Reliability of Magnetic Resonance Imaging Findings Interpretation in Patients with Lumbar Disk Herniation

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ABSTRACT

Purpose: The present study aimed to find reliability of magnetic resonance imaging (MRI) in patients with lumbar disk herniation.

Methods: In this cross-sectional study, 110 individuals aged 20-50 years with chronic low back pain (LBP) of more than 3 months were enrolled by nonprobability convenient sampling method. Only disk herniated patients of L4-L5 and L5-S1, diagnosed by physicians on the basis of MRI, were included in the study. Sagittal and axial MRI scans were taken and examined to rule out acute pathology. Two examiners interpreted the MRI results without knowing the results of clinical tests and questionnaires. Reliability at intra- and inter-level was done twice with the interval of 5 days. Reliabilities of findings such as affected disk level, extent of disk herniation, nerve root involvement, dehydration, and ligamentum flavum involvement were also assessed.

Results: Intra- and inter-test values for disk level were 0.87 and 0.80, for disk grade were 0.81 and 0.76, for lateral canal stenosis were 0.81 and 0.75, for dehydration were 0.81 and 0.72, for spondylolisthesis were 0.88 and 0.81, and for ligamentum flavum involvement were 0.79 and 0.75.

Conclusion: Repeatability of MRI results in patients with lumbar disk herniation at intra- and inter-level was good to excellent.

1. Introduction

Low back pain (LBP) is one of the most common problems referred to medical professionals and 70%-80% of adults experience it at some point in their lives [1]. In the industrialized countries, LBP is very common and lumbar disk degenerative disease is one of the main causes of LBP all over the world [2]. LBP may occur due to degenerative changes, Stenosis of spinal cord, neoplasm, injury, infection, and arthritic effects [3]. Lumbar disk herniation (LDH) is the main spinal degenerative dis-

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order that leads to LBP along with radiculopathy. Disk inflammation and nerve root compression together are responsible for radicular pain [4].

MRI can visualize various pathoanatomical changes in lumbar disk prolapse and is used as a gold standard test to find out how disk material, soft tissue and neural structures are interrelated, but terminologies used for the explanation of LDH and nerve root compression were confusing [5]. Despite the routine administration of MRI for patients with suspected intervertebral disk prolapse, one is not sure which MRI findings are clinically relevant, and have diagnostic as well as prognostic values [6].

At present MRI is a trustworthy modality to diagnose central and paracentral disk herniation but its reliability to diagnose LDH is not fully established. So, the present study was done to establish the diagnostic value of simple MRI to diagnose LDH, based on analyses of inter- and intra-observer reliability [7].

Proper assessment of MRI scan changes is very necessary for lumbar disk surgical procedures. Boden and others [8, 9] showed that asymptomatic patients may also show abnormal MRI. So, clinical correlation is always necessary before any surgical consideration. Patients may show clinical signs and symptoms of acute herniated disk, and yet insufficient pathology on MRI. Thus, an accurate and objective criteria could help surgeons in LDH diagnostic confirmation to qualify "substantial" herniated disk in terms of both size and location constraints [10].

2. Materials and Methods

Of the patients with LDH of both genders, 110 individuals (based on initial study results, standard deviation of 1.82 with 0.1 error and accepted confidence level of 0.90, the sample size was considered as 110), aged 20-50 years with chronic LBP for more than 3 months were chosen by non-probability convenient sampling method. The L4-L5 and L5-S1 disk herniated patients, who reported to medical and physiotherapy centers of University of Social Welfare and Rehabilitation Sciences from January 2015 to December 2015 and were diagnosed by physicians on the basis of MRI, were included in this study.

The present study was approved by the Research Committee of University of Social Welfare and Rehabilitation Sciences. In the next step, the patients having history of spinal injury, tumor, spinal stenosis at lumbar, infection, cauda equina syndrome, metabolic spinal disease, previous spinal surgery, spondylolisthesis, or any contraindication for MRI (pacemakers and metal implant, prosthesis inside the body, etc.) were excluded from this study. A thorough physical examination of abdomen, hips and sacroiliac joints were performed to rule out the cause of pain from these regions.

The patients were neither addicted to drugs nor used any pain killer or anti-inflammatory drug for the previous one week. After screening, the researchers explained the methodology, research goals, and experimental procedures to the selected participants who signed the consent forms.

Using a 1.5 Tesla machine, MRI was taken with standard protocol by means of a circular polarized spine array coil positioned under lumbar spine. This procedure included T1-weighted fast spin echo scans (TR/TE/NEX: 500 ms/12 ms/1 ms, slice width: 3 mm, matrix size: 256×516 FOV: 25 cm with angle of flip: 90°) and T2-weighted fast spin echo scans (TR/TE/NEX: 2,220 ms/ 80 ms/ 20 ms, slice width: 3mm, matrix size: 256×516 FOV: 25 cm, flip angle: 67°). MRI was performed Axially (across the lumbar disks and superior and inferior end plates of vertebrae) and sagittally. Before assessing the disk diseases, MRI scans were first looked up to rule out any inflammation, infection, neoplasm, metabolic diseases; spinal stenosis and previous surgery [11].

