

Development of an All-Wales National Health Service Surgical Lymphedema Supermicrosurgery Service

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Background: The management of lymphedema includes an array of conservative measures, but must also include surgical intervention as a management option where appropriate. Within the National Health Service in Great Britain, the surgical provision for lymphedema patients is very minimal. This article provides a historical overview of the inception of the lymphedema service within Wales, which is the only holistic lymphedema service within the National Health Service.

Methods: All patients discussed at the lymphedema multidisciplinary team (MDT) meeting were included. Data were collected during a 5-year period from June 2017 to May 2022. MDT meeting outcomes were also recorded (conservative or surgical management), and if surgical intervention was used, the type of surgical procedure was documented.

Results: A total of 175 patients were discussed by the lymphedema surgical MDT. Of these, 129 (74%) were recommended for surgery and 46 (26%) were managed using conservative measures alone. The most common surgical recommendation was for lymphovenous anastomosis (61, 47%), followed by liposuction (40, 31%). Vascularized lymph node transfer was recommended in 19 (15%) cases.

Conclusions: The authors highlight the efficiency of the service, whereby despite more than 7500 referrals a year, only a small minority that are eligible for surgery undergo a surgical assessment. The authors hope that this article provides an impetus for such services to be similarly replicated across other nations. (*Plast Reconstr Surg Glob Open* 2025;13:e6672; doi: [10.1097/GOX.0000000000006672](https://doi.org/10.1097/GOX.0000000000006672); Published online 10 April 2025.)

INTRODUCTION

Lymphedema is chronic swelling due to lymphatic system failure and affects up to 250 million people worldwide. It can occur from a congenital lymphatic abnormality, or from lymphatic damage by inflammation, infection, trauma, tumor, surgery, or radiation. According to the literature, the incidence of breast cancer-related lymphedema, following axillary lymph node clearance, varies from 24% to 49% after mastectomy and 4% to 28% after breast-conserving therapy.¹⁻³ Lymphedema can impact individuals physically, psychologically, and socially⁴⁻⁷ and evidence suggests that 80% of people with lymphedema are unable to continue their normal employment,⁸ with

8% giving up work entirely.⁹ Physical symptoms include pain, discomfort, heaviness, and reduced mobility.¹⁰ Psychologically, those with lymphedema experience anxiety, stigma, and depression.^{4,7,11,12}

In Wales, there are approximately 20,000 patients diagnosed with lymphedema (more than 6 per 1000 population). An epidemiological breakdown is displayed in [Figure 1](#). Our service receives more than 7500 new referrals and discharges around 6000 patients per annum. The mainstay management of lymphedema is conservative.¹³

Before 2009, lymphedema management across Wales had wide variations in practice due to limited funding, lack of strategic oversight, and the absence of consistent surgical treatments. In 2009, the Welsh Government developed the lymphedema strategy, and in April 2011, £1 million of recurring funding was made available to allow its implementation,¹⁴ which spearheaded the creation of Lymphedema Clinical Network Wales (LCNW).

There is well-established evidence for surgical strategies for both the prevention and treatment of lymphedema.

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Established surgical options such as liposuction¹⁵ and lymphatic supermicrosurgery have been shown to reduce limb circumference and rates of cellulitis.^{16–19} At our institution, liposuction is reserved for more advanced diseases, and unlike lymphovenous anastomosis (LVA), it is not a cure, requiring lifelong compression garment use. LVA allows obstructed lymphatic pathways to be bypassed by connecting superficial lymphatic vessels to nearby venules.²⁰ Campisi et al²¹ reported some of the earliest large patient series (1800) with outcome measures for proximal LVAs using a sleeve anastomosis technique, reporting subjective improvement in 87% of patients and objective volume changes in 83%. Importantly, of the patients followed up in their study, 85% were able to discontinue the use of conservative measures. The use of vascular lymph node transfers (VLNTs) was first described by Shesol et al²² in 1979 in a rodent animal model and subsequently popularized by plastic and reconstructive surgeons for the treatment of lymphedema. A recent systematic review of the literature demonstrated a mean reduction in the volume between the healthy and affected extremities of 40.31% following VLNT,²³ which held true for patients undergoing VLNT both with and without breast reconstruction using the deep inferior epigastric perforator (DIEP) flap.²⁴ Surgery is thus an essential treatment in any lymphedema

Takeaways

Question: What is the history of the lymphedema service in Wales, and how can its template be used to replicate other centers of excellence?

