# LYMPH TAPING AND SEROMA FORMATION POST BREAST CANCER

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## Abstract

*Background:* The most common complication of breast cancer treatment is seroma formation. Lymph taping has the potential to prevent or reduce seroma formation, but currently its potential benefits have not been fully investigated. *Aims:* To investigate the potential of lymph taping to combat seroma formation. *Methods:* Nine women treated for breast cancer were recruited to this randomised clinical trial; four developed seromas requiring aspiration. Bio-impedance spectroscopy of the breast was used to assess intra and extracellular fluid levels in each of the four quadrants of the breast. From day one postoperatively, lymph taping was applied over the watershed between skin territories on the posterior thorax between the spine and axilla on those allocated to the treatment group. Measurements were repeated at five, nine and 16 days. *Results:* The extracellular fluid value at $t_{16}$ was 0.1037 ± 0.0324 (15.3 % decrease) over $t_1$ in the lymph taping group and 0.1066 ± 0.0227 (4.6 % decrease) in the current best practice group (n=4 in each group). After 16 days of treatment, substantial changes were found in burning sensations, tightness and heaviness in favour of the lymph taping group. In particular, pain perception in the lymph taping group improved. *Conclusions:* This study has demonstrated that lymph taping has the ability to reduce extracellular fluid accumulation and improve a range of quality of life measures.



*Key words*

Breast cancer
Lymphoedema
Seroma formation
Lymph taping


Breast cancer surgery is treated with either modified radical mastectomy (MRM), wide local excision (WLE) and axillary lymph node dissection (ALND), or sentinel lymph node biopsy (SLNB). Common complications of breast surgery include bleeding, infection, lymph oedema and nerve damage (Leica and Apantaku, 2002). The most common complication following breast surgery is seroma formation. Incidence of seroma formation after breast surgery varies between 2.5% and 51% (Brayant and Baum, 1987; Barwell et al, 1997; Woodworth et al, 2000). Vitug and Newman (2007) report that 10% to 80% of ALND and mastectomy cases require seroma aspiration.

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Various methods have been used to prevent seroma formation. However, the use of lymph taping in this context has not been fully evaluated in the current literature.

## Seroma

Seroma is defined as a serous fluid collection that develops under the skin flaps during mastectomy or in the axillary dead space after axillary dissection (Pogson et al, 2003). Seroma formation generally begins on the seventh day post surgery, reaches a peak rate of growth on the eighth day and slows continuously until the sixteenth day when it generally resolves (Menton and Roemer, 1990).

Watt-Boolsen et al (1989) found that the composition of the fluid and aspirates and the time-related changes of the investigated criteria suggested that:

- Seroma is not an accumulation of serum, but an exudate
- Exudate is an element in an acute inflammatory reaction, i.e. the first phase of wound repair
- Seroma formation reflects an increased intensity and a prolongation of this repair phase.

Watt-Boolsen et al (1989) also posited that the predominant white cells present in a seroma were granulocytes rather than lymphocytes, indicating that the fluid is likely to be exudate. The protein concentration in seromas was found to be more consistent with that of an exudate produced as a result of acute inflammation during wound healing (Watt-Boolsen et al, 1989).

Gardner et al (2005) suggests that there are seven causative factors contributing to seroma formation:

- Poor adherence of flaps to chest wall
- Division of several larger lymph trunks

- Large dead space/large raw area in the axilla
- Pump action of upper limb increasing lymph flow
- Local inflammatory mediators,
- Irregular shape of chest wall and axilla
- Shear forces during respiration.

Although seromas are not life-threatening, they can lead to significant morbidity (e.g. flap necrosis, wound dehiscence, predisposition to sepsis, impaired shoulder function [muscle strength weakness], prolonged recovery period and multiple physician visits) and may delay adjuvant therapy (Budd et al, 1978; Aitkin and Minton, 1983; Gardner et al, 2005).

Extensive dissection generates a considerable potential space as breast tissue is removed and lymphatic vessels are severed allowing lymph to pass into the dead space. The distensibility of the skin flaps raised during the surgery further establishes a potential space in which fluid can collect. In addition, axillary lymph node dissection results in the division of several larger lymph trunks, and when the arm is mobilised post-operatively, the upper-limb musculature acts as a pump, increasing lymph flow (Gardner et al, 2005).

