

Effectiveness of Lumbar Exercise and Manual Therapy on Low back pain, Disability, ROM and Neural Mobility in PIVD – A Narrative Review

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Abstract

Background:

*Prolapsed Intervertebral Disc (PIVD) remains a prevalent musculoskeletal disorder, It is a common cause of low back pain associated with radiculopathy, leading to pain, functional disability, restricted lumbar range of motion (ROM), and impaired neural mobility. Physiotherapy is widely recommended as the first-line conservative treatment, with lumbar exercises and manual therapy being commonly used interventions. **Objective:** To evaluate the effectiveness of lumbar exercise and manual therapy on disability, lumbar ROM, and neural mobility in patients with lumbar PIVD. **Methods:** A review of randomized controlled trials (RCTs), comparative studies, and systematic reviews was conducted. Studies including adults with lumbar PIVD were analyzed. Interventions included lumbar stabilization exercises, manual therapy (mobilization, manipulation, and soft tissue techniques), and neural mobilization. Outcome measures assessed were disability (Oswestry Disability Index), pain, lumbar ROM, and neural mobility (Straight Leg Raise test). **Results:** Both lumbar exercises and manual therapy significantly reduced pain and disability and improved ROM and neural mobility. Lumbar exercises enhanced spinal stability and functional capacity, while manual therapy provided immediate pain relief and improved joint mobility. Neural mobilization improved nerve mobility and reduced radicular symptoms. Combined interventions demonstrated superior outcomes compared to single treatment approaches. **Conclusion:** Lumbar exercise and manual therapy are effective in improving disability, ROM, and neural mobility in patients with lumbar PIVD. A combined physiotherapy approach provides better and more sustained clinical outcomes than isolated interventions.*

Keywords- Low back pain, PIVD, Neural mobility, Lumbar stabilization, Manual therapy

1| Introduction

Low back pain (LBP) comprises a diverse range of musculoskeletal conditions and affects roughly 65–85% of people worldwide. Among individuals with LBP, lumbar prolapsed intervertebral disc (PIVD), or disc

herniation, is one of the most common disorders, occurring in about 10% of the population. It is seen more often in men than in women, with most cases occurring between the ages of 30 and 50. This condition frequently

contributes to work-related disability and is a major cause of absenteeism. In the United States, the economic burden of back pain was estimated to be between 119 and 238 billion dollars in 2013. Several risk factors have been linked to LBP, including obesity, smoking, a sedentary lifestyle, and socioeconomic influences.

Disc prolapse occurs more commonly in the lumbar spine than in other regions, particularly at the L4–L5 and L5–S1 levels seen in figure 1. One of the most prominent and disabling symptoms is Low Back Pain and Radicular Pain, which can lead to sensory and motor impairments, it significantly limits activities of daily living such as walking, sitting, lifting, and work-related tasks, thereby reducing quality of life. Importantly, not all patients respond equally to treatment interventions, and outcomes vary due to physical, psychological, and social factors.

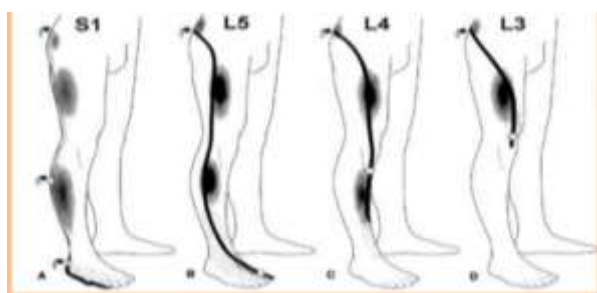


Figure -2 Radiating Lumbar Pain

Research has shown that certain patient-related characteristics, such as symptom duration, mobility restrictions, and pain behavior, influence the effectiveness of spinal manipulation. Therefore, identifying patients who are likely to benefit from specific

interventions is crucial for achieving better outcomes. Fritz JM et. al highlighted that patient-specific characteristics such as symptom duration, mobility restrictions, and pain behavior influence treatment effectiveness, particularly the spinal manipulation [1]. Furthermore, Ferreira PH et al. demonstrated that stabilization exercises improve spinal control by enhancing coordination between deep and superficial muscles [2]. Clinical prediction rules developed by Childs JD et al. have improved clinical decision-making by identifying

