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Research article

Evaluating the combined effect of scar management techniques and scapular strengthening exercises on posture and scapulohumeral rhythm in women after mastectomy: a protocol study

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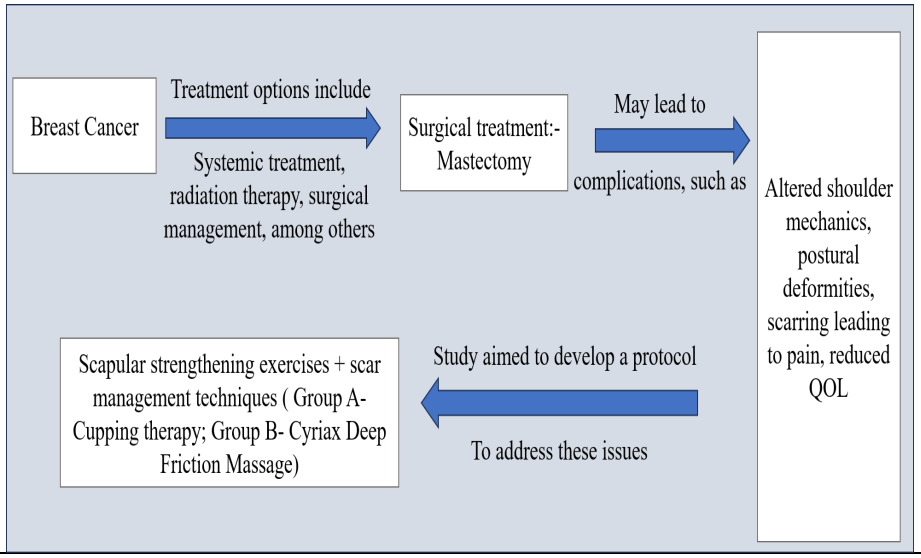
ABSTRACT

Although it is established that scarring following a mastectomy affects shoulder mechanics, there is a scarcity of research available. This study aims to evaluate the effectiveness of a combined intervention of scapular strengthening exercises and scar tissue management techniques on posture and scapulohumeral rhythm in women following unilateral mastectomy. A total of 28 participants who meet the inclusion criteria will be recruited for the study. The participants will be randomly divided into two groups, one group will receive cupping therapy for scar management while the other group will receive Cyriax deep friction massage. Both the groups will receive scapular strengthening exercises. The intervention will be performed and supervised by qualified physiotherapists. This research is distinctive as it combines two essential, but often separately examined rehabilitation aspects which are scapular strengthening exercises and scar management methods, to tackle postural and scapulohumeral rhythm issues in women following mastectomy. Furthermore, this study fills a notable void in the existing literature by investigating the direct effects of scar management techniques on postural alignment and scapular movement patterns, a topic that has garnered little focus despite its importance in clinical practice.



Keywords: Mastectomy, Scar management, Posture, Scapulohumeral rhythm, Oncology rehabilitation.

INTRODUCTION

Breast cancer remains a significant global health challenge, representing one of the most prevalent malignancies among women worldwide [1]. In 2020, approximately 2.3 million new cases of breast cancer were diagnosed, and about 685,000 deaths occurred due to the disease, making it a leading cause of cancer-related mortality among women worldwide [2].

In India, breast cancer represents a serious concern, largely attributable to the late detection of the disease. Government data from the Indian Minister of State in the Ministry of Health and Family Welfare indicates that, on average, 40% of women diagnosed with breast cancer in India in 2020 succumbed to the illness [3].

Treatment modalities for breast cancer have evolved significantly over the years, encompassing a multifaceted approach that integrates surgical interventions, systemic therapies, and radiation therapy to optimize patient outcomes [4]. Surgical procedures remain a fundamental aspect of managing breast cancer. Mastectomy refers to the surgical excision of all or part of the breast, along with nearby tissues and lymph nodes [5]. A modified radical mastectomy is a more comprehensive surgery that involves the total removal of breast tissue and the associated lymph nodes [6].

