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Respondent

1 Anonymous

32:05
Time to complete

Your information

1. Name: *

Amer Durrani

2. Job title: *

Consultant Plastic & Reconstructive Surgeon

3. Organisation: *

Cambridge University Hospitals NHS Foundation Trust

4. Email address: *

[redacted]

5. Professional organisation or society membership/affiliation: *

British Association of Plastic, Reconstructive & Aesthetic Surgeons (BAPRAS)

6. Nominated/ratified by (if applicable):

BAPRAS

7. Registration number (e.g. GMC, NMC, HCPC) *

4101668

How NICE will use this information:

The information that you provide on this form will be used to develop guidance on this procedure.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Your name, job title, organisation and your responses, along with your declared interests will also be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

For more information about how we process your data please see our privacy notice: https://www.nice.org.uk/privacy-notice

8. I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. *

- (●) I agree
- ( ) I disagree

The procedure/technology

Please answer the following questions as fully as possible to provide further information about the procedure/technology and/or your experience.

9. Please describe your level of experience with the procedure/technology, for example:

   Are you familiar with the procedure/technology?

   I undertake regional lymph node dissections and sentinel lymph node biopsies for melanoma as part of my routine clinical practice. I am familiar with LYMPHA and the use of other surgical approaches to manage lymphoedema and am looking to set up a lymphoedema surgery service here in Cambridge.

10. Have you used it or are you currently using it?

    - Do you know how widely this procedure/technology is used in the NHS or what is the likely speed of uptake?

    - Is this procedure/technology performed/used by clinicians in specialities other than your own?

    - If your specialty is involved in patient selection or referral to another specialty for this procedure/technology, please indicate your experience with it.

    This procedure is not widely used in the NHS and speed of uptake may be slow as funding may be an issue.

11. Please indicate your research experience relating to this procedure (please choose one or more if relevant):

- [x] I have done bibliographic research on this procedure.
- [ ] I have done research on this procedure in laboratory settings (e.g. device-related research).
- [ ] I have done clinical research on this procedure involving patients or healthy volunteers.
- [ ] I have published this research.
- [ ] I have had no involvement in research on this procedure.
- [ ] Other

12. Does the title adequately reflect the procedure?

- (•) Yes
- ( ) Other

13. Is the proposed indication appropriate? If not, please explain

Yes

14. How innovative is this procedure/technology, compared to the current standard of care? Is it a minor variation or a novel approach/concept/design?

It is very innovative and a novel concept, but needs a review of evidence to confirm safety

15. Which of the following best describes the procedure:

- ( ) Established practice and no longer new.
- ( ) A minor variation on an existing procedure, which is unlikely to alter the procedure's safety and efficacy.
- (•) Definitely novel and of uncertain safety and efficacy.
- ( ) The first in a new class of procedure.

16. Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care?

It may replace current standard of care

Current management

17. Please describe the current standard of care that is used in the NHS.

Standard of care involves a regional node dissection without LYMPHA

18. Are you aware of any other competing or alternative procedure/technology available to the NHS which have a similar function/mode of action to this?

    If so, how do these differ from the procedure/technology described in the briefing?

Other procedures include lymphatico-venous and lymphatico-lymphatic anastamoses and free lymph node transfers

Potential patient benefits and impact on the health system

19. What do you consider to be the potential benefits to patients from using this procedure/technology?

Reduction in risk of limb lymphoedema and the attendant morbidities

20. Are there any groups of patients who would particularly benefit from using this procedure/technology?

All patients undergoing regional lymph node dissections (groin and axilla)

21. Does this procedure/technology have the potential to change the current pathway or clinical outcomes to benefit the healthcare system?

    Could it lead, for example, to improved outcomes, fewer hospital visits or less invasive treatment?

Yes: lymphoedema is a lifelong chronic condition that has to be managed for the duration of the patient's life ie hospital reviews, compression hosiery, hospital admissions with cellulitis - all of which could be prevented or reduced by LYMPHA

22. What clinical facilities (or changes to existing facilities) are needed to do this procedure/technology safely?

NHS funding approval; specialised operating microscopes for supermicrosurgery

23. Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?

Not for established microsurgeons who also undertake regional node dissections, all as part of their routine surgical practice.

Safety and efficacy of the procedure/technology

24. What are the potential harms of the procedure/technology?

    Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:

    - Adverse events reported in the literature (if possible, please cite literature)
    - Anecdotal adverse events (known from experience)
    - Theoretical adverse events

    Adverse events: development of lymphoedema; anaphylaxis to blue dye

25. Please list the key efficacy outcomes for this procedure/technology?

    Prevention of lymphoedema and it's sequelae

26. Please list any uncertainties or concerns about the efficacy and safety of this procedure/technology?

    Reconstruction of lymphatics for limb tumours ie melanoma or SCC may create a pathway for onward transit of metastatic disease beyond regional lymph nodes

27. Is there controversy, or important uncertainty, about any aspect of the procedure/technology?

    Reconstruction of lymphatics for limb tumours ie melanoma or SCC may create a pathway for onward transit of metastatic disease beyond regional lymph nodes

28. If it is safe and efficacious, in your opinion, will this procedure be carried out in:

- ( ) Most or all district general hospitals.
- (•) A minority of hospitals, but at least 10 in the UK.
- ( ) Fewer than 10 specialist centres in the UK.
- ( ) Cannot predict at present.

Abstracts and ongoing studies

29. Please list any abstracts or conference proceedings that you are aware of that have been recently presented / published on this procedure/technology (this can include your own work).

    Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important.

30. Are there any major trials or registries of this procedure/technology currently in progress? If so, please list.

    I am not aware of any currently
    LYMPHA: Eliminating the Burden of Lymphedema in Patients Requiring Nodal Dissection in USA was terminated due to COVID-19

31. Please list any other data (published and/or unpublished) that you would like to share.

I am not aware beyond case series in literature

Other considerations

32. Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?

In Cambridge 300 patients per annum

33. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

Beneficial outcome measures.

These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured.

Prevention of lymphoedema with short and long term benefits/cost savings.
Standard QoL measures for cancer patients/risk of lymphoedema/effects of non-surgical management of lymphoedema
5 years duration

34. Please suggest potential audit criteria for this procedure/technology. If known, please describe:

Adverse outcome measures.

These should include early and late complications. Please state the post procedure timescales over which these should be measured:

Pre-operative limb assessment & measurement
Post-operative assessment and measurement of lymphoedema tied into standard oncological follow up eg stage III melanoma - 3 monthly for 3 years, 6 monthly for 2 years to a total of 5 years

Further comments

35. If you have any further comments (e.g. issues with usability or implementation, the need for further research), please describe *

Further evidence review required

Declarations of interests

Please state any potential conflicts of interest relevant to the procedure/technology (or competitor technologies) on which you are providing advice, or any involvements in disputes or complaints, in the previous **12 months** or likely to exist in the future. Please use the NICE policy on declaring and managing interests as a guide when declaring any interests. Further advice can be obtained from the NICE team.

36. Type of interest: *

- [ ] Direct: financial
- [ ] Non-financial: professional
- [ ] Non-financial: personal
- [ ] Indirect
- [x] No interests to declare

37. Description of interests, including relevant dates of when the interest arose and ceased. *

None

38. I confirm that the information provided above is complete and correct. I acknowledge that any changes in these declarations during the course of my work with NICE, must be notified to NICE as soon as practicable and no later than 28 days after the interest arises. I am aware that if I do not make full, accurate and timely declarations then my advice may be excluded from being considered by the NICE committee.

Please note, all declarations of interest will be made publicly available on the NICE website. *

- (●) I agree
- ( ) I disagree

Signature

39. Name: *

Amer Durrani

40. Date: *

08/03/2023

NICE National Institute for Health and Care Excellence

Professional Expert Questionnaire

Technology/Procedure name & indication: IP1893 Lymphovenous anastomosis at the time of axillary/inguinal lymph node dissection for the prevention of secondary lymphoedema

Your information

Name:	Miss Judith Hunter
Job title:	Consultant Plastic, Aesthetic and Reconstructive Surgeon
Organisation:	Imperial College Healthcare NHS Trust
Email address:	[redacted]
Professional organisation or society membership/affiliation:	BAPRAS
Nominated/ratified by (if applicable):	Click here to enter text.
Registration number (e.g. GMC, NMC, HCPC)	4675240

How NICE will use this information:

The information that you provide on this form will be used to develop guidance on this procedure.

√ Please tick this box if you would like to receive information about other NICE topics.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Your name, job title, organisation and your responses, along with your declared interests will also be published online on the NICE website as part of public consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

For more information about how we process your data please see our privacy notice.

√ I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. If consent is NOT given, please state reasons below:

Click here to enter text.

Please answer the following questions as fully as possible to provide further information about the procedure/technology and/or your experience.

1	Please describe your level of experience with the procedure/technology, for example: Are you familiar with the procedure/technology?	Yes, I am comfortable doing LYMPHA procedures and have performed personally at least 25 of them- as a department we have performed over 50 cases
	Have you used it or are you currently using it? – Do you know how widely this procedure/technology is used in the NHS or what is the likely speed of uptake? – Is this procedure/technology performed/used by clinicians in specialities other than your own? – If your specialty is involved in patient selection or referral to another specialty for this	It is not widely used yet, but there is a lot of interest in the UK and multiple units are starting to perform these cases. Worldwide it is an established technique in specialist centres in the US and Italy. The LYMPHA technique was pioneered by a general surgeon, but in general has been taken up by plastic surgeons due to the microsurgery techniques that are used which we are trained in and familiar with. Breast surgeons perform part of the procedure with us, and the axillary lymph node dissection needs to be performed slightly differently to enable us to have access to long enough vessels to anastomose to and to identify lymphatics using ICG and/or blue dye. We would offer all patients having axillary lymph node dissections the LYMPHA procedure if we had the resources to do so- NICE approval would help with that.

	procedure/technology, please indicate your experience with it.	
2	– Please indicate your research experience relating to this procedure (please choose one or more if relevant):	I have done bibliographic research on this procedure. YES I have done research on this procedure in laboratory settings (e.g. device-related research). NO I have done clinical research on this procedure involving patients or healthy volunteers. YES I have published this research. YES- presented at BAPRAS National Meeting 2022, being prepared to be written up as a paper
3	Does the title adequately reflect the procedure? Is the proposed indication appropriate? If not, please explain. How innovative is this procedure/technology, compared to the current standard of care? Is it a minor variation or a novel approach/concept/design? Which of the following best describes the procedure (please choose one):	Yes Yes although I only have experience of it related to the axilla, not the groin. Established practice and no longer new- Yes internationally in specialist centres in US A minor variation on an existing procedure, which is unlikely to alter the procedure's safety and efficacy- Yes, no increase in morbidity at time of surgery (although adds some time), but can reduce lymphoedema risk from 30-40% down to 3-4% in large studies by Boccardo et al, and repeated worldwide in multiple different centres including our own, where our lymphoedema rate has decreased from 30% to 2% using this technique. Lymphoedema itself is a significant cost to the patient and healthcare system (sleeves, manual lymphatic drainage, recurrent infections). Definitely novel and of uncertain safety and efficacy. No The first in a new class of procedure. No
4	Does this procedure/technology have the potential to replace current standard care or	It would be used in addition- those that need an axillary lymph node dissection would also be offered LYMPHA.

	would it be used as an addition to existing standard care?	
5	Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure? Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?	No No

Current management

6	Please describe the current standard of care that is used in the NHS.	Axillary lymph node dissection only- with rate of lymphoedema arising from this approx. 30-40%
7	Are you aware of any other competing or alternative procedure/technology available to the NHS which have a similar function/mode of action to this? If so, how do these differ from the procedure/technology described in the briefing?	No

