

A Novel Eschar-Preserving Technique: Micrografting Autologous Skin into Perforated Burn Eschar for Enhanced Wound Healing

Mengmeng Ou

the First People's Hospital of Xuzhou

Tao Wang

the First People's Hospital of Xuzhou

Chen Lin

the First People's Hospital of Xuzhou

Songtao Li

the First People's Hospital of Xuzhou

Xu Shi

the First People's Hospital of Xuzhou

Hangqing Wu

whq_hhhh@sina.com

the First People's Hospital of Xuzhou

Article

Keywords: Deep burn wounds, Eschar perforating, Skin inlaying, Autologous skin grafting, Micrografting

Posted Date: September 29th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10531675/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Burn care has been limited in recent years due to the limited availability of allogenic skin. Nevertheless, some burn patients may refuse surgery because of their age, physical condition, or economic status. We propose a new method involving eschar perforating and inlaying of small autogenic skin patches for the treatment of deep burn wounds in this study. A total of 10 deep burn wounds were included in the study. The skin patches were inlayed 4–21 days after the patients were burned. The ratio of the skin peeling area and the skin grafting area was 1:17 – 1:25. The skin graft survival rate was 53.85%-72.73%. The grafts expanded 3–4 weeks after transplantation and then fused 35–55 days after transplantation. Follow-up examinations revealed that the skin graft area healed well and that scar hyperplasia was less obvious than that in the surrounding area without a skin graft. It is feasible for eschar holing and inlaying of autologous small skin patches in the treatment of deep burn wounds, while the optimal timing and specific methods for skin inlaying still need further research and optimization.

INTRODUCTION

Burn injuries are severe injuries that result from contact with a thermal, radiation, chemical or electrical device and are a major public health concern. ¹Burn injuries destroy the skin and subcutaneous tissue, thus affecting homeostasis as well as the immune system.²

Deep burns are common worldwide and are divided into deep partial- and full-thickness burns. Deep partial-thickness burns penetrate the reticular dermal layer. The surface of the burn often appears deep red with mottling due to ruptured erythrocytes within the dermis, does not blanch with pressure, may appear dry, and may exhibit reduced sensitivity to pinprick. Full-thickness burns may appear white, brown or black in color, involve the full thickness of the skin, and extend into subcutaneous tissues. The formation of an eschar is typical of deep partial- and full-thickness burns.³ Deep burns are associated with scar growth, joint dysfunction, deformity, and even death.⁴ Deep burns are difficult to cure in a short time because of their complexity and related complications,⁵ and they may be accompanied by psychological distress and economic burdens for both the patients and their families.⁶ Burn wounds, especially deep burn wounds, are difficult to treat, and methods to promote the healing of burn wounds are needed.^{7,8}

Various strategies including debridement and coverage with autografts, allografts or xenografts have been used as remedies for burn injuries. Therapeutic agents have also been applied.⁹ Skin grafting or autografting are considered the gold standard in the management of full- and partial-thickness burns. Among these methods, intermingled skin grafting, which was created at Guangci Hospital, Shanghai, in the 1960s has been proven successful. The method involves the placement of a large, partial-thickness allograft with holes for inlaying small pieces of partial-thickness autografts.^{10,11} This intermingled transplantation method has been used as a rescue measure for several patients with severe, extensive

full-thickness burns. It is a low-cost method for definitive coverage of extensive burns and achieves good cosmetic outcomes.¹²

Burn care has been limited in recent years due to the limited availability of allogenic skin. Nevertheless, some burn patients may refuse surgery because of their age, physical condition, or economic status. Therefore, a new method that is suitable and accessible to all burn patients is needed. Although a burn eschar is considered a complication, they can have a protective effect on burn wounds. Thus, we propose a new method involving eschar perforating and inlaying of small autogenic skin patches for the treatment of deep burn wounds.

