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ORIGINAL ARTICLE

Comparative Effectiveness of Mulligan SNAGs and the McKenzie Method in the Management of Chronic Neck Pain: A Clinical Trial

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ABSTRACT

Background: Chronic neck pain (CNP) is a prevalent musculoskeletal condition that significantly affects quality of life and functional capacity. Among the various physiotherapy interventions available, Mulligan Sustained Natural Apophyseal Glides (SNAGs) and the McKenzie Method (Mechanical Diagnosis and Therapy) are commonly employed manual therapy techniques. However, direct comparisons of their clinical effectiveness remain limited.

Objective: To compare the effectiveness of Mulligan SNAGs and the McKenzie Method as adjuncts to standard physiotherapy in reducing pain, improving function, enhancing range of motion (ROM), and promoting psychological well-being in patients with CNP.

Methods: A randomized clinical trial was conducted on 56 participants with chronic neck pain, divided equally into two intervention groups: Mulligan SNAGs and McKenzie Method, both combined with standard physiotherapy. Interventions were applied five times weekly for four weeks. The outcome measures included the Numerical Pain Rating Scale (NPRS), neck pain and disability scale-Gujarati version (NPAD-G), WHO-5 Well-Being Index, cervical ROM, and Global Rating of Change (GRoC). Assessments were conducted at baseline, 2 weeks, and 4 weeks.

Results: Both groups showed statistically significant within-group improvements across all outcome measures ($p < 0.05$). Pain intensity, functional disability, and psychological well-being improved notably with increased cervical ROM and high patient satisfaction. However, the between-group differences were not statistically significant ($p > 0.05$).

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Conclusion: Mulligan SNAGs and the McKenzie Method are both effective adjuncts to standard physiotherapy for managing chronic neck pain. Both techniques can be selected based on patient preference, therapist expertise, and clinical presentation.

KEYWORDS

• Chronic Neck Pain • Mulligan SNAGs • McKenzie Method • Manual Therapy • Physiotherapy • NPRS • NPAD-G • WHO-5 well-being index • GRoC

INTRODUCTION

Chronic neck pain (CNP) is one of the most pervasive and disabling musculoskeletal conditions worldwide, significantly impairing functional capacity, quality of life, and psychological well-being. According to the International Association for the Study of Pain (IASP), cervical spinal pain is defined as discomfort perceived in the posterior cervical region, extending from the superior nuchal line to the first thoracic spinous process. Epidemiological evidence reveals that CNP affects nearly two-thirds of individuals at some point in their lives, with a global prevalence estimated at 288.7 million cases, accounting for 28.6 million years lived with disability in 2017. These findings underscore the pressing need for effective evidence-based interventions in physiotherapy to mitigate the burden of this condition.

The cervical spine is particularly vulnerable to repetitive strain and mechanical dysfunction owing to its anatomical and functional complexities. It supports the head, facilitates multidirectional motion, and houses critical neurovascular structures, making it susceptible to degenerative and postural impairments. CNP often manifests with features such as restricted range of motion, muscular tightness, psychological distress, and functional disability. These multifactorial characteristics necessitate a multimodal therapeutic approach tailored to an individual's clinical presentation and treatment response.

Physiotherapy remains the frontline noninvasive treatment modality for managing CNP. Among the numerous available techniques, manual therapy and therapeutic exercise regimens have demonstrated efficacy in reducing pain and restoring function. Two widely employed and clinically relevant approaches are the Mulligan Sustained Natural Apophyseal Glide (SNAGs) and McKenzie Method of Mechanical Diagnosis and Therapy (MDT). Both interventions aim to enhance cervical mobility, reduce pain, and improve patient autonomy, but differ fundamentally in their theoretical underpinnings and practical execution.

The Mulligan concept, developed by Brian Mulligan, involves the application of sustained joint glides by a therapist in conjunction with active movements by the patient. SNAGs, the cornerstone of this approach, target specific cervical segments to correct positional faults, facilitate joint motion, and alleviate pain through mobilization with movement principles. This technique has been praised for its immediate and measurable benefits in terms of pain relief and functional gain in various clinical settings.

