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Comparative Study of Myofascial Release Vs Tens in Reducing Shoulder Pain and Improving Function in Post Mastectomy in Cancer Patients

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Abstract

BACKGROUND: Breast cancer is the most diagnosed malignancy in women globally. While mastectomy is an effective procedure for achieving oncological control and it often leads to post operative side effects such as shoulder pain, upper extremity dysfunction on operated side. These deficits frequently result in pain, loss of shoulder function and ROM, myofascial adhesions.

OBJECTIVE: To compare the effectiveness of Myofascial release and Transcutaneous electrical nerve stimulation in improving pain levels, shoulder mobility and functional outcomes in post mastectomy breast cancer patients.

METHODOLOGY: A comparative study was conducted at the oncology department of king George hospital. The study was conducted on 30 participants, only women aged 30 – 60 years diagnosed with breast cancer who underwent unilateral radical mastectomy. Patients were randomly divided into 2 equal groups (GROUP A) MFR Group and (GROUP B) TENS Group. Both groups receiving standard physical therapy. Each patient must complete a 4- week protocol after enrollment in the study. Examination is performed on Day 1 at base line and then last day of week 4.

RESULTS: The difference in the outcome measures in MFR Group is ROM and DASH significant with p value of $p < 0.01$ and NPRS is considered significant with p value of $p < 0.01$. There was a statistical significance in ROM, DASH, and NPRS $P < 0.01$ in both groups after treating with MFR and TENS respectively.

CONCLUSION: The study concludes MFR improves shoulder mobility and function and TENS gives better result in pain reduction. Combining these techniques with a physiotherapy program that has clear structure may benefit individuals with breast cancer in post mastectomy condition.

KEYWORDS: Post Mastectomy, Myofascial Release, Transcutaneous Electrical Nerve Stimulation, Numerical Pain Rating Scale, Range Of Motion, Disability Of Arm Shoulder And Hand Score.

INTRODUCTION

Breast cancer ranks as the most prevalent malignancy diagnosed in women globally, posing a substantial health challenge despite advancements in screening, diagnosis, and various treatment modalities. It contributes significantly to cancer-related morbidity and mortality, particularly in low- to middle-income nations where late-stage presentations and limited access to rehabilitation services are persistent issues.[1],[2]

The treatment of breast cancer typically encompasses surgery, chemotherapy, radiotherapy, or hormonal and targeted therapies tailored to the tumour's stage and biological traits. Among these options, surgery especially modified radical mastectomy remains a primary method for local control of the disease.[3],[4] Nonetheless, while mastectomy effectively secures oncological outcomes, it is accompanied by potential post-operative complications that can profoundly impact both the physical and psychological well-being of patients. Commonly reported issues following mastectomy include shoulder pain on the operated side or dysfunction in the upper extremity.[5]–[7] These conditions are often characterized by pain, reduced range of motion, myofascial adhesions, altered body posture, and restricted capacity for daily activities all of which can lead to decreased quality of life and long-term disabilities if left unaddressed.[8]–[10] Post-mastectomy shoulder complications arise from multiple factors including surgical trauma, soft tissue injury, nerve damage, scar formation, and reduced post-operative activity levels.[11],[12] The surgical removal of breast tissue along with axillary lymph nodes modifies shoulder girdle biomechanics leading to increased fibrosis and contraction of fascial muscles alongside changes in scapulothoracic mechanics.[13],[14] Scar tissue and fascial adhesions reduce tissue elasticity and hinder smooth gliding movements within the shoulder joint, resulting in discomfort.[15] If early disuse occurs in the affected upper limb following surgery, muscle weakness along with joint stiffness may increase over time leading to chronic functional limitations.[16],[17]

