RESEARCH ARTICLE

Comparative analysis of Maitland mobilization *versus* Butler's neural mobilization techniques with concurrent use of muscle energy technique for shoulder adhesive capsulitis: A prospective study

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ABSTRACT

Background: Shoulder peri-arthritis/adhesive capsulitis/frozen shoulder is a progressive self-limited shoulder capsule inflammation characterized by pain and global restriction in shoulder range of motion (ROM), such as shoulder flexion, abduction, and internal and external rotation. The shoulder capsule joint complex thickens and adheres to the underlying bone in this condition. Very few studies have been conducted to date to compare the effectiveness of Maitland mobilization *versus* Butler's neural mobilization in common use with Muscle Energy Technique (MET) in the management of adhesive capsulitis. *Objective*: The present study aimed to compare the effectiveness of Maitland mobilization versus Butler's neural mobilization with concurrent use of MET in managing adhesive capsulitis. *Methods*: Thirty individuals presented with symptoms of adhesive capsulitis in the Physiotherapy Clinic of Brainware University. They were divided randomly into two groups: (i) Group A received Maitland mobilization +MET. (ii) Group B received Butler's neural mobilization + MET. The treatment was scheduled for four weeks, three sessions per week for both groups. The pain intensity level and functional mobility were assessed before and after treatment. *Results*: The Shoulder Pain and Disability Index (SPADI) score for inter-group comparison showed a significant improvement in Group B patients compared to group A, along with an increase in ROM, particularly in abduction and internal rotation.*Conclusion*: The present study illustrates that both groups experienced significant improvements in ROM, with Group B showing better ROM and a significant reduction in SPADI score.

Keywords: Adhesive capsulitis, Maitland mobilization, Butler's neural mobilization, Muscle energy technique.

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INTRODUCTION

Adhesive capsulitis, also known as frozen shoulder, is a gradual, self-limited inflammation of the shoulder capsule that causes pain and limitation in the Range of Motion (ROM) of the shoulder, including shoulder flexion, abduction, internal and external rotation, and is the hallmark of adhesive capsulitis or shoulder periarthritis.[1] Due to discomfort, stiffness, and limited ROM at the glenohumeral joint, Duplay[2] initially referred to it as 'periarteritis-scapula-humeral.' The shoulder capsule joint complex thickens and adheres to the underlying bone[3] in this condition. Occasionally, the shoulder capsule may also separate from the bone.[4] The condition is often difficult to define, explain, or treat.[1,5] According to the American Academy of Orthopedic Surgeons, a frozen shoulder is "a condition of varying severity characterized by the gradual development of global limitation of active and passive shoulder motion where radiographic findings other than osteopenia are absent".[5] Reduced capsular extensibility, an adhering axillary recess, which severely limits the humeral head's ability to rotate externally and pass beneath the acromion process during abduction.

It was also reported that this adhesive capsulitis affects 3-5% of the general population and up to 20% of people with diabetes.[6] This condition is most common between ages 40 to 60 years and rare in those under 40 years. Women are more frequently affected than men, comprising about 70% of cases.[6] Affected individuals have a 5-34% chance of developing the illness in the contralateral shoulder, and 14% of affected individuals develop bilateral shoulder involvement.[7] It is uncommon in those under 40 years. Studies show higher incidence rates in diabetics, with a 2 to 4 times greater likelihood in the US and 23-30% in the UK, Australia, and India.[8]

Research suggests that capsular fibrosis and synovial inflammation often accompany adhesive capsulitis.[9,10] Collagen types I and III are laid down in the shoulder joint area, followed by a contraction of the surrounding tissue. Cytokines may occasionally result in long-term fibrosis,

