Sudan University of Science & Technology

College of Graduate Studies

Assessment of Degenerative Lumbar Spine Diseases using Magnetic Resonance Imaging

تقييم امراض الفقرات القطنية الانحلالية باستخدام التصوير بالرنين المغناطيسي

A thesis submitted for partial Fulfillment for the requirement of M.Sc. degree in Radiologic Imaging Diagnosis

By:

Sitfatima Alsiddig Abdualrhim Ali

Supervisor:

Dr. Ahmed Mostafa Mohammed Abukonna

December 2016

الآية

قال تعالى:-

﴿ رَبِّ أَوْزِعْنِي أَنْ أَشْكُـــــرَ نِعــــمْتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَى وَالِـــدَيَّ وَأَنْ أَعْمَـلَ صَـــالِحـاً تَــرْضَـــاهُ وَأَصْلِحْ لِي فِي ذُرِّيَّتِي إِنِّي تُبْتُ إِلَيْكَ وَإِنِّي مِنَ الْمُسْلِمِينَ ﴾

سورة الأحقاف

الآية (15)

Dedication

This research dedicated to my parents, husband, brothers, sisters and to my kid.

To all teachers who taught me and to my colleagues

And to everyone help me to complete this research.

Acknowledgement

First and always thank God for enabling me to complete this research. Secondly a great thank to **Dr. Ahmed Abukonna** my teacher and my supervisor .Thirdly a big thanks to all members of MRI centers where my work took place. Finally I continue to be extremely grating full to all those colleagues’ family members who have supported me both professionally and personally and who continue to encourage me.

Abstract

Degenerative lumbar spine diseases continue to be a common public health problem even with modern medicine in the 21 century.

The aim of this study was to assess the degenerative lumbar spine diseases using MRI. This statistical study was conduct at Police hospital center, Khartoum modern center and Antalya medical center during period from September to December 2016. Open and close MRI machine were used and routine lumbar spine was performed. A total of 69 patients (30 male, 39 female) with age range (23-80) who referred to MRI department.

The result of study revealed that the mean and standard deviation of age and weight was 55.62+ 12.064(years) and 81.29 +15.414(kg) respectively. The MRI findings were interpreted independently and correlated with clinical history and examination, findings from patients' records Results. The incidence of patient with osteophytes and degenerative disc disease with neural compression had the highest percentage (31.9%). Disc degeneration on MRI was most frequent at L4-L5 level (56.5%). The incidence of degenerative lumbar spine diseases (DLSD) in male is greater than female.

MRI is the procedure of choice in evaluation of DLSD .but isn't only factor to determine DLSD etiology, for that proper history and clinical examination are very necessary to determine which type of image is need, and also allow the technologist to focus the effort of examination at the proper disc levels.

ملخص البحث

` الأمراض التنكسية في العمود الفقري القطني من مشاكل الصحة العامة و لا تزال شائعة حتى مع الطب الحديث في القرن 21.

الغرض من هذه الدراسة هو تقييم الامراض التنكسية في العمود الفقري القطني باستخدام التصوير بالرنين المغناطيسي. هذه الدراسة هي دراسة إحصائية أجريت في مستشفى الشرطة و مركز أنطاليا والمركز الطبي الحديث خلال الفترة من أيلول / سبتمبر إلى كانون الأول / ديسمبر 2016 . تم تصوير 69 مريض بالرنين المغناطيسي للفقرات القطنية (30 ذكر أنثى 39) مع الفئة العمرية تتراوح بين (23–80).

اظهرت الدراسة أن المتوسط والانحراف المعياري للعمر و الوزن كان 55.62 +12.064(سنوات) و 81.29 +15.414(كغم) على التوالي. التصوير بالرنين المغناطيسي النتائج تفسر بشكل مستقل و حدد ارتباطها بالتاريخ السريري للمرضى. اظهرت الدراسة أن الأمراض التنكسية للقرص مع الضغط علي القناة العصبية أعلى نسبة مئوية (31.9%). تنكس الأقراص أكثر شيوعا في الفقرات القطنية الرابعة و الخامسة بنسبة (56.5%) كما ان نسبة الذكور المصابين اعلي بقليل من نسبة الإناث

أن التصوير بالرنين المغناطيسي هو الإجراء المفضل في تقييم الأمراض التنكسية في العمود الفقري ولكن يجب اضافة الأعراض السريرية و التاريخ المرضي ضروري لتحديد أي نوع من الصورة. كما أن التقني يحتاج تركيز الجهد لمعرفة مستوي الفقرات المصابة .

List of contents

List of figures

List of Tables

Chapter One

1.1 Introduction

The lumbar spine consists of 5 moveable vertebrae numbered L1-L5. The complex anatomy of the lumbar spine is a remarkable combination of these strong vertebrae, multiple bony elements linked by joint capsules, and flexible ligaments/tendons, large muscles, and highly sensitive nerves. It also has a complicated innervation and vascular supply. The lumbar spine is designed to be incredibly strong, protecting the highly sensitive spinal cord and spinal nerve roots. At the same time, it is highly flexible, providing for mobility in many different planes including flexion, extension, side bending, and rotation(Drake et.al,2009).

This characteristic of lumbar spine may be affected by many diseases for example, degenerative lumbar spine disease (DLSD) which includes spondylitis (arthritic) and degenerative disc disease of the lumbar spine with or without neuronal compression or spinal instability. Most degenerative changes in the lumbar spine related to natural aging process, although other causes may include spinal injuries, infections and genetically inherited spinal weakness. Patients with DLSD often present with range of symptoms such as, lumbar back pain, sciatica and claudication.

In terms of investigation the diagnostic techniques of computed tomography (Ct) and magnetic resonance imaging (MRI) have made an important contribution to study of degenerative spine diseases. In particular MRI provide very sensitive examination of degenerative phenomena of lumbar spine, even in initial stage of disease lifetime The MRI clearly demonstrates the neural element and define any area of bony, the ligamentous or discal degeneration and compression .CT scan remain a useful alternative in patients who are unable to tolerate a MRI scan or in whom MRI is contraindicated such as those with pacemakers. CT scan also useful if detailed information about the bone structures is required particularly in patients who undergo instrumented spinal fixation(Keyoumars et.al,2015).

1.2 Problem of study:

The lumbar spine supports most of body weight; any pain caused by DLSD can affect the function of the spine.

1.3 Objectives:

1.3.1 General Objective:

To assess degenerative lumbar spine diseases (DLSD) using MRI.

1.3.2 Specific Objectives:

- MR Imaging characterization of the disc degenerative changes of the lumbar spine.
- To evaluate extent of the involvement of the degenerative disc disease and its sequel.
- To identify the changes associated with the degenerative disc disease.

1.4 Overview of study

This study will be consisting of five chapters. Chapter one will deals with introduction, problem and objectives of the study. Chapter two will highlight the literature review related to title of the study. Chapter three will shows the method and material used in this study. Chapter four will deals with the result and finally chapter five will include the discussion, Conclusions, Recommendations, references and appendices.

Chapter Two

Theoretical Background and Previous Study

2.1 Anatomy

The lumbar spine consists of 5 moveable vertebrae numbered L1-L5. The complex anatomy of the lumbar spine is a remarkable combination of these strong vertebrae, multiple bony elements linked by joint capsules, and flexible ligaments/tendons, large muscles, and highly sensitive nerves. It also has a complicated innervation and vascular supply. The lumbar spine is designed to be incredibly strong, protecting the highly sensitive spinal cord and spinal nerve roots. At the same time, it is highly flexible, providing for mobility in many different planes including flexion, extension, side bending, and rotation (Drake et.al,2009)

2.1.1 Bones

The lumbar vertebrae, numbered L1-L5, have a vertical height that is less than their horizontal diameter. They are composed of the following 3 functional parts:

- The vertebral body, designed to bear weight
- The vertebral (neural) arch, designed to protect the neural elements
- The bony processes (spinous and transverse), which function to increase the efficiency of muscle action

The lumbar vertebral bodies are distinguished from the thoracic bodies by the absence of rib facets. The lumbar vertebral bodies (vertebrae) are the heaviest components, connected together by the intervertebral discs. The size of the vertebral body increases from L1 to L5, indicative of the increasing loads that each lower lumbar vertebra absorbs. Of note, the L5 vertebra has the heaviest body, smallest spinous process, and thickest transverse process (Drake et.al,2009).

The intervertebral discal surface of an adult vertebra contains a ring of cortical bone peripherally termed the epiphysial ring. This ring acts as a growth zone in the young while anchoring the attachment of the annular fibers in adults. A hyaline cartilage plate lies within the confines of this epiphysial ring.

Each vertebral arch is composed of 2 pedicles, 2 laminae, and 7 different bony processes (1 spinous, 4 articular, 2 transverse) (see the following image), joined together by facet joints and ligaments(Drake et.al,2009)

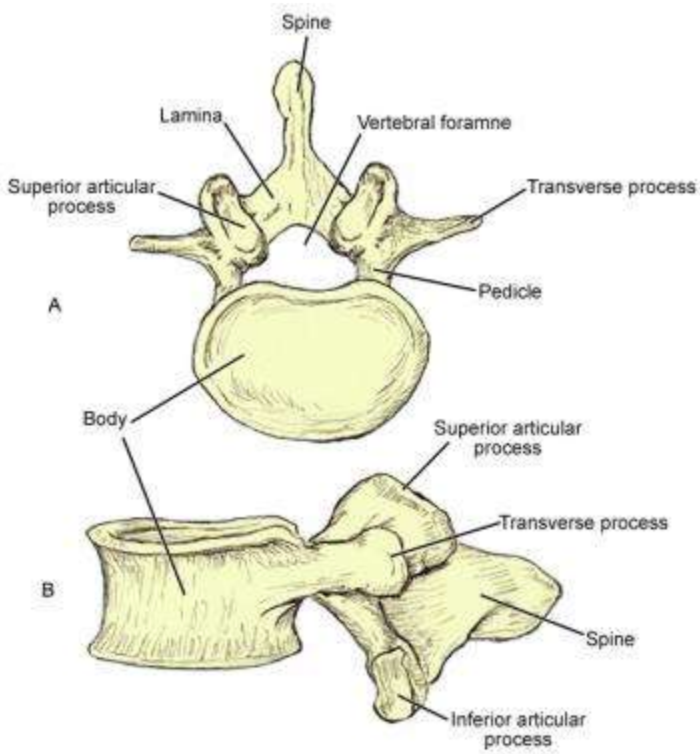


Figure 2-1: Shows Anatomy of lumbar vertebra

Lumbar vertebrae are characterized by massive bodies and robust spinous and transverse processes. Their articular facets are oriented somewhat parasagittal, which is thought to contribute the large range of anteroposterior bending possible between lumbar vertebrae. Lumbar vertebrae also contain small mammillary and accessory processes on their bodies. This bony protuberance is sites of attachment of deep lumbosacral muscles.The pedicle, strong and directed posteriorly, joins the arch to the posterolateral body. It is anchored to the cephalad portion of the body and function as a protective cover for the caudaequina contents. The concavities in the cephalad and caudal surfaces of the pedicle are termed vertebral notches(Drake et.al,2009)

Beneath each lumbar vertebra, a pair of intervertebral (neural) foramina with the same number designations can be found, such that the L1 neural foramina are located just below the L1 vertebra. Each foramen is bounded superiorly and inferiorly by the pedicle, anteriorly by the intervertebral disc and vertebral body, and posteriorly by facet joints. The same numbered spinal nerve root, recurrent meningeal nerves, and radicular blood vessels pass through each foramen. Five lumbar spinal nerve roots are found on each side (Drake et.al, 2009)

The broad and strong laminae are the plates that extend posteromedially from the pedicle. The oblong shaped spinous processes are directed posteriorly from the union of the laminae.Beneath each lumbar vertebra, a pair of intervertebral (neural) foramina with the same number designations can be found, such that the L1 neural foramina are located just below the L1 vertebra. Each foramen is bounded superiorly and inferiorly by the pedicle, anteriorly by the intervertebral disc and vertebral body, and posteriorly by facet joints. The same numbered spinal nerve root, recurrent meningeal nerves, and radicular blood vessels pass through each foramen. Five lumbar spinal nerve roots are found on each side (Drake et.al, 2009).

