Clinical Significance of Electrodiagnosis in L_5 - S_1 DISC Herniation

***Narkeesh, **N.K. Multani, ***S.K. Verma**

* Reader, Dept. of Physiotherapy, ** Prof & Head, Dept. of Physiotherapy, ***Prof & Head, Dept. of Sports Science, Punjabi University, Patiala (Punjab)

Abstract

This was an experimental and comparative study done to see the effect of L5 – S1 disc herniation on MNCV, its latency difference and H reflex latency and to prove the efficacy of electrodiagnosis as a reliable tool to assess the S1 radiculopathy due to disc herniation. MNCV, its latency difference and H reflex latency was compared between affected and unaffected sides of 12 symptomatic and MRI diagnosed subjects. Affected side data was also compared with normative data. CONCLUSION: MNCV and H latency showed significant changes between affected and unaffected sides but M latency presented insignificant results. Comparison of data with normative data also showed significant changes, thus proving electrodiagnosis as a reliable adjunct to MRI.

Key Words

MRI, Electrodiagnosis, MNCV, H-reflex, S_1 Radiculopathy

Introduction

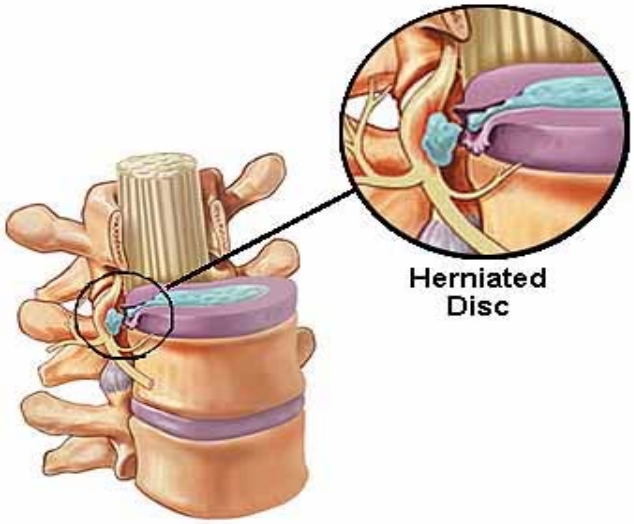
Backache is a national, personal and clinical problem because it is experienced by most of the populations at some time and is a drain on the nation's resources, personal because it can remain a major unsolved dilemma, but methods of treatment are conflicting and often unrewarding(A VAISHNAVI). There are many causes of low back pain (LBA) and it is mainly related to the disc pathologies. As a result of wear and tear on the spine, ligaments, and disks, a disk may begin to protrude or collapse and put pressure on the nerve root leading to a leg or foot, causing pain in those areas (sciatica).The problem can be aggravated by associated conditions, such as lumbar canal stenosis, spondylolisthesis. Low back pain is sometimes caused by excessive stress to the back, such as lifting something heavy; Minimal movement, such as bending or reaching for something; Arthritis of the spine; Problems with tendons or ligaments in and around the spine; Malpositioning of vertebrae (Giuliano V)'

Lumbar disc herniation occurs 15 times more often than cervical disc herniation, and it is one of the most common causes of lower back pain. The cervical discs are affected 8% of the time and the thoracic discs only 1 - 2% of the time (V). Most disc herniations occur when a person is in their thirties or forties when the nucleus pulposus is still a gelatin-like substance. With age the nucleus pulposus changes ("dries out") and the risk of herniation is greatly reduced. After age 50 or 60, osteoarthritis degeneration or spinal stenosis are more likely causes of low back pain or leg pain.

Symptoms of disc herniation may include dull or sharp pain, muscle spasm or cramping, sciatica, and leg weakness or loss of leg function. Sneezing, coughing, or bending usually intensifies the pain. Rarely bowel or bladder control is lost. Sciatica is a symptom frequently associated with a lumbar herniated disc. Pressure on one or several nerves can cause pain, burning, tingling, and numbness that extends from the buttock into the leg and sometimes into the foot. Usually one side (left or right) is affected.