Potential patient benefits and impact on the health system

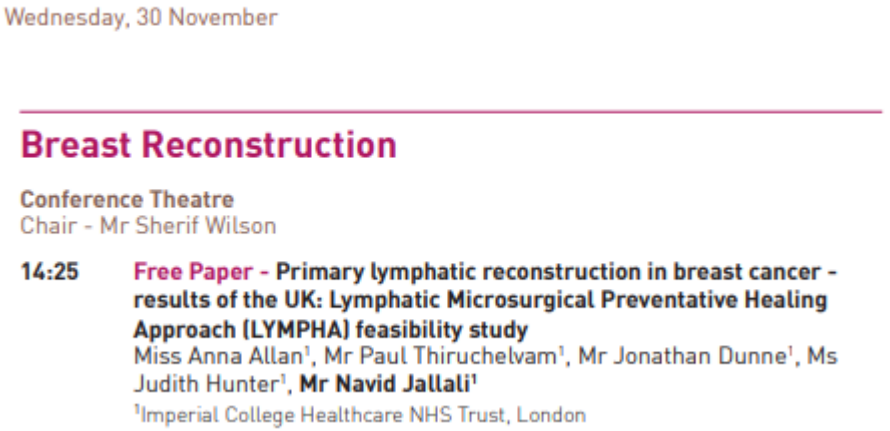
8	What do you consider to be the potential benefits to patients from using this procedure/technology?	Multiple studies and our own demonstrate a decrease in lymphoedema rate after Axillary lymph node dissection (ALND) from 30-40% to 3-4% or less- this means less patients needing treatment for lymphoedema (which is debilitating and chronic) such as manual drainage, sleeves, recurrent infections
9	Are there any groups of patients who would particularly benefit from using this procedure/technology?	All those having ALND are at risk so ideally all should be offered LYMPHA too, but there are groups at even higher risk (those also having radiotherapy, with a high BMI, diabetic, having concurrent mastectomy, higher lymph node positive burden, taxane chemotherapy, previous lymphatic insufficiency, older patients)
10	Does this procedure/technology have the potential to change the current pathway or clinical outcomes to benefit the healthcare system? Could it lead, for example, to improved outcomes, fewer hospital visits or less invasive treatment?	Yes- less lymphoedema would be a significant cost saving for the healthcare system and improve patient outcomes and morbidity. Yes to all- less need for lymphoedema clinic appointments, less need for outpatient or inpatient treatment of lymphoedema associated infections, less need for other surgery such as liposuction (which has limited efficacy)
11	What clinical facilities (or changes to existing facilities) are needed to do this procedure/technology safely?	Training of breast surgeons in their part of the surgery, theatre slots to allow plastic surgeons and breast surgeons to work together even more regularly than they do now
12	Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?	Yes, some mentoring of experienced surgeons with those learning the technique to ensure less learning curve- but techniques are all an extension of what we are all already trained to do- we have the skills and equipment (microscope and micro instruments) already. Using ICG technology in addition is helpful for visualisation of the lymphatics, but blue dye alone can be used.

Safety and efficacy of the procedure/technology

13	What are the potential harms of the procedure/technology?	Very little – possible allergy to ICG or blue dye, but these are agents are already regularly used for these patients. Blue dye allergy 1.8%/ICG allergy much lower-

	Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence: Adverse events reported in the literature (if possible, please cite literature) Anecdotal adverse events (known from experience) Theoretical adverse events	routinely used in sentinel lymph node biopsies however No significant increased risks with LYMPHA vs ALND alone except increased surgical time (approx. 90 mins)
14	Please list the key efficacy outcomes for this procedure/technology?	Decreased long term lymphoedema rates- from 30-40% down to 3-4% in multiple published studies in centres worldwide
15	Please list any uncertainties or concerns about the efficacy and safety of this procedure/?	none
16	Is there controversy, or important uncertainty, about any aspect of the procedure/technology?	People being convinced that the effort is worth it
17	If it is safe and efficacious, in your opinion, will this procedure be carried out in (please choose one):	Most or all district general hospitals. No A minority of hospitals, but at least 10 in the UK. Yes- in those centres that carry out microsurgical breast reconstruction (i.e those hospitals with plastic surgery departments) Fewer than 10 specialist centres in the UK. ? Cannot predict at present. ?

Abstracts and ongoing studies

18	Please list any abstracts or conference proceedings that you are aware of that have been recently presented / published on this procedure/technology (this can include your own work). Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important.	 Wednesday, 30 November **Breast Reconstruction** **Conference Theatre** Chair - Mr Sherif Wilson **14:25** Free Paper - **Primary lymphatic reconstruction in breast cancer - results of the UK: Lymphatic Microsurgical Preventative Healing Approach (LYMPHA) feasibility study** Miss Anna Allan[1], Mr Paul Thiruchelvam[1], Mr Jonathan Dunne[1], Ms Judith Hunter[1], **Mr Navid Jallali[1]** [1]Imperial College Healthcare NHS Trust, London BAPRAS Meeting 2022;
19	Are there any major trials or registries of this procedure/technology currently in progress? If so, please list.	Yes- in Italy, Barcelona and the US
20	Please list any other data (published and/or unpublished) that you would like to share.	Our data n=53 LYMPHAs with ALND for breast cancer, performed since 2018, >70% also having Radiotherapy, >90% also chemo; median 18 month follow up; 9 more than 36 months follow up, 20 more than 24 months- one possible case of mild lymphoedema only so far identified- we would expect to have seen at least 16 cases based on our usual rates of lymphoedema. We have had no cases where we have failed to perform a lymphovascular anastomosis.

Other considerations

21	Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?	Every breast cancer patient having an axillary lymph node dissection: this rate is decreasing as less invasive surgery to the axilla is advocated but there will still be a significant cohort with locally advanced enough cancer that will need a lymph node dissection and would benefit from LYMPHA

22	Please suggest potential audit criteria for this procedure/technology. If known, please describe: – Beneficial outcome measures. These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured. – Adverse outcome measures. These should include early and late complications. Please state the post procedure timescales over which these should be measured:	Beneficial outcome measures: Less cases of lymphedema- increased quality of life, less burden on lymphoedema services, less infections to treat Lymphedema rates can be measured by following up arm volume or circumference post-op or visualising working lymphatics using ICG for example; these outcome measures and their timescales have already been described in the literature Adverse outcome measures: Early-Failure to perform anastomosis, none in our study, but a few percent in other studies; should also look at increased complications such as wound healing, haematoma or seroma post surgery- we have not found there is an increased risk of these complications by adding in LYMPHA to ALND Late- failure to prevent lymphoedema ?5 year follow up

Further comments

23	If you have any further comments (e.g. issues with usability or implementation, the need for further research), please describe.	

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Declarations of interests

Please state any potential conflicts of interest relevant to the procedure/technology (or competitor technologies) on which you are providing advice, or any involvements in disputes or complaints, in the previous **12 months** or likely to exist in the future. Please use the NICE policy on declaring and managing interests as a guide when declaring any interests. Further advice can be obtained from the NICE team.

Type of interest *	Description of interest	Relevant dates	
		Interest arose	Interest ceased
Choose an item.	I have been paid by Stryker to talk about ICG technology in the past, but not since 2021.		
Choose an item.			
Choose an item.			

√ I confirm that the information provided above is complete and correct. I acknowledge that any changes in these declarations during the course of my work with NICE, must be notified to NICE as soon as practicable and no later than 28 days after the interest arises. I am aware that if I do not make full, accurate and timely declarations then my advice may be excluded from being considered by the NICE committee.

Please note, all declarations of interest will be made publicly available on the NICE website.

Print name:	**Miss Judith Hunter**
Dated:	**22/3/2023**

NICE National Institute for Health and Care Excellence

Professional Expert Questionnaire

Technology/Procedure name & indication: IP1893 Lymphovenous anastomosis at the time of axillary/inguinal lymph node dissection for the prevention of secondary lymphoedema

Your information

Name:	Paul Thiruchelvam
Job title:	Consultant Breast & Reconstructive Surgeon
Organisation:	Imperial College NHS Trust
Email address:	[redacted]
Professional organisation or society membership/affiliation:	American Society of Breast Surgeons, Association of Breast Surgeons of Great Britain and Ireland, American College of Surgeons, British Lymphology Society
Nominated/ratified by (if applicable):	British Association of Plastic & Reconstructive Surgeons
Registration number (e.g. GMC, NMC, HCPC)	4729606

How NICE will use this information:

The information that you provide on this form will be used to develop guidance on this procedure.

X Please tick this box if you would like to receive information about other NICE topics.

Your advice and views represent your individual opinion and not that of your employer, professional society or a consensus view. Your name, job title, organisation and your responses, along with your declared interests will also be published online on the NICE website as part of public

consultation on the draft guidance, except in circumstances but not limited to, where comments are considered voluminous, or publication would be unlawful or inappropriate.

For more information about how we process your data please see our privacy notice.

X I give my consent for the information in this questionnaire to be used and may be published on the NICE website as outlined above. If consent is NOT given, please state reasons below:

Click here to enter text.

Please answer the following questions as fully as possible to provide further information about the procedure/technology and/or your experience.

1	Please describe your level of experience with the procedure/technology, for example: Are you familiar with the procedure/technology? Have you used it or are you currently using it? – Do you know how widely this procedure/technology is used in the NHS or what is the likely speed of uptake? – Is this procedure/technology performed/used by clinicians in specialities other than your own?	I have been undertaking immediate lymphatic reconstruction / lymphatic microsurgical preventative healing approach (LYMPHA) procedure in the United Kingdom for the past 5 years. Prior to this I visited the index centre in the Italy in which it was first described. Furthermore, I visited other centres which undertake axillary reverse mapping and immediate lymphatic reconstruction (including Columbia, USA; Beth Israel Deaconess, USA and Memorial Sloan Kettering, USA, University of Arkansas Medical Center, USA and University of Kanazawa, Japan). I have amalgamated this experience into my current practice. I currently serve on the American Society of Breast Surgeons lymphatic surgery working group which runs regular courses on lymphoedema prevention and have published on lymphoedema prevention. I am not aware of other units which are undertaking this technique in the UK and that have visited either Genoa or the unit at Imperial. Several units have expressed an interest in undertaking this technique and implementing it into their practice. This technique is performed jointly between breast surgery and plastic surgery. However, there is some evidence supporting immediate lymphatic reconstruction being done by the breast/general surgeons alone – this modification of the technique is called S-LYMPHA (simplified-LYMPHA). I have visited the University of Miami, USA where this was first described, and their outcomes are equivalent to LYMPHA undertaken jointly with a plastic surgeon. This opens up access of the procedure to a wider group of surgeons. Having seen both techniques (LYMPHA and S-LYMPHA)

	– If your specialty is involved in patient selection or referral to another specialty for this procedure/technology, please indicate your experience with it.	in practice, I feel this is best undertaken jointly between general surgery and plastic surgery, due to the size of the lymphatics (02.-0.5mm diameter) and the potential need to use a vein graft in cases to avoid technical failure.
2	– Please indicate your research experience relating to this procedure (please choose one or more if relevant):	**I have done bibliographic research on this procedure.** **I have done research on this procedure in laboratory settings (e.g. device-related research).** **I have done clinical research on this procedure involving patients or healthy volunteers.** **I have published this research.** I have had no involvement in research on this procedure. Other (please comment)
3	Does the title adequately reflect the procedure? Is the proposed indication appropriate? If not, please explain. How innovative is this procedure/technology, compared to the current standard of care? Is it a minor variation or a novel approach/concept/design?	Or alternatively: “immediate lymphatic reconstruction with axillary/inguinal lymph node dissection for the prevention of secondary lymphoedema” Yes Established practice and no longer new. A minor variation on an existing procedure, which is unlikely to alter the procedure’s safety and efficacy. Definitely novel and of uncertain safety and efficacy. The first in a new class of procedure.

	Which of the following best describes the procedure (please choose one):	
4	Does this procedure/technology have the potential to replace current standard care or would it be used as an addition to existing standard care?	This would replace the current standard of care
5	Have there been any substantial modifications to the procedure technique or, if applicable, to devices involved in the procedure? Has the evidence base on the efficacy and safety of this procedure changed substantially since publication of the guidance?	There have been no substantial modifications to the technique

Current management

6	Please describe the current standard of care that is used in the NHS.	The standard of care in the NHS is for patients with node positive disease having an upfront surgery to have an axillary clearance without lymphatic reconstruction and the attendant risk of lymphoedema >20%
7	Are you aware of any other competing or alternative procedure/technology available to the NHS which have a similar function/mode of action to this? If so, how do these differ from the procedure/technology described in the briefing?	There are no competing or alternative procedures/technology available to the NHS which have a similar function/mode of action to this.