The broad and strong laminae are the plates that extend posteromedially from the pedicle. The oblong shaped spinous processes are directed posteriorly from the union of the laminae(Drake et.al,2009)

The 2 superior (directed posteromedially) and inferior (directed anterolaterally) articular processes, labeled SAP and IAP, respectively, extend cranially and caudally from the point where the pedicles and laminae join. The facet or zygapophyseal joints are in a parasagittal plane. When viewed in an oblique projection, the outline of the facets and the pars interarticularis appear like the neck of a Scottie dog(Pansky,1996) .

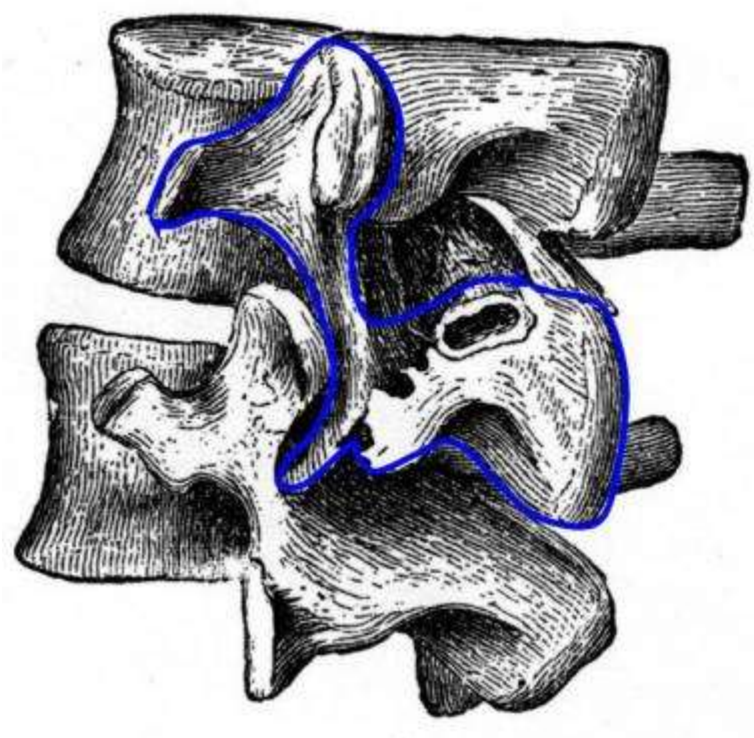


Figure2-2:Showslumbar vertebra on oblique view (Scottie dog) (PanskyB.u,1996)

Drawing of 2 lumbar segments viewed from an oblique angle. The outline of the facets and the pars interarticularis has the appearance of the "neck" of a Scottie dog(Pansky,1996) .

Between the superior and inferior articular processes, 2 transverse processes are projected laterally that are long, slender, and strong. They have an upper tubercle at the junction with the superior articular process (mammillary process) and an inferior tubercle at the base of the process (accessory process). These bony protuberances are sites of attachments of deep back muscles.

The lumbar spine has an anterior, middle, and posterior column that is pertinent for lumbar spine fractures(Drake et.al,2009)

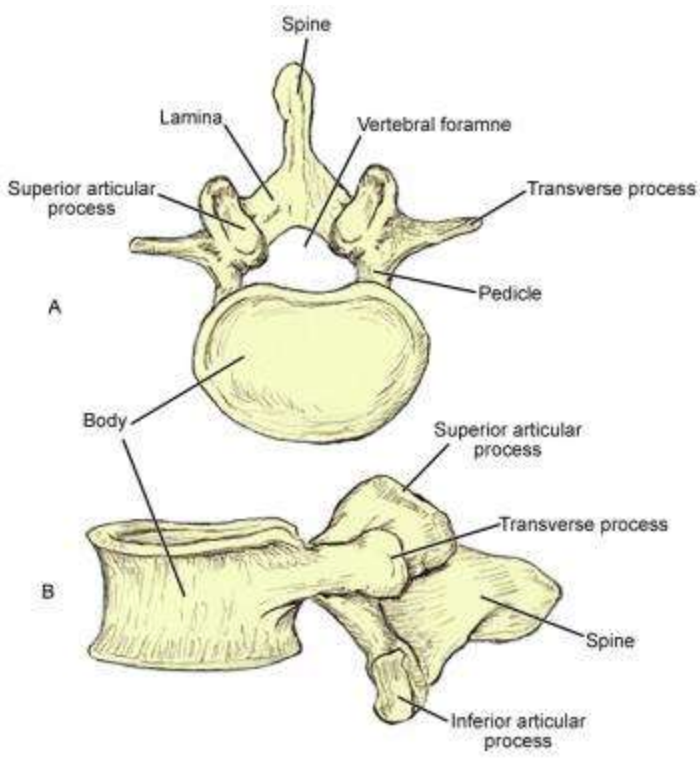


Figure 2-3: Shows Anatomy of a vertebra(Drake et.al,2009) .

The lumbar vertebral bodies (vertebrae) are the heaviest components, connected together by the intervertebral discs. The size of the vertebral body increases from

L1 to L5, indicative of the increasing loads that each lower lumbar vertebra absorbs. Of note, the L5 vertebra has the heaviest body, smallest spinous process, and thickest transverse process. These bony protuberances are sites of attachment of deep lumbosacral muscles(Drake et.al,2009)

2-1-2Lumbar vertebral joints

The mobility of the vertebral column is provided by the symphyseal joints between the vertebral bodies, formed by a layer of hyaline cartilage on each vertebral body and an intervertebral disc between the layers.

The synovial joints between the superior and inferior articular processes on adjacent vertebrae are termed the facet joints (also known as zygapophysial joints or Z-joints *)*. They permit simple gliding movements. The movement of the lumbar spine is largely confined to flexion and extension with a minor degree of rotation (see the image below). The region between the superior articular process and the lamina is the pars interarticularis. A spondylolysisoccurs if ossification of the pars interarticularis fails to occur (Drake et.al,2009)

2-1-3Lumbar intervertebral discs

Discs form the main connection between vertebrae. They bear loading during axial compression and allow movement between the vertebrae. Their size varies depending on the adjacent vertebrae size and comprises approximately one quarter the length of the vertebral column (Drake et.al,2009).

Each disc consists of the nucleus pulposus, a central but slightly posterior mucoid substance embedded with reticular and collagenous fibers, surrounded by the annulus fibrosus, a fibrocartilaginous lamina. The annulus fibrosus can be divided into the outermost, middle, and innermost fibers. The anterior fibers are strengthened by the powerful anterior longitudinal ligament (ALL). The posterior longitudinal ligament (PLL) affords only weak midline reinforcement, especially at L4-5 and L5-S1, as it is a narrow structure attached to the annulus. The anterior and middle fibers of the annulus are most numerous anteriorly and laterally but deficient posteriorly, where most of the fibers are attached to the cartilage plate(Drake et.al,2009)

.

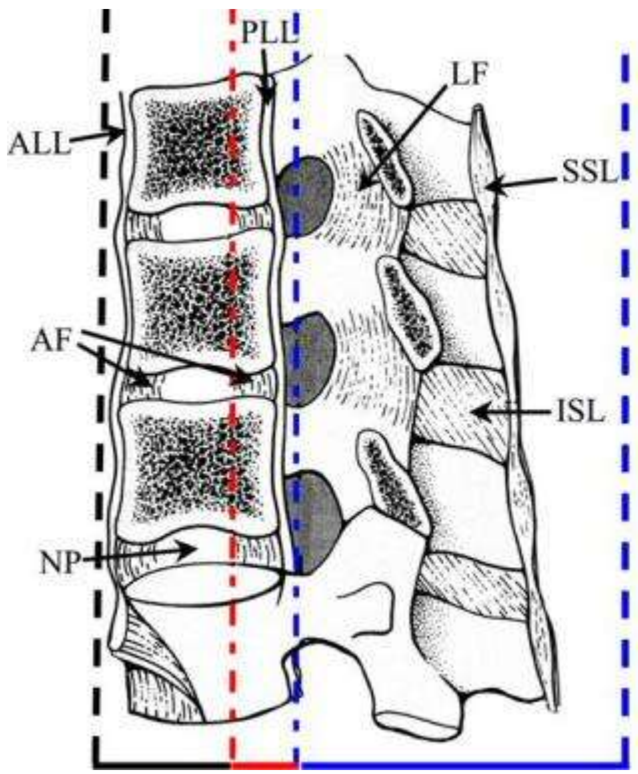


Figure 2-4:ShowsLateral drawing of the 3 spinal columns of the thoracolumbar junction

The anterior column (black dotted line) includes the anterior spinal ligament, the anterior annulus fibrosus (AF), the intervertebral disc, and the anterior two thirds of the vertebral bodies. The middle column (red dotted line) includes the posterior aspect of the vertebral bodies, the posterior annulus fibrosus, and the posterior longitudinal ligament (PLL). The posterior column (thick blue dotted line) includes the entire spine posterior to the longitudinal ligament (thick blue dotted line). ALL = anterior longitudinal ligament; ISL = interspinous ligament; LF = ligamentumflavum; NP = nucleus pulposus; SSL = supraspinous ligament(Drake et.al, 2009).

The annular fibers are firmly attached to the vertebral bodies and are arranged in lamellae. This annular arrangement permits limiting vertebral movements, reinforced by investing ligaments.

2-1-4 Lumbar vertebral ligaments

The ALL covers the ventral surfaces of lumbar vertebral bodies and discs. It is intimately attached to the anterior annular disc fibers and widens as it descends the vertebral column. The ALL maintains the stability of the joints and limits extension(Drake et.al,2009).

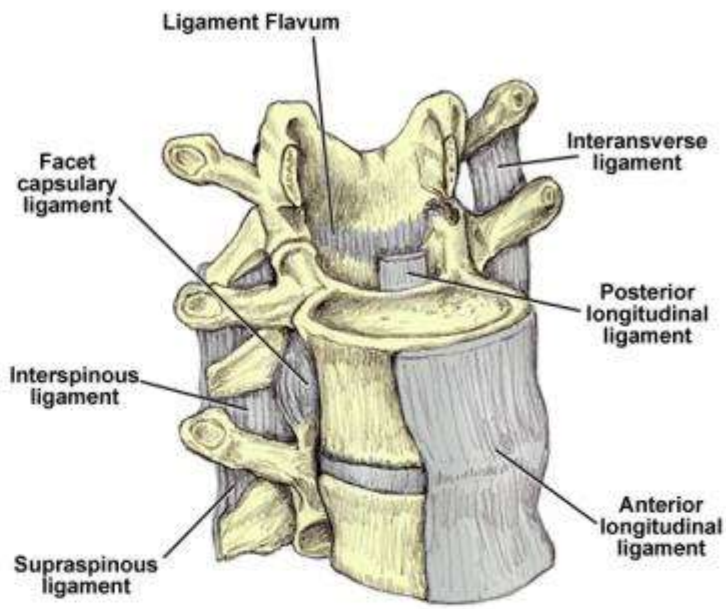
The PLL is located within the vertebral canal over the posterior surface of the vertebral bodies and discs. It functions to limit flexion of the vertebral column, except at the lower L-spine, where it is narrow and weak.

The supraspinous ligament joins the tips of the spinous processes of adjacent vertebrae from L1-L3. The interspinous ligament interconnects the spinous processes, from root to apex of adjacent processes. Sometimes described together as the interspinous/supraspinous ligament complex, they weakly resist spinal separation and flexion (Drake R, Vogl W, Mitchell AVM, Mitchell A. ,2009)

The ligamentumflavum (LF) bridges the interlaminar interval, attaching to the interspinous ligament medially and the facet capsule laterally, forming the posterior wall of the vertebral canal. It has a broad attachment to the undersurface of the superior lamina and inserts onto the leading edge of the inferior lamina.