Lumbar disc herniations occur most often between the fourth (L_4) and fifth (L_5) lumbar vertebral bodies or between the L5 and the sacrum (S_1) (R. Prasad,).

Reprint requests: Narkeesh
Reader, Dept. of Physiotherapy
Punjabi University, Patiala (Punjab)



To diagnose PIVD, the most commonly used diagnostic tool is Magnetic Resonance Imaging. The development of large bore homogeneous magnets and computer assisted imaging extended its use into mapping of hydrogen nuclei densities and their effect on surrounding molecules in vivo. Since these vary from tissue to tissue MRI can provide detailed image of whole body. Now the studies have proved that MRI is not reliable as it gives false positive findings in asymptomatic patients also.

Now where imaging studies and clinical assessment do not coincide, electrodiagnosis can provide reliable information. Imaging studies visualize the structural abnormalities from which the neurological sequlae may be inferred, whereas the electro diagnostic methods such as nerve conduction studies and electromyography assess the physiological integrity of the nerve root and have the added benefit of sensitivity to the non structural root disease.[35]

This study attempts to find out the efficacy of electro diagnostic studies (MNCV and their latency differences and H- reflex latency) in the diagnosis of S1 radiculopathy due to L5- S1 disc herniation and to prove it as a reliable adjunct to MRI.

Methodology

Population

143 subjects of either sex, aged between 20 – 50 years were selected on the basis of inclusion and exclusion criteria.

Source

Subjects were taken from the following centres:

- Department of Physiotherapy,Punjabi University, Punjab.
- Department of Physiotherapy, SBSPGI, Dehradun

Sample

Twelve (12) subjects were selected for the study on the basis of inclusion and exclusion criteria.

Procedure

1. Recording MNCV:

Before beginning with the procedure, the subjects who were selected on the basis of inclusion criteria were explained the entire procedure in detail and their consent was taken. They were then assessed according to the assessment chart. The subject were made to lie down in prone position comfortably on a plinth. Metallic ornaments on the limb were removed. The lower limbs were exposed from mid thigh to the foot. The resistance of the skin of leg was reduced using cotton dipped in alcohol. The recording electrodes were placed in the foot with the cathode placed over the belly of abductor hallucis brevis muscle and the anode on the belly tendon montage. The ground electrode was strapped to the mid calf. First, the supramaximal stimulus was given to the tibial nerve distally posterior to the medial malleolus . The wave and distal latency were recorded. The second supramaximal stimulus was given proximally

at the popliteal fossa medial to the mid line at the popliteal crease. The distance between the proximal and the distal stimulating sites was measured using a flexible measuring tape. The wave and latency were recorded bilaterally. The MNCV was then calculated as follows:

$$MNCV = \frac{D \text{ (meters)}}{PL - DL \text{ (seconds)}}$$

Where,

D= distance

PL= proximal latency

DL= distal latency

2. Recording H- reflex:

For recording H- reflex the cathode electrode was placed over the mucle tendon junction and the anode was placed over the tendon of the gastrosoleus muscle. Ground electrode was strapped to the mid calf region. Submaximal stimulus was given at popliteal fossa lateral to the midline and wave and latency were recorded bilaterally.

The data obtained from affected and unaffected sides were compared and analysed. MNCV and H-reflex latency of affected side were also compared with the normative data from previous literature (values of normative data of MNCV and H reflex latency is 54.002 ± 2.7 and 27.3 ± 1.5 respectively).

Data Analysis and Results

The data was analyzed by using the Software SPSS version 11.0. The paired t test has been done for comparing the affected and unaffected H-latency and MNCV values. The unpaired t test has been done for comparing the H-latency and MNCV values of affected side and normative data provided in previous study. Significance level has been selected as 0.05.

