



# Physiotherapy in Spondylolisthesis



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## TABLE

# DIFFERENTIAL DIAGNOSIS FOR LUMBAR BACK PAIN

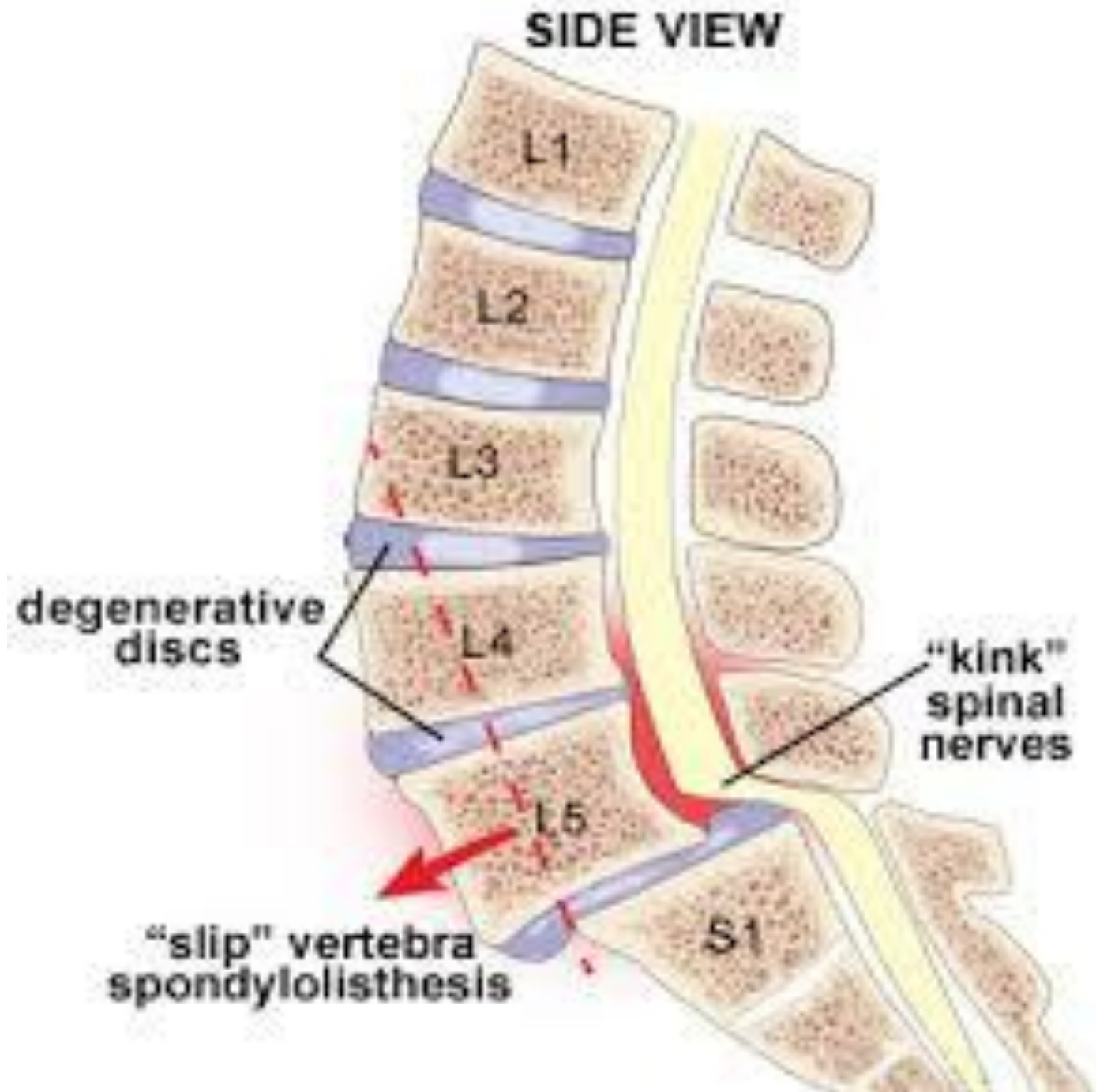
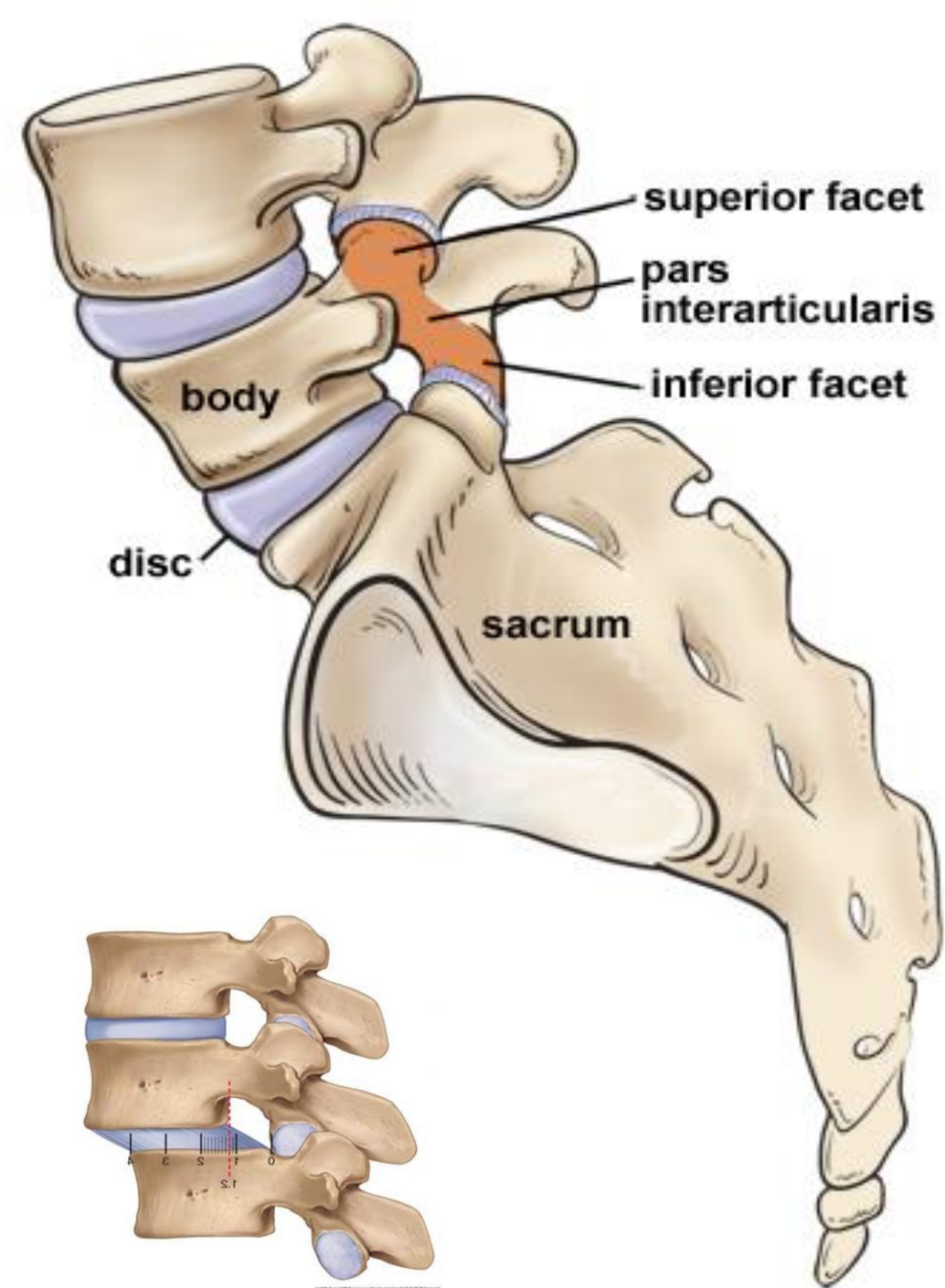
- Mechanical (muscular) pain
- Sacroiliac dysfunction
- Lumbar disk herniation
- Tumor
- Spondylolysis
- Spondylolisthesis

Adapted from Kraft DE.<sup>1</sup>

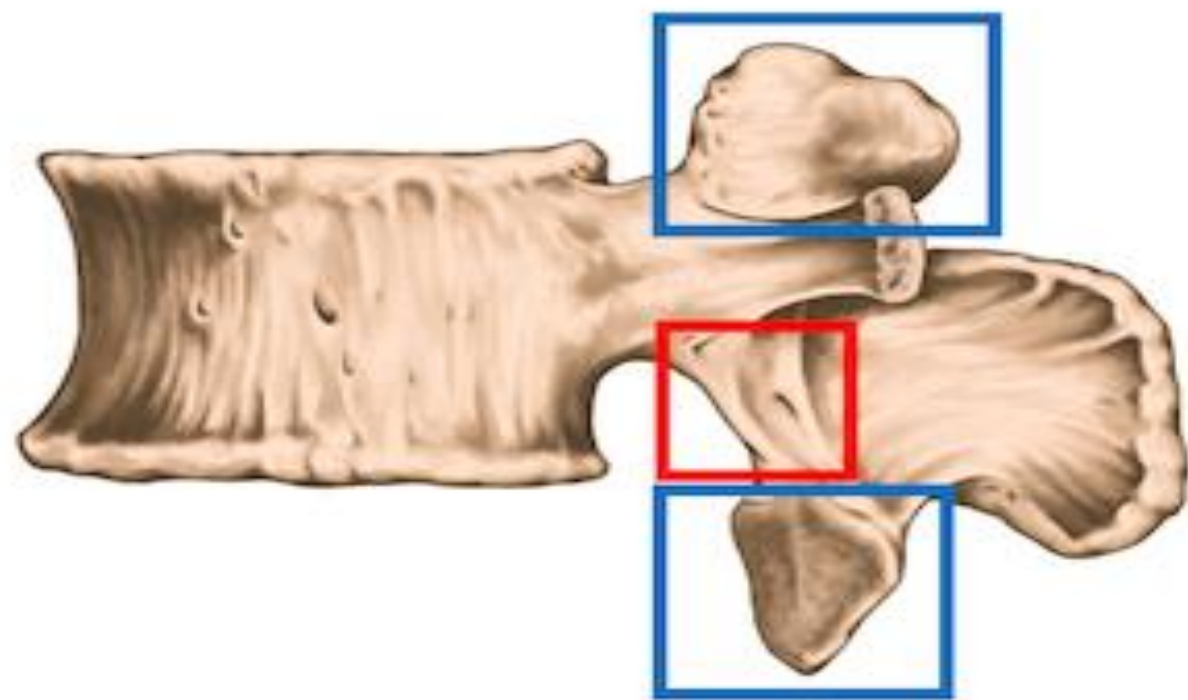
## Systems-Based Approach to Acute Low Back Pain

Intrinsic Spine	Systemic	Referred
<ul style="list-style-type: none"> <li>- Lumbar strain</li> <li>- Herniated nucleus pulposus</li> <li>- Compression fracture</li> <li>- Spinal stenosis</li> <li>- Spondylolisthesis, spondylolysis, spondylosis</li> </ul>	<ul style="list-style-type: none"> <li>- Inflammatory spondyloarthropathy</li> <li>- Connective tissue disease</li> <li>- Malignancy</li> <li>- Vertebral discitis/osteomyelitis</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Vascular</b> - abdominal aortic aneurysm</li> <li>- <b>GI</b> – pancreatitis, PUD, cholecystitis</li> <li>- <b>Neurologic</b> - herpes zoster</li> <li>- <b>Pelvic</b> – endometriosis, PID, prostatitis</li> <li>- <b>Retroperitoneal</b> – renal colic, pyelonephritis</li> </ul>

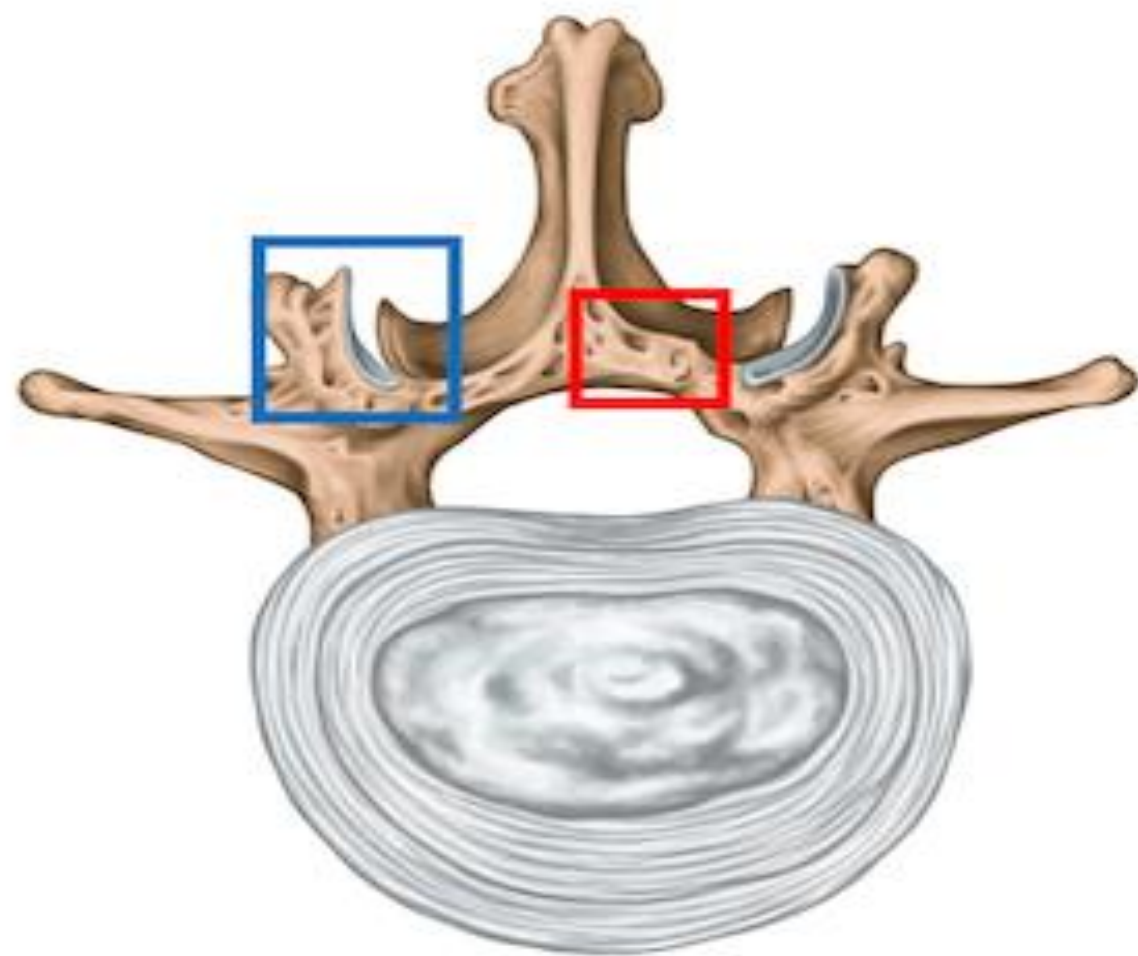
Casazza BA, *Am Fam Physician* 2012 15;85(4):343-350.





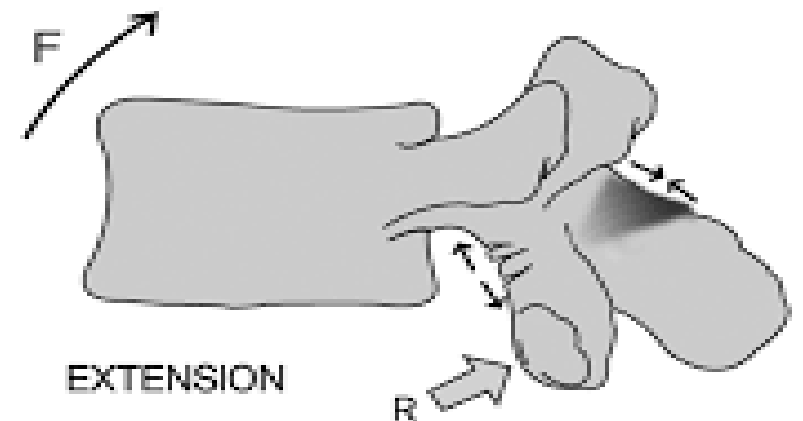
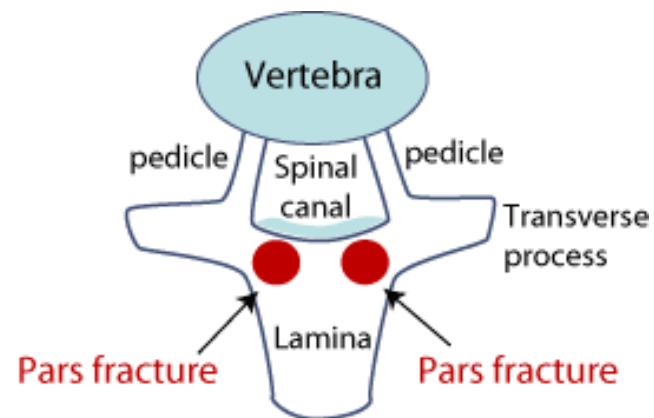
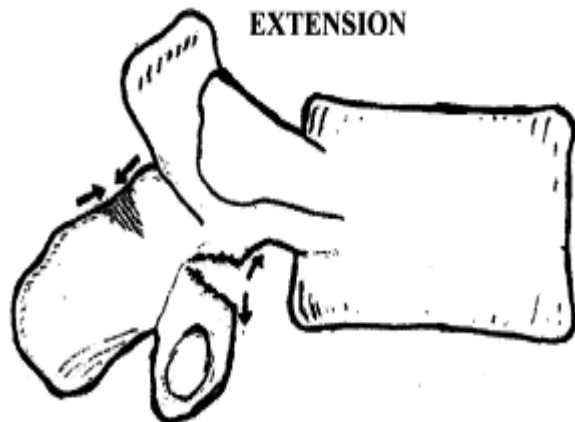
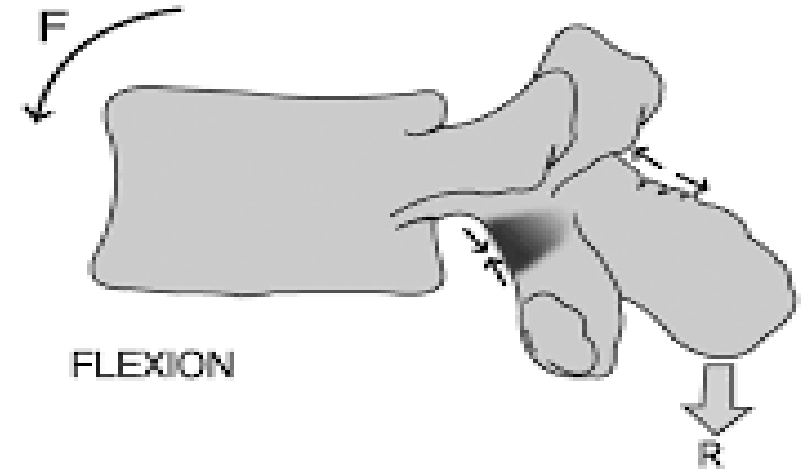
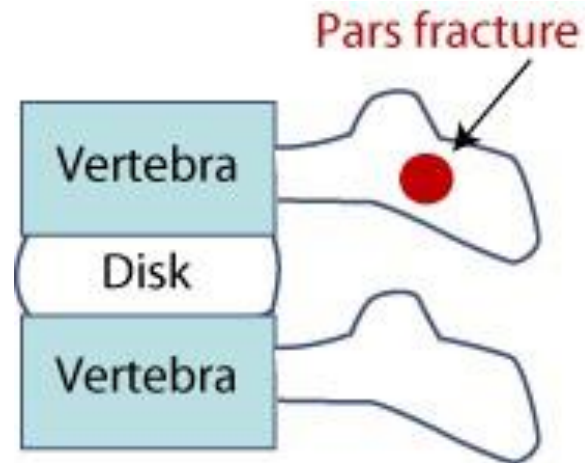
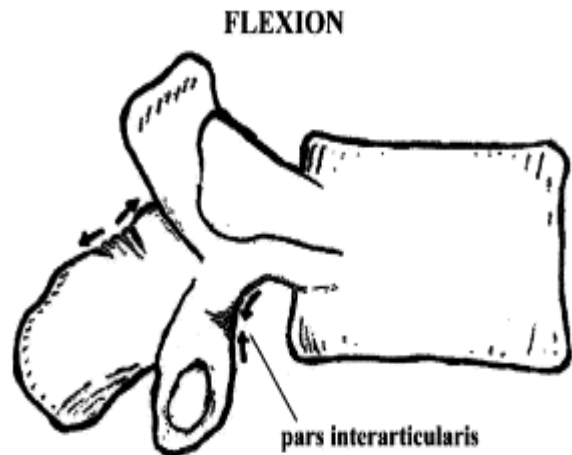


