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Treatment of Skin Defects with an Artificial Dermis, PELNAC™

—Key Points for Use in Wounds with High Risk of Infection—

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Introduction

PELNAC, an artificial dermis, is useful for reconstructing various full-thickness skin defect such as third-degree burns, giant nevi, traumas and donor sites of skin flaps. It is also highly useful after resection of malignant skin tumors because it can reduce the sacrificial burden of skin grafts or flaps if extended surgery becomes necessary. However, its use for chronic wounds with a high risk of infection should generally be avoided because it is an artificial material that is not antibacterial. Basic fibroblast growth factor (bFGF) is a cytokine that promotes granulation tissue formation and angiogenesis, and the author has had excellent treatment outcomes even for wounds with a high risk of infection by using bFGF in combination with PELNAC. In this News Letter, the author explains the general usage of PELNAC for wounds with a low risk of infection, as well as its usage for wounds with a relatively high risk of infection.

PELNAC is a bilayer material consisting of a layer of atelocollagen sponge with reduced collagen antigenicity and a silicone film layer. When applied in full-thickness skin defects (Fig. 1a), fibroblasts and capillaries infiltrate the collagen sponge from the surrounding area and proliferate (Fig. 1b). As the collagen produced by fibroblasts increases, the collagen in PELNAC is degraded, absorbed and replaced by dermis-like tissue (Fig. 1c). After 2 to 3 weeks, the silicone film is peeled off and the wound is closed by split-thickness skin grafting (Fig. 1d). Small wounds can close spontaneously through the process of epithelialization.

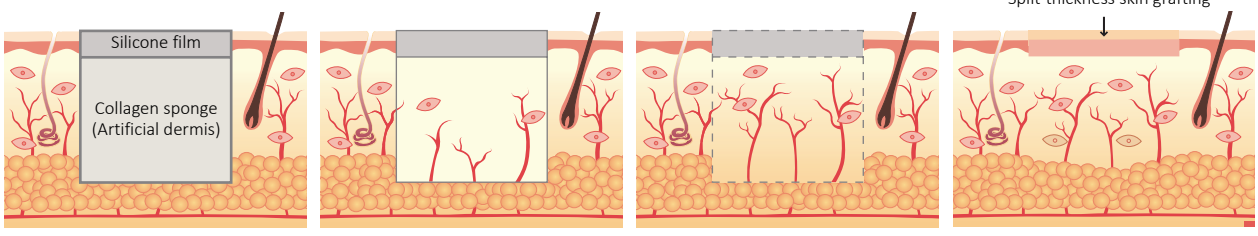

Fig. 1a
PELNAC is applied to full-thickness skin defects.

Fig. 1b
Fibroblasts and capillaries infiltrate and proliferate into the collagen sponge.

Fig. 1c
The original collagen is gradually absorbed and replaced by dermis-like tissue.

Fig. 1d
PELNAC is applied to full-thickness skin defects.

General Usage

Key points

1. Hematoma formation due to bleeding or displacement after application of the artificial dermis hinders the infiltration of cells into the sponge. For this reason, it is important to confirm hemostasis during surgery and to apply mild compression and fixation after surgery. However, caution should be exercised because the pores of the sponge may be crushed if the compression is too strong.
2. During the first 3~4 days after surgery, which is when angiogenesis starts, the wound site should not be disturbed but should be monitored for signs of infection.
3. Since the collagen sponge will dissolve if a postoperative infection occurs, measures and disinfection must be taken at an early stage by removing the silicone film and irrigating.
4. The artificial dermis is replaced by the patient's own dermis-like tissue by about 3 weeks after surgery, leading to formation of a favorable wound bed with abundant blood flow.

Usage of artificial dermis

[Case 1: A female patient aged 67 years, with a third-degree burn on the left lower leg]

Fig. 2a
Before surgery.

Fig. 2b
PELNAC was applied after the removal of eschar.

Fig. 2c
The silicone film was removed 3 weeks after surgery.
The area underneath the film had been replaced by dermis-like tissue

Fig. 2d
After light debridement, thin (8/1000 inch) split-thickness skin grafting was performed.

Fig. 2e
1 year after surgery. The skin graft did not contract, and the texture was favorable.

Usage for Wounds with High Risk of Infection.

Key points

Artificial dermis should be used carefully for patients with chronic skin ulcers with a high risk of postoperative infection, such as diabetic ulcers and pressure ulcers. Since artificial dermis is usually not resistant to infection, it is likely to dissolve if the site becomes infected.