PATIENTS AND METHODS

Patients

Seven patients who were treated for deep burn wounds between October 2019 and January 2024 in the Department of Burns and Plastic Surgery and Wound Repair at the First People's Hospital of Xuzhou were included. The inclusion criteria were as follows: definite diagnosis of deep burns (deep partial- or full-thickness burns); no tumor, bleeding disorder, intellectual disability, or severe systemic disease; complete perioperative data; and willing to cooperate with follow-up procedures. All participants signed an informed consent form prior to inclusion in the study. The work described has been carried out in accordance with the Declaration of Helsinki for experiments involving humans, and approved for implementation by the Ethics Committee of the First People's Hospital of Xuzhou (approval number xyyll[2023]077, March 20, 2023.).

The study was conducted on the basis of the theory of shared decision-making (SDM). SDM is an approach that involves the discussion of available treatment options with patients, thus equipping them with pertinent information necessary for decision making. Through collaborative engagement between physicians and patients, the potential benefits and risks associated with various outcomes are thoroughly evaluated. Additionally, the values and preferences of patients are integrated into the decision-making framework. For deep burn patients, options such as eschar excision, allo- or xeno-skin grafting and routine autoskin transplantation were presented. In this study, patients were informed about the surgery as well as the severity of their condition, enabling them to make their choice autonomously. Thus, the optimal approach was tailored to meet the patient's needs. Seven patients with 10 deep burns chose to undergo eschar perforating and inlaying of small skin patches. Basic information, including the ratio of the skin peeling area to the grafting area, skin graft survival rate and incidence of scar hyperplasia, were analyzed.

Preoperative treatment

Novel treatments for patients with extensive burns include preventive tracheotomy and assisted mechanical ventilation, relieving incisions to the thoracic region and limbs, fluid resuscitation with

lactated Ringer's solution and plasma transfusion. Systemic antibiotics were applied to prevent infection and silver sulfadiazine powder was externally applied for eschar preservation. Meanwhile, oral and intravenous nutritional supplements were also conducted according to the patient's nutritional status.

Surgical technique for eschar holing and inlaying of autologous small skin patches

The operation can be performed at the bedside in the ward or during routine surgeries in the operating room. Holes were made through the eschar. The distance between the holes was approximately 1.5 cm-2.0 cm, the length of the incision was approximately 0.8 cm-1 cm, and all the holes were made below the fat layer. Then a piece of autologous split-thickness skin was harvested and cut into small patches with tissue scissors; each skin patch measured 0.3 cm × 0.3 cm-0.3 cm × 0.5 cm. The donor site was covered with Vaseline gauze. The skin patches were inlayed into the holes. The eschar was pressed to maintain its intact state; however, if there was exudate, the holes were filled with a small saline gauze.

Postoperative treatment

The eschar was preserved for approximately 5–7 days after the operation and then dissolved with silver sulfadiazine cream. The eschar was carefully removed with tissue scissors. The dressing was changed regularly after the eschar was removed, and the dressing was changed more frequently if there were excess secretions. Anti-infection therapy and nutritional supplements were also administered.

RESULTS

General results

This study included 3 males and 4 females who ranged in age from 31 to 86 years. All the patients had burns on 15%-80% of the TBSA (total body surface area) and full-thickness burns on 5%-30% of the TBSA. Two patients with major degree burns refused further escharotomy and skin grafting after undergoing skin grafting surgery for partial-thickness burn wounds, and 4 patients with moderate degree burns refused skin grafting surgery because of their age and economic status. The other patient participated in this study after undergoing routine surgical treatment. A total of 10 deep burn wounds were included in the study. The skin patches were inlayed 4–21 days after the patients were burned. The skin peeling area was 2–6 cm² and the skin grafting area was 50–150 cm², for which the ratio was 1:17 – 1:25. Dressings were changed once per day for 10 days due to evident secretions after the eschar was removed, then dressings were changed once every 2 days. The skin graft survival rate was 53.85%-72.73%. The grafts expanded 3–4 weeks after transplantation and then fused 35–55 days after transplantation. The donor sites healed within 7–10 days without obvious scars. The follow-up period was 4–10 months. Follow-up examinations revealed that the skin graft area healed well and that scar hyperplasia was less obvious than that in the surrounding area without a skin graft.