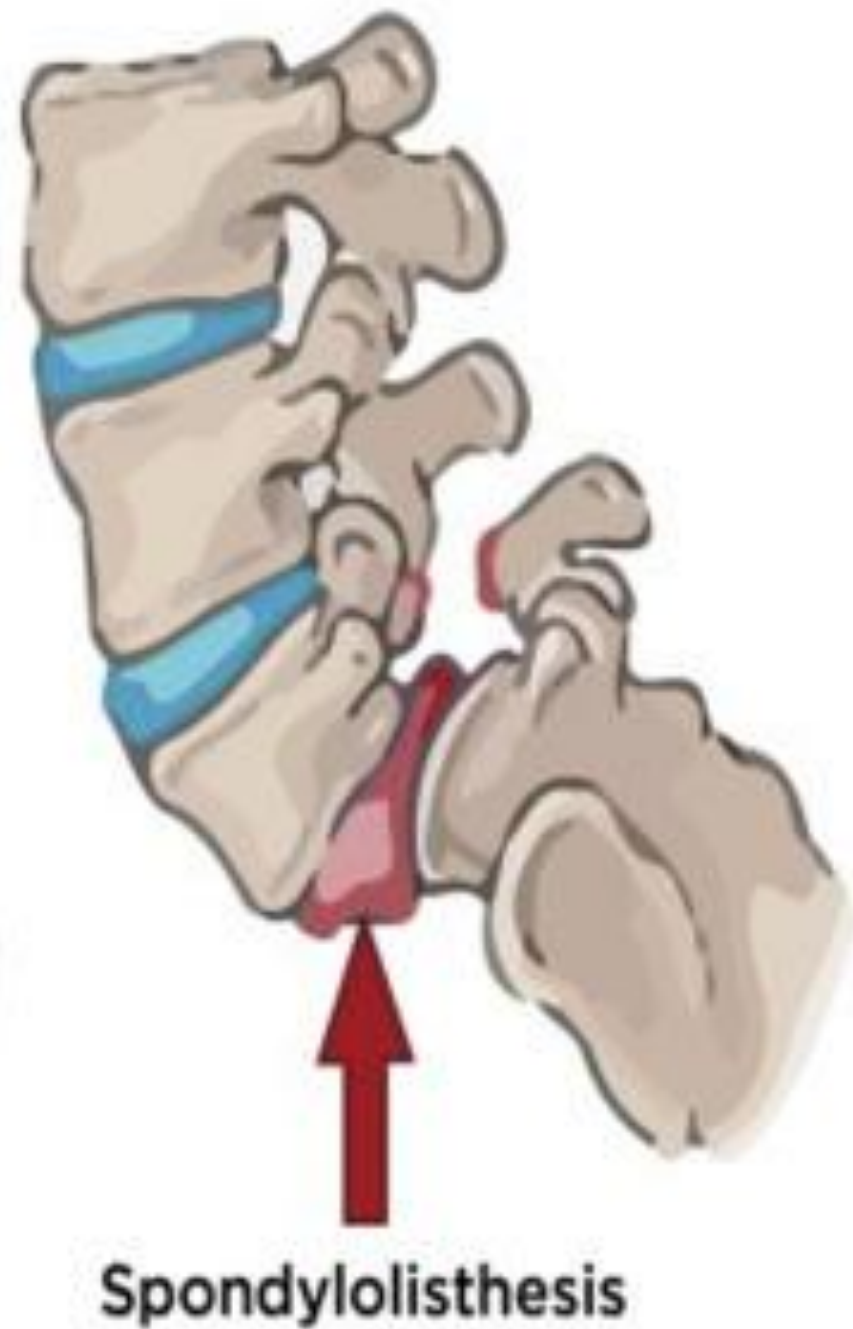
facet joints



pars interarticularis

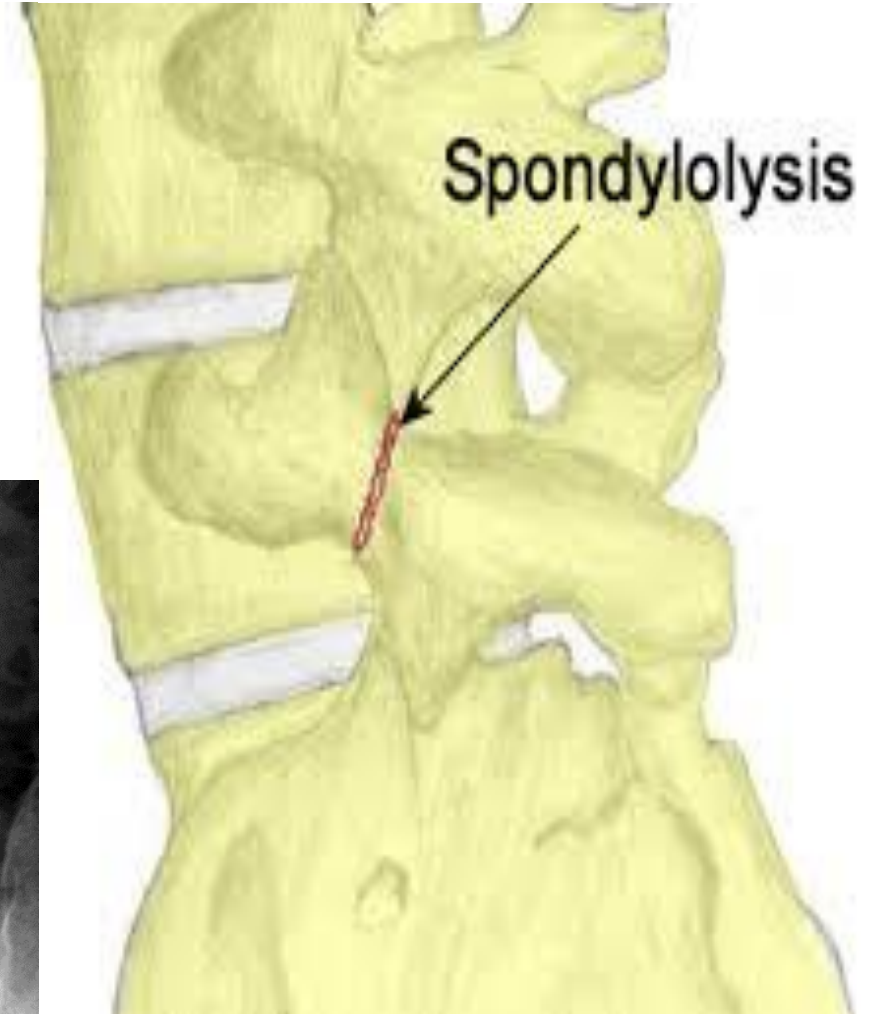
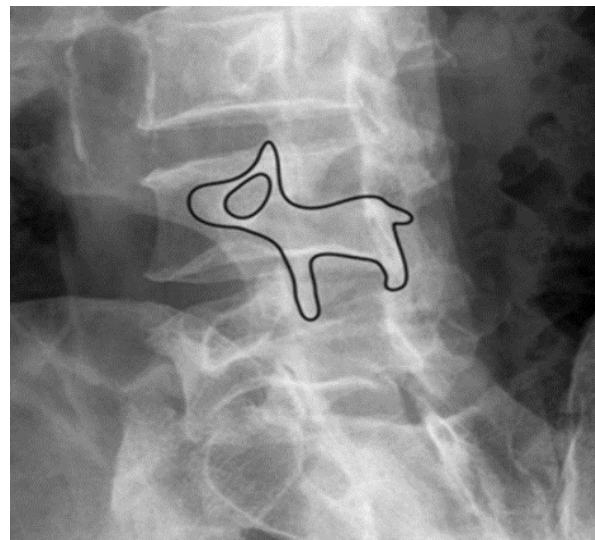
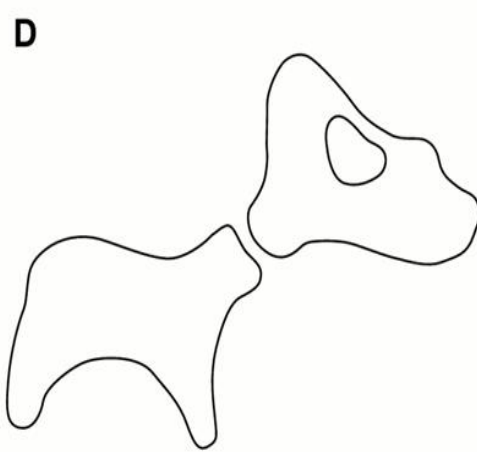
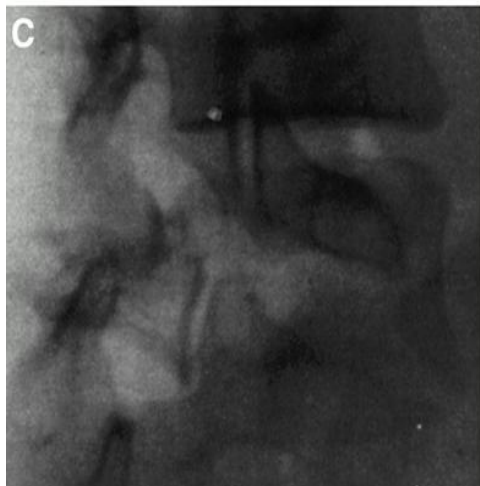
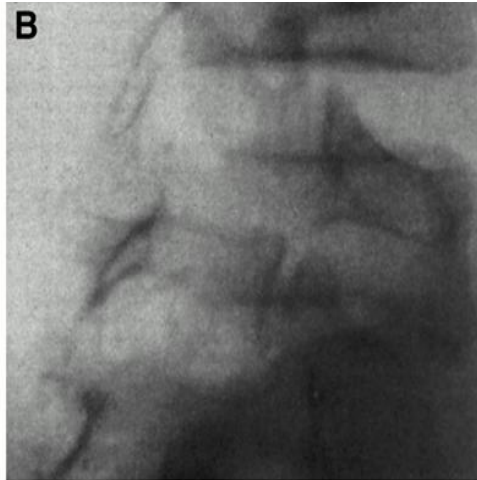
# Biomechanics of spondylosis

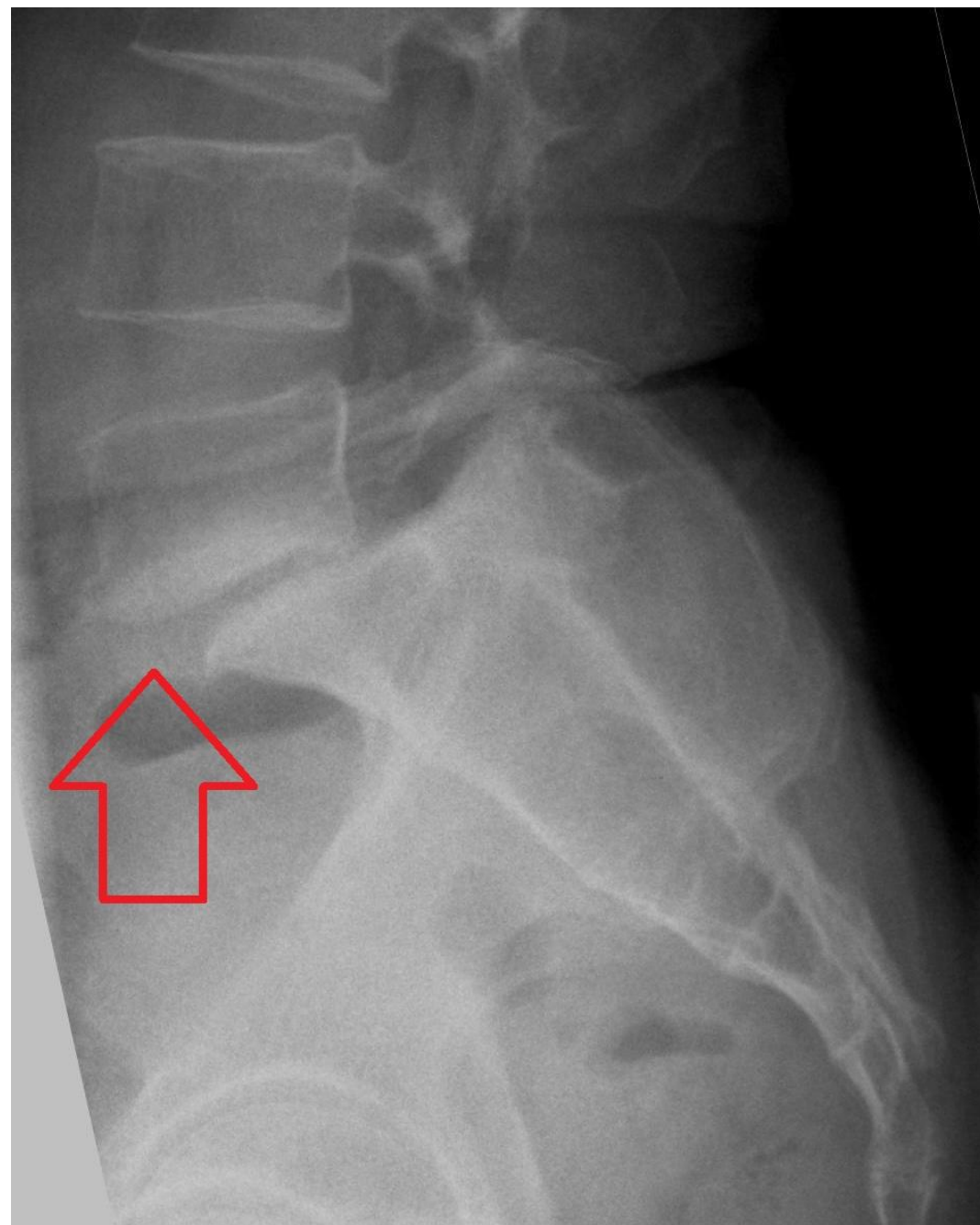
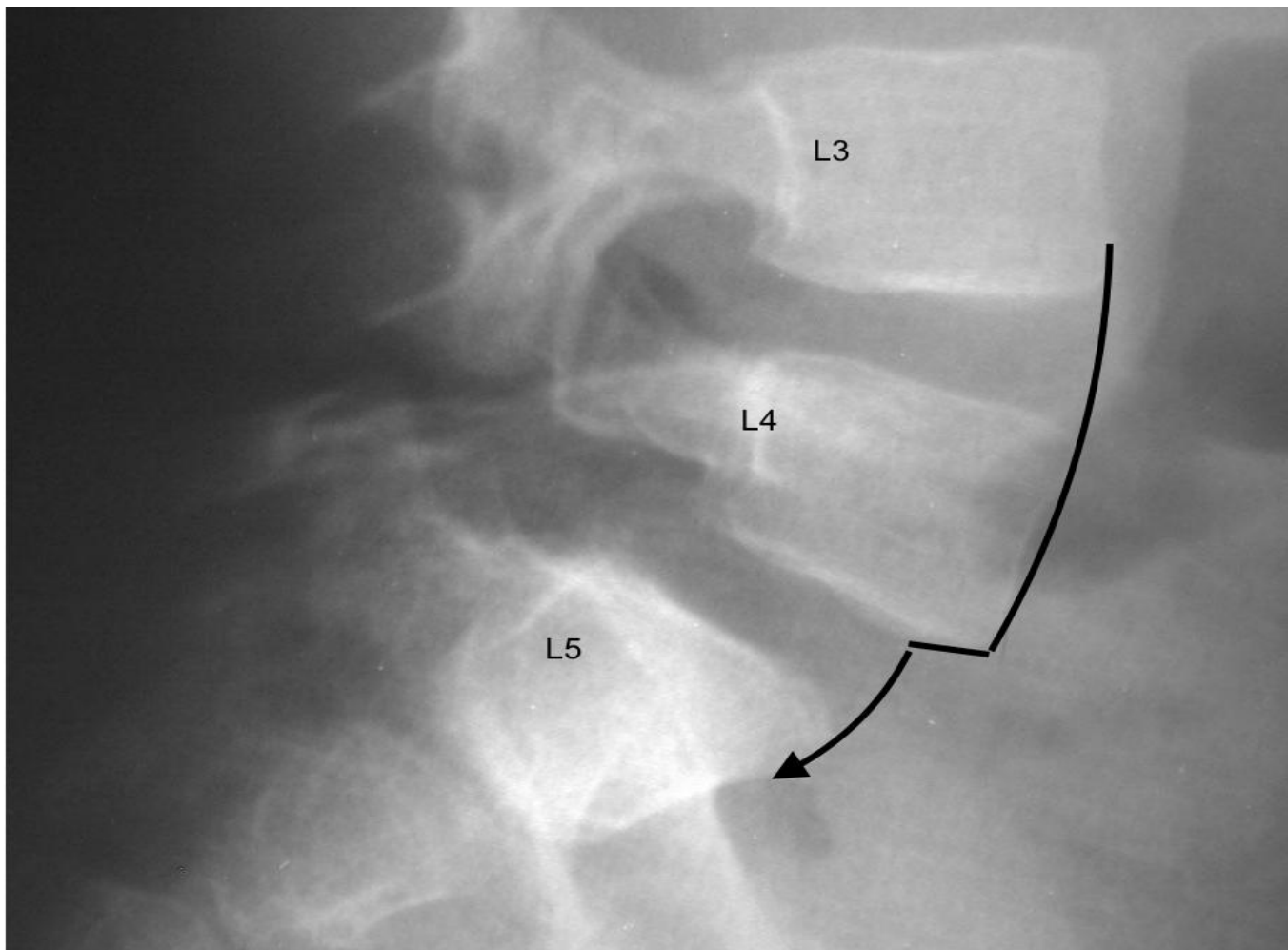


**A****B****C**



# Scottish dog



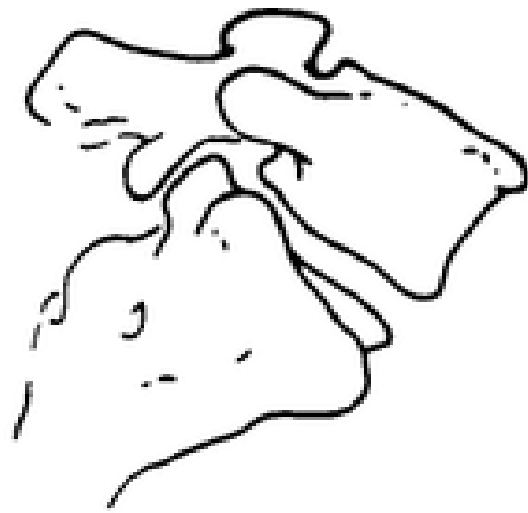




# Types of spondylolisthesis include:

- **Congenital spondylolisthesis** occurs when a baby's spine doesn't form the way it should before birth. The misaligned vertebrae put the person at risk for slippage later in life.
- **Isthmic spondylolisthesis** happens as a result of spondylolysis. The crack or fracture weakens the bone.
- **Degenerative spondylolisthesis**, the most common type, happens due to aging. Over time, the disks that cushion the vertebrae lose water. As the disks thin, they are more likely to slip out of place.
- Less common types of spondylolisthesis include:
  - **Traumatic spondylolisthesis** happens when an injury causes vertebrae to slip.
  - **Pathological spondylolisthesis** occurs when a disease (such as osteoporosis) or tumor causes the condition.
  - **Post-surgical spondylolisthesis** is slippage as a result of spinal surgery.

