INTRODUCTION

Treatment of wounds with exposed tendons is difficult because of poor blood flow. Therefore, wound closure has been performed using flaps or artificial dermis. However, in 2003, Kouraba advocated the use of perifascial areolar tissue as a novel and free graft material for coverage of exposed tendons. Perifascial areolar tissue is very useful in the closure of such intractable ulcers but requires donor sacrifice. The OASIS collagen matrix, derived from porcine small intestine submucosa, is a less invasive alternative. OASIS functions as a scaffold to promote the migration, adhesion, and cell proliferation of epidermal keratinocytes and fibroblasts around the wound site and gradually becomes a new dermis-like tissue. To date, there are no reports on the simultaneous application of OASIS collagen matrix and skin grafting. A 76-year-old man presented with a necrotizing soft-tissue infection in the left foot. After debridement, we applied the OASIS collagen matrix to the dorsal tendon-exposed wound and simultaneously performed skin grafting for wound closure. We achieved successful closure of the 8 × 20 cm wound. Graft adhesion was good and toe movement was preserved. The OASIS collagen matrix should be considered in cases with extensively exposed tendons caused by trauma and burns, in which thick-layer or full-thickness skin grafting needs to be performed.

CASE REPORT

The patient was a 76-year-old man with a history of cardiogenic cerebral infarction, diabetes, and hypertension. At the initial visit, the left foot was swollen and hot with some purpura. The laboratory risk indicator for necrotizing fasciitis score was 8. Computed tomography revealed a high-density area with suspected liquid accumulation around the dorsum of the foot. Therefore, necrotizing soft-tissue infection was suspected, and an emergency debridement was performed. Postoperatively, the open wound was washed daily and necrotic skin and fat tissue were excised. The extensor tendons of the second, third, and fourth toes were exposed. From the second postoperative day, we started negative pressure wound therapy (NPWT) with instillation and dwelling (V.A.C.Ulta, KCI Co., Tokyo, Japan). Granulation was gradually observed, but the tendon-exposed area was not covered (Fig. 1). On the 24th postoperative day, reconstruction by split-skin grafting was performed. The skin of the left upper thigh was harvested at 12/1000 inch, a single layer of OASIS collagen matrix (Cook Medical Corporation, Tokyo, Japan) was applied to the tendon-exposed area, which measured about 4 × 5 cm (Fig. 2), and mesh skin grafting was performed (Fig. 3). The skin graft was fixed with V.A.C. When the fixation was removed on the seventh day post–skin grafting, graft adhesion was good and the granulation was increased in the mesh gap. Thereafter, we applied white petrolatum every day. Complete epithelialization occurred on the 25th day post–skin grafting. The OASIS collagen matrix attachment site showed no color or texture differences compared with the surrounding site, and postoperative contracture had not occurred (Fig. 4). After confirming graft acceptance, rehabilitation involved load bearing with gradual walking. Dorsiflexion and plantar flexion abilities were preserved. Toe movement was weak, but gradual improvement was confirmed. On the 37th day post–skin grafting, the pa-
tient was discharged home and was able to walk using crutches.

**DISCUSSION**

For tendon-exposed wounds, NPWT alone cannot achieve sufficient granulation. Therefore, NPWT and artificial dermis are used together to enhance granulation formation, followed by wound closure with a skin graft. However, even with artificial dermis, good granulation may not be achieved on the tendon, and it is very susceptible to bacterial infection.

Kouraba described perifascial areolar tissue (PAT) as a covering material enhancing self-organization in tendon-exposed wounds.¹ It is a reconstruction material that effectively utilizes tissue with a horizontal vascular network collected from the external oblique fascia or the fascia lata. Kouraba reported that good engraftment occurred in cases where skin grafting was performed at the same time as PAT transplantation. Therefore, we performed the

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**Fig. 1.** Progress postdebridement. Day 10 shows granulation after NPWT, but the tendon-exposed area is not covered.

**Fig. 2.** Intraoperative picture. OASIS collagen matrix is applied to the tendon-exposed area.

**Fig. 3.** Mesh skin grafting is completed.
skin grafting and used OASIS collagen matrix simultaneously in this case.

The tendon surface is poorly vascularized and relies on synovial fluid from the synovial tendon sheath for nourishment; however, if the sheath is absent, as in this case, the blood flow on the tendon surface is poor, granulation is not formed, and the skin graft is rejected. In this case, OASIS collagen matrix application promoted cell proliferation from the surrounding cells to the interior and a dermis-like tissue was formed on the tendon, resulting in the formation of a good scaffold. The OASIS collagen matrix is similar in cost to other biologic wound care products, but in Japan, OASIS collagen matrix is currently the only product that combines the scaffold function with the ability to promote cell proliferation through signal transduction. We think that this promotion of cell proliferation differentiates the OASIS collagen matrix from other biologic wound care products and enables simultaneous application with skin grafting.

A single-layer OASIS collagen matrix was chosen because of the simultaneous skin grafting. As a precaution, the OASIS collagen matrix was maintained in contact with the graft bed granulation tissue as much as possible and we used a NPWT-based dressing, as we believe it is most effective for skin graft fixation. In this case, dorsiflexion ability was maintained without adhesion or scar contracture postoperatively, and the cosmetic and functional prognosis was good.

OASIS may be useful for cases with limited range of motion after operation, such as in cases of exposure of the extensor tendon of the dorsum of the hand or exposure of the Achilles tendon by trauma and burns. Furthermore, a single-step reconstruction combining OASIS with skin grafting can reduce treatment duration compared with a staged reconstruction.

Fig. 4. Progress post–skin grafting. Day 64 shows good color and texture.

REFERENCES

1. Kouraba S, Takeuchi A, Honda K, et al. Perifascial areolar tissue graft: novel autologous graft material and its clinical application for coverage of exposed bone and tendon. *Aust N Z J Surg*. 2003;73:A260.
2. Edith S, Chad E, Michael C. Bioactivity of small intestinal submucosa and oxidized regenerated cellulose/collagen. *Adv Skin Wound Care*. 2008;21:479–486.
3. Michael Hiles, Jason Hodde. Tissue engineering a clinically useful extracellular matrix biomaterial. *Int Urogynecol J*. 2006;17:39–43.

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