Normally, the ligament is taut, stretching for flexion and contracting its elastin fibers in neutral or extension. It maintains constant disc tension.
The intertransverse ligament joins the transverse processes of adjacent vertebrae and resists lateral bending of the trunk.

The iliolumbar ligament arises from the tip of the L5 transverse process and connects to the posterior part of the inner lip of the iliac crest. It helps the lateral lumbosacral ligament and the ligaments mentioned above stabilize the lumbosacral joint(Drake et.al,2009).



.

Figure 2-4: Shows Anterolateral view of the lumbar spine demonstrating the multiple ligaments of the lumbar spine.

These ligaments include the following: ligamentumflavum (LF), anterior longitudinal ligament (ALL), posterior longitudinal ligament (PLL), intertransverse ligament, interspinous ligament, supraspinous ligament, and facet capsular ligament(Drake et.al,2009).

2-1-5 Spinal cord

Other than the brain, the spinal cord is one of the 2 anatomic components of the central nervous system (CNS). It is the major reflex center and conduction pathway between the brain and the body. As noted earlier, the spinal cord normally terminates as the conus medullaris within the lumbar spinal canal at the lower margin of the L2 vertebra, although variability of the most caudal extension exists

2-1-6 Lumbar spine musculature

Four functional groups of muscles govern the lumbar spine and can be divided into extensors, flexors, lateral flexors, and rotators. Synergistic muscle action from both the left and right side muscle groups exist during flexion and extension of the L-spine (Haughton, 2009)

2-1-7 Lumbar spine vasculature

2-1-7-1Arterial:

Lumbar vertebrae are contacted anterolaterally by paired lumbar arteries that arise from the aorta, opposite the bodies of L1-L4. Each pair passes anterolaterally around the side of the vertebral body to a position immediately lateral to the intervertebral canal and leads to various branches (Haughton, 2009).

2-1-7-2Venous:

The venous drainage parallels the arterial supply. Venous plexuses are formed by veins along the vertebral column both inside and outside the vertebral canal (internal/epidural and external vertebral venous plexuses). Both plexuses are sparse laterally but dense anteriorly and posteriorly. The large basivertebral veins form within the vertebral bodies, emerge from the foramen on the posterior surfaces of the vertebral bodies, and drain into the internal vertebral venous plexuses, which may form large longitudinal sinuses. The intervertebral veins anastomose with veins from the cord and venous plexuses as they accompany the spinal nerves through the foramen to drain into the lumbar segmental veins (Haughton, 2009)

2-1-8 Cross-sectional anatomy of lumbar spine:

On T1weighted image normal adult(yellow/fatty) bone marrow has" high signal(i.e. it is hyper intense or whitish in color) and c.s.f has a low signal (i.e.it is hypo intense or black in color). Neural tissue such as spinal cord or nerve roots it is intermediate in signal intensity. Cortical bone lacking mobile protons to produce asignal is hypo intense on all pulse sequence. On T2 weighted image bone marrow become lower in signal intensity, C.S.F become hyper intense and neural tissue maintains an intermediate signal intensity (Michael et.al,2004)

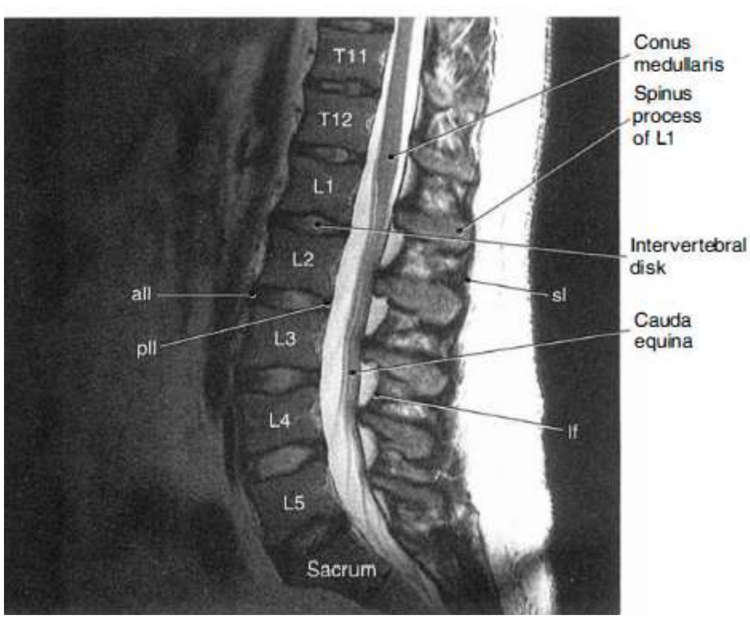


Figure 2.5: Midsagittal T2-wighted MR scan of lumber spine

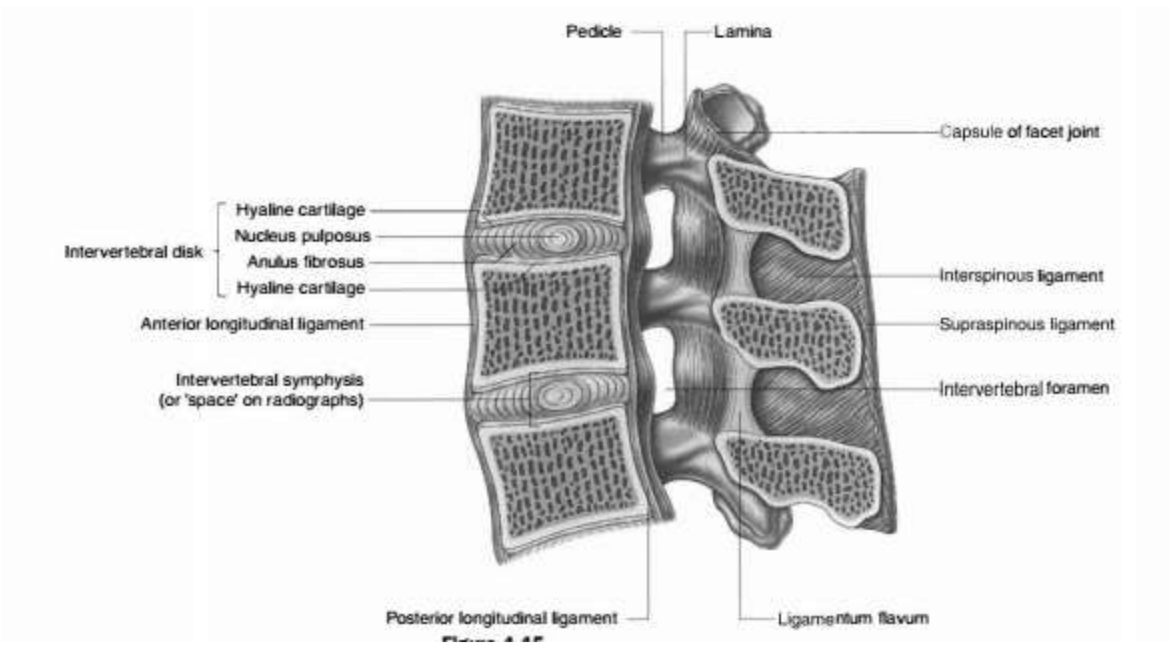


Figure 2.6: Midsagittal view of spinal ligaments.

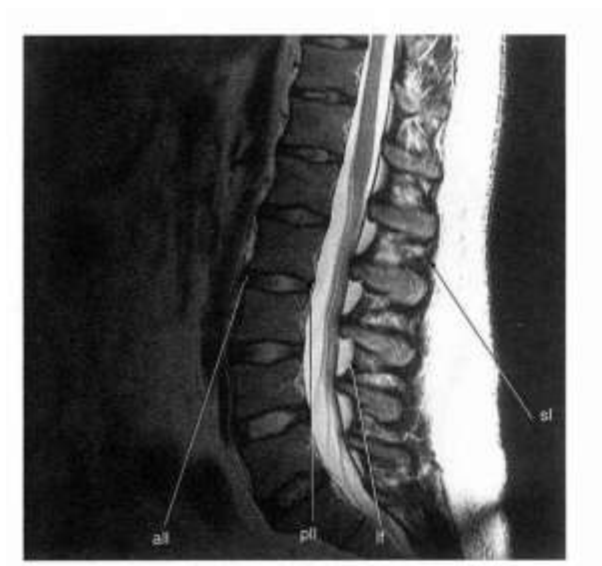


Figure 2.7: Midsagittal, T2-weighted MR scan of lumbar spine demonstrating spinal ligaments.

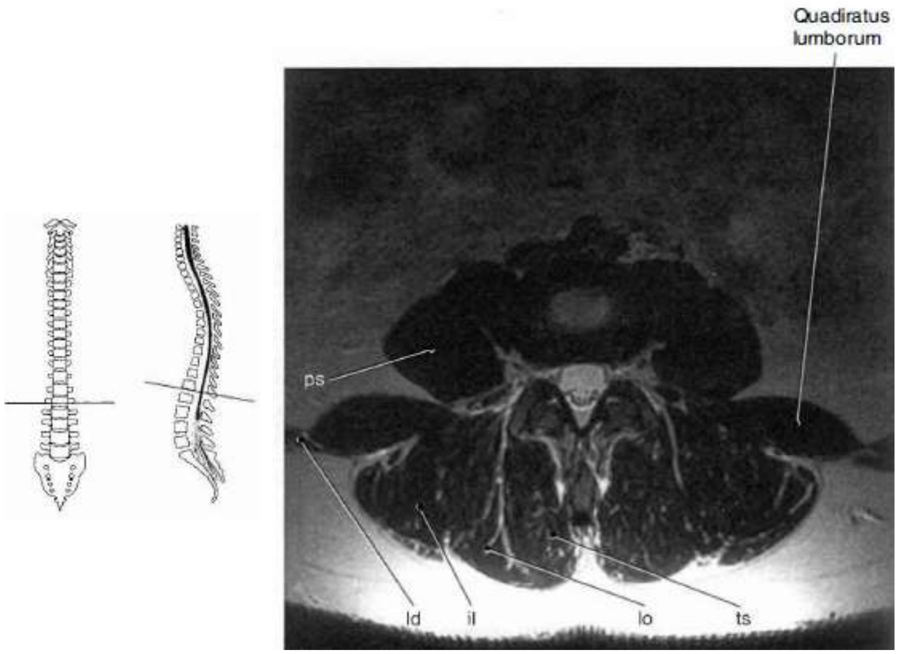


Figure 2.8: Axial, T2-weighted MR scan of lumbar spine with spinal muscles.

