

Revision surgery with dermal regeneration template and vacuum sealing drainage for reconstruction of complex wounds following necrosis of reattached avulsed skins in a degloving injury

A case report

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Abstract

Rationale: Degloving injury of the upper limb often extends to underlying tendons and bone, which is at high risk of treatment failure if only simple reattachment of defatted avulsed skins was performed. Pelnac dermal regeneration template could be used as a treatment choice for necrosis of the reattached avulsed skins in a degloving injury.

Patient concerns: A 48-year-old woman with a degloving injury of the right forearm, wrist, and hand received initial treatment by reattachment of the defatted avulsed skins over the wound bed. However, 17 days postoperatively, the reattached skins developed complete necrosis, leaving large size of tissue defects and tendon/bone exposure.

Diagnosis: Failure to reconstruct the skin and soft-tissue envelop by reattachment of the defatted avulsed skins in a severe degloving injury of the upper limb.

Interventions: We decided to use a 2-stage procedure of Pelnac dermal regeneration template and secondary skin graft to solve this issue, in consideration of these conditions and the patient' demanding of limb function and aesthetic appearance.

Outcomes: At the final follow-up, this patient obtained an excellent result, in term of scar quality, aesthetic appearance, and the ability to perform the daily activities.

Lessons: We believe this could become an interesting option in patients who needed revision procedure for management of complex wounds with tendon/bone exposure following the necrosis of reattached skins in degloving injuries.

Abbreviations: NPWT = negative pressure wound therapy, VSD = vacuum sealing drainage.

Keywords: bone/tendon exposure, degloving injury, dermal regeneration template, pelnac, skin defect

Editor: Johannes Mayr.

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Patient has provided informed consent for publication of the case.

All the authors declare that they have no conflict of interest with any organization that sponsored the research.

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Medicine (2019) 98:23(e15864)

Received: 11 December 2018 / Received in final form: 18 April 2019 / Accepted: 9 May 2019

<http://dx.doi.org/10.1097/MD.00000000000015864>

1. Introduction

Degloving injury of the forearm and hand is not uncommon and often extends to the underlying tendons and bone.^[1] Despite various reports of treatments, degloving injury remains a challenge for orthopedic or reconstructive surgeons. In consideration of the functional and social role of forearm and hand, an optimal functional and esthetic outcome should be targeted as a priority when a reconstructive surgery is considered. Traditionally, simple reattachment of the avulsed skin, full- or split-thickness skin graft, or flaps have always been the mainstream treatments of degloving injuries. However, some drawbacks must be taken into consideration, such as low survival rate of the grafted skins, limited availability of the flaps, and donor site morbidity. In a case series study of 21 patients sustaining degloving injury, authors found a 10% to 50% rate of the necrosis of reattached avulsed skins and postoperative infections.^[2] As for these areas of necrotic grafted skins, revision surgery with autologous skin graft or flap techniques is generally considered, but remains to be compromised by the above-mentioned issues.

During the past 40 years, various dermal regeneration templates have been applied in clinical practices and are

