

Mid-term effects of Mulligan mobilization technique on pain intensity, cervical range of motion, and functional disability in individuals with chronic non-specific neck pain

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Abstract:

Chronic neck pain (CNP), defined as pain persisting beyond three months, and is a prevalent global health issue characterized by hyperalgesia and functional impairment. Among conservative interventions, Mulligan's mobilization techniques are widely adopted in clinical practice for their established immediate and short-term benefits. However, the mid-term therapeutic effects of these techniques specifically for non-specific CNP (CNSNP) patients remain inadequately explored and constitute a significant gap in the current evidence base. The present research was therefore needed to address these gaps in the current evidence base with the aim to assess the mid-term clinical effectiveness of the Mulligan technique on pain intensity, cervical range of motion, and self-reported functional disability in individuals with non-specific CNSNP. In this randomized controlled trial, 100 participants were randomly assigned to two groups: an experimental group (n = 50), receiving Mulligan mobilization techniques, including natural apophyseal glides, sustained natural apophyseal glides, self-administered sustained natural apophyseal glides, along with hot packs, or; and a control group (n = 50), receiving isometric exercises, stretching, active neck exercises, transcutaneous electrical nerve stimulation, ultrasound therapy, and hot packs. Both interventions were applied three times per week over a six week period. Outcome measures included pain intensity assessed by the visual analog scale, cervical range of motion measured with a cervical range of motion CROM basic spinal assessment device, and functional disability assessed using the Neck Disability. Assessments were conducted pre- and post-intervention, with both groups demonstrating statistically significant within-group improvements in all outcome measures following the intervention ($p < 0.05$). Between-group analyses indicated that the experimental group achieved significantly greater post-intervention improvements ($p < 0.05$) in pain intensity, cervical range of motion in all movements, and functional disability compared to the control group ($p < 0.001$). This finding suggested that the Mulligan technique was superior in clinical effectiveness to conventional physiotherapy.

Key Words: conventional physiotherapy; manual therapy approaches; joint mobilization techniques; functional outcome measures

Introduction

Chronic neck pain (CNP) is a major global public health concern, with a lifetime prevalence rate of 66% and a 14% chance of individuals developing it (Lam et al., 2020). The literature highlights a complex interplay of physical, psychological, and occupational risk factors that contribute to neck pain (Jahre et al., 2021; Kazeminasab et al., 2022; Siedlecki et al., 2020), which can negatively affect social, psychological, and physical functioning (Suvarnato et al., 2019). Despite its poorly understood pathophysiology, chronic neck pain is defined as neck pain persisting for longer than three months, often accompanied by hyperalgesia and movement limitations, and is now recognized as a distinct disease entity. (Lazoura et al., 2025). Reduced range of motion, muscle weakness, and deficiencies in proprioception and postural control are among the functional impairments frequently associated with non-specific CNP (CNSNP) (Ullah et al., 2025).

In clinical practice, a variety of conservative interventions are employed for patients with CNSNP, including education, manual therapy, therapeutic exercise, electrotherapy, acupuncture, medication including non-steroidal anti-inflammatory drugs (NSAIDs), or a combination of these approaches (Castellini et al., 2022). Manual therapy has demonstrated improvement in function, range of motion, and pain sensitivity in patients with CNSNP. Consequently, a growing number of therapists have begun to use Brian Mulligan's methods in their practice (Morsi et al., 2023). The Mulligan method aims to restore optimal joint positioning and improve biomechanical function by promoting synovial fluid circulation and reducing pain through mobilization combined with active movement (Dilip et al., 2016). The Mulligan technique is a passive oscillatory

mobilization approach involving the application of a force parallel to the facet joint planes of the cervical and upper thoracic spine (Naz et al., 2023). The most frequently applied variants are “natural apophyseal glides” (NAGs) and “sustained natural apophyseal glides” (SNAGs) (Said et al., 2017). NAGs are passive oscillatory mobilizations applied in an anteroposterior direction, parallel to the facet joint plane, targeting restricted cervical segments (Naz et al., 2023). SNAGs, in contrast, involve applying a passive glide along the facet joint plane during active movement in a weight-bearing position, directed cephalad over the symptomatic segment (Said et al., 2017).

