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ORIGINAL ARTICLE

Effectiveness of myofascial release after breast cancer surgery in women undergoing conservative surgery and radiotherapy: a randomized controlled trial

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Abstract

Purpose The scars derived from the treatment of breast cancer lead to adverse effects such as fibrosis or retractions of the connective tissue. Myofascial release (MR) seeks to reduce restrictions of the fascial system. Therefore, the aim of this study was to analyze the clinical impact of MR treatment on women survivors of breast cancer.

Methods We enrolled 24 women with breast cancer, 13 received myofascial release treatment (MR) and 11, a placebo manual lymphatic drainage treatment (PMLD). Both interventions were administered over a period of 4 weeks. The outcomes studied were pain, shoulder range of motion (ROM), functionality, quality of life (QoL), and depression, immediately after treatment and 1 month later.

Results After 4 weeks of treatment, only the participants who received MR experienced a significant decrease in pain intensity in the short and midterm ($p < 0.05$). This therapy also achieved a general improvement in ROM ($p < 0.05$), except for internal rotation, that persisted 1 month after treatment. Regarding functionality, both therapies achieved the level of significance ($p < 0.05$), but only MRG sustained the improvement in the midterm. General QoL, assessed with FACT-B, and its physical well-being dimension were significantly improved after MR implementation ($p < 0.05$), while the emotional dimension and the breast cancer subscale improved only with PMLD ($p < 0.05$).

Conclusions In conclusion, an MR-based treatment shows physical benefits (i.e., overall shoulder movement, functionality, and perceived pain) in women after breast cancer surgery.

Trial registration This study is registered on ClinicalTrials.gov NCT03182881.

Keywords Breast cancer · Myofascial release · Range of motion · Quality of life

Introduction

Breast cancer (BC) is a pathology with a high incidence worldwide [1] The most common medical treatments include conservative surgery or mastectomy, and both must be accompanied by coadjuvant techniques such as radiotherapy [RT] or brachytherapy [BT] [2]. However, these treatments often lead to a series of side effects, such as lymphedema, with an incidence of 42% [3], which produces chronic inflammation, causing, in turn, a diverse symptomology such as pain in the arm and neck region [4]. Likewise, other side effects often develop, such as fibrosis or retractions of the connective tissue derived from scars caused primarily by the radiation or the surgical intervention itself [5]. Early treatment of these side effects may prevent the retractions from becoming established and permanently limiting functionality [5].

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Different approaches to treating these side effects are found in the scientific literature. Some of the main physical treatments include (i) manual lymphatic drainage (MLD), one of the most-used in the treatment of lymphedema and used to improve the volume of the affected arm [6] and reduce pain [7]; (ii) compressive bandages which, alone or in conjunction with lymphatic drainage, have been shown to be effective in reducing volume [8]; (iii) complex decongestive therapy (CDT), which combines the previous two therapies plus certain exercises, and has also been shown to be effective in volume reduction of lymphedema [9] and in the improvement of overall well-being [9]; (iv) physical exercise in general, which has been shown to be effective in achieving an improvement in the increased volume caused by lymphedema and in functionality [10].

Myofascial release (MR) is another treatment with potential benefits for patients with side effects related to BC. The techniques used apply sustained pressure seeking to reduce restrictions of the fascial system. The mechanical stimulation that is produced with myofascial release or induction treatment promotes the reorientation of collagen fibers and thus quality of movement, allowing an improvement in fluid circulation and lymphatic drainage [11], which could help reduce the adherences caused by scarring and the fibrosis caused by radiation. This could, in turn, promote improvement in mobility and function, while reducing the intensity of perceived pain [12]. Thus, improvements in terms of quality of life and depressive symptoms could also be obtained. However, to date, only one study has analyzed the impact of the MR treatment approach in patients with BC, although in this case MR techniques were not used in isolation, but combined with other physiotherapy techniques, such as passive mobilizations, stretching, and massage [13].