Conversely, the McKenzie Method emphasizes patient-led management through repeated directional movements and sustained positions, aimed at centralizing pain and improving mechanical function. It incorporates a strong educational component that empowers patients with self-management strategies that may help prevent recurrence. The MDT classifies patients based on symptom response patterns, which guides the selection of individualized exercises and postural corrections.

Despite the widespread clinical application of both approaches, there is a paucity of high-quality, head-to-head comparative studies evaluating their relative effectiveness in managing CNP. This study aimed to address this gap by conducting a clinical trial comparing the effects of Mulligan SNAGs and McKenzie Method, both of which are administered as adjuncts to standard physiotherapy. The key outcome measures included pain intensity (NPRS), functional disability (NPAD-G), cervical range of motion (ROM), psychological well-being (WHO-5), and patient satisfaction (GRoC).

METHODS

Study Design

This study was a prospective clinical trial involving two parallel groups that aimed to compare the efficacy of Mulligan Sustained Natural Apophyseal Glides (SNAGs) and McKenzie Method in individuals with chronic neck pain (CNP). The trial followed the CONSORT guidelines to ensure methodological rigor and transparency. Participants were randomly allocated to either the Mulligan SNAGs group or the McKenzie Method group using the lottery method. Patient blinding was employed, in which participants were not informed of the intervention group to which they were assigned. Assessor blinding was performed during the data collection.

Study Setting and Duration

The study was conducted over a one-year period across various physiotherapy centers and orthopedic outpatient departments, including Lockhat Hospital and private clinics in Surat, India. Ethical approval was obtained from the Institutional Ethics Committee of The Sarvajanik College of Physiotherapy, Surat.

Participants

A total of 56 adult participants (aged 25–55 years) diagnosed with chronic neck pain lasting >12 weeks were enrolled. The inclusion criteria were adults of either sex with an NPRS score between 3 and 6 and with or without radiating pain to the upper extremities. Participants were excluded if they had a history of recent neck trauma, cervical surgery within the past six months, serious neurological conditions (e.g., myelopathy or tumor), or coexisting musculoskeletal disorders, such as rheumatoid arthritis or ankylosing spondylitis. Written informed consent was obtained from all participants prior to enrollment.

Sample Size Calculation

The sample size was determined using G-Power 3.1.9.2 software. With a significance level (α) of 0.05, statistical power of 0.80, and effect size of 0.8, the required sample size was 52 (26 per group). Four additional participants were included to account for possible attrition, resulting in 56 participants.

Randomization and Blinding

Participants were randomly assigned to one of two intervention groups using the lottery method. The outcome assessors were blinded to the group allocation to minimize assessment bias.

Interventions

Group A – Mulligan SNAGs + Standard Physiotherapy: Participants in this group received SNAGs targeting cervical flexion, extension, rotation, and side bending. The technique was applied with the therapist standing behind the seated patient using thumb-over-thumb contact to apply sustained anterior and upward glides during active neck movement. Overpressure was provided in the end range with patient assistance. These mobilizations were performed daily, five times per week, for four weeks. In addition, all participants received standard physiotherapy, including hot pack application, scapular and neck strengthening exercises, stretching, and ergonomic advice.

Group B – McKenzie Method + Standard Physiotherapy: Participants in this group followed the McKenzie Method, consisting of repeated cervical retractions, extensions, flexions, lateral flexions, and rotations performed in a seated position. Each movement was held for 10 seconds and repeated 10 times per session. The focus was on identifying directional preferences and centralizing symptoms. Sessions were conducted five times per week for four weeks, along with the same standard physiotherapy regimen as in Group A.

Outcome Measures

Primary and secondary outcome measures were assessed at baseline, post-2 weeks, and post-4 weeks.

- **Primary Outcomes:**
  - **Pain intensity:** measured using the Numerical Pain Rating Scale (NPRS), which is an 11-point scale ranging from 0 (no pain) to 10 (worst pain).
  - **Functional disability:** measured using the Neck Pain and Disability Scale–Gujarati version (NPAD-G).
- **Secondary Outcomes:**
  - **Range of Motion (ROM):** assessed using a universal goniometer for flexion, extension, rotation, and lateral flexion.
  - **Quality of life:** Evaluated using the WHO-5 Well-Being Index-Gujarati version.

