

# Minimal Invasive Lymphaticovenular Anastomosis Under Local Anesthesia for Leg Lymphedema

## *Is It Effective for Stage III and IV?*

Isao Koshima, MD, Yuzaburo Nanba, MD, Tetsuya Tsutsui, MD, Yoshio Takahashi, MD, Seiko Itoh, MD, and Misako Fujitsu, MD

**Abstract:** This is the first report on the effectiveness of minimal invasive lymphaticovenular anastomosis under local anesthesia for leg lymphedema. Fifty-two patients (age: 15 to 78 years old; 8 males, 44 females) were treated with lymphaticovenular anastomoses under local anesthesia and by postoperative compression using elastic stockings. The average duration of edema of these patients before treatment was  $5.3 \pm 5.0$  years. The average number of anastomosis in each patient was  $2.1 \pm 1.2$  (1–5). The patients were followed for an average of  $14.5 \pm 10.2$  months, and the result were considered effective (82.5%) even for the patients with stage III (progressive edema with acute lymphangitis) and IV (fibrolymphedema), but others showed no improvement. Among these cases, 17 patients showed reduction of over 4 cm in the circumference of the lower leg. The average decrease in the circumference excluding edema in bilateral legs was  $41.8 \pm 31.2\%$  of the preoperative excess length. These results indicate that minimal invasive lymphaticovenular anastomosis under a local anesthesia is valuable instead of general anesthesia.

**Key Words:** lymphedema, lymphaticovenular anastomosis, supermicrosurgery, lower leg lymphedema, microsurgery

(*Ann Plast Surg* 2004;53: 261–266)

Received February 22, 2003 and accepted for publication, after revision, January 12, 2004.

From the Department of Plastic and Reconstructive Surgery, Graduate School of Medicine and Dentistry, Okayama University, Okayama, Japan.

A part of this work was presented at the 44th Annual Meeting of the Japanese Society of Plastic and Reconstructive Surgery in Osaka, on April 12, 2001; the 5<sup>th</sup> International Course on Perforator Flaps in Gent, Belgium, on September 28, 2001; and the 2<sup>nd</sup> World Society for Reconstructive Microsurgery in Heidelberg, Germany, on June 11, 2003.

Reprints: Isao Koshima, MD, Plastic and Reconstructive Surgery, Graduate School of Medicine and Dentistry, Okayama University, 2-5-1, Shikata, Okayama City, 700–8558, Japan. E-mail: plakoshi@cc.okayama-u.ac.jp

Copyright © 2004 by Lippincott Williams & Wilkins

ISSN: 0148-7043/04/5303-0261

DOI: 10.1097/01.sap.0000120319.89926.07

O'Brien and colleagues<sup>1–3</sup> developed microlymphaticovenous anastomoses for obstructive lymphedema and summarized their long-term results. They mentioned that a decrease in excess volume was observed more frequently in the upper extremities than in the lower extremities.<sup>3</sup> Thereafter, several authors, including the present authors, reported on the effectiveness of this anastomosis for lower leg edema.<sup>4–10</sup> Among them, Campisi et al<sup>9</sup> stressed the importance of staging of lymphedema (stage I: initial and irregular edema; II: persistent edema; III: persistent and progressing edema with acute lymphangitis; IV: fibrolymphedema; V: elephantiasis) for selection of the treatments. They indicated surgical anastomosis for the cases with stages II and III.

Recent supermicrosurgical techniques, with which vascular anastomoses less than 1 mm are possible, have made possible the anastomosis of more precise vessels of 0.3- to 0.8-mm caliber size.<sup>11–13</sup> This technique means a vascular anastomosis less than 0.8 mm with 6 to 8 watertight stitches using 11–0 or 12–0 nylon with a 50- to 30- $\mu$ m needle can be used. Even in legs with lymphedema of long duration, we believe that there remain a sizable number of lymphatics and subdermal venules (0.5 mm). With the supermicrosurgical technique, anastomosis of lymphatics and the subdermal venular system with a higher patency rate has been possible. The application of this technique to the drainage of lymphatic fluid into the subdermal venular system had been achieved with improved results. Based on our previous results of lymphedema patients operated upon under general anesthesia, it is considered that this surgery can be achieved under local anesthesia.

