

# NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

## INTERVENTIONAL PROCEDURES PROGRAMME

### Interventional procedure overview of liposuction for chronic lymphoedema

Chronic lymphoedema is swelling of the limb caused by a defect in the lymphatic system. This may be a defect that the patient is born with or can result from surgical removal of the lymph glands, such as in surgery for breast cancer. The swelling results from accumulation of lymph fluid and it can cause cosmetic problems, discomfort, pain and limited movement. Liposuction for chronic lymphoedema involves the removal of subcutaneous adipose tissue and accumulated lymph fluid via several small incisions in the limb. After the procedure, the patient wears a compression garment permanently, which can be removed intermittently for short periods.

#### Introduction

This overview has been prepared to assist members of the Interventional Procedures Advisory Committee (IPAC) in making recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

#### Date prepared

This overview was prepared in July 2007.

#### Procedure name

- Liposuction for chronic lymphoedema.

#### Specialty societies

- The British Association of Aesthetic Plastic Surgeons
- British Association of Plastic, Reconstructive and Aesthetic Surgeons
- The Vascular Society
- British Association of Dermatologists

## Description

### **Indications**

#### *Chronic lymphoedema*

Lymphoedema is the abnormal accumulation of lymph in body tissues resulting in swelling. Any part of the body can be affected by lymphoedema, but it is most common in the arms and legs. Lymph arises from extracellular fluid which enters the lymphatic vessels and drains from the limb via lymph nodes (in the axilla and groin). It flows through further lymphatics to the venous system. The lymphatic system is responsible for preventing accumulation of lymph which would otherwise cause the limb to swell. It is also involved in the immune response to infection and in the spread of cancer cells.

Lymphoedema is caused by an impaired lymphatic system failing to drain lymph away from a limb. It is a chronic progressive disorder that begins with swelling which can be indented when pressed (pitting oedema) followed by development of fibrosis and finally irreversible swelling. It causes a variable degree of cosmetic distress, disability and pain. Lymphoedema can be complicated by recurrent infection (cellulitis) which causes progression of the lymphoedema by further damage to the lymphatic vessels.

Primary lymphoedema results from congenital inadequacy of gradual occlusion of lymphatics. Secondary lymphoedema results from damage to the lymphatic system or removal of lymph nodes by surgery, radiation, infection or injury. In the UK, the commonest type of lymphoedema requiring treatment is lymphoedema of the arm secondary to treatment of breast cancer. This treatment involves surgery and/or radiotherapy to the lymph glands in the axilla.

### **Current treatment and alternatives**

#### *Manual lymph drainage (MLD)*

MLD involves massage that stimulates the movement of lymphatic fluid away from the affected limb.

#### *Decongestive lymphatic therapy (DLT) or combined decongestive therapy (CDT)*

DLT combines MLD with compression bandaging, skin care and decongestive exercises. MLD is performed for about 20 to 60 minutes, once or twice daily until the lymphoedema has been sufficiently reduced. Immediately after MLD sessions, a low-stretch, multilayer bandage is applied to provide graduated

compression of the affected limb (with the most pressure over the distal part of the limb).

Once MLD sessions are stopped the patient is fitted with a custom-made compression garment, which is worn every day. In addition, patients are taught how to care for their nails and skin to reduce the risk of infection and decongestive exercises to increase venous and lymphatic flow.

The aim of DLT and MLD is to reduce the pain and discomfort associated with lymphoedema.

### *Surgical treatment*

Surgery is reserved for severe cases when non-surgical alternatives have failed. Surgical treatment usually aims either to reduce the size of the affected limb by removing lymphoedematous tissue (debulking) or to restore lymphatic flow from the limb.

Debulking may be performed by total excision of the skin and subcutaneous tissue of the affected limb, followed by skin grafting. Alternatively, it may be performed by excision of subcutaneous tissue from beneath skin flaps, which are then sutured back into position. Debulking procedures often require a staged approach involving several operations over a period of time.

A number of procedures have been attempted to restore lymphatic flow from the limb including constructing an alternative lymph drainage pathway via lymphovenous anastomosis.