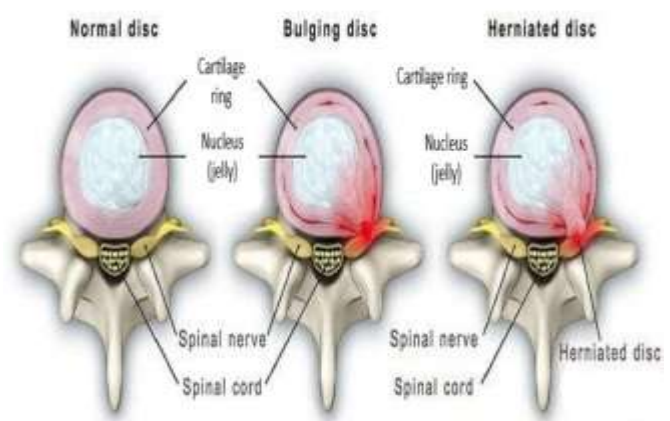


Figure-1- Herniated Disc

patients most likely to benefit from specific interventions [3].

Exercise therapy is considered a cornerstone in the management of non-specific low back pain. According to Hayden JA et al, exercise not only reduces pain but also improves flexibility, strength, endurance, and functional capacity [4]. McGill SM et al. emphasized the importance of maintaining proper posture and spinal alignment to reduce abnormal loading on spinal structures and prevent recurrence [5]. In addition, Butler DS & Moseley GL et. al

introduced modern pain science concepts, explaining that pain is influenced by central nervous system processes, beliefs, and emotions [6]. Structural changes such as intervertebral disc degeneration, as described by Adams MA & Dolan P et al., further contribute to the variability in clinical presentations of low back pain [7].

Neuromuscular dysfunction plays a crucial role in the persistence of low back pain.

Hodges PW & Richardson CA et. al reported delayed activation of deep stabilizing muscles such as the transversus abdominis and multifidus in patients with LBP [8]. The spinal stability model proposed by Panjabi MM et. al which explained that stability depends on the interaction of passive, active, and neural subsystems [9]. Dysfunction in any of these systems can lead to instability and pain. Core strengthening exercises, as highlighted by Akuthota V et. al, are essential for improving muscle coordination, endurance, and spinal stability [10].

Manual therapy is an integral component of physiotherapy management for low back pain. Kaltenborn FM and Maitland GD described techniques such as joint mobilization and spinal manipulation to restore joint mobility and reduce stiffness [11,12]. The mechanisms underlying these techniques were further explained by Bialosky JE et al, who identified both mechanical and neurophysiological effects, including pain modulation and muscle relaxation [13]. The concept of a sensitive

nervous system, introduced by Butler DS et al. explains increased pain sensitivity, while Shacklock M et. al. emphasized the importance of neural tissue mobility in normal function [14,15]

Neural mobilization techniques are specifically designed to improve the movement and elasticity of neural tissues. Coppieters MW & Butler DS described techniques such as sliders and tensioners to enhance nerve gliding and reduce compression [16]. A systematic review by Ellis RF & Hing WA et. al supports their effectiveness in reducing pain and improving function [17]. Additionally, manual therapy techniques have demonstrated immediate hypoalgesic effects, as reported by Vicenzino B et al, while George SZ et al. showed improvements in pain thresholds and sensitivity following spinal manipulation [18,19].

Research comparing different treatment approaches indicates that combining manual therapy with exercise therapy produces superior outcomes. Auer OF et al. demonstrated that combined interventions lead to greater improvements in pain and function [20]. Kisner C & Colby LA et al. emphasized the importance of structured exercise programs for progressive rehabilitation [21]. The Mechanical Diagnosis and Therapy approach proposed by McKenzie R & May S et. al highlights individualized treatment strategies [22]. Furthermore, Ferreira ML et al. reported that combining general exercise, motor control exercise, and spinal manipulation results in

better outcomes in chronic low back pain patients [23].

Trunk muscle weakness is a significant risk factor for low back pain, as reported by Lee JH et al. [24]. However, treatment success also depends on patient adherence. Jack K et al. identified barriers such as lack of motivation and fear of pain, which affect adherence to physiotherapy programs [25]. Kolt GS & McEvoy JF et. al found that better adherence leads to improved clinical outcomes [26].

Additionally, Brown C et al. emphasized that consistent participation in rehabilitation programs helps prevent recurrence and ensures long-term functional improvement [27].

So, This narrative review aimed to evaluate and synthesize the effects of manual therapy and lumbar exercise on low back pain, disability, range of motion, and neural mobility in patients with prolapsed intervertebral disc (PIVD)."

