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Physiotherapy Management of Lumbar Herniated Nucleus Pulposus: A Case Report

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Abstract

Introduction: Lumbar Herniated Nucleus Pulposus (HNP) is a spinal disorder characterized by protrusion of the intervertebral disc beyond its anatomical boundaries, frequently compressing adjacent nerve roots. This condition commonly presents with lower back pain, radicular pain, reduced spinal mobility, altered gait, and both sensory and motor impairments, ultimately diminishing quality of life.

Methods: This case report describes a young adult patient presenting with right-sided radicular pain, decreased lower limb muscle strength, and diminished deep tendon reflexes. The physiotherapy intervention included Microwave Diathermy (MWD), McKenzie exercises, Bugnet exercises, and targeted stretching techniques.

Results: After a single physiotherapy session, the patient experienced a reduction in pain intensity from 7 to 4 on the Numerical Rating Scale (NRS) and demonstrated increased lumbar flexibility.

Discussion: This case illustrates the short-term effectiveness of a multimodal physiotherapy approach in managing lumbar HNP. The combination of MWD and McKenzie exercises appeared to provide rapid symptom relief, particularly in young patients with radicular symptoms. These findings are consistent with existing literature highlighting the role of exercise therapy and physical modalities in reducing pain and improving function in HNP patients. However, the results should be interpreted with caution due to the single-session intervention and the case report design, which limits generalizability.

Conclusion: A multimodal physiotherapy approach incorporating MWD, McKenzie, and stretching exercises may be effective in reducing pain and improving lumbar mobility in patients with HNP. Further longitudinal and controlled studies are needed to establish long-term efficacy and optimize treatment protocols.

Keywords

Lumbar Vertebrae, Intervertebral Disc Displacement, McKenzie Method, Exercise Therapy, Physical Therapy Modalities, Pain Management

Introduction

The lumbar spine functions as the primary support for the upper body. It is structurally larger than other segments of the vertebral column, allowing it to bear axial loads transmitted from the head, neck, and trunk. The lumbar spine also forms a canal that protects the spinal cord, which facilitates communication between the central nervous system and the lower extremities. Among all spinal segments, the lumbar spine is the most mobile, enabling movements such as flexion, extension, rotation, and lateral flexion. Morphologically, when viewed laterally, it exhibits an inward curvature called lumbar lordosis, which helps maintain postural balance and efficiently distributes body weight to the pelvis during bipedal locomotion.[1] Each lumbar vertebra is connected by intervertebral discs that serve as shock absorbers.[2] These discs consist of three main components: the nucleus pulposus, annulus fibrosus, and vertebral endplates.[3]

The nucleus pulposus, located centrally within the intervertebral disc, has a gel-like consistency and contributes to both flexibility and load-bearing capacity of the spine. It is composed primarily of water (66% to 86%) and collagen—mostly type II—along with types VI, IX, XI, and a significant amount of proteoglycans.[2] The outer part of the disc, known as the annulus fibrosus, is made up of concentric collagen fibers called lamellae. This annulus is divided into inner and outer zones, each with distinct collagen compositions: the outer annulus is rich in type I collagen, whereas the inner portion contains type II collagen and proteoglycans. These differences enable the disc to withstand compressive forces while maintaining flexibility.[4] The posterior and inferior surfaces of the disc are covered by the vertebral endplate, which serves as the primary source of nutrition for the disc. In cases of disc degeneration, the endplate is typically the last structure to be damaged.[2]

Under certain conditions, the nucleus pulposus may protrude through the layers of the annulus fibrosus, resulting in a condition known as Herniated Nucleus Pulposus (HNP). This condition often presents as lower back pain radiating to the lower extremities and, in more severe cases, may lead to muscular weakness and sensory disturbances.[5]

HNP is more commonly observed in males than in females, with an approximate male-to-female ratio of 2:1. [6] The most affected age group ranges between 30 and 50 years. The overall prevalence is about 4% in males and 5% in females.[7] The most frequently involved lumbar levels are L4–L5 (94%) and L5–S1 (62%), with less common involvement at L2–L3 (16%) and L1–L2 (3%).[7]

In the present case, the subject was a 20-year-old female, placing her in a demographic group less frequently affected by HNP, particularly under the age of 30. This case is therefore considered clinically unique and warrants further exploration. It highlights the importance of individualized assessment and management, as the clinical presentation and therapeutic response in younger female patients may differ from those typically observed in males aged 30–50 years.

