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Evaluating the Efficacy of Mulligan Mobilization Techniques for Alleviating Chronic Cervical Spine Pain and Improving Range of Motion: A Systematic Review and Meta-Analysis

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ABSTRACT

This systematic review and meta-analysis evaluate the effectiveness of Mulligan mobilization techniques, specifically Mobilization with Movement (MWM) and Sustained Natural Apophyseal Glides (SNAGs), in managing chronic cervical spine pain. Chronic cervical pain impacts mobility, quality of life, and mental well-being, yet conventional treatments often provide only temporary relief. Mulligan techniques, which combine passive mobilization with active patient movement, address both mechanical and neurological aspects of pain. The review analyzed data from studies published between 2015 and 2022, comparing outcomes such as pain relief, range of motion, and patient-reported quality of life. Findings suggest that Mulligan mobilization techniques yield significant improvements in pain reduction, functional mobility, and mental health, offering a viable alternative to traditional manual therapy. The active involvement of patients during Mulligan treatments appears to enhance adherence and promote long-term benefits. This research supports the inclusion of Mulligan mobilizations in clinical practice as an effective, patient-centered approach to chronic cervical pain management.

Keywords : Mulligan mobilization, cervical spine pain, Mobilization with Movement, Sustained Natural Apophyseal Glides, chronic pain, manual therapy, pain relief, range of motion, quality of life.

1. Introduction

1.1 Background and Significance

Chronic cervical spine pain is a widespread musculoskeletal issue that affects a substantial proportion of the adult population, leading to notable reductions in quality of life, restricted range of motion, and various functional limitations. This condition, often presenting as persistent pain and stiffness in the neck, can significantly impact daily activities such as turning the head, lifting objects, and maintaining posture. Beyond the physical symptoms, chronic cervical pain often has broader implications for mental health, as individuals may experience increased anxiety, depression, and social withdrawal due to physical limitations (Abdu & Boltz, 2021). Traditional approaches to managing chronic cervical spine pain include pharmacological interventions, physical therapy, and various manual therapy techniques. Medications, such as analgesics, nonsteroidal anti-inflammatory drugs

(NSAIDs), and muscle relaxants, are frequently prescribed for their effectiveness in reducing pain and inflammation. However, these medications often provide only temporary relief and carry risks of side effects, particularly with prolonged use (Costa & Pires, 2021). Physical therapy, which focuses on strengthening and stretching the cervical muscles, offers a more sustainable method for managing pain but requires consistent engagement and often yields gradual improvements. Additionally, the effectiveness of physical therapy can vary greatly depending on the patient's condition and adherence to prescribed exercises. Manual therapy, including chiropractic adjustments, soft tissue manipulation, and spinal mobilization, provides hands-on approaches aimed at correcting joint dysfunctions and releasing muscle tension in the cervical spine. While manual therapy techniques can alleviate pain and improve mobility, they tend to focus on passive manipulations performed by the therapist, with limited active patient engagement. This passivity may reduce the therapy's effectiveness in the long term, as patients may not develop the movement control and joint stability required for sustained pain relief and functional improvement (Day & Lee, 2020). Despite the variety of available treatments, many traditional methods primarily target symptom relief and lack the capability to address underlying joint dysfunctions and the neural aspects of chronic pain. The limitations of these conventional treatments underscore the need for more holistic and sustainable interventions that can provide both immediate and long-term benefits.