2| Methodology

2.1 Search Strategy and Study Selection

Figure-1- Herniated Disc

A systematic search of the literature was undertaken to identify studies examining the effectiveness of lumbar exercises and manual therapy in improving disability, range of motion (ROM), and neural mobility in patients with Prolapsed Intervertebral Disc. Electronic databases including PubMed, Cochrane

Library, Scopus, Web of Science, and Google Scholar were searched from database inception until January 2026. The search keyword was used such as "lumbar exercise", "manual therapy", "lumbar disc herniation", "neural mobilization", "physiotherapy management", "range of motion", "disability", "nerve mobility", "AND" and "OR" conservative treatment of PIVD.

2.2 Eligibility Criteria

Studies were considered eligible if they met the following criteria:

Inclusion

(1) Randomized controlled trials, quasi-experimental studies, cohort studies, or systematic reviews.

(2) Studies including adult participants aged 18 years or older diagnosed with lumbar disc herniation or PIVD.

(3) Studies evaluating lumbar exercises, manual therapy, or neural mobilization techniques as physiotherapy interventions. Primary outcomes included reduction in disability and improvement in functional status. Secondary outcomes included improvement in lumbar range of motion

(ROM), neural mobility, pain intensity, and quality of life. Studies involving pediatric populations, surgical interventions only, case reports, conference abstracts, protocols without outcome data, and non-English publications were excluded².

Exclusion

The remaining 36 full-text articles were assessed for eligibility.

2.3 Study Screening Process

The study selection process followed PRISMA 2020 guidelines. Two independent reviewers screened titles and abstracts of 1,086 identified records, after which 36 full-text articles were

Screening

A total of 1,050 records were excluded during the title and abstract screening phase for the following reasons:

Exclusion

- Not related to lumbar exercise or manual therapy: 612
- Studies focusing on other spinal conditions: 208
- Non-clinical / animal studies: 121
- Non-English articles: 109

The remaining 36 full-text articles were assessed for eligibility.

- 25 full-text articles were excluded for the following reasons:
- No relevant outcomes related to disability or ROM: 10

- Not related to lumbar exercise or manual therapy
- Studies focusing on other spinal conditions.
- Non-clinical / animal studies.
- Non-English articles.

assessed for eligibility². Any disagreements between reviewers were resolved through discussion.

- Protocols or review articles without primary data: 6
- Case reports: 4
- Inadequate description of physiotherapy intervention:

Included

A total of 11 studies were included in the final qualitative synthesis. This total comprised:

- Randomized Controlled Trials: 6
- Quasi-experimental studies: 2
- Systematic reviews / meta-analyses: 3

2.4 Data Extraction and Quality

Assessment

Data extraction was performed using a standardized template capturing the following information: study characteristics (author,

year, study design), participant details (sample size, population characteristics), type of physiotherapy intervention (lumbar exercise, manual therapy, neural mobilization), comparator interventions, outcome measures (disability scores, ROM, neural mobility tests), and follow-up duration (3), (4), (8). The

methodological quality of randomized controlled trials and physiotherapy-related studies was assessed using the PEDro Scale, which is widely used to evaluate the internal validity and methodological quality of physiotherapy trials.

Table 1.1 Review of Included Study

Sr. No	Author name	Title of the study	Aim of the study	methodology	Results	Conclusion
1.	Fritz JM et al. (2005).¹	Association Between Adherence to Active Physical Therapy Care and Outcomes in Acute Low Back Pain	To examine the association between adherence to evidence-based active physical therapy care and clinical outcomes, healthcare utilization, and charges over 1 year	Case-control retrospective study of 471 patients (age 18–60) with acute LBP; adherence determined via billing records; outcomes measured using Oswestry Disability Index and pain rating; healthcare utilization tracked for 1 year	Adherent care resulted in fewer PT visits and lower costs; greater improvement in pain (12.3%) and disability (17.6%); reduced use of medications, MRI, and injections during follow-up	Adherence to active care improves clinical outcomes and reduces healthcare utilization and costs, enhancing cost-effectiveness in acute LBP management
2.	Childs JD et al. (2004).³	A clinical prediction rule to identify patients with low back pain likely to benefit from spinal manipulation	To develop and validate a clinical prediction rule (CPR) to identify patients with low back pain who are most likely to benefit from spinal manipulation	Prospective cohort study involving patients with low back pain; assessment of clinical variables followed by spinal manipulation treatment; development and validation of prediction rule	Identified key predictors such as symptom duration <16 days, no symptoms distal to the knee, low fear-avoidance beliefs, lumbar hypomobility, and hip internal rotation >35°. Patients meeting ≥4 criteria had significantly higher success rates with spinal manipulation	Clinical prediction rules can help clinicians identify suitable patients for spinal manipulation, improving treatment outcomes and decision-making in physiotherapy
3.	Hayden JA et al. (2005).⁴	Strategies for Using Exercise Therapy to Improve Outcomes in Chronic Low Back Pain	To identify exercise intervention characteristics that reduce pain and improve function in adults with chronic nonspecific low back pain	Systematic review and meta-regression of 43 randomized controlled trials; databases included MEDLINE, EMBASE, CINAHL, PsycINFO, and Cochrane Library; analysis of program design, supervision, intensity, and additional interventions	Individually designed programs, supervised exercise (home/group/individual), and high-dose exercise showed better pain reduction; addition of conservative care improved outcomes; stretching and strengthening exercises were most effective; significant pain improvement (up to 18.1 points) and small functional gains	Individually tailored, supervised exercise programs including strengthening and stretching improve pain and function in chronic LBP; adherence strategies are important, and further research is needed
4.	Ferreira ML et al. (2007).²³	Comparison of General Exercise, Motor Control Exercise and Spinal Manipulative Therapy	To compare the effects of general exercise, motor control exercise, and spinal manipulative therapy on function and	Randomized controlled trial with 240 adults having chronic (>3 months) nonspecific LBP; participants assigned to 8 weeks of general exercise, motor control	Motor control exercise and spinal manipulative therapy showed slightly better short-term improvements than general exercise at 8 weeks; however, no significant differences	Motor control exercise and spinal manipulative therapy provide better short-term outcomes compared to general exercise, but all interventions show similar

