"CORRELATION OF SUBJECTIVE AND IMAGING FINDINGS WITH NEURODYNAMIC TEST IN SUBJECT WITH LUMBO-SACRAL RADICULOPATHY"

A Dissertation

Submitted

In Partial Fulfillment of the Requirements

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MASTER OF PHYSIOTHERAPY

in

Neurology

Submitted by

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INDIA

June 2022

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This is to certify that **Mr. Mohammad Akeel Quraishi, (**En. No. 1500101819) ha**s** carried out the research work presented in the dissertation entitled **"Correlation of Subjective and Imaging findings with Neurodynamic test in subject with Lumbo-sacral Radiculopathy"** submitted for partial fulfillment for the award of the **Degree of Master of Physiotherapy in Neurology** from **Integral University, Lucknow** under my supervision.

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I hereby recommend that the project under my supervision by **Mr. Mohammad Akeel Quraishi,** entitled **"Correlation of Subjective and Imaging findings with Neurodynamic test in subject with Lumbo-sacral Radiculopathy"** is an original work done by him and be accepted in partial fulfillment for the degree of Master of Physiotherapy.

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DECLARATION

I hereby declare that the dissertation entitled **"Correlation of Subjective and Imaging findings with Neurodynamic test in subject with Lumbo-sacral Radiculopathy"** is an authentic record of the research work carried out by me under the supervision of prof. (Dr). Abdur Raheem khan(PT), Head of Department of Physiotherapy, for the period from November 2021 to April 2022 at Integral Hospital-Lucknow. No part of this thesis has been presented elsewhere for any other degree or diploma earlier.

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Mohammad Akeel Quraishi

DEDICATION

My Teachers

For grooming a professional out of me

And

My parents my friends

For continuous support & encouragement at all times

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LIST OF SYMBOLS AND ABBREVIATIONS, NOMENCLATURE etc-

LBP	Low Back Pain
SLR	Straight Leg Raise
SLRT	Straight Leg Raise Test
MRI	Magnetic Resonance Imaging
LS SPINE	Lumbosacral Spine
Rt.	Right
Lt.	Left
B/L	Bilateral
IV Disc	Intervertebral disc
PIVD	Prolapsed intervertebral disc

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ABSTRACT

BACKGROUND- Lumbar radiculopathy remains a clinical challenge among primary care professionals in both assessment and diagnosis. This often leads to misdiagnosis and inappropriate treatment of patients resulting in poor health outcomes. Prolapsed intervertebral disc (PIVD) is one of the most common cause. Magnetic Resonance Imaging (MRI) is routinely done for diagnosis of lumbar disc prolapsed. Many abnormalities of disc are observed even an asymptomatic patient. Subjective finding & straight leg raise (SLR) and other neurologic tests are used to know the exact site of herniation.

PURPOSE- The purpose of this study was to determine the accuracy of Subjective findings with neurodynamic test is enough to diagnose disc herniation for the set-ups where MRI is not easily available, contraindicated &/or unaffordable for the patients.

METHODS-This was a cross-sectional analytic study conducted on 30 consecutive patients with a history suggestive of lumbosacral radiculopathy were screened for inclusion. Patients were evaluated from November 2021 to April, 2022 in the outpatient of department of Physiotherapy, Integral Hospital-Lucknow. Patients were examined and signs involving dermatomal levels noted of affected lower limb. The SLR test was investigated concomitantly to determine the sensitivity and specificity. All the patients have MRI investigation. Clinical findings were then correlated with MRI findings.

RESULT- Out of 30 patients 16 (53.33%) were Male and 14 (46.66%) were Female. Age range between 25 to 55 years, with Mean age and SD (39.03± 9.67). 24 (80%) patients have chronic LBP out of 30. Clinical examination revealed that L5 was the commonest area of pain distribution (63.33%). Straight Leg Raise test was positive in 24 (80 %) patients. The correlation shows there is no statistically significant difference in SLR and radiologic findings (except for disc desiccation, p value ,<0.05) for sub-acute and chronic Lumbosacral Radiculopathy (p value >0.05).

CONCLUSION- Present study concluded that there is no statistically significant difference in SLR and radiologic findings (except for disc desiccation) for sub- acute and chronic Lumbosacral Radiculopathy. SLR and MRI findings can be used interchangeably for chronic and sub-acute cases. Thus SLR test is enough to diagnose disc herniation as MRI for the set-ups where MRI is not easily available, contraindicated or unaffordable for the patients. SLR test is a cost effective method to diagnose disc herniation & lower the financial burden on patients.

Keywords- Lumbosacral radiculopathy, MRI, SLR, Disc Desiccation, Disc herniation, Sub-acute, & chronic LBP**.**

CHAPTER-1

INTRODUCTION

Low back pain is a very common problem in our society now a days and most of the people experience it at some point of their life. Radicular pain radiates down to the legs directly along the course of involved dermatome of spinal nerve root and is often described by patients as electric, burning, or sharp. Often accompanying numbness or tingling occurs with a distribution similar to the pain. Radicular pain is elicited by ectopic discharges originating from an inflamed or lesioned dorsal roots or its ganglion.

The impairment of sensory fibers causes numbness (dermatomal pattern); however, blockade of motor fibers causes weakness (myotomal). Sensory or motor block may result in diminished reflexes. Lumbosacral radiculopathy has been estimated to be 3%-5% of the population, affecting both gender. Symptoms typically begin in midlife, with men often affected in the 40s while women are affected in the 50s and 60s.[1]

The prevalence of LBP increase in last decade and continues to increase dramatically in the aging population, with a significant impact on activities of daily living (ADL) and occupational activities. LBP represents the leading cause of disability and economic problem. Henne B Albert et al (2019), stated that Radicular pain is usually due to a combination of inflammation and ischemic compression of the nerve root, collectively referred to as nerve root irritation.[2]

The Lumbar disc bulging or herniation is one of the common cause of radicular low back pain. According to combined statement of North American Spine society, the American society of Spine Radiology, and the American society of Neuroradiology, disc herniation can be defined as ‘localised or focal displacement of disc material beyond the limits of intervertebral disc space’. Almost three fourth cases of disc pathology are of degeneration and one fourth are actual disc herniation.[3] Disc desiccation is a common degeneration changes of intervertebral discs. On

MRI, the disc losses its central height T2 signal.[4] Herniated discs can be classified as disc bulge, protrusion, extrusion, or sequestration.

Nerve Root irritation can also be caused by stenosis (either of the central canal or foramen), spondylolisthesis or other pathological conditions like infections or malignancies. Lumbar spinal stenosis (LSS) secondary to degenerative changes (eg. Osteophytes & hepertrophic ligamentum flavum) at a single or multiple level(s) may lead to unilateral or bilateral radiculopathy. James A Berry (2019) stated that 95% of lumbar disc herniation involves L4/5 and L5/S1 level, the latter being the commonest.[1] The duration of pain can be classified into; Acute (pain lasts <6 weeks), Sub-acute (pain lasts 3 weeks to 3 months) and Chronic (pain lasts ≥3 months).[5]

Most of the lumbar disc herniation causes varying degrees and duration of back pain. Higher level herniation (2^{nd} or 3^{rd} lumbar levels) can radiate front of thigh to knee; Fourth lumbar (L4) radiates to Lateral thigh & Medial lower leg; Fifth lumbar (L5) radiculopathy causes Buttock, back & side of thigh, and Lateral lower leg and dorsum of foot; and First sacral (S1) radiculopathy causes pain in Buttock, back of thigh and lower leg & lateral foot or the heel.

On examination, patients may be neurologically normal or show features of radiculopathy. Gait is often abnormal. Muscle weakness may be revealed particularly when testing is done by walking on heels and toes. In clinical practice, the diagnosis of lumbosacral radiculopathy involves the use of various tools and procedures including neuropathic pain screening, clinical neurological examination (dermatome, myotome, reflex) electro diagnosis & radiological imaging. Assurance of the radiculopathy is dependent upon the examiner's awareness of clinical presentation, physical examination knowledge of possible pathology, mechanism of injury and ability to perform the test correctly. The clinical practicality of

neurological examination is largely determined by the accuracy with which they determine the presence or absence of the suspected patho-neuro-physiology. Early and accurate diagnosis of lumbar radiculopathy is crucial to ensure target-specific treatment and avoid chronicity, disability and work loss.[6]

Clinical assessment and imaging findings are used to evaluate the patient's symptoms, and MRI is the most important tool to identify the etiology and determine the level of the anatomical abnormality. However, MRI alone is not enough to find the cause of lumbosacral radiculopathy. Comparing clinical findings with MRI findings at different nerve root level in patients with lumbosacral radiculopathy remains essential to determine which of the MRI detected abnormalities are symptomatic.

The straight leg raise (SLR) Test or Lasegue's test are diagnostic tests widely used in clinical practice and it used to examine the nerve roots of the patient.[7] The mechanism of pain during a SLR is increased dural tension placed upon the lumbosacral spine. The examiner flexes the patient's hip with knee extended until the patient complains of pain or tightness in the back. At this point, the examiner brings down the leg until the patient feels painfree. The examiner should then dorsiflex the foot (Bragard's test); the neck may also be flexed.

The straight leg raise test induced 3-well defined patterns of pain; low back pain only, leg pain only, and low back pain & leg pain. The disc protrusion may be situated in a central, intermediate or lateral. Patients with central protrusion tend to have only low back pain; patients with lateral protrusion tend to have only leg pain, although patients with intermediate protrusion tend to have low back pain & leg pain both.[15]

A positive test elicits pain in the leg, buttock, or back same as that described in the history at 30-70 degrees of leg elevation, when the majority of nerve movement occurs at the

intervetebral foramen and is suggestive of lower lumbar nerve root involvement (L4 to S1).[8] The pain is typically worsened by dorsiflexion of ankle or neck flexion, and is relieved with flexion of knee. They provoke pain or other sensory symptoms that reveal the root lesion (Lasegue's sign).[9]

Aims and Objectives of the study

1) To determine the accuracy of Subjective findings with neurodynamic test is enough to diagnose disc herniation for the set-ups where MRI is not easily available, contraindicated &/or unaffordable for the patients.

2) To find out the correlation of subjective findings and MRI findings with neurodynamic test in patients with lumbosacral radiculopathy.

3) To determine clinico radiological correlations in patients with lumbosacral radiculopathy.

Hypothesis

Null hypothesis:

There will be no significant difference in subjective and MRI findings with neurodynamic test in patients with Lumbosacral radiculopathy.

Alternative hypothesis:

There will be significant difference in subjective and MRI findings with neurodynamic test in patients with Lumbosacral radiculopathy

CHAPTER-2

REVIEW OF LITERATURE

2.1 ANATOMY OF LS SPINE

The lumbar spine comprises the lower end of the spinal column between the last thoracic vertebra (T12) and the first sacral vertebra (S1). The spinal cord in this region has protection from five durable and mobile vertebrae (L1-L5) that allow for the dispersion of axial forces. The spinal cord runs through the center of the vertebral column and terminates in the conus medullaris at the level of the L1-L2 vertebrae. The cauda equina, Latin for horse's tail, is a bundle of spinal nerve roots that begin at the termination of the spinal cord and descend through the remainder of the canal. .

The lumbar spine is comprised of bone, cartilage, ligaments, nerves, and muscle. Each of these components plays an integral role in the form and function of the lumbar spine. Each lumbar vertebra consists of multiple components. These include the vertebral body and the dorsal structures termed the posterior elements. Immediately dorsal to the vertebral body lie two pedicles that attach to the laminae. The pedicles resist motion and transmit forces from the posterior elements to the vertebral body. From the junction of the two laminae, the spinous process extends posteriorly.

At the junction between the pedicles and laminae, four articular processes and two transverse processes reside. The transverse processes extend laterally, serving as attachment points for ligaments and musculature. The superior and inferior articular processes create the zygapophyseal joints (also k/a facet joints). This joint occurs between the superior articular process of a vertebra and the inferior articular process of the vertebra immediately cephalad. These joints lie in the sagittal plane and participate in flexion and extension of the lumbar spine. The pars interarticularis is the location of the lamina between the superior and inferior articular

processes and is prone to the development of stress fractures (spondylolysis) in the growing spine.

The lumbar disc is a fibrocartilaginous structure that is seated between two vertebral body endplates. The primary function of the lumbar disc is shock absorption. Two longitudinal ligaments lie anterior and posterior to the vertebral body. The anterior longitudinal ligament resists lumbar extension, translation, and rotation. The posterior longitudinal ligament resists lumbar flexion. The segmental ligaments include the ligamentum flavum, which is perforated when performing a lumbar puncture. The remaining segmental ligaments include the supraspinous and interspinous ligaments, which lie between the spinous processes and resist lumbar flexion.[27]

Disc is made of 3-components; cartilaginous endplates, peripheral annular fibrosus, and central nucleus pulposus. Endplates are located on bodies of adjacent vertebra. A unique multilayer structure of annulus fibrosus has made of collagen type-1 & type-2 fibers and proteoglycans, each layer oriented 30 degree horizontally & successive layer in opposite direction that leads to a criss-cross pattern and such unique structure gives the annular more tensile modulus against torsional, axial & tensile loads.

Nucleus pulposus contains approximately 70% water, notochondral cells along with fibroblast & chondrocyte like cells. A chondral cells stimulate collagen and proteoglycans production & control apoptosis of chondrocyte like cells. Hydrostatic pressure is developed in disc due to imbibed water. Hydrophilic proteoglycan macro-molecules of nucleus pulposus make a unique composition within collagen matrix. The nucleus pulposus provides resistance to axial compression. The endplates are composed mainly of water followed by chondrcytes, proteoglycans, and type-2 collegen.

Capillary network of cartilaginous layer may extend into the outer portions of annular fibrosus upto a short distance that provide nourishment. Nutition of disc cells occurs via diffusion through vertebral endplates. Disc is poorly innervated. Normally, nucleus pulposus and inner annulus fibrous has no innervations. However, outer annulus fibrosis is innervated.[3]

The lumbar spine is comprised of bone, cartilage, ligaments, nerves, and muscle. Each of these components plays an integral role in the form and function of the lumbar spine.[27] There are three main functions of the lumbar spine. First, the lumbar spine assists in supporting the upper body. The lumbar vertebrae (L1-L5) are much larger when compared to other regions of the vertebral column, which allow them to absorb axial forces delivered from the head, neck, and trunk. The lumbar vertebrae form a canal that serves to protect the spinal cord and spinal nerves. This arrangement allows for the communication of information from the central nervous system to the lower extremities and vice versa.

The lumbar spine allows for diverse types of truncal motion, including flexion, extension, rotation, and side bending. From a lateral view, the lumbar spine has a concave curvature, referred to as the lumbar lordosis. This curvature is variable in degree and transfers the upper body mass over the pelvis to allow for efficient bipedal motion.

The lumbar spine comprises the lower end of the spinal column between the last thoracic vertebra (T12) and the first sacral vertebra (S1). The spinal cord in this region has protection from five durable and mobile vertebrae (L1-L5) that allow for the dispersion of axial forces. The spinal cord runs through the center of the vertebral column and terminates in the conus medullaris at the level of the L1-L2 vertebrae.

The spinal cord has a rich blood supply stemming from three main longitudinal arteries. A single anterior spinal artery supplies the anterior two-thirds of the cord. On the dorsal side, two

posterior spinal arteries supply the posterior one-third of the cord. Several anterior and posterior radicular arteries provide collateral blood supply to the vertebral column. These radicular arteries run along with the ventral and dorsal nerve roots, supplying them with blood. The artery of Adamkiewicz is the largest radiculomedullary artery and provides vascular supply to the lumbar spinal cord. The artery has a variable origin between T8-L2, branching from a posterior intercostal or radicular artery. It typically lies left of the spinal cord and ascends the spinal canal, making a hairpin loop before joining the anterior spinal artery.

Specific to the lumbar spine, four pairs of lumbar arteries originate from the abdominal aorta. These paired arteries travel posteriorly along the vertebral bodies to supply each vertebra. These arteries also supply blood to the adjacent musculature, such as the transversus abdominis and internal oblique.

Five pairs of mixed spinal nerves emerge from either side of the lumbar spinal cord, carrying both motor and sensory nerve fibers—the spinal nerves branch after exiting the neural foramen into ventral and dorsal rami. The dorsal rami supply motor innervation to the erector spinae musculature and sensation to the skin over the back. The ventral rami supply motor and sensory fibers to the remainder of the prevertebral musculature and lower limbs.

The T12 to L4 ventral rami combine to form a network of nerves called the lumbar plexus. The lumbar plexus gives rise to the obturator (L2-L4) and femoral (L2-L4) nerves, respectively. The remaining nerves of the lumbar plexus include the iliohypogastric (T12-L1), ilioinguinal (L1), genitofemoral (L1-L2), and lateral femoral cutaneous nerve of the thigh (L2-L3)—the lumbosacral plexus form from the L4 to S4 ventral rami. The L4 and L5 roots join to form the lumbosacral trunk, which descends into the pelvis to join to sacral plexus. The lumbosacral plexus then gives rise to the sciatic nerve (L4-S3), which branches into the common

peroneal and tibial nerves. The sacral plexus also includes the superior gluteal (L4-S1), inferior gluteal (L5-S2), posterior femoral cutaneous of the thigh (S1-S3), and pudendal nerve (S1-S4).

Each lumbar spinal nerve exits below its corresponding vertebra—for example, the L4 nerve exits below the L4 vertebra through the L4-L5 neural foramen. A majority of lumbar disc herniations occur centrally and do not compress the exiting nerve root at the level of the disc. The nerve root most commonly affected exits one level below the herniated disc. For example, an L4-L5 central disc herniation will most commonly compress the L5 nerve root in the lateral recess of the spinal canal. However, in the setting of a far lateral disc herniation, the L4 nerve root is compressed, albeit less commonly. This difference is due to the more central position of the traversing spinal nerves when compared to the more lateral position of the exiting spinal nerves. Each spinal nerve supplies an area of skin with afferent sensory fibers.[27]

Radicular symptoms are primarily produced by nerve root inflammation by surrounded structures. The foramina are formed by the pedicle superiorly and inferiorly, ligamentum flavum posteriorly, disc and vertebral body anteriorly, and this small space normally allows the nerve roots excursion of 4mm, however during the SLR test this root excursion can be compromised. Mechanical compression sole does not always generate radicular symptoms as many patients have asymptomatic foraminal stenosis in MRI. Therefore, positive SLR test may undergo influence by nerve root irritation secondary to inflammation as well as mechanical compression.[9]