This paper reports on the usefulness of supermicrosurgical lymphaticovenular anastomosis under local anesthesia as a minimal invasive treatment of leg lymphedema with stages III and IV.

### Operative Technique

Operative treatment was applied to patients with severe edema who had shown little improvement with conservative

treatment of at least 6 months' duration. Under local anesthesia, after making short incisions on the medial aspects (totally 2 or 3 incisions, each one 3 cm in length), the lymphatics and subdermal venules (each 0.5 mm in diameter) are explored using a loupe or operating microscope through the great saphenous vein. A tourniquet cannot be used because the surgery is under local anesthesia. The incisions are preferable on thin adiposal portions such as the medial aspect of the pretibial areas of the proximal and middle lower leg and ankle, because the lymphatic can be easily found with a short incision. The lymphatics, normally translucent and sometimes white with a thick fibrotic wall, can be detected by reflecting microscopic light between adiposal particles in a superficial or deep adiposal layer, sometimes in a subdermal layer.

The affected lymphatics are often dilated or sclerotic. Dye staining is not always a good indicator for finding lymphatics because their collecting function has been lost. When no suitable lymphatics are found in one site, other incisions are made in other portions of the leg and foot dorsum. The subdermal venules, which exist anywhere beneath the dermis, can be usually detected adjacent to the lymphatics. Regarding the selection of these channels, lymphatics with strong drainage function, which are easily detected after transecting them under an operating microscope, should be selected to establish powerful lymph-venous shunting. Small subdermal venules of 0.5-mm caliber size are most suitable for joining with the lymphatics, because larger cutaneous veins may have higher intravascular pressure than that of the lymphatics. Larger dilated lymphatics over 0.5 mm, which are sometimes detected in either the superficial or deep adiposal layer, are anastomosed to the small venular branches of the main cutaneous vein. The distal side of venous system must be transected to establish anterograde lymphatic flow because the venous valves exist in the venules. Without a vascular clump, end-to-end lymphaticovenular anastomoses of the same size are carried out using 50- or 30- $\mu$ m needle sutures (with 11-0 or 12-0 nylon) with a fine needle holder (specially produced by MEDICONE Company, Germany; Koshima ultramicro series) under high magnification (20 to 30 $\times$ ). During anastomosis, lymphatic fluid coming back to the ends of transected lymphatics expands both ends of the transected lymphatics and venules. After completion of anastomosis, expansion of the venule is detected by filling of the lymphatic flow. Although these operations can be completed within 2 hours, some patients with irradiated bladders need catheter urination. Postoperatively, a low-pressure bandage and vascular dilating drug (prostaglandin E1) are applied, and the patients are allowed to walk freely. Five or 6 hours after surgery, erythema of the affected whole leg sometimes occurs in cases with establishment of reverse flow from the venous to the lymphatic system. The erythema usually disappears

spontaneously within 5 days. A week later, elastic stockings are used for at least half a year.

### Patient Summary

A total of 57 patients with lymphedema of the leg including stage IV with persistent and progressing edema with lymphangitis and stage IV with fibrolymphedema were operated upon with lymphaticovenular anastomoses. These patients, who had been treated with conservative methods, showed little improvement, or the circumference of the lower leg had reached a plateau. The most common cause of edema was hysterectomy (including pelvic lymph node dissection) with or without radiation therapy for uterine cancer. Following surgery, the patients underwent conservative treatment consisting of the continuous wearing of an elastic stocking and occasional pumping. For an objective assessment of edema, the circumferences of the affected and opposite normal lower leg were measured at 10 cm above the superior border of the patella and at 10 cm below the inferior border of the patella, at the ankle and foot, and also measured in the morning at our outpatient clinic.