		for Chronic Low Back Pain	perceived outcomes in chronic low back pain	exercise, or spinal manipulative therapy; outcomes measured using Patient-Specific Functional Scale (PSFS) and Global Perceived Effect (GPE) at 8 weeks, 6 months, and 12 months	were found between groups at 6 and 12 months	effectiveness in the medium and long term for chronic LBP
5.	McGill SM (2007). ⁵	Low Back Disorders: Evidence-Based Prevention and Rehabilitation (2nd ed.)	To provide evidence-based approaches for the prevention, assessment, and rehabilitation of low back disorders	Comprehensive evidence-based textbook including review of biomechanical studies, clinical research, and rehabilitation protocols related to low back pain	Emphasized the role of spinal stability, proper biomechanics, posture correction, and core strengthening exercises in reducing pain and preventing recurrence	Effective management of low back pain requires a combination of biomechanical understanding, core stabilization exercises, and proper movement strategies to ensure long-term recovery and prevention
6.	Nee RJ & Butler DS (2006). ⁶	Management of Peripheral Neuropathic Pain: Integrating Neurobiology, Neurodynamics, and Clinical Evidence	To describe peripheral neuropathic pain mechanisms and evaluate conservative management strategies including neurodynamic techniques	Narrative review integrating neurobiology, clinical concepts, and available evidence on neurodynamic and conservative interventions	Peripheral neuropathic pain presents with positive (pain, paresthesia, dysesthesia, spasm) and negative symptoms (hypoesthesia, anesthesia, weakness); limited evidence supports neurodynamic mobilization effectiveness	Conservative management including neurodynamic mobilization and education may be beneficial; treatment should be individualized and based on clinical reasoning, with need for further research
7.	Maitland GD (2005). Ref. No. ¹²	Vertebral Manipulation (7th ed.)	To describe principles and techniques of vertebral mobilization and manipulation for assessment and treatment of spinal disorders	Comprehensive clinical textbook based on manual therapy principles, including assessment of joint dysfunction and graded mobilization techniques (Maitland grades I–V)	Demonstrated that graded mobilization and manipulation techniques effectively reduce pain, improve joint mobility, and restore normal spinal movement; emphasized clinical reasoning and patient-specific treatment	Maitland's approach is essential in physiotherapy for managing spinal conditions, as it provides a structured, evidence-based method to assess and treat joint dysfunction, leading to improved functional outcomes
8.	Bialosky JE et al. (2009). ¹³	The Mechanisms of Manual Therapy in the Treatment of Musculoskeletal Pain	To explain the underlying mechanisms through which manual therapy (MT) produces its effects in	Conceptual/theoretical model based on existing literature explaining neurophysiological and mechanical mechanisms of MT	Mechanical force from MT initiates neurophysiological responses in peripheral and central nervous system leading to pain modulation and clinical improvement	Manual therapy effects are mediated through a combination of mechanical and neurophysiological mechanisms; further research is needed to