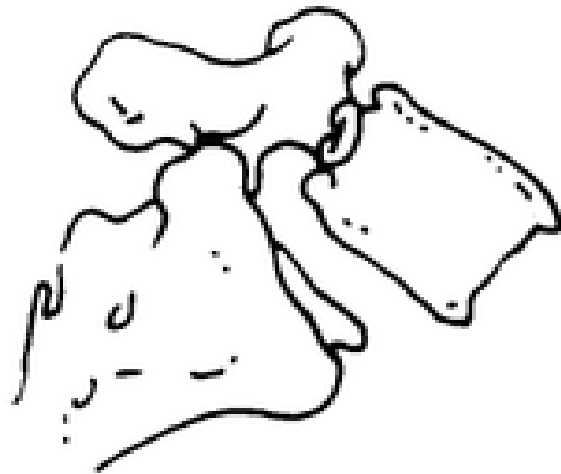
# Mechanism of injury



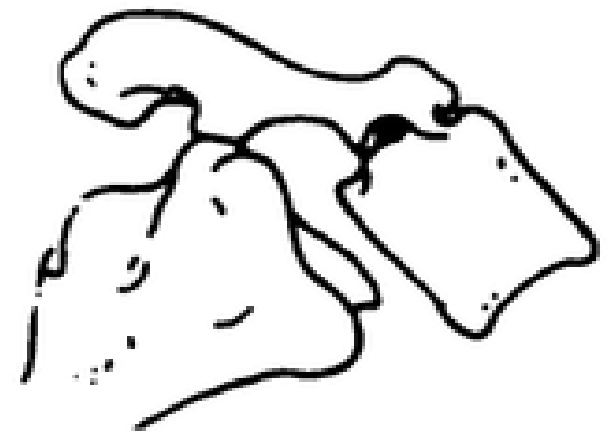
Normal



Spondylolytic Spondylolisthesis



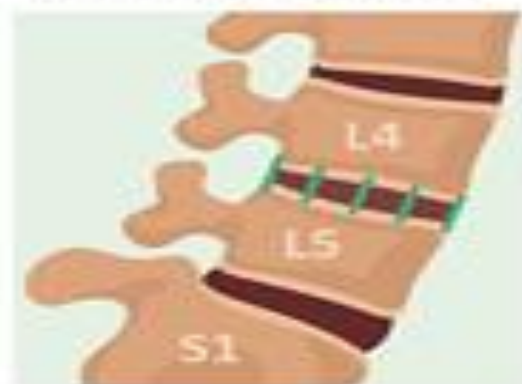
Degenerative  
Spondylolisthesis



Dysplastic  
Spondylolisthesis

# SPONDYLOLISTHESIS STAGES

SPINE WITHOUT  
SPONDYLOLISTHESIS



SPINE WITH  
SPONDYLOLISTHESIS



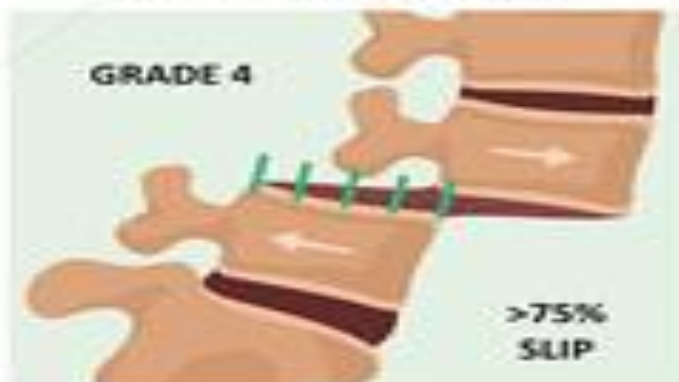
SPINE WITH  
SPONDYLOLISTHESIS



SPINE WITH  
SPONDYLOLISTHESIS



SPINE WITH  
SPONDYLOLISTHESIS

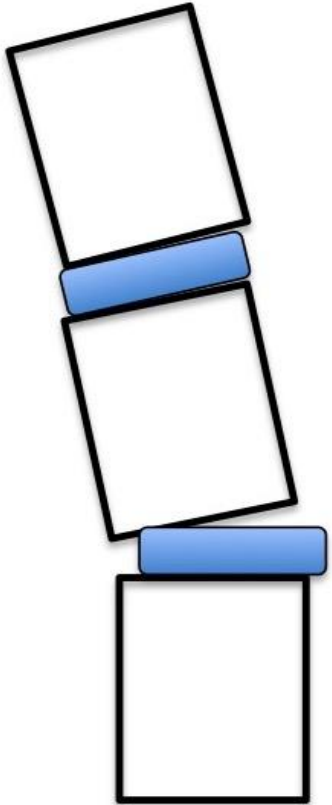


SPINE WITH  
SPONDYLOLISTHESIS

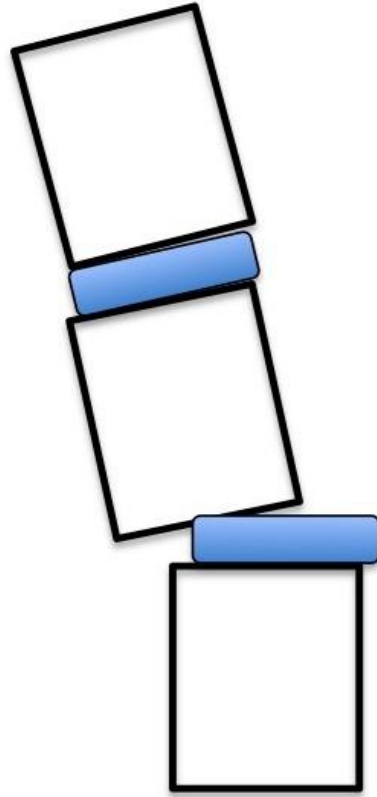




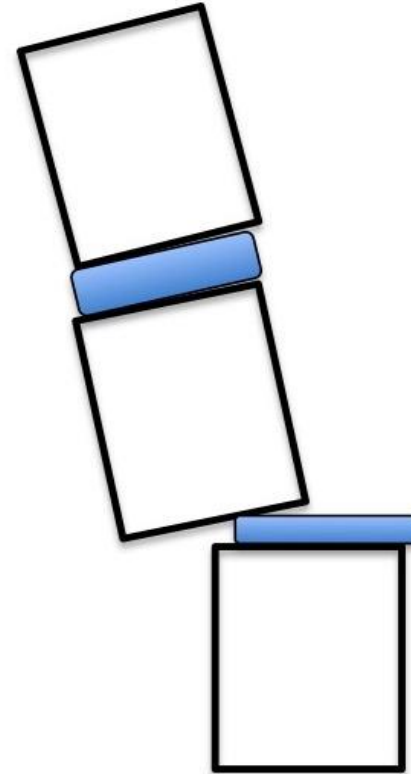
# Grading of Spondylolisthesis



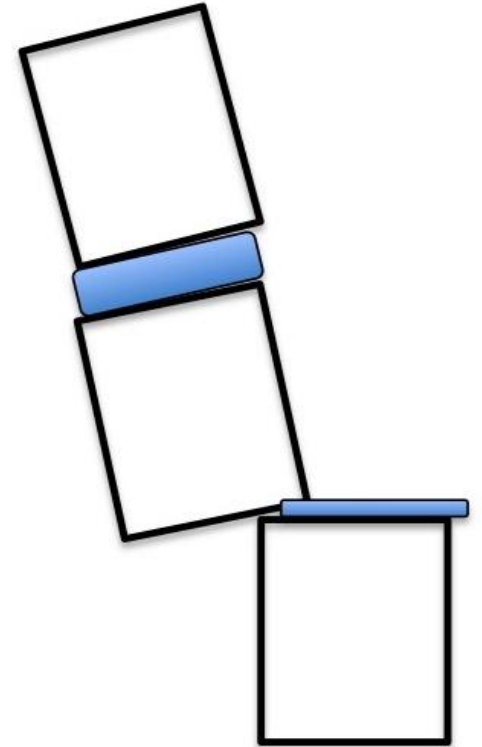
0-25%  
Grade I



25-50%  
Grade II

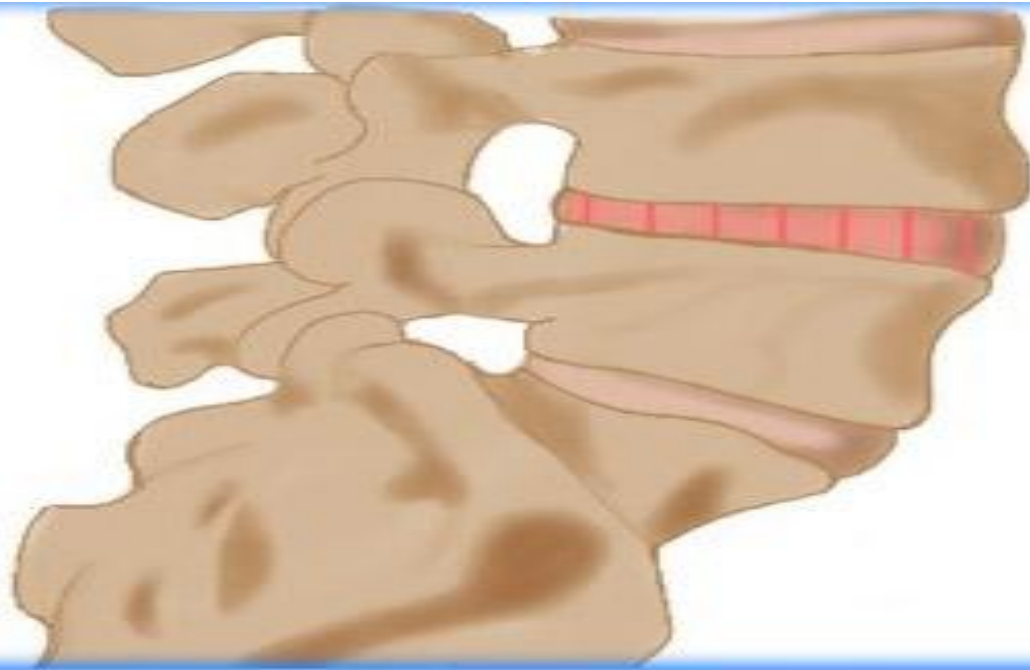


50-75%  
Grade III



75-100%  
Grade IV

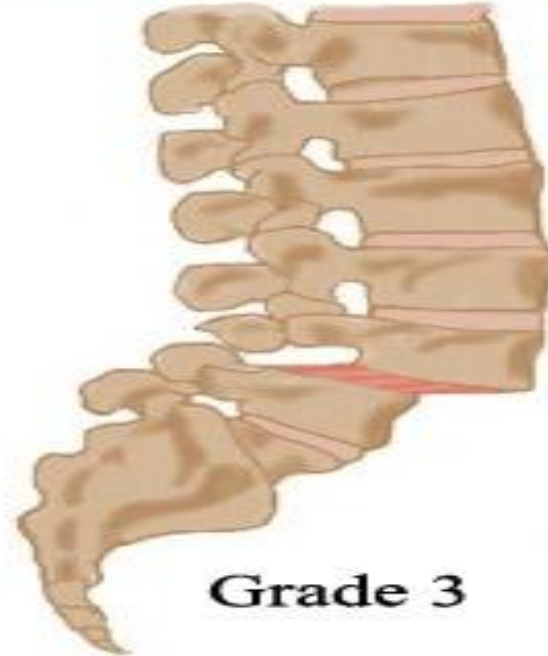
**Normal**



**Grade 1**



**Grade 2**



**Grade 3**



**Grade 4**

# Investigations



Method	Mainly use for identify
<b>X-rays</b>	Osteoporotic fractures, Dislocations.
<b>Bone scan</b>	Infection, Paget disease.
<b>CT</b>	Bone tumours, Fractures, Spinal stenosis.
<b>MRI</b>	Spinal cord, Nerve roots, Discs, Haemorrhage problems.
<b>Dexa Scan</b>	Bone density

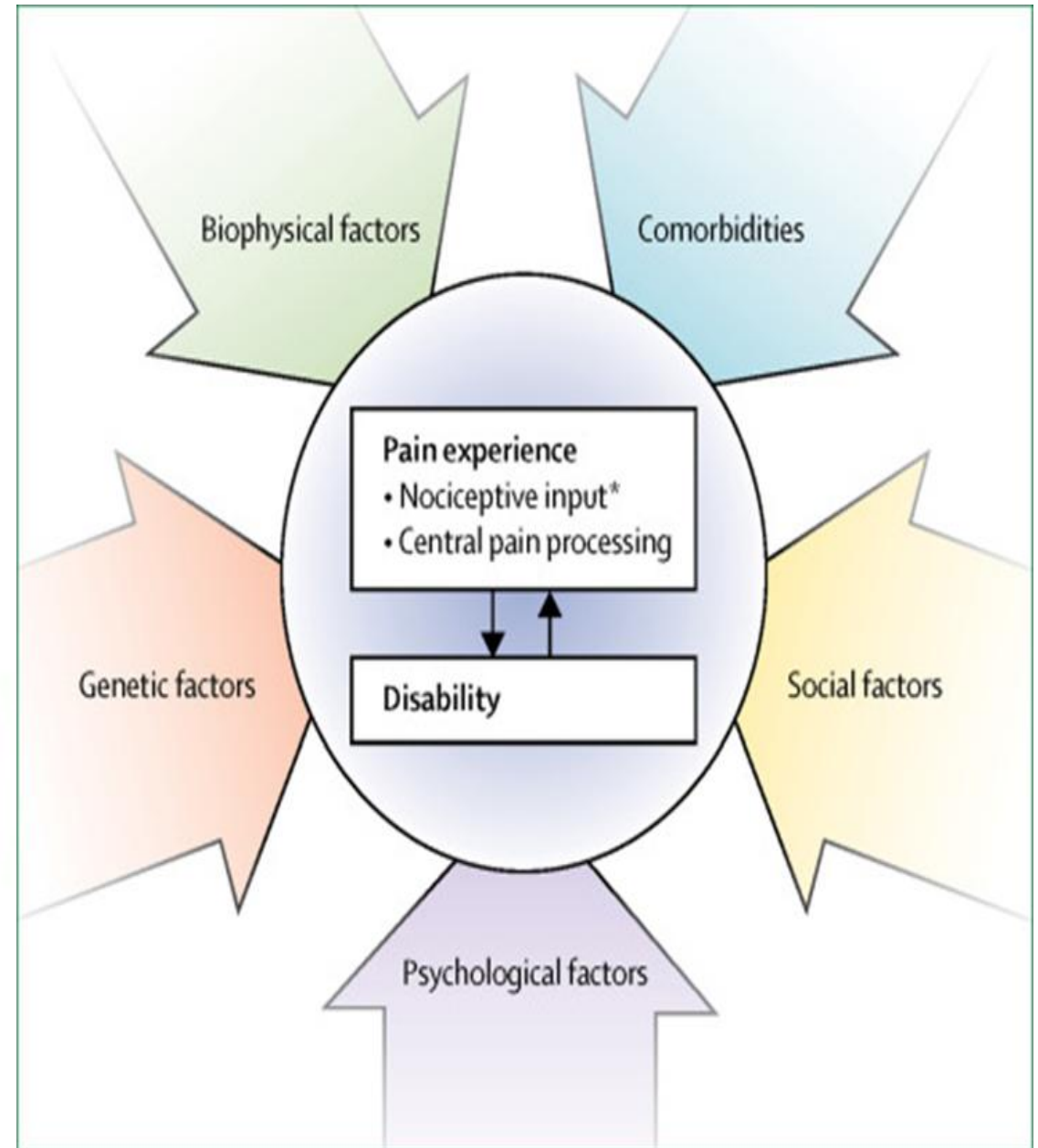
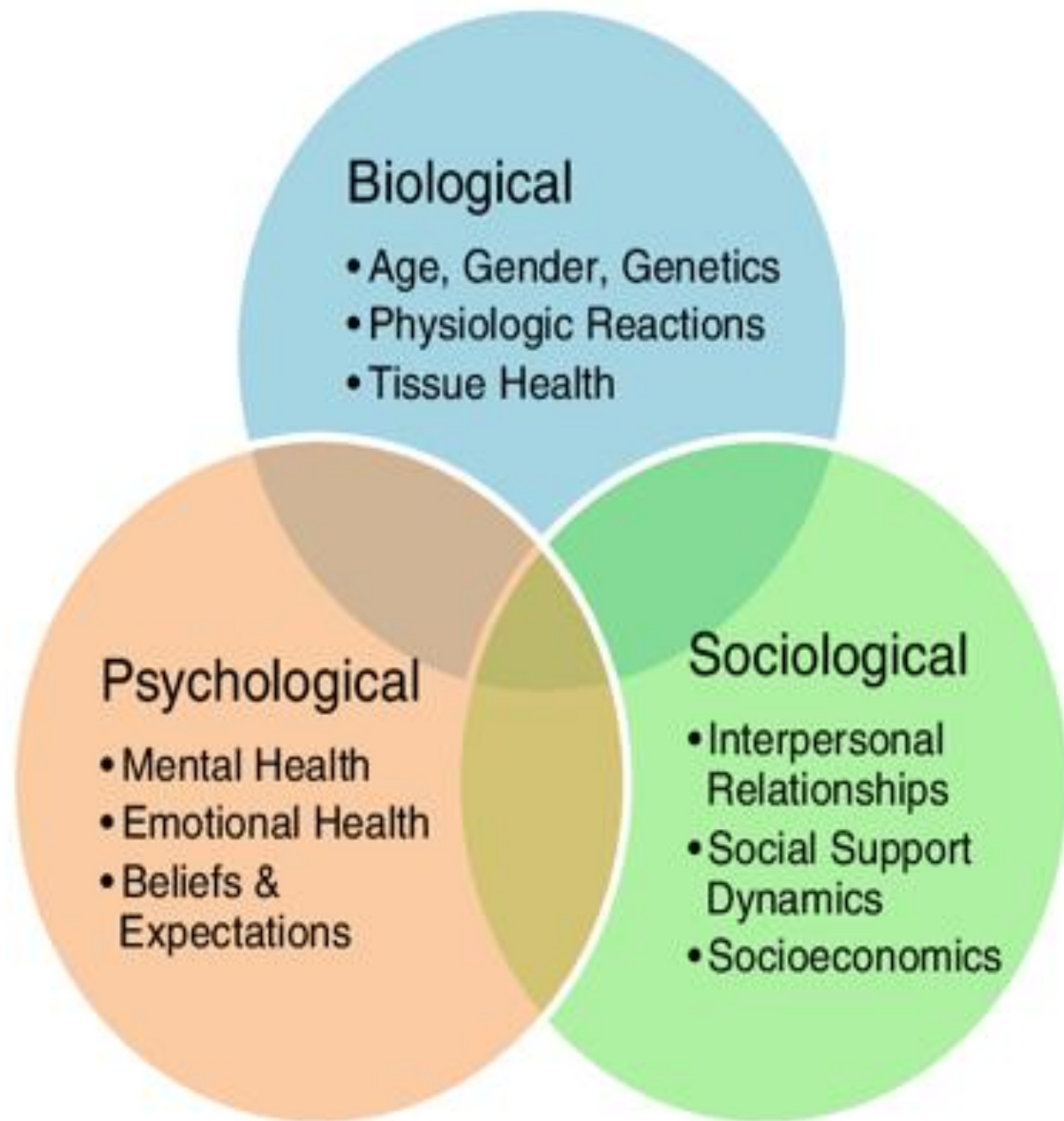