Based on the foregoing, our primary objective was to analyze the short and midterm effects of BC-specific MR, as a single treatment, on pain, mobility, and functionality of the upper limbs. Secondarily, its effects on quality of life and depression were analyzed.

Materials and methods

Participants

The sample included women from the Valencia Spanish Association Against Cancer, who were recruited using a purposive sampling technique. The study was carried out from January to May of 2017. The inclusion criteria were being aged between 30 and 60 years old, diagnosed with breast cancer and treated with conservative/partial surgery at least 4 months earlier, without lymphedema or with stage 1 lymphedema [14], presenting pain and having one or more of the following symptoms: heaviness, numbness, oppression, stiffness, alterations in the function, or mobility of the shoulder [15]. Additionally, subjects must have completed adjuvant treatment (i.e., radiotherapy or chemotherapy). Excluded from the study were women with muscle or tendon injuries in the arm and/or neck, skin conditions, circulatory pathologies, or surgical history in adjacent areas (i.e., shoulder, neck, or chest).

Study design

The study was a randomized controlled trial. Upon completion of the recruitment process, the participants were randomly allocated by a statistician to two different groups using computer software: the treatment group, in which MR was applied (MRG), and the control group in which a placebo MLD (PMLD) was performed (CG). Both interventions were administered over a period of 4 weeks (one session per week), with a duration of approximately 50 min per session. To analyze the effect of the interventions, three evaluations were carried out: one before beginning treatment (T0), one upon its completion (T1), and at follow-up 1 month after completion (T2).

Both the evaluator and the statistician were blinded to the goals of the study. The treatments were applied by an experienced physiotherapist with the necessary training in these techniques. All procedures were conducted in accordance with the principles of the Declaration of Helsinki of the World Medical Association, and were approved by the Human Research Ethics Committee of the University of Valencia with protocol number H1442824702282. This trial was registered at www.clinicaltrials.gov (registration number: NCT03182881). Written informed consent was obtained from the participants before the trials started.

Interventions

Both treatments were performed with the patient in supine decubitus position, with arms extended alongside the body with the affected arm slightly lifted (approximately 30°), and no lubricant was applied. During the treatment, the patient was instructed to breathe gently and consciously. In each session, possible injuries were recorded by the physiotherapist.

Myofascial release The treatment applied was based on the technique proposed by Pilat, A. [11]. Four maneuvers were selected for the perinodal and upper thoracic region. They were applied in the following order: sterno-pectoral, global pectoral, pectoral, and subscapularis (Fig. 1). Each technique was applied placing both hands in contact with the skin in order to perform a three-dimensional fascial movement with light pressure and stretching of the connective tissue. The approximate duration of each technique was 10 min. The purpose of this treatment was to release the most relevant fascial

