

# Soft Tissue Reconstruction With Ovine Forestomach Matrix After Wide Excision of Plantar Fibromatosis

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## Abstract

**Background.** Plantar fibromatosis, or Ledderhose disease, presents as plantar fascia nodules caused by hyperactive proliferating fibroblasts. These benign tumorous growths can persist causing pain as well as reduced mobility and quality of life. Plantar fibromatosis may not respond to conservative nonsurgical treatment resulting in surgical intervention, including wide excision of the affected tissue and subsequent reconstruction. Reconstruction of the full-thickness plantar defect is challenging given the location, and recurrence rates are relatively high. Here we present a staged reconstruction of plantar fibromatosis following wide excision using a biologic graft to regenerate the neodermis and subsequent skin grafting. This reconstructive approach provided an alternative to free flap transfer, with excellent functional outcomes.

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**Key words:** plantar fibromatosis; ovine forestomach matrix; extracellular matrix; Ledderhose disease

## Introduction

Plantar fibromatosis (PF; Ledderhose disease) is a rare hyperproliferative benign lesion of the plantar aponeurosis.<sup>1</sup> Lesions are characterized by the proliferation of highly differentiated fibroblasts, abnormal collagen deposition, and multinucleated giant cells.<sup>2,3</sup> While originating at the aponeurosis, severe disease may invade the underlying musculature or overlying subcutaneous tissue, dermis, and epidermis.<sup>4</sup> In the early phases of the disease, symptom-oriented therapies such as offloading orthotic inserts, oral anti-inflammatory medications, corticosteroid injections, and physical therapy can be offered. In some jurisdictions radiotherapy is offered and has been shown to reduce pain.<sup>5</sup> Although these therapies may improve a patient's symptoms, they do not prevent disease progression.<sup>6</sup> Where persistent symptomatic nodes have developed, surgical options may be considered for excision of the lesion(s).

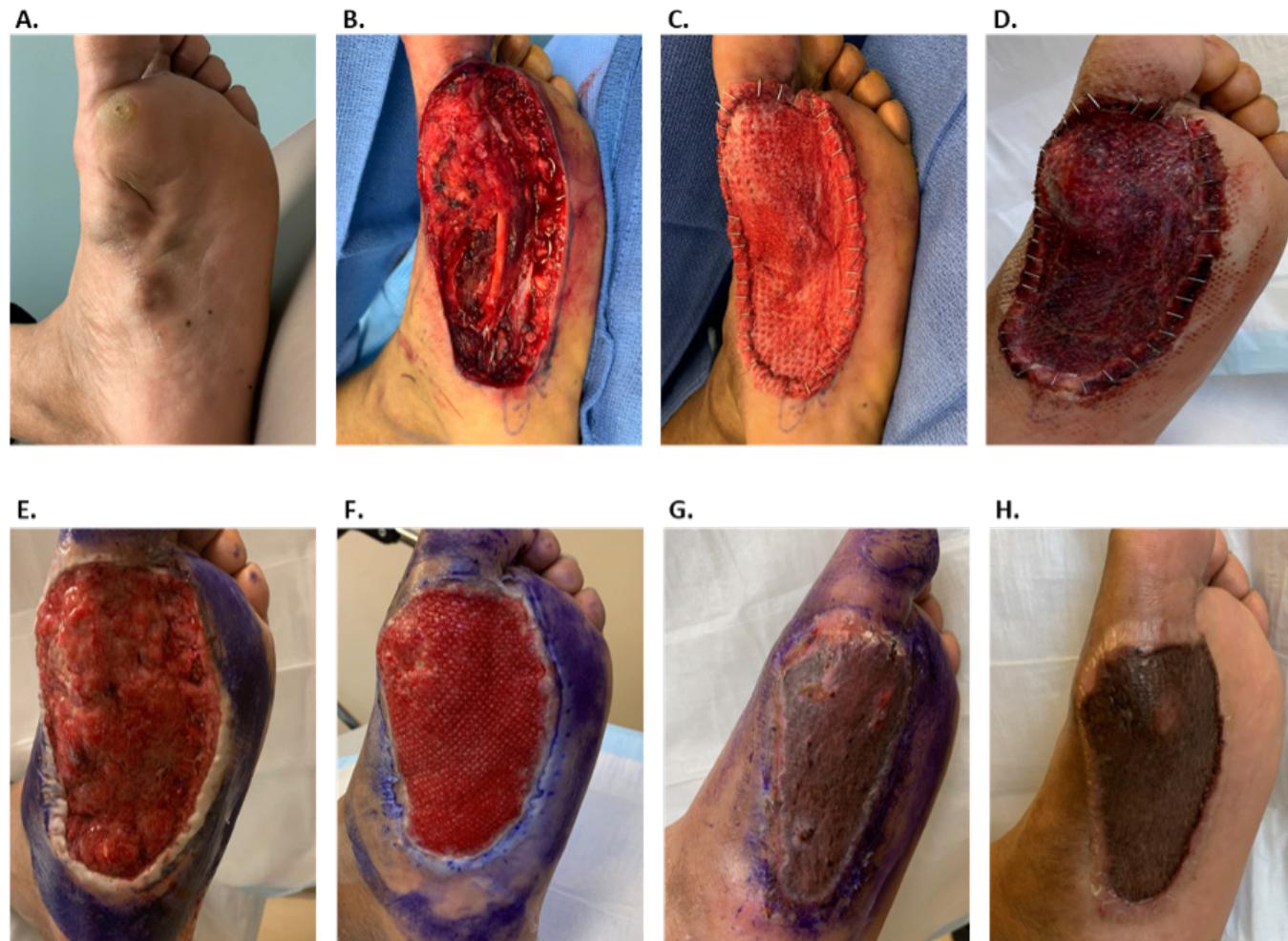
Local surgical excision of lesions typically suffers from poor outcomes with a recurrence rate ranging from 57% to 100%.<sup>1</sup> Wide excision (2–3-cm margin) may slightly reduce these recurrence rates (8%–80%).<sup>1</sup> When the fibroma invades the underlying and/or overlying structures, excision with the fibroma may be required, making primary closure challenging or impossible. In these scenarios, large-volume defects with exposed vital struc-

