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Effectiveness of maitland mobilization with therapeutic Exercises versus proprioceptive neuromuscular Facilitation with therapeutic exercises in improving pain, Range of motion and performance-based function in Patients with adhesive capsulitis

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Abstract
Background: Adhesive capsulitis (frozen shoulder) is a painful and disabling condition characterized by progressive loss of shoulder motion and functional limitation, with higher incidence among individuals aged 50–70 years and those with diabetes mellitus and sedentary lifestyle. Conservative physiotherapy, including manual therapy and therapeutic exercises, is the primary management approach [1]
Objective: To compare the effectiveness of Maitland mobilization with therapeutic exercises versus proprioceptive neuromuscular facilitation (PNF) with therapeutic exercises in improving pain, range of motion (ROM), and performance-based function in patients with adhesive capsulitis.
Materials and Methods: A randomized comparative study was conducted on 34 patients (age 35– 50 years) diagnosed with adhesive capsulitis and fulfilling specified inclusion and exclusion criteria. Participants were randomly allocated into Group A (Maitland mobilization plus therapeutic exercises, n=17) and Group B (PNF plus therapeutic exercises, n=17). Both groups received treatment 5 days per week for 8 weeks, 45 minutes per session. Outcome measures included Visual Analogue Scale (VAS) for pain, goniometric ROM (external rotation, abduction, internal rotation), and Shoulder Pain and Disability Index (SPADI) assessed pretreatment, at 4 weeks, and at 8 weeks. Data were analyzed using paired and unpaired t-tests with significance set at $p<0.05$.
Results: Both groups showed significant within-group improvements in pain, ROM, and SPADI scores at 8 weeks. Between-group analysis revealed greater pain reduction in the Maitland group (VAS change 3.20±0.69) compared with the PNF group (1.99±0.35: p=0.0001). External rotation improved by 50.12°±8.34° in the Maitland group versus 24.76°±7.77° in the PNF group (p=0.0001), while abduction increased by 43.71°±15.03° versus 22.06°±10.43°, respectively (p=0.0001). Internal rotation changes were not significantly different between groups (p=0.3803). SPADI improvement was significantly greater in the Maitland group (27.15±4.26) than in the PNF group (14.53±2.32: p=0.0001).
Conclusion: Maitland mobilization and PNF, when combined with therapeutic exercises, are both effective for reducing pain and improving function in adhesive capsulitis. However, Maitland mobilization showed superior outcomes in pain reduction, external rotation, abduction, and functional disability, and can be recommended as the preferred intervention in the painful and stiff phases, while PNF may serve as a useful adjunct for enhancing muscular control and flexibility in later stages.

Keywords: Adhesive capsulitis, frozen shoulder, Maitland mobilization, proprioceptive neuromuscular facilitation, PNF, therapeutic exercises, range of motion, SPADI, physiotherapy

Introduction

Adhesive capsulitis, also termed frozen shoulder or periarthritis of the shoulder, is characterized by inflammation and fibrosis of the glenohumeral capsule leading to pain and global restriction of active and passive movements in a capsular pattern (external rotation > abduction > internal rotation).

The condition typically runs through three stages—freezing (painful), frozen (stiff), and thawing (resolution)—and may take up to 30 months, with some patients experiencing residual pain and limitation for up to five years.

The incidence in the general population is reported as 3–5%, rising to about 20% among individuals with diabetes mellitus, with a higher prevalence in women aged over 50 years, and frequent involvement of the non-dominant shoulder.

Pathophysiologically, primary adhesive capsulitis involves idiopathic capsular fibrosis, whereas secondary adhesive capsulitis is associated with intrinsic shoulder pathologies (such as rotator cuff tendinopathy or calcific tendinitis) and extrinsic conditions including cervical disc disease, thyroid disorders, cardiovascular disease, or prolonged immobilization.

Conservative management is preferred initially and may include medication, injections, and, crucially, physiotherapy interventions such as joint mobilization, stretching, and strengthening exercises.