Fifty-two patients (age: 15 to 78 years old; 8 males, 44 females) were followed after lymphaticovenular anastomoses and postoperative conservative treatment. The average duration of edema of these patients before treatment was  $5.3 \pm 5.0$  years. The average number of anastomosis in each patient was  $2.1 \pm 1.2$ .<sup>1-5</sup> The patients were followed for an average of  $14.5 \pm 10.2$  months, and the result were considered effective (82.5%). However, others showed no improvement. Among these cases, 17 patients showed reduction of over 4 cm in the circumference of the lower leg. The average decrease in the circumference excluding edema in bilateral legs was  $41.8 \pm 31.2\%$  of the preoperative excess length.

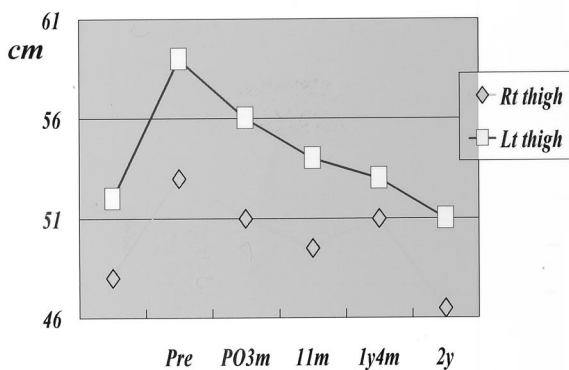
### CASE REPORT

#### Case 1: Early Anastomosis for Stage III (Progressive Edema With Acute Lymphangitis)

A 35-year-old woman experienced secondary lymphedema of the bilateral leg. After hysterectomy and following radiation for uterus carcinoma, the edema of the right leg of 2 months' duration and of the left leg of 4 months' duration was treated surgically because the edema resisted strong and constant compressive therapy and both legs showed phlegmon. Under local anesthesia, one lymphaticovenular anastomosis was made at the distal thigh medial aspect of each leg. Fourteen months after the primary surgery, a third operation was performed at the bilateral ankle under local anesthesia. Two years after the primary operation with compressive therapy, a constant and gradual reduction in the circumference of both legs ( $-6.5$  cm in the right thigh;  $-8$  cm in the left thigh) has been achieved (Fig. 1). Now, 3 years after the primary anastomosis, the patient has continued her former full time job, nutritionist, with standing all day.



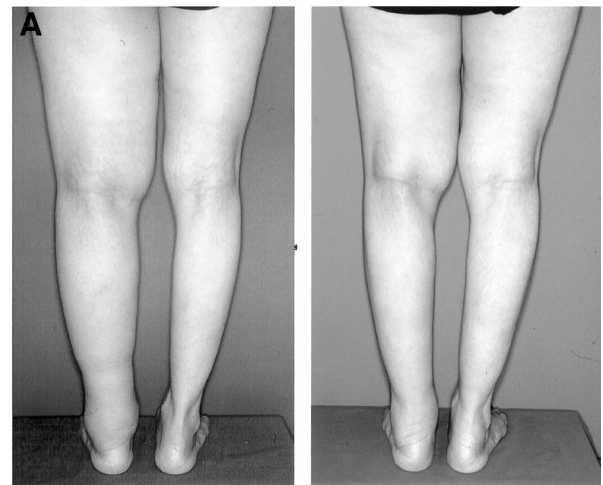
**C** 35yF Bilateral leg edema



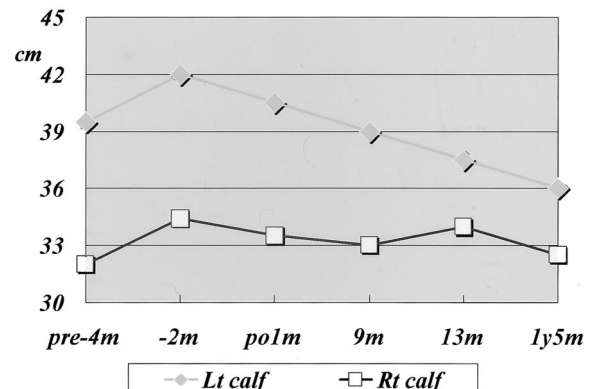
**FIGURE 1.** (A) Case 1 (stage III). Left: A 35-year-old woman with bilateral lymphedema within 4 month duration. Right: Two years after anastomoses and continuous treatment with elastic stockings. (B) Left: Lymphaticovenular anastomosis under local anesthesia in the right thigh medial aspect. Right: Anastomosis through minimal incision in the medial aspect of the left thigh. (C) Preoperative increase and postoperative decrease of the circumferences at bilateral thigh.