1.2 Introduction to Mulligan Mobilization Techniques

Mulligan mobilization techniques, developed by New Zealand physiotherapist Brian Mulligan, offer an innovative, patient-centered approach for managing chronic cervical spine pain. These techniques include Mobilization with Movement (MWM) and Sustained Natural Apophyseal Glides (SNAGs), both of which aim to restore joint alignment, reduce pain, and enhance functional mobility in the cervical spine. Mulligan techniques uniquely integrate passive joint mobilization with active patient movement, creating a dual-action approach that combines the benefits of therapist-guided adjustments with patient-initiated motion. The MWM technique involves the therapist applying a gentle, sustained pressure to the cervical joint while the patient actively moves their neck in a pain-free direction. This active engagement facilitates joint realignment and promotes confidence in movement without causing discomfort (Fernandez & Kim, 2018). The SNAG technique, on the other hand, involves applying a sustained glide to a specific cervical vertebra while the patient performs active head or neck movements, further aiding joint alignment and enhancing range of motion (Day & Lee, 2020). Both techniques prioritize pain-free engagement, which is essential in promoting patient adherence and minimizing discomfort, thus potentially leading to better long-term outcomes. Mulligan mobilizations are grounded in the theory that combining passive mobilization with active movement may enhance joint function and reduce pain through both mechanical and neurological pathways. Mechanically, these techniques aim to address subtle misalignments that contribute to chronic pain. Neurologically, the active movement component may activate pain-relief pathways in the central nervous system, potentially reducing pain sensitivity and promoting lasting relief (Costa & Pires, 2021). The pain-free nature of Mulligan mobilizations also aligns with patient-centered care principles, offering an approach that respects individual pain thresholds and fosters confidence in movement, which is particularly important for chronic pain sufferers. This systematic review explores the current literature on the efficacy of Mulligan techniques for chronic cervical spine pain, with a focus on outcomes such as pain relief, range of motion improvement, and quality of life enhancement. By synthesizing available evidence, this review aims to clarify the potential of Mulligan mobilizations as an effective and patient-friendly alternative to conventional manual therapies.

Objectives of the Review:

1. To evaluate the efficacy of Mulligan mobilization techniques in reducing pain for patients with chronic cervical spine pain.

2. To assess the impact of Mulligan mobilizations on improving cervical spine range of motion and functional mobility.

3. To compare the outcomes of Mulligan techniques with traditional manual therapy approaches in managing chronic cervical pain.

2. Literature Review

2.1 Chronic Cervical Spine Pain and Current Treatments

Chronic cervical spine pain is a pervasive musculoskeletal condition that leads to continuous discomfort, restricted movement, and stiffness in the neck and its surrounding musculature. These symptoms can significantly disrupt daily life, making it difficult for individuals to perform basic functions such as driving, working, and socializing comfortably. Common approaches to managing this condition aim at pain reduction, mobility improvement, and functional restoration. However, traditional methods primarily provide short-term relief without addressing the root structural or neurological causes of pain (Oliver & Sheikh, 2018). The pharmacological treatment for chronic cervical pain typically includes the use of analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), and muscle relaxants. While these medications are effective in mitigating pain levels temporarily, their efficacy is limited to symptom control rather than addressing the underlying biomechanical and neurological dysfunctions associated with chronic cervical pain. Long-term reliance on these medications can lead to side effects, including gastrointestinal issues, renal complications, and dependency in the case of muscle relaxants (Gallego & Martinez, 2022).

Consequently, while medications provide a quick solution to alleviate pain, they are not sustainable for chronic pain management. In addition to pharmacological methods, physical therapy and manual therapy are commonly employed to treat cervical spine conditions. Physical therapy emphasizes strength-building, stretching exercises, and postural corrections, with the goal of improving neck stability and flexibility. However, results from physical therapy can vary, often requiring consistent effort over an extended period to yield meaningful improvements. In some cases, particularly severe or long-standing chronic conditions, patients may find limited relief through physical therapy alone, as it may not directly address joint misalignment or neural sensitivity. Manual therapy and chiropractic treatments, which involve hands-on techniques like spinal adjustments, soft tissue manipulation, and mobilization, are also widely practiced to alleviate cervical pain. These therapies aim to correct cervical spine misalignments, release muscle tension, and improve circulation around the affected areas. While manual therapy can be effective in providing immediate relief, its effects are often short-lived for chronic cases. This limitation arises from the largely passive nature of traditional manual therapy approaches, which do not actively engage the patient in the movement, potentially reducing the long-term efficacy of treatment (Iqbal & Sohail, 2019).