Review of Literature

Mamoona Anwar *et al* (2023): were conduct the study to find the role of Maitland mobilization technique in treatment of frozen shoulder gaining of ROM and pain management. Results shows the improve abduction in patients treated with the mulligan method compared with those treated with Maitland mobilization method. More significantly this study will be focused on the examining the shoulder active and passive ROMs and pain reduction after and before the treatment. All measured characteristics of frozen shoulder patients will be compared with those of the subjects with asymptomatic shoulders. Conclusion of this

study in comparison with mulligan mobilization technique, Maitland mobilization technique is more effective in frozen shoulder management [10].

Michel GCAM Mertens *et al* (2021) [5]: Exercise therapy is effective for improvement in ROM, function and pain in patients with frozen shoulder. It is the systemic review and metaanalysis, archives of physical medicine and rehabilitation. Conclusion of this study was
ROM, function and pain improve with both solely exercises and programs with exercises, but for ROM and pain there was little to no difference between programs and for function the evidence was uncertain. Adding exercises improve active ROM compared to a program without exercises, while adding physical modalities has no beneficial effect. Muscle energy techniques are a beneficial type of exercise therapy for improving function compared to other type of exercise unfortunately, no conclusion can be drawn about the results in the long term and most effective dose of exercise therapy [5].

Waleed Medhat Ali *et al* (2020): studied the effectiveness of mobilization with conventional physiotherapy in frozen shoulder. Aim of this study was to determine the recent research evidences for the effectiveness of mobilization along with conventional therapy in frozen shoulder patients. And the results show that mobilization along with conventional therapy is effective technique in reducing pain and increasing ROM in frozen shoulder patients without adverse effect. Conclusion of the study is mobilization program with conventional therapy designed for frozen shoulder treatment can be more effective in increasing shoulder ROM and reducing pain [2].

Manoj Malik *et al* (2019) [3]: efficiency of proprioceptive neuromuscular facilitation and joint mobilization in management of frozen shoulder. In their Study the ROM was enhanced and score of VASA was lessened at the end of every week after 3 weeks of treatment session. Significant reduction was seen in scoring of VAS and ROM variables ($P < 0.005$). But intergroup differences did not show any significant result ($P < 0.005$). Conclusion of their Study was based on the findings of study, both groups were equally significant in the lessening intensity of pain and increasing ROM in subject of frozen shoulder [3].

Jaya Shankar Tedla, Devika Rani Sangadala (2019): this systematic review aims to determine the effectiveness of proprioceptive neuromuscular facilitation treatment technique in adhesive Capsulitis for decreasing pain and disability and increasing ROM and function.
Through computerized search was done using database search engines by two reviewers. Conclusion of the Study was among the 10 included studies, 9 showed that the PNF group showed superior improvement than the control groups, with an effect size of 0.59, 0.41 and 0.57 for shoulder extension, rotation, abduction and pain respectively. The contract and hold relax technique of PNF applied in upper limb patterns were shown to be effective decreasing ROM and function in subjects with adhesive Capsulitis [6].

Moon *et al* (2015): was proposed the study in which they compared the Maitland and kaltenborn mobilization techniques to improving the shoulder pain and range of motion in frozen shoulder. Result of this study was in both groups exhibited significant decreases in pain post-intervention. ROM and external rotation increased significantly post-intervention in both groups. But there is no significant difference between in both groups with respect to pain improvement or ROM. The conclusion of this study is the posterior Maitland and kaltenborn mobilization techniques are improving pain and ROM in frozen shoulder patients. therefore, physiotherapist recommend both techniques for such patients [17].

Saba Aijan Ali *et al* (2015): The aim of this work was to evaluate the effectiveness of exercises with manual therapy and exercises alone in adhesive capsulitis. Results of this study was after 5 weeks of interventions both groups made significant improvements in all outcome measures. Conclusion of this study was that both exercises with manual therapy and exercises alone are equally effective in management of adhesive capsulitis of the shoulder joint [9].

N. Maricar *et al* (2009): it is the single case design study in which they show the effectiveness of Maitland mobilization and exercises for the treatment of shoulder adhesive capsulitis.in which they designed the single case research study was ABCBC, where A phase corresponded to no treatment baseline phase. B phase (B1 & B2) Were exercises only treatment phase and C phases (C1& C2) where exercise plus mobilization phase. The purpose of this study was to investigate the response of shoulder motions, pain, and function to two commonly used physiotherapy management approaches. In which after treatment sessions the shoulder pain and disability index (SPADI) was used to monitor pain and functional measured. All shoulder movements improved under both management approaches, although more gain in motion was observed when mobilization was added to an exercise program [7].

