

# Correlation between Electrodiagnostic Study and Magnetic Resonance Imaging in Lumbar Radiculopathy Patients in a Tertiary Care Hospital

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## Abstract

**Background:** Involvement of lumbar spinal nerve root, revealed as pain, numbness or weakness in the lower limbs. Typically caused by the compression of nerve at the spine level. **Objective:** The purpose of the study was to examine the patients with clinically presumed lumbar radiculopathy and find the correlation between their electrodiagnostic study and magnetic resonance imaging. **Setting, duration and study type:** Retrospective cross-sectional study of one year (January 2019 - February 2020) in Shifa International Hospital Islamabad. **Methods:** A total of 96 patients with clinically suspected lumbar radiculopathy were included. Chi-square test, international business machines (IBM) SPSS rendition 21.0 was applied on the clinical information, electrodiagnostic study and MRI were coordinated and affectability and particularity were judged. Selected patients were undergone both electrodiagnostic study and magnetic imaging resonance in the selected 1-year span. The study investigated correlation between both diagnostic tools in lumbar radiculopathy patients. **Expected outcomes:** Anatomical specificity in seen through magnetic resonance imaging while physiological through electrodiagnostic study, which may not correlate in the evaluation of lumbar radiculopathy.

## Keywords

Electrodiagnostic, Radiculopathy, Myotome, Atrophy, Spondylolisthesis, Spinal Ligament Hypertrophy

## 1. Introduction

Lumbar radiculopathy is a common complaint seen in clinical practice, the main

source for individuals with disabilities was low back pain. The diagnosis of lumbar radiculopathy depends on the patient's physical assessment and clinical history [1]. Patient usually presents with hip and lower back pain which radiates down the back of the thigh and into the legs [2]. The main cause can be the compression of nerve root resulting in burning pain and paresthesia. Disc herniation can be a reason when the peripheral part is compressed by swelling of the disc [3]. A valid management of low back pain is knowing the exact cause and reason for the pain. Other than actual assessment, imaging strategies like MRI and symptomatic devices like electrodiagnostic study (NCS/EMG) are a useful, NCS/EMG is the particular test for nerves and muscles [4]. The most important in the evaluation of the patient is clinical examination. Both electrodiagnostic study and MRI are sensitive analysis providing different information [5]. It can be a helpful in evaluating physiologic functions rather than an anatomic snap of the spine, discs and nerves. Regardless of abnormal MRI, electrodiagnostic abnormalities can help to select the best treatment option [6]. EDX can be utilized to separate neuromuscular problems, electromyography (EMG) method is utilized to restrict the myotomal conclusion and muscle examination is needed with both needle EMG and root stimulation [7]. The level of nerve damage is an important indicator in the clinical decision-making. EMG involves detection of a possible electrodiagnostically verifiable radiculopathy, if anyone muscle in the test is abnormal the procedure must be extended. False positive result of MRI has led to a more absolute role of EDX as confirmatory test. In this study, two diagnostic tools MRI and EDX findings were compared in lumbar radiculopathy patients specifically, while correlation of diagnostic tools with the physical examinations was done earlier [8].

## 2. Objectives

To find a correlation between electrodiagnostic study and magnetic resonance imaging according to clinical assessment, such as low back pain which radiates in symptomatic lumbar radiculopathy patients.

## 3. Methodology

### 1) Setting, duration and study type:

With written consent, the institutional review board (IRB) form Ref: IRB# 385-1205-2020 was submitted to the Shifa Tameer-e-Millat University (STMU) Ethics committee. A retrospective cross-sectional study, conducted in January 2019 to February 2020.

### 2) Data size:

A sample of 96 patients was calculated through WHO sample size calculator, referred with suspicion of lumbar radiculopathy to a neurophysiology laboratory of one year (January 2019 to February 2020). The prevalence of specific sign and symptoms of the sample were compared with the abnormal EDX findings.

### 3) Inclusion and exclusion criteria:

Inclusion:

- The participants aged > 18 years.
- History/complaint of lower back pain.
- Numbness, diminished sensations, muscle atrophy, pain and weakness in lower limbs.
- The patients with indications of radiculopathy.
- The evaluation was limited to the patients with MRI of spine performed in Shifa International Hospital, Islamabad.

Exclusion:

- Patients aged < 18 years.
- The history of road traffic accident.
- Trauma patients.
- Patients with 2 or more nerve involvements.
- Patients with history of spine surgery.

## 4) Study instrument:

- a) Nihon Kohden for NCS/EMG.
- b) Siemens and Toshiba MRI machine.

Procedures and data collection sheets were filled for all the participating patients by order. Detailed information of patients, their symptoms and medical history was included in the form. For all the patients following data was entered;

- a) magnetic resonance imaging of lumbar region.
- b) electromyography.
- c) nerve conduction study.

