



Original Research

Analyzing Spondylolisthesis in Patients with Proven Spinal Stenosis Using Plain X-Rays and Supine MRI: A Retrospective Study of Five Years

Mumtaz Ali¹, Akram Ullah¹, Ramzan Hussain¹, Hanif Ur Rahman¹, Sajid Khan¹
Aafaq Ahmad Qarnain Khalil², Amjad Ali³, Abdul Haseeb Sahibzada¹

¹Ali Institute of Neurosciences, Irfan General Hospital, Peshawar

²Prime Teaching Hospital, Peshawar

³Hayatabad Medical Complex, Peshawar – Pakistan

ABSTRACT

Objective: This study aimed to evaluate the frequency of cases in which patients were diagnosed with lumbar spinal stenosis using MRI and later were categorized as having spondylolisthesis when evaluated through plain X-rays.

Material and Methods: This retrospective study was conducted at the Ali Institute of Neurosciences, Irfan General Hospital from 2017 to 2022. All those patients were included in the study who underwent lumbar spine MRI between 2017 and 2022 with evident findings of spinal stenosis, patients who subsequently underwent plain X-rays of the lumbar spine, and patients with available medical records and imaging data for review. While all those were excluded who did not undergo plain X-rays following MRI. Data was analyzed using SPSS version 22. Descriptive statistics, such as frequencies and percentages, were used to summarize the categorical data while mean and standard deviation were reported for numerical data.

Results: The mean age of the study population was 45 years, with a range from 26 to 65. Among the patients included in the study (1156), 380 were the cases missed initially on MRI and later diagnosed with spondylolisthesis on plain X-rays. This corresponds to a frequency of 33% of misdiagnosed spondylolisthesis cases based on MRI.

Conclusion: This study highlights that the frequency of missed spondylolisthesis cases on lumbar spine MRI was one-third of the cases and the importance of additional imaging modalities, such as plain X-rays, for accurate diagnosis.

Keywords: Spondylolisthesis, Spinal Stenosis, Plain X-rays, Retrospective Study.

Corresponding Author: Ramzan Hussain
Ali Institute of Neurosciences, Irfan General Hospital,
Peshawar
Email: yousha223@gmail.com

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INTRODUCTION

Degenerative spinal pathology, including adult-onset backache, can be attributed in part to degenerative lumbar spondylolisthesis (DSL). Degenerative alterations in the lumbar spine cause the cranial vertebra to slip over the caudal vertebra in DSL. There is no pars interarticularis deficiency, in contrast to spondylolytic spondylolisthesis. Furthermore, the neural arch and the vertebral body of the sliding segment are not separated and several patients may be asymptomatic.¹⁻² Owing to the disease's natural course, DSL patients can exhibit a wide range of clinical signs and symptoms, from asymptomatic individuals to highly varied cases. Furthermore, the clinical appearance may be substantially influenced by other related degenerative disorders. Patients might present with combinations of neurogenic claudication, radiculopathy, axial back pain, and varying degrees of loss of movement and senses, as well as other neurologic symptoms.³

Patients with degenerative spondylolisthesis frequently present in a way that resembles the characteristics of lumbar spinal stenosis. Patients report the clinical presentations of lower extremities radiculopathy, neurogenic claudication, and low back pain.⁴ Neurogenic claudication, leg discomfort, and/or numbness are frequent symptoms of spinal stenosis and degenerative spondylolisthesis (DS), which are made worse by standing or walking.⁴ Acquired degenerative alterations that gradually restrict the spinal canal result in Lumbar spinal canal Stenosis. With advancing age, these alterations become more prevalent, with stenosis most typically affecting the L4-L5 level, followed by L3-L4, L5-S1, and L1-L2.⁶ The well-known cause of lumbar central canal, lateral recess, and neural foraminal stenosis is attributed to lumbar spondylolisthesis, which can include anterolisthesis, Laterolisthesis or retrolisthesis, the symptoms of which are worsened in upright weight-bearing position.⁷

The most common noninvasive diagnostic technique used routinely in evaluating lumbar

pathologies is magnetic resonance imaging (MRI). However, the severity of pathologic abnormalities in the lumbar spine may be underestimated by standard MRI, even it sometimes leads to misdiagnosis if findings are not incorporated with clinical features and other diagnostic modalities such as plain X-rays.⁸⁻⁹ The incidence of Degenerative Spondylolisthesis in lumbar degenerative disease will be greatly underestimated by supine MRI examination alone. Evidence suggests that the combination of magnetic resonance imaging (MRI) and standing radiographs is the most accepted way to diagnose degenerative spondylolisthesis (DS) with lumbar stenosis or two isolate both conditions.¹⁰ even though computed tomography (CT), magnetic resonance imaging (MRI), and bone scans help locate the lesion site,⁵ the lateral lumbar plain film radiographs in conjunction with flexion and extension views to evaluate spondylolisthesis and the level of spinal instability are used. These particular radiographic views are simple to obtain in a clinic or community hospital and offer timely results at a low cost.¹¹

This study aimed to evaluate the frequency of cases in which patients were diagnosed with lumbar spinal stenosis using MRI and later were categorized as having spondylolisthesis when evaluated through plain X-rays.

