

An Effective Approach to Collecting Lymph Vessels Using a Small Diameter Wire for Lymphaticovenous Anastomosis in Upper Limb Lymphedema

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Summary: Lymphaticovenous anastomosis (LVA), which involves connecting lymphatic vessels to veins under a microscope, is widely performed around the world as a surgical treatment for lymphedema due to its relatively low patient burden and consistent efficacy. One of the crucial points of LVA is identifying suitable lymphatic vessels from among many lymphatic vessels and connecting them at the most effective site, but in practice, this is not easy to do. To overcome this issue, we have been able to effectively drain lymph by connecting lymphatic vessels to veins just before the occluded site using a lymphatic wire that was just recently developed in Japan. The device guides the subcutaneous deep collecting lymphatic vessels from the peripheral relatively superficial lymphatic vessels. While this special wire is typically adapted in the lower limbs, we have confirmed its effectiveness in upper limb lymphedema as well. Overall, this approach shows promise for improving the accuracy and success rates of LVA procedures, which can have significant benefits for patients with upper limb lymphedema. In this article, we share our experience using lymphatic wire for upper limb lymphedema cases. (*Plast Reconstr Surg Glob Open* 2023; 11:e5441; doi: [10.1097/GOX.0000000000005441](https://doi.org/10.1097/GOX.0000000000005441); Published online 14 December 2023.)

INTRODUCTION

Lymphaticovenous anastomosis (LVA) has been widely performed for the treatment of lymphedema around the world due to its low invasiveness. However, it has been reported that the anastomotic site may become occluded over time, and the reduction effect of swelling by LVA alone is limited by standard methods.^{1,2} Therefore, clinically resolving the issue of how to achieve a “high-quality anastomosis” that has high drainage efficiency and remains open in the long term has become a challenge. In other words, it is desirable to identify suitable lymphatic vessels from among many lymphatic vessels and connect them at the most effective site.

Starting in 2022, we began using a recently developed specialized lymph wire (LW) called LymTracer (Boston

Scientific, Tokyo, Japan), which has a diameter of 0.3mm and can be inserted into lymphatic vessels.³ (See figure, **Supplemental Digital Content 1**, which shows the LymTracer. <http://links.lww.com/PRSGO/C912>.) This special wire is a device that improves upon the guide wire used for peripheral arterial disease and has moderate flexibility, making it possible to insert it into lymphatic vessels with a diameter of 0.3mm or more. By inserting it from the first identified lymphatic vessel toward the central side, it strongly assists in identifying lymphatic vessels during LVA. LymTracer was developed for use in relatively large lymphatic vessels (0.3mm or more) in lower limb lymphedema. Although there has been one report of its use in lower limb lymphedema,³ there have been none for upper limb lymphedema.

Here, we attempted to expand the range of applicability of the LW for upper limb lymphedema. First, using ICG and ultrasound, we identified relatively large (0.3mm or more) lymphatic vessels in the inner central forearm.⁴

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In this article, the authors share the surgical technique of performing LVA using an LW for upper limb lymphedema.

METHOD

Study Design

In August 2022, the LW was first used for a case of upper limb lymphedema at Miniren Chuo Hospital. Subsequently, all cases of upper limb lymphedema that underwent LVA from that point until March 2023 were retrospectively reviewed.

Situations in Which Using LW for Lymphatic Vessels Is Appropriate

Stages 1 and 2 of the International Society of Lymphology classification are good indications. Stage 3 is unlikely to be considered an indication because it is difficult to find a collecting lymphatic vessel suitable for wire insertion, but it may be considered an indication if something resembling a lymphatic vessel of about 0.3 mm is identified using ultrasound echo.

Surgical Technique

1. Notes on Inserting LW

When inserting the wire into the lymphatic vessels located beneath the subcutaneous fat and superficial fascia, it is important to be cautious about the angle between the wire and the vessel. If the angle is too large, there is a risk of damaging the central end of the upper wall of the lymphatic vessel incision. To avoid this, it is recommended to insert the wire at a sharp angle, and for this purpose, as shown in Supplemental Digital Content 2, a guide wire can be inserted horizontally through the peripheral side skin from the incision to help correct insertion of the wire. (See figure, Supplemental Digital Content 2, which shows the cross-sectional view of insertion of the LW into the lymphatic duct lumen. <http://links.lww.com/PRSGO/C913>.)

2. Points to Note When Operating the LW

Although the LW comes with an inserter, it is not necessary to use it every time. When operating the wire, insert it slowly to prevent it from bouncing back at the insertion site. If resistance is encountered during insertion, lymphatic stenosis or obstruction may be present. It is important to be careful not to push too hard, as this can puncture the lymphatic vessel wall.

3. The Flow of the Procedure in the Actual Surgical Technique

First, ICG fluorescence lymphangiography is performed. A small amount of ICG is injected between the affected side fingers, and the flow of ICG is confirmed with a fluorescent camera. If a linear fluorescent pattern is confirmed in the forearm, the incision is planned in a position where a vein is nearby. The collecting lymphatic vessels are sufficiently dissected, and a silicone background sheet is passed underneath the lymphatic vessel to slightly lift and fix it on the skin side. The upper wall of the lymphatic vessel is incised with microscissors, but the length of the

Takeaways

Question: The key to successful LVA is identifying suitable lymphatic vessels from among many lymphatic vessels and connecting them at the most effective site.

