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COMPARISON BETWEEN PHONOPHORESIS WITH THERABAND EXERCISES AND PHONOPHORESIS WITH SCAPULAR STABILIZATION EXERCISES IN SECONDARY FROZEN SHOULDER AFTER MASTECTOMY: A COMPARATIVE STUDY

Dr Muhammad Waleed[*1], Dr Sana Javed[2], Dr Unsa Malik[3], Dr Faryal Hayat[4]

[*1,2,3]*Allied College of Health Science*
[4]*The Physio College of Rehabilitation and Sciences*

Corresponding Author: *
Dr Muhammad Waleed
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ABSTRACT

Background: *Secondary frozen shoulder (adhesive capsulitis) is prevalent and disabling postmastectomy complication that greatly impairs the mobility of the shoulder and functional independence. The use of physical therapy modalities like phonophoresis, TheraBand resistance exercises, and scapular stabilization has been shown to have clinical promise in treating these impairments, but their relative efficacy in patients postmastectomy is not well studied.*

Objective: *To determine the comparative effectiveness of phonophoresis with TheraBand exercises and phonophoresis with scapular stabilization exercises in enhancing pain, range of motion (ROM), and function in patients with secondary frozen shoulder after mastectomy.*

Methods: *32 subjects diagnosed with secondary adhesive capsulitis post-mastectomy were randomly assigned to two groups. Group 1 underwent phonophoresis with TheraBand exercises, and Group 2 underwent phonophoresis with scapular stabilization exercises. Treatment was given three times a week for six weeks. Outcome measures were Visual Analogue Scale (VAS) for pain, Disabilities of the Arm, Shoulder, and Hand (DASH) score, and ROM measurements for flexion, abduction, external and internal rotation. Paired t-tests were used for intra-group analysis with correlation and confidence intervals estimated.*

Results: *Both groups exhibited statistically significant improvements for all the measurements of outcome ($p < 0.05$). Group 2 had better improvement in DASH and ROM values with higher correlations ($r = 0.66$ to 0.79) and higher effect sizes. Reduction in pain was better in the scapular stabilization group (VAS mean post-treatment: 2.01 ± 0.60 vs. 3.45 ± 0.72 in Group 1).*

Conclusion: *Phonophoresis along with scapular stabilization exercises was superior to when paired with TheraBand training in increasing ROM, pain, and upper extremity function in secondary frozen shoulder following mastectomy. The addition of scapular-based rehabilitation could result in improved clinical outcomes in such patients.*

Keywords: *Secondary frozen shoulder, mastectomy, phonophoresis, TheraBand, scapular stabilization, ROM, DASH, VAS.*

INTRODUCTION

Background Knowledge

Breast cancer (BC) is the leading venom among women globally and surgical procedures especially modified radical mastectomy are life-saving but often accompanied by post-operative complications such as shoulder dysfunction, pain, and adhesive capsulitis (frozen shoulder) (Prajwalraje Pramod Mohite 1, 2023). Mastectomy may disturb scapulothoracic biomechanics, scar tissue, and nerve integrity and produce restricted glenohumeral motion and disturbed scapular kinematics, which may significantly affect activities of daily living.

Adhesive capsulitis (AC) is marked by progressive pain and stiffening of the shoulder joint capsule, progressing through three phases freezing (prenatal pain and progressive stiffness), frozen (profound restriction of ROM), and thawing (return of ROM gradually). AC can be idiopathic, but trauma following surgery like mastectomy predisposes patients to secondary AC. Secondary frozen shoulder tends to occur between 6 and 12 months after surgery, which is the time for maturation of the scar and tissue fibrosis (Aboelnour, 2023).

Physical therapy is the primary treatment for post-mastectomy shoulder morbidity. Yet, protocols are very heterogeneous, with little agreement on optimal practice. Scapular stabilization exercises have gained more support: a randomized controlled trial by Aboelnour et al. (2023) demonstrated that integrating progressive TheraBand strengthening with scapular stabilization provided better improvement in pain, DASH scores, and ROM than standard physiotherapy alone in post-mastectomy AC patients.

TheraBand resistance training provides dynamic strengthening, enhanced neuromuscular coordination, and reduced risk of injury from elastic resistance. Scapular stabilization addresses the scapulothoracic-lumbar chain, maximizing patterns of muscle activation and reestablishing glenohumeral rhythm, which is critical when post-mastectomy pain and scar tissue lead to scapular deskin (Prajwalraje Pramod Mohite 1, 2023).

Phonophoresis, trans-dermal administration of local anti-inflammatory like Naproxen or Diclofenac by ultrasound, increases local tissue penetration of drugs, decreases inflammation, and alleviates pain in adhesive capsulitis. Barua et al. (2014) concluded better pain relief and faster ROM improvement when phonophoresis was added to exercise compared to exercise alone in primary frozen shoulder. There is limited evidence for phonophoresis in secondary AC (after mastectomy), with a requirement for more sophisticated comparative trials.

Scapular-centered modalities can provide unique biomechanical benefits. Findings from Küçükdeveci et al. suggest that scapular-centered exercise regimens provide larger ROM and functional results compared to traditional resistive exercise in AC. Early treatment that addresses scapular mechanics may minimize capsular stiffness and enhance shoulder control in post-mastectomy groups where frequent protraction and inferior glide are common.

In spite of the specific advantages of phonophoresis, scapular stabilization, and TheraBand resistance, no study has compared and contrasted the treatment of secondary frozen shoulder following mastectomy using the combination of phonophoresis and TheraBand training versus phonophoresis combined with scapular stabilization. Filling this gap was the intent of the present comparative study, which predicted that the integration of scapular motor control training with phonophoresis would provide greater enhancement in ROM, pain relief and functional disability (as evaluated by DASH) than integrating phonophoresis with general TheraBand strengthening.

Anatomy of shoulder joint (structure and its function)

The shoulder joint (SJ) is a freely moveable joint of ball and socket type. The shoulder is the most complicated articulation in the humans , primarily due to the fact that it consists of five distinct articulations, including the glenohumeral joint (GHJ), the sternoclavicular joint (SCJ), the acromioclavicular joint (ACJ), the coracoclavicular joint (CCJ) and the scapulothoracic joint (STJ). In

order to move and stabilize the various components have to function in co-ordination like muscles, tendons, ligaments and cartilaginous structures. (Kadi, Milants et al. 2017)

Articular surfaces

Articular surfaces are following,

1. Sternoclavicular joint (SCJ):

The closer segment of the S shaped clavicle is joined with the clavicular notch of the manubrium of the sternum and the first rib's cartilage to create the SCJ. It is the principal rotational axis for motions of the clavicle and scapula. Rotations at the SCJ take place with shoulder shrugging, raising the arms above the head.

2. Acromioclavicular joint (ACJ):

The acromion process of the scapula articulates with the lateral end of the clavicle is referred to as the ACJ. Rotation is at the ACJ on elevation of the arm.

3. Coracoclavicular joint (CCJ):

The CCJ is a fibrous joint, where the coracoid process of the scapula and the lower surface of the clavicle are joined by the CCL. Little movement is allowed by the joint.

4. Glenohumeral joint (GHJ):

The GHJ is the joint formed between the head of the humerus and the glenoid cavity of the scapula. (J.Hall 2015) The most moveable joint in the whole human body is the SJ, this is credited to a cooperative action of four individual articulations. (Chaurasia's 2013) GH joint facilitates flexion (Flex), extension (Ext), hyperextension (Hyper-Ext), abduction (Abd), adduction (Add), horizontal abduction and adduction, and medial rotation (MR) and lateral rotation (LR). The humerus's hemispherical head possesses three to four times as much surface area as the shallow glenoid fossa (GF) of the scapula with which it articulates. The GF is surrounded by the glenoid labrum, a soft tissue rim on the outer edge of the GF that provides stability to the GHJ. Various ligaments blend with the capsule, such as the superior, middle and inferior GHL on the anterior aspect of the joint and the CHL on the superior aspect. Tendons of four muscles also blend with the joint capsule. They are referred to as rotator cuff muscles due to the fact that they help in rotation of the humerus. These include supraspinatus, infraspinatus, teres minor and subscapularis (SITS).

5. Scapulothoracic joint (STJ):

Scapula can also be moved in median and lateral plane in relation to the trunk and the area between anterior scapula and thoracic wall sometimes called STJ. The muscles that attach to the scapula have two actions. First, they can contract to stabilize the shoulder area. Second, the muscles of the scapula can produce movements of the upper limb by proper placement of the GHJ. (J.Hall 2015)

Osseous anatomy

Proximal humerus:

The proximal humerus is made up of the humeral head, the greater tuberosity (GT) and lesser tuberosity (LT) the humeral neck and the bicipital groove. The GT is found on the lateral side of the proximal humerus and is where the supraspinatus, infraspinatus and teres minor tendons insert. The LT is found on the anterior surface of the proximal humerus. The subscapularis tendon attaches here in a wide band. The anatomical neck is the oblique curve of the humeral head and is that part of the bone which is situated between the tuberosities, separating the head from them.

Cartilage:

The articular cartilage of the humeral head is thicker centrally and thinner peripherally as opposed to the GA cartilage which is relatively thinner centrally and thicker peripherally.

Scapula:

The scapula is a wedge-shaped bone which include the scapular body (SB), the scapular spine (SS), the scapular neck (SN), the acromion, the GF and the coracoid process.

The posterior surface of the scapula is split by the scapular spine into supraspinous fossa and infraspinous fossa where the supraspinatus and infraspinatus muscles insert. Scapula resting on

posterolateral surface of thorax, covering ribs 2 to 7. The scapular plane is 30° to 45° anterior to the coronal body plane and articulates with the retroverted head of the humerus. This scapular position to the coronal body plane and humeral head allows for the wide normal range of shoulder motions. (Paine and Voight 2013)

Glenoid:
The glenoid is oval shaped or pear shaped on sagittal section. Three basic forms of the glenoid surfaces are defined, concave, flat or convex. The posteroinferior edge of glenoid may be of diverse forms, such as normal triangular, J-shaped or rounded and delta shaped.

Acromion: It is posterolateral projection of the SS above the glenoid and serves as the origin for the deltoid and trapezius muscles.

Coracoid process:
The coracoid process is a hook-like bone formation extending anterolaterally from the superior part of the SN, above and medial to the GF. It is also the tendinous origin for pectoralis minor and long head of the bicep brachii.

Joint capsule:
The area of the capsule is roughly double the humeral head, facilitating huge range of movement. The capsule is truncated in size and the lower part (axillary pouch) is redundant. The capsuloligamentous complexes reciprocally tighten and loosen with arm rotation to restrict translation. In the middle range of motion, these complexes are fairly lax and stability is provided primarily by the concavity - compression effect of the activity of the rotator cuff and biceps. On the extreme of movement, ligaments get tense and functional, they play a vital role in stabilizing when all other stabilization mechanisms are compromised. (Terry and Chopp 2000).

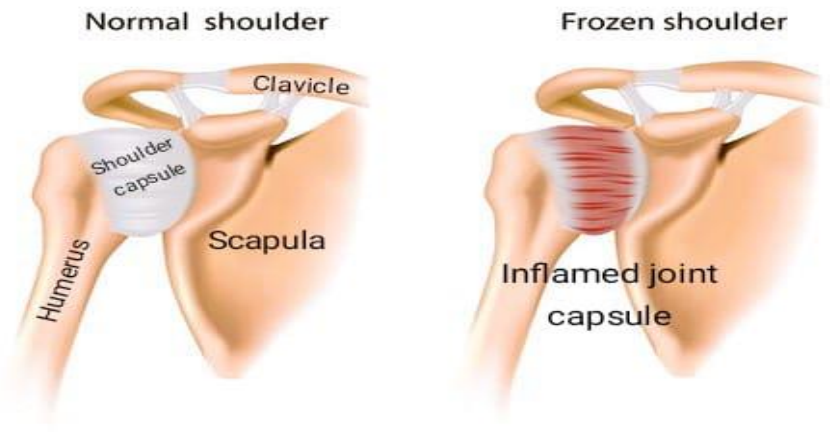


Figure of Frozen shoulder (Adhesive capsulitis "2022)

Bursa:
Small fibrous pouches that secrete synovial fluid internally in a manner analogous to the JC are present in the zone of the shoulder. These sacs referred to as bursae, serve as a soft layer and minimize resistance between moving soft tissues. (J.Hall 2015) The shoulder is encircled by a few bursas

- The subacromial (subdeltoid) bursa
- The subscapularis bursa is in communication with the joint space
- The infraspinatus bursa can be in communication with the joint space
- Subacromial bursa intervenes between acromion process, coracoacromial ligaments, supraspinatus tendon and allows for easy movement. (Chaurasia's 2013)

Ligaments

Ligaments of shoulder are following

- **Capsular ligament (CL):**

It is extremely lax and allows full ROM. It is least stabilized inferiorly where displacement occurs. Medially, it is attached to the shoulder blade. Posteriorly, to the supraglenoid tubercle and borders of the rim. Laterally, to the anatomical neck of the humerus. Inferiorly, the attachment reaches down to the surgical neck. Superiorly, it is lacking for the passage of the tendon of the long head of the bicep brachii.

- **Glenohumeral ligaments (GHL):**

Anteriorly, the capsule is supported by additional fibrous bands known as the superior, middle and inferior GHL. These are most significant passive stabilizers of the SJ.

- **Superior glenohumeral ligament complex (SGHL):**

It consists of two proximal attachments, one to the anterosuperior (AS) surface of labrum combined with the bicep's tendon and the other on base of the coracoid process.

- **Middle glenohumeral ligament (MGHL):**
- It is derived from AS labrum and mid-anterior labrum, generally beneath the SGHL and passes obliquely to be attached to anatomic neck of humerus.

- **Inferior glenohumeral ligaments (IGHL):**

It is a complex of anterior and posterior strips along with an axillary pouch supported by the fascicle's obliques on the glenoid side. The anterior strip has its origin from the inferior glenoid rim from the two o'clock to four o'clock positions. The posterior strip has its origin from the inferior glenoid rim at the seven o'clock to nine o'clock position. Both ligament bands insert along the inferior edge of the surgical neck of humerus.

- **Coracohumeral ligament (CHL):**

It runs from the base of the coracoid process to neck of the humerus. It provides stability to the capsule.

- **Transverse humeral ligament (THL):**

It spans the top of the upper half of the bicipital groove of humerus. Long head of bicep brachii tendon passes behind ligament.

- **Coracoglenoid ligament (CGL):**

It originates from the mid-point of the coracoid process and inserts behind the supraglenoid tubercle.

- **Coracoacromial ligament (CAL):**

It is firm fibrous triangular band runs from the margins of acromion, in front of articular surface of AC joint, to lateral margin of coracoid process.

- **Coracoclavicular ligament (CCL):**

It links distal end of clavicle to coracoid process, regulates vertical stability of AC joint. It is made up of two distinct bundles, trapezoid and conoid ligament.