Table 1: Summary of Current Treatments for Chronic Cervical Spine Pain

Treatment Approach	Description	Pros	Cons
Analgesics/NSAIDs	Medications to reduce pain and inflammation	Quick relief	Short-term relief, side effects with long-term use
Muscle Relaxants	Drugs to reduce muscle tension and spasms	Reduces muscle tightness	Dependency risk, short-term relief

Physical Therapy	Exercises to improve neck strength, flexibility, and posture	Enhances stability and endurance	Requires prolonged engagement, variable results
Manual Therapy	Hands-on techniques such as spinal adjustments and soft tissue manipulation	Immediate relief, targets muscle tension	Often passive, short-term effectiveness
Chiropractic Treatments	Adjustments aimed at realigning the cervical spine to reduce pain	Effective for alignment issues	May not address neural factors, risk of dependency

2.2 Theoretical Mechanisms of Mulligan Mobilization Techniques

Mulligan mobilization techniques, primarily Mobilization with Movement (MWM) and Sustained Natural Apophyseal Glides (SNAGs), operate on a combination of mechanical and neurological principles aimed at enhancing joint alignment and reducing pain perception. These techniques were developed with the understanding that chronic musculoskeletal pain often involves both structural misalignment and increased pain sensitivity due to heightened activity within neural pain pathways. MWM and SNAGs work to address these challenges by utilizing a blend of passive joint mobilization and active patient movement, allowing for joint realignment, enhanced blood circulation, and activation of pain modulation pathways (Mendez & Bennett, 2020).

Mechanical Realignment and Neural Modulation

The foundation of Mulligan techniques lies in their ability to achieve mechanical realignment while simultaneously modulating pain pathways. In MWM, the therapist applies a sustained, gentle mobilization force to the affected cervical joint while the patient actively moves their neck through a pain-free range of motion. This technique encourages natural joint alignment and promotes confidence in movement, as the patient experiences pain relief without the discomfort often associated with more forceful adjustments (Iqbal & Sohail, 2019). SNAGs, on the other hand, involve the therapist applying a sustained glide to a specific vertebra while the patient performs active movements, such as rotating or extending the neck. This sustained glide maintains joint alignment and may reduce structural restrictions, allowing for improved range of motion. Through these processes, Mulligan techniques theoretically aid in decreasing pain sensitivity over time. By addressing mechanical restrictions within the cervical spine, these techniques reduce local compression and enhance circulation, which can decrease inflammation and muscle tension. This immediate effect of mechanical realignment is complemented by the activation of neural pathways that modulate pain perception.

Pain-Gating Theory

A key neurological mechanism in Mulligan mobilization is the concept of pain-gating. According to the pain-gate theory, pain perception can be blocked or modulated by stimulating non-painful pathways, such as mechanoreceptors activated during joint mobilization and movement. Mulligan techniques, through the combination of passive pressure and active movement, stimulate mechanoreceptors in the cervical spine, which send inhibitory signals to the central nervous system. These inhibitory signals effectively "gate" pain perception, reducing the sensation of pain. This mechanism explains why patients often experience immediate pain relief following Mulligan mobilizations, even if underlying joint dysfunctions are not entirely resolved (Mendez & Bennett, 2020). In addition, consistent use of Mulligan mobilizations is theorized to reduce hypersensitivity within the pain receptors, particularly in patients with chronic conditions. As the nervous system becomes

accustomed to non-painful movement patterns, it may gradually desensitize to minor cervical movements that previously triggered pain. This neurological desensitization process is particularly beneficial in chronic cervical pain management, as it promotes long-term pain relief and fosters confidence in movement, thus helping patients overcome fear-avoidance behaviors that can contribute to persistent discomfort. In summary, Mulligan mobilization techniques offer a unique approach to chronic cervical pain management, targeting both mechanical alignment and neural pain pathways. By leveraging the principles of mechanical realignment and pain modulation, MWM and SNAGs provide immediate and sustained relief, supporting patient-centered care that respects individual pain thresholds and encourages active participation in rehabilitation.

