بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Sudan University of Sciences and Technology

Collage of Graduate Studies

Correlation between Lower limbs Length Discrepancy and Lumbar Disc Prolapse Using Magnetic Resonance Imaging

الارتباط بين تناقض طول الاطراف السفليه وهبوط القرص القطني عن طريق التصوير بالرنين المغنطيسي

A Thesis Submitted of Partial Fulfillment for the Requirement of M.SC. Degree in Diagnostic Radiological Technology

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August 2020

الاية

قال تعالي :

اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ (1) خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ (2) اقْرَأْ وَرَبُّكَ الْأَكْرَمُ (3) الَّذِي عَلَّمَ بِالْقَلَمِ (4) عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ (5)

صدق الله العظيم

سوره العلق _الايه 1- 5

DEDICATION

I would like to dedicate this work to my family who supporting me in everything to my teachers who never failed to teach and guide me To my friends who helping me to finish this research.

ACKNOWLEDGMENT

Grateful thanks and grace to Allah for guiding and helping me finishing this research. I would like to express my deepest thanks to my Supervisor **Dr. Mona Ahmed** for her guidance. Also great thanks for all people who help me to finish this work

ABSTRACT

Analytic descriptive study MRI examination of lumber vertebral disc prolapse and lower limb discrepancy was done for 100 Patients in two hospitals in Khartoum state (Antalya center and nilien medical diagnostic center) were collected in the period from December 2019 to April 2020.

This study was done to knew the patients there comeing to MRI department with low pack pain or disc prolapse why developed habits of walking with avoiding pressed on the effected side are they because pain on effected side or because shortening on lower limbs.

The objectives of study to evaluate correlation between lower limb discrepancy and vertebral disc prolapse at lumbar spine, to correlation lumbar vertebral disc prolapse with age, hight and weight and To evaluate lower limbs length discrepancy associated with side of radiating pain .

Material and method of Study is contains of 100 sample (47 male and 53 female). Their age ranged from (20 to 90) years. almost all those complaining of lower back pain to do lambosacral spine mri , this study carried out which equipped by high quality machine 1.5 Tesla and 0.5 Tesla .And using data sheet for collecting data , the patients were registered (age, gender, weight, high, lumbar disc prolapse level, lower limbs length, side affected by prolapse, pain radiated, severity of prolapse).

Descriptive statistics was used to describe the study variables, using the Statistical Package Software (SPSS) to analyze variables.

The result of study found association between lumbar vertebral level and Severity. There no association between pain side and RT LL or LT LL.

There's no significant difference between means of RT&LF limb length according to Severity level .The level of disc prolapses lumber spine at the level l5 –S1 was the most common, followed by disc prolapse at level of L3-L4, L4-L5, L5 –S1.The side of disc prolapse, the central is the most one. The most common age of prolapse in (41-50) years and disc change are more common in male than female.

Recommendation of study future studies must use large sample to support the findings, and use more accurate way for measure the length of lower limbs like one film shoot in X-ray.

ملخص البحث

دراسة وصفية تحليلية تم إجراء فحص التصوير بالرنين المغناطيسي لتدلي القرص الفقري الخشبي وتباين الأطراف السفلية لـ 100 مريض في مستشفيين بولاية الخرطوم (مركز أنطاليا ومركز الن التشخيص الطبي) في الفترة من ديسمبر 2019 إلى أبريل 2020.

أجريت هذه الدراسة لمعرفة المرضى الذين يأتون إلى قسم التصوير بالرنين المغناطيسي وهم يعانون من آلام منخفضة أو تدلي القرص سبب تطور عادات المشي مع تجنب الضغط على الجانب المتأثر هل بسبب الألم في الجانب المصاب أم بسبب قصر الأطراف السفلية.

أهداف الدراسة لتقييم الارتباط بين تناقض الأطراف السفلية وتدلي القرص الفقري عند العمود الفقري الخشبي ، وارتباط تدلي القرص الفقري القطني بالعمر والارتفاع والوزن ولتقييم التباين في طول الأطراف السفلية المرتبط بجانب الألم المشع.

مادة وطريقة الدراسة تحتوي على 100 عينة (47 ذكور و 53 إناث). تراوحت أعمارهم بين (20 - 90) سنة. تقريبا جميع الذين يشكون من آلام أسفل الظهر للقيام بعملية الرنين المغناطيسي للعمود الفقري القطني العجزي ، أجريت هذه الدراسة التي تم تجهيزها بآلة عالية الجودة 1.5 تسلا و 0.5 تسلا. وباستخدام ورقة البيانات لجمع البيانات ، تم تسجيل المرضى (العمر والجنس والوزن وارتفاع ، مستوى هبوط القرص القطني ، طول الأطراف السفلية ، الجانب المصاب بالتدلي ، الألم المشع ، شدة التدلي).

تم استخدام الإحصاء الوصفي لوصف متغيرات الدراسة باستخدام برنامج الحزمة الإحصائية (SPSS) لتحليل المتغيرات.

وجدت نتيجة الدراسة ارتباطًا بين مستوى العمود الفقري القطني والشدة. لا يوجد ارتباط بين جانب الألم و RT LL أو LT LL.لا يوجد فرق كبير بين متوسطات طول الطرف LF & RT وفقًا لمستوى الخطورة. كان مستوى القرص يتدلى من العمود الفقري الخشبي عند المستوى L5- S1 هو الأكثر شيوعًا ، يليه هبوط القرص عند المستوى L3-L4 و L4-L5 و L5 - S1- جانب هبوط القرص ، المركزي هو الأكثر. العمر الأكثر شيوعًا للتدلي في (41-50) عامًا ، وتغير القرص أكثر شيوعًا عند الذكور منه عند الإناث.

يجب أن تستخدم توصية الدراسات المستقبلية عينة كبيرة لدعم النتائج ، واستخدام طريقة أكثر دقة لقياس طول الأطراف السفلية مثل تصوير فيلم واحد بالأشعة السينية.

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LIST OF ABBREVIATION

PT	Patient
ALL	Anterior Longitudinal Ligament
PLL	Posterior Longitudinal Ligament
MRI	Magnetic Resonance Imaging
CT	Computed Tomography
T	Tesla
RF	Radio frequency
PD	Proton Density
FSE	Fast Spin Echo
SE	Spin Echo
LLD	Leg length discrepancy
LBP	Lower back pain

List of contents

Chapter one

Introduction

Chapter one

Introduction

1.1 Introduction:

Vertebra bone of the neck and back provides structural support for the spine, protect and encases the spinal cord.Radiologist and orthopedic surgeons use a number of different terms when they refer to disc problems , herniated disc ruptured disc , protruded disc , prolapsed disc and slipped disc generally all mean the same things.The disc line between the end surfaces of the bony blocks (vertebrae) that make up the spine. They have a soft center with is sarwondid by tough outer ring, the disc allow move mint of the spine and also act as shock absorber. The nerve witch run from the brain to the arm and leg lies within spinal canal. As the nerves leave the spine to go to the musicale and skin, they pass very close to back of the disc. When disc is damage the soft center may slip out (prolapsed) and pass on nerve. The usual place for such prolapsed to occur in the lower back (lumber) region or occur in the neck (cervical) region (Drake et.al,2009). Inter vertebral disc space and disc prolapsed and most common pathology associated in the vertebral column .the lumber spine is the first common site. Spinal imaging firstly applied by plain x -ray and myelographyreplacedby computed tomography and recently MRI , these procedures regarding economic status of the patient and radiation protection .(keyomars,et.al,2015). MRI has opened new horizons in the diagnosis and treatment of many musculatal diseases. It demonstrates abnormalities in the bones and soft tissue before they become evident at other imaging modalities. The exquisite soft tissue contrast resolution , noninvasive nature and multiplanner capabilities of MR imaging make it especially valuable for the detection and assessment of verify of soft

tissue disorder of the ligament (e.g. sprain) tendons (tendonitis , rupture , dislocation)another soft tissue strictures (e.g. sinuses tarsal syndrome , synovial disorders) MR imaging has also been shown to be highly sensitive in the detection and staging of number for musculoskeletal infections including cellulites and osteomyelitis in addition, MR imaging is excellent for the early detection and assessment of number of osseous abnormalities such as bone contusion , streets and insufficiency fractures, osteochondral fractures, osteonecrosis and transient bone marrow edema. 2 The first choice in diagnosing the cervical spine disc prolapsed in the emergency x-ray department is conventional x-ray radiograph. Conventionalx-ray is use full for evaluating the spinal trauma. Such as fractures, subluxation and arthopathies such as rheumatoid arthritis , x-ray generate imaging by striking a detector that either exposes a film or in sends the image to a computer . a dense tissue the body such as bones absorbs many of x-rays and looks white on an x-ray image. Less dense tissue such as muscles and organs absorb fewer of the x-ray and look like shades of grey on an x-ray image. X -ray that passes only through air looks black on image.Claustrophobia is common problem in MRI examination room the sight of the magnet bore and unfamiliar surroundings increase their anxiety. The enclosing nature of the bore and equipment such as head coil in verify exaggerates any claustrophobic or nervous tendons (Drake et.al, 2009)

2.1 Problem of study

The complication of disc prolapsesis shortening of lower limbs which affect the disability. Most of patients withlow back Pain or disc prolapse developed habits of walking with avoiding pressed on the affected Side which may lead to shortening of the affected limes.