TABLE 1: Mean and S.D. of the Age of Subjects of This Study and Subjects of Normative Data

VARIABLE	MEAN	S.D.
SUBJECTS OF THIS STUDY AGE	37.833	8.177
SUBJECTS OF NORMATIVE DATA AGE	23.96	2.398

The table 1 shows values of mean and S.D. of age of the subjects of this study and the normative data. The values of mean ± S.D. are 37.833±8.177 and 23.96±2.398 respectively.

TABLE 2: Mean and S.D. Values of H Latency of Affected and Unaffected Side

VARIABLES	AFFECTED	UNAFFECTED	DIFFERENCE
MEAN	33.7000	32.9143	.7857
S.D	2.93712	3.22461	.59841

The table 2. shows mean and S.D. values of H- latency of affected and unaffected side. The values of means ± S.D. of H –latency of affected and unaffected side are 33.700± 2.93712 and 32.9143 ± 3.22461 respectively

TABLE 3:Mean and S.D. Values of MNCV Affected and Unaffected Side

VARIABLES	AFFECTED	UNAFFECTED	DIFFERENCE
MEAN	46.8475	50.3942	-3.5467
S.D	3.56392	7.21837	5.32523

The table 3 shows mean and S.D. values of MNCV of affected and unaffected side.

The values of means ± S.D. of MNCV of affected and unaffected side are 46.8475± 3.56392 and 50.3942 ± 7.21837 respectively.

TABLE 4: Comparison Between Values of H-Latency and MNCV Affected and Unaffected side (Paired t-Test)

VARIABLES	t VALUE	P VALUE	SIGNIFICANCE
H-LATENCY	3.474	.013	S
MNCV	-2.307	.042	S

Table 4 shows comparison between affected and unaffected values of H-latency and MNCV. Paired t- test applied between the values of affected and unaffected sides. The t value for H-latency is 3.474 and p-value is .013, which is significant. The t- value for MNCV is 2.307 and p- value is .042, which is significant.

TABLE 5: Mean and S.D. Values of H-Latency of affected and Normative Data

VARIABLES	AFFECTED	NORMAL
MEAN	33.70000	27.3
S.D	2.93712	1.5

The table 5 shows mean and S.D. values of H-latency of affected and normative data. The values of means ± S.D. of H-latency of affected and normative data are 33.700±2.93712 and 27.3 ± 1.5 respectively. .

TABLE 6: Mean and S.D. Values of MNCV of Affected and Normative Data

VARIABLES	AFFECTED	NORMAL
MEAN	46.8475	54.002
S.D	3.56392	2.7

The table 6 shows mean and S.D. values of MNCV of affected and normative data

The values of means ± S.D. of MNCV of affected and normative data are 46.8475± 3.56392 and 54.002 ± 2.7 respectively.

TABLE 7: Comparison Between Values of H-Latency and MNCV Affected and Normal Side (Unpaired t-Test)

VARIABLES	t VALUE	p VALUE	SIGNIFICANCE
H-LATENCY	8.994	< 0.05	S
MNCV	7.840	< 0.05	S

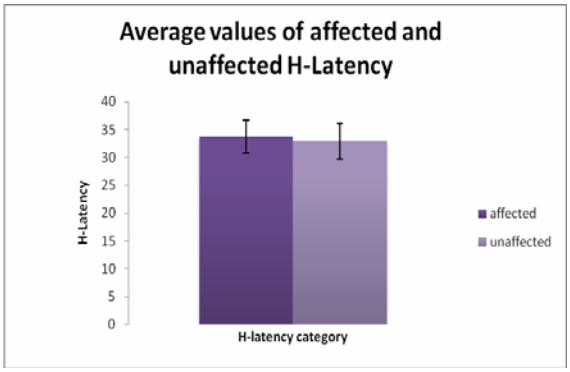
Table 7 shows comparison between affected and normative data of H-latency and MNCV. Unpaired t- test applied between the values of affected and normative data. The t value for H-latency is 8.994 and p-value is < 0.05, which is significant. The t- value for MNCV is 7.840 and p- value is < 0.05, which is significant.

