Medical and Health Journal
Volume 5, Issue 2, 2026, pp. 455-461
e-ISSN: 2807-3541
Open Access: https://jos.unsoed.ac.id/index.php/mhj

Association Between Lumbar Vertebral MRI Findings and Neuropathic Pain in Patients With Low Back Pain at Prof. Dr. Margono Soekarjo General Hospital

Hening Yanita Rizki Adiputri[1*], Prasetyo Tri Kuncoro[1], Untung Gunarto[1], Tisna Sendy Pratama[1], Octavia Permatasari, Kamal Agung Wijayana[1], Muhamad Rifqy Setyanto[1]

[1]Faculty of Medicine, Jenderal Soedirman University, Purwokerto, Indonesia

ARTICLE INFO

Article history:
Received December 24, 2025
Revised January 21, 2026
Accepted February 16, 2026
Available online February 20, 2026

Keywords:
Low back pain; Neuropathic pain; Lumbar MRI; Radicular pain

ABSTRACT

Background: Low back pain (LBP) is a common musculoskeletal condition that may be accompanied by neuropathic pain due to irritation or compression of lumbar neural structures, often associated with structural abnormalities detected on MRI. Objective: This study aimed to assess the association between lumbar MRI findings and neuropathic pain in patients with LBP at Prof. Dr. Margono Soekarjo General Hospital. Methods: An analytical observational study with a cross-sectional design was conducted involving 68 patients, using lumbar MRI data and neuropathic pain screening with the ID Pain questionnaire. Associations were analyzed using Chi-square tests and multivariate logistic regression with a significance level of p < 0.05. Results: The most frequent MRI findings are herniated nucleus pulposus (85.3%), spinal stenosis (57.4%), spondylosis (38.2%), and spondylolisthesis (19.1%), while neuropathic pain is identified in 66.2% of patients. Significant associations are observed between neuropathic pain and all MRI findings, with lumbar spinal stenosis identified as the strongest predictor. ***Conclusion:*** *Lumbar MRI abnormalities are significantly associated with neuropathic pain in patients with LBP, and spinal stenosis represents the most influential factor, emphasizing the importance of radiological evaluation in the management of LBP with neuropathic components.*

1. INTRODUCTION

This study aimed to analyze the association between lumbar vertebral magnetic resonance imaging (MRI) findings and neuropathic pain in patients with low back pain (LBP). LBP is a common musculoskeletal disorder involving the L1–L5 spinal segments and represents a major global health concern. In 2020, approximately 619 million individuals worldwide were affected, with a reported prevalence of around 18% in Indonesia. Structural abnormalities of the lumbar spine may result in nerve root irritation or compression, leading to radiating pain with neuropathic characteristics. Clinically, pain in LBP can be classified as nociceptive, arising from non-neural tissue injury, or neuropathic, resulting from lesions or dysfunction of the somatosensory nervous system. Neuropathic pain is generally more severe, persistent, and less responsive to conventional analgesics, often requiring specific pharmacological management such as neuromodulatory agents. Typical symptoms include burning sensations, electric shock like pain, numbness, paresthesia, and hyperalgesia. Therefore, accurate identification of the neuropathic component has important implications for appropriate therapeutic decision-making.

Screening for neuropathic pain in this study was performed using the ID Pain questionnaire, a simple, patient-reported instrument that is easily applied in clinical practice. A score of ≥2 indicates a high likelihood of neuropathic pain. Compared with other diagnostic tools that require additional clinical examination or longer administration time, ID Pain is considered more practical for routine clinical use. MRI plays a crucial role in identifying structural abnormalities of the lumbar spine, including disc herniation, spinal stenosis, spondylolisthesis, and disc degeneration,

*Corresponding author
E-mail addresses: nitaadiputri048@gmail.com (Hening Yanita Rizki Adiputri)

which may contribute to nerve root compression or inflammatory processes underlying neuropathic pain mechanisms. Although MRI is widely utilized to evaluate lumbar structural changes, previous studies have predominantly focused on anatomical findings without directly correlating them with neuropathic pain characteristics assessed using standardized clinical instruments. To date, research specifically examining the association between lumbar vertebral MRI findings and neuropathic pain measured through validated screening questionnaires remains limited. Consequently, the structural–functional relationship between radiological abnormalities and neuropathic pain has not been fully elucidated. The novelty of this study lies in its correlational analysis between lumbar MRI findings and neuropathic pain screening results using the ID Pain questionnaire as a standardized clinical instrument. This approach is expected to provide a more comprehensive understanding of the relationship between structural abnormalities and neuropathic pain components in patients with LBP.