1.3 Project Objectives:

1.3.1 General Objective:

To determine the Correlation between lower limbs length discrepancy and lumbar disc prolapse

1.3.2 Specific objective:

- To determine the Correlation between lower limbs length discrepancy and lumbar disc prolapse.
- To correlate between disc prolapse and height and weight.
- To evaluate lower limbs discrepancy associated with side of radiating pain.
- To correlate between the vertebral disc with patient age

1.4 The overview of the research:

Chapter one deals with introduction, problem, objectives, significance and overview of research. Chapter two deals with literature review including theoretical background (anatomy, physiology and pathology) and previous studies. Chapter three deals with research Materials and Methods Chapter our deals with results and finally chapter five deals with discussion, conclusion and recommendation.

Chapter Two

Theoretical Background and Literature Review

Chapter two
Theoretical Background

2.1 Theoretical Background

2.1.1 Anatomy:

2.1.1.1The Spine:

The spine is made of 33 individual bones stacked one on top of the other. Ligaments and muscles connect the bones together and keep them aligned. The spinal column provides the main support for your body, allowing you to stand upright, bend, and twist. Protected deep inside the bones, the spinal cord connects your body to the brain, allowing movement of your arms and legs. Strong muscles and bones, flexible tendons and ligaments, and sensitive nerves contribute to a healthy spine. Keeping your spine healthy is vital if you want to live an active life without back pain (Drake 2009)**.**

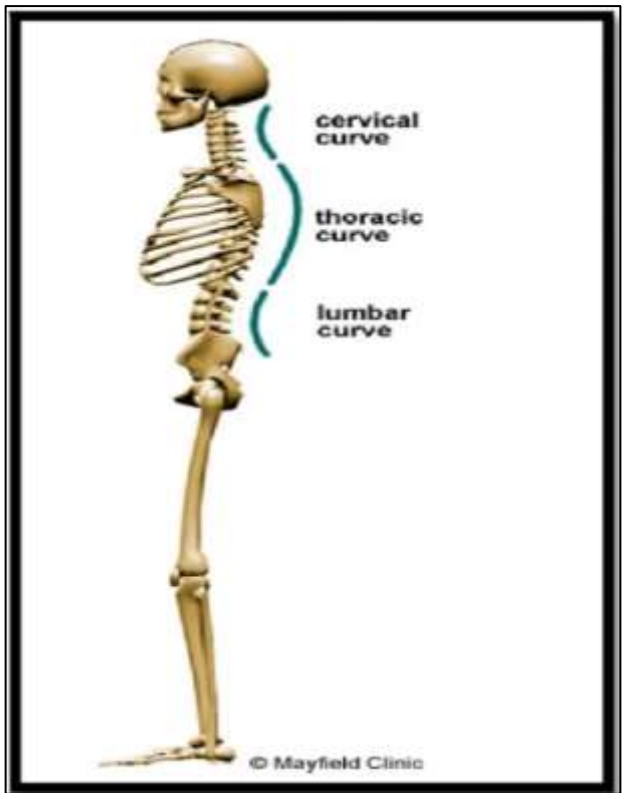


Figure 2.1: The spine has three natural curves that form an S-shape(Drake 2009)

2.1.1.2 The spinal curves

When viewed from the side, an adult spine has a natural S-shaped curve. The neck (cervical) and low back (lumbar) regions have a slight concave curve, and the thoracic and sacral regions have a gentle convex curve .The curves work like a coiled spring to absorb shock, maintain balance, and allow range of motion throughout the spinal column. (Drake 2009)

2.1.1.3 The vertebrae:

Vertebrae are the 33 individual bones that interlock with each other to form the spinal column. The vertebrae arenumbered and divided into regions: cervical, thoracic, lumbar, sacrum, and coccyx .Only the top 24 bones are moveable; the vertebrae of the sacrum and coccyx are fused. The vertebrae in each region have unique features that help them perform their main functions. (Drake 2009)

Cervical (neck) - the main function of the cervical spine is to support the weight of the head (about 10 pounds). The seven cervical vertebrae are numbered C1 to C7. The neck has the greatest range of motion because of two specialized vertebrae that connect to the skull. The first vertebra (C1) is the ring-shaped atlas that connects directly to the skull. The second vertebra (C2) is the peg-shaped axis, which has a projection called the odontoid, that the atlas pivots around. (Drake 2009) Thoracic (mid back) - the main function of the thoracic spine is to hold the rib cage and protect the heart and lungs. The twelve thoracic vertebrae are numbered T1 to T12.

The range of motion in the thoracic spine is limited. (Drake 2009) Lumbar (low back) - the main function of the lumbar spine is to bear the weight of the body. The five lumbar vertebrae are numbered L1 to L5. These vertebrae

are much larger in size to absorb the stress of lifting and carrying heavy objects.(Drake 2009) Sacrum- the main function of the sacrum is to connect the spine to the hip bones (iliac). There are five sacral vertebrae, which are fused together. Together with the iliac bones, they form a ring called the pelvic girdle. (Drake 2009) Coccyx region - the four fused bones of thecoccyx or tailbone provide attachment for ligaments and muscles of the pelvic floor. (Drake 2009)

2.1.1.4 The intervertebral discs:

Each vertebra in your spine is separated and cushioned by an intervertebral disc, keeping the bones from rubbing together. Discs are designed like a radial car tire. The outer ring, called the annulus, has criss-crossing fibrous bands, much like a tire tread. These bands attach between the bodies of each vertebra. Inside the disc is a gel-filled center called the nucleus, much like a tire tube.(Rosse 1997) figure (2.2)

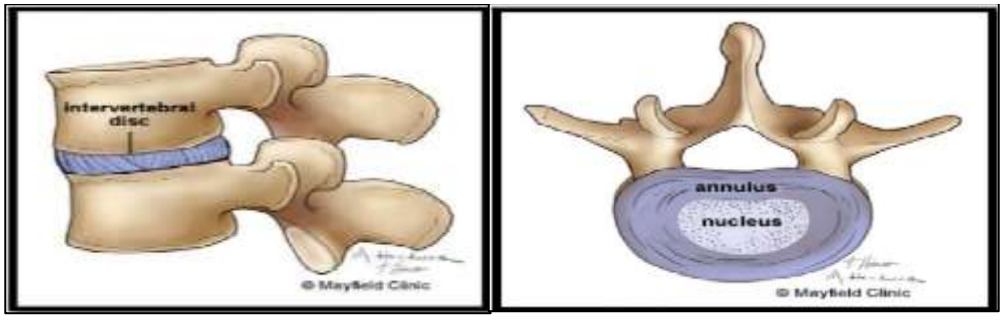


Figure 2.2: Intervertebral discs(Pansky,1996)

2.1.1.5 Vertebral arch & spinal canal:

The arch is made of two supporting pedicles and two laminate. The hollow spinal canal contains the spinal cord, fat, ligaments, andblood vessels. Under

each pedicle, a pair of spinal nerves exits the spinal cord and pass through the intervertebral foramen to branch out to your body. Seven processes arise from the vertebral arch: the spinous process, two transverse processes, two superior facets, and two inferior facets.(Rosse 1997)

2.1.1.6 The ligaments:

There are different ligaments involved in the holding together of the vertebrae in the column, and in the column's movement. The anterior and posterior longitudinal ligaments extend the length of the vertebral column along the front and back of the vertebral bodies. The interspinousligaments connect the adjoining spinous processes of the vertebrae. The supraspinous ligament extends the length of the spine running along the back of the spinous processes, from the sacrum to the seventh cervical vertebra. From there it is continuous with the nuchal ligament (Williams 2007) figure (2.3)

Figure 2.3: The ligamentumflavum, anterior longitudinal ligament (ALL), and posterior longitudinal ligament (PLL). (Pansky,1996)

2.1.1.7 The muscle:

The two main muscle groups that affect the spine are extensors and flexors. The extensor muscles enable us to stand up and lift objects. The extensors

are attached to the back of the spine. The flexor muscles arein the front and include the abdominal muscles. These muscles enable us to flex, or bend forward, and are important in lifting and controlling the arch in the lower back. (Williams 2007)

