Chirurgia (2026) 121: 559-567
No. 5, September - October
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http://dx.doi.org/10.21614/chirurgia.3405

Breast Cancer-Related Lymphedema, a Frequent Complication of Axillary Surgery: A Prospective Single-Arm Study of Outcomes Before and After Decongestive Physical Therapy

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Abbreviations:
BCRL: Breast cancer-related lymphedema;
ALND: axillary lymph node dissection;
SLNB: sentinel lymph node biopsy;
TAD: targeted axillary dissection;

Received: 17.07.2026
Accepted: 17.09.2026

Rezumat

Limfedemul secundar cancerului mamar, o complicație frecventă a chirurgiei axilare: studiu prospectiv, cu un singur braț al rezultatelor înainte și după terapia decongestivă

Introducere: Limfedemul asociat tratamentului cancerului mamar (BCRL) este o complicație frecventă a intervenției chirurgicale axilare, care afectează una din cinci paciente. În cadrul acestui studiu am mmonitorizat evoluția circumferinței membrului superior, a durerii, a anxietății şi a depresiei în cursul unui program de kinetoterapie bazat pe drenaj limfatic.
Material şi metodă: Acesta este un studiu prospectiv, cu un singur braț, fără lot de control. În 2025, 54 de paciente consecutive cu limfedem secundar al membrului superior au efectuat 10 şedințe de kinetoterapie cu drenaj limfatic manual, de trei ori pe săptămână. Parametrul principal de evaluare a fost circumferința totală a membrului superior (suma măsurătorilor efectuate din 10 în 10 cm), iar parametrii secundari au fost durerea (scala numerică de evaluare), anxietatea şi depresia (HADS, analizate pe categorii). Vizita 1 şi vizita 10 au fost comparate cu teste neparametrice.
Rezultate: Circumferința totală a membrului superior a scăzut cu o mediană de 8,50 cm (IC 95%: 6,50–11,50), iar durerea de la valoarea inițială de 6 până la 1 punct. Cu toate acestea, proporția pacientelor cu anxietate a crescut de la 29,6% la 63,0%, iar a celor cu depresie de la 24,1% la 74,1% (toate $p < 0,001$, mărimi mari ale efectului). Reducerea circumferinței membrului superior a fost mai mare în stadiul 2 decât în stadiul 1.
Concluzii: În această cohortă fără lot de control, parcurgerea programului a fost asociată cu ameliorarea semnificativă a tuturor parametrilor, însă, absența controlului

BMI: body mass index;
CDT: Complex decongestive therapy;
MLD: manual lymphatic drainage;
HADS: Hospital Anxiety and Depression Scale;

nu a permis stabilirea unei relații cauzale. Rezultatele obținute susțin principiul de a încorpora în procesul de monitorizare postoperatorie a pacientelor cu neoplasm mamar supravegherea precoce a limfedemului şi inițierea şedințelor de kinetoterapie cu scop de drenaj limfatic.

Cuvinte cheie: limfadenectomie axilară, limfedem secundar cancerului mamar, complicație chirurgicală, kinetoterapie, durere, anxietate şi depresie

Abstract

Background: Breast cancer-related lymphedema (BCRL) is a frequent complication of axillary surgery, affecting about one in five patients. Complex decongestive therapy is the standard of care. We assessed limb circumference, pain, anxiety, and depression over a physical therapy programme.

Methods: Prospective single-arm study, without a control group. In 2025, 54 consecutive women with secondary upper-limb lymphedema underwent 10 physical therapy sessions with manual lymphatic drainage, three times weekly. Endpoints were total limb circumference (primary; sum of measurements every 10 cm), pain (Numerical Rating Scale) and anxiety and depression (Hospital Anxiety and Depression Scale, ordinal categories). Visit 1 and Visit 10 were compared using non-parametric tests.