Pain associated with mastectomy is complex; it can originate from nociceptive or neuropathic sources.[18] Nociceptive pain is typically linked to tissue damage as well as inflammatory and mechanical alterations within muscles and connective tissues during surgical procedures.[19] Damage to peripheral nerves especially around the intercostobrachial nerve frequently impacted during axillary dissections can provoke neuropathic pain sensations.[20],[21] Without adequate management strategies in place, post-mastectomy pain alongside shoulder dysfunction may develop into chronic pain syndromes such as adhesive capsulitis along with posture-related changes that perpetuate upper-limb restrictions; this underlines the necessity for prompt and suitable rehabilitation therapy.[22],[23] Physiotherapy plays a crucial role in preventing, managing, and rehabilitating complications arising after mastectomy procedures. Initial physiotherapeutic interventions aim to alleviate discomfort while restoring shoulder mobility; they also seek to minimize subsequent musculoskeletal issues ensuring patients maintain functional independence.[24]–[26] Rehabilitation approaches post-mastectomy vary among physiotherapists ranging from therapeutic exercises to manual techniques such as electrotherapy combined with patient education efforts. However, determining which interventions or combinations thereof are most effective remains an area ripe for further clinical investigation.[27],[28]

Myofascial Release (MFR) represents one form of manual therapy aimed at addressing restrictions within the fascial system facilitating improvements in muscle mobility alongside pain reduction. Fascia comprises a connective tissue network throughout the body enveloping muscles as well as nerves among other structures essential for force transmission and movement efficiency; however postoperative alterations (like thickening or adhesion formation) may disrupt this balance affecting both mobility (potential loss of sensation) and increasing levels of discomfort.[29],[30] MFR involves applying sustained low-load manual pressure on restricted fascial tissues allowing for gradual elongation or release of adhesions over time through enhanced local circulation reduction in tissue stiffness while stimulating mechanoreceptors may also help modulate pain perception.[31]–[33]

Transcutaneous Electrical Nerve Stimulation (TENS) operates primarily based on the gate control theory of pain: it induces stimuli via larger diameter afferent nerve fibers thereby obstructing nociceptive signal

transmission at spinal cord levels while simultaneously promoting endogenous opioid release—including endorphins—and enkephalins that play roles in central modulation of pain experiences.[34–37].

Despite the available evidence indicating that both Myofascial Release (MFR) and Transcutaneous Electrical Nerve Stimulation (TENS) are effective individually in the rehabilitation process following mastectomy, there is a scarcity of studies directly comparing their relative effects. Most research to date has focused on these treatments separately, resulting in inadequate evidence regarding their comparative influence on shoulder pain, range of motion, and functional outcomes for the upper limb in breast cancer patients post-mastectomy. Consequently, conducting a comparative analysis of these therapies is crucial for informing evidence-based and patient-centered physiotherapy practices, ultimately enhancing rehabilitation approaches.

METHODOLOGY

This study was based on an experimental comparative study with the purpose of measuring the efficacy of Myofascial Release (MFR) and Transcutaneous Electrical Nerve Stimulation (TENS) in females after mastectomy for breast cancer who are suffering from shoulder pain and functional limitations. Research was performed over a period of twelve months in the Oncology and Physiotherapy Departments of King George Hospital. Thirty women (who had received a unilateral modified radical mastectomy 3 to 6 months ago) of the age of 30 and 65 years, and judged to be qualified for physiotherapy were sampled in a non-probability convenience sample. Recruitment criteria were limited to shoulder pain and restricted movement, and participants with a history of shoulder trauma or surgery, bone metastases affecting the shoulder area, neurological problems affecting the upper limb, skin infections or open wounds at the treatment site, implanted devices such as pacemakers, and cognitive changes were excluded from participation. Eligible subjects were grouped into a 15-member group:

Myofascial Release group (Group A), and Transcutaneous Electrical Nerve Stimulation group (Group B), which received ordinary physiotherapy. Before the interventions began, baseline evaluations were made and follow-up assessments completed at the conclusion of a four-week intervention. Participants in Group A were assigned to Myofascial Release therapy and once they received an expounding explanation of the procedure, each session was conducted in a serene setting. This intervention consisted of 4 sessions a week during four consecutive weeks, which each lasted approximately about ten minutes. MFR was performed with a light manual pressure that was within patient tolerance, considering the tissue sensitivity in postoperative post-mastectomy. Subjects were positioned either supine, side-lying, or seated during sessions when presented with muscle strength tests, with palpation on which muscle groups the fascial tightness was present. For specific muscles and structures, it was targeted as pectoralis major, pectoralis minor, subscapularis, upper trapezius, and levator scapulae. Patients were supine with shoulder slightly abducted for the manipulation of pectoralis major muscle after which a continuous push was applied towards the anterior chest wall, from medial to lateral, to create shoulder abduction. Patients had a pectoralis minor applied in a supine position with gentle downward and medial pressure near the coracoid process until fascial release could be felt for better scapular positioning. Treatments for subscapularis were performed in either supine or side-lying positions with slight abduction and external rotation of the shoulder; indirect gentle sustained pressure along its lateral border promoted release from deep fascial restriction. On upper trapezius treatment sessions the session consisted in sustained applied pressure on its length from cervical regions to acromion while sitting or reclining in supine position as well as gentle stretching manoeuvres to relieve muscle tightness and enhance scapular mobility. Levator scapulae