- **Acromioclavicular ligament (ACL):**

It is split into superior and inferior components. The superior ACL runs from the upper acromion to the tip of the clavicle. This ligament regulates horizontal stability of the ACJ. The inferior ACL is thinner than the superior, it caps the lower portion of the joint and is affixed to the two bones along their adjacent surfaces.

- **Glenoid labrum (GL):**

Fibrocartilaginous border covering edges of glenoid cavity hence deepening cavity. Various shapes are reported ventrally and dorsally as triangular (most typical), circular, cleaved, notched, flat and an absent labrum. (Kadi, Milants et al. 2017)

Arthrokinematics:

Inferior surface of fossa is larger than superior surface and it curves both anteriorly and superiorly. In fact, surfaces are ovoid rather than spherical, and joint surfaces are not perfectly matched. Through the majority of glenohumeral joint's range of motion, this anatomical complexity reduces surface area of contact and there is only one point in range where joint surfaces can fit nearly perfectly, while other places are looser. Loose packed position (LPP) states provide improved synovial lubrication, lower frictional resistance on joint surfaces and enhance mobility. The closed pack position, is position of nearly perfect fit.The closed pack position(CPP)

for the GHJ would be full (Abd) and full (ER). The joint is inherently stable in this position and movement while in this position frequently indicates ligamentous instability. The LPP is of greater functional significance than the CPP. During forward elevation of the humerus, or flexion, the humeral head slides inferiorly, rolls posteriorly and spins into (IR). Hence, greater total ROM is accomplished with combined slide, roll and spin than if only the simple rolling of the surfaces was permitted. The slide and spin are more pronounced than the roll. If any of these accessory movements are limited, full ROM will also be limited.Side elevation or (Abd) occurs in a similar manner. During (Abd), the humerus slides inferiorly, roll superiorly, and spins into (ER). During forward elevation, the humeral shaft travels in the sagittal plane about a coronal axis through the humeral head. During that movement, the shaft rotates internally about an axis through the shaft in the sagittal plane Since the axis of rotation continuously moves in the sagittal plane, the plane of rotation is difficult to describe and clinically is not applicable. (Abd) is permitted only if there are the following available movements:

- Elevation of the coronal plane with respect to a sagittal plane axis
- A longitudinal axis down the shaft that is rising in the coronal plane is the external spin of the humeral shaft.
- Slide of the humeral head downward
- The humeral head rolls up very little.
- Similar descriptions apply to the external rotation's simpler movements when the arm is held at the side:
- Joint spin is ER about a sagittal or coronal plane axis in the transverse plane.
- Humeral head's anterior slide
- Roll of the humeral head posteriorly

Arthrokinetics:

The study of joints moving under the action of certain forces is called arthrokinetics (AKs). The approach to AKs will be to describe the external or internal forces acting on the shoulder which combine to provide motion. External forces are easiest to describe since they most frequently consist of gravity and the force applied by the hands of the clinician. Gravity, acting through the centre of mass of the (UE), functions as the initial force against which the muscles have to work. Gravity usually acts to lower the distal end of the extremity. The effect of this force changes with the position of the extremity. For example, while standing with the arm hanging by the side, gravity tends to distract the GHJ. However, gravity compresses the GHJ when the hand is overhead and the elbow is stretched. Most significantly, the deltoid and rotator cuff work in conjunction with gravity to maintain the extremity's stability or equilibrium. Any forces produced or transmitted by soft tissues, such as muscles, ligaments, capsules, etc., are referred to as internal forces. Typically, connective tissues are mostly responsible for preventing motion, which provides stability, while muscle forces are primarily responsible for function. A wide ROM is made possible by the numerous muscle forces operating on the SG. (Bechtol and Research® 1980)

Essential movements of shoulder joint:

- **Flexion and extension:**

During (flex), the arm moves forwards and medially and during (ext), the arm moves backwards and laterally. Thus, (flex) and (ext) take place in a plane parallel to the surface of the GC.

- **Abduction and Adduction:**

Occur approx. midway between the sagittal and coronal planes, at right angles to the plane of (flex) and (ext). The arm separates from the trunk anterolaterally during (Abd). This movement occurs in the same plane as the scapula's body.

- **Medial and lateral rotations:**

In this position, the hand is moved medially across the chest either in front or behind the chest in med-rot, and laterally in lat-rot of the SJ.

- **Circumduction:**

The hand moves in a circle as a result of a combination of several actions. The availability of a moveable joint surface area on the humeral head determines the range of any movement. GHJ motion cannot bring about the 180 degree of movement that takes place in overhead shoulder movements. The scapula contributes to overhead (flex) and (Abd) by rotating upwardly by 50- 60

degree. The GHJ contributes 100-120 degree of flex and 90- 120 degree of abd to the total 170-180 degree of overhead movements. This makes the overall ratio of 2 degree of motion of shoulder to 1 degree of scapulothoracic motion and is often referred to as scapulothoracic rhythm. Thus, for every 15 degree of elevation, 10 degree occur at (SJ) and 5 degree are due to movement of the shoulder blade.

Anatomy of Axilla

Pyramid shaped axilla is located between arm above and chest wall. Anatomically it has an apex, base and four walls, three walls.

- **Apex:**

It is oriented upward and medially towards the neck root. Anteriorly, by the posterior aspect of clavicle. Posteriorly, by the sup. border of scapula and med.border of the coracoid process. Medially, by the outer border of the first rib. Such an oblique course is referred to as the cervicoaxillary canal. Axillary artery, axillary vein and brachial plexus enter the axilla via this canal.

- **Base:**

It is downwardly directed and is composed of skin, superficial and axillary fascia. It is convex superiorly in harmony with concavity of armpit.

- **Anterior wall:**

It is composed of the pectoralis major and minor muscles. The entire pectoralis major constitutes part of the wall, whereas the middle part of the pectoralis minor constitutes part of it. The space between the sup-border of the pectoralis minor and clavicle is filled with clavipectoral fascia, whereas the space between the inf-border of the pectoralis minor muscle and dermis at the base of the axillary pouch is filled by the suspensory ligament of the axilla.

- **Posterior wall:** This is created by the subscapularis muscle in its sup- portion and the latissimus dorsi and teres major muscles, in its inf-portion.

- **Medial wall:**

This is created by the first four ribs with their intercostal muscles and also the sup- portion of the serratus anterior muscles.

- **Lateral wall:**

Anterior and posterior walls merge laterally towards the humerus and the lat-wall is constructed by the long head of the bicep brachii muscle's tendon, more medially by the coracobrachialis muscle. (de la Pared Torácica and y Mama 2006)

Contents of the axilla:

The contents of the axilla include the axillaris artery(AA) and its branches, the axillaris vein and tributaries, nerves predominantly from the plexus brachialis (BP) and lastly lymph vessels (LV) and axillaris lymph nodes (ALN).

Axillary lymph nodes:

ALNs are disseminated within the fibrofatty tissue of the axilla. They are classified into five groups:

- Nodes of the anterior (pectoral) group are along the lateral thoracic vessels, along the lower edge of the pectoralis minor. They drain lymph from the upper half of the anterior wall of the trunk, and from most of the breast.
- The posterior (scapular) nodes are found along the subscapular vessels on the posterior fold of the axilla. They drain lymph from the posterior wall of the upper half of the trunk, and from the axillary tail of the breast.
- The lateral nodes are found along the upper border of the humerus, medial to the axillary vein. They drain lymph from the upper limb.
- The nodes of the central group are found within the fat of the upper axilla. They are drained and drained by lymph from the previous groups. They are supplied with some direct vessels from the floor of the axilla. They have a close relationship with the intercostobrachial nerve.
- Nodes of the apical or infraclavicular group are situated deep to clavipectoral fascia, along axillary vessels. Anterior and central groups of nodes are commonly involved in carcinoma breast. (Chaurasia's 2013).

Anatomy of breasts:

The mammary gland is conical in shape and are positioned on either side, in the subcutaneous layer of the thoracic wall, anterior to the pectoralis

major muscle. They expend superiorly up to the level of the second rib, inferiorly up to the level of sixth or seventh ribs, laterally up to the anterior axillary line and medially up to the lateral border of the sternum. They come into contact dorsally with pect major fascia, serratus anterior and obliques externus muscles and the most cranial part of the rectus abdominis muscle. Three anatomically distinguished portions are the gland proper (glandula mammaria), the mammary papilla (papilla mammariae) and the areola (areola mammae).

The mammary gland consists of fifteen to twenty radially arranged lobes (lobi glandulae mammariae) bounded by septa of conjunctive tissue and adipose tissue in the subcutaneous layer. The parenchyma of the mammary gland is richer in the upper half, particularly in the superolateral quadrant. The parenchyma often spreads beyond the visible border of the breast, extending towards the axilla as the axillary process or tail of Spence. The main duct of each lobe, the lactiferous duct, has an individual opening into the mammary papilla. The lobe again is created by minor functional units, the lobules from which the ducts coverage towards the main duct of the lobe. The subcutaneous layer (tela subcutaneous) encircles the glands entirely, except where the papilla is refers to as superficial fascia (SF). The portion of this layer immediately in the anterior position of the fascia of the pectoralis major muscle was mistakenly referred to as the deep layer of the SF. In the subcutaneous layer, fascicles of conjunctive tissue are found to invade the lobes and lobules, especially in the upper region of the gland, which traverse the breast anteroposterior, from the dermis to that portion of the subcutaneous layer adjacent to the fascia of the pectoralis major muscle. These fascicles are referred to as the suspensory or Cooper ligaments of the breast. Breast neoplasms can involve them and produce localized retraction of the overlying skin. The area between the deep portion of the subcutaneous layer and the pectoralis major muscle fascia is termed as retromammary bursa, sub mammary serous bursa or also referred to as Chassagne bursa. The space is readily visible in a mastectomy. It is responsible for the mobility of the breast on the thoracic wall. The areola is a raised disc-shaped zone of varying size that encircles the papilla. It is rosy in color during early times but, from the second month of pregnancy, becomes permanently pigmented (chestnut brown). It shows granular and point like elevations on its surface called areolar tubercles or Montgomery tubercles. Breast cancer is a malignancy in which malignant cells arise in the breast tissues. Increased risk of (BC) is caused by family history of BC and other factors. Inherited mutations of genes sometimes cause BC.

The most frequent BC is ductal carcinoma, which originates in the cells lining the ducts. BC that originates in the lobes or lobules is known as lobular carcinoma and occurs more frequently in both breasts than other forms of breast cancer do. Inflammatory BC is a rare form of BC in which the breast is red, warm and swollen. A lump or thickening in or under the breast or in the armpit. A change in breast size or shape. A dimple or puckering of the skin on the breast. A nipple drawn into the breast. Fluid, other than milk, from the nipple, particularly if it is bloody. Scaly, red or inflamed-looking skin on the breast, nipple or areola. Dimples in the breast that resemble the skin of an orange, referred to as peau d'orange.

Breast Cancer & Mastectomy:

BC is the most prevalent cancer diagnosed among women worldwide, making it a serious global health concern. About 2.3 million women received a breast cancer diagnosis in 2022 and 670,000 of them lost their lives from this condition.

Breast cancer is categorized according to a number of factors:

- **Histological Type**: Most prevalent type is invasive ductal carcinoma, which is followed by invasive lobular carcinoma(Ricci, 2021).
- **Hormone Receptor Status**: Treatment choices may be influenced by expression of human epidermal growth factor receptor 2 (HER2), progesterone receptors (PR), or estrogen receptors (ER) in tumors.
- **Molecular Subtypes**: Luminal A, Luminal B, HER2-enriched, and triple-negative/basal-like

are subtypes that are based on gene expression profiles.

Global Epidemiology

The incidence of BC varies globally, with richer countries having greater rates. The difference is explained by variations in lifestyle choices, screening program accessibility and reproductive patterns. For example, women in high-income countries are more likely to have children later in life and to become pregnant less frequently, both of these raise risk (Ryan S Selley 1, 2019).

Prevalence of Mastectomy

Mastectomy can cause biomechanical abnormalities in shoulder girdle due to scarring, soft tissue strain and post-operative pain. Upper limb dysfunction may be exacerbated by these changes, which can lead to secondary diseases such adhesive capsulitis (Navarro-Ledesma, 29 March 2024).

According to a study with 208 women, 85% of them had at least one arm issue six months post mastectomy. Even though frozen shoulder was less frequent a reported 22% it is still a serious risk ("IASP,").

This problem was more common in patients between the ages of 50 and 59 and those having mastectomy surgery, whether or not reconstruction was involved ("WIKIPEDIA,").

Surgery can encompass lumpectomy, partial mastectomy (PM), segmental mastectomy (SM), quadrantectomy or breast sparing surgery (BSS). Surgical excision can be unilateral or bilateral.

Breast conserving surgery (BCS):

It is a procedure to take out cancer and some of surrounding healthy tissue, but not breast. Some of chest wall lining can be taken out as well if cancer is close to it. It is also referred to as lumpectomy.

Total mastectomy (TM):

TM is surgical removal of entire breast that contains cancer. It's also referred to as a simple mastectomy. A few of lymph nodes in arm area may be taken out and tested for cancer. This can be done during the breast operation, or it can be done afterward. This is done with a second incision.

Complications:

Complications of BC following mastectomy is pain syndrome (PS), secondary frozen shoulder (SFS), lymphedema (Trayes and Cokenakes 2021).

Stages of Frozen Shoulder:

Over time, the categorization of adhesive capsulitis (AC), or frozen shoulder (FS), into discrete stages has changed. Dr. Ernest Amory Codman was the first to describe the syndrome in 1934("MEDICOVER HOSPITALS,"). Later physicians, most notably Dr. Julius Neviaser, built on Codman's work to divide the disease's course into phases. The three main stages of the condition are separated by the most generally used model currently in use:

1. **Freezing Stage** (Painful Phase):
- Duration: roughly 6 weeks to 9 months
- Symptoms: steepening stiffness; pain that gets worse when you move
- Pathophysiology: inflammation of the synovial lining causes pain and a progressive loss of range of motion("MEDICOVER HOSPITALS,")

2. Frozen Stage (Stiffening Phase):
- Duration: roughly 4 to 12 months
- Symptoms: pain may lessen, but stiffness persists; shoulder movement is significantly reduced; daily tasks become difficult
- Pathophysiology: Thickening and tightening of the joint capsule restrict movement

3. Recovery Phase (Thawing Stage):
- Duration: roughly 5 to 26 months
- Symptoms: a gradual increase in shoulder mobility, ongoing pain reduction, and a restoration to normal or almost normal function.
- Pathophysiology: The joint capsule gradually relaxes, allowing for movement again.

Notably, a fourth initial stage often referred to as the "Pre-Adhesive" or "Painful" stage has been hypothesized by certain physicians and researchers("MAYO Clinic,"). This stage is marked by minor discomfort and little movement

restriction. This level is not as widely acknowledged, though. Customizing treatment plans, which may involve physical therapy, medication, or, in certain situations, surgical procedures, requires an understanding of these phases.

