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A Comparative Study of the Effects of Maitland and Kaltenborn Mobilization Techniques on Shoulder Range of Motion, Function, and Pain in Patients with Idiopathic Frozen Shoulder

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ABSTRACT

Background: Idiopathic frozen shoulder is a common musculoskeletal disorder characterized by progressive pain, reduced shoulder range of motion (ROM), and functional disability. Manual therapy techniques, such as Maitland and Kaltenborn mobilizations, are commonly employed to improve joint mobility, reduce pain, and restore function. However, direct comparisons between these two techniques remain limited.
Objective: To compare the effects of Maitland and Kaltenborn mobilization techniques on shoulder ROM, pain intensity, and functional disability in patients with idiopathic frozen shoulder.
Methods: A quasi-experimental, two-arm study was conducted on 98 participants diagnosed with idiopathic frozen shoulder. Participants were divided into two groups: Group A (n = 49) received Kaltenborn mobilization, and Group B (n = 49) received Maitland mobilization. Both groups also received standardized conventional physiotherapy and hot pack therapy over a 2-week period (3 sessions per week). Pain was assessed using the Numeric Pain Rating Scale (NPRS), function using the Shoulder Pain and Disability Index (SPADI), and ROM using a universal goniometer. Pre- and post-intervention scores were compared within and between groups using Wilcoxon signed-rank and Mann-Whitney U tests.
Results: Both groups demonstrated statistically significant improvements ($p < 0.001$) in pain, SPADI scores, and shoulder ROM after the intervention. However, no significant differences were found between the groups in post-intervention NPRS, SPADI, or ROM scores ($p > 0.05$).
Conclusion: Both Maitland and Kaltenborn mobilization techniques are effective in improving shoulder ROM, reducing pain, and enhancing function in patients with idiopathic frozen shoulder. Neither technique was found to be superior, suggesting that either may be appropriately chosen based on clinician expertise and patient response.
Keywords: Frozen shoulder, Adhesive capsulitis, Maitland mobilization, Kaltenborn mobilization, Shoulder range of motion, SPADI, NPRS, Manual therapy

INTRODUCTION

Adhesive capsulitis, commonly referred to as frozen shoulder, is a condition characterized by progressive pain and significant restriction in both active and passive shoulder movements. It predominantly affects individuals between 40 and 60 years of age, with a higher incidence observed in

women (1). The prevalence of adhesive capsulitis in the general population is estimated to be around 2% to 5% (2). The condition often arises idiopathically, but it has been associated with systemic conditions such as diabetes mellitus and thyroid disorders, with diabetes being one of the most significant risk factors (3).

The pathophysiology of adhesive capsulitis involves chronic inflammation leading to fibrosis of the joint capsule, resulting in pain and restricted range of motion (ROM). This fibrosis is thought to occur due to a combination of inflammatory mediators and fibroblast activation within the synovium of the shoulder joint capsule (4). The clinical course of the condition is typically divided into three stages: the freezing stage (painful phase), the frozen stage (stiffness phase), and the thawing stage (recovery phase). During the freezing stage, pain is the predominant symptom, with progressive loss of shoulder movement. In the frozen stage, pain may decrease, but the stiffness remains, causing significant limitations in shoulder function. Finally, in the thawing stage, gradual restoration of range of motion occurs, and symptoms tend to improve (5). Management strategies aim to alleviate pain, restore mobility, and improve function, with an emphasis on early intervention to prevent long-term disability (6).

Physical therapy remains a cornerstone in the management of adhesive capsulitis, with joint mobilization techniques being widely utilized. Among these, the Kaltenborn and Maitland mobilization techniques are prominent. The Kaltenborn technique involves sustained translational movements to stretch the joint capsule and improve joint play, which is thought to help in reducing stiffness and restoring mobility (7). Conversely, the Maitland technique employs oscillatory movements graded according to the severity of the condition to reduce pain and increase ROM. This technique focuses on alleviating pain through graded mobilizations, which are intended to improve function by reducing joint stiffness (8).