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inflammation, and a loss of normal collagenous remodeling, which stiffens the ligaments and capsule.[11,12] Shoulder ROM is changed due to an imbalance in the shoulder muscles in addition to the restricted ROM, and the scapular stabilizers are out of balance because the upper trapezius is often more active than the lower trapezius.[13] When patients with adhesive capsulitis eventually display the "shrug sign," it is indicated by the scapula rising upward before a 60° angle of abduction in glenohumeral joint elevation because of a lack of capsular extensibility.[14,15] Bunker and Anthony[15] also reported that adhesive capsulitis is characterized by dense shoulder capsule fibrosis, resulting in a contracture of the rotator interval and coracohumeral ligament.[15,16] Bunker and Anthony also mentioned the presence of cytokines that regulate fibroblast growth and influence fibroblast collagen production. In any way, this adhesive capsulitis ultimately results in shoulder pain, stiffness, and a restricted ROM at the glenohumeral joint. The average ROM in frozen-stage shoulder patients is 98° abduction, 117° flexion, 33° external rotation, and 18° internal rotation with the shoulder abducted to 90°.[17] Furthermore, internal rotation causes more discomfort than external rotations when a rotator cuff injury occurs. When the arm goes up and outward, discomfort is felt in the 60-90° ROM, indicative of subacromial or subdeltoid bursitis.[18]

The administration of physical therapy is very common in treating adhesive capsulitis. This includes manual therapy techniques (such as Maitland, Mulligan, and Kaltenborn mobilization techniques), therapeutic exercises (including Codman, self-stretching, and dynamic strengthening exercises with open and closed kinetic chains), and therapeutic modalities like ultrasound and interferential therapy. However, none of the methods can fully restore the full ROM at the shoulder joint within a reasonable short period. Therefore, the present study combined two widely used manual therapies, Maitland mobilization and Butler's neural mobilization therapy,[19] along with the Muscle Energy Technique (MET).

METHODOLOGY

The study was conducted over three months in the Physiotherapy Laboratory, Department of Allied Health Sciences, Brainware University, utilizing the Instrumental Tools and Universal Goniometer. With clearance from the University's Institutional Ethics Committee, the patients were approached for enrolment in the study after obtaining written informed consent. All the study groups received a verbal explanation of the research purpose and a comprehensive description of the study protocol. The sample size was calculated as per Cochran's formula online[20] with a confidence level of 95% and a margin of error ±5% of the measured value considering a population size of 70 as the patient turnout in this clinic was approximately 75 during the above-mentioned period. Following screening using the inclusion (Idiopathic or primary adhesive capsulitis, Age between 40 to 60 years, Male and female, Progressive loss of passive ROM of shoulder joint relative to non-affected side in at least one direction) and exclusion criteria (Other conditions involving the shoulder such as rheumatoid arthritis, damage of glenohumeral cartilage, and osteoporosis, Neurologic deficit affecting shoulder function, Patients with shoulder girdle fracture, Injection with corticosteroids in the affected shoulder in the preceding four weeks, Malignancy of any kind and type 2 diabetes mellitus), 38 patients were recruited for this study. The patient's informed consent was taken before the treatment protocol. A random sampling procedure was carried out to divide the 30 patients into two study groups. The chosen patient underwent a thorough evaluation, as documented in the assessment chart, which included the study's parameters (ROM in degrees using a goniometer and SPADI).

Study Groups

The patients were divided into two groups, each comprising 15 patients. Group A: For four weeks, each patient in this group underwent three weekly sessions of Maitland mobilization and simultaneous MET. Group B: For four weeks, each patient in this group underwent three weekly sessions of Butler's neural mobilization and simultaneous MET.

Both groups underwent four weeks of therapeutic intervention. The shoulder pain and SPADI scores were used to measure the intensity of pain and disability, and a goniometer was used to measure ROM in degrees. The evaluation was conducted on the first day, prior to treatment, and at the end of the fourth week of treatment.

Therapeutic Interventions

Maitland mobilization

Maitland mobilization seeks to increase the ROM by dissolving the adhesion. For one minute, the glides are delivered at a pace of two to three glides per second, with a 30-second break in between. The procedure for Maitland mobilization is as follows: Glenohumeral joint distraction, glenohumeral caudal glide, glenohumeral dorsal glide, glenohumeral ventral glide, sternoclavicular caudal glide, acromioclavicular dorsal glide, acromioclavicular ventral glide, and scapulothoracic distraction.[1,21]

Neural mobilization

The primary theoretical goal was to minimize intrinsic stresses on neural tissue and support optimal physiological function by attempting to restore the dynamic equilibrium between the relative mobility of neurons and their surrounding mechanical interfaces. Group B received the procedure for Butler's neural mobilization as follows: ULTT1, ULTT2, ULTT3, and ULTT4.[19]