Mulligan mobilization techniques, particularly SNAGs, have demonstrated both immediate and short-term efficacy in reducing symptoms associated with cervical spine pain (Morsi et al., 2023; Put et al., 2016; Said et al., 2017; Vijayan et al., 2022; Waqas et al., 2017; Youssef et al., 2025; Zemadani, 2018). Moreover, these techniques have also proven effective in managing acute non-specific cervical pain (Aggarwal & Verma, 2018; Vijayan et al., 2022).

However, despite growing evidence supporting their short-term benefits, the mid-term effects of Mulligan technique, particularly in individuals with CNSNP, remain insufficiently investigated. Furthermore, limited research has examined the combined implementation of SNAGs, NAGs, and self-SNAGs as a unified intervention strategy or compared them with standard physiotherapy. To the best of our knowledge, the literature lacks high-quality randomized controlled trials (RCTs) that address these gaps. Therefore, there is a need for further investigation to evaluate the sustained therapeutic potential of these techniques over longer durations and in chronic clinical populations.

The present research was conducted within the context of contemporary physiotherapy practice, where manual therapy techniques are frequently integrated with exercise and physical modalities, yet their relative effectiveness over longer treatment periods remains uncertain. By systematically comparing Mulligan mobilization techniques with conventional physiotherapy in a randomized controlled design, this study seeks to clarify whether Mulligan techniques provide superior mid-term improvements in pain intensity, cervical range of motion, and functional disability in individuals with chronic non-specific neck pain. This work aims to contribute to the existing body of knowledge and support clinicians in selecting the most effective conservative treatment strategies for managing CNSNP in everyday practice.

Material & methods

Study Design

This RCT aimed to compare the mid-term therapeutic effectiveness of various Mulligan techniques—SNAGs, NAGs, and self-administered SNAGs—with conventional physiotherapy approaches. The objective was to determine the relative benefits of these interventions in the management of chronic cervical dysfunction. The detailed structure, design, and flow of the trial procedures are illustrated in Figure 1. The authors declare that no generative AI or AI-assisted technologies were used in the writing or preparation of this manuscript.

Sample Size Determination

The sample size was calculated a priori using G*Power software (version 3.1.9.2). The calculation was based on an independent t-test for two-group mean comparisons, assuming a moderate effect size (Cohen's $d = 0.6$) informed by previous cervical pain management studies (Gross et al., 2015). A two-tailed alpha level (α) of 0.05 and a power ($1 - \beta$) of 80% were applied, with a 1:1 allocation ratio. The estimated required sample size was 100 participants (50 per group), providing 81% power to detect the predefined effect size at the 5% significance level. To accommodate potential attrition and ineligibility, 144 individuals were initially recruited. After applying inclusion and exclusion criteria and accounting for withdrawals prior to randomization, 100 eligible participants were retained and randomly assigned to the two study groups. This sample size aligns with CONSORT guidelines for RCTs (Schulz et al., 2010).

Participants

A total of 100 individuals with CNSNP were enrolled and randomly allocated to one of two intervention groups using a computer-generated randomization sequence, with allocation concealment ensured through opaque, sealed envelopes. All participants were referred by either a physician or an orthopedic specialist (Miftari et al., 2024; Zejnullahi et al., 2025).

Participants included in the study were individuals aged between 18 and 45 years, in generally good health, with non-specific neck pain persisting for more than three months (Bernal-Utrera et al., 2020; Gumuscu et al., 2023). Individuals were excluded if they had cervical disc herniation, advanced degenerative disease, prior cervical surgery, or recent physiotherapy treatments (within three months). Additional exclusion criteria comprised pregnancy, lactation, planned pregnancy, and comorbidities such as diabetes, malignancy, tuberculosis, rheumatoid arthritis, neurological, psychiatric, or cardiovascular disorders (Bernal-Utrera et al., 2020; Morsi et al., 2023; Naz et al., 2023; Zemadani, 2018).