- **Patient satisfaction:** Measured using the Global Rating of Change (GRoC) scale.

Statistical Analysis

The data were screened for transcription errors, normality, and homogeneity of variance. Statistical analyses were conducted using IBM SPSS Statistics version 20.0, with the significance set at $p<0.05$ (two-tailed). Descriptive statistics included means and standard deviations. The Shapiro-Wilk test was used to test data normality. Depending on the distribution, either parametric (repeated-measures ANOVA) or non-parametric tests (Friedman and Kruskal-Wallis) were used.

RESULTS

Participant Characteristics

A total of 56 participants were enrolled and randomly allocated into two groups: the **Mulligan SNAGs group** (n=28) and the **McKenzie Method group** (n=28). Demographic characteristics, such as age, height, weight, duration of symptoms, and sex distribution, were comparable between the two groups, indicating successful randomization.

Table 1: Demographic Characteristics of Participants

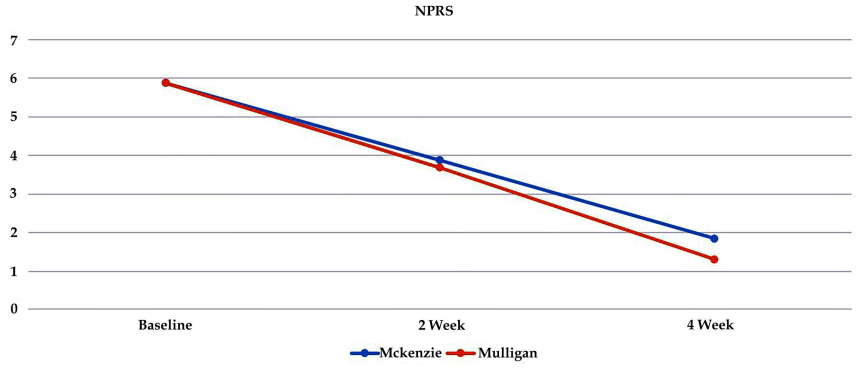
Demographic Variable	Mckenzie roup (Mean ± SD)	Mulligan Group (Mean ± SD)	P-Value
Age (Years)	39.50 ± 10.77	38.27 ± 10.92	0.795
Height (Cm)	166.91 ± 9.66	166.01 ± 7.71	0.162
Weight (Kg)	67.69 ± 16.32	65.35 ± 10.53	0.636
Duration of Pain (Weeks)	18.62 ± 19.87	12.00 ± 11.59	**0.013**
NPADG Baseline	49.23 ± 14.46	53.23 ± 11.96	0.565
WHO-5 Baseline	37.69 ± 20.68	34.15 ± 18.63	0.920
Groc Baseline	-2.19 ± 1.79	-1.96 ± 1.66	0.740
NPRS Baseline	5.88 ± 0.33	5.88 ± 0.33	0.838

Pain Intensity (NPRS)

Both groups demonstrated a statistically significant reduction in pain intensity over time. However, the between-group differences were not statistically significant at any follow-up point.

Table 2: NPRS Scores Over Time

Timepoint	Mckenzie Group (Mean ± SD)	Mulligan Group (Mean ± SD)	P-Value
Baseline	5.88±0.33	5.88± 0.33	1.00
Post 2 Weeks	3.88±0.91	3.69±0.93	0.46
Post 4 Weeks	1.85±1.05	1.31±0.79	0.047*