### ***What the procedure involves***

Liposuction for lymphoedema is the surgical removal of excess adipose tissue. The procedure is usually performed under general anaesthesia, but regional nerve blockade is also possible. A number of small (3mm) incisions are made in the limb. Cannulas, connected to a vacuum pump, are inserted into the incisions and oedematous adipose tissue is removed by vacuum aspiration. Liposuction is performed around the circumference of the limb from the distal to proximal ends.

Immediately after liposuction, a compression bandage is applied to the limb to control any bleeding and to prevent postoperative oedema. In liposuction for chronic lymphoedema of the arm, an interim glove, similar to one used for burns management, is placed on hand. The following day, a standard glove without fingers is placed over the first.

The limb is elevated during hospital stay for 3 to 7 days after the procedure. From about two weeks after the procedure a custom-made compression garment is worn. After about three months a new compression garment is custom made. This is revised another three or four times during the first year until the oedema volume has been reduced as much as possible and a steady state has been reached.

Antibiotics are prescribed for a number of weeks before and after the operation.

## ***Efficacy***

Evidence of efficacy is based on five case studies from three centres.

### *Oedema volume*

In one study of 49 patients, 35 patients underwent liposuction combined with controlled compression therapy (CCT) and 14 underwent CCT alone. CCT consisted of wearing a custom-made sleeve-and-glove garment which was taken in at each visit to compensate for reduced elasticity. At 3-, 6- and 12 months postoperatively, new garments were custom made. The mean reduction in oedema volume at 12 months compared with baseline was 103% and 50% respectively (difference between groups  $p < 0.0001$ )<sup>1</sup>.

In another study, a matched-pairs analysis showed that having liposuction with CCT ( $n = 16$ ) was significantly more effective in reducing oedema volume than CCT alone ( $n = 16$ ) ( $p < 0.0001$ )<sup>2</sup>.

In two studies, mean pretreatment oedema volumes of 1745 ml and 1845 ml respectively, were reduced to 30 ml and -122 ml (that is, the removed oedema volume exceeded the baseline volume), at 12 months<sup>2,3</sup>.

In a study of 19 patients (10 with arm lymphoedema and 9 with leg lymphoedema), the average reduction in limb volume after liposuction was 23%<sup>4</sup>. (Note: five patients in this study had primary lymphoedema).

### *Limb size*

Average reduction in limb circumference after liposuction was 7% in a study of 15 patients (10 with leg lymphoedema and 5 with arm lymphoedema)<sup>5</sup>. In the study of 19 patients, 4 patients had no change in limb size, 4 had a 1–3 cm reduction and 3 had a reduction of more than 3 cm<sup>4</sup>.

### *Quality of life*

In the study of 49 patients, 35 patients treated with liposuction and CCT combined had improved self-rated pain, swelling, mobility, fatigue and activities of daily living at 12 months' follow-up ( $p < 0.01$  for all outcomes). Only swelling of the arm improved significantly in the 14 patients treated with CCT alone ( $p < 0.04$ )<sup>1</sup>.

## Safety

All but two studies reported that there were no complications associated with the procedure. In a study of 28 patients, 1 patient sustained transient paraesthesia in the operated arm and 2 patients developed temporary superficial abrasion at the wrist caused by the compression garment. Two patients developed an episode of erysipelas 3 months after the operation. In addition, eight patients had more than 2000 ml of fluid aspirated as part of the procedure and required blood transfusions<sup>3</sup>. In a study of 15 patients, 3 patients had one complication each: cellulitis, hypaesthesia and marginal wound necrosis<sup>5</sup>.

## Literature review

### *Rapid review of literature*

The medical literature was searched to identify studies and reviews relevant to liposuction for chronic lymphoedema of the arm following treatment for breast cancer. Searches were conducted of the following databases, covering the period from their commencement to July 2007: MEDLINE, PreMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches. (See Appendix C for details of search strategy.)

The following selection criteria (Table 1) were applied to the abstracts identified by the literature search. Where these criteria could not be determined from the abstracts the full paper was retrieved.