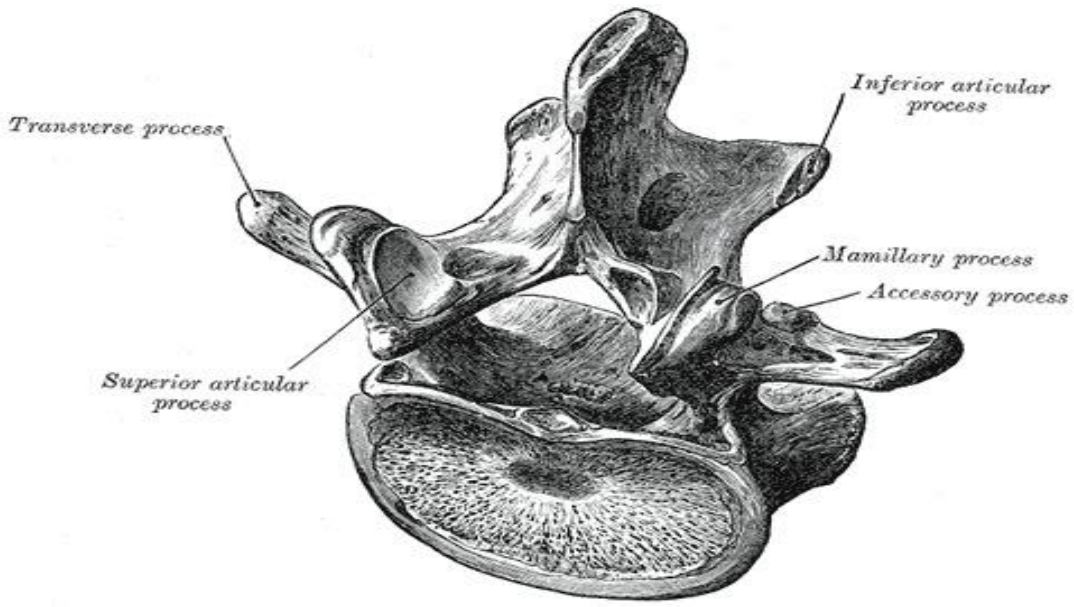


Figure 2.1: lumbar vertebra from above and behind

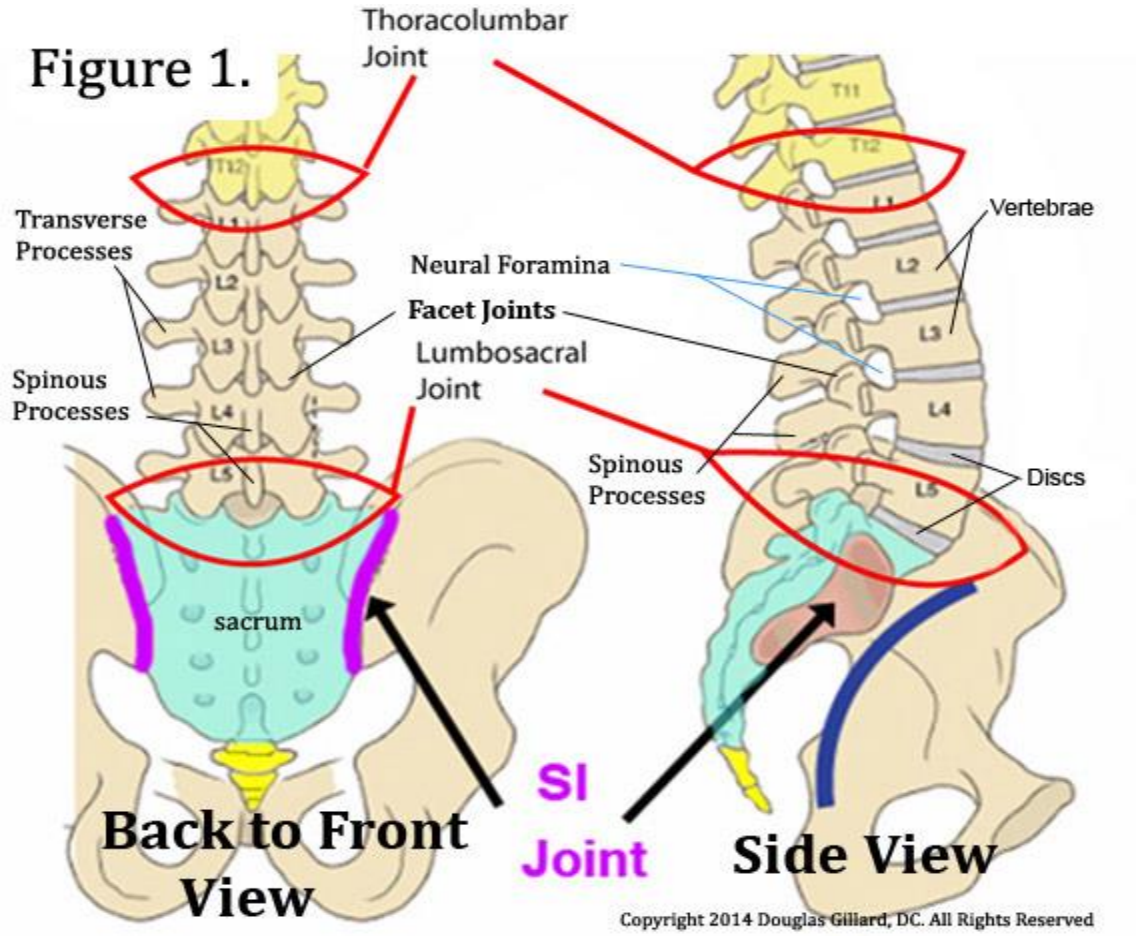


Figure 2.2: anatomy of Lumbosacral spine

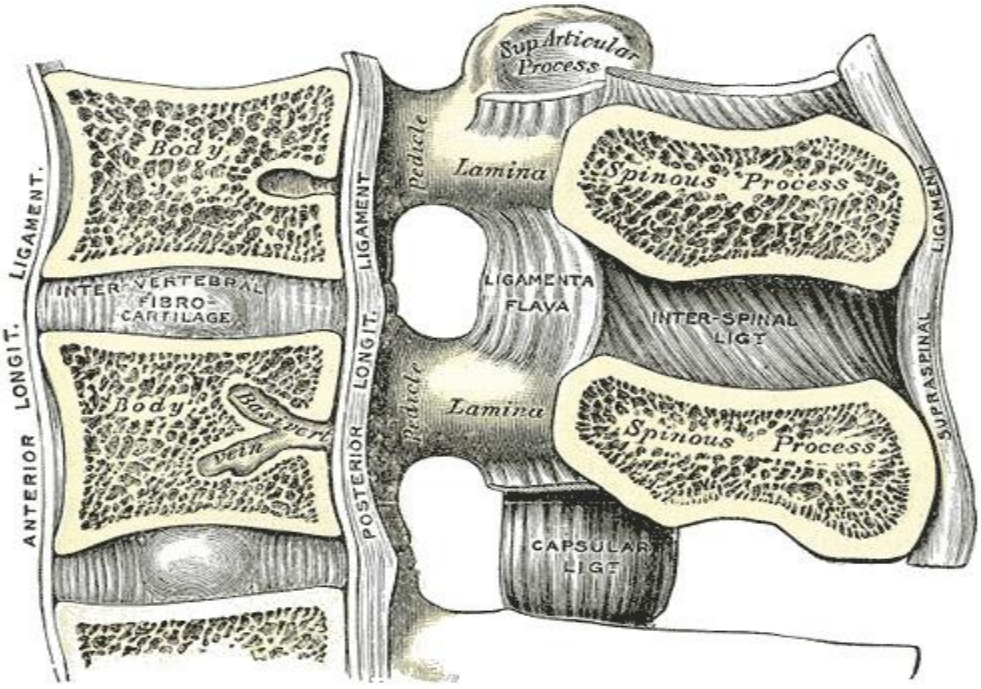
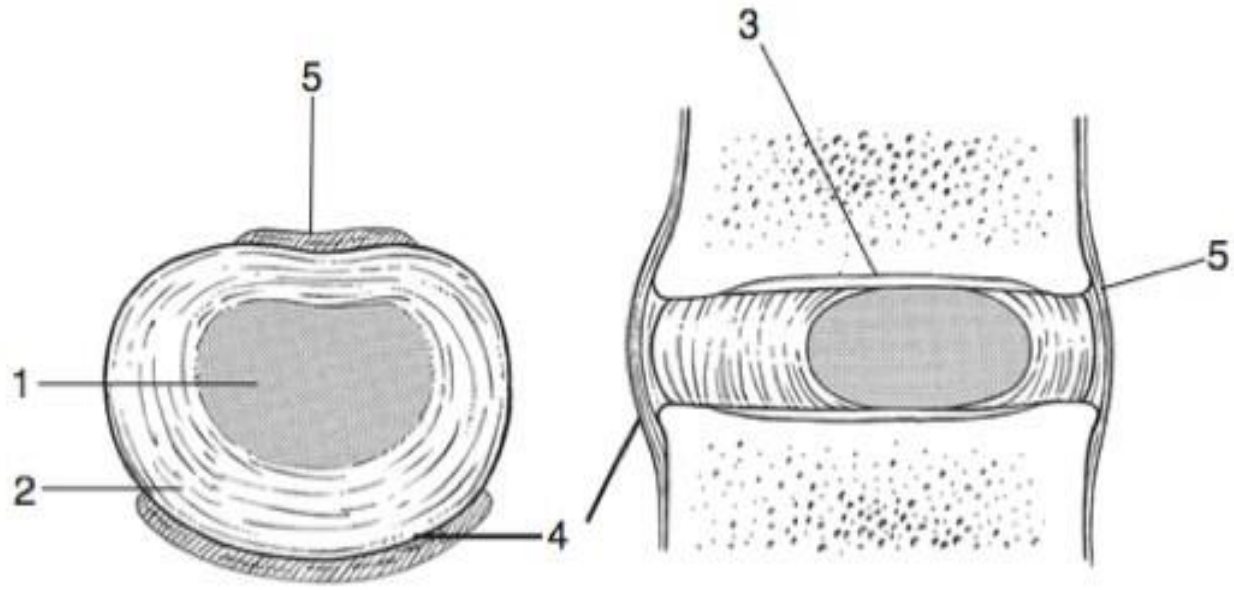


Figure 2.3: Medial sagittal section of lumbar vertebrea



The intervertebral disc: 1, nucleus; 2, annulus; 3, cartilaginous endplate; 4, anterior longitudinal ligament; 5, posterior longitudinal ligament.

Figure 2.4:Lumbar Intervertebral disc

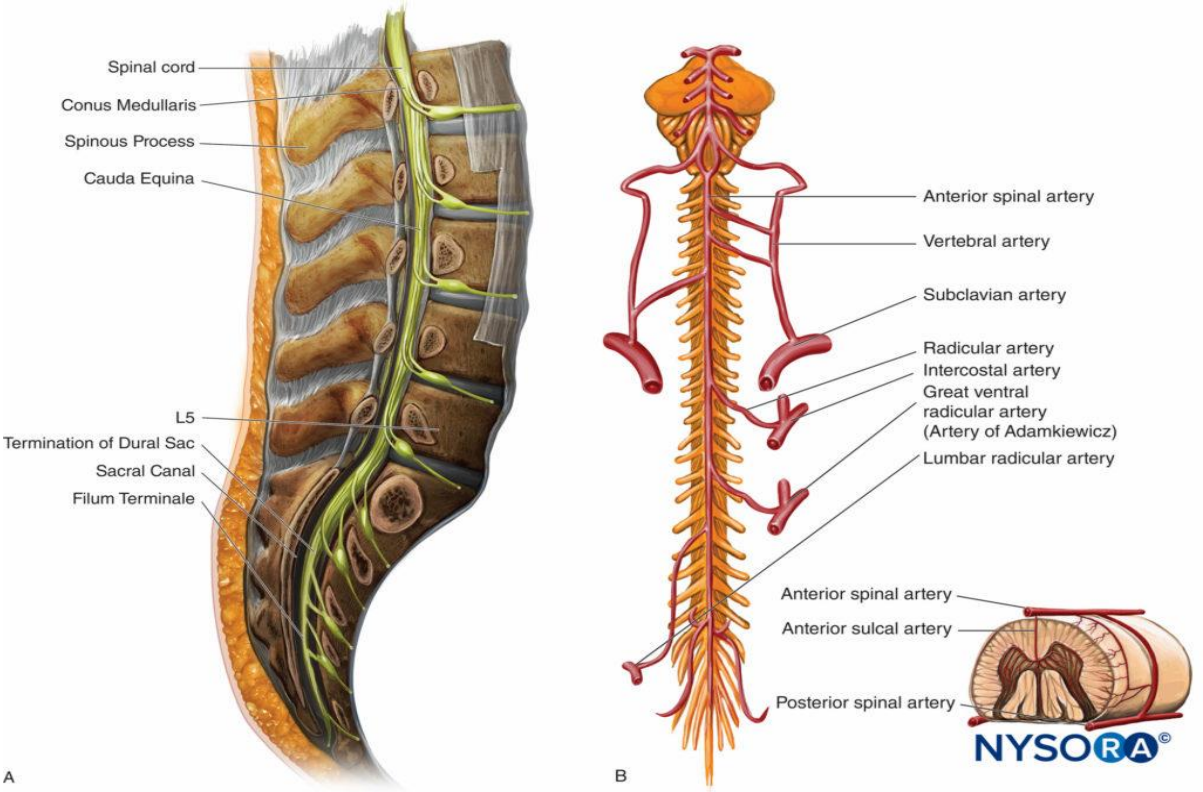


Figure 2.5: Sagittal view of the lumbar vertebrae. a) The spinal cord terminates at the L1-L2 interspace. b) Arterial supply to the anterior spinal cord.

2.2 PATHOPHYSIOLOGY

Natural degenerative changes in intervertebral disc include decrease in number of capillaries, altered cell morphology and density of nucleus pulposus. Annular clefts and apoptosis of fibroblast-like cells are increased in intervertebral disc. Disc herniation is categorized in three sages: protrusion, extrusion and sequestration. Mechanical compression is commonly considered as cause of radiculopathy. Nerve roots are compressed of endoneurium similar to peripheral nerve while cerebrospinal fluid and dural lining are present instead of perineurium and epineurium respectively. Such type of structure make nerve root soft and prone to get compressed mechanically.

Nerve roots are in close approximation to vertebral bodies. Disc herniaton exerts tensile force on nerve root similar to bowstring effect. Nutrition is impaired in mechanically compressed nerve root as both blow flow and nutrient diffusion are compromised. Intraneural edema, nerve fibrosis and injury may lead to compartment syndrome in mechanically compressed nerve. A large number of studies conclude that mechanical effect is main contributing factor in radiculopathy.[3]

The pathophysiology of lumbar radiculopathy involves a combination of pressure and chemical factors. Multiple studies have identified circulatory compromise, decreased transport of nutrients resulting in neuro-ischemia, as an important mechanism through which pressure contributes to lumbar radiculopathy. Pressure on nerves induced a decrease in nerve impulse conduction, and this was more pronounced in nerve roots than in peripheral nerves. Nerve conduction velocity in this model of acute compression was found to be decreased at pressure levels of 100 and 200 mmHg, but not at 50 mmHg, and the observed decreases were more prominent with immediate (<0.1 seconds) onset of pressure as compared to a gradual increase over 20 seconds.

Reduced blood flow, subsequent ischemia and/or nutrition transport failure to the nerve tissue are the most likely mechanisms by which pressure can impair nerve functioning. In addition to the blood supply, usually from radicular arteries, nerve roots also have a significant supply of nutrients from cerebrospinal fluid (CSF).[11] This, along with the lack of supportive tissue such as epi- and perineurium, is believed to contribute to the high susceptibility to nerve dysfunction caused by both pressure and chemical factors as compared to that of peripheral nerves. It is also recognized that reduced blood flow, with subsequent neuro-ischemia and lack of nutrients, is the most important pathophysiological mechanism through which pressure induces

nerve dysfunction. This knowledge has had limited clinical implications, primarily in lumbar spinal stenosis.

To conclude, pressure on nerve roots seems to induce nerve dysfunction due to reduced blood flow, subsequent relative ischemia and lack of nutrients in the nerve tissue. Pressure alone does not seem to be a significant cause of pain but contributes to pain in the presence of one or more chemical factor, acting to sensitize the nerve root.

The hypothesized importance of one or more biologically active substances, or chemical factors, independent of pressure in the pathophysiology of lumbar radiculopathy has been suggested in several articles. Due to the typical proximity of disc tissue to the symptomatic nerve root in lumbar radiculopathy caused by disc herniation, the disc hernia tissue is the likely source of such a chemical factor. The following will review the biological effects of disc tissue, mainly nucleus pulposus (NP), on nerve tissue from a macroscopic level down to subcellular mechanisms, through which mechanisms these effects are mediated and how these are believed to contribute to symptoms in lumbar radiculopathy.

Olmarker et al. found that NP applied to a nerve root and its dorsal root ganglion (DRG) did not induce changes in thresholds for mechanical or thermal stimuli.[27] However, it was found that the combination of mechanical deformation and NP exposure of the nerve root-induced pain, but mechanical deformation alone did not. It thus seems evident that NP acts to sensitize the nerve root to produce pain upon mechanical deformation and/or pressure, but also that NP likely has an inherent ability to induce pain without mechanical deformation. These effects, however, are likely related to subcellular mechanisms rather than structural changes in the nerve.

Another possible subcellular mechanism involves serotonergic transmission. Serotonin (5-HT) is a monoamine known to be involved in nociception, both by directly excite sensory

nerve fibers and possibly also as a modulator of signal transmission at the spinal level through gate control mechanisms.[28]

2.3 BIOMECHANICS OF LS SPINE[29]

1) Back pain is associated with spinal degeneration:-

Most spinal tissues are anatomically capable of giving rise to pain, but it has long been suspected that severe and chronic back pain often arises from the intervertebral discs. The posterior longitudinal ligament and peripheral annulus fibrosus contain nerve endings from the sinuvertebral nerve. In severely degenerated and painful discs, nerves and accompanying capillaries can grow right into the centre of the nucleus pulposus, possibly because such discs have lost the high hydrostatic pressure which normally characterises their central regions.

The sinuvertebral nerve contains both somatic and sympathetic fibres, and any tissue innervated by it could theoretically be a direct source of pain. Pain-provocation studies on sedated patients confirm that a full symptomatic pain response can often be reproduced by relatively gentle probing of the posterior annulus. Radiating buttock and leg pain arise primarily from lumbar nerve roots.

2) Genetic inheritance, ageing, and loading history make spinal tissues vulnerable to injury-

Injuries can occur when normal forces are applied to abnormally weak tissues, or when abnormally high forces are applied to normal tissues. Biomechanical studies report a very wide variation in spinal strength: for example, the compressive strength of lumbar motion segments varies between 2 and 14 kN. Much of this variability can probably be attributed to genes, because epidemiological studies on identical twins have shown that genetic inheritance explains 70% of the variance in intervertebral disc degeneration.

Genes that are known to be involved affect the biochemical composition and strength of skeletal tissues: they include genes for collagen Type IX, proteoglycans, and vitamin D metabolism. Other genes could conceivably affect strength by influencing the size of spinal structures, or the mechanisms by which cells control the balance between anabolism (building up tissue) and catabolism (breaking it down).

Ageing also weakens spinal tissues. Biochemical changes in ageing cartilage include the fragmentation and loss of proteoglycans, which reduces the tissue's water-binding properties, and increased cross-linking between fibrous proteins, especially the collagens, which increases tissue stiffness.

Biochemical deterioration of cartilage is accompanied by an age-related fall in cell density, with surviving cells being less responsive to their mechanical environment. In intervertebral discs, these changes may well be attributable to problems of metabolite transport within the avascular matrix. Impaired cell function would make the disc more vulnerable to, and less able to recover from, mechanical damage. This probably explains why smoking cigarettes, and changes in vertebral endplate permeability are associated with disc degeneration.

Another cause of tissue vulnerability to mechanical damage is loading history. Vigorous repetitive loading can propagate micro-cracks in bone, and fatigue damage can also accumulate in intervertebral discs. Avascular cartilage has a very limited ability to repair any microdamage. Certainly it is unable to strengthen as rapidly as muscle, which is responsible for most of the forces applied to the spine. Conversely, a history of abnormally low loading will cause atrophy in muscle, cartilage, and bone, leaving them less able to resist high loading during incidents such as direct impacts and falls.

4) Mechanical loading can precipitate spinal injury –

In elderly people, compressive overload is more likely to lead to collapse of the anterior portion of the vertebral body to form a 'wedge fracture'. Vertebral damage could cause back pain indirectly by generating high stress concentrations within the adjacent intervertebral discs and subsequently could cause the annulus to collapse into the nucleus. This mechanism is supported by a survey of adolescents, which confirmed that vertebral body damage is often followed by disc degeneration several years later.

Other experiments have demonstrated how torsion can injure the apophyseal joint that is in compression; how a combination of bending and compression can cause even a healthy disc to prolapse.

4) Spinal 'degeneration' can represent a cell-mediated response to injury-

Skeletal tissue cells adapt the surrounding matrix to prevailing mechanical demands (Fig. 2.2). Intervertebral disc cells in the inner annulus and nucleus normally experience hydrostatic pressures, and consequently their metabolism in-vitro is sensitive to changes in pressure. On the other hand, cells of the outer annulus experience tensile strains in-vivo, and are insensitive to hydrostatic pressures invitro. Increased or oscillating hydrostatic pressures generally cause cartilage cells to increase collagen and proteoglycan synthesis. However, very high or very low pressures both inhibit synthesis, especially if applied in a static manner. Hydrostatic pressure in excess of 3 MPa stimulates disc cells to increase production of the matrix-degrading enzymes the MMPs. This could indicate cells breaking down the surrounding matrix prior to building it up again stronger than before. Cell responses to an altered mechanical environment are likely to be beneficial if the environmental changes are small and reversible. However, cell responses to the large and non-reversible changes which follow structural disruption may be harmful, as discussed previously.

Cells are most influenced by their local mechanical environment, and structural disruption has such a harmful effect on tissue metabolism because it uncouples the local tissue environment from overall loading of the structure. Moreover, it does so permanently. Animal experiments confirm that direct physical disruption of an intervertebral disc leads inexorably to cell-mediated degenerative changes during the following weeks or months. High dynamic loading can have a similar effect, presumably because it causes early disruption of the annulus.