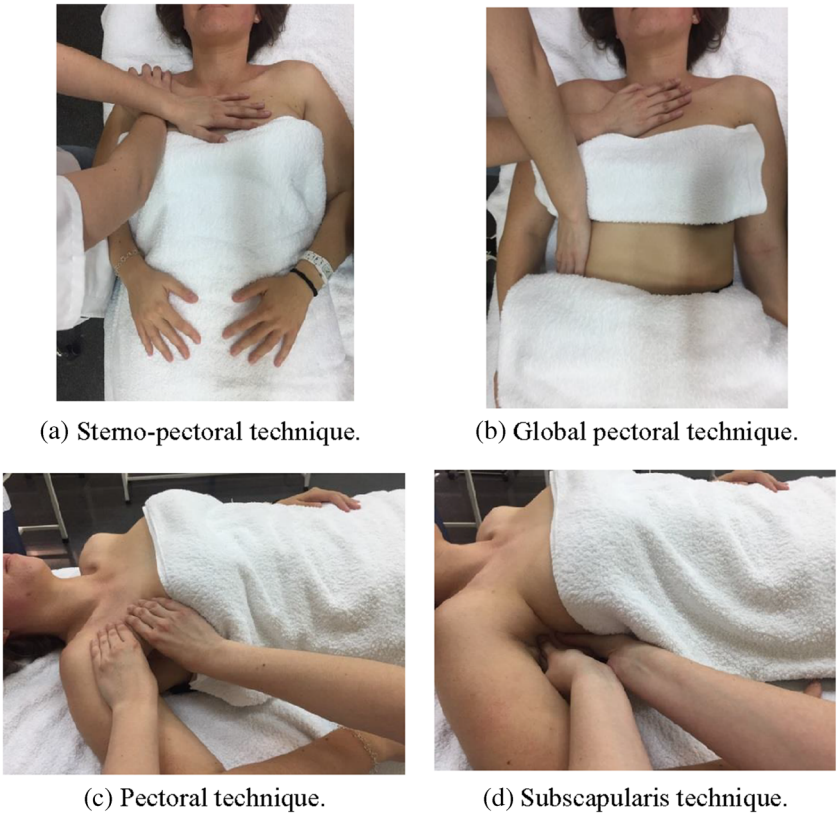


Fig. 1 **a** Sterno-pectoral technique. **b** Global pectoral technique. **c** Pectoral technique. **d** Subscapularis technique

and fibrosis-related restrictions and thus improve pain, mobility, and functionality of the upper limb.

Placebo manual lymphatic drainage The intervention was applied following the method of Leduc et al. [16], and gentle, superficial manipulation of the axillary lymph nodes in the chest and arm region was performed following the same sequence as that used by Guerero et al. [17]. The primary objective of this study intervention was to establish a control group.

Measurements

Primary outcome

Pain Self-perceived pain intensity was measured with a visual analog scale (VAS). This scale, whose reliability has been demonstrated [18], consists of making a mark on a horizontal line 10 cm in length according to the pain intensity perceived, with 0 being "no pain at all," and 10 being "maximum tolerable pain" [19].

Secondary outcomes

Range of motion The active angular reach was measured for all movements of the shoulder (i.e., flexion, extension, abduction, adduction, internal, and external rotation) using a manual goniometer, which has been shown to be a valid and reliable tool [20]. The assessment of active shoulder mobility of the injured arm was performed with the participants sitting on a rigid seat with their trunk upright, knees flexed at 90°, and feet flat on the floor. Two repetitions of each movement were conducted, and the average of these two measurements was used in further analyses. Goniometric measurements were performed by aligning the fulcrum of the goniometer with the corresponding location of the glenohumeral joint axis and aligning the goniometer arms with different bony landmarks depending on the movement [21]. The instructions were brief: "Lift your arm as much as you can and hold it in that position."

Shoulder functionality (functionality) This was measured using the disabilities of the arm, shoulder, and hand scale (DASH) [22] This self-administered questionnaire is a specific instrument that measures the perception of disability in the performance of daily activities, as well as pain, stiffness, or loss of strength. It consists of 30 items, each scored from 1 to 5 according to the intensity of symptoms. The total score ranges from 0 (best possible score) to 100 (worst possible score). The Spanish version of the questionnaire used showed very good internal consistency (Cronbach's $\alpha = 0.96$), and very good reliability ($r = 0.96$) [23].

Depression This variable was assessed by the Patient Health Questionnaire-9 (PHQ-9), as this questionnaire is used in

oncology studies [24]. It consists of 9 items which evaluate the presence of depressive symptoms during the last 2 weeks. The score ranges from 0 to 27, and each item is scored from 0 (never) to 3 (more than half the days). A diagnosis of depression is suggested when 5 of the 9 symptoms have been present more than half of the days of the past 2 weeks. The validated Spanish version has shown similar properties to those of the original version, with good internal consistency (Cronbach's $\alpha = 0{,}835$) [25].