Findings: The financial benefit to the economy for treating lymphedema is demonstrated, in addition to a template for the service on offer in Wales.

Meaning: Setting up a lymphedema service requires a lot of planning, with bids, funding, and procurement. The surgeon is a practitioner and must be provided suitable surgical candidates by therapists, as most lymphedema patients are not suitable for surgery.

service. The aim of this article is to illustrate the process of developing and delivering a surgical lymphedema service in Wales, the only National Health Service (NHS)–funded service of its kind in the United Kingdom.

The Delivery of a Surgical Lymphedema Service

The surgical lymphedema service in NHS Wales is offered for patients with established lymphedema who meet the eligibility criteria (Table 1). The criteria were

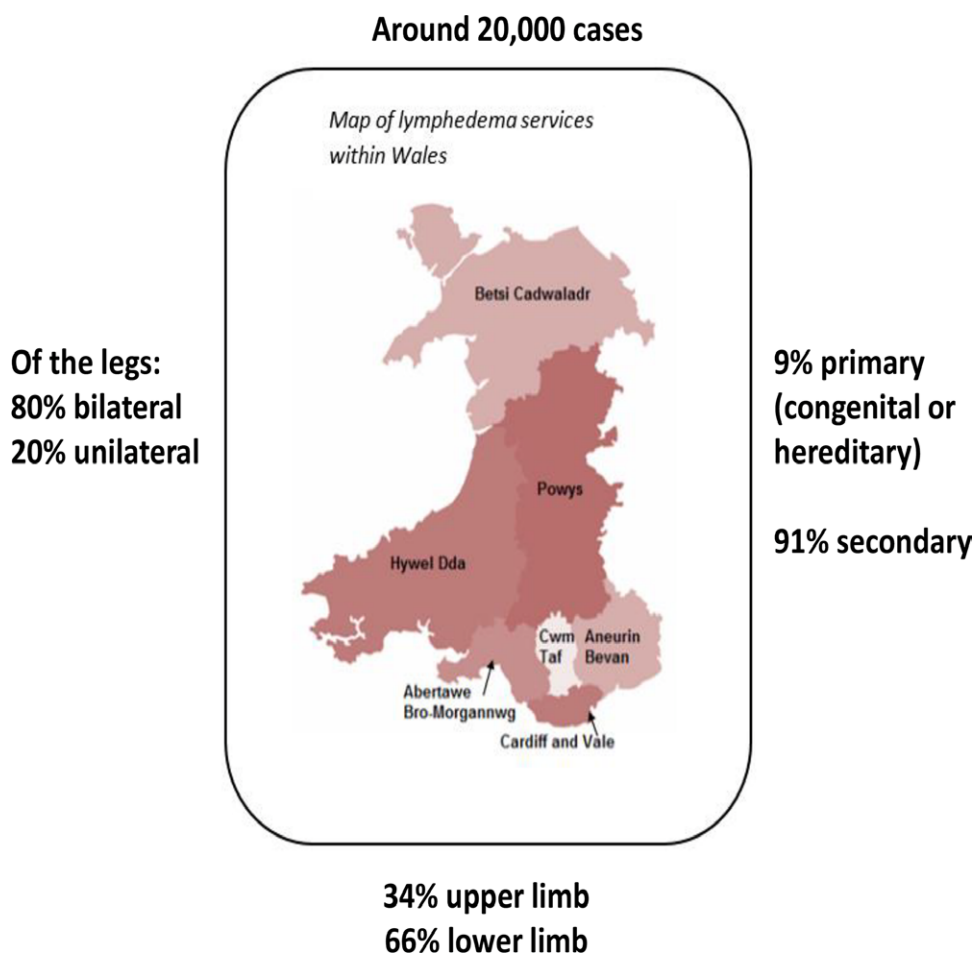


Fig. 1. Epidemiological data and geographic distribution of the service.

