Nepal Orthopedic Association Journal
https://doi.org/10.59173/noaj.20241002g

Original Article

Association of Straight Leg Raising Test and The Transverse Intervertebral Foramen Diameter with Type of Lumbar Disc Herniation in Magnetic Resonance Imaging

Pawan Marasini[1], Himal khanal[2], Bishal kafle[3], Grishma Shrestha[1], Rabindra Lal Pradhan[4], Kushal Bhattarai[1]
[1] Karnali Academy of Health Sciences, Jumla, Karnali, Nepal
[2] Civil hospital, Kathmandu, Nepal
[3] Lumbini Medical College, Palpa, Nepal
[4] Kathmandu Medical College Teaching Hospital, Kathmandu, Nepal

ABSTRACT

Background: Low back pain is a common problem in patients visiting orthopedics clinics. Around 80% normal population experience low back pain, among those 15 percent have neurological back pain due to lumbar disc herniation. This study aims to associate clinical signs with X-rays and other radiological parameters.

Methods: Fifty patients with low back pain, radiating to the leg who presented between January 2019 to June 2020 were included. The correlation was done between the straight-leg raise test with transverse intervertebral foraminal diameter in flexion X-ray of the lumbar spine and with the type of disc herniation and percentage of canal compromise in magnetic resonance imaging.

Results: A significant correlation was found between the straight-leg raise test and transverse intervertebral foraminal diameter R2 = 0.40 and between the straight-leg raise test and type of lumbar disc herniation (p=0.003) but` no correlation found between straight-leg raise test and percentage of canal compromise (p=>0.05)

Conclusion: Clinical parameter straight-leg raise test correlates with transverse intervertebral foraminal diameter in flexion radiograph. The Straight-leg raise test relates to the type of lumbar disc herniation but not the percentage of canal compromise after lumbar disc herniation.

Keywords: Lumbar disc herniation; Magnetic resonance imaging; Transverse Intervertebral Foramen; Straight-leg raise test and X-ray

INTRODUCTION

Low back pain is 80 % common among orthopedic clinic patients, with 15 % being lumbar disc herniation.[1] Herniation involves focal disc material displacement beyond intervertebral disc space limits. It manifests the degenerative cascade, resulting from failure due to hoop stress to contain the nucleus into the annulus, and advanced imaging has recognized them in symptomatic and asymptomatic individuals. [2–6]

The intervertebral foramen is bounded by disc and facet anteriorly and posteriorly. The spinal canal is divided longitudinally into central, lateral recess, foraminal, and extraforaminal, and horizontally moving from center to the right into central, right central, right subarticular, and right foraminal or right extraforaminal. [5]

Straight leg raising sign (SLRT), is 77 % sensitive in diagnosing lumbar disc herniation.[7] Straight leg raising causes distal sliding of the spinal cord with its nerve roots. [8] SLRT stretches sciatic nerve and correlates with foraminal vertical diameter (FVD) and transverse diameter (FTD). FTD is narrow compared to FVD, and likely causes compression to exiting nerve root.[9–11]This study aims to associate clinical signs with X-rays and other radiological parameters.

METHODS

This was a Cross-sectional study conducted at the department of Orthopedic Surgery and Department of Radiology, Kathmandu Medical College, Teaching Hospital, between January 1, 2019, and June 31, 2020. Ethical approval was obtained from the IRC of KMC, and all the patients who consented to the study were taken as subjects. Inclusion criteria were Age 20-55 years[12] , Radicular pain in one of both lower limbs, Positive Straight leg raise test (SLRT), and patients who gave consent. Exclusion criteria were Back surgery, Any psychiatric illness, Major medical comorbidities such as TB, Malignancy, DM, Renal dysfunction, any Neurological conditions, and Patient with hip pain.

Correspondence:

Dr. Pawan Marasini
Department of Orthopedics, Karnali Academy of Health Sciences, Jumla, Karnali, Nepal
Tel No: 9849376000, Email: pawanmarasini@gmail.com

The sample size was calculated using the following formula:

$Z^2\ p\ (1-p)/d^2$

Z- Z value at 95% confidence interval, the value is 1.96
P- Percentage of lumbar disc herniation (p=15)
Q- (1-P)
d- Allowable error (10%)
Sample size = 50

Statistical analysis

Pearson correlation was used to correlate SLRT with TFD and SLRT with % of canal compromise. An unpaired t-test was used to correlate SLRT and Type of lumbar disc herniation. SPSS was used for data analysis.

The patients with back pain radiating to either leg and consented to a study with an MRI of the lumbosacral spine were recruited from the OPD. Following this demographic variables were noted along with a short history and the side of radiation was noted. The T2 weighted Image of the axial section of the involved segment in MRI was captured using a camera.