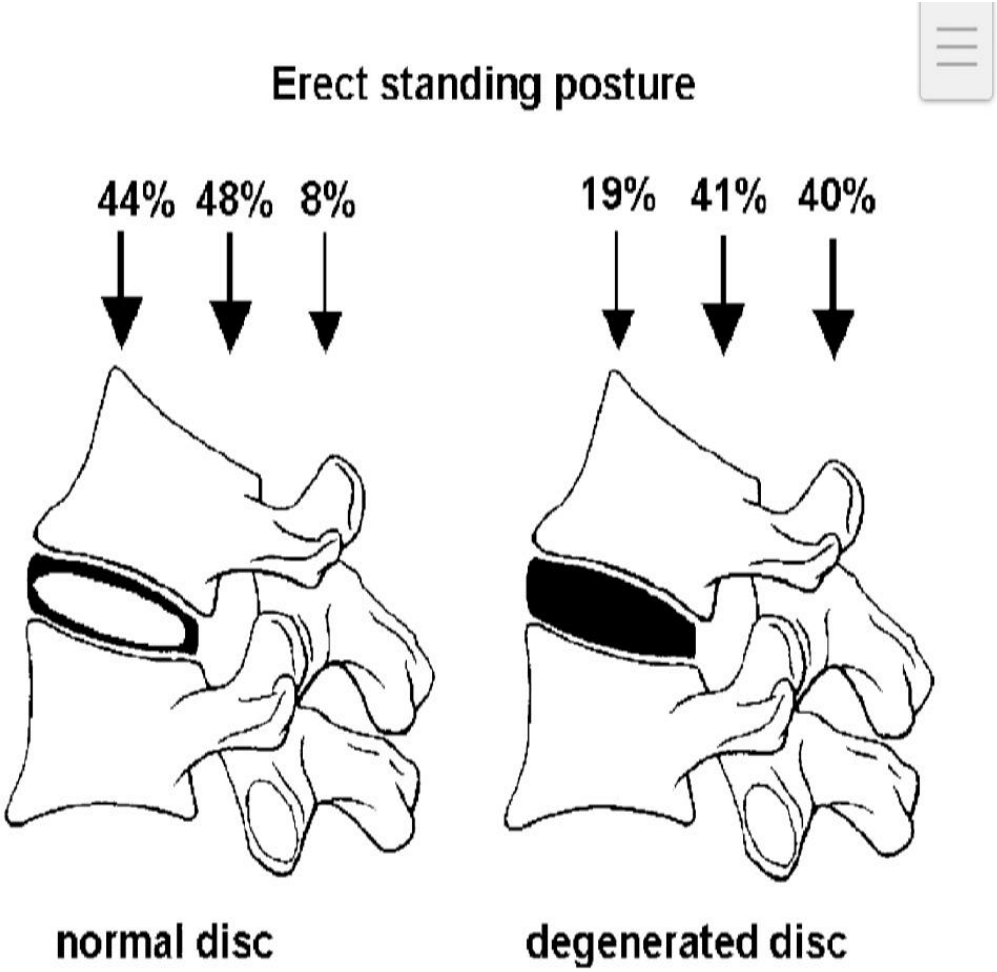


Figure 2.6: load sharing in the lumbar spine is affected by intervertebral disc

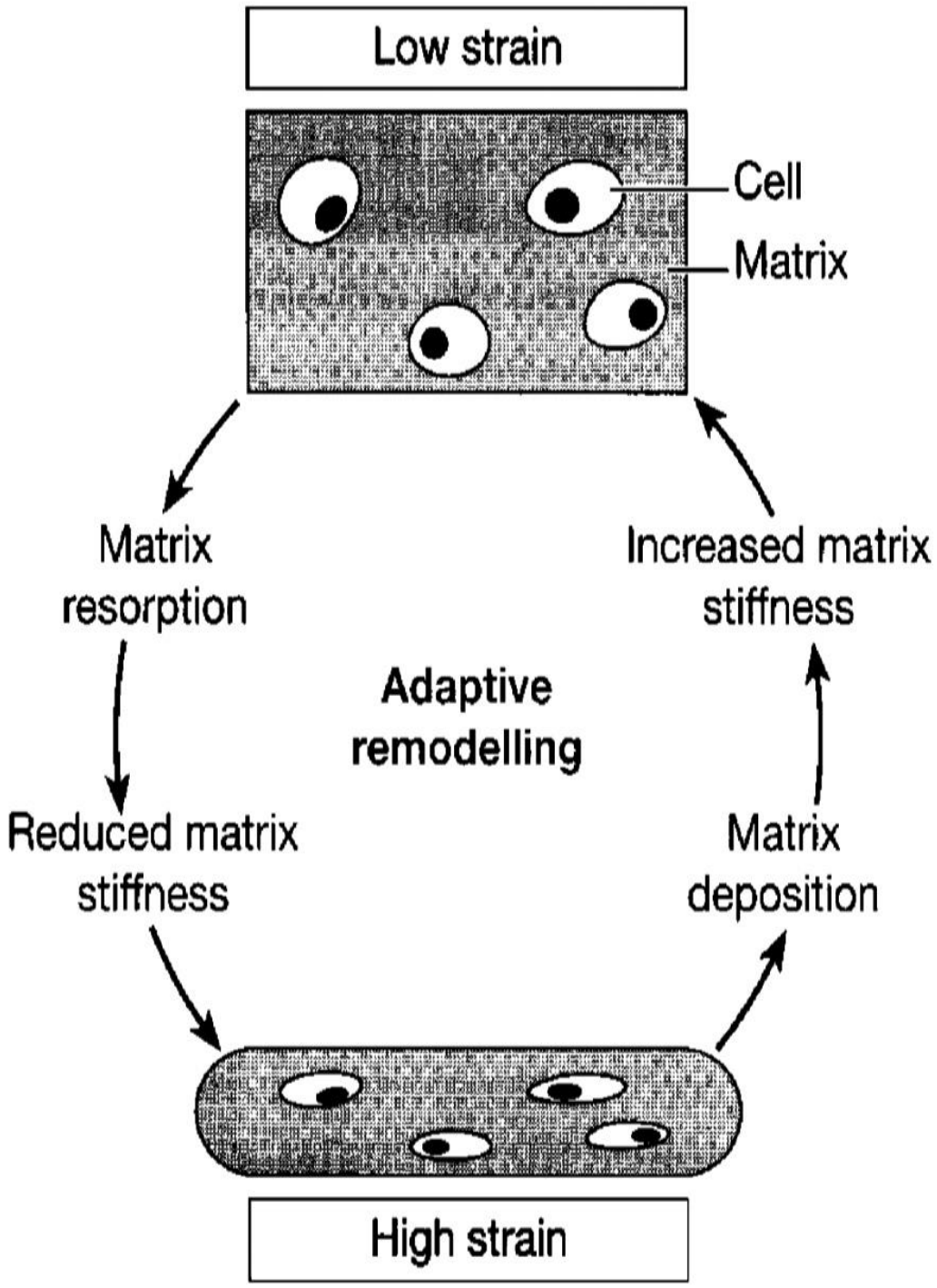


Figure 2.7: In the process of adaptive remodeling, cells within a connective tissue adjust the stiffness of their extracellular matrix to suit the external loading, and so keep matrix strain within the desired normal range.

5) Functional pathology: spinal pain can arise without degeneration?

Changes in posture affect the relative orientation of adjacent vertebrae, and profoundly alter stress distributions within the apophyseal joints and intervertebral discs. Therefore the precise manner in which a person sits, stands and moves could affect pain perception from innervated tissues, even if the stress concentrations are insufficient to cause detectable injury or other pathology: such a pain mechanism can be referred to as 'functional pathology'.

Postural effects are exaggerated following sustained (creep) loading because compressive creep squeezes water from the discs and reduces the separation of vertebrae by 1–2 mm. Large stress concentrations in innervated tissues arising from relatively small changes in posture suggest that 'bad' posture could conceivably lead to spinal pain, even in the apparent absence of degenerative changes in the affected tissues.[29]

2.4 SUBJECTIVE FINDINGS

Lumbosacral radiculopathy has been estimated to be 3%-5% of the population, affecting both gender. Symptoms typically begin in midlife, with men often affected in the 40s while women are affected in the 50s and 60s.[1] The duration of pain can be classified into; Acute (pain lasts <6 weeks), Sub-acute (pain lasts 3 weeks to 3 months) and Chronic (pain lasts ≥3 months).[5]

Patients can present with radiating pain, numbness/tingling, weakness, and gait abnormalities across a spectrum of severity. Depending on the nerve root(s) affected, patients can present with these symptoms in predictable patterns affecting the corresponding dermatome or myotome. Most of the lumbar disc herniation causes varying degrees and duration of back pain. Higher level herniation (2^{nd} or 3^{rd} lumbar levels) can radiate front of thigh to knee; Fourth lumbar (L4) radiates to Lateral thigh & Medial lower leg; Fifth lumbar (L5) radiculopathy causes

Buttock, back & side of thigh, and Lateral lower leg and dorsum of foot; and First sacral (S1) radiculopathy causes pain in Buttock, back of thigh and lower leg & lateral foot or the heel.[30]

Performance of a careful history and physical examination is the initial and integral step in the diagnosis and management of lumbosacral radiculopathy. Lesion localization depends on demonstration of a segmental myotomal or dermatomal distribution of abnormalities; a working knowledge of the relevant anatomy is essential. Sciatica, the classic presenting symptom of lumbosacral radiculopathy, is characterized by pain in the back radiating into the leg. Patients variably describe this pain as sharp, dull, aching, burning, or throbbing. Pain related to disk herniation is exacerbated by bending forward, sitting, coughing, or straining and relieved by lying down or sometimes walking.[31]

Radiating pain, abnormal sensation and weakness in area of Lumbosacral nerve roots in lowerlimb are primary clinical presentation of lumbar disc herniation. There may localized paresis coldness in leg, limited trunk flexion, exacerbation in pain with sneezing, straining and coughing. Patients complain difficulty in sitting, as it increases disc pressure upto 40% as compared to upright standing. Forward flexion also contributes to increase in pain as pressure on lumbar disc is increased by 100-400%. So lumbar disc prolapsed induced radiating pain, abnormal sensation, weakness, paresis, cold leg, limited ROM and difficulty in sitting.[3]

Acute disk herniation produces symptoms by direct compression of the nerve roots and by inflammatory and ischemic mechanisms involving the roots and dorsal root ganglia. The intervertebral disks affected most frequently are L4-5 and L5-S1, leading to L5 or S1 radiculopathies.[35] Incidence of LBP is highest for those aged 30 to 50 years.[12]

The area of skin supplied by group of nerve is referred as dermatome. Each lumbar spinal nerve also innervates a group of muscles with motor fibers, termed a myotome. Dermatomes and

myotomes trace back to our embryological development. Dermatomes and myotomes are clinically relevant as they can be used to determine the lumbar spinal nerve(s) involved in the setting of pathology.

This will focus on the sensory and major muscular innervations of the lumbar spinal nerves. L1 and L2 innervate the iliopsoas muscle and provide sensory innervation to the inguinal crease and medial thigh. L3 partially innervates the adductors, iliopsoas, and quadriceps musculature. L3 provides sensory innervation to the anterior-medial thigh. L4 contributes to the femoral and sciatic nerves, innervating the iliopsoas, adductors, quadriceps, and tibialis anterior. The L4 nerve provides sensory innervation to the anterior thigh and medial lower leg. The L3 and L4 nerves contribute to the patellar reflex arc.

L5 innervates the gluteus medius, tensor fascia latae, medial hamstrings, tibialis anterior, extensor hallucis longus, extensor digitorum longus/brevis, peroneus longus, tibialis posterior, and the flexor digitorum longus. L5 provides sensory innervation to the lateral leg and dorsum of the foot. It is clinically important to note that each dermatome overlaps with adjacent dermatomes. Therefore, dense numbness is exceedingly rare in the setting of nerve root compression. Each myotome also overlaps, leading to nearly every muscle of the lower extremity receiving innervation from 2 or 3 lumbar spinal nerves.[27]

2.5 MAGNETIC RESONANCE IMAGING

Magnetic Resonance Imaging (MRI) is used as a gold standard tool for confirmation of lumbar disc prolapsed due to its high inter-observer reliability.[3] MRI is a gold standard diagnostic investigation for PIVD. Even after high sensitivity of MRI, sometimes it shows abnormal findings even in absence of clinical features. It is important to identify anatomic variations in MRI to correlate with symptoms in patient of lumbar disc disease.[12]

MRI will display both physiological and pathological changes which may miss-lead a less experienced health professional and can also create bad mental impact on an otherwise normal individuals.[21] MRI has provided clinicians with a non-invasive mechanism for viewing lumbar anatomy in great detail. Disc herniation of the same size may be asymptomatic in one patient and can lead to significant clinical symptoms in other patient.[13]

In MRI of spine the term degeneration referred to any one or more among the following imaging findings including desiccation of IV Disc, reduction in height of disc space, diffuse bulging or prolapsed of the disc, extensive fissuring (ie. Numerous annular tears, mucinous degeneration of annulus, modic changes in the end plates, endplate sclerosis and osteophytes at the vertebral apophyses).[32]

Clinical assessment and imaging studies are used to evaluate the patient's symptoms, and magnetic resonance imaging (MRI), being the most diagnostic importance, is employed to identify the etiology and determine the level of the anatomical abnormality. The clinical significance of the MRI findings has been questioned, although being highly sensitive for identifying disc problems; not all of the identified lesions cause symptoms. Neural foramen compromise and multiple disc lesions are the radiological findings that are most likely to cause clinical symptoms. In some patients, MRI findings do not coincide with clinical findings, or the lesion cannot be identified (e.g., far extraforaminal lesion); therefore, sometimes the need arises to use another test to reach the diagnosis.[30]

MRI examination of the lumbo-sacral spine is proposed to provide detailed anatomic assessment of the spine, however, it has a high potential of identifying incidental findings which are morphologically abnormal but not responsible for, or even related to, patients' symptoms. Lumbo-sacral MRI findings may sometimes be irrelevant in clinical decision making and

ultimate treatment outcomes. Such findings may influence further investigations, unnecessary treatment options, increased cost of care and possibly poor outcomes.[33]

MRI of the lumbo-sacral spine has been proven to be able to detect alterations in both the anatomy (disc herniations and spinal canal stenosis) and tissue properties (disc desiccation and reactive marrow changes), which then need to be considered within a clinical context. Other characteristics investigated by MRI include disc contour abnormalities (bulge and herniations), and degenerative changes of the inter-vertebral discs, bone marrow, neuro-foramina, spinal canal and facet joints. The diagnostic utility of MRI in assessing normal lumbar anatomy, internal disc chemistry and architecture, features of lumbar spine degeneration, and in diagnosing herniated lumbar discs have been well documented. However, it's accuracy in detecting nerve root compromise remains questionable.[33]

Abnormal lumbo-sacral imaging findings in patients with Lumbosacral radiculopathy are in some instances coincidental, hence the need to correlate imaging findings with the patient's clinical picture. This shortcoming, on the likelihood of false positive findings on MRI, coupled with high economic cost of radiological imaging, and the surgical interventions they may trigger, has invoked consistent criticism among authorities in the fields of neurology and musculo-skeletal heath care as indicated earlier in the American Agency for Health Care Policy and Research (AHCPR).[33]

2.6 SLR TEST

Typically, history and physical exams are sufficient for evaluation of back pain.[34] SLR Test is one of most commonly performed maneuvers in clinical practice. Sciatic pain is radiating from buttocks to the leg and is frequently associated with LBP. Neurological examination is fundamental in discriminating patients with isolated LBP from those with associated with

radiculopathy. The clinical usefulness of SLR test remains important and should still be considered a relevant component of physical examination.[35]

A positive test elicits pain in the leg, buttock, or back same as that described in the history at 30-70 degrees of leg elevation, when the majority of nerve movement occurs at the intervetebral foramen and is suggestive of lower lumbar nerve root involvement (L4 to S1).[8] The pain is typically worsened by dorsiflexion of ankle or neck flexion, and is relieved with flexion of knee. They provoke pain or other sensory symptoms that reveal the root lesion (Laegue's sign).[9]

Lasegue test is basically a symptoms provocation test that evidences radicular irritation in the Lumbosacral region by passively flexion of lower limb (figure 2.3).[18] Exact clinical examination is the best and easiest way to detection. Physical findings in SLR test, neurological tests, and others are not only helpful in detecting the problem but also they can be used in specifying exact pathological location.

The SLR test is performed with the patient in supine position. The examiner gently raise the patients leg by flexing the hip with the knee in extension, and the test is considered positive when the patient experiences pain along the lower limb in the same distribution of the lower radicular nerve roots (usually L5 or S1)[9]

The straight leg raise test induced 3-well defined patterns of pain; low back pain only, leg pain only, and low back pain & leg pain. The disc protrusion may be situated in a central, intermediate or lateral. Patients with central protrusion tend to have only low back pain; patients with lateral protrusion tend to have only leg pain, although patients with intermediate protrusion tend to have low back pain & leg pain both.[15]