Muscle energy technique (MET)

A study narrated the clinical outcomes of patients with cervical radiculopathy treated non-surgically, including

the use of MET, neural mobilization, ice applications, and/or medication. It is suggested that the strain induced in a muscle when it is isometrically contracted produces stretching of the series elastic component. However, when it is additionally being actively or passively stretched, a muscle and intramuscular connective tissue will be elongated, called Post-isometric Relaxation(PIR).[22]

Statistical Analysis

A paired Student's t-test was conducted to compare parameters before and after the intervention within each group, with $p < 0.05$ used as the indicator of statistical significance. 20 The percentage change of ROM after the treatment protocol in both groups was also compared using the Student's t-test.

RESULTS

The present study indicates that after four weeks of treatment, Group A (Maitland + MET) and Group B (Butler's neural mobilization + MET) exhibited significant improvements in all ROM, as illustrated in Table 1. There is a significant improvement in all ROM in both groups, as shown in Figure 1. However, it was observed that there is a significant improvement ($p = 6.9002 \times 10^{-6}$, which is less than $p < 0.05$)in the percentage change of internal rotation and abduction movement after the treatment in the Group B population than Group A, as shown in Figure 2.

The SPADI mean score was recorded to assess the pain score among both groups. Group B demonstrated enhanced functional mobility and pain reduction, with the SPADI mean score dropping from 77.88 to 40.79 in comparison to group A, as illustrated by Figure 3. The data points and the fitted linear curves indicate the improvements over the four-week training period for each group, with the improvement being more pronounced in group B.

DISCUSSION

The primary objective of this study was to assess the comparative efficacy of two manual therapy techniques, Maitland mobilization and Butler's neural mobilization, in conjunction with MET, for managing adhesive capsulitis of the shoulder joint in terms of reducing pain and improving

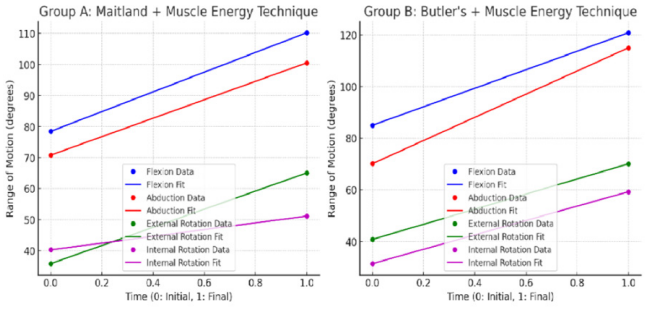

Figure 1: Comparison between different ranges and motions before and after treatment in Groups A and B patients

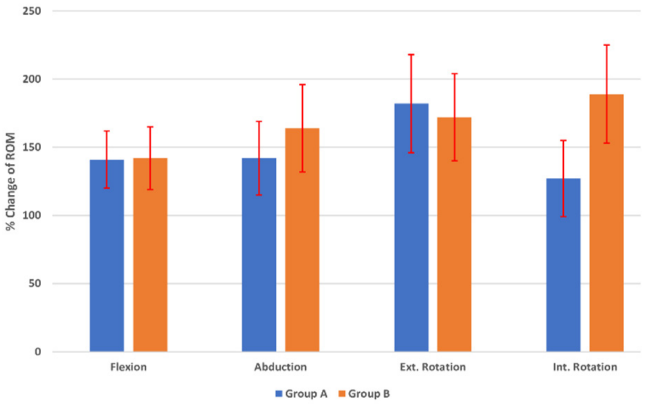

Figure 2: Histogram showing the percentage change of ROM in degrees before and after treatment in both groups