Table 1. Eligibility Criteria for LVA Referral

Diagnosis of lymphedema from cancer or noncancer origin (this includes a primary and secondary lymphedema diagnosis)
Lymphedema affecting the upper or lower limb
Mild to moderate swelling with a maximum of 20% total volume excess
Tissues must be soft (can be pitting or nonpitting)
Body mass index equal to or less than 30
Concordance to lymphedema self-management plans
International lymphedema grading of 0–2
Medical history to include 2 or more cellulitis episodes (as of January 2022, this has reduced to 1 or more episodes of cellulitis)
Exclusion criteria
Skin changes from the lymphedema diagnosis including fibrosis, hyperkeratosis, papillomatosis, and skin folds
Active cancer disease
Current fungal infection
Renal impairment
Uremia
Liver disease
Pregnancy
Smoker (must have given up 3 mo presurgery)
Vascular insufficiency

Table 2. Prudent Healthcare Principles

Do no harm—minimum appropriate intervention consistent with the seriousness of the illness and the patient's goals
Resources should be expended wisely and ethically, determined by clinical need and clinical prioritization
Equity—matching need and spending so we put our maximum resources where our needs are greatest

developed in line with the prudent principles (Table 2).²⁵ The surgical treatment options included the following:

LVA^{16–18} was performed under local anesthetic with dual consultant operating for patients with favorable lymphatic anatomy on indocyanine green (ICG) scan. (See figure, Supplemental Digital Content 1, which displays an illustration of the ICG scanning process to identify suitable lymphatic channels, <http://links.lww.com/PRSGO/D953>.) This is an essential step. Normally lymphatics on ICG show a linear pattern of superficial lymphatic channels. In pathological lymphatics, the pattern becomes more diffuse, called the “stardust” sign. If there are no linear channels at all, such as in advanced disease, then LVA is not an option. The technique for LVA in our institution is similar to that of Koshima et al²⁰ in that the majority are end-to-end or end-to-side anastomoses, distal in the limb, and with multiple surgical sites. This is as opposed to Campisi et al²¹ who used multiple proximal lymphatics for sleeve anastomosis into an adjacent proximal vein.

1. VLNTs,¹⁹ for example, most commonly use the superficial inguinal lymph nodes in patients undergoing DIEP flap breast reconstruction or supraclavicular lymph nodes if the inguinal system is contraindicated. This is an important management option within our framework for those who are not suitable for LVA, that is, inadequate lymphatic channels identified on ICG scan or those where LVA has been unsuccessful.

2. Liposuction¹⁵ is offered to patients with late-stage lymphedema who are not candidates for LVA or VLNT. Our institution uses body-jet water-assisted liposuction, which is only offered to patients with a body mass index of less than 30 and an excess limb volume of greater than 20%.

Patients are referred by local lymphedema therapists across Wales to our surgical lymphedema service and discussed at our monthly surgical multidisciplinary team (MDT) meetings, consisting of a plastic surgeon, a lymphedema therapist, and an administrator, and assessed against eligibility criteria (Fig. 2). It is pertinent to note that in our institution the aim is to offer LVA in the first instance where patients are eligible, and then consider VLNT or liposuction if they do not respond. In other international centers, a dual combined approach for LVA and VLNT is offered. In a resource-limited NHS, this is unfortunately not feasible. For less-developed countries, performing LVA is more feasible than VLNT, as it can be performed under local anesthetic with fewer resource implications and greater case turnover.

The Process of Developing a Surgical Lymphedema Service

In 2014, there was a drive for the establishment of a supermicrosurgery service due to the recognition of the scale of the problem through referrals from LCNW. Thus, key members of LCNW together with a plastic surgery-trained supermicrosurgeon submitted a health technology bid to the Welsh Government for a capital investment of £158,000 to purchase the lymphatic clinical imaging scanning equipment called a Stryker SPY-PHI. This capital bid was successful, and a formal curing lymphedema through innovation and technology program (CLP) was developed. Vitrally, executive leads from all 7 health boards in NHS Wales were approached to partake along with patient stakeholders and clinicians. Positively, a regional plastic surgery department with trained staff was able to accommodate the LVA service. To aid national approval, a formal business case (Table 3) was created using the 5-case model (strategic, economic, financial, commercial, and management).²⁶ The surgical lymphedema service commenced in September 2015 with agreement from NHS Wales that LVA could be offered to 42 patients per annum. The Welsh Health Specialist Service Committee together with the CLP created a service specification and commissioning LVA document.²⁷

METHODS

Data Collection and Patient Outcomes

All patients discussed by the lymphedema MDT were included. Data were collected during a 5-year period from June 2017 to May 2022. The LCNW database was reviewed, and subsequently, patients' medical notes were retrospectively studied, capturing anonymous clinical and demographic information, with prior approval from the Health Board Audit Department. MDT meeting outcomes were also recorded (conservative or surgical management), and if surgical intervention was used, the type of surgical procedure was documented, that is, LVA, VLNT, liposuction, or