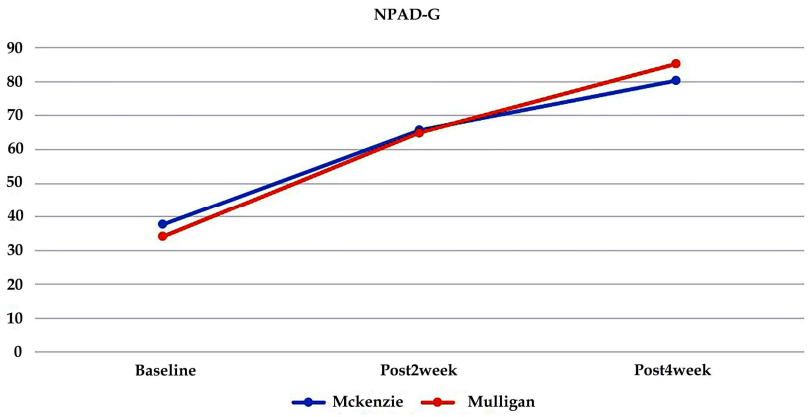
Graph 1: NPRS scores over time

Functional Disability (NPAD-G)

Significant improvements were observed in both groups from baseline to post-intervention. No significant between-group differences were observed.

Table 3: NPAD-G Scores Over Time

Timepoint	Mckenzie Group (Mean ± SD)	Mulligan Group (Mean ± SD)	P-Value
Baseline	49.23 ± 14.46	53.23 ± 11.96	0.902
Post 2 Weeks	24.88 ± 8.52	24.65 ± 9.71	0.930
Post 4 Weeks	14.15 ± 6.75	11.27 ± 5.59	0.100



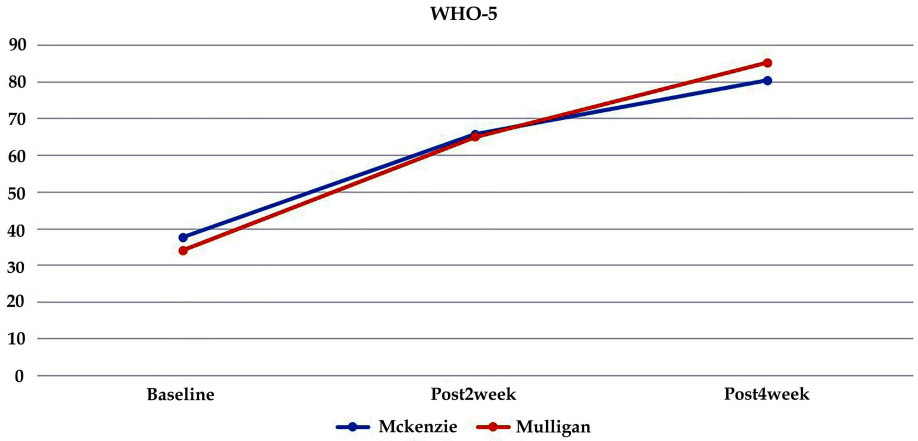
Graph 2: NPAD-G scores over time

Psychological Well-being (WHO-5 Well-being Index)

Both groups experienced improvements in WHO-5 scores, with the Mulligan group showing slightly higher gains, although the differences were not statistically significant.

Table 4: WHO-5 Well-being Index Scores

Timepoint	Mckenzie Group (Mean ± SD)	Mulligan Group (Mean ± SD)	P-Value
Baseline	37.69 ± 20.68	34.15 ± 18.63	0.959
Post 2 Weeks	65.77 ± 13.46	65.00 ± 13.65	0.840
Post 4 Weeks	80.38 ± 13.02	85.23 ± 8.82	0.120



