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Mind the gap: treating post-surgical scar tissue in post-mastectomy patients – a randomized clinical trial

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Abstract

Introduction. Post-mastectomy physiotherapy typically includes massage, exercise, and stretching, but often fails to treat post-surgical scar tissue, a significant contributor to long-term disability. This study aimed to compare conventional therapy with myofascial manual therapy for treating post-surgical scar tissue in post-mastectomy patients and to determine the effectiveness of these treatments.
Methods. The study was an experimental controlled study with pre- and post-testing of two parallel groups. Forty-eight women experiencing shoulder and/or upper torso impairment following mastectomy were randomly allocated to either a control group (n = 21) or a myofascial therapy group (n = 27). Conventional physiotherapy involving exercise and massage or myofascial therapy was used. Pre- and post-therapy measurements included muscle length, pain intensity, range of motion (ROM), and scar mobility.
Results. Myofascial therapy was superior to conventional physiotherapy in reducing the percentage of patients with below-normal muscle lengths at several sites. Significant decreases from baseline were observed in the treatment group for the pars clavicularis, descending trapezius, pars sternocostalis, latissimus dorsi, and levator scapulae muscles. Myofascial therapy also improved mobility in the scar area, with increases of 3 mm relative to the xiphoid process and 4 mm relative to the coracoid.
Conclusions. Our study indicates that myofascial interventions improve upper limb ROM and muscle elasticity in the upper limb girdle of post-mastectomy patients. These findings provide empirical evidence supporting the benefits of myofascial intervention over conventional physiotherapy in the treatment of post-surgical scar tissue in this patient group.
Key words: mastectomy, breast neoplasms, scar tissue, myofascial treatment, range of motion, muscle elasticity

Introduction

Breast cancer is the most common type of cancer in women and often requires surgical resection of the entire breast in many patients. In 2020, 2.3 million cases of breast cancer were diagnosed [1].

Age-standardized 5-year net survival has constantly increased, and for women diagnosed during 2010–2014, it was 85% or higher in the top 25 countries and ranged worldwide from 66.1% (India) to 90.1% (USA) [2]. Unfortunately, mastectomy can lead to numerous late complications, including hypertrophic post-surgical scarring, upper limb lymphedema, fibrosis, and muscle contracture, all of which can limit normal mobility in the upper body and limbs [3, 4]. These treatment-related physical impairments can have wide-ranging adverse effects on quality of life and can impede the performance of important activities of daily living [5].

One of the most common side effects of mastectomy is limited mobility in the upper limb girdle. This impairment is typically multifactorial, caused by a combination of pain, scar tissue, fibrosis, passive tissue, and neurological factors, all of which cause the patient to reduce the use of the musculature in this area, leading to decreased muscle strength, a natural phenomenon associated with surgery [6, 7]. The presence of post-surgical scar tissue often plays a particularly important role in limiting motion in the upper limb girdle, chest, and neck (patients commonly report a "pulling" feeling during movement). Despite the high incidence of scarring and the mobility limitations associated with scar tissue, only a few studies have investigated [6, 8, 9] the impairment of glide movements between the fascia and the connected tissue structures. It is one of the possible factors influencing musculoskeletal system limitations following mastectomy. Little high-quality research has been conducted in this area.

Based on the research of other authors, it appears that scar tissue is one of the reasons that prolongs recovery [5, 9], but conventional physiotherapy often fails to resolve scar tissue-related dysfunction. For this reason, soft tissue therapy, such as myofascial manual therapy, has been proposed as a beneficial addition to conventional post-mastectomy physiotherapy (typically based on massage, therapeutic exercises, and manual lymphatic drainage). Myofascial techniques were previously implemented on post-C-section scars to improve their structure and function even after complete remodeling [10]. Myofascial therapy can significantly improve function and quality of life in breast cancer survivors by reducing or elimi-

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nating mobility limitations in the musculoskeletal system, particularly in scar tissue, and decreasing pain intensity [11].

Scar tissue mobilization is difficult to quantify, and consequently, mobilization is usually assessed subjectively and characterized dichotomously as either "normal" or "limited" [5, 12]. Given these limitations, we aimed to develop a new, more objective approach to measuring mobility based on the previous work by Lewit of the Czech school of manual therapy [13]. This approach measures movement (in centimeters) relative to the xiphoid process and the coracoid process, providing an objective measure of progress in mobilizing scar tissue.