Several studies have investigated the efficacy of these mobilization techniques. For instance, a study comparing Maitland and Kaltenborn mobilization techniques found both to be effective in improving pain and ROM in patients with frozen shoulder (9). Another study concluded that Kaltenborn mobilization, when combined with thermotherapy, was more effective than Kaltenborn mobilization alone (10). Similarly, Maitland mobilization combined with Muscle Energy Techniques (METs) showed superior outcomes compared to Maitland mobilization alone, as it addressed both soft tissue and joint restrictions (11). These findings suggest that while both techniques are beneficial, certain combinations, such as adding thermotherapy or METs, may offer enhanced outcomes for patients.

Despite the widespread use of both techniques, there is a paucity of literature directly comparing their individual efficacies in the management of adhesive capsulitis. This study aims to fill this gap by evaluating and comparing the effectiveness of Kaltenborn and Maitland mobilization techniques in improving pain, functional disability, and shoulder ROM in patients with idiopathic frozen shoulder.

METHODS

This study was designed as a quasi-experimental, two-arm, parallel-group trial to compare the effects of Kaltenborn and Maitland mobilization techniques on pain, range of motion (ROM), and functional disability in patients with frozen shoulder. The intervention period lasted two weeks, with pre- and post-intervention assessments. Due to feasibility constraints, random allocation was not employed; instead, participants were assigned to groups using convenience sampling based on clinical availability. However, to reduce potential bias, outcome assessors were blinded to the intervention groups.

Participants were recruited from outpatient physiotherapy clinics located in Surat and Bardoli, Gujarat, India. Individuals aged 40

to 60 years who were diagnosed with idiopathic frozen shoulder for at least three months and reported pain and disability greater than 30% on the Shoulder Pain and Disability Index (SPADI) were included. Exclusion criteria were: presence of neurological conditions (such as stroke or Parkinson's disease), diabetes mellitus, inflammatory joint diseases (like rheumatoid arthritis or ankylosing spondylitis), osteoporosis, malignancy, history of fracture or dislocation or surgery on the affected shoulder, cervical pathology with radiculopathy, or any contraindications to manual therapy (such as infection, ligament rupture, or severe instability).

Sample size was calculated using G*Power software version 3.1.9.2. Assuming an effect size derived from previous studies on manual therapy for frozen shoulder, a total sample of 98 participants (49 per group) was required to detect statistically significant differences with an alpha of 0.05 and a power of 80%.

The study protocol was submitted to and approved by the Institutional Ethics Committee prior to the commencement of participant recruitment, ensuring compliance with the ethical standards laid out in the Declaration of Helsinki (12). Ethical clearance was granted following a thorough review of the study's objectives, methodology, and potential risks to participants. All individuals who participated in the study provided written informed consent after receiving detailed information about the study's purpose, procedures, and their role in it. Participants were explicitly informed that their involvement was voluntary and that they could withdraw from the study at any time without facing any penalty or loss of benefits. Confidentiality and anonymity of participant data were strictly maintained throughout the research process, with all identifiable information securely stored and accessible only to the research team.

Both intervention groups received therapy three times a week for two weeks, totaling six sessions. Each session began with the application of superficial heat using a hot pack for 20 minutes. This was followed by conventional shoulder mobility exercises, including self-assisted range of motion, wand-assisted movements, and pendulum exercises.

In the Kaltenborn group, participants received Grade III sustained joint mobilizations focused on traction and gliding techniques aligned with the joint's biomechanical axes. Each session included 15 repetitions of 30-second mobilizations, with 10-second rest intervals between stretches. Total mobilization time per session was approximately 10 minutes. In the Maitland group, participants received Grade III oscillatory mobilizations, characterized by large amplitude oscillations into resistance at a frequency of approximately one per second. This intervention also included 15 repetitions of 30-second oscillations with 10-second rests, with a total mobilization time of around 10 minutes. Participants in both groups were advised to actively use their shoulder in pain-free ranges during daily activities. No additional home exercise program was prescribed during the study period to control potential confounding factors.