1. an infection is apparent before surgery, it is important to control it by conservative treatment, consisting primarily of bedside irrigation and—of course—incision and drainage, with debridement performed as appropriate.
2. Artificial dermis can be used even if an infection cannot be eradicated, as long as it can be controlled. However, adequate debridement and irrigation will be required during surgery.
3. Since artificial dermis alone is not resistant to infection, angiogenesis should be promoted by combined use of bFGF.
4. Postoperative administration of bFGF is effective if it is administered daily or every other day. The dosage level is different for each patient depending on the total area, but the needed amount (0.3 mL <30 μg> for wound surfaces requiring spraying 5 times per application) can be injected directly into the artificial dermis using a syringe. To spray bFGF it is also possible to slit the silicone film or use the fenestrated type.
5. If an infection occurs despite these measures, problems can be avoided by removing the silicone film and irrigating at an early stage, and then applying conservative treatment again. However, the infection may become getting worse if the intervention is too late. Therefore, careful observation is important at the time of daily wound care.

Combined use of artificial dermis and bFGF (1)

[Case 2: A female patient aged 63 years, with a diabetic ulcer on the left foot]

Fig. 3a

The patient had skin ulcers with necrotic tissue in the plantar region and the 1st to 3rd toes.

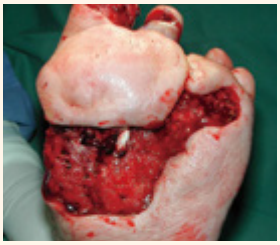

Fig. 3b

Debridement was performed.

Fig. 3c

Combination therapy by PELNAC application and bFGF application was started for wound bed preparation.

Fig. 3d

Favorable growth of granulation tissue was observed 2 weeks after surgery.

Fig. 3e

3 months after skin grafting. The skin graft survived and had a favorable texture.

Combined use of artificial dermis and bFGF (2)

[Case 3: A male patient aged 80 years, with a pressure ulcer in the sacral region]

Fig. 4a

At emergency hospitalization. Because an infection was present, a subcutaneous pocket was incised and drained.

Fig. 4b

Conservative treatment was carried out for 1 month by irrigation and ointment application.

Fig. 4c

However, the bone and ligament remained exposed.

Fig. 4d

Debridement was performed.

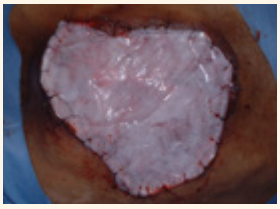

Fig. 4e

Combination therapy by PELNAC application and bFGF application was started.

Fig. 4f

2 weeks after surgery. Granulation tissue had begun to grow over the exposed bone and ligament.

Regenerative medicine requires the following three elements: cells, a scaffold and cytokines. If cells obtained by in vivo culture are utilized, regenerative medicine can be implemented in clinical settings by using an artificial dermis as the scaffold and in Japan a commercially available bFGF preparation as the cytokine. bFGF promotes infiltration of fibroblasts into the collagen sponge and subsequent proliferation, resulting in formation of dermis-like tissue in a short time. In addition, early formation of a vascular system in the artificial dermis enables resistance to infection. In this way, PELNAC can be used even for cases at risk of postoperative infection, situations in which such use had previously been avoided. Favorable results in terms of quality can also be expected because the regenerated tissue is elastic.

Conclusion

Advantages of PELNAC

1. Wound bed preparation

PELNAC is suited even for wound surfaces with exposed bone, cartilage or tendon, as well as areas with poor blood flow, because it promotes formation of a favorable wound bed with abundant blood flow (unlike in the case of conventional skin grafting).

2. Prevention of skin graft contracture

Outcomes equivalent to those of full-thickness skin grafting can be achieved by split-thickness skin grafting because dermal components are regenerated.

3. Reduced sacrifice at donor sites

Skin grafting can be harvested from the same region by performing thin split-thickness skin grafting. In addition, unnecessary sacrifice can be avoided if histopathological diagnosis indicates that additional resection is needed to fully excise a malignant tumor.

Disadvantages of PELNAC

1. Lack of resistance to infection

PELNAC is susceptible to infection because it is an artificial material, and its collagen sponge component would likely dissolve.

2. Prolongation of treatment period until second-stage skin grafting

The duration of treatment is prolonged because it takes 3 weeks for dermis-like tissue to form.

(Excerpted from the author's educational seminar presented at the 53rd Annual Meeting of Japan Society of Plastic and Reconstructive Surgery)

References

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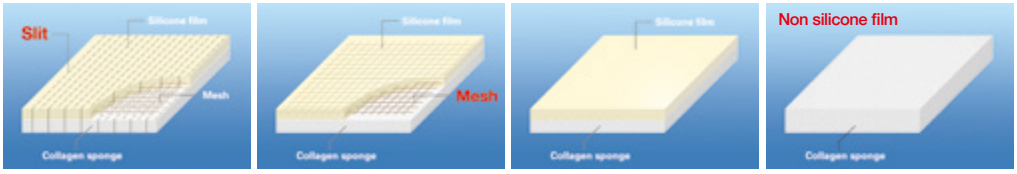
Product image

Variation



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