A 58-year-old female patient presented with pain and edema throughout her left leg. She had surgery for cervical cancer 10 months previously, but developed pain in her left leg and edema from her left groin to her lower leg just four weeks following surgery. She had been receiving complex decongestive therapy (CDT) with manual lymphatic drainage twice a week for several months, and had been wearing flat-knit compression garments daily for the leg.

**CLINICAL FINDINGS**

The patient was a slender woman (body mass index 18) whose left leg was edematous from the groin to the ankle. Bisgaard’s sign was visible, and the Kaposi-Stemmer sign was negative. Nevertheless, the fatty tissue on the entire leg was compressible, and remodeling of the edema into a solid mass had begun. The right leg was unremarkable and slender. There was no evidence of cutaneous changes in the context of the tumor, and the patient had not been conspicuous in tumor follow-up.

**DIAGNOSIS**

Secondary lymphedema stage 2 of the left leg after neoadjuvant chemotherapy and radical hysterectomy with left adnexectomy for cervical carcinoma FIGO IIa2 pN1 (6/18).

**CONSERVATIVE THERAPY AND COURSE**

We recommended that the patient push the current outpatient CDT under inpatient conditions, and referred her to an appropriate specialized clinic. During the 1-week treatment, she underwent lymphatic drainage and bandaging twice daily. The condition of the leg and edematization improved progressively. After discharge from inpatient treatment, the patient received CDT twice a week as before. Custom-made compression stockings with padding in the groin were prescribed for the patient and worn all day.

Six months later, the patient presented again, still receiving CDT twice a week. Reduction or discontinuation attempts led to renewed worsening of symptoms. She now requested surgical treatment for secondary lymphedema. The goal of this treatment was to remove the circumferentially proliferating subcutaneous tissue and reduce the need for CDT to below 20% of the original requirement. After consultation at our specialized clinic, the patient underwent surgery with the added goal of removing any scar tissue from previous CDT treatments.

**Summary:** Proteoglycans (PG) are essential for regulating water flow in the interstitium. From stage 1 of lymphostasis, there is an accumulation of interstitial PG, which regulate the increasing fluids. As the disease progresses, more PG are formed than degraded, resulting in proliferation, and increases in circumference and volume of solid tissue. The removal of this subcutaneous tissue, which is very rigid due to cross-linked PG, is a particular challenge in lymphedema surgery. Hyaluronidase has a lytic effect on these PG structures and, after subcutaneous infiltration, reduces the viscosity of the extracellular matrix, promoting diffusion and penetration of solutions into the surrounding tissue. By using hyaluronidase in our vascular-sparing surgical protocol (lymphological liposculpture), we have not observed any lymphedema recurrences even after 15 years. *(Plast Reconsr Surg Glob Open 2021;9:e3995; doi: 10.1097/GOX.0000000000003995; Published online 10 December 2021.)*

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the patient opted for lymphological liposculpture, a surgical intervention approach with special postoperative lymphatic vessel training.1

THE SURGICAL METHOD
“LYMPHOLOGICAL LIPOSCULPTURE” WITH MODIFIED TUMESCENT LOCAL ANESTHESIA (TLA+H)

Because with hyaluronidase in TLA, it can be assumed that only very small amounts of enzyme are absorbed by the patient,5 we have titrated up to 6000 I.U. per liter, which provides good efficacy. Using the spreading effect of hyaluronidase, we prepare the subcutaneous matrix for lymphological liposculpture2,3 with 6000 I.U. of hyaluronidase (“Hylase Dessau”), 10 mL of 2% lidocaine, and 10 mL of 1% prilocaine per liter of TLA+H. The use of hyaluronidase described here is an off-label use.

In this case, 1800 ml of TLA with 10,800 I.U. hyaluronidase was used in the first operation. After exposure for 90 min, we removed 1800 ml of tissue from the outer half of the left leg from the groin to the ankle using the MicroAire PAL (Power-assisted Liposuction) system with a 5 mm cannula in vibration mode. In the second surgery, 4 weeks later, the subcutaneous tissue was again infiltrated with 1800 ml of TLA+H and 1500 ml of tissue was aspirated from the inner side of the left leg.