Introduction to Phonophoresis

A non-invasive therapy method called phonophoresis, sometimes known as sonophoresis, uses ultrasonic waves to help topical medications absorb and penetrate the skin. As a way to deliver pharmaceutical substances into deep tissues without the discomfort of needles or oral medication, it has grown in popularity in physical therapy. By reducing inflammation and relieving discomfort, phonophoresis aims to alleviate localized musculoskeletal issues such tendinitis, bursitis, and muscle sprains.

Phonophoresis is accomplished by applying a coupling medium, which is an ultrasonic gel that contains a medication such as diclofenac or hydrocortisone. When ultrasound waves are passed through this medium, they produce thermal and non-thermal effects that transiently weaken the stratum corneum (the outer layer of skin). The weakening of the stratum corneum enhances skin permeability so that the drug can penetrate more successfully into the desired tissues.

Phonophoresis is especially useful in the management of conditions where deeper penetration of anti-inflammatory or analgesic drugs in the tissue is required. It is generally preferred to iontophoresis with the use of electrical currents because it has the dual advantage of ultrasound therapy and drug delivery. The ultrasound also increases blood flow, enhances cellular repair, and inhibits muscle spasms to facilitate healing of the tissue.

Clinical use of phonophoresis involves appropriate patient evaluation to ascertain their appropriateness and the presence or absence of contraindications like open wounds, malignancies, or acute infection over the treatment area. The treatment parameters like frequency, intensity, and duration of ultrasound should be chosen judiciously depending on the ailment being treated.

Though with its benefits, the effectiveness of phonophoresis is controversial in the scientific literature, as some research indicated its usefulness while others show little difference between the phonophoresis and conventional ultrasound or placebo therapy. Nevertheless, it is a useful addition to the rehabilitation protocols if properly utilized (Sonophoresis, 2024).

Introduction to TheraBand Exercises

Widely utilized resistance training types is TheraBand exercises, which use elastic bands to offer progressive resistance during strength and recovery exercises. The bands are also easy for patients from all levels of physical functioning, from postoperative patients to professional athletes, they are colored differently to offer different resistance level.

Functional strength training and rehabilitation both depend on progressive loading of the muscles, which is provided through TB resistance. Primary stabilizers and movers can both be trained in more than one plane of motion. Physical therapists can design individualized programs of exercise to address specific deficiencies in strength, ROM and neuromuscular control due to this flexibility.

In the rehab setting, TheraBand exercises (TB-Ex) are often employed to allow recovery of musculoskeletal injury like rotator cuff reconstruction, ACL reconstruction, and overall muscle deconditioning. They are especially effective at the initial stage of rehabilitation where controlled resistance of low magnitude is needed. With further development of strength, resistance can be augmented by changing to a higher-resistance band.

Exercises with TB also helpful in proprioception and balance, both essential for avoiding injury as well as overall functional ability. It showed that resisted external rotation of the shoulder or eversion of the ankle with a band not only strengthens specific muscle groups but also increases joint stability and coordination.

The evidence favoring the employment of elastic resistance training is overwhelming. Research has

established that the TheraBand exercises are as effective in enhancing the muscular strength and endurance as the traditional weight training. Additionally, their low cost and ease of use make them an option that is easily accessible to both the patients and practitioners (Picha, 2020).

Introduction to scapular stabilization exercises:
Scapular stabilization exercises (SS-Ex) are integral parts of rehabilitation programs for patients with shoulder dysfunction, pain, or instability. These exercises are directed to the muscles responsible for controlling and stabilizing the scapula (shoulder blade), such as the trapezius, serratus anterior, rhomboids, and levator scapulae. Most effective functioning of scapular muscles is drawn by coordinated shoulder movement and ideal upper limb biomechanics.
Scapular dyskinesis, defined as an upset pattern of scapular movement or position, is commonly involved in shoulder pathologies including impingement syndrome, rotator cuff tendinopathy, and labral tears. Stabilization exercises aim to alter deformed patterns by increasing the stability of the scapula through strengthening the scapular stabilizers and enhance neuromuscular control.
The exercises consist of range from simple to complex. It includes scapular retraction, prone horizontal abduction, wall push-up with a plus, and dynamic movements with resistance bands or free weights. They are designed to enhance scapular kinematics, postural alignment, and decrease compensatory muscle activation, which can lead to pain and dysfunction.
In shoulder rehabilitation, stabilization of the scapula is introduced early in clinical practice and progressed gradually according to patient tolerance and performance. There is focus on technique, control, and activation of the muscle groups in question rather than resistance used. The exercises are typically combined with glenohumeral mobility and rotator cuff strengthening for the purpose of comprehensive shoulder rehabilitation.
Evidence exists for the usage of scapular stabilization exercises in enhancing shoulder functioning and reducing symptoms in patients with subacromial impingement and other shoulder pathologies. When we use it as part of a formal rehabilitation program, these exercises help to promote enhance outcomes and decrease recurrence (Struyf, 2012).

Causes and Risk Factors:
Secondary Adhesive Capsulitis Causes and Risk Factors

Shoulder trauma and surgery: Injuries such as fractures, dislocation, and rotator cuff tears, as well as surgeries involving the shoulder can cause a long-lasting immobilization of the joint. This immobilization is believed to be responsible for the inflammation and fibrosis of the JC resulting in adhesive capsulitis.

- Systemic diseases: Some extrinsic diseases have been shown to increase the risk
- Diabetes mellitus: markedly increases risk (10–20% prevalence in diabetics)
- Thyroid disorders: Hypothyroidism and hyperthyroidism both correlate with a higher incidence("MEDICOVER HOSPITALS,")
- Cardiovascular diseases: Myocardial infarction and stroke are associated with increased risk.
- Autoimmune conditions: Conditions like rheumatoid arthritis and scleroderma increase risk("Frozen Shoulder (Adhesive Capsulitis),").

Postoperative Immobility: Prolonged shoulder immobility post-surgery, including cardiac surgeries, is a significant risk factor. Post-cardiac surgery setting was associated with a joint stiffness manifestation with 29% prevalence of adhesive capsulitis in a Pakistan study, with age, diabetes, and female gender contributing 4 studied factors (Ryan S Selley 1, 2019).
Neurological Conditions: Other neurological events such as strokes can sometimes cause hemiplegia, causing decreased shoulder mobility and increased chance of AD.

Other Contributing Factors:

- Age and Gender: People above 40, particularly female, actually are much more at risk.

- Hormonal Imbalances: Certain conditions, such as hypoadrenalism, may contribute(LORI B. SIEGEL).
- Genetic Factors: There is a genetic linkage with a hereditary factor: a family record of psoriatic arthritis and some genetic markers (such as HLA-B27) have been related(Waqar Ahmed Awan, 2019).

AIMS & OBJECTIVE

Main aims and objectives are follows:

- To compare the effectiveness of phonophoresis with theraband exercises and phonophoresis with scapular stabilization exercises in patient with secondary frozen shoulder following mastectomy.
- To determine the most effective treatment approach for improving shoulder mobility, limiting pain and enhancing functional ability in patient with secondary frozen shoulder post mastectomy.

Hypothesis: This research shows the comparison between the effectiveness of phonophoresis with TheraBand exercises vs phonophoresis with scapular stabilization exercises on secondary frozen shoulder after mastectomy

- **Null Hypothesis:**

There is no difference between the effectiveness of phonophoresis with TheraBand exercises and phonophoresis with scapular stabilization exercises

- **Alternate Hypothesis**:

There is a difference between effectiveness of phonophoresis with TheraBand exercises and phonophoresis with scapular stabilization exercises.

LITERATURE REVIEW

A literature review was conducted to assess the interaction between various levels of arm pain and overall state of general health in individuals who have survived breast cancer for an extended period. The objective of the study was to evaluate how chronic pain in the diseased arm affects general physical and psychological functioning of survivors. Measured variables were levels of pain, pain interference, cancer-related fatigue, activities of physical nature, physical fitness, mood state, and health-related quality of life (HRQoL). The results showed that 63.75% of the participants had pain of mild to severe intensity in the injured arm. Pain was notably linked to increased fatigue, as well as mood issues such as anxiety and depression and deteriorations in overall quality of life. Interference from pain adversely influenced participants' physical activity and fitness levels, thus yielding decreased functional well-being. Furthermore, the review pointed out alcohol use and hair loss-related emotional distress as independent predictors of higher pain levels. These findings highlight the multidimensional impact of arm pain following post-treatment in breast cancer survivors and emphasize the importance of addressing physical as well as emotional factors in survivorship care. Pain management programs should anticipate comprehensive pain care with psychosocial intervention as well as physical rehabilitation to maximize long-term health outcomes(Francisco Álvarez-Salvago 1, 2025).

A research study was conducted to examine the effectiveness of scapular stability exercises in individuals with a diagnosis of subacromial pain syndrome (SPS), a condition often characterized by abnormal scapular mechanics and chronic shoulder dysfunction. It sought to establish how these focused exercises influence important clinical measures, such as scapular dyskinesis, pain intensity at the shoulder, scapular upward rotation, muscular strength, range of motion, and overall shoulder-related disability. They were stratified into two groups: one underwent scapular stabilization exercise training, and the other was a control group, which was given standard treatment. The outcomes revealed that the intervention group had significantly improved more in several variables than the control group ($p < 0.05$). These included less scapular dyskinesis, lower pain scores, shoulder disability scores, and improved muscular strength. The greatest improvements were shown in functional and strength assessments, even though ROM and scapular upward rotation were evaluated. In comparison to traditional therapy alone, scapular

stability exercises efficiently repair biomechanical deficits, decrease symptoms, and increase shoulder function(Ertugrul Yuksel, 2024)

Another study conducted to assess how well intra-articular triamcinolone injections work to treat patient's adhesive capsulitis following breast cancer surgery. Shoulder range of motion (ROM), capsular stiffness, and pain intensity were the variables that were measured. Following breast cancer surgery, 22.2% of patients experienced adhesive capsulitis. Shoulder range of motion and discomfort were quickly improved by intra-articular triamcinolone injections. Additionally, the study discovered that the group who underwent breast cancer surgery had considerably more capsular stiffness than the group that had idiopathic adhesive capsulitis, indicating more serious structural alterations(Sungwon Kim, 2024).

A review of shoulder problems in cancer survivors, such as adhesive capsulitis, and a discussion of treatment are presented by this study. Incidence, risk factors, stages, and therapies of adhesive capsulitis are all variables that are quantified. Adhesive capsulitis may occur following mastectomy or other painful and stressful surgeries that alter the biomechanics of the shoulder. Risk factors include dissection of lymph nodes, breast reconstruction, aromatase inhibitor medication, lymphedema, and age. The management aim is to enhance range of motion and discomfort by means of physical therapy, scapular stabilizing exercises, and progressive banded strengthening exercises(Stubblefield, 2024).

To evaluate the latest interventional and rehabilitation therapy for shoulder problems after breast cancer operations, such as adhesive capsulitis. The efficacy of different exercise regimens and physical therapy interventions are some of the features that are quantified. From the analysis, early initiation of physical therapy can be safe and helpful. It means the strength, endurance, and mobility of the upper extremities are enhanced. More research needs to be done to determine standardized rehabilitation protocols because research has demonstrated wide variation in treatment strategies(P. E. Ferrara, 2024).

Exhaustive review of studies from the PubMed, Scielo, and LILACS databases from 2007–2017 conducted to establish which physiotherapy methods most frequently used are applied after mastectomy. The most widely used and effective physiotherapies were as follows', or complex decongestive therapy, lymphatic manual draining, exercise Therapy, treatment with low-power laser, compression by pneumatics, manual treatment, kinesio recording, electrical stimulation with high voltage(Matheus Gonçalves Ribeiro, 2024).

To provide a literature of the issues in treating different forms of breast cancer and new targeted medicines. Trastuzumab, neratinib, and novel antibody-drug conjugates are used to treat HER2+ malignancies; TNBC: No specific targets; PI3K/mTOR pathway inhibitors and Palbociclib and ribociclib, two CDK4/6 inhibitors, are employed to treat HR+ breast cancer; PARP inhibitors (olaparib, talazoparib) may be useful in situations involving BRCA mutations.

Drug resistance and heterogeneity provide complications that call for adaptive trial designs and biomarker-guided strategies. The findings demonstrated that targeted therapy directed by molecular subtypes considerably improves prognosis; nonetheless, TNBC is still difficult because there are no reliable molecular targets(Luying Xu 1 Qiheng Gou, 2024).

A research was conducted to assess the degree of pain after breast cancer surgery and examine whether it may relate to high-sensitivity C-reactive protein (hs-CRP) and serum vitamin D levels. It was planned to study whether nutritional status or systemic inflammation affects chronic postoperative pain in breast cancer patients.The most critical variables documented were pain intensity, ascertained with the use of the McGill Pain Questionnaire, serum vitamin D levels, and hs-CRP levels, an indicator of inflammation. The findings indicated that high levels of hs-CRP levels were substantially linked to elevated pain intensity, which indicates that inflammation may be a significant etiology of chronic post-surgical pain in this patient population. Conversely, serum vitamin D levels were not significantly correlated with pain severity, indicating that although vitamin D deficiency is a frequent condition

among cancer survivors, it is unlikely to directly affect pain perception in this population. The role of inflammatory markers such as hs-CRP is noted in patient identification at elevated risk for postoperative chronic pain following breast cancer treatment and implications that anti-inflammatory interventionsare useful to manage chronic postsurgical pain(Taghizade, 2024).

Compared to traditional physical therapy, the purpose of this investigation was to ascertain whether functional scapular stability training was more beneficial in enhancing shoulder function and reducing pain in individuals suffering from frozen shoulder syndrome. The restrictive range of motion and persistent pain associated with frozen shoulder can make everyday tasks and life quality difficult. Among the crucial elements of shoulder kinematics, scapular stability and control exercises, was employed in the intervention. During a period of 12 weeks, intervention group participants completed a battery of clinical tests. Range of motion (ROM) tests administered were the external rotation, passive abduction, coracoid pain test, Shoulder Pain and Disability Index (SPADI), and Numeric Pain Rating Scale (NPRS). By the end of 12 weeks, the intervention group demonstrated notable progress in the ROM of external rotation with the mean change at 7.8 degrees ($p = 0.01$). Additionally, there was a noticeable reduction in pain ascertained by NPRS with 95% confidence interval (CI) of 0.67–2.07 ($p = 0.01$). Functional disability improved significantly with a 95% CI of 2.95–16.74 ($p = 0.01$). These results showed the clinical significance of the inclusion of scapular-directed exercises in the rehabilitation regimen of frozen shoulder. Enhanced scapular mechanics probably underpin improved shoulder mobility and pain control. This type of targeted intervention presents a useful strategy for managing both functional deficits and pain. The research warrants the application of functional scapular stabilization training as a better alternative or complement to conventional physiotherapy. Significantly, these results might impact both outpatient and clinical therapies. These results indicate that a beneficial role in the management of adhesive capsulitis exists for scapular rehabilitation(Saloni Karnawat 1, 2023).