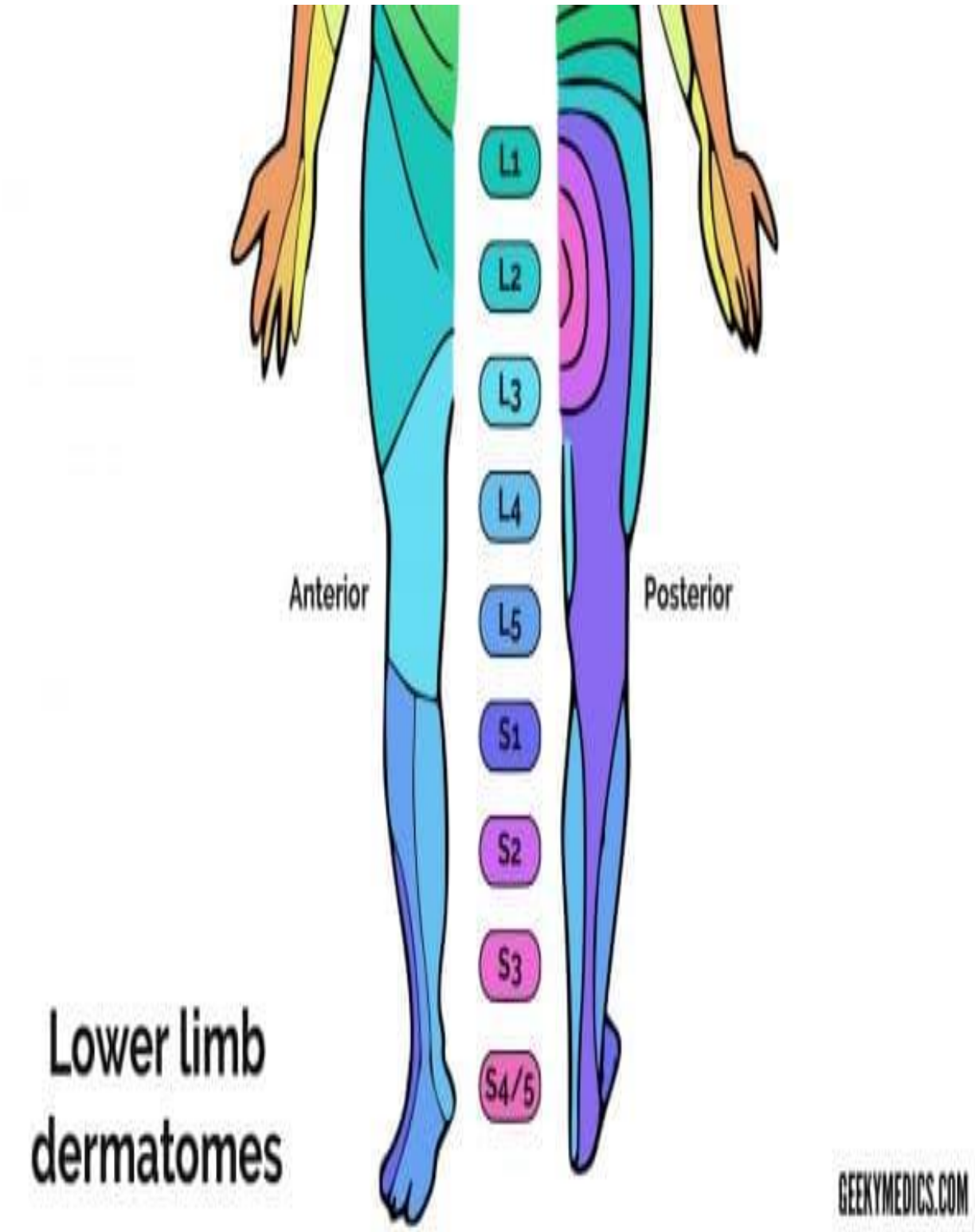


Figure 2.8: Lower limb dermatomes

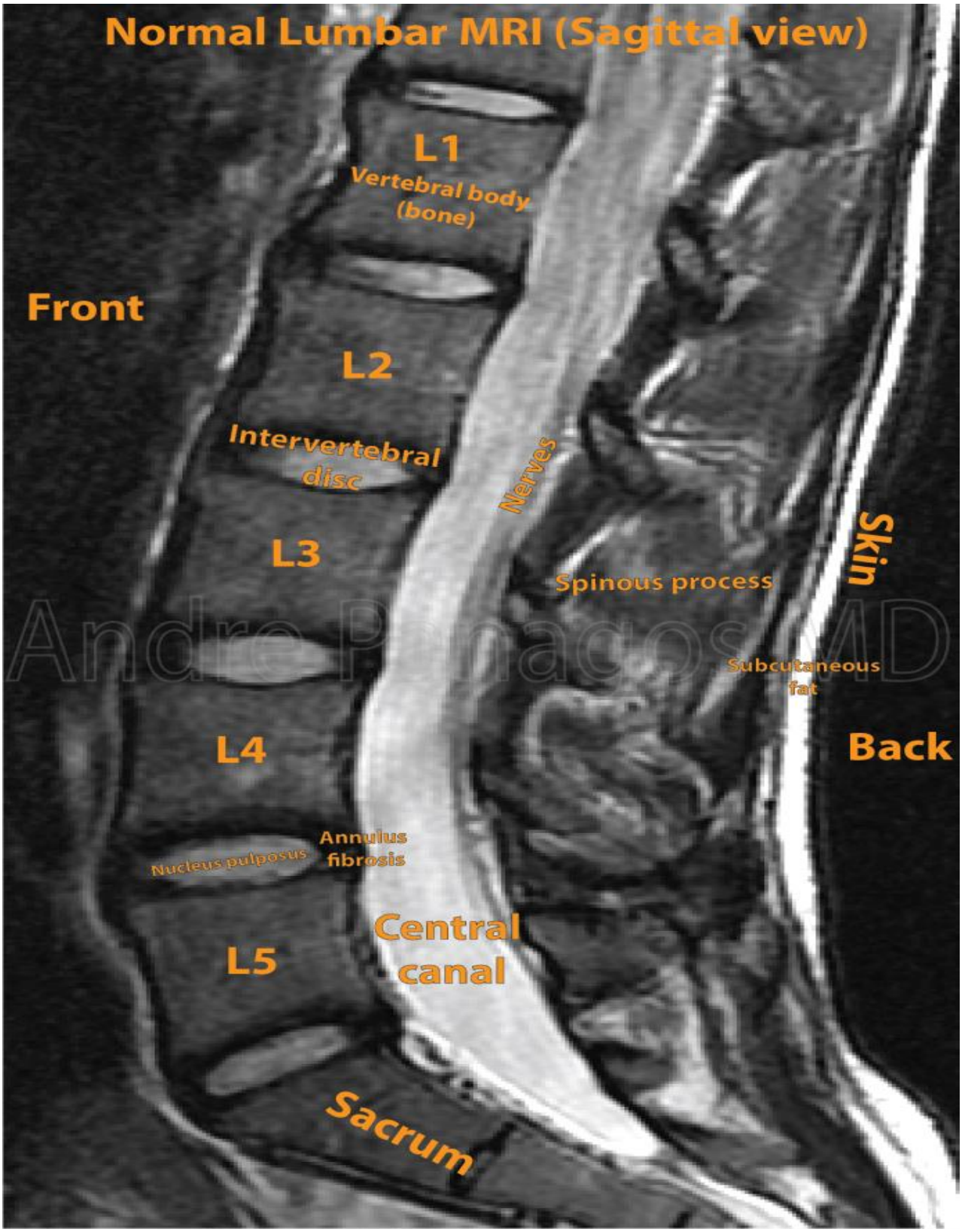


Figure 2.9: Normal Lumbar MRI; Sagittal view

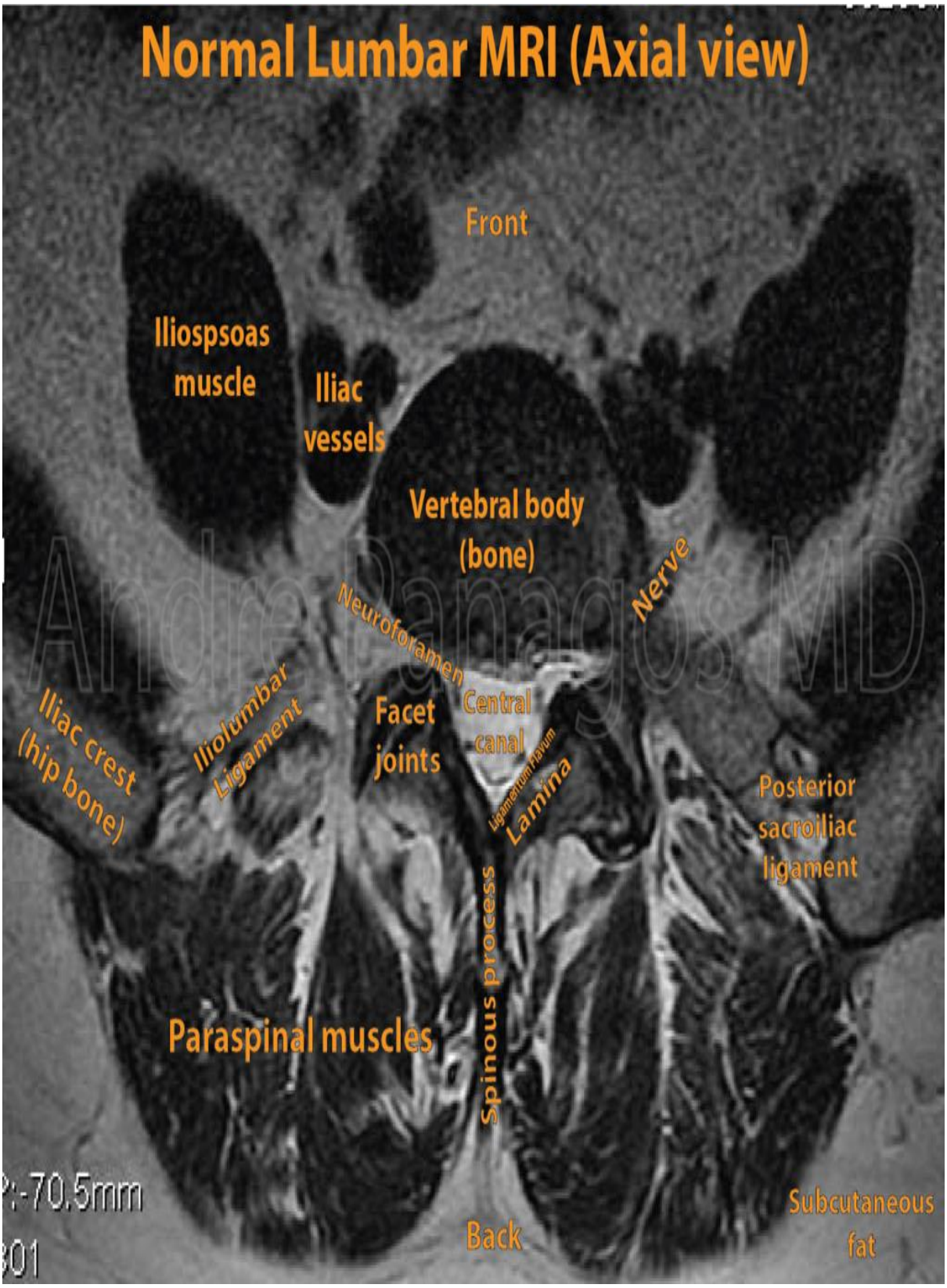


Figure 2.10: normal lumbar MRI; Axial view

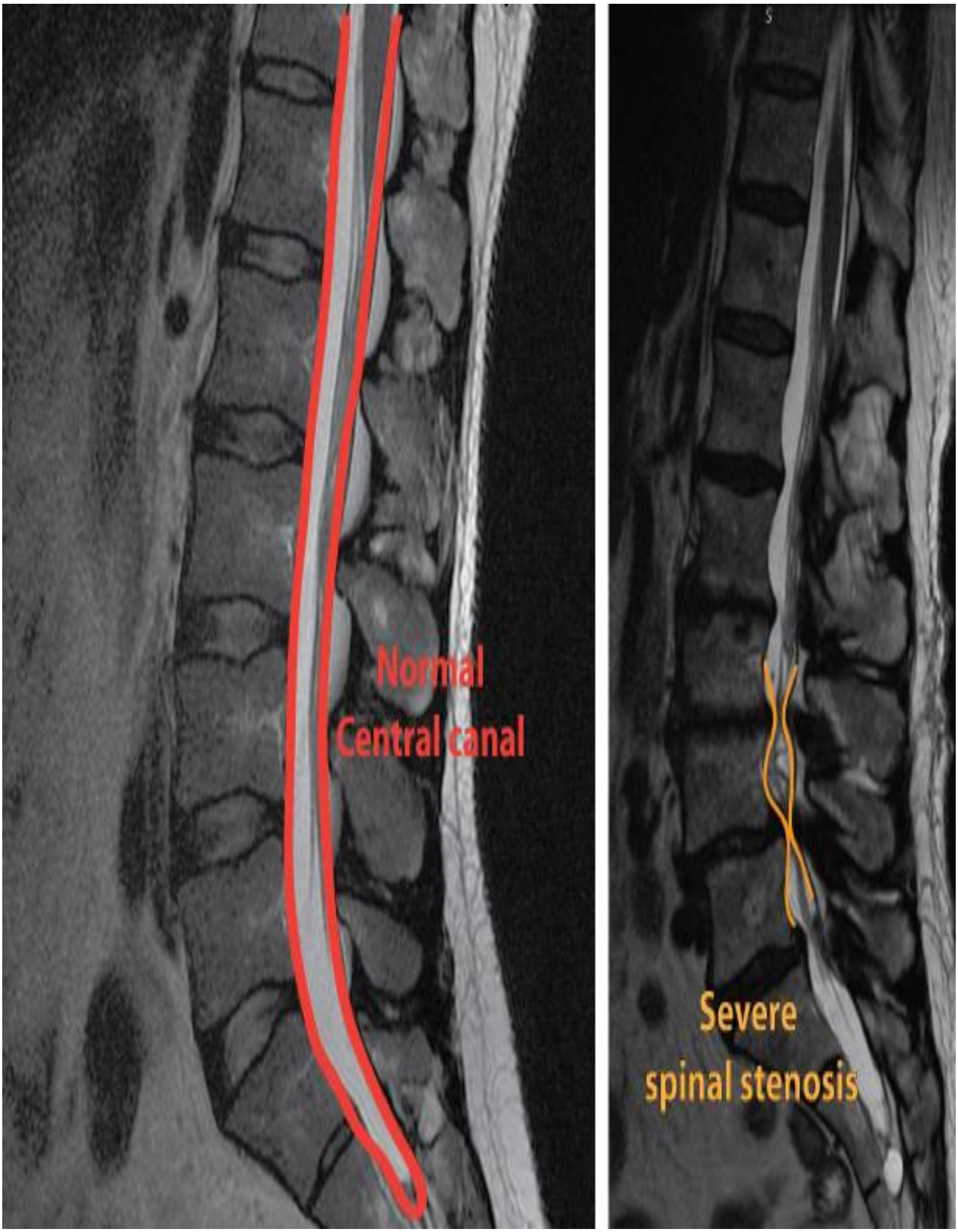


Figure 2.11: Showing normal central canal and severe spinal stenosis

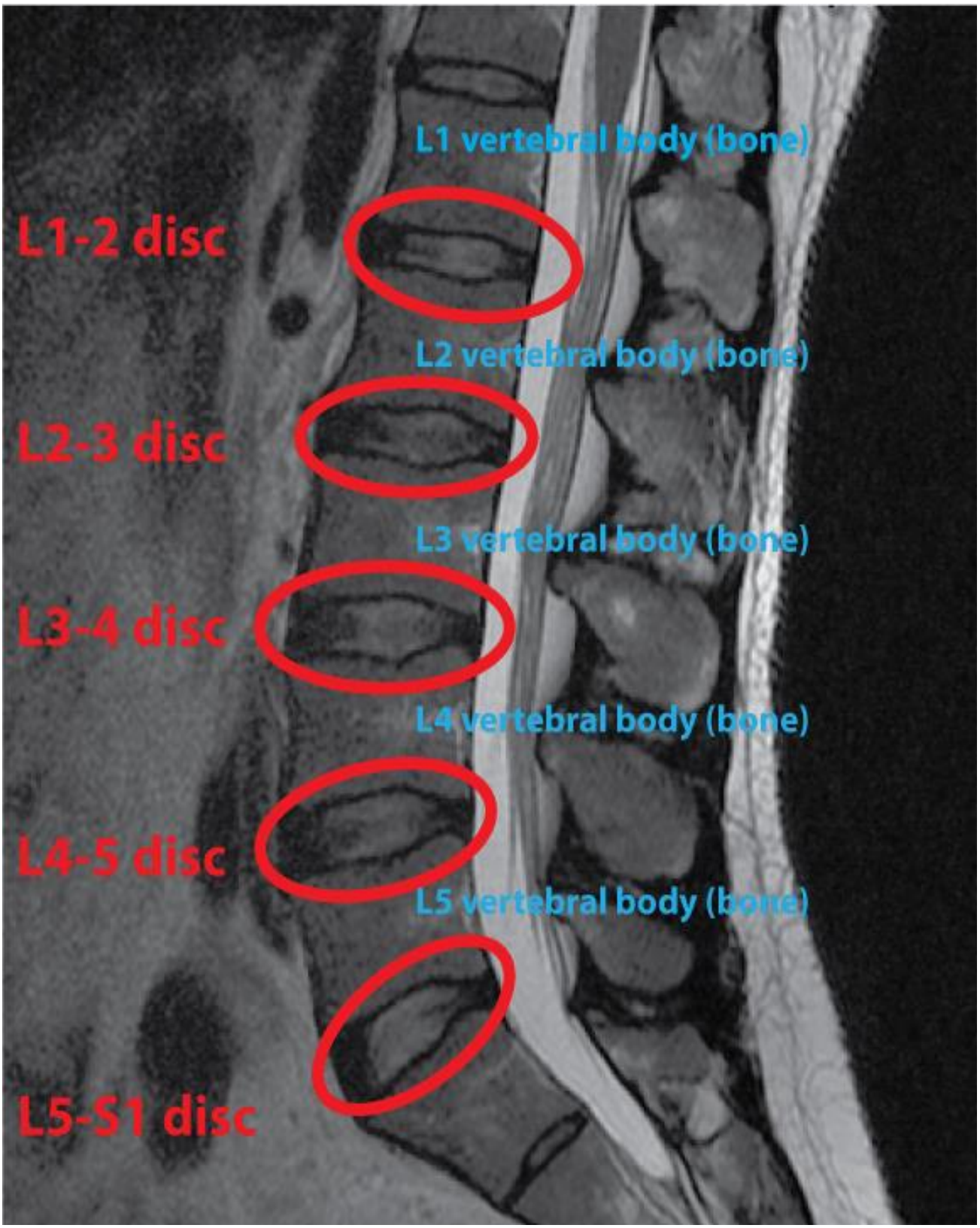


Figure 2.12: MRI showing intervertebral discs

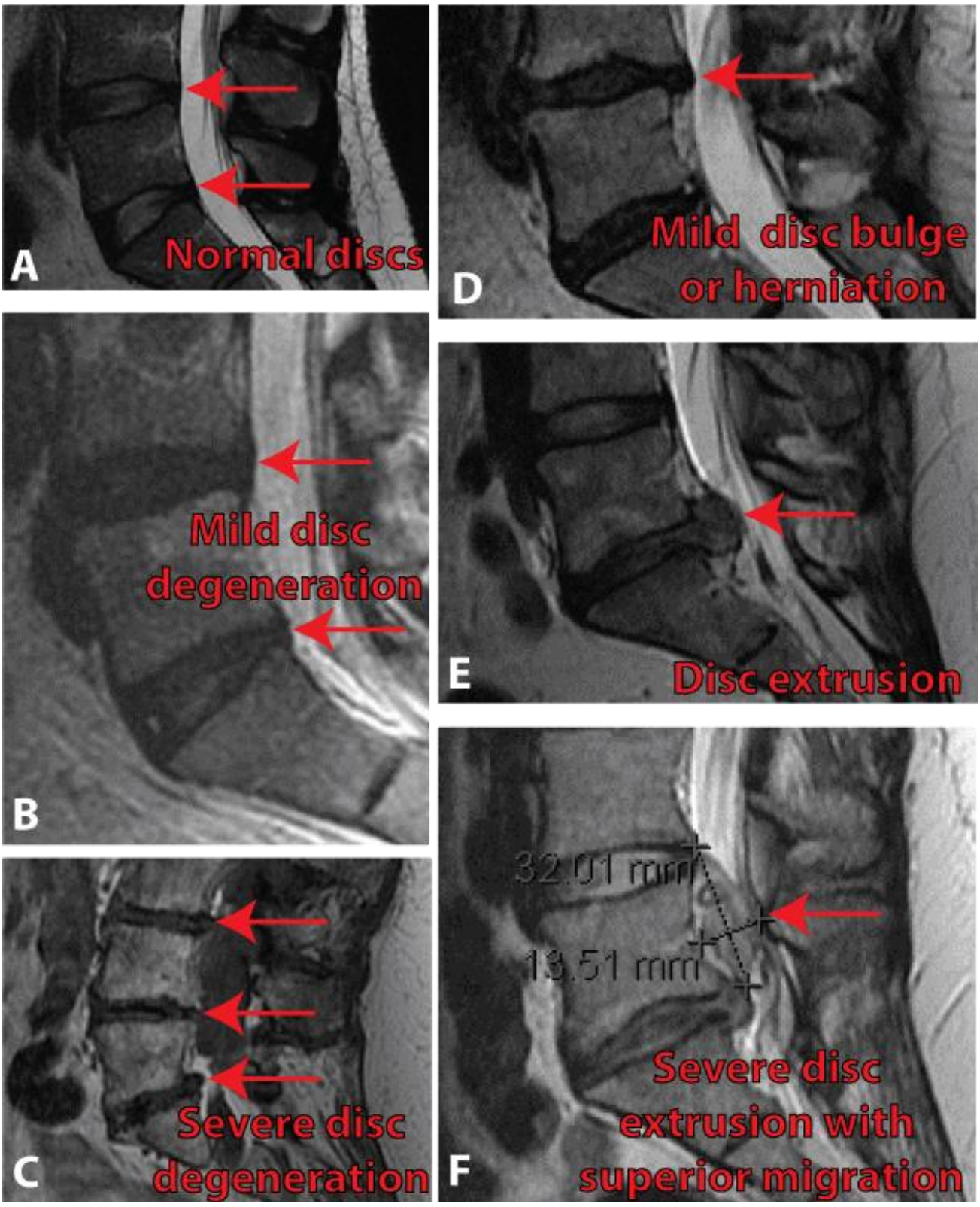


Figure 2.13: MRI showing disc degeneration & disc herniation

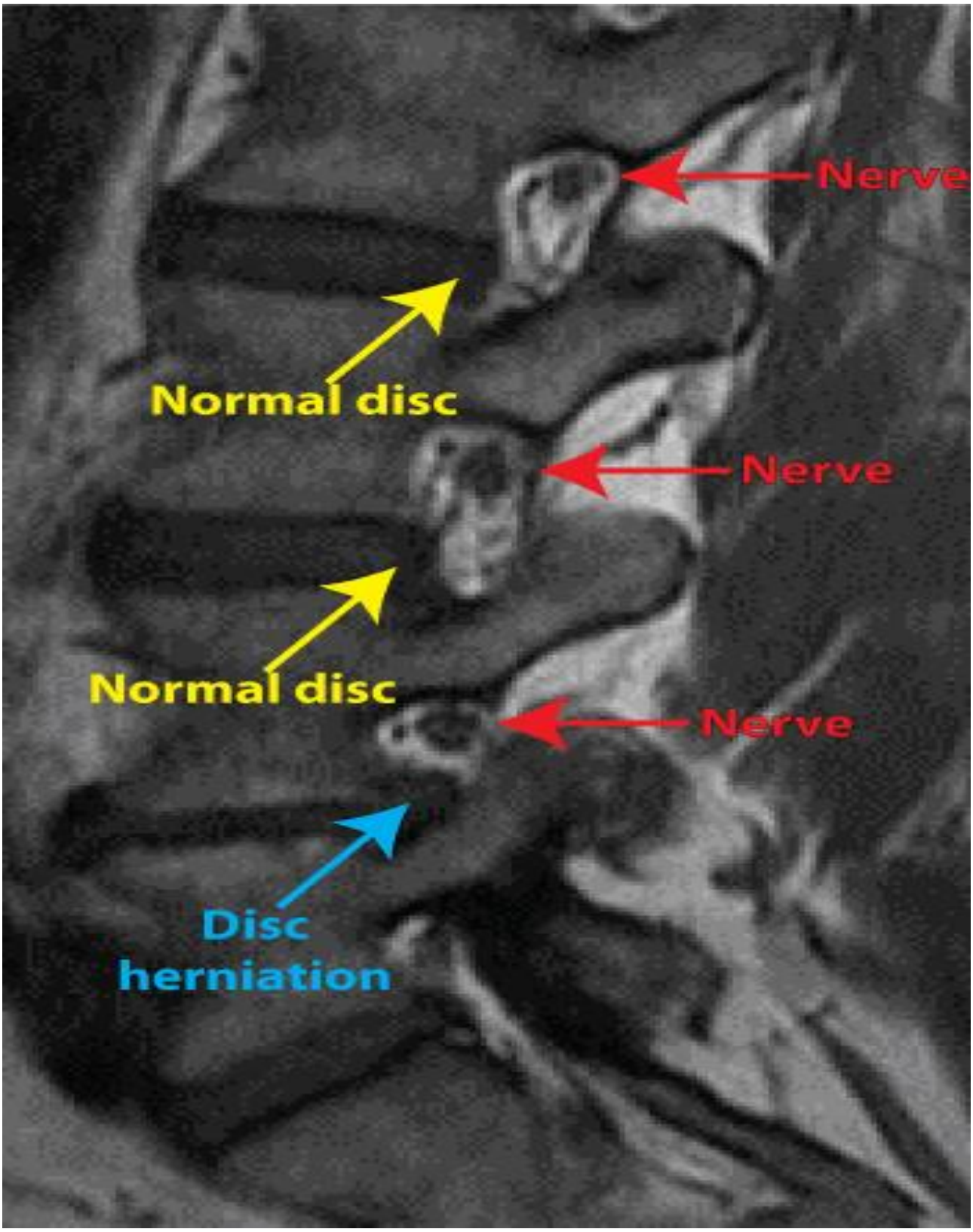


Figure 2.14: MRI showing pinched nerve with disc herniation

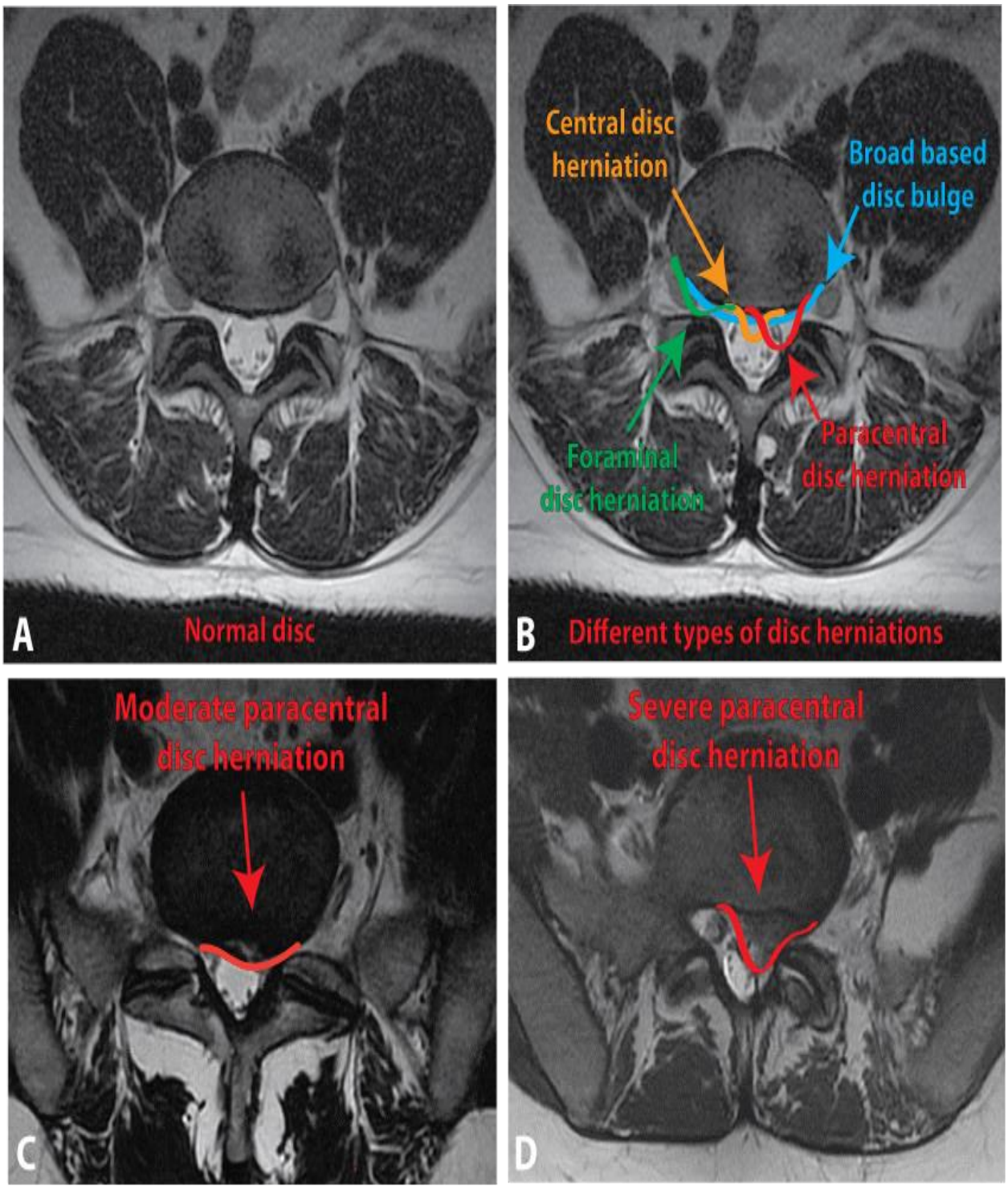


Figure 2.15: MRI showing various disc disorder in axial view

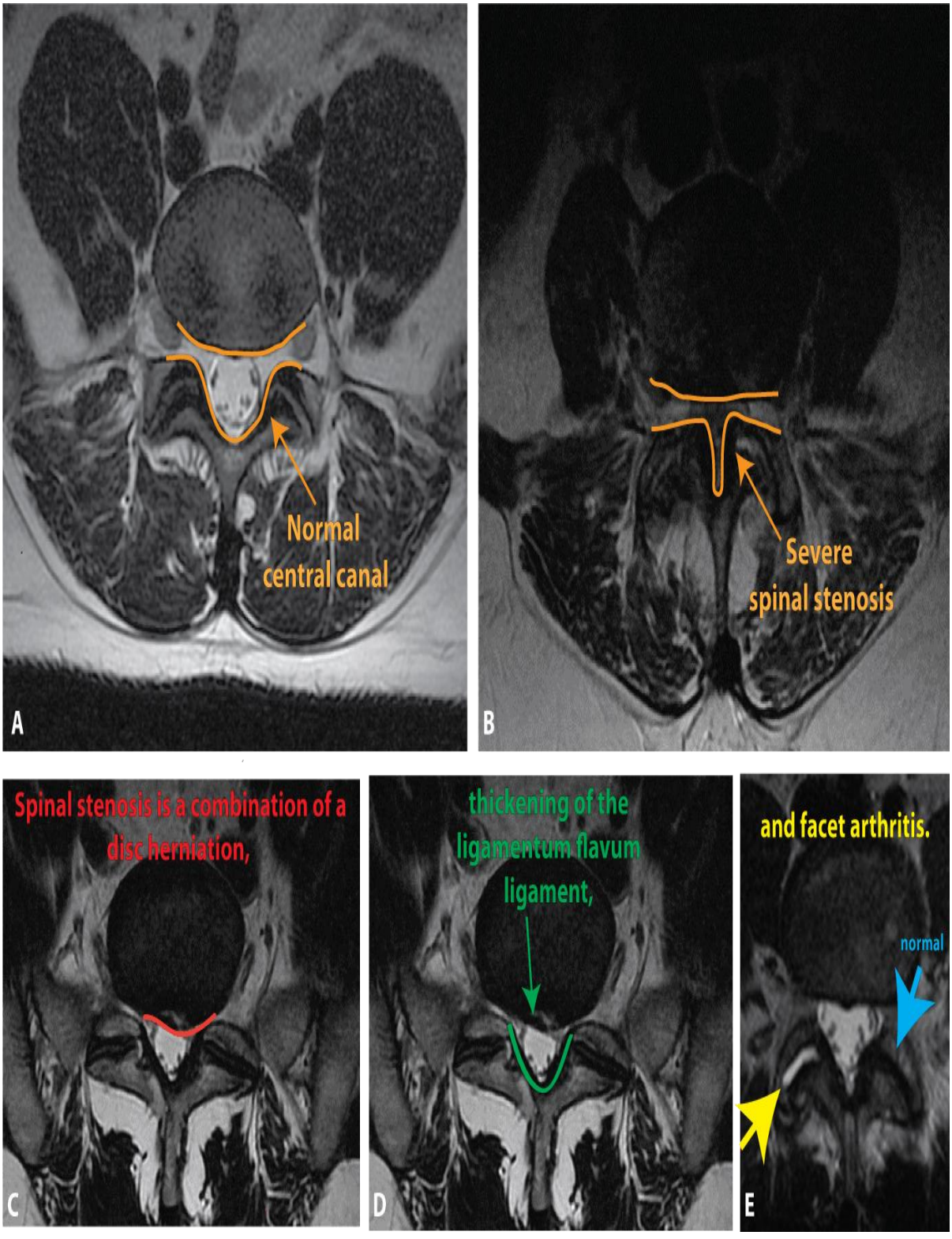


Figure 2.16: MRI showing spinal stenosis

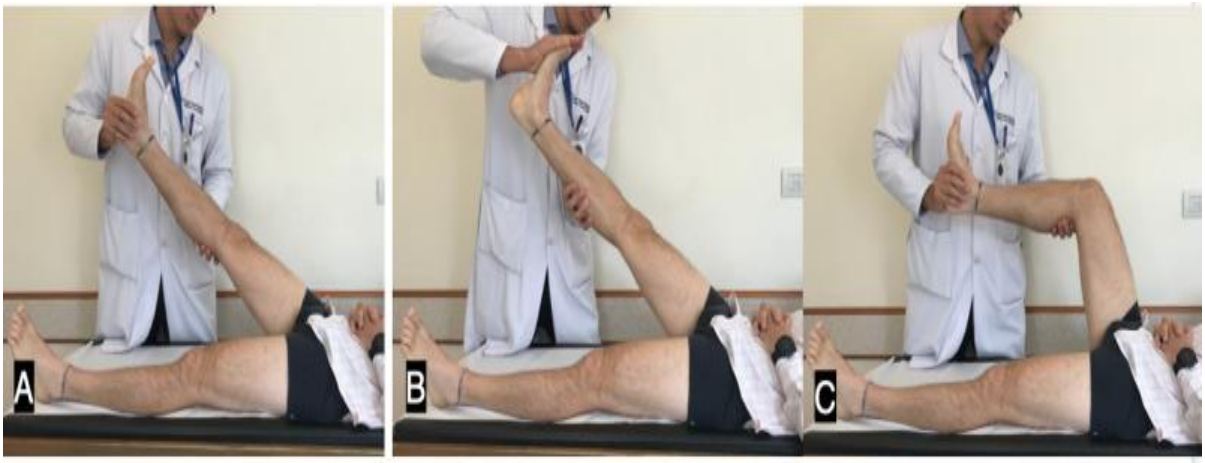


Figure 2.17: SLR test; a) Straight leg raising, b) Dorsiflexion, c) Knee flexion

2.7 ANALYSIS OF DATA

1) Correlation study-

A correlation research design investigates relationships between variables without the researcher controlling or manipulating any of them. A correlation reflects the strength and/or direction of a correlation can be either positive or negative. In positive correlation, both variables change in the same direction as height increases, weight also increases. In negative change in opposite directions as coffee consumption increases, tiredness decreases. In zero correlation, there is no relationship between the variables coffee consumption is not correlated with height.

There are many different methods can use in correlation research. In the social & behavioral sciences, the most common data collection methods for this type of research include surveys, observations, & secondary data. It is important to carefully choose and plan methods to ensure the reliability and validity of results. It should carefully select a representative sample so that data reflects the population you are interested in without bias.

2) cross-sectional analytic study-

This study is a cross-sectional analytical study. A cross sectional study is defined as a type of observational research that analyze data of variables collected at one given point in time

across a sample population or a pre-defined subset. This study type is also known as cross sectional analysis. The data collected in this study involves subjects or participants who are similar in all variables-except the one which is under review. Analytical cross sectional research investigates the association between two related or unrelated parameters.

2) Descriptive analysis-

Descriptive statistics uses the data to provide descriptions of the population, either through numerical calculations or graph or tables. Example- measure of central tendency, dispersion.

3) Null hypothesis-

A hypothesis is an assumption or supposition about the population parameter, which has to be prove or disprove. Null hypothesis is accepted in this study. It reflects no difference, no risk, no effect etc.

4) Non-parametric test; Chi-square test-

Non parametric test is used where the data is nominal or ordinal and the assumptions of parametric tests are inappropriate. The parametric assumption of particularly worrisome for small sample size (N<30). Non-parametric tests are often a good option for these data. Chi square test is a non parametric test not based on any assumption or distribution of any variable. In general, test we use to measure the differences between what is observed and what is expected according to an assumed hypothesis is called chi square test. This test based on frequencies and not on the parameters like mean and standard deviation. This test can also be applied to a complex contingency table with several classes and as such is a very useful test in research work.

5) Contingency table-

A contingency table is a type of table in a matrix format that displays the frequency distribution of the variables. They provide a basic picture of the interrelation between 2 variables and can help find interactions between them. The chi square statistic compares the observed count in each table cell to the count which would be expected under the assumption of no association between the row and column classifications.

6) Fisher's p-value-

The probability of obtaining a result equal to, or more extreme than, that actually observed, under the assumption that the null hypothesis (there is no difference between specified populations) is correct. Ronald Fisher (1890-1962), considered the father of modern statistical inference, introduced the idea of significance levels as a means of examining the discrepancy between the data and the null hypothesis.

A P-value of 0.05 infers, assuming the postulated null hypothesis is correct, any difference seen (or an even bigger 'more extreme' difference) in the observed results would occur 1 in 20 (or 5%) of the times a study was repeated. A P-value of 0.01 infers, assuming the postulated null hypothesis is correct, any difference seen (or an even bigger 'more extreme' difference) in the observed results would occur 1 in 100 (or 1%) of the times a study was repeated.

The panel discussed many misconception about p values. P> is the probability that the null hypothesis is true. 1 minus the p value is the probability that the alternative hypothesis is true. A statistically significant test result ($p \leq 0.05$) means that the test hypothesis is false or should be rejected. A p-value greater than 0.05 means that no effect was observed. The ASA panel defined the p-value as the probability under a specified statistical model that statistical summary of the data would be equal to or more extreme than its observed value.[6]

1. Anubhav Rijal et al,(2020), concluded that Straight leg raising test (SLRT) and neurological findings correlates well with nerve root compression visible in MRI. Whereas the type of disc herniation does not correlate with the neurological deficit. Thus, clinical findings correlate well with MRI findings, but all MRI not likely to be responsible for the patients symptoms.[10]
2. Francisco Javier Gonazalez Epinosa de los Monteros et al (2020), concluded that SLR & Bragard tests is simple & low cost technique and also it is very easy to perform in the clinical setting and these tests can be considered as appropriate to diagnose lumbosacral radiculopathy.[11]
3. Dr. Sahil single et al (2020) conformed that there is a good correlation between clinical findings and MRI findings of lumbar PIVD but not all MRI findings are symptomatic in patients. MRI reveals multiple disc level involvement but clinically all levels are not symptomatic So, examiners should put more focus on clinical examination and then correlate these findings with MRI findings to reach final diagnosis.[12]
4. Saman mubashar et al (2020), recommended that for all patient of sciatica, MRI should not be compulsory and careful clinical evaluation will help the examiners for avoiding unnecessary MRI in patients with sciatica.[13]
5. Varun singh et al (2020), concluded that Multidirectional movements together with rotational forces and axial loads frequently lead to lumbar disc herniations that may be associated with radiculopathy and Appropriate diagnosis for assessment of level involved, severity of compression and neurological involvement can be assessed by clinical examination, patient history assisted by radiological evidences of magnetic resonance imaging (MRI).[14]

6. Gaston O. Camino Willhuber et al, (2019) stated that the straight leg raise test (Lasegue test), is a fundamental neurological maneuver most commonly performed across clinical practice and provides important information when making the clinical decision.[9]
7. James A. Berry et al (2019) concluded that Common occurrence of lumbar radiculopathy has been estimated to be 3-5 % of the population, affecting both gender.[1]
8. Rizwan khan et al (2019), concluded that the subjects having prolapsed intervertebral disc (PIVD), experience severe disability.[14]