Advancements in breast cancer treatment have led to improved survival rates leading to the 5-year survival rate being more than 90% in patients undergoing unilateral mastectomy [7-9]. Due to the increased survival rates, it is crucial to acknowledge the potential for treatment-related musculoskeletal and functional complications that can significantly impact patients' well-being [10]. These complications often manifest as shoulder pain, restricted shoulder mobility, anatomical and biomechanical changes in the shoulder girdle, thereby affecting patients' ability to perform activities of daily living [1, 11]. The underlying causes of shoulder pain following breast cancer treatment are multifaceted, encompassing muscle tightness, neurogenic pain stemming from lymph node removal, and restricted range of motion [1].

Unilateral mastectomy can disrupt muscle tension balance in the body, resulting in postural abnormalities such as trunk rotation, spinal misalignment, scapula and shoulder asymmetry, and changes in pelvic tilt. These issues lead to postural imbalances that can increase the risk of musculoskeletal pain and dysfunction [10]. Such postural distortions not only compromise physical function but can also precipitate negative self-image and somatic symptoms such as back and neck pain, thereby diminishing overall quality of life [12, 13]. Notably, the prevalence and severity of postural changes tend to increase progressively over time following unilateral mastectomy, particularly within the initial 3 to 6 months post-surgery, underscoring the importance of early intervention and targeted rehabilitation strategies to mitigate these adverse effects [10].

After a modified radical mastectomy, shoulder tightness can impact glenohumeral translation and Scapulohumeral rhythm, leading to alterations in scapular motion. Specifically, the shortening of the pectoralis major and minor muscles, which cover the front of the shoulder and chest and can restrict shoulder range of motion [14]. Scapular strengthening exercises, along with conventional treatment, have demonstrated efficacy in improving shoulder function, reducing pain, and enhancing functional ability following modified radical mastectomy [1].

Scarring is a natural part of the wound healing process and is known to be one of the most frequent complications that arises after a mastectomy [15]. Scars can significantly influence an individual's physical, social, emotional, and cognitive well-being, thereby impacting their health-related quality of life (HRQOL); therefore understanding the implications of scarring has become extremely important. Mastectomy scars can cause soft tissue adhesions, leading to pain, stiffness, and restricted shoulder movement, which hinder daily activities and reduce quality of life. Beyond physical discomfort, these scars may also affect emotional, social, and cognitive well-being, impacting overall HRQOL. Factors such as scar visibility, texture, and location further influence body image and self-satisfaction [16].

Cupping therapy, an ancient healing technique, involves placing cups on the skin to create localized suction. This process promotes increased blood flow, facilitates tissue mobilization, and provides pain relief. It's often used in scar therapy as a supportive technique. By creating suction at sub atmospheric pressure, cupping enhances blood circulation and improves tissue flexibility. Additionally, it is simpler to apply than traditional methods like massage and stretching [17, 18].

Cyriax deep friction massage, developed by Dr James Cyriax, aims to preserve the mobility of the soft tissue structures preventing the formation of adherent scars. This method helps to eliminate or prevent abnormal fibrous adhesions (which are cross-links or cross-bridges) by applying transverse stress to the remodelling collagen of the tissue, thereby softening the adhesions. Consequently, DTFM improves the quality of scar tissue by aligning the collagen fibers of normal soft tissue longitudinally. Research suggests that DTFM promotes proper healing and helps avoid abnormal scarring. Its mechanical effect also increases blood flow to the affected area, resulting in hyperemia [19].

Considering the crucial role of the scapula in shoulder mechanics and the negative consequences of scarring after mastectomy, along with the limited research available in this field, this study aims to evaluate the synergetic effect of scapular strengthening

exercises and scar tissue management techniques on Posture and Scapulohumeral Rhythm in women after unilateral mastectomy.