## 5) Procedure:

The patients were referred by neurosurgeons, neurologists and orthopedic surgeons. The standardized EDX including both nerve conduction study and electromyography consisted of:

- a) One lower-limb motor and sensory conduction study.
- b) Needle EMG done with concentric needle sizes of (1.5 mm × 26 mm) and (2 mm × 26 mm). Muscles which were part of testing procedure and studies for all subjects (clinically possible) included; lumbosacral paraspinal muscles, vastus lateralis, tibialis anterior and medial gastrocnemius. Information of additional nerves and muscles study was recorded and all the data was reviewed for accuracy and consistency.

c) Non paraspinal muscles were considered abnormal which were the following;

- Positive sharp waves (positives).
- Fibrillation potentials (fibs).
- Complex repetitive discharges (CRDs).
- High amplitudes.
- Broad duration.
- Increased polyphasic motor units.
- Reduced neuropathic recruitment. Paraspinals which showed deviations were considered abnormal.

MRI and EDX both are sensitive in detecting structural and physiological lesions respectively. MRI was interpreted by the specialists, experienced in neuro-radiology. Any signs of bulging, forced out lumbar disc as well as non-disc related cause, cysts with synovial fluid, bone spurs, spondylolisthesis (slipped out vertebrae), spinal ligament hypertrophy on MRI was defined as an abnormal finding.

6) Statistical method:

The collected data was entered on IBM SPSS Statistics for Windows, Version 21.0. Descriptive data was taken as a mean and SD (standard deviation) for continuous variables and relative frequencies (%) for conditional variables for clear outcomes. Total number of patients with normal and abnormal EDX and MRI findings is shown in **Figure 1**. Chi-square test was applied and MRI/ EDX findings were assessed. P-value < 0.05 was considered substantial. Sensitivity and specificity of both the test was found by crosstabulation see **Table 1**.

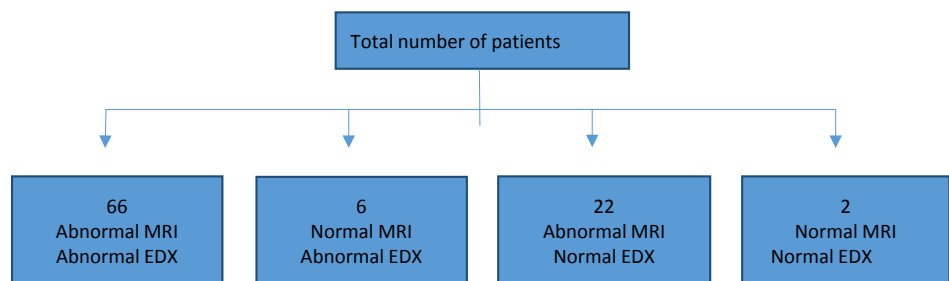
**4. Results**

A sum of 96 patients with lumbar radiculopathy experienced both electrodiagnostic study, and magnetic resonance imaging. The sample made out of 55 (57.3%) males and 41 (42.7%) females of age between 19 - 90 years with a mean age of 55.78 ± 14.5 SD years see **Figure 2**. The EDX sensitivity and specificity according to MRI results were 75% and 25%, respectively see **Table 2**. The number of abnormal EDX was 72 (75%) and normal 24 (25%) see **Figure 3** while abnormal MRI was 88 (91.6%) and 8 (8.3%) normal reported see **Figure 4**. Reduced amplitudes or nerve conduction velocity was considered evidence of radiculopathy along with prolong F-wave latency and H-reflex prolongation.

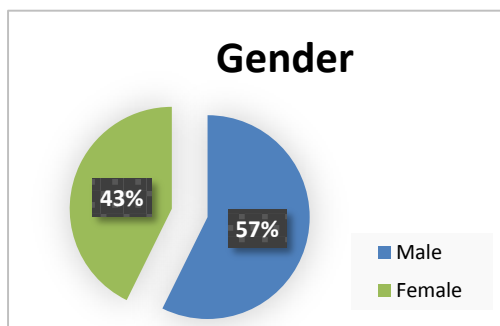
**Table 1.** EDX\*MRI crosstabulation in lumbar radiculopathy patients:

		EDX	
		Abnormal	Normal
MRI	Abnormal	66 (true positive)	22 (false positive)
	Normal	6 (false negative)	2 (true negative)

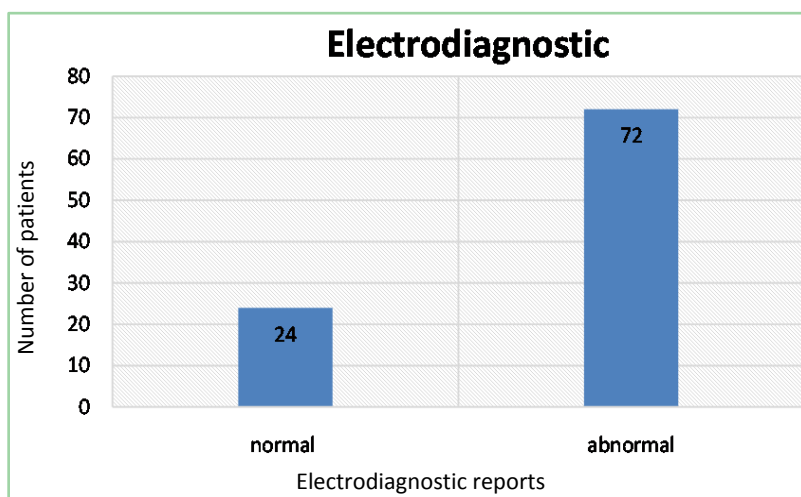
P-value 0.73 (>0.05), which is insignificant.