2.1.1.8 Spinal cord:

The vertebral column surrounds the spinal cord which travels within the spinal canal, formed from a central hole within each vertebra. The spinal cord is part of the central nervous system that supplies nerves and receives information from the peripheral nervous system within the body. The spinal cord consists of grey and white matter and a central cavity, the central canal. Adjacent to each vertebra emerge spinal nerves. The spinal nerves provide sympathetic nervous supply to the body, with nerves emerging forming the sympathetic trunk and the splanchnic nerves. (Williams 2007) The spinal canal follows the different curves of the column; it is large and triangular in those parts of the column which enjoy the greatest freedom of movement, such as the cervical and lumbar regions; and is small and rounded in the thoracic region, where motion is more limited. The spinal cord terminates in the conusmedullaris and caudaequina. (Williams 2007)

2.1.2 Pathology

2.1.2.1 Annular Disc Tear:

An intervertebral disc is a strong ligament that connects one vertebral bone to the next. The discs are the shock-absorbing cushions between each vertebra of the spine. Each disc has a strong outer ring of fibers, called the annulus fibrosis, and a soft, jelly-like center, called the nucleus pulposus. The annulus is the strongest area of the disc and connects each vertebra

together. (Underwood, 1996) The annulus can tear or rupture anywhere around the disc. If it tears and no disc material is ruptured, this is called an annular tear. The outer 1/3 of the disc's annular ring is highly innervated with pain fibers. Thus, if a tear involves the outer 1/3 it may be extremely painful. This tear will heal with scar tissue over time but is more prone to future tears and injury. Studies also indicate that annular tears may lead to premature degeneration of the disc, endplates, and facet joints.(Underwood, 1996)

2.1.2.1.1 Types of annular tear:

The annulus fibrosis is constructed of Completeal layers, each of which can become torn. The nature of the tear and the layers it affects will be the basis for how the Tear is categorized:

1- Radial tears — Typically caused by the natural aging process, radial tears begin at the center of the disc and extend all the way through the outer layer of the annulus fibrosus. 11 These tears can cause a disc to herniate, which occurs when the center nucleus of a disc extrudes through the tear to the outside of the disc. (Underwood, 1996)

2- Peripheral tears — (also known as rim lesion or transverse tear) These tears occur in the outer fibers of the annulus fibrosus and are usually brought on by traumatic injury or contact with a bone spur. Peripheral tears can lead to the degeneration or breakdown of an intervertebral disc. (Underwood, 1996)

3- Concentric tears — (also known as circumferential tears, or delaminations), the broken fibers are parallel with the borders of the intervertebral disc at some distance in between the center and edge. Tears here create spaces between adjacent concentric fibers which can fill with fluid, such as the nucleus pulposus. These tears often occur with compressive stress on older discs, which is usually caused by injury. (Underwood, 1996)

4- Horizontal tear —also known as a transverse tear), which are usually small and may represent early stages of age-related disc deformity. These are often found in conjunction with radial tears. (Underwood, 1996)

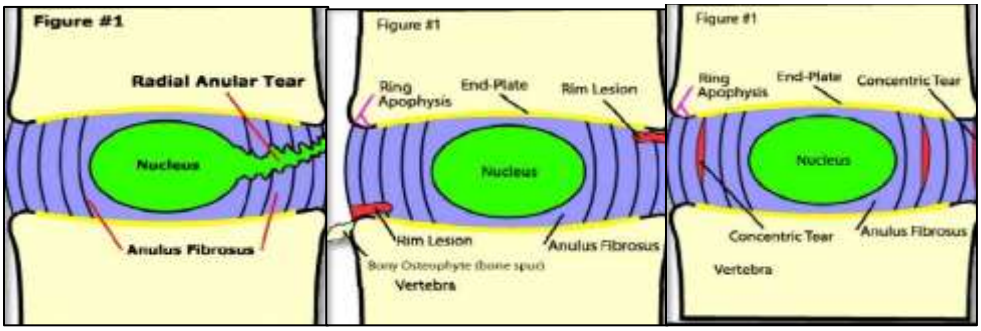


Figure 2.4: Types of annular tear(Underwood, 1996)

2.1.2.2 Osteophytes:

Lumbar osteophytes, also known as bone spurs, are smooth growths that form on the facet joints and/or around the vertebrae in the lower spine. Bone spurs do not always cause pain, but in some cases may compress nerves in the lower back causing symptoms of radiating pain, weakness, tingling, or numbness in the legs and feet, along with stiffness and lack of movement in the lower back. (Edward f. Goljan.1998) figure (2.5)

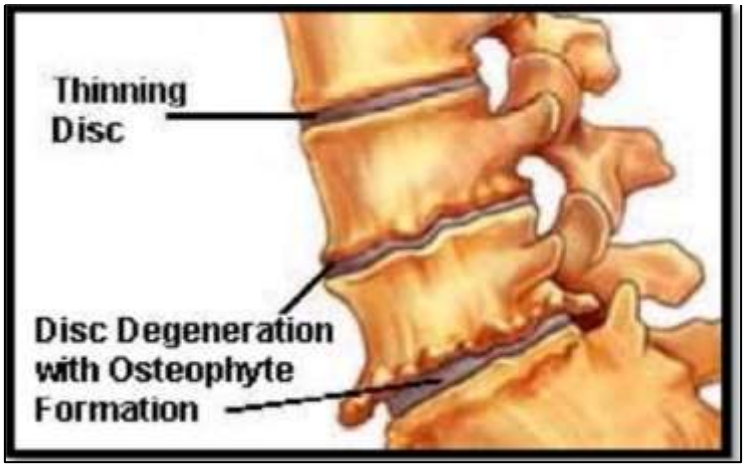


Figure 2.5: Lumbar osteophytes (Edward f. Goljan.1998)

2.1.2.3Ligamentumflavum thickening:

Ligamentumflavum thickening was measured on the axial image, perpendicular to the spinal canal axis and parallel to the lamina, where ligamentumflavum were seen along their entire length & measurement were taken at the half length of ligamentflavum. A mean thickness of the ligamentumflavum of 4.44 mm in the patients with the spinal canal stenosis labeled as thickened and 2.44 mm thickness in the control group. So, we had labeled a >4 mm ligamentumflavum thickening as thickened. (Edward. Goljan.1998)

2.1.2.4Spondylosis:

Spondylosis is a general term for degenerative arthritic changes of the spine, or more simply arthritis. Most degenerative changes of the spine are part of the normal aging process, much like developing grey hair. Everyone is expected to have some evidence of spondylosis as they get older. Many times, patients who have spondylosis on imaging studies do not have any

symptoms. In fact, more than 90% of adults over 65 show signs of arthritis. These degenerative changes most commonly occur at the vertebral body and openings for nerve roots. (Edward .Goljan, 1998)

2.1.2.5 Spinal Stenosis:

Spinal stenosis the narrowing of the spinal canal This narrowing of the spinal canal limits the amount of space for the spinal cord and nerves. Pressure on the spinal cord and nerves due to limited space can cause symptoms such as pain, numbness, and tingling. The most common reason to develop spinal stenosis is degenerative arthritis, or bony and soft tissue changes that result from ageing. Spinal stenosis is usually seen in patients over 50 years of age, and becomes progressively more Completee with increased age, Spinal canal diameter less than 12 mm indicates narrowing of the canal.(Edward f. Goljan, 1998)

2.1.2.6 Herniated disc or disc prolapsed:

A herniated disc occurs when the inter vertebral disc outer fibers (the annuls are damage and the soft inner material of the nucleus pulpous protrude out of its normal space if the annulus tear near the spinal canal). This can cause mush pressure on the spinal cord and nerve root. There is also some evidence that the nucleus pulpous material cause a chemical irritation of nerve root and the chemical irritation can lead to problems thenerve function. A herniated disc is common in lumbar spine because of the all pressure it supports. Herniated lumber disc often produce sciatica, condition where the lower back pain and numbness radiation down to the back of the leg. (Underwood, 1996) figure (2.6)

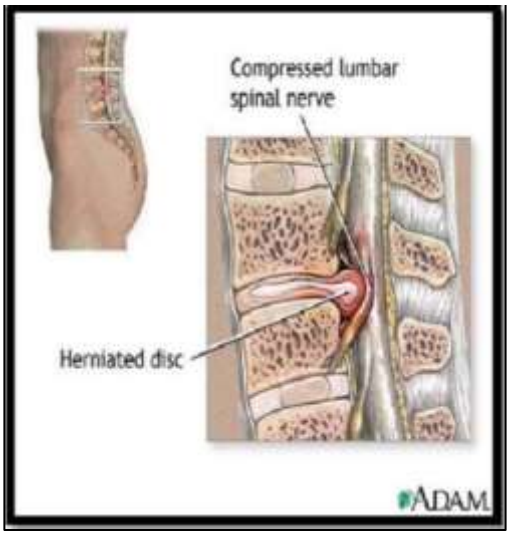


Figure 2.6: A spinal disc herniation(Underwood, 1996)

The human spine consists of alternating bonyvertebrae and intervertebral discs extending from the neck to the coccyx. The lower portion of the spine in the region of the lower is called the lumber spine. (pansky,1996). The intervertebral discs are the ‘shock absorbers’ of the body and are composed of an outer strong fibrous membrane and an inner ‘jellylike’ nucleus giving both strength and elasticity.A disc prolapse occurs when there is a weakening in the outer membrane leading to a protrusion of the inner nucleus. This protrusion usually heads poster laterally towards the lateral parts of spinal canal which contains the nerve root. Occasionally the protrusion heads more centrally and can cause compression of the spinal cord. (Drake et.al, 2009).There is no known cause of lumber 15 discprolapses. Heavy lifting and straining may exacerbate the condition. Traumatic disc prolapses may occur with localized high velocity pressure.