# Subjective Assessment

- Insidious or gradual onset
- Low back pain primarily worsening with extension-related activities
- Pain varies from a dull ache to sharp pain especially upon extension
- Muscle guarding either unilateral or bilateral
- Improves with rest
- Individuals may be excessively hypermobile
- Pain radiating to buttock
- Pain worsening with sport activity

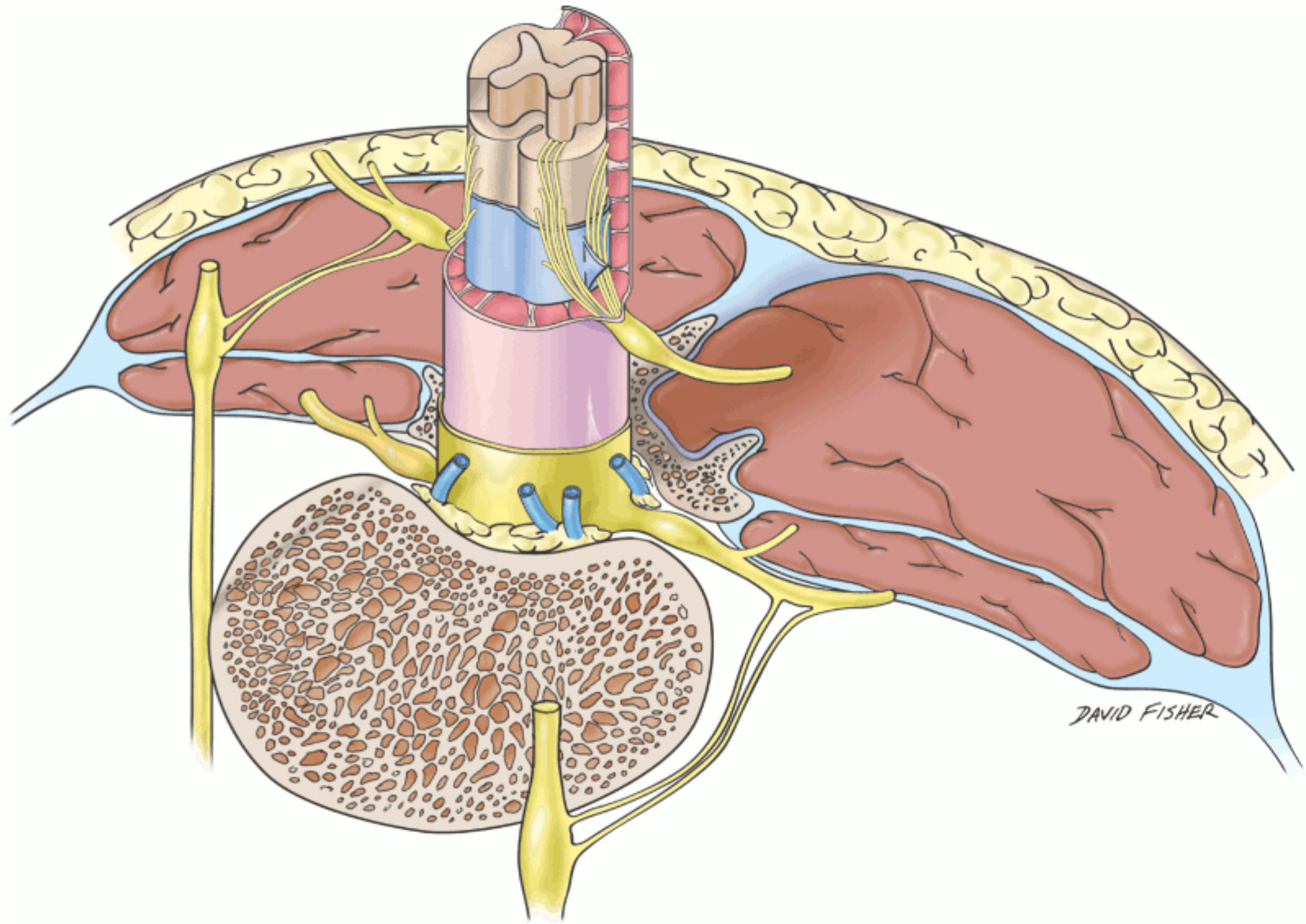
# Objective Assessment

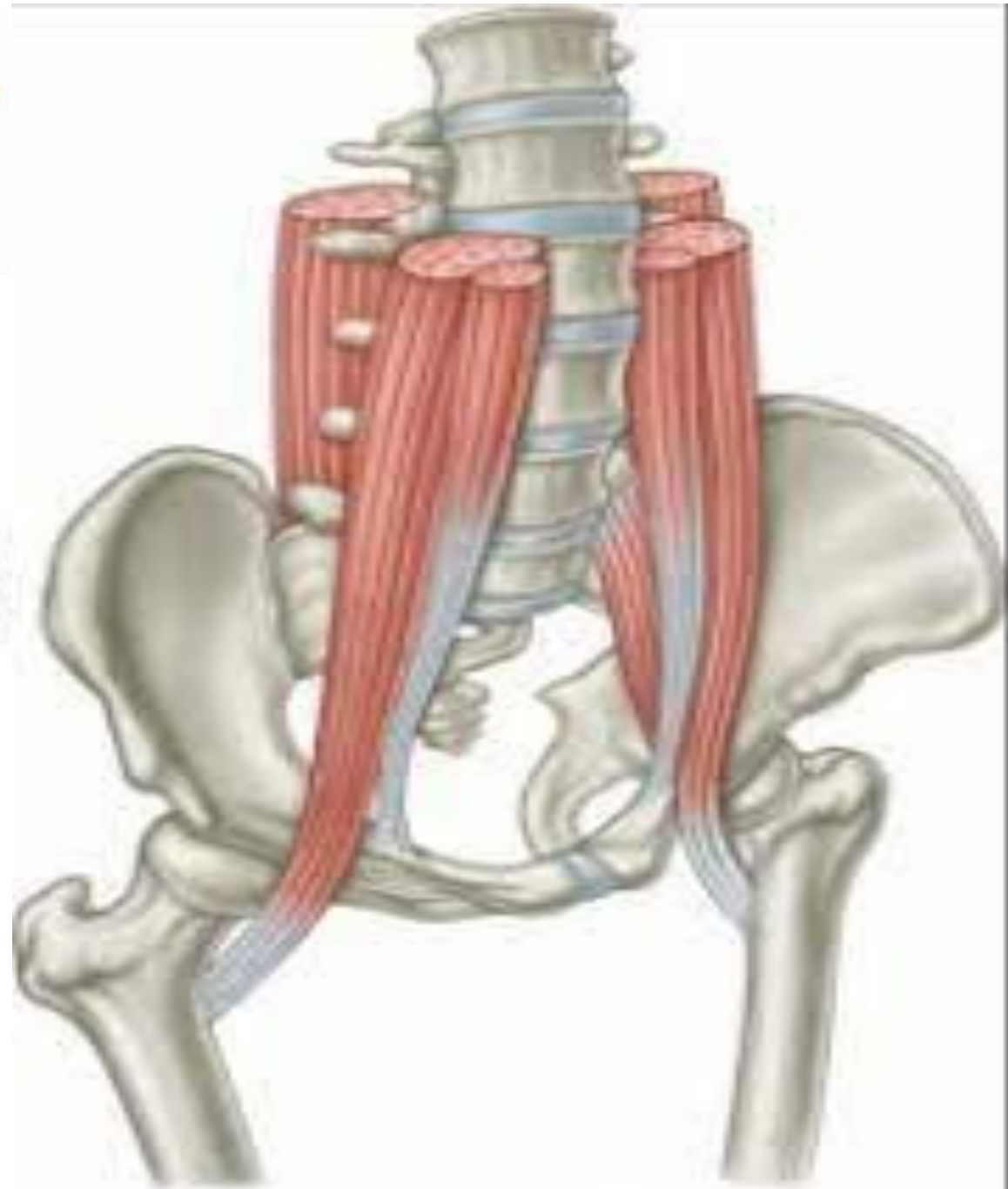
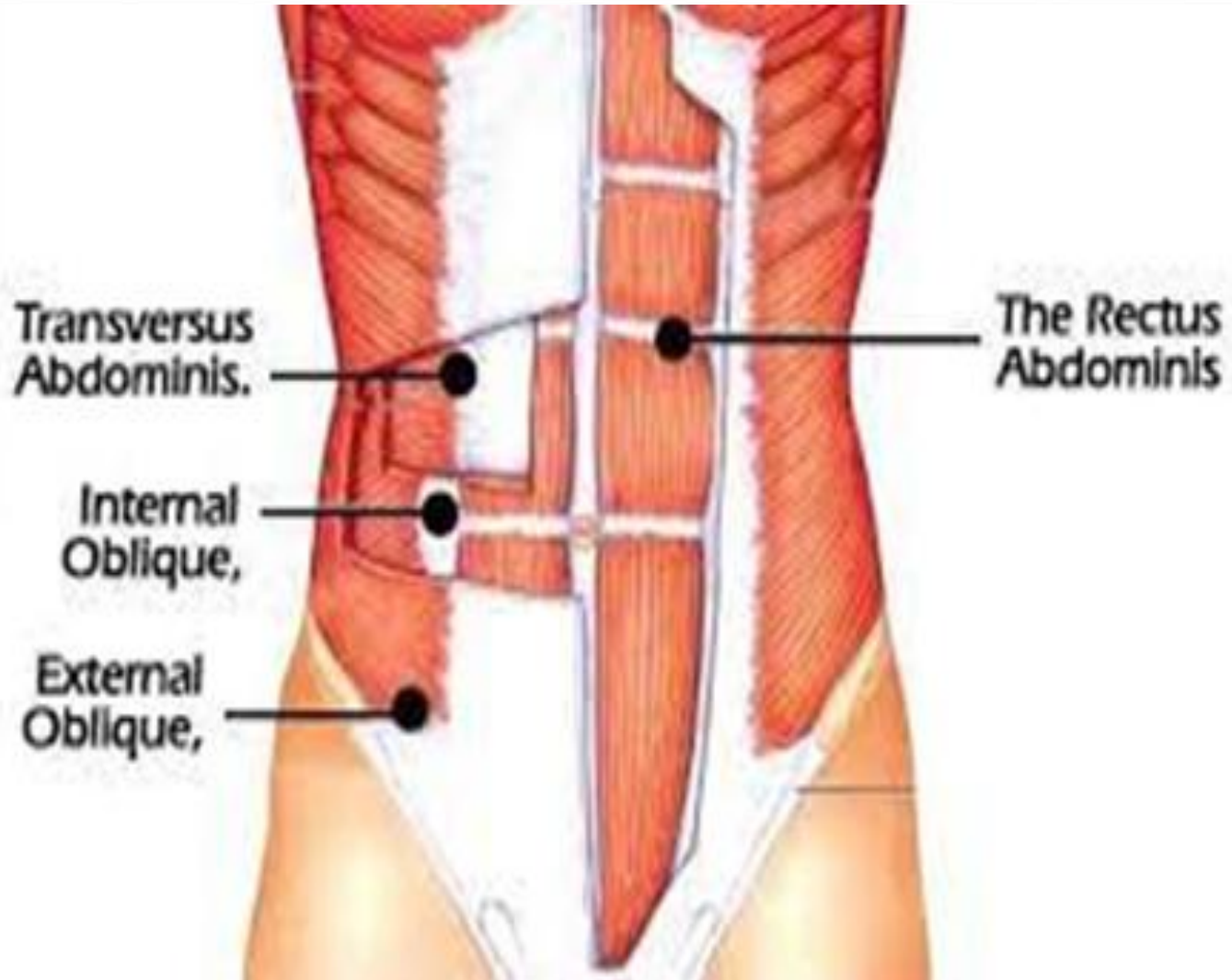
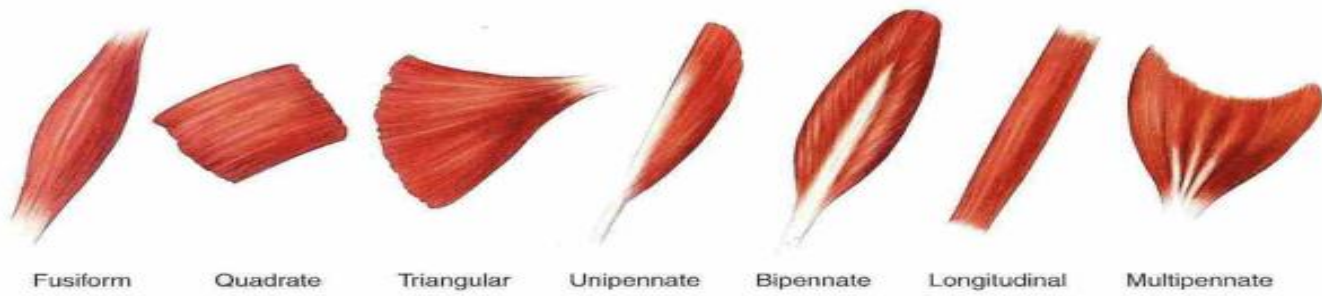
- Tenderness and pain on palpation of the spinous process of affected vertebra
- Lordotic lumbar spine
- Muscle guarding either unilateral or bilateral of erector spine
- Weakness in gluteal and abdominals
- Pain on extension
- Positive single-leg hyperextension test
- Hamstring tightness





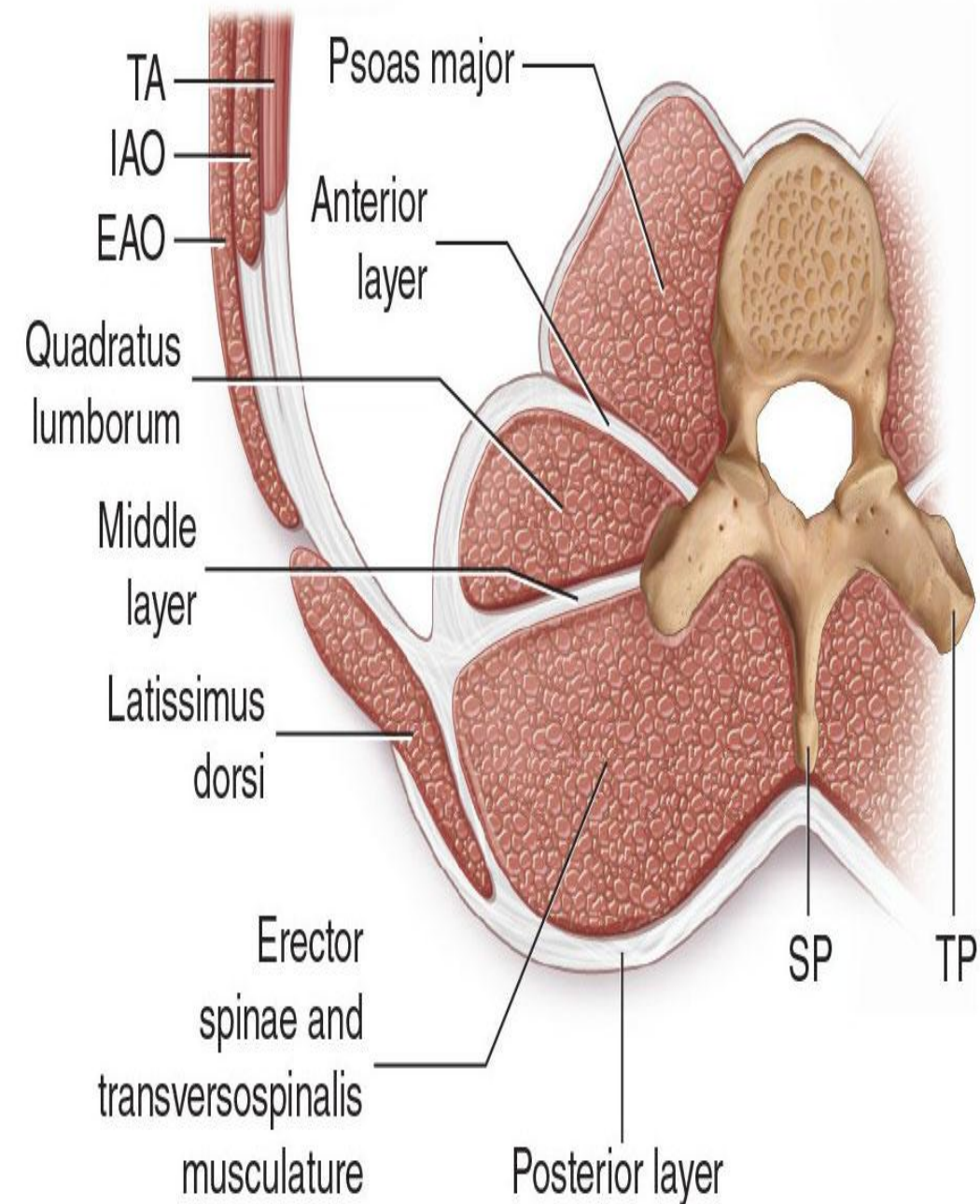
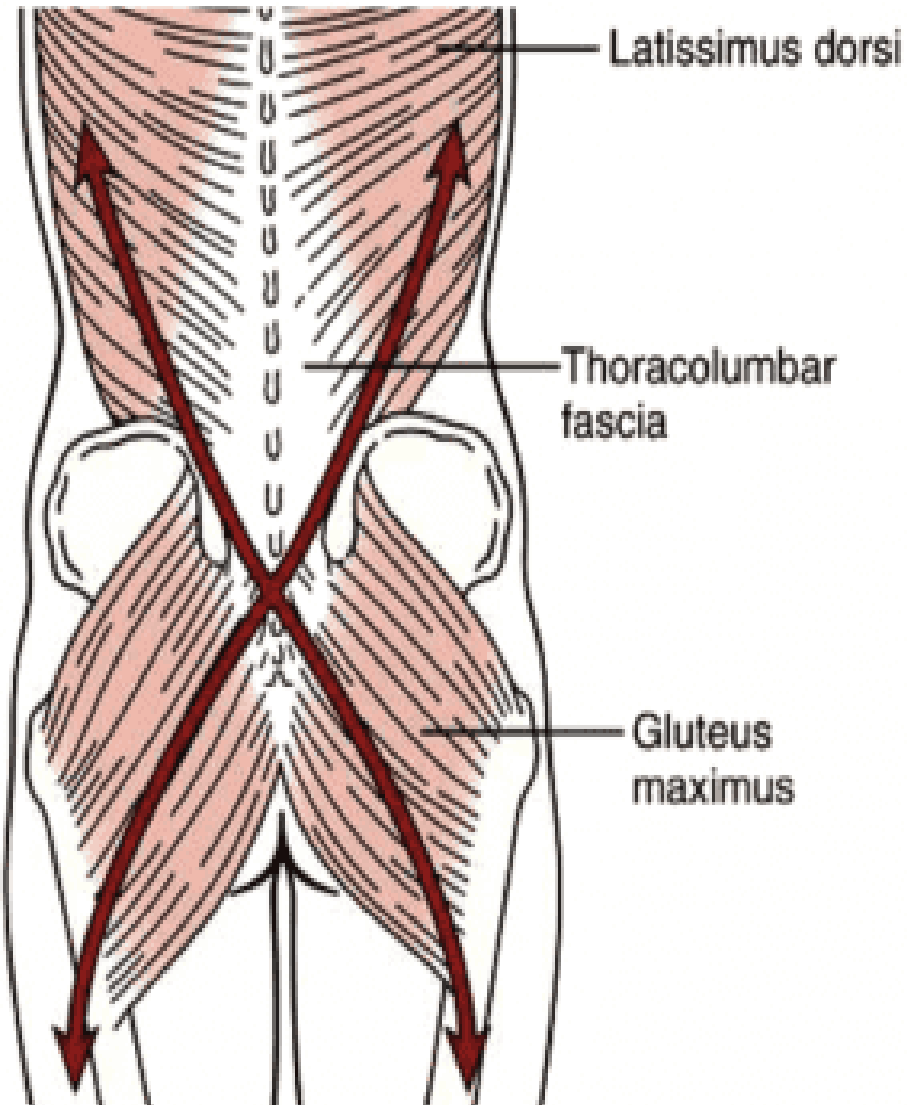
# Elements