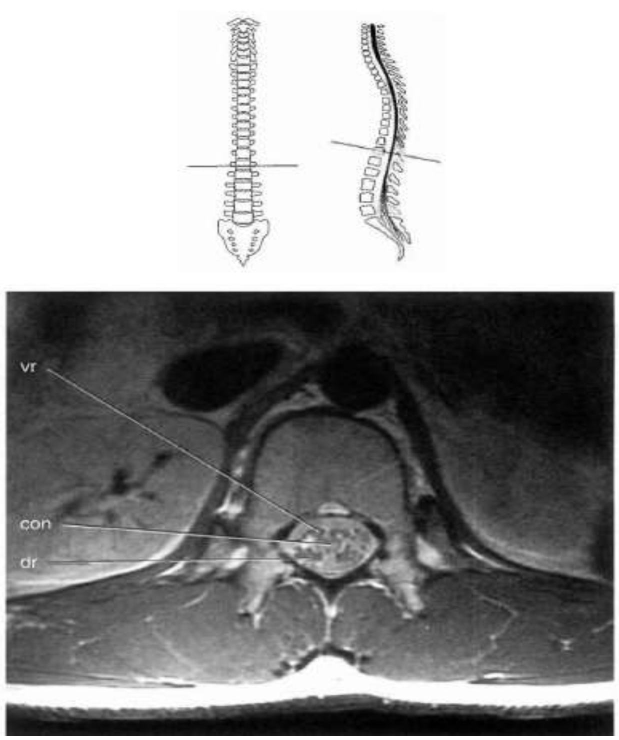


Figure 2.9: Axial, Tl-weighted MR scan of conus medullaris

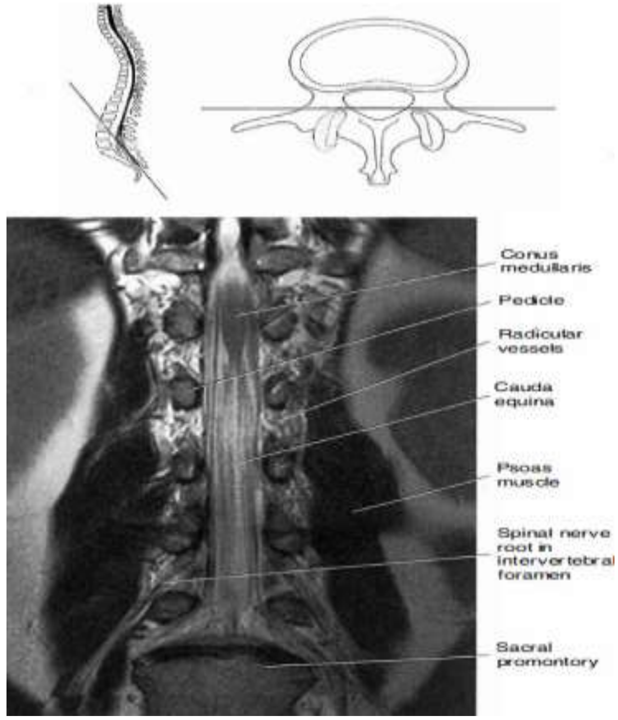


Figure (2.10) Coronal, T2-weighted MR scans of spinal cord with conus medullaris and caudaequina

2.2 Physiology

Lumbar spine is designed to protect the spinal cord, support the body and facilitate movement

2-2-1 Vertebrae

The vertebrae support the majority of the weight imposed on the spine. The body of each vertebra is attached to a bony ring consisting of several parts. A bony projection on either side of the vertebral body called the pedicle supports the arch that protects the spinal canal. The laminae are the parts of the vertebrae that form the back of the bony arch that surrounds and covers the spinal canal. There is a transverse process on either side of the arch where some of the muscles of the spinal column attach to the vertebrae. The spinous process is the bony portion of the vertebral body that can be felt as a series of bumps in the center of a person's neck and back(Haughton, 2009).

2-2-2 Intervertebral Disc

Between the spinal vertebrae are discs, which function as shock absorbers and joints. They are designed to absorb the stresses carried by the spine while allowing the vertebral bodies to move with respect to each other. Each disc consists of a strong outer ring of fibers called the annulus fibrosis, and a soft center called the nucleus pulposus. The outer layer (annulus) helps keep the disc's inner core (nucleus) intact. The annulus is made up of very strong fibers that connect each vertebra together. The nucleus of the disc has a very high water content, which helps maintain its flexibility and shock-absorbing properties(Haughton, 2009).

2-2-3 Facet Joint

The facet joints connect the bony arches of each of the vertebral bodies. There are two facet joints between each pair of vertebrae, one on each side. Facet joints connect each vertebra with those directly above and below it, and are designed to allow the vertebral bodies to rotate with respect to each other (Haughton, 2009).

2-2-4 Neural Foramen

The neural foramen is the opening through which the nerve roots exit the spine and travel to the rest of the body. There are two neural foramen located between each pair of vertebrae, one on each side. The foramen creates a protective passageway for the nerves that carry signals between the spinal cord and the rest of the body (Haughton, 2009).

2-2-6 Spinal cord and nerves

The vertebral column surrounds the spinal cord. It travels within the spinalcanal, a central hole within each vertebra. The spinal cord is part of thecentral nervous system that supplies nerves and receives information fromthe peripheral nervous system within the body. The spinal cord consists ofgrey matter and white matter and a central cavity. Adjacent to each vertebraemerge spinal nerves. The spinal nervous provide sympathetic nervoussupply to the body, with nerves emerging forming the sympathetic trunk andthe splanchnic nerves.The spinal canal follows the different curves of thecolumn; it is large and triangular in those parts of the column which enjoythe greatest freedom of movement, such as the cervical and lumbar regions;and is small and rounded in the thoracic region, where motion is morelimited. The spinal cord terminates in the conusmedullaris and caudaequine(Kathleen et.al, 2005) .

2.3: pathology

In most patients DLSD is the result of "normal" wear and tear associated with the aging process or overuse. Other causes include a congenitally narrowed spinal canal, genetic predisposition to early disc disease, trauma, infection, inflammation and rarer conditions such as ossification of the posterior longitudinal ligament.

2.3.1. Congenital lumbar spine abnormality

2.3.1.1. Spinal stenosis

Spinal stenosis is the narrowing of the spinal canal through which the spinalcord passes. Vertebral foramina enclose the spinal canal. Stenosis canbevery serious if it compromises the spinal cord, resulting in pain, strangeneural sensations, and even paralysis. It can be caused by a number ofconditions, such as a ruptured disk or a dislocation of vertebrae, but here wewill focus on the narrowing of the foramen because of vertebraldegenerationwith aging, the stability of the vertebrae, especially at the facetjoints degenerates. To counter these stresses, the bone in the vertebraethickens and the ligaments become thick and stiff. This results in anarrowing of the spinal canal. Stenosis can occur in the cervical, thoracic,lumbar, or all three regions.Treatment options include physical therapy tostrengthen back and abdominal muscles and increase flexibility. Medicationscan provide relief from mild symptoms. Pain-blocking injections cantemporarily reduce inflammation of the spinal nerves and nerve roots (Gray,1977).

Surgery to remove pressure is usually recommended for patients with severe,persistent symptoms.Laminectomy is the most common surgical techniqueto relieve spinal cord or nerve branch compression due to stenosis. Itinvolves the cutting of the vertebral lamina and the removal of the posteriorportion of the vertebra.In the traditional "open" procedure, the muscles arecut in the approach, increasing recovery time. If done laparoscopically, the muscles are merely pushed aside, reducing recovery (Gray,1977).

2.3.2. Genetic Component of Degeneration

An undeniable genetic component to degenerative disc disease becomes evident when looking at results from twin studies and studies involving mice with a knockout for genes suspected to play a role in disc degeneration (M. Boyd, W. J. Richardson, K. D. Allen et al.,2008) .Among the genes suggested to be involved in DDD, are genes that code for collagens I, IX, and XI, interleukin 1 (IL-1), aggrecan, the vitamin D receptor, matrix metalloproteinase 3 (MMP-3), and other proteins . It is well recognized that DDD is regulated by these and many other genes. Interactions among those genes, which in concert contribute substantially to DDD despite presumably small individual contributions, as well as gene-environment interactions, are very likely (Kalichman and D. J. Hunter,2008) .

2.3.3. Trauma to the spinal column

Fractures occur when internal or external forces on the vertebrae exceedtheir structural strength. Common causes are vehicle accidents, sports,violence, and falls. Fractures can be further classified into two more groups:minor and major.

When a posterior column element, such as the facet joint, is fractured it is"minor" because that structure is not vital to the stability of the spine. On theother hand, if the vertebral body is fractured (middle or anterior column), itis "major" because the stability of the spine may be at risk or damage to thespinal cord may occur. Vertebral body fractures may be further termed a stable or unstable. If a fracture is unstable, the bone fragments can damagethe spinal cord and immediate intervention is necessary (Gray,1977).

2.3.4. Inflammatory spine diseases

2.3.4.1Osteoarthritis (Degenerative Joint Disease)

Osteoarthritis is an extremely common generalizeddisorder characterized pathologically by loss of jointcartilage and reactive new bone formation. Part ofthe wear and tear of the aging process, degenerativejoint disease tends to affect predominantly the weightbearingjoints (spine, hip, knee, ankle) and the interphalangealjoints of the fingers. A secondary formof degenerative joint disease may develop in a jointthat has been repeatedly traumatized or subjected toabnormal stresses because of orthopedic deformities,or it may be a result of a septic or inflammatory arthritisthat destroys cartilage(Ronald et.al,2012)

2.3.5. Infectious spine diseases

2.3.5.1. Arthritis

Pyogenic (pus-forming) organisms may gain entry intoa joint by the hematogenous route, by direct extensionfrom an adjacent focus of osteomyelitis, or from traumato the joint (e.g., after surgery). The onset of bacterialarthritis usually occurs abruptly with a high fever, shakingchills, and one or a few severely tender and swollenjoints. The most common type today is a migratoryarthritis from Lyme disease(Ronald et.al,2012).

2.3.5.2Tuberculous Osteomyelitis

Tuberculous osteomyelitis (which is rare today) mostcommonly involves the thoracic and lumbar spine. Pott'sdisease (tuberculosis of the spine) occurs in the mid-thoracicspine and thoracolumbar region. Irregular, poorlymarginated bone destruction within the vertebral bodyis often associated with a characteristic paravertebralabscess, an accumulation of purulent material that produces
a fusiform soft tissue mass about the vertebra.The spread of tuberculous osteomyelitis causes narrowingof the adjacent intervertebral disk and the extensionof infection and bone destruction across the diskto involve the adjacent vertebral body. Unlike bacterialinfection, tuberculous osteomyelitis is rarely associatedwith periosteal reaction or bone sclerosis(Ronald et.al,2012)

2.3.6.Spinal injury

The spinal cord contains the nerves that carry messages between yourbrain and body. The cord passes through your neck and back. A spinal cordinjury is very serious because it can cause loss of movement (paralysis)below the site of the injury spinal cord injury may be caused by Bullet , stabwound Traumatic injury to the face, neck, head, chest, or back (forexample, a car accident),Diving accident. Electric shock Extreme twisting ofthe middle of the body, Landing on the head during a sports injury,Fallfrom a great height. (American Collage of Surgeons, 1997)

2.3.7lumbar spine tumors :

Spine tumors are examined under two subtitles called primary tumors which originate from the spine itself and its adjacent structures and secondary (metastatic) tumors of distant organs which spread hematogenously and lymphatically and are located in the spine and its surrounding tissues. As the spine is well vascularized and has close relationship with regional lymphatic and venous drainage systems (especially Batson's venous plexus), it is generally susceptible to metastasis. Metastatic tumors are most common (97%) tumors of the spine(Lewandrowski KU, Anderson ME, McLain RF.,2011). It is known that the adenocarcinomas which mostly originate from the lung, breast, prostate, kidney, gastrointestinal tract and thyroid tend to metastasize especially to the spine. It was found that the percentage of cancer patients who have had bone metastasis before death is between 50% and 70%, and especially in case of breast cancer this percentage rose up to 85%. Up to 10% of patients who have symptomatic spine metastases can be treated by surgery . The most common (70%) sites for spine metastasis are thoracic and thoracolumbar spine, and lumbar spine and sacrum have more than 20% of metastatic lesions. Cervical spine is a less frequent metastasis site(Deolet.al,2005) .

As primary tumors of the spine are rare and most of these lesions are asymptomatic, their real incidence is unknown. It is estimated that the incidence of hemangiomas and enostoses, which were accepted as the most common primary tumors of the spine, is between 11% and 14%. This ratio has been found to be dependent on lesions which have been detected incidentally in performing diagnostic procedures for another reasons (Aboulaflia,2002) .

2.3.8Paget's Disease

Paget's disease (osteitisdeformans) is one of the most common chronic metabolic diseases of the skeleton. Destruction of bone, followed by a reparative process, results in weakened,deformed, and thickened bony structures that tend to fracture easily. The disease, seen most commonly during middle life, affects men twice as often as women and has been reported to occur in about 3% of all persons older than 40 years. Although the destructive phase often predominates initially, there is more frequently a combination of destruction and repair in the pelvis and weight-bearing bones of the lower extremities. The reparative processmay begin early and may be the prominent feature, ofteninvolving multiple bones. Paget's disease affectsparticularlythe pelvis, femurs, skull, tibias, vertebrae, clavicles,and ribs(Ronald et.al,2012).