9. Ali abdul-rahman et al (2019), concluded that Straight leg raise test is positive in the majority of patients with sciatica and the use of sensitizing maneuvers, like-ankle dorsiflexion or neck flexion increases symptoms in patients with sciatica with positive SLR test.[15]
10. Anna babinska et al (2019), concluded that combined LS-MRI changes do not correlate with pain intensity or quality of life in LBP patients.[16]
11. Gurmeet singh sarla (2018), concluded that the multiple level disc involvement is commoner than single level disc involvement and due to disc degenerative changes L4-L5 & L5-S1 level discs are commonly affected.[17]
12. Surendra U. Kamath (2017), stated that positive Lasegue's sign has a high sensitivity (0.80-0.97) for a low lumbar disc protrusion but has a low specificity (about 0.4).[18]
13. R Selvaraj et al (2017) concluded that symptoms of lumbar disc radiculopathy is highly indicative of the level of disc disease and Disc bulge hardly presents with radiculopathy.[19]

14. Kaynoosh homayouni et al (2017), concluded that the modified Bragard test can help to increase discriminative power of clinical examination in patients with acute symptoms of L5 or S1 nerve root compression who exhibit a negative SLR test result.[20]
15. Sasi kuppuswamy et al (2017), emphasize the value of clinical history and clinical evaluation in high prevalence of disc degeneration and disc herniation in MRI of normal subjects.[21]
16. Thapa SS et al (2016),stated that habitation of disc protrusion with gross neural foaramen compromise or nerve root compression were fairly correlated with clinical features.[22]
17. Saima omar et al (2016), concluded that the certainty between SLR test & MRI was calculated as 84.9% thus the SLR test is adequate to diagnose disc herniation as MRI for the set-ups where MRI is unavailable or contraindicated.[23]
18. Jabir hasan obaid al shami et al (2015), concluded that highest percent of patients with chronic back pain had abnormal MRI study (disc herniation).[24]
19. Mukul sarkar et al (2015), concluded that Clinical evaluation and MRI findings were statistically significant at the L4, L5 and S1 root level on both side but L3 root level on both side and also Clinical severity & MRI grading of Lumbosacral Radiculopathy statistically not significant. So, clinical findings correlate well with MRI findings but all MRI abnormalities need not have a clinical significance.[25]
20. Pokhraj suthar et al (2015), concluded that Low back pain is most commonly caused by Lumbar disc degeneration and Men are more frequent affected to the disc degeneration.[4]
21. Pierre C. Milette et al (1999) concluded that loss of disc height or abnormal signal intensity is extremely predictive of symptomatic tears extending into or beyond the outer annulus in chronic low back patients.[26]

CHAPTER-3

METHODOLOGY

MATERIALS AND METHODS

Sample Size:

30 patients with history of Lumbosacral radiculopathy confirmed MRI recruited in the study.

Study Deigned:

This study is a cross-sectional analytical study conducted in the duration from November 2021 to April 2022

Population Area:

Patients presenting with clinical features of lower limb radiculopathy to the outpatient department of physiotherapy- Integral Hospital Lucknow, were screened for Inclusion in the study.

SELECTION CRITERA

Inclusion Criterion:

1. Patients who had an MRI (LS-Spine); L4/5, &/or L5/S1 radiculopathy.
2. Age= 25-55 year
3. Gender= both male & female
4. Radicular pain along a specific dermatome.
5. Presence of neurological signs and symptoms.

Exclusion Criteria:

1. Low back pain without radiculopathy
2. Tumour, infectious or inflammatory disease
3. Cauda equina syndrome
4. Patient with recent low back surgery

5. Myelopathy
6. Patients who had completely recovered
7. Patient not giving informed consent

Variables

Dependent Variables:

1. SLR
2. MRI

Independent variables:

1. LS Radicullopathy

PROCEDURES

Patients will be recruited from outpatient of department of Physiotherapy, Integral hospital- Lucknow. Patients which were screened according to inclusion & exclusion criteria.
A consent sheet will be provided to all participants outlining the purpose of study with benefit and risk of participating and study.

All patients underwent clinical assessment, their MRI films and reports were reviewed, and SLR test was performed by principal investigator. Both lower limbs in all subjects are examined.

Clinical assessment included history taking and examination carried out by the principal investigator. The history included duration of symptoms, types of pain, side affected, dermatomal distribution of symptoms (pain, tingling, numbness) and previously received treatments.

Lumbosacral radiculopathy may be in the form of involvement of spinal nerve roots-

Spinal nerve root involvement	Pain distribution (Dermatome)
L3	Front of thigh & knee
L4	Lateral thigh, Medial lower leg
L5	Buttock, back & side of thigh, Lateral lower leg and dorsum of foot.
S1	Buttock, back of thigh and lower leg & lateral foot or the heel.

Table No. 3.1: Involvement of nerve roots which presented with pain distribution in dermatome.

MRI- 30 patients had MRI evidences of nerve root compression. All patients' MRI films-LS Spine (sagittal and axial T1 & T2 sequences) were reported by a radiologist blinded to physical examination findings. MRI reports were used by the principal investigator to obtain the following information; the level of the involved intervertebral disc, extent, & localization of the disc prolapsed, presence of nerve root compression and neural canal compromise.

SLR Test- the neurodynamic test considered positive if it reproduces the patient symptoms (pain, numbness, tingling). The examiner flexes the patient's hip with knee extended until the patient complains of pain or tightness in the back. At this point, the examiner brings down the leg until the patient feels painfree. The examiner should then dorsiflex the foot (Bragaad's test); the neck may also be flexed (Soto-Hall test). (figure-1) A positive test elicits pain in the leg, buttock, or back same as that described in the history at 30-70 degrees of leg elevation.(Figure No. 3.1)

Duration of study- 4-6 months

Figure 3.1: Performing SLR test; a) Straight leg raising, b) Dorsiflexion of foot, c) knee Flexion

Statistical analysis

The obtained data from the patients were organized in a master chart. Various tables were derived for statistical analysis for easy interpretation of results. All statistical data were analyzed by the professional analyst. Descriptive statistics were carried out using EXCEL-sheet. Data were expressed as the mean with standard deviation and median and as the number and percentage. The chi-square test/fisher p-value were used in this study. A p-value of <0.05 was considered significant. Contingency table was created to compare SLR test to MRI findings (disc desiccation, disc bulge, disc protrusion & disc extrusion).

PROTOCOL

On the basis of inclusion and exclusion criteria

Two patients were excluded because of Infective spondyloscitis & cauda equina syndrome.

Subjects was selected having complain of low back pain with radiculopathy

History was taken & SLR will be done on both the lower limb

MRI reports will be taken for assessment

One time data collection

Data analysis

Comparison of results

Result

CHAPTER-4

RESULTS

Out of 30 patients 16 (53.33%) were Male and 14 (46.66%) were Female. Age range between 25 to 55 years, with Mean age and SD (39.03± 9.67). Null hypothesis is accepted as there is no significant difference in subjective and MRI findings with SLR test in Lumbosacral radiculopathy patients. The result of this study suggest positive relation of SLR test with chronicity of pain (acute, sub-acute & chronic) and MRI findings classified as disc desiccation, disc bulge & disc protrusion.

Graph No.4.1: Pie chart representing gender ratio in study population.