Measure

Each participant underwent a comprehensive physiotherapeutic clinical assessment, including measures of pain intensity, cervical range of motion, functional disability via standardized questionnaires, and anthropometric measurements, conducted by the principal evaluating physiotherapist. Outcome assessments were performed at baseline and after six weeks of intervention; however, anthropometric measurements were

obtained only at baseline. The evaluating physiotherapist, who also verified eligibility of participants according to predefined inclusion and exclusion criteria, remained blinded to group assignment and was not involved in the delivery of any treatment throughout the study.

Pain intensity assessment was measured using the visual analog scale (VAS), where participants were asked to indicate their perceived pain level on a scale from 0 (no pain) to 10 (worst imaginable pain) (Bernal-Utrera et al., 2020; Kim & Shin, 2024; Miftari et al., 2024; Morsi et al., 2023; Said et al., 2017; Youssef et al., 2025). A cervical range of motion CROM basic spinal assessment device, which is a head-mounted instrument specifically designed for measuring cervical spine mobility, was employed to assess the cervical range of motion. Unlike the universal goniometer, the CROM remains affixed to the patient's head during the entire assessment, thereby minimizing the potential for palpation or alignment errors. The device demonstrates acceptable intratester reliability and offers several practical advantages, including ease of use, rapid readability of measurements, and a lightweight, patient-friendly design that enhances comfort during assessment (Morsi et al., 2023; Put et al., 2016; Youssef et al., 2025).

Finally, to assess the impact of neck pain on daily activities and functional ability, the Neck Pain Disability Index (NDI), a self-reported questionnaire, was employed. It consists of 10 sections evaluating pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleep, and recreation. Each section is scored from 0 to 5, with a total score converted into a percentage. The severity of disability is categorized as minimal (0–20%), moderate (20–40%), severe (40–60%), crippling (60–80%), or complete (80–100%), with higher scores indicating greater impairment (Bernal-Utrera et al., 2020; Kim & Shin, 2024; Morsi et al., 2023; Said et al., 2017).

Intervention procedures

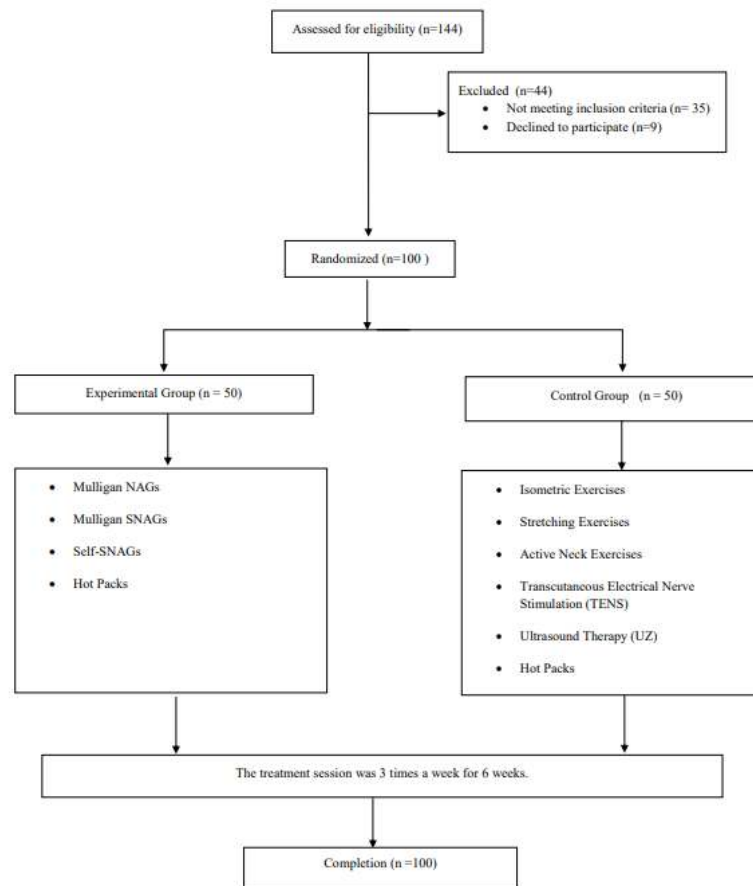
The study was conducted at the “Rehabilitimi” Physiotherapy Clinic in the Municipality of Podujeva, Kosovo. The experimental group received a manual therapy intervention comprising SNAGs and NAGs consisted of three sets of six repetitions, with the mobilization frequency maintained at 2–3 Hz, using Mulligan's guidelines. The technique utilized a sustained glide to the targeted cervical segment while participants actively moved their neck in various pain-free directions, including flexion, extension, lateral flexion, and rotation. Participants received 10 repetitions of each technique per therapy session, with each mobilization lasting approximately 10 seconds. All movements were performed within a pain-free range and direction, ensuring patient comfort and safety throughout the procedure (Morsi et al., 2023; Mulligan, 2010; Naz et al., 2023; Put et al., 2016; Said et al., 2017; Vijayan et al., 2022; Zemadani, 2018).