It is common for people who have had their lymph nodes removed to experience fullness under the arm after the drain(s) has been removed. Evidence on the effect of drains on seroma formation is inconclusive (Gardner et al, 2005). People often describe seroma as like 'having a ball fixed into their armpit'.

Following a modified radical mastectomy it is also possible to develop seroma on the chest wall. As with a haematoma, this fluid is reabsorbed by the body over time.

Persistent seromas have traditionally been treated with repeated aspirations, local pressure dressings, and occasionally surgical ablation (Gardner et al, 2005). Seromas should only be aspirated when symptomatic (Anand et al, 2002). In some cases, the fluid collection may recur so this may need to be done more than once (Cancer Society of New Zealand, 2003). Seromas can generally be managed by one to six aspirations (Gonzalez et al, 2003). However, the use of fine needle aspiration to assess changes in an oedematous breast can be problematic and may, in itself, produce additional inflammation and oedema (Williams, 2006).

**Although seromas are not life-threatening, they can lead to significant morbidity (e.g. flap necrosis, wound dehiscence, predisposition to sepsis, impaired shoulder function [muscle strength weakness], prolonged recovery period and multiple physician visits) and may delay adjuvant therapy.**

Several interventions have been reported with the aim of reducing seroma formation including the use of pressure garment and prolonged limitation of arm activity. However, it has been suggested that the use of these interventions not only reduces seroma formation, but may also increase the incidence of seroma formation after removal of the drain (O'Hea et al, 1999), and even might cause shoulder dysfunction (Dawson et al, 1989).

Seroma formation after breast cancer surgery occurs independently of drainage duration, compression dressing and other known prognostic factors in breast cancer patients except the type of surgery, i.e. there is a 2.5 times higher risk of seroma formation in patients who undergo a modified radical mastectomy compared to breast-conserving surgery (Hashemi et al, 2004). Schultz et al (1997) were able to show that immobilisation of the shoulder until day seven postoperatively significantly reduced the incidence of seroma. However, other authors describe how immobilisation of the upper limb generated unacceptable rates of frozen shoulder and, therefore, advise early shoulder exercises. Evidence for a clear role of immobilisation in seroma prevention is still lacking (Gardner et al, 2005).

Postoperative breast seroma, therefore, is an important cause of morbidity that continues to cause difficulties for surgeons and for which the best treatment has long been debated (Gardner et al, 2005).

The use of taping for the management of seroma is gaining popularity and while there is significant clinical experience of this approach, there is little published research. Lymph taping is a part of the Medical Taping Concept, which is believed to contribute to the stimulation and improvement of lymphatic drainage (www.medicaltaping.com).

## Lymph taping

In its most common application, lymph taping is applied to the poorly draining area (lymphatic territory) of the lymphoedematous limb or area. The special tape used has an elasticity similar to that of the skin and is similar in weight to the epidermis. By applying the tape in a proximal to distal direction and positioning the body in a way that the tape is stretched during application, the lymphatic drainage system is stimulated 24 hours a day.

The tape must be applied in accordance with the anatomy of the lymph flow. The tape lifts the skin slightly, opening the lumen of the lymph angioma and reducing the pressure on the blood vessels. Moreover, the tape acts as a conductor of interstitial fluid, moving fluids from areas of higher pressure towards areas of lower pressure (Kase et al, 2003). The tape may also influence the deeper lymphatic system and encourage myofascial release, enhancing drainage in the subfascial

lymphatics (although this remains to be proven).

Shim et al (2003) posit that endothelium may act as a micro-valve along the walls of the initial lymphatics. These valves open during any stretching of the lymphatics and during the influx of interstitial fluid into the lumen, while anchoring filaments keep the endothelial cells tightly attached to the adjacent collagen network. Expansion of the initial lymphatics causes the interstitial fluid to fill the open endothelial micro-valves through percolation, while compression causes closure of the endothelial micro-valves and outflow along the lumen of the micro-lymphatics, with eventual transport to collecting lymphatics. Reflux towards the initial lymphatics is prevented by bicuspid valves.