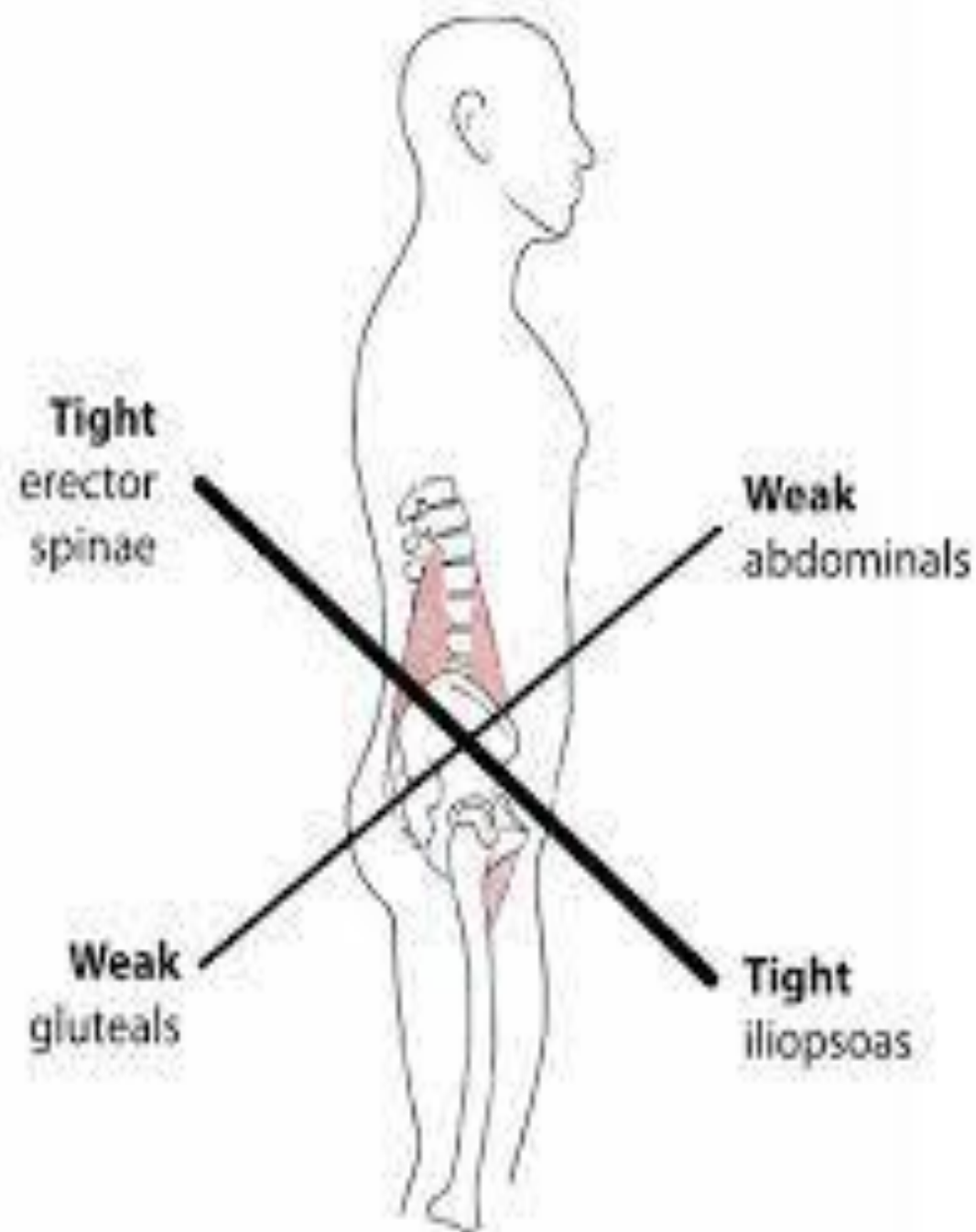
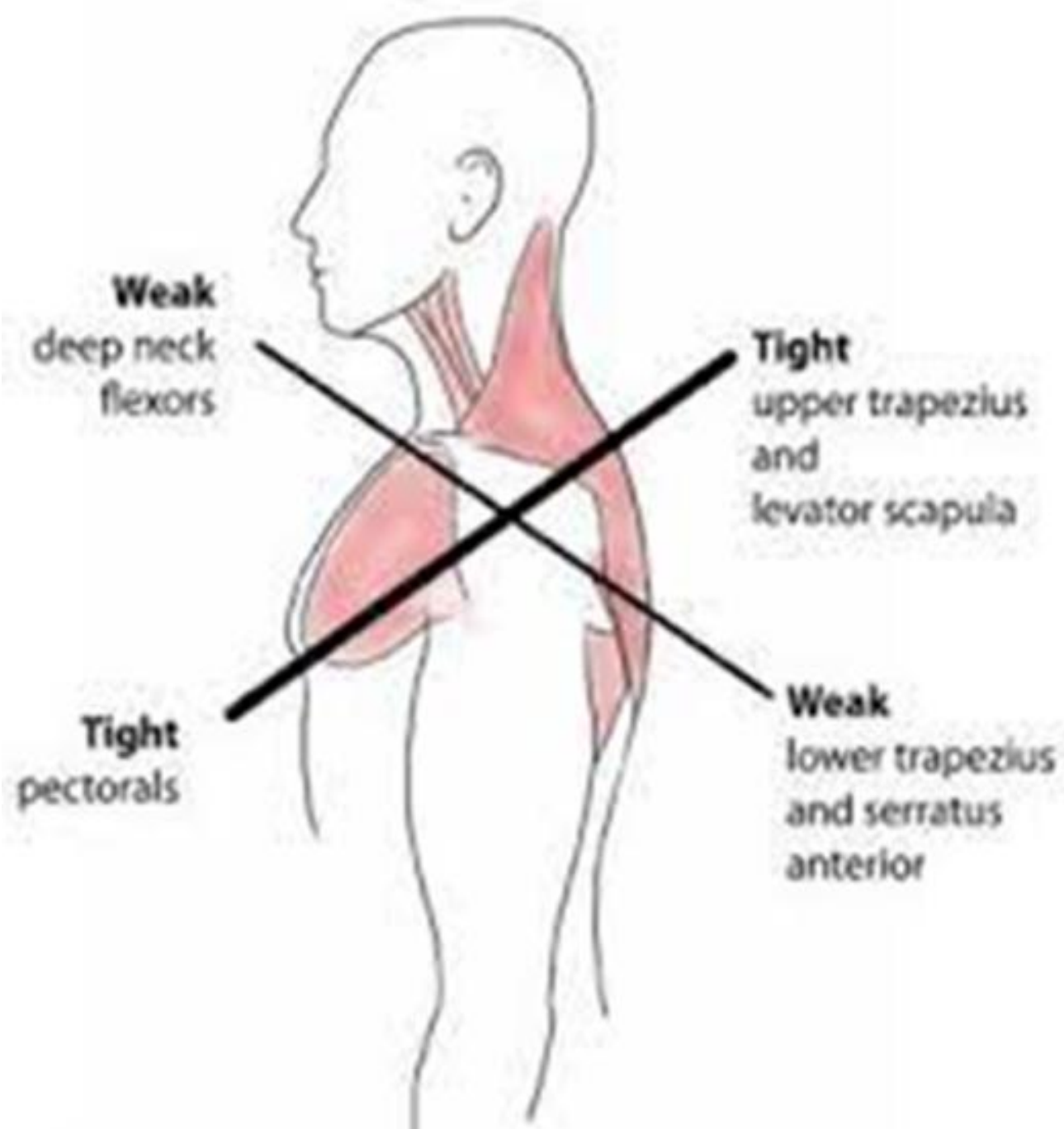