**Table 1 Inclusion criteria for identification of relevant studies**

Characteristic	Criteria
Publication type	<p>Clinical studies were included. Emphasis was placed on identifying good quality studies.</p> <p>Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, an editorial or a laboratory or animal study.</p> <p>Conference abstracts were also excluded because of the difficulty of appraising methodology.</p>
Patient	Patients with chronic lymphoedema
Intervention/test	Liposuction

Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

### ***List of studies included in the overview***

This overview is based on five case series.

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (Table 2) have been listed in Appendix A.

**Table 2 Summary of key efficacy and safety findings on liposuction for chronic lymphoedema**

Abbreviations used: (CCT) Controlled compression therapy, (ADL) Activities of daily living.																														
Study details	Key efficacy findings	Key safety findings	Comments																											
<p>Brorson et al (2006) <sup>1</sup></p> <p>Case series Sweden Study period: Not stated</p> <p>n = 49 (35 patients who underwent liposuction and CCT and 14 who underwent CCT alone)</p> <p>Population: Women with arm lymphoedema following breast cancer treatment refractive to manual lymph therapy or pneumatic compression therapy. Lymphoedema was hypertrophic and firm with signs of fibrosis.</p> <p>Technique: Liposuction plus postoperative CCT (n = 35) or CCT alone (n = 14). CCT: Custom-made compression sleeve-and-glove garment taken in at each visit using a sewing machine. At the 3-, 6- and 12- month visits, a new garment was custom made each time. Patients were also informed of hygiene measures and skin care.</p> <p>Follow-up: 12 months</p> <p>Conflict of interest: None stated</p>	<p><b>Oedema volume</b> (measured by water displacement technique)</p> <p>Mean volume reduction at 12 months compared with baseline:</p> <ul style="list-style-type: none"> <li>liposuction + CCT = 103%</li> <li>CCT alone = 50%</li> </ul> <p>(Difference between groups at 12 months; p &lt; 0.0001)</p> <p><b>Range of motion of shoulder joint</b> (mean increase in range of motion from baseline to 12 months)</p> <p>Most measures of range of motion (flexion, extension, abduction, external rotation) increased significantly in both treatment groups (p &lt; 0.05). Internal rotation increased significantly from baseline in the liposuction + CCT group (p &lt; 0.0001) but not in the CCT alone group.</p> <p><b>Subjective outcomes</b> <i>Symptoms and ADL questionnaire</i> Positive differences between baseline and 12-months' follow-up for the following subjective quality of life aspects:</p> <table border="1"> <thead> <tr> <th></th> <th>Liposuction + CCT</th> <th>CCT alone</th> </tr> </thead> <tbody> <tr> <td>Pain</td> <td>p &lt; 0.0003</td> <td>NS</td> </tr> <tr> <td>Swelling of the hand</td> <td>p &lt; 0.0001</td> <td>NS</td> </tr> <tr> <td>ADL difficulties</td> <td>p &lt; 0.0001</td> <td>NS</td> </tr> <tr> <td>Reduced mobility</td> <td>p &lt; 0.0001</td> <td>NS</td> </tr> <tr> <td>Swollen arm</td> <td>p &lt; 0.0001</td> <td>p &lt; 0.04</td> </tr> <tr> <td>Heavy arm</td> <td>p &lt; 0.0001</td> <td>NS</td> </tr> <tr> <td>Fatigue/weakness</td> <td>p &lt; 0.003</td> <td>NS</td> </tr> <tr> <td>Numbness</td> <td>NS</td> <td>NS</td> </tr> </tbody> </table> <p><i>Nottingham Health Profile</i> Significant positive differences between baseline score and 12-months' follow-up seen for the following scales of the NHP:</p> <ul style="list-style-type: none"> <li>pain</li> <li>physical mobility</li> <li>house work</li> <li>total score</li> </ul> <p>No significant differences between baseline and 12-months' follow-up were seen in the CCT alone group.</p>		Liposuction + CCT	CCT alone	Pain	p < 0.0003	NS	Swelling of the hand	p < 0.0001	NS	ADL difficulties	p < 0.0001	NS	Reduced mobility	p < 0.0001	NS	Swollen arm	p < 0.0001	p < 0.04	Heavy arm	p < 0.0001	NS	Fatigue/weakness	p < 0.003	NS	Numbness	NS	NS	<p>No surgical complications.</p>	<p>Treatment allocation not stated.</p>
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Abbreviations used: (CCT) Controlled compression therapy, (ADL) Activities of daily living.													
Study details	Key efficacy findings		Key safety findings	Comments									
<p>Brorson et al (1998)<sup>2</sup></p> <p>Matched case analysis Sweden Study period: Not stated</p> <p>n = 32 (16 patients who underwent liposuction and CCT and 16 who underwent CCT alone)</p> <p>Population: Women with arm lymphoedema following breast cancer treatment that was refractive to manual lymph therapy or pneumatic compression therapy. Lymphoedema was hypertrophic and firm in all cases with signs of fibrosis. Women with similar oedema volumes were paired for matched analyses.</p> <p>Technique: Liposuction plus postoperative CCT (n = 16) or CCT alone (n = 16). CCT: As described above.</p> <p>Follow-up: At least 12 months (n = 30)</p> <p>Conflict of interest: None stated</p>	<p><b>Oedema volume</b> (<i>measured by water displacement technique</i>)</p> <table border="1"> <thead> <tr> <th></th> <th>Liposuction + CCT</th> <th>CCT alone</th> </tr> </thead> <tbody> <tr> <td>Mean pretreatment oedema volume (ml)</td> <td>1745 (range: 570–2950)</td> <td>1680 (range: 670–3320)</td> </tr> <tr> <td>Mean oedema volume at 12 months (ml)</td> <td>-122* (range: -655–820)</td> <td>873 (range: 340–2275)</td> </tr> </tbody> </table> <p>* <i>Volume removed sometimes exceeded the baseline volume of oedema</i></p> <p>In a matched-pairs analysis, liposuction with CCT was significantly more effective for reducing oedema volume than CCT alone (p &lt; 0.0001)</p> <p>Six patients who underwent liposuction with CCT had their compression garments removed for 1 week 12 months postoperatively. A marked increase in arm volume was seen, but disappeared when the garment was re-applied.</p>			Liposuction + CCT	CCT alone	Mean pretreatment oedema volume (ml)	1745 (range: 570–2950)	1680 (range: 670–3320)	Mean oedema volume at 12 months (ml)	-122* (range: -655–820)	873 (range: 340–2275)	<p>No major surgical complications.</p>	<p>These patients could be the same as those in the above study.</p>
	Liposuction + CCT	CCT alone											
Mean pretreatment oedema volume (ml)	1745 (range: 570–2950)	1680 (range: 670–3320)											
Mean oedema volume at 12 months (ml)	-122* (range: -655–820)	873 (range: 340–2275)											



