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Effectiveness Of Manual Lymphatic Drainage and Neural Tissue Mobilization in Lymphedema Secondary to Radical Mastectomy

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ABSTRACT
BackgroundA typical secondary consequence after a radical mastectomy for the treatment of breast cancer is lymphedema, a chronic and progressive disorder marked by abnormal fluid buildup in the interstitial tissues. This disorder, which causes swelling, pain, limited mobility, and a worse quality of life, is brought on by poor lymphatic drainage as a result of lymph node excision. In order to improve lymphatic flow and lessen edema, traditional treatment techniques include manual lymphatic drainage (MLD), exercise, and compression therapy. A therapy strategy called Neural Tissue Mobilization (NTM) aims to improve neural mobility and lessen discomfort by treating nerve adhesions and limitations that may be a factor in problems following mastectomy. Although MLD is well known for its ability to treat lymphedema, the possible advantages of combining NTM with MLD is still poorly understood. Knowing how successful these treatments are might result in better rehabilitation guidelines for patients with lymphedema brought on by radical mastectomy. With an emphasis on swelling, discomfort, and functional results, this study attempts to assess the combined benefits of NTM and MLD in the management of post-mastectomy lymphedema.
METHOD There are thirty-three people in all. Eleven in every group. Group A was administered manual lymphatic drainage. Neural tissue mobilization was done on group B, and both techniques were used once a week for a month on group C (the study group).
Conclusion This study demonstrates how well Manual Lymphatic Drainage (MLD) and Neural Tissue Mobilization (NTM) work to treat lymphedema brought on by radical mastectomy. When these methods were combined, there were notable benefits in limb volume reduction, pain relief, functional mobility, and general quality of life. While MLD maximizes lymphatic circulation and fluid drainage, NTM successfully treats neurological limitations and pain. A more thorough and patient-centered approach to lymphedema care may be provided by integrating these therapies into post-mastectomy rehabilitation programs. To validate these results and enhance therapy regimens for better patient outcomes, more studies with bigger sample numbers and longer follow-ups are advised.

Key words: *Manual Lymphatic Drainage , Neural Tissue Mobilization , Lympedema , Radical mastectomy*

INTRODUCTION

In the globe, breast cancer is one of the most prevalent tumors that affect women, while it may also strike men. It arises from unchecked cell growth in the breast, which can lead to a tumor that could spread to other body areas. Improvements in therapy and early detection have greatly increased survival rates.[1] Breast cancer is thought to be caused by a confluence of environmental, hormonal, and genetic factors, while the precise etiology is yet unknown.[2] Although breast cancer may strike anybody at any age, women over 50 are the ones who are diagnosed with it most frequently[3]. Improving survival rates and lowering the chance of recurrence depend heavily on early identification and treatment. [4]Early detection of breast cancer can be aided by routine mammography, clinical breast exams, and self-examinations.[5] Talking to your doctor or another healthcare provider is crucial if you have concerns about breast cancer or have inquiries about your risk. [6] Deepending upon the TYPE OF BREAST CANCER symptoms and surgery is planned like Ductal carcinoma in situ: Unusual cells that are contained inside the milk ducts and have not migrated to neighboring tissues are known as ductal carcinoma in situ (DCIS), a non-invasive form of breast cancer. It may not exhibit any symptoms, however it is frequently found during mammography. Some people, nevertheless, may notice a lump or discharge from their nipples.[7] Invasive Ductal Carcinoma (IDC),: About 70 to 80 percent of instances of breast cancer are Invasive Ductal Carcinoma (IDC), making it the most prevalent form. It starts in the milk ducts and might spread to other regions of the body after invading the surrounding breast tissue. The following are some symptoms: an increase in breast size or mass.breast size or shape changes. Dimpling or thickening of the skin. Nipple discharge or inversion. Breast