Results: Total circumference decreased by a median of 8.50 cm (95% CI: 6.50–11.50) and median pain from 6 to 1 point. Normal anxiety levels rose from 29.6% to 63.0% and normal depression from 24.1% to 74.1% (all $p < 0.001$, large effect sizes). Circumference reduction was greater in stage 2 than in stage 1.

Conclusions: The programme was associated with significant improvement in all endpoints, but the absence of a control arm precludes causal attribution. The findings support integrating early lymphedema surveillance and prompt referral into post-operative follow-up.

Key words: axillary lymph node dissection, breast cancer-related lymphedema, surgical complication, physical therapy, pain, anxiety and depression

Introduction

Breast cancer-related lymphedema (BCRL) is a chronic condition that develops as a consequence of surgical treatment and/or radiation therapy. It results from disruption of the lymphatic system and is characterized by accumulation of protein-rich lymphatic fluid in the soft tissues, leading to inflammation, adipose hypertrophy and fibrosis (1). Clinically it is dominated by swelling of the affected upper limb, pain and recurrent cellulitis.

BCRL affects approximately one in five patients treated for breast cancer, and the principal determinant is the type of axillary surgery performed: axillary lymph node dissection (ALND) leads to upper limb lymphedema in 30–50% of cases (2). ALND removes en bloc the level I and level II nodal groups, and an adequate clearance customarily yields ten or more nodes; the removal of this interconnected block of nodal and adipose tissue severs the principal drainage pathway of the upper limb (3). The transition from radical ALND towards sentinel lymph node biopsy (SLNB) and targeted axillary dissection (TAD) has substantially reduced both the risk and the severity of lymphedema, by preserving normal axillary lymphatic pathways; the reported incidence after SLNB ranges between 2% and 8% (4). TAD combines SLNB with excision of previously biopsy-proven, clipped positive nodes, permitting localized nodal staging without extensive lymphatic damage (5).

Regional lymph node irradiation raises the incidence of lymphedema to approximately 21–22%, and the highest incidence is observed in patients who undergo both axillary dissection and radiation, since ALND removes the primary lymphatic channels while radiation induces fibrosis of the remaining tissues (6,7). Neoadjuvant chemotherapy followed by ALND, particularly in obese patients, further increases the

incidence (8). Beyond treatment intensity, the development of BCRL is multifactorial, being influenced by biological predisposition — notably the patient's capacity to form collateral lymphatic pathways after injury — and by potentially modifiable factors such as body mass index (BMI) (9,10). BCRL represents a lifelong risk for breast cancer survivors and has a sustained impact on physical function, daily living and psycho-emotional status (11).

Awareness of the surgical risk factors and early detection are essential in limiting progression (12). Axillary surgery has become increasingly selective: ALND is no longer necessary in clinically node-negative patients with up to two positive sentinel nodes, or when no residual nodal disease is found after neoadjuvant chemotherapy, and the remaining indications are few (13). Prospective surveillance programmes, in which limb measurements are obtained preoperatively and repeated during follow-up, detect subclinical lymphedema and reduce its progression (14). Complex decongestive therapy (CDT) — compression, skin care, exercise and manual lymphatic drainage (MLD) — is the current standard of care (15), and structured patient education is an established component of management (16).

Although BCRL originates in the operating theatre, its management is usually delegated to rehabilitation services, and the surgical team rarely receives structured feedback on the functional and psycho-emotional consequences of the axillary procedure it has performed. The objectives of this study were to describe the evolution of limb circumference, pain, anxiety, and depression over a structured, individually tailored programme of decongestive physical therapy, and to identify which categories of patients — defined by lymphedema stage, age, BMI and diabetes status — show the greatest change, so as to inform referral practice in the postoperative pathway.

Material and Method

Design, Setting and Participants

This was a prospective, single-arm, pre- and post-interventional study, without a control group and without randomization, conducted at St. Luca Chronic Diseases Hospital, Bucharest, during 2025. Fifty-four consecutive female patients treated for breast cancer, who had developed secondary lymphedema of the ipsilateral upper limb, were enrolled.