Additionally, participants performed self-SNAGs based on Mulligan's manual therapy principles. Using a towel for guidance, gentle overpressure was applied at the end of each movement. The protocol included three sets of three repetitions per session, following two supervised familiarization trials to ensure proper technique and safety (Mulligan, 2010; Naz et al., 2023; Zemadani, 2018). The physiotherapist who administered the treatment has successfully completed a training program, possesses extensive clinical experience, and holds formal certification in the Mulligan Concept. Both groups underwent thermotherapy consisting of a 10-minute application of a hot pack heated to 65°C, applied to the upper trapezius muscle (Gashi et al., 2022; Kim & Shin, 2024). The conventional intervention consisted of electrotherapy, therapeutic exercises, and thermotherapy. The included electrotherapy modalities were transcutaneous electrical nerve stimulation (TENS) and therapeutic ultrasound (US). TENS was administered for 20 minutes at an intensity of 10–30 mA and a frequency of 80 Hz using surface electrodes placed over the painful cervical region (Gashi et al., 2023; Gumuscu et al., 2022). The intensity was individually adjusted to remain below the respective participant's sensory discomfort threshold (Miftari et al., 2024). This was followed by continuous US applied to the cervical area at 1.5 W/cm² for 5 minutes (Gumuscu et al., 2023). The therapeutic exercises intervention consisted of isometric exercises targeted at the cervical flexor, extensor, rotator, and lateral flexor muscle groups. Participants performed 10 repetitions of 5-second isometric contractions against self-applied manual resistance or therapist resistance, with hand placement aligned to the direction of the engaged musculature (Gashi et al., 2022; Gumuscu et al., 2023; Vijayan et al., 2022; Youssef et al., 2025). Further, cervical active range of motion (AROM) exercises were implemented, with each movement held for 5 seconds before returning to the neutral starting position. These exercises were performed for 5–10 repetitions per session (Youssef et al., 2025). Complementing the active exercises, passive stretching targeting all cervical muscle groups—including flexors, extensors, rotators, and lateral flexors—was administered. Each stretch was held for 10 seconds and repeated in six sets to optimize muscle flexibility and joint mobility (Gashi et al., 2022; Gashi et al., 2023; Montalvo et al., 2023).

Statistical analysis

Data were analyzed using IBM SPSS Statistics software 22.0. Descriptive statistics including means, standard deviations (SD), and minimum and maximum values were calculated. Inferential analyses included independent and paired t-tests, one-way analysis of variance (ANOVA), correlation, and regression analyses, as appropriate. Statistical significance was evaluated at the 95% and 99% confidence levels, corresponding to $p < 0.05$ and $p < 0.01$, respectively.