This second experiment aimed to evaluate the impact of a combined intervention scapular stabilization exercises and graded Thera-Band strengthening on physical functioning, shoulder discomfort, and overall quality of life in patients who were having adhesive capsulitis after mastectomy. Adhesive capsulitis, is a usual consequence of breast surgery, frequently resulting in pain, limited movement, and decreased daily function. Outcome assessment utilized a balanced range of measurements, which covered pain severity according to the Visual Analogue Scale (VAS), physical limitations determined by the Disability of the Arm, Shoulder, and Hand (DASH) survey, shoulder range of motion, strength in the main groups (internal and external rotators, flexors, and abductors), and quality of life on the SF-36 health questionnaire for the survey, which is established and reputable for assessing the topic. The participants were divided into an intervention group given the combined exercise protocol and a control group that was given standard care. Upon the end of the intervention, the scapular stabilization and Thera-Band strengthening group had statistically significant changes in all the parameters of measurement $P < 0.001$ in comparison to the control group. These included improvements in overall quality of life scores and notable improvements in muscle strength. According to these results, incorporating scapular-specific stability exercises with progressive resistance training with Thera-Bands can have significant value in post-mastectomy rehabilitation. Targeting both pain and functional ability, this treatment represents a promising, evidence-based approach to the management of adhesive capsulitis in breast cancer survivors.(Nancy H Aboelnour 1, 2023)

Literature showed, scapular stabilization exercises were demonstrated to benefit the functional consequences of shoulder pathology, especially among individuals with diabetes who experienced stage 2 adhesive capsulitis. The frozen shoulder's second stage is usually marked by increasing joint mobility restriction and severe discomfort, especially among diabetics who are also more

susceptible to long-term musculoskeletal morbidities. The research cited measured functional improvement using the shoulder joint's active range of motion (AROM) and shoulder pain and disability index (SPADI). Two groups of patients were formed: one undergoing standard physiotherapy alone, and the other undergoing an adjunct regime of scapular stabilization exercises. Outcomes were found to reveal that the group including scapular stabilization exercises demonstrated significantly increased improvements in shoulder mobility and functional capacity, statistical significance being established at $P < 0.05$. Such gains indicate that interventions aimed at improving scapular mechanics may help improve neuromuscular control, decrease compensatory movements, and provide enhanced joint mobility. The research underlines the incorporation of scapular-centered rehabilitation within the management of adhesive capsulitis in individuals with diabetes as a more detailed and beneficial intervention in regaining shoulder function(Karnawat, 2023)

This study aimed to evaluate the effectiveness of various therapy approaches that specifically target the scapulothoracic complex in individuals with subacromial impingement syndrome and frozen shoulder. Abnormal scapular kinematics are commonly associated with both diseases, which can lead to discomfort and significant shoulder mobility impairment. Successful interventions were the incorporation of verbal and tactile feedback, made to increase patient awareness and control over scapular movement. These interventions were found to result in quantifiable improvement in scapular positioning and movement. Throughout the reviewed studies, there was widespread evidence of the positive impacts of scapular-directed therapy on enhancingscapular kinematics, specifically upward rotation and posterior tilt, which eventually result in the reduction of shoulder pain and enhancement of functional ability. The study emphasizes the need for the incorporation of scapular control and neuromuscular re-education methods into treatment programs for adhesive capsulitis and subacromial impingement patients. These methods provide biomechanically rational and evidence-based means of restoring normal shoulder function.

The study aimed to evaluate how thera-and, co-contraction and isometric workouts affect function, discomfort and range of motion (ROM) in individuals with chronic frozen shoulder. The Numerical Pain Rating Scale (NPRS), goniometric assessments for shoulder range of motion, and the Shoulder Pain and Disability Index (SPADI) were the variables that were measured. After six weeks, Thera-Band exercises significantly enhanced range of motion (ROM) in comparison to the other groups, but co-contraction and isometric workouts were more successful in lowering discomfort ($p < 0.05$)(Rosario Ferlito 1, 2023).

In order to ascertain contributing factors and the prevalence of frozen shoulder in patients who had surgery for breast cancer, a study was conducted. The primary factors were the postoperative prevalence of frozen shoulder, a common MSK complication that can significantly impact quality of life and rehabilitation. Analysis of the data confirmed that frozen shoulder was seen more commonly among patients between 50 to 59 years old and individuals who had either a mastectomy or a mastectomy combined with reconstruction. Both these observations imply that age and the degree of surgery are critical risk factors for the development of shoulder joint stiffness and discomfort following the administration of breast cancer. The paper stresses the significance of early detection and rehabilitative treatment in such high-risk groups to avoid lasting functional impairment and enhance a fuller postoperative rehabilitation(Guang-Hua Deng a, 2023).

A research study was conducted to evaluate the correlation between breast cancer and and adhesive capsulitis prevalence (frozen shoulder) in an effort to ascertain whether or not patients with breast cancer are more likely to contract this musculoskeletal disorder. The most important variable that was measured was the frequency of adhesive capsulitis in patients with breast cancer. The results revealed a high correlation between the two conditions, suggesting that individuals with breast cancer are very susceptible to adhesive capsulitis as opposed to the overall population. The enhanced vulnerability is possibly due to

factors like immobilization after surgery, radiation impact, lymphatic complications (lymphedema), and the physical and emotional trauma of cancer treatment. The research emphasizes the significance of early screening and preventative rehabilitation strategies in breast cancer treatment to reduce the risk of shoulder dysfunction. Understanding this correlation is important for oncologists, physiotherapists, and rehabilitation professionals in formulating integrated treatment plans that favor both cancer remission and musculoskeletal well-being(Louis Jacob, 2023).

Study conducted in order to investigate breast cancer and the factors that cause it, such as the influence of lifestyle, the environment, genetics, and psychology on the occurrence and progression of the disease. Key findings were lifestyle factors (Active and passive smoking of cigarettes has been linked to a greater likelihood of breast cancer. Smoking between the ages of 10 and 14 years further heightened this risk), genetic Factors (The risk of breast and ovarian cancers was greatly increased by mutations in genes such as BRCA1. In addition, hereditary tumor occurrence made one more susceptible), dietary influences (more obese postmenopausal women, as well as higher body mass index (BMI) individuals were more likely to develop breast cancer. High consumption of animal protein and animal fat were also indicated), psychosocial Aspects (Medical and family practitioners were major support systems that helped patients adjust and improve their well-being. Religious faith helped reduce stress and adaptability as a coping strategy), immunological System (the immunological functions of cytokines IL-12 and IFN-γ in fighting malignancies were emphasized), regionalinsights (the fact that Iran is seeing a rise in breast cancer, and that its patients present themselves ten years before those of rich nations, has been observed) (Hangcheng Xu, 2023).

Study conducted to find out the prevalence, characteristics, and contributing factors for chronic pain among female survivors of breast cancer.Variables Assessed: Prevalence of pain, severity of pain, interference with function, neuropathic pain symptoms, and sociodemographic variables.Results: 59% of respondents had chronic pain, with 39% presenting with neuropathic pain. Younger age and some professions were linked to increased prevalence of pain(Nelisiwe Shabangu 1, 2023).

A further study was conducted to assess the comparative efficacy of scapular stabilization versus non-stabilization stretching on patients' shoulder pain in terms of shoulder range of motion (ROM). The main outcome metric used in this investigation was shoulder ROM, which tends to be impaired in shoulder dysfunction resulting from pain, muscle spasm, or postural asymmetry. The participants were allocated into two groups: one was given stretching exercises under scapular stabilization, and the other was given non-stabilized stretches. Findings showed that scapular-stabilized stretching was significantly superior to non-stabilized stretching in raising shoulder mobility. The improvements in ROM were found right after treatment sessionsand were maintained over several sessions, demonstrating both immediate and persistent effects. This indicates that stabilization of the scapula on stretching most probably minimizes compensatory movement, maximizes muscle elongation, and promotes more effective targeting of the shoulder musculature. The research justifies incorporation of scapular control techniqueswithin rehabilitation protocols for shoulder pain in order to obtain better and more sustainable improvements in joint mobility(Alan J Howell, 2022).

In diabetic patients with adhesive capsulitis (frozen shoulder), the impact of increasing dynamic scapular awareness on shoulder discomfort and functional impairment was evaluated using a randomized controlled trial (RCT). Diabetic patients are especially susceptible to delayed recovery and severe functional impairment because of musculoskeletal complications. The research quantitatively assessed two variables: scapular upward rotation and the Shoulder Pain and Disability Index (SPADI), which considers both physical function and pain severity. The participants received a four-week intervention program based on dynamic scapular exercises to enhance control during movement and proprioceptive feedback. According to the results, the intervention led to a

significant decrease in shoulder discomfort and disability as well as a remarkable improvement in scapular movement and proprioception. These results emphasized how important it is to treat scapular motor control in diabetic individuals with frozen shoulder as part of a rehabilitation program(Mohamed, 2022).

In Abbottabad, a cross-sectional observational study was conducted to determine the incidence of common risk factors for adhesive capsulitis, often known as frozen shoulder. The study's primary goal was to ascertain and evaluate the prevalence of various comorbidities and conditions that are likely to contribute to the onset of this musculoskeletal condition among the residents. Adhesive capsulitis presents with pain and limited motion in the shoulder joint that severely compromises daily activities and quality of life. As it has a multifactorial cause, identification of the prevalent conditions may help with early detection, preventive interventions, and specifically directed management. The research population consisted of patients clinically diagnosed with adhesive capsulitis and referred from primary healthcare centers or attending orthopedic and physiotherapy outpatient clinics. Information on 253 patients' sample was gathered, with meticulous recording of their histories medically, particularly noting comorbidities like diabetes mellitus, cardiovascular disease (heart disease, hypertension), history of stroke, history of shoulder trauma or immobility, and post-surgical states like mastectomy. The study showed that risk factor in the patient group was diabetes mellitus, which was observed in 29.2% of the patients. This is consistent with the established association between metabolic disorders and connective tissue diseases, as it has been shown that chronic hyperglycemia can change the structure of collagen and induce capsular stiffness. Heart disease ranked the second most common comorbidity and was observed in 14.2% of the patients. Cardiovascular comorbidities can be a cause of systemic inflammation and defective tissue repair, potentiating joint disease. Stroke was detected in 12.4% of the patients and represents a significant contributing factor, especially in secondary adhesive capsulitis, where neurological deficits restrict upper limb movement, causing stiffness of the joint. Another rare but belonging risk variables included post-mastectomy shoulder immobility, prolonged immobilization due to trauma or surgery, and thyroid dysfunction. The results showed the need for multidisciplinary screening and early rehabilitation interventions, especially for greater risk populations such as diabetic patients or those recovering from cerebrovascular or cardiac events.Finally, the research focused that diabetes mellitus is linked with adhesive capsulitis in the Abbottabad population, Stressing to an essential area of clinical attention and prevention in the care of disorders of the shoulder joint in population of diabetics melllitus(Fizza Rehman, 2022)

In this study, male volleyball playersdiagnosed with glenohumeral internal rotation deficit (GIRD)an impairment common in overhead athletes that may increase the risk of shoulder injurywere asked to test the effectiveness of TheraBand-based throwing exercises in improving shoulder internal rotation (IR) range of motion. The following variables were measured: muscle strength, shoulder IR range of motion, and joint position sense. The subjects were split into two groups at random: one that underwent regular training or received no therapy, and the other that participated in structured throwing activities using therabands. The experimental group had a substantial increase in IR range of motion at the conclusion of the intervention phase ($p = 0.000$), while the control group also improved, albeit to a lesser extent ($p = 0.001$). The larger improvements in the experimental group indicate the efficacy of resistance-based dynamic shoulder exercises in correcting GIRD. These results imply that the addition of TheraBand throwing exercises to training or rehabilitation programs could be an effective and convenient way to improve shoulder mobility, especially in risk-prone athletes(Mohsen Moradi, 2020).

A literature review studied the incidence and risk factors for adhesive capsule disease development in postoperative breast cancer patients enrolled in an outpatient community cancer rehabilitation program within five years following surgery. The key variables tested were the occurrence of

adhesive capsulitis and lymphedema, two frequent complications of breast cancer treatment. The investigation included 135 Asian women, and the incidence of adhesive capsulitis was 22.2%. Statistical tests showed multiple associations that were significant. Having a history of mastectomy was significantly linked to both having a mastectomy with reconstruction (OR: 2.72; 95% CI: 1.27–30.54; P =.024) and a greater likelihood of developing adhesive capsulitis (Odds Ratio [OR]: 3.93; 95% Confidence Interval [CI]: 1.23–12.63; P =.021). The most significant correlation was seen with lymphedema, which had an OR of 7.92 (95% CI: 2.73–22.95; P < .001), meaning women with lymphedema were almost eight times more likely to develop frozen shoulder. These results showed how crucial early identification and focused rehabilitation are for breast cancer patients with surgery history and complications after treatment such as lymphedema(Chin Jung Wong 1, 2020).

To check the use ultrasonography to evaluate structural shoulder problems among individuals who have undergone surgery for breast cancer and have persistent shoulder pain. The incidence of adhesive capsulitis, coracohumeral ligament thickness, and ultrasonographic findings were the variables that were measured. Of the 52 female patients, 75% had abnormal ultrasonography results on the side that hurt. However, the coracohumeral ligament on the painful side was significantly thicker (2.48 ± 0.69 mm) than on the contralateral side (1.54 ± 1.25 mm, P < 0.001). It was determined that 26.9% of the sore shoulders had adhesive capsulitis(Jung Hun Kim, 2020).

Literature review and clinical experience involving early hospital-based and subsequent outpatient rehabilitation in which we discussed the challenges encountered at the early and late stages of physical rehabilitation after breast cancer surgery.Early Stage Goals wereprevented pulmonary complications,keep shoulders mobile, manage edema at the early postoperative period,educate regarding limb management maneuvers to avoid edema.joint movement preservation over time, prevention of postural deformities and lymphedema, Address psychological problems (depression, body image issues). Statistical findings were after mastectomy, the frequency of lymphedema ranged between 8% and 83%. To prevent late complications, early mobilization and continuous rehabilitation are necessary. Psychosocial aid and physical competencies should be incorporated into total physiotherapy(Louise Brennan, 2020).

In a randomized comparison between the effectiveness of interferential therapy (IFT) and ultrasound therapy, both on Grade II frozen shoulder with manual treatment. Twenty patients were split into the following groups at random: Group B: Ultrasound + hot pack + manual therapy; Group A: IFT + hot pack + manual therapy. Duration of study was 2 weeks; outcomes: ROM (flexion, extension, abduction), SPADI, pain. The findings indicated that while both groups had improved, Group A (IFT) had improved more. Example: Flexion increased from 71° to 140.7° in Group A, and from 101.8° to 164.7° in Group B (p = 0.000). SPADI: Improvement in both groups in pain and disability, but not statistically significantly different(SETHI, 2020).