## Bio-impedance

A promising technique in measuring breast changes is bio-impedance. Local bio-impedance uses electrical currents to measure the impedance of the tissue and, therefore, the fluid volume. This type of technique has been previously used to measure arm lymphoedema (Cornish et al, 2001; Box et al, 2002), breast fluid volume (Mosely and Piller, 2008), and breast tumours (Ohmine et al, 2000). As demonstrated in *Table 1*, the covariance for bio-impedance measurements is quite low, ranging from 0.20–0.86%, demonstrating that the between subject reproducibility is consistent and therefore reliable (Mosely and Piller, 2008).

## Rationale

This study was undertaken to determine the effect of lymph taping on post-operative seroma following breast cancer surgery. Most of the literature is based on the effect of lymph taping in oedema of the arm. However, the use of lymph taping for seroma management does not appear to be considered, even though there are similarities in the nature of the fluid accumulation.

## Method

Ethical approval was obtained from Flinders University and Medical Centre Clinical Research Ethics Committee prior to commencing the study.

Nine women who had undergone surgical treatment for their breast cancer (± radiotherapy ± chemotherapy) were recruited for this clinical trial. Before surgery ($t_0$), participants were measured using bio-impedance spectroscopy and filled out a quality of life (QoL) questionnaire. A patch test was also performed to ensure the participants were not allergic to the tape material or adhesive.

After surgery, participants were divided in two groups, a lymph taping group and a current best practice group

Starting on day one postoperatively, lymph taping was applied every five days to the lymph taping group. The tape was cut into three strips and applied over the watershed between the posterior thoracic skin territories and from spine to axilla (*Figure 1*). The patient was positioned so that the skin was slightly stretched before the application of the tape. Once the skin returned to its normal position, it was drawn up to create an underlying negative pressure (Williams, 2006).

The participants were encouraged to perform early arm motion, including abduction of the arm at 90° and arm raising. Participants were also encouraged to resume their normal daily activities (Gonzalez et al, 2003). General advice was provided to participants regarding skincare, e.g. how to wash and dry the skin, to avoid using warm air to dry the tape and to seek advice if problems occurred.

In both the current best practice group and the lymph taping group, seroma aspirations were taken using techniques currently approved by the Department of Surgery, at Flinders University and Medical Centre.

Parameters collected from the sample groups included age, body mass index (BMI), type of surgery performed, tumour size, number of lymph nodes removed, number of lymph nodes infiltrated and the frequency and number of aspirations. Bio-impedance and QoL was measured on day one postoperatively ($t_1$), day five postoperatively ($t_5$), day nine postoperatively ($t_9$) and day 16 postoperatively ($t_{16}$).

**Table 1**

**Between subject reproducibility: bio-impedance measurements (Moseley and Piller, 2008)**

| Position | Covariance (%) |
|---|---|
| Affected Breast | |
| Upper outer quadrant (R0[a]) | 0.34% |
| Upper inner quadrant (R0) | 0.24% |
| Lower outer quadrant (R0) | 0.24% |
| Lower inner quadrant (R0) | 0.53% |
| Upper outer quadrant (Rf[b]) | 0.40% |
| Upper inner quadrant (Rf) | 0.48% |
| Lower outer quadrant (Rf) | 0.86% |
| Lower inner quadrant (Rf) | 0.54% |
| Normal Breast | |
| Upper outer quadrant (R0) | 0.20% |
| Upper inner quadrant (R0) | 0.36% |
| Lower outer quadrant (R0) | 0.48% |
| Lower inner quadrant (R0) | 0.33% |
| Upper outer quadrant (Rf) | 0.38% |
| Upper inner quadrant (Rf) | 0.45% |
| Lower outer quadrant (Rf) | 0.39% |
| Lower inner quadrant (Rf) | 0.32% |

*a R0 represents the extracellular fluid measurement*
*b Rf represents both the intra and extracellular measurement*