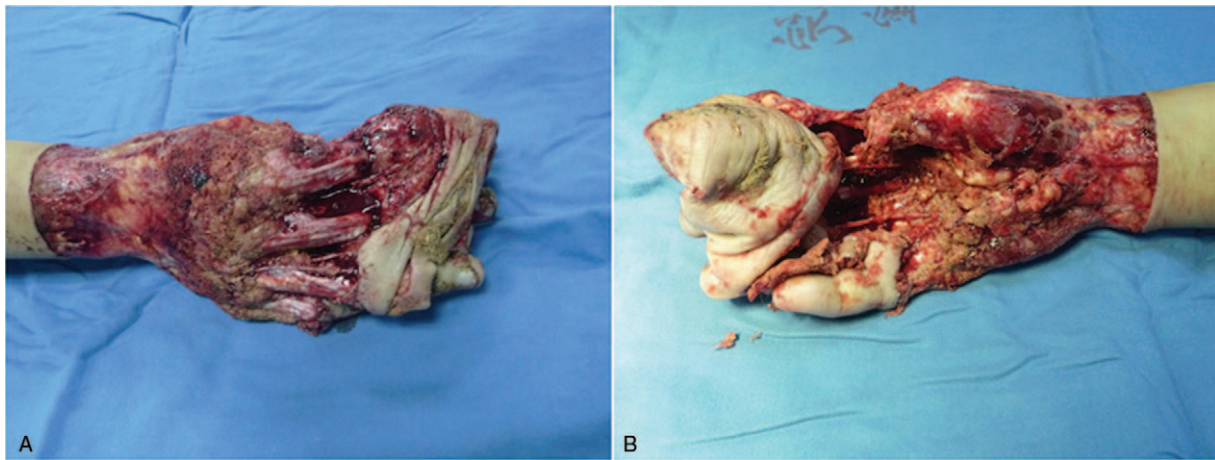


Figure 1. The denuded distal forearm, wrist, and hand showed a complete exposure of both extensor and flexor tendon planes.

demonstrated as useful tools to reconstruct complex full-thickness wounds.^[3–8] Pelnac is such a dermal regeneration template, composed of the overlying silicon layer and the underlying atelocollagen matrix; it is first applied over the skin defect; and after 3 weeks' "waiting" time for complete revascularization of the wound bed, autologous split-thickness skin graft is performed.

In the present study, we report a case of successful reconstruction of skin defects due to necrosis of reattached avulsed skin in a degloving injury of the forearm, wrist, and hand. In this case, Pelnac dermal regeneration template was used in a revision procedure with adjunct and negative pressure wound therapy (NPWT), and 3 weeks afterward, the second-stage autologous split-thickness skin graft was performed.

2. Case report

Ethical approval was obtained from the ethics committee of the 3rd Hospital of Hebei Medical University. The patient has provided written informed consent for publication of the case.

A 48-year-old female, with medical history of hypertension, had experienced a circumferential degloving injury from the distal forearm to her proximal segment of fingers, with distal thumb severed, after her right forearm was caught in a roller in an

industrial accident. The size of the avulsed skin was 280 cm². At her presentation in the emergency department, the denuded distal forearm, wrist, and hand showed a complete exposure of both extensor and flexor tendon planes (Fig. 1).

In the operating room, under the brachial plexus anesthesia, we performed the emergency surgery (indicated as the first operation): thorough debridement of the avulsed skins and wound bed, kirschner pin fixation of the thumb fracture, vascular anastomosis of the thumb, middle and ring finger, and transplantation anastomosis of the dorsum vein. The avulsed skin was defatted until the exposure of the dermal papilla and then 0.5 to 1 cm small stabs were made with 1 cm apart to form the meshed split-thickness skin graft; then, it was reattached over the wound bed and sutured to the surrounding skin. At the 17th day after the first operation, the distal segment of the thumb was completely necrotic; the reattached skins of the palmar and dorsal hand were completely necrotic; the reattached skins of the proximal segment of the middle and ring fingers were partially necrotic (Fig. 2).

At the 18th day after the first operation, the patient was taken back to the operating room for the debridement of necrotic skins and the subcutaneous tissues. Operatively, partial degenerated and necrotic extensor tendon was removed, and distal segment of the thumb was amputated. Vacuum sealing drainage (VSD,

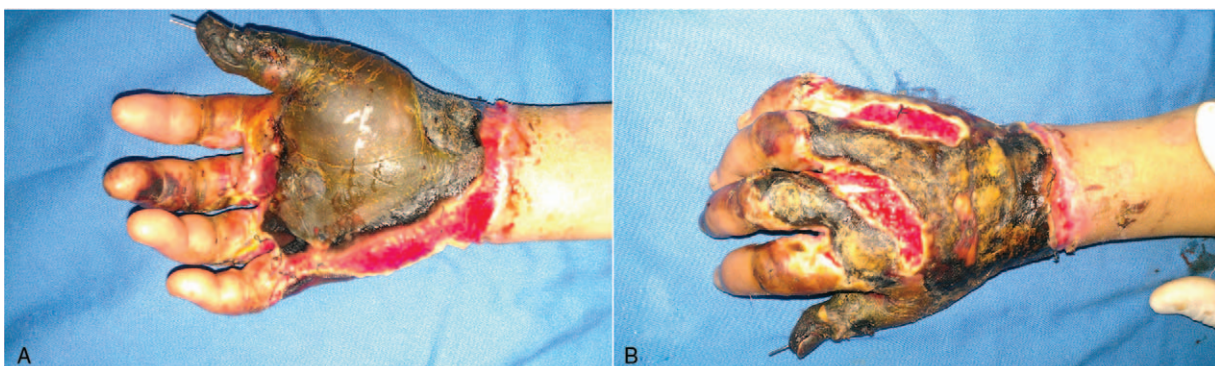


Figure 2. The completely or partially necrotic tissues at the 17th d after the first operation.