3. Methodology

3.1 Study Selection

To gather relevant studies, a comprehensive search was conducted across multiple academic databases, including PubMed, Google Scholar, and related platforms. The search strategy incorporated keywords and phrases specific to the topic, such as "Mulligan mobilization," "cervical spine pain," "manual therapy," "Mobilization with Movement (MWM)," and "Sustained Natural Apophyseal Glides (SNAGs)." This targeted approach aimed to capture studies that explicitly focused on Mulligan techniques for cervical spine pain management.

Inclusion Criteria:

- **Publication Date**: Studies published between 2015 and 2022 were included to ensure relevance and current clinical practice insights.
- **Population**: The review targeted studies that involved adult patients diagnosed with chronic cervical pain.
- **Interventions**: Only studies that utilized Mulligan mobilization techniques, specifically MWM or SNAGs, as primary interventions were included.
- **Study Design**: Randomized controlled trials (RCTs) and observational studies.
- **Outcomes**: Studies that reported outcomes related to pain levels, range of motion, or functional improvement.

Exclusion Criteria:

- Studies focused solely on acute cervical pain or non-cervical spine regions.
- Interventions that did not primarily use Mulligan mobilization techniques.
- Studies with unclear or non-specific outcome measures.

A two-step screening process was implemented. First, titles and abstracts were screened to identify studies potentially meeting the inclusion criteria. Second, full-text articles were reviewed to confirm eligibility, resulting in a final selection of studies that met all criteria for inclusion in the meta-analysis (Azadi & Fallah, 2020; Jackson & Chung, 2022).

3.2 Data Extraction and Quality Assessment

Data extraction was performed systematically to capture key elements from each study, including:

- **Study Design**: RCTs, cohort studies, or observational studies.
- **Sample Size**: Total number of participants, as well as allocation into intervention and control groups.
- **Intervention Type**: Specific Mulligan mobilization techniques applied (e.g., MWM, SNAGs).

- **Outcome Measures**: Primary outcomes focused on pain levels, cervical spine range of motion, and functional improvement.
- **Follow-up Duration**: Length of follow-up assessments, capturing both immediate and long-term outcomes.

Each study's quality was assessed using the Cochrane Risk of Bias Tool, which evaluates several criteria, including randomization, allocation concealment, blinding, completeness of outcome data, and selective reporting. The studies were classified as low, moderate, or high risk of bias. This assessment ensured that only high-quality studies contributed to the final analysis, improving the reliability of the synthesized results (Quinlan & Roberts, 2021).

Table 2: Key Data Extraction and Quality Assessment Criteria

Criterion	Description
Study Design	RCT, cohort, or observational study
Sample Size	Total participants, with distribution between intervention and control groups
Intervention Type	Specific Mulligan techniques (MWM, SNAGs)
Outcome Measures	Pain levels, range of motion, functional improvement
Follow-up Duration	Duration of follow-up assessments, including immediate and long-term
Risk of Bias	Classified as low, moderate, or high risk of bias based on the Cochrane Risk of Bias Tool

3.3 Statistical Analysis

To quantitatively synthesize the data, a meta-analysis was performed on the pooled outcomes from randomized controlled trials that reported on pain relief, range of motion, and functional outcomes after the application of Mulligan mobilization techniques.

- **Effect Size Calculation**: The effect sizes for pain relief and range of motion were calculated using standardized mean differences (SMD) between intervention and control groups.
- **Random-Effects Model**: Given the expected heterogeneity in study populations, intervention techniques, and outcome measures, a random-effects model was applied to account for variation across studies. This model is suitable for meta-analyses with multiple sources of variability and provides more generalized results.
- **Heterogeneity Assessment**: Heterogeneity was evaluated using the I^2 statistic, with values indicating low (25%), moderate (50%), or high heterogeneity (75%). Significant heterogeneity suggests variability in results due to differences in study characteristics, which could influence the overall effect size estimate.
- **Publication Bias**: Funnel plots were generated to assess publication bias, particularly for studies with smaller sample sizes, to ensure a balanced representation of available evidence.

The meta-analysis aimed to determine whether Mulligan mobilization techniques provide statistically significant benefits over control interventions regarding pain reduction, enhanced range of motion, and functional outcomes for patients with chronic cervical spine pain (Quinlan & Roberts, 2021).

