

# One-stage Pelnac Reconstruction in Full-thickness Skin Defects with Bone or Tendon Exposure

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**Summary:** Dermal regeneration template, such as Integra and Pelnac, was originally designed for treating large area burn injury by inducing regeneration of dermis. To date, it has been widely applied in various acute and chronic wound sites. The present study demonstrated that application of artificial dermis alone induced 1-stage wound healing for wounds with bone or tendon exposure that should usually be repaired by flap surgery. Eight patients who presented with skin defects with bone and/or tendon exposure were treated by 1-stage Pelnac approach. All wounds healed within 20 weeks without skin graft or flap surgery. The wound area was reconstructed by nearly normal skin structure and linear scar. In the case of scalp defect, evidence of hair follicle cell migration and regeneration during healing process was observed. Thereby, the 1-stage Pelnac reconstitution can be considered as a novel method for inducing regrowth of epidermis and hair follicles to cure large full-thickness skin defect with bone and tendon exposure in 1 stage. (*Plast Reconstr Surg Glob Open* 2018;6:e1709; doi: 10.1097/GOX.0000000000001709; Published online 21 March 2018.)

**D**ermal regeneration template, such as Integra and Pelnac, was originally designed for treating large area burn injury by inducing regeneration of dermis. To date, it has been widely applied in various acute and chronic wound sites. Classically, dermal regeneration template is a 2-stage artificial dermis followed by skin graft for wound healing.<sup>1-5</sup> Interestingly, several studies have revealed that 1-stage wound healing of scalp and facial defects (range, 1.3–63.5 cm<sup>2</sup>) was achieved by using artificial dermis solely. In these studies, researchers presumed that defects with different sizes were closed by wound contraction and/or reepithelialization.<sup>6-8</sup> However, these defects resulted from skin cancer excision without bone

and tendon exposure. Hereby, the present study demonstrated that application of artificial dermis alone induced 1-stage wound healing for wounds with bone or tendon exposure that should usually be repaired by flap surgery.

## PATIENTS AND METHODS

This study was approved by the Hospital Ethics Committee of the Huazhong University of Science and Technology of Tongji Medical College. All patients agreed to the inclusion of their treatment and healing process (with pictures) in the present study by informed consent. We used Pelnac, which is the artificial dermal product approved by China Food and Drug Administration in mainland China, for wound treatment. Pelnac double layer is composed of atelocollagen sponge layer and a silicone layer. All surgical procedures were performed under aseptic conditions. After debridement and hemostasis, the wound was rinsed with H<sub>2</sub>O<sub>2</sub> and 0.1% povidone iodine 3 times. Then, the wound was covered by Pelnac following the manufacturer's protocol. Shortly, the Pelnac was trimmed for fitting the shape and size of the wound, and then immersed in saline for 15 seconds before coverage. The Pelnac was fixed on the defect by sutures (5/0 Prolene). Drainage holes with small size were made in the silicon film for facilitating exudation. The external dressing was

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changed every 10 days. The silicon film was not detached from the wound until the wound healed completely.

## RESULTS

In this study, 8 patients (range, 4–72-year-old) were treated with Pelnac for covering wounds with bone or tendon exposure (range, 5–49.5 cm<sup>2</sup>) in the scalp and limbs. All wounds resulted from traumatic injuries. Ten to 31 days after primary debridement, the defects were filled with Pelnac by suturing in place. Final wound healing occurred within 13 weeks in average (range, 7–20 weeks). One or 2 linear scars were left in original wound area, depending on the shape of wound. The width of scars varied from 1 to 15 mm depending on the size of wounds.

### Case 1

A 4-year-old girl who suffered from a traffic accident presented a scalp wound. After debridement, a 9×5.5 cm scalp defect and a cranial outer table exposure (5×2.5 cm) were observed, and we reconstructed the wound with artificial dermis (Pelnac, Gunze Limited, Japan) (Fig. 1; see figure, Supplemental Digital Content 1, which displays a wound area before debridement and after wound healing (Case1), <http://links.lww.com/PRSGO/A687>).

The dressing was changed every 10 days, but the silicon film was maintained until suture shedding at 9 weeks after surgical intervention. At this time point, the wound area was reduced to 7×4 cm. Many hairs newly presented in the reepithelialization area close to the wound margin. These hairs featured with short, thin, and curved hair shafts, which were significantly different from the hairs in intact scalp (see figure, Supplemental Digital Content 2, which displays hair follicle regrowth during wound healing (Case1), <http://links.lww.com/PRSGO/A688>). Over the next 9 days, the density of hairs in the same area was increased and hair shafts were longer. More importantly, 2 hairs (black arrow head) were visible in the granulation area (Supplemental Digital Content 2). At 16 weeks after surgical intervention, a 4×2 cm wound area was observed. The pattern of hair distribution close to wound margin was similar to 6 weeks before. At least 4 hairs were observed

in the area without epidermis (Supplemental Digital Content 2). At 18 weeks after surgical intervention, a 3×1.5 cm wound area was observed, and 2 hairs were visible in this area (Supplemental Digital Content 2). At 20 weeks after surgical intervention, the wound healed with a curved scar (Fig. 1B; Supplemental Digital Content 1).