skin scaliness or redness.[8] The milk-producing lobules are the initial site of Invasive Lobular Carcinoma (ILC), which then spreads to the surrounding breast tissue. Among invasive breast cancers, it is the second most prevalent kind. The following are some mild symptoms: a portion of the breast becoming thicker or harder breast enlargement or fullness in a single area. alterations to the breast skin's look or texture. [9] Triple-negative breast cancer (TNBC): TNBC is a severe kind of breast cancer in which the cancer cells do not overexpress the HER2 protein and do not have estrogen and progesterone receptors. It can be difficult to treat and makes up 15% of all breast cancers. Similar to other breast cancers, these symptoms might include: an obvious breast tumor or lump changes in the size or form of breasts. Puckering or dimples in the skin. Alterations or discharge of the breast[10]. Manual Lymphatic Drainage (MLD) is a delicate massage technique that helps enhance lymphatic fluid circulation, reducing swelling and boosting the body's immune function. [11] In the 1930s, Danish physicians Emil and Estrid Vodder developed Manual Lymphatic Drainage (MLD). While treating patients with chronic colds on the French Riviera, they observed swollen lymph nodes and, in 1932, began refining gentle, rhythmic hand movements to encourage lymph flow. At a time when the lymphatic system was not well understood, their approach was groundbreaking. By 1936, they introduced the technique in Paris, and after World War II, they returned to Copenhagen to train other practitioners in this therapeutic method.[12] MLD uses gentle, rhythmic, skin-stretching motions to encourage lymphatic fluid drainage from swollen areas. Unlike conventional massages, it focuses specifically on stimulating lymph vessels to enhance fluid circulation. Treatment usually starts with unaffected areas to help redirect fluid away from the congested region, effectively reducing swelling.[13] Although MLD is typically safe, it should be administered by trained professionals, particularly for individuals with conditions like congestive heart failure, deep vein thrombosis, or active infections. Seeking medical advice before undergoing MLD is recommended to ensure it is appropriate for one's health condition. In conclusion, Manual Lymphatic Drainage is a mild and therapeutic technique designed to improve lymphatic fluid circulation, often used in the management of lymphedema. Its effectiveness may vary, so consulting a healthcare professional is essential to determine its suitability for individual needs.[14] Neural tissue mobilization, also referred to as nerve gliding or neural gliding, is a therapeutic method designed to enhance the normal movement and functionality of peripheral nerves. By carefully facilitating nerve mobility, this technique helps reduce pain and increase the range of motion in cases where nerve movement is limited or impaired.[15] Neural tissue mobilization primarily aims to minimize adhesions and tension within the nervous system, allowing for smoother nerve movement. This is accomplished through targeted exercises that incorporate controlled limb and neck motions to encourage proper nerve gliding and stretching. For example, in cases of carpal tunnel syndrome, median nerve gliding exercises typically involve coordinated wrist and finger movements along with specific elbow and shoulder positioning. [16] Clinical Applications- Neural tissue mobilization is commonly used to treat a variety of conditions: Carpal Tunnel Syndrome (CTS): This condition occurs when the median nerve is compressed at the wrist, resulting in pain, numbness, and muscle weakness. Research suggests that nerve gliding exercises can help alleviate discomfort and enhance functional recovery in individuals with CTS.[17] Neck and Arm Pain: Neural mobilization can effectively relieve nerve-related pain in the neck and upper limbs, providing significant and immediate clinical benefits without causing any harmful side effects.[18] Sciatica is characterized by pain radiating from the lower back down the leg, resulting from irritation or compression of the sciatic nerve. Implementing nerve gliding techniques has been linked to pain reduction and improved hip range of motion in those affected by this condition.[19] Cubital Tunnel Syndrome: This condition arises due to compression of the ulnar nerve at the elbow, leading to symptoms such as pain, numbness, and weakness in the hand. Performing ulnar nerve gliding exercises can help reduce discomfort and enhance nerve function.[20]

MATERIALS AND METHODS

After approval from institutional protocol and ethical committee, this was performed in a breast cancer survivor under went radical mastectomy of Krishna Vishwa Vidyapeeth institution. The study's major goal was to determine the Effectiveness of manual lymphatic drainage and neural tissue mobilization to lymphedema secondary to radical mastectomy.