Inclusion criteria were: age ≥ 18 years; secondary upper-limb lymphedema after treatment for breast cancer; ECOG performance status 0–2; a referral for medical rehabilitation from the treating oncologist; and written informed consent. Patients with an ECOG performance status of 3–4, without an oncologist's referral, or who declined participation, were excluded. Assessments were performed at Visit 1 (T0) and Visit 10 (T1). The study protocol was not registered before enrolment; it was registered retrospectively on the Open Science Framework (OSF), DOI: 10.17605/OSF.IO/PNFHB. Although the study was registered retrospectively, the primary and secondary endpoints had been defined in the ethics-approved study protocol before participant enrolment.

Intervention

Patients received physical therapy three times weekly, for a total of 10 visits, each lasting approximately 35–40 minutes. Depending on the individual presentation, the Vodder, Leduc, Földi, and Casley-Smith MLD techniques were used; compression was manual and adjusted to the degree of lymphedema; concentric and eccentric exercises with a pumping effect were performed to engage the lymphatic system. MLD was delivered by a single therapist specialized in the management of lymphedema since 2020. Patients also received structured education on skin care, compression garments, exercise, and lifestyle modification.

For reproducibility, the components of complex decongestive therapy were applied uniformly: each 35–40 minute session comprised manual lymphatic drainage (approximately 20–25 minutes), remedial exercises (approximately 10 minutes), and skin care, followed by multilayer short-stretch compression bandaging maintained between sessions; patients were advised to wear a flat-knit compression garment during the day. The manual lymphatic drainage technique (Vodder, Leduc, Földi or Casley-Smith) was selected by the same specialized therapist according to oedema consistency and localization, but the sequence, direction and intensity of strokes and the compression regimen were standardized across patients. Adherence to the ten supervised sessions was complete (54/54); adherence to home compression between sessions was recommended but not formally quantified, which is acknowledged as a limitation.

Endpoints and Measurements

The primary endpoint was the total circumference of the affected upper limb, defined as the arithmetic sum of the circumferential measurements obtained at 10 cm intervals from the carpal bone proximally to the shoulder, using a flexible tape, before MLD and exercise at each visit. It should be emphasized that this is a summed linear measure of a single limb; it is not a volumetric estimate, and it was not normalized

against the contralateral limb. Consequently, it cannot be converted into excess limb volume, and comparisons with studies reporting percentage excess volume are indirect. The change in total circumference between Visit 1 and Visit 10 was the pre-specified primary comparison. Circumferential measurement at designated anatomical distances remains the most widely used method for the clinical quantification of lymphedema (17), and lymphedema stage was assigned according to the International Society of Lymphology classification (18).

This summed circumferential measure was chosen because it is simple, inexpensive, and reproducible at the bedside, it requires no dedicated equipment, and integrates change along the whole limb rather than at a single reference point; it is the measure that was recorded prospectively for every patient in this cohort. We acknowledge, however, that it is not a volumetric estimate and is not referenced to the contralateral limb, and that this limits direct comparison with studies reporting excess limb volume; this is addressed in the Limitations.

Secondary endpoints were pain intensity, assessed with the Numerical Rating Scale (NRS, 0–10; 1–3 mild, 4–6 moderate, 7–10 severe) (19), and anxiety and depression, assessed with the Hospital Anxiety and Depression Scale (HADS) (20). The HADS comprises two 7-item subscales scored 0–21 (HADS-A, anxiety; HADS-D, depression), with cut-offs of 0–7 normal, 8–10 borderline, 11–14 moderate and 15–21 severe. In the present analysis the HADS was handled as an ordinal categorical variable (Normal = 0, Borderline = 1, Moderate = 2, Severe = 3) rather than as a continuous 0–21 score; the continuous subscale scores were not retained for analysis. This reduces the sensitivity of the instrument and is acknowledged as a limitation.