SIGNS AND SYMPTOM: a variety of symptoms are present with a lumberdisc prolapse may occur due to the acute disc rupture itself, and any

pressure that may occur on neurological structures as a result and includes: back pain, focal neurological deficits (weakness, numbness, tingling)

2.1.2.7Myelopathy:

A large or central disc prolapse may result in pressure on the spinal cord. This may result in disruption of the nerve signals to the legs and cause spastic legs, hyper-reflexes legs and difficulty walking (myelopathy).It may also result in radicular symptoms with pain shooting into the arms, torso or legs. There may also be loss of control of the bowel and bladder function. (Haughton,2006).

2.1.3 The physics ofMagnetic resonance imaging:

The basis of MRI is the directional magnetic field, or moment, associated with charged particles in motion. Nuclei containing an odd number of protons and/or neutrons have a characteristic motion or precession. Because nuclei are charged particles, this precession produces a small magnetic moment.When a human body is placed in a large magnetic field, many of the free hydrogen nuclei align themselves with the direction of the magnetic field. The nuclei precess about the magnetic field direction like gyroscopes. This behavior is termed Larmorprecession. (Pfirrmann,2001) In a 1.5 T magnetic field at room temperature this difference refers to only about one in a million nuclei since the thermal energy far exceeds the energy difference between the parallel and ant parallel states. Yet the vast quantity of nuclei in a small volume sum to produce a detectable change in field. Most basic explanations of MRI will say that the nuclei align parallel or anti-parallel with the static magnetic field; however, because of quantum mechanics quantum mechanical reasons, the individual nuclei are actually

set off at an angle from the direction of the static magnetic field. The bulk collection of nuclei can be partitioned into a set whose sum spin are aligned parallel whose sum spin are anti-parallel. (Pfirrmann,2001)

2.1.4 Equipment of MRI:

The MRI equipment consists of following components: The magnet generates the magnetic field.Shim coils make the magnetic field homogeneous.Radio frequency coils transmit the radio signal into the body part being imaged.Receiver coils detect the returning radio signals.Gradient coils provide spatial localization of the 18 signals.Shielding coils produce a magnetic field that cancels the field from primary coils in regions where it is not desired.The computer reconstructs the signals into the image.The MRI scanner room is shielded by a faraday shield.Different cooling systems cool the magnet, the scanner room and the technique room. (https://www.mr-tip.com)

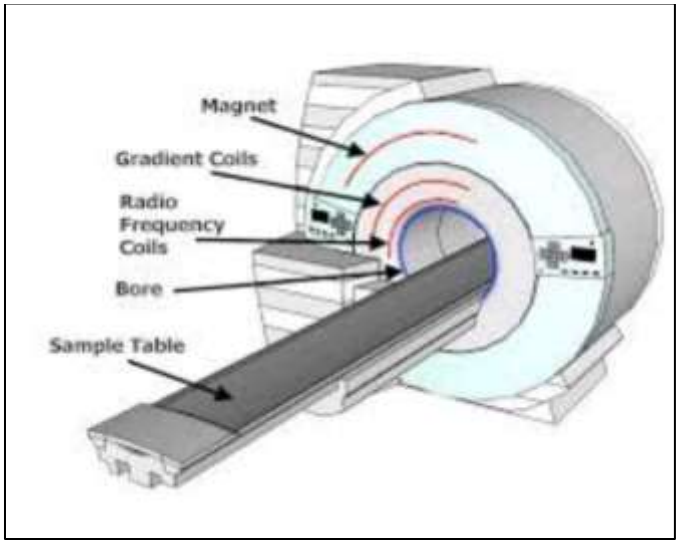


Figure2.7: Component of MRI machine. (https://www.mr-tip.com)

2.1.5 Magnet:

The magnet is the largest and most expensive component of the scanner, and the remainder of the scanner is built around it. The strength of the magnet is measured in Teslas (T). Clinical magnets generally have field strength in the range 0.1–3.0 T. Three types of magnet have been used: 1-Permanent magnet: Conventional magnets made from ferromagnetic materials. 2-Resistive electromagnet: A solenoid wound from copper wire is an alternative to a permanent magnet. 3-Superconducting electromagnet: most common type found in MRI scanners today. (Pfirrmann,2001)

2.1.5.1 Radio frequency(RF) system

The RF transmission system consists of a RF synthesizer, power amplifier and transmitting coil. This is usually built into the body of the scanner. The power of the transmitter is variable, but high-end scanners may have a peak output power of up to 35 kW, and be capable of sustaining average power of 1 kW. The receiver consists of the coil, pre-amplifier and signal processing system. (Pfirrmann,2001)

A recent development in MRI technology has been the development of sophisticated multi-element phased array coils which are capable of acquiring multiple channels of data in parallel. This 'parallel imaging' technique uses unique acquisition schemes that allow for accelerated imaging, by replacing some of the spatial coding originating from the magnetic gradients with the spatial sensitivity of the different coil elements. However the increased acceleration also reduces SNR and can create residual artifacts in the image reconstruction. Two frequently used parallel acquisition and reconstruction schemes are sense. (Pfirrmann,2001)

2.1.5.2 Coils:

A Coil are part of the hardware of MRI machines and are used to create a magnetic field by voltage induced in the wire, coil consists of one or more loops of conductive wire, looped around the core of the coil. (Pfirrmann,2001)

Different types of MRI coils are used in MR systems:

2.1.5.2.1 Surface Coil:

Is essentially a loop of conducting material, This typeofreceiver coil is placed directly on or over the region of interest for increased magnetic sensitivity.(Pfirrmann,2001)

2.1.5.2.2Volume Coil:

That surrounds either the whole body, or one specific region, such as the head or a knee. Volume coils have a better RF homogeneity than surface coils, which extends over a large area.(Pfirrmann,2001)

2.1.5.2.3 Gradient Coil:

Current carrying coils designed to produce a desired magnetic field gradient, Gradient coils in general vary the main magnetic field, so that each signal can be related to an exact location. (Pfirrmann,2001)

2.1.6 Technique of MRI in lumber spine

Posterior spinal coil/phased array spinal coil. Foam pads to elevate the knees. (Catherine Westbrook, 2008).

2.1.6.1 Equipment:

2.1.6.2 Patient positioning:

The patient lies supine in the couch with their knees elevated over foam pad for comfort and to flatten the lumber curve. The coil should extend from xiphoidsternum to the bottom of the sacrum. The longitudinal alignment light lie in the midline and the horizontal one passes just below the low costal margin. (Catherine Westbrook, 2008).

2.1.6.3 Suggested protocol:

Sagittal T1 SE, Sagittal T2 FSE, prescribed on either side of the longitudinal light from the lift to the right lateral borders of the vertebral bodies. axial PD/T2 FSE, Angled to that they are parallel to each disc space, the lower three lumber discs are commonly examined contrast is used for determining disc prolapses versus scar tissues. (Catherine Westbrook, 2008).

2.1.7 Other Diagnosis modalities:

2.1.7.1 X-ray:

X-rays are effective at showing narrowed spinal channels (spinal stenosis), fractures, bone spurs (osteophytes), or osteoarthritis On the plain films, your surgeon will be looking for vertebral alignment, scoliosis, and fracture—other spinal issues that can come along with DDD, Your surgeon may also order flexion and extension x-rays to evaluate the stability of your spine and your range of motion (how well your joints move). You'll be asked to bend forward (flexion) and backwards (extension) during these x-rays. (Schneiderman, 1987)

2.1.7.2 Computed tomography:

A CT scan works by shooting an X-ray beam through the body. Next, a computer is used to reformat the image into cross sections of the spine. This process is repeated at multiple different intervals, a CT scan is often used to evaluate the bony anatomy in the spine, which can show how much space is available for the nerve roots and within the neural foramina and spinal canal.CT scans should not be performed for women who may be pregnant..(Schneiderman, 1987)

2.2 Literature review

2.2.1 Previous studies:

In the study of Albert ten Brinke, Hans E van der Aa, Job van der Palen, Frits Oosterveld.Spine 24 (7), 684-686, 1999.they found that Seventy-three patients (55%) were men, and 59 (45%) were women. The mean age was 40 years, and 99% of all herniated discs appeared at L4-L5 (n= 60) or L5-S1 (n= 71). In 64 (62%) of the 104 patients with a leg length discrepancy of 1 mm or more, the pain radiated in the shorter leg (P= 0.02). In subgroups of patients with larger leg length discrepancies, similar results were found but because of smaller sample sizes, these findings did not reach statistical significance. In 32 of the 57 men (56.1%), the pain radiated to the shorter leg (P= 0.43); this was observed in 33 of the 47 women (70.2%; P= 0.01).