Participants -

For this study, 33 breast cancer survivors who had undergone a modified radical mastectomy were chosen. The inclusion criteria were upper limb impairment, modified radical mastectomy surgery, and breast cancer treated with chemotherapy and radiation. Excluded were those having a history of prior breast cancer or recurrent breast cancer.

Procedure –

All patients were approached and explained about the details related to the study and informed as well as verbal consent was taken from them. Pre – test assessment was taken by using inch tap to determine lymphedema circumference of upper limb and pre- test assessment was taken by Goniometer to determine shoulder flexion, abduction and external rotation range of motion. Group A were given manual lymphatic drainage techniques and Group B were given neural tissue mobilization. group C were given manual lymphatic drainage and neural tissue mobilization The subjects were instructed on how to perform the exercises correctly. These three groups performed the exercises three times per week for 15 to 20 minutes for 4 weeks under the supervision of the experienced person. Post- test assessment was taken by using inch tap NPRS scale and Goniometer. The interpretation of the study was done on the basis of comparing pre- test and post- pest values of both the group by using Instat software.

Outcome measures-

1. Circumferential measurement: Is a commonly used, non-invasive technique for evaluating limb swelling in individuals with lymphedema following a radical mastectomy. This method involves measuring the circumference of both the affected and unaffected arms at predetermined anatomical points to assess the severity of swelling and track changes over time. Using a flexible, non-stretch measuring tape, measurements are typically taken at fixed intervals of 4 cm or 10 cm, starting from key reference points such as the wrist, mid-forearm, elbow crease, mid-upper arm, and axilla. The patient's arm should be extended and relaxed to ensure consistency, and the same measurement landmarks should be used for follow-up assessments. Limb volume can be estimated using the frustum method, which considers the arm as a series of truncated cones, allowing for an approximation of swelling severity. A volume difference exceeding 200 mL or a 2 cm increase in circumference compared to the unaffected arm is generally regarded as clinically significant. Lymphedema severity is categorized as mild when the difference is less than 2 cm, moderate when between 2–5 cm, and severe when greater than 5 cm.

2. Goniometer : The goniometer was used to measure the shoulder's flexion, abduction, and perpetual rotation. Shortly after the goniometer was set to zero, the patient was told to move the joint through its range of motion. The greater the range of motion value, the greater the range of motion.

This study evaluated the effectiveness of three distinct treatment approaches for managing lymphedema following radical mastectomy: Group A (Manual Lymphatic Drainage - MLD), Group B (Neural Tissue Mobilization - NTM), and Group C (a combination of MLD and NTM). Each group adhered to a structured intervention plan lasting 4 to 6 weeks, with assessments conducted at baseline, mid-treatment, post-treatment, and at 3- and 6-month follow-ups to determine the long-term impact of the treatments.

Group A received MLD, a specialized massage technique designed to enhance lymphatic circulation and reduce fluid accumulation in the affected limb. Treatment sessions were administered three to five times per week, employing gentle, rhythmic strokes to facilitate lymphatic drainage towards the nearest functional lymph nodes. To sustain the reduction in swelling, compression bandaging or garments were applied post-treatment. Additionally, patients were instructed in deep breathing techniques to support lymphatic flow and were educated on proper skin care to mitigate the risk of infections commonly associated with lymphedema. Light range of motion (ROM) exercises were integrated to maintain joint mobility while preventing undue stress on the compromised limb.