Ethical Approval The study was approved by the Ethics Committee of the Faculty of Medicine, University of Prishtina (Approval No. 2407). All participants provided written informed consent prior to enrollment and were fully informed of their right to withdraw from the study at any point without any penalty.



Flow Chart 1: Diagram of the Study Design (Said et al., 2017)

Results

Table I presents the study population's baseline anthropometric and demographic characteristics. No significant differences were observed between the experimental and control groups in terms of gender distribution ($p = 0.64$), age ($p = 0.55$), weight ($p = 0.22$), or height ($p = 0.19$), thus indicating that the two groups were comparable at baseline. Consequently, any post-treatment differences were likely attributable to the intervention rather than pre-existing disparities.

Table I. Comprehensive Baseline Anthropometric and Demographic Assessment in the Study Population

	Experimental Group (n = 50)	Control Group (n = 50)	P-value*
Gender			
Men	19 (38%)	22 (44%)	0.64
Women	31 (62%)	28 (56%)	
Age (year)	34.2 ± 12.1	35.5 ± 11.3	0.55
Weight (kg)	74.6 ± 14.8	71.3 ± 13.5	0.22
Height (cm)	169.0 ± 8.7	171.3 ± 7.9	0.19

*Data are expressed as mean ± standard deviation for continuous variables and as n (%) for categorical variables. Group differences were evaluated using an unpaired t-test for continuous variables and the Chi-square test for categorical variables, with a p-value < 0.05 considered statistically significant.

Comparison of pain among groups pre- and post-treatment

Before treatment, the mean VAS pain scores were comparable between the experimental (Mean = 8.90, SD = 1.02) and control groups (Mean = 8.82, SD = 1.14), indicating a similar level of pain intensity across both groups. The minimal difference in pre-treatment scores suggests that both groups experienced comparable pain levels before the intervention. However, there was a substantial reduction in pain levels post-treatment, with the experimental group showing a greater improvement (Mean = 1.10, SD = 1.02) compared to the control group (Mean = 2.66, SD = 1.33) (Table II). This reduction in VAS scores highlights the effectiveness of the experimental intervention in alleviating pain. The control group also exhibited a decrease in pain but to a lesser extent, suggesting that while standard treatment had beneficial effects, the experimental intervention was more effective in pain relief.

Table II. Comparison of Pain (VAS) Scores Among Groups Pre- and Post-Treatment

VAS		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Pre-treatment	Experimental Group	50	8.90	1.02	0.14	7	10
	Control Group	50	8.82	1.14	0.16	7	10
	Total	100	8.86	1.08	0.11	7	10
Post-treatment	Experimental Group	50	1.10	1.02	0.14	0	4
	Control Group	50	2.66	1.33	0.19	0	5
	Total	100	1.88	1.19	0.12	0	5

The ANOVA analysis further confirms the significant difference in post-treatment pain levels between groups, with statistically significant results of an F-value of 43.34 and a p-value of < 0.001 . This indicates that the observed differences were unlikely due to chance, reinforcing the conclusion that the experimental intervention led to superior pain reduction compared to the control treatment (Table III).

Table III. The ANOVA Analysis of VAS Score Between Groups Post-Treatment

ANOVA		Sum of Squares	df	Mean Square	F	Sig.
VAS	Between Groups	60.84	1	60.84	43.34	< 0.001
	Within Groups	137.66	98	1.40		
	Total	198.50	99			

Comparison of cervical ROM among groups pre- and post-treatment

Before treatment, there were minimal differences in ROM between the two groups, as indicated by the relatively small differences in means across various cervical movements, including flexion, extension, lateral bending, and rotation. However, post-treatment results demonstrate notable improvements in the experimental group across all cervical ROM measurements. Specifically, the experimental group exhibited substantial improvements in flexion, extension, and both right and left rotation, with higher mean ROM values compared to the control group post-treatment (Table IV).