Mehmet Sabri Balik, Ayhan Kanat, Adem Erkut, Bulent Ozdemir, Osman Ersagun Batcik.Journal of Craniovertebral Junction & Spine 7 (2), 87, 2016 ,they found that A total number of 39 subjects (31 women and eight men) with leg length discrepancy and LBP and 43 (25 females and 18 males) patients with LBP as a control group were tested. Occurrence of disc

herniation is statistically different between patients with hip dysplasia and control groups (P< 0.05).

The results of this study showed a statistically significant association between leg length discrepancy and occurrence of LDH. The changes of spine anatomy with leg length discrepancy in hip dysplastic patients are of importance in understanding the nature of LDH

Gamal Abdel Salam (2015) studied of the age related changes in the lumbar spine in Egyptian People Detected by Magnetic Resonance Image (MRI). Lumbar region is the mobile part of the vertebral column which bearing region. Unfortunately, the available data detecting the lumbar spine degenerative changes by MRI are still limited, particularly in Egypt. The present study aimed to the examination of possible age related changes in the lumbar spine in Egyptian people detected by MRI. Mid sagittal MRI scan were obtained from eighty symptomless persons (30 female's 37.5% and 50 males 62.5% of cases) between 25-70 years of age. They were divided into two groups: first group forty cases, 25-40 years (21males& 19 females) and the second group forty cases 41-70years (29 males & 11 female).

Ali Hassan A.Ali (2010) studied evaluation of age related changes in lumbar spine in SaudiArabian adult population: using magnetic resonance Images, the main objective of ourstudy was to investigate the frequency of lumbar spine degeneration in magneticresonance images. We evaluated magnetic imaging (MRI) results from 210 patientscomplaining low back pain for age-related degeneration in the lumbar spine. In thisstudy, 210 adult cases ranging between 18-90 years of age were included. The cases wereclassified into 3 groups: young age group (18 – 35 years old) (66 cases), middle agegroup(36 -55 years old) (75 cases)and old age group(56-90 years old) (69

cases).theirMRI scans were performed in the department of radiology, King Khalid Hospital, Alkharj and studied for any age related changes. The most common feature observed in youngage group was reduced signal intensity and modic type changes were more frequentlyseen in the old age group. Degenerative findings in the lumbar spine, suggestingdegeneration, were common subjects. These results provide normative data for evaluating patients with degenerative lumbar diseases in Saudi adult symptomatic subjects.

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

Statistical analysis Study done in two Khartoum hospitals (Antalya Medical center) (Nilein Medical Diagnostic center) were collected in the period from December 2019 to April 2020.

3-1 Materials:

3-1-1 patient:

A total of 100 subjects were retrospectively investigated for Sudanese patients were included, in both gender. Their age ranged from (20 to 90) years. There were adults. Males and females. MRI scan study of the lumbosacral was performed for all the patients for following indication: back pain, LF lower limb pain or RT lower limb pain.

3-1-2 Area and duration:

The data will be collected in Khartoum state hospital from (Antalya Medical center) (Nilein Medical Diagnostic center) were collected in the period from December 2019 to April 2020.

3-1-3 Equipment:

American GE close machine in Antalya Medical Center and Siemens open machine in Nilien medical diagnostic center.

3-2 Methods:

3-2-1 Technique protocol:

The patient lies supine on the couch with spinal coil extending from the top of the shoulders to the lower costal margin. Longitudinal alignment light lies

in the midline and horizontal alignment light passes through the center of the coil. Sequences: Anatalya center l: sagittal T1, sagittal T2 and axial T2 additional protocol coronal T1, coronal T2 Nilein Medical Diagnostic center: sagittal T1,sagittal T2 and axial T1.

Measurement the length of lower limbs from ASIS to medial malleolus in centimeters.

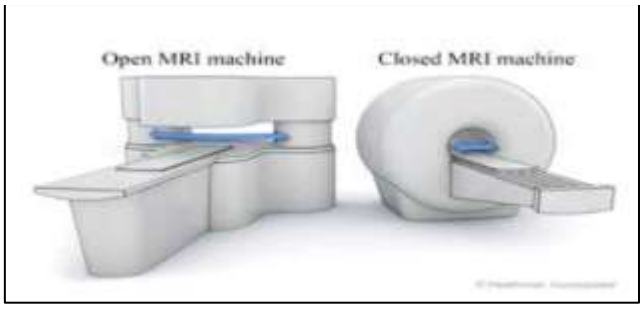


Figure 3.1: open and close MRI machines

3-2-2Interpertation:

This data is entered by **Dr. murtada**

3-2-2 Data collection:

Random samples consist of 100 patients who underwent MRI lumber spine examination. The patients were registered (age, gender, weight, high, lumbar disc prolapse level, lower limbs length, side affected by prolapse, pain radiated, Completety of prolapse).

3.2.3 Data analysis:

Descriptive statistics will used to describe the study variables, using the Statistical Package Software (SPSS) to analyze variables.

Chapter four

Results

Chapter four

Results

Table (4.1) frequency distribution of gender

Gender	N	%
Female	53	53%
Male	47	47%
Total	100	100%

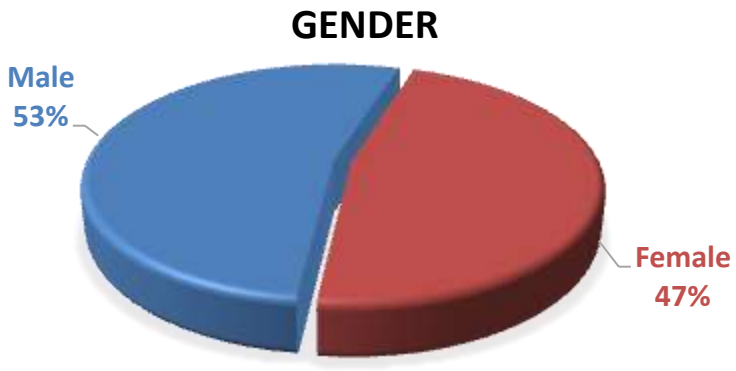


Figure (4.1) frequency distribution of gender

Table (4.2) frequency distribution of age \years

Age Groups	Female		Male		Total	
	N	%	N	%	N	%
20-30	1	2%	5	11%	6	6%
30-40	8	15%	12	26%	20	20%
40-50	13	25%	9	19%	22	22%
50-60	15	28%	10	21%	25	25%
60-70	11	21%	7	15%	18	18%
70-80	5	9%	4	9%	9	9%
Total	53	100%	47	100%	100	100%

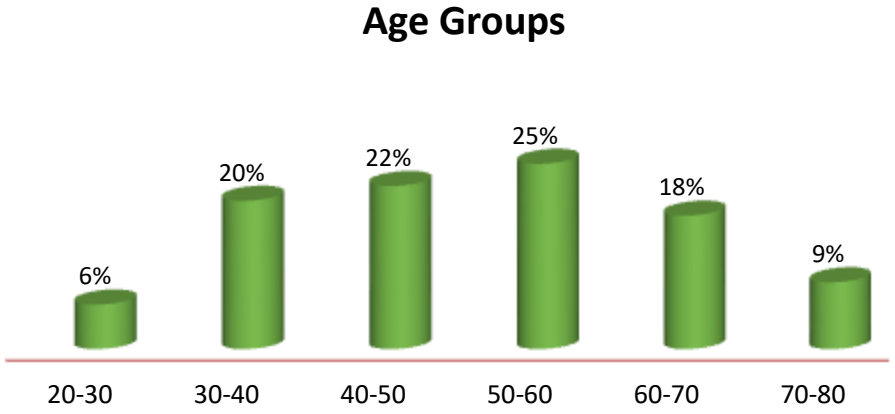


Figure (4.2) total frequency distribution of age \years

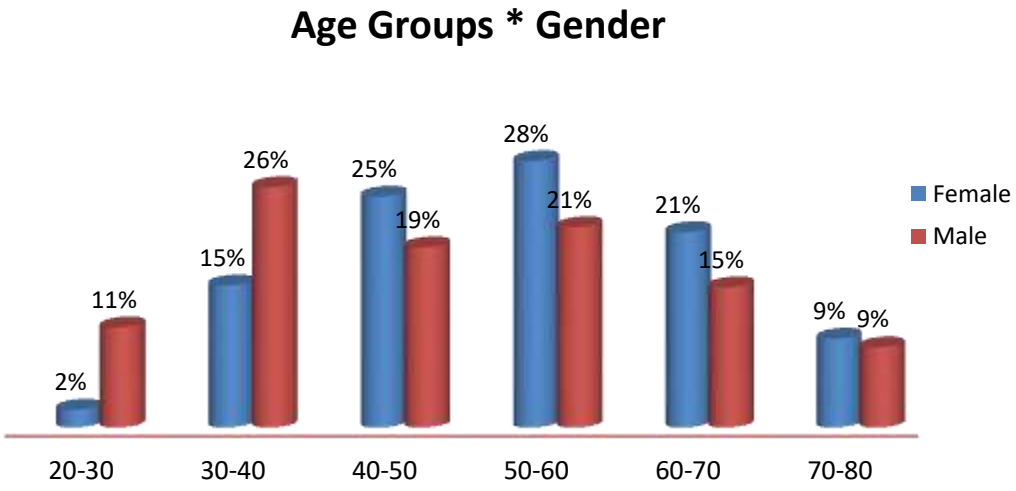


Figure (4.3) frequency distribution of age \years for both gender

Table (4.3) descriptive statistic of age \years and measurements (min, max, mean± Std. Deviation)