Treatment consisted of sitting with neck flexed in contralateral rotation and applying prolonged pressure along the muscle fibers to raise the shoulder. All therapy was carried out until the tissue resistance can be observed to be softened, and patient comfort and tissue response were monitored continuously. In Group B, participants underwent Transcutaneous Electrical Nerve Stimulation in a relaxed environment, explained clearly about this method as well. Like Group A's regimen, TENS treatments consisted of 4 sessions for four weeks with approximate duration of ten minutes per session, each time targeting pain modulation using the same conventional high-frequency TENS use methods used in this setting. Careful examination was taken prior to electrode placement, keeping skin clean over shoulders so that they could be used (conducted) followed by the positioning of participants either in supine or seated comfortably again, followed by the application of self-adhesive electrodes directly addressing pain causing pain, such as anterior/posterior deltoid fibres adjacent to upper trapezius/pectoralis major (based on pain distribution reported by patients as observed and controlled for), ensuring stimulation delivered at a consistent frequency around 100 Hz, a pulse width set at 100 microseconds throughout the therapy session, increasing intensity progressively to produce a comfortable state of tingling pain while allowing sufficient volume of effort as well as to maintain the degree of discomfort incurred (no active movements involving shoulder movements) during the therapy overall and keeping strict monitoring of response levels observed under electrodes.

OUTCOME MEASURES

In post-mastectomy breast cancer patients, validated assessment tools were utilized to evaluate pain intensity, shoulder joint mobility, and upper-limb functional ability as outcome measures. Pain intensity was quantified using the Numeric Pain Rating Scale (NPRS), where patients subjectively rated their shoulder pain on a scale from 0 (indicating no pain) to 10 (representing the worst possible pain), with lower scores reflecting a reduction in pain following the intervention. Shoulder joint mobility was measured using a universal goniometer that assessed active range of motion through flexion, extension, and abduction. The functional capability of the upper limbs was evaluated with the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, which is a standardized self-report tool; lower scores on this questionnaire signify improved functional status. All outcome measures were obtained at baseline prior to intervention and were re-administered after four weeks of treatment to assess the effects of Myofascial Release and Transcutaneous Electrical Nerve Stimulation.

STATISTICAL ANALYSIS :

Data were entered and analyzed using IBM SPSS Statistics version 31.0. Descriptive statistics including mean, standard deviation, frequency, and percentage were reported on demographic and baseline characteristics of the participants. The normality of the outcome variables was evaluated with the Shapiro–Wilk test applied to the difference scores (post–pre) within each group. Range of Motion (ROM) and Disabilities of the Arm, Shoulder and Hand (DASH) scores demonstrated normal distribution in both Myofascial Release (MFR) and Transcutaneous Electrical Nerve Stimulation (TENS) groups, and homogeneity of variances was identified using Levene's test. Consequently, paired t-tests assessed ROM and DASH scores before and after each treatment in each group and independent t-tests were conducted for differences between groups of these constructs. Since the Numeric Pain Rating Scale (NPRS) scores were not normally distributed, within-group comparisons were performed using the Wilcoxon signed-rank

test, and between-groups comparisons were performed using the Mann–Whitney U test. A p-value of less than 0.05 was considered statistically significant.

DESCRIPTIVE STATISTICS: -

Descriptive statistics were computed for all outcome measures for both MFR (Myofascial release) and TENS (Transcutaneous electrical nerve stimulation) group.