2.3.9.Degenerative lumbar spine disease

As anormalsequel of aging, disc degeneration begins early in life due to lossofhydrationresulting in disc height loss and diffuse bulging[15].Degenerative lumbar spine disease (DLSD) includes spondylotic (arthritic) and degenerative disc disease of the lumbar spine with or without neuronal compression or spinal instability. DLSD is common. Patients with DLSD often present with range of symptoms such as, lumbar back pain ,sciatica and claudication . In symptomatic patients, a significant proportion of symptoms are due to bony, discal or ligamentous compression of neural elements at the spinal canal or nerve root exit foramina. Caudaequina syndrome due to compression of the caudaequina by a herniated central lumbar disc is a specific condition requiring emergency neurosurgical attention.In terms of aetiology, in most patients DLSD is the result of "normal" wear and tear associated with the aging process or overuse. Other causes include a congenitally narrowed spinal canal, genetic predisposition to early disc disease, trauma, infection, inflammation and rarer conditions such as ossification of the posterior longitudinal ligament.(Keyoumars,2015)

2.3.9.1Degenerative disc disease :

As normal sequel of aging .degenerative begin early in life due to loss of hydration result in disc loss and diffuse bulging .the degenerative disc may cause discogenic pain that usually cause pain felt in lower back pain (Sutton David, 2003)

Findings on MRI scan include disc space narrowing, loss of T2 signal within the nucleus pulposus, endplate changes, and signs of internal disc derangement or tears . High Intensity Zones (HIZ) have been found in close to one third of patients undergoing MRIs for low back pain and have been used as amarker for internal disc derangement.

2.3.9.1.1 Degenerative (surgical lesion) :

The loss of disc space height associate with degeneration result in misalignment and alter mechanical stress on the facet joint .In an attempt at stabilization ,facet joint, ligament and bone hypertrophidat adjacent end plat occurs . This together with diffuse canal later recesses and neural foramen (Sutton David, 2003)

2.3.9.1.2 Herniated disc (nucleus pulpous):

A herniated disc occurs when intervertebral disc outer fibers (the annuls are damage and the soft inner material of nucleus pulpous protrude out of it is normal space if the annulus tear near the spinal canal) .

A herniated disc is common on lumbar spine because of all pressure it supports .herniated lumbar disc often produce sciatica a condition where the lower back pain and numbness radiated to back of leg . (Sutton David, 2003)

2.3.9.2 Spondylatic degenerative change:

2.3.9.2.1Spondylosis:

Is incomplete development and formation of the connecting part of the vertebra, the pars interarticularis.

Multilevel spondylosis means that these changes affect multiple vertebrae in the spine. There are several medical terms that sound similar to and are often confused with spondylosis including the following:

Spondylitis is inflammation of one or more vertebrae, such as in ankylosing spondylitis, an inflammatory form of arthritis of the spine. This is a very different process than spondylosis because spondylosis is degenerative while spondylitis is inflammatory (Keyoumars,2015)

2.3.9.2.2 Spondylolisthesis:

Is forward or backward displacement of the body of one vertebrae in relation to an adjacent vertebra. For example, anterior spondylolisthesis of L4 on L5 means that the fourth lumbar vertebra has slipped forward on the fifth lumbar vertebra. As a result, the spine is not normally aligned. If the displaced vertebrae shift with movement of the spine, this is referred to as dynamic spondylolisthesis. Dynamic shifting of the vertebrae is visualized with X-rays of the spine performed with patients flexing (bending forward) and then extending (bending backward) their back(Keyoumars, 2015).

Sagittal plane MRI is best for displaying the abnormal anatomy of spondylolisthesis T2 weighted images for the canal and T1 weighted images for the pars interarticularis and neural foramina . The MRI sagittal view clearly shows the degree of sublaxation and relationship of intervertebral disc to adjacent vertebral bodies and spinal canal.(HarryN.Herkowitz ,2004)

2.3.9.2.3 Spondylosisdeformans

Is growth of bone spurs (osteophytes) or bony bridges around a degenerating intervertebral disc in the spine (Keyoumars,2015) .

Figure (2-11) Sagittal T2W image shows spondylolisthesisof L5 vertebra. Sagittal T2W image shows spondylolisthesis of L5 vertebra. (HarryN.Herkowitz ,2004) .

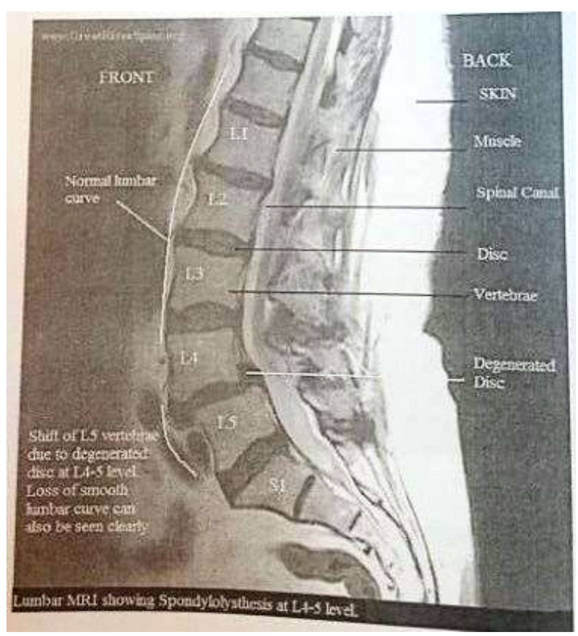


Figure (2-12) T2 sagittal MRI show spondylolisthesis with degenerative disc disease at L4-L5 (S Verma, et al ,2010)

2.3.9.2.4 Spinal Instability

The basic concept behind spinal instability is that there is an excess of motion between two spinal segments that results in pain or compromised neurologic function. The controversy in diagnosis arises, because in the majority of cases, the motion is not demonstrated, but only inferred solely by the presence of pain. We know that pain can be the result of excess motion. Since there is pain, we infer motion. The problem is that pain is often due to other factors and so that inferring that the pain is due to undetectable motion is a stretch. Surgery that is based on such an inference has a poorer success rate than surgery done in cases of demonstrable instability. In my opinion, this circular logic and the subsequent surgical treatments that follow is the main reason that spine surgery has developed such a poor reputation(Sutton David,2003) .

2.3.9.2.5 Diagnosis of degenerative lumbar spine disease

Patients with lumbar disc disease often present with amyriad of symptoms including pain, radicular symptoms, and weakness. LBP may be exacerbated by position and movement. Flexion often worsens the symptoms, while extension will relieve them. An increase in pain with extension may indicate facet arthropathy hen examining patients with presumed lumbar DDD,it is important to exclude other potential known etiologies for their pain. Abdominal pathology including aorticaneurysms, pancreatic disease, and renal calculi must be excluded. Furthermore, it is imperative that patients be questionedregarding other symptoms such as fevers, chills,fatigue, and weight loss, which may be indicative of otherpathology (R. Ricketson, J. W. Simmons, and B. O. Hauser,1996) .

Upright plain radiographs in two planes are the initialimaging study of choice. They aid in ruling out pathologiescauses of back pain and, often supplemented by otherimaging modalities, are evaluated for signs of degeneration.

Findings in degenerative discs include disc space narrowing,endplate sclerosis, “vacuum” phenomenon within the disc,and osteophytes. Flexion and extension views may be helpfulif instability is suspected (Ricketson et.al,1996)

2.4 Magnetic Resonance Imaging (MRI)

Magnetic Resonance Imaging (MRI) has emerged as a non invasivemultiplanar imaging modality with a superior soft tissue contrast resolution which can better define degenerative changes in the lumbar spine.

2.4.1 Equipment

- Posterior spinal coil/multi-coil array spinal coil
- Foam pads to elevate the knees
- Earplugs/headphones(Westbrook, 2014)

2.4.2 Patient positioning

The patient lies supine on the examination couch with their knees elevated over a foam pad, for comfort and to flatten the lumbar curve so that the spine lies nearer to the coil. The coil should extend from the xiphisternum to the bottom of the sacrum for adequate coverage of the lumbar region. The patient is positioned so that the longitudinal alignment light lies in the midline, and the horizontal alignment light passes just below the lower costal margin, which corresponds to the third lumbar vertebra. Depending on the particular coil configuration, the patient may be placed either head first or feet first. If the patient is anxious or claustrophobic, when/if possible, the feet-first position may be better tolerated. (Westbrook, 2014)

2.4.3 Suggested protocol

Sagittal/coronal SE/FSE T1 or coherent GRE T2: Acts as a localizer if three-plane localization is unavailable. The coronal or sagittal planes may be used. Coronal localizer: Medium slices/gaps are prescribed relative to the vertical alignment light, from the posterior aspect of the spinous processes to the anterior border of the vertebral bodies. The area from the conus to the sacrum is included in the image. (Westbrook, 2014)

P 20mm to A 30mm

Sagittal localizer: Medium slices/gaps are prescribed on either side of the longitudinal alignment light, from the left to the right lateral borders of the vertebral bodies. The area from the conus to the sacrum is included in the image. (Westbrook, 2014)

Figure (2-13) Sagittal FSE T1-weighted midline slice through the lumbar spine showing normal appearances (Westbrook, 2014)

Sagittal SE/FSE T1 (Figure 9.13): Thin slices/gaps are prescribed on either side of the longitudinal alignment light, from the left to the right lateral borders of the vertebral bodies (unless the paravertebral region is required). The area from the conus to the sacrum is included in the image. (Westbrook, 2014)

L 22mm to R 22mm

Sagittal SE/FSE T2 or coherent GRE T2: Slice prescription as for sagittal T1.

Axial/oblique SE/FSE T1/T2 or coherent GRE T2: Thin slices/gaps are angled so that they are parallel to each disc space and extend from the lamina below to the lamina above the disc. The lower three lumbar discs are commonly examined. (Westbrook, 2014)

Figure (2-14) Sagittal FSE T2-weighted midline slice through the lumbar spine showing normal appearances. (Westbrook, 2014)

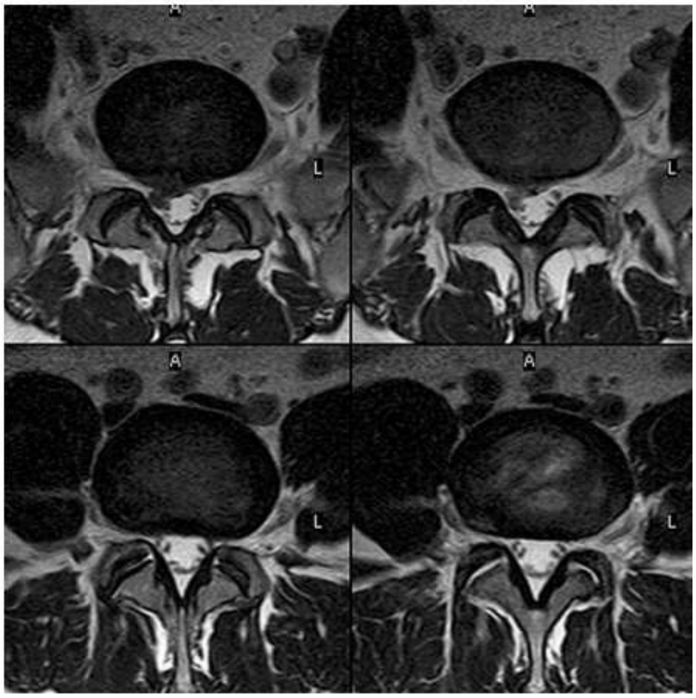


Figure (2-15) Axial/oblique FSE T2-weighted image of the lumbar spine (Westbrook, 2014)