Therefore, there is a need to implement myofascial techniques, which, unlike conventional methods, have a direct impact on improving slide tissue and tissue fibrosis. The specific techniques on each fasciae layer indicate a significant decrease in limitations, such as restriction of tissue and joint mobility.

To the best of our knowledge, no studies have yet been conducted to assess this method in post-mastectomy patients. The aim of this study was to evaluate the effects of myofascial manual therapy compared to conventional therapy in the treatment of post-surgical scar tissue in post-mastectomy breast patients. We hypothesized that myofascial therapy can treat post-mastectomy scar tissue more effectively than conventional methods in terms of range of motion (ROM) and scar mobility. This is why we decided to compare myofascial manual therapy and conventional therapy in the treatment of post-surgical scar tissue in post-mastectomy patients. Our goal was to provide clinical evidence to determine whether this type of soft-tissue therapy could improve dysfunction in these patients.

Subjects and methods

Data collection

This parallel randomized controlled trial was conducted at the Greater Poland Cancer Centre hospital between January 2013 and December 2014.

Participants

The participants were patients from the Greater Poznan Cancer Centre who had previously undergone total mastectomy for breast cancer with axillary lymph node dissection and adjuvant radiotherapy. The study group was recruited from patients referred to the Physiotherapy Department of the Greater Poland Cancer Centre for rehabilitation. Patients were directed for rehabilitation by a physician due to a restriction in the post-mastectomy area.

The sample size calculation assumed a power of 0.80 and an error rate (p) of 0.005 for detecting a difference in proportions of 35% (10% in the control group and 45% in the treatment group), resulting in a requirement of 48 subjects (24 subjects in each group). Under the same assumptions, for detecting a difference between average results (expressed as the effect size $d = 0.75$, which corresponds to 75% of the standard deviation), the sample size calculation also required 48 subjects. A total of 61 patients were enrolled in this trial between January 2013 and December 2014.

The patients were randomized to either the treatment group ($n = 30$) or the control group ($n = 26$); using a coin toss; of these patients, 48 met all study protocol requirements, including final assessment. Subject eligibility was determined by the investigator (S.M.) before allocation to one of the two groups. Random allocation was performed by J.D. Inclusion criteria were 1) presence of functional difficulties in the shoulder area and/or upper torso on the surgical side and 2) eligibility for physiotherapy as determined by the treating physician. Patients with recurrent disease and/or inflammatory or acute ailments were excluded.

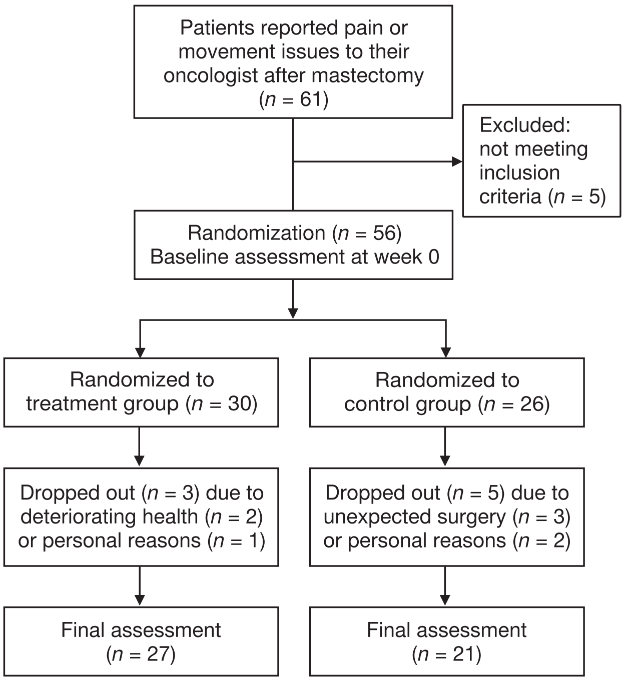

Figure 1. Flow of participants through the trial

The treatment group received myofascial treatment, while the control group received conventional therapy consisting of exercise and massage. The flow of participants through the trial is shown in Figure 1.