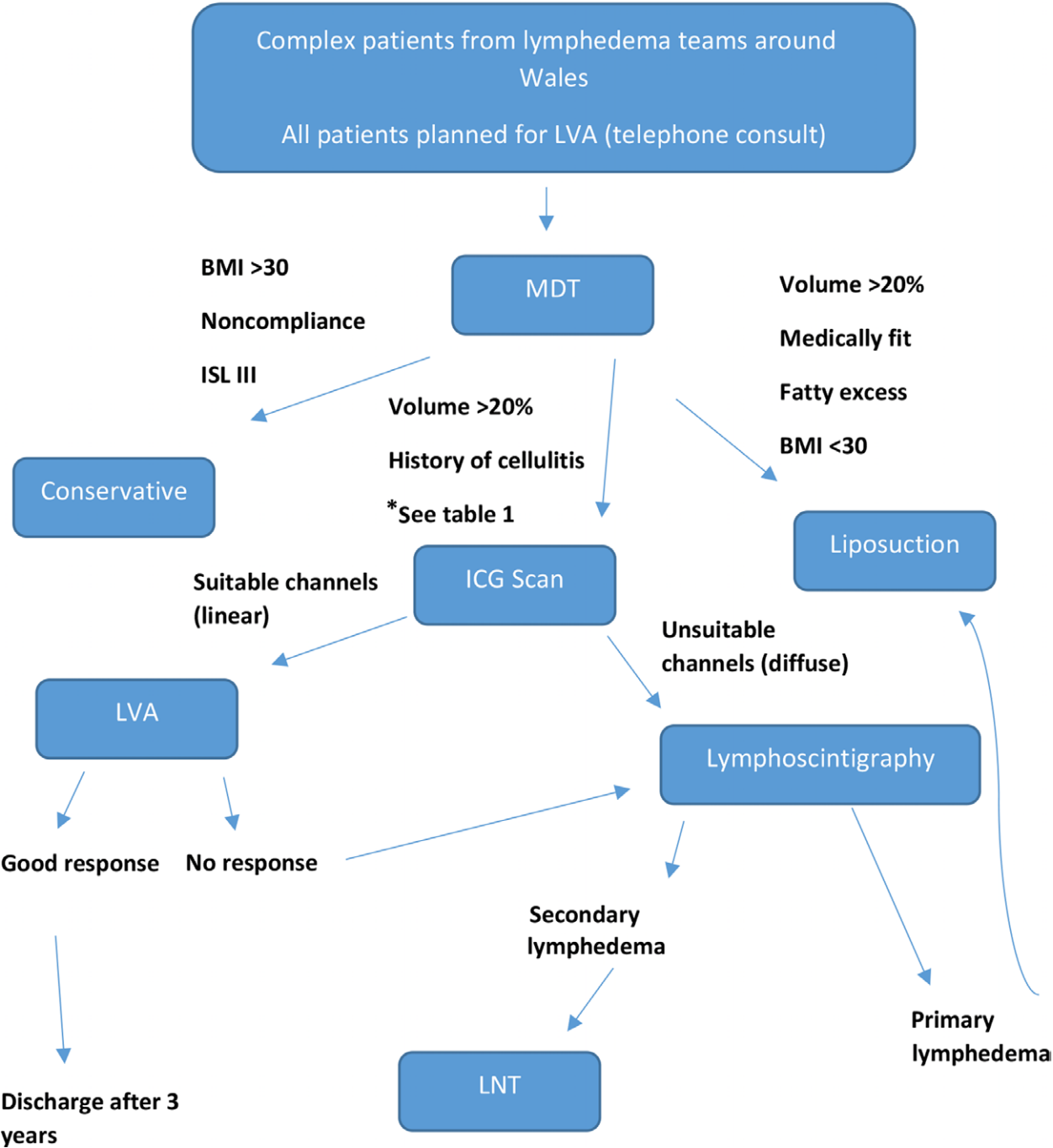


Fig. 2. Patient pathway through the lymphedema MDT. BMI, body mass index; ISL, International Society of Lymphology III; LNT, lymph node transfer.

other. Quantitative and qualitative data for each patient undergoing LVA were also captured and are displayed in Table 4. It is important to highlight that there are no outcome measures assessed in this article, as this is part of an ongoing clinical trial. Instead, we provide a template for the development of the service, including the MDT setup.