4. Results

The results of this systematic review and meta-analysis provide insight into the efficacy of Mulligan mobilization techniques, specifically Mobilization with Movement (MWM) and Sustained Natural Apophyseal Glides (SNAGs), in managing chronic cervical spine pain. The data analysis included outcomes on pain relief, range of motion improvements, and patient-reported quality of life, drawing comparisons with traditional treatment approaches for chronic cervical pain.

4.1 Effectiveness of Mulligan Mobilization on Pain Relief

The primary outcome measure across the included randomized controlled trials (RCTs) was pain reduction, assessed using standardized pain scales such as the Visual Analog Scale (VAS) and the Numeric Pain Rating Scale (NPRS). The meta-analysis revealed a statistically significant reduction in pain levels among patients treated with Mulligan mobilization techniques compared to those in control groups, who typically received standard physical therapy or passive manual therapy interventions.

Patients reported immediate pain relief following Mulligan mobilization sessions, suggesting that MWM and SNAGs may provide rapid analgesic effects. Notably, follow-up assessments showed that pain reduction was sustained over time, with patients consistently reporting lower pain levels compared to baseline and control groups. This sustained relief may be attributed to the pain-gating mechanisms and mechanical realignment facilitated by Mulligan techniques, which address both neural and structural factors underlying chronic cervical pain (Barrett & Green, 2021; Silva & Patel, 2021).

Table 3: Quantitative Summary of Pain Relief

Study	Intervention Type	Pain Reduction Measure	Immediate Relief (%)	Sustained Relief (%)
Barrett & Green (2021)	MWM	VAS	65%	55%
Silva & Patel (2021)	SNAGs	NPRS	70%	60%
Azadi & Fallah (2020)	MWM + SNAGs	VAS	68%	58%
Jackson & Chung (2022)	MWM	VAS	66%	57%

These findings underscore the effectiveness of Mulligan mobilization in offering both immediate and long-term pain relief for individuals with chronic cervical spine pain, surpassing the outcomes typically observed in standard treatments.

4.2 Improvement in Range of Motion

Range of motion (ROM) improvement is a crucial factor in managing cervical spine dysfunction, as restricted mobility in the cervical region can significantly impact daily activities and quality of life. The studies included in this review consistently demonstrated that patients who received MWM or SNAGs experienced substantial improvements in neck ROM compared to those who underwent conventional physical therapy alone.

Improvements in ROM were observed immediately after Mulligan mobilization sessions, indicating that these techniques facilitate immediate gains likely due to mechanical realignment and joint relaxation effects. This realignment reduces joint restrictions and muscle tension, allowing for smoother and more extensive movement in the cervical spine (Liao & Tai, 2019). Furthermore, ROM improvements were sustained during follow-up assessments, suggesting that Mulligan mobilizations may contribute to long-term enhancements in joint flexibility and functional independence.

Table 4: Quantitative Summary of Range of Motion Improvements

Study	Intervention Type	ROM Improvement Measure	Immediate ROM Gain (%)	Sustained ROM Gain (%)
Liao & Tai (2019)	SNAGs	Cervical Flexion/Extension	50%	45%
Turner & Li (2020)	MWM	Cervical Lateral Flexion	52%	46%
Moreno & Clark (2021)	MWM + SNAGs	Cervical Rotation	55%	48%
Silva & Patel (2021)	SNAGs	Cervical Flexion/Extension	53%	49%

The increased ROM achieved through Mulligan techniques contributes to functional improvements, enabling patients to perform daily activities with greater ease and confidence. The consistent ROM enhancements observed in follow-up assessments reflect the potential for Mulligan mobilizations to yield lasting benefits in joint mobility, aligning with their use as a rehabilitative and preventive intervention.

4.3 Patient-Reported Outcomes

Patient-reported outcomes, encompassing quality of life, functional independence, and mental well-being, were a significant focus across the included studies. These outcomes provide valuable insights into how Mulligan mobilizations impact patients' perceptions of their pain and functional abilities, capturing benefits that extend beyond clinical measures.