Typical case

A 52-year-old female patient was accidentally burned by fire at home, resulting in burns covering 64% of the TBSA; deep partial-thickness burns covered approximately 11% of the TBSA, whereas full-thickness burns covered approximately 53% of the TBSA (Fig. 1A, B and C). Patients underwent treatments such as tracheotomy and assisted mechanical ventilation, relieving incisions on the upper limbs, fluid resuscitation and the application of systemic antibiotics preoperatively. Silver sulfadiazine powder was applied to the wounds for eschar preservation after admission. Routine surgeries, including wound excision, xenograft skin coverage and autologous skin grafting, were conducted on the upper limbs and the left lower limb. In accordance with the wishes of the patient's family members, small autogenic skin patches were inlayed under the topical eschar of the anterior wound on the right thigh on post-burned day (PBD) 13 (Fig. 2A and B) and under the eschar at the root of the left thigh after routine skin grafting on the wound of the left lower limb on PBD 19 (Fig. 3A and B). The eschars were dissolved with silver sulfadiazine cream 5–7 days after the skin was inlayed and then gradually removed during dressing changes. Most of the skin patches survived, although some dissolved (Fig. 2C and Fig. 3D). The skin patches expanded rapidly 3 weeks after transplantation (Fig. 2D, E and F and Fig. 3E, F) and fused in approximately 35 days, whereas the surrounding wounds turned into granulation wounds without skin islands (Fig. 4A). Afterward, the granulation wound underwent stamp skin grafting and mesh skin grafting (Fig. 4B and C), and dressings were routinely changed for the residual wounds. All the wounds healed within two and a half months (Fig. 5A) and maintained a good state 3 months after discharge (Fig. 5B). The degree of scar hyperplasia in the skin inlaying area was less obvious than that in the surrounding area at 6 months after discharge (Fig. 5C and D).

DISCUSSION

Burn wounds are difficult to treat and major public health issues. They have a serious impact on and are extremely stressful for victims and their families, physically, psychologically, and financially.¹³ Burn wounds are traditionally managed with regular dressing changes and skin grafting surgery. Burns covering a total body surface area (TBSA) > 30% may require skin transplantation. In general, split-thickness skin grafting is the gold standard treatment. Skin transplantation leads to the regeneration of the epidermis and is associated with less skin contracture as well as less extracellular matrix deposition.¹⁴

However, the limited availability of autograft skin from suitable sources limits the success of treatment and the quality of healing of extensive burns.¹⁵ Therefore, clinicians need a tool or a skin grafting technique to expand the limited donor site to maximize coverage of the denuded wound. There are several examples of techniques that facilitate larger expansion ratios, such as the meshed technique, the conventional postage stamp skin graft technique, the Meek micrograft technique, the intermingled transplantation technique using autografts, homografts, microskin, allografts, or xenografts.

When the skin graft is meshed or minced, the actual expansion rate is lower than the estimated expansion rate and the claimed expansion rates (ninefold-fold), with substantial discrepancies between the estimated and actual expansion rates, whereas the actual and estimated expansion rates of the micrografting technique are better than those of the skin meshing technique.¹⁶ The expansion ratio of the postage stamp skin graft ranged from 1:4 to 1:9, with the harvested skin being cut into 0.5-1.0 cm postage-stamp-like squares and applied to the recipient sites at a distance of 0.5-2.0 cm.¹⁷ However, the transplantation of postage stamp skin grafts is time consuming, both directly and piece-by-piece. Moreover, compared with meshed skin grafts, Meek micrografts provide an expansion ratio of 1:4, 1:6 or 1:9, require a smaller donor graft site, lead to higher graft survival rates, and has greater resistance to infection. This technique provides better long-term aesthetic outcomes at the recipient site. However, it has a steep learning curve, is time consuming, and expensive.¹⁸ Intermingled transplantation and microskin transplantation are hampered by a lack of allogenic skin.

