Effect of Mulligan's Mobilization with Arm Movement Combined with Conventional Treatment on Pain and Cervical ROM in Patients with Unilateral Cervical Radiculopathy

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Abstract

Objective: This study aimed to investigate the impact of Mulligan's Mobilization with Arm Movement (SMWAM) combined with conventional treatment on pain and cervical ROM in patients with unilateral cervical radiculopathy. **Design:** A randomized controlled trial was conducted, including 40 participants aged 20 to 60 years. They were randomly assigned to either the treatment group (SMWAM) or the control group (conventional treatment). **Methods:** Both groups underwent six treatment sessions over three weeks. The treatment group received SMWAM and conventional therapy, whereas the control group received only conventional therapy, which included hot pack applications, active range of motion exercises, and isometric strengthening exercises. Outcome measures included pain intensity assessed using the Visual Analog Scale (VAS) and cervical range of motion (CROM). **Results:** Post-intervention analysis showed significant improvements in cervical range of motion (flexion, extension, side bending, and rotation) in the treatment group compared to the control group ($p < 0.05$). pain intensity (VAS) was significantly reduced in both groups, with greater improvements in the treatment group ($p < 0.05$). The study shows that SMWAM effectively improves cervical range of motion and reduces pain in patients with unilateral cervical radiculopathy. **Conclusion:** SMWAM accompanied by conventional treatment improves cervical mobility and pain relief more effectively than conventional treatment alone. Further research is needed to explore its long-term effects and potential mechanisms.

Key words: Neurodynamics; Manual Therapy; Rehabilitation; Physical Therapy; Spine Disorders.

1. Introduction

Cervical radiculopathy is a condition characterized by pain and/or sensorimotor deficits due to compression of a cervical nerve root. This compression may result from disc herniation, spondylosis, instability, trauma, or, in rare cases, tumors. Patients may experience pain, numbness, tingling in the upper extremities, or even weakness [(1)].

This condition affects both genders, with an annual prevalence of 107.3 cases per 100,000 in men and 63.5 cases per 100,000 in women [(2)]. Disc herniation is a primary cause of nerve compression, particularly in younger individuals (30–40 years old), while disc degeneration becomes a more significant factor in the fifth and sixth decades of life [(3)].

Several risk factors contribute to cervical disc herniation, including smoking, male gender, heavy lifting, and occupations involving vibration exposure [(4)]. The most affected nerve root is C7 (due to C6-C7 herniation), followed by C6 (C5-C6 herniation) and C8 (C7-T1 herniation) [(5)].

Mechanical compression and chemical irritation contribute to nerve damage. The mechanical aspect induces localized ischemia and nerve injury, whereas the chemical pathway involves an inflammatory cascade triggered by nucleus pulposus exposure, leading to increased nerve sensitivity and pain [(6)].

Unlike axial neck pain, cervical radiculopathy typically presents as unilateral pain, often radiating into the ipsilateral arm in a dermatomal pattern. However, the absence of arm pain does not necessarily rule out the condition [7].

The Mulligan concept integrates pain-free accessory mobilization with active or passive physiological movements. It proposes that minor positional faults in joints, resulting from injuries or sprains, can disrupt spinal and peripheral joint mechanics. Developed in the late 1990s, spinal mobilization with limb movement involves sustained transverse gliding on the spinous process while performing restricted joint movements, aiming for symptom-free movement with immediate improvements [8].

Studies have shown that Mulligan mobilization techniques positively influence pain relief, range of motion (ROM), fear of movement, and overall quality of life in older adults with neck pain [9]. SMWAM, a newer application of the Mulligan concept, combines spinal mobilization with arm movement to facilitate pain-free mobilization throughout the extremity's range. It aimed to assess the effect of SMWAM on pain and cervical ROM in patients with cervical radiculopathy [10].

Previous studies examined the effects of Mulligan mobilization with arm movement along with neurodynamics and manual traction on cervical radiculopathy, primarily measuring pain levels and cervical ROM [11,12]. However, no study examined the effect of Mulligan mobilization with arm movement combined with conventional treatment alone. This study aims to investigate the effect of SMWAM combined with conventional treatment on pain levels and cervical ROM.