Potential patient benefits and impact on the health system

8	What do you consider to be the potential benefits to patients from using this procedure/technology?	Significant benefit to patients in terms of quality of life and cost savings to the healthcare system
9	Are there any groups of patients who would particularly benefit from using this procedure/technology?	Any patient having axillary clearance surgery but in particular certain patients are at greater risk of developing lymphoedema i.e. 1. Increased BMI 2. Locoregional radiotherapy 3. Neoadjuvant chemotherapy 4. Afro-Caribbean race
10	Does this procedure/technology have the potential to change the current pathway or clinical outcomes to benefit the healthcare system? Could it lead, for example, to improved outcomes, fewer hospital visits or less invasive treatment?	This procedure has the potential to markedly improve patient quality of life from a debilitating, progressive condition which requires ongoing maintenance and treatment, sometimes this involves hospital admissions for recurrent cellulitis. Preventing these episodes will have a significant cost savings to the healthcare system.
11	What clinical facilities (or changes to existing facilities) are needed to do this procedure/technology safely?	Access to a suitably trained microsurgeon, breast surgeon and a near infra-red camera
12	Is any specific training needed in order to use the procedure/technology with respect to efficacy or safety?	Training is required for the reverse axillary mapping technique, the change in axillary dissection technique to preserve recipient veins and identify lymphatics. The microsurgeons need advice on the intussusception technique for the lymphovenous bypass (lymphatic reconstruction).

Safety and efficacy of the procedure/technology

13	What are the potential harms of the procedure/technology? Please list any adverse events and potential risks (even if uncommon) and, if possible, estimate their incidence:	Increased time in theatre (1.5-2hrs) ; skin staining and risk of anaphylaxis if blue dye is used (0.1%) – there are no other potential harms

	Adverse events reported in the literature (if possible, please cite literature) Anecdotal adverse events (known from experience) Theoretical adverse events	
14	Please list the key efficacy outcomes for this procedure/technology?	Reduced risk of lymphoedema, improved patient reported outcomes, cost saving to healthcare system and society
15	Please list any uncertainties or concerns about the efficacy and safety of this procedure/?	Recent RT (in press) demonstrates a significant reduction in rates of lymphoedema in patients having an immediate lymphatic reconstruction (9%) vs those who did not (31%). This backs up other multicenter cohort studies with similar outcomes
16	Is there controversy, or important uncertainty, about any aspect of the procedure/technology?	There is no controversy or uncertainty about the technique.
17	If it is safe and efficacious, in your opinion, will this procedure be carried out in (please choose one):	Most or all district general hospitals. **A minority of hospitals, but at least 10 in the UK.** Fewer than 10 specialist centres in the UK. Cannot predict at present.

Abstracts and ongoing studies

18	Please list any abstracts or conference proceedings that you are aware of that have been recently presented / published on this procedure/technology (this can include your own work). Please note that NICE will do a comprehensive literature search; we are only asking you for any very recent	B: Lymphatic Microsurgical Preventative Healing Approach (LYMPHA) / Primary Lymphatic Reconstruction **1. Casabona F, Bogliolo S, Ferrero S, Boccardo F, Campisi C. Axillary reverse mapping in breast cancer: a new microsurgical lymphatic-venous procedure in the prevention of arm lymphedema. Ann Surg Oncol. 2008 Nov;15(11):3318-9. doi: 10.1245/s10434-008-0118-5. Epub 2008 Aug 15. PMID: 18709416.**

	abstracts or conference proceedings which might not be found using standard literature searches. You do not need to supply a comprehensive reference list but it will help us if you list any that you think are particularly important.	**2. Boccardo F, Casabona F, De Cian F, Friedman D, Villa G, Bogliolo S, Ferrero S, Murelli F, Campisi C. Lymphedema microsurgical preventive healing approach: a new technique for primary prevention of arm lymphedema after mastectomy. Ann Surg Oncol. 2009 Mar;16(3):703-8. doi: 10.1245/s10434-008-0270-y. Epub 2009 Jan 13. PMID: 19139964.** **Background:** The purpose of this manuscript is to assess the efficacy of direct lymphatic venous microsurgery in the prevention of lymphedema following axillary dissection for breast cancer. **Methods:** Nineteen patients with operable breast cancer requiring an axillary dissection underwent surgery, carrying out LVA between the blue lymphatics and an axillary vein branch simultaneously. The follow-up after 6 and 12 months from the operation included circumferential measurements in all cases and lymphangioscintigraphy only in 18 patients out of 19 cases. **Results:** Blue nodes in relation to lymphatic arm drainage were identified in 18/19 patients. All blue nodes were resected and 2-4 main afferent lymphatics from the arm could be prepared and used for anastomoses. Lymphatic-venous anastomoses allowed to prevent lymphedema in all cases. Lymphangioscintigraphy demonstrated the patency of microvascular anastomoses. **Conclusions:** Disruption of the blue nodes and closure of arm lymphatics can explain the significantly high risk of lymphedema after axillary dissection. LVA proved to be a safe procedure for patients in order to prevent arm lymphedema. **3. Boccardo FM, Ansaldi F, Bellini C, Accogli S, Taddei G, Murdaca G, Campisi CC, Villa G, Icardi G, Durando P, Puppo F, Campisi C. Prospective evaluation of a prevention protocol for lymphedema following surgery for breast cancer. Lymphology. 2009 Mar;42(1):1-9. Erratum in: Lymphology. 2009 Sep;42(3):149. PMID: 19499762.** Lymphedema is a common complication of axillary dissection and thus emphasis should be placed on prevention. Fifty-five women who had breast-conserving surgery or modified radical mastectomy for breast cancer with axillary dissection were randomly assigned to either the preventive protocol (PG) or control group (CG) and assessments were made preoperatively and at 1, 3, 6, 12 and 24 months postoperatively. Arm volume (VOL) was used as measurement of arm lymphedema. Clinically significant lymphedema was confirmed by an increase of at least 200 ml from the preoperative difference between the two arms. The preventive protocol for the PG women included preoperative upper limb lymphscintigraphy (LS), principles for lymphedema risk minimization, and early management of this condition when it was identified. Assessments at 2 years postoperatively were completed for 89% of the 55 women who were randomly assigned to either PG or CG. Of the 49 women with unilateral breast cancer surgery who were measured at 24 months, 10 (21%) were identified with secondary lymphedema using VOL with an incidence of 8% in PG women and 33% in CG women. These prophylactic strategies appear to reduce the development of secondary lymphedema and alter its progression in comparison to the CG women. **4. Campisi CC, Larcher L, Lavagno R, Spinaci S, Adami M, Boccardo F, Santi P, Campisi C. Microsurgical primary prevention of lymphatic injuries following breast cancer treatment. Plast Reconstr Surg. 2012 Nov;130(5):749e-750e. doi: 10.1097/PRS.0b013e318267d906. PMID: 23096640.** **5. Campisi CC, Ryan M, Boccardo F, Campisi C. LyMPHA and the prevention of lymphatic injuries: a rationale for early microsurgical intervention. J Reconstr Microsurg. 2014 Jan;30(1):71-2. doi: 10.1055/s-0033-1349348. Epub 2013 Jul 1. PMID: 23818252.**

6. Boccardo F, Casabona F, De Cian F, Friedman D, Murelli F, Puglisi M, Campisi CC, Molinari L, Spinaci S, Dessalvi S, Campisi C. Lymphatic microsurgical preventing healing approach (LYMPHA) for primary surgical prevention of breast cancer-related lymphedema: over 4 years follow-up. Microsurgery. 2014 Sep;34(6):421-4. doi: 10.1002/micr.22254. Epub 2014 Mar 26. Erratum in: Microsurgery. 2015 Jan;35(1):83. DeCian, Franco [corrected to De Cian, Franco]. PMID: 24677148.

Breast cancer-related lymphedema (LE) represents an important morbidity that jeopardizes breast cancer patients' quality of life. Different attempts to prevent LE brought about improvements in the incidence of the pathology but LE still represents a frequent occurrence in breast cancer survivors. Over 4 years ago, Lymphatic Microsurgical Preventing Healing Approach (LYMPHA) was proposed and long-term results are reported in this study. From July 2008 to December 2012, 74 patients underwent axillary nodal dissection for breast cancer treatment together with LYMPHA procedure. Volumetry was performed preoperatively in all patients and after 1, 3, 6, 12 months, and once a year. Lymphoscintigraphy was performed in 45 patients preoperatively and in 30 also postoperatively after at least over 1 year. Seventy one patients had no sign of LE, and volumetry was coincident to preoperative condition. In three patients, LE occurred after 8-12 months postoperatively. Lymphoscintigraphy showed the patency of lymphatic-venous anastomoses at 1-4 years after operation. LYMPHA technique represents a successful surgical procedure for primary prevention of arm LE in breast cancer patients.

7. Feldman S, Bansil H, Ascherman J, Grant R, Borden B, Henderson P, Ojo A, Taback B, Chen M, Ananthakrishnan P, Vaz A, Balci F, Divgi CR, Leung D, Rohde C. Single Institution Experience with Lymphatic Microsurgical Preventive Healing Approach (LYMPHA) for the Primary Prevention of Lymphedema. Ann Surg Oncol. 2015 Oct;22(10):3296-301. doi: 10.1245/s10434-015-4721-y. Epub 2015 Jul 23. PMID: 26202566.

Background: As many as 40 % of breast cancer patients undergoing axillary lymph node dissection (ALND) and radiotherapy develop lymphedema. We report our experience performing lymphatic-venous anastomosis using the lymphatic microsurgical preventive healing approach (LYMPHA) at the time of ALND. This technique was described by Boccardo, Campisi in 2009.

Methods: LYMPHA was offered to node-positive women with breast cancer requiring ALND. Afferent lymphatic vessels, identified by injection of blue dye in the ipsilateral arm, were sutured into a branch of the axillary vein distal to a competent valve. Follow-up was with pre- and postoperative lymphoscintigraphy, arm measurements, and (L-Dex®) bioimpedance spectroscopy.

Results: Over 26 months, 37 women underwent attempted LYMPHA, with successful completion in 27. Unsuccessful attempts were due to lack of a suitable vein (n = 3) and lymphatic (n = 5) or extensive axillary disease (n = 1). There were no LYMPHA-related complications. Mean follow-up time was 6 months (range 3-24 months). Among completed patients, 10 (37%) had a body mass index of ≥30 kg/m(2) (mean 27.9 ± 6.8 kg/m(2), range 17.4-47.6 kg/m(2)), and 17 (63%) received axillary radiotherapy. Excluding two patients with preoperative lymphedema and those with less than 3-month follow-up, the lymphedema rate was 3 (12.5%) of 24 in successfully completed and 4 (50 %) of 8 in unsuccessfully treated patients. **Conclusions:** Our transient lymphedema rate in this high-risk cohort of patients was 12.5%. Early data show that LYMPHA is feasible, safe, and effective for the primary prevention of breast cancer-related lymphedema.

8. Johnson AR, Singhal D. Immediate lymphatic reconstruction. J Surg Oncol. 2018 Oct;118(5):750-757. doi: 10.1002/jso.25177. Epub 2018 Aug 16. PMID: 30114329.

Although surgical and medical treatment options are available for the treatment of chronic lymphedema, there is no cure. Recent advances in microsurgery have provided an opportunity to perform immediate lymphatic reconstruction after lymphadenectomy

for disease prevention. In this review, we provide the historical background leading to a paradigm shift in performing this procedure. We will also discuss the current evidence for immediate lymphatic reconstruction, potential oncologic procedures amenable to this approach, and detail ongoing challenges.

9. Agrawal J, Mehta S, Goel A, Pande PK, Kumar K. Lymphatic Microsurgical Preventing Healing Approach (LYMPHA) for Prevention of Breast Cancer-Related Lymphedema-a Preliminary Report. Indian J Surg Oncol. 2018 Sep;9(3):369-373. doi: 10.1007/s13193-018-0731-0. Epub 2018 Feb 17. PMID: 30288000; PMCID: PMC6154369.