After properly explaining the procedure, a straight leg raise test was performed and measured. Before the procedure, patients were asked whether they had a history of hip pain and difficulty flexing the hip normally. The patients who did not have pain and restriction of hip movement were taken as study subjects. Patients were placed on a firm bed with their necks slightly extended. Patients were asked to let loose the lower limb on the examiner's hands with one hand over the front of the thigh and another holding the leg. The patient, leg was raised above the bed gently to the point where the patient experienced pain which they used to experience i.e. pain in the lower back and radiated to the foot was regarded as positive. The degree to which the leg was raised was noted. Regarding the genuineness, patients were asked to sit in bed under the pretext of examining the back from behind. The patients who fell back on the couch with the pain or flexed the knee were considered to have genuine pain due to SLRT.[13]

After doing SLRT patients were sent for the flexion X-ray of the lumbar spine standing. Before that patients were asked regarding any difficulties in flexing the spine. Those who could flex the hip spine (forward bend) were asked for an X-ray.

While taking the X-rays radiographers were instructed to maintain an affixed distance between the X-ray tube and the cartridge of 110 cm with the patient standing close to the cartridge and with breath held in expiration. The exposure was determined according to the body mass of the patient.

A sagittal MRI image confirmed the transverse intervertebral foramen(FTD). Following confirmation transverse intervertebral foramen was measured from the posterior margin of the superior vertebra and the anterior surface of the superior articular process of the inferior vertebra. The transverse intervertebral foramina was measured in a Digital image and communications in medicine (DICOM) image from the computer using pre-installed software Carestream of the X-ray machine. (Figure 1)

Figure 1: Measurement of the FTD in flexion X-ray

Three measurements of transverse intervertebral foramen were taken after the average of 5 measurements as the final reading. The DICOM image, measurement, and X-ray recording were saved in a specified folder on the computer.
The T2 weighted image of the patient taken earlier was matched and saved in specified folders respectively.
In the axial section of the MRI the type of lumbar disc herniation, whether central or Para central was recorded and noted.

The % of canal compromise was calculated by measuring the decrease in dural sac area due to herniation (Figure 2). It was measured at the level of lumbar disc herniation in T2 weighted axial images. The area measurements were made after properly calibrating the image fed to image J and the edge of herniation and bony canal was marked using a mouse pointer. The percentage of canal compromise was measured.[14,15]

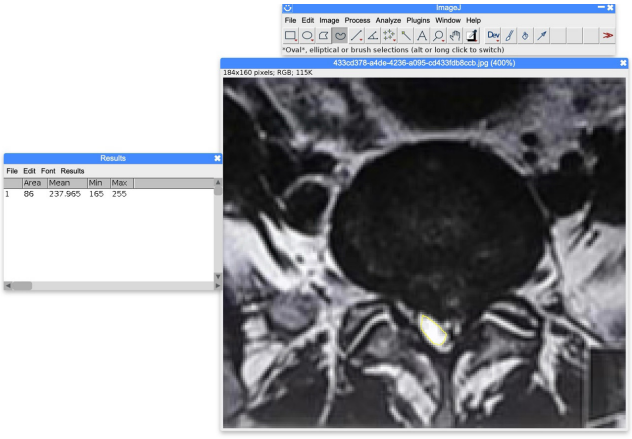

Figure 2: Measurement of the percentage of canal compromise using Image

RESULTS

A total of 50 patients were taken in the study 32 male and 18 female. The age range was from 24 to 55 years. Most common site of disc herniation was at L4/L5 54% followed by L5/S1 42% and L3/L4 4 %. SLRT ranged from 30 to 90 degrees. The mean intervertebral diameter was 5mm and ranged from 4 to

7.1 mm. The mean percentage of spinal canal compromise was 10% and ranged from 3% to 19%.

Correlation of SLRT and FTD

A moderate positive correlation was found between SLRT and FTD.

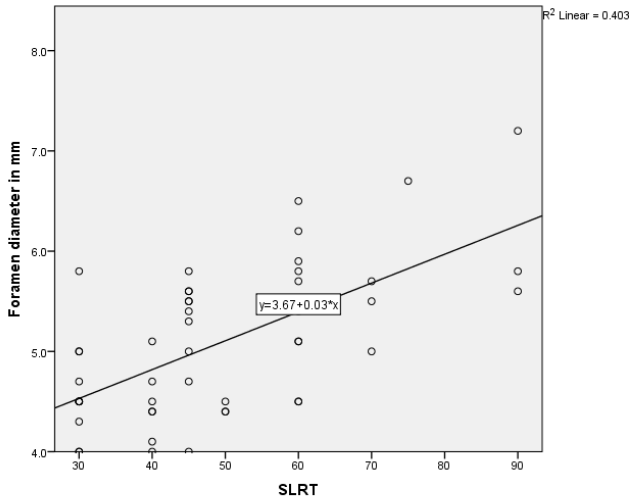

Figure 3. Shows the correlation curve, with scatter plot between SLRT and Foramen diameter where R^2 = 0.40 which means there is a correlation between SLRT and TFD

Correlation between the SLRT and type of lumbar disc herniation

A moderate correlation between the SLRT and the paracentral Type of lumbar disc herniation was seen using an unpaired t-test and was statistically significant with a p-value of 0.003.