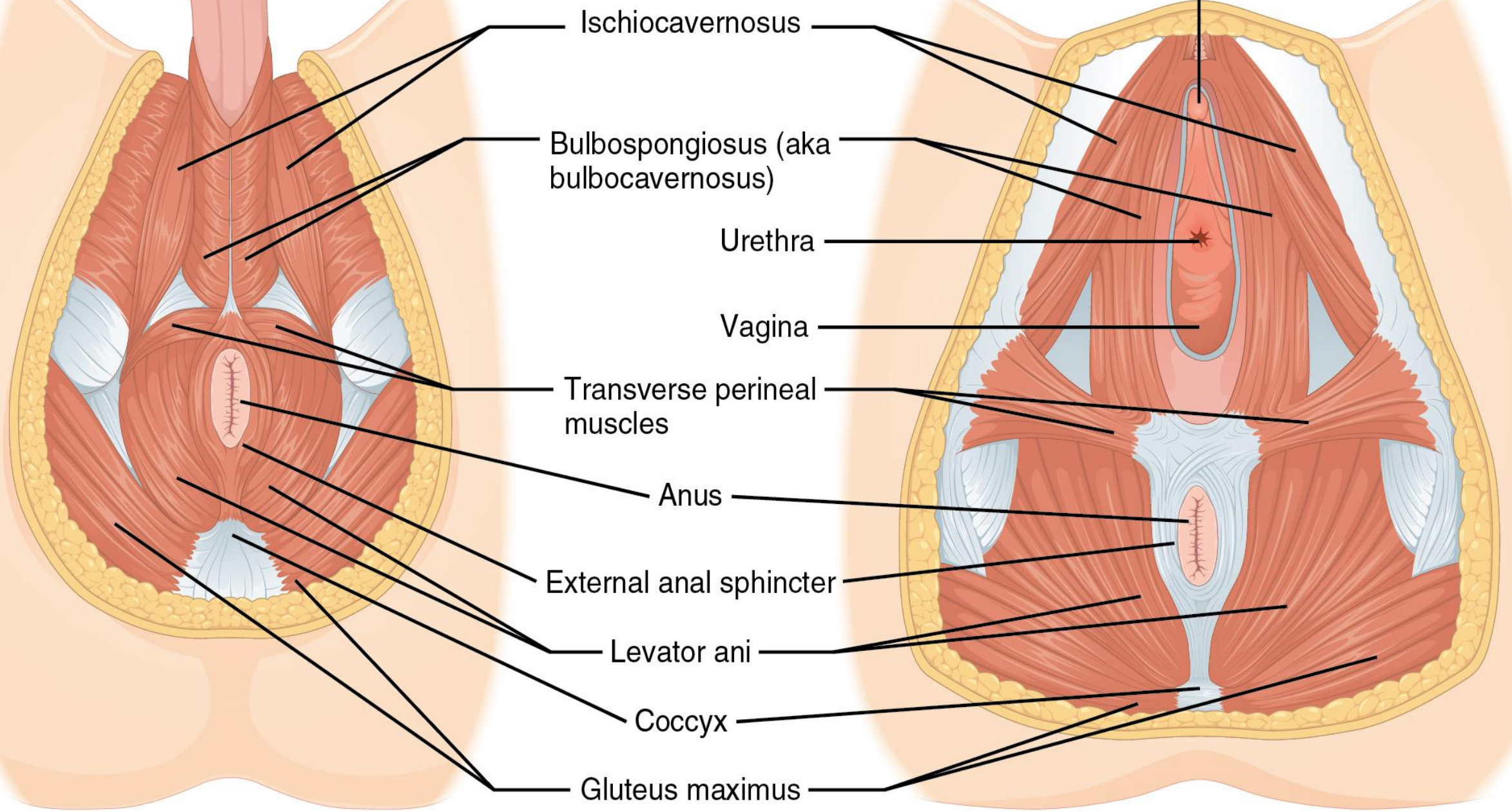


# Lumbar & Pelvic Muscles









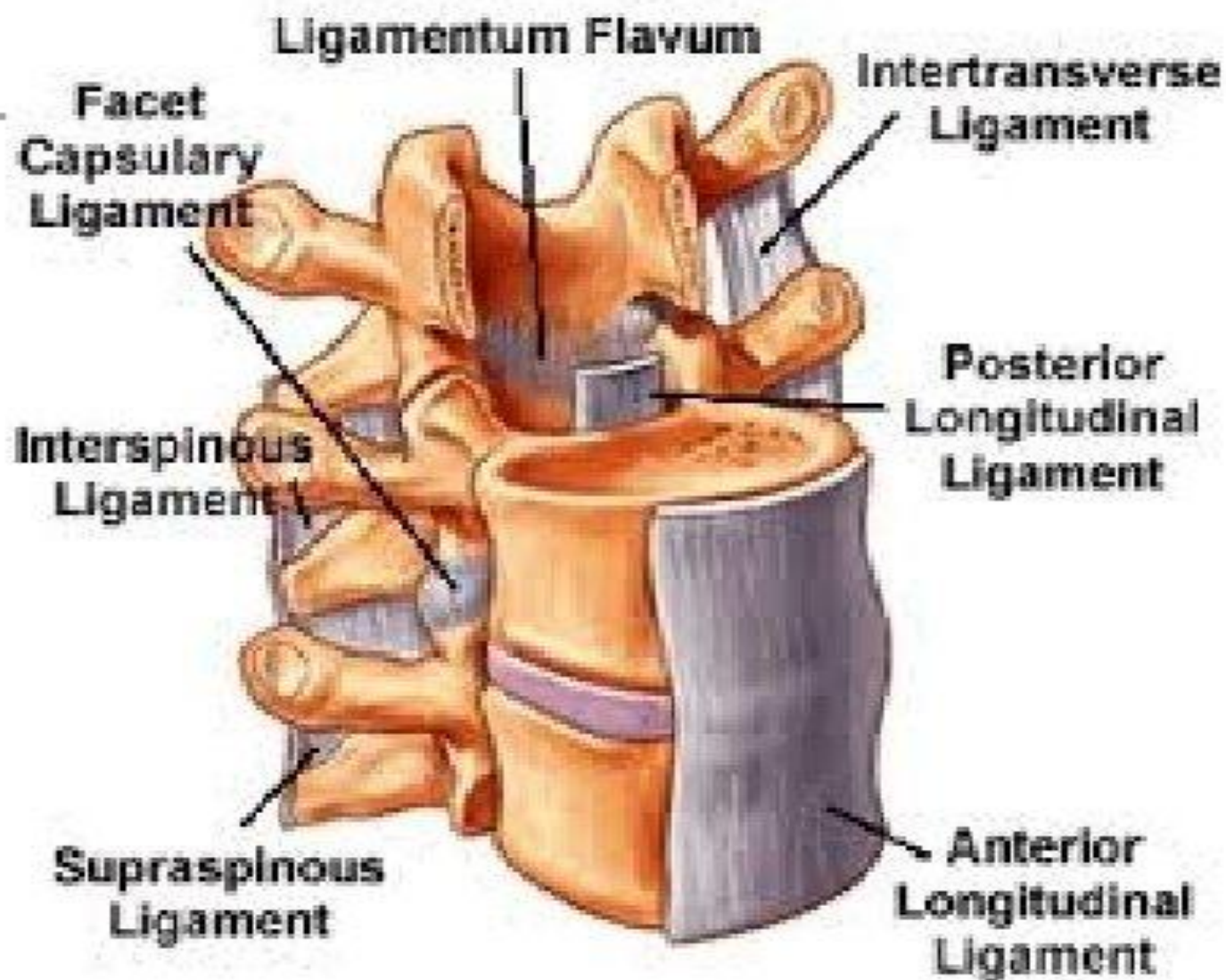
Male perineal muscles: inferior view

Female perineal muscles: inferior view



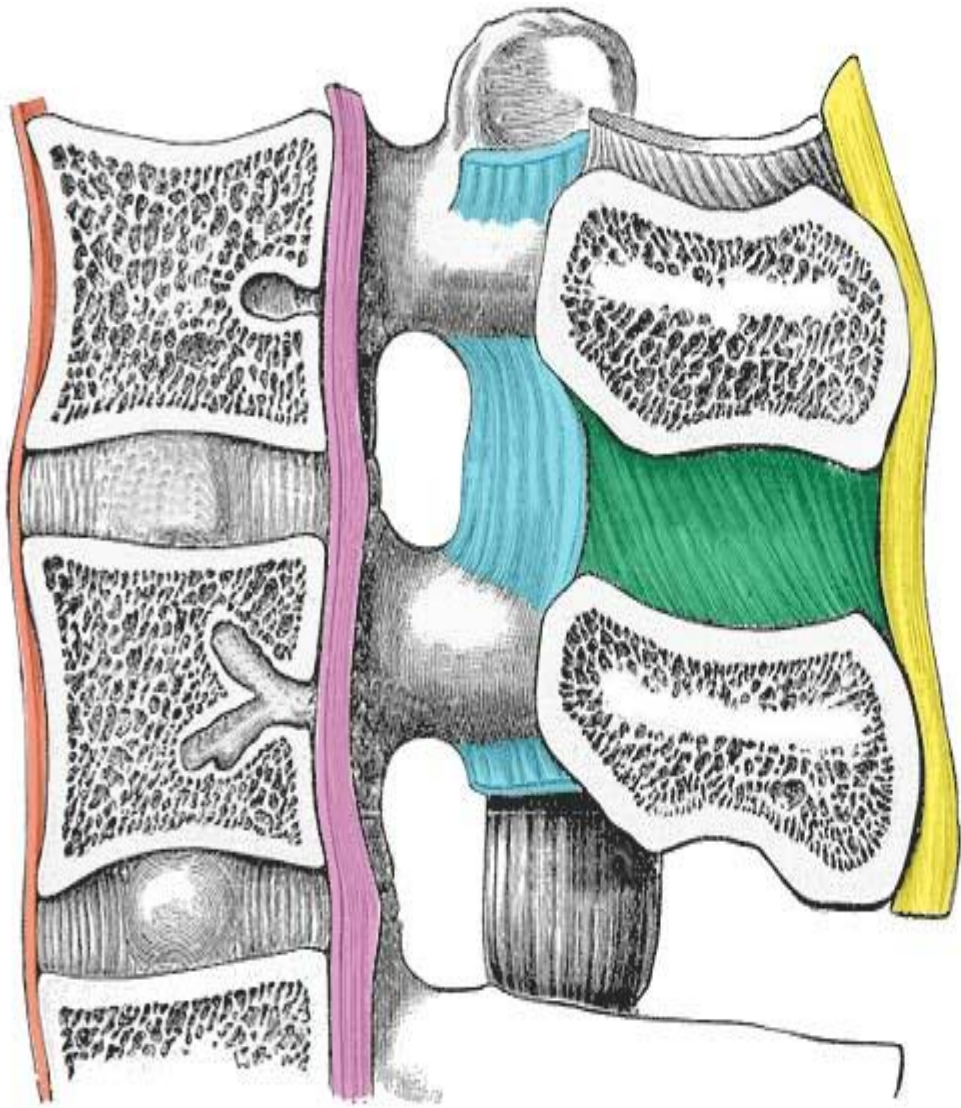
# Major Lumbar Ligaments

ALL: Anterior  
Longitudinal Ligament  
PLL: Posterior  
Longitudinal Ligament  
**LF: Ligamentum  
Flavum**  
ISF: Inter-Spinous  
Ligament  
SSL: Supra-Spinous  
Ligament





# Lumbar Ligaments



Anterior longit. ligament

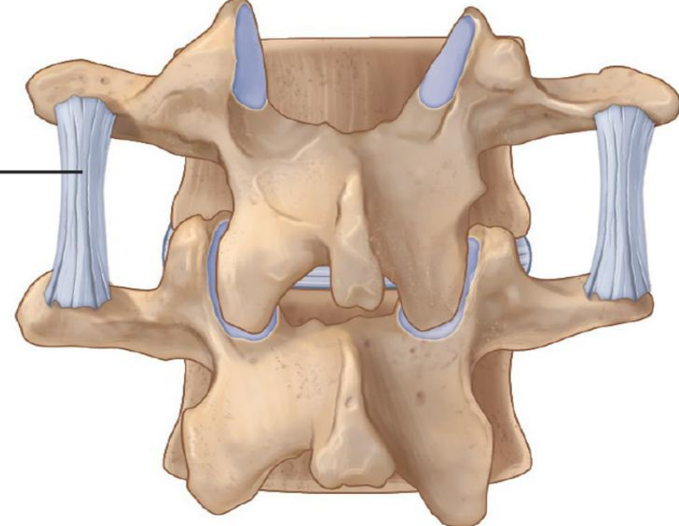
Posterior longit. ligament

Ligamentum flavum

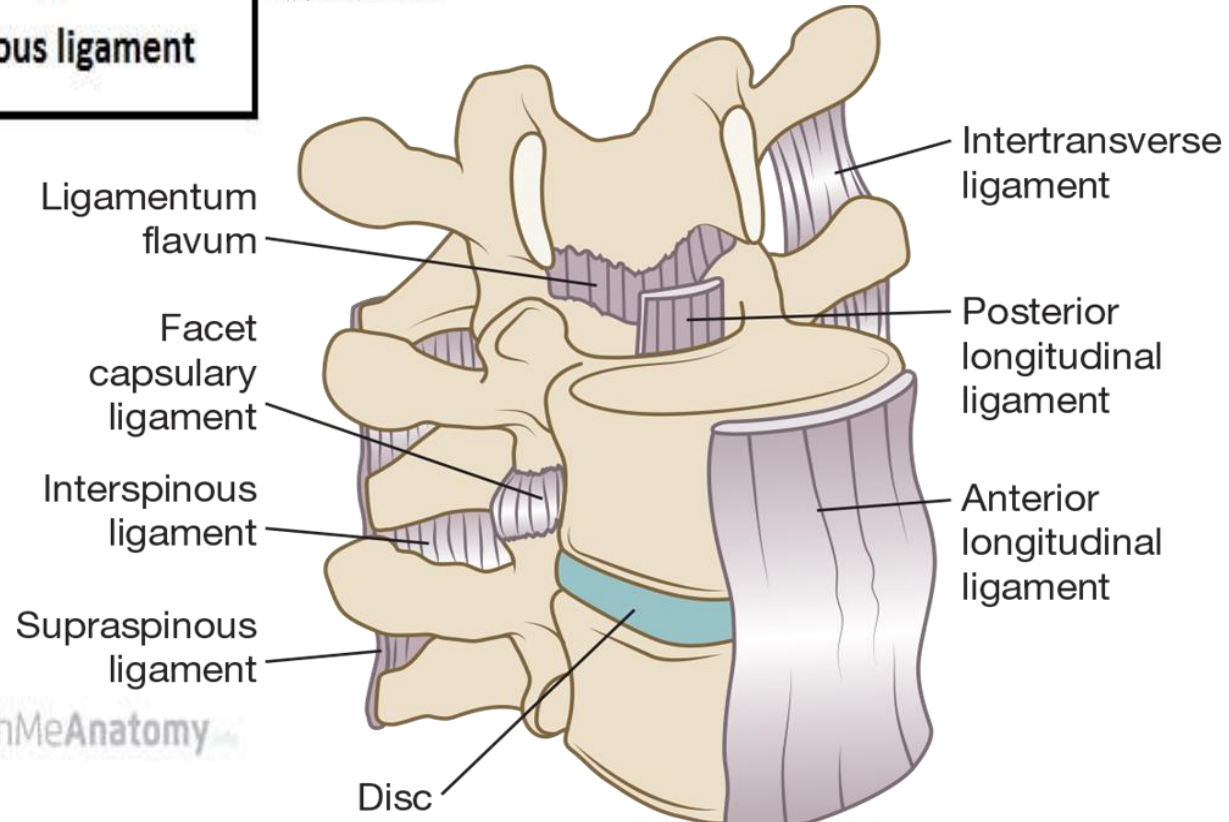
Interspinous ligament

Supraspinous ligament

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Intertransverse ligament

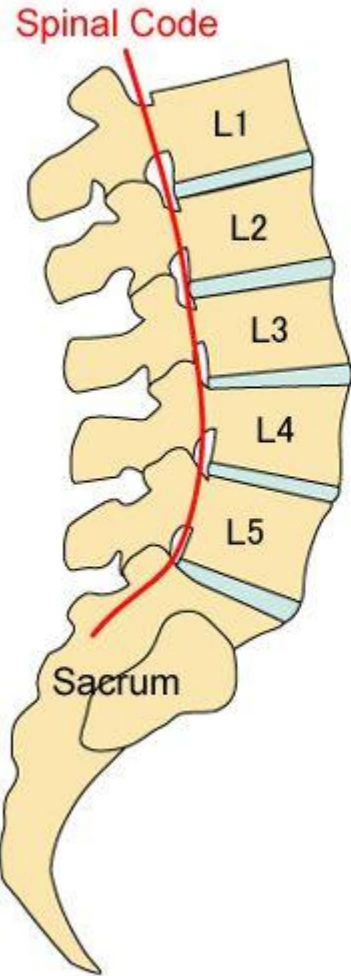




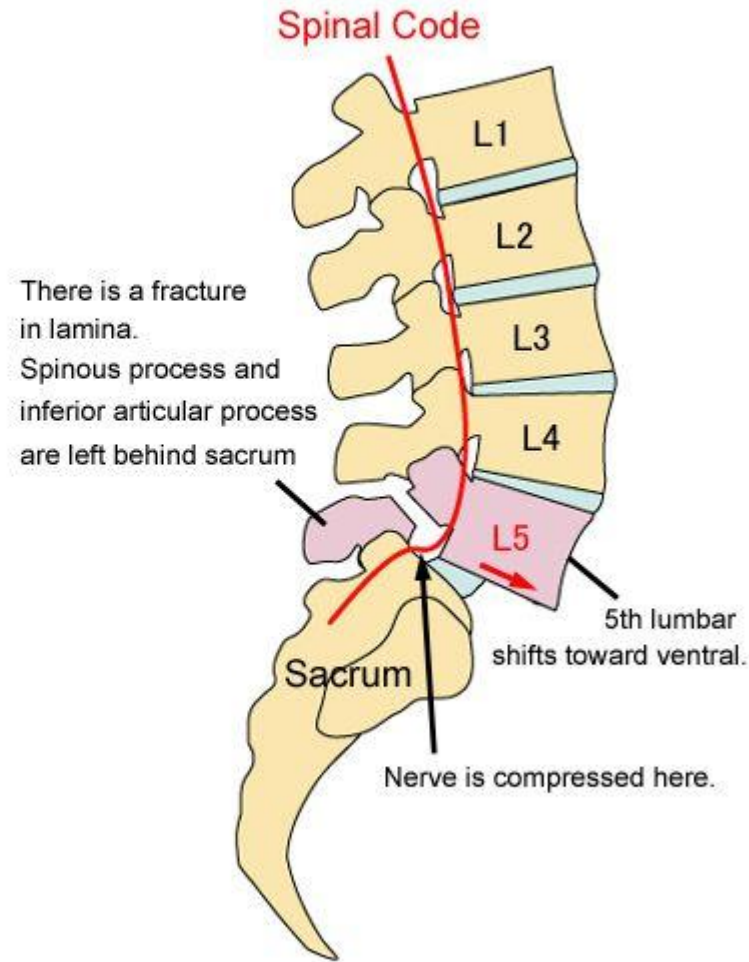


# spondylolisthesis and nerve compression

Normal Situation



5th Lumbar Spondylolysis & Spondylolisthesis



# Can we reduce risk of spondylolisthesis?

- Do regular exercises for strong back and abdominal muscles.
- Maintain a healthy weight. Excess weight puts added stress on your lower back.
- Eat a [well-balanced diet](#) to keep your bones well-nourished and strong.
- Prevent from injury & high risk performance in life.



# Complementary Treatments

- The following well-tolerated treatments can be used throughout rehabilitation to help reduce pain symptoms:
- Thermotherapy
- NSAIDS
- Epidural Steroid Injections
- Massage
- Osteopathic/chiropractic manipulation
- Cognitive Behavioral Therapy (CBT)

# Physiotherapy Management

- Physiotherapy management focuses on reducing pain levels as well as **optimizing physical function** through the use of **specific stabilization, strengthening and range of motion exercises**. More recently, **Pilates and Transcutaneous Electrical Nerve Stimulation (TENS)** have been introduced for the management of chronic lower back pain conditions, including spondylolysis, however; there is little to no research illustrating the effectiveness of TENS. The **main goal of physiotherapy management is to promote normal movement patterns which are pain free**.
- Initially, a period of rest is needed to settle down symptoms and promote additional blood flow in order to speed up pars interarticularis healing. This is usually followed by months of physiotherapy training, incorporating a 'return to play' stage towards the end of rehabilitation.

# PHYSIOTHERAPY

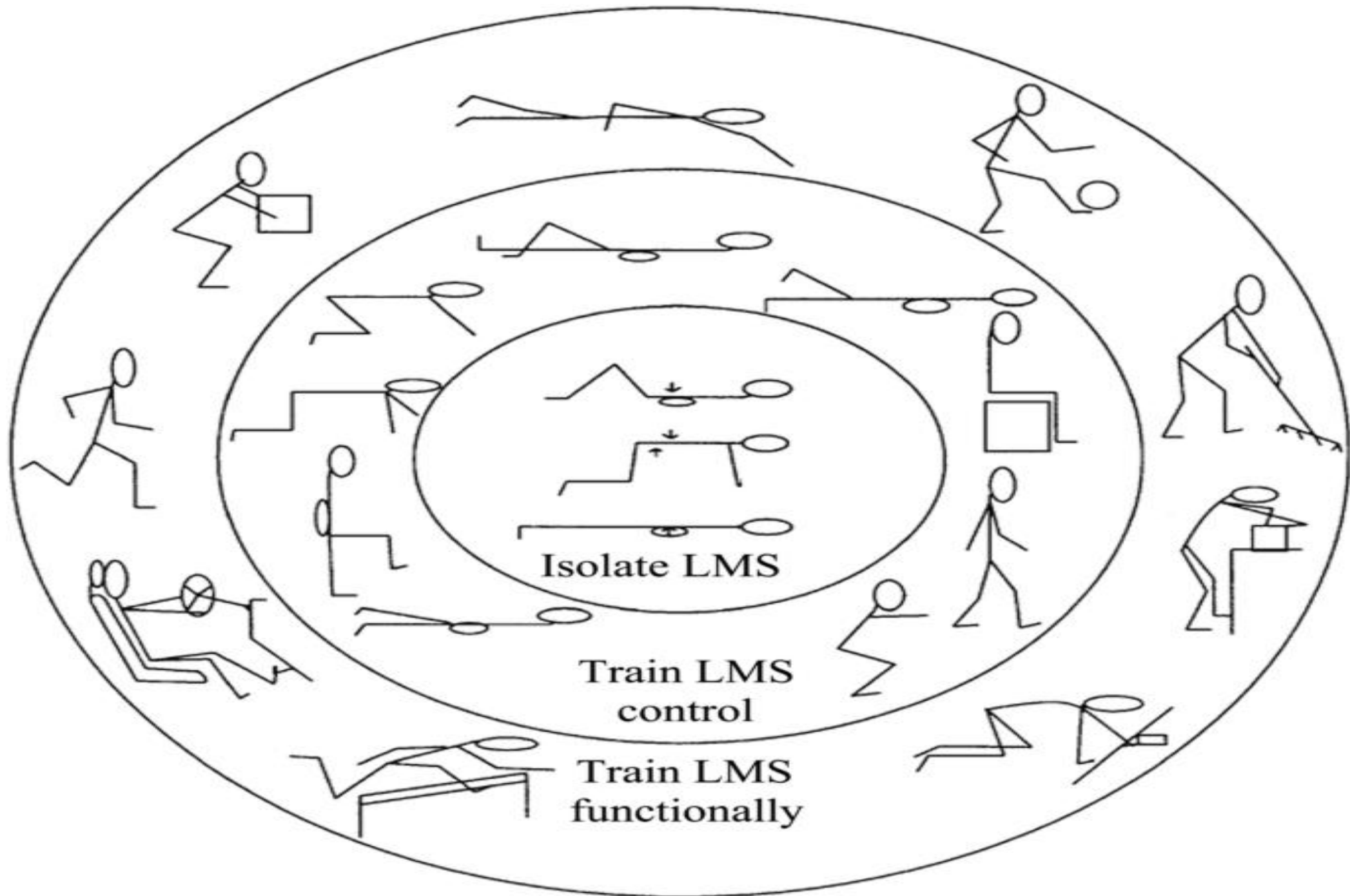
- Cryotherapy for acute pain
- Electrotherapy - Diapulse, Ultrasound, TENS
- Exercise therapy-
- Gentle spinal mobility exercises in early stages
- Gentle flexion rotatory manipulation
- Relaxed mobilisation of spine after recumbency

Firstly, the physiotherapist will evaluate your condition; check your reflexes and strength. Then, the physiotherapist will move on to the following treatments:

- **Stretching, strengthening and straightening exercises:** Before beginning these exercises, your physiotherapist will first apply cold or heat to the affected area and then proceed with a deep tissue massage or electric stimulation. When your muscles are relaxed, the exercises will begin only then. These exercises are performed to strengthen the muscles in your neck. Through these, you will learn how to improve your range of movement and posture.
- **Neck traction:** Pulling your head to stretch out your spine is called neck traction. This technique is used to improve movement and ease the pain. Traction is used to open the spaces between the vertebrae gently in order to ease pressure on the distressed discs. Traction is done continuously or sporadically, with short periods of rest in between. If you cannot find the right physiotherapist to do this for you, there are devices to help you stretch your spine.
- **Cervical collars and pillows:** Neck pillows or cervical pillows, are made to keep your neck steady while you sleep. Cervical collars are also called neck braces which are used to support the neck. While cervical collars have been proven to be quite beneficial, there isn't much evidence to support cervical pillows in treating cervical spondylosis. You can always consult physiotherapist before purchasing a cervical pillow.