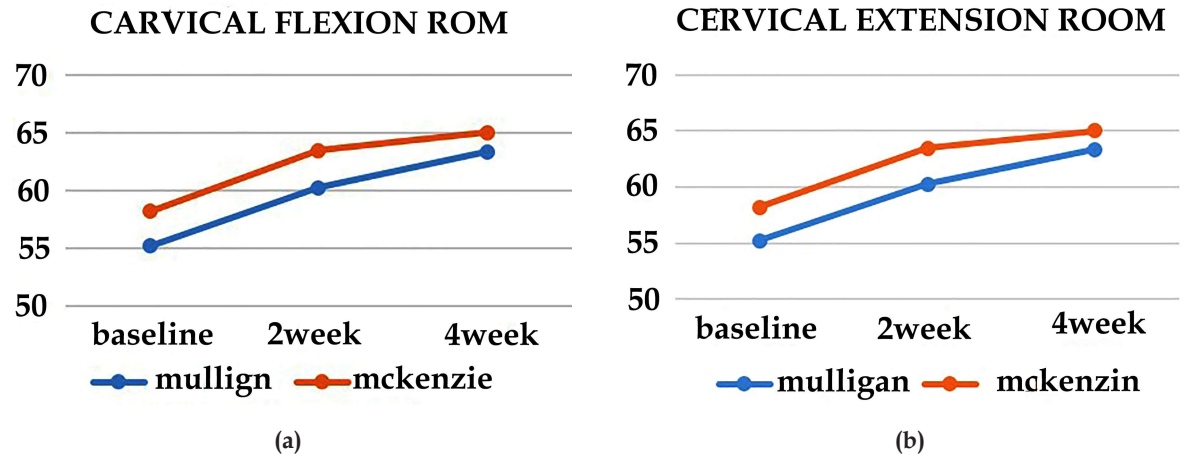
Graph 3: WHO-5 Well-being Index scores over time

Cervical Range of Motion (ROM)

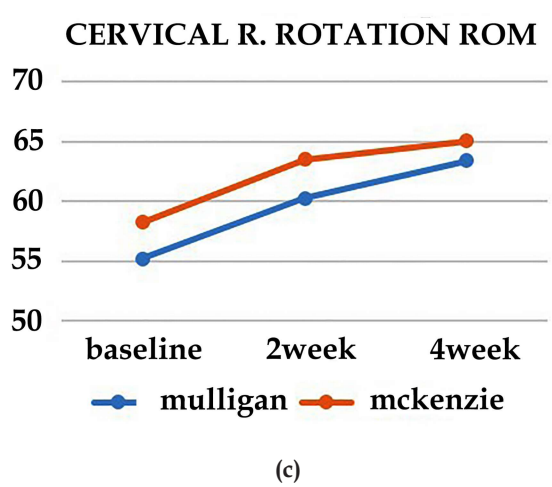
Improvements in cervical ROM were observed in both groups, especially in flexion and rotation, although the between-group differences were not statistically significant. Owing to the normal distribution of ROM data, repeated-measures analysis of variance (ANOVA) was used.

Table 5: Between and Within Group Comparison for Cervical ROM

Measurements		Mckenzie Group (N=28)	Mulligan Group (N=28)	Between Group F and P Values
		Mean±SD	Mean±SD	
Baseline	Flexion	38.62±8.4	36.96±6.85	F=0.71
	Extension	56.30±10.06	56.65±9.78	P=0.791
	R.Side Flexion	36.50±8.58	36.77±6.60	
	L.Side Flexion	37.19±9.99	37.23±5.81	
	R.Rotation	55.15±8.13	51.31±9.44	
	L.Rotation	58.23±9.84	55.23±13.31	
Post 2 Weeks	Flexion	42.23±6.81	41.35±4.64	
	Extension	61.54±7.67	63.00±6.58	
	R.Side Flexion	40.31±7.82	42.08±5.21	
	L.Side Flexion	41.54±8.51	43.46±4.62	
	R.Rotation	60.54±7.80	57.27±8.49	
	L.Rotation	63.50±8.82	60.27±11.37	
Post 4 Weeks	Flexion	43.96±5.79	43.38±3.48	
	Extension	63.08±5.98	65.81±4.45	
	R.Side Flexion	42.88±8.71	45.38±4.77	
	L.Side Flexion	43.50±8.28	46.23±4.23	
	R.Rotation	62.92±7.70	60.85±6.95	
	L.Rotation	65.04±7.53	63.38±8.31	
Within Group F And P Values		F=137.87 P = 0.001		
ROM*Group		F=2.170 P=0.137.		