The demographic characteristics of both groups were comparable, with no significant difference at baseline (Figure 1). The mean age in the treatment group was 60.2 years (± 8.5) compared to 62.6 years (± 7.0) in the control group ($p > 0.05$).

The median time between mastectomy and treatment was 31 months in the treatment group and 29.5 months in the control group ($p > 0.05$) (range, 4 months to 25 years).

Interventions

The mean treatment duration in both groups was 4 weeks. Therapy was performed daily, excluding weekends and consisted of 45 min of individual work with an oncological physiotherapist in the hospital rehabilitation center.

Myofascial therapy group

In the treatment group, manual myofascial techniques were used to reduce muscle tension and increase the elasticity of soft tissues in the surgical area as well as in tissues that could affect ROM and cause pain. The procedure was performed 5 times a week for 45 min over a total of 4 weeks. This physiotherapy schedule is regularly used at the Greater Poland Cancer Centre for patients undergoing rehabilitation stays (4 weeks).

Fascial techniques consisted of the following: deep massage of neck and shoulder girdle muscles; trigger point therapy; scar tissue treatment near and directly on the scar through stretching, breaking, pulling, as well as static and dynamic rolling; post-isometric relaxation (stretching) of shoulder and neck muscles; active release technique for the chest and shoulder; selected fascial distortion model techniques; and fascial manipulation techniques aimed at developing specific center of coordination and center of fusion points in the operated area and the shoulder on the same side [8, 14]. The exact sequence and number of procedures varied for each patient based on individual needs determined by prior functional examination. Before or after each treatment session, patients underwent a 10-minute manual lymphatic drainage of the limb on the mastectomy side. Lymphatic drainage was performed regardless of the extent of surgery or presence of lymphedema, because it is considered a safe technique also used for prevention.

Control group

The control group received kinesiotherapeutic procedures 5 times a week for 45 min over 4 weeks. The control therapy included various floor gymnastic exercises with gymnastic sticks, balls, and/or elastic tapes, lymphatic massage of neck and shoulder girdle muscles, and therapeutic exercises aimed at increasing ROM in the upper limb and chest area. No myofascial techniques were used in the control group. Before or after each treatment session, patients underwent a 10-minute manual lymphatic drainage of the limb on the mastectomy side.

Outcome measures

Patient interviews and diagnostic examinations were performed at baseline (pre-treatment) and after-treatment finalization. All measurements before and after treatment were conducted by the same investigator to reduce the risk of measurement errors. The following variables were assessed during the diagnostic examination of muscle length using Janda's protocol:

– Pectoralis major – pars clavicularis: The normal length of these fibers allows the patient's arm (in an extended position close to the body) to rest below the horizontal.

– Pectoralis major – pars sternocostalis: The normal length of these fibers allows abduction of the patient's arm to 90° to rest below the horizontal.

– Pectoralis major – pars abdominalis: The normal length of these pectoral fibers allows abduction of the patient's arm to 150° with slight external rotation to rest in a horizontal position.

– Latissimus dorsi: The normal length allows the arm to rest horizontally on the table with the lumbar spine flat against the table.

– Descending part of trapezius: The length is assessed qualitatively by noting the end-feel resistance. The normal end feel is gradual rather than abrupt.

– Levator scapulae: The length is assessed qualitatively by noting the end-feel resistance. The normal end feel is gradual rather than abrupt [15].

Active ROM in the shoulder joint on the surgical side (flexion, extension, abduction, internal rotation, external rotation in horizontal flexion), and pain intensity measured on a 10-point visual analog scale (VAS) at rest and during the therapist's palpation with the same pressure on half the length of the scar and during motion in the glenohumeral joint were assessed. Scar mobility was measured using a centimeter measure as the difference in distance from the bone point to the most limited place in the scar. Measurements were taken in the cranial direction (distance from the ridge of the coracoid) and transverse direction (distance from the xiphoid process). The scar was marked on the patient's examination card to ensure measurement consistency, as the restriction site could change due to therapy. The therapist manually moved (glided) the scar to increase this distance, and the difference in measurement was recorded.

Visual dysfunction of the scar (retraction) and the presence of axillary web syndrome (AWS) were also observed [5, 6, 16, 17].