	Gender				Total	
	Female		Male			
	Mean	S.E	Mean	S.E	Mean	S.E
Age	51.23	1.74	46.81	2.09	49.15	1.36
high	162.11	1.90	174.17	1.03	167.78	1.27
wieght	77.09	1.49	81.32	1.60	79.08	1.11
RT limb length	91.53	0.80	93.17	1.11	92.3	0.67
LF limb length	91.71	0.81	93.21	1.11	92.42	0.68

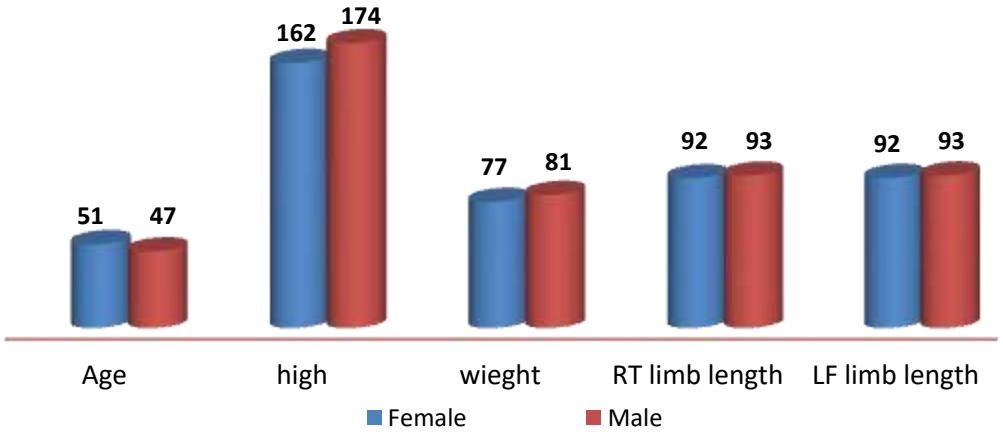


Figure (4.4) descriptive statistic of age \years and measurements (min, max, mean± Std. Deviation)

Table (4.4) frequency distribution of level disc prolapse

LV	N	%
L1&L2	4	4.0
L1&L2+L2&L3+L3&L4+L4&L5+L5&S1	14	14.0
L2&L3	4	4.0
L2&L3+L4&L5+L5&S1	7	7.0
L3&L4	3	3.0
L3&L4+L4&L5	3	3.0
L3&L4+L4&L5+L5&S1	19	19.0
L4&L5	16	16.0
L4&L5+L5&S1	6	6.0
L5&S1	24	24.0
Total	100	100.0