Lymphatic microsurgical preventing healing approach (LYMPHA) for prevention of breast cancer-related lymphedema (BCRL)-a preliminary report BCRL-is a chronic debilitating condition which impairs quality of life of breast cancer survivors. The aim is to study the feasibility of preventing lymphedema by performing "Lymphatic Microsurgical Preventive Healing Approach (LYMPHA)." Patients undergoing breast cancer surgery with complete nodal dissection were taken up for the study. After the standard axillary nodal dissection, lymphatics were identified by the help of blue dye and were anastomosed with a tributary to the axillary vein. Post-operatively, patients were followed up clinically for development of lymphedema and lymphoscintigraphy was performed after treatment completion. A total of 35 patients were enrolled for the study. The average BMI was 29.5. LYMPHA was feasible in all cases. The number of lymphatics identified was 1 to 5 per axilla. Two patients developed transient lymphedema which resolved with conservative therapy and patients were able to discontinue the compression garment. Follow-up lymphoscintigraphy is performed in two patients, which showed normal lymphatic flow. LYMPHA is a feasible technique, not difficult to perform, takes a short time, is accomplished in same general anesthesia as for axillary dissection, and gives no extra scar. The early results are promising and long-term follow-up may make the procedure as a routine.

10. Johnson AR, Kimball S, Epstein S, Recht A, Lin SJ, Lee BT, James TA, Singhal D. Lymphedema Incidence After Axillary Lymph Node Dissection: Quantifying the Impact of Radiation and the Lymphatic Microsurgical Preventive Healing Approach. Ann Plast Surg. 2019 Apr;82(4S Suppl 3):S234-S241. doi: 10.1097/SAP.0000000000001864. PMID: 30855393.

Background: Axillary surgery and radiotherapy are important aspects of breast cancer treatment associated with development of lymphedema. Studies demonstrate that Lymphatic Microsurgical Preventive Healing Approach (LYMPHA) may greatly reduce the incidence of lymphedema in high-risk groups. The objective of this study is to summarize the evidence relating lymphedema incidence to axillary lymph node dissection (ALND), regional lymph node radiation (RLNR) therapy, and LYMPHA.
Methods: We performed a literature search to identify studies involving breast cancer patients undergoing ALND with or without RLNR. Our primary outcome was the development of lymphedema. We analyzed the effect of LYMPHA on lymphedema incidence. We chose the DerSimonian and Laird random-effects meta-analytic model owing to the clinical, methodological, and statistical heterogeneity of studies.
Results: Our search strategy yielded 1476 articles. After screening, 19 studies were included. Data were extracted from 3035 patients, 711 of whom had lymphedema. The lymphedema rate was significantly higher when RLNR was administered with ALND compared with ALND alone ($P < 0.001$). The pooled cumulative incidence of lymphedema was 14.1% in patients undergoing ALND versus 2.1% in those undergoing LYMPHA and ALND ($P = 0.029$). The pooled cumulative incidence of lymphedema was 33.4% in those undergoing ALND and RLNR versus 10.3% in those undergoing ALND, RLNR, and LYMPHA ($P = 0.004$).

		Conclusion: Axillary lymph node dissection and RLNR are important interventions to obtain regional control for many patients but were found to constitute an increased risk of development of lymphedema. Our findings support that LYMPHA, a preventive surgical technique, may reduce the risk of breast cancer-related lymphedema in high-risk patients. **11. Agarwal S, Garza RM, Chang DW. Lymphatic Microsurgical Preventive Healing Approach (LYMPHA) for the prevention of secondary lymphedema. Breast J. 2020 Apr;26(4):721-724. doi: 10.1111/tbj.13667. Epub 2019 Oct 20. PMID: 31631442.** Lymphedema is a chronic, morbid condition in which the upper or lower extremity experiences swelling and fibrosis due to impaired lymphatic clearance. Among breast cancer patients, this condition is primarily attributed to axillary lymph node dissection (ALND) performed for oncologic management. While nonoperative and operative approaches to lymphedema management may be implemented to "manage" this condition, they are typically not curative. Therefore, lymphedema prevention in patients who have undergone ALND is of critical importance. Here, we briefly describe lymphedema and available management strategies, and focus on prevention in patients undergoing ALND using the Lymphatic Microsurgical Preventive Healing Approach (LYMPHA). Currently available clinical and experimental evidence suggests that LYMPHA may provide protection against the development of lymphedema in carefully selected patients. This procedure can serve as an adjunct surgical option for patients at the time of ALND. **12. Johnson AR, Fleishman A, Tran BNN, Shillue K, Carroll B, Tsai LL, Donohoe KJ, James TA, Lee BT, Singhal D. Developing a Lymphatic Surgery Program: A First-Year Review. Plast Reconstr Surg. 2019 Dec;144(6):975e-985e. doi: 10.1097/PRS.0000000000006223. PMID: 31764631.** **Background:** Lymphedema is a chronic condition that carries a significant physical, psychosocial, and economic burden. The authors' program was established in 2017 with the aims of providing immediate lymphatic reconstruction in high-risk patients undergoing lymphadenectomy and performing delayed lymphatic reconstruction in patients with chronic lymphedema. The purpose of this study was to describe the authors' clinical experience in the first year. **Methods:** A retrospective review of our clinical database was performed on all individuals presenting to the authors' institution for lymphatic surgery consideration. Patient demographics, clinical characteristics, and surgical management were reviewed. **Results:** A total of 142 patients presented for lymphatic surgery evaluation. Patients had a mean age of 54.8 years and an average body mass index of 30.4 kg/m. Patients with lymphedema were more likely to be referred from an outside facility compared to patients seeking immediate lymphatic reconstruction ($p < 0.001$). For patients with lymphedema, the most common cause was breast cancer related. Thirty-two percent of all patients evaluated underwent a lymphatic procedure. Of these, 32 were immediate lymphatic reconstructions and 13 were delayed lymphatic reconstructions. In the authors' first year, 94 percent of eligible patients presenting for immediate lymphatic reconstruction underwent an intervention versus only 38 percent of eligible lymphedema patients presenting for delayed lymphatic reconstruction ($p < 0.001$). **Conclusions:** First-year review of our lymphatic surgery experience has demonstrated clinical need evidenced by the number of patients and high percentage of outside referrals. As a program develops, lymphatic surgeons should expect to perform more time-sensitive immediate lymphatic reconstructions, as evaluation of chronic lymphedema requires development of a robust team for workup and review.

		13. Schwarz GS, Grobmyer SR, Djohan RS, Cakmakoglu C, Bernard SL, Radford D, Al-Hilli Z, Knackstedt R, Djohan M, Valente SA. Axillary reverse mapping and lymphaticovenous bypass: Lymphedema prevention through enhanced lymphatic visualization and restoration of flow. J Surg Oncol. 2019 Aug;120(2):160-167. doi: 10.1002/jso.25513. Epub 2019 May 29. PMID: 31144329. **Background:** A lymphedema (LE) prevention surgery (LPS) paradigm for patients undergoing axillary lymphadenectomy (ALND) was developed to protect against LE through enhanced lymphatic visualization during axillary reverse mapping (ARM) and refinement in decision making during lymphaticovenous bypass (LVB). **Methods:** A retrospective analysis of a prospective database was performed evaluating patients with breast cancer who underwent ALND, ARM, and LVB from September 2016 to December 2018. Patient and tumor characteristics, oncologic and reconstructive operative details, complications and LE development were analyzed. **Results:** LPS was completed in 58 patients with a mean age of 51.7 years. An average of 14 lymph nodes (LN) were removed during ALND. An average of 2.1 blue lymphatic channels were visualized with an average of 1.4 LVBs performed per patient. End to end anastomosis was performed in 37 patients and a multiple lymphatic intussusception technique in 21. Patency was confirmed 96.5% of patients. Adjuvant radiation was administered to 89% of patients. Two patients developed LE with a median follow-up of 11.8 months. **Conclusion:** We report on our experience using a unique LPS technique. Refinements in ARM and a systematic approach to LVB allows for maximal preservation of lymphatic continuity, identification of transected lymphatics, and reestablishment of upper extremity lymphatic drainage pathways. **14. Johnson AR, Granoff MD, Suami H, Lee BT, Singhal D. Real-Time Visualization of the Mascagni-Sappey Pathway Utilizing ICG Lymphography. Cancers (Basel). 2020 May 8;12(5):1195. doi: 10.3390/cancers12051195. PMID: 32397246; PMCID: PMC7281680.** **Background:** Anatomic variations in lymphatic drainage pathways of the upper arm may have an important role in the pathophysiology of lymphedema development. The Mascagni-Sappey (M-S) pathway, initially described in 1787 by Mascagni and then again in 1874 by Sappey, is a lymphatic drainage pathway of the upper arm that normally bypasses the axilla. Utilizing modern lymphatic imaging modalities, there is an opportunity to better visualize this pathway and its potential clinical implications. **Methods:** A retrospective review of preoperative indocyanine green (ICG) lymphangiograms of consecutive node-positive breast cancer patients undergoing nodal resection was performed. Lymphography targeted the M-S pathway with an ICG injection over the cephalic vein in the lateral upper arm. **Results:** In our experience, the M-S pathway was not visualized in 22% (*n* = 5) of patients. In the 78% (*n* = 18) of patients where the pathway was visualized, the most frequent anatomic destination of the channel was the deltopectoral groove in 83% of patients and the axilla in the remaining 17%. **Conclusion:** Our study supports that ICG injections over the cephalic vein reliably visualizes the M-S pathway when present. Further study to characterize this pathway may help elucidate its potential role in the prevention or development of upper extremity lymphedema.

15. Shaffer K, Cakmakoglu C, Schwarz GS, ElSherif A, Al-Hilli Z, Djohan R, Radford DM, Grobmyer S, Bernard S, Moreira A, Fanning A, Tu C, Valente SA. Lymphedema Prevention Surgery: Improved Operating Efficiency Over Time. Ann Surg Oncol. 2020 Nov;27(12):4695-4701. doi: 10.1245/s10434-020-08890-z. Epub 2020 Jul 27. PMID: 32720042.

Background: Lymphedema prevention surgery (LPS), which identifies, preserves, and restores lymphatic flow via lymphaticovenous bypasses (LVB), has demonstrated potential to decrease lymphedema in breast cancer patients requiring axillary lymph node dissection. Implementing this new operating technique requires additional operating room (OR) time and coordination. This study sought to evaluate the improvement of LPS technique and OR duration over time.
Methods: A prospective database of patients who underwent LPS at our institution from 2016 to 2019 was queried. Type of breast and reconstruction surgery, number of LVB performed, and OR times were collected. LPS details were compared by surgical group and year performed.
Results: Ninety-four patients underwent LPS, and 88 had complete OR time data available for analysis. Average age was 51 years, body mass index of 28, with an average of 15 lymph nodes removed. Reconstructive treatment groups included prosthetic reconstruction 56% (49), oncoplastic reduction 10% (9), and no reconstruction 34% (30). The number of patients undergoing LPS increased significantly from 2016 to 2019, and average number of LVB per patient doubled. In patients without reconstruction, the average time for LPS improved significantly from 212 to 87 min from 2016 to 2019 ($p = 0.015$) and similarly in patients undergoing LPS with prosthetic reconstruction from 238 to 160 min ($p = 0.022$).
Conclusions: LVB is an emerging surgical lymphedema prevention technique. While requiring additional surgical time, our results show that with refinement of technique, over 4 years, we were able to perform double the number of LVB per patient in half the OR time.

16. Johnson AR, Bravo MG, James TA, Suami H, Lee BT, Singhal D. The All but Forgotten Mascagni-Sappey Pathway: Learning from Immediate Lymphatic Reconstruction. J Reconstr Microsurg. 2020 Jan;36(1):28-31. doi: 10.1055/s-0039- 1694757. Epub 2019 Aug 9. PMID: 31398762.