Table IV. Comparison of cervical range of motion (ROM) among groups pre- and post-treatment

Cervical ROM			N	Mean	Std. Deviation	Minimum	Maximum
Cervical flexion	Pre-treatment	Experimental Group	50	40.2	4.16	30	45
		Control Group	50	42.5	2.72	35	45
		Total	100	41.35	3.89	30	45
	Post-treatment	Experimental Group	50	44.67	1.27	40	45
		Control Group	50	42.00	2.82	35	45
		Total	100	43.33	2.55	35	45
Cervical extension	Pre-treatment	Experimental Group	50	23.6	8.21	10	40
		Control Group	50	31.2	6.84	15	40
		Total	100	27.4	9.12	10	40
	Post-treatment	Experimental Group	50	38.77	5.20	25	45
		Control Group	50	33.00	5.35	15	40
		Total	100	35.88	5.98	15	45
Cervical right-sided bending	Pre-treatment	Experimental Group	50	33.8	6.34	15	45
		Control Group	50	35.1	5.92	15	45
		Total	100	34.45	6.15	15	45
	Post-treatment	Experimental Group	50	39.83	4.25	30	45
		Control Group	50	37.83	4.09	25	45
		Total	100	38.83	4.26	25	45
Cervical left-sided bending	Pre-treatment	Experimental Group	50	31.4	6.78	20	40
		Control Group	50	35.7	5.23	20	40
		Total	100	33.55	6.51	20	40
	Post-treatment	Experimental Group	50	41.47	4.20	30	45
		Control Group	50	38.00	4.66	30	45
		Total	100	39.73	4.73	30	45
Cervical right rotation	Pre-treatment	Experimental Group	50	62.3	8.45	45	80
		Control Group	50	65.8	7.21	50	80
		Total	100	64.05	8.01	45	80
	Post-treatment	Experimental Group	50	73.00	6.64	60	80
		Control Group	50	66.67	5.47	55	75
		Total	100	69.83	6.83	55	80
Cervical left rotation	Pre-treatment	Experimental Group	50	61.7	8.92	40	80
		Control Group	50	66.4	6.87	50	75
		Total	100	64.05	8.32	40	80
	Post-treatment	Experimental Group	50	74.33	7.40	55	80
		Control Group	50	67.33	6.40	55	80
		Total	100	70.83	7.71	55	80

ANOVA analysis further supports the conclusion that the experimental group experienced statistically significant improvements in cervical ROM post-treatment. The F-values for flexion ($F = 37.27$, $p < 0.001$), extension ($F = 29.90$, $p < 0.001$), lateral bending (right: $F = 5.75$, $p = 0.018$; left: $F = 15.29$, $p < 0.001$), and rotation (right: $F = 27.07$, $p < 0.001$; left: $F = 25.59$, $p < 0.001$) were all significant, confirming that the experimental intervention had a considerable impact on improving ROM compared to the control group (Table V).

Comparison of NDI questionnaire scores among groups pre- and post-treatment

Before treatment, the mean disability scores for the experimental and the control groups were 3.50 and 3.34, respectively, indicating a similar level of disability between the groups prior to the intervention. However, the variability in scores was higher in the experimental group ($SD = 0.678$) compared to the control group ($SD = 0.479$), suggesting greater dispersion in the experimental group. Post-treatment, the mean disability score in the experimental group decreased to 1.54, indicating a significant improvement. In contrast, the control group's mean disability score decreased only to 2.48, demonstrating an improvement lesser than that of the experimental group. These findings suggest that the experimental intervention has a greater effect on reducing neck disability compared to standard physiotherapy (Table VI).