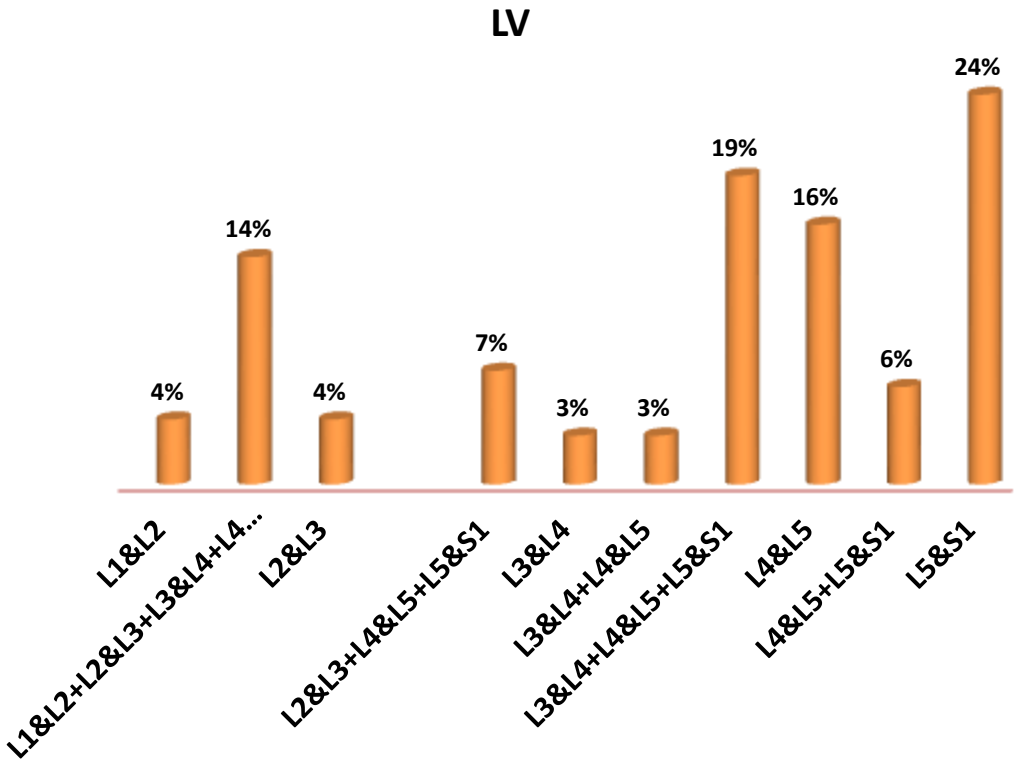


Figure (4.5) frequency distribution of level disc prolapse

Table (4.5) frequency distribution of Severity

Severity	N	%
COMPLETE	39	39%
PARTIAL	37	37%
MILD	24	24%
Total	100	100%

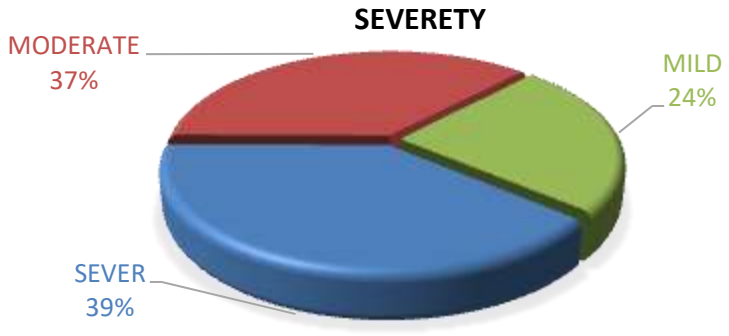


Figure (4.6) frequency distribution of Severity

Table (4.6) frequency distribution of disc side

Disc side	N	%
RT	27	27%
LF	20	20%
CENTRAL	53	53%
Total	100	100%

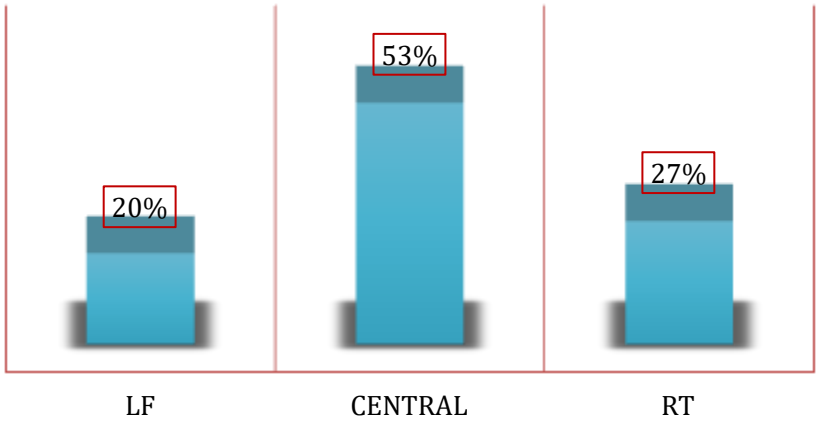


figure (4.7) frequency distribution of disc side

Table (4.7) frequency distribution of pain side

Pain side	N	%
RT	56	56%
LF	33	33%
RT&LF	11	11%
Total	100	100%

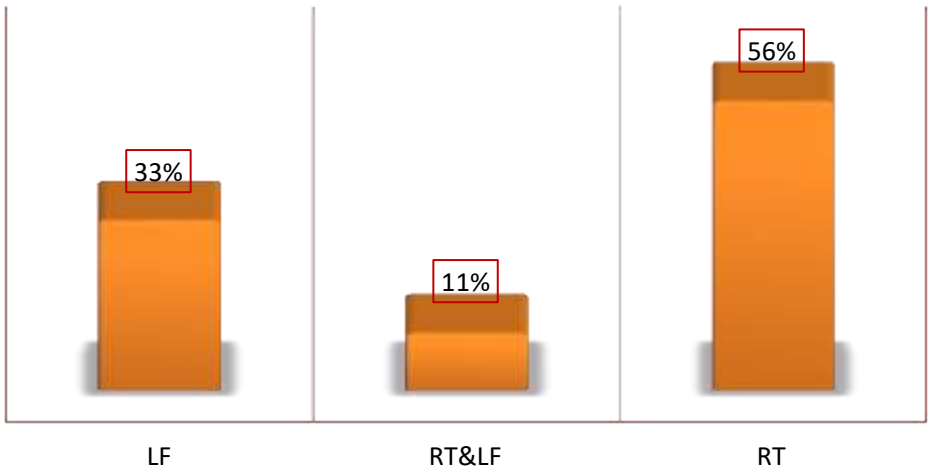


figure (4.8) frequency distribution of pain side

Table (4.8) correlation between RT LL , LF LL and pain side

		pain side			ANOVA Test P-value
		RT	LF	RT&LF	
RT limb length	Mean	93.3	91.8	89.5	0.208
	S.E	1.0	1.0	1.5	
LF limb length	Mean	93.46	91.57	90.18	0.224
	S.E	1.02	.97	1.46	

α=0.05

95% confidence level.

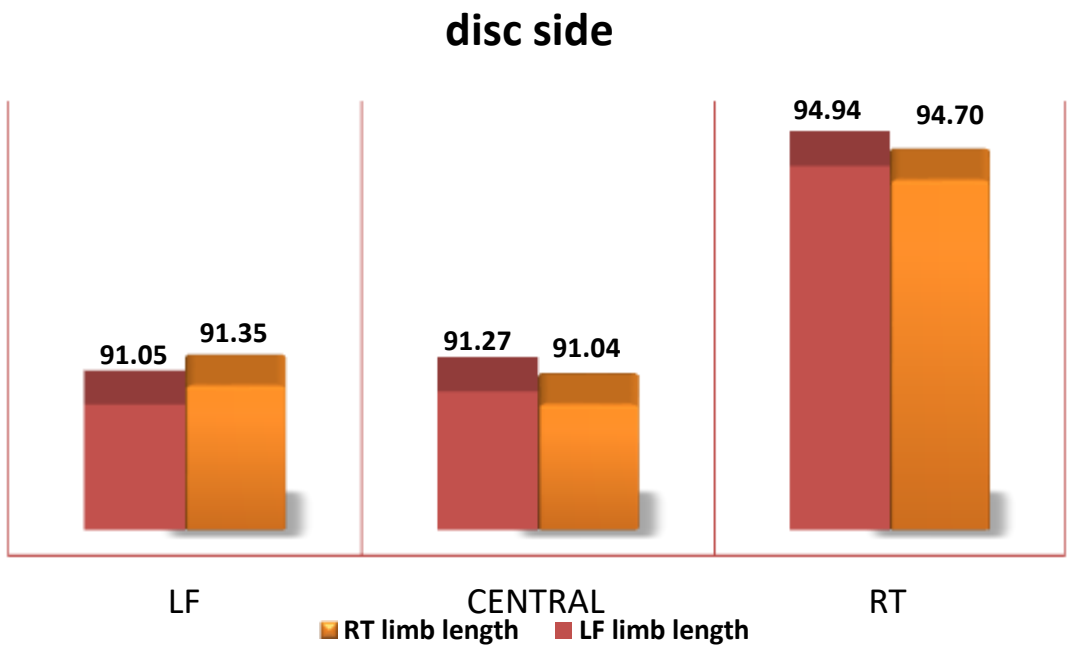


figure (4.9) correlation between RT LL , LF LL and pain side

Table (4.9) the Chi-Square correlation between LV and Severity

LV	Severity						Chi-Square P-value
	COMPLETE		PARTIAL		MILD		
	N	%	N	%	N	%	
L1&L2	2	5%	2	5%	0	0%	0.010
L1&L2+L2&L3+L3&L4+L4&L5+L5&S1	6	15%	8	22%	0	0%	
L2&L3	0	0%	4	11%	0	0%	
L2&L3+L4&L5+L5&S1	1	3%	3	8%	3	13%	
L3&L4	0	0%	0	0%	3	13%	
L3&L4+L4&L5	2	5%	1	3%	0	0%	
L3&L4+L4&L5+L5&S1	11	28%	5	14%	3	13%	
L4&L5	8	21%	2	5%	6	25%	
L4&L5+L5&S1	1	3%	3	8%	2	8%	
L5&S1	8	21%	9	24%	7	29%	

α=0.05,

95% confidence level

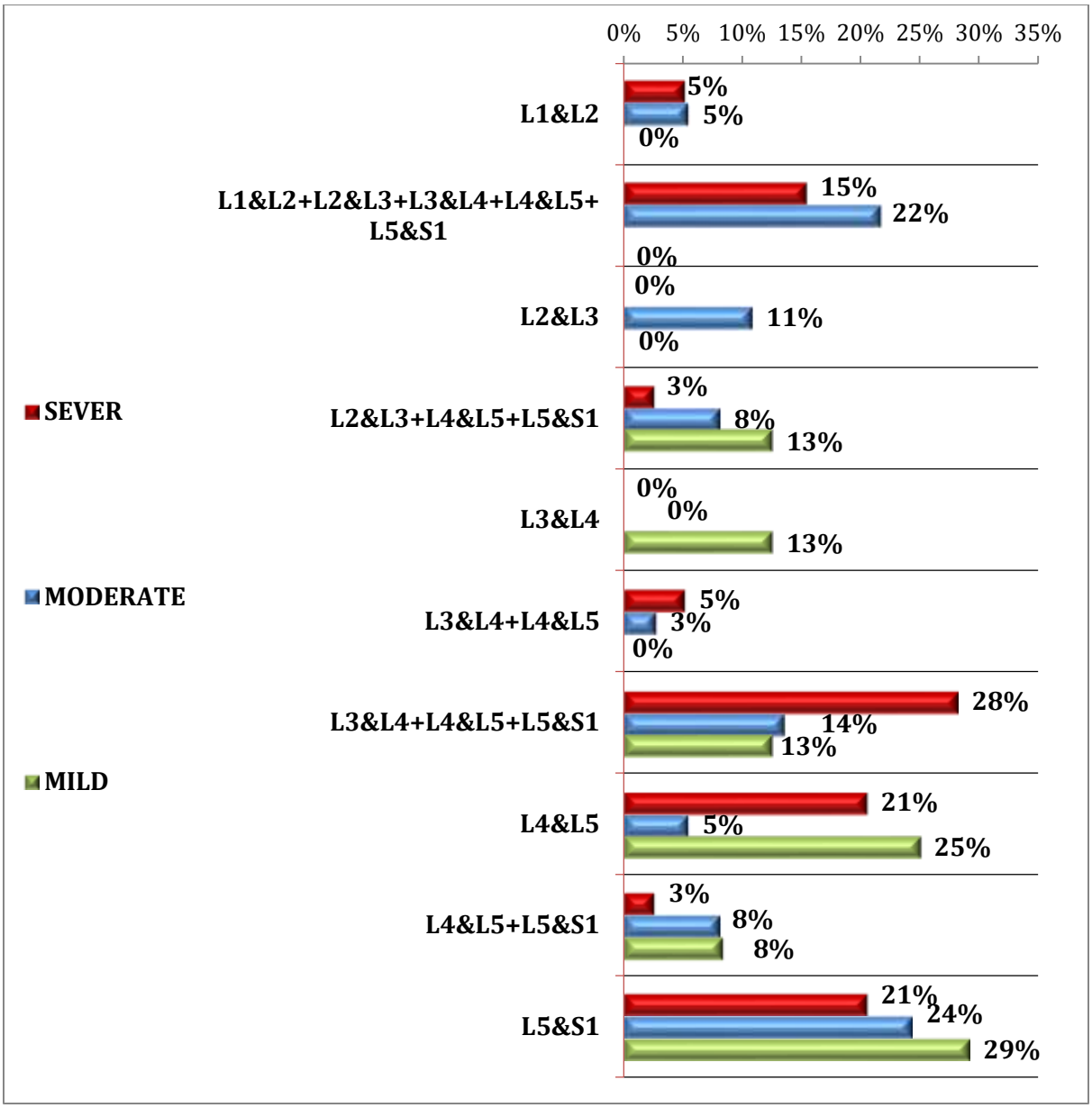
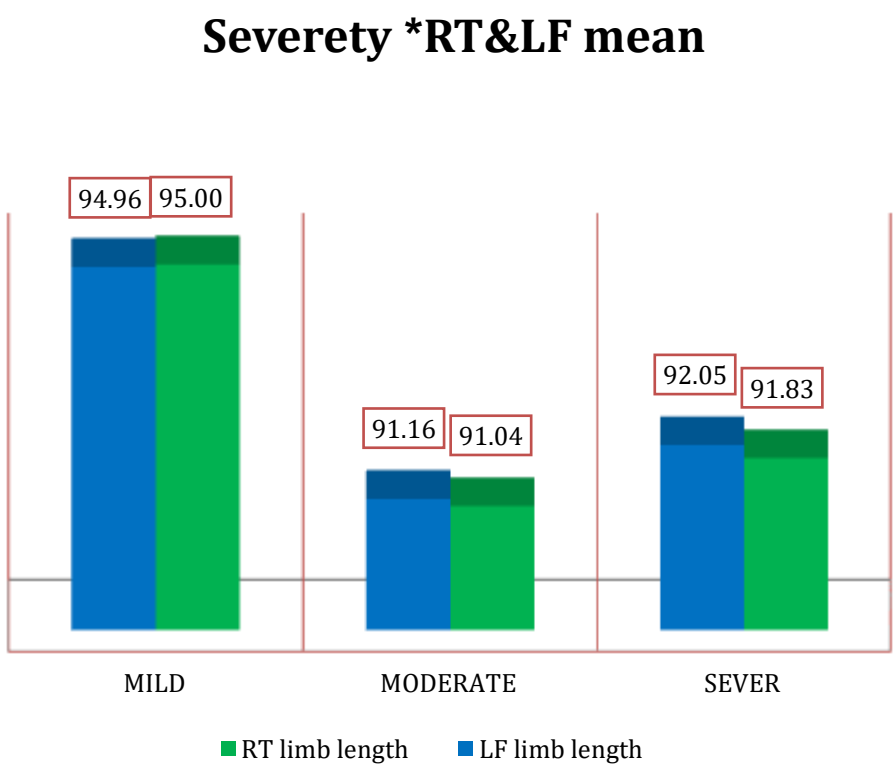