2. Materials and Methods

2.1. Study Design

This study was a Randomized Controlled Trial (RCT) designed to evaluate the effectiveness of Mulligan's Mobilization with Arm Movement (MWAM) combined with conventional treatment in individuals diagnosed with cervical radiculopathy. Participants were randomly allocated into two groups:

- *Treatment Group:* Received MWAM in addition to conventional treatment.
- *Control Group:* Received conventional treatment only.

The intervention spanned three weeks, with each participant undergoing six treatment sessions.

2.2. Participants

The sample size was determined before the study based on previous research with a similar design, totalling 40 patients [13].

Selection Criteria:

Inclusion Criteria:

- Diagnosed with cervical radiculopathy.
- Aged 20-60 years.
- Experiencing unilateral radiating pain along the median nerve pathway.
- Positive upper limb tension test (ULTT 1).
- Both genders included.
- Able to understand instructions and willing to participate.

Exclusion Criteria:

- History of trauma, dislocation, or subluxation of the upper extremity.
- Rheumatoid arthritis, malignancy, or spinal canal stenosis.
- Cervical instability, spondylolisthesis, or vertebral-basilar insufficiency (VBI).

- Referred pain from cardiac ischemia.
- Prior cervical/thoracic spine surgeries.
- Systemic conditions such as diabetic neuropathy.
- Recent fractures or surgeries around the shoulder.
- Carpal tunnel syndrome or thoracic outlet syndrome.

2.3. Randomization

Participants were randomly allocated into two groups using the lottery method by a blinded independent researcher:

Control Group (Group A): 20 patients received conventional therapy only.

Experimental Group (Group B): 20 patients received conventional therapy plus Mulligan's MWAM at the affected cervical level.

Both groups received treatment twice weekly for three weeks.

Conventional Treatment Components

- Hot packs applied to the cervical region for pain relief and muscle relaxation.
- Active range of motion (AROM) exercises to maintain or improve joint flexibility.
- Isometric exercises to strengthen the cervical musculature and reduce pain.

Instrumentation

- Visual Analog Scale (VAS): Measured pain intensity.
- Cervical Range of Motion (CROM) Measurement: Used a CROM goniometer to assess motion in all directions.

Assessment Procedures

- VAS for Pain Assessment: Patients marked their pain level on a 10 cm scale, from 0 (no pain) to 10 (worst pain) [(14)].
- CROM Measurement: Utilized a CROM goniometer, with participants seated in a standardized posture.

Intervention

Pre-Treatment for Both Groups:

VAS, CROM, measurements were recorded before treatment.

Treatment Group:

- MWAM applied using Sustained Mobilization with Arm Movement (SMWAM) [(15)].
- Patient Position: Seated upright.
- Therapist Position: Standing behind the patient.
- Mobilization Technique:
  Transverse glide from affected to unaffected side while the patient performed active movements (flexion/abduction/horizontal adduction/horizontal abduction).

Control Group:

Conventional Treatment Only:

- Hot packs: 10 minutes.

- AROM exercises: 3 sets of 10 repetitions.
- Isometric exercises: 20 repetitions per movement, holding for 6-10 seconds each [16,17].

Both Groups:

Advised to refrain from additional treatments during the study.

Outcome Measures

Primary Outcomes:

- Pain Intensity: Measured using VAS.
- Cervical ROM: Assessed with a CROM goniometer.

Data Collection

- Pre-test: Baseline values recorded before intervention.
- Post-test: Measurements taken after the 6 sessions (3 weeks) to assess changes in primary and secondary outcomes.

Statistical Analysis:

With the alpha level set at 0.05, the measured variables were statistically evaluated and compared using the SPSS for Windows version 25.

3. Results

The study compared a control group (Group A) with a treatment group (Group B) to evaluate the effects of a specific intervention on pain and cervical range of motion (CROM). Demographic data revealed that the control group had a mean age of 31.25 ± 13.19 years, while the treatment group's mean age was 34.67 ± 14.54 years. An independent samples t-test indicated no statistically significant age difference between the groups ($t = 0.78$, $p = 0.44$).