Table 1: -

Outcome	Group	Pre mean ± SD	Post mean ± SD
NPRS	**MFR** **TENS**	7.8000±0.66436	2.0333±0.71480
ROM Flex	**MFR** **TENS**	110.7667±2.47307	151.7333±12.69891
ROM Ext	**MFR** **TENS**	30.5333±1.00801	44.5333±4.39226
ROM Abd	**MFR** **TENS**	97.7667±2.35889	143.4333±14.02383
DASH	**MFR** **TENS**	61.0667±1.87420	22.4333±4.71010

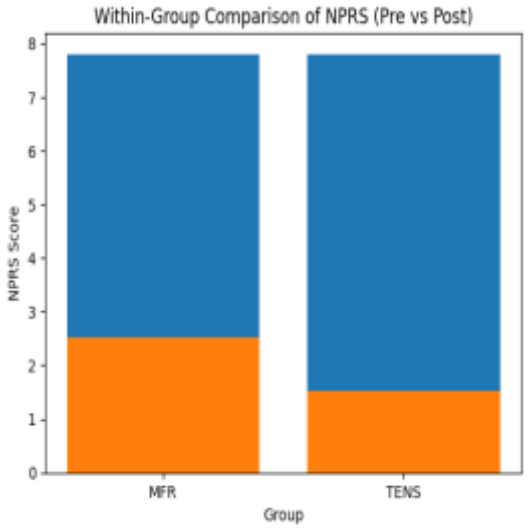
WITHIN GROUP ANALYSIS: -

NPRS (Wilcoxon signed rank test): -

Within group comparison using Wilcoxon signed rank test demonstrated statistically significant reduction in pain (NPRS) in both groups following intervention.

Table 2: - within group comparison of NPRS

Outcome	Group	Pre mean ± SD	Post mean ± SD
NPRS	MFR	7.8000±0.67612	2.5333±0.51640
NPRS	TENS	7.8000±0.67612	1.5333±0.51640



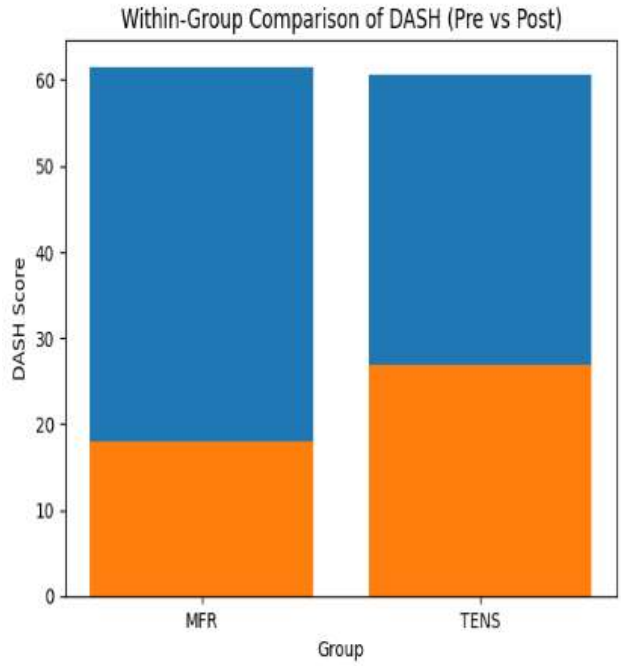
GRAPH-1: Showing within group comparison of NPRS Pre vs Post

PAIRED T TEST: -

Paired T Test analysis showed statistically significant impact in both DASH and ROM values in MFR and TENS groups following intervention.

Table 3: - within group (paired T test)

Group	Outcome	Pre mean	Post mean	t- value	Interpretation
MFR	ROM Flex	109.9333	163.7333	-102.020	Significant
MFR	ROM Ext	30.6000	48.1333	-24.037	Significant
MFR	ROM Abd	97.8667	156.6667	-66.456	Significant
MFR	DASH	61.5333	18.0000	135.322	Significant
TENS	ROM Flex	111.6000	139.7333	-68.202	Significant
TENS	ROM Ext	30.4667	40.9333	-63.345	Significant
TENS	ROM Abd	97.6667	130.2000	-151.115	Significant
TENS	DASH	60.6000	26.8667	126.500	significant



GRAPH-2: Showing the within group comparison of DASH Pre vs Post

BETWEEN GROUP ANALYSIS: -

NPRS (Mann Whitney U test)

Between group comparison of post intervention NPRS scores with the Mann whitney U test showed statistically significant difference favouring TENS group.