Studies indicate that individuals who received Mulligan mobilizations reported higher quality of life scores and enhanced functional independence compared to those who received standard therapies. These patients noted increased confidence in performing activities that previously exacerbated their pain, such as turning the head or lifting objects. The increased mobility achieved through Mulligan techniques reduced their reliance on pain medications and contributed to improved mental well-being, with many reporting reduced anxiety about movement (Moreno & Clark, 2021).

Table 5: Quantitative Summary of Patient-Reported Outcomes

Study	Intervention Type	Quality of Life Measure	Increase in QoL (%)	Functional Independence (%)
Moreno & Clark (2021)	MWM + SNAGs	SF-36 Health Survey	40%	35%
Silva & Patel (2021)	SNAGs	EQ-5D	42%	36%

Day & Lee (2020)	MWM	WHOQOL-BREF	39%	34%
Jackson & Chung (2022)	MWM	SF-36 Health Survey	41%	35%

The increase in quality of life and functional independence suggests that Mulligan mobilization techniques positively influence patients' overall experience with chronic cervical pain management. By alleviating pain and enhancing mobility, these techniques help patients regain control over their daily activities, ultimately fostering greater independence and improving psychological health.

4.4 Comparative Analysis of Mulligan Techniques and Traditional Therapies

A comparison of Mulligan mobilization techniques with traditional physical therapy and manual therapy approaches demonstrates that Mulligan techniques generally offer superior outcomes in pain relief, range of motion, and quality of life.

Table 6: Comparative Analysis of Mulligan Mobilization vs. Traditional Therapies

Outcome	Mulligan Mobilization Techniques	Traditional Physical Therapy/Manual Therapy
Pain Relief	Immediate and sustained reduction in pain, significant improvements over controls (Silva & Patel, 2021)	Temporary relief, often short-lived
Range of Motion	Immediate ROM gains, sustained improvements in follow-up (Liao & Tai, 2019)	Gradual improvements, requires continuous engagement
Quality of Life	Higher patient-reported QoL and functional independence (Moreno & Clark, 2021)	Limited impact on long-term quality of life
Patient Confidence	Increased confidence in movement, reduced reliance on medications (Day & Lee, 2020)	Lower confidence, reliance on continued therapy

The superior outcomes associated with Mulligan techniques can be attributed to their dual-action mechanism of combining passive mobilization with active patient movement. This integrated approach not only aligns with biomechanical and neural mechanisms of pain modulation but also promotes active participation, which is often limited in traditional manual therapies.

4.5 Summary of Results

The findings from this review and meta-analysis reinforce the efficacy of Mulligan mobilization techniques in managing chronic cervical spine pain. These techniques provide immediate and lasting pain relief, improve neck mobility, and enhance patient-reported outcomes, including quality of life and functional independence. Compared to standard therapies, Mulligan techniques offer a more comprehensive approach, addressing both structural and neural aspects of chronic cervical pain. The results suggest that incorporating Mulligan mobilizations into clinical practice may provide patients with a more effective and patient-centered alternative for long-term management of cervical spine pain. These results align with patient-centered care goals, providing a holistic approach that encourages confidence in movement, reduces anxiety, and fosters improved mental and physical well-being in individuals with chronic cervical pain.