RESULTS

Between 2017 and 2022, a total of 176 patients were referred to the lymphedema surgical MDT. One patient

was excluded from the final results as they did not attend any appointments. Of the 175 patients discussed by the MDT and thus included in this study, 144 (82%) were women and 31 (18%) were men. The modal age range was from 50 to 59 years, with more than 85% of patients being 40 years of age or older (Fig. 3). Of 175 cases, 149 (85%) had lymphedema, and 26 (15%) had other conditions. Of the lymphedema cases, the majority (103, 69%) were secondary to lymph node dissection for cancer treatment. These data are displayed in Table 5.

Table 3. The Elements of the Business Case

Case Subsection	Key Points
Strategic	<ul style="list-style-type: none"> • Patients are to receive safe, high-quality treatment with minimal variation across the country • The service needs to be effective, safe, sustainable, accessible, affordable, and achievable
Economic	<ul style="list-style-type: none"> • LVA offers value for money • Quantitative and qualitative benefits to patients are clear • Calculations performed to do nothing, out-source, or perform within Wales
Financial	<ul style="list-style-type: none"> • Costings and savings were calculated
Commercial	<ul style="list-style-type: none"> • Funding was agreed from commissioning health boards
Management	<ul style="list-style-type: none"> • An implementation plan was put in place • Timescales were set

Table 4. Patient Data Captured for Each LVA

Age and sex	Weight and body mass index
Lymphedema type or related condition	Tape measure circumference every 4 cm along the affected and unaffected limb
Perometer (parallel-acting light curtains made of photograph sensors and LEDs) measuring both affected and unaffected limbs	Pitting edema test whereby the thumb is held down firmly for 60 s with a plus or minus result
Moisture meter data (records water in the tissues 0%–99%, using a high-frequency lower power electromagnetic wave) on 2 points of the limb on the affected and unaffected sides	Bodystat Quadscan 4000 (bioimpedance machine that measures fluid and body composition analysis)
Number of cellulitis episodes and whether these required hospital admission including length of stay	Pain scale
Range of movement of affected limb pre and postoperatively	Pressure garment use in hours
Stemmer's sign±	Skin assessment
Severity scale (International Society of Lymphology scale and British Lymphology Society scales)	LYMPROM score
Capturing PROMs and EQ-5D-5L data throughout the care journey (preoperatively and up to 24 mo postoperatively)	

Of the 175 discussed by the MDT, 129 (74%) were recommended for surgery. Only 46 (26%) were managed using conservative measures alone. This breakdown is displayed in Table 6. The most common surgical recommendation was for LVA (61, 47%), followed by liposuction (40, 31%). VLNT was recommended in 19 (15%) cases.

The treatment option is individualized for each patient and guided by eligibility criteria, anatomical assessment of lymphatics, as well as patient preferences and comorbidities, and is less dependent on the underlying lymphedematous condition, that is, whether the lymphedema is secondary to nodal clearance postcancer or noncancer (infection, radiation, or trauma) or primary (congenital, praecox, or tarda). Exceptions to this are that 1 patient with neurofibromatosis and 1 with Klippel-Trenaunay syndrome were each offered liposuction for debulking. It is important to highlight that the authors have separated

these causes from other primary causes. For example, one must consider the venous malformations and valvular insufficiency in Klippel-Trenaunay syndrome and its impact on LVA success.

Lymphovenous Anastomosis

Of the 61 patients recommended for LVA by the MDT, 42 (69%) were to the upper limb and 19 (31%) were to the lower limb. The etiology of lymphedema in these patients was breast cancer in 40 (66%), primary lymphedema in 11 (18%), cervical cancer in 2 (3%), endometrial cancer (1), vulvar cancer (1), penile cancer (1), uterine cancer (1), previous fasciotomy (1), Dupuytren contracture (1), varicose vein surgery (1), and noma infection (1). The mean operative time was 132 minutes, and the mean number of anastomoses was 4. All were performed under local anesthetic as a day-case procedure.

The author's surgical technique: Preoperative intradermal injection of ICG into the second and fourth web space of the hand or foot takes place in the day surgery area. The lymphatics are drawn onto the limb. Then, a vein visualization system using near-infrared light is used to mark the veins. Any intersections between veins and lymphatics are marked with a cross. On the table, patent blue dye is injected subdermally to stain the lymphatics. Local anesthetic is infiltrated. Dissection is performed using an artery clip rather than tenotomy scissors. The anastomotic technique is performed using a combination of parachuting sutures, or end-to-end, end-to-side, and side-to-side, depending on the size mismatch. It is important to remember to remove the parachuting sutures once the lymphatics are parachuted into the vein. Veins with backflow are generally avoided.

