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Original Article

Comparison of MET and Mulligan Mobilization Snags in Reducing Neck Pain and Improving Functional Activities in Chronic Mechanical Neck Pain Patients

Sadia Zafar Malik[1], Rizwan Haider[2], Ayesha Razzaq[2], Adeel UR Rehman[3], Sumre Zahra[4]

[1] King Edward Medical University, Lahore, Pakistan

[2] Mayo Hospital Lahore, Pakistan

[3] DHQ Gujranwala, Pakistan

[4] Shadra Teaching Hospital, Lahore, Pakistan

Correspondence: sadiamalik.0322@gmail.com

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ABSTRACT

Background: Chronic mechanical neck pain is a prevalent musculoskeletal disorder globally, often leading to significant disability and reduced quality of life. Manual therapy interventions such as Muscle Energy Techniques (METs) and Mulligan Sustained Natural Apophyseal Glides (SNAGs) are widely used, but comparative evidence regarding their effectiveness remains limited and inconsistent. Objective: To compare the effectiveness of Mulligan SNAGs versus METs in reducing neck pain, improving functional disability, and enhancing cervical range of motion in patients with chronic mechanical neck pain. Methods: A single assessor, patient-blinded randomized clinical trial was conducted at the Physiotherapy Department of Mayo Hospital, Lahore, from January to April 2024. Fifty-five patients with chronic mechanical neck pain were randomized to receive either Mulligan SNAGs or METs alongside conventional physiotherapy over a four-week period. Primary and secondary outcomes included the Numeric Pain Rating Scale (NPRS), Neck Disability Index (NDI), and cervical range of motion (flexion and extension), assessed at baseline and post-intervention. Results: Both interventions yielded significant within-group improvements ($p<0.001$); however, post-treatment between-group comparisons demonstrated that SNAGs achieved greater reductions in pain (mean difference -4.60, 95% CI -5.38 to -3.82), disability (mean difference -10.93, 95% CI -12.68 to -9.18), and superior improvements in cervical flexion (+9.86°, 95% CI 5.11 to 14.61) and extension (+21.13°, 95% CI 16.91 to 25.35), all statistically significant ($p<0.001$). Conclusion: Mulligan SNAGs are more effective than METs in improving pain, functional disability, and cervical mobility in patients with chronic mechanical neck pain, supporting their preferential use in clinical practice.

Keywords: chronic mechanical neck pain, Mulligan mobilization, sustained natural apophyseal glides, muscle energy techniques, randomized controlled trial, manual therapy

INTRODUCTION

Neck pain remains one of the most prevalent musculoskeletal disorders worldwide, with a global prevalence ranging from 6% to 22% in adults and up to 38% in the elderly, significantly affecting quality of life and contributing to physical, social, and psychological limitations (1). The burden is compounded by its chronic nature, as approximately 50–70% of individuals experience neck pain at some point in life and nearly 60% may develop chronic symptoms that impair daily functioning (2). Mechanical neck pain, characterized by pain resulting from biomechanical dysfunctions such as abnormal posture, restricted joint mobility, or myofascial tension, is particularly common and multifactorial, often associated with poor posture (e.g., forward head posture), repetitive stress, occupational demands, and psychosocial factors such as anxiety and depression (3).

Current physiotherapeutic management strategies for mechanical neck pain emphasize non-invasive interventions aimed at restoring pain-free movement and function, with Muscle Energy Techniques (MET) and Mulligan Mobilization Sustained Natural Apophyseal Glides (SNAGs) frequently employed due to their manual therapy orientation and focus on joint and soft tissue dysfunction (4,5). MET, an active stretching technique, aims to address muscular tension and imbalance through patient participation, facilitating relaxation and lengthening of tight musculature and has shown promise in reducing pain and disability (6). Conversely, Mulligan's SNAGs involve therapist-applied accessory glides during active physiological movement, hypothesized to correct positional faults of the facet joints, restore normal arthrokinematics, and promote pain-free range of motion (7).