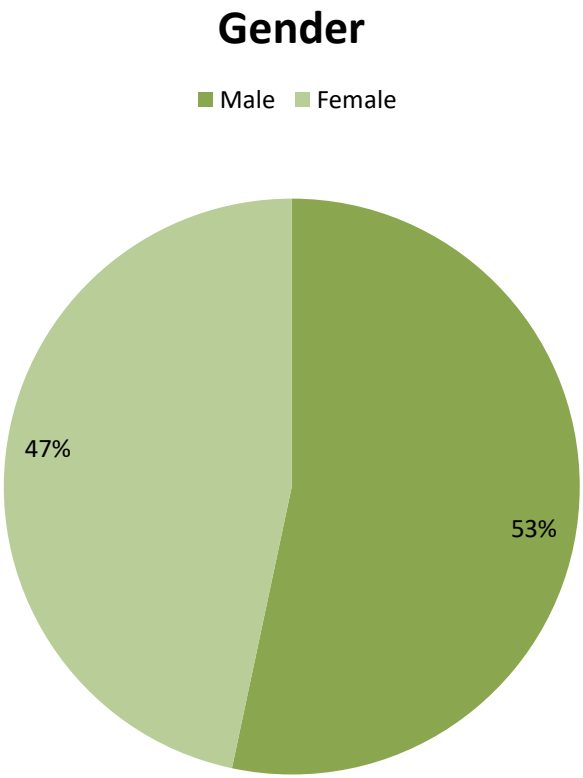


Table 4.1: Representing Gender ratio in study population (N=30)

Gender	No. Of patients (N=30)	%
Male	16	53.33
Female	14	46.66

Radiculopathy-

Graph 4.2: Pie chart representing distribution of pain location by the side of the patients

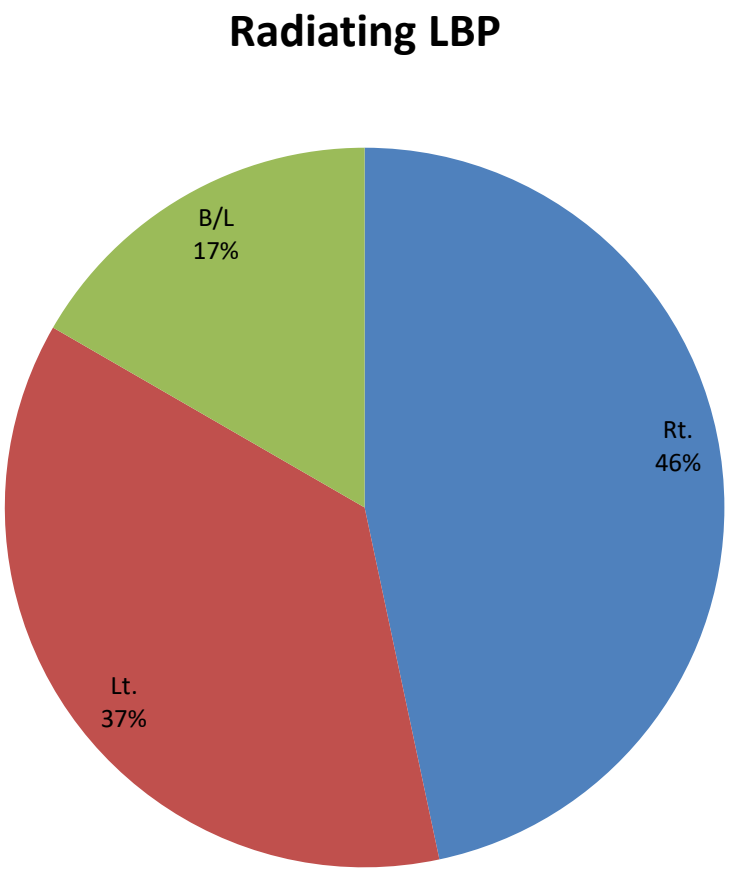


Table 4.2: distribution of pain location by side of the patients (N=30)

Pain location by side	No. Of Patients (N=30)	%
Rt.	14	46.66
Lt.	11	36.66
B/L	5	16.66

Table 4.2 shows that out of 30 patients, right unilateral involvement was most common observed in 14 patients, left unilateral involvement was less common observed in 11 patients, and bilateral radiculopathy was uncommon, present only in 5 patients.

Duration of LBP-

Graph no.4.3: Pie chart representing duration of LBP

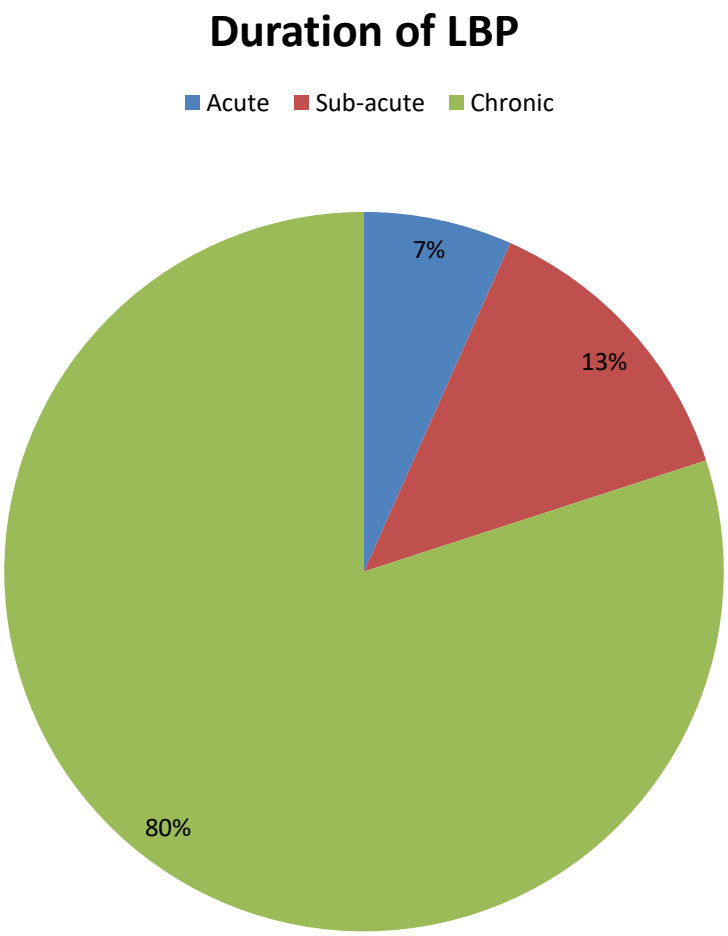


Table 4.3: duration of pain

Duration of Pain	No. Of patients (N=30)	%
Acute	2	6.66
Sub-acute	4	13.33
Chronic	24	80

Table 4.3 shows that out of 30 patients, 24 patients have chronic LBP, 4 patients have Sub-acute while only 2 patient have Acute LBP.

Graph 4.4: Pie chart representing pain distribution level in dermatomal pattern.

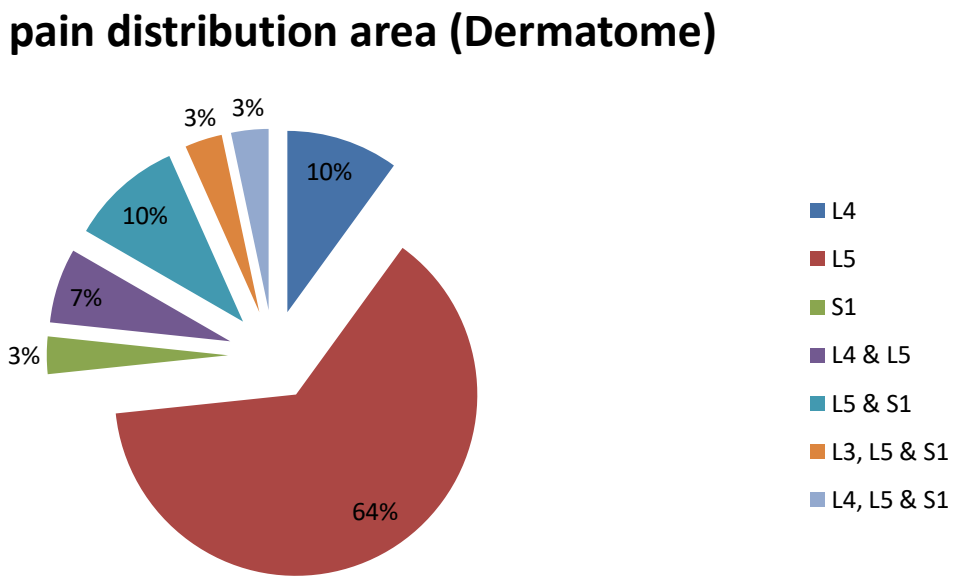


Table 4.4:Pain distribution area (Dermatome)

Pain distribution area (Dermatome)	**No. of patients (N=30)**	**%**
S1	1	3.33
L5	19	63.33
L4	3	10
L5 & S1	3	10
L4 & L5	2	6.66
L3, L5 & S1	1	3.33
L4, L5 & S1	1	3.33

Table 4.4 shows that the pain distribution was also classified as per Dermatomal level where 19 patients have L5 level, 3 patients have L4 level, 1 patient have S1 level, 3 patients have L5&S1 level, 2 patients have L4&L5, 1 patient have L3,L5&S1 level and 1 patient have L4,L5&S1 Dermatomal level of distribution. Clinical examination revealed that L5 was the commonest area of pain distribution (63.33%).

SLR Test-

Graph 4.5: Bar chart representing SLR Test

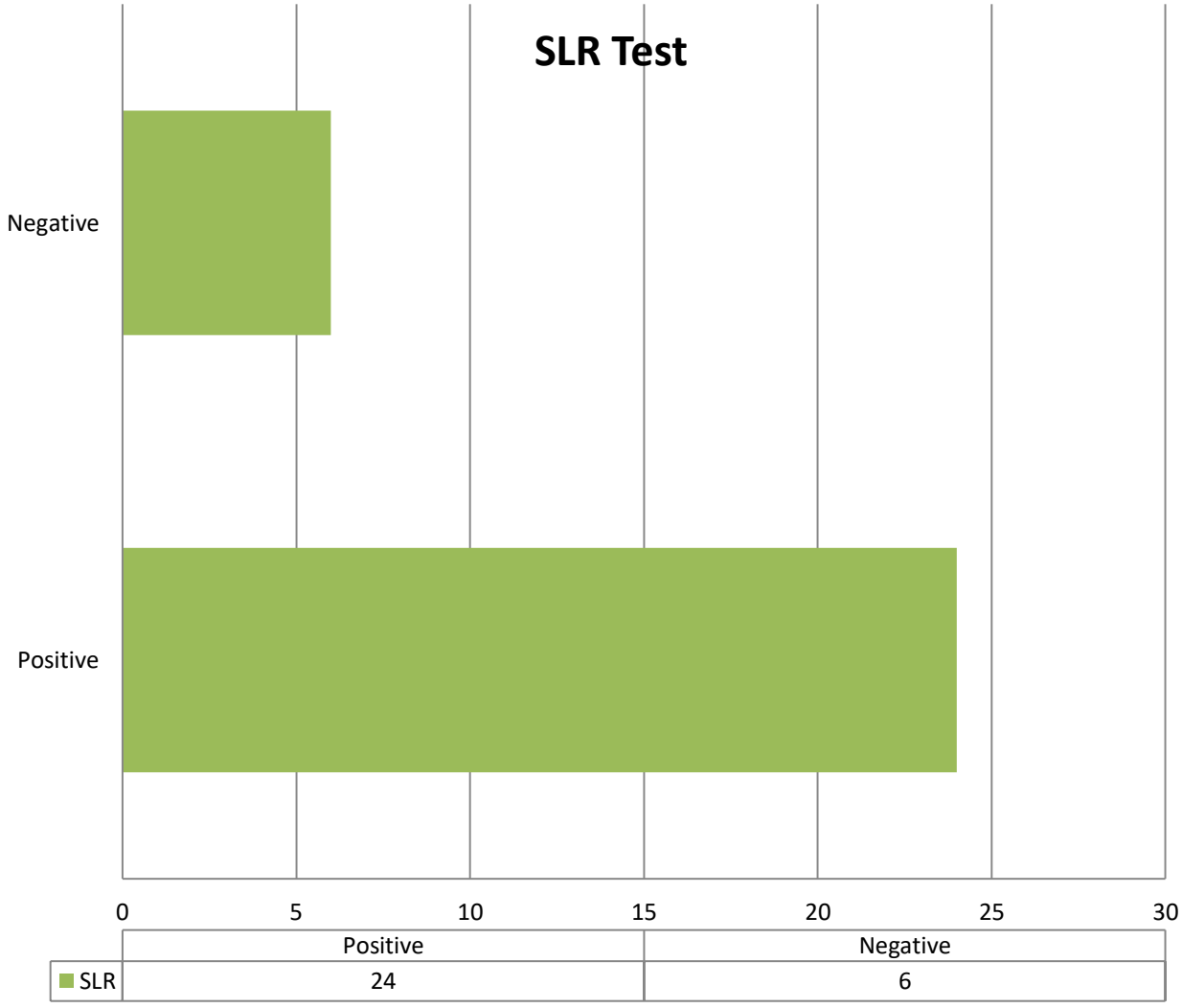


Table 4.5: SLR Test (N=30)

SLR Test	No. Of patients (N=30)	%
Positive	24	80
Negative	6	20

Table 4.5 shows that Straight Leg Raise test was positive in 24 patients (80 %).

Disc desiccation-

Graph 4.6: Pie chart representing disc desiccation levels.

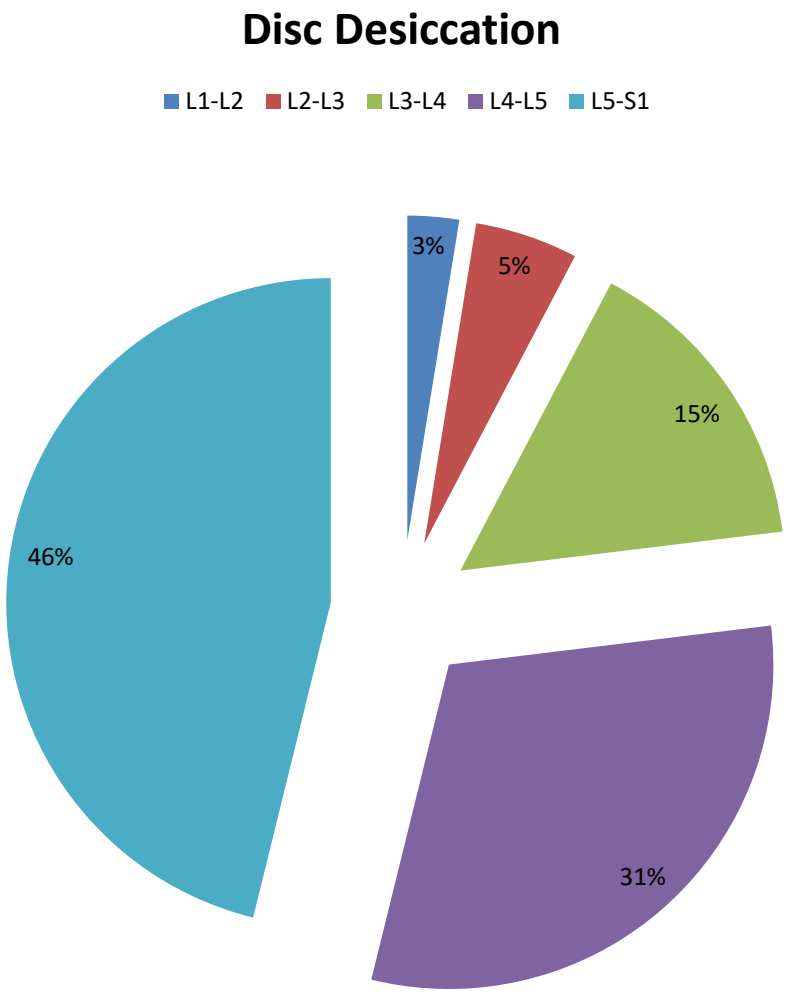
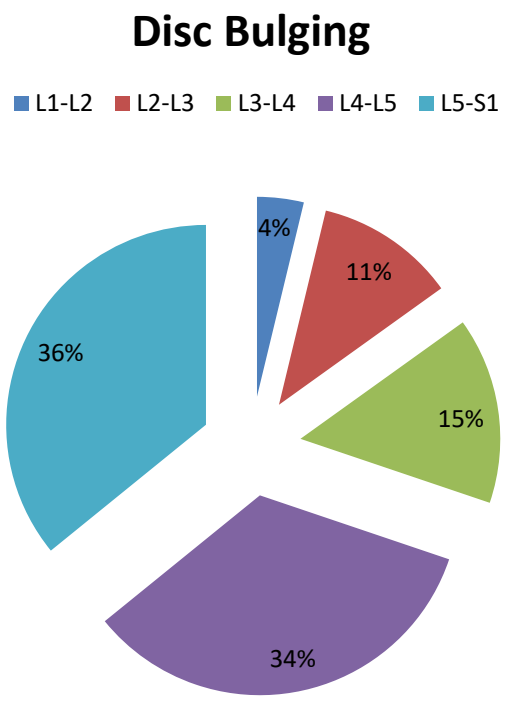


Table 4.6: Disc desiccation levels

Disc desiccation	No. Of patients (N=30)	%
L1-L2	1	2.5
L2-L3	2	5.1
L3-L4	6	15.3
L4-L5	12	30.7
L5-S1	18	46

Table 4.6 shows that Disc desiccation was noticed in 39 levels out of 30 patients; highest prevalence was multiple level involvement, L5-S1 and L4-L5 levels are involved in most of the cases accounting 18 and 12 cases respectively. L3-L4 level involvement in 6 cases, L2-L3 level involvement in 2 cases and L1-L2 level involvement in only one cases.

Graph 4.7: Pie chart representing disc bulging levels.



Graph 4.8: Pie chart representing disc protrusion level

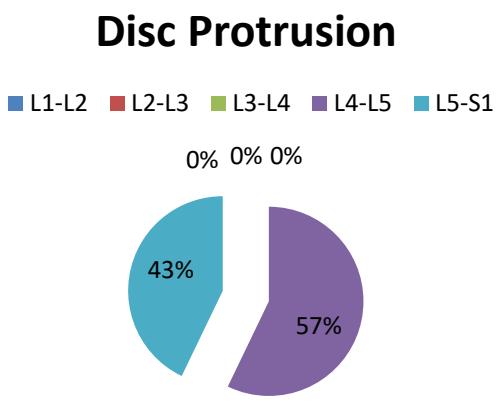


Table 4.9; Pie chrt representing disc protrusions

Types of disc herniation seen in MRI findings-

Table 4.7: Levels of disc herniation in MRI (Number of patients,N=30)

Level	Disc bulge (N & %)	Disc protrusion (N & %)	Disc extrusion (N & %)
L1-L2	2 (3.77 %)	0 (0 %)	0 (0 %)
L2-L3	6 (11.32 %)	0 (0 %)	0 (0 %)
L3-L4	8 (15.09 %)	0 (0 %)	0 (0 %)
L4-L5	18 (33.96 %)	4 (57.14 %)	0 (0 %)
L5-S1	19 (35.84 %)	3 (42.85 %)	0 (0 %)

Table 4.7: shown that levels of disc herniation seen in MRI. There were 60 disc levels of disc abnormality shown in 30 patients; Disc bulge was most common type of disc herniation in this study (53 levels). L5-S1 & L4-L5 levels are involved in most of the cases accounting 19 & 18 cases respectively. Second most common type of disc herniation was disc protrusion (7 cases). L5-S1 & L4-L5 levels were involved accounting 3 & 4 cases respectively, and none of the subjects had disc extrusions.

Correlation between SLR test and MRI findings for Disc Desiccation with chronicity of pain in Lumbosacral Radiculopathy-

		SLR	
	Chronic	Positive	Negative
Disc Desiccation	Positive	17	2
	Negative	4	1
Fisher P value	0.521		

		SLR	
	Total	Positive	Negative
Disc Desiccation	Positive	19	2
	Negative	5	4
Fisher P value	0.0492		

		SLR	
	Sub- Acute	Positive	Negative
Disc Desiccation	Positive	2	0
	Negative	1	1
Fisher P value	1.00		

Table 4.8: Data reflects that, out of 21 chronic LBP patients, 17 were Positive for SLR test as well as Disc Desiccation; while 2 of them shows Negative SLR. On the other hand, 4 Patients out of 24 with no Disc Desiccation in MRI findings shows positive SLR and 1 of them shows Negative SLR. (Fisher p-value is 0.521 shows the data are not statistically significant. Thus, result reflects the disc desiccation is well correlated with SLR)

Among 4 Sub-acute patients, 2 shows disc desiccation with positive SLR test and none of them shows Negative SLR. One patient with No Disc Desiccation shows positive SLR and one patient shows negative SLR. (Fisher p-value is 1.00 considered to be not statistically significant. Thus, it can be concluded that disc desiccation is correlated with SLR in Sub-acute LBP patients.

But when we compare total cases (Acute, Sub-acute & Chronic, N=30) the fisher p-value is 0.0492 is considered to be statistically significant correlation between SLR test and disc Desiccation.

Correlation between SLR test and MRI findings for Disc bulging with chronicity of pain in Lumbosacral Radiculopathy-

		SLR	
	Chronic	Positive	Negative
Disc Bulging	Positive	18	3
	Negative	3	0
Fisher P value	1.00		

		SLR	
	Total	Positive	Negative
Disc Bulging	Positive	20	6
	Negative	4	0
Fisher P value	0.557		

		SLR	
	Sub- Acute	Positive	Negative
Disc Bulging	Positive	2	1
	Negative	1	0
Fisher P value	1		

Table 4.9: Results revealed that out of 24 chronic patients have disc bulging, 18 of them shows positive SLR test and 3 of them shows negative SLR. For 3 patients have no disc bulging seen on MRI findings all 3 patients shows positive SLR and none of them shows negative SLR. (Fisher p-value 1.00 reflects statically statistically non-significant correlation between disc bulging seen in MRI findings and SLR test in chronic patients.)

