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Original article

Examining Consistency Among Observers in MRI Assessment of Lumbar Disc Disease and its Clinical Consequences: An In-Depth Investigation in a Developing Nation

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Abstract

This study aims to investigate the inter-observer consistency among two qualified neuro-radiologists and a neurosurgeon in the assessment of nerve root compression on MRI. The primary objective is to explore the consistency and discordance in their interpretations, shedding light on the reliability of radiological evaluations in identifying nerve root compression. This correlation analysis has direct implications for clinical decision-making, potentially altering the management algorithm by influencing the decision to pursue surgery or opt for a non-surgical approach. Notably, this study represents the largest series reporting such analyses from a third-world country, contributing valuable insights into the context-specific challenges and nuances associated with neuroimaging assessments in resource-constrained settings.

Keywords: ***Lumbar Disc Disease, Diagnostic Modality of Choice, MRI Interpretation, Observer Variation, Developing World.***

Introduction

Lower back pain is a pervasive issue in the adult population, frequently leading to activity limitations, and an escalating problem of work-related absenteeism [1]. For patients presenting with radiculopathy syndrome unresponsive to conservative management, the consensus is that MRI of the lumbosacral spine is a crucial diagnostic tool [2,3]. In such cases, the clinical decision to pursue surgical intervention hinges on the essential correlation of clinical findings with radiological diagnosis [4]. This correlation is not only fundamental to improving clinical outcomes and preventing unnecessary surgeries but also serves as a deterrent against the development of failed back syndrome.

While a universally accepted classification system for stratifying surgical versus non-surgical candidates with herniated lumbar discs (HLD) remains elusive, MRI has demonstrated its significant role in guiding such decisions [5]. Cheng et al. concluded that patients with severe disc herniation or severe spinal stenosis are more likely to be classified as surgical candidates compared to those with milder findings [5], a finding that has been echoed by other researchers [6]. Within the medical literature, there is substantial variation in the classification of disc degeneration [7], and controversies persist regarding the nomenclature employed in disc interpretation [8]. This issue holds paramount significance as MRI is pivotal in both diagnosing and managing lumbar disc disease [9]. The two commonly used classification systems for degenerative disc disease are the CTF and the Nordic systems [10-12]. In this study, we utilize the CTF classification to report MRI findings.

It is essential to recognize that patients often experience anxiety and concern when there is a discrepancy between the radiologist's report and the interpretation by a neurosurgeon [13]. Therefore, achieving a strong consensus between the neurosurgeon and radiologist regarding MRI interpretations is of utmost importance.

The objective of our study was to analyze the examination consistency among a team consisting of two qualified neuro-radiologists and a neurosurgeon in evaluating nerve root compression on MRI. This correlation has the potential to influence the management algorithm, either leading to a decision for surgery or suggesting a non-surgical approach, and vice versa. To the best of

our knowledge, this study represents the largest series reporting such an analysis from a third-world country.

Material and Methods

The study was conducted at the Neurosurgery and Radiology Department of Liaquat National Hospital in Karachi. The study was prospectively and it encompassed patients who presented to the clinic with complaints of back pain and radiculopathy between January 2022 and July 2022. Inclusion criteria comprised patients with clinical suspicion of herniated lumbar discs (HLD) and lumbar radiculopathy (LR) whose symptoms did not improve with conservative treatments, including physiotherapy and oral analgesics. Exclusions were made for patients with a history of previous spinal surgeries, multilevel stenosis, tumors, and infections. Additionally, individuals below 18 and above 65 years of age were excluded.100 consecutive patients who met the inclusion criteria were added in the study.

Imaging for all patients was conducted using 1.5 Tesla GE (General Electric) MRI machines. The standard imaging protocol involved T2 weighted sagittal and axial cuts. Radiological interpretation was carried out using RadiAnt Dicom Viewer, version 2022.1 (64-bit). The study involved two fellowship-trained radiologists, each possessing over five years of experience in reporting spine MRIs, and a neurosurgeon with similar experience who had received training from an accredited institution in Neuro-radiology and Neurosurgery. All participants had access to the patients' medical histories and symptoms and were tasked with independently interpreting the MRI images and documenting their findings on a Performa.