Active ROM in the joints of the upper limb girdle on the operated side was measured with a goniometer while the patient was seated in a chair. This method has been used previously for measuring shoulder ROM in patients who underwent surgical breast cancer treatment [18, 19]. During the examination, AWS was assessed visually and by palpation [6, 17, 20].

The examinations and rehabilitation procedures were performed in two specialized (i.e., post-mastectomy physiotherapy) rehabilitation clinics by qualified oncological physiotherapists with ≥ 5 years of experience working with post-mastectomy patients.

Statistical analysis

The distribution of continuous data was evaluated using the Shapiro–Wilk test. When a quantitative variable was not normally distributed, the Wilcoxon Mann–Whitney test was used to compare the two study groups. For normally distributed quantitative variables, Student's t-test was used to compare the means of two groups. Pearson's chi-squared test and Fisher's exact test were used to assess between-group differences in the categorical variables. A p-value < 0.05 was considered statistically significant for all statistical analyses.

Results

Basic characteristics of the two groups are reported in Table 1. No adverse effects were observed in subjects in either group during the study.

Table 1. Baseline demographic and clinical characteristics of participants

Characteristic	Treatment (n = 27)	Control (n = 21)	p-value
Height (cm)	163.93	165.48	0.339 (Student's t-test)
Weight (kg)	73.46	81.07	0.1342 (Mann–Whitney test)
BMI	27.33	29.58	0.1687 (Student's t-test)

BMI – body mass index

As shown in Table 2, significant between-group differences were observed in the percentage of patients achieving normal muscle length following treatment for the pectoralis major, pars sternocostalis, latissimus dorsi, and the descending trapezius. No between-group differences were observed in other muscles.

Myofascial therapy was superior to conventional physiotherapy in reducing the percentage of patients with below-normal muscle lengths at several sites. In the treatment group, significant decreases from baseline were observed for the pars clavicularis (67% with shortened muscles at baseline vs. 22% post-treatment; p = 0.002, chi-squared test with Yates continuity correction), descending trapezius (81% vs. 26%; p < 0.001, chi-squared test with Yates continuity correction), pars sternocostalis (37% to 7%; p = 0.02, chi-squared test with Yates continuity correction), latissimus dorsi (52% to 15%; p = 0.008, chi-squared test with Yates continuity correction), and levator scapulae muscle (41% to 7%; p = 0.009, chi-squared test with Yates continuity correction). In contrast, the corresponding values in the control group were as follows:

Table 2. Percentage of patients in each group with below-normal muscle lengths pre- and post-treatment

	Treatment (*n* = 27) (%)		Control (*n* = 21) (%)		OR_T/OR_C	*p*-value
	PRE	POST	PRE	POST		
Pectoralis major pars clavicularis	18 (67)	6 (22)	6 (29)	2 (10)	1.84	0.287
Pectoralis major pars sternocostalis	10 (37)	2 (7)	8 (38)	10 (48)	10.8	0.014
Pectoralis major pars abdomen	5 (19)	2 (7)	8 (38)	7 (33)	2.31	0.225
Latissimus dorsi	14 (52)	4 (15)	6 (29)	6 (29)	6.19	0.031
Levator scapulae	11 (41)	2 (7)	7 (33)	1 (5)	0.86	0.543
Descending trapezius	22 (81)	7 (26)	8 (38)	5 (24)	6.38	0.029

OR – odds ratio. The *p*-values are based on a one-sided Fisher's exact test.

Table 3. Mean changes in range of motion in the shoulder in the treatment and control groups

Motion	PRE (mean ± *SD*)			POST (mean ± *SD*)		
	treatment	control	*p*-value	treatment	control	*p*-value
Flexion	168.9 (29.8)	176.2 (6.3)	0.543	177.8 (11.5)	176.6 (8.3)	0.05
Extension	49.6 (10.4)	56.5 (15.1)	0.051	55.9 (7.0)	61.1 (10.2)	0.025
Abduction	164.8 (35.7)	176.7 (6.4)	0.614	177.4 (9.9)	178.6 (3.2)	0.52
Int. rot. in h. flexion	49.8 (22.2)	72.9 (20.9)	< 0.001	60.9 (15.8)	78.2 (14.3)	< 0.001
Ext. rot. in h. flexion	83.4 (14.3)	79.4 (11.9)	< 0.001	88.5 (4.5)	78.1 (11.3)	< 0.001

Int. rot. in h. flexion – internal rotation in horizontal flexion, Ext. rot. in h. flexion – external rotation in horizontal flexion
The *p*-values are based on a Wilcoxon Mann–Whitney test.