Background: Upper extremity lymphedema occurs in 25 to 40% of patients after axillary lymph node dissection (ALND). Immediate lymphatic reconstruction (ILR) or the lymphatic micro- surgical preventative healing approach has demonstrated a significant decrease in postoperative rates of lymphedema (LE) from 4 to 12%. Our objective was to map the Mascagni - Sappey pathway, the lateral upper arm draining lymphatics, in patients undergoing ILR to better characterize the drainage pattern of this lymphosome to the axilla.
Methods: A retrospective review of our institutional lymphatic database was conducted and consecutive breast cancer patients undergoing ILR were identified from November 2017 through June 2018. Patient demographics, clinical characteristics, and intraoperative records were retrieved and analyzed.
Results: Twenty-nine consecutive breast cancer patients who underwent ILR after ALND were identified. Patients had a mean age of 54.6years and body mass index (BMI) of 26.6 kg/m2. Fluorescein isothiocyanate (FITC) was injected at the medial upper arm and isosulfan blue was injected at the cephalic vein, or lateral upper arm, prior to ALND. After ALND, an average 2.5 divided lymphatics were identified, and a mean 1.2 lymphatics were bypassed. In all patients, divided FITC lymphatics were identified. However, in only three patients (10%), divided blue lymphatics were identified after ALND. **Conclusion:** In this study, variable drainage of the lateral upper arm to the axillary bed was noted. This study is the first to provide a description of intraoperative findings, demonstrating variable drainage patterns of upper extremity lymphatics to the axilla. Moreover, we noted that the lateral- and medial-upper arm lymphosomes have mutually exclusive pathways draining to the axilla. Further study of lymphatic

		anatomy variability may elucidate the pathophysiology of lymphedema development and influence approaches to immediate lymphatic reconstruction. **17. Johnson AR, Asban A, Granoff MD, Kang CO, Lee BT, Chatterjee A, Singhal D. Is Immediate Lymphatic Reconstruction Cost-effective? Ann Surg. 2021 Dec 1;274(6):e581-e588. doi: 10.1097/SLA.0000000000003746. PMID: 31850991.** **Mini:** We conducted a cost-utility analysis to evaluate the cost and quality of life of patients undergoing axillary lymph node dissection (ALND) and ALND with regional lymph node radiation (RLNR), with and without lymphatic microsurgical preventive healing approach (LYMPHA), in a node-positive breast cancer population. We found that the addition of LYMPHA to both ALND or ALND with RLNR is more cost-effective. **Objective:** This manuscript is the first to employ rigorous methodological criteria to critically appraise a surgical preventative technique for breast cancer-related lymphedema from a cost-utility standpoint. **Summary of background data:** Breast cancer-related lymphedema is a well-documented complication of breast cancer survivors in the US. In this study, we conduct a cost-utility analysis to evaluate the cost-effectiveness of the LYMPHA. **Methods:** Lymphedema rates after each of the following surgical options: (1) ALND, (2) ALND + LYMPHA, (3) ALND + RLNR, (4) ALND + RLNR + LYMPHA were extracted from a recently published meta-analysis. Procedural costs were calculated using Medicare reimbursement rates. Average utility scores were obtained for each health state using a visual analog scale, then converted to quality-adjusted life years (QALYs). A decision tree was generated and incremental cost-utility ratios (ICUR) were calculated. Multiple sensitivity analyses were performed to evaluate our findings. **Results:** ALND with LYMPHA was more cost-effective with an ICUR of $1587.73/QALY. In the decision tree rollback analysis, a clinical effectiveness gain of 1.35 QALY justified an increased incremental cost of $2140. Similarly, the addition of LYMPHA to ALND with RLNR was more cost-effective with an ICUR of $699.84/QALY. In the decision tree rollback analysis, a clinical effectiveness gain of 2.98 QALY justified a higher incremental cost of $2085.00. **Conclusions:** Our study supports that the addition of LYMPHA to both ALND or ALND with RLNR is the more cost-effective treatment option. **18. Cook JA, Sasor SE, Loewenstein SN, DeBrock W, Lester M, Socas J, Ludwig KK, Fisher CS, Hassanein AH. Immediate Lymphatic Reconstruction after Axillary Lymphadenectomy: A Single-Institution Early Experience. Ann Surg Oncol. 2021 Mar;28(3):1381-1387. doi: 10.1245/s10434-020-09104-2. Epub 2020 Sep 9. PMID: 32909127.** **Purpose:** Lymphedema is progressive arm swelling from lymphatic dysfunction which can occur in 30% patients undergoing axillary dissection/radiation for breast cancer. Immediate lymphatic reconstruction (ILR) is performed in an attempt decrease the risk of lymphedema in patients undergoing axillary lymph node dissection (ALND). The purpose of this study was to assess the efficacy of ILR in preventing lymphedema rates in ALND patients. **Methods:** An institutional review board-approved retrospective review was performed of all patients who underwent ILR from 2017 to 2019. Patient demographics, comorbidities, operative and pathologic findings, number of LVAs, limb measurements,

		complications, and follow-up were recorded and analyzed. Student's sample t-test, Fisher's exact test, and ANOVA were used to analyze data; significance was set at $p < 0.05$. **Results:** Thirty-three patients were included in this analysis. Three patients (9.1%) developed persistent lymphedema, and two patients (6.1%) developed transient arm edema that resolved with compression and massage therapy. A significant effect was found for body mass index and the number of lymph nodes taken on the development of lymphedema ($p < 0.01$). **Conclusions:** The rate of lymphedema in this series was 9.1%, which is an improvement from historical rates of lymphedema. Our findings support ILR as a technique that potentially decreases the incidence of lymphedema after axillary lymphadenectomy. Obesity and number of lymph nodes removed were significant predictive variables for the development of lymphedema following LVA. **19. Mele A, Fan B, Pardo J, Emhoff I, Beight L, Serres SK, Singhal D, Magrini L, James TA. Axillary lymph node dissection in the era of immediate lymphatic reconstruction: Considerations for the breast surgeon. J Surg Oncol. 2021 Mar;123(4):842-845. doi: 10.1002/jso.26355. Epub 2021 Feb 1. PMID: 33524160.** **20. Johnson AR, Fleishman A, Granoff MD, Shillue K, Houlihan MJ, Sharma R, Kansal KJ, Teller P, James TA, Lee BT, Singhal D. Evaluating the Impact of Immediate Lymphatic Reconstruction for the Surgical Prevention of Lymphedema. Plast Reconstr Surg. 2021 Mar 1;147(3):373e-381e. doi: 10.1097/PRS.0000000000007636. PMID: 33620920.** **Background:** Breast cancer-related lymphedema affects one in five patients. Its risk is increased by axillary lymph node dissection and regional lymph node radiotherapy. The purpose of this study was to evaluate the impact of immediate lymphatic reconstruction or the lymphatic microsurgical preventative healing approach on postoperative lymphedema incidence. **Methods:** The authors performed a retrospective review of all patients referred for immediate lymphatic reconstruction at the authors' institution from September of 2016 through February of 2019. Patients with preoperative measurements and a minimum of 6 months' follow-up data were identified. Medical records were reviewed for demographics, cancer treatment data, intraoperative management, and lymphedema incidence. **Results:** A total of 97 women with unilateral node-positive breast cancer underwent axillary nodal surgery and attempt at immediate lymphatic reconstruction over the study period. Thirty-two patients underwent successful immediate lymphatic reconstruction with a mean patient age of 54 years and body mass index of 28 ± 6 kg/m2. The median number of lymph nodes removed was 14 and the median follow-up time was 11.4 months (range, 6.2 to 26.9 months). Eighty-eight percent of patients underwent adjuvant radiotherapy of which 93 percent received regional lymph node radiotherapy. Mean L-Dex change was 2.9 units and mean change in volumetry by circumferential measurements and perometry was -1.7 percent and 1.3 percent, respectively. At the end of the study period, we found an overall 3.1 percent rate of lymphedema. **Conclusion:** Using multiple measurement modalities and strict follow-up guidelines, the authors' findings support that immediate lymphatic reconstruction at the time of axillary surgery is a promising, safe approach for lymphedema prevention in a high-risk patient population.

21. Le NK, Weinstein B, Serraneau K, Tavares T, Laronga C, Panetta N. The Learning Curve: Trends in the First 100 Immediate Lymphatic Reconstructions Performed at a Single Institution. Ann Plast Surg. 2021 Jun 1;86(6S Suppl 5):S495- S497. doi: 10.1097/SAP.0000000000002884. PMID: 34100805.

Background: Cancer-related lymphedema will affect 10% to 50% of breast cancer survivors. Early data show that immediate lymphatic reconstruction may help prevent breast cancer lymphedema; however, the details have not been fully elucidated. The purpose of this study was to evaluate the cohort of our first 100 patients for trends in demographics, treatment, and technique.

Methods: At a tertiary care cancer center, high-risk breast cancer-related lymphedema patients underwent axillary reverse lymphatic mapping and immediate lymphatic reconstruction. After institutional review board approval, demographics, technique, and outcomes were recorded. The first 100 patients were analyzed to compare the differences between the first 50 versus the second 50 patient cohorts.

Results: Of the first 100 axillary reverse lymphatic mapping performed, there was a significant difference in neoadjuvant chemotherapy with 81% in the earlier cohort versus 98% in the later cohort (P = 0.01). An arborized technique was used more frequently in the second cohort (82% vs 54%, P = 0.01). The incidence of lymphedema was lower in the latter cohort (7 patients vs 1 patient, P = 0.03). The first cohort was 12.2 times more likely to develop lymphedema despite lymphatic reconstruction than the second cohort (P = 0.03).

Conclusions: The data demonstrate multiple trends in the learning curve associated with immediate lymphatic reconstruction at a single institution including improvements in identifying and dissecting lymphatic structures, performing more anastomoses per patient, using the arborized technique more frequently, performing the operation with shorter operative times, and reducing the incidence of lymphedema.

22. Lipman K, Luan A, Stone K, Wapnir I, Karin M, Nguyen D. Lymphatic Microsurgical Preventive Healing Approach

(LYMPHA) for Lymphedema Prevention after Axillary Lymph Node Dissection-A Single Institution Experience and Feasibility of Technique. J Clin Med. 2021 Dec 24;11(1):92. doi: 10.3390/jcm11010092. PMID: 35011833; PMCID: PMC8745451.

While surgical options exist to treat lymphedema after axillary lymph node dissection (ALND), the lymphatic microsurgical preventive healing approach (LYMPHA) has been introduced as a preventive measure performed during the primary surgery, thus avoiding the morbidity associated with lymphedema. Here, we highlight details of our operative technique and review postoperative outcomes. For our patients, limb measurements and body composition analyses were performed pre- and postoperatively. Intraoperatively, axillary reverse lymphatic mapping was performed with indocyanine green (ICG) and lymphazurin. SPY-PHI imaging was used to visualize the ICG uptake into axillary lymphatics. Cut lymphatics from excised nodes were preserved for lymphaticovenous anastomosis (LVA). At the completion of the microanastomosis, ICG was visualized draining from the lymphatic through the recipient vein. A retrospective review identified nineteen patients who underwent complete or partial mastectomy with ALND and subsequent LYMPHA over 19 months. The number of LVAs performed per patient ranged between 1-4 per axilla. The operating time ranged from 32-95 min. There were no surgical complications, and thus far one patient developed mild lymphedema with an average follow up of 10 months. At the clinic follow up, ICG and SPY angiography