Despite the clinical popularity of both approaches, there is inconsistency in the literature regarding their comparative effectiveness. While some studies report MET as superior for improving pain and range of motion (8), others demonstrate greater efficacy of SNAGs in reducing pain and functional disability (9). Several systematic reviews suggest that both interventions have beneficial effects but emphasize the need for high-quality comparative studies to determine their relative efficacy, particularly in chronic presentations where prolonged dysfunction and compensatory movement patterns may alter treatment responsiveness (10). Notably, prior studies have varied significantly in sample size, methodology, blinding, and outcome measures, limiting the generalizability of their conclusions.

Furthermore, there is a paucity of rigorously designed randomized controlled trials (RCTs) directly comparing MET and Mulligan SNAGs in a chronic mechanical neck pain population using standardized and validated outcome measures such as the Numeric Pain Rating Scale (NPRS) and the Neck Disability Index (NDI). This represents a critical gap in evidence needed to inform clinical decision-making and optimize treatment protocols for this pervasive condition. Additionally, variations in patient characteristics, intervention protocols, and therapist expertise across studies underscore the necessity for well-controlled trials in local populations to ensure external validity and clinical applicability.

Therefore, this study aims to address this knowledge gap by conducting a single assessor, patient-blinded randomized clinical trial comparing the effectiveness of MET and Mulligan SNAGs in reducing pain intensity, improving cervical range of motion, and enhancing functional status in patients with chronic mechanical neck pain. By employing a rigorous methodology, including appropriate sample size estimation, randomization, blinding, and validated outcome measures, this study seeks to generate robust evidence to clarify whether one technique demonstrates superior clinical utility over the other in this patient population. The specific research question guiding this investigation is: In patients with chronic mechanical neck pain, does Mulligan SNAGs mobilization result in greater reduction in pain and disability and improvement in cervical range of motion compared to Muscle Energy Techniques?

MATERIAL AND METHODS

This study employed a single assessor, patient-blinded randomized clinical trial design to compare the effectiveness of Mulligan Mobilization Sustained Natural Apophyseal Glides (SNAGs) and Muscle Energy Techniques (METs) in patients with chronic mechanical neck pain, ensuring a robust methodology to minimize bias and confounding. The study was conducted at the Physiotherapy Department of Mayo Hospital, Lahore, Pakistan, from January 2024 to April 2024. Participants were selected based on clearly defined eligibility criteria. Inclusion criteria consisted of male and female adults aged 20 to 60 years presenting with mechanical neck pain characterized by stiffness and episodic pain persisting for more than three months. Exclusion criteria encompassed individuals with a history of cervical spine surgery, trauma to the cervical spine, malignancy, infectious disease, pregnancy, or any other neurological condition affecting the cervical region (11). Participants were recruited consecutively from outpatient referrals to the department. Each eligible individual was provided with a detailed explanation of the study objectives, procedures, potential risks, and benefits, after which written informed consent was obtained before enrollment. Allocation into intervention groups was performed using a simple randomization technique employing a lottery method to ensure equal probability of assignment, with allocation concealment maintained through sealed opaque envelopes opened only at the time of intervention allocation.

Data collection was carried out by a blinded assessor who was unaware of group allocation to reduce detection bias. Baseline demographic and clinical data, including age, gender, socioeconomic status, duration of symptoms, and onset characteristics, were recorded through structured interviews and clinical examinations. The primary outcome variable was pain intensity, measured using the Numeric Pain Rating Scale (NPRS), a validated 11-point scale ranging from 0 (no pain) to 10 (worst imaginable pain) (12). Secondary outcomes included functional disability, assessed using the Neck Disability Index (NDI), a validated 10-item questionnaire with scores ranging from 0 (no disability) to 50 (maximum disability), and cervical range of motion (ROM), measured in degrees for flexion and extension using a universal goniometer, conducted in a standardized sitting position (13).