The original continuous 0–21 subscale scores were not retained in the study database, and only the four HADS severity categories were available for analysis. A complementary reanalysis of HADS-A and HADS-D as continuous scores, although desirable, was therefore not possible; this is stated as a limitation.

Statistical Analysis

Analyses were performed in Python 3 (SciPy, NumPy, Pandas), with $\alpha = 0.05$. The Shapiro-Wilk test indicated non-normal distributions for all variables (all $p < 0.05$, $W = 0.66–0.93$), so non-parametric methods were used throughout and central tendency is reported as the median with interquartile range. Paired Visit 1 versus Visit 10 comparisons used the Wilcoxon signed-rank test, with effect size $r = Z/\sqrt{N}$ ($r < 0.3$ low; 0.3–0.5 moderate; ≥ 0.5 high). Two independent groups were compared with the Mann-Whitney U test (rank-biserial coefficient, r_rb) and three or more groups with the Kruskal-Wallis H test (η^2). Ninety-five per cent confidence intervals for the median difference were obtained by bootstrapping (5000 resamples). Subgroup analyses were exploratory and were not adjusted for multiple comparisons; their p values should be interpreted as hypothesis-generating. The comparison by lymphedema stage was restricted to stage 1 versus stage 2 (n = 48), because the stage 3 subgroup (n = 6) was too small to support a separate comparison; these six patients were nonetheless included in all whole-group analyses. Similarly, the single underweight patient was excluded from the BMI comparison, which therefore contrasted three categories (normal weight, overweight, obesity; n = 53).

Ethics

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of St. Luca Chronic Diseases Hospital, Bucharest (protocol no. 487, 16 January 2023). All participants gave written informed consent.

Results

The baseline characteristics of the 54 patients are presented in *Table 1.* Median age was 57.0 years (IQR 51.5–65.0; range 31–74). Most patients were overweight or obese (83.3%), 63.0% had stage 1 lymphedema and 27.8% had diabetes mellitus.

Table 1. Baseline characteristics of the study population (n = 54).

Characteristic	Value
Age, years — median (IQR)	57.0 (51.5–65.0)
Age, years — mean ± SD (range)	57.24 ± 9.72 (31–74)
Age ≤ 55 years — n (%)	24 (44.4)
Age > 55 years — n (%)	30 (55.6)
Lymphedema stage 1 — n (%)	34 (63.0)
Lymphedema stage 2 — n (%)	14 (25.9)
Lymphedema stage 3 — n (%)	6 (11.1)
BMI: underweight — n (%)	1 (1.9)
BMI: normal weight — n (%)	8 (14.8)
BMI: overweight — n (%)	29 (53.7)
BMI: obesity — n (%)	16 (29.6)
Diabetes mellitus — n (%)	15 (27.8)
Total limb circumference at Visit 1, cm — median (IQR)	160.75 (141.25–177.00)
Pain at Visit 1, NRS — median (IQR)	6.00 (5.00–7.00)
Abnormal HADS-A level at Visit 1 — n (%)	38 (70.4)
Abnormal HADS-D level at Visit 1 — n (%)	41 (75.9)

IQR — interquartile range; SD — standard deviation; BMI — body mass index; NRS — Numerical Rating Scale; HADS — Hospital Anxiety and Depression Scale. Lymphedema stage according to the International Society of Lymphology classification. An abnormal HADS level denotes any category other than Normal.

Table 2. Endpoints before and after the ten-session programme — whole group (n = 54; Wilcoxon signed-rank test).