		were used to confirm intact lymphatic conduits with an uptake of ICG across the axilla. This study supports LYMPHA as a feasible and effective method for lymphedema **prevention.** **23. Chun MJ, Saeg F, Meade A, Kumar T, Toraih EA, Chaffin AE, Homsy C. Immediate Lymphatic Reconstruction for Prevention of Secondary Lymphedema: A Meta-Analysis. J Plast Reconstr Aesthet Surg. 2022 Mar;75(3):1130-1141. doi: 10.1016/j.bjps.2021.11.094. Epub 2021 Dec 1. PMID: 34955392.** **Background:** Secondary lymphedema remains one of the most notorious complications of axillary and pelvic lymph node surgery following mastectomy. There is a lack of high-level evidence found on the effectiveness of immediate lymphatic reconstruction (ILR) in preventing secondary lymphedema. This meta-analysis evaluates the outcomes of ILR for prevention of secondary lymphedema in patients undergoing different surgeries, and provides suggestions for lymphatic microsurgical preventive healing approach (LYMPHA). **Methods:** A review of PubMed, Embase, and Web of Science was performed according to Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines. All English-language studies published from January 1, 2009 to June 1, 2020 were included. We excluded non-ILR interventions, literature reviews/letters/commentaries, and nonhuman or cadaver studies. A total of 789 patients that were enrolled in 13 studies were included in our one-arm meta-analysis. **Results:** A total of 13 studies (n=789) met inclusion criteria: upper extremity ILR (n=665) and lower extremity ILR (n=124). The overall incidence of lymphedema for upper extremity ILR was 2.7% (95%CI: 1.1%-4.4%) and lower extremity ILR was 3.6% (95%CI: 0.3%-10.1%). For upper extremity ILR, the average follow-up time was 11.6 ± 7.8 months and the LE incidence appeared to be the highest approximately 1 to 2 years postoperation. **Conclusions:** Lymphedema is a common complication in cancer treatment. ILR, especially LYMPHA, may be an effective technique to facilitate lymphatic drainage at the time of the index procedure but future studies will be required to show its short-term efficacy and long-term outcomes. **24. Coriddi M, Mehrara B, Skoracki R, Singhal D, Dayan JH. Immediate Lymphatic Reconstruction: Technical Points and Literature Review. Plast Reconstr Surg Glob Open. 2021 Feb 17;9(2):e3431. doi: 10.1097/GOX.0000000000003431. PMID: 33680675; PMCID: PMC7929616.** Recent studies have provided evidence that lymphovenous bypass-microsurgical re-routing of divided lymphatics to an adjacent vein-performed at the time of lymph node dissection decreases the rate of lymphedema development. Immediate lymphatic reconstruction in this setting is technically demanding, and there is a paucity of literature describing the details of the surgical procedure. In this report, we review the literature supporting immediate lymphatic reconstruction and provide technical details to demystify the operation for surgeons who wish to provide this option to their patients. **25. Herremans KM, Cribbin MP, Riner AN, Neal DW, Hollen TL, Clevenger P, Munoz D, Blewett S, Giap F, Okunieff PG, Mendenhall NP, Bradley JA, Mendenhall WM, Mailhot-Vega RB, Brooks E, Daily KC, Heldermon CD, Marshall JK, Hanna MW, Leyngold MM, Virk SS, Shaw CM, Spiguel LR. Five-Year Breast Surgeon Experience in LYMPHA at Time of ALND for Treatment of**

		Clinical T1-4N1-3M0 Breast Cancer. Ann Surg Oncol. 2021 Oct;28(10):5775-5787. doi: 10.1245/s10434-021- 10551-8. Epub 2021 Aug 7. PMID: 34365563; PMCID: PMC8840814. **Background:** Breast cancer-related lymphedema (BCRL) is a source of postoperative morbidity for breast cancer survivors. Lymphatic microsurgical preventive healing approach (LYMPHA) is a technique used to prevent BCRL at the time of axillary lymph node dissection (ALND). We report the 5-year experience of a breast surgeon trained in LYMPHA and investigate the outcomes of patients who underwent LYMPHA following ALND for treatment of cT1-4N1-3M0 breast cancer. **Methods:** A retrospective review of patients with cT1-4N1-3M0 breast cancer was performed in patients who underwent ALND with and without LYMPHA. Diagnosis of BCRL was made by certified lymphedema therapists. Descriptive statistics and lymphedema surveillance data were analyzed using results of Fisher's exact or Wilcoxon rank-sum tests. Logistic regression and propensity matching were performed to assess the reduction of BCRL occurrence following LYMPHA. **Results:** In a 5-year period, 132 patients met inclusion criteria with 76 patients undergoing LYMPHA at the time of ALND and 56 patients undergoing ALND alone. Patients who underwent LYMPHA at the time of ALND were significantly less likely to develop BCRL than those who underwent ALND alone ($p = 0.045$). Risk factors associated with BCRL development were increased patient age ($p = 0.007$), body mass index (BMI) ($p = 0.003$), and, in patients undergoing LYMPHA, number of positive nodes ($p = 0.026$). **Conclusions:** LYMPHA may be successfully employed by breast surgeons trained in lymphatic-venous anastomosis at the time of ALND. While research efforts should continue to focus on prevention and surveillance of BCRL, LYMPHA remains an option to reduce BCRL and improve patient quality of life. **26. Coriddi M, Kim L, McGrath L, Mehrara B, Dayan J. Immediate lymphatic reconstruction: Outcomes of a single- institution pilot study. J Plast Reconstr Aesthet Surg. 2022 Mar;75(3):1261-1282. doi: 10.1016/j.bjps.2022.01.006. Epub 2022 Jan 19. PMID: 35094952; PMCID: PMC8992546.** **27. Weinstein B, Le NK, Robertson E, Zimmerman A, Tavares T, Tran T, Laronga C, Panetta NJ. Reverse Lymphatic Mapping and Immediate Microsurgical Lymphatic Reconstruction Reduces Early Risk of Breast Cancer-Related Lymphedema. Plast Reconstr Surg. 2022 May 1;149(5):1061-1069. doi: 10.1097/PRS.0000000000008986. Epub 2022 Mar 7. PMID: 35255010.** **Background:** Breast cancer-related lymphedema is a progressive disease that poses tremendous physical, psychosocial, and financial burden on patients. Immediate lymphaticovenular anastomosis at the time of axillary lymph node dissection is emerging as a potential therapeutic paradigm to decrease the incidence of breast cancer-related lymphedema in high-risk patients. **Methods:** Eighty-one consecutive patients underwent reverse lymphatic mapping and, when feasible, supermicrosurgical immediate lymphaticovenular anastomosis at the time of axillary lymph node dissection at a tertiary care cancer center. Patients were followed prospectively in a multidisciplinary lymphedema clinic (plastic surgery, certified lymphatic therapy, dietary, case management) at 3-month intervals with clinical examination, circumferential limb girth measurements, and bioimpedance spectroscopy. An institutional control cohort was assessed for the presence of objectively diagnosed and treated breast cancer-related lymphedema. Data were analyzed by a university statistician.

		Results: Seventy-eight patients met inclusion, and 66 underwent immediate lymphaticovenular anastomosis. Mean follow- up was 250 days. When compared to a retrospective control group, the rate of lymphedema in patients who underwent immediate lymphaticovenular anastomosis was significantly lower (6 percent versus 44 percent; $p < 0.0001$). Patients with 6-month follow-up treated with combined adjuvant radiation therapy and chemotherapy had significantly greater risk of developing breast cancer-related lymphedema ($p = 0.04$) compared to those without combined adjuvant therapy. Arborized anastomotic technique had a statistically shorter operative time than end-to-end anastomosis ($p = 0.005$). **Conclusions:** This series of consecutive patients demonstrate a 6 percent incidence of early-onset breast cancer-related lymphedema with immediate lymphaticovenular anastomosis and an increased risk in those undergoing combined adjuvant treatment. These early data represent an encouraging and substantial decrease of breast cancer-related lymphedema in high-risk patients. **28. Hill WKF, Deban M, Platt A, Rojas-Garcia P, Jost E, Temple-Oberle C. Immediate Lymphatic Reconstruction during Axillary Node Dissection for Breast Cancer: A Systematic Review and Meta-analysis. Plast Reconstr Surg Glob Open. 2022 May 9;10(5):e4291. doi: 10.1097/GOX.0000000000004291. PMID: 35558135; PMCID: PMC9084431.** The objective of this study is to summarize the current body of evidence detailing the impact of immediate lymphatic reconstruction (ILR) on the incidence of breast cancer-related lymphedema (BCRL) following axillary node dissection (ALND). **Methods:** Medline and Embase databases were queried for publications, where ILR was performed at the time of ALND for breast cancer. Exclusion criteria included lymphaticovenous anastomosis for established BCRL, animal studies, non-breast cancer patient population studies, and descriptive studies detailing surgical technique. Meta-analysis was performed with a forest plot generated using a Mantel -Haenszel statistical method, with a random-effect analysis model. Effect measure was reported as risk ratios with associated 95% confidence intervals. The risk of bias within studies was assessed by the Cochrane Collaboration tool. **Results:** This systematic review yielded data from 11 studies and 417 breast cancer patients who underwent ILR surgery at the time of ALND. There were 24 of 417 (5.7%) patients who developed BCRL following ILR. Meta-analysis revealed that in the ILR group, 6 of 90 patients (6.7%) developed lymphedema, whereas in the control group, 17 of 50 patients (34%) developed lymphedema. Patients in the ILR group had a risk ratio of 0.22 (CI, 0.09 -0.52) of lymphedema with a number needed to treat of four. **Conclusions:** There is a clear signal indicating the benefit of ILR in preventing BCRL. Randomized control trials are underway to validate these findings. ILR may prove to be a beneficial intervention for improving the quality of life of breast cancer survivors. **29. Buchan G, Cakmakoglu C, Schwarz GS. ICG lymphographic findings following immediate lymphatic reconstruction in breast cancer patients. J Plast Reconstr Aesthet Surg. 2022 Jul;75(7):2164-2171. doi: 10.1016/j.bjps.2022.02.020. Epub 2022 Feb 24. PMID: 35370119.** **Background:** Immediate lymphatic reconstruction (ILR), performed at the time of axillary lymph node dissection (ALND), has demonstrated promising reductions in breast cancer-associated lymphedema. However, questions remain over the effects of adjuvant therapies on the continued patency of the lymphaticovenous anastomosis. Our study aimed to assess lymphographic

outcomes, including ICG pattern and LVB patency, in patients at high risk for breast cancer-associated lymphedema following axillary ILR.

Methods: Baseline ICG lymphography studies performed during ILR of 15 patients were compared to repeat ICG studies obtained during second-stage breast reconstructive procedures to assess for changes in lymphatic flow patterns through the at-risk arm and transit into the axilla.
Results: All 15 patients in this study demonstrated linear lymphatic flow in baseline lymphography. Repeat lymphographic studies showed linear lymphatic transit in 12/15 patients. Of these 12 patients, 10 received chemotherapy, and all 12 received post-mastectomy radiation (PMRT). Dermal backflow patterns were recorded in 3/15 patients. All 3 patients received chemotherapy and 2/3 underwent PMRT. Additionally, repeat ICG studies of 7/12 lymphedema-free patients demonstrated clear visualization of linear ICG flow from the lymphatics of the arm into the axilla.

Conclusion: We have demonstrated that ICG lymphography can be implemented as a postoperative tool to assess lymphatic function in patients who have undergone ILR in the axilla. Repeat ICG studies in the majority of patients demonstrated linear ICG flow similar to baseline studies. Additionally, ICG flow patterns through the axilla in repeat lymphography provided visual evidence supporting sustained LVB patency, despite axillary irradiation.

30. Friedman R, Bustos VP, Postian T, Pardo J, Hamaguchi R, Lee BT, James TA, Singhal D. Utilizing a lower extremity vein graft for immediate lymphatic reconstruction. J Plast Reconstr Aesthet Surg. 2022 Aug;75(8):2831-2870. doi: 10.1016/j.bjps.2022.06.076. Epub 2022 Jun 24. PMID: 35821010; PMCID: PMC9707267.

Immediate lymphatic reconstruction (ILR) is targeted at preventing breast cancer related lymphedema (BCRL) by anastomosing disrupted arm lymphatic channels to axillary vein tributaries. Inadequate vein length and venous back- bleeding are two technical reasons that lead to ILR procedures being aborted intraoperatively. Recently, our team began routinely harvesting a lower extremity vein graft (LEVG) for all ILR procedures to reduce our abort rate. We describe the surgical approach of an LEVG and evaluate the effects on aborted case rates and intraoperative time. A retrospective review of our institutional lymphatic database was conducted. Two hundred and forty-seven breast cancer patients were taken to the operating room for attempted ILR in the past 5 years. Prior to the use of an LEVG (n = 205), our abort rate was 14%. Since routinely performing an LEVG with ILR (n = 42), we have not aborted a single case. Despite an LEVG requiring one additional anastomosis to connect the vein graft to the native axillary vein tributary, this technique has not changed the intraoperative time for ILR procedures. In this technical contribution, we describe our early experience performing immediate lymphatic reconstruction utilizing a lower extremity vein graft. Implementation of this technique appears to have promising effects on aborted case rates without affecting intraoperative time, and greatly facilitates the lymphovenous anastomosis.

31. Chiang SN, Skolnick GB, Westman AM, Sacks JM, Christensen JM. National Outcomes of Prophylactic Lymphovenous Bypass during Axillary Lymph Node Dissection. J Reconstr Microsurg. 2022 Oct;38(8):613-620. doi: 10.1055/s-0042- 1742730. Epub 2022 Feb 14. PMID: 35158396.