2. METHODS

This study employed an analytical observational design with a cross-sectional approach to examine the association between lumbar vertebral magnetic resonance imaging (MRI) findings and neuropathic pain in patients with low back pain (LBP). Secondary data were obtained from the medical records of patients who underwent lumbar MRI between January and December 2024. Data collection and analysis were conducted in October 2025. The sample size was determined using the Slovin formula with a margin of error of 5%. The study population consisted of LBP patients who met the inclusion criteria, namely: (1) a clinical diagnosis of LBP, (2) having undergone lumbar vertebral MRI examination, and (3) having complete ID Pain questionnaire data documented in the medical records. Patients were excluded if they had a history of severe spinal trauma, spinal malignancy or infection, central neurological disorders, or incomplete medical records. The data source consisted of medical records, while the research instruments included lumbar vertebral MRI for the identification of structural abnormalities (as the gold standard for anatomical abnormalities, not for the diagnosis of neuropathic pain) and the ID Pain questionnaire as a patient-reported neuropathic pain screening tool with a cut-off score of ≥2, documented in the patients' medical records. The association analysis was performed using the Chi-square test with a significance level of $p < 0.05$ using IBM SPSS Statistics.

The data source comprised patients' medical records containing clinical information and imaging results. Lumbar vertebral MRI was used to identify structural abnormalities, including herniated nucleus pulposus (HNP), spinal stenosis, spondylosis, and spondylolisthesis. MRI served as the gold standard for detecting anatomical abnormalities, but not for diagnosing neuropathic pain. Neuropathic pain was assessed using the ID Pain questionnaire, a validated patient-reported screening tool. A cut-off score of ≥2 indicated a high likelihood of neuropathic pain. All questionnaire results were retrieved from documented anamnesis in the medical records. Data processing and statistical analyses were performed using IBM SPSS Statistics software.

Research Procedure

The study was conducted at RSUD Prof. Dr. Margono Soekarjo in October 2025. Secondary data were collected from radiology reports of lumbar MRI examinations performed between January and December 2024. Radiologist interpretations were used to classify structural abnormalities into HNP, spinal stenosis, spondylosis, and spondylolisthesis. Neuropathic pain status was determined based on documented ID Pain questionnaire results recorded during clinical anamnesis. All eligible data were extracted, coded, and classified according to the study variables. The dataset was then analyzed to evaluate the association between lumbar vertebral MRI findings and neuropathic pain in patients with LBP. Ethical approval was obtained prior to data collection, and patient confidentiality was strictly maintained through data de-identification.

The collected data were analyzed using univariate and bivariate analyses. Univariate analysis was performed to describe the distribution of demographic data of the research subjects and the research variables, which were presented in the form of frequency distribution tables. The

demographic data of the research subjects included age and sex, while the research variables included lumbar vertebral MRI findings and the results of neuropathic pain assessment based on documented anamnesis data. Bivariate analysis was conducted to examine the relationship between lumbar vertebral MRI findings and the incidence of neuropathic pain in patients with low back pain. The statistical test used was the Chi-square test. The results of the analysis were presented in the form of p-values to determine the significance of the relationship between variables.

3. RESULT AND DISCUSSION

Result

The analysis was conducted on 68 samples that met the inclusion and exclusion criteria, and univariate, bivariate, and multivariate analyses were performed.

Table 1. Distribution of Research Subjects Based on Sex and Age

Characteristic	Frequency	Percentage
Sex		
Male	29	42,6%
Female	39	57,4%
Age (Years)		
<40 years	7	10,3%
>60 years	29	42,6%
40-60 years	32	47,1%

Among the 68 patients included in this study, the majority were aged 40–60 years, comprising 32 individuals (47.1%). Overall, these findings indicate that low back pain (LBP) was most commonly observed in older adults. Female patients were more frequently affected than male patients. This distribution may be associated with biological and hormonal factors, as women are generally reported to have greater sensitivity to musculoskeletal pain. In addition, age-related hormonal changes, particularly fluctuations in estrogen levels, may influence bone density and joint stability, thereby increasing susceptibility to LBP in middle-aged and older women.

Table 2. Lumbar Vertebral MRI Findings of HNP, Stenosis, Spondylosis, Spondylolisthesis

HNP	Frequency	Percent
Absent	10	14,7
Present	58	85,3
Total	68	100,0
Stenosis	**Frequency**	**Percent**
Absent	29	42,6
Present	39	57,4
Total	68	100,0
Spondylosis	**Frequency**	**Percent**
Absent	42	61,8
Present	26	38,2
Total	68	100,0
Spondylolisthesis	**Frequency**	**Percent**
Absent	55	80,9
Present	13	19,1
Total	68	100,0

Total 68 patients who underwent lumbar MRI examination, the majority demonstrated HNP abnormalities, accounting for 58 cases (85.3%). These findings confirm that HNP is the most frequently identified abnormality among patients with low back pain at RSUD Prof. Dr. Margono Soekarjo. In addition, stenosis was identified in 39 cases (57.4%), indicating that spinal canal narrowing is a relatively common finding. Spondylosis was recorded in 26 cases (38.2%), suggesting that the majority of patients did not exhibit degenerative changes in the lumbar segment. Meanwhile, only 13 patients (19.1%) experienced spondylolisthesis, making it the least frequent abnormality compared to other lumbar vertebral abn ormalities in this study.