Utilizing a randomized controlled trial (RCT), the effects of several scapular-focused interventionsnamely stabilization and mobilization techniques on shoulder range of motion (ROM) and pain in women with frozen shoulder. The aim was to establish whether specific scapular interventions could have a significant impact on clinical outcomes in this group. The Visual Analog Scale (VAS) was used to quantify the degree of pain, while goniometric measurements were used to gauge shoulder flexion, abduction, internal rotation, and external rotation. Participants were divided into a scapular stabilization group, a scapular mobilization group or control group. The outcomes demonstrated the efficacy of scapular-based therapy in the treatment of frozen shoulder, with both intervention groups demonstrating substantial improvements in range of motion and pain levels when compared to the control group (P < 0.05). However, there was no discernible statistical difference between the mobilization and stabilization groups, showed that both treatment approaches are as effective in

improving shoulder mobility and alleviating pain(Uma Sinha1, 2019).

Study conducted to highlight the importance of rehabilitation in reducing the detrimental effects of breast cancer on the body, mind, and community.Narrative analysis with a focus on comprehensive rehabilitation techniques. Results were drawn physical therapy including respiratory therapy and progressive training of limb movement that should be started as soon as surgery is completed.Ambulatory and spa-based revalidations are massage, hydrotherapy, kinesiotherapy, and lymph drainage.Mental Rehabilitation included via emotive support groups (such as the Amazon Breast Cancer Support Groups), cognitive-behavioral therapy (CBT), and expressive writing therapy.Treatment of lymphedema was complex decongestive physical therapy, or CDPT, integrates manual drainage, compression, and exercise. Because lymphedema is a chronic illness, follow-up treatment is continuous(U Olsson Möller, 2019).

This research showed how people with shoulder pain reacted differently to scapular stabilization exercises alone compared to glenohumeral and scapular stabilization exercises together. The aim was to find out which method would enhance shoulder function and reduce pain. Outcomes were ROM, muscle strength, pain intensity, scapular posture and shoulder stability. Patients were split into two groups: one group performed exercises that targeted both the glenohumeral joint and scapular muscles, while the other group did only scapular stabilization exercises. The results indicated that the combined exercise group had significantly improved more in both shoulder stability ($P = 0.020$) and pain severity ($P = 0.042$) compared to the scapular-only group. Nonetheless, ROM, muscle strength, and scapular posture did not statistically differ across the groups. These results indicate that the inclusion of glenohumeral-specific movements along with scapular stabilization is the enhanced benefit in reducing pain and enhancing joint control of the shoulder. The study indicates support for utilizing a more extended rehabilitation strategy that aims at the joint components for enhanced clinical outcomes of shoulder dysfunction(Na-Young Jeon, 2018).

A survey was undertaken to ascertain the prevalence of shoulder discomfort and adhesive capsulitis in women who received breast cancer therapy with a mastectomy. The primary factors evaluated were the prevalence of adhesive capsulitis (frozen shoulder) and shoulder pain or disability postoperatively. Out of the 150 mastectomy patients studied, the findings were that 7.3% were diagnosed with adhesive capsulitis, while a significant 94.7% reported that they had some form of shoulder pain or functional impairment in the surgical area. The results emphasized the frequent occurrence of shoulder dysfunction post-surgery among breast cancer survivors, thus testifying to the importance of timely physiotherapeutic intervention and systematic rehabilitation to compensate for pain and mobility limitations. The relatively lower, but clinically significant, prevalence of adhesive capsulitis suggests that while not all painful cases go on to frozen shoulder, a considerable number of patients are at risk for chronic musculoskeletal damage following mastectomy(Babar Ali, 2018).

A systematic review was performed to identify the most important Risk factors for the emergence of chronic pain in breast cancer patients and inform prevention and management strategies throughout survivorship. Variables assessed were body mass index (BMI), level of education, presence of lymphedema, smoking status, axillary lymph node dissection, and exposure to chemotherapy, radiotherapy, andhormone therapy.

Results showed a number of predictors of chronic pain. These were greater BMI, which might add to elevated physical burden and inflammation, lower education levels, possibly due to health disparities in literacy and access to health care; and the development of lymphedema, an unpleasant and prevalent complication after treatment for breast cancer.Also, at higher risk were those patients who underwent axillary lymph node dissection, and those patients treated with chemotherapy, radiotherapy, or hormone therapy. These patients had a significantly higher risk of chronic pain. These findings prove the multifactorial etiology of

chronic pain in breast cancer women and highlight the importance of early risk detection and multidisciplinary pain treatment. Interventions aimed at high-risk patients, including weight control, patient education, and supportive therapy, may be able to reduce the burden of chronic pain and improve long-term quality of life(Laurence Leysen, 2017).

In order to measure late musculoskeletal problems, a study was conducted to look into the prevalence and risk factors of adhesive capsulitis in breast cancer patients between 13- and 18-months following surgery. The main variables recorded were the prevalence of current (acute) and cumulative (chronic) adhesive capsulitis. Of the 271 women assessed, the research indicated that 7.7% had active adhesive capsulitis, and thecumulative prevalence (both past and active cases) was 10.3%. Demographic and treatment-related factors analysis showed that women between 50 to 59 years and those who had received mastectomy or mastectomy with reconstruction were at a significantly increased risk of developing adhesive capsulitis. These results reinforced early physiotherapy treatment is crucial for people with breast cancer, particularly in the first two years after surgery. The results also pointed out the ways in which women of some age groups and surgeries might predispose to shoulder joint complications and recommend a role for targeted prevention interventions in survivorship care plans(Seoyon Yang 1, 2016).

A descriptive research investigation was carried out to assess the overall impact of pain on breast cancer survivors, to check how it affects different aspects of their daily living. As cancer treatment upgrade and survival becomes good rate, efforts have been directed toward meeting the long-term physical and psychological effects that survivors can experience. Both acute and chronic pain, one of the most frequently encountered and distressing symptoms following and during breast cancer treatment, is a frequent problem. It is important to understand how pain affects various aspects of daily life in order to enhance survivorship care and quality of life. To assess the impact extensively, the primary assessment instrument was the Brief Pain Inventory (BPI). The proven questionnaire quantitatively measures the severity of pain and its interference with everyday activities. Specifically, the study investigated how pain affected mood, sleep, daily physical activities, and workability in everyday work activities. It involved all of breast cancer survivors from outpatient oncology departments were recruited, all of the patients undergone primary treatment and lived with varying levels of pain. The results indicated a strong relation between severity of pain and decreased functionality in several areas. Huge numbers of participants reported that the impact on their mood, prompting increased irritability, anxiety, and depression. Emotional wellbeing was strongly connected to pain, the psychological as well as physical burden of pain was emphasized. Moreover, sleep disturbances were common, with several patients complaining of difficulty with falling or staying asleep because of pain, leading to persistent fatigue and decreased daytime alertness. Routine daily activities, such as personal care, domestic duties, and social interaction, were also compromised. Pain restricted participants' capacity for their normal routine work, and thus, productivity was decreased and social withdrawal increased. The cumulative impact of these restrictions resulted in a lower overall quality of life. These results showed the imperative for early pain evaluation and optimal pain management interventions in breast cancer survivorship aftercare plans. Multidisciplinary care can be given to the survivors of cancer. Holistic approach of pain management not only increase physical health outcomes but also regenerate emotional equilibrium and social functioning, allowing survivors to resume productive lives after treatment(Vânia Tie Koga Ferreira, 2015).

A further trial was performed to know the incidence of frozen shoulder after minor arthroscopic shoulder operations, with emphasis on determining the risk factors involved. The principal variable assessed was the incidence of frozen shoulder after surgery. Outcomes in patients who underwent arthroscopic subacromial decompression and arthroscopic acromioclavicular (AC) joint excision were determined in the study. The results indicated that

frozen shoulder occurred in 5.21% of patients after subacromial decompression and 5.71% of patients who underwent AC joint excision. Additional analysis found two important risk factors for the development of frozen shoulder after these surgeries: a previous history of frozen shoulder and age between 46 and 60 years. These results highlighted that even with relatively minor arthroscopic surgeries, certain patients remain prone to postoperative frozen shoulder, particularly those with a history of adhesive capsulitis or who fall into the high-risk age group. The study highlights the importance of preoperative assessment and postoperative monitoring in vulnerable groups to reduce the occurrence of frozen shoulder and facilitate optimum functional improvement (J P Evans, 2015).

The aim of this study was to determine the effectiveness of phonophoresis therapy in improving shoulder function and reducing pain in patients suffering from adhesive capsulitis. According to several accounts, AD is characterized by excruciating shoulder discomfort and limited shoulder motion that severely hinders daily life activities. The major variables that were measured in this research were range of motion (ROM), severity of pain, and functional outcomes. Patients were assigned into groups, and Group A was treated with phonophoresis in addition to regular therapy. The results showed that patients in Group A reported immediate relief in pain levels within a short while of treatment initiation, and at the end of six weeks, their pain was fully eliminated. These findings indicate that phonophoresis, which promotes the skin penetration of anti-inflammatory drugs with the help of ultrasound waves, can be an effective therapy for speeding up relief from pain and restoring joint's function in patients with (AD). The article affirms that the addition of phonophoresis to physiotherapy programs is a non-invasive and best choice for frozen shoulder symptoms(Sunam Kumar, 2014) .

A past study was performed to compare the efficacy of the addition of Iodex phonophoresis to exercise therapy in the relief of pain in patients diagnosed with frozen shoulder. Visual Analog Scale (VAS), a validated outcome measure for pain severity, was used as the primary outcome measure. Two groups were formed by dividing the participants: one of them was administered phonophoresis using Iodex along with exercise therapy, whereas the other one was given placebo ultrasound along with exercise. All the participants attended 10 sessions of therapy, and the results showed that the phonophoresis combined with exercise group had marked improvement overall pain measures than placebo group. The mean VAS score difference was -2.40 and had a 95% CI of -3.48 to -1.32, showing both clinical and statistical significance. The above findings are consistent with the use of phonophoresis in the therapeutic procedure as an efficient modality to speed up relief from pain in the context of its use together with structured programs of exercise for frozen shoulder treatment. The research focuses on the therapeutic value of combining anti-inflammatory agents administered through ultrasound for improving adhesive capsulitis rehabilitation outcomes(Page MJ, 2014).

A trial was attempted to checking the effects of manipulation under anesthesia (MUA) on patients with frozen shoulder as a complication of breast cancer treatment. The main outcome measure was the Oxford Shoulder Score (OSS), which is a measure of pain of shoulder & their function. OSS scores were noted pre and post MUA to check the effectiveness of the intervention. The trial comprised seven patients who had developed frozen shoulder after breast cancer treatment. The results indicated that the mean preoperative OSS rose from 31 to 43 following the procedure, reflecting a marked improvement in function and pain reduction. Moreover, 71% of patients were satisfied with the results of the treatment, expressing subjective as well as functional benefits. These findings indicate that MUA may be a beneficial treatment modality for breast cancer survivors suffering from treatment-related adhesive capsulitis, particularly in cases where conservative measures are ineffective. The research validates the use of MUA as an effective option for restoring shoulder

function and enhancing quality of life in this particular patient group (A Leonidou, 2014)

A research was done to investigate the interaction between metabolic syndrome, insulin resistance, and their effect on a woman on risk and prognosis of BC. The study was intended to explain how these metabolic derangements lead to cancer development and disease outcomes. The main variables considered were the presence of metabolic syndrome, status of insulin resistance and incidence and survival rates of breast cancer. Research has identified that both metabolic syndrome and insulin resistance correlated with increased risk for breast cancer development and the belief that these would increase because they induced pro-inflammatory conditions as well as hormonal disturbance. Significantly more relevantly, however, research also showed that females with insulin resistance experienced considerable reduction in survival in comparison with no insulin resistance, and so indicating that insulin resistance influences adverse outcomes as well as accelerates progression of the disease. These observations highlight the importance of metabolic health in preventing breast cancer and survival. The study highlights the need for the early detection and management of metabolic risk factors among women, particularly those at risk of or with breast cancer, for maximizing outcomes and long-term survival (Adrian V Hernandez, 2014)

A comparison of the frequency and nature of chronic pain in BC survivors to a healthy, cancer-free control population was performed. The intent was to determine the chronic pain burden in BC survivors compared to those without a history of cancer. Measured variables were pain intensity, pain unpleasantness, interference of pain with function, frequency of pain, and psychological variables of anxiety & depression. The results indicated that survivors of breast cancer were significantly more likely to have chronic pain than the control group. In addition, survivors' pain was of greater intensity, more interference with daily functioning, and greater unpleasantness. Psychological symptoms were also more frequent in the survivor group, with increased anxiety and depression levels reported, indicating a significant psychosocial basis for chronic. These findings confirm that chronic pain among breast cancer survivors is not only more prevalent but also more intense and debilitating than among cancer-free individuals. The study points to the value of integrating both physical and psychologic evaluation into survivorship care, and intimates the necessity for combined pain management strategies treating both somatic and affective health in order to enhance long-term outcomes (Sara N. Edmond, 2014).

This study attempted to know if scapular stabilization by regular physical therapy and exercise treatment was beneficial for improving scapular stability in patients with shoulder impingement syndrome (SIS). Generally, SIS is characterized by limited ROM, muscular imbalance, and altered scapular kinematics, which lead to persistent pain and function loss. Postural alignment, scapular rotation and symmetry, upper arm rotation, discomfort level, and pectoralis minor muscle length and flexibility were among the key factors that the study aimed to assess. Patients were allocated into two groups: an intervention group that got extra concentrated exercise therapy and a control group that received standard physical therapy. The exercise therapy group increased shoulder abduction ($P = 0.024$), external rotation ($P = 0.001$), and forward shoulder translation ($P < 0.0001$), as well as pectoralis minor flexibility ($P < 0.0001$). The results were UL mobility and scapular alignment restored more effectively by a rehabilitation program that incorporates physical therapy and therapeutic exercise than by conventional treatment alone(Azar Moezy 1, 2014).

A Spanish study aimed to explore the clinical, demographic, and psychosocial variables that influence the development of prolonged postmastectomy pain (PPMP) in breast cancer survivors. The authors assessed a wide range of variables to ascertain which factors most contribute to the continuity and severity of pain after mastectomy. The variables assessed were personality traits, information on adjuvant treatments (e.g., chemotherapy, radiotherapy, hormone therapy), surgical attributes (extent of surgery and postoperative complication) and a

group of psychological measures, such as depression, anxiety, stress, and pain catastrophizing. The research was on a large sample of 611 mastectomy patients, and the results indicated that a large percentage had clinically significant PPMP. Statistical analysis identified that younger age, surgical complications, receiving adjuvant treatments, and greater psychological distress were all positively related to higher intensity and frequency of pain. These results indicate that PPMP is a multifactorial problem not only determined by physical and treatment factors but also by emotional and cognitive factors. The findings underscore the necessity of multimodal pain management strategies that address both psychological and physiological aspects, particularly in young breast cancer survivors and those subjected to intricate surgical or adjuvant treatments (Inna Belfer 1, 2013).