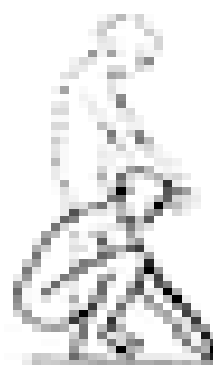
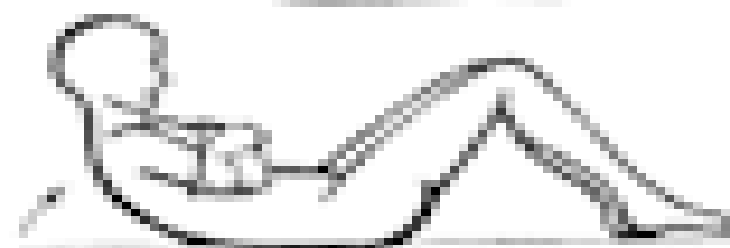


# Local muscle system



# Williams Flexion

- ⌚ Pelvic Tilt
- ⌚ Single knee to chest
- ⌚ Double knee to chest
- ⌚ Partial sit up
- ⌚ Hamstring stretch
- ⌚ Hip flexor stretch
- ⌚ Squat



# Williams flexion exercises

- Pelvic Tilts
- Partial sit-ups
- Knee-to-chest
- Hamstring stretch
- Standing lunges
- Seated trunk flexion
- Full squat





Exercise 1



Exercise 2



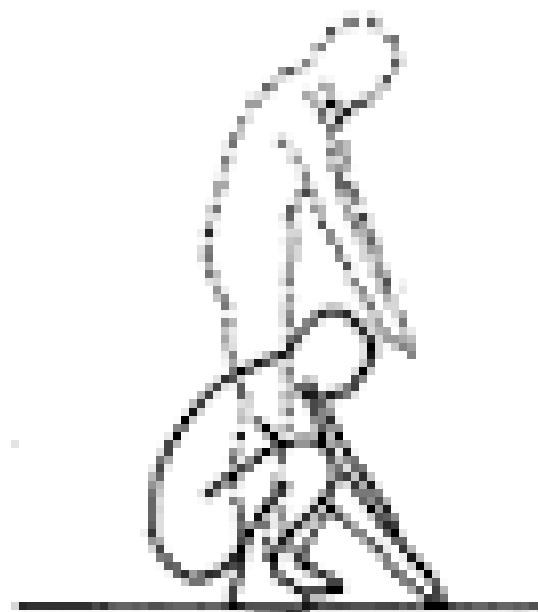
Exercise 3



Exercise 4



Exercise 5



Exercise 6

# Main exercise for spondylolisthesis:



1. Single knee to chest



2. Double knee to chest



3. Hip flexors stretching



4. Hamstring stretching



5. Piriformis stretching



6. Heel slide



7. Bridging



8. Partial curl up



9. Diagonal curl up



10. Leg cycling

# Spondylolysis and Spondylolisthesis Rehabilitation Exercises



Pelvic tilt



Dead bug exercise



Gluteal stretch



Partial curl



Double knee to chest



Quadruped arm/leg raise



Side Plank

Level 1

Level 2

Level 3

Level 4

Trunk stabilization & posterior chain strength and endurance

Superman



Hip raise



Leg raise



Lower limbs & hip muscles strength

Squat



Hip abduction





### Side-lying gluteus medius (clamshells)

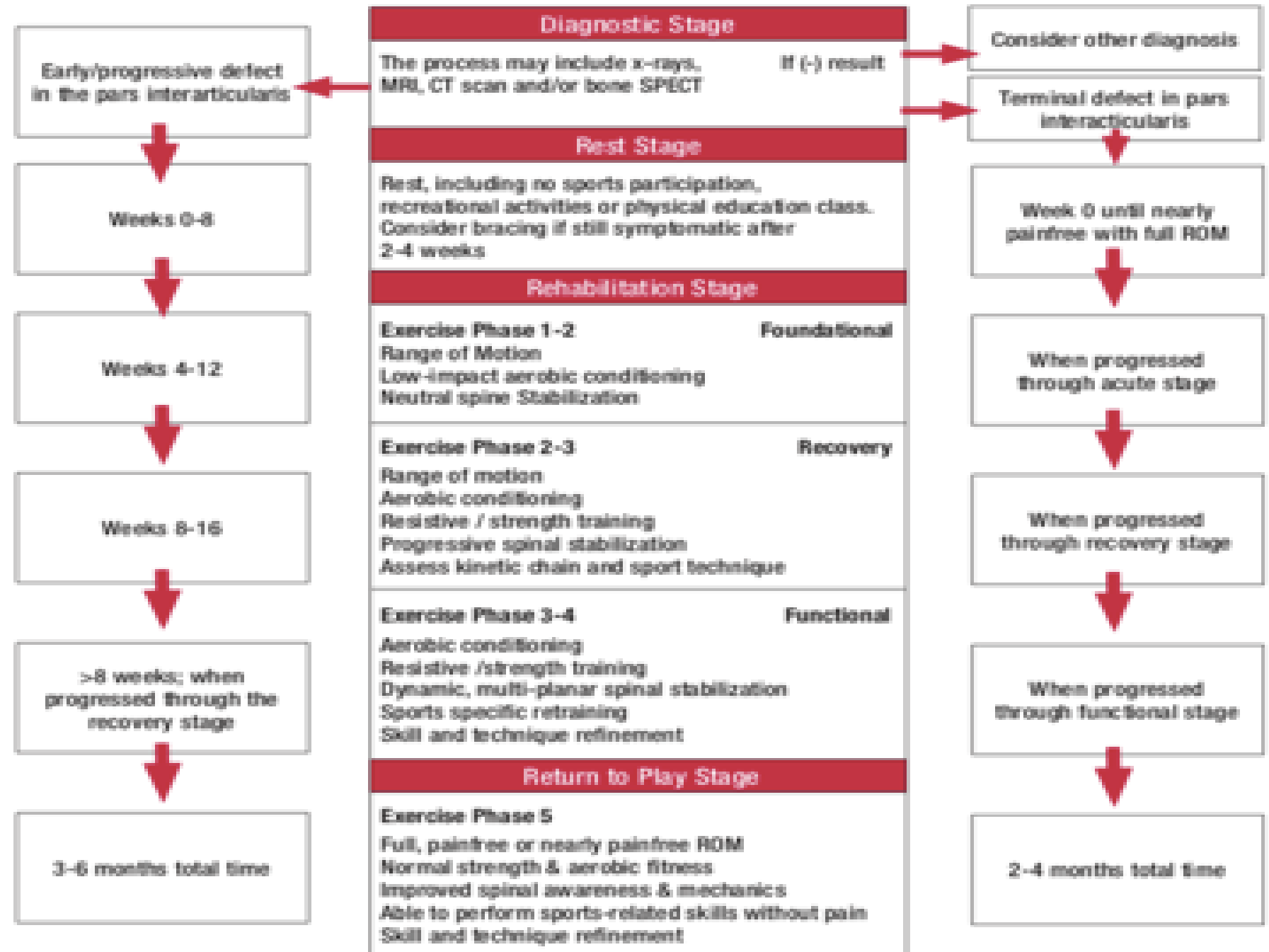
- (i) Lie on your side with your knees bent
- (ii) Tie an elastic band around your knees
- (iii) Activate your TA, then lift and lower your upper knee without moving your pelvis, keeping feet together

Repeat  $2 \times 10$  reps

Avoid: rocking the pelvis or trunk



# Guidelines



# Physical Therapy Management

- Spondylolisthesis should be treated first with conservative therapy, which includes physical therapy, rest, medication and braces.
- The Rehabilitation exercise program should be designed to improve muscle balance rather than muscle strength alone.
- Good exercise choices include:

# Static Stretches

## Static hamstring stretch



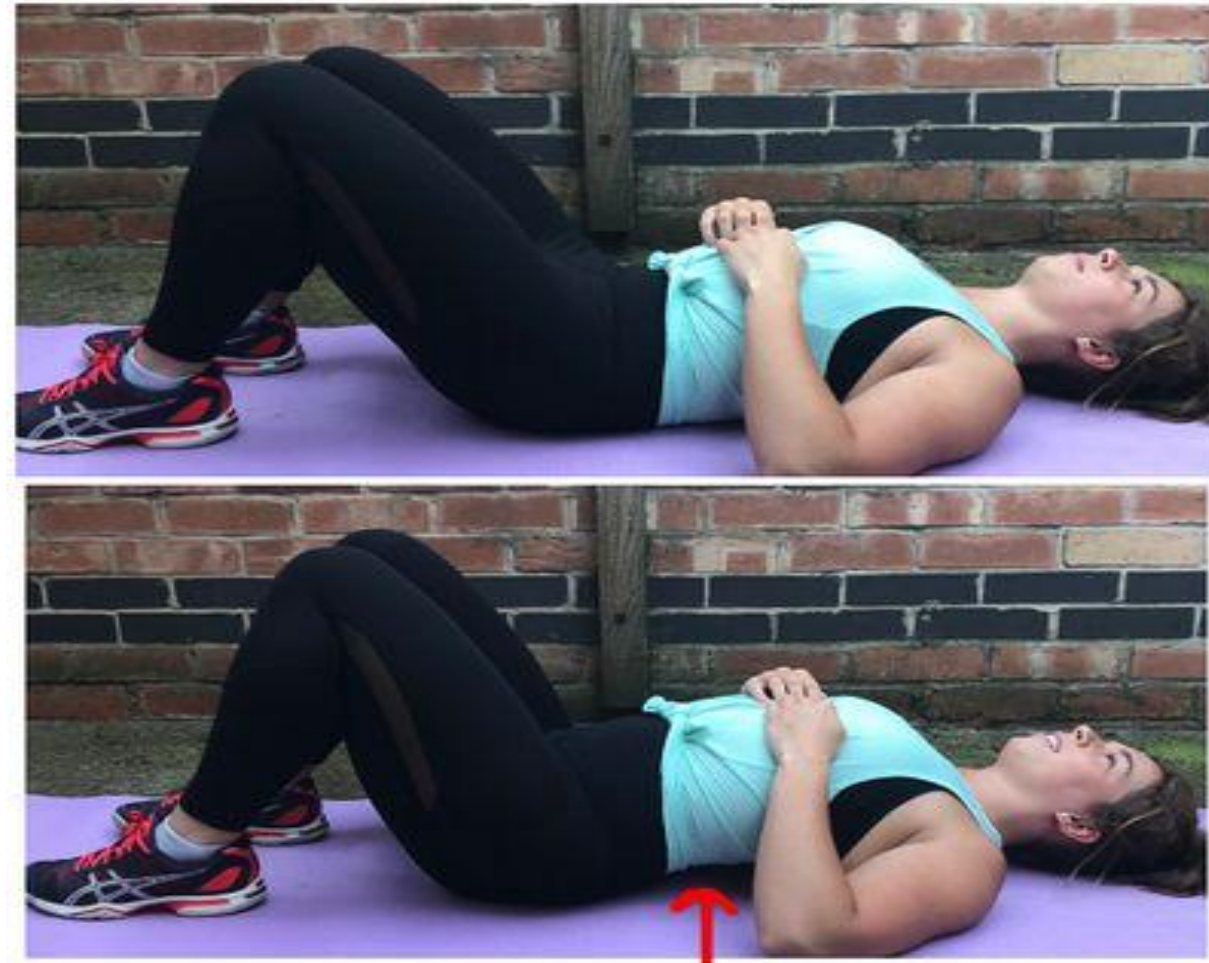


# Static hip flexor stretch



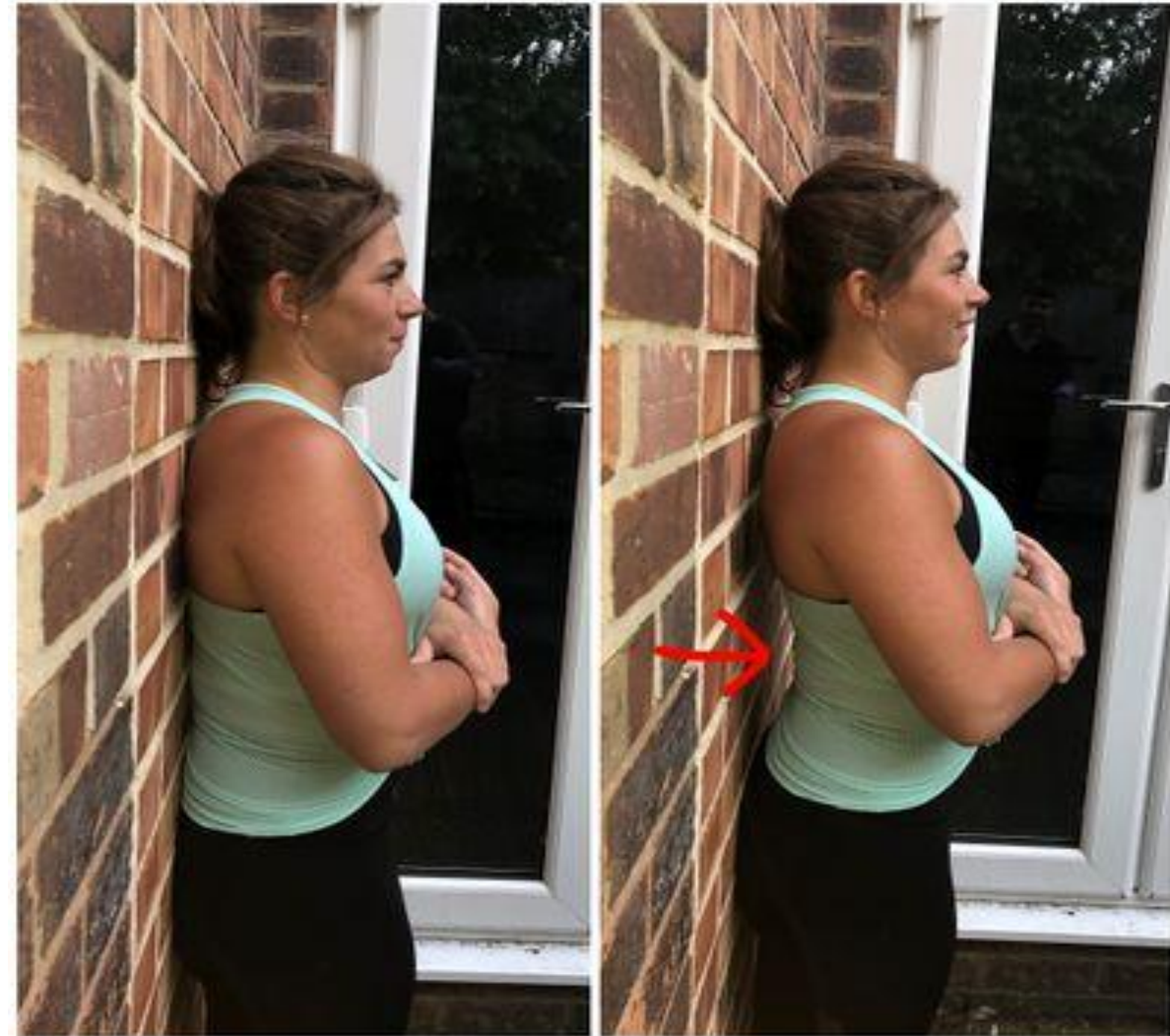
# Core Stabilization

Transverse abdominis activation:  
Early stage exercise



# Core Stabilization

Transverse abdominis activation:  
Late stage exercise





# Rectus abdominis training

## Early stage exercise



# Rectus abdominis training

## Later stage exercise



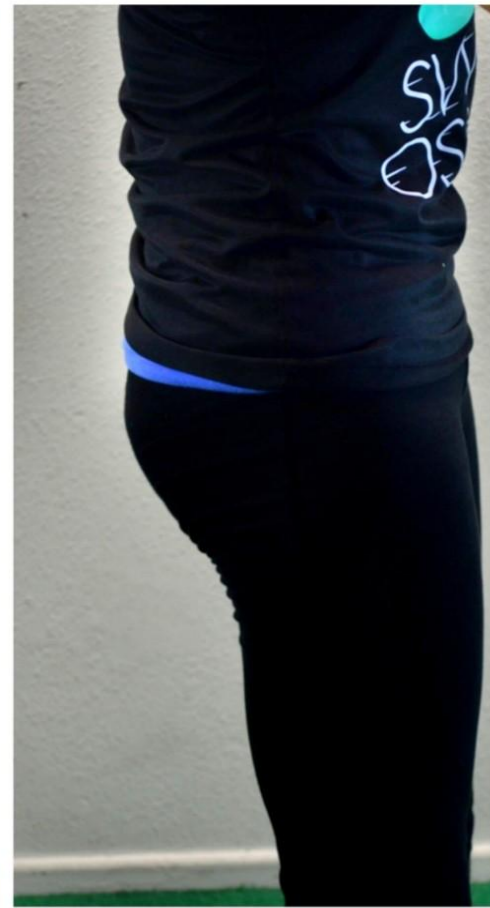
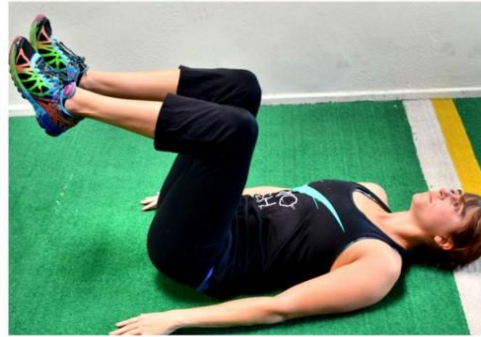
# Pelvic tilt control

## Early stage exercise





# Pelvic tilt control Later stage exercise



# Standing arm exercise for spondylolisthesis



**Starting position**

**Final position**

# Plank





# bridge



**Starting position**



**Final position**

# Outcome Measures

- Disability: Oswestry Disability Index, the SF-36 Physical Functioning scale, the Quebec Back Pain Disability Scale
- Dysfunctional thoughts: Short Form of the Medical Outcomes Study (SF-36)
- Pain: Pain Numerical Rating Scale, VAS.
- Quality of life: Short-Form Health Survey
- Kinesiophobia and Catastrophising:
  - ✓ Tampa Scale for Kinesiophobia,
  - ✓ Pain Catastrophising Scale

# Summary of rehabilitation:

- **Isometric and isotonic exercises** beneficial for strengthening of the **main muscles** of the **trunk**, which **stabilize the spine**. These techniques may also play a role in pain reduction.
- **Core stability exercises**, useful in reducing pain and disability in chronic low back pain in patient with spondylolisthesis.
- **Movements in closed-chain-kinetics, antilordotic movement patterns** of the spine, **elastic band exercises in the lying position**
- **Gait training**
- **Stretching and strengthening exercises**, to agonist muscle tightness, antagonist weakness, or both, which may result in **decreased lumbar lordosis**.
- In order to improve the patient's mobility stretching exercises of the **hamstrings, hip flexors and lumbar Para spinal muscles** are important.
- **Balance training** including - Sensomotoric training on unstable devices, walking in all variations, coordinative skills
- **Hydrotherapy**
- **Endurance training of muscles**, effective for chronic low back pain.
- **Cardiovascular exercise**
- **Williams flexion** exercises are a set of exercises that decrease lumbar extension and focuses on lumbar flexion.