The patient, a university student, reported lower back pain radiating to both legs, especially while standing or performing trunk flexion (e.g., during prayer). The pain first occurred in junior high school but later resolved, only to recur during senior high school after a motorcycle accident involving a fall on the buttocks. In December 2024, she was evaluated at a hospital and diagnosed with HNP. No family history of the condition was reported. In April 2025, she was hospitalized in Makassar due to severe low back pain that impaired her ability to walk.

Methods

This case report was conducted at the physiotherapy outpatient clinic of Dadi Special Regional Hospital, Makassar, South Sulawesi. The subject was a 20-year-old female university student, referred to by the initials M.A., who was hospitalized with a diagnosis of Lumbar Herniated Nucleus Pulposus (HNP). The participant was selected purposively based on clinical diagnosis and symptom criteria relevant to HNP.

Clinical data collection involved a comprehensive assessment process. The initial step included a patient interview to obtain subjective complaints and a detailed history of the presenting condition. This was followed by visual observation of the patient's posture and movement patterns, both in static and dynamic conditions. A physical examination was then conducted, consisting of joint range of motion assessment, manual muscle testing, and neurological evaluation through sensory testing and physiological reflex assessment.

To confirm the diagnosis and functional impact, several specific orthopedic tests were performed, including the compression test, Lasègue test, Neri test, Bragard test, Patrick test, and anti-Patrick test. Functional disability related to low back pain was measured using the Oswestry Disability Index (ODI), a validated questionnaire comprising ten items. The patient completed the ODI independently, and the total score was classified into five disability levels.

Supporting diagnostic evidence was obtained through Magnetic Resonance Imaging (MRI), which was performed by the radiology department to determine the location and severity of the herniated disc. Based on these clinical and imaging findings, a physiotherapy diagnosis was formulated using the International Classification of Functioning, Disability and Health (ICF) framework, covering impairments in body function and structure, activity limitations, and participation restrictions.

Following the diagnostic process, primary and secondary physiotherapy problems were identified. A key clinical challenge in this case was to differentiate between nerve root compression and musculoskeletal pain originating from muscle spasms. Clinical reasoning was supported by the predominance of radiating pain symptoms and a positive Lasègue test, confirming the diagnosis of HNP. Despite the severity of the pain, the patient's young age and absence of neurological deficits indicated a favorable prognosis.

Short-term and long-term physiotherapy goals were then established to guide intervention planning. Interventions were selected based on clinical findings, and the outcomes were evaluated descriptively. The results were then compared with normative reference values to assess the patient's clinical progress over time.

Results

Case History

The patient, referred to as M.A., is a 20-year-old female university student who presented with complaints of lower back pain radiating to both lower limbs, particularly aggravated during standing and performing forward bending movements, such as during prayer. The initial onset of pain occurred in junior high school (grade 8) but spontaneously resolved. The symptoms reappeared during senior high school (grade 11) following a fall from a motorcycle, landing in a seated position. In December 2024, the patient underwent a medical examination and was diagnosed with Herniated Nucleus Pulposus (HNP). In April 2025, she was admitted to a hospital in Makassar due to severe low back pain, which significantly impaired her ability to walk.

Physical Examination Findings

The patient opted for conservative management and underwent physiotherapy at the outpatient clinic. A functional movement assessment of the trunk and lower extremities revealed that she could perform active movements of the trunk and hips; however, both active and passive range of motion (ROM) were limited. During isometric testing against resistance, the patient demonstrated minimal resistance due to pain and exhibited muscle weakness in the trunk and hip regions. Examination of the knees and ankles revealed normal function with full active ROM.

The static inspection showed that the patient arrived in a wheelchair, wore a lumbar brace, and appeared physically weak. Dynamic inspection revealed that the patient was able to move her trunk and lower limbs, though with pain, and exhibited an antalgic gait with weight-bearing predominantly on the left leg. Palpation showed normal skin contour, absence of edema, localized warmth in the lumbar region, and tenderness at the L4–L5 level. The patient was able to transition from sitting to standing and walk short distances, although with difficulty. She was unable to perform prayer movements, particularly the bowing (rukuk) position. Basic movement function assessments indicated ROM

limitations in both active and passive trunk and hip movements, while knee and ankle ROM remained within normal limits. Isometric testing showed minimal resistance.