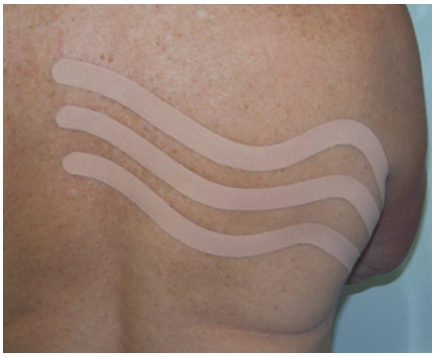

**Figure 1. Lymph taping over the watershed between the posterior thoracic skin territories from the spine to axilla.**

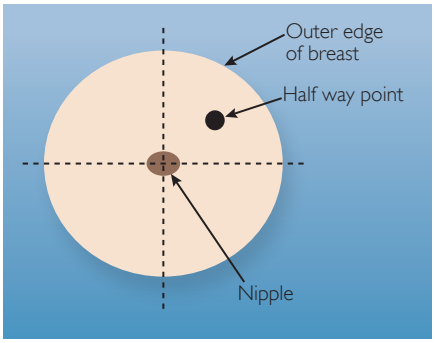


**Figure 2. Breast quadrants and halfway point.**

Allocation to either the treatment group or the current best practice group was performed by the toss of a coin for the first patient — subsequent participants were then allocated to each group alternately.

### Local bio-impedance

The fluid impedance of each breast quadrant was measured using the Impedimed® Imp SFB7 bio-impedance unit (Impedimed). The electrodes were placed in a straight line along the halfway point of the breast (*Figure 2*) and a multi-frequency current (5-500Hz) was applied through the electrodes to measure the fluid impedance. The measurement data was then downloaded and stored in a laptop.

### Analysis

All data was analysed using SPSS®. All results are expressed as means ± standard deviation in tables. Paired t-tests were used to compare the extracellular fluid (ECF) volume and QoL with and without lymph taping. The ECF volume was determined using the formula:

*ECF volume index = L^2/R0*
(where 'L' is the length and R0 is the value measured by the bio-impedance device)

Because the resistivities for extracellular fluid (ECF), intracellular fluid (ICF) and total body fluid (TBF) are not known, the authors could not draw interferences about the relative amounts. Nevertheless, it was possible to draw conclusions from the trend in each. If the resistivity of ECF in the breast quadrants is ever measured in the future, the authors could multiply their volume index and work out the actual volume (ECF volume = pECF*L^2/R0). A P value of <0.05 was considered significant.

**Table 2**

**Characteristics of the participants**

| Subject | Age (years) | Weight (kgs) | Height (cms) | BMI * |
|---|---|---|---|---|
| Mean | 57.5 | 66.8 | 162 | 25.5 |
| Standard Deviation | 13.0 | 11.5 | 5.8 | 4.1 |

** Body Mass Index calculated as weight (kgs) / height ($m^2$)*

## Results

Nine women who had treatment for their breast cancer entered the study but one was excluded due to a prolonged surgical intervention. The mean age of the women was 57.5 years with a range of 41–79 years. Four participants had undergone MRM, while the other four had undergone WLE. Six were also treated with ALND, while a further two underwent a SLNB. *Table 2* displays the group demographic and anthropometric characteristics.

Closed suction drainage was used in all participants and the carcinoma was invasive in all of the participants. Four participants developed seromas that required aspiration — three of these had undergone MRM and one had undergone WLE. All were treated with ALND.

Two of the four participants who developed seromas were treated with lymph taping, while the other two received current best practice, including general skin and limb care advice and a gentle exercise programme. The mean amount of aspirate was 175.82 ± 109.29ml (range 20–335ml). The number of aspirations ranged from 2–5.

The mean tumour diameter of all participants was 33.63±14.59mm (range 13–50mm). Seromas required aspiration in one of the three participants with a tumour diameter less than 25mm and in three of the five with a tumour diameter greater than 25mm.

There were two grade I tumours (25%), three grade II (37.5%), and two grade III (25%). In one patient there were no tumour grade details listed. There were two seromas requiring aspiration in the grade II tumour group and one in the grade III tumour group.

The model number of lymph nodes removed was 10 ± 6 (range 1–15). Four participants (50%) had positive lymph nodes, while three of the four developed seromas that needed aspiration.

The bio-impedance figure (see Analysis section above for explanation) representing the mean volume of extracellular fluid (ECF) at $t_0$ was 0.0868 ± 0.0106 and 0.0858 ± 0.0182 for lymph taping and current best practice groups respectively. At one day postoperatively the mean volume of ECF was 0.1224 ± 0.0279 (a 41% increase) and 0.1118 ± 0.0083 (a 30% increase) respectively for the lymph taping and current best practice groups. Taping was commenced after this first postoperative measure.