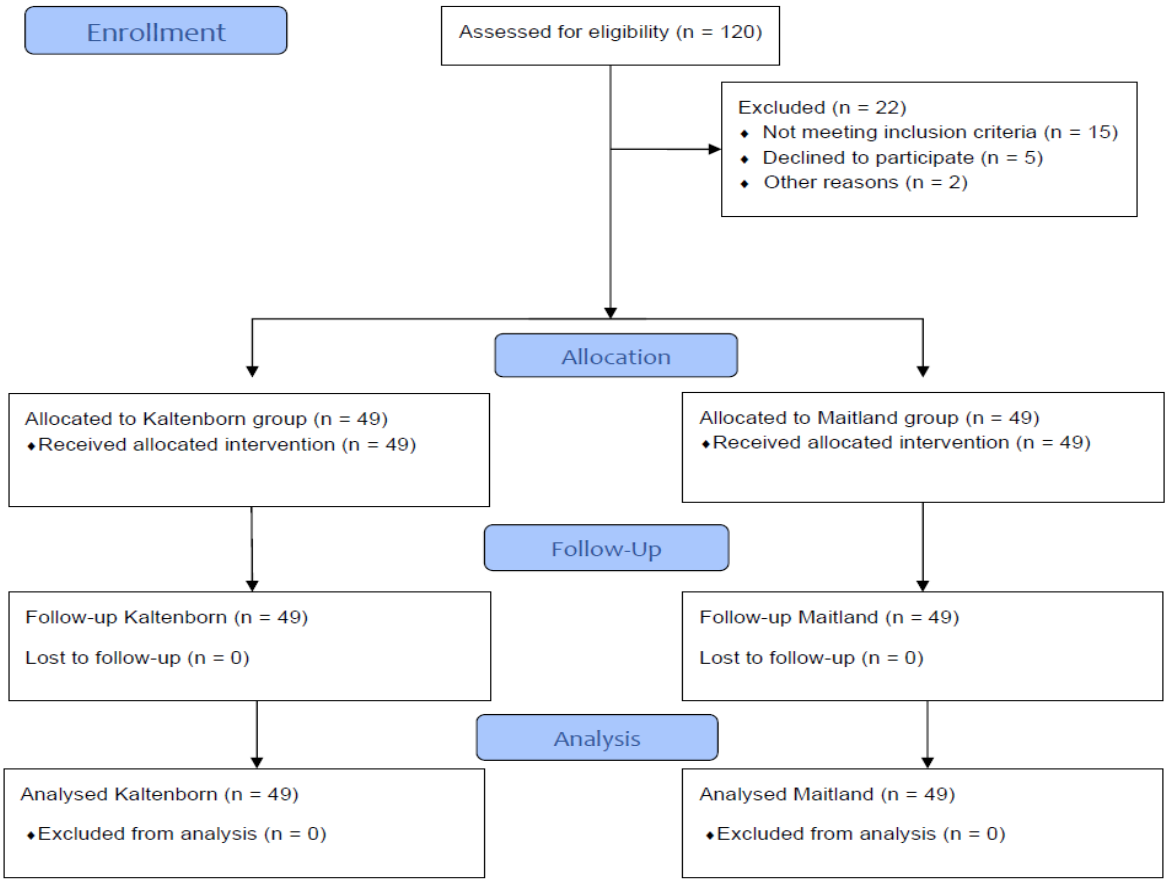
Outcome measures were assessed at baseline and after two weeks of intervention. Primary outcome measures included active shoulder ROM (flexion, extension, abduction, internal and external rotation, horizontal abduction and adduction), pain intensity, and functional disability. ROM was measured using a standard universal goniometer, which has demonstrated high inter- and intra-rater reliability (13). Pain was assessed using the Numeric Pain Rating Scale (NPRS), a validated and reliable 11-point scale where 0 denotes no pain and 10 indicates the worst pain imaginable (14). Functional disability was assessed using the SPADI, a self-reported questionnaire comprising 13 items split across pain and disability domains. The SPADI has demonstrated moderate to high reliability and validity in musculoskeletal populations (15).

Although the allocation of participants was non-randomized, every effort was made to

reduce bias. Group allocation was performed based on therapist availability and clinic timing, but the outcome assessors remained blinded to treatment allocation. Participants were also unaware of the specific type of manual mobilization they were receiving, helping to reduce performance bias.

Data were analysed using IBM SPSS Statistics version 26. Descriptive statistics were used to summarise demographic and clinical characteristics of participants. As the data did not meet the assumptions of normality, non-parametric tests were employed for all inferential analyses. Within-group comparisons (pre- and post-intervention) were conducted using the Wilcoxon signed-rank test, while between-group comparisons were performed using the Mann–Whitney U test. Baseline characteristics were comparable between groups; hence, no covariate adjustments were required. Effect sizes were calculated using rank biserial correlation for the Mann–Whitney U test and r (derived from the z-value) for the Wilcoxon signed-rank test, to evaluate the clinical relevance of the findings. A *p*-value of less than 0.05 was considered statistically significant.