Other newer therapeutic approaches are available to manage skin burn wounds. Nanotechnology-based wound management, which involves the delivery of growth factors to burned skin, scaffolds, dressings, etc., for exogenous stem cells to aid in skin regeneration, have shown exceptional efficacy.^{19,20} Cultured epidermal autograft (CEA) transplantation has also shown good clinical effects, such as soft skin, good texture, and better recovery of skin pigmentation and scar conditions.²¹ The keratinocytes obtained from a skin biopsy are cultured with feeder cells and can be expanded more than 5,000- to 10,000-fold; however, transplantation must be delayed by 3 to 4 weeks.^{22,23}

The various successful techniques for treating deep burn wounds must be performed in high-level facilities with high-quality materials, making such techniques expensive to perform; therefore, conservative treatment is still needed in certain situations for certain patients. In addition to the shortage of allogenic skin, which hampers some techniques, the patient's age, physical condition, and economic status also affect the outcomes of routine surgery. Moreover, for patients with critical burns, wounds in the lower limbs are treated first, followed by those in the upper limbs and the torso, and wounds in the thigh root, hip, and iliolumbar are treated last. Nevertheless, the treatment of some wounds in the limbs may be delayed because of delays in harvesting skin from the scalp. Therefore, there is a need for wound management strategies that can be used as an alternative or supplementary treatment to early eschar excision and routine skin grafting but can accomplish the same outcomes.

In this study, we suppose that a burn eschar can be useful as coverage material if it can be well preserved. Among various conventionally available antimicrobial formulations, silver sulfadiazine (SSD), which can penetrate the eschar to control subeschar bacterial invasion in deep burns, is considered the mainstay topical therapy for the management of major burns.²⁴ The eschar can be preserved for as long as one month or so.

We made the holes through the eschar with a distance between the holes of approximately 1.5 cm-2.0 cm, which was a slightly greater distance than that of conventional intermingled skin grafting, whereas the small skin patches were 0.3 cm × 0.3 cm-0.3 cm × 0.5 cm in size, which was smaller than that of

conventional intermingled skin grafting.²⁵ The expansion ratio in this study was greater than that of conventional skin grafting; however, the higher the ratio was, the longer it took to close the wounds.

One of the greatest risks of eschar preservation is wound infection. As is well known, eschar excision with skin grafting is the gold standard for treating massive burns. In recent years, eschar excision has been performed as early as 3 or 4 days after burn injury to decrease the risk of wound infection and death in burn patients.^{26,27} Owing to the different conditions of each patient, the skin remained inlaid from the 4th to the 21st day after burn injury, and several patients had a long-term eschar. When the eschar was dissolved with silver sulfadiazine cream, the necrotic tissue softened, and the amount of secretions increased. Moreover, the risk of infection increased, and some skin patches dissolved, which reduced the survival rate of the skin patches to some extent.

Nonetheless, the benefit of this approach is that it may preserve the dermal tissue as much as possible, which is considered a key factor in determining wound healing and scar quality.²⁸ Non tangential excision (sharp debridement) plays an important role in preserving dermal tissue. Enzymatic debridement has been proven to be a safe method for the treatment of burns covering more than 15% of the TBSA.²⁹ It can reduce the blood loss volume, improve dermal preservation and even reduce the need for autografting.³⁰ Another effective method of debridement is hydrosurgical excision, which is a novel alternative for managing deep partial-thickness and full-thickness burn wounds.³¹ The precision and tissue selectivity of the hydrosurgical technique for excising burn tissue while preserving dermal tissue have been established, although the procedure must be performed in special facilities, which may be expensive. Therefore, we expect that in our subsequent research, enzymatic debridement or hydrosurgical excision can be used during the debridement process to improve wound treatment efficiency, which may reduce the risk of skin dissolution and increase the skin survival rate to some extent.