Figure 3. No. 11 scalpel blade was used to stab the overlying silicone layer.

Wuhan VSD Medical Science & Technology Co, Ltd, Wuhan, Hubei, China) was used over the wound bed for drainage of wound exudates and prevent potential complications.

At the 28th day after the first operation, VSD was removed, and the wound bed was additionally debrided, with meticulous hemostasis. After complete hemostasis was obtained, the Pelnac dermal regeneration template was trimmed to the appropriate size and shape to achieve a tension-free closure, and was sutured to the surrounding skin. The overlying silicone layer was stabbed with No.11 scalpel blade to facilitate drainage of effusion (Fig. 3). VSD was again used to stabilize the Pelnac and prevent the potential complications such as infections, hematoma, or seroma.

At the 50th day after the first operation, the overlying silicone layer was removed and fresh and plump granulation tissue was visible. Then, under the local anesthesia and brachial plexus block anesthesia, autologous split-thickness skin graft (0.3 mm) harvested from the anteromedial thigh was applied over the Pelnac dermal regeneration template, and tie-over fixation was performed. Dressing change was performed at every second day or as needed. At the 65th day after the first operation, the grafted skins have complete “take,” without any grafted skin loss (Fig. 4). No infections, no infections, hematoma, or seroma was observed. At the 69th day, the patient was discharged from the hospital.

At the 31-month follow-up, the patient had a satisfactory result with high-quality skin characteristics of favorable flexibility and pliability, smooth texture and color matches to the surrounding skin, with only slight pigmentation. No hypertrophic or keloid scar was formed. The patient’ subjective satisfaction for the overall aesthetic appearance was 82/100 (Fig. 5). The pinch test (8) revealed a good scar mobility of 10 mm without any tendon adhesions (Fig. 6). In term of the function of the operated limb to

perform daily activities, patient had an excellent disabilities of the arm, shoulder and hand score of 6 (Fig. 7).

3. Discussion

Degloving injury of the extremities represents a difficult-to-treat condition for the orthopedic or reconstructive surgeon. The role of traditional treatments such as simple reattachment of the avulsed skin, full- or split-thickness skin graft, and regional or free flaps is being challenged, because of the low survival rate of the grafted skins,^[2] limited availability of the flaps, donor site morbidity and the poor aesthetic outcome.^[9] In recent decades, dermal regeneration templates have become a very popular alternative method for reconstruction of full-thickness skin defects in various causes and were reported to result in favorable clinical outcomes.^[6,10–12] In the present case, we used dermal regeneration template Pelnac and the adjunct VSD in a revision procedure to manage large skin defects due to the necrosis of the reattached avulsed skins in a degloving injury; and finally the patient obtained the favorable results in term of high-quality grafted skins, function of the operated limb to perform daily activities, and the aesthetic appearance. To our best knowledge, this is the first report of Pelnac use in a revision procedure following the failure of initial surgery for degloving injury.

The successful take of the dermal regeneration template is the most key step in this 2-stage surgery. A surgically clean wound must be guaranteed; otherwise, any residual devitalized tissue or product by host reaction would potentiate failure. In our clinical practices, after Pelnac was sutured to the surrounding skin, small stabs were made into the overlying silicone layer to facilitate drainage of effusion; and the similar measures have been also



Figure 4. At the 65th d, the grafted skins have complete “take,” without any grafted skin loss and other complications.

