control group at 6 months postoperatively ($p < 0.001$ and 0.013, respectively) (Figure 3D,E).

### 3.4 | Typical case

In one typical case, a 67-year-old male patient was clinically diagnosed with (1) a third-degree burn on the lower extremity, (2) a total body surface area involved that was <10%, and (3) concurrent hypertension. Section A of the wound was treated with BHBO gauze, whereas section B received a petrolatum gauze dressing. Nine days after surgery, the external dressings were removed to allow semi-exposure. The data indicated accelerated healing of the wound segment treated with BHBO, which achieved complete epithelialization by Day 11, compared with the wound section covered with petrolatum gauze, which reached a comparable state of healing on Day 13 (Figure 4A–F).

## 4 | DISCUSSION

On the basis of clinical and subjective data, we found significant differences in wound healing and pain between the two donor-site dressings.

Various clinical studies have demonstrated BHBO's potential to accelerate burn wound healing[8,12,13] In the Sun's study, the result showed that BHBO could increase glutathione concentration in wounds, thus enhancing antioxidation which reduced wound damage.[8] These results were consisted with our findings. Gao and his coworkers found that emodin had higher levels in five types of anthraquinone in BHBO.[12] Emodin was demonstrated to inhibit NF-κB, MAPK, and PI3K pathways and decrease proinflammatory cytokine production in LPS-induced RAW264.7 macrophages to have an anti-inflammatory effect,[13] which is beneficial for wound healing.

The time for wound healing is demarcated by complete epithelialization and is intrinsically dependent on multiple factors, including, but not limited to, the patient's nutritional status and vascular sufficiency, as well as the type of dressing applied to the wound. In the present study, BHBO expedited the wound healing process. This may be attributed to the bioactive constituents inherent to TCM. For instance, rhubarb elevates the expression of epidermal growth factor and vascular endothelial growth factor (VEGF), which promote wound healing.[14] Sanguisorba alcohol extract amplifies the levels of transforming growth factor beta 1 and VEGF-A while concurrently attenuating interleukin-6 serum concentrations.[15] Moreover, vitamin A present in sanguisorba not only augments epithelial tissue growth but also exerts a substantial effect on wound healing.[16] Additionally, calamine can ameliorate the local