Another disadvantage of our study is that it was a time-consuming and slow process to inlay the skin patches piece-by-piece into the holes, and the subsequent workload of dressing changes also brought significant pressure to medical staff. This is also an important reason why intermingled skin grafting has almost been forgotten, as was said by Domres B.¹² In recent years, scholars have reported that the use of negative pressure wound therapy (NPWT) can significantly reduce the frequency of dressing changes, which may be a psychological and logistical advantage.³² We assume that the NPWT technique will be applied to an isolated deep burn wound in our study after the eschar is removed to simplify the dressing change process and improve wound healing efficiency.

Our current research focused mainly on exploring the feasibility of this method, so the skin graft area was relatively small. If the skin graft area is larger, an excessively long operative time may become the greatest barrier to this method. However, patients who are unwilling to undergo conventional skin grafting surgery still benefit more from this method. Moreover, it can be used as a supplementary treatment for routine skin grafting as well as for burn sites (thigh root, hip, ilio-lumbar, etc.) outside the conventional surgical area of patients with extensive burns.

In future research, we will optimize the experimental design to determine the optimal time for skin inlaying, appropriate size of skin patches and optimal distance between the skin patches, as well as a more effective wound treatment after skin inlaying.

CONCLUSIONS

This report reviews several routine skin grafting techniques, including intermingled transplantation and microskin transplantation. Given the lack of allogenic skin, which hampers skin grafting, and the unwillingness of certain patients to undergo routine surgery, we propose for the first time a new method for treating deep burn wounds. We confirmed that it is feasible for eschar perforating and inlaying small autologous skin patches in the treatment of deep burn wounds. It can be used as a supplementary treatment for routine skin grafting as well as for burn sites (thigh root, hip, iliolumbar, etc.) outside the conventional surgical area of patients with extensive burns. It can also be used as an effective conservative management scheme for patients with deep burns who refuse conventional skin grafting. The optimal timing and specific method of skin inlaying still need further research and optimization.

Declarations

Author contributions

Conceptualization, H.W. and M.O.; Surgical procedures, H.W.; Surgical assistance, M.O., T.W., C.L., S.L., and X.S.; Methodology, M.O. and T.W.; Patient recruitment and perioperative care, T.W. and C.L.; Data curation, S.L.; Writing – original draft, M.O.; Writing – review & editing, H.W.; Visualization, X.S.; Funding acquisition, H.W. All authors have read and agreed to the published version of the manuscript.

Competing interests

The authors declare no competing interests.

Institutional review board statement

This study was approved for implementation by the Ethics Committee of the First People's Hospital of Xuzhou, with approval number xyyl[2023]077.

Data availability statement

The clinical data generated and/or analysed during the current study are not publicly available due to patient privacy and confidentiality protections, but are available from the corresponding author on reasonable request.

Funding

This study was supported by the Xuzhou Municipal Health Commission Science and Technology Project [grant number: XWKYHT20250008] and the Xuzhou "Health Peak" Team Training Project [grant number:

References

1. Kaddoura, I., Abu-Sittah, G., Ibrahim, A., Karamanoukian, R. & Papazian, N. Burn injury: review of pathophysiology and therapeutic modalities in major burns. *Ann. Burns Fire Disasters*. **30**, 95–102 (2017).
2. Legemate, C. M. et al. Application of hydrosurgery for burn wound debridement: An 8-year cohort analysis. *Burns* **45**, 88–96. 10.1016/j.burns.2018.08.015 (2019).
3. Deodhar, A. K. & Rana, R. E. Surgical physiology of wound healing: a review. *J. Postgrad. Med.* **43**, 52–56 (1997).
4. Wang, Y. et al. Burn injury: Challenges and advances in burn wound healing, infection, pain and scarring. *Adv. Drug Deliv Rev.* **123**, 3–17. 10.1016/j.addr.2017.09.018 (2018).
5. Abazari, M., Ghaffari, A., Rashidzadeh, H., Momeni Badeleh, S. & Maleki, Y. Current status and future outlook of nano-based systems for burn wound management. *J. Biomed. Mater. Res. B Appl. Biomater.* **108**, 1934–1952. 10.1002/jbm.b.34535 (2020).
6. Chouinard, N. H. et al. The economic burden of burned patients for hospitalization in Canada. *Burns* **50**, 1494–1503. 10.1016/j.burns.2024.03.036 (2024).
7. Gurtner, G. C., Werner, S., Barrandon, Y. & Longaker, M. T. Wound repair and regeneration. *Nature* **453**, 314–321. 10.1038/nature07039 (2008).
8. Franz, M. G. et al. Guidelines to aid healing of acute wounds by decreasing impediments of healing. *Wound Repair. Regen.* **16**, 723–748. 10.1111/j.1524-475X.2008.00427.x (2008).
9. Wang, W., Lu, K. J., Yu, C. H., Huang, Q. L. & Du, Y. Z. Nano-drug delivery systems in wound treatment and skin regeneration. *J. Nanobiotechnol.* **17**, 82. 10.1186/s12951-019-0514-y (2019).
10. Yang, Z. C. [Recalling the 60 years' glory of burn medicine in China]. *Zhonghua Shao Shang Za Zhi.* **34**, 497–499. 10.3760/cma.j.issn.1009-2587.2018.08.001 (2018).
11. Liao, Z. J. [The intermingled transplantation used in severe burn patients after eschar excision]. *Zhonghua Shao Shang Za Zhi.* **24**, 340–342 (2008).
12. Domres, B., Kistler, D. & Rutczynska, J. Intermingled skin grafting: a valid transplantation method at low cost. *Ann. Burns Fire Disasters.* **20**, 149–154 (2007).
13. Sadeghi-Bazargani, H., Maghsoudi, H., Soudmand-Niri, M., Ranjbar, F. & Mashadi-Abdollahi, H. Stress disorder and PTSD after burn injuries: a prospective study of predictors of PTSD at Sina Burn Center, Iran. *Neuropsychiatr Dis. Treat.* **7**, 425–429. 10.2147/ndt.S23041 (2011).
14. Singh, M., Nuutila, K., Collins, K. C. & Huang, A. Evolution of skin grafting for treatment of burns: Reverdin pinch grafting to Tanner mesh grafting and beyond. *Burns* **43**, 1149–1154. 10.1016/j.burns.2017.01.015 (2017).
15. Jeschke, M. G. & Herndon, D. N. Burns in children: standard and new treatments. *Lancet* **383**, 1168–1178. 10.1016/s0140-6736(13)61093-4 (2014).