Endpoint	Visit 1 median (IQR)	Visit 10 median (IQR)	Median change (95% CI)	p	r	Effect
Total limb circumference, cm	160.75 (141.25–177.00)	152.50 (131.50–168.88)	8.50 (6.50–11.50)	< 0.001	0.862	high
Pain intensity, NRS (0–10)	6.00 (5.00–7.00)	1.00 (1.00–1.75)	5.00 (4.50–5.50)	< 0.001	0.877	high
Anxiety, HADS-A (ordinal 0–3)	2.00	0.00	2.00 (1.00–2.00)	< 0.001	0.811	high
Depression, HADS-D (ordinal 0–3)	2.00	0.00	1.00 (1.00–1.00)	< 0.001	0.780	high
Normal HADS-A level, n (%)	16 (29.6)	34 (63.0)	—	—	—	—
Normal HADS-D level, n (%)	13 (24.1)	40 (74.1)	—	—	—	—

Change = Visit 1 - Visit 10. Confidence intervals obtained by bootstrapping (5000 resamples). r = Z/√N; effect size interpreted as low (< 0.3), moderate (0.3–0.5) or high (≥ 0.5). Anxiety and depression were coded ordinally: Normal = 0, Borderline = 1, Moderate = 2, Severe = 3.

All patients had received systemic and/or loco-regional oncological treatment: 51 (94.4%) had undergone radiotherapy, 48 (88.9%) chemotherapy and 16 (29.6%) endocrine therapy. The type of axillary surgery (ALND, sentinel lymph node biopsy or targeted axillary dissection) had not been systematically recorded and could not be analyzed; this is addressed in the Limitations.

Outcomes before and after the programme are summarized in *Table 2*. Total limb circumference decreased from a median of 160.75 cm to 152.50 cm, a median reduction of 8.50 cm (95% CI: 6.50–11.50; $p < 0.001$; $r = 0.862$). Pain intensity decreased from a median of 6 to 1 point on the NRS (median reduction 5 points; 95% CI: 4.50–5.50; $p < 0.001$; $r = 0.877$), a change exceeding the 2-point minimal clinically important difference conventionally accepted for this scale. The proportion of patients with a normal HADS-A level rose from 29.6% to 63.0%, and with a normal HADS-D level from 24.1% to 74.1% (both $p < 0.001$; $r = 0.811$ and $r = 0.780$ respectively). Effect sizes were high ($r > 0.5$) for all four endpoints. The distribution of HADS categories before and after the programme is shown in *Fig. 1*.

Within-subgroup analyses showed statistically significant improvement in all four endpoints in every subgroup examined — both age groups, both lymphedema stages, all BMI categories and patients with and without diabetes (all $p < 0.001$, all effect sizes high, $r = 0.76$–0.93).

Baseline values differed across subgroups (*Table 3*), which is relevant to the interpretation of the between-subgroup comparisons below. In particular, patients with stage 2 lymphedema had a higher baseline limb circumference and pain than those with stage 1, and patients with diabetes had a substantially higher baseline psycho-emotional burden than those without (abnormal HADS-A 93.3% vs 61.5%; abnormal HADS-D 100% vs 66.7%). Greater absolute improvement in these subgroups may therefore partly reflect a higher