Background: Breast cancer treatment, including axillary lymph node excision, radiation, and chemotherapy, can cause upper extremity lymphedema, increasing morbidity and health care costs. Institutions increasingly perform prophylactic lymphovenous bypass (LVB) at the time of axillary lymph node dissection (ALND) to reduce the risk of lymphedema but reports of complications

		are lacking. We examine records from the American College of Surgeons (ACS) National Surgery Quality Improvement Program (NSQIP) database to examine the safety of these procedures. **Methods:** Procedures involving ALND from 2013 to 2019 were extracted from the NSQIP database. Patients who simultaneously underwent procedures with the Current Procedural Terminology (CPT) codes 38999 (other procedures of the lymphatic system), 35201 (repair of blood vessel), or 38308 (lymphangiotomy) formed the prophylactic LVB group. Patients in the LVB and non-LVB groups were compared for differences in demographics and 30-day postoperative complications including unplanned reoperation, deep vein thrombosis (DVT), wound dehiscence, and surgical site infection. Subgroup analysis was performed, controlling for extent of breast surgery and reconstruction. Multivariate logistic regression was performed to identify predictors of reoperation. **Results:** The ALND without LVB group contained 45,057 patients, and the ALND with LVB group contained 255 (0.6%). Overall, the LVB group was associated with increased operative time (288 vs. 147 minutes, $p < 0.001$) and length of stay (1.7 vs. 1.3 days, $p < 0.001$). In patients with concurrent mastectomy without immediate reconstruction, the LVB group had a higher rate of DVTs (3.0 vs. 0.2%, $p = 0.009$). Reoperation, wound infection, and dehiscence rates did not differ across subgroups. Multivariate logistic regression showed that LVB was not a predictor of reoperations. **Conclusion:** Prophylactic LVB at time of ALND is a generally safe and well-tolerated procedure and is not associated with increased reoperations or wound complications. Although only four patients in the LVB group had DVTs, this was a significantly higher rate than in the non-LVB group and warrants further investigation. **32. Cook JA, Sinha M, Lester M, Fisher CS, Sen CK, Hassanein AH. Immediate Lymphatic Reconstruction to Prevent Breast Cancer-Related Lymphedema: A Systematic Review. Adv Wound Care (New Rochelle). 2022 Jul;11(7):382-391. doi: 10.1089/wound.2021.0056. Epub 2022 Feb 23. PMID: 34714158.** **Significance:** Lymphedema is chronic limb swelling from lymphatic dysfunction. The condition affects up to 250 million people worldwide. In breast cancer patients, lymphedema occurs in 30% who undergo axillary lymph node dissection (ALND). **Recent Advances:** Immediate lymphatic reconstruction (ILR), also termed Lymphatic Microsurgical Preventing Healing Approach (LyMPHA), is a method to decrease the risk of lymphedema by performing prophylactic lymphovenous anastomoses at the time of ALND. The objective of this study is to assess the risk reduction of ILR in preventing lymphedema. **Critical Issues:** Lymphedema has significant effects on the quality of life and morbidity of patients. Several techniques have been described to manage lymphedema after development, but prophylactic treatment of lymphedema with ILR may decrease risk of development to 6.6%. **Future Directions:** Long-term studies that demonstrate efficacy of ILR may allow for prophylactic management of lymphedema in the patient undergoing lymph node dissection. **33. McEvoy MP, Gomberawalla A, Smith M, Boccardo FM, Holmes D, Djohan R, Thiruchelvam P, Klimberg S, Dietz J, Feldman S. The prevention and treatment of breast cancer- related lymphedema: A review. Front Oncol. 2022 Dec 6;12:1062472. doi: 10.3389/fonc.2022.1062472. PMID: 36561522; PMCID: PMC9763870.** **Background:** Breast cancer- related lymphedema (BCRL) affects about 3 to 5 million patients worldwide, with about 20,000 per year in the United States. As breast cancer mortality is declining due to improved diagnostics and treatments, the long- term effects of treatment for BCRL need to be addressed. **Methods:** The American Society of Breast Surgeons Lymphatic Surgery Working Group conducted a large review of the literature in order to develop guidelines on BCRL prevention and treatment. This was a comprehensive but not systematic review of the

		literature. This was inclusive of recent randomized controlled trials, meta-analyses, and reviews evaluating the prevention and treatment of BCRL. There were 25 randomized clinical trials, 13 systemic reviews and meta-analyses, and 87 observational studies included. **Results:** The findings of our review are detailed in the paper, with each guideline being analyzed with the most recent data that the group found evidence of to suggest these recommendations. **Conclusions:** Prevention and treatment of BCRL involve a multidisciplinary team. Early detection, before clinically apparent, is crucial to prevent irreversible lymphedema. Awareness of risk factors and appropriate practice adjustments to reduce the risk aids are crucial to decrease the progression of lymphedema. The treatment can be costly, time- consuming, and not always effective, and therefore, the overall goal should be prevention. **Keywords:** LyMPHA; axillary reverse mapping; axillary surgery; breast cancer; breast cancer related lymphedema; lymphedema. **34. Levy AS, Murphy AI, Ishtihar S, Peysakhovich A, Taback B, Grant RT, Ascherman JA, Feldman S, Rohde CH. Lymphatic Microsurgical Preventive Healing Approach for the Primary Prevention of Lymphedema: A 4-Year Follow-Up. Plast Reconstr Surg. 2023 Feb 1;151(2):413-420. doi: 10.1097/PRS.0000000000009857. Epub 2022 Nov 15. PMID: 36696330.** **Background:** Axillary lymph node dissection (ALND) remains the leading cause of lymphedema nationally, and there is still no cure for the disease. The lymphatic microsurgical preventive healing approach (LYMPHA) is a promising option for lymphedema prophylaxis in patients undergoing ALND, but long-term outcomes of the LYMPHA are not well established. **Methods:** The authors conducted a retrospective review of patients undergoing ALND at their center from November of 2012 to November of 2016 and assembled two cohorts, those who received the LYMPHA and those who did not (non- LYMPHA). Patient data were collected to evaluate lymphedema risk and long-term lymphedema incidence of each group. **Results:** Forty-five women were included in both our LYMPHA and non-LYMPHA cohorts. Mean body mass index (27.7 kg/m2 versus 29.9 kg/m2; P = 0.15) and radiation therapy rates (60.0% versus 68.9%; P = 0.51) did not differ between groups. Non-LYMPHA patients underwent complete mastectomy more frequently than LYMPHA patients (97.8% versus 77.8%; P = 0.007), but had a similar number of nodes removed during ALND (14.4 versus 15.8; P = 0.32). Median follow-up time was greater than 4 years for both LYMPHA and non-LYMPHA groups (57.0 months versus 63.0 months; P = 0.07). Overall, lymphedema incidence was 31.1% in the LYMPHA group and 33.3% in the non-LYMPHA group (P > 0.99). No significant differences in lymphedema incidences were observed between the LYMPHA and non-LYMPHA groups for patients with obesity, patients who received radiation therapy, or patients with obesity who also received radiation therapy (P > 0.05 for all subgroups). **Conclusions:** The LYMPHA may not prevent lymphedema long-term in patients who undergo ALND. More long-term studies are needed to determine the true potential of the procedure. **35. Guzzo HM, Valente SA, Schwarz GS, ElSherif A, Grobmyer SR, Cakmakoglu C, Djohan R, Bernard S, Lang JE, Pratt D, Al- Hilli Z. Oncologic safety of axillary lymph node dissection with immediate lymphatic reconstruction. Breast Cancer Res Treat. 2022 Dec;196(3):657-664. doi: 10.1007/s10549-022-06758-2. Epub 2022 Oct 14. PMID: 36239840.** **Purpose:** Immediate lymphatic reconstruction (ILR) at the time of axillary lymph node dissection (ALND) can reduce the incidence of lymphedema in patients with breast cancer. The oncologic safety of ILR is unknown and has not been reported. The purpose of

this study was to evaluate if ILR is associated with increased breast cancer recurrence rates.
Methods: Patients with breast cancer who underwent ALND with ILR from September 2016 to December 2020 were identified from a prospective institutional database. Patient demographics, tumor characteristics, and operative details were recorded. Follow-up included the development of local recurrence as well as distant metastasis. Oncologic outcomes were analyzed.
Results: A total of 137 patients underwent ALND with ILR. At cancer presentation, 122 patients (89%) had clinically node positive primary breast cancer, 10 patients (7.3%) had recurrent breast cancer involving the axillary lymph nodes, 3 patients (2.2%) had recurrent breast cancer involving both the breast and axillary nodes, and 2 patients (1.5%) presented with axillary disease/occult breast cancer. For surgical management, 103 patients (75.2%) underwent a mastectomy, 22 patients (16%) underwent lumpectomy and 12 patients (8.8%) had axillary surgery only. The ALND procedure, yielded a median of 15 lymph nodes pathologically identified (range 3-41). At a median follow-up of 32.9 months (range 6-63 months), 17 patients (12.4%) developed a local (n = 1) or distant recurrence (n = 16), however, no axillary recurrences were identified. **Conclusion:** Immediate lymphatic reconstruction in patients with breast cancer undergoing ALND is not associated with short term axillary recurrence and appears oncologically safe.

36. Deban M, McKinnon JG, Temple-Oberle C. Mitigating Breast-Cancer-Related Lymphedema-A Calgary Program for Immediate Lymphatic Reconstruction (ILR). Curr Oncol. 2023 Jan 24;30(2):1546-1559. doi: 10.3390/curroncol30020119. PMID: 36826080; PMCID: PMC9955571.

With increasing breast cancer survival rates, one of our contemporary challenges is to improve the quality of life of survivors. Lymphedema affects quality of life on physical, psychological, social and economic levels; however, prevention of lymphedema lags behind the progress seen in other areas of survivorship such as breast reconstruction and fertility preservation. Immediate lymphatic reconstruction (ILR) is a proactive approach to try to prevent lymphedema. We describe in this article essential aspects of the elaboration of an ILR program. The Calgary experience is reviewed with specific focus on team building, technique, operating room logistics and patient follow-up, all viewed through research and education lenses.

37. Lin YS, Kuan CH, Tsai LW, Wu CH, Huang CH, Yeong EK, Tai HC, Huang CS. The effect of immediate lymphatic reconstruction on the post-operative drain output after axillary lymph node dissection for breast cancer: A retrospective comparative study. Microsurgery. 2023 Feb 10. doi: 10.1002/micr.31007. Epub ahead of print. PMID: 36762663.

Introduction: Axillary lymph node dissection (ALND) for breast cancer has been considered to be associated with a variety of complications, such as excessive postoperative wound drainage, prolonged drain placement, or seroma formation in the short term, or arm lymphedema in the long run. Immediate lymphedema reconstruction (ILR) has been proposed to reduce the occurrence of arm lymphedema by anastomosing the transected arm lymphatics to nearby branches of the axillary vein immediately after ALND. This study aims to demonstrate that ILR can also reduce the postoperative drainage amount. **Patients and methods:** Between April 2020 and January 2022, a total of 76 breast cancer patients receiving ALND were reviewed. Forty four of them also received ILR immediately after ALND. The assignment of ILR surgery was non-random, based on patients' willingness and plastic surgeons' availability. The lymphatic vessels in the axillary wound were anastomosed with nearby terminal branches of the axillary vein under surgical microscope. Patients' characteristics, including age, body mass index (BMI), neoadjuvant therapy, type of breast surgery, the occurrence of seroma formation, number of removed lymph nodes, number of positive nodes, and the drainage amount from the operative wounds were compared between ILR and non-ILR groups.

Results: No statistically significant difference was noted between groups in terms of age (56.5 ± 9.8 vs. 60.9 ± 10.7, p = .09), BMI (22.6 ± 3.7 vs. 23.7 ± 3.8, p = .27), type of breast surgery (p = .32), the occurrence of seroma formation (p = 1.0), the likelihood of receiving neoadjuvant therapy (p = .12), number of lymph nodes removed (17.5 ± 7.6 vs. 17.4 ± 8.3, p = .96), or number of positive nodes on final pathology (3.7 ± 5.4 vs. 4.8 ± 8.5, p = .53) except the ILR group had statistically significantly less drainage amount than non-ILR group (39.3 ± 2.6 vs. 48.3 ± 3.7, p = .046).