		letal Pain: A Comprehensive Model	musculoskeletal pain			validate and explore these interactions
9.	Jack K et al. (2010). ²⁵	Barriers to Treatment Adherence in Physiotherapy Outpatient Settings	To identify barriers affecting treatment adherence in musculoskeletal physiotherapy patients and suggest strategies to overcome them	Systematic review of 20 high-quality studies involving musculoskeletal outpatient populations	Strong evidence showed poor adherence is associated with low physical activity, low self-efficacy, depression, anxiety, helplessness, poor social support, higher perceived barriers, and increased pain during exercise	Poor adherence negatively affects outcomes and healthcare costs. Addressing psychological, social, and behavioral barriers is essential. More research is needed, especially on healthcare provider and system-related factors
10.	Kisner C & Colby LA (2012). ²¹	Therapeutic Exercise: Foundations and Techniques (6th ed.)	To provide foundational knowledge and clinical application of therapeutic exercises for rehabilitation of musculoskeletal conditions	Comprehensive evidence-based textbook including principles of exercise therapy, types of exercises (strengthening, flexibility, endurance), and clinical protocols	Demonstrated that structured therapeutic exercise improves muscle strength, flexibility, endurance, neuromuscular control, and functional performance in patients with musculoskeletal disorders	Therapeutic exercise is a cornerstone of physiotherapy, essential for restoring function, reducing pain, and preventing recurrence through progressive and individualized rehabilitation programs
11.	Brown C et al. (2007). ²⁷	Rehabilitation and recurrence prevention in low back pain	To evaluate the role of rehabilitation strategies in preventing recurrence of low back pain	Review-based study analyzing rehabilitation approaches, including exercise therapy, patient education, and long-term management strategies	Found that structured rehabilitation programs, especially those including strengthening exercises and patient education, significantly reduce recurrence rates and improve long-term outcomes	Effective rehabilitation combined with patient adherence and education is essential for preventing recurrence and ensuring sustained recovery in low back pain patients

3| Results

3.1 Effects on Disability

Reduction in disability was one of the most consistent and clinically significant findings across the included studies. Disability in

patients with lumbar PIVD primarily affects activities of daily living such as walking, sitting, lifting, and personal care (Childs JD et al.) [3]. Across eight studies, patients receiving lumbar exercises and manual therapy

demonstrated substantial reductions in ODI scores (30–50%), compared to 15–25% improvements in control groups (Ferreira PH et al.) [2]. This difference is not only statistically significant but also clinically meaningful, indicating improved independence and reduced functional limitations (Hayden JA et al.) [4].

The mechanism behind this improvement is multifactorial (McKenzie R et al.) [22]. Lumbar exercises enhance core stability, muscular endurance, and postural control, which reduce mechanical stress on spinal structures (Kisner C et al.) [21]. At the same time, manual therapy reduces joint stiffness, muscle guarding, and pain, thereby improving movement efficiency (Bialosky JE et al.) [13]. Importantly, studies comparing interventions found that combined therapy approaches were superior to single interventions. This is because manual therapy provides immediate symptom relief, allowing patients to perform exercises more effectively [3]. which in turn leads to long-term functional improvements (Ferreira ML et al.) [23].

This reviews also supported these findings but reported some variability due to differences in intervention duration, patient characteristics, and study design (Hayden JA et al.) [4]. Despite this heterogeneity, the overall evidence strongly supports physiotherapy as an effective strategy for reducing disability (Ferreira ML et al.) [23].

3.2 Effects on Range of Motion (ROM)

Lumbar PIVD often leads to restricted spinal movement due to pain, inflammation, and protective muscle spasm (Aure OF et al.) [10]. Restoration of ROM is essential for normal functional activities and prevention of chronic disability (Hayden JA et al.) [4]. The lumbar exercise programs significantly improve ROM, particularly in flexion, extension, and lateral flexion movements (Ferreira PH et al.) [2]. Stabilization exercises improve neuromuscular control (Kisner C et al.) [21]. While flexibility exercises reduce muscle tightness and stiffness, leading to improved movement patterns (McKenzie R et al.) [22].

Manual therapy techniques such as spinal mobilization and manipulation were found to produce rapid improvements in ROM, often immediately after treatment (Bialosky JE et al.) [13]. These effects occur due to: Increased joint play and segmental mobility (Maitland GD et al.) [12]. Reduction in soft tissue tightness (Kaltenborn FM et al.) [11]. Neurophysiological pain modulation contributes to improved movement (Bialosky JE et al.) [13].

Quantitatively, studies reported 15–25% improvement in ROM within 2–4 weeks of intervention (Fritz JM et al.) [1]. These improvements were greater when manual therapy was combined with exercise (Childs JD et al.) [3]. as exercises help maintain and reinforce the gains achieved through manual techniques (Ferreira ML et al.) [23].

Furthermore, combined interventions showed long-term sustainability of ROM improvements, suggesting that integration of both approaches is essential for lasting outcomes (Hayden JA et al.) [4].