Table 4. Mean changes in pain intensity before and after treatment

Pain assessment category	PRE VAS (mean ± *SD*)			POST VAS (mean ± *SD*)		
	treatment	control	*p*-value	treatment	control	*p*-value
Resting position	3.2 (2.9)	1.7 (2.7)	0.068	1.3 (2.1)	1.1 (1.8)	1.0
Palpation	1.6 (2.6)	1.7 (2.8)	0.779	1.2 (2.2)	1.4 (2.3)	0.79
During motion in shoulder joint	3.1 (3.0)	1.8 (2.7)	0.059	1.7 (2.2)	1.1 (2.1)	0.238

VAS – visual analog scale. The *p*-values are based on a Wilcoxon Mann–Whitney test.

Table 5. Mean changes in scar mobility pre- and post-physiotherapy

Scar mobility measured in relation to:	PRE (mean ± *SD*)		POST (mean ± *SD*)			
	treatment	control	*p*-value	treatment	control	*p*-value
Xiphoid process	0.9 (0.4)	0.9 (0.4)	1.0	1.2 (0.4)	0.9 (0.4)	0.018
Coracoid	0.6 (0.3)	0.7 (0.3)	0.829	1.1 (0.3)	0.7 (0.3)	0.002

The *p*-values are based on a Wilcoxon Mann–Whitney test.

Table 6. Number and percentage of patients in both groups with impairment in the scar area before and after physiotherapy

Dysfunction	PRE (%)				POST (%)			
	treatment	control	chi^2	*p*-value	treatment	control	chi^2	*p*-value
Retraction	7 (26)	3 (14)	0.393	0.531	5 (19)	3 (14)	0.152	0.697

The *p*-values are based on Pearson's chi-squared test.

pars clavicularis (29% shortened at baseline vs. 10% post-treatment; $p = 0.238$, chi-squared test with Yates continuity correction), descending trapezius (38% vs. 24%; $p = 0.505$, chi-squared test with Yates continuity correction), pars sternocostalis (38% to 48%; $p = 0.756$, chi-squared test with Yates continuity correction), latissimus dorsi (29% vs. 29%; $p = 1.0$, chi-squared test with Yates continuity correction), and levator scapulae muscle (33% to 5%; $p = 0.45$, chi-squared test with Yates continuity correction).

As shown in Table 3, significant between-group differences were observed in pre- and post-physiotherapy shoulder joint mobility for extension. The range of flexion, abduction, internal rotation, and external rotation in horizontal flexion improved more in the treatment group, although the differences were not statistically significant (Table 3).

No statistically significant differences in pain (VAS) were found between the two groups before or after physiotherapy. However, a greater (but non-significant) decrease in pain at rest and during shoulder movement from baseline to post-treatment was observed in the treatment group (Table 4).

As shown in Table 5, improvement in scar mobility relative to the xiphoid process and coracoid was significantly greater in the treatment group compared with the control group.

No statistically significant differences were found between the groups in terms of retraction of the scar tissue. After myofascial therapy, the number of patients with scar retraction decreased from 7 to 5. In contrast, no changes were observed in these dysfunctions in the control group (Table 6).

Improvement in AWS was observed in 3 patients in the treatment group, but no changes were observed in the control group ($chi^2 = 0.95$; $p = 0.329$).

Discussion

Scar tissue is the most common cause of long-term disability after mastectomy [5, 9], yet treatment of this tissue is often overlooked by conventional therapy, partly due to the difficulty of quantifying mobilization of this type of tissue. In such patients, mastectomy can cause severe disability, and conventional physiotherapy offers only limited improvement. For this reason, we sought to compare conventional therapy to myofascial manual therapy to determine whether this type of soft-tissue therapy could improve dysfunction in these patients. Our main findings are that manual scar therapy and soft tissue treatment were superior to conventional physiotherapy in restoring normal tissue and joint mobility in patients after mastectomy. Specifically, myofascial therapy significantly reduced the percentage of patients with below-normal muscle lengths at several sites, including the pars clavicularis, descending trapezius, pars sternocostalis, latissimus dorsi, and levator scapulae muscle. Myofascial therapy also significantly improved mobility in the scar area, with increases of 3 mm ($p = 0.02$) relative to the xiphoid process and 4 mm relative to the coracoid ($p = 0.001$). In contrast, no significant improvements in these parameters were achieved with conventional physiotherapy.