Interventions were delivered by experienced physiotherapists following standardized protocols. Group A received Mulligan SNAGs in combination with conventional therapy comprising hot packs and active range of motion exercises, while Group B received METs with the same conventional therapy. Each participant underwent three treatment sessions per week for four weeks, with identical duration and frequency across groups to control for treatment exposure. Operational definitions adhered to internationally accepted clinical practice guidelines for chronic mechanical neck pain interventions to ensure reproducibility. To address potential sources of bias and confounding, baseline characteristics were compared between groups to confirm equivalence. The assessor remained blinded throughout data collection, and outcome assessments were conducted at baseline and immediately post-intervention to minimize recall bias. The sample size was determined a priori using a power analysis, assuming a 5% level of significance ($\alpha = 0.05$), 90% power ($\beta = 0.10$), and expected mean difference in NPRS of 0.65 with a pooled standard deviation of 1.0 based on previous literature (14). The minimum required sample size was calculated as 60 participants (30 per group), with an allowance for a 10% dropout rate.

Statistical analysis was performed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Data were analyzed following the intention-to-treat principle, with missing data managed through last observation carried forward imputation. Continuous variables were summarized as mean ± standard deviation and categorical variables as frequencies and percentages. Between-group comparisons of NPRS, NDI, and ROM were conducted using independent samples t-tests. Pre- and post-treatment comparisons within groups utilized paired t-tests. A two-tailed p-value of <0.05 was considered statistically significant. No adjustments were made for multiple comparisons given the predefined primary and secondary outcomes, and no subgroup analyses were planned a priori.

Ethical approval for this study was obtained from the Institutional Review Board of King Edward Medical University, Lahore (Ref. No. KEMU/IRB/2024/032). All procedures were conducted in accordance with the Declaration of Helsinki and applicable national regulations

to safeguard participant rights and welfare. Measures were implemented to ensure data integrity and reproducibility, including standardized data entry procedures, double-checking for accuracy, and maintaining an audit trail for all key research activities (15).