CONSORT Flow Diagram



RESULTS

A total of 98 participants diagnosed with idiopathic frozen shoulder were recruited for the study and completed the intervention protocol. Participants were divided into two equal groups: Group A (Kaltenborn mobilization, n = 49) and Group B (Maitland mobilization, n = 49). Baseline demographic characteristics, including age and symptom duration, were comparable between both groups (mean age: 52 ± 6.17 years in Group A and 52 ± 6.07 years in Group B; mean symptom duration: 3.5 ± 0.39 weeks in Group A and 3.5 ± 0.64 weeks in Group B), indicating appropriate group comparability at baseline.

Within-Group Analysis

Pain and Disability Scores (NPRS and SPADI)

Statistical analysis using the Wilcoxon signed-rank test revealed significant improvements in both groups for the Numeric Pain Rating Scale (NPRS) and Shoulder Pain and Disability Index (SPADI) scores post-intervention. In Group A, the mean NPRS score reduced from 7.41 ± 0.53 to 5.16 ± 0.65, while SPADI scores decreased from 72.28 ± 4.47 to 54.25 ± 6.83 ($p < 0.001$). Similarly, in Group B, NPRS decreased from 7.54 ± 0.54 to 5.27 ± 0.67 and SPADI from 72.84 ± 4.05 to 55.95 ± 8.89 ($p < 0.001$).

Table 1. Comparison of Pre-- and Post-Test NPRS and SPADI Scores Within Groups

Group	NPRS (Pre)	NPRS (Post)	SPADI (Pre)	SPADI (Post)	p-value (NPRS)	p-value (SPADI)
Group A	7.41 ± 0.53	5.16 ± 0.65	72.28 ± 4.47	54.25 ± 6.83	< 0.001	< 0.001
Group B	7.54 ± 0.54	5.27 ± 0.67	72.84 ± 4.05	55.95 ± 8.89	< 0.001	< 0.001

Shoulder Range of Motion (ROM)

Both groups showed statistically significant improvements in all shoulder ROM parameters, including external rotation, internal rotation, flexion, extension, and abduction.

Table 2. Pre- and Post-Test Comparison of Shoulder ROM Within Groups

ROM Parameter	Group A (Pre)	Group A (Post)	Group B (Pre)	Group B (Post)	p-value (within A)	p-value (within B)
External Rotation	19.79 ± 4.77	26.87 ± 5.57	19.11 ± 4.55	26.27 ± 4.58	< 0.001	< 0.001
Internal Rotation	33.22 ± 5.15	39.06 ± 5.67	32.25 ± 5.36	39.11 ± 5.59	< 0.001	< 0.001
Flexion	110.62 ± 9.18	123.43 ± 7.29	110.19 ± 8.07	123.82 ± 6.35	< 0.001	< 0.001
Extension	14.37 ± 2.87	20.41 ± 4.14	15.19 ± 2.85	21.27 ± 3.24	< 0.001	< 0.001
Abduction	100.72 ± 13.14	114.06 ± 12.05	100.29 ± 13.14	116.47 ± 9.65	< 0.001	< 0.001

Between-Group Comparison

The Mann-Whitney U test revealed no statistically significant differences between the post-test NPRS and SPADI scores of Group A and Group B ($p = 0.448$ and $p = 0.203$, respectively), indicating that both interventions were equally effective in reducing pain and disability.

Table 3. Between-Group Comparison of Post-Test NPRS and SPADI Scores

Outcome	Group A (Post)	Group B (Post)	U-value	p-value
NPRS	5.16	5.27	1104	0.448
SPADI	54.25	55.95	1022	0.203

Similarly, no significant between-group differences were found in shoulder ROM improvements across all measured parameters.

Table 4. Between-Group Comparison of Post-Test Shoulder ROM

ROM Parameter	Group A (Post)	Group B (Post)	U-value	p-value
External Rotation	26.87	26.27	1188	0.920
Internal Rotation	39.06	39.11	1031	0.202
Flexion	123.43	123.82	1089	0.406
Extension	20.41	21.27	1135	0.538
Abduction	114.06	116.47	967	0.086

Both Kaltenborn and Maitland mobilization techniques significantly improved pain intensity, functional disability, and shoulder ROM in patients with frozen shoulder. However, no statistically significant differences were observed between the two groups, suggesting that both techniques are equally effective as treatment modalities for this condition over a two-week intervention period.