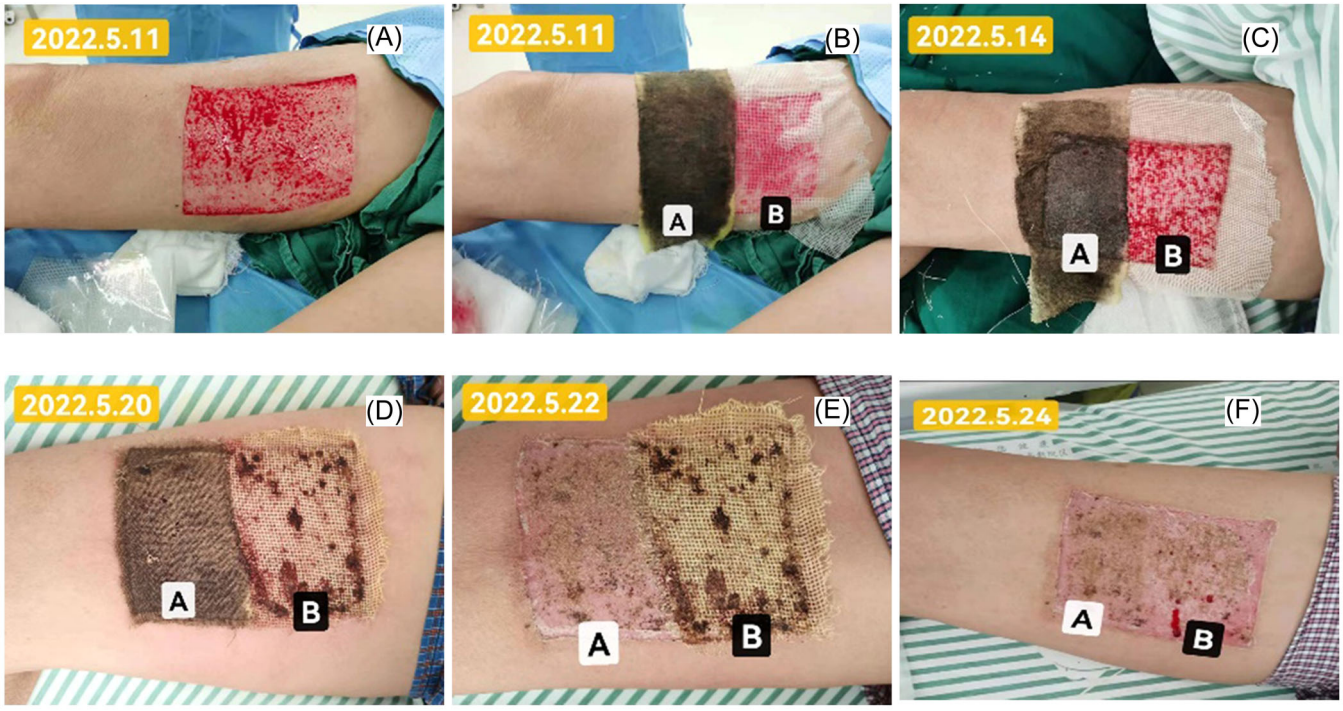


**FIGURE 4** Comparison of dressings between two groups after skin removal in a typical case. (A) Wound surface status after skin debridement. (B) Postdebridement: section A received BHBO, whereas section B was dressed with petrolatum gauze. (C) Dressing change on postoperative Day 3. (D) The wound surface appears dry, warranting semi-exposure treatment on postoperative Day 9. (E) Complete epithelialization is achieved for the wound covered by BHBO gauze on postoperative Day 11, at which point the BHBO gauze naturally sloughed off. In contrast, the petrolatum gauze remains adherent to this juncture. (F) On postoperative Day 13, the wound covered with petrolatum gauze achieved epithelialization, and the gauze dislodged itself.

microcirculation, stimulate desmocyte and capillary formation, and accelerate granulation tissue proliferation.[17] *Phellodendron amurense* enhances local tissue microcirculation, thus shortening the wound-healing process.[18]

Pain as a postoperative complication may be severe enough to inhibit early patient mobilization.[19] Therefore, it is critical to alleviate pain.[20] BHBO can relieve pain during the initial stages of post-operative recovery. In this study, the BHBO group exhibited lower pain levels than the control group on postoperative Days 3 and 6. Chinese medicines in BHBO gauze facilitate myogenesis and induce wound contraction. Consequently, it can facilitate epithelial regeneration and protect the exposed nerve endings.[21]

The wound healing time is an important determinant of scar tissue formation. Previous studies have substantiated the inverse correlation between the length of wound healing time and the resultant quality of scar tissue.[22] Similarly, our findings confirmed a statistically significant difference in scar quality scores between the BHBO and control groups at the 6-month postoperative follow-up. Therefore, BHBO gauze can improve scar quality.

An examination revealed that Galla chinensis within BHBO can reduce scar hyperplasia. Galla chinensis can downregulate the expression of *miR-21* and upregulate the expression of *PTEN* in the mTOR signaling pathway, which can inhibit the expressions of *p-Akt* and *p-mTOR*.[23] Consequently, the wound healing time in the BHBO group was reduced compared with that in the control group, which indirectly ameliorated the scar quality.

We are aware of potential confounding factors that were not adjusted for during data collection, including the inclusion of donor-site wounds from a single department coupled with a modest sample size. To further confirm these preliminary findings, it is necessary to increase the sample size and diversity of the sample sources. Further experience with BHBO is required to better define its role in the management of split-thickness skin graft donor sites.

## 5 | CONCLUSIONS

BHBO appears to result in faster donor-site healing, reduced postoperative pain, and improved scar quality at the 6-month follow-up than petrolatum gauze alone. The results from this study show that BHBO possesses useful qualities that make it suitable as a donor site dressing. These inherent properties set BHBO gauze apart from petrolatum gauze because of TCM. Areas for future studies include investigating the mechanism of BHBO and the role of each herbal intergerns in BHBO.

## AUTHOR CONTRIBUTIONS

**Wen-Jing Liu**: Conceptualization; data curation; formal analysis; investigation; methodology. **Han-Ying Qian**: Conceptualization; data curation; formal analysis; investigation; software; supervision; validation; visualization; writing—original draft. **Yuan-Yuan Zhang**: Formal analysis; investigation; methodology; project administration; visualization; writing—original draft. **Le Qiu**: Formal analysis; validation. **Fei Wang**: Investigation; methodology; project administration. **Xu-Lin Chen**: Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; resources; supervision; validation.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found in the article.

## TRANSPARENCY STATEMENT

The lead author Xu-Lin Chen affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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