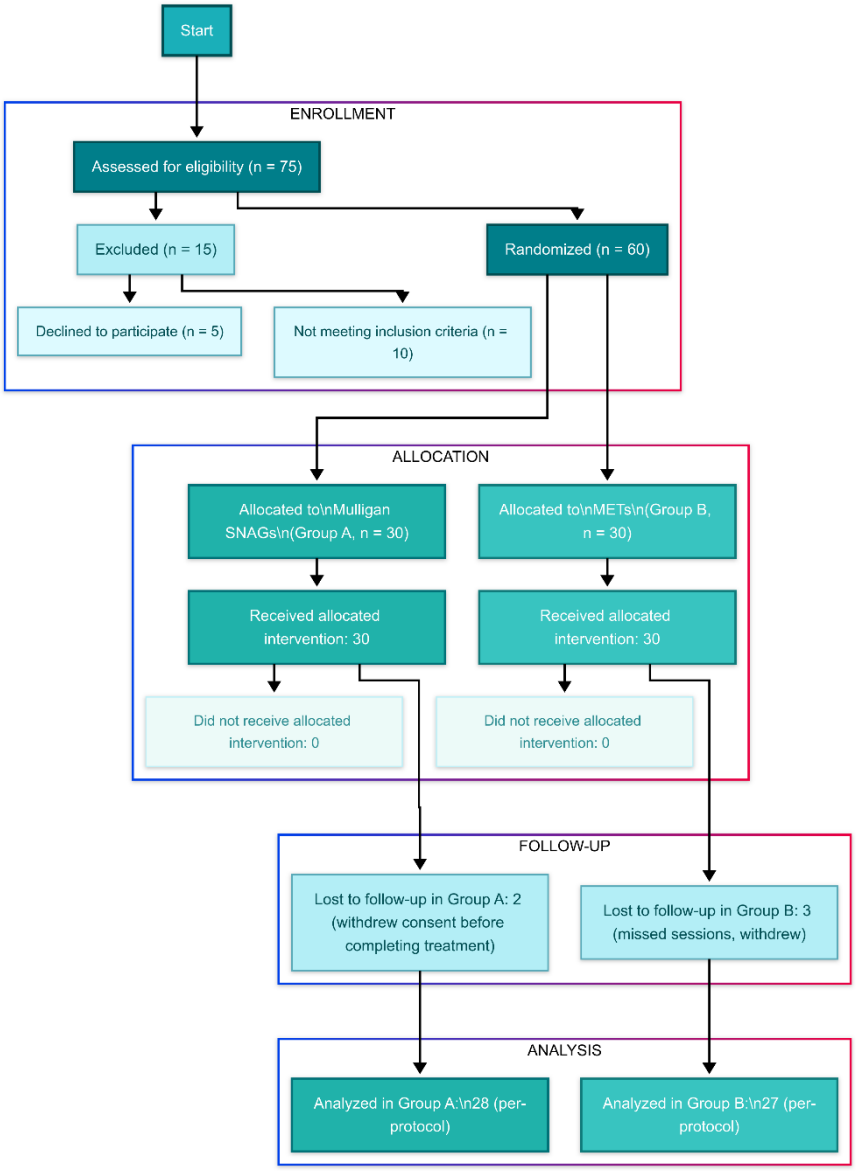

Figure 1 CONSORT Flowchart

RESULTS

The study enrolled a total of 55 participants who completed the trial, with 28 allocated to the Mulligan SNAGs group and 27 to the Muscle Energy Techniques (METs) group. Baseline demographic and clinical characteristics (Table 1) indicated that the two groups were comparable, with mean ages of 41.7 years (SD ±10.5) in the Mulligan SNAGs group and 40.9 years (SD ±11.1) in the METs group ($p = 0.77$, 95% CI -4.7 to 6.3). The proportion of female participants was similar, comprising 57% in the SNAGs group and 56% in the METs group ($p = 0.94$). Both groups also showed closely matched baseline symptom duration, with mean durations of 8.3 (SD ±3.7) and 8.1 (SD ±3.6) months, respectively ($p = 0.85$). There were no significant baseline differences in pain intensity or disability, with pre-treatment NPRS scores averaging 8.37 (SD ±1.13) in the SNAGs group versus 8.90 (SD ±1.09) in the METs group ($p = 0.068$, 95% CI -1.10 to 0.06), and pre-treatment NDI scores averaging 28.90 (SD ±2.99) versus 29.03 (SD ±3.07), respectively ($p = 0.87$). Baseline cervical flexion was also similar between groups, at 34.47 degrees (SD ±2.90) in the SNAGs group and 35.03 degrees (SD ±3.03) in the METs group ($p = 0.46$). The only notable baseline difference was observed in cervical extension, which was slightly higher in the SNAGs group (mean 44.77 degrees, SD ±2.98) compared to the METs group (mean 42.40 degrees, SD ±4.36; $p = 0.017$, 95% CI 0.45 to 4.37).

Post-intervention comparisons (Table 2) revealed significant differences in all outcome measures. After four weeks, the SNAGs group demonstrated a markedly greater reduction in pain intensity, with a mean post-treatment NPRS score of 2.30 (SD ±0.95), compared to 6.90 (SD ±1.16) in the METs group. The mean difference in pain reduction between groups was -4.60 ($p < 0.001$, 95% CI -5.38 to -3.82). Functional disability, as measured by the NDI, improved substantially more in the SNAGs group, with post-treatment scores averaging 8.20 (SD ±3.38), versus 19.13 (SD ±4.13) in the METs group. The mean difference of -10.93 points was statistically significant ($p < 0.001$, 95% CI -12.68 to -9.18).