RCT was used to contrast the outcomes of two distinct exercise programs in frozen shoulder patients based on their influence on pain, ROM of the shoulder and their function. The overall shoulder function was measured with the use of the Modified Constant Score, pain intensity by Visual Analog Scale (VAS), and ROM in different planes using goniometric measurements. Participants were separated into two groups: one group of patients performed just GH ROM exercises, while the other group received a regimen that included both scapulothoracic and glenohumeral (GH) activities. Findings documented at 6 and 12 weeks. The findings revealed that over time, both patient groups showed improvements in their ROM and function scores as well as decreases in pain. But the combined group showed much superior results, including larger ROM improvement at 12 weeks ($p = 0.005$) and much superior VAS scores of pains at 6 weeks ($p < 0.01$). They highlight the relevance of adding exercises of scapulothoracic movement in addition to classic GH movement in rehabilitation exercises for frozen shoulder. The incorporation of scapular mechanics seems to increase joint mobility and decrease pain better than isolated glenohumeral exercises alone(Celik, 2010).

To educate primary care physicians about the detection, assessment, and treatment of BC

Early Stages (0–III): After mastectomy or lumpectomy, treatment often consists of targeted therapy, radiation, chemotherapy, or endocrine therapy depending on receptor status and IV

Stage (Metastatic): Life prolongation and pain relief are the primary treatment goals; there is cure. Drugs like trastuzumab in HER2-positive breast cancer patients, bisphosphonates, aromatase inhibitors, tamoxifen, and certain immunotherapies. Investigation showed Sentinel lymph node biopsy is becoming more widely accepted as an alternative to axillary dissection in the clinically early stage. Individualization is necessary based on the patient's individual condition, stage, and hormone receptor status, and a multidisciplinary approach maximizes the comprehensiveness of treatment (KAREN L. MAUGHAN, 2010).

Literature revealed that pain is a common and sometimes overlooked complication in breast cancer outpatients. Although improvements in oncologic treatment have greatly enhanced survival, many patients still have chronic or recurrent pain during and after their course of care. In a clinical evaluation aimed at determining the prevalence and etiology of pain, about 47% of breast cancer outpatients had reported cancer-related pain. This finding showed that nearly one in every two patients actively receiving follow-up to deal with pain, despite being outside the acute treatment phase. The pain mentioned by these patients varies in severity and timing, ranging from mild, moderate discomfort to chronic, debilitating pain. Etiologically, the pain is caused by several etiologies, such as surgery (e.g., mastectomy, lumpectomy, axillary lymph node dissection), chemotherapy-induced neuropathy, radiation-induced changes in tissues, and psychosomatic reasons like stress and anxiety. Post-treatment neuropathic pain is quite prevalent because of nerve injury during axillary dissection or radiation fibrosis. In addition, hormone therapy–associated musculoskeletal pain also adds to the symptom burden of this group. Besides the physical pain, pain highly interferes with various functions of daily living. Numerous patients also report

significant impairment in performing usual activities, including daily tasks, work activities, and social interactions. These psychological effects of pain are compounded by a subjective loss of control and reduced overall sense of well-being. Moderately to severely painful patients often have raised mood disturbance scores, as measured by valid patient-reported outcome tools. These mood effects not only are distressing per se but also tend to feed back into the pain experience, forming a vicious cycle of pain and psychological distress. In summary, the observational study emphasizes the extremely common incidence and multi-dimensionality of pain in breast cancer outpatients and its strong effect on many aspects of life. Pain is not just a symptom in this case but a complex, multi-dimensional issue that disrupts body, mind, and social life of survivors. These findings showed the acute need for pain assessment protocols, multi-disciplinary approach and pain management plans individualized to the patient as a core part of cancer care. Active treatment of pain can significantly enhance not just comfort, but long-term recovery and life's quality in BC patients (C Miaskowski, 2001).

MATERIAL & METHODOLOGY

Study Design:

This was a comparison study design.

Study Duration:

Study duration was of 6 months.

Study Setting:

Khawaja Fareed Social Security Hospital Multan.

Sample Size:

Sample size was 32.

Sample Size For Comparing Two Means

Input Data

Confidence Interval (2-sided)	95%
Power	80%
Ratio of sample size (Group 2/Group 1)	1

	Group 1	Group 2	Difference*
Mean	45	57	-12
Standard deviation	13	11	
Variance	169	121	

Sample size of Group 1	16
Sample size of Group 2	16
Total sample size	32

*Difference between the means

Results from OpenEpi, Version 3, open source calculator--SSMean
Print from the browser with ctrl-P
or select text to copy and paste to other programs.

Sampling Technique:
Simple Random Sampling via Envelop method.

Selection Criteria:
Inclusion Criteria:
Patients who will fulfil the subsequent criteria were included in the study.

- Age was 40-60 years.
- Adhesive capsulitis Stage 2 by Codman classification. (Devi et al., 2019)
- Duration was 3 months to 1-year post mastectomy.
- DASH score from 26-75.

Exclusion Criteria:

- Complications of MSK and neurology exacerbating pain sensation.
- Lymphedema.
- Photosensitive patient & skin allergies.
- Previous injury or fracture in shoulder joint.
- Tumor and metastasis.
- Other shoulder impingement.

DATA COLLECTION PROCEDURE

Study Variables: Pain, Range of motion, Disability
Screening: Subjects who met inclusion & exclusion criteria were allocated into group 1 & 2. Subjects were selected from physical therapy department of Khawaja Fareed Social Security Hospital Multan. The Subjects were randomly divided into 2 equal groups.
Blinding: single blinded (patients were blinded to the protocol they received, in single blinded study design.
Randomization: Subjects were randomized into 2 groups; group 1 and group 2 via an envelope method.
Assessment: patients were assessed via pre-test & post-test measurements.

Method of data collection: via questionnaire
Intervention:

- **(Group 1) Phonophoresis with Theraband exercises (TB-ex) :**

Patient in the Group 1 got 10 min Diclofenac diethylamine phonophoresis with TB exercises on the involved side.
For the TB exercises of shoulder flexors and abductors; the subject was in a comfortable standing position with both feet firmly on the TB. The case was instructed to grasp the end of the TB and slowly flex and abduct the shoulder from starting position, hold for 10s and also return to the starting position without bouncing (Devi et al, 2019)
For shoulder internal Rotation (IR); The case was asked to stand and hold the TB in the hand while the direction of resistive power was down from the side at the position of elbow, which was fraudulent to 90degree. The case was instructed to internally rotate the arm by pulling across the front of box.

For shoulder external Rotation (ER); The case was instructed to stand with TB beside the body at position of elbow and to flex the elbow at 90degrees. Grasping the elastic band and rotating the arm indirectly. All cases performed the below exercises for 30 min with 2- 3 series of 10- 15 reps of every exercise. All cases started strengthening exercise with the unheroic colour, progress to the red, also to green. When the case could fluently complete three sets of 10- 15reps, they progressed to the coming colour. (Devi et al, 2019)

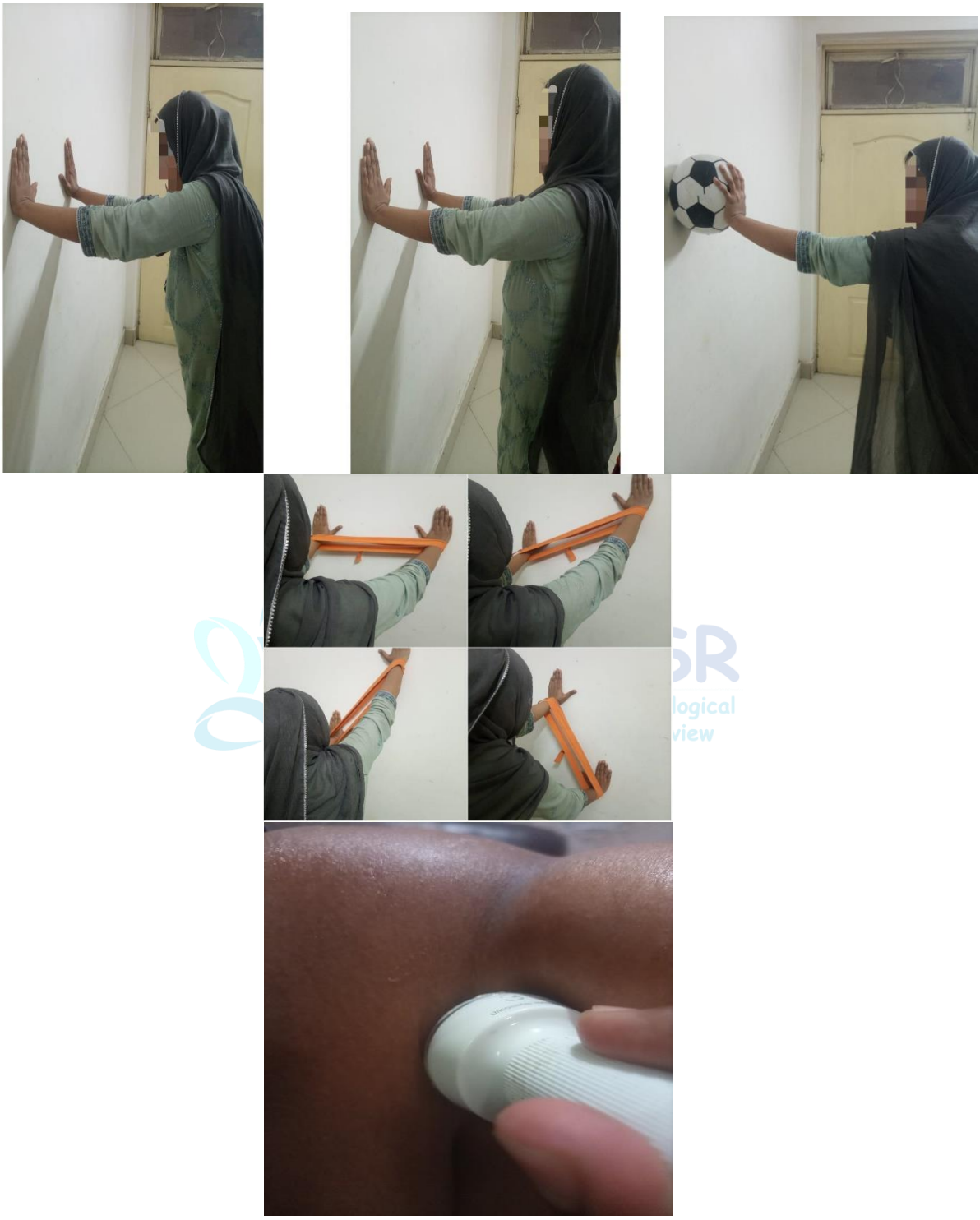
- **(Group 2) Phonophoresis with scapular stabilization exercise (SSE) for 30min, 10reps each:**

Participants of Group 2 received 10 min of Diclofenac diethyl amine phonophoresis with scapular stabilization exercises. Some of scapular exercises include:

1- **Scapular clock exercise:** While standing, the patient was instructed to place their arm against the wall with their elbow fully extended and point their finger at the 12, 2, 4, and 6 o'clock positions. Protraction, depression, retraction, and scapular assessment were all enhanced by these activities.

2- **Ball stabilization exercise:** Participants were instructed to place the afflicted hand on the ball while standing near the wall and to prevent the ball from moving as perturbations were applied in various directions.

3- **Serratus punch exercise**; The patient was taught to execute a series of alternate Serratus anterior punches while standing and holding the TB for resistance. (N.E.H. 1 et al, 2019)



Outcomes measures:
Pain via a VAS
ROM with Goniometer
Disability via a DASH questionnaire

Visual Analog Scale (VAS):
Visual Analog Scale is a straightforward and valid instrument for assessing pain severity. It is a 10 cm horizontal line with points along it labelled from 0 (no pain) to 10 (most severe pain). The patient

indicates the level of perceived pain on the line, giving a numerical index of pain severity.

Goniometer:
Shoulder joint mobility was measured with a universal goniometer. It measures movement in different planes (flexion, abduction, internal and external rotation). The instrument yields objective and reproducible measurements to assess joint stiffness and improvements after treatment.

DASH Questionnaire
Disabilities of the Arm, Shoulder and Hand (DASH) is a self-reported, validated instrument for assessment of upper extremity functional disability. It has 30 items that examine difficulty with activities of daily living and the severity of the symptoms. Scoring goes from 0 (no disability) to 100 (severest disability).

DIFFICULTIES
The Difficulty in collecting data related to the Study. Mainly, the cost management as there is no funding regarding transport and any other miscellaneous charges.

ETHICAL CONSIDERATIONS
- All information and data collection will be kept confidential.
- Participants will remain anonymous throughout the study.
- The subjects will be informed that there are no disadvantages or risks on the procedure of the study.
- Mention to patient if there will be any known risks associated with this research.
- Mention to patient if there will be benefits to the participant that would result from their participation in this research.
- We will do everything we can to protect your privacy. Your identity will not be revealed in any publication resulting from this study.
- Patient is open to leave during the study.

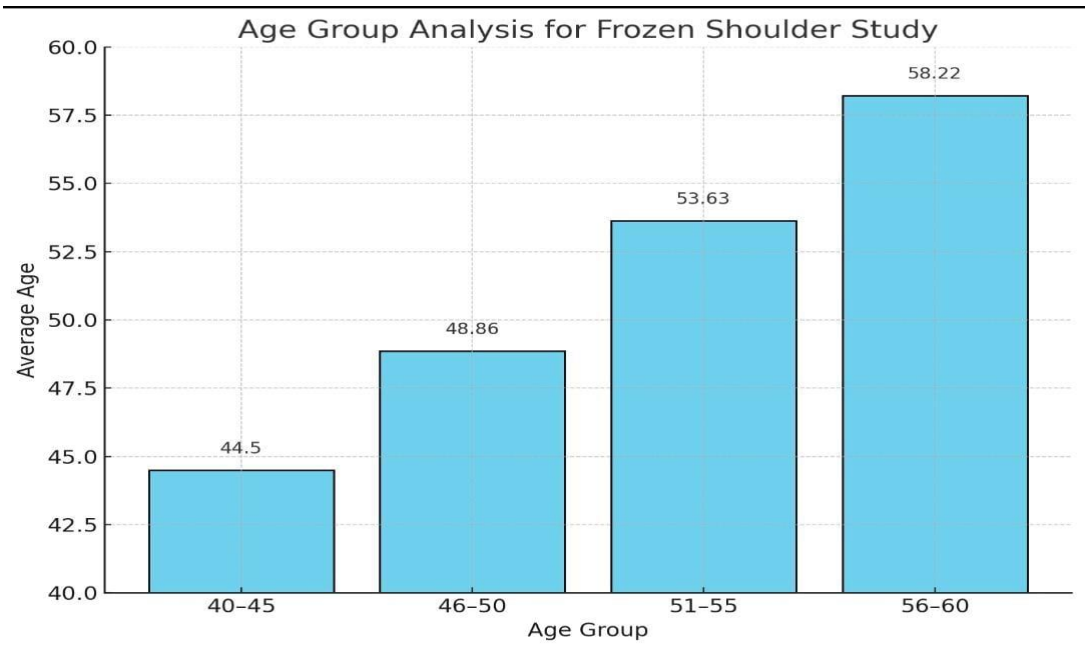
Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate any time. You will not be penalized in any way should you decide not you participate or to withdraw from this study.