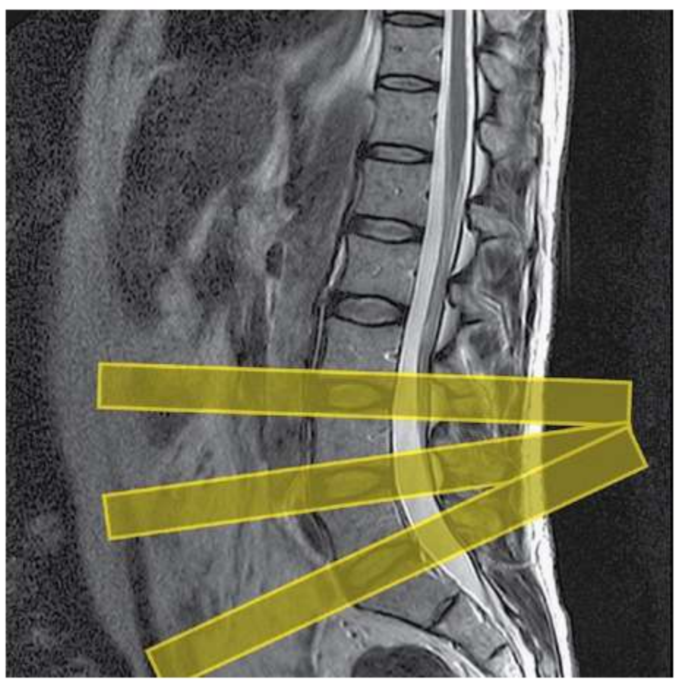


Figure (2-16) Sagittal FSE T2-weighted midline slice showing slice prescription boundaries and orientation for axial/oblique imaging of lumbar discs. (Westbrook, 2014)

2.4.4 Additional sequences

Axial/oblique or sagittal SE/FSE T1: With contrast for determining disc prolapse versus scar tissue in failed back syndrome, and for some tumours. Without contrast in spinal dysraphism. Tissue suppression is beneficial to differentiate between fat and enhancing pathology. (Westbrook, 2014)

Coronal SE/FSE T1: For cord tethering or alternative view of conus when sagittals are inconclusive. (Westbrook, 2014)

Axial/oblique FSE T2: For arachnoiditis. As for axial/obliques, except prescribe one slice through, and parallel to, each disc space and vertebral body from the sacrum to the conus . (Westbrook, 2014)

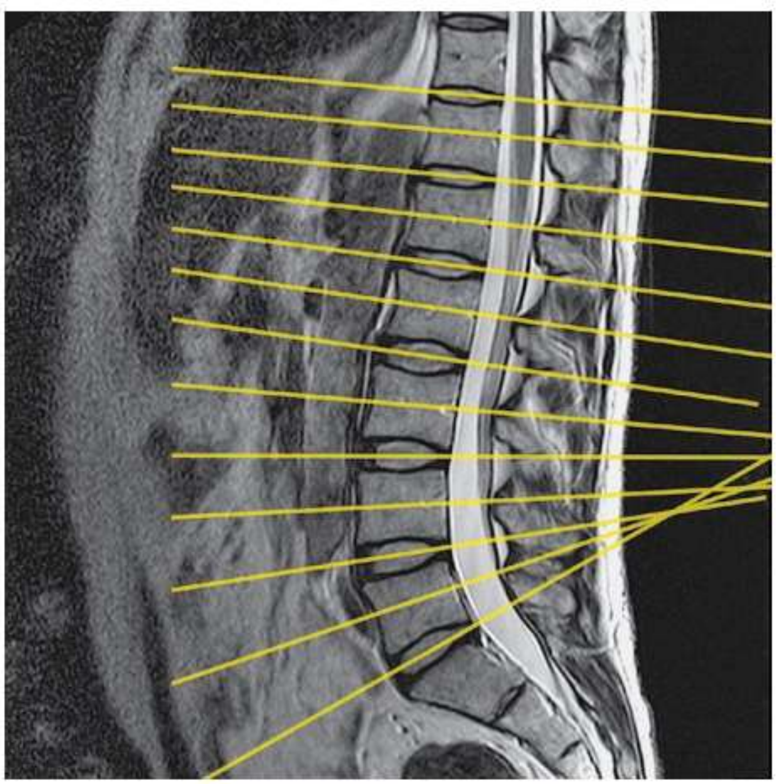


Figure (2-17) Sagittal FSE T2-weighted image of the lumbar spine showing axial/oblique slice prescription for arachnoiditis. (Westbrook, 2014)

STIR: While FSE sequences provide excellent T2-weighted images of the spine, the signal intensity from the normal fat in the marrow of the vertebral bodies is generally high, even with longer TE times. For that reason, marrow pathology, such as tumours or fractures, may not be adequately visualized on T2-weighted FSE sequences. A STIR sequence can be utilized to visualize bone marrow abnormalities better. (Westbrook, 2014)

The T1-weighted FSE shows an acute fracture of the L1 vertebral body. The T2-weighted FSE also shows the fracture, but the majority of the bone marrow signal in the L1 vertebral body appears similar to the other vertebral bodies. The STIR clearly shows the increased signal within the L1 vertebral body consistent with an acute fracture. (Westbrook, 2014)

2.5 Previous study

Megha Jain, ManishaVijaywargiya ,2015(Degenerative changes in Lumbar spine on MRI) A retrospective study The widespread prevalence of patients complaining of backache has resulted in Spine as the most frequently requested neuroimaging examinations. Various imaging modalities like X-ray, myelography, discography and CT scan have been used to study the cause of backache in the past. However with the advent of Magnetic Resonance Imaging (MRI), revolutionary changes have occurred in the study and management of degenerative spinal diseases due to its superior soft tissue contrast resolution and its ability to define the anatomy, underlying pathophysiology and biomechanics of degenerative disc disease. Method: The present study is a MRI based retrospective study, conducted on 100 patients of lower backache segregated on the basis of age and level of lumbar spine involvement. Result: MRI findings suggested that maximum number of patients with complaint of lower backache referred for MRI belonged to 40-60 years age group with most earliest and most frequent degenerative changes found to be in the intervertebral disc with maximum affection at L4-5 level followed by L5-S1 level. Conclusion: MRI has emerged as a non invasive multiplanar imaging modality with a superior soft tissue contrast resolution which can better define degenerative changes in the spine. In our study the earliest and most frequent degenerative changes were found to be in the intervertebral disc with maximum affection at L4-5 level.

Twomeylt, Taylor JR (Age change in lumbar vertebrae and intervertebral disc) Reduction of stature in old age has been attributed to loss of disc height. A measurement study of 204 cadaveric lumbar spines from subjects ranging in age from one day to 97 years confirmed data on loss of "spinal stature" but could not confirm a loss of disc height. With aging, there is a progressive increase in vertebral end-plate concavity, associated with decreased bone density. These changes are more evident and take place earlier in females than in males. In the cancellous bone of vertebral bodies, a decrease in the number of horizontal trabecular "cross braces" leads to fracture of the vertical weight-bearing "beams" supporting the vertebral endplate. The intervertebral discs expand centrally and become increasingly convex. Measurements of average disc height demonstrate that loss of disc height is unusual in a normal, aging population. Only a minority of lower lumbar discs from elderly subjects show "thinning" and degeneration (beyond Rolander's Grade 2). Thus, loss of stature in the elderly is attributable to loss in vertebral height rather than loss in disc height. Dessication and thinning of discs, or discs that "bulge like underinflated automobile tires" are not typical of elderly spines.

FadiTaher, 2012(Lumbar Degenerative Disc Disease: Current and Future Concept of Diagnosis and Management) The primary symptom of DLSD is axial spinal pain. "Back pain" has a prevalence rate of 12 to 35 percent in the Western world with 10 percent of patients becoming chronically disabled, representing a major socio-economic degree burden. The other presenting features of DLSD will depend on the site of the disease, the of neural compression and its rate of development.Central lumbar canal stenosis typically presents chronically and with signs and symptoms of multi-nerve root dysfunction, termed spinal claudication. Thus patients complain of back and progressive leg pain, numbness and heaviness on walking with symptoms resolving at rest or on forward flexion. Intermittent claudication due to vascular insufficiency in the legs is an important differential diagnosis. Acute central lumbar canal stenosis, usually due to a large prolapsed disc, may present with caudaequina syndrome. The red flag signs are: sphincter dysfunction with painless urinary incontinence and reduced anal tone, saddle numbness and bilateral sciatica. This is a neurosurgical emergency warranting urgent referral and treatment to avoid permanent neurological deficits. Lateral compression of a nerve root in the lumbar spine presents with characteristic dermatomal radicular pain, so called "sciatica", with associated lower motor neuron signs and symptoms. In term of diagnosis Magnetic Resonance Imaging (MRI) is a more sensitive maging study for the evaluation of degenerative DLSD. Objective– This study was done to assess the spectrum of pathology of lumbar degenerative disc disease via MRI.

S Verma et.al their study was done to assess the spectrum of pathology of lumbar degenerative disc disease via MRI, to correlateMRI findings withSymptomand assessment of relevance of MRI findings in young adult patients with low backpain.Methods: A retrospective hospital based study was done of 232 patients who underwent lumbar spine MRI for low backpain symptom complex with exclusion of acute spinal infection, recent trauma, tumors, spinal dysraphism and metabolicconditions from the study. The MRI findings were interpreted independently and subsequently correlated with clinical history andexamination findings from patients' records.Results- 26 (11.2%) of the 232 patients in the study group had completely normalMRI findings. 2 patients had zygapophyseal joint arthropathy only with no evident diskal abnormality on MRI. Multiplecontiguous level disc disease was noted in 138 (59.5%) patients, multiple level disc disease with skipped segments was notedin 14(6%) patients, and 52 (22.4%) patients had single level disc involvement. Disc degeneration on MRI was most frequent atL4-L5 level (79.3%) followed by L5-S1 level (68.9%), L3-L4 level (32.8%), L2-L3 level (16.3%) and L1-L2 level (9.5%). Discherniations were most frequent at L4-L5, L5-S1 and L3-L4 levels in decreasing order of frequency. Nerve root compromise wasnoted most frequently at L4-L5 level (56.9%), followed by L5-S1(41.4%) and L3-L4 (19%) levels. Annular tear was most frequentin L4-L5 intervertebral disc (36.2 % cases), followed by L5-S1 (32.8%) , L3-L4 (8.6%) and L2-L3 (3.4%) respectively.

Mavrych V, 2014(Age-Related Changes of Lumbar Vertebral Body Morphometry) .This study was designed to provide a large, accurate database of vertebral body size, focusing on age-related changes along the lumbar spine, and to look for size variations with relation to sex. All lumbar vertebrae (L1-L5) of 212 individuals (0-90 years) were dissected and analyzed by age and sex. A digital caliper was used to measure all vertebral body heights, lengths, and widths. This study showed that the vertebral body size was independent of sex but correlated with the individuals' age. The most intensive growth of vertebral body sizes was found in children 1-7 year-old and the second peak of growth was observed in teenagers 13-16 year-old.

Anterior and posterior vertebral body heights were almost identical for all lumbar vertebrae in newborns and continuously increased through children, teenagers and adult age groups, then slightly decreased in senior persons due to osteopenia. The posterior vertebral body height was smaller than the anterior vertebral body height at L2 through L5 indicating posterior wedging with a peak at L3-L4 (except individuals of the 1st year of postnatal life). The superior vertebral body lengths constantly increased from L1 to L5 and inferior lengths - from L1 to L4, slightly decreased at L5. No significant difference was found between the superior and inferior vertebral body lengths of the same vertebra ($P > 0.05$). The superior vertebral body width typically was smaller than inferior widths of the same vertebra and superior width of adjacent inferior vertebra, resulting in a trapezoidal vertebral body shape in the lumbar spine.

As result of this research, a comprehensive database of vertebral body dimensions was generated from direct measurements of 1060 lumbar vertebrae. These results are invaluable in establishing an anthropometric model of the human lumbar spine.

Chapter Three

Materials and Methods

3.1Materials:

.3.1.1 Subject

This study was conducted at Police hospital center,Khartoum modern center and

Antalya medical center, data were collected in the period from September 2016 to December 2016. A total of 69 patients with clinical symptoms of degenerative lumbar spine diseases Which referred to MRI department.