Specific Tests

Pain was assessed using the Visual Analogue Scale (VAS), with scores of 2 (mild) for palpation pain, 8 (severe) for pain at rest, and 10 (severe) for movement-induced pain. Manual Muscle Testing (MMT) showed a muscle strength grade of 4 in all tested muscles of the lumbar, hip, and knee regions bilaterally. Trunk ROM was measured at 0°–35°, and hip ROM at 0°–140°. Sensory testing (sharp/dull, light/deep touch, and two-point discrimination) and physiological reflexes (patellar and Achilles) were normal. Provocative tests revealed positive results on the Compression, Lasègue, Neri, Bragard, Patrick, and anti-Patrick tests, indicating sciatic nerve irritation and sacroiliac joint dysfunction. The Oswestry Disability Index (ODI) score was 51%, indicating severe disability. MRI findings showed lumbar spondylosis, disc bulging at L4–L5, and disc degeneration.

Physiotherapy Diagnosis

The physiotherapy diagnosis was formulated using the International Classification of Functioning, Disability and Health (ICF) framework as follows:

- Body Function:
  - b280: Pain associated with movement
  - b730: Muscle weakness in the gluteal, piriformis, and quadriceps muscles
  - b735: Increased muscle tone in the erector spinae, quadratus lumborum, iliopsoas, and hamstring muscles
  - b710: Joint mobility limitation (ROM restriction)
- Body Structure:
  - s198: Involvement of spinal nerve roots and the sciatic nerve
  - s76002: Lumbar vertebral structures (intervertebral disc / HNP)
  - s7401: Sacroiliac joint dysfunction
- Activity Limitation:
  - d4501: Limited ability to walk long distances
  - d530: Difficulty with toileting
  - d930: Inability to perform religious rituals (praying)
- Participation Restriction:
  - d830: Limited academic participation as a student
  - d920: Restricted engagement in recreational activities

Based on these findings, the patient was diagnosed with impaired movement and function characterized by pain, muscle weakness, muscle tightness, ROM limitation, and reduced ability to perform activities of daily living (ADL), suspected to be Grade 2 HNP. Primary physiotherapy problems included pain; secondary problems were muscle weakness in the gluteal, piriformis, and quadriceps muscles, muscle tightness in the erector spinae, quadratus lumborum, iliopsoas, and hamstrings, ROM limitations in the trunk and hips, and stiffness in the hip joints. Complex problems involved functional limitations in walking, toileting, and praying.

The short-term physiotherapy goals focused on reducing pain, improving muscle strength, relieving muscle tightness, increasing ROM, and reducing joint stiffness. Long-term goals aimed at improving functional capacity in daily activities, including walking, toileting, and praying.

Tabel 1. Intervention Program

No.	Problem	Modality	Frequency (F)	Intensity (I)	Technique (T)	Duration (T)
1	Pre-exercise preparation	Microwave diathermy	Each session	70%	Applied to the local lumbar area (L4–L5)	10 min
2	Pain	Manual therapy	Each session	Tolerance-based	Soft tissue release of *M. Quadratus Lumborum* and *M. Erector Spinae*	5 min
3	Muscle weakness	Exercise therapy	Each session	10 reps × 3 sets	Strengthening exercises: McKenzie with Bugnet, Bugnet side-lying, Bridging	3 min each
4	Muscle tightness	Stretching exercises	Each session	16 reps × 3 sets	Targeting *M. Quadratus Lumborum*, *M. Iliopsoas*, *M. Hamstring*	5 min
5	ROM limitation and joint stiffness	Passive and active-assisted ROM exercises (PROMEX, AA-AROMEX)	Each session	8 reps × 3 sets	–	5 min
6	ADL limitations	Functional walking exercises	Each session	Training zone	Walking practice	5 min

The intervention program was designed based on the patient's primary clinical problems and aimed at reducing pain, improving muscle strength and flexibility, restoring ROM, reducing stiffness, and enhancing ADL capacity.