Table V. The ANOVA analysis of cervical ROM between groups post-treatment

ANOVA		Sum of Squares	df	Mean Square	F	Sig.
Cervical flexion	Experimental Group	178.23	1	178.23	37.27	< 0.001
	Control Group	468.70	98	4.78		
	Total	646.93	99			
Cervical extension	Experimental Group	832.33	1	832.33	29.90	< 0.001
	Control Group	2727.46	98	27.83		
	Total	3559.79	99			
Cervical right-sided bending	Experimental Group	100.00	1	100.00	5.75	0.018
	Control Group	1704.74	98	17.40		
	Total	1804.74	99			
Cervical left-sided bending	Experimental Group	301.03	1	301.03	15.29	< 0.001
	Control Group	1928.42	98	19.68		
	Total	2229.45	99			
Cervical right rotation	Experimental Group	1001.73	1	1001.73	27.07	< 0.001
	Control Group	3626.51	98	37.01		
	Total	4628.24	99			
Cervical left rotation	Experimental Group	1225.00	1	1225.00	25.59	< 0.001
	Control Group	4690.28	98	47.86		
	Total	5915.28	99			

Table VI. Comparison of NDI measurement among groups pre- and post-treatment

NDI		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Pre-treatment	Experimental Group	50	3.50	.678	.096	1	5
	Control Group	50	3.34	.479	.068	3	4
	Total	100	3.42	.592	.059	1	5
Post-treatment	Experimental Group	50	1.54	.542	.077	1	3
	Control Group	50	2.48	.505	.071	2	3
	Total	100	2.01	.777	.077	1	3

The ANOVA analysis between groups, with $F = 80.62$ and $p < 0.001$, indicates a statistically significant difference between the two groups. This suggests that the experimental intervention has a greater impact, and the statistical results confirm that this improvement is not due to random chance (Table VII).

Table VII. The ANOVA analysis of NDI between groups post-treatment

ANOVA		Sum of Squares	Df	Mean Square	F	Sig.
NDI	Between Groups	22.09	1	22.09	80.62	< 0.001
	Within Groups	26.85	98	.274		
	Total	48.94	99			

Discussion

This study demonstrates that Mulligan mobilization techniques produce superior mid-term outcomes for individuals with CNSNP compared with conventional physiotherapy. Participants in the Mulligan program experienced greater reductions in pain intensity, clinically meaningful improvements in cervical range of motion, and larger decreases in neck-related functional disability. These effects were consistent across the primary outcomes and supported by robust statistical findings ($p < 0.001$), indicating that the results are unlikely due to chance and predominantly due to the intervention.

Our findings align with previous literature demonstrating clinical outcomes associated with Mulligan mobilizations to be superior to conventional treatment modalities (e.g., Aggarwal & Verma 2018; Naz et al.,

2023; Vijayan et al., 2022). For instance, Aggarwal and Verma (2018) reported that nursing professionals with work-related neck pain who practiced self-SNAGs for two weeks achieved significantly greater improvements in pain intensity, disability, and cervical range of motion relative to those receiving conventional physiotherapy, which included neck isometrics and hot packs. Similarly, Vijayan et al. (2022) observed that short-term SNAGs produced notable reductions in pain, improved craniovertebral angle, and enhanced cervical motion in patients with non-specific neck pain compared to conventional care. Additionally, Naz et al. (2023) conducted an RCT involving 26 patients with CNP and demonstrated that Mulligan mobilizations—including SNAGs, NAGs, and self-SNAGs—yielded faster and more pronounced improvements in cervical range of motion and disability scores than self-directed McKenzie exercises. Collectively, these studies highlight the value of Mulligan techniques in providing biomechanical correction and neuromuscular facilitation beyond what is achieved through standard physiotherapy. These convergent findings further substantiate Mulligan mobilization's clinical utility as an effective and versatile treatment for diverse patient populations with neck pain, thereby supporting its integration into contemporary rehabilitation protocols.

Standardized application of NAGs, SNAGs, and self-SNAGs over a structured treatment protocol appears to facilitate both pain relief and mobility restoration. The benefits observed here also parallel studies reporting enhanced outcomes when manual techniques are combined with adjunctive modalities such as thermotherapy (Aggarwal & Verma, 2018). Thermotherapy is clinically and physiologically known to reduce neck pain through its influence on nociception in soft tissues, enhancement of local circulation, stimulation of metabolism, and improvement of functionality (Karaarslan et al., 2022). Clinical improvements observed following Mulligan mobilizations can be attributed to both neurophysiological and biomechanical mechanisms. These mobilizations likely enhance joint movement quality and alleviate pain through mechanical restoration of accessory motions, while simultaneously modulating afferent input that influences central pain processing and motor control (Dilip et al., 2016).