Quality of life This variable was assessed with The Functional Assessment of Cancer Therapy for breast cancer patients (FACT-B + 4), which presents 36 items. The first 27, which correspond to a general part of the questionnaire (FACT-G) [26] combined with the last 9 items, a subscale specifically related to breast cancer, made up the overall score, with higher scores representing a better quality of life. Further, FACT-G offers four dimensions: physical well-being (7 items), social/family well-being (7 items), emotional well-being (6 items), and functional well-being (7 items). Response options are Likert-type with 5 levels (0 = not at all; 4 = a lot). The internal consistency of FACT-B is very good ($\alpha = 0.90$) and its reliability is acceptable (ICC = 0.75) [27].

Sample size calculation

Sample size calculation was based on the primary outcome, that is, the perceived pain score. The sample size was calculated at 90% power to detect a mean difference of 4 points [28] with a standard deviation of 6 points, on the VAS, using a type 1 error (α) of 5%, and a type 2 error (β) of 10%. This calculation rendered 11 patients in each group. Ultimately, 13 women were included in the MRG and 11 in the CG. G-Power® 3.1. version was used for sample size estimation (Institute for Experimental Psychology, University of Düsseldorf, Düsseldorf, Germany).

Statistics

All statistical analyses were performed with SPSS v.22 (IBM SPSS, Inc., Chicago, IL, USA). Standard statistical methods were used to obtain the mean and standard deviation (SD). Inferential analyses of the data were performed using two-way mixed multivariate analysis of variance (MANOVA), with an inter-subject factor called "group" with two categories (CG and MRG) and a within-subject factor called "treatment" with three categories (T0, T1, and T2). Post-hoc analysis was conducted using the Bonferroni correction provided by the statistics package used, and the effect size was calculated using Cohen's *d*. We also compared the age and the level of pain experienced between groups using an independent Student *t* test to ensure that the two groups were similar at baseline. Type I error was established as < 5% ($p < 0.05$).

Results

Participants

Twenty-four women participated in the study with a mean (SD) age of 53.71 (9.10) years, ranging from 24 to 69 years. Thirteen women made up the MRG and 11 made up the CG, with a mean (SD) age of 53.15 (10.91) years and 54.36 (6.86) years, respectively. For both groups, all of the participants completed the therapy program, attending all planned sessions (Fig. 2) and without reporting any injury in any of the sessions. The clinical profile of the participants is shown in Table 1. Results showed no differences in age, range of motion, or pain at baseline between groups ($p > 0.05$).

Effect of the treatment

A significant multivariate effect of the interaction between "group" and "treatment" was obtained $F(32,52) = 1.81$, $p < 0.05$, $\eta^2 = 0.53$. The significant differences and effect size among the three assessments (i.e., T0, T1, and T2) for each group and each variable are shown in Table 2, as well as the differences between groups in each of the assessments. Pain significantly decreased immediately after MR, and this improvement persisted 1 month after treatment. No effects on pain were observed in the CG, either in the short or the midterm. Regarding ROM, MR therapy significantly improved the range of all movements, except for internal rotation. These improvements were maintained in the follow-up measurement. Likewise, PMLD therapy also presented a significant positive effect on ROM, but only for extension, adduction, and internal rotation. This increase in ROM also endured after treatment for extension and adduction, but not for internal rotation. Regarding functionality, both therapies achieved the established level of significance, thus showing an increase in functionality, but only the MRG sustained the improvement in the midterm. The depression score decreased significantly in the CG only.

Figure 3 shows the results of QoL measured by the FACT-B + 4 questionnaire (all dimensions and the general score) for both groups. There were no differences between groups in any of the conducted assessments ($p > 0.05$). The comparisons among the assessments in each group showed that MLD had a significant positive effect on the emotional well-being dimension (mean difference (MD) = 2.27 points; $p = 0.02$) that persisted in the follow-up measurement (MD = 2.00 points; $p = 0.03$), as well as on the breast cancer subscale in the short-term only (MD = 3.27 points; $p = 0.04$). MR resulted in a significant positive effect on the physical well-being dimension (MD = 4.83 points; $p = 0.01$) and on the FACT general score (MD = 9.75 points; $p = 0.02$), both in the short term.