Two examiners with at least 8 years of experience in interpreting the MRI results were assigned for reconfirmation of images without having known the results of clinical tests and questionnaires. Reliabilities at inter- and intra-level were done twice by 2 examiners with the interval of 5 days (Table 1). The confounding factors were controlled by statistical analysis. Reliabilities for findings such as affected disk level, extent of disk herniation, nerve root involvement, dehy-dration, and ligamentum flavum involvement were also assessed.

Diagnostic method for the extent of disk herniation was as follows [11, 12]:

- **Bulging disk:** A small bulge which remained in contact with main disk and was not separated.
- **Protrusion:** A bulge that was in contact with the original disk and bridges between these two was broader than any diameter of the displaced material.
- **Extrusion:** When the diameter of the disk material beyond the inter-space is wider than the bridge, if any, that connects to the disk of origin.
- **Sequestration:** A bulge that was not in contact with the main disk and had entered the spinal canal.

Table 1. Interpretation of the strength of agreement determined with the kappa values.

Strength of agreement	Kappa value
Poor	<0.00
Slight	0.00-0.20
Fair	0.21-0.40
Moderate	0.41-0.60
Substantial	0.61-0.80
Almost perfect	0.81-1.00

PHYSICAL TREATMENTS

Statistical Package for Social Sciences (SPSS) 20 was used to analyze the data. In order to analyze the reliability and evaluate the degree of agreement between the qualitative variables, Cohen's kappa was used. Standard kappa values are as given in Table 3 [13].

3. Results

Sex distribution was comparable and among the total 110 participants, 56 were males and 54 females. Minimum age of the participants was 23 years and maximum age was 50 years with standard deviation of 9.62 years. Descriptive statistics of individual characteristics are as Table 2.

Disk protrusion in 38.20% of the participants was at L4-L5 level, in 31.80% cases at L5-S1, and in 30% at both levels. Majority of the patients (56.40%) had lateral canal stenosis, 13.60% spondylolisthesis, 79.10% dehydration, and 56.40% hypertrophic ligamentum flavum.

Based on the results obtained from the Cohen's kappa, the concordance rate of test timings and results between examiners were as follows. Intra- and inter-test values for the level of disk bulging were 0.87 and 0.80, for the extent of disk bulge were 0.81 and 0.76, for nerve root stenosis were 0.81 and 0.75, for dehydration were 0.81 and 0.72, for vertebral degeneration were 0.88 and 0.81and for yellow ligament involvement were 0.79 and 0.75 (Table 3).

4. Discussion

The findings in the present research about the reliability of MRI images were similar with some studies and different from some others. One study was performed by Lurie

Table 2. Individual characteristics.

	Minimum	Maximum	Mean	SD
Age	23	50	43.46	9.62
Height (cm)	145	188	170.27	8.70
Weight (kg)	51	115	78.0545	12.50

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Table 3. The Kappa values for intra- and inter-examiner agreements.

Variables	Inter-examiner	Intra-examiner
Disc level	0.80	0.87
Disc grade	0.76	0.81
Lateral canal stenosis	0.75	0.81
Dehydration	0.72	0.81
Spondylolisthesis	0.81	0.88
Flavum ligamentum	0.75	0.79

PHYSICAL TREATMENTS

et al. on the assessment of agreement between radiologist and physician's interpretation regarding MRI findings. Their study showed results similar to the present study by having high agreement for determining the level of lumbar disk protrusion but had low agreement (κ=0.24) regarding the extent of lumbar disk bulging [14]. Regarding the level of bulged disk in axial view (spinal stenosis), there was a high agreement (κ=0.81) between 2 examiners. One basic reason for the low agreement on the extent of "lumbar disk bulge" was due to not specifying the process of disk bulging by radiologist in 42% of cases. But in the present study (κ=0.75), both examiners assessed all the morphologic aspects of disk very carefully on the basis of defined criteria [11, 12, 15].

In other studies, Brant-Zawadzki et al. as well as Jarvik and associates had reported a moderate level of agreement in MRI results [16, 17]. Similar to the present study, Solgaard, Weishaupt and their associates had shown good agreement (κ=0.79) in their studies [14, 18]. Another reason for high agreement in these studies was using well-organized questionnaire and selection of examiners on the basis of same specialties [15]. Apparently, studies done by the examiners from different specialties showed less agreement between the examiners but other factors like lack of skills and incomplete questionnaire also affect the results [19]. In the present study, the examiners used to match their procedure with questionnaire and other variables to determine the extent of bulge disk which was also an approval of high agreement between them [19].

In a few studies, the extent of agreement between the examiners was moderate (κ=0.51) and in test timings, it was excellent (κ=0.88) for the first examiner but good for the second examiner [11]. Similar to the present study, was the findings of Raininko and associates [15].

The present study had some limitation though. It was done on affected disks of L4-L5 and L5-S1. We could include the other spine sections in this study. Also, the sample size in this research comprised 110 patients who were selected by non-probability convenient sampling method. Furthermore, most patients had more than 2 affected disks which imposed some limitations in selection of the patients. Based on the study results, we suggest that organized methodological and longitudinal research for assessing the reliability of MRI be done among experts from different specialties in the same domain. Also, the age range and sample size be increased for future studies. Finally, other areas of spine could be included for research in the future.

In conclusion, MRI plays an important role in the diagnosis of disk herniation, but it should be used for confirming the pathology after taking the patient's history and doing physical examination.

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Conflict of Interests

The authors declared no conflict of interests.

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