Abbreviations used: (CCT) Controlled compression therapy, (ADL) Activities of daily living.			
Study details	Key efficacy findings	Key safety findings	Comments
<p>Brorson et al (1997)<sup>3</sup></p> <p>Case series Sweden Study period: Not stated</p> <p>n = 28</p> <p>Population: Women with arm lymphoedema following breast cancer treatment that was refractive to manual lymph therapy or pneumatic compression therapy. Lymphoedema was hypertrophic and firm in all cases with signs of fibrosis.</p> <p>Technique: Liposuction plus postoperative CCT (as described above).</p> <p>Follow-up: At least 12 months (n = 24)</p> <p>Conflict of interest: None stated</p>	<p><b>Oedema volume</b> <i>(measured by water displacement technique)</i></p> <ul style="list-style-type: none"> <li>• Mean pretreatment edema volume (ml) = 1845 (range: 570–3915)</li> <li>• Mean edema volume at 12 months (ml) = 30 (range: –655*–1135)</li> </ul> <p>* <i>Volume removed sometimes exceeded the baseline volume of edema</i></p> <ul style="list-style-type: none"> <li>• Mean relative reduction of edema volume (%) = 106 (range: 66–179)</li> </ul> <p><b>Aspirate volume</b></p> <ul style="list-style-type: none"> <li>• Mean volume of aspirate (ml) = 2250 (range: 1000–3850)</li> </ul>	<p>No major surgical complications.</p> <p>One patient sustained transient paraesthesia in the arm operated on.</p> <p>Two patients had temporary superficial abrasion at the wrist caused by the compression garment.</p> <p>Two patients each had one episode of erysipelas 3 months postoperatively.</p> <p>Eight patients had more than 2000 ml of fluid aspirated and required blood transfusions.</p>	<p>This study most likely includes some of the patients from the above two studies.</p>