16. Kamolz, L. P., Schintler, M., Parvizi, D., Selig, H. & Lumenta, D. B. The real expansion rate of meshers and micrografts: things we should keep in mind. *Ann. Burns Fire Disasters*. **26**, 26–29 (2013).
17. Chang, L. Y. & Yang, J. Y. Clinical experience of postage stamp autograft with porcine skin onlay dressing in extensive burns. *Burns* **24**, 264–269. 10.1016/s0305-4179(98)00015-1 (1998).
18. Noureldin, M. A., Said, T. A., Makeen, K. & Kadry, H. M. Comparative study between skin micrografting (Meek technique) and meshed skin grafts in paediatric burns. *Burns* **48**, 1632–1644. 10.1016/j.burns.2022.01.016 (2022).
19. Rajendran, N. K., Kumar, S. S. D., Houreld, N. N. & Abrahamse, H. A review on nanoparticle based treatment for wound healing. *J. Drug Deliv. Sci. Technol.* **44**, 421–430. <https://doi.org/10.1016/j.jddst.2018.01.009> (2018).
20. Mofazzal Jahromi, M. A. et al. Nanomedicine and advanced technologies for burns: Preventing infection and facilitating wound healing. *Adv. Drug Deliv Rev.* **123**, 33–64. 10.1016/j.addr.2017.08.001 (2018).
21. Kan, T. et al. Clinical course of more than 10 years in a patient with extensive skin burns who received cultured epidermal autograft transplantation. *Regen Ther.* **19**, 154–157. 10.1016/j.reth.2022.01.007 (2022).
22. Matsumura, H., Matsushima, A., Ueyama, M. & Kumagai, N. Application of the cultured epidermal autograft JACE(®) for treatment of severe burns: Results of a 6-year multicenter surveillance in Japan. *Burns* **42**, 769–776. 10.1016/j.burns.2016.01.019 (2016).
23. Atiyeh, B. S. & Costagliola, M. Cultured epithelial autograft (CEA) in burn treatment: three decades later. *Burns* **33**, 405–413. 10.1016/j.burns.2006.11.002 (2007).
24. Howell-Jones, R. S. et al. A review of the microbiology, antibiotic usage and resistance in chronic skin wounds. *J. Antimicrob. Chemother.* **55**, 143–149. 10.1093/jac/dkh513 (2005).
25. Kistler, D., Hafemann, B. & Hettich, R. Cytogenetic investigations of the allodermis after intermingled skin grafting. *Burns* **15**, 82–84. 10.1016/0305-4179(89)90134-4 (1989).
26. De La Tejera, G. et al. Early wound excision within three days decreases risks of wound infection and death in burned patients. *Burns* **49**, 1816–1822. 10.1016/j.burns.2023.06.003 (2023).
27. Greenwood, J. E. Advantages of immediate excision of burn eschar. *Anaesth. Intensive Care.* **48**, 89–92. 10.1177/0310057x19895523 (2020).
28. Song, G. et al. Experience and efficacy of surgery for retaining viable subcutaneous tissue in extensive full-thickness burns. *Burns* **42**, 71–80. 10.1016/j.burns.2015.06.012 (2016).
29. Hofmaenner, D. A. et al. Safety of enzymatic debridement in extensive burns larger than 15% total body surface area. *Burns* **47**, 796–804. 10.1016/j.burns.2020.10.012 (2021).
30. Bowers, C. et al. Enzymatic debridement in critically injured burn patients - Our experience in the intensive care setting and during burn resuscitation. *Burns* **48**, 846–859. 10.1016/j.burns.2021.07.023 (2022).

31. Cao, Y. L., Liu, Z. C. & Chen, X. L. Efficacy of hydrosurgical excision combined with skin grafting in the treatment of deep partial-thickness and full-thickness burns: A two-year retrospective study. *Burns* **49**, 1087–1095. 10.1016/j.burns.2022.07.012 (2023).
32. Tapking, C. et al. Negative pressure wound therapy in burns: a prospective, randomized-controlled trial. *Burns* **50**, 1840–1847. 10.1016/j.burns.2024.04.005 (2024).

Figures



A



B



C

Figure 1

Burn wounds when admitted (A, B & C).



Figure 2

Treatment for the wound on the front side of the right thigh. (A) Small skin patches and holes on the eschar were made. (B) Skin patches inlayed into the holes with physiological saline gauze ball. (C) Most skin patches survived when the eschar was moved. (D, E and F) The skin patches expanded gradually.



Figure 3

Treatment for the wound on the left lower limb. (A) Mesh and stamp-like skin transplantation. (B) Small skin patches made for the wound at the root of the left thigh. (C) Skin patches inlaid into the eschar with physiological saline gauze ball. (D) Most skin patches survived when the eschar was moved. (E and F) The skin patches expanded gradually.



Figure 4

Overall healing status of wounds in both lower limbs. (A) The skin patches fused together while the surrounding wounds became granulation wounds. (B and C) Mesh skin and stamp-like skin transplantation for the granulation wounds.



Figure 5

Wound healing and follow-ups. (A) All the wounds healed well. (B) Follow up for 3 months. (C) Follow up for 6 months.