tures (eg, tendon, bone, neurovasculature) have traditionally been managed with free-flap reconstruction. In addition to the technical difficulty and donor site morbidity, free-flap reconstruction to the plantar foot offers unique challenges because it is a weight-bearing surface.<sup>7</sup>

Here we present a case report of a 60-year-old male patient with a history of recurrent PF, which was refractory to conservative management and 3 previous local excisions. Rather than a wide excision and free-flap reconstruction, the full-thickness defect was reconstructed using a staged reconstruction with application of an ovine forestomach matrix (OFM) graft, regeneration of the plantar neodermis, and closure via a split-thickness skin graft.

## Materials and Methods

The procedure was performed under general anesthesia involving plastic surgery and orthopedic surgery teams. The orthopedic surgeon performed wide excision of the lesion, involving the plantar fascia and superficial flexor muscles (**Figure 1B**). The excision created a defect measuring approximately 15 x 8 x 1.5 cm. The defect was full thickness, with exposure of vital structures including approximately 8 cm of flexor tendon and exposure of periosteum of the first metatarsal phalangeal joint. The resected tissue underwent pathology review with immunohistochemistry



**FIGURE 1.** A) A 60-year-old male with recurrent plantar fibromatosis to the left foot; B) Full-thickness wide excision; C) OFM graft placement; D) postoperative day 4; E) postoperative day 10, thin coverage of first metatarsal phalangeal joint noted; F) postoperative day 33; G) postoperative day 67, 14 days post STSG; H) postoperative day 138, 3 months post STSG.

staining. Spindle cells were positive for  $\beta$ -catenin and smooth muscle actin (SMA), while negative for cytokeratin (AE1/AE3), S100, and desmin. These pathology findings are compatible with a diagnosis of deep plantar fibromatosis.<sup>8</sup>