Our smaller numbers of LVA compared with projections is because our service ceased to function during the pandemic. For example, in the first year of data collection, our service performed 37 LVAs. Even after COVID-19, unfortunately, LVA was at the low end of the clinical priority list. We hope, therefore, that sticking to our original 42 is reasonable given the extenuating circumstances and that prepandemic levels were close to this projection.

Vascularized Lymph Node Transfer

Of the 19 patients recommended for VLNT, 11 were in isolation, and 8 were in conjunction with a DIEP flap. For isolated VLNT, 10 patients had a diagnosis of breast cancer whose lymphedema was attributed to axillary node clearance, and 1 patient with a diagnosis of cervical cancer who had undergone pelvic node dissection. The most common donor nodes chosen for VLNT were the superficial inguinal nodes in 6 cases and the supraclavicular nodes in 4, with 1 case being unknown, as the patient sought treatment privately. The most common reasons for recommending VLNT over LVA were ineligible ICG scans, or previous LVA surgery having already been attempted.

It is important to note that the lymphedema surgical MDT pathway is not the most common way VLNT and DIEP are offered at our institution. Most of the VLNT and DIEP cases are performed outside of the MDT via the breast reconstruction pathway.

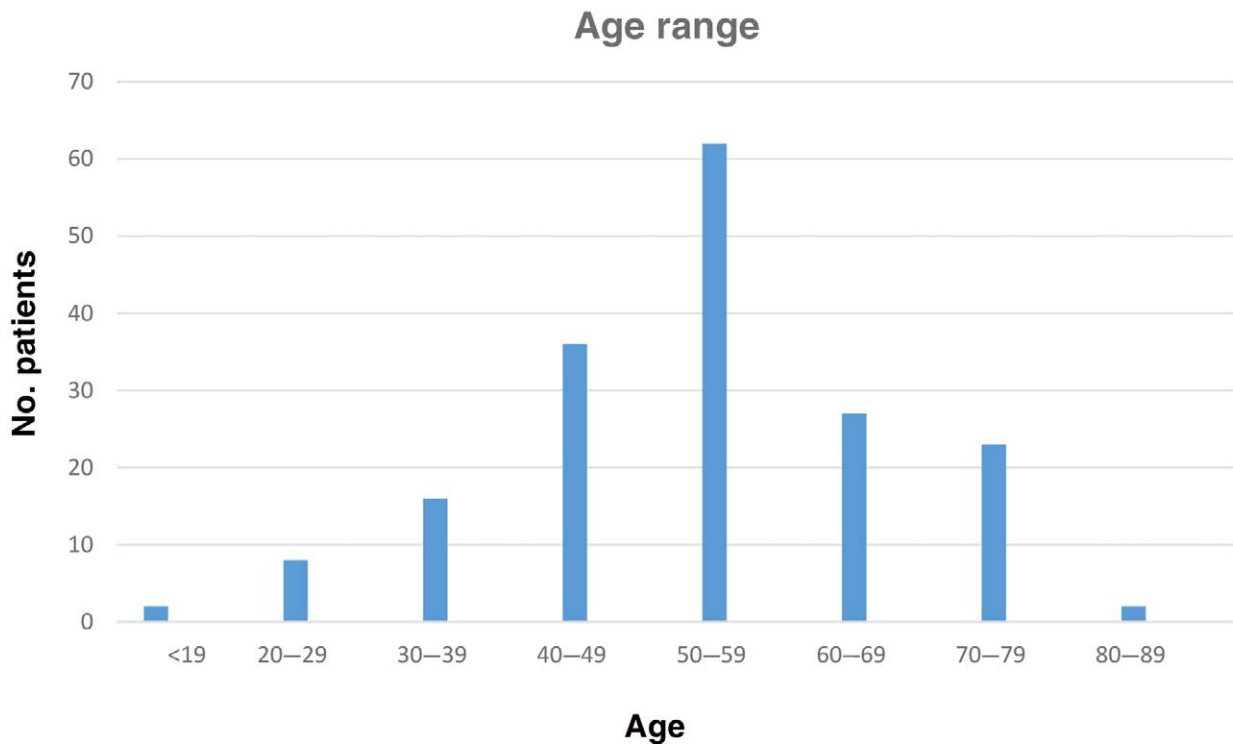


Fig. 3. Patient age range distribution of those discussed by the MDT.