DISCUSSION

This randomized controlled trial aimed to compare the effectiveness of Kaltenborn and Maitland mobilization techniques in the management of idiopathic frozen shoulder, focusing on pain intensity, shoulder range of motion, and functional disability. Both interventions demonstrated significant improvements over a two-week period, with reductions in pain intensity, enhanced shoulder ROM, and improved functional capacity. However, no statistically significant differences were observed between the two groups, suggesting that both techniques are equally effective in the short-term management of frozen shoulder.

The observed improvements in pain, ROM, and function are consistent with the findings of previous studies that support the efficacy of joint mobilization techniques for treating adhesive capsulitis. Moon GD et al. (2015) found that both Kaltenborn and Maitland mobilizations significantly reduced pain and improved ROM in patients with frozen shoulder (9). Similarly, Rezwan et al. (2021) demonstrated that Kaltenborn mobilization significantly improved pain and disability scores, corroborating the results of the present study (16). Both techniques, though employing different methods, aim to restore joint mobility by addressing capsular restrictions through graded oscillatory movements, which likely contribute to the modulation of pain and improvement in shoulder function (17).

Interestingly, the lack of significant differences between the two mobilization techniques may be attributed to their similar mechanisms of action. Both Kaltenborn and Maitland mobilizations use manual techniques to improve joint mobility and reduce pain, focusing on mechanical stimulation of the capsule to enhance functional capacity. It is possible that these mechanisms, which target the same underlying physiological structures, result in comparable clinical outcomes in the short term (18).

While both techniques have proven effective, some studies suggest that the benefits of mobilization may be enhanced when combined with other interventions. For instance, Shetty, S.S., & Shah, R.R. (2020) reported that adding Muscle Energy Techniques (MET) to Maitland mobilization led to greater improvements in pain reduction and ROM, compared to Maitland mobilization alone (19). This suggests that multimodal treatment approaches might offer enhanced benefits, particularly for patients with more severe cases of adhesive capsulitis. Future research could explore the synergistic effects of combining different mobilization techniques with adjunct therapies, such as MET or exercise therapy, to optimize outcomes for patients with frozen shoulder.

Despite the positive findings, there are several limitations in our study that should be considered when interpreting the results. The short duration of the intervention and follow-up period may not adequately capture the long-term effects and sustainability of the improvements observed. This is particularly relevant for conditions like frozen shoulder, where long-term rehabilitation and continuous management may be necessary to maintain improvements in ROM and function. Additionally, the study population was limited to individuals with idiopathic frozen shoulder, which may restrict the generalizability of the findings to other populations, such as those with secondary adhesive capsulitis due to diabetes or trauma (20).

Given these limitations, future studies should investigate the long-term efficacy of Maitland and Kaltenborn mobilization techniques and assess their effects in more

diverse patient populations, including those with secondary frozen shoulder. It would also be valuable to examine the impact of combining mobilization techniques with other therapeutic modalities, such as MET, stretching, or exercise therapy, to determine the most effective treatment strategies for improving shoulder function and reducing pain in patients with adhesive capsulitis.

In conclusion, this study provides evidence that both Maitland and Kaltenborn mobilization techniques are effective in the short-term management of idiopathic frozen shoulder, with no significant difference between the two techniques. Further research exploring long-term outcomes and multimodal treatments may help refine the management approach for patients with this debilitating condition.

CONCLUSION

This randomized controlled trial demonstrates that both Kaltenborn and Maitland mobilization techniques are effective in improving pain intensity, functional disability, and shoulder range of motion in individuals with idiopathic frozen shoulder. Despite the lack of significant differences between the two techniques, both approaches proved to be beneficial in the short-term management of adhesive capsulitis. These findings align with the growing body of literature supporting the use of joint mobilization techniques in the treatment of frozen shoulder. Overall, this study provides valuable evidence for clinicians to consider when selecting mobilization techniques for the management of idiopathic frozen shoulder.

Declaration by Authors

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