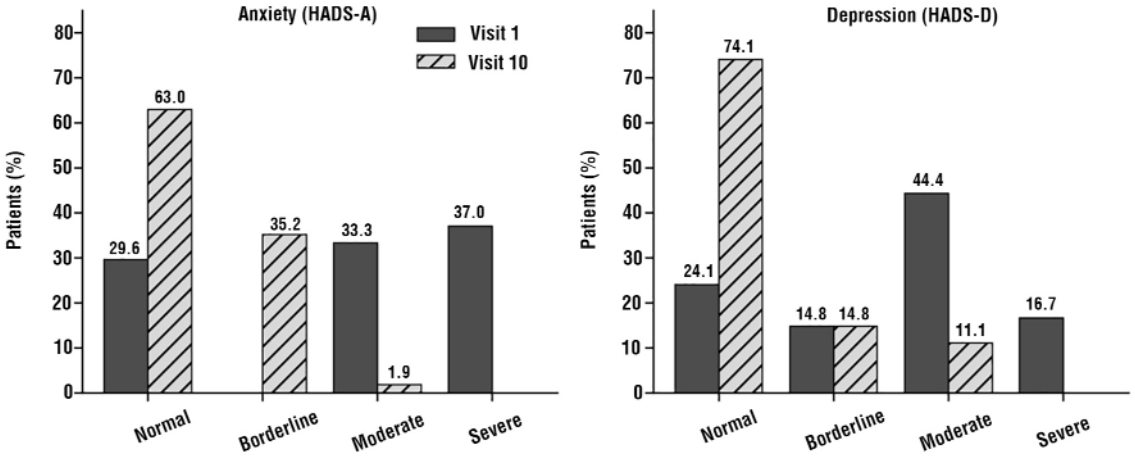


Figure 1. Distribution of Hospital Anxiety and Depression Scale categories at Visit 1 and Visit 10 (n = 54).

Table 3. Baseline values by subgroup

Subgroup	n	Circumference T0, cm median (IQR)	Pain T0, NRS median (IQR)	Abnormal HADS-A at V.1, %	Abnormal HADS-D at V.1, %
Stage 1	34	154.0 (134.6–174.1)	6.0 (5.0–7.0)	64.7	70.6
Stage 2	14	167.0 (155.6–176.1)	7.0 (7.0–7.8)	78.6	85.7
Stage 3	6	250.0 (249.0–255.5)	5.5 (5.0–7.5)	83.3	83.3
Age 55 years	24	142.0 (126.2–167.5)	6.5 (5.8–8.0)	70.8	75.0
Age > 55 years	30	172.5 (154.2–178.5)	6.0 (5.0–7.0)	70.0	76.7
Normal weight	8	160.0 (134.9–175.5)	5.5 (5.0–8.0)	75.0	75.0
Overweight	29	154.0 (139.0–176.5)	6.0 (6.0–7.0)	69.0	79.3
Obesity	16	168.5 (147.6–196.5)	6.0 (5.0–7.0)	68.8	68.8
Diabetes: yes	15	161.0 (149.0–184.0)	6.0 (5.0–7.0)	93.3	100.0
Diabetes: no	39	160.5 (138.8–176.8)	6.0 (6.0–8.0)	61.5	66.7

IQR: interquartile range; NRS: Numerical Rating Scale; HADS: Hospital Anxiety and Depression Scale; V.1: Visit 1. An abnormal HADS level denotes any category other than Normal. Stage 3 patients were excluded from between-stage inferential comparisons because of the small subgroup size (n = 6), but were included in all whole-group analyses.

starting point and regression to the mean rather than a differential treatment effect.

Comparisons of the magnitude of change between subgroups are presented in *Table 4*. No differences were detected between age categories or between BMI categories for any endpoint. By contrast, the reduction in total circumference was significantly greater in stage 2 than in stage 1 lymphedema (median 11.75 cm vs. 6.00 cm; U = 71.0, p < 0.001, r_rb = 0.702), as was pain relief (U = 152.0, p = 0.044, r_rb = 0.361), whereas the reductions in anxiety and depression did not differ by stage. Patients with diabetes showed a significantly greater reduction in anxiety (U = 410.5, p = 0.007, r_rb = −0.403) and depression (U = 406.0, p = 0.021, r_rb = −0.388) than patients without diabetes, while the changes in circumference and pain did not differ between these groups.

Discussion

In this consecutive cohort of 54 women with lymphedema following treatment for breast cancer, completion of a ten-session decongestive physical therapy programme was associated with statistically significant short-term changes in limb circumference, pain, anxiety and depression, with high effect sizes throughout. The reduction in circumference and pain was greater in stage 2 than in stage 1 lymphedema.

The magnitude and direction of the changes we observed are concordant with the published literature. Tunay et al., in 40 elderly breast cancer patients, reported the effectiveness of a multidimensional physiotherapy programme in relieving pain (21), and the review of systematic reviews by Gilchrist et al. concluded that CDT is the standard of care and that larger volume reductions are obtained in later-stage

Table 4. Magnitude of change compared between subgroups (exploratory analyses).