Table 5. Distribution of Etiology of Lymphedema and Other Conditions Discussed

Total number	N = 175
Lymphedema cases	n = 149
Secondary to cancer	103
Primary	23
Secondary noncancer	22
Both primary and secondary	1
Other conditions	n = 26
Lipedema	16
Limb hypertrophy	3
Genetic condition (neurofibromatosis, Klippel-Trenaunay syndrome)	2
Revision of breast reconstruction	2
Venous insufficiency	2
Lipodystrophy	1

In patients undergoing DIEP flap with upper limb lymphedema, the obvious choice of lymph node basin is the superficial inguinal group of nodes. In the senior author's experience, a separate anastomosis of this group is then performed based on the thoracodorsal system. An essential step for this procedure is dual mapping of the nodes draining the lower limbs via ICG versus the

abdominal wall via patent blue. This avoids harvesting the deep inguinal node basin that could result in lower limb lymphedema. For other donor nodes, the senior author prefers the supraclavicular basin due to a favorable aesthetic donor site. There are many other possible donor sites, including the submental node group, but there is less experience of this and others in our institution.

Liposuction

Of the 40 patients recommended for liposuction, 7 had previously failed LVA treatment, and 8 had a volume discrepancy greater than 20%, making them ineligible for LVA. Thirty-three of the 40 cases were to the lower limb, with 5 to the upper limb, and 2 to the mons region. Eight patients had a diagnosis of lipedema, and 1 had a diagnosis of limb hypertrophy.

Other

The 9 other surgical options included 3 recommendations for breast reconstruction; 1 below elbow amputation in a case of severe lymphedema ineligible for LVA, where the patient was too high risk to undergo liposuction; 1 apronectomy in a case of lymphedema of an abdominal apron; a bariatric referral; and 3 general plastic surgery referrals.

Table 6. MDT Recommendation

Surgical (n = 129)					Conservative (n = 46)	
LVA	Liposuction	VLNT	VLNT + DIEP	Other	Conservative	Conservative (Declined Surgery)
61	40	11*	8	9	37	9

*Superficial inguinal 6, supraclavicular 4, and unknown 1.

Table 7. Type of Assessment for the Surgical MDT

Type of Assessment	N	%
Face to face	95	54
Teleconference	53	30
Discussion via notes	25	14
Unknown	2	1
Total	175	—

Table 8. Cost of 42 LVAs per Annum

Area of costs	£000s
Direct theater session	
Consultant surgeon	17.1
Consultant anesthetics	27.3
Specialist resident support	5.3
Nursing	21.2
Pre- and posttheater resurgeon and anesthetics	10.3
MDT follow-up	5.1
Nonpay	10.5
Maintenance costs of LVA equipment	16.4
Ward costs	5.0
Secretarial support	5.6
Indirect costs and overheads	21.5
Depreciation	32.8
Subtotal direct cost of undertaking LVA	178.2
Plus follow-up costs (2 per annum for each patient in the second year)	10.2
Total revenue costs per annum	188.5

Conservative

Of the 46 conservative recommendations, the majority were due to not fulfilling the eligibility criteria in [Table 1](#). Only 9 declined surgery when offered. The majority (54%) of surgical MDT appointments were face-to-face, but others were via teleconference (30%) ([Table 7](#)).

Reported Costs and Estimated Savings of LVA

The total cost per patient undergoing day-case LVA treatment was quantified as £4243, which includes staffing, preoperative imaging, use of a microscope, instruments, suture material, and follow-up appointments for 2 years. This does not include the purchase cost for the microscope or scanning devices. For the proposed 42 cases per year, this represented an annual cost of around £189,000. The breakdown for this is displayed in [Table 8](#). The CLP business case emphasized that the £4243 investment for each patient undergoing LVA could accrue benefits in the following areas based on previous research⁷:

- decreased admissions to the hospital for cellulitis;
- reduction in antibiotic usage;
- reduced need for lifelong compression garments;
- decreased hospital follow-up appointments;
- reduced need for lymphedema intensive management sessions;
- more people being discharged from lymphedema services as their condition is controlled;
- improved health benefits for those with lymphedema including
 - quality of life using validated tools,
 - decreased pain,

Table 9. Cost Savings by Implementing an LVA Service (2015)

Assumed number of patients treated per year	42
Estimated annual savings	£19,349
Gross estimated savings (over 20 y)	£386,980
Net present value of discounted savings over 20 y	£275,000

Note that savings would be higher now due to inflation.