Objectives

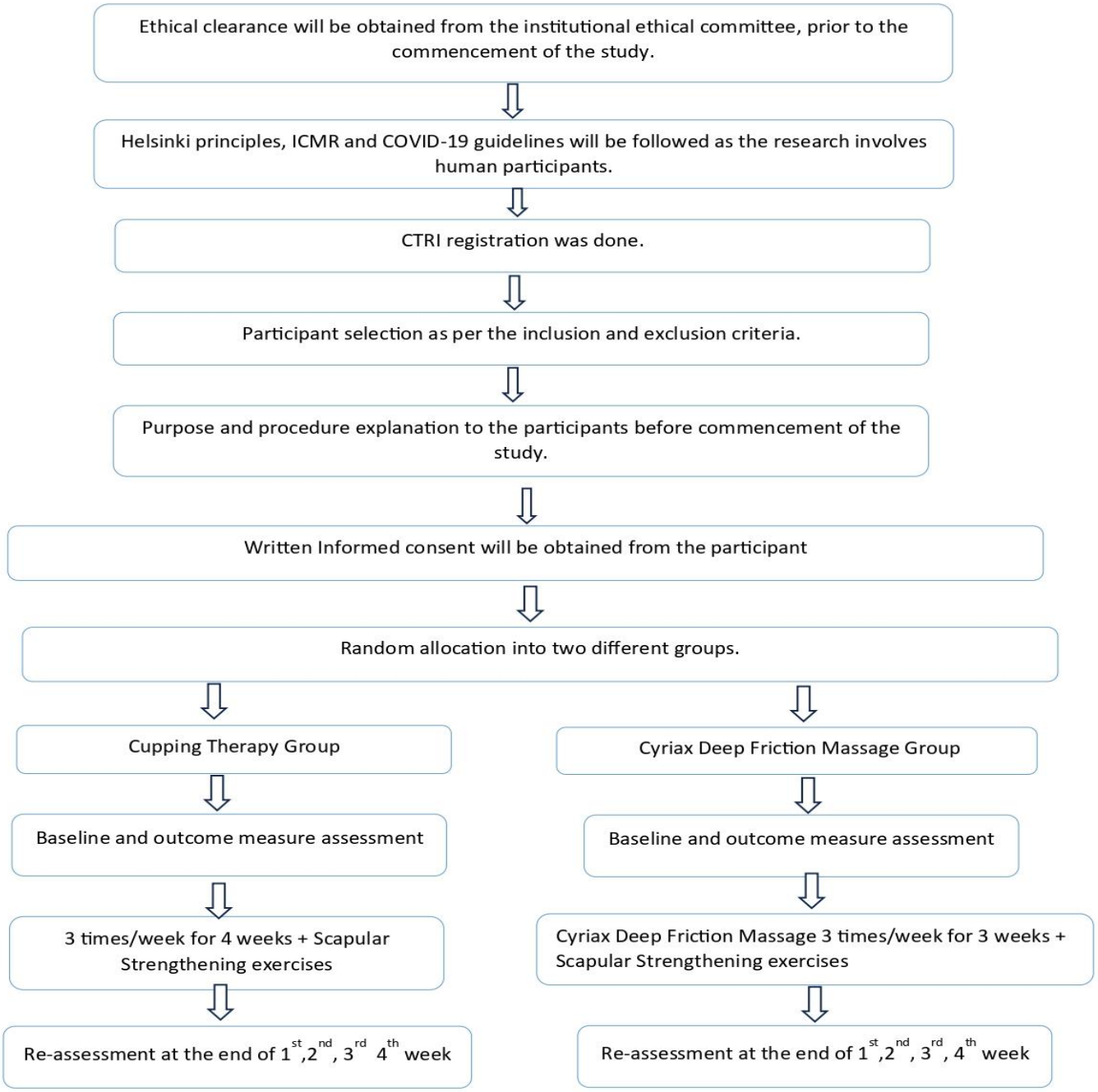
This study aims to evaluate the synergetic effect of scapular strengthening exercises and scar tissue management techniques in terms of the primary outcome measures which are Forward head and rounded shoulder posture (Photographic Method) [20] and Scapulohumeral rhythm (modified digital inclinometer.) [21, 22] which will be measured at baseline and at the end of 1st, 2nd, 3rd, and 4th week