TABLE 8: Mean and S.D. Values of Motor Nerve Latency of Affected and Unaffected Side

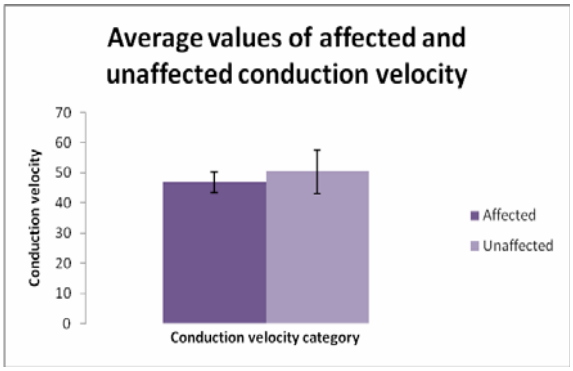
VARIABLE	MEAN	S.D.
AFFECTED	3.8775	1.117
UNAFFECTED	3.4808	1.317

The table 8 shows mean and S.D. values of Motor Nerve Latency of affected and unaffected sides. The values of means ± S.D. of MNCV of affected and normative data are 3.8775± 1.117 and 3.4808 ± 1.317 respectively.

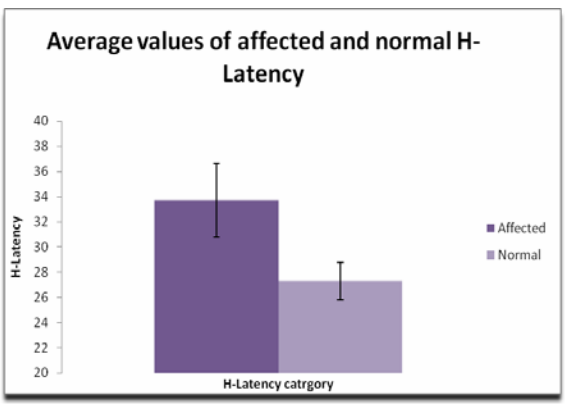
GRAPH 1



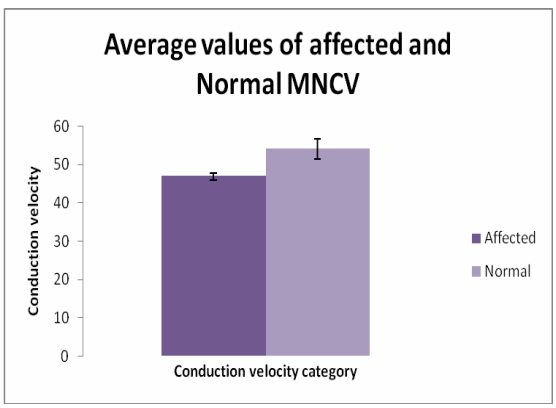
GRAPH 2



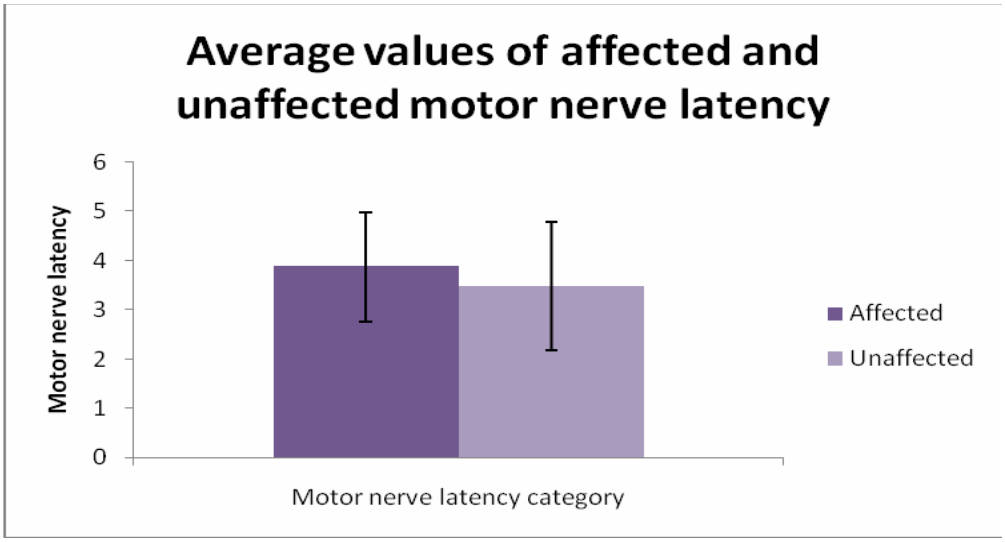
GRAPH 3



GRAPH 4



GRAPH 5



Discussion

This was an experimental study done to see the effect of L5-S1 disc herniation on H reflex latency, MNCV and their latency differences. Nerve root involvement due to disc herniation is characterised by clinical abnormalities and confirmed by radiological examination. MRI is a clinically superior diagnostic test in evaluation of patient with suspected lumbar disc herniation. Imaging studies visualize structural abnormalities, however they are associated with high false positive results as stated by (Masui et al (2005), Giuliano et al (2004)). To avoid any inaccuracy in diagnosing nerve root compression, electrodiagnostic studies must be incorporated. One form of electro diagnostic testing is Nerve Conduction Studies. NCV is widely used for evaluation of musculoskeletal and neuromuscular complaints. Although similar clinical value is expected for the evaluation of nerve root compression, prior application of NCV studies yielded widely varying results.

In this study 12 subjects with MRI confirmed disc prolapse at L5 – S1 level were taken. The subjects had at least one of the following findings on clinical examination: positive straight leg raise test, diminished or absent ankle jerk, sensory loss in S1 dermatome. The posterior tibial nerve was evaluated bilaterally in all the subjects using standard nerve conduction procedures, which consisted of measurement of motor nerve conduction velocity, latency differences and H reflex latency.