Conclusion: For breast cancer patients receiving ALND, the immediate lymphatic reconstruction can reduce the postoperative drainage amount from the operative wound.

38. Abdelfattah U, Pons G, Masià J. Evaluating the Impact of Immediate Lymphatic Reconstruction for the Surgical Prevention of Lymphedema. Plast Reconstr Surg. 2023 Mar 1;151(3):522e-523e. doi: 10.1097/PRS.0000000000009942. Epub 2022 Nov 29. PMID: 36730128.

39. Le NK, Liu L, Jesus Cruz R, Parikh J, Rotatori RM, Wainwright DJ, Weinstein B, Tavares T, Panetta NJ. Efficacy of Immediate Lymphatic Reconstruction in Prevention of Breast Cancer-Related Lymphedema. Ann Plast Surg. 2023 Mar 6. doi: 10.1097/SAP.0000000000003457. Epub ahead of print. PMID: 36913564.

Introduction: Breast cancer-related lymphedema (BCRL) is a chronic condition that can negatively affect the quality of life of breast cancer survivors. Immediate lymphatic reconstruction (ILR) at the time of axillary lymph node dissection is emerging as a technique for the prevention of BCRL. This study compared the incidence of BRCL in patients who received ILR and those who were not amenable to ILR.

Methods: Patients were identified through a prospectively maintained database between 2016 and 2021. Some patients were deemed nonamenable to ILR due to a lack of visualized lymphatics or anatomic variability (eg, spatial relationships or size discrepancies). Descriptive statistics, independent t test, and Pearson $\chi 2$ test were used. Multivariable logistic regression models were created to assess the association between lymphedema and ILR. A loose age-matched subsample was created for subanalysis.

Results: Two hundred eighty-one patients were included in this study (252 patients who underwent ILR and 29 patients who did not). The patients had a mean age of 53 ± 12 years and body mass index of 28.6 ± 6.8 kg/m2. The incidence of developing lymphedema in patients with ILR was 4.8% compared with 24.1% in patients who underwent attempted ILR without lymphatic reconstruction (P = 0.001). Patients who did not undergo ILR had significantly higher odds of developing lymphedema compared with those who had ILR (odds ratio, 10.7 [3.2-36.3], P < 0.001; matched OR, 14.2 [2.6-77.9], P < 0.001).

Conclusions: Our study showed that ILR was associated with lower rates of BCRL. Further studies are needed to determine which factors place patients at highest risk of developing BCRL.

40. Granoff MD, Fleishman A, Shillue K, Johnson AR, Ross J, Lee BT, Teller P, James TA, Singhal D. A Four-Year Institutional Experience of Immediate Lymphatic Reconstruction. Plast Reconstr Surg. 2023 Mar 8. doi: 10.1097/PRS.0000000000010381. Epub ahead of print. PMID: 36877759.

		Introduction: Up to 1 in 3 patients may go on to develop breast cancer-related lymphedema (BCRL) after treatment. Immediate Lymphatic Reconstruction (ILR) is a surgical procedure that has been shown in early studies to reduce the risk of BCRL. However, long-term outcomes are limited due to its recent introduction and different institutions' eligibility requirements. This study evaluates the incidence of BCRL in a cohort that underwent ILR over the long-term. **Methods:** A retrospective review of all patients referred for ILR at our institution from September 2016 through September 2020 was performed. Patients with preoperative measurements, a minimum 6-months follow-up data and at least one completed lymphovenous bypass were identified. Medical records were reviewed for demographics, cancer treatment data, intra-operative management and lymphedema incidence.Results: A total of 186 patients with unilateral node-positive breast cancer underwent axillary nodal surgery and attempt at ILR over the study period. Ninety patients underwent successful ILR and met all eligibility criteria, with a mean patient age of 54 (sd: 12.1) years and median BMI of 26.6 (q1-q3: 24.0-30.7) kg/m2. Median number of lymph nodes removed was 14 (q1-q3: 8-19). Median follow-up was 17 months (range: 6-49). 87% of patients underwent adjuvant radiotherapy of which 97% received regional lymph node radiation. At the end of the study period, we found an overall 9% rate of LE. **Conclusion:** Utilizing strict follow-up guidelines over the long-term, our findings support ILR at time of axillary lymph node dissection is an effective procedure that reduces the risk of BCRL in a high-risk patient population. **41. Chung JH, Kwon SH, Jung SP, Park SH, Yoon ES. Assessing the preventive effect of immediate lymphatic reconstruction on the upper extremity lymphedema. Gland Surg. 2023 Mar 31;12(3):334-343. doi: 10.21037/gs-22-554. Epub 2023 Feb 24. PMID: 37057043; PMCID: PMC10086774.** **Background:** An immediate lymphatic reconstruction (ILR) combining axillary reverse lymphatic mapping (ARLM) and lymphovenous anastomosis (LVA) has been gradually in the spotlight as a novel surgical technique to prevent lymphedema. In this study, we investigate the preventive effect of ILR for the risk of upper extremity lymphedema. We will compare the incidence of postoperative lymphedema between the ILR treatment group and the no-try or failure group during the same period with analysis of the effects of different variables. **Methods:** In this retrospective cohort study, we analyzed 213 patients who had undergone mastectomy for node-positive unilateral breast cancer in our institution between November 1, 2019 and February 28, 2021. To assess the effect of preventive ILR, we divided the patients into a treatment group (n=30) and a control group (n=183). Univariate and multivariate Cox proportional hazards regression models were used to evaluate the association between ILR and lymphedema occurrence. **Results:** Of the 30 patients who were attempted, we successfully performed ILRs in 26 patients (86.7%). During a mean follow-up of 14 months, one patient (3.8%) was confirmed to have upper extremity lymphedema in the treatment group, whereas 14 out of 183 patients (7.7%) were diagnosed in the control group. In multivariate analysis, ILR success showed a borderline significant decrease in risk of lymphedema [hazard ratio (HR) =0.174; 95% confidence interval (CI): 0.022-1.374; P=0.097]. **Conclusions:** Our results suggested that ILR may be a promising surgical treatment to prevent postoperative lymphedema. There is a need for larger studies with longer follow-up to confirm the findings obtained in our study. C: Simplified - Lymphatic Microsurgical Preventative Healing Approach (LYMPHA) **1. Ozmen T, Lazaro M, Zhou Y, Vinyard A, Avisar E. Evaluation of Simplified Lymphatic Microsurgical Preventing Healing Approach (S-LYMPHA) for the Prevention of Breast Cancer-Related Clinical Lymphedema After Axillary Lymph Node Dissection. Ann Surg. 2019 Dec;270(6):1156-1160. doi: 10.1097/SLA.0000000000002827. PMID: 29794843.**

		Objective: To assess the efficiency of Simplified Lymphatic Microsurgical Preventing Healing Approach (S-LYMPHA) in preventing lymphedema (LE) in a prospective cohort of patients. **Background:** LE is a serious complication of axillary lymph node dissection (ALND) with an incidence rate of 25%. LYMPHA has been proposed as an effective adjunct to ALND for the prevention of LE. This procedure, however, requires microsurgical techniques and significant coordination between services. **Methods:** All patients, undergoing ALND with or without S-LYMPHA between January 2014 and December 2016 were included in the study. During follow-up visits, tape-measuring limb circumference method was used to detect LE. The incidence of LE was compared between ALND with and without S-LYMPHA. **Results:** A total of 380 patients were included in the analysis. Median follow-up time was 15 (1-32) months. Patients, who underwent S-LYMPHA, had a significantly lower rate of LE both in univariate and multivariate analysis [3% vs 19%; P = 0.001; odds ratio 0.12 (0.03-0.5)]. Excising more than 22 lymph nodes and a co-diagnosis of diabetes mellitus were also correlated with higher clinical LE rates on univariate analysis, but only excising more than 22 lymph nodes remained to be significant on multivariate analysis. **Conclusions:** S-LYMPHA is a simple method, which decreases incidence of LE dramatically. It should be considered as an adjunct procedure to ALND for all patients during initial surgery. **2. Ozmen T, Layton C, Friedman-Eldar O, Melnikau S, Kesmodel S, Moller MG, Avisar E. Evaluation of Simplified Lymphatic Microsurgical Preventing Healing Approach (SLYMPHA) for the prevention of breast cancer-related lymphedema after axillary lymph node dissection using bioimpedance spectroscopy. Eur J Surg Oncol. 2022 Aug;48(8):1713-1717. doi: 10.1016/j.ejso.2022.04.023. Epub 2022 Apr 30. PMID: 35527056.** **Background:** Lymphedema is a serious complication of axillary lymph node dissection (ALND) with an incidence rate of 20%. Simplified Lymphatic Microsurgical Preventing Healing Approach (SLYMPHA) is a safe and relatively simple method, which decreases incidence of lymphedema dramatically. Our initial study showed an 88% decrease in clinical lymphedema rate. In the initial study, we used arm circumference measurement for the diagnosis of lymphedema and median follow up was 15 months. The aim of this study was to confirm these results after a long-term follow up period and by using bioimpedance spectroscopy (L-Dex) technology in detecting lymphedema. **Study design:** All patients, undergoing ALND with or without SLYMPHA between January 2014 and November 2020 were included in the study. Patients with no postoperative L-Dex measurements were excluded. A L-Dex score outside the normal range (±10 L-Dex unit) or ≥10 L-Dex unit increase above patient's baseline was considered as lymphedema. The incidence of lymphedema was compared between patients with and without SLYMPHA. **Results:** 194 patients were included in the study. 57% of cohort underwent SLYMPHA. Mean follow-up time was 47 ± 37 months. Patients, who underwent SLYMPHA, had a significantly lower rate of lymphedema (16% vs 32%; p = 0.01; OR 0.4 [0.2-0.8]). **Conclusion:** SLYMPHA is a safe and relatively simple method, which continued its efficacy after a long-term follow up period. It should be considered as an adjunct procedure to ALND for all patients during initial surgery.

19	Are there any major trials or registries of this procedure/technology currently in progress? If so, please list.	Does Immediate Lymphatic Reconstruction Decrease the Risk of Lymphedema After Axillary Lymph Node Dissection ClinicalTrials.gov Identifier: NCT04241341
20	Please list any other data (published and/or unpublished) that you would like to share.	As above data in pubmed on immediate lymphatic reconstruction / LYMPHA

Other considerations

21	Approximately how many people each year would be eligible for an intervention with this procedure/technology, (give either as an estimated number, or a proportion of the target population)?	10% of all women having treatment for breast cancer and having an axillary dissection
22	Please suggest potential audit criteria for this procedure/technology. If known, please describe: − Beneficial outcome measures. These should include short- and long-term clinical outcomes, quality-of-life measures and patient-related outcomes. Please suggest the most appropriate method of measurement for each and the timescales over which these should be measured. − Adverse outcome measures. These should include early and late complications. Please state the post procedure timescales over which these should be measured:	Beneficial outcome measures: 1. Rates of lymphoedema as measured objectively RVC and BIS (3-4years) 2. Patient quality of life measure – CESD-R & BAI for 3 years 3. Patient reported outcome measures – LYMQOL, ULL-27 for 3 years Adverse outcome measures: 1. Perioperative complications 2. Episodes of cellulitis – for 5 years 3. Rates of lymphoedema as measured objectively RVC and BIS (3-4years)

Further comments

23	If you have any further comments (e.g. issues with usability or implementation, the need for further research), please describe.	This surgical technique has demonstrable improvement in rates of lymphoedema which in turn improves patient quality of life. This has now been confirmed on a recent RCT. This should be performed by surgeons in both breast and microsurgical specialities with appropriate training to ensure surgical quality assurance. This procedure should ideally be undertaken in centres with these specialities.

Declarations of interests

Please state any potential conflicts of interest relevant to the procedure/technology (or competitor technologies) on which you are providing advice, or any involvements in disputes or complaints, in the previous **12 months** or likely to exist in the future. Please use the NICE policy on declaring and managing interests as a guide when declaring any interests. Further advice can be obtained from the NICE team.

Type of interest *	Description of interest	Relevant dates	
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Please note, all declarations of interest will be made publicly available on the NICE website.

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