Correlation between the SLRT and % of canal compromise

No correlation was found between the SLRT and % of canal compromise shown

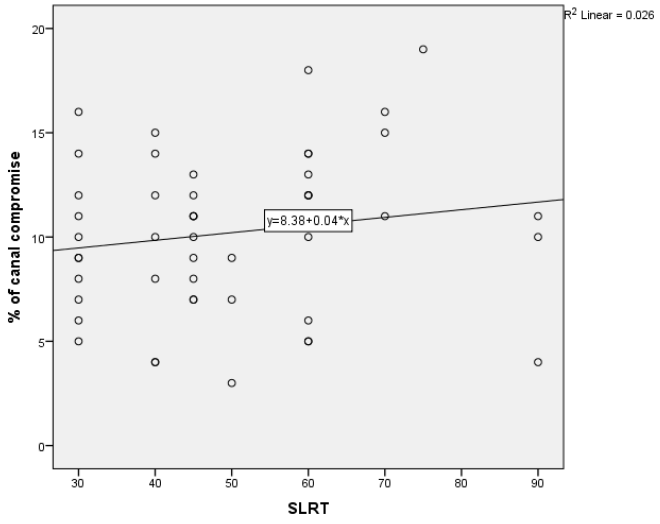

Figure 4: Showing correlation between SLRT and % of canal compromise.

DISCUSSION

The transverse intervertebral foramen diameter in our study group ranged from 4.0mm to 7.1 mm which must be pathological. MI Yusof et al, found the normal transverse intervertebral foramen diameter in a Caucasian population in the lumbar region ranges from 7.4 mm to 8.1 mm both right and left.[11]

A slight change in the Transverse foramen diameter leads to pain along the distribution of the nerve because the intervertebral foramen bounded by pedicles above and below accounts 6 times the nerve root diameter as stated by LA Hadley et al.[16]

The current study correlates between the SLRT and the FTD because the bony architecture is one of the important factors along with nerve root compression and tension over nerve roots is required for positive SLRT. B Jönsson et al, mentioned the affection of the nerve root with the bony stenosis rather than the disc herniation alone with positive SLRT.[12]

SLRT correlates more with paracentral lumbar disc herniation, i.e., relatable with the study by B Jönsson et al, where the vast majority of patients had paracentral disc herniation for SLRT being positive.[12] Also in a study by J Majlesi et al, SLRT correlates with paracentral lumbar disc herniation because the paracentral disc is closer to the nerve root, and compression of the nerve root is possible because of its proximity to the nerve.[17]

No correlation was found between SLRT and the Percentage of canal compromise, the percentage of canal compromise ranged from 6% to 19% in our study. Ul Thelander et al, in their study of the correlation of the SLRT with the morphology of the lumbar disc hernias and the spinal canal, postulated that there was no significant relation between clinical test with the type of disc herniation and canal size. Although the decrease in the size of the hernia was related to the improvement of the symptom and a relative increase in the SLRT, no significant correlation was found between the decrease in the size of the hernia in the canal and the SLRT.[10]

We were unable to correlate the SLRT with the % of canal compromise, this might be because the content of the hernia could migrate below or above the level of foramen before compression of the nerve root, the patient had not presented acutely because of which the herniated lumbar disc had already gone towards resolution. As S Kobayashi et al, described periradicular adhesion around the lumbar disc herniation such as nucleolus pulposus, change in vascular permeability, vasodilation followed by adhesion, and the degranulation of the mast cell with the release of histamine and other cellular processes increases susceptibility towards the nerve root compression.[18].

CONCLUSION

The clinical parameter SLRT is related to the radiological parameter transverse intervertebral foramen diameter in the Flexion radiograph. SLRT is also related to the type of lumbar disc herniation in MRI but not to the % of canal compromise that occurs after the disc has been herniated.