Materials and Methodology

Study Desig

Randomized controlled trial.

Study Setting and Population

The study was conducted at multiple hospitals and clinics among patients diagnosed clinically with adhesive capsulitis. Eligible participants were aged 35–50 years and presented with a capsular pattern of movement restriction and shoulder pain.

Sample Size and Randomization

Based on internal rotation data from Malik *et al*., a sample of 17 participants per group (total n=34) achieved 80% power at 5% significance to detect a clinically meaningful difference. Participants were randomly assigned to Group A (Maitland mobilization plus therapeutic exercises) or Group B (PNF plus therapeutic exercises).

Inclusion Criteria

Age 35–50 years. Shoulder pain with clinical diagnosis of frozen shoulder in any stage. Capsular pattern limitation (external rotation, abduction, internal rotation). Willingness to participate and provide informed consent.

Exclusion Criteria

History of shoulder surgery. Rotator cuff tear or severe osteoarthritis. Cardiorespiratory or neurological conditions affecting the upper limb. Recent trauma to the shoulder. Pregnancy.

Instrumentation and Outcome Measures
Goniometer for active and passive ROM of flexion, abduction, external and internal rotation in supine. VAS (0–10 cm) to quantify pain intensity. SPADI to assess shoulder pain and disability, scored 0–100 with higher scores indicating greater impairment.

Intervention Protocol
Group A (Maitland mobilization): Posterior–anterior glenohumeral mobilizations Grades I–IV combined with therapeutic exercises such as wand/wall exercises, Codman pendulum exercises, and pulley exercises. Sessions lasted 45 minutes, 5 days per week for 8 weeks.

Group B (PNF): PNF techniques (hold–relax, contract–relax, D1 and D2 diagonal patterns) applied to the shoulder, followed by the same therapeutic exercise program and schedule as Group A.

Data Collection and Statistical Analysis
Baseline demographics and clinical characteristics were recorded. VAS, ROM, and SPADI were assessed pre-treatment, at 4 weeks, and at 8 weeks. Change scores were calculated (pre–post) and compared between groups using unpaired t-tests: within-group changes were analyzed using paired t-tests. A p-value <0.05 was considered statistically significant.

Results
Both groups exhibited statistically significant improvements in VAS, ROM, and SPADI from baseline to 8 weeks. However, between-group comparisons favored Maitland mobilization in most parameters.

Pain (VAS): Mean reduction 3.20±0.69 in Maitland group versus 1.99±0.35 in PNF group (p=0.0001).

External Rotation: Gain of 50.12°±8.34° versus 24.76°±7.77° for Maitland and PNF groups, respectively (p=0.0001).

Abduction: Improvement of 43.71°±15.03° in Maitland group compared with 22.06°±10.43° in PNF group (p=0.0001).

Internal Rotation: No significant difference between groups (4.76°±7.66° vs 6.65°±9.01°, p=0.3803). SPADI: Mean improvement 27.15±4.26 in Maitland group and 14.53±2.32 in PNF group (p=0.0001).

Discussion
The results confirm that both interventions are beneficial in adhesive capsulitis, but Maitland mobilization yields superior improvements in pain, external rotation, abduction, and functional scores.
Graded oscillatory movements likely stimulate joint mechanoreceptors, reduce nociceptive input, and restore capsular mobility, aligning with previous studies where mobilization combined with exercise enhanced ROM and reduced pain more than exercise alone.
PNF, which targets neuromuscular control and muscle flexibility, showed comparable effects on internal rotation, consistent with evidence that PNF particularly influences muscle length and coordination.

Conclusion
Maitland mobilization with therapeutic exercises and PNF with therapeutic exercises are both effective for managing pain and disability in adhesive capsulitis.
Maitland mobilization demonstrated significantly better outcomes in VAS, external rotation, abduction, and SPADI, and may therefore be recommended as the first-line manual therapy in the painful and stiff phases, while PNF can be integrated later to optimize muscular control and flexibility.

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