(a) (b)



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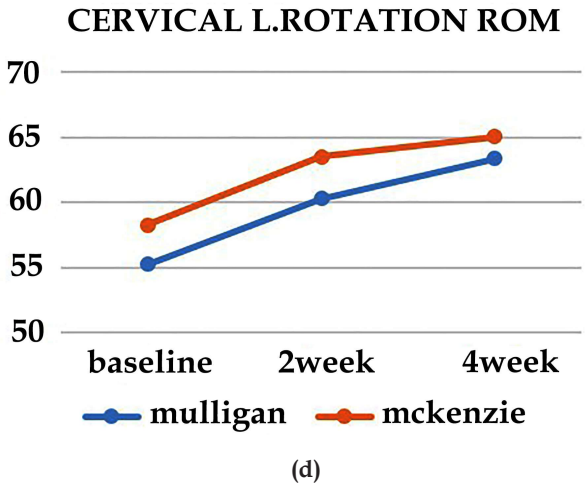

(d)

Graph 4 (a-d): Cervical ROM scores over time.

Patient Satisfaction (GRoC)

The GRoC scores at the end of four weeks showed high satisfaction in both groups, with the Mulligan group achieving a marginally higher mean score. However, this difference was not statistically significant.

Table 6: GRoC Scores at 4 Weeks

Group	Mean ± SD	Median (IQR)	P-Value
Mckenzie	4.73 ± 1.00	4.5 (4–6)	0.422
Mulligan	4.92 ± 0.69	5 (4–5)	

Significant within-group improvements were observed in all outcome measures (NPRS, NPAD-G, WHO-5, cervical ROM and GRoC) in both Mulligan and McKenzie groups. No statistically significant differences were found between the two groups at any time point. This indicates that both interventions are effective and comparable adjuncts to standard physiotherapy for the management of chronic neck pain.

DISCUSSION

This study was designed to compare the effectiveness of two widely used manual therapy approaches, Mulligan Sustained Natural Apophyseal Glide (SNAGs) and McKenzie Method of Mechanical Diagnosis and Therapy (MDT), as adjuncts to standard physiotherapy for the treatment of patients with chronic neck pain (CNP). The primary outcome measures included pain intensity (NPRS) and functional disability (NPAD-G), whereas the secondary outcomes included cervical range of motion (ROM), psychological well-being (WHO-5), and patient satisfaction (GRoC). After four weeks of intervention, both treatment groups showed statistically significant improvements in all clinical parameters. However, no significant differences were observed between the groups, indicating that both the Mulligan SNAGs and McKenzie techniques are comparably effective when used in conjunction with standard physiotherapy. These findings align with those of previous systematic reviews that have demonstrated the efficacy of both manual therapy and exercise-based interventions for CNP.[1,2]

INTERPRETATION OF FINDINGS

Pain Intensity

The observed reductions in pain intensity (NPRS) in both groups were in agreement with the existing literature. The Mulligan SNAGs group reported a decrease from a baseline mean of 5.88 to 3.69 at four weeks, while the McKenzie group showed a reduction from 5.88 to 3.88. This substantial reduction exceeds the minimal clinically important difference (MCID) of 2.0 points established for the NPRS in patients with mechanical neck pain.[3] Our findings are consistent with those of Buyukturan *et al.*[4] and Elkeblawy *et al.*[5], who found that SNAGs were effective in reducing neck pain through biomechanical correction of joint misalignment and pain inhibition via neuromodulation. The neurophysiological mechanisms underlying these improvements

may include both peripheral and central effects, as proposed by Vicenzino *et al.*[6], who demonstrated immediate hypoalgesic effects of cervical mobilization techniques.

Similarly, studies by Jung *et al.*[7] and Arshad *et al.*[8] support the efficacy of McKenzie exercises in promoting symptom centralization, reducing pain through repeated end-range movements, and improving postural alignment. The centralization phenomenon, a hallmark of the McKenzie method, has been associated with better outcomes for spinal pain, as demonstrated by May and Aina[9] in their systematic review. Our results confirm these findings, with the McKenzie approach showing robust pain-relieving effects comparable to those achieved with manual therapy.

Functional Disability

Functional disability, as measured using the NPAD-G scale, also improved markedly in both groups. The Mulligan group improved from 53.23 to 11.27, while the McKenzie group improved from 49.23 to 14.15. These improvements exceed the MCID of 11.5 points established for neck disability measures.[10] These results support the notion that addressing both the mechanical and neuromuscular components of neck dysfunction plays a critical role in restoring function. This aligns with the findings of Alansari *et al.*[11], who demonstrated improved functional capacity following mobilization techniques, and Diab *et al.*[12], who found benefits comparable to those of McKenzie-based self-management programs.