Table (1). Age difference between both groups:

Age	Group A	Group B	MD	T-value	P-value	Sig.
Mean (yrs)	31.25	34.67	-3.42	0.78	0.44	NS
± S.D.	13.19	14.54				

Pain:

Pain was measured using the Visual Analog Scale (VAS). The control group's VAS scores decreased from 5.15 ± 2.03 to 3.75 ± 1.77 (mean difference of 1.40, 27.18% reduction; $p < 0.001$), whereas the treatment group's scores dropped from 5.48 ± 2.16 to 2.81 ± 1.75 (mean difference of 2.67, 48.72% reduction; $p < 0.001$). The treatment group demonstrated a significantly greater reduction in pain ($p < 0.001$).

Table (2): Pain intensity difference between both groups:

Parameter	Group A MD	Group A % Change	Group B MD	Group B % Change	p-value	Significance
VAS	1.4	27.18%	2.67	48.72%	<0.001	S

Cervical Range of Motion (CROM):

- For cervical flexion, both groups showed significant improvements after treatment. In the control group, flexion increased from 39.00 ± 7.71° pre-treatment to 44.25 ± 7.83° post-treatment (mean difference of 5.25°, 13.46% change; p = 0.004). The treatment group improved from 37.62 ± 8.46° to 48.10 ± 7.33° (mean difference of 10.48°, 27.87% change; p = 0.004). The treatment group's gain was significantly greater than that of the control group (p = 0.004).
- Cervical extension also improved significantly in both groups. The control group's extension increased from 56.75 ± 9.77° to 61.25 ± 7.41° (mean difference of 4.50°, 7.93% change; p = 0.005), while the treatment group advanced from 54.76 ± 9.68° to 64.29 ± 7.12° (mean difference of 9.53°, 17.40% change; p = 0.005). The change scores confirmed that the treatment group experienced significantly better improvement than the control group (p = 0.005).
- For lateral flexion, improvements were noted on both sides. On the right, the control group increased from 30.00 ± 8.74° to 37.25 ± 9.66° (mean difference of 7.25°, 24.17% change; p = 0.001), while the treatment group improved from 25.95 ± 8.00° to 39.05 ± 8.31° (mean difference of 13.10°, 50.44% change; p = 0.001). The treatment group's improvement was significantly greater (p = 0.001). For left side-bending, the control group moved from 33.00 ± 8.01° to 37.00 ± 8.49° (mean difference of 4.00°, 12.12% change; p = 0.001) compared to the treatment group's increase from 30.95 ± 7.52° to 40.48 ± 7.89° (mean difference of 9.53°, 30.78% change; p = 0.001). Again, the treatment group outperformed the control group significantly (p < 0.001).
- for cervical rotation, on the right side the control group's rotation increased from 55.25 ± 9.80° to 57.75 ± 8.96° (mean difference of 2.50°, 4.53% change; p = 0.004), whereas the treatment group improved from 53.33 ± 9.26° to 60.24 ± 8.87° (mean difference of 6.91°, 12.96% change; p = 0.004). The treatment group's increase in rotation was statistically greater than that of the control group (p < 0.001). For left rotation, the control group increased from 53.75 ± 9.72° to 58.25 ± 8.63° (mean difference of 4.50°, 8.37% change; p = 0.004) while the treatment group progressed from 50.71 ± 9.78° to 60.71 ± 8.70° (mean difference of 10.00°, 19.71% change; p = 0.004), with between-group comparisons favoring the treatment group (p < 0.001).