Findings: We have been able to achieve highly effective LVA by connecting lymphatic vessels to veins just before the occluded site using a lymphatic wire that was just recently developed in Japan.

Meaning: This unique device can allow us to improve the accuracy and success rates of LVA procedures, which can have significant benefits for patients, even with upper limb lymphedema.

incision is kept to the extent that a wire can be inserted. When inserting the wire, make a sharp angle with the lymphatic vessel and slowly advance it. After advancing 4–5 cm, use an ultrasound diagnostic device to confirm the tip of the wire. At this time, the superficial fascia serves as a guide for wire confirmation, and it is easier to confirm the position by moving the wire tip back and forth (Video 1). If resistance is felt during insertion, an echo examination is performed to confirm the tip. Intraoperative findings and a photographic illustration of the overall view are shown in Figure 1. If stenosis or occlusion of the lymphatic vessel is confirmed at the tip of the wire, the incision site is determined while confirming the position relationship with nearby veins. If there is not enough distance from the wire insertion site, lymphatic vessel and vein anastomosis are performed at the wire insertion site. In this case, if the wire insertion site where the lymphatic vessel is incised is enlarged, side-to-end anastomosis may not be possible, so end-to-end anastomosis may be performed. (See Video 1 [online], which shows echographic findings when moving the wire tip back and forth.) (See Video 2 [online], which shows end-to-end anastomosis of lymphatic vessels and veins using the end of a lymph guide wire as a stent.)

RESULTS

From August 2022 to March 2023, we performed LVA on eight patients, and in three cases, we were able to identify the central lymphatic vessel and perform LVA using the LW. Furthermore, by guiding the LW through the central lymphatic vessel, we were able to easily identify the collection lymphatic vessel of the upper arm, which is difficult to identify using ICG lymphography alone. In the cases with LW, two LVAs were performed on one affected limb.

DISCUSSION

The advantage of using an LW is that it allows for lymphatic vessel anastomosis to be performed in a simple and time-efficient manner, particularly in areas where therapeutic effects can be easily obtained. Specifically, by using the LW, it is possible to identify the most central part of the collecting lymphatic vessel in the deep layer, where stenosis or occlusion of the lumen may occur, and to perform the most efficient lymphatic drainage if



Fig. 1. Intraoperative findings and a photographic illustration of the overall view. A, The practitioner inserts the LW into the lymphatic vessel using his left hand and pushes it forward. B, The black LW inserted into the lymphatic vessel is visible. C, The LW has been inserted into the lymphatic vessel, reaching the upper arm, but insertion is blocked at a point of obstruction in the lymphatic vessel. D, An overview of the postoperative sutured wound on the affected limb.

there is an appropriate vein for anastomosis at that site. In addition, it is also possible to confirm the patency of the anastomosis by re-inserting the device after the anastomosis has been completed. As a result, it is expected to alleviate patient burden and also reduce labor costs for healthcare professionals. Meanwhile, one drawback of the LW is that its own diameter is approximately 0.5 mm, making it unsuitable for use in lymphatic vessels with a diameter below 0.5 mm in their expanded state. Another disadvantage is that the technique needs the additional

cost of the wire. This device was developed in Japan and has not been in use for a long time since receiving regulatory approval, so there is still no sufficient evidence of its efficacy. Although the evidence for the utility of the LW is still lacking, it is currently found that surgical time is reduced in all cases using this device. In this article, we would like to highlight this novel technology with additional innovative elements. Firstly, it has been successfully used on the upper limbs with no issues, improving efficiency. Additionally, although the conventional

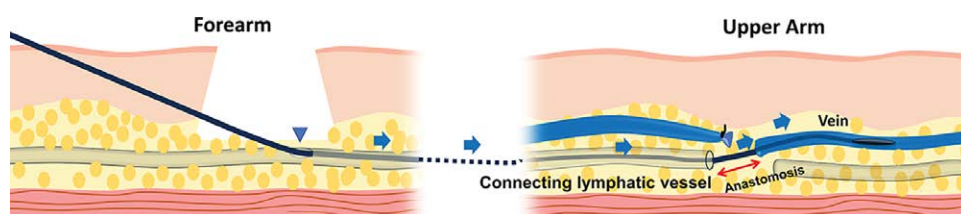


Fig. 2. Cross-sectional view of insertion of the LW from the lymphatic duct lumen to the vein in the upper arm.

approach recommends inserting a specialized wire through incisions to search for lymphatic vessels and veins, we inserted the wire through the peripheral skin and subcutaneous tissue without using this method. This technique has resulted in increased stability during use and is believed to reduce the risk of damaging the lymphatic vessels (Fig. 2).

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

PATIENT CONSENT

The patient's guardians provided consent for the use of their images.

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