Paired t test was used to analyse the readings obtained from affected and unaffected sides. The MNCV for posterior tibial nerve was found to be significantly lowered in the affected side ($p < 0.042$) but changes in the latency difference were found to be non significant ($p > 0.05$). The result supports the study of Ogura T (2003), Shikata H. They stated that the CMAP amplitude was significantly lower in the patients with lumbar disc herniation, and the latency was also prolonged when the stimulating electrode was placed above the lesion. This technique may thus be a useful non-invasive method for assessing lumbosacral nerve root function in patients with lumbar disc herniation.

The H latency on the affected side was significantly prolonged on affected side in seven patients ($p < 0.013$)as also shown by Han TR et al (1997) and Bobinac – Geogogevski et al (1991). The H reflex was absent in four patients bilaterally and unilaterally on affected side in one patient which gives 41% absent H reflex data.

The probable reason for the above observations may be that the lumbar disc herniation causes two types of effects on nerve roots that is chemical and mechanical. Presence of disc material in the epidural space is thought to initially result in direct toxic injury to the nerve root by biochemical means which will cause intraneural oedema within 2 hours and that will lead to a reduction of intraneural blood

flow within 3 hours. Histological changes of nerve roots are present after 3 hours and subsequent reduction of nerve conduction velocity will start between 3 to 24 hours after disc protrusion (Robert Gunzburg). The contact pressure exerted by lumbar disc herniation on the nerve roots was recorded to be 53 mm Hg which produces mechanical deformation and causes conduction block (Takahashi K)

When the H-reflex latency and MNCV of affected side was compared with normative data obtained from previous studies (the values of MNCV and H reflex latency is 54.002 ± 2.7 and 27.3 ± 1.5), the results were highly significant with p value = 0.000 and 0.000 respectively.