In Sub-acute cases out of 4 patients 2 were disc bulging and positive SLR and 1 patient have no disc bulge seen in MRI shows positive SLR test. (Fisher p-value 1 is considered to be statistically not significant correlation of disc bulging with SLR test in Sub-acute patients.)

When combined for total cases (Acute, Sub-acute & Chronic,N=30), 20 patients with disc bulge shows positive SLR test and 6 shows negative SLR test. Whereas, 4 patients with no disc bulge shows positive SLR test and none of them shows negative SLR. (Fisher p-value 0.557 reflects statistically non-significant correlation with disc bulging and SLR test)

Correlation between SLR test and MRI findings for Disc protrusion with chronicity of pain in Lumbosacral Radiculopathy-

		SLR	
	Chronic	Positive	Negative
Disc Protrusion	Positive	5	0
	Negative	16	3
Fisher P value	1.00		

		SLR	
	Total	Positive	Negative
Disc Protrusion	Positive	7	0
	Negative	17	6
Fisher P value	0.290		

		SLR	
	Sub- Acute	Positive	Negative
Disc Protrusion	Positive	2	0
	Negative	1	1
Fisher P value	1.00		

Table 4.10: In chronic patients the results reflects that out of 24 patients who have disc protrusion of MRI findings 5 of them shows positive SLR test and none of them shows negative SLR test. For patient with no disc protrusion in MRI, 16 of them shows positive SLR test and 3 of them shows negative SLR. (Fisher p-value 1.00 reflects statistically non-significant correlation between disc protrusion of MRI findings and SLR in chronic patients.)

In Sub-acute cases out of 4 patients 2 were positive for disc protrusion of MRI findings and SLR test and 1 patient with no disc protrusion in MRI findings shows positive SLR test and 1 shows negative SLR test. (Fisher value 1.00 shows statistically non-significant correlation between disc protrusion in MRI findings with SLR test in Sub-acute cases)

When combined for total cases (Acute, Sub-acute & Chronic,N=30), 7 patients with disc protrusion in MRI findings shows positive SLR test and none of them shows negative SLR test. Whereas, 17 patients with no disc protrusion in MRI findings shows positive SLR test and 6 of them shows negative SLR test (Fisher p-value 0.290).

CHAPTER-5
DISCUSSION

The present study was conducted to find out the correlation of subjective findings and MRI abnormalities with SLR test in patients with Lumbosacral Radiculopathy on total 30 patients presented in OPD of Integral Hospital- Lucknow. This study is therefore not a community based and does not exactly reflect the demographic pattern of lumbosacral radiculopathy.

This study was done to determine the accuracy of clinical findings is enough to diagnose the lumbosacral disc herniation. In present study there is no statistically significant difference in SLR and radiologic findings (except for disc desiccation) in sub- acute and chronic LBP.

Table 4.1 shows the gender distribution of patients in study population. 53.33% of the patients were Male & 46.66% patients were Female, Which was similar to study conducted by M H Raman et al (Sep.2016), in which he found male preponderance population, most probably due to increased mechanical stress and prone to injuries due to more outdoor activities.

Table 4.2 shows that distribution of pain in 14 (46.66 %) patients was on right side, 11(36.66 %) on left side and 5 (16.66 %) on both side. Posterolateral disc herniation is more common than central disc herniation. So, unilateral involvement is more common than bilateral involvement.

Table 4.3 shows that chronicity of pain in study population. Out of 30 patients, 24 (80%) patients had chronic pain, 4 (13.33%) patients had sub-acute and only 2 (6.66%) patient had acute pain. In our study 80% patients had chronic Lumbosacral radiculopathy, which is comparable to study made by jeetendra bajpai et al (2013) was found that most of the patients the duration of LBP was 1-2 z

Table 4.4 shows that the pain distribution area in dermatomal pattern. There were 39 different dermatomal levels distributions of radicular pain (in 30 patients), of them 4 patients had more than one dermatomal level distribution of pain. 19 patients had L5 level distribution of pain, 3 patients had L4 level, 1 patient had S1level,3 patients had L5&S1 level, 2 patient had L4&L5 level, 1 patient had L3,L5&S1 level and 1 patient had L4,L5&S1 level distribution of pain. In the study by Mukul K Sarkar et al (2015), also found that L5 level involvement to be commonest.[25]

Table 4.5 shows that straight leg raising test was positive in 24 (80%) patients among them 30. Thus a positive SLRT is indicative of nerve root compression. In the study by Kaynoos homayoni et al (2017), found that sensitivity for SLR test for sciatica was 63.46 % & specificity was 45.88 %.[20] In patients with acute phase of lumbosacral radiculopathy, the sensitivity and specificity of SLR decreases slightly. A possible explanation for this difference in SLR could be the initial minimum inflammation of the nerve roots at the level of compression in the acute phase of the disease.

Table 4.6 shows that disc desiccation was noticed in 39 levels (in 30 patients). Degeneration can occur at any level of spine but most commonly seen at L4-L5 & LS-S1 level of Lumbosacral spine probably due to highest mechanical stress at these levels. In the study by Sasi Kuppuswamy et al (2017), also found that more changes at L5-S1 level.[21] Disc degeneration in less than 35 year age can probably due to genetic predisposition; though, other factors like repeated trauma & more physical load can leads to early precipitation of disc degeneration.

In this study we found that there were multiple disc degeneration levels on MRI but not all levels are clinically significant and symptomatic. Which was also concluded in study concluded by Janardhana (2015), in which they found in their study, out of 189 levels of disc lesions only 89 are symptomatic, that means not all MRI levels are symptomatic[37]. Table 4.7 shows that levels of intervertebral disc herniation in MRI revealed that 60 levels of disc herniation were shown in 30 patients. Bulge was noticed in 53 levels, protrusion was noticed in 7 levels and none of patients had extrusion.

The study shows that commonly involved level of disc abnormality is L4-L5(22) & L5-S1(22). This is because L4-L5 level is the transition point for coupled axis of rotation and bending, it experiences higher stress than other lumbar level. Disc bulge was most common type of disc herniation in this study (53 levels) & most commonly involved level in disc bulge cases

was L5-S1 (19 levels) then involving L4-L5 (18 levels). In the study by Jeetendra bajpai et al (2013), also found that L4-L5 & L5-S1 disc involved in 94% of the cases[37]. In the study by Mukul k sarkar et al, 2015 found that disc bulge (61.52%) is more common than disc protrusion (23.08%)[25].

In this study none of the subjects had disc extrusions. In the study N. Djuric et al, (2020) revealed that macrophages infiltration was positively associated with an extruded type of disc herniation as well as extent of reduction during one year followup in patients with sciatica[38].

Result of this study suggests that in chronic & sub-acute cases there is no statically significant difference in SLR & MRI findings for Disc Desiccation as (p value >0.05) but when we combine all cases of (acute, sub-acute & chronic) LBP result shows statistically significant differences (p value <0.05) between SLR & MRI findings.(Table 4.8.) We belief this difference was probably because of small population for acute cases in our study.

Result of this study suggests that in chronic & sub-acute cases there is no statically significant difference in SLR & MRI findings for Disc Bulging as (p value >0.05) also when we combine all cases of (acute, sub-acute & chronic) LBP result shows no statistically significant differences (p value >0.05) between SLR & MRI findings (Table 4.9.). In the study W. Brinjiskji et al, 2015 found that disc bulge had a strong association with LBP[39].

Result of this study suggests that in chronic & sub-acute cases there is no statically significant difference in SLR & MRI findings for Disc Protrusion as (p value >0.05) also when we combine all cases (acute, sub-acute & chronic) of LBP result shows no statistically differences (p value >0.05) between SLR & MRI findings as shown in Table 4.10. In the study Dr. Alison Endean etal (2011) suggests that disc protrusion in MRI abnormality most stronglt associated with LBP[40].

Limitations-

The small population is a marked drawback of this study. Patients were recruited from only one hospital, which is a limitation in our study. The sample size can be more in future research.

Only those patient with clinical diagnosis of lumbar radiculopathy and could afford to undergo MRI of lumbar spine were included in this study.

The MRI reporting was done by different radiologists which might have lead to inter observer variations which is a drawback of the study.

CHAPTER-6

CONCLUSION

In the present study, we observed that there is a good correlation between clinical findings and MRI findings of Lumbosacral radiculopathy but not all MRI findings need to be investigated. MRI shows clinically asymptomatic multiple disc involvement. This can be safely concluded that examiner should put more emphasise on clinical examination.

Present study concluded that there is no statistically significant difference in SLR and radiologic findings (except for disc desiccation) for sub- acute and chronic Lumbosacral Radiculopathy. SLR and MRI findings can be used interchangeably for chronic and sub-acute cases, but not for acute cases, where MRI is only able to diagnose. Thus SLR test is enough to diagnose disc herniation as MRI for the set-ups where MRI is not easily available, contraindicated or unaffordable for the patients. SLR test is a cost effective method to diagnose disc herniation & lower the financial burden on patients.

CHAPTER-8
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CHAPTER-9

APPENDICES

APPENDIX-1

MASTER CHART

Master Chart

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	AGE	GENDER	RADIATING LBP		LBP		DERMATOME	SLR		DIS	ESSI	TION			LEVE	OF DI	BULG	S		DI	PROT	SION			DI	EXTI	SION	
2				ACUTE	SUB-ACUTE	CHRONIC			L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1
3	29	M	Rt.			☒	L5	positive				☒					☒											
4	48	F	B/L			☒	L5	positive			☒	☒	☒	☒	☒		☒	☒										
5	30	F	Lt.			☒	L5	positive			☒	☒	☒			☒	☒	☒										
6	25	M	Rt.		☒		S1	positive					☒															
7	44	F	Rt.			☒	L5	Negative							☒	☒	☒	☒										
8	55	F	Lt.			☒	L5	positive					☒		☒	☒	☒	☒										
9	28	F	Lt.			☒	L5	Negative					☒					☒										
10	30	M	Rt.			☒	L5	positive					☒					☒				☒						
11	25	F	Lt.		☒		L5	positive									☒	☒										
12	55	F	Lt.			☒	L5	positive								☒						☒						
13	45	F	Rt.			☒	L4-L5	positive	☒			☒	☒				☒	☒										
14	43	F	Lt.		☒		L4	Negative									☒	☒										
15	37	M	Rt.			☒	L5-S1	Negative			☒	☒	☒	☒	☒	☒	☒											
16	48	F	Rt.			☒	L5	positive			☒	☒	☒				☒	☒										
17	36	M	Rt.	☒			L4	Negative										☒										
18	49	M	B/L	☒			L5	Negative									☒											
19	35	F	B/L			☒	L5-S1	positive					☒					☒										
20	35	M	B/L			☒	L5-S1	positive				☒	☒				☒	☒										
21	35	M	Lt.			☒	L4-L5	positive		☒			☒		☒			☒										
22	51	M	Rt.			☒	L5	positive								☒	☒											
23	37	M	Rt.			☒	L5	positive				☒	☒			☒	☒	☒										
24	50	M	Lt.			☒	L3,L5&S1	positive			☒	☒	☒			☒	☒	☒										
25	39	M	B/L		☒		L5	positive		☒					☒							☒						
26	44	F	Rt.			☒	L5	positive															☒					
27	43	F	Rt.			☒	L5	Positive				☒	☒				☒	☒										
28	25	M	Lt.			☒	L4	Positive					☒				☒	☒										
29	28	M	Lt.			☒	L5	Positive					☒															
30	25	M	Lt.			☒	L5	Positive									☒						☒					
31	52	F	Rt.			☒	L4,L5&S1	Positive			☒	☒	☒					☒				☒						
32	45	M	Rt.			☒	L5	Positive				☒																
33																												
34																												

APPENDIX-2

DATA COLLECTION SHEET

Data COLLLECTION sHHEET

S.N.	AGE	GENDER	RADIATING LBP	LBP			DERMATOME	SLR	LEVEL OF DISC DESICCATION		LEVEL OF DISC BULGE		LEVEL OF DISC PROTRUSION			LEVEL OF DISC EXTRUSION		
				ACUTE	SUB-ACUTE	CHRONIC												
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

APPENDIX-3

INFORMED CONSENT

INFORMED CONSENT

I……..……Age……Gender.....

hereby consent to participate as requested for the study on **"**Correlation of Subjective and Imaging Findings with Neurodynamics Test in Subject with Lumbosacral Radiculopathy**."**

- Purpose of study:- The purpose of this study was to determine the accuracy of Subjective findings with neurodynamic test is enough to diagnose disc herniation for the set-ups where MRI is not easily available, contraindicated &/or unaffordable for the patients.
- Risk:- I have been explained that the procedure that i have to undergo will not pose any risk of failure & The details of procedures and any risk have been explained to my satisfaction.
- Benefits:- above study will help to analyse the clinical finding accuracy with diagnostic approach.

I do understand and appreciate that the information in this study will be published as it is. I will not be identified and individual information will remain confidential, hence I grant permission and consent for utilizing my data in future report/article.

I am free to withdraw from the study at any time and i am free to decline to particular question.

Participant's signature…… researcher's signature…….

Date-

Place-

APPENDIX-4

OUTPUT SHEET

AGE	
Mean	39.03333333
Standard Error	1.766536538
Median	38
Mode	25
Standard Deviation	9.675719107
Sample Variance	93.61954023
Kurtosis	-1.259069844
Skewness	0.004629348
Range	30
Minimum	25
Maximum	55
Sum	1171
Count	30
Confidence Level (95.0%)	3.612972892

APPENDIX-5

MANUSCRIPT

CORRELATION OF SUBJECTIVE AND IMAGING FINDINGS WITH NEURODYNAMIC TEST IN SUBJECT WITH LUMBO-SACRAL RADICULOPATHY

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ABSTRACT

BACKGROUND- Lumbar radiculopathy remains a clinical challenge among primary care professionals in both assessment and diagnosis. This often leads to misdiagnosis and inappropriate treatment of patients resulting in poor health outcomes. Prolapsed intervertebral disc (PIVD) is one of the most common cause. Magnetic Resonance Imaging (MRI) is routinely done for diagnosis of lumbar disc prolapsed. Many abnormalities of disc are observed even an asymptomatic patient. Subjective finding & straight leg raise (SLR) and other neurologic tests are used to know the exact site of herniation.

PURPOSE- The purpose of this study was to determine the accuracy of Subjective findings with neurodynamic test is enough to diagnose disc herniation for the set-ups where MRI is not easily available, contraindicated &/or unaffordable for the patients.

METHODS-This was a cross-sectional analytic study conducted on 30 consecutive patients with a history suggestive of lumbosacral radiculopathy were screened for inclusion. Patients were evaluated from November 2021 to April, 2022 in the outpatient of department of Physiotherapy, Integral Hospital-Lucknow. Patients were examined and signs involving dermatomal levels noted of affected lower limb. The SLR test was investigated concomitantly to determine the sensitivity and specificity. All the patients have MRI investigation. Clinical findings were then correlated with MRI findings.

RESULT- Out of 30 patients 16 (53.33%) were Male and 14 (46.66%) were Female. Age range between 25 to 55 years, with Mean age and SD (39.03± 9.67). 24 (80%) patients have chronic LBP out of 30. Clinical examination revealed that L5 was the commonest area of pain distribution (63.33%). Straight Leg Raise test was positive in 24 (80 %) patients. The correlation shows there is no statistically significant correlation in SLR and radiologic findings (except for disc desiccation, p value ,<0.05) for sub-acute and chronic Lumbosacral Radiculopathy (p value >0.05).

CONCLUSION- Present study concluded that there is no statistically significant correlation in SLR and radiologic findings (except for disc desiccation) for sub- acute and chronic Lumbosacral Radiculopathy. SLR and MRI findings can be used interchangeably for chronic and sub-acute cases. Thus SLR test is enough to diagnose disc herniation as MRI for the set-ups where MRI is not easily available, contraindicated or unaffordable for the patients. SLR test is a cost effective method to diagnose disc herniation & lower the financial burden on patients.

Keywords- Lumbosacral radiculopathy, MRI, SLR, Disc Desiccation, Disc herniation, Sub-acute, &chronic LBP.

INTRODUCTION

Low back pain is a very common problem in our society now a days and most of the people experience it at some point of their life. Radicular pain radiates down to the legs directly along the course of involved dermatome of spinal nerve root and is often described by patients as electric, burning, or sharp. Often accompanying numbness or tingling occurs with a distribution similar to the pain. Radicular pain is elicited by ectopic discharges originating from an inflamed or lesioned dorsal roots or its ganglion.

The impairment of sensory fibers causes numbness (dermatomal pattern); however, blockade of motor fibers causes weakness (myotomal). Sensory or motor block may result in diminished reflexes. Lumbosacral radiculopathy has been estimated to be 3%-5% of the population, affecting both gender. Symptoms typically begin in midlife, with men often affected in the 40s while women are affected in the 50s and 60s.[1]

Henne B Albert et al (2019), stated that Radicular pain is usually due to a combination of inflammation and ischemic compression of the nerve root, collectively referred to as nerve root irritation.[2]

The Lumbar disc bulging or herniation is one of the common cause of radicular low back pain. According to combined statement of North American Spine society, the American society of Spine Radiology, and the American society of Neuroradiology, disc herniation can be defined as 'localised or focal displacement of disc material beyond the limits of intervertebral disc space'. Almost three fourth cases of disc pathology are of degeneration and one fourth are actual disc herniation.[3] Disc desiccation is a common degeneration changes of intervertebral discs. On MRI, the disc losses its central height T2 signal.[4] Herniated discs can be classified as disc bulge, protrusion, extrusion, or sequestration.

Nerve Root irritation can also be caused by stenosis (either of the central canal or foramen), spondylolisthesis or other pathological conditions like infections or malignancies. Lumbar spinal stenosis (LSS) secondary to degenerative changes (eg. Osteophytes & hepertrophic ligamentum flavum) at a single or multiple level(s) may lead to unilateral or bilateral radiculopathy. James A Berry (2019) stated that 95% of lumbar disc herniation involves L4/5 and L5/S1 level, the latter being the commonest.[1] The duration of pain can be classified into; Acute (pain lasts <6 weeks), Sub-acute (pain lasts 3 weeks to 3 months) and Chronic (pain lasts ≥3 months).[5]

In clinical practice, the diagnosis of lumbosacral radiculopathy involves the use of various tools and procedures including neuropathic pain screening, clinical neurological examination (dermatome, myotome, reflex) electro diagnosis & radiological imaging. Assurance of the radiculopathy is dependent upon the examiner's awareness of clinical presentation, physical examination knowledge of possible pathology, mechanism of injury and ability to perform the test correctly. The clinical practicality of neurological examination is largely determined by the accuracy with which they determine the presence or absence of the suspected patho-neuro-physiology. Early and accurate diagnosis of lumbar radiculopathy is crucial to ensure target-specific treatment and avoid chronicity, disability and work loss.[6]

Clinical assessment and imaging findings are used to evaluate the patient's symptoms, and MRI is the most important tool to identify the etiology and determine the level of the anatomical abnormality. However, MRI alone is not enough to find the cause of lumbosacral radiculopathy.

Comparing clinical findings with MRI findings at different nerve root level in patients with lumbosacral radiculopathy remains essential to determine which of the MRI detected abnormalities are symptomatic.

The straight leg raise (SLR) Test or Lasegue's test are diagnostic tests widely used in clinical practice and it used to examine the nerve roots of the patient.[7] The mechanism of pain during a SLR is increased dural tension placed upon the lumbosacral spine. The examiner flexes the patient's hip with knee extended until the patient complains of pain or tightness in the back. At this point, the examiner brings down the leg until the patient feels painfree. The examiner should then dorsiflex the foot (Bragard's test); the neck may also be flexed.

The straight leg raise test induced 3-well defined patterns of pain; low back pain only, leg pain only, and low back pain & leg pain. The disc protrusion may be situated in a central, intermediate or lateral. Patients with central protrusion tend to have only low back pain; patients with lateral protrusion tend to have only leg pain, although patients with intermediate protrusion tend to have low back pain & leg pain both.[15]

A positive test elicits pain in the leg, buttock, or back same as that described in the history at 30-70 degrees of leg elevation, when the majority of nerve movement occurs at the intervetebral foramen and is suggestive of lower lumbar nerve root involvement (L4 to S1).[8] The pain is typically worsened by dorsiflexion of ankle or neck flexion, and is relieved with flexion of knee. They provoke pain or other sensory symptoms that reveal the root lesion (Lasegue's sign).[9]

Aims and Objectives of the study

1) To determine the accuracy of Subjective findings with neurodynamic test is enough to diagnose disc herniation for the set-ups where MRI is not easily available, contraindicated &/or unaffordable for the patients.
2) To find out the correlation of subjective findings and MRI findings with neurodynamic test in patients with lumbosacral radiculopathy.
3) To determine clinico radiological correlations in patients with lumbosacral radiculopathy.

METHODOLOGY

Inclusion Criterion:

1) Patients who had an MRI (LS-Spine); L4/5, &/or L5/S1 radiculopathy.
2) Age= 25-55 year
3) Gender= both male & female
4) Radicular pain along a specific dermatome.
5) Presence of neurological signs and symptoms.

Exclusion Criteria:

1) Low back pain without radiculopathy
2) Tumour, infectious or inflammatory disease
3) Cauda equina syndrome
4) Patient with recent low back surgery
5) Myelopathy
6) Patients who had completely recovered
7) Patient not giving informed consent

Variables

Dependent Variables:

1. SLR
2. MRI

Independent variables:

1. LS Radiculopathy

PROCEDURES

Patients will be recruited from Physiotherapy OPD, Integral hospital-Lucknow. Patients which were screened according to inclusion & exclusion criteria.
A consent sheet will be provided to all participants outlining the purpose of study

with benefit and risk of participating and study.