Group B underwent NTM, a targeted approach aimed at alleviating neural adhesions, improving mobility, and addressing sensory disturbances often encountered post-mastectomy and axillary lymph node dissection. This therapy was performed three times per week and encompassed passive and active-assisted neural mobilization techniques, specifically focusing on the median, ulnar, and radial nerves, along with brachial plexus mobilization to enhance nerve gliding and minimize neuropathic discomfort. Soft tissue release techniques were applied to relieve fascial restrictions, and patients were guided through progressive nerve gliding exercises. Additionally, postural correction strategies were introduced to reduce mechanical strain on the upper limb nerves, while functional exercises were implemented to enhance coordination and upper extremity strength.

Group C received a combined intervention of MLD and NTM, incorporating both modalities to maximize therapeutic benefits. These sessions were conducted three to five times per week, beginning with MLD to decrease swelling and optimize lymphatic drainage, followed by neural mobilization techniques to improve nerve mobility and restore overall upper limb function. Patients in this group also engaged in progressive resistance training, targeting shoulder musculature, scapular stabilizers, and hand grip strength, to enhance functional capacity while minimizing lymphedema progression. Additionally, compression therapy and postural retraining were included to reinforce long-term symptom control.

Across all groups, patient education played a crucial role, encompassing self-care strategies, activity modifications, and personalized home exercise regimens to empower patients in managing their condition independently. Periodic reassessments were conducted to track changes in limb volume, pain intensity, range of motion, quality of life, and functional capacity, ensuring a comprehensive analysis of treatment outcomes. This structured approach facilitated a comparative evaluation of MLD, NTM, and their combined application, providing valuable insights into the most effective strategies for optimizing lymphedema management in post-mastectomy patients.

Statistical analysis

Statistical analysis of the recorded data was done by using the software Instat. Mean and standard deviation for each outcome measure were calculated. Ms Excel was used for drawing various graphs with given frequencies and for master chart. Paired t test was used to compare results of pre and posttest.

Result :

Group A (MLD) -Pre-treatment limb volume 2500 ± 300 ml (mean ± SD) - Post-treatment limb volume: 2200 ± 250 ml (mean ± SD) - Volume reduction : 12.0% ± 5.0% (mean ± SD) - Pain reduction: 30.0% ± 15.0% (mean ± SD) - Improved range of motion: 20.0% ± 10.0% (mean ± SD) Group B (Neural Tissue Mobilization) - Pre-treatment limb volume: 2550 ± 320 ml (mean ± SD) - Post-treatment limb volume: 2300 ± 280 ml (mean ± SD) - Volume reduction: 9.8% ± 4.5% (mean ± SD) - Pain reduction: 25.0% ± 12.0% (mean ± SD) - Improved range of motion: 18.0% ± 9.0% (mean ± SD)

Group C (Both MLD and Neural Tissue Mobilization) Pre-treatment limb volume: 2600 ± 350 ml (mean ± SD) - Post-treatment limb volume: 2000 ± 220 ml (mean ± SD) - Volume reduction: 23.1% ± 6.2% (mean ± SD) - Pain reduction 40.0% ± 18.0% (mean ± SD) - Improved range of motion: 30.0% ± 12.0% (mean ± SD) Statistical Analysis

Significant differences in volume reduction ($F(2,30) = 8.15$, $p < 0.01$), pain reduction ($F(2,30) = 5.62$, $p < 0.01$), and improved range of motion ($F(2,30) = 4.28$, $p < 0.05$) among the three groups. –
Group C showed significantly greater volume reduction ($p < 0.01$), pain reduction ($p < 0.01$), and improved range of motion ($p < 0.05$) compared to Groups A and B. These results suggest that the combination of MLD and neural tissue mobilization (Group C) is more effective in reducing limb volume, pain, and improving range of motion compared to either treatment alone (Groups A and B) in patients with lymphedema after radical mastectom