According to the principles of myofascial therapy, physiotherapy should focus on reversing an imbalance of fascia and muscle tissues; in other words, the aim is to restore structural homeostasis. Restoring myofascial plasticity and elasticity is possible by applying precise manual mobilization to target specific anatomical tissue layers and their range of movement. The greater the tissue damage, the greater the influence of precise application of mechanical forces (pressing and pulling) on tissue remodeling. The structure of connective tissue is analogous to that of bone tissue: it is modified by stress in a given area according to the direction in which the pressure acts. Therefore, appropriately selected force and direction of myofascial mobilization at various stages of the healing process ensure the correct structure of collagen fibers, allowing appropriate balance to be maintained between the components of connective tissue, thereby enhancing the regeneration of lymphatic and blood vessels and limiting excessive formation of tissue adhesion, and reducing the inflammatory response. Myofascial therapy differs from other treatment methods in various ways, including physiological stimulation to rebuild tissues, massage techniques, peak force (or other physical) exercises, and application of subtle therapy coupled with precision. By identifying specific types of tissue damage, we can optimize treatment and reduce recovery time. Studies conducted in recent years have shown that myofascial therapy provides benefits for many aspects of patient outcomes and should be further investigated [5].

The accurate assessment of ROM in post-mastectomy patients can be difficult [21]. In our study, we measured ROM in the shoulder girdle joints with a goniometer and applied a muscle length scale range to determine whether muscle length was within normal limits [4, 12, 22]. An important distinction should be made between our study and the techniques used to measure ROM in other studies: we measured changes in ROM after soft tissue therapy rather than after gymnastic exercises. In addition to ROM, we also performed several functional tests because these provide a more comprehensive picture of the patient's ability to perform complex activities compared to simple active movements measured by a goniometer. For example, functional tests offer a more accurate and objective assessment of the patient's status than the Wingate test proposed by Oliveira et al. [12], which is based on the patient's subjective assessment of task difficulty (e.g., making a bed, reaching the scapula from an up or down position). In that test, patients rate tasks (subjectively) as "difficult", "easy", or "impossible" to perform. In contrast, in our study, we precisely measured the changes (in centimeters) to objectively quantify the changes. Our novel approach contrasts with commonly used, patient-reported (and therefore subjective) evaluations.

Post-surgical pain, typically present from the first hours after the procedure, is one of the most important factors affecting patients' ability to perform daily activities of living. Pain plays an important role in quality of life after mastectomy, and therefore pain management is an essential component of rehabilitation. Our results are consistent with findings reported by other authors who used similar myofascial treatments to significantly reduce pain [6]. However, unlike those authors, we used a more detailed pain classification system to better characterize the type of pain. This system enabled us to more accurately assess treatment effectiveness by evaluating pain at rest, on palpation, and during shoulder joint mobilization. We found that pain was more intense during palpation and shoulder joint mobilization than in the resting position.

The use of this scale allowed precise identification of factors responsible for pain. We also performed a biomechanical analysis of soft tissues to pinpoint the most painful sites. In most cases, these areas coincided with sites (i.e., surgical scars) under the greatest tissue tension (pulling) during shoulder joint movements.

Conventional post-mastectomy treatment models involve positioning the limb in alignment with the surgical side while patients perform various floor gymnastic exercises. Other treatments include exercises performed with a gymnastic stick, balls, and/or elastic tapes. Stretching exercises are also a common component of conventional therapy [6]. However, given our current understanding of the importance of the myofascial system, it is clear that such exercises alone are insufficient to restore full functionality after mastectomy. Indeed, this explains why new soft tissue therapies have been increasingly included in rehabilitation programs for these patients [5, 23, 24].

Our study introduces a novel approach to assessing scar mobility after cancer surgery, which – as noted above – is often difficult due to problems with objectively measuring mobility. Standard methods of measuring fascia are inadequate because they depend on subjective assessments of mobility, described as "normal" or "limited" [5, 12]. To overcome these limitations, we have developed a new, more objective approach – based on the work of Lewit and Olsanska [13] – to measuring mobility. In our approach, movement is measured in centimeters relative to specific bone parts (the xiphoid process and coracoid).