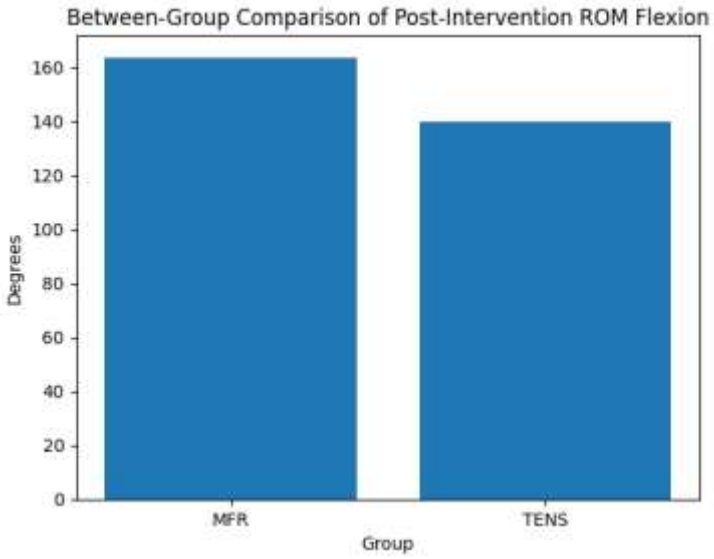
Table 4: -Between group NPRS

Outcome	MFR post mean	TENS post mean	Z value	P value	Interpretation
NPRS	2.5333	1.5333	-3.814	<0.01	Significant

INDEPENDENT T TEST: -

Table 5: -Between group ROM and DASH

Outcomes	MFR (post) Mean± SD	TENS (post) Mean± SD	t value	P value	interpretation
ROM Flex	163.7333±3.59497	139.7333±2.89005	20.152	<0.01	Significant
ROM Ext	48.1333±3.24844	40.9333±1.27988	7.987	<0.01	Significant
ROM Abd	156.6667±5.06623	130.2000±2.54109	18.086	<0.01	Significant
DASH	18.0000±1.25357	26.8667±1.50555	-17.529	<0.01	significant



GRAPH-3 : Between group comparison of post intervention ROM flexion

DISCUSSION

The purpose of this study was to compare the relative success of Myofascial Release (MFR) and Transcutaneous Electrical Nerve Stimulation (TENS) in alleviating shoulder pain and enhancing upper limb function among post-mastectomy breast cancer patients. Results revealed statistically significant reductions in pain intensity, shoulder range of motion, and functional outcomes, for both interventions, after four weeks of treatment. However, TENS was found to be a higher analgesic than MFR, while MFR was effective in improving shoulder range of motion and DASH scores.[3],[4],[9],[10]

However, the TENS group showed substantial pain relief compared to the MFR group. This conclusion may be consistent with well-established physiogenic mechanisms of TENS, particularly gate control by Melzack and Wall[14], and neurophysiological studies showing large-diameter afferent fiber activation and endogenous opioid release. The findings in this review also corroborate the findings of systematic reviews and meta-analyses which state TENS as an effective analgesic in reducing cancer- and surgical postoperative pain.[17–19],[23] This larger reduction in NPRS scores among the TENS group in the current study is consistent with these findings and validates its clinical utility for acute and subacute post-mastectomy pain management.

On the other hand, the Myofascial Release group showed significantly better improvement in shoulder flexion, extension, abduction, and DASH scores than the TENS group. Shoulder dysfunction after mastectomy has primarily been characterized by tightness of the fasciae, adhesions to scars and soft tissue

limitations due to surgical insults and biomechanical changes.[5,7,11] MFR specifically responds to this by increasing the extensibility of the fasciae, as well as the gliding between fascial layers, with low-load, repeated manual pressure. Though TENS modifies pain, it does not address directly mechanical limitations or fascial adhesions that limit shoulder mobility.