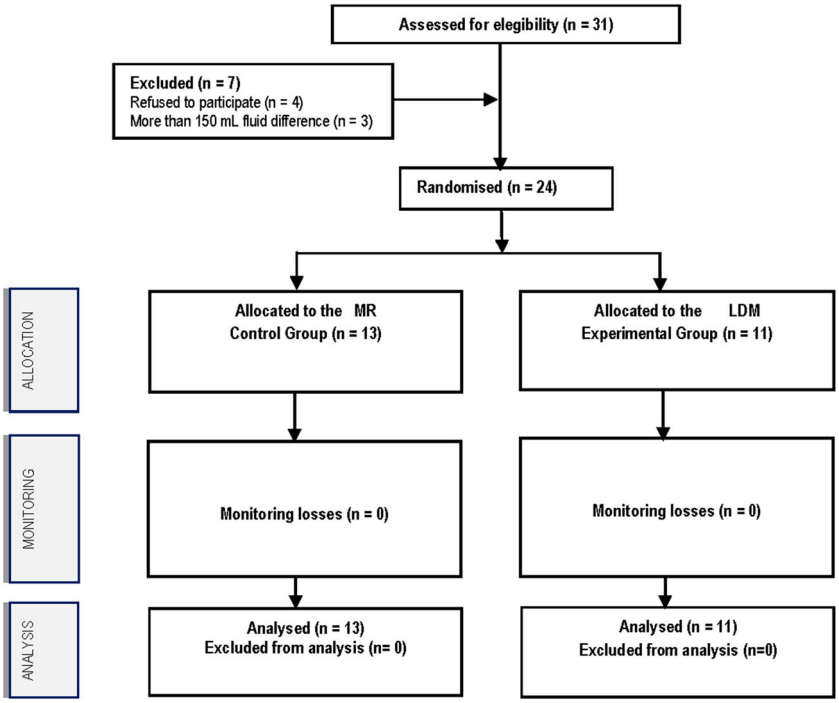


Fig. 2 Flowchart according to CONSORT statement for the report of randomized trials

Discussion

The current study shows that an MR-based treatment presents short- and midterm therapeutic benefits on clinical parameters related to pain and physical function in women after conservative breast cancer surgery and radiotherapy.

Regarding the pain intensity experienced, only the MRG experienced an improvement beyond the minimum clinically significant difference in pain severity (i.e., greater than 3 points) [28]. It is noteworthy that this improvement was observed both in the short and the midterm, suggesting that MR therapy is able to restore the optimal physiological condition of the fascial system, thus alleviating pain. Indeed, MR is a manual technique that applies the principles of biomechanical loading of soft tissue and the modifications of the neural reflexes through stimulation of the mechanoreceptors in the fascia [29]. This is a connective tissue that forms a three-dimensional network, which surrounds and supports the muscular, skeletal, and visceral components of the body. Fascial restrictions can join and exert pressure and stress on the body and its soft tissue structures, causing pain and dysfunction. The objective of MR is to release these fascial restrictions and restore the healthy tissue [30], thus having a potential effect on perceived pain. These results are consistent with previous studies that have used MR for the treatment of cervical and lumbar pain [31] and pain associated with epicondylitis [32].

With regard to ROM, PMLD had an impact on shoulder range of motion, with a statistically significant increase in movements in which the arm moves towards the body midline (i.e., extension, adduction, and internal rotation). Nevertheless, these significant differences did not go beyond the minimum detectable change (MDC) [33], so our results are in line with those of existing studies that concluded that PMLD did not produce a significant benefit alone and should be combined with other therapies [34]. However, MR achieved a significant impact on movements towards the midline, but also those in the outward direction (except for internal rotation), and the significant increases always exceeded the minimum detectable change [33]. Furthermore, the improvements obtained persisted 1 month after the completion of the intervention.