All patients underwent clinical assessment, their MRI films and reports were reviewed, and SLR test was performed by principal investigator. Both lower limbs in all subjects are examined.

Clinical assessment included history taking and examination carried out by the principal investigator. The history included duration of symptoms, types of pain, side affected, dermatomal distribution of symptoms (pain, tingling, numbness) and previously received treatments.

Lumbosacral radiculopathy may be in the form of involvement of spinal nerve roots-

Spinal nerve root involvement	Pain distribution (Dermatome)
L3	Front of thigh & knee
L4	Lateral thigh, Medial lower leg
L5	Buttock, back & side of thigh, Lateral lower leg and dorsum of foot.
S1	Buttock, back of thigh and lower leg & lateral foot or the heel.

Table No.1: Involvement of nerve roots which presented with pain distribution in dermatome.

MRI- 30 patients had MRI evidences of nerve root compression. All patients' MRI films-LS Spine (sagittal and axial T1 & T2 sequences) were reported by a radiologist blinded to physical examination findings. MRI reports were used by the principal investigator to obtain the following information; the level of the involved intervertebral disc, extent, & localization of the disc prolapsed, presence of nerve root compression and neural canal compromise.

SLR Test- the neurodynamic test considered positive if it reproduces the patient symptoms (pain, numbness, tingling). The examiner flexes the patient's hip with knee extended until the patient complains of pain or tightness in the back. At this point, the examiner brings down the leg until the patient feels painfree. The examiner should then dorsiflex the foot (Bragaad's test); the neck may also be flexed (Soto-Hall test). (figure-1) A positive test elicits pain in the leg, buttock, or back same as that described in the history at 30-70 degrees of leg elevation.(Figure No. 3.1)

Duration of study- 4-6 months

Figure 1: Performing SLR test; a) Straight leg raising, b) Dorsiflexion of foot, c) Flexion of knee

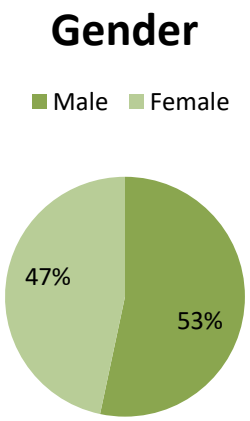
Statistical analysis

The obtained data from the patients were organized in a master chart. Various tables were derived for statistical analysis for easy interpretation of results. All statistical data were analyzed by the professional analyst. Descriptive statistics were carried out using EXCEL-sheet. Data were expressed as the mean with standard deviation and median and as the number and percentage. The chi-square test/fisher p-value were used in this study. A p-value of >0.05 was considered non significant. Contingency table was created to compare SLR test to MRI findings (disc desiccation, disc bulge, disc protrusion & disc extrusion).

RESULTS

Out of 30 patients 16 (53.33%) were Male and 14 (46.66%) were Female. Age range between 25 to 55 years, with Mean age and SD (39.03± 9.67). Null hypothesis is accepted as there is no significant correlation in subjective and MRI findings with SLR test in Lumbosacral radiculopathy patients. The result of this study suggest positive relation of SLR test with chronicity of pain (acute, sub-acute & chronic) and MRI findings classified as disc desiccation, disc bulge & disc protrusion.

Graph No.1: Pie chart representing gender ratio in study population.



Radiculopathy-

out of 30 patients, right unilateral involvement was most common observed in 14 patients, left unilateral involvement was less common observed in 11 patients, and bilateral radiculopathy was uncommon, present only in 5 patients.

Duration of LBP-

Out of 30 patients, 24 patients have chronic LBP, 4 patients have

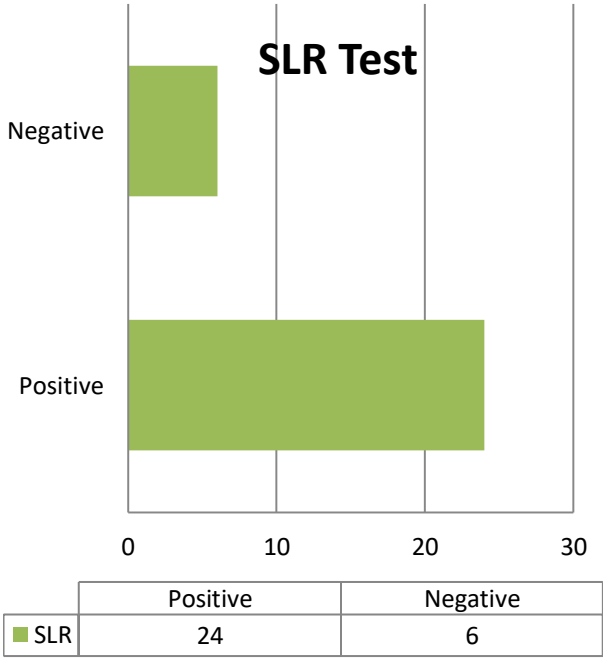
Sub-acute while only 2 patient have Acute LBP.

Pain distribution area (Dermatome)-

The pain distribution was also classified as per Dermatomal level where 19 patients have L5 level, 3 patients have L4 level, 1 patient have S1 level, 3 patients have L5&S1 level, 2 patients have L4&L5, 1 patient have L3,L5&S1 level and 1 patient have L4,L5&S1 Dermatomal level of distribution. Clinical examination revealed that L5 was the commonest area of pain distribution (63.33%).

SLR Test-

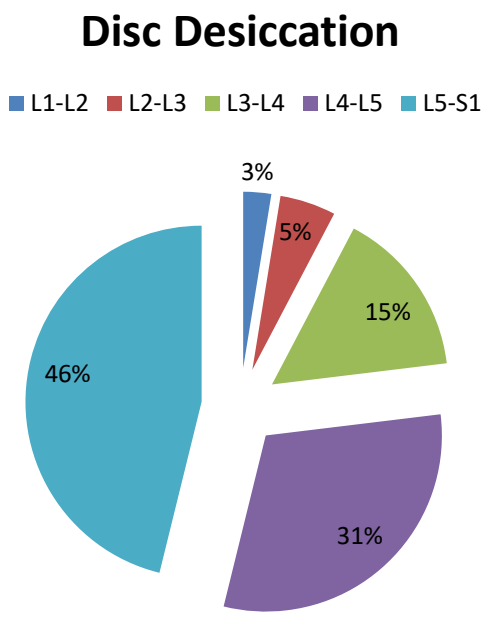
Graph 2 Bar chart representing SLR Test



Graph 2 shows that Straight Leg Raise test was positive in 24 patients (80 %).

Disc desiccation-

Graph 3: Pie chart representing disc desiccation levels.



Graph 4: Pie chart representing disc desiccation

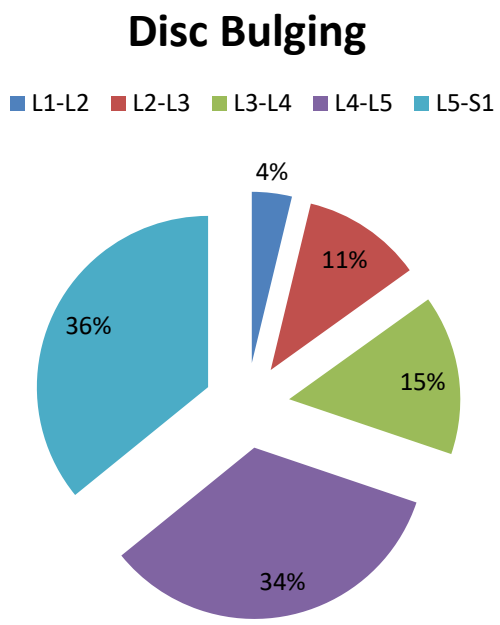


Table 2: Disc desiccation levels

Disc desiccation	No. Of patients (N=30)	%
L1-L2	1	2.5
L2-L3	2	5.1
L3-L4	6	15.3
L4-L5	12	30.7
L5-S1	18	46

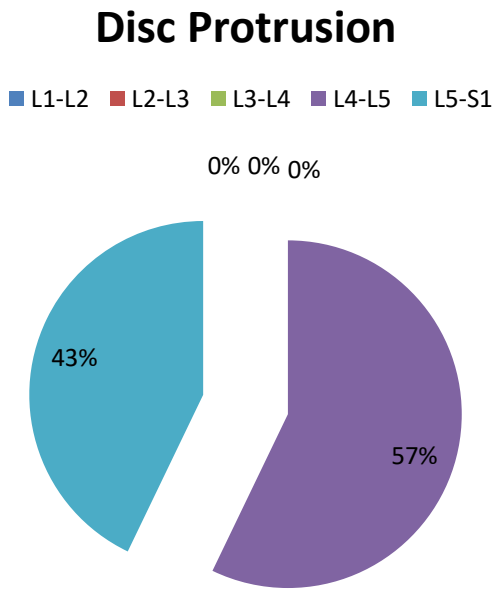
(Number of patients, N=30)

Table 2 shows that Disc desiccation was noticed in 39 levels out of 30 patients; highest prevalence was multiple level involvement, L5-S1 and L4-L5 levels are involved in most of the cases accounting 18 and 12 cases respectively. L3-L4 level involvement in 6 cases, L2-L3 level involvement in 2 cases and L1-L2 level involvement in only one cases.

Disc Bulging-

Disc Protrusion-

Graph 5: Pie chart representing disc protrusion leveL



Types of disc herniations seen in MRI Findings-

Level	Disc bulge (N & %)	Disc protrusion (N & %)	Disc extrusion (N & %)
L1-L2	2 (3.77 %)	0 (0 %)	0 (0 %)
L2-L3	6 (11.32 %)	0 (0 %)	0 (0 %)
L3-L4	8 (15.09 %)	0 (0 %)	0 (0 %)
L4-L5	18 (33.96 %)	4 (57.14 %)	0 (0 %)
L5-S1	19 (35.84 %)	3 (42.85 %)	0 (0 %)

Table 3: shown that levels of disc herniation seen in MRI. There were 60 disc levels of disc abnormality shown in 30 patients; Disc bulge was most common type of disc herniation in this study (53 levels). L5-S1 & L4-L5 levels are involved in most of the cases accounting 19 & 18 cases respectively. Second most common type of disc herniation was disc protrusion (7 cases). L5-S1 & L4-L5 levels were involved accounting 3 & 4 cases respectively, and none of the subjects had disc extrusions.

Table 4: Correlation between SLR test and MRI findings for Disc Desiccation with chronicity of pain in Lumbosacral Radiculopathy-

Table 4: Data reflects that, out of 21 chronic LBP patients, 17 were Positive for SLR test as well as Disc Desiccation; while 2 of them shows Negative SLR. On the other hand, 4 Patients out of 24 with no Disc Desiccation in MRI findings shows positive SLR and 1 of them shows Negative SLR. (Fisher p-value is 0.521 shows the data are not statistically significant. Thus, result reflects the disc desiccation is well correlated with SLR)

		SLR	
	Chronic	Positive	Negative
Disc Desiccation	Positive	17	2
	Negative	4	1
Fisher P value	0.521		

		SLR	
	Total	Positive	Negative
Disc Desiccation	Positive	19	2
	Negative	5	4
Fisher P value	0.0492		

		SLR	
	Sub-Acute	Positive	Negative
Disc Desiccation	Positive	2	0
	Negative	1	1
Fisher P value	1.00		

Among 4 Sub-acute patients, 2 shows disc desiccation with positive SLR test and none of them shows Negative SLR. One patient with No Disc Desiccation shows positive SLR and one patient shows negative SLR. (Fisher p-value is 1.00 considered to be not statistically significant. Thus, it can be concluded that disc desiccation is correlated with SLR in Sub-acute LBP patients.

But when we compare total cases (Acute, Sub-acute & Chronic, N=30) the fisher p-value is 0.0492 is considered to be statistically significant correlation between SLR test and disc Desiccation.

Table 5: Correlation between SLR test and MRI findings for Disc bulging with chronicity of pain in Lumbosacral Radiculopathy-

		SLR	
	Chronic	Positive	Negative
Disc Bulging	Positive	18	3
	Negative	3	0
Fisher P value	1.00		

		SLR	
	Total	Positive	Negative
Disc Bulging	Positive	20	6
	Negative	4	0
Fisher P value	0.557		

		SLR	
	Sub-Acute	Positive	Negative
Disc Bulging	Positive	2	1
	Negative	1	0
Fisher P value	1		

Table 5: Results revealed that out of 24 chronic patients have disc bulging, 18 of them shows positive SLR test and 3 of them shows negative SLR. For 3 patients have no disc bulging seen on MRI findings all 3 patients shows positive SLR and none of them shows negative SLR. (Fisher p-value 1.00 reflects statically statistically non-significant correlation between disc bulging seen in MRI findings and SLR test in chronic patients.)

In Sub-acute cases out of 4 patients 2 were disc bulging and positive SLR and 1 patient have no disc bulge seen in MRI shows positive SLR test. (Fisher p-value 1 is considered to be statistically not significant correlation of disc bulging with SLR test in Sub-acute patients.)

When combined for total cases (Acute, Sub-acute & Chronic,N=30), 20 patients with disc bulge shows positive SLR test and 6 shows negative SLR test. Whereas, 4 patients with no disc bulge shows positive SLR test and none of them shows negative SLR. (Fisher p-value 0.557 reflects statistically non-significant correlation with disc bulging and SLR test)

Table 6: Correlation between SLR test and MRI findings for Disc protrusion with chronicity of pain in Lumbosacral Radiculopathy-

		SLR	
	Chronic	Positive	Negative
Disc Protrusion	Positive	5	0
	Negative	16	3
Fisher P value	1.00		

		SLR	
	Total	Positive	Negative
Disc Protrusion	Positive	7	0
	Negative	17	6
Fisher P value	0.290		

		SLR	
	Sub-Acute	Positive	Negative
Disc Protrusion	Positive	2	0
	Negative	1	1
Fisher P value	1.00		

Table 6 shows, In chronic patients the results reflects that out of 24 patients who have disc protrusion of MRI findings 5 of them shows positive SLR test and none of them shows negative SLR test. For patient with no disc protrusion in MRI, 16 of them shows positive SLR test and 3 of them shows negative SLR. (Fisher p-value 1.00 reflects statistically non-significant correlation between disc protrusion of MRI findings and SLR in chronic patients.)

In Sub-acute cases out of 4 patients 2 were positive for disc protrusion of MRI findings and SLR test and 1 patient with no disc protrusion in MRI findings shows positive SLR test and 1 shows negative SLR test. (Fisher value 1.00 shows statistically non-significant correlation between disc protrusion in MRI findings with SLR test in Sub-acute cases)

When combined for total cases (Acute, Sub-acute & Chronic,N=30), 7 patients with disc protrusion in MRI findings shows positive SLR test and none of them shows negative SLR test. Whereas, 17 patients with no disc protrusion in MRI findings shows positive SLR test and 6 of them shows negative SLR test (Fisher p-value 0.290).

DISCUSSION

The present study was conducted to find out the correlation of subjective findings and MRI abnormalities with SLR test in patients with Lumbosacral Radiculopathy on total 30 patients presented in OPD of Integral Hospital- Lucknow. This study is therefore not a community based and does not exactly reflect the demographic pattern of lumbosacral radiculopathy.

This study was done to determine the accuracy of clinical findings is enough to diagnose the lumbosacral disc herniation. In present study there is no statistically significant correlation in SLR and radiologic findings (except for disc desiccation) in sub-acute and chronic LBP.

In this study 53.33% of the patients were Male & 46.66% patients were Female, Which was similar to study conducted by M H Raman et al (Sep.2016), in which he found male preponderance population, most probably due to increased mechanical stress and prone to injuries due to more outdoor activities.

The distribution of pain in 14 (46.66 %) patients was on right side, 11(36.66 %) on left side and 5 (16.66 %) on both side. Posterolateral disc herniation is more common than central disc herniation. So, unilateral involvement is more common than bilateral involvement.

The chronicity of pain in study population. Out of 30 patients, 24 (80%) patients had chronic pain, 4 (13.33%) patients had sub-acute and only 2 (6.66%) patient had acute pain. In our study 80% patients had chronic Lumbosacral radiculopathy, which is comparable to study made by jeetendra bajpai et al (2013) was found that most of the patients the duration of LBP was 1-2 years[36].

In this study 39 different dermatomal levels distributions of radicular pain (out of 30 patients), 4 patients had more than one dermatomal level distribution of pain. 19 patients had L5 level distribution of pain, 3 patients had L4 level, 1 patient had S1level,3 patients had L5&S1 level, 2 patient had L4&L5 level, 1 patient had L3,L5&S1 level and 1 patient had L4,L5&S1 level distribution of pain. In the study by Mukul K Sarkar et al (2015), also found that L5 level involvement to be commonest.[25]

The straight leg raising test was positive in 24 (80%) patients among them 30. Thus a positive SLRT is indicative of nerve root compression. In the study by Kaynoos homayoni et al (2017), found that sensitivity for SLR test for sciatica was 63.46 % & specificity was 45.88 %.[20] In patients with acute phase of lumbosacral radiculopathy, the sensitivity and specificity of SLR decreases slightly. A possible explanation for this difference in SLR could be the initial minimum inflammation of the nerve roots at the level of compression in the acute phase of the disease.

Table 2 shows that disc desiccation was noticed in 39 levels (in 30 patients).

Degeneration can occur at any level of spine but most commonly seen at L4-L5 & LS-S1 level of Lumbosacral spine probably due to highest mechanical stress at these levels. In the study by Sasi Kuppuswamy et al (2017), also found that more changes at L5-S1 level.[21] Disc degeneration in less than 35 year age can probably due to genetic predisposition; though, other factors like repeated trauma & more physical load can leads to early precipitation of disc degeneration.

In this study we found that there were multiple disc degeneration levels on MRI but not all levels are clinically significant and symptomatic. Which was also concluded in study concluded by Janardhana (2015), in which they found in their study, out of 189 levels of disc lesions only 89 are symptomatic, that means not all MRI levels are symptomatic[37]. Table 3 shows that levels of intervertebral disc herniation in MRI revealed that 60 levels of disc herniation were shown in 30 patients. Bulge was noticed in 53 levels, protrusion was noticed in 7 levels and none of patients had extrusion.

The study shows that commonly involved level of disc abnormality is L4-L5(22) & L5-S1(22). This is because L4-L5 level is the transition point for coupled axis of rotation and bending, it experiences higher stress than other lumbar level. Disc bulge was most common type of disc herniation in this study (53 levels) & most commonly involved level in disc bulge cases was L5-S1 (19 levels) then involving L4-L5 (18 levels). In the study by Jeetendra bajpai et al (2013), also found that L4-L5 & L5-S1 disc involved in 94% of the cases[37]. In the study by Mukul k sarkar et al, 2015 found that disc bulge (61.52%) is more common than disc protrusion (23.08%)[25].

In this study none of the subjects had disc extrusions. In the study N. Djuric et al, (2020) revealed that macrophages infiltration was positively associated with an extruded type of disc herniation as well as extent of reduction during one year followup in patients with sciatica[38].

Result of this study suggests that in chronic & sub-acute cases there is no statically significant difference in SLR & MRI findings for Disc Desiccation as (p value >0.05) but when we combine all cases of (acute, sub-acute & chronic) LBP result shows statistically significant correlation (p value <0.05) between SLR & MRI findings.(Table 4) We belief this difference was probably because of small population for acute cases in our study.

Result of this study suggests that in chronic & sub-acute cases there is no statically significant correlation in SLR & MRI findings for Disc Bulging as (p value >0.05) also when we combine all cases of (acute, sub-acute & chronic) LBP result shows no statistically significant correlation (p value >0.05) between SLR & MRI findings (Table 5.). In the study W. Brinjiskji et al, 2015 found that disc bulge had a strong association with LBP[39].

Result of this study suggests that in chronic & sub-acute cases there is no statically significant correlation in SLR & MRI findings for Disc Protrusion as (p value >0.05) also when we combine all cases (acute, sub-acute & chronic) of LBP result shows no statistically correlation (p value >0.05) between SLR & MRI findings as shown in Table 6. In the study Dr. Alison Endean etal (2011) suggests that disc protrusion in MRI abnormality most stronglt associated with LBP[40].

The small population is a marked drawback of this study. Patients were recruited from only one hospital, which is a limitation in our study. The sample size can be more in future research.

Only those patient with clinical diagnosis of lumbar radiculopathy and could afford to undergo MRI of lumbar spine were included in this study.

The MRI reporting was done by different radiologists which might have lead to inter observer variations which is a drawback of the study.

CONCLUSION

In the present study, we observed that there is a good correlation between clinical findings and MRI findings of

Lumbosacral radiculopathy but not all MRI findings need to be investigated. MRI shows clinically asymptomatic multiple disc involvement. This can be safely concluded that examiner should put more emphasise on clinical examination.

Present study concluded that there is no statistically significant correlation in SLR and radiologic findings (except for disc desiccation) for sub- acute and chronic Lumbosacral Radiculopathy. SLR and MRI findings can be used interchangeably for chronic and sub-acute cases, but not for acute cases, where MRI is only able to diagnose. Thus SLR test is enough to diagnose disc herniation as MRI for the set-ups where MRI is not easily available, contraindicated or unaffordable for the patients. SLR test is a cost effective method to diagnose disc herniation & lower the financial burden on patients.

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