The primary complaints typically revolved around leg pain and/or paresthesia, which radiated to the ankle or foot and were more pronounced than low back pain. The pain was often intermittent and improved with positional or postural changes. The neurosurgeon specifically sought signs of root irritation, which included assessing straight leg raising (SLR) and considering the reproduction of leg pain as a key indicator of nerve root irritation. Signs of root compression were identified when muscle weakness, atrophy, sensory deficits, and reduced reflexes occurred in a myotomal or dermatomal pattern. All these clinical findings were meticulously documented for subsequent correlation with the MRI images.

A Performa was designed to collect comprehensive patient data, encompassing age, gender, symptom characteristics, and MRI interpretations as assessed by the neuroradiologists and the neurosurgeon. The focus of the interpretation was on identifying the most significant disc level responsible for the clinical symptoms. Discs and nerve roots from L1-2, L2-3, L3-4, L4-5, and L5-S1 were meticulously evaluated for nerve compression attributable to disc herniation. Each level and side (right or left) were assessed separately for the presence of disc herniations or otherwise. Notably, all three participants independently evaluated the imaging, with no knowledge of each other's interpretations. Separate proformas were used for each radiologist and the neurosurgeon to minimize bias. As this part of the study involved solely the collection of data, it was conducted under a waiver of consent. Each member documented their findings regarding the most significant disc level and the side (right or left) causing the symptoms independently. The interobserver agreement was assessed using the kappa coefficient. Subsequently, clinical examination findings were incorporated into the proforma and correlated with the MRI findings. Data analysis was conducted using SPSS version 22.

Results

During the study period, a total of 312 patients were recommended for MRI lumbosacral spine evaluation. However, only 100 of these patients met the stringent inclusion criteria, comprising 49 males and 51 females. The mean age of the study participants was 49.09 (+/- 14.248) years.

The most frequently reported symptom is "bilateral leg pain or numbness" i.e. 34%. The distribution of presenting complaints is summarized in Table 1.

There is good agreement between radiologist 1 and the neurosurgeon (Kappa= 0.750). For radiologist 2, there is excellent agreement with the neurosurgeon (Kappa= 0.86). The consistency suggests that both radiologists are reliable in identifying significant spinal levels compared to the neurosurgeon.

In some cases, there is perfect agreement between radiologist 1 and the neurosurgeon. For example, when the neurosurgeon identified "right l3-4" as the most significant level, radiologist 1 also identified "right l3-4" in all cases (100% agreement). However, in some cases, there is disagreement. Same is the case with agreement between radiologist 2 and the neurosurgeon that in some cases i.e level "right l3-4" (100% agreement). However, in other cases, there is disagreement. Table 2(Radiologist 1 and Neurosurgeon) and Table 3 (Radiologist 2 and Neurosurgeon).

Table 1: Presenting Compliant

Presenting complaint				
Valid	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Low back pain	18	18.0	18.0	18.0
Right leg pain or numbness	25	25.0	25.0	43.0
Left leg pain or numbness	23	23.0	23.0	66.0
Bilateral leg pain or numbness	34	34.0	34.0	100.0
Total	**100**	**100.0**	**100.0**	

Table 2: Radiologist 1 and Neurosurgeon

Radiologist 1 most significant level				
Valid	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Right l3-4	12	12.0	12.0	12.0
Left l3-4	8	8.0	8.0	20.0
Right l4-5	26	26.0	26.0	46.0
Left l4-5	28	28.0	28.0	74.0
Right i5-s1	9	9.0	9.0	83.0
Left l5-s1	17	17.0	17.0	100.0
Total	100	100.0	100.0	

Table 3: Radiologist 2 and Neurosurgeon

Radiologist 2 most significant level				
Valid	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Right l3-4	10	10.0	10.0	10.0