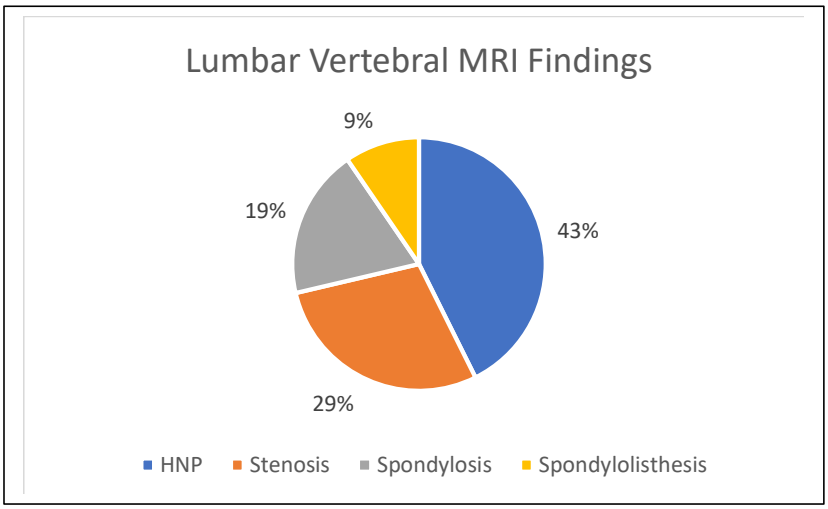

Figure 1. Lumbar Vertebral MRI Findings

Figure 1 shows that out of a total of 68 patients, there were 58 (43%) cases of HNP, 39 (29%) cases of stenosis, 26 (19%) cases of spondylosis, and 13 (9%) cases of spondylolisthesis. These findings demonstrate that HNP was the most prevalent lumbar vertebral abnormality compared to stenosis, spondylosis, and spondylolisthesis in the studied patient population.

Table 3. Neuropathic Pain Findings

Neuropathic pain	Frequency	Percent
Absent	23	33,8
Present	45	66,2
Total	68	100,0

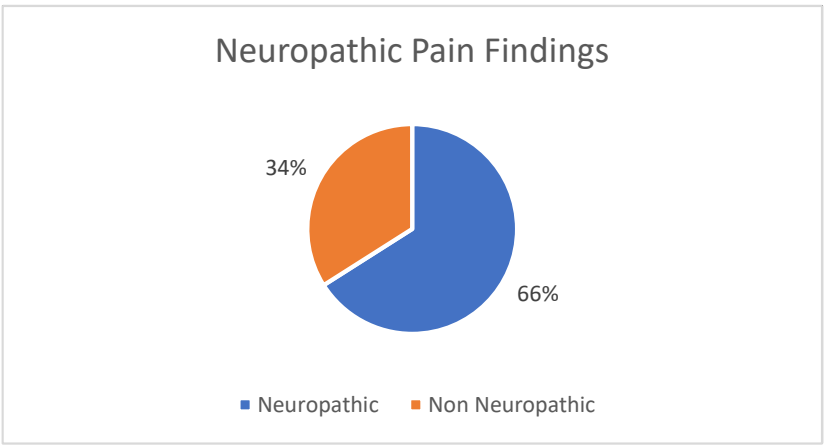

Figure 2. Neuropathic Pain Findings

Figure 2 shows that out of a total of 68 patients, the majority of patients with low back pain experienced neuropathic pain. The findings indicate that 45 (66%) patients were classified

as having neuropathic pain, whereas 23 (34%) patients did not exhibit neuropathic pain. These results suggest that neural involvement represents a dominant component in patients with low back pain.

Table 4. Cross Tabulation Between Variables Using the Chi-Square Test

Variable	Category	Neuropathic	Non Neuropathic	p Value	Interpretation
HNP	Yes	35	23	0.014	Significant
	No	10	0		
Stenosis	Yes	20	19	0.003	Significant
	No	25	4		
Spondylosis	Yes	12	14	0.006	Significant
	No	33	9		
Spondylolisthesis	Yes	13	0	0.004	Significant
	No	32	23		

The study results demonstrated that the four spinal conditions HNP, stenosis, spondylosis, and spondylolisthesis were significantly associated with the occurrence of neuropathic pain, as indicated by all p-values < 0.05. Therefore, each of these conditions significantly contributed to an increased risk of neuropathic pain in patients.