Table 1 Clinical profile of the participants

	MRG		CG		Total	
	n	%	*n*	%	*n*	%
Surgery						
Quadrantectomy	5	38.5	7	63.6	12	50.0
Lumpectomy	8	61.5	4	36.4	12	50.0
Affected Breast						
Right	8	61.5	3	27.3	11	45.8
Left	5	38.5	8	72.7	13	54.2
Axillary clearance						
Yes	5	38.5	5	45.5	10	41.7
No	8	61.5	6	54.5	14	58.3
Radiotherapy						
Yes	13	100.0	11	100.0	24	100.0
No	0	0.0	0	0.0	0	0.0
Brachytherapy						
Yes	2	15.4	0	0.0	2	8.3
No	11	84.6	11	100.0	22	91.7

MRG, myofascial release group; *CG*, control group; *n*, absolute frequencies; %, relative frequencies

Table 2 Comparison of the interventions in the short and medium term

	Groups	T0	T1	T2	Cohen's *d* T0-T1	Cohen's *d* T0-T2	Cohen's *d* T1-T2
Pain	CG	4.95 (2.09)	3.77 (2.49)	4.68 (1.61)	0.51	0.01	0.43
	MRG	6.48 (1.52)	2.87 (1.99)*	3.62 (3.07)‡	2.03	1.18	0.29
Flexion	CG	161.91 (11.93)	169.27 (8.78)	161.82 (12.32)	0.70	0.70	0.01
	MRG	144.83 (29.18)	166.5 (15.38)*	162.33 (15.17)‡	0.92	0.75	0.27
Extension	CG	35.55 (14.26)	45.64 (9.49)*	46.64 (8.83)‡†	0.83	0.94	0.11
	MRG	36 (17.07)	50.67 (11.41)*	53.92 (6.36)‡	1.01	1.39	0.35
Abduction	CG	110 (25.59)	116.18 (23.49)	127.18 (26.67)	0.25	0.66	0.44
	MRG	101.67 (32.72)	121.92 (25.88)*	137.67 (38.3)‡	0.69	1.01	0.48
Adduction	CG	34.27 (9.35)	44.55 (5.08)*	43.73 (3.00)‡	1.35	1.34	0.20
	MRG	36 (9.52)	44.25 (4.82)*	42.67 (5.78)‡	1.09	0.85	0.30
Internal rotation	CG	67.73 (13.26)	74.36 (9.28)*	67.64 (19.52)	0.58	0.01	0.44
	MRG	75.92 (5.45)	73.92 (9.3)	74.67 (9.27)	0.26	0.16	0.08
External rotation	CG	62.18 (18.2)	69.09 (15.81)	70.82 (17.02)	0.40	0.49	0.06
	MRG	59.17 (18.49)	68.67 (14.17)*	69.42 (17.28)‡	0.58	0.57	0.05
Functionality	CG	34.77 (14.32)	25.37 (11)*	33.55 (19.39)	0.74	0.07	0.72
	MRG	33.46 (14.92)	20.69 (16.2)*	22.26 (14.49)‡	0.82	0.76	0.10
Depression	CG	11.64 (6.6)	8.18 (4.4)*	8.00 (4.00)	0.62	0.67	0.04
	MRG	9.08 (4.01)	7.08 (4.03)	6.92 (3.7)	0.50	0.56	0.04

Data are shown as mean (standard deviation). T0, baseline measurement; T1, post-treatment measurement; T2, follow-up measurement; MRG, myofascial release group; CG, control group; *significant differences ($p < 0.05$) between T1 and T0; ‡significant differences ($p < 0.05$) between T2 and T0; †significant differences between groups. Cohens's *d*: size effect

The MR approach e is focused on the reduction of fibrosis and scarring, but our results show that it may lead to an increase in general shoulder ROM. These results are in agreement with previous studies that have observed a positive influence of MR on knee ROM [35] and on range and ease of movement of the wrist in patients with diffuse systemic sclerosis [36]. However, to our knowledge, no previous studies have examined the repercussions of this technique on general ROM of the upper limb in people with breast cancer, making this the first work to demonstrate its effectiveness, not only in pain reduction, but also in the improvement of ROM. This is of great importance, since it has been reported that decreased shoulder motion in breast cancer survivors may put women at risk for developing symptomatic rotator cuff disease [37].