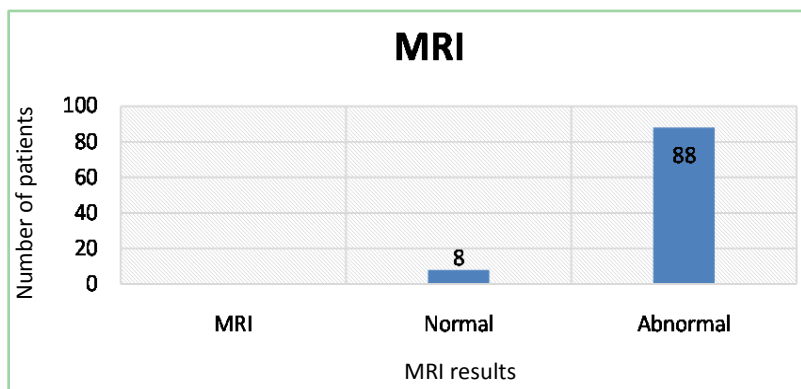
**Figure 1.** Total number of abnormal and normal EDX and MRI patients.



**Figure 2.** Gender distribution of the lumbar radiculopathy patients.



**Figure 3.** Electrodiagnostic test findings of lumbar radiculopathy patients.



**Figure 4.** MRI findings in lumbar radiculopathy patients.

**Table 2.** Sensitivity, specificity, positive predictive and negative predictive value of EDX and MRI of lumbar radiculopathy patients.

Study	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %
EDX	91.6	8.3	75	25
MRI	75	25	91.6	8.3

Chi Square test was applied to pass judgment on the relation between MRI and EDX which gives the huge estimate of 0.73 ( $>0.05$ ) with 95% confidence interval which shows no significant relationship among MRI and EDX. This reflects there is no significant contrast between Electrodiagnostic study, and Magnetic Resonance Imaging in assessing Lumbar Radiculopathy.

## 5. Discussion

Yousif *et al.* (2020) in Sudan investigated the correlation between physical examination, MRI and NCS, while the study we conducted was based on NCS/EMG and MRI of patients based on their physical examination, and history of back ache. Their results revealed there is no significant correlation between the MRI and EDX study while physical examination and MRI do correlate. MRI findings showed higher abnormalities as compared to EDX findings [8]. In our study, nerve compression at a root level was considered radiologically abnormal. MRI and EDX are corresponding to one another, and it is appropriate to add both EDX and MRI studies to detect abnormalities. The common faced abnormality in NCS was prolongation of H-reflex and F-wave latency. Other abnormalities seen were reduced amplitudes and conduction velocities. The current study additionally did not show a measurable relation between MRI and EDX, results demonstrated 75% abnormal EDX study compared with 56.7% patients also resembles the findings showed in Yousif *et al.* and 58% abnormal findings in study by Soltani *et al.* [9].

Study revealed distinct findings of both NCS and EMG and considered as it adds further diagnostic information [7]. This correlated to our study as both NC and EMG were equally important in diagnosis. Dillingham *et al.* conducted a study that also showed abnormal paraspinal findings in their study in which they correlated EMG with MRI [10]. Most of the abnormal findings encountered in NCS were prolonged or absent H-reflex and EMG mostly showed abnormal paraspinal findings which resemble the previous study.

Karen Bar *et al.* (2013) examined muscles individually using neuropathic definition which gives higher identification rate [11] and this correlates to our conducted study as muscles and nerves of the complaining side were assessed individually. This explained the fact that MRI is involved mainly with structural abnormalities and EDX with physiological abnormalities. Our study showed that EDX has lower specificity compared with MRI findings in contrast to the previous study while MRI showed higher sensitivity compared with EDX, which correlates with the findings of a previous study in which they compared EMG, MRI and Physical examination [12].

The main limitation in diagnostic studies of nerve root inclusion is the non-appearance of a benchmark due to the inborn limits of all diagnostic techniques even effective findings [13].

Our study supports the current act of reflecting MRI as the highest quality level of examination in detecting the reason of clinical radiculopathy, being very

delicate in detecting anatomical irregularities and relates with clinical findings. Imaging study in contrast to EDX cannot define the severity of axon loss, it cannot reveal the prognosis. Nerve conduction studies in EDX are noninvasive tests and can be used to follow patients' progression over time. There were certain limitations related to retrospective study, physical examination data was obtained from the history noted in patients' profile. Secondly patients undergone MRI and EDX studies in Shifa International Hospital were considered. Those who had EDX lumbar radiculopathy findings but did not go through an MRI were not included vice versa. Both the tests, MRI and EDX are dependent upon restrictions which influence its diagnostic sensitivity and specificity.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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