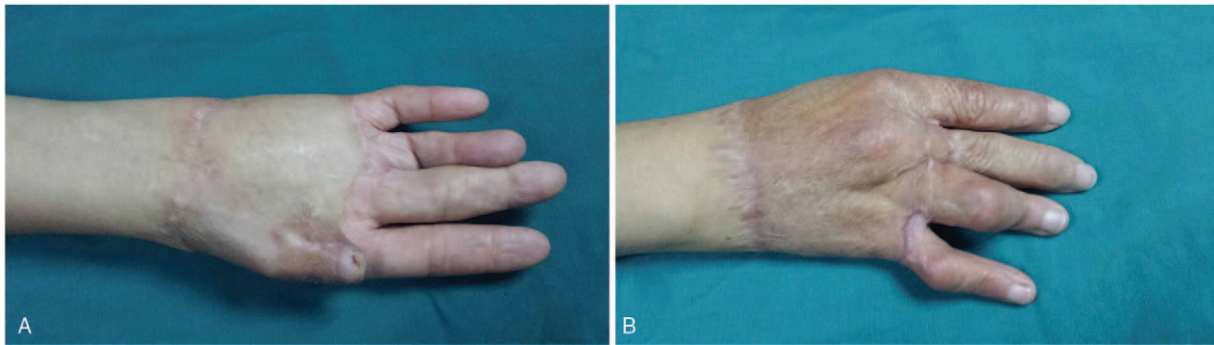


Figure 5. No hypertrophic or keloid scar was formed.

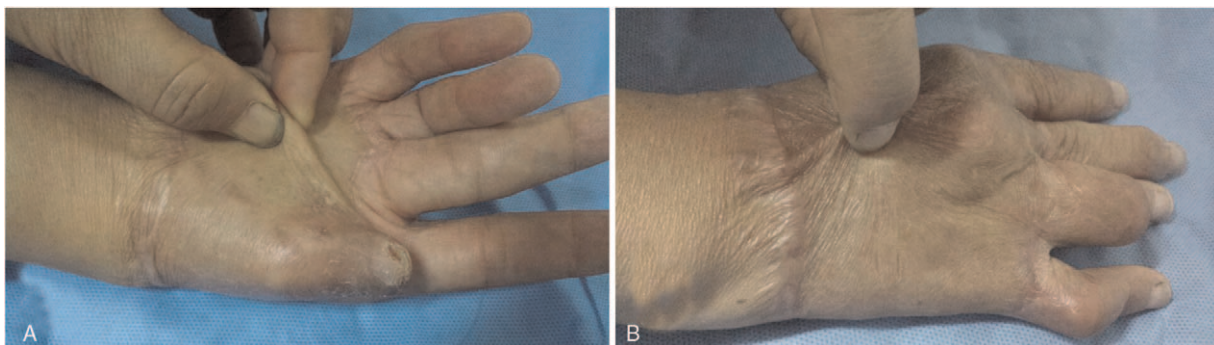


Figure 6. The pinch test revealed a good scar mobility of 10mm without any tendon adhesions.

used in other studies and were demonstrated to be very effective.^[13–15] VSD was also a valuable adjunct, and in this study it was used both for coverage of wound bed after debridement of the necrotic skins and subcutaneous tissue, and

for coverage of the Pelnac dermal regeneration template. A variety of recent studies have reported the favorable results with this technique, although the mechanisms might be different. Compared with conventional bandage-fixing and dressing