Interestingly, our functional improvements mirror those reported by Kim *et al.*[13,] who demonstrated that both passive mobilization and active exercise yielded significant improvements in disability scores through different physiological pathways. Although Mulligan techniques may primarily influence joint mechanics and afferent neural input, McKenzie exercises are likely to enhance muscular endurance and neuromuscular control, ultimately contributing to improved functional capacity.

Cervical Range of Motion

Improvements in cervical range of motion (ROM) were also noteworthy and clinically significant, although statistically non-differential between the groups. Mulligan SNAGs have been shown to improve ROM in several trials by enhancing joint kinematics and reducing stiffness through sustained accessory glides.[14,15] Similarly, McKenzie techniques may improve ROM by reducing discogenic or postural derangements that limit cervical motion.[16] Studies by Manzoor *et al.*[17] and Seo *et al.*[18] reported similar outcomes, indicating the mechanical and neuromuscular values of both interventions.

Our ROM findings align with those of a meta-analysis by Coulter *et al.*[19], which demonstrated that both manual therapy and exercise interventions yielded comparable improvements in cervical mobility. The equivalent outcomes between the groups may reflect the shared biomechanical principles underlying both approaches: restoration of normal arthrokinematics and reduction of protective muscle guarding.

Psychological Well-being

Psychological well-being, assessed using the WHO-5 Well-Being Index, showed significant improvement in both groups. The Mulligan group's score rose to 85.23 from a baseline score of 34.15, while the McKenzie group improved to 80.38 37.69. These improvements substantially exceeded the minimal clinically important difference of 10% for WHO-5.[20] This psychological uplift may be attributed not only to pain reduction, but also to improved self-efficacy, body image, and daily functioning. The biopsychosocial model of chronic pain supports the idea that functional and psychological domains are interrelated and that addressing pain mechanically can foster emotional relief.[21]

Our findings regarding psychological parameters are consistent with those of Thompson *et al.*[22], who demonstrated that successful management of physical symptoms leads to cascading benefits in psychosocial domains. Furthermore, O'Sullivan *et al.*[23] have highlighted those interventions which empower patients through enhanced self-management capabilities (like McKenzie) or provide immediate relief (like Mulligan SNAGs) may have added benefits for psychological well-being beyond their biomechanical effects.

Patient satisfaction, as measured using the GRoC scale, was high in both groups. Although the Mulligan group reported a slightly higher mean score (4.92 vs. 4.73), the

difference was not statistically significant. This finding underscores the importance of individualized therapy based on patient preferences, therapist expertise, and clinical presentation. When patients perceive therapy as beneficial, regardless of modality, they are more likely to adhere to treatment and report positive outcomes.

Comparison With Previous Research

Our findings are consistent with those of previous comparative studies and provide new insights into the relative efficacy of these approaches. Naz *et al.*[24] found Mulligan SNAGs more effective than McKenzie exercises in improving pain and function in the short term, whereas our results showed no significant between-group differences. This discrepancy might be explained by the use of both techniques as adjuncts to standard physiotherapy rather than standalone interventions.

Alarab *et al.*[25] found that both techniques were equally beneficial for chronic mechanical neck pain, which aligns with our findings. However, our study extends their work by including psychological outcomes and a comprehensive ROM assessment. Kotagiri *et al.*[26] highlighted the superiority of McKenzie combined with neural mobilization over Mulligan for cervical spondylosis, suggesting the potential advantages of hybrid or condition-specific protocols. Our comparable outcomes across multiple measures reinforce the versatility and clinical relevance of both approaches for managing chronic mechanical neck pain.

In contrast to the work of Garcia *et al.*[27], who found that manual therapy was superior to exercise for immediate pain relief in CNP, our study demonstrated equivalent pain reduction in both groups. This discrepancy might be attributed to our longer intervention period (four weeks vs. single session) and the use of specific rather than general exercise protocols. Our findings are consistent with those of Celenay *et al.*[28], who reported that a combined approach of manual therapy and exercise yielded optimal outcomes in patients with CNP.