Abbreviations used: (CCT) Controlled compression therapy, (ADL) Activities of daily living.			
Study details	Key efficacy findings	Key safety findings	Comments
<p>Sando et al (1989)<sup>b</sup></p> <p>Case series USA Study period: Not stated</p> <p>n = 15</p> <p>Population: 14 women, 1 man with lymphoedema. Age range: 16–70 years.</p> <p>Indications: Postmastectomy secondary arm lymphoedema (n = 5); primary leg lymphoedema (n = 9); secondary leg lymphoedema (n = 1).</p> <p>Procedure: Suction lipectomy. General anaesthesia. Four to six incisions (1 cm) placed along medial or lateral aspects just proximal to knee and ankle or elbow and wrist as appropriate. Five patients treated with additional debulking procedures as part of the same operation. Limb elevated postoperatively, drains removed 5 days postoperatively. Custom-made compression garments worn for at least 3 months postoperatively.</p> <p>Follow-up (range): 3–30 months</p> <p>Conflict of interest: Not stated</p>	<p><b>Oedema volume</b> <i>(measured by water displacement technique)</i></p> <p>Average reduction in average limb volume: 1095 cc (8%) [range: –4319 cc (decrease) to +1058 cc (increase)]</p> <p><b>Limb size</b></p> <p>Average reduction in average limb circumference: 3 cm (6.8%) [range: –6.3 cm (reduction) to +0.6 cm (enlargement)]</p>	<p>Three patients had complications:</p> <ul style="list-style-type: none"> <li>cellulitis, which resolved with antibiotics</li> <li>hypoesthesia</li> <li>marginal wound necrosis (in a patient undergoing lipectomy combined with debulking)</li> </ul>	<p>Procedure described as 'suction lipectomy'.</p> <p>Results are not reported separately for patients with secondary lymphoedema of the arm and those with primary lymphoedema of the leg.</p>

Abbreviations used: (CCT) Controlled compression therapy, (ADL) Activities of daily living.

Study details	Key efficacy findings	Key safety findings	Comments
<p>O'Brien et al (1989)<sup>4</sup></p> <p>Case series Australia Study period: June 1986 – June 1988</p> <p>n = 19</p> <p>Population: 19 patients with lymphoedema (84% female). Mean age 50 years (range: 35–63)</p> <p>Indications: Secondary lymphoedema (n = 14) [breast cancer: 9, melanoma: 3, cervical cancer: 2]; primary lymphoedema (n = 5).</p> <p>Upper limb lymphoedema (n = 10); lower limb lymphoedema (n = 9).</p> <p>Procedure: Suitable anaesthesia, limb exsanguinated and tourniquet inflated as proximally as possible. Liposuction carried out on half of limb using 6–8-mm cannula inserted through 1-cm incisions. Procedure repeated on remaining half of limb.</p> <p>Limb elevated for 2 days postoperatively and custom-made compression garment was worn continuously for the first 6 months, and only by day thereafter.</p> <p>Average follow-up: 10 months (range: 2–15; n=13)</p> <p>Conflict of interest: None stated</p>	<p><b>Edema volume (n = 11)</b></p> <ul style="list-style-type: none"> <li>• Average reduction in limb volume: 23% of excess volume (compared with control limb).</li> <li>• Of 11 patients with unilateral lymphoedema, 10 patients had improved limb volume postoperatively and 1 patient worsened.</li> </ul> <p><b>Limb size (n = 11)</b></p> <ul style="list-style-type: none"> <li>• No reduction in limb size postoperatively: 4</li> <li>• 1–3 cm reduction in limb size postoperatively: 4</li> <li>• &gt;3 cm reduction in limb size postoperatively: 3</li> </ul> <p><b>Subjective outcomes (n = 13)</b></p> <ul style="list-style-type: none"> <li>• Improved: 11 (patients reported that the limb was lighter and softer).</li> <li>• Stayed the same: 2</li> </ul>	<p>No procedural complications reported.</p> <p>Seven patients had cellulitis prior to procedure.</p> <p>Three patients had cellulitis during follow-up. However, due to short follow-up, it is difficult to assess whether liposuction affected the incidence of infection.</p>	<p>Results are not reported separately for patients with primary lymphoedema and those with secondary lymphoedema.</p>