Immediately following the initial wide excision, an OFM graft (Myriad Matrix, 3-layer, Aroa Biosurgery Limited) was placed over the full-thickness defect. The graft was trimmed and fixed using absorbable sutures and staples (Figure 1C). A non-adherent dressing was applied, with negative pressure wound therapy (NPWT; 125 mmHg) being used as the secondary dressing. During the immediate postoperative period, the patient was strictly offloaded (knee scooter and immobilizing ankle boot), with guidance against any ambulation or pressure application. The patient underwent weekly dressing changes in the outpatient wound center. At postoperative day 10 (Figure 1E) there was an area of thin soft tissue coverage over the first metatarsal phalangeal joint, and the patient was treated with additional weekly outpatient applications of OFM (Endoform Natural, Aroa

Biosurgery Limited) to promote targeted neodermis formation over this area. NPWT dressings were changed twice weekly and non-weight-bearing status was maintained for 4 weeks. At postoperative day 53 a split-thickness skin graft (STSG; 0.0018 inches) was performed, a non-adherent dressing and NPWT (125 mmHg) were applied, and non-weight-bearing precautions were continued. The patient was followed for approximately 9 months.

## Results

The patient with a >10-year history of recurrent PF (Figure 1A) presented for definitive treatment with wide local excision of the recurrent lesions and immediate coverage of the full-thickness defect using an OFM graft. The goal of placing the OFM graft was to provide tissue coverage over the exposed vital structures as part of a staged reconstruction as an alternative to a free flap procedure. At postoperative day 4 the OFM graft was well adhered and beginning to integrate (Figure 1D), and by day 19 it was

fully integrated except for a small area over the first metatarsal phalangeal joint. Due to the limited coverage at this site, placement of a STSG was delayed until postoperative day 53 and the defect was healed by day 75 (Figure 1G), 14 days after the STSG was performed. At long-term follow-up (postoperative day 138, Figure 1H) the defect remained healed and functional tissue persisted. At approximately 9 months, the patient had excellent range of motion, with pliable conforming dermal tissues over the site (see supplementary Video). The patient was referred to an orthotist for customized offloading orthotic inserts that can be worn with normal footwear. The patient was educated regarding lifelong foot checks and appropriate footwear to minimize surgical-site breakdown. At 9 months the patient reported normal pain-free walking and the resumption of an active lifestyle after >10 years of PF.

## Discussion

PF has been reported to account for 18.9% of all soft tissue tumors affecting the foot and ankle.<sup>9</sup> Where conservative interventions fail, surgical intervention is often considered as a last resort to restore function. The challenge with surgical intervention is restoration of the plantar surface post excision. These full-thickness defects may be healed via secondary intention,<sup>10</sup> delayed application of a STSG,<sup>11</sup> or free tissue transfer. While popular, free-flap reconstruction may lead to insensate tissue, donor site morbidity, or flap necrosis due to it being a weight-bearing surface. Additionally, revision surgeries may be required to de-bulk the flap and achieve a functional foot profile.

As an alternative to a free-flap reconstruction we considered a staged approach using a biologic graft, and to our knowledge this is the first report of a staged reconstruction using a biologic graft after wide excision of PF. The OFM graft is a decellularized extracellular matrix developed for applications in soft tissue regeneration,<sup>12</sup> including staged reconstructions of full-thickness defects with exposed structures.<sup>13</sup> OFM provides a scaffold to support host cell infiltration, adhesion, and migration, as well as the formation of new local vascular networks.<sup>14</sup>

Although products such as the OFM graft do not supersede or replace flap-based reconstructions, these devices represent an alternative option where free or rotational flaps are not appropriate or possible due to anatomy, patient selection, potential for donor site morbidity, or surgical training. Further, free flaps can potentially increase the cost of care as they require several hours of operating room time, additional operating room resources, anesthesia, cost to manage the donor site, and possibly longer length of stay to monitor the flap viability. This case represents a successful reconstruction of a large plantar weight-bearing foot using an OFM graft and weekly visits in the outpatient center. With this approach, soft tissue coverage and contour restoration were achieved as a less invasive and technically demanding alternative to a free-flap reconstruction. Additionally, this approach

avoided the creation of a bulky flap that could have reduced ambulation, made footwear challenging, and led to an insensate plantar surface. The described approach of conservative staged surgical management of PF may offer patients a new option for consideration.

## Conclusions

In conclusion, this case report highlights the utility of an OFM graft as part of a wide excision and staged reconstruction of PF as an alternative to a free-flap reconstruction.

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