Both therapies conducted showed a statistically significant improvement in *Functionality* of the shoulder. Nevertheless, only the MR therapy presented an effect beyond the MDC [38, 39] and achieved benefits that persisted one month after treatment. The increase in almost all shoulder movements as described above may have an impact on functionality in activities of daily life, as has been shown in previous studies addressing the relationship between ROM and functionality [40].

When QoL was studied based on the different dimensions of the FACT questionnaire, the MRG showed a significant increase in the short and midterm, not only in the general score but also in the specific physical well-being score, which reinforces the previous results related to greater functionality following the application of this type of therapy. However, this therapy had no influence on other dimensions not directly related to the physical condition, as did the CG intervention. PMLD affected the specific subscale for breast cancer in which self-perception and feelings or fears about the future are assessed, as likewise reported in a previous study by Ridner et al. [41]. Additionally, this intervention had an impact on the emotional subscale.

The different variable improvements obtained by each group may suggest that placebo MLD, used for the control group (since our sample showed no signs of severe lymphedema), affected the emotional area, as has been previously reported in patients with venous disease, for whom anxiety and depression improved [42], and in patients with breast cancer [43], while MR has a positive impact on the functional and pain domains.

These results for the emotional sphere are also consistent with those obtained for the variable depression, which improved only when PMLD was applied, but not with MR therapy. The effect on depression in the CG achieved a level of statistical significance consistent with the results reported by Williams et al. [43], whereby an improvement in depressive symptoms was also achieved following PMLD intervention. It is suggested that PMLD produces acute neural effects that increase relaxation [44], with yawning being one of the symptoms of relaxation or low