In contrast, while MFR may improve tissue flexibility and functional capacity, its analgesic effect might not be direct but rather secondary. These findings accentuate the fact that post-mastectomy shoulder dysfunction has a multi-factorial basis with both nociceptive and neuropathic pain components as well as biomechanical limitations.[1,2,22] Therefore, a single-modality approach may not be up to the task of entirely treating all aspects of shoulder malfunction.

From clinical viewpoint, findings indicate that TENS might be prioritized in the initial phase of rehabilitation when pain restricts movement but MFR should be considered in cases of mobility limitations and functional impairment. Combination of the two modalities (combination, or sequential), for example, may yield a synergistic benefit with pain modulation and mechanical restoration. This is consistent with previous works indicating that multimodal physiotherapy for breast cancer recovery is feasible.[25,26]

Some methodological issues must be noted even in the light of the positive findings. Limitations: Although a small sample size and convenience sampling were applied, issues of generalisation of the results are questionable. Furthermore, intervention duration was restricted to four weeks without a long term follow-up to assess effects.[3,11] Similar methodological shortcomings in similar physiotherapy studies of breast cancer patients have already been noted.[3] Subsequent studies with larger randomized controlled trials and longer follow-up periods may confirm long-term efficacy and assess combined control protocols.

This study adds to the available literature by directly comparing Myofascial Release and Transcutaneous Electrical Nerve Stimulation in post-mastectomy shoulder injury, thus contributing to the field. The findings show that both therapies have been shown effective in treating different areas of a patient's weakness. Combining pain modulation techniques with manual therapies to restore soft tissue mobility may help maximize rehabilitation outcomes in post-mastectomy breast cancer survivors for aftercare in the patient.

CONCLUSION

It aims to compare the impact of Myofascial Release with Transcutaneous Electrical Nerve Stimulation for breast cancer after mastectomy on patients suffering from shoulder pain and functional limitations. Patients in both groups experienced a major decline in shoulder pain and an increase in range of motion and daily functional function at shoulder pain/activities of daily life range. This emphasizes the significant role of physiotherapy in the rehabilitation of post-mastectomy patients.

Consequently, the results here suggest that Myofascial Release and TENS confer specific post-mastectomy rehabilitation beneficial effects. TENS for pain relief and Myofascial Release for mobility and function have better overall outcomes. Combining these techniques, with a physiotherapy program that has a clear structure, may benefit individuals who post-mastectomy breast cancer as a whole toward improvement.

LIMITATIONS AND RECOMMENDATIONS

LIMITATIONS: The sample size was small (30 in number), a limitation in the applicability of the findings to the generalising population of post-mastectomy breast cancer survivors. Because we used convenient sampling. Due to lack of long-term follow-up, the sustainability of pain reduction and

improved function could not be assessed. Limited patient period (3-6 months) after surgery only was included (result cannot be generalisable to postoperative women during later phases). Pain and functional capacity were most relevant, but other important findings including quality of life, psychological effects, and muscular endurance have not been assessed. The blinding of the therapist and sample were not possible. It was not possible to blind both the therapist and participants in any case, which may have distorted those outcome measures.

RECOMMENDATIONS: Substantial recruitment of a broader sample to improve the validity and generalizability of the results of these findings, future studies for which such findings were conducted with a larger sample size should be carried out to increase its validity and applicability in the future. Future studies should aim at investigating combined treatment protocol for Myofascial Release together with TENS to evaluate efficacy. A multimodal approach to therapy is necessary for better results. Further studies should provide additional outcome measures such as quality of life, muscle strength, posture, and psychological well-being. This kind of study can be done in patients at varying stages of post-operative course as well, including early and late post-mastectomy periods. From a clinical standpoint, physiotherapists are advised to shape their treatment regimens based on the needs of the patient, employing TENS predominantly for pain relief and Myofascial Release for mobility and function enhancements.