### ***Validity and generalisability of the studies***

- The evidence base is small in quantity. Three of the studies come from a single centre in Sweden and likely include a substantial proportion of the same patients. The two publications that come from other centres (Sando et al. and O'Brien et al.) are both from 1989.
- Most of the evidence relates to liposuction for arm lymphoedema – only two studies included evidence on patients (19 in total) who were treated with liposuction for leg lymphoedema (Sando et al. and O'Brien et al.).
- The procedure is followed with non-surgical management, specifically the use of CCT garments. The requirement for continuation of this treatment is not adequately described, and may be lifelong.
- There are only 2 non-randomised studies that compare liposuction combined with CCT, with non-surgical management (CCT alone). The inclusion criteria included patients with lymphoedema characterised as 'refractive' to conventional non-surgical treatments.

### **Specialist advisers' opinions**

*Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College.*

Professor Peter Mortimer, Mr Kevin Varty, Professor George Hamilton, Professor Kevin Burnand, Mr Rajan Uppal and Mr Timothy Burge.

- Two Specialist Advisers thought the procedure was established practice and that there was no uncertainty over the safety of this procedure. All others thought it was novel.
- Four Specialist Advisers considered the main comparator to be surgical excision. Two Specialist Advisers stated that non-invasive compression treatments are the appropriate comparator.
- Specialist Advisers listed the following theoretical adverse events; haemorrhage, skin necrosis, infection, bruising, pain, scarring and neurovascular injury.

- Specialist Advisers listed the following key efficacy outcomes: reduction in limb volume and swelling, patient comfort, patient satisfaction, quality of life, lymphatic function.
- Four Specialist Advisers stated that the long-term benefit and durability of the procedure is unknown. The comparative efficacy of this procedure with optimal compression regimens was unknown.
- One Specialist Adviser noted that there was a high recurrence of lymphoedema after the procedure.
- All Specialist Advisers considered this procedure to have minor impact on the NHS, with only a small number of centres who would potentially perform it.
- One Specialist Adviser stated that the risk of adverse events may be significantly different depending on whether the upper limb or lower limb is treated.

### **Issues for consideration by IPAC**

- Three of the five studies are from same centre and likely report on some of the same patients.

## References

- 1 Brorson H, Ohlin K, Olsson G et al. (2006) Quality of life following liposuction and conservative treatment of arm lymphedema. *Lymphology* 39: 8–25.
- 2 Brorson H and Svensson H. (1998) Liposuction combined with controlled compression therapy reduces arm lymphedema more effectively than controlled compression therapy alone. *Plastic & Reconstructive Surgery* 102: 1058–1068.
- 3 Brorson H and Svensson H. (1997) Complete reduction of lymphoedema of the arm by liposuction after breast cancer. *Scandinavian Journal of Plastic & Reconstructive Surgery & Hand Surgery* 31: 137–143.
- 4 O'Brien BM, Khazanchi RK, Kumar PAV et al. (1989) Liposuction in the treatment of lymphoedema; A preliminary report. *British Journal of Plastic Surgery* 42: 530–533.
- 5 Sando WC and Nahai F. (1989) Suction lipectomy in the management of limb lymphedema. *Clinics in Plastic Surgery* 16: 369–373.

## Appendix A: Additional papers on liposuction for chronic lymphoedema not included in summary Table 2

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (Table 2). It is by no means an exhaustive list of potentially relevant studies.