The data of this study supports the concept that there are significant changes in MNCV and H reflex latency in unilateral S1 radiculopathy supporting the alternate hypothesis and rejecting the null hypothesis. The use of NCV studies for this application has several advantages like H- reflex component of NCS directly examines the electrophysiological function of S1 root, secondly, the non invasive and wide availability of nerve conduction measurement may facilitate their clinical use in assessment of possible nerve root compression. After all the analysis and comparison with previous studies we can say that this study will help in the diagnosis of S1 nerve root compression.

Conclusion

The MNCV of affected side was markedly reduced and H latency was prolonged, which are suggestive of diagnosis of S1 radiculopathy. In the results obtained, latency differences were found to be non significant so latency difference cannot be taken as reliable tool in diagnosing S1 radiculopathy. This study thus proves that MNCV and H reflex can be used as reliable diagnostic tool for S1 radiculopathy. When the significance level of H- reflex latency and MNCV were compared, the H- reflex latency was found to be more reliable tool in the diagnosis of S1 radiculopathy.

References

1. American Academy of Orthopaedic Surgeons,September 2007, www.orthoinfo.aaos.org
2. A Vaishnavi, Lumbar Spine Disorders(1999), chapter – 349, 2750-2751
3. Èes. a slov.r, " H reflex in diagnosis of Radiculopathy of S1", Czech medical association J. Ev. Purkyne journal, 63/96, 2000, No. 5, p. 291-296.
4. Cynthia Norkin, "Joint structure and function", 3rd edition, Jaypee Brothers Publishers.
5. Giuliano V, et al 2004. "Cervical MRI: Correlates better with symptomatic disc herniation than lumbar MRI", Emerg Radiology. 2002 Nov; 9(5):249-53.
6. James M. Cox, D. C., D. A. C. B. R., Low back pain, 6th edition, 377 – 501, Williams & Wilkins.
7. Kenneth W. Lintsay, "Neurology and neurosurgery illustrated", 3rd edition, Churchill Livingstone, 1997, 39- 40.
8. Masui T et al, "Natural History of Patients with Lumbar Disc Herniation Observed by Magnetic Resonance Imaging for Minimum 7 Years",J Spinal Disorder Tech, 2005 Apr; 18(2):121-126.
9. Matsui H, Kanamori M, Kawaguchi Y, Kitagawa H, Nakamura H, Tsuji H,Spine. "Clinical and electrophysiologic characteristics of compressed lumbar nerve roots", 1997Sep15;22(18):2100-5.
10. M. Natarajan (2002), "Text book of orthopaedics & traumatology", 5th edition, 133 – 134.
11. Riccardo Mazzocchio, Giovanni Battista Scarfò, Aldo Mariottini, Vitaliano Francesco Muzii and Lucio Palma, "BMC Musculoskeletal Disorders" 2001, 2:4doi:10.1186/1471-2474-2-4
12. R. Prasad, M. F. Hoda, M. Dhakal, K. Singh, A. Srivastava, V. Sharma: "Epidemiological Characteristics Of Lumbar Disc Prolapse In A Tertiary Care Hospital", The Internet Journal of Neurosurgery. 2006. Volume 3 Number 1
13. Robert Gunzburg, Marek Szpalski, "Lumbar disc herniation", Chapter no. – 3, page no.- 31
14. Takahashi K, Shima I, Porter RW, "Nerve root pressure in lumbar disc herniation", Spine. 1999 Oct 1;24(19):2003-6.
15. Walter G. Bradley, Robert B. Daroff, "Neurology in clinical practice", Chapter no. – 35, Page no. – 451, Edition no. – 3rd, Volume no. – 1
16. Z. Han TR et al "A study on diagnostic criteria of H reflex", electromyography clinical neurophysiology june-july 37(4): 241 – 50.