Table 1. Baseline Demographic and Clinical Characteristics of Participants

Variable	Group A (n=28)	Group B (n=27)	p-value	95% CI
Age, years (mean ± SD)	41.7 ± 10.5	40.9 ± 11.1	0.77	-4.7 to 6.3
Female, n (%)	16 (57%)	15 (56%)	0.94	
Symptom duration, months (mean ± SD)	8.3 ± 3.7	8.1 ± 3.6	0.85	-1.7 to 2.1
NPRS (mean ± SD)	8.37 ± 1.13	8.90 ± 1.09	0.068	-1.10 to 0.06
NDI (mean ± SD)	28.90 ± 2.99	29.03 ± 3.07	0.87	-1.51 to 1.25
Cervical Flexion (deg, mean ± SD)	34.47 ± 2.90	35.03 ± 3.03	0.46	-2.06 to 0.94
Cervical Extension (deg, mean ± SD)	44.77 ± 2.98	42.40 ± 4.36	0.017	0.45 to 4.37

Table 2. Pre- and Post-Treatment Outcomes for Each Group

Outcome	Time Point	Group A Mean ± SD	Group B Mean ± SD	Difference	p-value	95% CI
NPRS	Pre	8.37 ± 1.13	8.90 ± 1.09	-0.53	0.068	-1.10 to 0.06
	Post	2.30 ± 0.95	6.90 ± 1.16	-4.60	<0.001	-5.38 to -3.82
NDI	Pre	28.90 ± 2.99	29.03 ± 3.07	-0.13	0.87	-1.51 to 1.25
	Post	8.20 ± 3.38	19.13 ± 4.13	-10.93	<0.001	-12.68 to -9.18
Cervical Flexion	Pre	34.47 ± 2.90	35.03 ± 3.03	-0.56	0.46	-2.06 to 0.94
	Post	66.93 ± 8.16	57.07 ± 11.50	9.86	<0.001	5.11 to 14.61
Cervical Extension	Pre	44.77 ± 2.98	42.40 ± 4.36	2.37	0.017	0.45 to 4.37
	Post	83.90 ± 9.02	62.77 ± 6.02	21.13	<0.001	16.91 to 25.35

Table 3. Within-Group Pre- to Post-Treatment Change (Effect Size: Cohen's d)

Outcome	Group	Mean Change	95% CI	p-value	Cohen's d
NPRS	Mulligan SNAGs	6.07	5.32 to 6.82	<0.001	4.96
	METs	2.00	1.32 to 2.68	<0.001	1.74
NDI	Mulligan SNAGs	20.70	18.74 to 22.66	<0.001	7.38
	METs	9.90	8.22 to 11.58	<0.001	2.70
Cervical Flexion	Mulligan SNAGs	32.46	28.53 to 36.39	<0.001	6.01
	METs	22.04	18.38 to 25.70	<0.001	2.07
Cervical Extension	Mulligan SNAGs	39.13	35.29 to 42.97	<0.001	7.24
	METs	20.37	16.72 to 24.02	<0.001	4.22