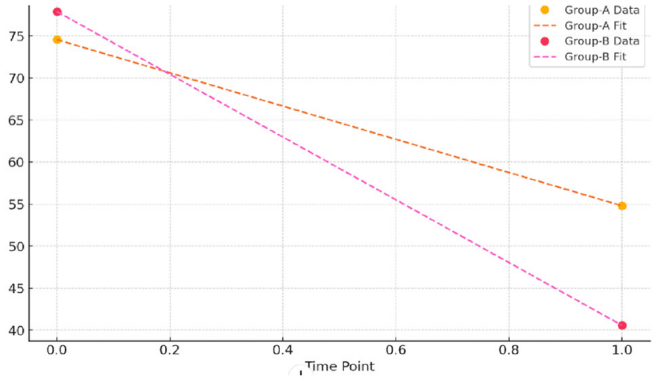

Figure 3: Plots displaying the changes in SPADI scores in both groups where Y axis denotes range of motion and X axis represents time point of range of motion

functional mobility. The selection criteria of this study were based on the inclusion of the subjects (40–60 years of age) with progressive loss of passive movement of the shoulder joint relative to the non-affected side in at least one direction. The present study found significant improvements in both groups after a four-week training schedule. Both groups experienced significant increases in range of motion (ROM), particularly in abduction and internal rotation for Group B. The study demonstrated a statistically significant improvement in outcome measures among the Maitland mobilization-treated group. This study showed that both types of mobilization were effective in treating adhesive capsulitis, which corroborates the findings of other researchers.[23]

Maitland mobilization techniques are primarily used to treat joints restricted by pain. Passive oscillatory movement stimulates the mechanoreceptors that block the nociceptive pathways at the spinal cord level, thereby reducing pain and restoring function.[24] The biomechanical effect manifests when force is applied toward resistance but within the patient's tolerance. The mechanical changes are breaking up the adhesion and realigning collagen fibers. Mobilization techniques are designed to enhance joint mobility by altering the properties of synovial fluid. A vital component of the Maitland treatment approach is that it is based on assessment

Table 1: Comparison of range of motion before and after treatment between the groups

Range of motion (Degrees)	*Group A*		*Group B*	
	Pre Treat	*Post Treat*	*Pre Treat*	*Post Treat*
Flexon	78.46 ± 19.68	110.20 ± 20.11*	85.32 ± 0.33	120.80 ± 18.08*
Abduction	70.80 ± 21.46	100.53 ± 19.19*	70.13 ± 0.19	115.00 ± 18.07*
External rotation	35.80 ± 14.0	65.06 ± 11.97	40.0 ± 11.02	70.06 ± 8.25*
Internal rotation	40.26 ± 6.20	51.13 ± 4.50	31.40 ± 6.93	59.26 ± 4.31*

Data are Mean ± SD. * indicates a significant (p <0.05) difference between pre and post-treatment results.

and reassessment, with subsequent individual modification of treatment techniques. Therefore, in this present study, the patient's responses were assessed, and the mobilization grade was decided accordingly.[24]

Butler's approach is based on the concept of homeostasis of neurodynamics and results in adverse neural tension (ANT).[25] The passive neural glides must be pain-free and can produce concurrent hypoalgesia during its application.

The response of group B (Butler's neural mobilization + MET) was better in improving all ROM, especially internal rotation ($p = 2.084 \times 10^{-13}$) and abduction ($p = 0.03358$). This present study employed MET as a common treatment due to practical and ethical considerations. Although it will be difficult to determine the exact effect of the two different mobilization techniques, both treatment techniques were equally effective in treating adhesive capsulitis, as indicated by improvements in functional range and reduced pain, as measured by the SPADI score and increased ROM. However, the response of group B (Butler's neural mobilization +MET) was better in improving most of the ROM, especially internal rotation and abduction, as evidenced in other research studies.[25,26]

Even after considering the limitations of the present study, like - short duration, small sample size, non-identical phase of adhesive capsulitis, absence of long-term follow-up, and lack of control, the results of this study showcased that treatment with Maitland mobilization along with the MET was more effective in patients with adhesive capsulitis than treatment with Butler's neural mobilization + MET. However, further study is needed to implement this technique universally.

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PEER-REVIEWED CERTIFICATION

During the review of this manuscript, a double-blind peer-review policy has been followed. The author(s) of this manuscript received review comments from a minimum of two peer-reviewers. Author(s) submitted revised manuscript as per the comments of the assigned reviewers. On the basis of revision(s) done by the author(s) and compliance to the Reviewers' comments on the manuscript, Editor(s) has approved the revised manuscript for final publication.