### Case 2

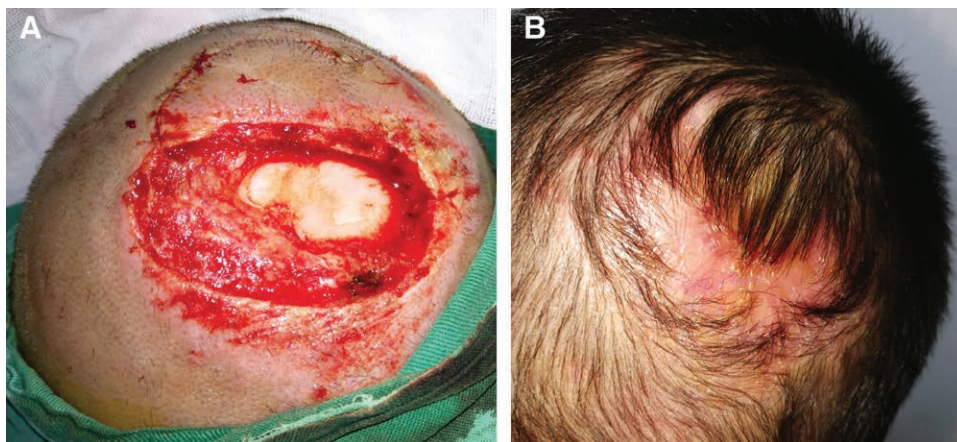
A 38-year-old woman who suffered from a machine injury presented with a 2.5×4 cm defect of dorsal skin with exposure of extensor tendon and intermediate phalange of left middle finger, together with defect of distal phalanx of left ring finger (Fig. 2A). Pelnac was mounted and tacked on the wound of middle finger at 10 days after primary debridement, whereas wound of ring finger was closed directly. The dressing change protocol was routine. The wound healed at 9 weeks postoperatively. By 13 months follow-up, the wound was reconstituted by nearly normal skin structure, and a “Y” type linear scar was evident in site (Fig. 2B).

### Case 3

A 65-year-old man was injured by a machine, resulting in a large skin defect (8×6 cm) with tendon exposure in the dorsal side of the right hand (see figure, Supplemental Digital Content 3, which displays wound healing of a skin defect of hand after treatment with ADT (Case 3), <http://links.lww.com/PRSGO/A689>). Fifteen weeks after Pelnac treatment, the wound healed with only a notch scar in the wound area. Few hairs were observed very close to the scar line (Supplemental Digital Content 3).

## DISCUSSION

Currently, the treatment of wounds with bone and tendon exposure that could not be closed directly often involves flap surgery. In the present study, we reported restoration of such wounds by treatment with Pelnac in 1 stage. All wounds healed within 20 weeks without free skin graft or flaps. The restored skin region displayed appearance and morphological features similar to those of the neighboring skin tissue. Moreover, we observed a



**Fig. 1.** Case 1 (4-year-old girl): scalp injury A, A scalp defect with cranial outer table exposure. B, Wound healed at 20 weeks after Pelnac treatment with a curved scar.



**Fig. 2.** Case 2 (38-year-old woman): hand injury. A, Wound of middle finger after debridement. B, By 13 months follow-up, the wound was repaired by nearly normal skin with a “Y” type linear scar.

series of evidence indicating hair follicle cell migration and regeneration in the scalp defect reconstructing process.

One-stage artificial dermis in reconstruction of scalp and facial defects has been demonstrated by few studies.<sup>6–8</sup> However, all defects from these reports were produced by skin cancer excision without bone or tendon exposure. Classically, wounds with bone and/or tendon exposure were treated by 2-stage artificial dermal template, in which the insertion of artificial dermis induced dermal regeneration followed by free skin graft for final wound coverage. In contrast, the wounds of this study were all with bone and/or tendon exposure and completely restored by 1-stage Pelnac without skin graft or flaps. Previously, researchers considered that the 1-stage wound healing after treatment of artificial dermis was achieved by reepithelization and scar contraction, whereas none of them reported regrowth of hair follicle or other skin appendages. Herein, we observed clear evidence of hair follicle regrowth in the wound area from the case of scalp injury. In this case, many new hairs were observed in the reepithelialized region neighboring wound margin at different time points. Besides, several hairs were visible even in nonepidermal area at different healing stages. In combination with evidence from other cases, these results indicate that the wound healing after treatment of artificial dermis is not only due to reepithelization and scar contraction but also related to regeneration of skin anexa, such as hair follicles, which may be a result of biomaterial-induced stem/progenitor cell migration toward wound area. The majority of patients from other studies were elderly and bald, so that the sign of hair regrowth was hardly to be noticed. In addition, the out-layer silicon film was removed earlier in previous reports than in the present study. In our experience, wounds after treatment of artificial dermis could be closed by reepithelization shortly after silicon removal, and stem cell migration might be hampered by complete wound healing simultaneously. Finally, the cost of Pelnac

(US\$ 816 in China) we used in this study is not expensive when compared with the cost of skin graft or flap surgery.

In conclusion, for selected patients, 1-stage Pelnac reconstitution can be considered as a novel method for inducing regrowth of epidermis and hair follicles to cure large full-thickness skin defect with bone and tendon exposure in 1 stage.

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