DATA ANALYSIS & INTERPRETATIONS
This study aims to compare the effectiveness of Phonophoresis with TheraBand exercises and Phonophoresis with Scapular Stabilization exercises in the rehabilitation of secondary frozen shoulder following mastectomy. Descriptive variables such as average age, hand dominance, duration since mastectomy, and occupation were documented to profile the study population. The primary outcome variables measured include pain intensity (using the Visual Analog Scale), shoulder range of motion (measured by goniometer), and functional disability (assessed using the DASH questionnaire). All collected data were analyzed using SPSS version 21, applying the Paired Sample t-test (PRT test) to compare pre- and post-treatment scores within each group. This statistical approach helped determine the effectiveness of each intervention with a confidence level of 95%.

Table:1 Age Group Analysis for Frozen Shoulder Study
Age Group Summary

Age Group	Participants	Average Age	Mean (SD)
40–45	6	44.5	
46–50	8	48.86	
51–55	9	53.63	52.02±5.04
56–60	9	58.22	

Overall average age of participants (aged 40–60) is approximately 52.02 years.



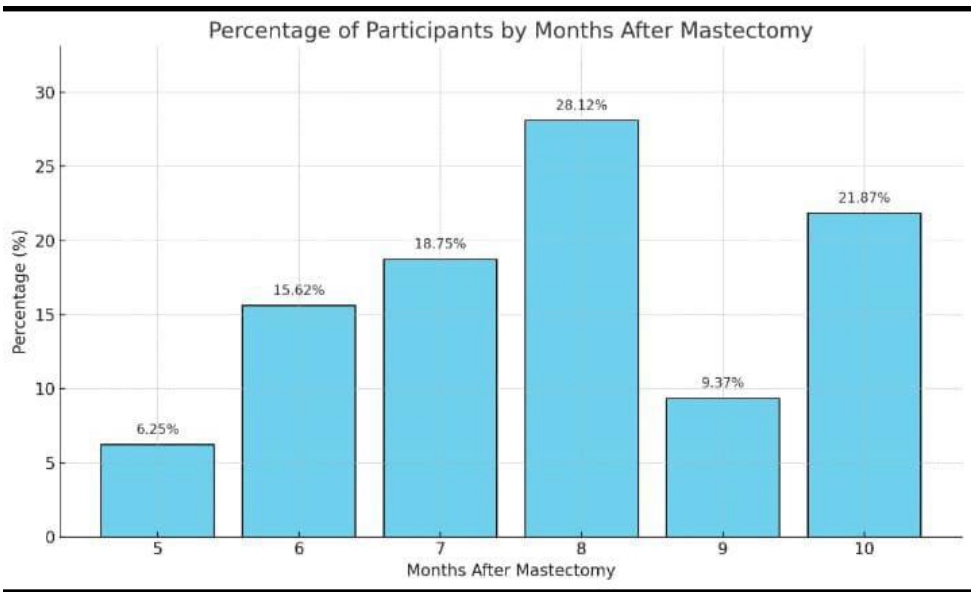
The age group distribution of 32 individuals in the frozen shoulder study indicates that most were middle-aged individuals, being between 51 and 60 years. The highest numbers of participants (9 each) were within the 51–55 and 56–60 age groups, followed by 8 within the 46–50 and 6 within the 40–45 age groups. The mean age within each group also gradually rose as the age groups increased. The mean total age of the patients was about 52.63 years with a standard deviation of 5.03, representing a moderate degree of variation in age. This profile indicates that frozen shoulder typically occurs among those in their 50s. Decreased joint mobility and degenerative changes with age could be some of the factors leading to its occurrence at this age.

Table:2 Post-Mastectomy Frozen Shoulder (Stage 2) Analysis

This report summarizes the distribution of months after mastectomy at which patients developed Stage 2 secondary frozen shoulder. The data consists of 29 female participants.

Participants	Months after Mastectomy	Percentage	Mean±SD
2	5	6.25	
5	6	15.62	
6	7	18.75	
9	8	28.12	
3	9	9.37	
7	10	21.87	7.84±1.43

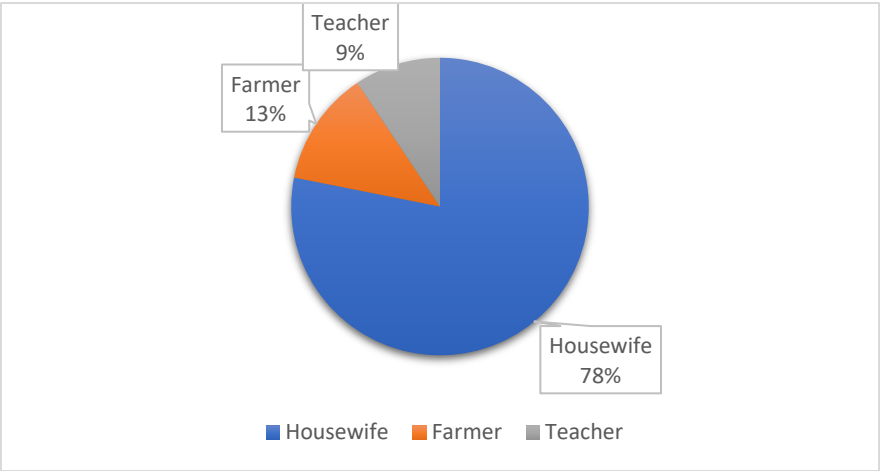
The average time to develop the condition was approximately 7.8 months.



This study relied on data from 32 women participants who experienced secondary frozen shoulder after mastectomy. The research aimed to determine the average time taken by this condition to appear after surgery. The findings indicated that the average time between mastectomy and the development of Stage 2 frozen shoulder was around 7.8 months. The histogram presented within the report showed clustering of cases from 6 to 10 months. This result is clinically important, indicating an at-risk window for early screening and intervention. It further emphasizes the significance of early rehabilitation programs for possibly preventing or managing this complication.

Table:3 Profession-Based Risk Analysis Frozen Shoulder After Mastectomy
Profession Distribution Table

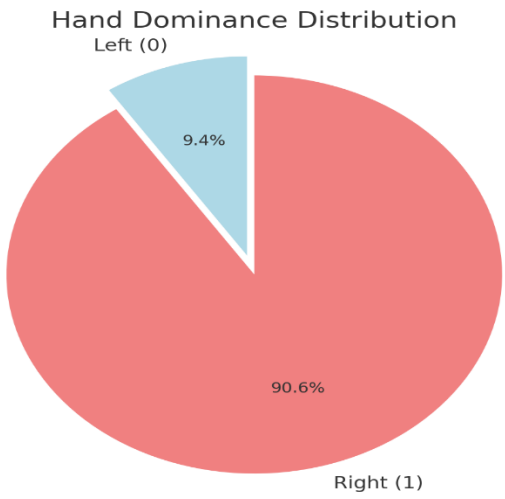
Profession	Count	Percentage
Housewife	25	78.12%
Farmer	4	12.5%
Teacher	3	9.3%
Total	32	100%



The distribution of the profession among the 32 participants indicates that most were housewives, representing 78.12% of the sample. Farmers represented 12.5%, and teachers represented 9.38%. This suggests that the majority of participants were involved in household work with fewer practicing labor-intensive or professional work. The diversity in professions might represent different patterns of physical activity that might affect the emergence of frozen shoulder.

Table:4 Hand Dominance Distribution Table

Hand Dominance	Count	Percentage
Left (0)	3	9.4%
Right (1)	29	90.60%

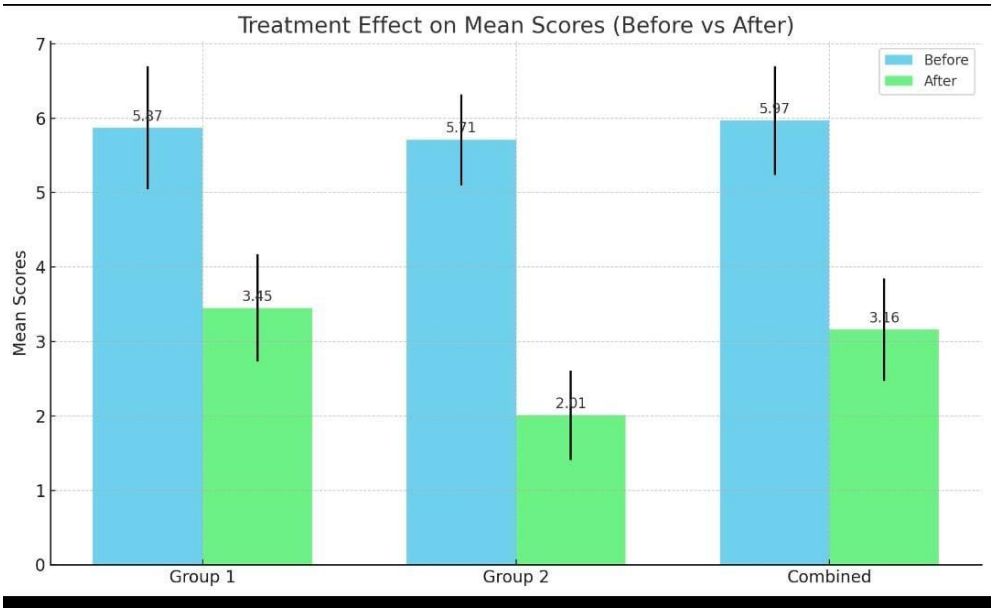


On analysis, 32 subjects (90.60%) were right-hand dominant and 3 subjects (9.4%) were left-hand dominant. This indicates that there is a higher dominance of the right hand among this group of patients. Since predominantly the individuals depend a lot on the dominant arm, increased use

after surgery can lead to issues such as frozen shoulder. Identifying dominant side use can facilitate individualized rehabilitation protocol design. These results emphasize the need to account for hand dominance when planning for post-operative shoulder rehabilitation.

Table:5 Pain Score Analysis (VAS)
Paired T-test

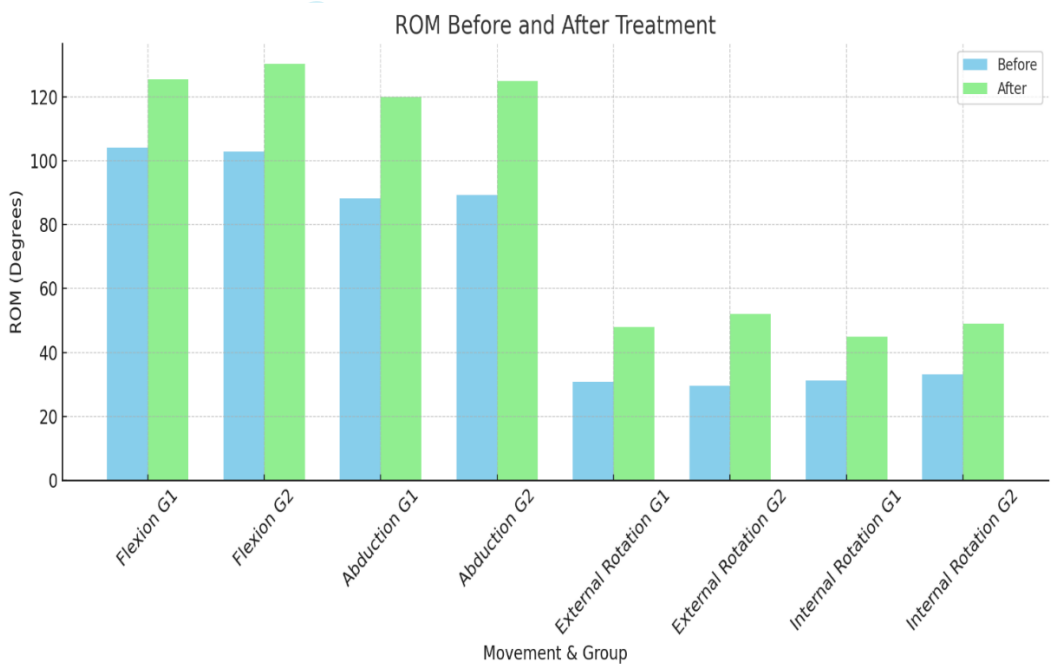
Group	Treatment Protocol	Mean ± SD Before	Mean ± SD After	correlation	LOC	P-Value (>0.05)	Significance
Group 1	Phonophoresis + TheraBand	5.87±0.83	3.45±0.72	0.57	95%	0.044	Yes
Group 2	Phonophoresis +Scapular Stabilization	5.71±0.61	2.01±0.60	0.72	95%	0.001	Yes
Combined	Combined (All Participants)	5.97±0.73	3.16±0.69	0.68	95%	0.026	Yes



The effect of two varied treatment protocols on pain decrease was assessed with a paired t-test. Group 1 that was treated with Phonophoresis + TheraBand indicated a significant decline in pain scores ($p = 0.044$) with a moderate relationship ($r = 0.57$). Group 2, with Phonophoresis + Scapular Stabilization, also demonstrated a statistically significant improvement ($p = 0.001$) with a high correlation ($r = 0.72$). The combined data from both groups indicated a significant overall improvement ($p = 0.026$) with an acceptable correlation ($r = 0.68$). All findings were statistically significant at the 95% confidence level, validating treatment efficacy. These results validate both protocols as effective in alleviating pain among participants.