از همراهی شما سپاسگزارم





# Physiotherapy of Spondylolysis

By: Elizabeth Ushry

# Identification of Injury

---

- Anatomy
- Suffers
  - Who does this condition affect?
- Diagnosis
- Etiology
- Pathology
- Signs & Symptoms
- Immediate Treatment
  - Why would this condition be handled that way



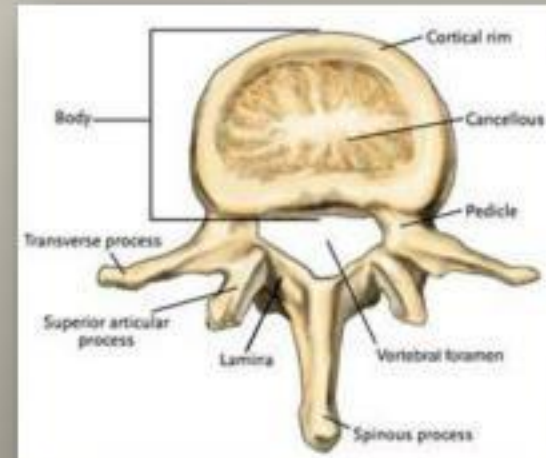
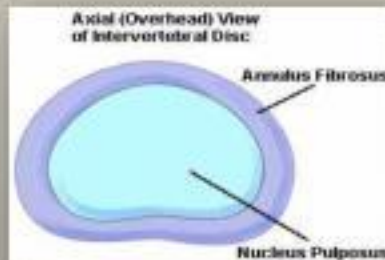
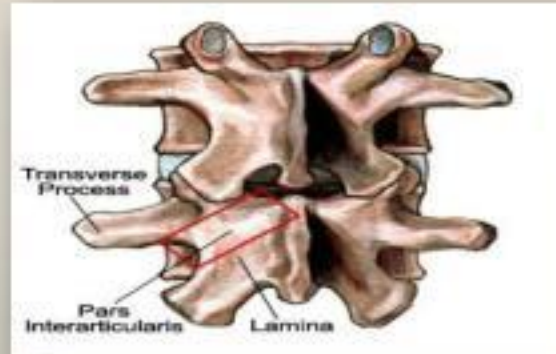
# Spondylolysis

- Define
  - Pars interarticularis
- This condition is most commonly seen in the lumbar spine and is brought on by repetitive stresses such as hyperextension.
- The defect present in spondylolysis is said to mimic a collared Scotty dog where the collar is the stress fracture



# Anatomy

- Pars Interarticularis
  - Area between the superior and inferior facets
- Lumbar Spine
  - L1-L5
  - Vertebral body
  - Disc
    - Nucleus pulposus
    - Annulus fibrosus
  - Pedicles
  - Laminae
  - Facet Joints





# Population of Suffers

- Spondylolysis is seen in sports requiring repetitive hyperextension motions of the spine
- Incidence is higher in the young athletic population than the general population
  - Gymnastics
  - Football
  - Wrestling
  - Diving



# Sports a Closer Look

- Elite athletes are practicing their skills daily
- Repetitive motions of hyperextension can cause serious trauma to the spine



# Diagnosis

- History
- Inspection
- Palpation
  - +L5
  - +disc and/or facet depending on the phase
- Range of Motion
  - Limited extension of the spine
- Strength
  - Not tested due to pain
- Special Test
  - Stork Standing Test
- Final diagnosis is seen on an oblique lumbar radiograph which will show the Scotty dog defect

Hmm...does this hurt?



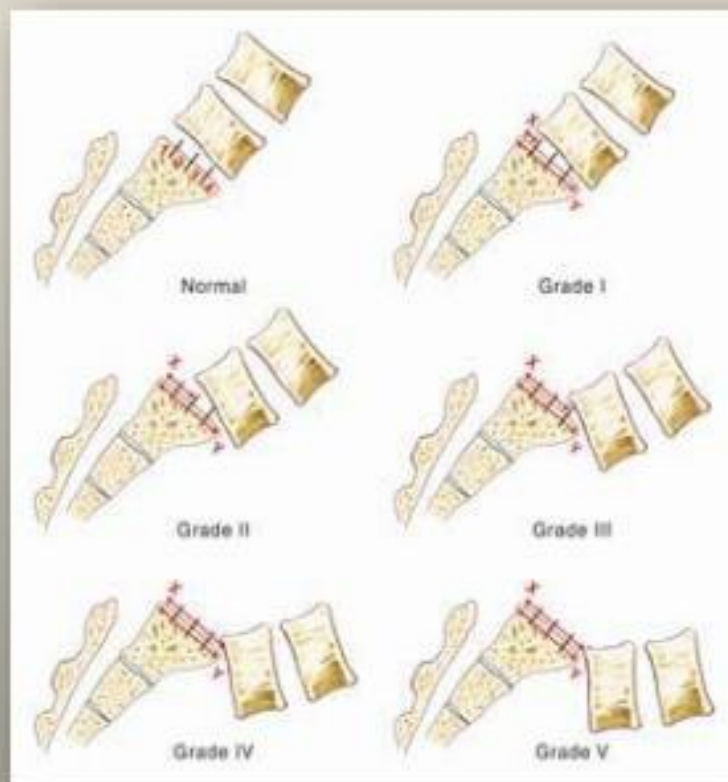
# Etiology

- What causes spondylolysis?
  - Congenital
  - Developmental
- Congenital
  - Genetically predisposed weakness in the pars interarticularis
  - 1<sup>st</sup> degree relative
- Developmental
  - Fatigue fracture
  - Minor trauma
  - Fifth lumbar

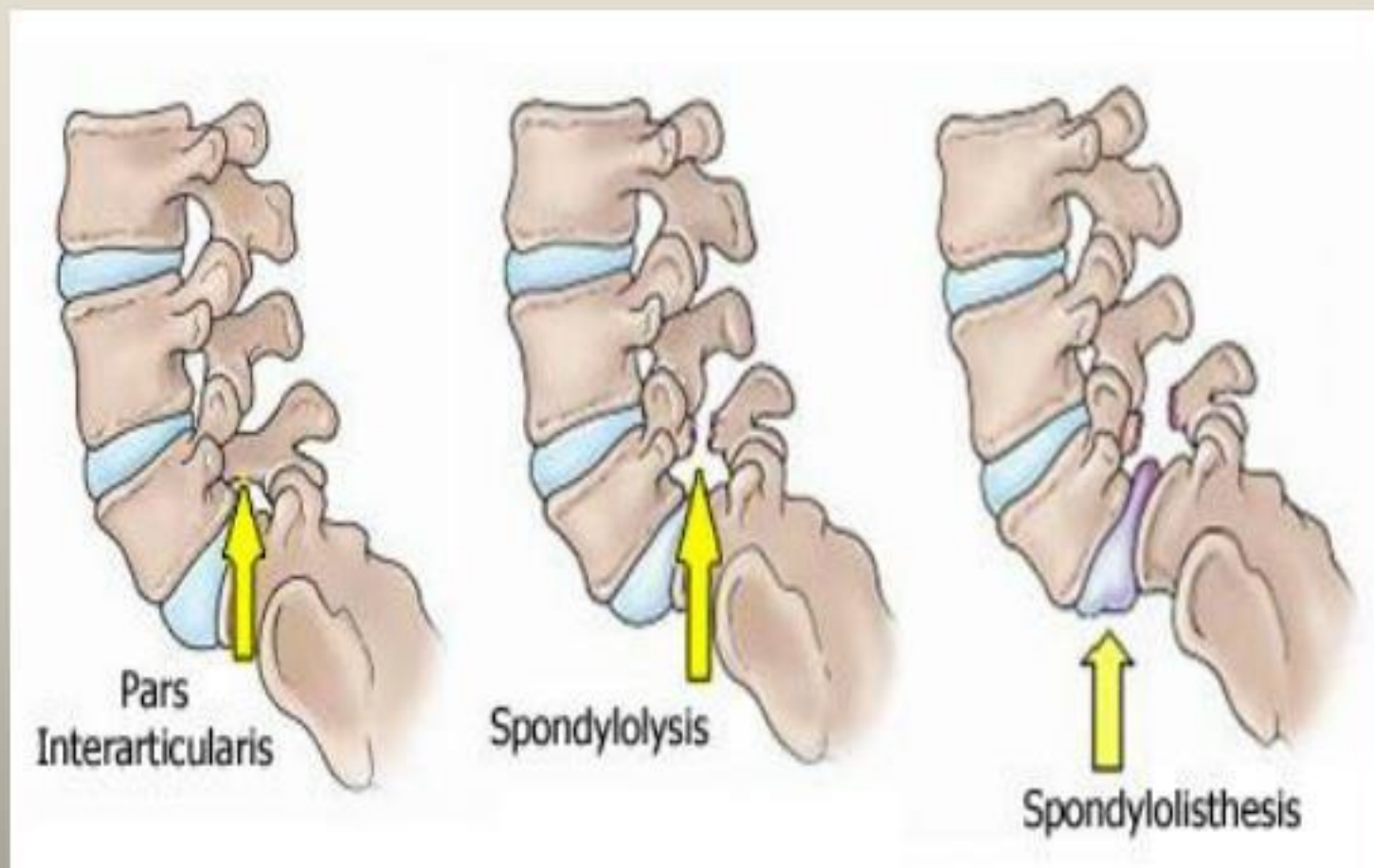


# Pathology

- Spondylolysis can occur unilaterally and bilaterally
  - Bilateral defects
- Spondylolysis may progress to spondylolisthesis
  - Severity
  - Population of Suffers
    - gymnasts
  - Evaluation
- Grading Scale
  - Grade I
  - Grade II
  - Grade III
  - Grade IV
  - Grade V

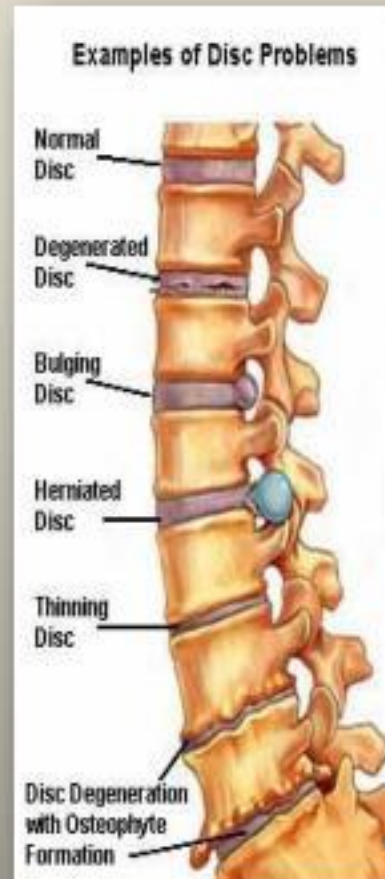


# Progression from Spondylolysis to Spondylolisthesis



# Pathology

- Spondylolysis in elders
- Fracture never completely healing
  - Asymptomatic
- Osteoarthritis
  - Osteophyte formation
- Degenerated disc
  - Bulging disc
  - Herniated disc





# Signs & Symptoms

- Stiffness
- Pain
  - Type
  - localized
- Restricted range of motion
- Muscle spasm
- Hamstring tightness
- Gait
- Hyper-lordotic curve



# Rationale for Immediate Treatment

- After diagnosis
- No lifting
- Bracing
- Modalities to control pain and muscle spasm



# Treatment Plan

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- Short Term Goals
- Long Term Goals
- Rehabilitation Program
- Return to Play Criteria & Procedures
- Procedures Used for Maintenance

# Short Term Goals

- Control Pain
  - Electrical stimulation
- Alleviate muscle spasm
- Flexibility
  - Hamstring
  - Piriformis
  - Gluteals
- Achieve pelvic stability
  - Pelvic neutral



# Electrical Stimulation Parameters

- Phase duration
- Frequency
- Treatment Time
- Electrode Placement
- IFC
- Description
- Goal



# Long Term Goals

- Improve gait
- Maintain pelvic neutral
  - What is pelvic neutral?
- Strengthen abdominals
- Regain range of motion

# Rehabilitation Program

- Acute Stage
  - Flexibility
  - Range of motion
  - Strength Training
  - Learning Pelvic Neutral
  - Low impact aerobic training
- Patient is asymptomatic
- Rest stage from diagnosis to week 12
- Progression
- Should be performed at least 3 times a week

# Flexibility

- Hamstrings
  - Knee flexion
- Piriformis
  - Hip external rotation
- Gluteus Maximus
  - Hip extension





# Range of Motion

- Trunk Flexion
- Trunk Rotation only if pain is absent
- Lateral bending



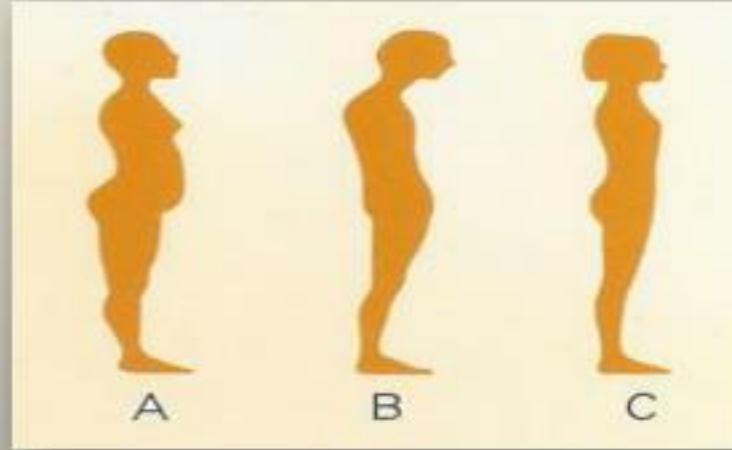
# Strength Training

- Latissimus Dorsi
  - Lat Pull Downs
- Abdominals
  - Core stabilization movements
- Gluteus maximus
  - Add a weight

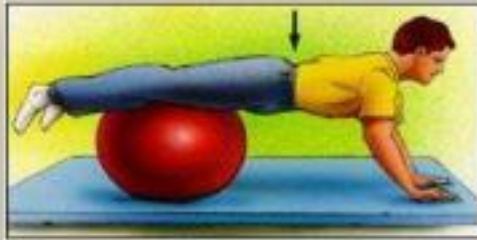


# Pelvic Stability

- Pelvic Stability is also referred to as lumbar, trunk or core stability
- Pelvic stability relies on the strength and control of several trunk muscles
  - Abdominals
  - Transverse abdominis
  - Multifidus
  - Quadratus lumborum
  - Latissimus dorsi
  - Gluteus maximus
- Since trunk extension movements want to be avoided the multifidus and quadratus lumborum



# Pelvic Stability Exercises





# Low Impact Aerobic Training

- Stationary bike riding
- This would provide the athlete with the safety of non weight bearing conditions



# Rehabilitation Program

- Recovery Stage
  - Maintaining spinal stabilization
  - Aerobic training
- The recovery stage is from week 16 to 5-7 months
- Recovery to functional stage
- Permitted to slowly move in extension range of motion

# Maintaining Stabilization



# Maintaining Stabilization

- Side Foot Reach
- Lateral Glide
- Pelvic Circles
- These exercises are done in order to demonstrate the ability to find pelvic neutral in the midst of all the movement



# Aerobic Training

- The patient is now allowed to graduate to a treadmill from the stationary bike
- The patient must be stretched prior to aerobic training
- They are permitted to doing training on the treadmill that coincides with their sport



# Rehabilitation Program

- Functional Stage
  - Sport-specific retraining
  - Aerobic training
    - All the athletes will be maintaining the aerobic status achieved in the functional stage
    - They can progress if the sports requires it
- There are four different sports that are involved with spondylolysis
  - Gymnastics
  - Football
  - Diving
  - wrestling
- Their individual functional stage program will differ
- The athletes will be performing extension movements

# Gymnast Sport Specific

- The gymnast will be performing basic movements
  - Back flip
  - Front flip
- They will all be assisted until the athlete feels comfortable
- All from a standing position
- The gymnast will progress to running and performing stunts



# Football Sport Specific

- The football players will begin basic drills to ease them back into the game
  - Running drills to gain agility
  - Side steps
  - Plyometric
- The wide receiver is focused on since they do most of the catches that sometimes require the extension of the back.





# Diving Sport Specific

- Before entering the water the diver can perform drills in a harness to get them use to their diving style and the extension type movements
- They can also lie on the floor in their original stance before diving



# Wrestling Sport Specific

- Full contact sport 100%
- Starting position
- The lumbar spine will continue to take on heavy loads throughout the match
- Asymptomatic to symptomatic



# Rehabilitation Program

- Return to Play Criteria & Procedures
  - When all the mentioned rehabilitation is complete
  - Full and pain free range of motion
  - Normal strength
  - Appropriate aerobic fitness for the specific sport
  - Spinal awareness and mechanics
  - Able to perform sports-related skills without pain
- When the athlete is admitted back to the sport they will not be at full intensity
- They will wean themselves back into 100%



## Procedures Used for Maintenance

- The athlete can continue to use modalities such as a cold whirlpool after activity
- Electric Stimulation
  - Not too often so the body does not accommodate
- Maintain flexibility of the hamstring
- Maintain core stabilization





# Discussion

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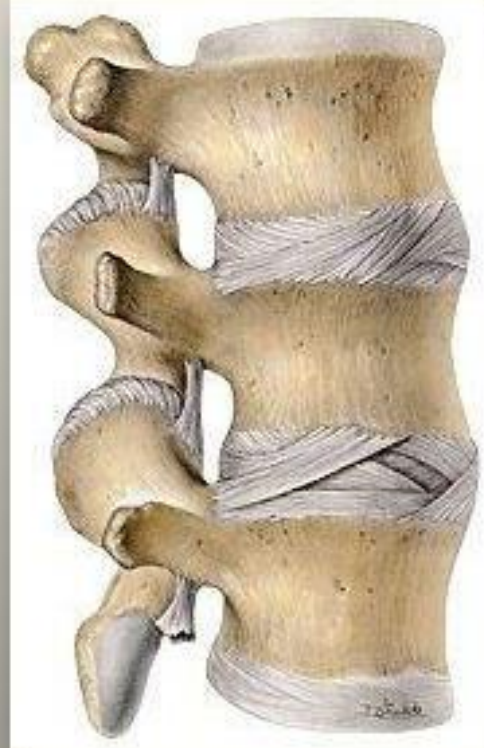
- Rationale of Therapeutic Exercise Program
- Common Problems with this condition
- Prognosis of the Injured Athlete
- Article
  - A Systematic Review of Physiotherapy for Spondylolysis and Spondylolisthesis

## Rationale for Therapeutic Exercise Program

- Why flexibility?
- Pelvic Tilt
- Hamstring tightness
- Abdominal strength
- Tight paraspinal musculature
- Maintaining pelvic neutral, abdominal strength and flexibility is key

## Common Problems with this Condition

- The fracture never fully heals
- Non-compliable to bracing
- In older clients more pathologies are present
  - Difficult to relieve pain



## Prognosis Injured Athlete

- If the athlete is diligent with rehabilitation they can return to play at the 5-7 month mark
- Depending on the sports, symptoms may resurface requiring removal from activity
- The athlete should continue measures to maintaining flexibility and core stabilization



# Article

- Incidence
  - Spondylolysis occurs in 6% of the population
  - Childhood 5% and 6% Adulthood
  - Boys to girls and men to women
  - Condition is common in sports like weight lifting, skiing, racquet sports, football, gymnastics, diving, wrestling, and rowing
  - Incidence of spondylolisthesis is between 2-6%
- Aetiology
  - Congenital Theory
  - Developmental Theory
- Signs and Symptoms
  - Pain
  - Restricted ROM
  - Muscle spasm
  - Abnormal gait
  - Hamstring tightness

# Article Continued

- Treatment
- Non-operative treatment is recommended
  - Physiotherapy includes
    - Modalities for pain relief
    - bracing,
    - Exercise
    - Electrical stimulation
    - Activity modification
- Discussion
  - Two articles were evaluated out of 71
  - The treatment group did exceptionally better than the control group
  - The O'Sullivan article focused on the rehabilitation of spondylolysis and spondylolisthesis
  - His treatment choice was focused on stabilization
  - Statistics showed his TG showed sign improvement at 30 months when compared to the control groups

Any Questions??