REFERENCES

1. Andersen KG, Kehlet H. Persistent pain after breast cancer treatment: a critical review of risk factors and strategies for prevention. J Pain. 2011;12(7):725-746.
2. Mejdahl MK, Andersen KG, Gärtner R, Kroman N, Kehlet H. Persistent pain and sensory disturbances after treatment for breast cancer: six-year nationwide follow-up study. BMJ. 2013;346:f1865.
3. McNeely ML, Campbell K, Ospina M, Rowe BH, Dabbs K, Klassen TP, et al. Exercise interventions for upper-limb dysfunction due to breast cancer treatment. Cochrane Database Syst Rev. 2010;(6):CD005211.
4. Lauridsen MC, Christiansen P, Hessov I. The effect of physiotherapy on shoulder function in patients surgically treated for breast cancer: a randomized study. Acta Oncol. 2005;44(5):449-457.
5. Shamley DR, Srinanaganathan R, Weatherall R, Oskrochi R, Watson M, Ostlere S, et al. Changes in shoulder muscle size and activity following treatment for breast cancer: a cross-sectional study. Breast Cancer Res Treat. 2007;106(1):19-27.
6. Panchik J, Masco S, Zinnikas P, Hillriegel B, Lauder T, Suttmann E, et al. Shoulder and upper-limb dysfunction in women with breast cancer: a cross-sectional study. Am J Occup Ther. 2012;66(1):111-120.
7. De Groef A, Van Kampen M, Tieto E, Schönweger P, Christiaens MR, Neven P, et al. Arm lymphoedema and upper limb impairments in sentinel node-negative breast cancer patients: a one-year follow-up study. Breast. 2016;29:102-108.
8. Torres Lacomba M, Yuste Sánchez MJ, Zapico Goñi A, Prieto Merino D, Mayoral del Moral O, Cerezo Téllez E, et al. Effectiveness of early physiotherapy to prevent lymphoedema after surgery for breast cancer: randomized single-blinded clinical trial. BMJ. 2010;340:b5396.
9. Beurskens CH, van Uden CJ, Strobbe LJ, Oostendorp RA, Wobbes T. The efficacy of physiotherapy upon shoulder function following axillary dissection in breast cancer: a randomized controlled study. BMC Cancer. 2007;7:166.

10. Box RC, Reul-Hirche HM, Bullock-Saxton JE, Furnival CM. Physiotherapy after breast cancer surgery: results of a randomized controlled study to minimize lymphoedema. Breast Cancer Res Treat. 2002;75(1):51-64.
11. Devoogdt N, Van Kampen M, Geraerts I, Coremans T, Christiaens MR. Different physical therapy interventions to prevent or manage arm lymphedema after breast cancer surgery: a systematic review. Arch Phys Med Rehabil. 2010;91(4):583-597.
12. Kim Y, Park EY, Lee H. The effect of myofascial release in patients with breast cancer-related lymphedema: a cross-over randomized controlled trial. Eur J Phys Rehabil Med. 2023;59(1):85-93.
13. Ajimsha MS, Binsu D, Chithra S. Effectiveness of myofascial release in the management of plantar fasciitis: a randomized controlled trial. J Bodyw Mov Ther. 2014;18(3):425-430.
14. Melzack R, Wall PD. Pain mechanisms: a new theory. Science. 1965;150(3699):971-979.
15. Sluka KA, Bjordal JM, Marchand S, Rakel BA. What makes transcutaneous electrical nerve stimulation work? Making sense of the mixed results in the clinical literature. Phys Ther. 2013;93(10):1397-1402.
16. Bjordal JM, Johnson MI, Ljunggreen AE. Transcutaneous electrical nerve stimulation (TENS) can reduce postoperative analgesic consumption: a meta-analysis with assessment of optimal treatment parameters. Eur J Pain. 2003;7(2):181-193.
17. Hurlow A, Bennett MI, Robb KA, Johnson MI, Simpson KH, Oxberry SG. Transcutaneous electric nerve stimulation (TENS) for cancer pain in adults. Cochrane Database Syst Rev. 2012;(3):CD006276
18. Santos KC, Avila MA, Cardoso Neto GI, Martucci AF, Righi NC, Liebano RE. Effects of transcutaneous electrical nerve stimulation on acute postoperative breast augmentation pain: study protocol. Pain Manag. 2024 Dec;14(12):611-618. doi: 10.1080/17581869.2024.2434450. Epub 2024 Nov 26. PMID: 39589933; PMCID: PMC11703423.
19. Akutay S, Yüceler Kaçmaz H, Ceyhan Ö. The healing power of transcutaneous electrical nerve stimulation: a systematic review on its effects after breast surgery. Support Care Cancer. 2025 Jan 13;33(2):90. doi: 10.1007/s00520-024-09129-3. PMID: 39804405; PMCID: PMC11729116.
20. Lv Y, Yin Y. A Review of the Application of Myofascial Release Therapy in the Treatment of Diseases. J Multidiscip Healthc. 2024 Sep 26;17:4507-4517. doi: 10.2147/JMDH.S481706. PMID: 39351042; PMCID: PMC11441305.
21. McNeely ML, Campbell K, Ospina M, Rowe BH, Dabbs K, Klassen TP, Mackey J, Courneya K. Exercise interventions for upper-limb dysfunction due to breast cancer treatment. Cochrane Database Syst Rev. 2010 Jun 16;2010(6):CD005211. doi: 10.1002/14651858.CD005211.pub2. PMID: 20556760; PMCID: PMC12861582.
22. Silva JG, Santana CG, Inocêncio KR, et al. Electrocortical analysis of patients with intercostobrachial pain treated with transcutaneous electrical nerve stimulation after breast cancer surgery. J Phys Ther Sci. 2014;26(3):349–353. PMID: 24707082.
23. Viderman D, Nabidollayeva F, Aubakirova M, Sadir N, Tapinova K, Tankacheyev R, et al. The impact of transcutaneous electrical nerve stimulation (TENS) on acute pain and other postoperative outcomes: a systematic review with meta-analysis. J Clin Med. 2024;13(2):427. PMID: 38256561. doi:10.3390/jcm13020427.
24. Lauridsen MC, Christiansen P, Hessov I. The effect of physiotherapy on shoulder function in patients surgically treated for breast cancer: a randomized study. Acta Oncol. 2005;44(5):449–57. PMID: 16118078.