Table 10. Annual Cash Releasing Savings for Each of the LVA Patients in Whom the Surgery Enabled Discharge Following Treatment (2015)

Item	£
Compression garments	300
Bandages for compression garments	150
Antibiotics	155
Total	605
Over 20 y*	12,100

Note that the numbers would be higher now due to inflation.

*An assumed 20 y of savings per patient is a prudent estimate, $605 \times 20 = 12,100$.

- improved function and movement,
- decreased fear, anxiety, and stigma,
- financial benefits such as less time off work, reduced appointments, and reduced travel.

Even though a range of qualitative, quantitative, and financial benefits have been identified by introducing LVA, accounting for and tracking any future savings is always a challenge. Assuming an average impact of 20 years for each person treated with LVA and based on the evidenced outcomes, an estimate of the real financial savings was calculated ([Table 9](#)). It is important to highlight this is not based on our real-life data but extrapolated from the literature as estimated savings. This figure was then discounted to give a net present value of these savings, set against the current cost of the initial treatment. The data displayed reveal a net present value saving over 20 years of £275,000 of only the “cash releasing” savings. Other quantifiable savings, such as reduced cellulitis admissions and improved economic impact by patient employment, were not included in this original business case but were considerable when assumed that each inpatient cellulitis admission costs on average £2000 and each person would have had at least 2 episodes of cellulitis per annum. A crude estimation of the financial benefit of 42 LVA patients would be £168,000 per annum, and over 20 years, the potential avoidance would be around £3 million. The savings on compression garments, bandages, and antibiotics are illustrated in [Table 10](#).

DISCUSSION

The treatment of lymphedema remains variable across the United Kingdom, with Wales being the only nation to offer an equitable and holistic lymphedema service. With more than 7500 new referrals a year, lymphedema therapists in the network bring patients to our supermicrosurgeons' attention for MDT discussion

only once eligibility testing has been performed. This maximizes efficiency. The psychological, health, and economic benefits of treating lymphedema have a clear evidence base.^{17,18,28–30} Moreover, with a growing prevalence of more than 200,000 patients with lymphedema in the United Kingdom alone, with it affecting around 2 in 10 people with breast cancer and 5 in 10 people with vulval cancer,³¹ the argument for change is well apparent. Twenty-nine percent of lymphedema patients will have at least 1 episode of cellulitis each year, which equates to 2523 patients in Wales, and 27% of those with cellulitis will require hospital admission for intravenous antibiotics, with a length of stay of 1–12 days, which equates to 681 in Wales annually. The average cost of each cellulitis episode is estimated to be £1342 if admitted to hospital (>£900,000 annually) and £194 if treated in the community (>£480,000 annually). We estimate the NHS spends approximately £1.4 million annually to treat cellulitis related to lymphedema.

The failure to offer LVA is certainly not due to safety concerns, as the surgery is a low-risk procedure performed under local anesthetic. Nor is it due to a lack of willing and trained consultant plastic and reconstructive surgeons across the United Kingdom. Plastic surgeons are competent in microsurgery, and offering a supermicrosurgery service provides an opportunity for training and fellowships, in turn providing supermicrosurgeons for the future. Sadly, the lack of LVA implementation is reflective of the difficulties in achieving financial approval from individual trusts and NHS care organizations.

CONCLUSIONS

The authors hope that this article provides an impetus for replication of similar surgical lymphedema services across the United Kingdom. As the all-Wales NHS surgical lymphedema supermicrosurgery service continues to grow and receive referrals earlier in the disease process, we hope it will be possible to perform LVA on patients before the cycle of cellulitis and scarring of the lymphatics occurs.

The key message of this article is that it is not a proper use of resources to have a plastic surgeon see every new lymphedema referral. The gold standard practice should be that a network of therapists who already regularly see and assess these patients for conservative management can refer eligible patients to the surgical MDT to discuss surgical options. Despite efforts from the lymphedema support network, NHS England has made it clear that no lymphedema strategy for England will be forthcoming.³² This is within the wider context of recent events, with the change in National Institute for Clinical Excellence guidance diminishing the use of liposuction for many patients with lipedema, which recommended further research on efficacy.³³ Surgical prevention strategies are also gaining increasing recognition and include immediate lymphatic repair, that is, a lymphatic microsurgical preventive healing approach

at the time of axillary lymph node clearance, and targeted lymphatic axillary repair.³⁴

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DISCLOSURE

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

ETHICAL APPROVAL

This study was registered with the trust audit department at Morrison Hospital and given approval for a retrospective review of the notes.

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