**Case 2: Relatively Early Anastomosis for Preoperative Ineffective Compression (Stage IV)**

A 49-year-old woman presented with secondary lymphedema with phlegmon of the left leg of 11 months' duration with ineffective preoperative compressive treatment. She had undergone resection for uterus cancer and postoperative radiation 11 years earlier. Under local anesthesia, 2 lymphaticovenular anastomoses were made at medial aspects of the proximal side of the lower leg and the ankle region. One year and 5 months after the operation with postoperative compressive therapy, a gradual reduction in circumference (−6 cm at the calf, −5 cm at the knee, and −6 cm at the thigh level) without phlegmon has been achieved (Fig. 2).



**B** 49yF 11y/11m Rad+



**FIGURE 2.** (A) Case 2 (stage IV). Left: A 49-year-old woman with left leg edema of 11 months' duration with ineffective compression therapy. Right: One and a half a years after 1 anastomosis at the ankle region. (B) Preoperative increase and postoperative decrease of circumferences at bilateral lower leg (10 cm below the patellar border).

**Case 3: Late Anastomosis for Stage IV**

A 68-year-old woman suffered from uterine cancer. Two years after hysterectomy without radiation therapy, lymphedema of the right leg appeared, and it continued for 8 years with ineffective conservative treatment. She had repeated phlegmon and could not walk a long distance. Under local anesthesia, one lymphaticovenular anastomosis was made at the medial aspect of the ankle joint of the right leg. One year and 2 months after the operation with a postoperative elastic stocking, a remarkable reduction in the circumference (−11.5 cm at the calf level and −6 cm at the ankle) was achieved (Fig. 3).

**Case 4: Anastomosis for Preoperative Ineffective Compression (Stage IV)**

A 57-year-old man had undergone resection of testicular carcinoma and the left inguinal lymph nodes 24 years

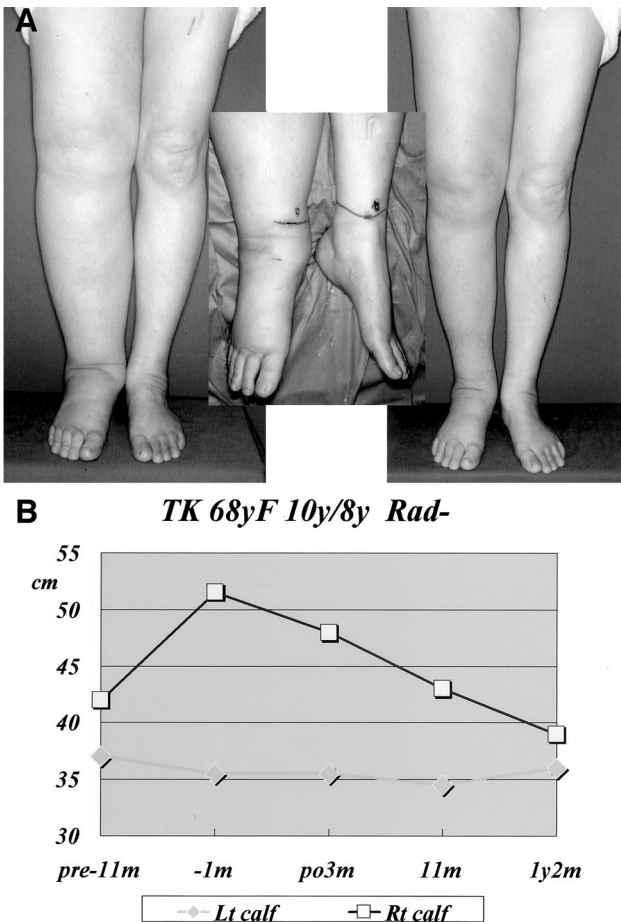
ago. Ten years later, left leg edema appeared. Despite constant and strong compressive therapy for 14 years' duration, he decided to undergo surgery because of progression of the edema. With small skin incisions on the medial aspect of the ankle, one lymphaticovenular anastomosis was made under local anesthesia. Ten months after the operation with constant compressive therapy, a constant gradual reduction in circumferential length (−8 cm in the calf; −10 cm in the ankle) has been achieved (Fig. 4).