Comparison	Endpoint	Test statistic	p	Effect size	Effect
Age ≤ 55 vs. > 55 years					
(n = 24 vs. 30; Mann-Whitney U)	Circumference	U = 337.0	0.695	r_rb = 0.064	low
	Pain relief	U = 381.5	0.705	r_rb = −0.060	low
	Anxiety	U = 389.5	0.547	r_rb = −0.082	low
	Depression	U = 379.0	0.733	r_rb = −0.053	low
Stage 1 vs. stage 2					
(n = 34 vs. 14; Mann-Whitney U)	Circumference	U = 71.0	< 0.001	r_rb = 0.702	high
	Pain relief	U = 152.0	0.044	r_rb = 0.361	moderate
	Anxiety	U = 227.0	0.776	r_rb = 0.046	low
	Depression	U = 202.5	0.398	r_rb = 0.149	low
BMI category					
(n = 53; Kruskal-Wallis H)	Circumference	H = 4.30 (df 2)	0.116	η^2 = 0.046	low
	Pain relief	H = 0.66 (df 2)	0.717	η^2 = 0.000	low
	Anxiety	H = 0.88 (df 2)	0.643	η^2 = 0.000	low
	Depression	H = 0.20 (df 2)	0.905	η^2 = 0.000	low
Diabetes vs. no diabetes					
(n = 15 vs. 39; Mann-Whitney U)	Circumference	U = 288.5	0.946	r_rb = 0.014	low
	Pain relief	U = 211.0	0.105	r_rb = 0.279	low
	Anxiety	U = 410.5	0.007	r_rb = −0.403	moderate
	Depression	U = 406.0	0.021	r_rb = −0.388	moderate

Stage 3 patients (n = 6) were excluded from the stage comparison and the single underweight patient from the BMI comparison, as these groups were too small for analysis; both were included in all whole-group analyses. Analyses were exploratory and were not adjusted for multiple comparisons.

lymphedema (15) — an observation that our stage 2 versus stage 1 comparison mirrors. The most plausible explanation for this gradient is arithmetic rather than biological: a limb with a greater initial excess offers greater scope for reduction. Atalay et al., in 58 patients undergoing CDT, demonstrated a significant reduction in depression with a positive correlation between arm circumference and depression score (22), and Abbasi et al. showed that relaxation techniques added to CDT further reduced anxiety and depression (23). Our results are consistent with both.

The burden that BCRL imposes is not confined to swelling. Amaden et al., in 327 women with breast cancer and pain, found that the 85 women with lymphedema reported greater pain severity and a reduced ability to perform moderate activities of daily living than women without lymphedema (24). Ge et al., in 1,613 patients operated for breast cancer, observed anxiety in 31% and depression in 21% of those with acute lymphedema (25), and Alcorso and Sherman identified body image disturbance as a driver of psychological distress, particularly in older women (26). In our cohort the baseline psycho-emotional burden was comparable: 70.4% of patients had an abnormal HADS-A level and 75.9% an abnormal HADS-D level at the first visit. This is a finding that the surgical team is unlikely to encounter in routine follow-up, since postoperative review rarely includes a formal psychometric assessment.

A greater psycho-emotional improvement was observed in the subgroup of patients with diabetes, but this result should be interpreted as circumstantial (27). The subgroup was small (n = 15), the analysis was exploratory and unadjusted for multiple comparisons, and these patients had a substantially higher baseline burden (abnormal HADS-D 100% vs 66.7%), so the larger apparent change is compatible with regression to the mean. We therefore do not present it as a conclusion. Obesity is an established, potentially modifiable risk factor for BCRL (28), and although 83.3% of our patients were overweight or obese, BMI category did not influence the magnitude of change in any endpoint.