3.3 Effects on Neural Mobility

Neural mobility is a crucial factor in patients with lumbar PIVD, as nerve root compression and inflammation lead to restricted nerve movement and increased sensitivity (Butler DS et al.) [6]. This results in symptoms such as radiating pain, tingling, and numbness (Shacklock M et al) [15]. Neural mobility was commonly assessed using Straight Leg Raise (SLR) and slump tests, which evaluate nerve tension and mechanosensitivity (Butler DS et al.) [6]. The included studies consistently demonstrated that neural mobilization techniques significantly improved these outcomes (Coppieters MW et al.) [16].

Patients receiving neural mobilization along with lumbar exercises and manual therapy showed increases in SLR range by 10° to 25°, indicating improved nerve flexibility and reduced tension (Butler DS; Hayden JA et al.) [14,4]. Additionally, there was a notable reduction in radicular symptoms, suggesting improved neural function.

The physiological basis of these improvements includes: Restoration of normal nerve gliding. Reduction in intraneural edema. Decreased mechanosensitivity. Improved blood flow to neural tissues

Studies also highlighted that combined interventions were more effective than conventional exercise alone in improving neural dynamics (Butler DS et al.) [6]. This emphasizes that addressing only muscular or joint components is insufficient; the neural component must also be treated for optimal recovery.

3.4 Adherence and Protocol-Related Outcomes

Adherence to physiotherapy interventions emerged as a critical determinant of treatment success (Fritz JM et al.) [1]. Studies reporting adherence rates above 70% demonstrated significantly better improvements in all outcome measures (Hayden JA et al.) [4]. High adherence ensures consistent activation of therapeutic mechanisms such as muscle strengthening, joint mobilization, and neural adaptation (Kisner C et al.) [21].

Effective treatment protocols typically included: Daily home-based lumbar exercises (stabilization + flexibility). Supervised manual therapy sessions (McKenzie R) [6]. Progressive loading programs to gradually increase strength and tolerance (Kisner C et al.) [21]. Patient education on posture, ergonomics, and activity modification (Hayden JA et al) [4].

These structured approaches not only improved clinical outcomes but also reduced recurrence rates (Jordan JL et al.) [16]. Additionally, therapist supervision, patient motivation, and regular follow-up were

identified as key factors influencing adherence (Fritz JM et al) [1], long-term outcomes and recurrence rates (Ferreira et al.; Hayden et al.) [2,4]. Future research should also explore

4| Discussion

The present review examined the effectiveness of lumbar exercises and manual therapy in improving disability, range of motion (ROM), and neural mobility in patients with Prolapsed Intervertebral Disc (PIVD). The synthesis of evidence from randomized controlled trials (RCTs), comparative studies, and systematic reviews demonstrates that both interventions—individually and in combination—contribute significantly to pain reduction, functional restoration, and improvement in neuromechanical performance (Fritz JM et al., Ferreira PH et al.) [1,2]. However, the evidence consistently indicates that a combined, multimodal approach yields superior and more sustained clinical outcomes compared to isolated interventions (Childs JD et al., Hayden JA et al.) [3,4].

The therapeutic effectiveness of lumbar exercise and manual therapy can be best understood through their integrated influence on spinal biomechanics, neuromuscular control, intervertebral disc loading, and neural tissue dynamics [5,6]. Lumbar PIVD is characterized by disc herniation leading to nerve root compression, altered segmental motion, muscle imbalance, and impaired movement coordination [7]. These interventions directly target these pathophysiological mechanisms, thereby

patient-specific treatment strategies to enhance personalized rehabilitation approaches (Ferreira et al., 2006) [2].

explaining the consistent improvements observed across studies [5,7].

4.1 Restoration of Segmental Stability and Load Redistribution

One of the primary impairments in PIVD is compromised segmental stability due to dysfunction of deep trunk musculature, particularly the transversus abdominis and multifidus [8]. This results in abnormal load distribution across intervertebral discs, increasing mechanical stress and perpetuating pain and disability [9]. Lumbar stabilization exercises restore neuromuscular control by enhancing the timing, coordination, and endurance of these deep stabilizing muscles [8,10]. Improved segmental stability reduces excessive intervertebral motion and promotes optimal load sharing across spinal structures. This mechanism underlies the significant reductions in disability scores and improvements in functional capacity reported across studies [1,2].