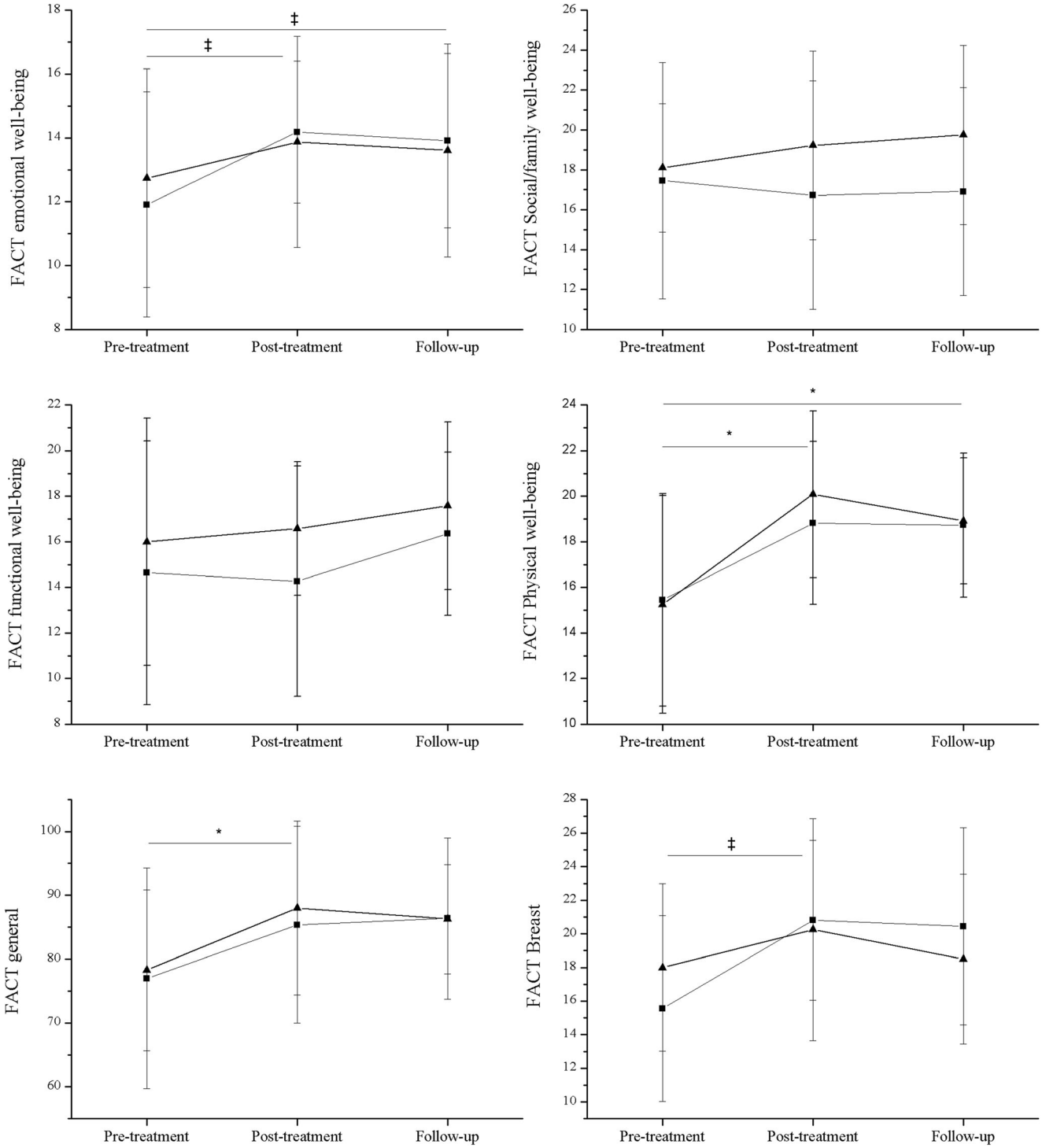


Fig. 3 Results of QoL measured by the FACT-B + 4 questionnaire

levels of alertness [45]. In this regard, we frequently observed yawning in patients during PMLD sessions, although this symptom was not recorded systematically.

Conversely, MR treatment had no effect on this emotional sphere. Instead, it specifically improved the ROM and pain experienced, implying that MR may be a beneficial therapeutic approach to this population in which movement restrictions and pain are common symptoms following conservative interventions.

Limitations and strengths

The main limitation of this study is the sample size. We calculated the sample size using the main outcome (i.e., pain) but

the sample is heterogeneously distributed in terms of range of motion. This could lead to a type II error. Therefore, the results for the range of motion should be interpreted cautiously. On the other hand, it would have been interesting to include a group of women with lymphedema ascertain if similar improvements might be achieved using MR treatment.

Although the results for MR are similar to those for manual lymphatic drainage (the most typical treatment for this population), benefits are also achieved for other functional aspects and pain; accordingly, this study has defined a new therapy which may be used in this population. It could further be used to treat pathologies or injuries that involve tissue restriction.

Conclusions

Based on the foregoing, an MR-based treatment appears to offer physical benefits, not only in terms of overall shoulder movement, but also of functionality and perceived pain in women following breast cancer surgery. Therefore, the use of MR may possibly counter certain secondary effects related to breast cancer and improve the recovery process.

Compliance with ethical standards

All procedures were conducted in accordance with the principles of the Declaration of Helsinki of the World Medical Association, and were approved by the Human Research Ethics Committee of the University of Valencia with protocol number H1442824702282. Written informed consent was obtained from the participants before the trials started

Conflict of interest The authors declare no conflict of interest, personally or related to funding.

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