Nonetheless, the literature is not unanimous. For example, Put et al. (2016) found that although Mulligan techniques produced superior cervical ROM restoration compared with a multimodal therapy package, both strategies yielded comparable reductions in pain and disability for certain patient groups. Moreover, a recent systematic review and meta-analysis (Barbosa-Silva et al., 2025) concluded that SNAGs, particularly when combined with other interventions, can outperform some alternative techniques for pain, disability and ROM. Yet, the overall certainty of evidence was rated low due to heterogeneity and methodological limitations. These findings suggest that Mulligan techniques may be especially effective for mobility, while multimodal programs can address pain and function depending on patient profile and treatment fidelity.

The notable strengths of this study include a standardized intervention protocol, comparable baseline characteristics between groups (minimizing confounding), and the use of validated outcome measures (VAS, CROM, NDI). Limitations include the mid-term follow-up window (restricting conclusions about long-term durability), potential therapist and participant expectation bias inherent in manual therapy trials, lack of therapist blinding, and the concurrent use of adjunct modalities, which complicates attribution of effects. Although statistical differences were strong, reporting outcomes relative to Minimal Clinically Important Difference thresholds would improve clinical applicability.

The clinical implications of the study's findings suggest that integrating Mulligan techniques into treatment plans for CNSNP can accelerate recovery of mobility and produce larger reductions in pain and disability than conventional physiotherapy alone. However, clinicians should apply standardized protocols and document both statistical and clinical effect sizes to better inform individualized care decisions. Additionally, future research should prioritize adequately powered, high-quality RCTs with rigorous blinding where feasible, standardized treatment manuals, and factorial designs that can separate the relative contributions of manual techniques, adjunct modalities, and exercise/self-management. Long-term follow-up and subgroup analyses (e.g., by symptom chronicity, occupational factors, or baseline mobility limitations) are necessary to identify which patients derive the greatest and most sustained benefit.

Conclusions

This randomized controlled study demonstrates that Mulligan mobilization techniques provide superior mid-term benefits compared with conventional physiotherapy in adults with chronic non-specific neck pain (CNSNP). Participants receiving Mulligan based interventions exhibited greater reductions in pain intensity and functional disability, together with more pronounced improvements in cervical mobility. These outcomes indicate that movement-oriented manual therapy approaches can achieve clinically meaningful improvements across key domains of function.

The findings support the incorporation of Mulligan mobilization techniques as an effective element of conservative management for CNSNP. The emphasis on pain-free mobilization and active patient involvement, including the use of self-SNAGs, may enhance neuromuscular control and cervical joint function while promoting patient engagement and self-management. Such characteristics are particularly relevant for optimizing functional recovery and maintaining therapeutic gains in routine clinical practice.

From a conceptual perspective, the results align with contemporary models of musculoskeletal rehabilitation that integrate biomechanical and neurophysiological mechanisms of pain modulation. The demonstrated mid-term effectiveness suggests that Mulligan techniques contribute not only to symptomatic relief but also to functional restoration, supporting their role within evidence-based physiotherapy strategies.

Nevertheless, the conclusions are limited to mid-term follow-up, and the specific contribution of individual treatment components cannot be fully determined. Future high-quality randomized trials with longer follow-up periods and more refined intervention designs are needed to establish long-term effectiveness and to clarify the mechanisms underlying observed improvements.

Overall, this study provides credible and applicable evidence that Mulligan mobilization techniques represent a valuable non-pharmacological approach for improving pain, mobility, and functional outcomes in individuals with CNSNP, with important implications for advancing conservative physiotherapy practice.

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Conflicts of interest The authors declare that there are no conflicts of interest.

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