MATERIAL AND METHODS

Study Design/setting/Duration:

This retrospective study was conducted from 2017 to 2022 at Ali Institute of Neurosciences, Irfan General Hospital Peshawar. After obtaining ethical approval from the hospital's Institutional Review Board, medical records and imaging data of patients who had both an MRI and a follow-up plain X-ray were examined.

Inclusion Criteria

Patients who had lumbar spine MRIs conducted

between 2017 and 2022 with clear results of spinal stenosis on MRI, as well as those who later had plain lumbar X-rays, were included in the study. Patients with reviewable imaging data and available medical records were included.

Exclusion Criteria

Patients with incomplete medical records or imaging data, those with a history of trauma or known congenital spinal abnormalities, and those with a history of spondylolisthesis were all excluded. Also, those patients who did not have plain X-rays taken after an MRI were excluded from the study.

Relevant demographic and clinical data, such as age, sex, presenting symptoms, and clinical indications for imaging, were taken from the medical records of included patients. To determine instances when spondylolisthesis was not initially recognized, MRI reports were examined. The frequency of misdiagnosed spondylolisthesis cases on MRI was calculated by dividing the number of cases initially missed by the total number of patients who underwent both MRI and plain X-rays.

Radiological Assessment

Skilled radiologists who were unaware of the ultimate diagnosis assessed the MRI and plain X-ray images. Spondylolisthesis was diagnosed on MRI based on the existence of anterior or posterior displacement of one vertebral body relative to another, facet joint degeneration, and spinal canal stenosis assessments, as well as intervertebral disc space narrowing. Plain X-rays were examined for the signs of spondylolisthesis such as any sign of fractures, loss of spinal alignment, and vertebral slippage.

Data Analysis

Data analysis was done with SPSS version 22. While mean and standard deviation were presented for

numerical data, descriptive statistics like frequencies and percentages were employed to summarize the categorical data.

RESULTS

Demographic/Patient Characteristics: In this retrospective investigation, 1156 patients who had lumbar spine MRIs between 2015 and 2022 and then conducted plain X-rays were included in total. The study population ranged in age from 26 to 65, with a mean of 45. There were 405 (35%) females and 751 (65%) males (Table 1).

Table 1: Demographic and patient characteristics:

| Demographic/Patient Characteristics | Frequency/Percentages |
|-------------------------------------|--------------------------------------|
| Gender | Male: 751 (65%) Female: 405(35%). |
| Age | Mean: 45 years Range: 26-65 |

Clinical Presentation: Based on a clinical presentation analysis of individuals who were misdiagnosed with spondylolisthesis, lower back pain (n=1156) and radiating leg pain (n=879) were the most common complaints. In 647 (56%) of the cases, additional related symptoms such as numbness, tingling, or weakness in the lower extremities were reported (Table 2).

Table 2: Clinical presentation.

| Clinical Presentation | Frequency/Percentages |
|--|-----------------------|
| Low back pain | 1156 (100%) |
| Radiating leg pain | 879 (76%) |
| Numbness, tingling, or weakness in the lower extremities | 647(56%) |

Frequency of Missed Cases through Radiological Findings: Of the total participants in the study, 381 cases were found to have spondylolisthesis on conventional X-rays after

being initially missed on MRI. This translates to a frequency of 33% of MRI-based cases of spondylolisthesis that are misdiagnosed (Table 3).

Table 3: Frequency of Missed Cases through Radiological Findings.

| Variables | Frequency/Percentages |
|---|-----------------------|
| Missed Cases | 381 (33%) |
| Accurately diagnosed cases as spinal stenosis | 775 (67%) |

Subtypes of Spondylolisthesis: Further analysis was conducted on the subtypes found on plain X-rays in the patients of misdiagnosed spondylolisthesis. Isthmic spondylolisthesis was identified in 150 patients (39%) of the cases that were overlooked. There were 200 patients (53%) with degenerative spondylolisthesis. Thirty-one patients (8%) of the missed cases, had other less prevalent subtypes such as pathological or traumatic spondylolisthesis.

Clinical Indications for Initial MRI Imaging

The clinical indications for undergoing MRI imaging were also determined. Of the patients with misdiagnosed spondylolisthesis, 50% were referred to MRI for assessment of radicular symptoms, and 45% had back pain as their primary complaint. In 5% of the cases that were overlooked, other indicators such as trauma or a possible spinal disease were the indications.