To our knowledge, no studies have yet been conducted to assess muscle elasticity in cancer patients. However, this is an important aspect to consider, because normal muscle length ensures proper muscle function, which in turn affects patients' ability to move and, thus, their overall well-being.

De Groef et al. [25] recently reported results from a randomized controlled trial comparing myofascial therapy to standard physical therapy in mastectomy patients. Those authors found that myofascial therapy yielded no additional improvement in upper limb function after mastectomy with lymphadenectomy. These findings contradict our results. We found a statistically significant difference in the percentage of subjects with below-normal muscle lengths post-treatment, and we also found that scar mobility did not improve significantly. Although there are similarities between our study and that of De Groef et al. [25], including sample sizes and average subject age, the therapy duration was longer in the De Groef study (12 weeks vs. 4 weeks), and fewer individual myofascial sessions were offered (12 vs. 20 in our study). Another important difference is the intervention technique. In our study, we not only worked on trigger points and myofascial adhesions but also applied treatments involving patient movement while the therapist used myofascial restriction to stabilize the tissue, a technique known as active release [26]. This method was used to minimize pain while extending the tissue to release the adhesions between the scar and connective tissues and between the scar and muscles. We believe that these are the restrictions that most significantly reduce upper limb mobility in female subjects after mastectomy. Additionally, we applied fascial manipulation techniques to address active densifications within the upper limb [8, 27]. In contrast, De Groef et al. [25] did not apply such techniques, an important difference between our studies that may explain the different outcomes. Although the findings reported by De Groef et al. [25, 28] suggest that myofascial therapy may provide no additional benefits, our findings strongly suggest that myofascial therapy provides significant benefits in this patient population. We believe that the differences in results between these two studies are likely attributable to differences in treatment intensity or myofascial procedures. However, larger samples will be needed to clarify this issue.

Limitations

This study had several limitations that may have affected the results. The most important factors include differences in the length of time elapsed between surgery and the study, variability among patients in the duration of therapy, and the inability to quantify the type of therapy because therapy was determined on an individualized basis according to each patient's unique situation (i.e., functional ability and specific needs). Another limitation was the scale used to measure scar mobility, which we developed for this study. This method has not been previously validated or used by other authors, which is why its accuracy is not known compared to other established methods. More studies should be performed, preferably with more homogeneous patient groups and a more balanced therapeutic duration, to confirm the findings of this study. Furthermore, long-term follow-up could be performed on this group of patients to verify whether the procedures provide long-term benefits. The measurements of scar mobility and muscle length are not validated and should be verified using future clinical examinations and biomechanical and kinesiological tests. Although the study met the calculated patient group size, we used random allocation to the two groups without setting the allocation ratio as 1:1. Using an allocation ratio of 1:1 would allow us to achieve higher statistical power in the conducted tests; however, the difference in power between equally sized groups and the allocation in this study (groups of 30 and 26 patients) was relatively small.

Finally in this study, patients were recruited without a limit on time elapsed after surgery. This means that our study included patients operated using both older techniques and more modern techniques, as well as patients with more recent and older scars.

Conclusions

The use of myofascial techniques positively improves upper limb ROM and muscle elasticity in the upper limb girdle. These findings suggest that scar therapy is a key factor in restoring normal tissue and joint mobility and in reducing pain. Therefore, this therapy merits greater attention in post-mastectomy rehabilitation. Additionally, manual myofascial therapy appears to be superior to conventional physiotherapy in post-mastectomy patients. Nevertheless, further studies, including histological, biochemical, and biomechanical analyses, are necessary to confirm the benefits of myofascial therapy and scar therapy in this patient population.

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Ethical approval

The research related to human use has complied with all relevant national regulations and institutional policies, has followed the principles of the Declaration of Helsinki, and has been approved by the Institutional Review Board #42/13 – Bioethics Committee at Poznan University of Medical Sciences in Poznan, Poland (Approval No.: #NCT04369079). The study was registered in the clinicaltrials.gov registry.

Informed consent

Informed consent was obtained from all individuals included in this study, and written consent was provided by all study participants.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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