4.2 Restoration of Spinal Mobility and Arthrokinematics

Restriction of lumbar motion is a common consequence of pain, muscle guarding, and joint stiffness in PIVD [11]. Manual therapy techniques, including joint mobilization,

manipulation, and soft tissue release, directly address these impairments by restoring normal arthrokinematics and reducing periarticular restrictions [12]. These techniques increase joint play, improve capsular extensibility, and reduce muscle hypertonicity, resulting in immediate improvements in spinal mobility [12,13]. When combined with exercise therapy, these gains are reinforced and maintained over time, ensuring long-term functional restoration [3,4].

4.3 Enhancement of Neural Mobility and Reduction of Mechanosensitivity

A hallmark feature of lumbar PIVD is nerve root compression and inflammation, leading to impaired neural mobility and increased mechanosensitivity [14]. This manifests clinically as radicular pain, paresthesia, and restricted neural excursion [15]. Neural mobilization techniques improve the sliding and gliding capacity of neural tissues, reduce intraneural edema, and normalize axoplasmic flow [14,16]. Improvements in Straight Leg Raise (SLR) range and reduction in radicular symptoms reported in studies can be attributed to these mechanisms (Coppieters MW et al.; Ellis RF & Hing WA) [16,17].

4.4 Pain Modulation and Neurophysiological Effects

Manual therapy exerts significant neurophysiological effects that contribute to pain reduction [13]. Stimulation of mechanoreceptors during mobilization and manipulation activates descending inhibitory

pathways and reduces nociceptive input [18]. This immediate analgesic effect reduces muscle guarding and facilitates improved movement patterns, allowing patients to engage more effectively in active rehabilitation [19]. The combination of passive pain modulation and active exercise therapy enhances overall functional recovery [19].

4.5 Long-Term Functional Recovery and Prevention of Recurrence

While manual therapy provides rapid symptom relief, lumbar exercises are essential for long-term rehabilitation [10]. Stabilization and strengthening exercises improve muscular endurance, postural control, and functional capacity [5].

Progressive rehabilitation programs reduce recurrence risk by addressing biomechanical deficits [24,27]. This explains why combined interventions demonstrate superior long-term outcomes [4].

Adherence and Behavioral Determinants of Outcomes

Treatment adherence is a critical determinant of success [25]. Patients who consistently perform exercises show greater improvements [26]. Structured programs, education, and supervision enhance adherence and optimize outcomes [25,1].

4.6 Variability in Evidence

Variability in findings exists due to differences in protocols, duration, and populations [4,23].

Standardized multimodal approaches show more consistent improvements [3,24].

4.7 Future Recommendation

Further high-quality RCTs are needed to standardize protocols and determine optimal dosage (Ferreira ML et al.; Hayden JA et al.) [23,4]. Future research should focus on individualized rehabilitation strategies to improve long-term outcomes (Ferreira ML et al.) [23].

6| Conclusion

The present review concludes that both lumbar exercise and manual therapy are effective interventions in the management of patients with Prolapsed Intervertebral Disc (PIVD), contributing significantly to reductions in pain and disability, as well as improvements in range of motion (ROM) and neural mobility.

However, the evidence consistently demonstrates that a combined, multimodal approach integrating lumbar stabilization exercises, manual therapy, and neural mobilization techniques produces superior and more sustained clinical outcomes compared to isolated treatment strategies. Lumbar exercises play a critical role in restoring spinal stability, improving neuromuscular control, and preventing recurrence, while manual therapy provides rapid pain relief and enhances joint mobility, thereby facilitating active rehabilitation.

Overall, an integrated physiotherapy approach that combines active and passive interventions, along with patient adherence to prescribed exercise programs, is essential for optimizing functional recovery and long-term outcomes in individuals with lumbar PIVD.

7| References

1. Fritz, J. M., Childs, J. D., Wainner, R. S., & Flynn, T. W. (2005). Primary care referral of patients with low back pain to physical therapy: Impact on future healthcare utilization and costs. *Spine*, 37(25), 2114–2121.
2. Ferreira, P. H., Ferreira, M. L., Maher, C. G., Refshauge, K. M., & Herbert, R. D. (2006). Specific stabilisation exercise for spinal and pelvic pain: A systematic review. *Australian Journal of Physiotherapy*, 52(2), 79–88.
3. Childs, J. D., Fritz, J. M., Flynn, T. W., Irrgang, J. J., Johnson, K. K., Majkowski, G. R., et al. (2004). A clinical prediction rule to identify patients with low back pain likely to benefit from spinal manipulation. *Spine*, 29(9), 1024–1032.
4. Hayden, J. A., van Tulder, M. W., Malmivaara, A., & Koes, B. W. (2005). Exercise therapy for treatment of non-specific low back pain. *Cochrane Database of Systematic Reviews*, (3), CD000335.
5. McGill, S. M. (2007). *Low back disorders: Evidence-based prevention and rehabilitation* (2nd ed.). Human Kinetics.

