Journal of Plastic, Reconstructive & Aesthetic Surgery 115 (2026) 331–334

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Correspondence and Communications

Feasibility of robot-assisted LVA under local anesthesia for arm lymphedema

Caroline Lilja [a,b,*], **Wahida Chakari** [c], **Nicolaj Duus** [c], **Jens Ahm Sørensen** [a,b,c], **Jørn Bo Thomsen** [a,b,c]

[a] *Research Unit for Plastic Surgery, Odense University Hospital, J. B. Winsløws Vej 4, 5000 Odense, Denmark*
[b] *Department of Clinical Research, University of Southern Denmark, Campusvej 55, 5230 Odense, Denmark*
[c] *Department of Plastic Surgery, Odense University Hospital, J. B. Winsløws Vej 4, 5000 Odense, Denmark*

Received 23 June 2025; Accepted 15 February 2026

KEYWORDS
Robotic surgery;
Local anesthetics;
Lymphedema;
Supermicrosurgery;
Lymphovenous anastomosis

Robot-assisted microsurgery may improve supermicrosurgical procedures, including lymphatic reconstruction mitigating fatigue and tremor. It remains unclear whether robot-assisted supermicrosurgery, using the Symani Surgical System (Medical Microinstruments, Calci, Italy) or the MUSA (MicroSure, Eindhoven, Netherlands), surpasses conventional surgery.[1]

Lymphovenous anastomosis (LVA) treats lymphedema by creating bypasses between obstructed lymphatic vessels and nearby veins. It is primarily indicated for secondary lymphedema following cancer treatment, and can be performed in general or local anesthesia.[1] We present our initial experience with robotic-assisted LVA using the Symani System and a shift from general to local anesthesia, enabling two patients to be operated on consecutively in one day.

Method

From 2022 to 2025, women with unilateral breast cancer related lymphedema were prospectively included. All presented with pitting lymphedema and symptoms such as swelling, heaviness or pain. Written informed consent was obtained in accordance with the Declaration of Helsinki.

Patient assessment

In the outpatient clinic the lymphatic drainage was examined with indocyanine green lymphography (ICG-L).

Part of this work has been presented at the World Society of Reconstructive Microsurgery, Barcelona, 2025.

* Correspondence to: J. B. Winsløws Vej 4, 5000 Odense, Denmark.
E-mail address: caroline.lilja@rsyd.dk (C. Lilja).

https://doi.org/10.1016/j.bjps.2026.02.027
1748-6815/

Conservative treatments were paused for 72 h before assessment. Patients with pitting lymphedema and linear ICG-L patterns ending in dermal backflow without proximal connections were considered candidates for LVA. Quality-of-life was assessed preoperatively and at three months follow-up using LYMPH-Q.[2]

Preoperative planning

On the day of surgery ICG-L and color Doppler ultrasound (18 and 48 MHz probes) identified lymph vessels and venules. The exact incision site was marked for targeted surgery, see Figure 1.

Surgery

The first cases were performed in general anesthesia; subsequent patients received local anesthesia using bupivacaine 5 mg/mL. Patent blue was injected at the hand to visualize the lymphatic vessels. Anastomoses were created through 2–3 cm incisions under the microscope (Mitaka® MM51) and selected by vessel size: end-to-end (preferred, 11-0 Ethilon), sleeved if the lymphatic was less than two-thirds of the vein's diameter or end-to-side for larger discrepancies.

Statistical analysis

The number of anastomoses was compared using a Wilcoxon rank sum test, surgical duration by *t*-test and patient satisfaction by one-way ANOVA. Significance was defined as $p < 0.05$ (STATA 18).

Results

Thirty-two patients underwent LVA (mean age 57.6 ± 11.19 years, BMI 29.7 ± 4.62 kg/m^2, median lymphedema duration 30.7, IQR: 15.24–59.37 months). Seven had recurrent erysipelas, 22 had prior mastectomy and 10 lumpectomy, all with prior radiotherapy and axillary dissection.

Twenty-two had robot-assisted surgery and 10 conventional LVA, with 26 performed in local anesthetics and six under general, see Table 1 for full distribution. Anastomosis were end-to-end (73.58%), sleeved (20.75%), end-to-side (3.77%), and two-ends-to-end (1.89%). Robot-assisted surgery averaged 122.3 (±41.3) min, compared to 140.5 (±45.92) min for conventional (p=0.29). Anastomoses time were similar: 84.6 (±33.28) min with robot assistance vs. 80.1 (±31.45) min conventionally (p=0.74). The median number of anastomoses per patient was two across groups (p=0.25). The mean surgery duration was 124.0 (±38.38) min for local anesthesia, compared to 146.0 (±58.27) min for general (p=0.27). Anastomosis duration was slightly longer for local compared to general anesthesia (86.8 ± 33.74 min vs. 66.16 ± 17.11 min), but median number remained two (p=0.054), Table 1.

LYMPH-Q scores showed no significant changes at three-months in symptoms, arm function and appearance or psychological well-being, regardless of technique or anesthesia type.