Implications for the Surgical Team

Three observations bear on surgical practice. First, patients with more advanced lymphedema showed the largest reductions in circumference and pain; these findings suggest that established lymphedema should not, by itself, be considered a reason to preclude referral for decongestive therapy. Second, pain and psycho-emotional distress improved independently of lymphedema stage, of age and of BMI, and were severe at baseline in a majority of patients. Postoperative surveillance restricted to limb measurement alone may therefore underestimate the burden borne by the patient, and a brief symptom and distress enquiry adds information that circumference does not capture. Taken together with the continuing de-escalation of axillary surgery (13) and with the evidence supporting prospective surveillance (14) and early-intervention programmes (29,30), these observations suggest that the postoperative pathway of the breast unit may reasonably be considered to include a baseline pre-operative measurement of limb circumference and early referral at the first sign of swelling, pain or distress. Because the type of axillary procedure was not recorded in this cohort, we do not draw conclusions about its relationship to the response observed.

Limitations

The principal limitation is the single-arm design. In the absence of a control group, of randomization and of blinding, the observed changes cannot be attributed causally to the intervention: regression to the mean, the natural history of recently diagnosed lymphedema, concurrent compression, and the non-specific effects of ten supervised therapist contacts may all have contributed, and the self-reported endpoints are susceptible to expectation effects in an unblinded setting. Four additional limitations should be acknowledged. First, the type of axillary surgery (ALND, sentinel lymph node biopsy or targeted axillary dissection) was not recorded, so the results cannot be stratified by the surgical variable of greatest interest to the operating surgeon; only radiotherapy, chemotherapy and endocrine therapy exposure were available, and these are reported descriptively. Second, the primary endpoint is a summed linear measure of the affected limb; the contralateral limb was not measured, so neither excess volume nor a percentage inter-limb difference could be computed, which limits external comparability. Third, the HADS was recorded only as severity categories, the continuous 0–21 subscale scores were not retained, and a continuous reanalysis was therefore not possible. Fourth, the subgroup analyses were exploratory, unadjusted for multiple comparisons and based on small groups — in particular the diabetes subgroup (n = 15), whose findings must be read as hypothesis-generating and are confounded by a markedly higher baseline burden (*Table 4*). The study was also single-centre, registered only retrospectively, and included no follow-up beyond Visit 10, so the durability of the changes is unknown and firm clinical recommendations cannot be based on so short an interval. Addressing the surgical

stratification prospectively is the primary aim of the continuation of this project during 2026.

Conclusions

Breast cancer-related lymphedema is a frequent and durable complication of axillary surgery, and its burden extends well beyond limb swelling. In this uncontrolled prospective cohort, completion of a ten-session programme of decongestive physical therapy was associated with significant reductions in limb circumference, pain, anxiety and depression, with large effect sizes and irrespective of age or BMI. The absence of a control arm means that these changes cannot be attributed causally to the intervention, and the findings should be regarded as supportive rather than confirmatory.

The results nonetheless indicate that patients with more advanced lymphedema are unlikely to be poor candidates for referral, and that psycho-emotional distress is common and largely invisible to circumference-based follow-up. The postoperative pathway of the breast surgery unit may therefore reasonably be considered to include a baseline limb measurement, a brief assessment of pain and distress, and prompt referral for decongestive therapy. Randomized, controlled and adequately powered studies are required to establish the causal contribution of physical therapy itself. Because no assessment was made beyond the tenth session, the durability of these changes remains unknown, and clinical recommendations should remain correspondingly cautious.

Conflicts of Interest

The authors declare no conflict of interest.

Funding

The project on the rehabilitation of cancer patients and patients with secondary lymphedema, within which this study was conducted, was supported by the Administration of Hospitals and Medical Facilities in Bucharest (ASSMB). The funder had no role in the design of the study, in the collection, analysis or interpretation of the data, in the writing of the manuscript, or in the decision to submit it for publication. No additional external funding was received.

Trial Registration

Registered retrospectively on the Open Science Framework (OSF), DOI: 10.17605/OSF.IO/PNFHB.

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