**DISCUSSION**

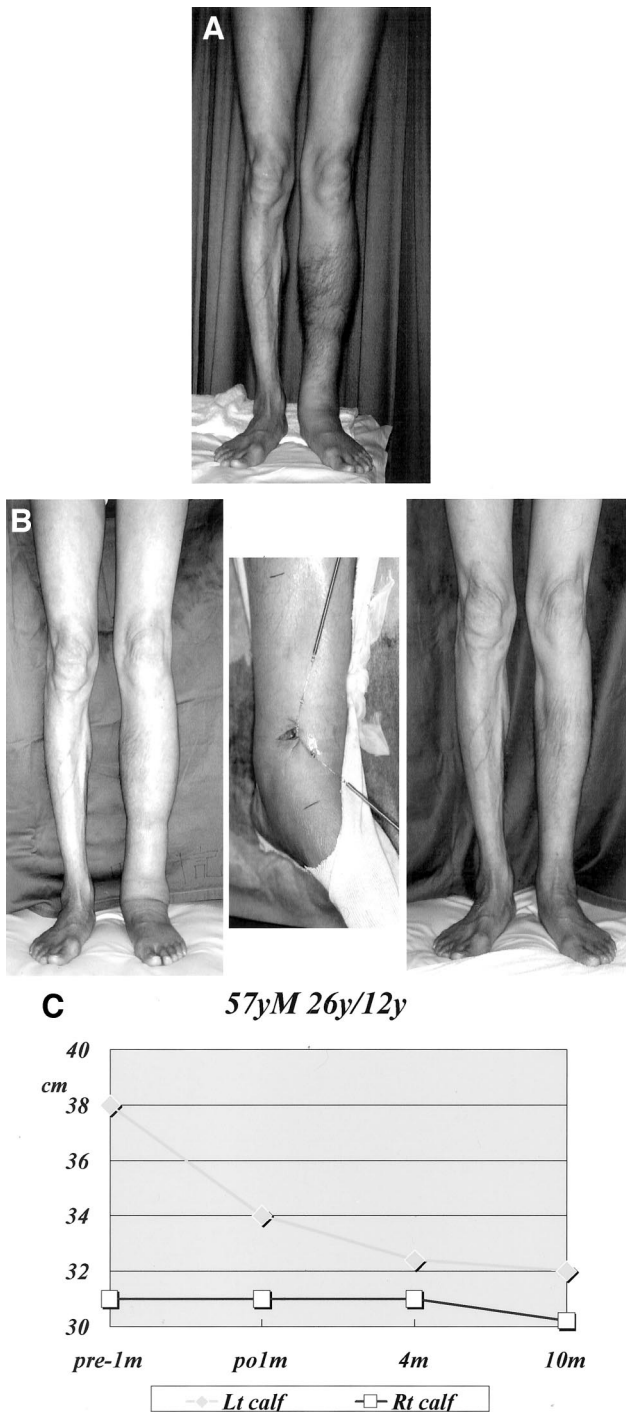
Although several authors described the usefulness of lymphaticovenous anastomosis, previous methods consisted of surgical anastomoses under general anesthesia because the detection of tiny lymphatics in the edematous legs is difficult under local anesthesia. Based on our previous cases under general anesthesia, we concluded that the majority of patients do not need a large number of anastomoses, and that 2 or 3 anastomoses are enough to reduce the volume.<sup>6,8,10</sup> Therefore, we tried to detect lymphatics and several anastomoses under local anesthesia and found this method to be useful as minimally invasive surgery completed within 2 hours. This is the first report on effective lymphaticovenular anastomosis under local anesthesia.