Left l3-4	8	8.0	8.0	18.0
Right l4-5	26	26.0	26.0	44.0
Left l4-5	29	29.0	29.0	73.0
Right l5-s1	11	11.0	11.0	84.0
Right l5-s1	16	16.0	16.0	100.0
Total	100	100.0	100.0	

Discussion

Lower back pain (LBP) ranks among the most prevalent reasons for seeking medical care, with substantial societal and individual consequences, including high healthcare costs and reduced productivity [14,15]. The incidence of LBP, although varying among epidemiological studies, is substantial, with a lifetime prevalence ranging from 60-90% [16]. In the majority of cases, no identifiable pathoanatomical origin can be pinpointed, constituting a diagnostic challenge for healthcare providers [17]. Notable differentials for non-traumatic LBP encompass conditions such as prolapsed intervertebral discs, neoplasia, infections, and inflammatory arthropathies, making accurate diagnosis crucial [18]. Amongst these, degenerative disc disease and lumbar disc herniation (LDH) stands as the most common culprit [19].

Radiological investigations, primarily MRI or CT scans, come into play when persistent sciatica follows a 4- 6-week conservative treatment period with physical therapy and oral analgesics [20] MRI, in particular, is the gold standard for evaluating relationship of soft tissues and neural structures, offering excellent insight into nerve root compression [10,21-24]. The management of patients with an established lumbar radiculopathy (LR) diagnosis includes surgical decompression when conservative treatments prove ineffective [25].

In developing countries, where healthcare infrastructure may not be as robust, the availability of radiological machinery and neuroradiologists can be limited, impacting the diagnosis and management of sciatica patients. [26,27]. In developing countries, where healthcare infrastructure may not be as robust, the availability of radiological machinery and neuroradiologists can be limited [28], impacting the diagnosis and management of sciatica patients [29]. Unwarranted radiological investigations can not only increase financial burdens [30] but also lead to unnecessary surgeries, contributing to economic strain and patient dissatisfaction [31].

In this study, we analyzed interobserver agreement between neuroradiologists and neurosurgeons, specifically focusing on assessing lumbar spine MRI findings. Our results indicated excellent agreement between neurosurgeons and radiologists, particularly when evaluating the most significant disc level.

Comparison with prior local and international studies demonstrated consistent trends of strong agreement in similar contexts, reaffirming the reliability of the Kappa statistic in measuring concordance beyond chance. While MRI is the preferred diagnostic tool for assessing disc herniation, disagreements among healthcare professionals may arise due to the lack of consensus on diagnostic criteria for herniated discs. Nonetheless, our results align with existing literature and underscore the robustness of interobserver agreement in this diagnostic context.

Our study also explored the correlation between radiologically identified nerve root compression and clinical radiculopathy syndrome, shedding light on the decision-making process. The association between radiological findings and clinical symptoms has been researched extensively in previous studies, reaffirming that MRI is an invaluable tool for identifying the anatomical source of symptoms. This correlation significantly impacts treatment decisions; when radiological assessments match clinical symptoms, it leads to more confident and informed treatment choices, including surgery when necessary. Conversely, when radiological findings do not align with clinical symptoms, the potential for treatment discrepancies is highlighted, emphasizing the importance of considering both clinical expertise and diagnostic imaging.

Our study has notable strengths, including a substantial patient population, although there are limitations such as the number of observers and the potential for bias due to variations in experience. Nevertheless, the concordance observed in our study supports the value of a well-experienced neurosurgeon's interpretation of MRI in the context of clinical findings for decision-making. This approach not only avoids the psychological impact of routine MRI reports but also leads to better functional outcomes in LBP patients. The focus on clinical reporting over image reporting has significant advantages [13].

In conclusion, our study reinforces the importance of clinical interpretation of MRI findings in the context of LBP and radiculopathy, particularly in regions with limited access to trained neuroradiologist. The concordance between neurosurgeons and radiologists and the impact of clinical correlation on treatment decisions underscore the value of integrating clinical expertise with diagnostic imaging in patient care.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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