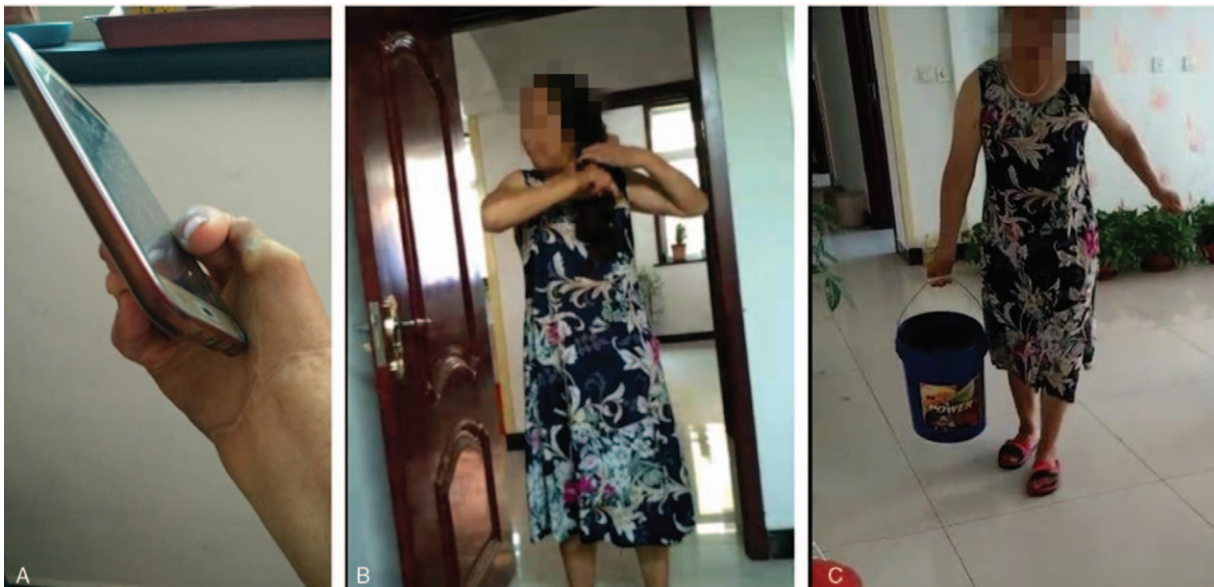


Figure 7. The patient had an excellent DASH score of 6 at the final follow-up. DASH = disabilities of the arm, shoulder, and hand.

changes, negative pressure therapy (VSD) has been beneficial in bacterial clearance, local blood flow, formation of granulation tissues, and provision of greater level of comfort for a patient.^[16] The negative pressure therapy (VSD) could also act as splintage to stabilize dermal regeneration template and accelerate its incorporation into the wound bed.^[15] Furthermore, VSD also seems to assist in neovascularization of the dermal regeneration template^[17] and shorten the time interval between placement of dermal regeneration template and epithelialization of the wound bed.^[15,17] In the present case, no infections, hematoma, or seroma was observed and there was 100% “take” of the dermal regeneration template and the grafted skins, which could be largely attributed to the use of VSD.

With respect to functional recovery, the result of this case also demonstrated favorable outcomes; the patient could perform most daily activities including use of cellphone, combing hairs, carrying the heavy weights, and so on (Fig. 7). Additionally, the pinch test also demonstrated the good grafted skin mobility, indicating no adhesions of the underlying tendons. On 1 hand, this good property of the regenerated tissues might be associated with favorable immunologic response of host tissue to the atelocollagen matrix, which protects underlying structures from incorporation into the overlying regenerated tissues by Pelnac. On the other hand, histological results in a study by Suzuki et al suggested that, the tissues regenerated by Pelnac had almost normal distribution of collagen fibers and elastic fibers, different from scar tissue.^[18] Furthermore, in this case, patient was instructed to gradually perform passive activities of the fingers from the 4th day after surgery, following the principle of gradual progress; from the 8th day, patient started the passive motion of the hand and the joints, assisted by massage for skin relaxation and other physiotherapy for muscle strength, so as to restore hand function as soon as possible. Therefore, relative to the traditional treatments such as free flaps^[19] or pedicled groin-umbilical flaps,^[20] dermal regeneration template is more likely to provide a predictable functional result, due to its allowance of early motion of the injured limb.

Dermal regeneration template includes has many advantages, such as simplicity of the technique, immediate availability and large quantities of the materials, and the predictable results. Despite, some drawbacks associated with Pelnac must be considered, including the high costs from the Pelnac dermal regeneration template and the hospital stays, the need of at least 2 surgical procedures and the long “waiting” time (about 3 weeks) to allow the well-vascularization of neodermis ready for skin graft.

In conclusion, revision surgery with dermal regeneration template and secondary grafting with split-thickness provides excellent results in this case of initially failed treatment of degloving injury; to our knowledge, this is the first report of Pelnac to solve such complex condition. NPWT is a valuable adjunct to promote graft take, facilitate wound care and prevent potential complications. We believe this could become an interesting option in patients who needed revision procedure for management of complex wounds with tendon/bone exposure following the necrosis of reattached skins in degloving injuries.

Acknowledgments

We are grateful to L Wang and D Zhang of the Department of plastic surgery for their kind assistance.

Author contributions

Yong Shen designed the study; Rui Jia and Qiusheng Wang followed up the participants and documented the data; Wenyuan Ding and Qiusheng Wang analyzed and interpreted the data; Lei Fu is responsible for follow-up and provision of the figures. Zhenmu Lv, Lili Yu, and Lei Fu wrote the manuscript and Yong Shen approved the final version of the manuscript.

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