The secondary outcome measures were Scar Quality (Patient And Observer Scar Assessment Scale 3.0)[23], Shoulder and pain disability (Shoulder Pain and Disability Index (SPADI)) [24], and Health-Related Quality of Life (Functional Assessment of Cancer Therapy - Breast) [25] measured at baseline and the end of 2nd, and 4th weeks and grip strength using hand held dynamometer.

Trial Design

The trial design is a single blinded Randomized Clinical Trial with parallel groups (Cupping therapy group and Cyriax Deep Friction Massage group). Sampling method that will be used is Simple random allocation using envelope with an allocation ration of 1:1. Figure 1 summarizes the study design. Participants will be randomly allocated in either cupping therapy group or Cyriax deep friction massage group. Both the groups will receive 12 sessions of treatment, which will be conducted 3 times a week for 4 weeks.

METHODOLOGY



METHODS

Eligibility criteria: A total of 28 participants who meet the inclusion criteria will be recruited for the study. The eligible subjects are female breast cancer survivors aged between 18 and 60 years, who have been referred for physiotherapy and have undergone mastectomy surgery at least three months prior. Participants must exhibit a craniovertebral angle of 50° or less (indicating forward head posture) or a forward shoulder angle of 52° or greater. Additionally, they should not be undergoing any scar therapy and must be willing to participate by providing a written informed consent. The exclusion criteria includes females diagnosed with metastatic cancer, those with a prior history of shoulder injury before mastectomy surgery, individuals with any unhealed wounds or scars less than six weeks old in the affected area, and those who have experienced trauma or suffer from conditions affecting muscles and joints, such as rheumatoid arthritis, skin grafting near the shoulder, or any neurological dysfunction or psychiatric disorders. The intervention will be performed and supervised by qualified physiotherapists.

Informed Consent

Informed consent will be obtained by one of the primary researchers: SG or NP. The informed consent process will begin with a thorough explanation of the study, including the assessments, procedures, associated risks, and benefits. Patients will have ample opportunity to ask any questions they may have. They will also be provided with a printed copy of the informed consent form to read at their leisure and take home for further consideration if they wish.

Trial Registration

The study is prospectively registered with the Clinical Trials Registry- India

https://ctri.nic.in/Clinicaltrials/pmaindet2.php?EncHid=MTE1Mjg5&Enc=&userName=CTRI/2024/11/076656

Outcome Measures

The primary outcome measures will include the Forward Head Angle (Craniovertebral Angle), Forward Shoulder Angle, and Scapulohumeral Rhythm, which will be assessed at baseline and at the end of weeks 1, 2, 3, and 4. The Forward Head Angle and Forward Shoulder Angle will be evaluated using a photographic method, while the Scapulohumeral Rhythm will be measured with a modified digital inclinometer (Pro 360, Baseline®). One end of the inclinometer will be placed at the spine's scapular root, and the other end will be positioned on the postero-lateral part of the acromion process. The upward rotation of the scapula will be recorded in four positions: at rest, and at 60, 90, and 120 degrees of humeral elevation in the scapular plane. Secondary outcome measures will include Scar Quality, assessed using the Patient and Observer Scar Assessment Scale 3.0 (POSAS) Linear version, the Shoulder Pain and Disability Index (SPADI), Hand Grip Strength measured by a Hand Held Dynamometer (Jamar), and Health-Related Quality of Life evaluated through the Functional Assessment of Cancer Therapy - Breast (FACT-B). These will be evaluated at baseline, at the end of week 2, and at the end of week 4.