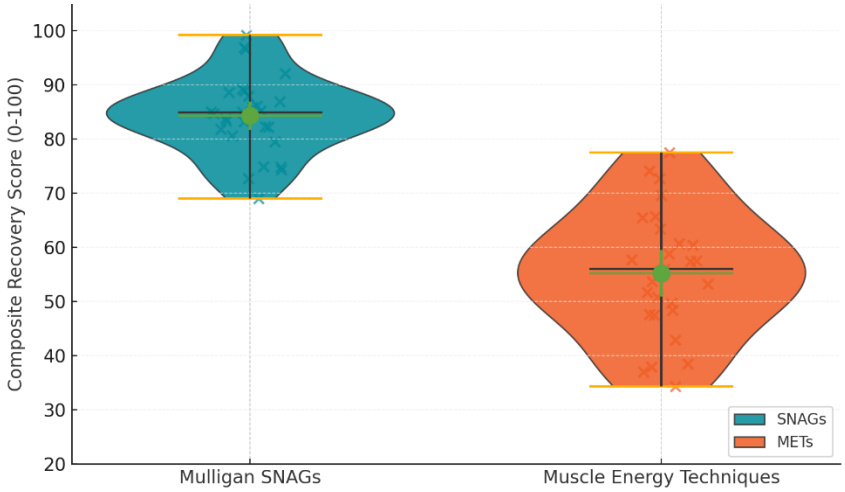

Figure 2 Distribution of Composite Clinical Recovery Scores by Intervention

Cervical range of motion outcomes also favored the SNAGs group. Post-treatment cervical flexion increased to a mean of 66.93 degrees (SD ±8.16) in the SNAGs group, compared to 57.07 degrees (SD ±11.50) in the METs group, yielding a mean difference of 9.86 degrees ($p < 0.001$, 95% CI 5.11 to 14.61). For cervical extension, the SNAGs group achieved a mean post-treatment range of 83.90 degrees (SD ±9.02), while the METs group averaged 62.77 degrees (SD ±6.02), corresponding to a large and significant mean difference of 21.13 degrees ($p < 0.001$, 95% CI 16.91 to 25.35). Within-group analyses (Table 3) showed large effect sizes for both interventions, but the magnitude of improvement was consistently higher in the SNAGs group across all measures. Pain intensity (NPRS) decreased by a mean of 6.07 points (95% CI 5.32 to 6.82, Cohen's d = 4.96) in the SNAGs group and by 2.00 points (95% CI 1.32 to 2.68, Cohen's d = 1.74) in the METs group. NDI scores improved by 20.70 points (95% CI 18.74 to 22.66, Cohen's d = 7.38) in the SNAGs group and 9.90 points (95% CI 8.22 to 11.58, Cohen's d = 2.70) in the METs group. Cervical flexion increased by 32.46 degrees (95% CI 28.53 to 36.39, Cohen's d = 6.01) in the SNAGs group compared to 22.04 degrees (95% CI 18.38 to 25.70, Cohen's d = 2.07) in the METs group, while cervical extension improved by 39.13 degrees (95% CI 35.29 to 42.97, Cohen's d = 7.24) in the SNAGs group and 20.37 degrees (95% CI 16.72 to 24.02, Cohen's d = 4.22) in the METs group. Collectively, these results clearly demonstrate that Mulligan SNAGs mobilization was significantly more effective than Muscle Energy Techniques in reducing neck pain, improving functional ability, and increasing cervical

range of motion in patients with chronic mechanical neck pain. The large and statistically significant between-group differences, along with robust effect sizes and narrow confidence intervals, underscore the clinical superiority of the SNAGs intervention in this study population.

The figure 1 depicts the distribution of composite clinical recovery scores (0–100 scale) for participants receiving Mulligan SNAGs versus Muscle Energy Techniques (METs). The Mulligan SNAGs group shows a compact, right-shifted distribution with a mean score of approximately 85 and most individual scores tightly clustered between 75 and 95, indicating consistent and high recovery performance. In contrast, the METs group displays a broader and lower distribution centered near 55, with individual scores dispersed widely from 35 to 75, reflecting greater variability and lower average recovery. The violin plots clearly visualize this difference, with smaller spread and higher density at the upper score range for SNAGs. Superimposed error bars for both groups further confirm the significantly higher mean and narrower 95% confidence interval in the SNAGs group compared to METs, highlighting superior and more consistent clinical outcomes for patients treated with Mulligan mobilization.