3.1.2Machines used:

Center	Type of machine	Company	Magnet type	Magnet power	Coils
police hospital center.	Open	Neusoft	Superconductive	0.35	spinal coil
khartoum modern center.	Close	general electric device	Superconductive	1.5	spinal coil
Antalya medical center	Close	general electric device	Superconductive	1.5	spinal coil

3.2 Method:

3.2.1 Patient position

The patient lies supine on the examination couch with their knees elevated over a foam pad, for comfort and to flatten the lumbar curve so that the spine lies nearer to the coil. The coil should extend from the xiphisternum to the bottom of the sacrum for adequate coverage of the lumbarregion. The patient is positioned so that the longitudinal alignment lightlies in the midline, and the horizontal alignment light passes just below thelower costal margin, which corresponds to the third lumbar vertebra

3.2.2 lumbar spine MRI protocol

MRI of lumbar spine was performed with multiplane image. Sagittal/coronal SE/FSE T1 or coherent GRE T2*(Acts as a localizer if three-plane localization is unavailable) , Sagittal SE/FSE T1 (Thin slices/gap are prescribed on either side of the longitudinal alignment light , from the left to the right lateral borders of the vertebral bodies), Sagittal SE/FSE T2 or coherent GRE T2* , Axial/oblique and SE/FSE T1/T2 or coherent GRE . Additional protocol Sagittal SE/FSE T1 With contrast for determining disc prolapse versus scar tissue in failed back syndrome, and for some tumours.

3.2.3. Data analysis

The data collected from the cases of patient and entered to SPSS

3.2.4Evaluation and image interpretations

Cases were evaluated by different consultant radiologist with different experiences and practice.

Chapter four

In this chapter we show the Result of study

Table 4.1: Descriptive statistics of gender distribution among study sample

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	30	43.5	43.5	43.5
	Female	39	56.5	56.5	100.0
	Total	69	100.0	100.0	

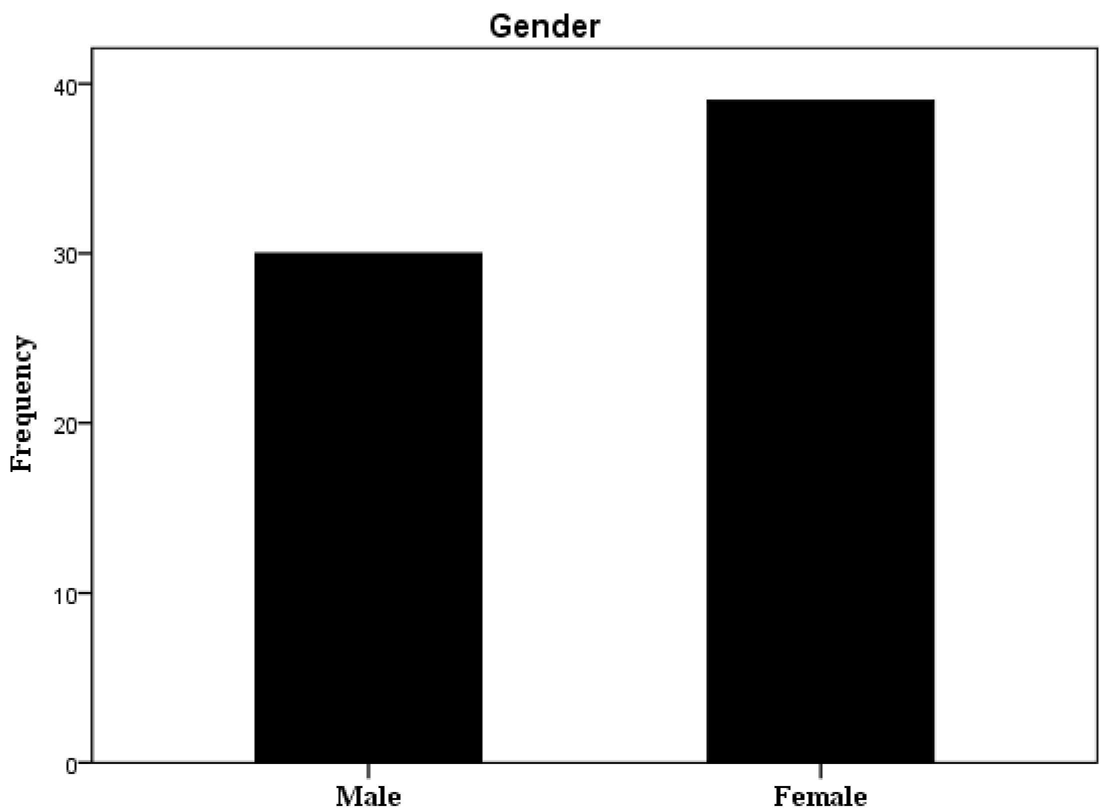


Figure 4-1: frequency of gender distribution among study sample

Table 4.2: Descriptive Statistics Mean, Standard deviation of age group and weight among study sample

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	69	23	80	55.62	12.064
weight	69	53	122	81.29	15.414

Table4.3: Descriptive Statistics Mean, Standard deviation of weight for the total sample

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
weight	Male	30	85.47	17.569	3.208
	Female	39	78.08	12.854	2.058

Table(4.4) frequency and percent of age among study sample

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30 years	2	2.9	2.9	2.9
	31-40 years	5	7.2	7.2	10.1
	41-50 years	15	21.7	21.7	31.9
	51-60 years	23	33.3	33.3	65.2
	61-70 years	18	26.1	26.1	91.3
	71-80 years	6	8.7	8.7	100.0
	Total	69	100.0	100.0	

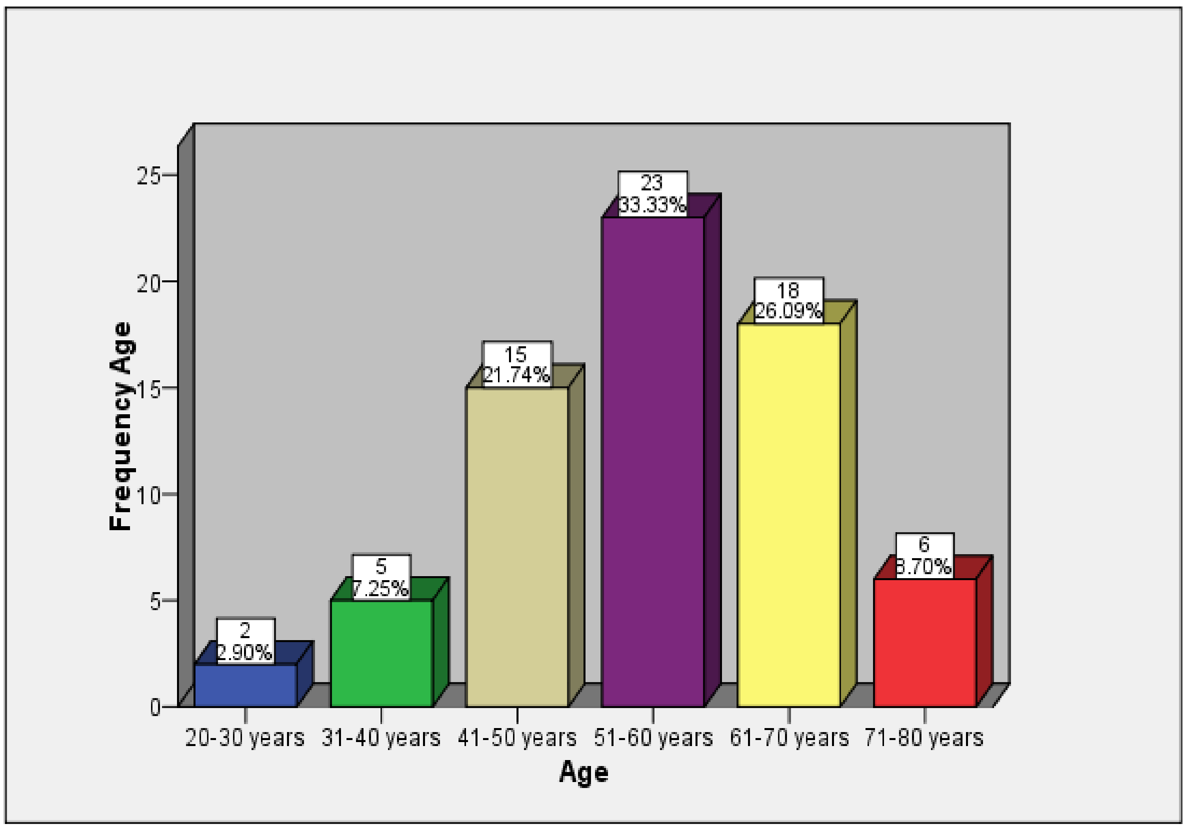


Figure 4.2: frequency and percent of age among study sample

Table (4.5): distribution of symptoms of DLSD for total sample

	Frequency	Percent
LBP	4	5.8
Claudication	1	1.4
LBP, Claudication and Sciatica	56	81.2
LBP and Sciatica	8	11.6
Total	69	100.0

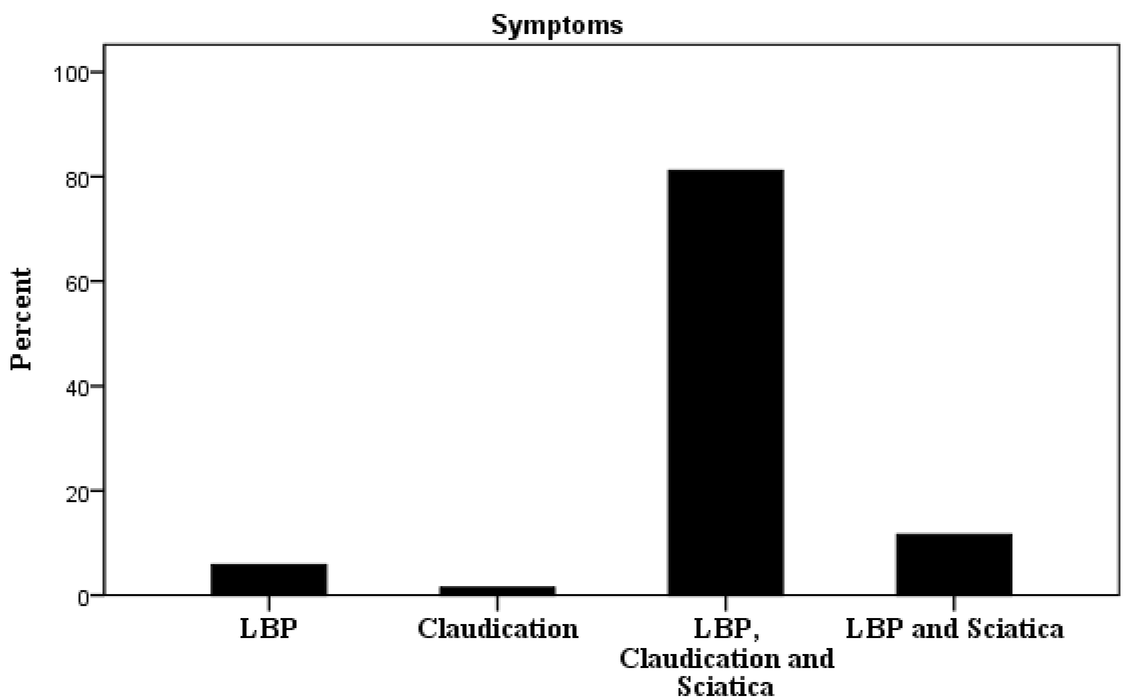


Figure (4.3) distribution of symptoms of DLSD for total sample

Table(4.6): distribution of frequency and percent of incidental MRI finding

Process

	Frequency	Percent	Valid Percent	Cumulative Percent
Osteophytes	6	8.7	8.7	8.7
Degenerative Disc Disease with Neural Compression	27	39.1	39.1	47.8
Disc Herniation	4	5.8	5.8	53.6
Osteophytes&Degenerative Disc Disease with Neural Compression	22	31.9	31.9	85.5
Osteophytes, Degenerative Disc Disease with Neural Compression and LigamentumFlavum Thickening	4	5.8	5.8	91.3
Osteophytes, Degenerative Disc Disease with Neural Compression and Spinal Canal Narrowing	4	5.8	5.8	97.1
Degenerative Disc Disease with Neural Compression and Spinal Canal Narrowing	1	1.4	1.4	98.6
Osteophytes and Spinal Canal Narrowing	1	1.4	1.4	100.0
Total	69	100.0	100.0	