The POSAS [23] consists of two components: the Patient Scar Assessment Scale, which includes 17 items, and the Observer Scar Assessment Scale, with 9 items. Each scale will use a 5-point scoring system, where 1 indicates normal skin and 5 means the greatest deviation from normal skin. The observer's scale will also allow for descriptions of the scar in terms of pigmentation, color due to vascularity, surface level, and texture.

Participants will be informed about the Shoulder Pain and Disability Index (SPADI) [24], a self-administered questionnaire that encompasses 13 questions focusing on pain and disability. Participants will rate their pain on a scale from 0 to 10 across five pain-related questions, and they will also indicate their level of disability on the same scale for eight questions related to disability.

The FACT-B [25] will evaluate five aspects of Health-Related Quality of Life in breast cancer patients: physical, social, emotional, functional well-being, and the breast cancer subscale (BCS). Higher scores will reflect a better quality of life. Grip strength will be assessed using a Hand Held Dynamometer by recording the average of three test scores.

Description of Interventions

Cupping therapy- Participants in the cupping therapy group will undergo treatment while lying on their back, with their arm elevated to a comfortable position and their elbow bent at a 90-degree angle. After applying lubricant, the therapist will perform myofascial release techniques starting from the coracoid end and moving along the muscle toward the sternal end to prepare the tissue for cupping. This will be followed by vertical mobilization and medial/lateral mobilization around the scar using a silicone cup for 3 to 4 minutes [26, 27].

Cyriax deep friction massage- In the Cyriax deep friction massage group, participants will also be positioned on their back with their arm raised within a pain-free range and the elbow bent at a 90-degree angle. The therapist will carefully palpate the area of the scar and perform friction massage transversely across it, ensuring that the patient's skin moves in sync with the therapist's fingers. This procedure will last between 10 to 12 minutes, depending on the length of the scar [28].

Participants of both the groups will then perform scapular strengthening exercises. After extensive literature search, a scapular strengthening exercise protocol was designed which is based on multiple studies that showed positive results including studies done by Seung Ah Lee, et al [29], and Prajwalraje Pramod Mohite, et al [1]. The description of the exercises along with the muscles targeted and the dosage of the exercise is given in Table 1.

Table 1a: Stretching and range of motion (rom) exercises

Exercises	Procedure
Clasping hands behind the back	In the standing position, the patient clasps hands behind the back, patient has to bend the body forward with a straight back until they feel the anterior chest stretching. 45 secs hold with 15 secs rest No. of repetitions- 3
Self-posterior capsular stretch	The patient has to take the affected arm across their body to rest their hand on the opposite shoulder, grasp the elbow with the other hand, gently push the elbow back, and keep pressure on as they pull the elbow and arm across the chest until the patient feels a stretch. 45 secs hold with 15 sec rest No. of repetitions- 3
Upper trapezius and levator scapulae stretch	The patient will be made to sit with feet supported on the ground, side flex the neck, and contra laterally look down into the armpit 45 secs hold with 15 sec rest No. of repetitions- 3
Pendular exercises	Lean well forward using a table or worktop for support a) Patient's arm hangs down as relaxed as possible. The patient has to swing their arm clockwise and then anticlockwise. b) Then swing forward and backward in line with the patient's body, parallel to their feet, Not across the body 10 reps x 2 sets in all direction