The mean volume of ECF on day five was 0.1189 ± 0.0308 (2.9% decrease) and 0.1165 ± 0.0181 (4.3% increase) respectively for the lymph taping and current best practice groups.

On day 9 this volume was 0.1302 ± 0.2922 (6.4% increase) and 0.1190

**Table 3**

**Extracellular fluid**

| Randomisation by treatment | | ECF $t_0$ | ECF $t_1$ | ECF $t_5$ | ECF $t_9$ | ECF $t_{16}$ |
|---|---|---|---|---|---|---|
| Current best practice total group n=4 | Mean | 0.0858 | 0.1118 | 0.1165 | 0.1190 | 0.1066 |
| | SD | 0.0182 | 0.0083 | 0.0181 | 0.2059 | 0.0227 |
| | Percentage | | 30% | +4.27% | +6.48% | –4.59% |
| Lymph taping total group n=4 | Mean | 0.0868 | 0.1224 | 0.1189 | 0.1302 | 0.1037 |
| | SD | 0.0106 | 0.0279 | 0.0308 | 0.2922 | 0.0324 |
| | Percentage | | +41% | –2.86% | +6.36% | –15.32% |
| Current best practice with aspirations n=2 | Mean | 0.0855 | 0.1138 | 0.1260 | 0.1259 | 0.1210 |
| | SD | 0.0235 | 0.0138 | 0.0106 | 0.0274 | 0.0228 |
| | Percentage | | +33.1% | +10.7% | +10.6% | +6.3% |
| Lymph taping with aspirations n=2 | Mean | 0.0859 | 0.1329 | 0.1409 | 0.1503 | 0.1301 |
| | SD | 0.0157 | 0.0344 | 0.0278 | 0.0227 | 0.0145 |
| | Percentage | | +54.7% | +6% | +13.1% | –2.1% |

ECF volume index = L^2/R0

**Table 4**

**Quality of life (scored on 10-point visual analog scale [means shown]**

| | $t_0$ | | $t_1$ | | $t_5$ | | $t_9$ | | $T_{16}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| QoL | LT | CBP | LT | CBP | LT | CBP | LT | CBP | LT | CBP |
| Pain | 2.75 | 1.20 | 4.25 | 2.25 | 5.00 | 1.67 | 4.50 | 3.00 | 4.25 | 2.50 |
| Heaviness | 1.50 | 1.00 | 1.50 | 1.00 | 3.25 | 1.00 | 1.75 | 2.25 | 2.00 | 2.00 |
| Tightness | 1.00 | 1.00 | 2.50 | 1.50 | 5.25 | 1.67 | 2.75 | 3.50 | 2.50 | 2.25 |
| Temperature | 1.00 | 1.00 | 1.00 | 1.00 | 2.75 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Burning sensations | 1.00 | 1.40 | 1.00 | 1.50 | 1.00 | 1.00 | 1.00 | 2.25 | 1.00 | 2.50 |
| Ball-like feeling | 2.00 | 1.00 | 1.00 | 1.00 | 4.25 | 1.00 | 2.50 | 2.25 | 3.50 | 1.50 |
| ROM | 2.75 | 1.00 | 5.00 | 3.50 | 4.00 | 2.83 | 2.50 | 2.88 | 1.88 | 1.75 |

± 0.2059 (6.5 % increase) for lymph taping and current best practice respectively. On day 16 the mean volume measurement of ECF was 0.1037 ± 0.0324 (15.3% decrease) and 0.1066 ± 0.0227 (4.6% decrease) respectively for the lymph taping and current best practice groups.

These results suggest that both the short term (five days postoperatively) and longer term (16 days postoperatively) participants benefit from lymph taping (*Table 3*). By looking at the participants requiring aspirations (two in each of the current best practice and lymph taping groups), the mean volume of ECF decreased more in the lymph taping group.

*Table 3* shows a mean volume of 0.1301 ± 0.0145 (a 2.1% decrease) and 0.1210 ± 0.0228 (a 6.3% increase) respectively for the lymph taping and current best practice groups on day 16. Thus lymph taping results in a decrease in volume of ECF, while current best practice results in an increase in volume of ECF.