Table (3): Cervical Range of Motion differences between both groups:

Parameter	Group A MD	Group A % Change	Group B MD	Group B % Change	p-value	Significance
Cervical Flexion (°)	5.25°	13.46%	10.48°	27.87%	0.004	S
Cervical Extension (°)	4.50°	7.93%	9.53°	17.40%	0.005	S
Side-bending (Right) (°)	7.25°	24.17%	13.10°	50.44%	0.001	S
Side-bending (Left) (°)	4.00°	12.12%	9.53°	30.78%	0.001	S
Rotation (Right) (°)	2.50°	4.53%	6.91°	12.96%	0.004	S
Rotation (Left) (°)	4.50°	8.37%	10.00°	19.71%	0.004	S

Both groups showed significant within-group improvements in pain and CROM. However, the treatment group consistently demonstrated greater enhancements in cervical flexion, extension, side-bending, and rotation, as well as more pronounced reductions in pain when compared with the control group. Overall, the study indicates that the treatment intervention is more effective than the control condition in reducing pain and improving cervical mobility.

4. Discussion

This study investigated the effect of Mulligan's Mobilization with Arm Movement (MWAM) when added to conventional treatment on pain intensity and cervical range of motion (ROM) in patients with unilateral cervical radiculopathy. Patients were randomly assigned into two equal groups: a treatment group receiving conventional treatment combined with MWAM, and a control group receiving conventional treatment alone.

Patients' ages were comparable between the two groups, with the control group having a mean age of approximately 31 years and the treatment group around 35 years. Both groups were similar in demographic characteristics, ensuring that any differences observed in outcomes could be attributed to the intervention rather than age or other demographic factors. Data were collected from all patients at baseline and after a four-week intervention period in an outpatient clinic setting.

Regarding the effects of MWAM on Pain Reduction:

Pain was measured using a Visual Analog Scale (VAS). Both groups experienced a reduction in pain; however, the treatment group reported a notably greater reduction. Specifically, the treatment group's pain scores decreased by roughly 2.67 points (about 49%), compared to a 1.4-point reduction (approximately 27%) in the control group. This significant difference suggests that MWAM is highly effective in reducing pain.

Regarding the effects of MWAM on cervical range of motion (ROM):

Cervical Flexion:

Both groups improved in cervical flexion over the course of the study. However, the treatment group exhibited a significantly greater improvement an increase of approximately 10.5° (nearly 28%) compared to an increase of about 5.3° (roughly 13%) in the control group. Statistical analysis confirmed that the improvement in the treatment group was significant.

Cervical Extension:

Significant improvements in cervical extension were also observed. The control group improved by about 4.5° (nearly 8%), while the treatment group's improvement was approximately 9.5° (around 17%). The differences between the groups were statistically significant, suggesting a favourable effect of MWAM on cervical extension.

Cervical Side bending:

For lateral bending, both right and left side-bending showed marked improvements in the treatment group compared to the control group. Right side-bending improved by about 13.1° (50%) in the treatment group versus 7.3° (24%) in the control group, and left side-bending increased by around 9.5° (31%) in the treatment group compared to 4° (12%) in the control group. These improvements were statistically significant for both directions, indicating that MWAM effectively enhances lateral cervical mobility.

Cervical Rotation:

Cervical rotation in both directions improved as well. The treatment group saw an increase of approximately 6.9° (13%) in right rotation and 10° (20%) in left rotation, compared to the control group's improvements of 2.5° (5%) and 4.5° (8%), respectively. Again, statistical tests confirmed that the differences between the groups were significant.

Regarding the effects of MWAM on pain intensity:

In summary, the treatment group demonstrated superior improvements in pain reduction and cervical ROM compared to the control group. The significant improvements in flexion, extension, side-bending, and rotation suggest that MWAM is effective in enhancing joint mobility. Also, the notable reductions in pain support the use of MWAM as a beneficial adjunct to conventional treatment in managing unilateral cervical radiculopathy.

we compared the results and methodologies of the current study, which examines the effects of Mulligan's Mobilization with Arm Movement (SMWAM) on pain and cervical range of motion (ROM) in patients with unilateral cervical radiculopathy, with three similar studies: we found ***That the results of this study are compatible with previous studies:***

1. Impact of SMWAM on Pain

Warude et al. found that Mulligan's mobilization produced a significantly greater reduction in pain than the McKenzie approach. In the current study, the treatment group showed a notably larger reduction in pain (VAS) scores ($p < 0.001$), aligning with Warude et al.'s observations [(18)].