Strengths of the Study

The use of standardized outcome measures NPRS, NPAD-G, WHO-5, and cervical ROM ensures consistency, reliability, and relevance in both clinical practice and research. Moreover, both patient and assessor blinding helped reduce observational and performance biases, thus addressing the methodological concerns raised in previous studies.[29] Another noteworthy strength is the inclusion of both subjective (pain, disability, and psychological well-being) and objective (ROM) outcomes, which provides a holistic picture of treatment efficacy, as recommended by the IMMPACT guidelines for chronic pain research.[30]

LIMITATIONS

Despite these strengths, this study had several limitations. First, the study duration was limited to four weeks, which may not capture long-term effects or recurrence rates. Chronic neck pain often requires long-term management strategies, and follow-up assessments at three or six months can provide deeper insights into the sustainability of benefits, as demonstrated by Ylinen *et al.*[31] in their longitudinal study of neck pain interventions. Second, a multicenter trial with a larger cohort would enhance the generalizability of the results, as regional variations in practice patterns and patient demographics might influence the outcomes.[32]

Additionally, we did not stratify the patients based on specific mechanical diagnoses or pain mechanisms, which might have obscured the differential effectiveness for subgroups, as suggested by Fritz *et al.*[33] in their study of classification-based approaches. The absence of a control group receiving only standard physiotherapy also limits our ability to determine the true added value of either the Mulligan or McKenzie technique, although previous research has established its superiority over minimal intervention.[1]

Third, the interventions were performed in clinical settings under professional supervision, and the efficacy of these techniques in home-based self-managed environments (especially McKenzie) remains unverified.

Clinical Implications

The comparable efficacy of Mulligan SNAGs and McKenzie exercises highlights

the importance of clinical flexibility. Physiotherapists can select either approach depending on patient presentation, therapist expertise, or logistical considerations, such as frequency of visits or patient adherence. McKenzie exercises may be more suitable for patients who prefer a self-directed approach, whereas Mulligan techniques may benefit those who respond better to manual therapy or have difficulty in self-managing movements. When integrated with standard physiotherapy, both interventions offer significant improvements in pain, function, and overall quality of life.

These findings support a shift away from dogmatic adherence to specific manual therapy "schools" toward an evidence-based, patient-centered approach that considers individual preferences and presentation, as advocated by Sackett *et al.*[34] in their seminal work on evidence-based practice. Furthermore, the substantial psychological benefits observed suggest that clinicians should consider and monitor mental well-being as an important outcome of physical therapy interventions for chronic pain.[35]

FUTURE RESEARCH

Further research is needed to assess the long-term outcomes and relapse rates of these interventions, ideally through longitudinal studies spanning 6-12 months as recommended by Kamper *et al.*[36] Future studies should explore the combined effects of the Mulligan and McKenzie techniques, potentially leveraging the strengths of both approaches in an integrated protocol. Additionally, subgroup analyses based on pain chronicity, occupational background, and psychosocial factors could help tailor individualized intervention plans following the precision medicine approach proposed by Foster *et al.*[35] for musculoskeletal conditions.

Investigation into the specific neurophysiological mechanisms underlying both interventions using quantitative sensory testing, functional imaging, or biomarker analysis could provide insights into their complementary or distinct effects on pain processing pathways.[37] Finally, cost-effectiveness analyses comparing these approaches would provide valuable information for healthcare policy and resource allocation decisions.[38]

CONCLUSION

Both the Mulligan SNAGs and McKenzie methods, when used alongside standard physiotherapy, significantly reduced pain, enhanced functional ability, improved cervical mobility, and promoted psychological well-being in patients with chronic neck pain. Although their mechanisms of action and delivery differ, their clinical outcomes are promising. The choice between these two methods should be guided by patient needs, clinical judgment, and resource availability. These findings contribute to a growing body of evidence supporting multimodal approaches to chronic neck pain management that incorporate both passive and active therapeutic elements.

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