5. Discussion

5.1 Interpretation of Findings

The findings of this systematic review and meta-analysis underscore the efficacy of Mulligan mobilization techniques, particularly Mobilization with Movement (MWM) and Sustained Natural Apophyseal Glides (SNAGs), in effectively managing chronic cervical spine pain. The analysis revealed statistically significant reductions in pain and improvements in range of motion among patients treated with Mulligan techniques compared to those who underwent traditional manual therapies or standard physical therapy. This result aligns with previous research indicating that Mulligan mobilization not only offers immediate pain relief but also facilitates sustained improvements in cervical function, allowing for more flexible movement and less discomfort during daily activities (Barrett & Green, 2021; Silva & Patel, 2021). The dual-action mechanism inherent in Mulligan techniques—combining passive mobilization with active patient movement—addresses both the mechanical and neurological dimensions of chronic cervical pain. This combination likely facilitates realignment of cervical joints, which reduces mechanical restrictions and promotes neural pathways associated with pain relief, thus contributing to both immediate and long-term pain reduction (Iqbal & Sohail, 2019). The consistent results across multiple studies indicate that the pain-relief effects of Mulligan mobilization are not only due to the physical adjustments but also due to the activation of pain-gating mechanisms, which may reduce the transmission of pain signals to the central nervous system (Calvo & Diaz, 2019). Additionally, Mulligan techniques promote joint stability, which may prevent further musculoskeletal issues in the cervical region. This stability, combined with enhanced joint mobility, provides functional benefits that could reduce the frequency and intensity of pain episodes, allowing patients to lead more active and productive lives with fewer limitations. The efficacy of these techniques in enhancing both pain relief and functional mobility supports their use as a viable alternative to conventional manual therapies, particularly in patients with chronic cervical pain who have not responded well to standard treatments (Moreno & Clark, 2021).

5.2 Comparison with Traditional Manual Therapy

When compared to traditional manual therapies, Mulligan techniques present several distinct advantages, largely due to the active participation of the patient during treatment. In traditional manual therapy, the therapist performs the treatment with minimal engagement from the patient, resulting in a more passive experience. Mulligan mobilization, however, incorporates active patient involvement, encouraging patients to move their neck or head in a pain-free direction while the therapist applies a gentle, sustained mobilizing force. This active involvement not only helps patients gain confidence in their movement but also fosters greater engagement and adherence to the treatment process, which is crucial for achieving long-term functional improvements (Handa & Martin, 2020). The active nature of Mulligan mobilization likely leads to enhanced proprioceptive feedback, or the body's awareness of movement and position. Proprioception is critical in motor learning and adaptation, as it enables the nervous system to refine movement patterns and correct maladaptive postures that may contribute to chronic pain. Enhanced proprioception through Mulligan mobilizations may, therefore, encourage proper alignment and reduce the likelihood of recurrence or aggravation of cervical pain symptoms. Traditional manual therapies may offer immediate pain relief but often lack this active engagement component, which may limit their effectiveness in promoting lasting behavioral and neuromuscular adaptations (Liao & Tai, 2019; Turner & Li, 2020). Additionally, Mulligan techniques have demonstrated greater patient-reported benefits in terms of quality of life and functional independence. By actively engaging patients in pain-free movement, these techniques may reduce fear-avoidance behaviors, or the tendency to avoid movement out of fear of exacerbating pain. Overcoming fear-avoidance behaviors is essential for chronic pain patients, as avoiding movement can lead to further muscle stiffness, reduced flexibility, and ultimately, greater discomfort. The structured, pain-free nature of Mulligan mobilizations may allow patients to regain confidence in their movement, thereby enhancing adherence to rehabilitation and increasing the likelihood of sustained improvements (Calvo & Diaz, 2019).

5.3 Clinical Implications

The clinical implications of these findings suggest that Mulligan mobilization techniques offer a valuable addition to treatment options for chronic cervical pain, particularly in cases unresponsive to traditional approaches. Mulligan techniques stand out for their non-invasive, patient-centered nature, aligning with modern practices in chronic pain management that emphasize individualized care and patient engagement. This patient-centered approach, which respects individual pain thresholds and fosters active involvement, could improve clinical outcomes and increase patient satisfaction with the treatment process (Day & Lee, 2020). Mulligan mobilizations also provide clinicians with an effective, hands-on treatment option that requires relatively low equipment and can be applied in various healthcare settings. The techniques are adaptable and can be tailored to each patient's specific needs, making them suitable for a broad range of patient populations. As the evidence suggests, integrating Mulligan mobilizations into standard clinical practice may reduce patients' reliance on pain medications, which are often associated with side effects and dependency risks. By achieving pain relief through non-pharmacological means, patients may experience improved physical health outcomes and reduced healthcare costs associated with prolonged medication use (Moreno & Clark, 2021). Furthermore, the documented improvements in patient-reported quality of life and functional independence highlight the broader impacts of Mulligan techniques. These outcomes suggest that Mulligan mobilizations not only address physical pain and mobility but also positively influence mental and social well-being by empowering patients to engage more actively in their daily lives. Clinicians can, therefore, consider Mulligan techniques as a comprehensive approach to chronic cervical pain, addressing both the physical and psychological aspects of this condition.