Evaluation

Table 1 presents the patient's clinical outcomes before and after a single physiotherapy intervention session, focusing on pain intensity, muscle strength, range of motion (ROM), and functional ability in daily activities.

Table 2. Evaluation of Clinical Outcomes Before and After a Single Physiotherapy Session

No.	Problem	Assessment Tool	Pre-Intervention	Post-Intervention	Outcome
1	Pain	VAS	Rest: 2, Movement: 8, Palpation: 10	Rest: 2, Movement: 7, Palpation: 8	Pain intensity decreased
2	Muscle weakness	MMT	All muscles scored 4	All muscles scored 4	No change in strength
3	ROM limitation	Goniometer	Trunk: 0°–35°, Hip: 0°–140°	Trunk: 0°–35°, Hip: 0°–140°	No change in ROM
4	ADL limitation	ODI	51% (Severe disability)	51% (Severe disability)	No change in ADL function

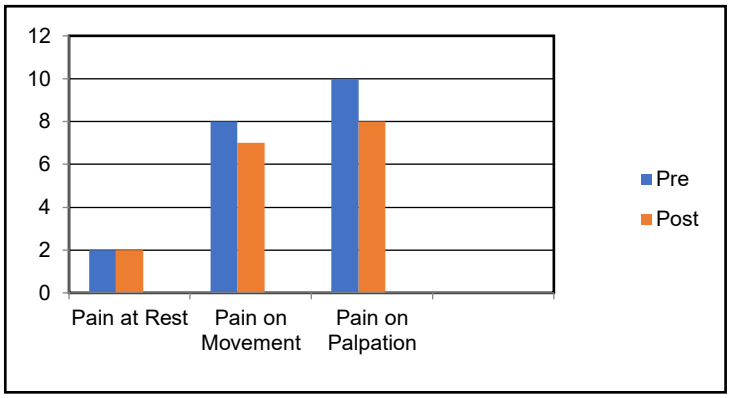

Figure 1. Pain Score Reduction Based on VAS

Post-intervention evaluation showed a slight reduction in pain intensity, while no significant improvements were noted in muscle strength, ROM, or ADL function. The patient remained cooperative throughout therapy sessions, and no adverse effects such as dizziness, nausea, or excessive fatigue were observed. Continued physiotherapy is recommended for monitoring and improving the patient's functional progress.

Discussion

Herniated Nucleus Pulposus (HNP) is a condition characterized by protrusion or extrusion of the intervertebral disc beyond its anatomical position, resulting in compression of adjacent nerve roots.[8] The most common clinical manifestations in patients with HNP include lower back pain, reduced flexibility in the lumbar muscles, limited range of motion (ROM), abnormal gait patterns, decreased quality of life, and, in some cases, deficits in motor, sensory, and reflex functions.[9] Lumbar HNP is a relatively frequent condition, with an incidence of 5 to 20 cases per 1,000 adults annually, and occurs more frequently in males than females with a 2:1 ratio.[10]

HNP is often associated with disc degeneration due to aging, leading to a decrease in proteoglycan production. This results in disc dehydration and collapse, increasing the load on the annulus fibrosus, which may subsequently tear and cause nucleus pulposus herniation. Additionally, excessive axial load on the disc increases biomechanical stress, which can cause extrusion of disc material through a weakened annulus fibrosus.[11] The pressure exerted by the herniated disc results in localized back pain, with radiating pain emerging when the disc compresses or contacts the lumbar nerve root, leading to ischemia and inflammation. The posterolateral area of the annulus fibrosus is thinner and not fully protected by the posterior longitudinal ligament, making it more susceptible to herniation. Due to the proximity of the nerve roots, posterolateral herniation has a higher potential to cause nerve root compression.[12] In rare cases, HNP may result in autonomic dysfunction, including bladder and bowel disturbances. In severe presentations, it can lead to cauda equina syndrome, characterized by loss of bowel and bladder control, bilateral leg numbness or weakness, intense back pain, and impaired ambulation.[13]

Diagnosis of HNP involves both history-taking and clinical examinations, including physical and adjunctive assessments. History-taking includes inquiries about typical clinical symptoms such as low back pain, radiculopathy, weakness according to lumbar nerve root distribution, sensory deficits, limited lumbar flexion or pain during flexion, and exacerbation of pain during coughing, straining, or sneezing. The quality and impact of pain on daily activities, trauma history, and the mechanism of injury are also explored.[7]