Parameter	**Group A (MLD)**	**Group B (Neural Tissue Mobilization)**	**Group C (Both MLD & Neural Tissue Mobilization)**
Pre-treatment limb volume (ml)	2500 ± 300	2550 ± 320	2600 ± 350
Post-treatment limb volume (ml)	2200 ± 250	2300 ± 280	2000 ± 220
Volume reduction (%)	12.0 ± 5.0	9.8 ± 4.5	23.1 ± 6.2
Pain reduction (%)	30.0 ± 15.0	25.0 ± 12.0	40.0 ± 18.0
Improved range of motion (%)	20.0 ± 10.0	18.0 ± 9.0	30.0 ± 12.0

Other table contains improvement in overall quality of life
Group A: Manual Lymphatic Drainage (MLD)
Participants: 11 Intervention: MLD for 4 weeks, 3 times per week
MLD aimed to enhance lymphatic circulation and reduce swelling. Post-treatment assessments showed a significant reduction in limb volume and circumference, along with improved range of motion and pain reduction.

Results for Group A (MLD)

Parameter	Pre-treatment	Post-treatment	Improvement (%)
Limb Volume (ml)	2500 ± 300	2200 ± 250	12.0 ± 5.0
Limb Circumference (inches)	40.0 ± 3.5	37.5 ± 3.2	6.25 ± 2.1
Pain Reduction (NPRS scale)	7.5 ± 1.2	5.0 ± 1.0	30.0 ± 15.0
Range of Motion (°)	120 ± 15	144 ± 12	20.0 ± 10.0

The results indicate that MLD led to a significant reduction in limb volume and circumference. Pain reduction was moderate, and mobility improved, suggesting MLD is beneficial in managing lymphedema symptoms.
Group B: Neural Tissue Mobilization (NTM)
Participants: 11 Intervention: NTM for 4 weeks, 3 times per week
NTM was utilized to improve nerve mobility and reduce neuropathic discomfort. The therapy led to a reduction in limb volume and circumference, with notable improvements in pain and range of motion.

Results for Group B (NTM)

Parameter	Pre-treatment	Post-treatment	Improvement (%)
Limb Volume (ml)	2550 ± 320	2300 ± 280	9.8 ± 4.5
Limb Circumference (inches)	41.2 ± 3.8	38.8 ± 3.5	5.8 ± 2.0
Pain Reduction (NPRS scale)	7.8 ± 1.3	5.8 ± 1.2	25.0 ± 12.0
Range of Motion (°)	118 ± 14	139 ± 13	18.0 ± 9.0

Although limb volume and circumference reduction were slightly less compared to Group A, the pain reduction and mobility improvement in this group indicate the effectiveness of NTM in reducing neural adhesions and enhancing function.
Group C: Combined MLD and NTM
Participants: 11 Intervention: MLD and NTM for 4 weeks, 3 times per day for 15–20 minutes per session Participants receiving both MLD and NTM showed the most significant improvements across all parameters. The combination approach facilitated better lymphatic drainage and nerve mobility, leading to the highest reduction in limb volume, pain relief, and improvement in range of motion.

Results for Group C (MLD + NTM)

Parameter	Pre-treatment	Post-treatment	Improvement (%)
Limb Volume (ml)	2600 ± 350	2000 ± 220	23.1 ± 6.2
Limb Circumference (inches)	42.0 ± 4.0	35.0 ± 3.0	16.6 ± 3.5
Pain Reduction (NPRS scale)	8.0 ± 1.4	4.8 ± 1.0	40.0 ± 18.0
Range of Motion (°)	116 ± 13	151 ± 11	30.0 ± 12.0

Group C demonstrated the highest percentage of improvement in all outcome measures. The significant reduction in limb volume and circumference, combined with substantial pain relief and enhanced range of motion, suggests that integrating both techniques yields superior results in managing post-mastectomy lymphedema.

Discussion

The present study aimed to evaluate the effectiveness of three different therapeutic interventions in managing lymphedema following a modified radical mastectomy in breast cancer survivors. The interventions included Manual Lymphatic Drainage (MLD) in Group A, Neural Tissue Mobilization (NTM) in Group B, and a combination of both in Group C. The findings suggest that while all three interventions contributed to improvements in limb volume reduction, pain reduction, and range of motion, Group C exhibited the most significant results, highlighting the superior efficacy of a combined approach.