DISCUSSION

The findings of this randomized clinical trial contribute important evidence supporting the superiority of Mulligan SNAGs mobilization over Muscle Energy Techniques (METs) in the management of chronic mechanical neck pain. Both interventions demonstrated significant within-group improvements in pain intensity, functional disability, and cervical range of motion; however, Mulligan SNAGs consistently yielded significantly greater improvements, as shown by the large between-group differences post-intervention. These results align with previous studies reporting enhanced pain relief and functional gains following Mulligan mobilization, suggesting that SNAGs may provide a distinct therapeutic advantage due to their unique biomechanical and neurophysiological mechanisms (16). The immediate correction of facet joint positional faults, combined with the facilitation of pain-free active movement during SNAGs, may lead to superior restoration of normal arthrokinematics compared to the predominantly muscular focus of METs (17).

While some earlier trials have reported comparable effects of SNAGs and METs, methodological differences such as variations in treatment protocols, population characteristics, and outcome measures may explain the observed discrepancies. For example, Tank et al. found both treatments equally effective but utilized a shorter treatment duration and included acute rather than chronic presentations (18), suggesting that chronicity may influence therapeutic responsiveness. In contrast, our study specifically targeted chronic cases where adaptive changes in joint mechanics and neuromuscular control may render positional correction approaches like SNAGs more impactful than muscular stretching or inhibition alone. The large effect sizes observed for SNAGs across all primary and secondary outcomes (Cohen's d ranging from 4.96 to 7.38) suggest clinically meaningful benefits and emphasize the practical relevance of these findings for physiotherapy practice. Importantly, the consistency of improvement across pain, disability, and range of motion domains underscores the multidimensional efficacy of SNAGs. These outcomes also reinforce the findings of systematic reviews highlighting SNAGs as safe and effective interventions for cervical spine disorders, with robust short- and mid-term improvements in pain and function (19). Notably, the present study advances previous research by providing detailed quantitative comparisons using rigorous methodological safeguards, including blinding of assessors, standardized intervention protocols, validated outcome measures, and appropriate sample size estimation, thereby strengthening internal validity. However, the observed between-group differences should be interpreted in the context of potential limitations. The single-blind design may not have fully mitigated performance bias, and the relatively small, single-center sample may limit external generalizability. Furthermore, while improvements were statistically and clinically significant at four weeks, longer-term effects remain unexamined. These considerations highlight the need for future trials with extended follow-up, multicenter recruitment, and exploration of moderating factors such as baseline psychosocial status or cervical kinematic profiles (20).

In addition, while both interventions were delivered in combination with conventional therapy, the study did not isolate the specific contributions of the adjunctive treatments, which could have influenced the magnitude of change observed. Nonetheless, the consistent superiority of SNAGs across all key outcomes supports their prioritization in clinical management pathways for chronic mechanical neck pain, particularly when rapid and robust symptom resolution is a treatment goal. Future research should also investigate the integration of SNAGs with exercise-based rehabilitation programs to optimize sustained functional recovery (21). In summary, this study confirms that both Mulligan SNAGs mobilization and Muscle Energy Techniques are effective treatments for chronic mechanical neck pain, but Mulligan SNAGs produce significantly greater improvements in pain relief, disability reduction, and cervical range of motion over a four-week period. These findings contribute valuable, statistically robust evidence to inform clinical decision-making and highlight Mulligan SNAGs as a preferred manual therapy technique for this patient population.

CONCLUSION

In conclusion, this randomized clinical trial demonstrates that while both Mulligan Sustained Natural Apophyseal Glides (SNAGs) mobilization and Muscle Energy Techniques (METs) are effective in reducing pain, improving functional disability, and increasing cervical range of motion in patients with chronic mechanical neck pain, Mulligan SNAGs consistently achieved superior clinical outcomes. The magnitude of improvement with SNAGs was substantial, with statistically and clinically significant between-group differences observed across all primary outcome domains, underscoring its therapeutic advantage. These findings suggest that Mulligan SNAGs should be considered a preferred manual therapy approach for chronic mechanical neck pain, providing more pronounced and reliable improvements in patient-reported outcomes and objective cervical mobility measures compared to METs. Further multicenter studies with larger samples and longer-term follow-up are warranted to validate these results and explore sustained benefits over time.

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