25. Shamley DR, Srinanaganathan R, Weatherall R, Oskrochi R, Watson M, Ostlere S, Sugden E. Changes in shoulder muscle size and activity following treatment for breast cancer: a cross-sectional study. Breast Cancer Res Treat. 2007;106(1):19–27. PMID: 17221154.
26. Cantarero-Villanueva I, Fernández-Lao C, Del Moral-Ávila R, Fernández-de-las-Peñas C, Feriche-Fernández-Castanys MB, Arroyo-Morales M. Manual therapy associated with upper limb exercises versus exercises alone for shoulder rehabilitation in postoperative breast cancer patients: a randomized controlled trial. Physiotherapy Theory Pract. 2011;27(7):500–508. PMID: 22007656.
27. Kibar S, Dalyan Aras M, Ünsal Delialioğlu S. The risk factors and prevalence of upper extremity impairments and an analysis of effects of lymphoedema and other impairments on the quality of life of breast cancer patients. Eur J Cancer Care (Engl). 2017;26(4):e12433. PMID: 27987963.
28. sluka KA, Bjordal JM, Marchand S, Rakel BA. What makes transcutaneous electrical nerve stimulation work? Making sense of the mixed results in the clinical literature. Phys Ther. 2013 Oct;93(10):1397-402. PubMed PMID: 23641031.
29. Cheing GL, Hui-Chan CW. Transcutaneous electrical nerve stimulation: nonparallel antinociceptive effects on chronic clinical pain and acute experimental pain. Arch Phys Med Rehabil. 2005;86(2):301-7. PubMed PMID: 15706558.
30. Cinar N, Seckin U, Keskin D, Donmez S, Stein J, Guven MA. The effectiveness of early rehabilitation in patients with modified radical mastectomy. Cancer Nurs. 2008 Mar-Apr;31(2):160-5. PubMed PMID: 18490890.
31. Cantarero-Villanueva I, Fernández-Lao C, Cuesta-Vargas AI, Del Moral-Ávila R, Fernández-de-Las-Peñas C, Arroyo-Morales M. The effectiveness of a manual therapy and exercise program in attenuating neoplasia-related pain and improving health status in breast cancer survivors: a randomized controlled trial. Clin Rehabil. 2013;27(2):135-48. PubMed PMID: 22760638.