Based on the result of case 1 with very severe bilateral leg edema, if performed within 4 months after initial edema, the size of the leg could be normalized with only 1 anastomosis. There is an opinion that surgical intervention was performed too early for this (case 1) early-stage edema because the edema would be improved spontaneously. We believe this case would never improve spontaneously because the edema was a very severe bilateral type, rapidly progressive, with lymphangitis and resistance for compression, and also the patient desired to continue her full-time job with standing all day. In addition, based on ultrastructural observations of the human lymphatics in edematous limbs, lymphatics in the early stage (stage III) still have drainage function of the lymphatics. This has been proved our previous ultramicrostructural findings of the lymphatic channels.<sup>6</sup> We have reported<sup>6</sup> that occlusion of the lymphatics and degeneration of the smooth muscle cells might start from the proximal end of the extremities and that the timing of the occlusion and the degeneration of the smooth muscle cells does not correspond to the duration of the edema. Because of this smooth muscle degeneration, the lymph drainage capacity of the proximal lymphatics of the extremities may be remarkably weakened. Therefore, we prefer anastomoses at an early stage of edema, as in case 1, because the lymphatic function is still preserved, and prefer anastomoses at the distal level of the leg, as well for edema of long duration (stage IV).

Case 2 was treated at a relatively early stage within 1 year after initial edema with repeated lymphangitis and following ineffective preoperative compression. The size of the



**FIGURE 3.** (A) Case 3 (stage IV). Left: A 68-year-old woman with right lymphedema of 8 years' duration. Compression did not stop the progression of edema. Center: One anastomosis under local anesthesia at the ankle level. Right: One year and 2 months after the operation. (B) Pre- and postoperative course of the circumferences at the lower leg.



**FIGURE 4.** (A) Case 4 (stage IV). A 57-year-old man with left lymphedema for 12 years after resection of testicular cancer. Before compression therapy. (B) Left: Seven years after constant and strong compressive treatment. The edema showed periodical progression. Center: One anastomosis at the ankle level. Right: Ten months after surgery. (C) Postoperative decrease of the circumference at bilateral calves.

operated leg could not be normalized, but dramatic improvement was obtained with 1 anastomosis. Case 3, with a long history of 6 years of ineffective compressive therapy, experienced dramatic improvement with a single anastomosis at the ankle region. In these cases, the thigh circumference improved when lymphatic diversions were performed at the distal ankle, not the proximal thigh level. We believe the mechanism of this improvement is mainly valve insufficiency due to dilated lymphatics, as in the late stage of varix. The lymphatic fluid in the proximal thigh could be directed through the damaged lymphatic channel in reverse direction to the distal ankle level.

Regarding the surgical indication for such patients, Campisi et al<sup>9</sup> indicated that improved results can be expected with earlier anastomosis (lymphaticovenous implantation method) for patients with stage II (persistent edema) and III (progressing edema with acute lymphangitis) and not for stage IV (fibrolymphedema) and V (elephantiasis). We do not agree with their surgical indication. The patients in stage IV, like cases 2, 3, and 4 with extensive fibrosis due to repeated phlegmons, are suitable candidates for supermicrosurgical anastomosis.

Regarding compressive treatment, Faeldi<sup>14</sup> described compression as the best method, and surgery should not be indicated, because the remaining lymphatics would be killed. Based on the results for case 4, however, constant and strong compressive therapy could not prevent the progression of his edema, and the anastomosis was very effective. Conservative treatments including compression support the postoperative effectiveness of anastomosis. O'Brien et al<sup>3</sup> also reported that 80% of their patients with anastomosis had an objective decrease (32% decrease in volume). Furthermore, with discontinued use of conservative measures, 51% of patients had an objective decrease (26% excess volume reduction).<sup>3</sup> These results mean conservative measures themselves have little effect, and surgical anastomoses with postoperative conservative treatment seem to be the best method for obtaining the maximum decrease after surgical treatment.