Figure (4.10) correlation between LV and Severity

table (4.10) correlation between LLD and Severity

		Severity			ANOVA Test P-value
		COMPLETE	PARTIAL	MILD	
RT limb length	Mean	91.8	91.0	95.0	0.068
	S.E	.7	1.4	1.2	
LF limb length	Mean	92.05	91.16	94.96	0.091
	S.E	.69	1.45	1.20	

.



Figure(4.11)correlationbetweenLLDand Complete it

Table (4.11): distribution of patients with respect to age

Age	Frequency	per cent
20- 30 years	4	4.0
30-40 years	21	22.0
41-50 years	24	24.0
51-60 years	21	22.0
61-70 years	20	18.0
70-80 years	10	10.0
Total	100	100.0

Table(4.12): distribution of patients with respect to gender

Gender	**Frequency**	**Percent**
Male	56	58.0
Female	44	42.0
Total	**100**	**100.0**

Chapter five

Discussion, conclusion and recommendations

Chapter five

Discussion, conclusion and recommendations

5.1 Discussion:

The study was interesting to correlate LLD and disc prolapse in Sudanese people in different age use MRI.

The study had done over both gander male and female with percentage 47% , 53 % respectively .(table 4.1)

With mean age of 51.23% years ± 1.7% years for female and 46.81 years± 2.09 years for male table (4.3) there age were classified with an interval 10 year as descriptive graph showed in figure (4.2) .

The variables were the mean of age 51.23 years ±1.74 years , high 126.11 cm ±1.90 cm , weight 77.09 kg ±1..49 kg , RT limb length 91.53 cm± 0.80 cm and LT limb length 91.71± cm 0.81 cm for female and mean :age 46.81 years± 2.09 years ,high 174.17 cm ±1.03 cm ,weight 81.32 kg± 1.60 kg ,RT LL 93.17 cm ±1.11 cm LT LL 93.21cm± 1.11cm table (4.3) . with no different were noted between both gander . this were stander measurement of Sudanese .

Also the study had explained :

The level of disc prolapse lumber spine at the level l5 –S1 was the most common percentage 24% ,followed by disc prolapse at level of L3-L4 ,L4-L5 ,L5 –S1 by 19% table (4.4) ,figure(4.5)

The Severity of prolapse presented in this study ,Complete was the most common on 39 % follow by Partial on 37 % and mild on 24% table (4.5) figure (4.6)

The side of disc prolapse presented in RT .LT and central by percentage of 27 % ,20 % and 53% respectively which the central is the most one table (4.6) figure (4.7)

The patient percentage in RT side 65% , and LT side 33% and in both side 11% table (4.7)

There no association between pain side and RT LL or LT LL with 95 % confidence level table (4.8)

There is association between lumbar vertebral level and Severity table (4.9)

Therefore, there's no significant difference between means of RT&LF limb length according to Severity level with a 95% confidence level .

The most common age of prolapse in 41-50 (table 4.11) .this result was agree with the previous studies which stated that The most common feature observed in young patient between(36-55).(AliHassan.2010)

The most common of gender of patients, 58% of patients were males while 42% are female, this result deal with (Gamal Abdel Salam. 2015) disc change are more common in male than female.

The study of Albert ten Brinke agree with this study in the most common level of prolapse in level L5-S1 . and not agree the Brimke study found there is relation ship between LLD and pain radiated short leg .

5.2 Conclusion:

MRI is the effective to demonstrate the disc prolapse in lumber vertebrae, MRI has become an attractive means for a safe, highly accurate, cost-effective diagnosis of lumber vertebrae and respects anatomically how the spinal cord is compressed and reflects the pathological changes within the spinal cord by showing a change in signal intensity of spinal cord.

The level of disc prolapse lumber spine at the level l5 –S1 was the most common ,followed by disc prolapse at level of L3-L4 ,L4-L5 ,L5 –S1 .

follow by Partial on 37 % and mild on 24% table (4.5) figure (4.6)

The side of disc prolapse , the central is the most one .

There is association between lumbar vertebral level and Severity but There is no association between pain side and RT LL or LT LL .

5.3Recommendation:

Future studies must use large sample to support the findings

Technologist must be interpreted how to read MRI images if needed for other sequence or protocols to help the radiologist in evaluation of disc prolapsed in lumber vertebrae MRI.

Requests for MRI lumbar spine must be written by experienced physician with clinical data to aid technologist in selecting proper MRI protocol.

Use more accurate way for measure the length of lower limbs like one film shoot in X-ray.

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www.conciergeradiologist.com

www.mr-tip.com www.wikipedia.org

APPENDICES

Appendix a. Data sheet:

Age	gender	high	weight	RTLL	LTLL	Pain side

Appendix b. Images of research:

Patient have 40 years old suffering from pain in lumber spine image clearly seen the disc prolapsed in L5-S1

Image 1: MRI scan of the lower back showing a prolapsed disc

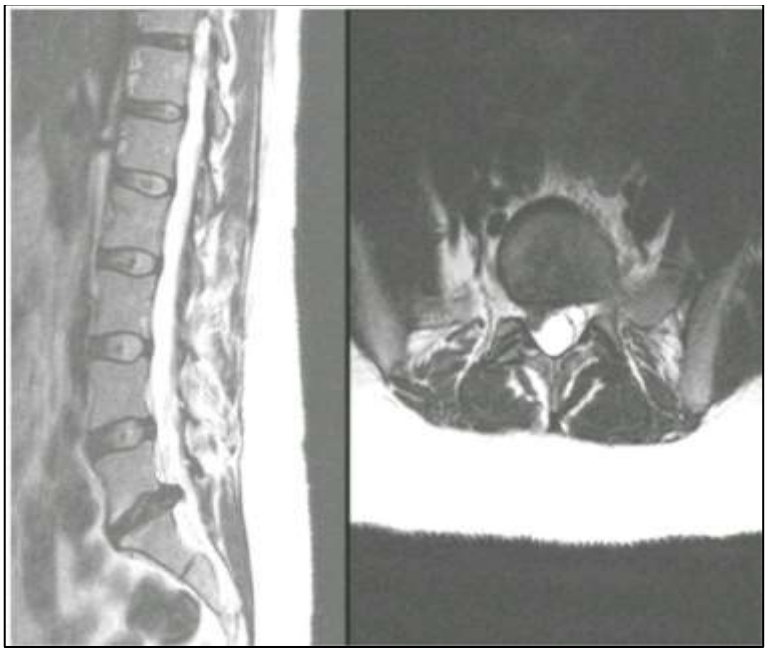

Image 2: sagittal and axial T2 Weighting MRI image with disc prolapse

Image 3: Large L4 disc herniation. Female patient have 45 years old complaining from back pain and the image clearly seen the disc prolapse in L4.