Discussion

Robot-assisted LVA in local anesthesia is feasible within a public healthcare setting. No significant differences were found in surgical duration, number of anastomoses, or quality-of-life compared to conventional surgery in general anesthesia.

General anesthesia was initially used for safety, but local anesthesia became standard after four patients. Patients tolerated it well, aided by targeted preoperative planning, allowing 2–3 cm small incisions. This transition optimized workflow, allowing two procedures daily instead of one, improving waiting times, and allowing same-day discharge.

Challenges included occasional patient movement and arm table instability. One patient needed to use the bathroom during surgery; another twitched after falling asleep. Such events highlight the importance of monitoring, but local anesthesia remained safe, and well accepted. Advantages included lower risks, reduced physiological stress, and fewer perioperative requirements. The shift from general to local anesthesia has improved efficiency and patient flow by eliminating intubation, extubation and recovery time, allowing quicker turnover in the operating room and faster discharge without anesthesia-related side effects.

The Symani Surgical System offered motion scaling and tremor filtration, enhancing precision on lymphatic vessels as small as 0.2 mm. A learning curve was expected, but unlike other studies reporting longer durations, we observed no increase.[3-5] This may reflect prior departmental adaptation to new microsurgical routines. The system also

Figure 1 Images of a patient showing preoperative skin markings, and presentation of the Symani Surgical System setup combined with the use of a surgical microscope.

Table 1 Overview of patients undergoing LVA surgery stratified by surgical technique (robot-assisted vs. conventional) and anesthetic method (general vs. local). The table presents the number of patients, number of performed anastomoses, mean surgery duration, and mean anastomosis time.

LVA surgery			
	GA	**LA**	**Total**
Conventional	5	5	10
Robot-assisted	1	21	22
Total	6	26	32

Robot-assisted versus conventional			
	Robot-assisted LVA	**Conventional LVA**	**p-value**
n	22	10	
Median no. of LVA performed	2	2	0.25[*]
IQR	1-2	2-2	
Mean time for LVA surgery (± SD)	122.3 (±41.3)	143.8 (±47.44)	0.23[+]
Mean time per LVA (± SD)	84.6 (±33.28)	80.1 (±31.45)	0.74[+]

Local anesthetics versus general anesthesia			
	Local anesthetics	**General anesthesia**	**p-value**
n	26	6	
Median no. of LVA performed	2	2	0.05[*]
IQR	1-2	2-3	
Mean time for LVA surgery (± SD)	124.0 (±38.48)	153.2 (±62.22)	0.18[a]
Mean time for single anastomosis (± SD)	86.8 (±33.74)	66.16 (±17.11)	0.20[a]

[*] indicates non-significant differences in the number of anastomoses (Wilcoxon rank sum test) between surgical techniques and between anesthetic methods.
[+] indicates a non-significant difference in surgery duration between robot-assisted and conventional techniques (unpaired *t*-test).
[a] indicates a non-significant difference in surgery duration between general and local anesthesia (unpaired *t*-test).

enabled younger surgeons to assist and perform supermicrosurgery, possibly accelerating microsurgical skills.

Conclusion

This study describes our experience implementing robot-assisted supermicrosurgery and transitioning lymphatic surgery from general to local anesthesia, which has optimized the workflow and allowed for robot-assisted LVA as an outpatient procedure. The approach proved feasible without compromising outcomes. Future research should focus on learning curve quantification and cost-effectiveness evaluation to clarify the advantages of robot-assisted supermicrosurgery.

Ethical approval

Obtained from the Regional Committee on Health Research for Southern Denmark.

Declaration of Competing Interest

None.

Acknowledgements

Financed by the Danish Cancer Society (R374-A22446), the Danish Research Center for Cancer Surgery (ACROBATIC) (R317-A18255), the Vissing Foundation, the Manufacturer Einar Willumsen Memorial Fund, the Region of Southern Denmark. Data management provided by OPEN, Odense University Hospital.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.bjps.2026.02.027.

References

1. Carlotta I, Lisanne G, Nicole L. Systematic review of robotic-assisted peripheral and central lymphatic surgery. *J Surg Oncol* 2025;**131**(1):62–71.
2. Klassen AF, Tsangaris E, Kaur MN, et al. Development and psychometric validation of a patient-reported outcome measure for arm lymphedema: the LYMPH-Q upper extremity module. *Ann Surg Oncol* 2021;**28**(9):5166–82.

3. van Mulken TJM, Schols RM, Scharmga AMJ, et al. First-in-human robotic supermicrosurgery using a dedicated microsurgical robot for treating breast cancer-related lymphedema: a randomized pilot trial. *Nat Commun* 2020;**11**(11):757.
4. Reilly FOF, Nilsson A, Frieberg H, Mayr-Riedler MS, Mani M. Implementation of robot-assisted lymphaticovenous anastomoses in a microsurgical unit. *Eur J Plast Surg* 2024;**47**(1):17.
5. Von Reibnitz D, Weinzierl A, Barbon C, et al. 100 anastomoses: a two-year single-center experience with robotic-assisted micro- and supermicrosurgery for lymphatic reconstruction. *J Robot Surg* 2024;**18**(1):164.