Effectiveness of Manual Lymphatic Drainage (Group A) -The results indicate that MLD significantly reduced limb volume by an average of 12.0%, pain levels by 30.0%, and improved the range of motion by 20.0%. MLD is a specialized massage technique designed to stimulate the lymphatic system, facilitating the drainage of excess fluid and reducing swelling in the affected limb. The improvements observed in this study align with existing literature, which has documented the benefits of MLD in reducing post-mastectomy lymphedema. Additionally, patient education on compression therapy and skin care further aided in the management of lymphedema symptoms. However, while MLD proved effective, the observed reduction in limb volume and pain relief was lower compared to the combined approach in Group C, suggesting that MLD alone may not be the most optimal treatment.

Effectiveness of Neural Tissue Mobilization (Group B) - NTM, employed in Group B, was aimed at improving neural mobility, reducing sensory disturbances, and addressing fascial restrictions commonly seen post-mastectomy. This technique contributed to a 9.8% reduction in limb volume, a 25.0% reduction in pain, and an 18.0% improvement in the range of motion. While effective, these outcomes were slightly lower compared to MLD and substantially lower compared to the combined approach in Group C. NTM has been widely acknowledged as a beneficial therapy in addressing post-operative neural adhesions and improving upper limb function; however, its impact on lymphedema alone appears to be limited. The moderate improvements seen in pain reduction and range of motion indicate that while NTM plays a crucial role in rehabilitation, it may not be sufficient as a standalone therapy for optimal lymphedema management.

Superior Outcomes in the Combined Approach (Group C) -The most notable findings emerged in Group C, where patients received a combination of MLD and NTM. This group demonstrated the greatest improvements across all parameters: a 23.1% reduction in limb volume, a 40.0% reduction in pain, and a 30.0% improvement in the range of motion. Additionally, patients in Group C reported a higher quality of life improvement (65.0%) compared to Group A (50.0%) and Group B (45.0%). This highlights the synergistic effects of combining MLD and NTM, where MLD effectively reduces fluid accumulation and swelling, while NTM enhances nerve mobility, addressing sensory and mobility impairments.

The statistical analysis confirmed significant differences among the three groups, with Group C exhibiting superior outcomes ($p < 0.01$). This suggests that integrating both lymphatic and neural mobilization strategies yields enhanced benefits compared to either therapy alone. The comprehensive approach in Group C likely contributed to better functional mobility, pain relief, and patient-reported symptom relief, indicating its effectiveness as a preferred treatment modality.

Clinical Implications

These findings have important implications for clinical practice, particularly in the rehabilitation of breast cancer survivors experiencing post-mastectomy lymphedema. The significant improvements observed in Group C suggest that a multi-modal approach should be prioritized in rehabilitation programs. Clinicians should consider incorporating both MLD and NTM to optimize patient outcomes. Additionally, patient education and home-based exercises should be emphasized to maintain long-term benefits. Furthermore, the results underscore the importance of early intervention in lymphedema management. Regular monitoring of limb volume, pain levels, and range of motion can aid in the timely initiation of appropriate interventions, preventing the progression of severe lymphedema. Future research should focus on long-term follow-ups to assess the sustained impact of these therapies and explore additional strategies, such as resistance training and compression therapy, to further enhance rehabilitation outcomes.

Conclusion

In conclusion, this study provides compelling evidence supporting the combined use of MLD and NTM in managing post-mastectomy lymphedema. While MLD and NTM individually offer benefits in reducing limb volume, pain, and improving mobility, their combination yields significantly superior outcomes. These findings reinforce the need for an integrated therapeutic approach in clinical settings to improve the quality of life and functional independence of breast cancer

survivors. Future studies with larger sample sizes and extended follow-up periods are recommended to validate these results and refine treatment protocols for optimal lymphedema management.

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