DISCUSSION

In this study, the subtypes of spondylolisthesis that were missed on initial imaging were assessed, as well as the prevalence of misdiagnosed spondylolisthesis on lumbar spine MRI. Our study's findings showed that nearly one-third of the cases had a spondylolisthesis diagnosis made by plain X-rays but had been overlooked in the original

supine MRI lumbar spine scan.

The study population's demographics showed that 1156 patients were included in the analysis, with a higher percentage of men (65%) than women (35%). This gender distribution is in line with other earlier research that found that men were more likely than women to develop spondylolisthesis.¹² While in contrast, one other study reported the prevalence of degenerative spondylolisthesis and its ratio greater in females than in men (3:1).¹³ The mean age of the study population was 45 years, falling within the range reported in the literature.¹⁴

In terms of clinical presentation, lower back discomfort (100%) and radiating leg pain (76%) were the most often reported symptoms in individuals with misdiagnosed spondylolisthesis. These results are consistent with earlier research showing that back pain is a common complaint among people with spondylolisthesis.¹⁵ Furthermore, associated symptoms, such as numbness, tingling, or weakness in the lower extremities, were noted in more than half of the cases, indicating the potential involvement of nerve compression due to spondylolisthesis.¹⁶

A comparison between the initial lumbar spine MRI and subsequent plain X-rays revealed that 33% of cases were overlooked. This result is in line with earlier research that found a notable percentage of MRI cases of spondylolisthesis were missed or misdiagnosed. The study also showed that, according to flexion-extension radiographs, 109 of the 416 patients who were eligible for an investigation had DS at levels L4-L5, L5-S1, or L3-L4. Of those, only 78 were shown to have a corresponding spondylolisthesis by MRI, meaning that 31/109 (28%) of the DS levels were not explained.¹⁷ It highlights the importance of performing additional imaging modalities, such as plain X-rays, to ensure accurate diagnosis and avoid overlooking cases that may have significant clinical implications.

Degenerative spondylolisthesis was found to be the most prevalent subtype, accounting for

52.6% of the missed cases, when the subtypes of spondylolisthesis were analyzed in the missed instances. 39.5% of the cases that were overlooked had isthmic spondylolisthesis, whereas 7.9% of the patients had less common subtypes, such as traumatic or pathological spondylolisthesis, which is in line with previous research work.¹⁸ There is an ongoing debate over the epidemiology of lumbar degenerative spondylolisthesis (DS). To better understand the frequency of DS in the general community, a systematic review was conducted in 2017, the findings of which indicated that DS prevalence is highly age- and gender-specific. Few women and men will experience DS before the age of 50. Both men and women start to have DS after the age of 50, with women experiencing it at a faster rate than males.¹⁹ It emphasizes the importance of identifying these subtypes accurately to guide appropriate management strategies.

After looking at the clinical criteria for initial MRI imaging, it was discovered that the majority of the time, radicular symptoms and back pain were the main causes of ordering an MRI. This is consistent with the typical presenting symptoms of spondylolisthesis and suggests that radiological results should be carefully evaluated to prevent cases from being missed that could be critical for patient management.²⁰

There are several limitations although the current study offers insightful information about the subtypes found and the prevalence of missing spondylolisthesis cases. Because this study was retrospective in design, selection bias, and other possible confounding factors may have affected the results. Furthermore, the results are based on the experience of a single center; hence, greater sample sizes and additional multi-site research are necessary to add to the valuable literature. Also, there is a need to conduct high-quality and prospective studies to avoid the possibilities of certain confounding factors.

CONCLUSION

This study emphasizes the significance of other imaging modalities, such as plain X-rays, for proper diagnosis and the frequency of missed spondylolisthesis patients on lumbar spine MRI, which accounted for one-third of the cases in our study. To make the best possible decision for better patient care, the results of the supine MRI should not be used solely; instead, they should be combined with the clinical findings with those from other diagnostic modalities, such as the CT scan and plain X-rays.

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Additional Information

Disclosures: Authors report no conflict of interest and all data can be provided if needed.

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Human Subjects: Consent was obtained by all patients/participants in this study.

Conflicts of Interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

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Data Sharing Statement: For data sharing, interested researchers can contact the corresponding authors.

AUTHORS CONTRIBUTIONS

| Sr.# | Author's Full Name | Intellectual Contribution to Paper in Terms of: |
|------|---|--|
| 1. | Mumtaz Ali & Akram Ullah | 1. Study design and methodology. |
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| 4. | Mumtaz Ali, Amjad Ali & Hanif ur Rahman | 4. Analysis of data and interpretation of results. |
| 5. | Mumtaz Ali, Abdul Haseeb Sahibzada & Ramzan Hussain | 5. Literature review and referencing. |
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