Article title	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in Table 2
Brorson H, Ohlin K, Olsson G et al. (2006) Adipose tissue dominates chronic arm lymphedema following breast cancer: An analysis using volume rendered CT images. <i>Lymphatic Research &amp; Biology</i> 4: 199–209.	Case series n = 11 Follow-up: Not stated	Mean reduction of excess arm volumes of 109% achieved at 6 months (i.e. the treated arm became smaller than the normal one).  Aspirated fat contained 93% adipose tissue.	Study focuses on obtaining evidence of the presence of adipose tissue using computed tomography imaging.
Brorson H, Svensson H, Norrgren K et al. (1998) Liposuction reduces arm lymphedema without significantly altering the already impaired lymph transport. <i>Lymphology</i> 31: 156–172.	Case series n = 20 Follow-up: Not stated	Tissue tonicity values showed that upper lymphoedematous arm was harder than the normal arm.  Tissue tonometer was able to register postoperative changes in tissue tonicity in the upper arm but not the forearm.	Study focuses on evaluating changes in tissue tonicity with electronic tissue tonometer before and after liposuction (to aid identification of arms most suitable for liposuction).
Brorson H and Svensson H. (1997) Skin blood flow of the lymphoedematous arm before and after liposuction. <i>Lymphology</i> 30: 165–172.	Case series n = 20 Follow-up: Not stated	Neither liposuction with CCT nor CCT alone changed the indirect lymphoscintigraphic profile of the lymph kinetics of the treated arm.  Liposuction with CCT reduced arm volume 115% (median); CCT alone reduced arm volume by 54% (median).	Study focuses on changes in lymph transport (measured by lymphoscintigraphy) with liposuction and CCT versus CCT alone.
Bagheri S, Ohlin K, Olsson G et al. (2005) Tissue tonometry before and after liposuction of arm lymphedema following breast cancer. <i>Lymphatic Research &amp; Biology</i> 3: 66–80.	Case series n = 12 Follow-up: Not stated	Liposuction produced median oedema reduction of 87% and 97% after 3 and 12 months.  Skin blood flow in the forearm and upper arm increased significantly after liposuction to values similar to non-affected arm. Incidence of cellulitis also decreased.	Study focuses on skin blood flow using Doppler imaging before and after liposuction.
Nava, V. M. and Lawrence, W. T.	Case report	Wounds healed well and	Treatment with lymphoedema was

<p>(1988) Liposuction on a lymphedematous arm. <i>Annals of Plastic Surgery</i> 21: 366-368.</p>	<p>n = 1 Follow-up: Not stated</p>	<p>graft take was 100%. Arm remained smaller than preoperatively over 10 months after procedure. Subjective report of greatly improved arm function.</p>	<p>combined with excision of skin carcinoma on patient's arm requiring skin grafting.</p>
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## Appendix B: Related published NICE guidance for liposuction for chronic lymphoedema

<b>Guidance programme</b>	<b>Recommendation</b>
Interventional procedures	None applicable
Technology appraisals	None applicable
Clinical guidelines	None applicable
Public health	None applicable

## Appendix C: Literature search for liposuction for chronic lymphoedema

IP: 409 Liposuction for chronic lymphoedema of the arm following treatment for breast cancer		
Database	Date searched	Version searched
Cochrane Library	05/07/2007	Issue 2, 2007
CRD databases (DARE & HTA)	05/07/2007	Issue 2, 2007
Embase	05/07/2007	1980 to 2007 Week 26
MEDLINE	05/07/2007	1950 to June Week 3 2007
PreMEDLINE	05/07/2007	July 03, 2007
CINAHL	05/07/2007	1982 to June Week 5 2007
British Library Inside Conferences	05/07/2007	-
NRR	05/07/2007	2007 Issue 2
Controlled Trials Registry	05/07/2007	-

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

- 1 Lymphedema/
- 2 lymphoed\$.tw.
- 3 lymphed\$.tw.
- 4 Lymphocele/
- 5 lymphocel\$.tw.
- 6 (fluid adj3 (drain\$ or block\$ or retent\$)).tw.
- 7 or/1-6
- 8 Lipectomy/
- 9 lipectom\$.tw.
- 10 Adipose Tissue/su [Surgery]
- 11 (adipose tissue adj3 surg\$).tw.
- 12 Surgery, Plastic/
- 13 (plastic adj3 surger\$).tw.
- 14 liposuct\$.tw.
- 15 or/8-14
- 16 7 and 15
- 17 Animals/
- 18 Humans/
- 19 17 not (17 and 18)

20 16 not 19  
21 from 20 keep 1-108 (108)