5.4 Limitations and Recommendations for Future Research

While this review demonstrates promising outcomes for Mulligan mobilization techniques, it is important to recognize certain limitations. One limitation is the heterogeneity in study designs, which included a mix of RCTs, cohort studies, and observational research. Variations in study methodologies, intervention protocols, and outcome measures may introduce biases or inconsistencies, potentially affecting the overall validity of the findings. Additionally, many of the studies reviewed had relatively small sample sizes, which can limit the generalizability of the results and increase the risk of Type II errors (Quinlan & Roberts, 2021). Future research should focus on conducting larger, multicenter RCTs with standardized protocols for Mulligan mobilization interventions to confirm these findings. Consistency in outcome measures, such as the use of uniform pain scales and ROM assessments, would allow for more precise comparisons across studies. Additionally, long-term follow-up studies are necessary to better understand the durability of Mulligan mobilization's effects, particularly in terms of sustained pain relief and functional independence. Exploring the neurological mechanisms underlying Mulligan techniques could also provide further insights into how these interventions achieve pain modulation and neural adaptation, potentially enhancing treatment protocols. Moreover, examining Mulligan mobilizations in comparison with other active manual therapy approaches, such as Maitland or McKenzie techniques, could clarify their unique contributions to chronic cervical pain management. This comparative research would assist clinicians in selecting the most appropriate intervention based on patient-specific needs and preferences. By addressing these research gaps, future studies can contribute to a more robust evidence base for Mulligan mobilizations, solidifying their role in chronic cervical pain management.

6. Conclusion

This systematic review and meta-analysis conclude that Mulligan mobilization techniques, specifically Mobilization with Movement (MWM) and Sustained Natural Apophyseal Glides (SNAGs), offer significant therapeutic benefits for individuals suffering from chronic cervical spine pain. By synthesizing the findings from recent studies, this review highlights that Mulligan mobilizations provide superior pain relief, enhanced range of

motion, and improved quality of life compared to traditional manual therapy approaches. The dual mechanism of Mulligan techniques—integrating passive mobilization with active patient movement—addresses both mechanical dysfunctions and neural pathways involved in chronic pain, resulting in immediate and sustained pain reduction. This dual-action approach also fosters patient confidence, reduces fear-avoidance behaviors, and empowers individuals to engage in daily activities more comfortably and independently. Clinical implications of these findings are substantial. Mulligan mobilizations, with their patient-centered and non-invasive nature, align with modern chronic pain management practices that prioritize individualized care and active patient involvement. Incorporating Mulligan techniques into standard therapeutic protocols may reduce patients' reliance on pain medications, decrease healthcare costs, and contribute to overall mental and physical well-being. Furthermore, Mulligan mobilizations offer a practical option for clinicians, requiring minimal equipment and allowing for adaptability based on each patient's needs and pain thresholds. While the review underscores the efficacy of Mulligan mobilizations, it also highlights limitations such as the heterogeneity in study designs, small sample sizes, and variable follow-up durations. Future research should focus on larger, multicenter randomized controlled trials with standardized protocols and long-term follow-up to further validate these findings and clarify the underlying neurological mechanisms of Mulligan mobilizations. Comparative studies against other manual therapy techniques, such as Maitland or McKenzie, would also enhance clinical decision-making by establishing a clearer understanding of the relative efficacy of Mulligan techniques. In summary, Mulligan mobilization techniques represent a promising addition to chronic cervical pain management, offering a holistic, patient-friendly alternative that addresses both the physical and psychological dimensions of pain. With further evidence, Mulligan mobilizations could become an integral component of chronic pain management strategies, enhancing the quality of life and functional independence of individuals with chronic cervical spine pain.

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