Table 5. Association Between Variables Using Logistic Regression Analysis

Variable	Sig.
Age (years)	0.376
Sex	0.486
HNP	0.054
Stenosis	0.004
Spondylosis	0.048
Spondylolisthesis	0.040

In the multivariate logistic regression analysis, stenosis demonstrated the most significant association with neuropathic pain (p = 0.004), followed by spondylolisthesis (p = 0.040) and spondylosis (p = 0.048). Therefore, stenosis was identified as the strongest independent factor in predicting the occurrence of neuropathic pain among patients with low back pain at RSUD Prof. Dr. Margono Soekarjo.

Discussion

The predominance of patients within the 40–60-year age group highlights the strong contribution of degenerative spinal processes to the development of low back pain (LBP). This finding aligns with previous studies by Howay et al. (2021) and Yelmaiza et al. (2021), which reported a progressive increase in LBP incidence during the fourth to sixth decades of life. Age-related structural deterioration—including reduced intervertebral disc hydration, decreased nucleus pulposus elasticity, and vertebral column stiffness—likely predisposes individuals to mechanical instability and nerve root irritation. These degenerative changes may not only initiate nociceptive pain but also facilitate the transition toward neuropathic mechanisms through chronic neural compression and inflammatory activation.

The higher proportion of female patients in this study further supports the hypothesis that biological and hormonal factors influence LBP susceptibility. Postmenopausal estrogen decline has been associated with decreased bone mineral density and altered lumbar biomechanics, potentially increasing vulnerability to disc degeneration and segmental instability. However, it is also important to consider that pain perception differences and healthcare-seeking behavior may partially contribute to the observed sex distribution.

Herniated nucleus pulposus (HNP) was identified as the most prevalent lumbar abnormality, reinforcing its established role as a major structural contributor to LBP. The extrusion or

protrusion of nucleus pulposus material through a weakened annulus fibrosus can directly compress adjacent nerve roots and trigger neuropathic pain. Beyond mechanical compression, biochemical factors may also play a critical role. Degenerated disc material has been shown to release pro-inflammatory mediators that sensitize dorsal root ganglion neurons, amplifying pain transmission. Therefore, the high proportion of HNP in this study supports the concept that disc degeneration represents a central mechanism in neuropathic LBP.

Spinal stenosis and spondylosis were also frequently observed. Chronic narrowing of the spinal canal in stenosis produces sustained neural compression, which may induce ischemia, demyelination, and axonal injury. This prolonged mechanical and inflammatory insult likely explains the strong association between stenosis and neuropathic pain observed in both bivariate and multivariate analyses. Notably, stenosis emerged as the most influential independent predictor in logistic regression analysis, suggesting that chronicity and extent of neural compromise may be more critical determinants of neuropathic transformation than disc herniation alone.

Although spondylosis is often considered a common age-related degenerative change, its contribution to neuropathic pain should not be underestimated. Osteophyte formation and reduced intervertebral disc height may gradually narrow neural foramina, leading to intermittent or chronic nerve root irritation. The variability in clinical presentation suggests that the relationship between structural degeneration and neuropathic pain is likely multifactorial and influenced by the degree of neural involvement.

Interestingly, all patients with spondylolisthesis in this study exhibited neuropathic pain, despite its lower overall prevalence. Vertebral displacement may create significant foraminal narrowing and segmental instability, resulting in repetitive mechanical stress on lumbar nerve roots. Chronic compression may promote axonal damage and sensory neuron hypersensitivity, thereby increasing the likelihood of neuropathic pain development. This finding underscores that although less frequent, spondylolisthesis may carry a disproportionately high neuropathic burden.

The significant associations observed between all structural abnormalities and neuropathic pain ($p < 0.05$) reinforce the pathophysiological link between mechanical compression and neuroinflammatory processes. The release of excitatory neurotransmitters such as glutamate, substance P, and inflammatory cytokines likely contributes to peripheral and central sensitization, facilitating the persistence of neuropathic symptoms.

Overall, the multivariate findings suggest that not all structural abnormalities exert equal influence on neuropathic pain development. Spinal stenosis appears to represent the strongest independent determinant, possibly due to its chronic and progressive nature. These results emphasize the importance of early identification of stenosis in LBP patients, as timely intervention may prevent the progression toward persistent neuropathic pain.

4. CONCLUSION

These findings indicate that degenerative lumbar spine abnormalities are significantly associated with the development of neuropathic pain in patients with low back pain, with spinal stenosis emerging as the most strongly related factor. Therefore, early identification and appropriate management of spinal stenosis are recommended for clinicians to prevent the progression of neuropathic pain, particularly in middle-aged and elderly patients.

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