CONFLICT OF INTEREST

None

REFERENCES

1. (Tr&Orth) AWBMbcMPFF, Sciences H of TH, School BM, Bristol U of, Bristol U, Surg DWMBFFEDH, et al. Apley and Solomon's System of Orthopaedics and Trauma. 2018. 1012 p.
2. Frei H, Oxland TR, Rathonyi GC, Nolte LP. The effect of nucleotomy on lumbar spine mechanics in compression and shear loading. Spine (Phila Pa 1976). 2001; https://doi.org/10.1097/00007632-200110010-00007
3. Fardon DF, Williams AL, Dohring EJ, Murtagh FR, Gabriel Rothman SL, Sze GK. Lumbar disc nomenclature: Version 2.0 Recommendations of the combined task forces of the North American Spine Society, the American Society of Spine Radiology and the American Society of Neuroradiology. Spine Journal [Internet]. 2014;14(11):2525-45. Available from: http://dx.doi.org/10.1016/j.spinee.2014.04.022 https://doi.org/10.1016/j.spinee.2014.04.022
4. Saal JA, Saal JS. Nonoperative treatment of herniated lumbar intervertebral disc with radiculopathy: An outcome study. Spine (Phila Pa 1976). 1989; https://doi.org/10.1097/00007632-198904000-00018
5. B.M. Christopher SAGRSteven. Lumbar Disc Herniation . In: Herkowitz HN GSEFBGBR, editor. the spine . 6th ed. Philadalphia : Elsevier; 2011. p. 887-909.
6. Panjabi MM, White AA.\ Basic biomechanics of the spine. Neurosurgery. 1980; https://doi.org/10.1097/00006123-198007000-00013
7. Rajasekaran S, Bajaj N, Tubaki V, Kanna RM, Shetty AP. ISSLS Prize Winner: The Anatomy of Failure in Lumbar Disc Herniation. Spine (Phila Pa 1976). 2013; https://doi.org/10.1097/BRS.0b013e31829a6fa6
8. Rade M, Könönen M, Vanninen R, Marttila J, Shacklock M, Kankaanpää M, et al. 2014 young investigator award winner: In vivo magnetic resonance imaging measurement of spinal cord displacement in the thoracolumbar region of asymptomatic subjects: Part 1: Straight leg raise test. Spine (Phila Pa 1976). 2014;39(16):1288-93. https://doi.org/10.1097/BRS.0000000000000263
9. Stewart m. Scham, MD and TFK tylor , d.phil FRCS F (ED). tension sign in lumbar disc prolapse.pdf. 2006. p. 195-206.
10. Thelander U, Fagerlund M, Friberg S, Larsson S. Straight leg raising test versus radiologic size, shape, and position of lumbar disc hernias. Vol. 17, Spine. 1992. p. 395-9. https://doi.org/10.1097/00007632-199204000-00003
11. Yusof MI, Hassan MN, Abdullah MS. The relationship amongst intervertebral disc vertical diameter, lateral foramen diameter and nerve root impingement in lumbar vertebra. Malays Orthop J. 2018;12(1):21-5. https://doi.org/10.5704/MOJ.1803.004
12. Jönsson B, Strömqvist B. Significance of a persistent positive straight leg raising test after lumbar disc surgery. J Neurosurg. 1999;91(1 SUPPL.):50-3. https://doi.org/10.3171/spi.1999.91.1.0050
13. Komori H, Okawa A, Haro H, Muneta T, Yamamoto H, Shinomiya K. Contrast-enhanced magnetic resonance imaging in conservative management of lumbar disc herniation. Spine (Phila Pa 1976). 1998; https://doi.org/10.1097/00007632-199801010-00015
14. Bellier A, Latreche A, Tissot L, Robert Y, Chaffanjon P, Palombi O. Movements of the lumbo-sacral nerve roots in the spinal canal induced by straight leg raising test: an anatomical study. Surgical and Radiologic Anatomy. 2018; https://doi.org/10.1007/s00276-018-2084-3
15. Cinotti G, De Santis P, Nofroni I, Postacchini F. Stenosis of Lumbar Intervertebral Foramen. Spine (Phila Pa 1976). 2002;27(3):223-9. https://doi.org/10.1097/00007632-200202010-00002
16. Hadley LA. Constriction of the intervertebral foramen: A Cause of Nerve Root Pressure. J Am Med Assoc. 1949; https://doi.org/10.1001/jama.1949.02900400027006
17. Majlesi J, Togay H, Ünalan H, Toprak S. The sensitivity and specificity of the slump and the straight leg raising tests in patients with lumbar disc herniation. Journal of Clinical Rheumatology. 2008; https://doi.org/10.1097/RHU.0b013e31816b2f99
18. Kobayashi S, Takeno K, Yayama T, Awara K, Miyazaki T, Guerrero A, et al. Pathomechanisms of sciatica in lumbar disc herniation: Effect of periradicular adhesive tissue on electrophysiological values by an intraoperative straight leg raising test. Spine (Phila Pa 1976). 2010;35(22):2004-14. https://doi.org/10.1097/BRS.0b013e3181d4164d