Quality of life was scored on seven variables (*Table 4*). Between $t_1$ and $t_5$ there was a substantial difference between the lymph taping group and current best practice group, but after $t_5$ the variables showed large improvements as shown in *Figures 3–5*.

The subjects' range of motion (ROM) improved during $t_1$ and $t_{16}$ in the lymph taping group. After 16 days of treatment, substantial improvements were found in burning sensations (66.7%), tightness (50%) and heaviness (100%) in the lymph taping group. However, the 'ball-like' feeling increased by 150% in the current best practice group compared to 250% in the lymph taping group. There was a small increase in pain (11.1%) in the current best practice group.

Substantial differences were observed for the pain perception between the two groups at $t_0$ ($P = .08$), $t_1$ ($P < .08$) and $t_5$ ($P < .08$). However at $t_9$ ($P < .22$) and $t_{16}$ ($P < .18$) this difference was no longer substantial, meaning that the pain perception for the lymph taping group improved (*Table 5*). None of these values were statistically significantly different, however, a larger study may show them to be so.

## Discussion

Seroma is widely accepted as a normal complication following breast cancer surgery. Gonzalez et al (2003) called it a 'necessary evil' that occurs unpredictably in a predictable number of patients. The authors believe that this view of seroma should change. Every aspiration may cause infection and, therefore, a higher risk of lymphoedema. Seroma should not be looked upon as being a normal complication.

The incidence of lymphoedema has been evaluated in many studies. However, the incidence of lymphoedema after the presence of a seroma has not yet been evaluated. The authors suggest that more

research needs to be conducted into the incidence of lymphoedema after the presence of a seroma.

In this study, one patient had thyroid problems and developed a seroma that needed aspiration. Although the patient was taking medication, thyroid problems may be a predisposing factor for seroma development. Because of the presence of an oedematherapist specialised in lymph taping at the breast care unit, this patient was referred for treatment. In most settings this is not the case.

A higher score of 'ball-like feeling' was reported in the lymph taping group. This might be explained through lymph taping pulling the fluids away from one area and allowing them to accumulate in another (resulting in the 'ball-like feeling'). If this is the case it could be seen as a positive development, i.e. the fluid moving away from the affected area, but perhaps not far enough.

The authors continue to seek methods that will decrease this 'ball-like feeling' and suggestions include a breathing programme (i.e. to set up a proximal pressure gradient between this area and the drainage points) or the placement of further lymph tape to stimulate drainage over the watershed to other lymphatic territories.

Before the study, it was hypothesised that lymph taping can be a useful and harmless strategy for the prevention or management of seroma after breast cancer surgery. This hypothesis was supported as those participants who received lymph taping had substantially less seroma on day 16 than those who received best current practice. However, the authors believe that studies with higher numbers of participants are required to demonstrate statistically significant changes. Nevertheless, there is still a degree of practical significance to support this hypothesis. In this study, the authors demonstrated a decrease in mean volume of extracellular fluid in