POSTOPERATIVE MANAGEMENT FOLLOWING LYMPHOLOGICAL LIPOSCULPTURE

After surgery, patients are treated with intermittent compression and remain at our facility for 24 hours for monitoring. They receive a compression stocking plus overlying bandaging from periphery to center and are then discharged.

Further postoperative care is provided by the patient’s on-site physical therapist: (1) Fourteen days of physical therapy with daily lymphatic drainage and compression stocking plus bandaging. (2) After 2 weeks, reduction of postoperative CDT to lymphatic drainage three times a week and daily 12-hour compression by stocking and pads, without additional bandaging.

Course and Discussion

Fourteen days after the last operation, the patient presented with a very satisfactory course of healing and largely resolved postoperative bruising. (See figure, Supplemental Digital Content 1, which shows photographic images of the legs two weeks after Lymphological liposculpture on the left leg. http://links.lww.com/PRSGO/B864.) She had already started the reduction of CDT as part of the postoperative management plan.

The subsequent course continued to be unproblematic: (1) CDT was reduced from three times to once per week over the next 3 months. Flat-knitted compression garment class 2 (23–32 mm Hg) was worn half-day. (2) A further 8 weeks later, the compression garment was worn only at work, and successfully omitted on weekends; lymphatic drainage was performed once every 14 days. (3) Two and a half years after the last surgery, lymphatic drainage is performed once a month, and compression is no longer necessary. At a follow-up examination two years after the surgical procedure, the volume of the legs was measured. The left leg was only about 4% thicker (7965 mL) than the right leg (7646 mL). The circumference at the thickest part of the thigh was 45.2 cm versus 44.6 cm on the right leg; for the lower leg, it was 32.4 cm versus 32.0 cm. The goal of lymphological liposculpture surgical treatment of secondary lymphedema, reduction of the need for CDT to below 20% of the original requirement, has been achieved, and the difference between the legs is almost eliminated (Fig. 1).

Since 2005, we have been using TLA+H in lymphological liposculpture of secondary lymphedema and have treated more than 20 lymphedema cases on arms and legs with this method. In our experience, the dissolution and dissection of the spongy proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglycan-perfused proteoglyc

Fig. 1. Lymphologic liposculpture results in leg approximation. Legs before (A, B) and 2.5 years after (C, D) lymphological liposculpture on the left leg.
subcutaneous tissue is greatly enhanced by the use of hyaluronidase. When hyaluronidase is administered simultaneously with a local anesthetic (e.g., procaine, lidocaine), the analgesic effect is accelerated, the pain-insensitive area is enlarged, the time to reach maximally anesthetized skin is shortened by up to one-third, and postoperative pain is significantly reduced. Importantly, neither the duration of action of the local anesthetic nor wound healing are negatively affected. We have not observed any side effects with the use of up to nearly 11,000 I.U. of hyaluronidase per surgery, significantly more than in other dermatological surgeries where lower volumes and doses of up to 1500 I.U. are used. In particular, there were no pectanginal complaints such as dizziness, shortness of breath, eczema or urticaria, or allergic reactions in the area of the face, lips, neck, ears, arms, or legs. Also inflammation, redness or pain, and nausea or vomiting did not occur in our patient. To quantify the supportive effect of hyaluronidase in greater detail, we suggest a study that compares lymphological liposculpture with and without the addition of the enzyme.

REFERENCES
1. Cornely ME. Lymphologische liposkulptur [Lymphologic liposculpture]. Der Hautarzt. 2007;58:653–658.
2. Cornely M. Lipödem und lymphödem. In: Plewig G, Prinz J, eds. Fortschritte der Praktischen Dermatologie und Venerologie. Springer-Verlag; 2003:255–263.
3. Klein JA. The tumescent technique for lipo-suction surgery. Am J Cosmetic Surg. 1987;4:263–267.
4. Clark LE, Mellette JR Jr. The use of hyaluronidase as an adjunct to surgical procedures. J Dermatol Surg Oncol. 1994;20:842–844.
5. Wohlrab J, Finke R, Franke WG, et al. Clinical trial for safety evaluation of hyaluronidase as diffusion enhancing adjuvant for infiltration analgesia of skin with lidocaine. Dermatol Surg. 2012;38:91–96.