Table 1 b: Scapular strengthening exercises

Exercises	Procedure
Forward elevation with one hand Muscles targeted- Anterior deltoid, coracobrachialis, pectoralis major	In a standing position, the patient has to step on the theraloop and hold one end of the band. Elevate the arm upward and forward. Be careful not to roll the shoulder back 10 reps x 2 sets
Outward elevation with one hand Muscles targeted- 0-15 – Supraspinatus 15-90- Medial deltoid >90- Upper Trapezius	In the standing position, the patient has to step on the therloop, hold one end of the theraloop, and elevate the arm upward and outward, being careful not to roll the shoulder back 10 reps x 2 sets
Serratus wall slides Muscles targeted- Scapular Protractors: Serratus Anterior Pectoralis Major Pectoralis Minor Rotator Cuff: Infraspinatus Teres Minor	The patient has a mini theraband loop around hands and elbows, against a wall just below shoulder height. The patient has to spread the hands to create tension in the band and keep them in line with elbows and shoulders. The patient has to slowly slide their forearm up the wall as high as possible and slide them back down 10 reps x 2 sets
Scapular retraction Muscle targeted- Rhomboid major, minor and trapezius	Patient has to stand upright (Patient can also stand against the wall) with feet apart and retract the shoulder blades without shrugging the shoulder upwards toward the ear 10 reps x 2 sets
Forward scapular punch Muscle targeted- Serratus Anterior	The patient is in a standing position, holding an elastic band, placing it behind their back, and grabbing it with both hands placed beside the body. At the beginning, the elbow and scapula of both arms are fully flexed and retracted. The motion is initiated by flexing the shoulders, extending the elbow, one arm going to 100 degrees of shoulder flexion with a fully protracted scapula, while punching forward and then returning to the starting position 10 reps x 2 sets
Sword pull exercise Muscle targeted- Primary Muscles- Deltoid (Med and Post fibers), Infraspinatus, supraspintus; Secondary Muscles- Trapezius, Rhomboids	Patient is in standing position, steps on one side of the band with one foot and holds the other side of the band with other hand. The band should not have any slack in he starting position, it should be positioned in front of opposite part to the hand grasping the band. Patient stretches the band, so it makes a semicircle movement until patient extends her arm behind her back. The movement is similar to pulling a sword 10 reps x 2 sets
Shrugs in standing Muscle targeted- Upper trapezius	In standing position, participant steps on the middle of the band and grabs both sides of the band tightly. After which the participant will shrug his shoulders and holds for 3–5 seconds 10 repetitions x 2 sets

Criteria for Discontinuing or Modifying Allocated Interventions

Discontinuation of the intervention will be upon participant request, or in the presence of any adverse effect.

Sample Size Calculation

To determine sample size, technique of estimating sample size for Paired "t" test was used where significance level of 5%, Power of 80%, anticipated drop outs of 10% was considered, and the total sample size was calculated as 28, that is 14 in each group.

Data Collection and Management

A physical therapist specializing in cancer rehabilitation will reach out to patients to evaluate outcomes both at the beginning and during follow-up sessions. The data will be recorded anonymously in an Excel spreadsheet. Both control and experimental groups will be assigned anonymous numeric codes (1, 2) to maintain blinding for the individual conducting the statistical analysis. Information will be collected on printed questionnaires and then entered into an Excel dataset. A monitor will ensure data completeness and closely oversee patient follow-ups. Statistical analysis will be conducted using descriptive statistics (mean, standard deviation, median, interquartile range, and frequencies) as well as inferential statistics using the SPSS® program. Analysis will be performed both within and between groups for all parameters.

DISCUSSION

This research outlines a protocol for a prospective randomized clinical trial aimed at examining the combined effects of scapular strengthening exercises and scar management techniques on posture and scapulohumeral rhythm in women who have undergone

mastectomy. Prior studies have indicated that scapular strengthening exercises can enhance shoulder function; however, they have not included scar management strategies. On the other hand, those studies focusing on scar management for post-mastectomy patients typically incorporated shoulder mobilization along with arm and grip strengthening exercises but not scapular strengthening exercises or their impact on posture.

This study is unique as it integrates two crucial but often separately studied rehabilitation components—scapular strengthening exercises and scar management techniques—to address postural and scapulohumeral rhythm impairments in women after mastectomy. Additionally, this study addresses a significant gap in current literature by examining the direct impact of scar management techniques on postural alignment and scapular movement patterns, an area that has received limited attention despite its clinical relevance. A possible challenge in this study could be the differences in postoperative duration among patients, which may be attributed to geographical constraints.

The proposed study received ethical clearance from the institutional ethics committee of KLE Institute of Physiotherapy on 25/06/24, SI no- 807.

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