Specific physiotherapy assessments include the Lasègue test to identify nerve root irritation. A positive result, characterized by pain at 30–70 degrees of hip flexion, indicates lumbar disc herniation at the L4-S1 level.[14] If the Lasègue test is positive, provocation tests such as the Bragard and Neri tests may follow. Muscle strength can be evaluated using Manual Muscle Testing (MMT), while ROM limitations can be assessed using a goniometer.[15] Functional disability related to lumbar HNP can be assessed using the Oswestry Disability Index (ODI), a questionnaire-based tool.[16] Imaging, particularly Magnetic Resonance Imaging (MRI), is the most reliable modality to evaluate soft tissue and nerve structures of the vertebrae and determine the degree of herniation.[17]

Physiotherapy plays a vital role in HNP rehabilitation through various intervention modalities tailored to the patient's condition. In this case, the patient presented with pain, muscle tightness, ROM limitations, and difficulties in activities of daily living (ADL), which align with common HNP manifestations. Physiotherapy interventions administered included Microwave Diathermy (MWD), strengthening exercises, McKenzie exercises, Bugnet exercises, bridging exercises, stretching exercises, and ROM exercises such as PROMEX and AAROMEX, as well as walking exercises to address ADL limitations. A home exercise program was also provided to enhance the effectiveness of interventions outside of rehabilitation sessions.

MWD is an electrotherapy modality that uses high-frequency electromagnetic waves to generate localized thermal effects, which improve blood circulation, reduce pain, and increase the flexibility of soft tissues. Its thermal effect penetrates deeply, making it effective in relaxing deep musculature.[18] To address muscle weakness, strengthening exercises are implemented, which involve muscle contractions against resistance.[19] Bridging exercises target core muscle strength, while McKenzie exercises aim to strengthen spinal extensors and reduce disc pressure.[20] Stretching exercises are essential in managing HNP as they help relieve pain by lengthening tight muscles and enhancing flexibility.[21]

Following a single physiotherapy session, evaluation showed a decrease in lower back pain intensity, presumably due to the interventions administered. Previous studies, such as that by Qudus et al., have demonstrated that MWD effectively reduces low back pain.[22] However, no significant improvements were observed in muscle strength, ROM, or ADL function based on the ODI. This is likely due to the limited duration and frequency of therapy, which were insufficient for producing measurable clinical changes. Furthermore, psychosocial factors play a critical role in patient recovery. In this case, the patient was within the typical age range for HNP and was also a university student, potentially contributing to stress and anxiety that may impede rehabilitation progress.

This case highlights the crucial role of physiotherapy in managing lumbar HNP, particularly in alleviating pain and restoring daily functional capacity. Individualized evaluation and tailored intervention approaches are essential to optimize outcomes. Continued exercise programs are recommended to achieve significant improvements in muscle strength, ROM, and ADL function.

Conclusion

Based on the patient's post-intervention evaluation following a single physiotherapy session, the treatment provided showed promising initial effects, particularly in reducing pain intensity. These findings underscore the importance of a multimodal approach in the early phase of rehabilitation for lumbar disc herniation (HNP). Such an approach may offer synergistic benefits by simultaneously addressing pain, mobility, and functional limitations. However, considering that this case report reflects short-term outcomes after one session, long-term evaluation is essential to confirm sustained effectiveness and to guide the development of individualized, phase-based treatment protocols. Future studies involving multiple treatment sessions, longer follow-up periods, and objective outcome measures are recommended to further validate the therapeutic efficacy and generalizability of the intervention used in this case.

Author Contribution

Umi Ismawati, Sri Gusti Lestari, and Rina Dwi Wulandari contributed to the conception and design of the case report. Hasanah Triana and Siti Nurhaliza were responsible for data collection and clinical documentation. Nur Indah Sari and Yuliana prepared the literature review and assisted in data interpretation. Umi Ismawati drafted the initial manuscript. All authors critically reviewed the manuscript, approved the final version, and are accountable for the integrity and accuracy of the work.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This case report was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from the patient for the publication of anonymized clinical information and images. Formal ethical approval was not required for the publication of a single case report, in line with institutional and national guidelines.

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