Although the follow-up of the results reported in this paper has not been as long as the postoperative course, it was believed that other patients operated on by us formerly who improved initially would continued to show decreased circumference over 6 years after anastomoses. Some patients have continued to improve up to 13 years postoperatively.<sup>8,10</sup> Based on these results, it is obvious that long-term patency of lymphaticovenular anastomosis can be obtained with postoperative continuous compression therapy.

Finally, at this stage, although supermicrosurgical lymphaticovenular anastomosis may be a difficult technique for beginners, because the detection of lymphatics of very small-caliber with thin walls and also because anastomosis requires a sophisticated technique, we believe it could soon be popularized as a new standard in reconstructive microsurgery. In

summary, supermicrosurgical lymphaticovenular anastomosis under local anesthesia is useful for lower leg edema, and it can be indicated for patients with stage IV fibrotic legs, as well as early acute stage III.

### ACKNOWLEDGMENTS

The authors thank Dr. Motohiro Hongo, Gynecology, Okayama Red Cross Hospital, Dr. Keiichi Fujiwara, Gynecology, Kawasaki Medical School, and Dr. Koyama, Tsukazaki Hospital in Himeji City, for their support of this work. This study was supported in part by a Grant-in-Aid for Cancer Research from the Japanese Ministry of Health, Welfare, and Labor (grant no. H14-17, H15-17).

### REFERENCES

- O'Brien BM, Chait LA, Hurwitz PJ. Microlymphatic surgery. *Orthoped Clin North Am.* 1977;8:405–424.
- O'Brien BM, Sykes PJ, Threlfall GN, et al. Micro-lymphaticovenous anastomoses for obstructive lymphedema. *Plast Reconstr Surg.* 1977;60:197–211.
- O'Brien BM, Mellow CG, Khazanchi RK, et al. Long-term results after microlymphaticovenous anastomoses for the treatment of obstructive lymphedema. *Plast Reconstr Surg.* 1990;85:562–572.
- Huang GK, Hu RQ, Liu ZZ, et al. Microlymphaticovenous anastomosis in the treatment of lower limb obstructive lymphedema: analysis of 91 cases. *Plast Reconstr Surg.* 1985;76:671–677.
- Campisi C. Use of autologous interposition vein graft in management of lymphedema: preliminary experimental and clinical observations. *Lymphology.* 1991;24:71–76.
- Koshima I, Kawada S, Moriguchi T, et al. Ultrastructural observation of lymphatic vessels in lymphedema in human extremities. *Plast Reconstr Surg.* 1996;97:397–405.
- Koshima I, Inagawa K, Urushibara K, et al. Supermicrosurgical lymphaticovenular anastomosis for the treatment of lymphedema in the upper extremities. *Reconstr Microsurg.* 2000;16:437–442.
- Yamamoto Y, Sugihara T. Microsurgical lymphaticovenous implantation for the treatment of chronic lymphedema. *Plast Reconstr Surg.* 1998;10:156–161.
- Campisi C, Boccardo F, Zilli A, et al. Long-term results after lymphaticovenous anastomoses for the treatment of obstructive lymphedema. *Microsurgery.* 2001;21:135–139.
- Koshima I, Nanba Y, Tsutsui T, et al. Long-term follow-up after lymphaticovenular anastomosis for lymphedema in the leg. *J Reconstr Microsurg.* 2003;19:209–215.
- Koshima I, Soeda S, Moriguchi T, et al. The use of arteriovenous anastomosis for replantation of the distal phalanx of the fingers. *Plast Reconstr Surg.* 1992;89:710–714.
- Koshima I, Inagawa K, Urushibara K, et al. Paraumbilical perforator flap without deep inferior epigastric vessels. *Plast Reconstr Surg.* 1998;102:1052–1057.
- Koshima I, Urushibara K, Inagawa K, et al. Free medial plantar perforator flaps for the resurfacing of plantar and foot defects. *Plast Reconstr Surg.* 2001;107:1753–1757.
- Faeldi M. Discussion for "Ultrastructural observations of lymphatic vessels in lymphedema in human extremities," written by Koshima I et al. *Plast Reconstr Surg.* 1996;97:406–407.