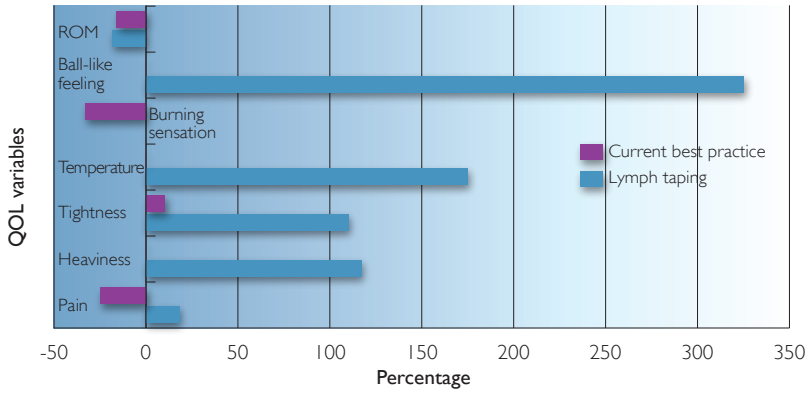


**Figure 3. Quality of life: percentage changes on day one post-op' *versus* day five post-op'**

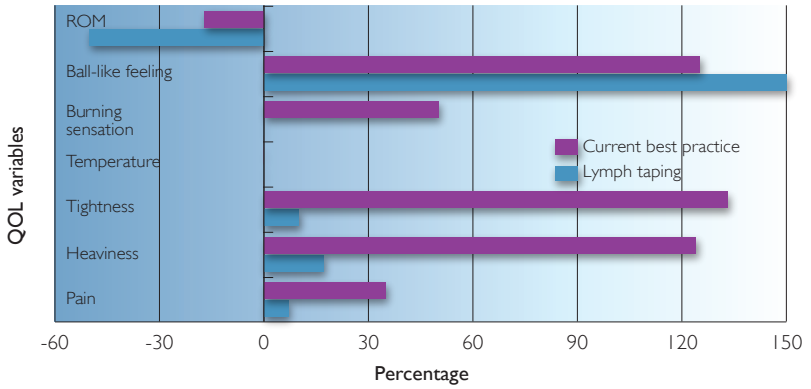


**Figure 4. Quality of life: percentage changes on day one post-op' *versus* day nine post-op'**

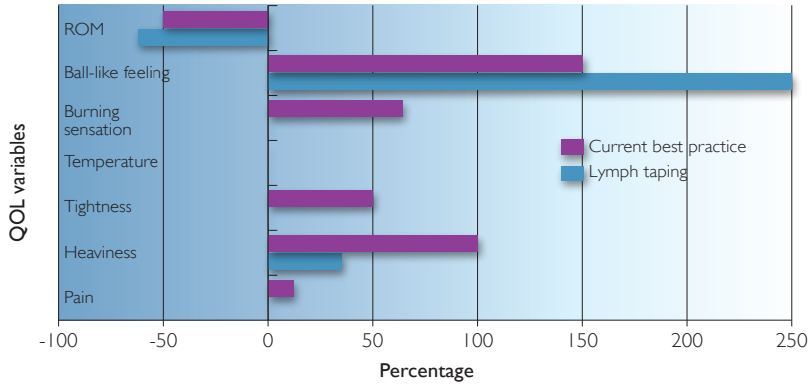


**Figure 5. Quality of life: percentage changes on day one post-op' *versus* day 16 post-op'**

**Table 5**

**Quality of life difference between groups (p values indicated)**

| | QOL $t_0$ | QOL $t_1$ | QOL $t_5$ | QOL $t_9$ | QOL $t_{16}$ |
|---|---|---|---|---|---|
| Pain | .080 | .076 | .072 | .215 | .180 |
| Heaviness | .264 | .317 | .079 | .741 | 1.000 |
| Tightness | 1.000 | .508 | .138 | .549 | 1.000 |
| Temperature | 1.000 | 1.000 | .186 | 1.000 | 1.000 |
| Burning sensations | .371 | .127 | 1.000 | .317 | .317 |
| Ball-like feeling armpit | .264 | 1.000 | .186 | .881 | .225 |

the breast. Concurrently, the subjects QoL improved on several variables, including ROM, burning sensations, tightness and heaviness.

These results suggest that the outcome for participants can be improved using this relatively easy approach.

## Conclusion

The optimal way to manage a seroma is unknown. Most clinicians will aspirate a symptomatic seroma and thereafter only re-aspirate if the seroma re-appears. Usually this is indicated by the patient or the breast nurse (on re-examination). In our opinion, the risk of additional inflammation and associated increased oedema is not acceptable with this invasive technique. This pilot study has demonstrated that Lymph Taping has the potential to become a non invasive method to manage seroma. However, further controlled trials need to be conducted to confirm this. JL

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### Key points

- Frequent complications of breast cancer treatment include bleeding, infection, lymphoedema (arm and breast) and nerve damage, but the most common is seroma formation.
- Lymph taping has the potential to reduce seroma formation but currently its potential benefits in this context have not been fully investigated.
- This study used bio-impedance spectroscopy of the breast, on the side of the surgery, to assess intra and extracellular fluid levels in each of the four quadrants of the breast. A questionnaire measuring quality of life was administered.
- The study also used a questionnaire to measure quality of life.
- The study showed that lymph taping has the ability to reduce extracellular fluid accumulation and improve quality of life.