Shafique et al. concluded that adding SMWAM to neurodynamic and traction techniques significantly improved pain outcomes in cervical radiculopathy patients. This mirrors our study's results, where the SMWAM group experienced more pronounced pain relief compared to the control group [(19)].

Arul Pragassame et al. also reported enhanced pain reduction with SMWAM combined with neurodynamics. The current study's significant improvements in these areas further substantiate the clinical benefits of SMWAM in managing cervical radiculopathy [(20)].

2. Impact of SMWAM on Cervical Range of Motion (ROM)

Warude et al. demonstrated that patients with lumbar disc prolapse exhibited significantly greater improvements in lumbar ROM with Mulligan's mobilization compared to the McKenzie approach. Similarly, the current study found that the SMWAM group experienced significantly greater improvements in all directions of cervical ROM (flexion, extension, side bending, and rotation; $p < 0.005$, suggesting that Mulligan-based techniques consistently enhance joint mobility across different regions of the spine [(21)].

Shafique et al. reported that, in cervical radiculopathy patients, the addition of SMWAM to neurodynamics and manual traction resulted in superior cervical ROM improvements compared to control interventions. The current study's findings of enhanced cervical mobility in the treatment group are in line with these results [(22)].

Arul Pragassame et al. observed that incorporating SMWAM with neurodynamics led to significant improvements in cervical ROM compared to conventional therapy. This reinforces our outcome that SMWAM, whether alone or as part of a combined treatment approach, is effective in improving cervical mobility [(23)].

3. General Characteristics and Methodological Considerations

Warude et al. ensured homogeneity in baseline demographics (e.g., age) between groups, a methodological strength mirrored in the current study. This careful demographic matching minimizes confounding factors and supports that observed improvements are attributable to the intervention [(24)].

Both studies employed randomized controlled designs with comprehensive outcome measures, similar to the rigorous approach used in the current study. This consistency in methodology across studies reinforces the reliability of the findings on SMWAM efficacy [(25)].

The clinical implications of these findings are considerable. The study indicates that incorporating MWAM into routine physiotherapy sessions can lead to more effective management of cervical radiculopathy. Significant pain relief and enhanced cervical mobility can improve patient outcomes and overall quality of life. Moreover, as MWAM is a cost-effective, manual therapy technique that does not rely on expensive equipment, it is particularly valuable in resource-limited settings. The early improvement in pain may also encourage greater patient engagement and compliance with therapy, facilitating quicker returns to normal activities [(26)].

There are several important considerations for future research. The current study was limited by its relatively small sample size and short follow-up duration. Future studies should aim to include a larger cohort and extend the treatment and follow-up periods to determine the long-term benefits and potential delayed effects of MWAM [(27)]. Additionally, while this study focused on MWAM as a standalone intervention with conventional treatment, it may be valuable to compare its effectiveness directly with other manual therapy techniques or combined treatment approaches [(28)]. Further investigation into the underlying mechanisms, particularly with neurophysiological assessments, could provide deeper insights into how MWAM influences nerve function.

Limitations

- A relatively small sample size limits the statistical power. Future studies with larger cohorts are needed.
- The short duration of follow-up may not capture long-term benefits or potential delayed effects of MWAM.
- The study evaluated MWAM, without comparing it directly to other interventions such as manual traction or neurodynamic techniques. A broader comparison could help delineate the relative efficacy of each approach.

Conclusion

The results of this study demonstrate that adding Mulligan's Mobilization with Arm Movement to conventional treatment significantly reduces pain and improves cervical range of motion in patients with unilateral cervical radiculopathy. Overall, MWAM appears to be a promising, practical, and cost-effective intervention that can be readily integrated into clinical practice to enhance patient outcomes in cervical radiculopathy.

Acknowledgments

The authors would like to thank all the contributor authors in the study.

Conflict of Interest

The authors have no conflicts of interest to declare.

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