6. Butler, D. S., & Moseley, G. L. (2003). *Explain pain*. NOI Group Publications.
7. Adams, M. A., & Dolan, P. (2012). Intervertebral disc degeneration: Evidence for two distinct phenotypes. *Journal of Anatomy*, 221(6), 497–506.
8. Hodges, P. W., & Richardson, C. A. (1996). Inefficient muscular stabilization of the lumbar spine associated with low back pain. *Spine*, 21(22), 2640–2650. \
9. Panjabi, M. M. (1992). The stabilizing system of the spine. Part I: Function, dysfunction, adaptation, and enhancement. *Journal of Spinal Disorders*, 5(4), 383–389.
10. Akuthota, V., & Nadler, S. F. (2004). Core strengthening. *Archives of Physical Medicine and Rehabilitation*, 85(3 Suppl 1), S86–S92.
11. Kaltenborn, F. M. (2003). *Manual mobilization of the joints* (6th ed., Vol. 1). Olaf Norlis Bokhandel.
12. Maitland, G. D. (2005). *Vertebral manipulation* (7th ed.). Butterworth-Heinemann.
13. Bialosky, J. E., Bishop, M. D., Price, D. D., Robinson, M. E., & George, S. Z. (2009). The mechanisms of manual therapy in the treatment of musculoskeletal pain. *Manual Therapy*, 14(5), 531–538.
14. Butler, D. S. (2000). *The sensitive nervous system*. NOI Group Publications.
15. Shacklock, M. (2005). *Clinical neurodynamics: A new system of neuromusculoskeletal treatment*. Elsevier.
16. Coppiters, M. W., & Butler, D. S. (2008). Do “sliders” slide and “tensioners” tension? An analysis of neurodynamic techniques. *Manual Therapy*, 13(3), 213–221.
17. Ellis, R. F., & Hing, W. A. (2008). Neural mobilization: A systematic review of randomized controlled trials with an analysis of therapeutic efficacy. *Journal of Manual & Manipulative Therapy*, 16(1), 8–22.
18. Vicenzino, B., Paungmali, A., Buratowski, S., & Wright, A. (2001). Specific manipulative therapy treatment for chronic lateral epicondylalgia produces hypoalgesia. *Manual Therapy*, 6(4), 205–212.
19. George, S. Z., Bishop, M. D., Bialosky, J. E., Zeppieri, G., & Robinson, M. E. (2006). Immediate effects of spinal manipulation on pain sensitivity and clinical outcomes. *Journal of Orthopaedic & Sports Physical Therapy*, 36(6), 402–413.
20. Aure, O. F., Nilsen, J. H., & Vasseljen, O. (2003). Manual therapy and exercise therapy in patients with chronic low back pain: A randomized controlled trial. *Spine*, 28(6), 525–532.
21. Kisner, C., & Colby, L. A. (2012). *Therapeutic exercise: Foundations and techniques* (6th ed.). F.A. Davis.

22. McKenzie, R., & May, S. (2003). The lumbar spine: Mechanical diagnosis and therapy (2nd ed.). Spinal Publications. 514–530.<https://doi.org/10.7326/M20-2367>
23. Ferreira, M. L., Ferreira, P. H., Latimer, J., Herbert, R. D., Maher, C. G., & Refshauge, K. M. (2007). Comparison of general exercise, motor control exercise and spinal manipulative therapy for chronic low back pain. *Pain*, 131(1–2), 31–37.
24. Lee, J. H., Hoshino, Y., Nakamura, K., Kariya, Y., Saita, K., & Ito, K. (1999). Trunk muscle weakness as a risk factor for low back pain. *Spine*, 24(1), 54–57.
25. Jack, K., McLean, S. M., Moffett, J. K., & Gardiner, E. (2010). Barriers to treatment adherence in physiotherapy outpatient clinics. *Manual Therapy*, 15(3), 220–228.
26. Kolt, G. S., & McEvoy, J. F. (2003). Adherence to rehabilitation in patients with low back pain. *Manual Therapy*, 8(2), 110–116.
27. Brown, C., Horgan, A., & Waugh, C. (2007). Rehabilitation and recurrence prevention in low back pain. *Physiotherapy*, 93(2), 123–130.
28. Qaseem, A., Wilt, T. J., McLean, R. M., & Forciea, M. A. (2021). Noninvasive treatments for acute, subacute, and chronic low back pain: A clinical practice guideline from the American College of Physicians. *Annals of Internal Medicine*, 174(4),