Table 4-7: frequency of disc degeneration:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	L1 - L 2	2	2.9	2.9	2.9
	L3 – L4	25	36.2	36.2	39.1
	L4- L5	39	56.5	56.5	95.7
	Multilevel	3	4.3	4.3	100.0
	Total	69	100.0	100.0	

Figure 4.4 frequency of disc degeneration

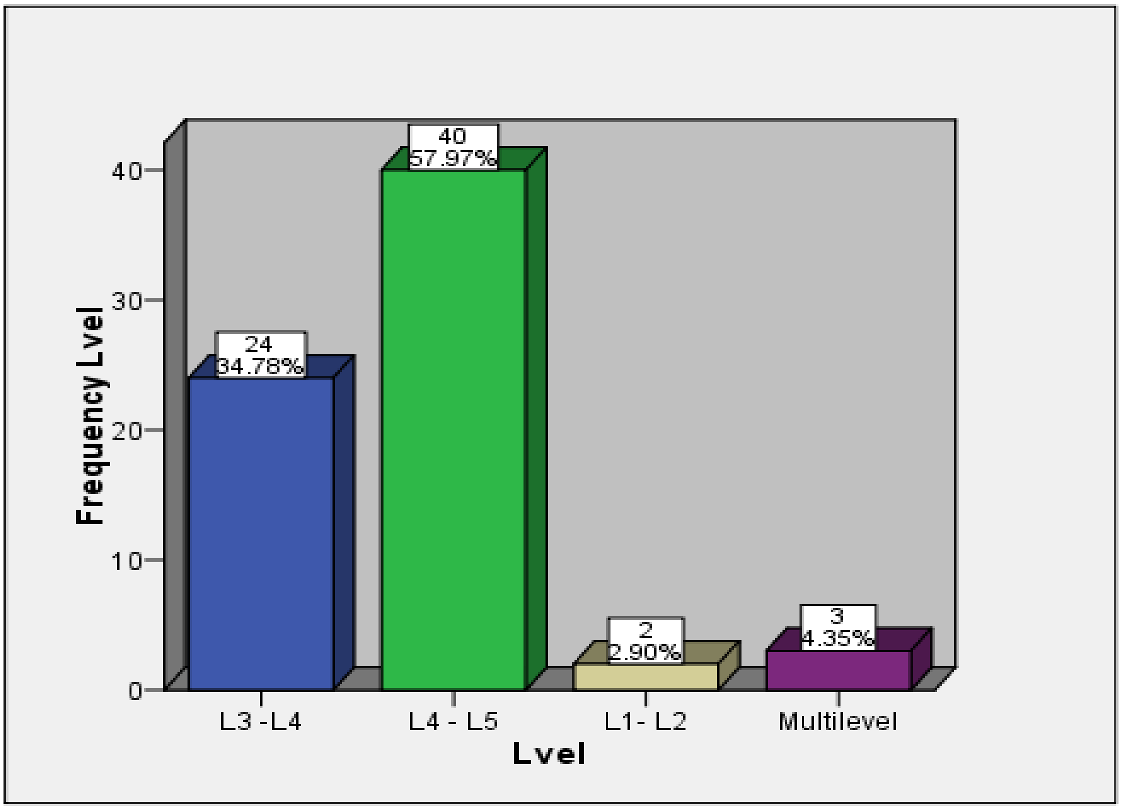


Table 4-8: Gender * Symptoms Crosstabulation

		Symptoms				Total
		LBP	Claudication	LBP, Claudication and Sciatica	LBP and Sciatica	
Male	Count	0	1	24	5	30
	% within Gender	.0%	3.3%	80.0%	16.7%	100.0%
Female	Count	4	0	32	3	39
	% within Gender	10.3%	.0%	82.1%	7.7%	100.0%
Total	Count	4	1	56	8	69
	% within Gender	5.8%	1.4%	81.2%	11.6%	100.0%

Chapter five

5.1 Discussion

Degenerative lumbar spine diseases (DLSD) are the most common medical problem. The aim of this study was to assess of degenerative lumbar spine diseases using MRI .The study conducted on 69 patients who refer to MRI department,30 male and 39 female, their age from 23 to 8o years and weight range from 53 to 122with symptoms of DLSD. The symptoms and MRI finding of DLSD was gathered in data collection sheet for each separate Patient analyzed. The result of this study showed that the incidence of female is greater than male about 56.5% and male 43.5%. The findings of our study were consistent with other studies (Cheung et.al, 2009)

With aging, there is a progressive increase of DLSD;these changes are more evident in age range (51-60) about 33.3%.The incidence of patients with symptoms of LBP, claudication and sciatica has the highest percent(81.2%) this result was quite similar to previous study (Taher, 2012).

The MRI findings were interpreted independently and correlated with clinical history and examination, findings from patients' records Results 6 (8.7%) of the 69patients in the study group had osteophytes and 4 (5.8%)patients had disc herniation without neural compression. degenerative disc disease with neural compression was noted in 27(3.9%) patients ,osteophytes and degenerative disc disease with neural compression had (31.9%) . degenerative disc disease with neural compression and spinal canal narrowing had (5.8%) Osteophytes, degenerative disc disease with Neural Compression and Ligamentum Flavum Thickening had (5.8%) , Degenerative Disc Disease with Neural Compression and Spinal Canal Narrowing had (1.4%) . Osteophytes and Spinal Canal narrowing had(1.4%).

Disc degeneration on MRI was most frequent atL4-L5 level (56.5%) this result was in line with all previous study. From these results there is strong correlation between age and DLSD, as age increase the risk of DLSD increase.

This study shows utility of MRI in detecting of degenerative lumbar spine disease in symptomatic patients with clinical suspicion of disease.

5.2 Conclusion:

Degenerative lumbar spine diseases is the most common cause of low back pain ,claudication and sciatica . Women are more frequently affected to the DLSD than men. Multiple levels of the disc involvement are seen per person. Disc herniation, disc extrusion, narrowing of spinal canal, narrowing of lateral recess, compression of neural foramen, and ligamentum flavum thickening is common at the L4 –L5 disc level. L1- L2 disc involvement and spondylolisthesis are less common. MRI is the standard imaging modality for detecting disc pathology due to its advantage of lack of radiation, multiplanar imaging capability, excellent spinal soft-tissue contrast and precise localization of intervertebral discs changes.

5.3 Recommendations:

- MRI centers should be available for more assessment of degenerative lumbar spine diseases.
- Antero-posterior (AP) and lateral views of the plain X-ray should be performed to visualizing gross anatomic changes in the intervertebral disc.
- MRI should be considered the standard imaging modality for detecting disc pathology due to its advantage of lack of radiation, a non invasive multiplanar imaging modality with a superior soft tissue contrast resolution which can better define degenerative changes in the spine
- Clinical history of the patient should be correlated to MRI findings.
- The researcher shoud increase sample size and variation sample in future study .

(Catherine, 2008)

References

Aboulaflia AJ, Levine AM. Musculoskeletal and Metastatic Tumors. In: Fardon DF, Garfin SR, et al., editors. OKU: Spine 2, Rosemont. American Academy of Orthopaedic Surgeons; 2002. pp. 411–431.transitional lumbosacral vertebrae. Spine (Phila Pa 1976). 2004.

American college of surgeons, Trauma life support programe,6th edition,1997.

Cheung KM, Karppinen J, Chan D, Ho DW, Song YQ, Sham P, et al. Prevalence and pattern of lumbar magnetic resonance imaging changes in a population study of one thousand forty-three individuals. 2009;34(9):934-40

Choi D, Crockard A, Bunger C, Harms J, Kawahara N, Mazel C, Melcher R, Tomita K. Review of metastatic spine tumour classification and indications for surgery: the consensus statement of the Global Spine Tumour Study Group. Eur Spine J. 2010;19:215–222.[PMC free article] [PubMed].

Drake R, Vogl W, Mitchell AVM, Mitchell A. Gray's Anatomy for Medical Students ,New York, NY: Churchill Livingstone, 2nd edition, 2009.

FadiTaher, (Lumbar Degenerative Disc Disease: Current and Future Concept of Diagnosis and Management) Department of Orthopedic Surgery, Spine Service, Hospital for Special Surgery, New York, NY 10021, 2012

Findings In 20 -40 Year Old Patients With Low Back Pain. Experience At A Semi Urban Tertiary Healthcare Centre In Northern India..The Internet Journal of Spine Surgery.2010 Volume 6 Number 1.

Gray, Henry (1977). Gray's Anatomy. New York: Crown Publishers, Inc. p. 34.

Y. Zhang, Z. Sun, J. Liu, and X. Guo, “Advances in susceptibility genetics of intervertebral degenerative disc disease," International Journal of Biological Sciences, vol. 4, no. 5, pp. 283–290, 2008.

Haughton V. Imaging intervertebral disc degeneration. J Bone Joint Surg Am. 2006;88 (Suppl 2):15-20.

kathleen J.W Wilson ,Annewaugh, Anatomy and physiology in Health and illness 8edition 1997.

KeyoumarsAshkan, degenerative lumbar spine disease, londan neurosurgery partnership, 2015 http://www.bupacromwellhospital.com/for-health-professionals/doctors-library/degenerative-lumbar-spine-disease/

Lewandrowski KU, Anderson ME, McLain RF. Tumors of the Spine. In: Herkowitz HN, Garfin SR, Eismont FJ, Bell GR, Balderston RA, et al., editors. Philadelphia: Elsevier Saunders; 2011. pp. 1480–1512.

LORRIE L. KELLEY, SECTIONAL ANATOMY FOR IMAGING PROFESSIONALS, Boise, Idaho, Mosby, Inc., an affiliate of Elsevier Inc. publication second edition,2007 .

Mavrych V, Austian journal of anatomy (Age-Related Changes of Lumbar Vertebral Body Morphometry) ,Austianpublushing group 2014.

Megha Jain, ManishaVijaywargiya(Degenerative changes in Lumbar spine on MRI)http://medresearch.in/index.php/IJMRR/article/view/627

Pansky B. Review of Gross Anatomy.. New York, NY: McGraw-Hill Medical, 6th edition 1996.

Physiology of lumbar spine. Element of spine http://neurospineinstitute.org/spinal-procedures/spine-anatomy-physiology/

R. Ricketson, J. W. Simmons, and B. O. Hauser, “The prolapsed intervertebral disc: the high-intensity zone with discography correlation,” Spine, vol. 21, no. 23, pp. 2758–2762, 1996.

Ronald L. Eisenberg. MD. JD. FACR ,COMPREHENSIVE RADIOGRAPHIC PATHOLOGY, Boston, Massachusetts Mosby, Inc., an affiliate of Elsevier Inc. FIFTH EDITION , 2012

Standring, S. ,Gray's anatomy: the anatomical basis of clinical practice, Elsevier Health Science , 2015

Sutton David, Text book of radiology and imaging , volume 2 chulhill,seven edition,2003 .

Twomeylt, Taylor JR ,2015 (Age change in lumbar vertebrae and intervertebral disc) https://www.ncbi.nlm.nih.gov/pubmed/3665259

Westbrook, (2014). Handbook of MRI Technique. United Kingdom: Wiley.

Appendix

Image (1) Sagittal T2W and TIW images shows posterior annular tear of L4-. L5 intervertebral disc with posterior protrusion. Bilateral zygapophyseal joint degenerative arthropathy noted.

Image (2) T2W axial image shows posterior annular tear of L4-. L5 intervertebral disc with posterior protrusion. Bilateral zygapophyseal joint degenerative arthropathy noted.

Image (3) Sagittal T2W image show spondyolisthesis of L5 vertebra with posterior disc protrusion.

Image (4) Sagittal T2W image shows herniated disc compression cauda equineat L3-L4 adspondyolisthesis of L5 vertebra.

Image (5) T2W axial image shows posterior annular tear of L4- L5 intervertebral disc with posterior protrusion.
YHJNHFY

Image (6) Sagittal T2W and TIW images of same patient Bilateral zygapophyseal joint degenerative arthropathynotedreveal Mo