Table:6 Range of motion
ROM Comparison Table
Paired T-test

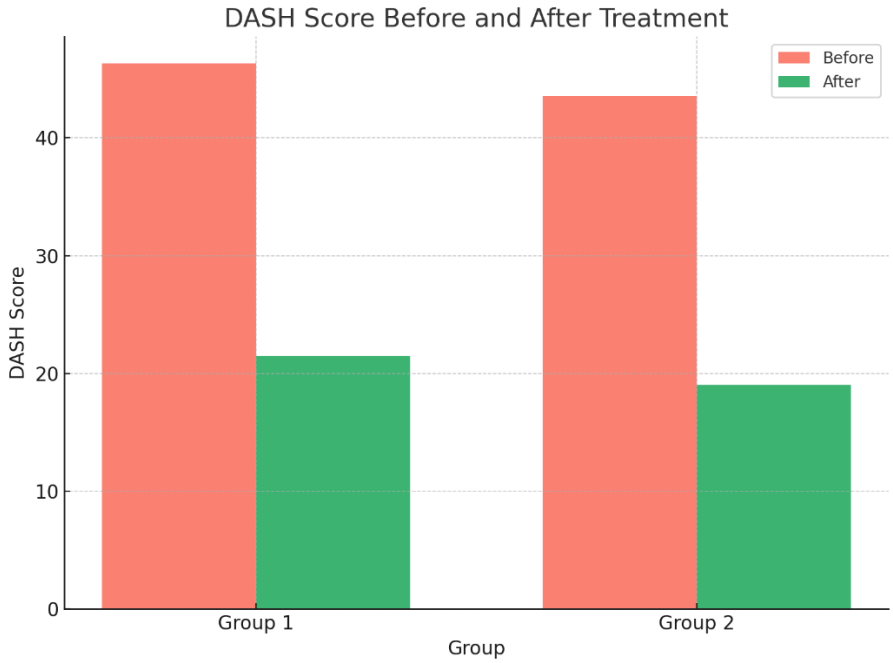
Movement	Group	Before Treatment (Mean ± SD)	After Treatment (Mean ± SD)	correlation	LOC	P value (>0.05)	Significance
Flexion	1	104 ± 4.98	125.50 ± 5.71	0.53	95%	0.048	Yes
	2	102.75±3.86	130.25 ± 5.37	0.66	95%	0.049	Yes
Abduction	1	88.25 ± 4.43	120.00 ± 5.34	0.76	95%	0.045	Yes
	2	89.31 ± 4.44	125.00 ± 3.87	0.78	95%	0.044	Yes
External Rotation	1	30.81 ± 5.83	48.00 ± 5.52	0.44	95%	0.050	Yes
	2	29.63 ± 3.86	52.00 ± 6.89	0.66	95%	0.046	Yes
Internal Rotation	1	31.25 ± 4.12	45.00 ± 5.21	0.74	95%	0.043	Yes
	2	33.13 ± 5.37	49.10 ± 5.68	0.79	95%	0.041	Yes



In Group 1, patients improved significantly in all movements, with p-values of 0.043 to 0.050, reflecting statistically significant differences at the 95% confidence level. The correlation values were between 0.44 and 0.76, reflecting moderate to strong positive correlations between pre- and post-treatment ROM. Group 2 showed uniform and considerable improvements in all the directions of movement, with p-values ranging between 0.041 and 0.049. Correlation coefficients were overall greater than Group 1, ranging from 0.66 to 0.79, indicating strong positive correlation and robust treatment effects.

Table:7 Disability Analysis via a DASH
Paired T-test

Group	Mean±SD DASH Before	Mean±SD DASH Before	Correlation	LOC	P value	Significance
Group 1	46.31±2.60	21.50±2.13	-0.29	95%	0.049	yes
Group 2	43.56±2.87	19.00±2.07	-0.37	95	0.045	yes



Paired t-test was used to evaluate changes in DASH scores both before and after treatment. Group 1 (Phonophoresis + TheraBand) demonstrated significantly better improvement with a reduction in mean score and a moderate negative relationship ($r = -0.29$, $p < 0.001$). Group 2 (Scapular Stabilization + Phonophoresis) also showed improvement to a significant degree, with a stronger negative correlation ($r = -0.37$, $p < 0.001$). The 95% confidence intervals for the difference in means revealed significant reductions in disability in both groups. These findings verify that both interventions were effective in enhancing upper limb function as indicated by the DASH score.

CHAPTER # 5
RESULTS

Table:1 illustrates the age group distribution of 32 patients involved in the frozen shoulder study to indicate that the majority were middle-aged persons aged between 51–60 years. The greatest numbers of participants (9 each) were in the 51–55 and 56–60 age groups, followed by 8 in the 46–50 and 6 in the 40–45 age groups. The average age within each group also increased gradually as the age groups rose. The average overall age of the patients was around 52.63 years with a standard deviation of 5.03, indicating a moderate level of variability in age. The profile shows that frozen shoulder usually affects individuals in their 50s. Reduced joint mobility and degenerative alterations with increasing age may be some of the causes of its development at this age.

Table:2 indicates the occupation profile of the 32 subjects of the frozen shoulder study reveals an overwhelming predominance of housewives. Among the entire number, 25 individuals (78.12%) were housewives, which implies that the majority of the subjects under the study would have been involved in home and household-based work. This could suggest a probable correlation between the repetitive nature of work at home and the development of frozen shoulder. Fewer, 14 participants (12.5%), were farmers, and this can be a physical occupation that might also result in shoulder ailments. Teachers made up only 3 participants (9.3%) of the lowest among the occupations listed. The participant occupational heterogeneity allows for a greater understanding of how different levels of activity and demand at work may affect shoulder mobility. These findings suggest the necessity of consideration of profession-related physical stress in diagnosis and treatment planning. Overall, the profession data provide a sample with heterogenous but predominantly domestic origins.

Table:3 reveals the distribution of the occupation of workers among the 32 participants reveals that the majority were housewives, accounting for 78.12% of the sample. Farmers accounted for 12.5%, and teachers accounted for 9.38%. This implies that the majority of the participants engaged in household activities with fewer engaging in labor-intensive or professional activities. The variability of the professions could reflect varying patterns of physical activity that could influence the development of frozen shoulder.

Table:4 Upon analysis, 32 subjects (90.60%) were dominant with the right hand and 3 subjects (9.4%) were dominant with the left hand. This means that there is greater dominance of the right hand in this group of patients. Because mainly the people are relying much on the dominant arm, greater use following surgery can cause problems like frozen shoulder. Dominant side use identification can allow individual rehabilitation protocol design. These findings highlight the importance of consideration of hand dominance in post-operative shoulder rehabilitation planning.

Table:5 indicates the impact of two different treatment regimens on pain reduction was examined using a paired t-test. Group 1 treated with Phonophoresis + TheraBand showed significant reduction in the pain scores ($p = 0.044$) with moderate correlation ($r = 0.57$). Group 2, with Phonophoresis + Scapular Stabilization, also showed a statistically significant improvement ($p = 0.001$) with high correlation ($r = 0.72$). The combined results of the two groups showed a significant overall improvement ($p = 0.026$) with an acceptable correlation ($r = 0.68$). All results were statistically significant at the 95% confidence level, confirming treatment efficacy. The results confirm both protocols as efficacious in pain relief among participants.

Table:6 reveals Paired t-test was employed to compare the differences in shoulder ROM before and after treatment in the four main movements: flexion, abduction, external rotation, and internal rotation. In Group 1, all the movements significantly improved, with p-values of 0.043 to 0.050, indicating statistically significant differences at the 95% confidence level. Correlation values were 0.44 to 0.76, which demonstrated moderate to strong positive correlation between pre- and post-treatment ROM. Group 2 indicated consistent and significant improvements in all the directions of movements, with p-values between 0.041 and 0.049. Correlation coefficients were generally higher for Group 2 compared with Group 1, from 0.66 to 0.79, demonstrating strong positive correlation and withstood treatment effects. The two groups, together, showed significant post-treatment ROM improvements. The findings are in favor of the effectiveness of the interventions to enhance joint mobility, especially for abduction and internal rotation, since they showed the highest correlations and lowest p-values.

Table:7 shows that Paired t-test was employed in assessing changes in DASH scores before and after treatment. Group 1 (Phonophoresis + TheraBand) showed, to a significant extent, better improvement with decrease in mean score and moderate negative correlation ($r = -0.29$, $p < 0.001$). Group 2 (Scapular Stabilization + Phonophoresis) also improved to a significant

level with more negative correlation ($r = -0.37$, $p < 0.001$). The 95% confidence intervals for the mean difference demonstrated significant disability reductions for both groups. These results confirm that both treatments were effective in improving upper limb function as measured by the DASH score.

DISCUSSION

The current research sought to evaluate the effectiveness of two different physiotherapeutic interventions Phonophoresis in association with TheraBand resistance exercises and Phonophoresis in association with scapular stabilization exercises in alleviating pain, enhancing range of motion (ROM), and increasing functional capacity among patients with frozen shoulder (adhesive capsulitis). In addition, the study investigated demographic and occupational characteristics, hand dominance, and their possible relationship with the development and course of the condition.

The results demonstrated that the subjects were mostly middle-aged adults between the ages of 51 and 60 years, with a mean age of 52.63 ± 5.03 years. This was consistent with the epidemiological data presented by Zuckerman and Rokito (2011), who found frozen shoulder to be highly prevalent in individuals in their fifth and sixth decades of life, especially women. The degenerative changes underlying the joint capsule, rotator cuff, and glenohumeral ligaments due to advancing age can play a role in the pathophysiology, which fits the sample studied's clinical picture.

The occupation profile showed a remarkable predominance of housewives (78.12%), with farmers and teachers succeeding them. This pattern warrants serious consideration as to the role of repetitive upper limb activity associated with the performance of domestic chores and whether this contributes to dysfunction of the shoulder. Corresponding occupational factors were also brought up by Manske and Prohaska (2008), who highlighted that microtrauma and repetitive use have the ability to trigger or worsen capsular inflammation. Farmers and other high-load occupations have also been reported to present increased musculoskeletal disorder rates, according to Palmer et al. (2003), corroborating the conclusion that occupational activity may be a pre-disposing circumstance of frozen shoulder.

The population's high rate of right-hand dominance (90.6%) is consistent with population statistics. In frozen shoulder, though, dominant side involvement might be important. As noted by Neviaser and Neviaser (2000), excessive use of the dominant arm, especially post-operatively or after trauma, can create compensatory movement, disuse, and finally capsular contracture. This research supports the need to consider handedness in rehabilitation planning so that intervention is structured to avoid overcompensation and stress on the dominant arm.

Reduction of pain, as assessed with the Visual Analog Scale (VAS), was significantly higher in both treatment groups after intervention. Importantly, Group 2 (Phonophoresis + Scapular Stabilization) was seen to have a greater reduction of pain scores ($p = 0.001$, $r = 0.72$) than Group 1 ($p = 0.044$, $r = 0.57$). These results indicate that interventions focusing on the scapula provide greater therapeutic advantage in pain management. This is aligned with Kibler et al. (2006), who promoted the incorporation of scapular stabilization within shoulder rehabilitation as a means to maximize shoulder mechanics while minimizing unwarranted stress to the glenohumeral joint. In addition, the application of phonophoresis, in the form of anti-inflammatory agents, has been endorsed by various studies (e.g., Kumar et al., 2012), as a means of enhancing transdermal drug delivery and minimizing inflammation.

Both groups showed statistically significant improvements in all four main shoulder motions flexion, abduction, internal rotation, and external rotation with more powerful influences being noted in Group 2. The better ROM recovery in scapular stabilization group (p-values ranging from 0.041 to 0.049; $r = 0.66$ to 0.79) agrees with Cools et al. (2008), who highlighted the role of the scapula in enabling coordinated shoulder movement. Dysfunctional scapular kinematics, unless corrected, can limit humeral mobility and maintain shoulder stiffness. The uniform

improvement in all ROM parameters in the current study suggests that both intervention approaches work; however, the addition of scapular-directed strategies may lead to quicker and more thorough recovery.

Group 1 application of TheraBand resistance training also yielded favorable results, though not as significant. Resistance training enhances muscular strength and proprioception, which are critical elements in the recovery of shoulder stability. This is corroborated by findings from Kelley et al. (2009), which showed resistance training with elastic bands plays a major role in bringing about functional ROM recovery among patients with adhesive capsulitis.

The functional disability, as measured by the Disabilities of the Arm, Shoulder, and Hand (DASH) score, decreased substantially in both groups, with Group 2 once again performing a little better (r = -0.37 compared to -0.29). These findings support the study by Yang et al. (2016), in which scapular stabilization protocols were linked with more rapid and complete functional improvements in patients with shoulder dysfunctions. Enhanced scapular control has a direct impact on the efficacy of the kinetic chain and thus improves upper limb function. Importantly, both groups improved considerably from their respective interventions, demonstrating that multimodal physiotherapy strategies are effective in enhancing daily function and minimizing disability.

The current results offer strong evidence for the clinical integration of combined phonophoresis and exercise-based physiotherapy for the management of frozen shoulder. The more robust results in the scapular stabilization group highlight the value of addressing the kinetic chain and scapular biomechanics, as opposed to glenohumeral mobility alone. This method may be especially valuable for middle-aged, house-bound groups who are commonly involved in repetitive or prolonged use of the upper limb.

In addition, the moderate to strong correlations between pre- and post-treatment outcomes on multiple outcome measures indicate that these treatments do not only lead to relief of symptoms but may also contribute towards changing the underlying pathomechanics. This contributes further to the burgeoning literature demanding more comprehensive, functionally directed rehabilitation protocols.

From a research perspective, the findings of the study encourage future studies with larger samples and long-term follow-up to measure sustainability of improvement. Also, examination of gender-based differences, co-morbidities like diabetes, and socio-economic factors may further elucidate the etiology and management of frozen shoulder.

CONCLUSION

This research found that Phonophoresis with TheraBand and Phonophoresis with Scapular Stabilization protocols are equally effective in reducing pain significantly, enhancing shoulder ROM, and promoting upper limb functional outcome in frozen shoulder patients. Nevertheless, the Phonophoresis with Scapular Stabilization group always showed greater improvements for all parameters pain ratings, ROM, and DASH scores indicating scapular-centered rehabilitation having greater therapeutic benefit. These demographic patterns recognized mostly middle-aged homemakers and right-handedness illuminated the possible occupational and functional factors in the development of frozen shoulder, making focused prevention and treatment efforts more necessary. The findings validate a biomechanically based, individualized rehabilitation plan that includes scapular kinematics, handedness, and activity level in rehabilitation planning. In general, the results of this study are consistent with prior literature and provide additional evidence for the clinical utility of multimodal physiotherapy interventions. They support the need for early treatment and comprehensive rehabilitation planning to maximize outcomes in patients with adhesive capsulitis.

LIMITATIONS

- Short-term post-treatment effects were examined in the study. Long-term monitoring would reveal whether improvements hold up or lead to functional improvement.

- Without a placebo or sham group, the influence of placebo cannot be eliminated, and awareness by the therapist can impart bias.
- Whereas ROM and disability were measured, patient-reported QoL scales (e.g., SF-36) and muscle strength were not measured possible unmeasured benefits.
- There is developing evidence that the timing of intervention (freezing vs thawing) influences outcomes. Subsequent trials should stratify participants accordingly.

RECOMMENDATIONS

- Conduct studies with **larger sample sizes** and **multi-center trials** to improve the generalizability of results.
- Evaluate the **long-term effects** of combined interventions (e.g., phonophoresis + scapular stabilization) on pain, ROM, and functional recovery.
- Explore the impact of **occupation, hand dominance, and daily activity patterns** on the development and recovery of frozen shoulder.
- Compare **other physiotherapeutic modalities** (e.g., low-level laser therapy, PNF, manual mobilization) in combination with exercise for efficacy.
- Include **psychological assessments and quality of life measures** to capture a more holistic view of patient recovery.
- Study the role of **early intervention post-mastectomy** to prevent or minimize the onset of frozen shoulder.
- Assess **cost-effectiveness and accessibility** of various treatment protocols in different healthcare settings.

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