بسم الله الرحمن الرحيم

# Laboratory

RHS 221
Manual Muscle Testing
Theory – 1 hour
practical – 2 hours
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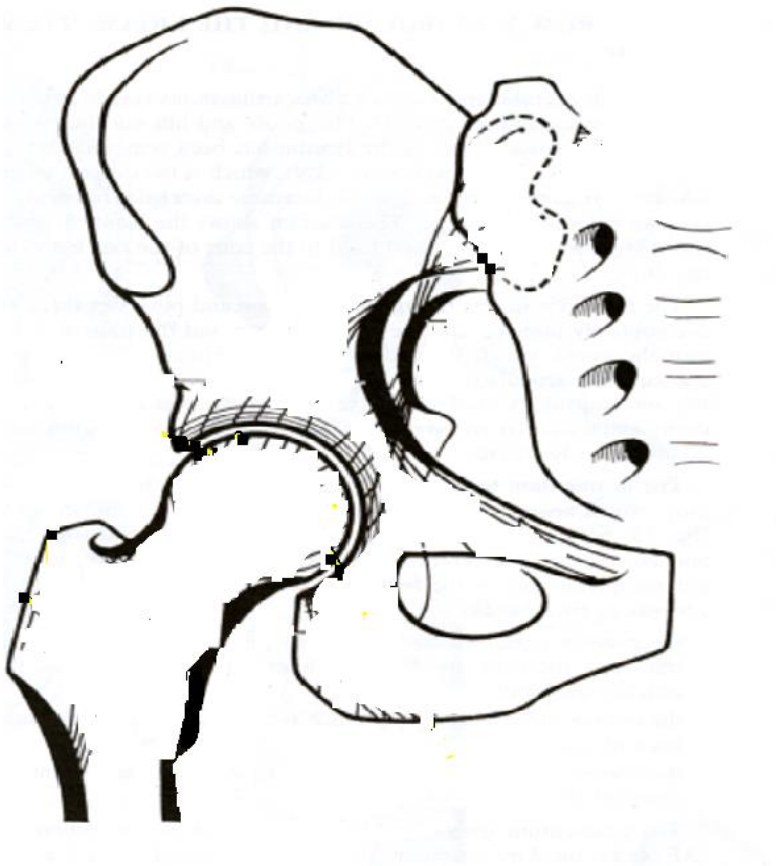
# Content Outline

- Brief Review of Anatomy
- Evaluation of the Hip Joint
- Muscle Testing and rang of motion measurement of the Hip Joint

# MUSCULOSKELETAL ANATOMY

# THE HIP JOINT

- Articulation of the femoral head with the acetabulum of the innominate



# GENERAL CHARACTERISTICS

- Ball and socket joint
- 3 degrees of freedom
- Loose-Packed/Resting Position: a point in the range of motion of a joint at which articulating surfaces are the **least congruent** and the supporting structures are the most laxity.

  Example: the hip joint:

  **30 degrees flexion, 30 degrees abduction, & slight external rotation.**

- Closed-Packed Position: the position that both of the articular surfaces are in the **maximum congruency** status for a joint, resulting in the greatest mechanical stability for that joint.
- In close-packed position, most ligaments and capsules surrounding to **the joint are taut**.

  Example:

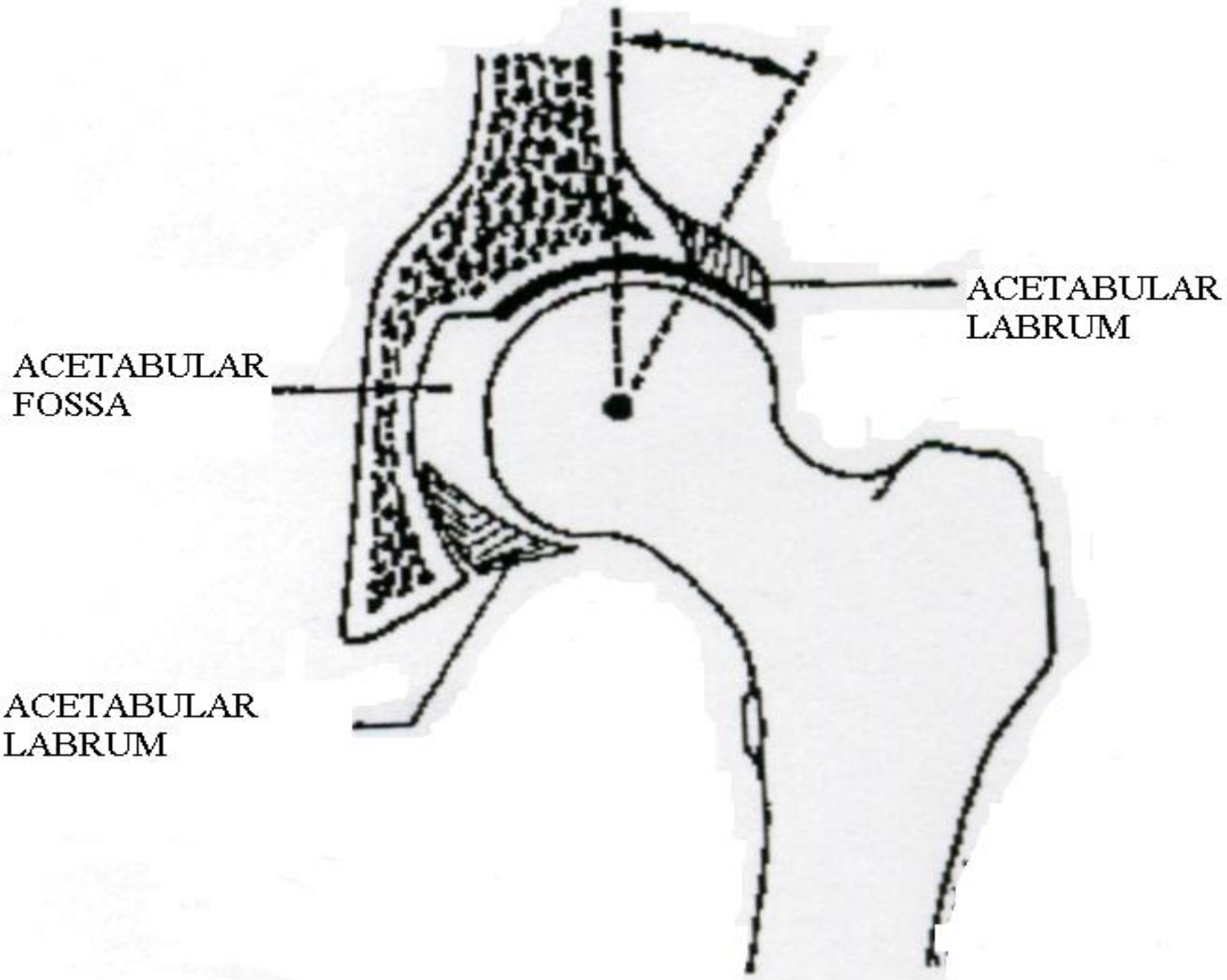
  **Extension with slight adduction and internal rotation.**

# INNOMINATE

- **Acetabulum**: Site of articulation with femoral head
- Deepened by fibrocartilagenous labrum (a structure corresponding to a lip)
- Orientation: lateral, anterior, and inferior.

◦ *NOTICE*: both the femoral head and labrum are oriented anteriorly; therefore the femoral head is not completely covered by the acetabulum.

# CENTER EDGE ANGLE

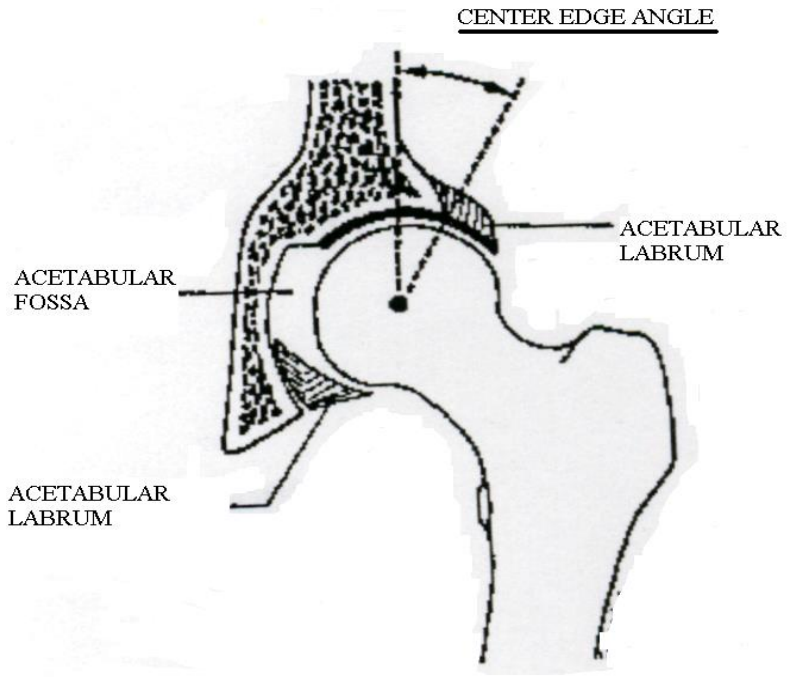


# ARTICULAR CARTILAGE

- **Acetabular**
  - Thickest superiorly.
    - Avascular
    - Not innervated
- **Femoral**
  - Thickest superiorly- posteriorly
  - Thinnest inferior

# ACETABULAR LABRUM

- **Acetabular Labrum**: Fibrocartilagenous ring attached to periphery of the acetabulum
  - Triangular Shape



# JOINT CAPSULE

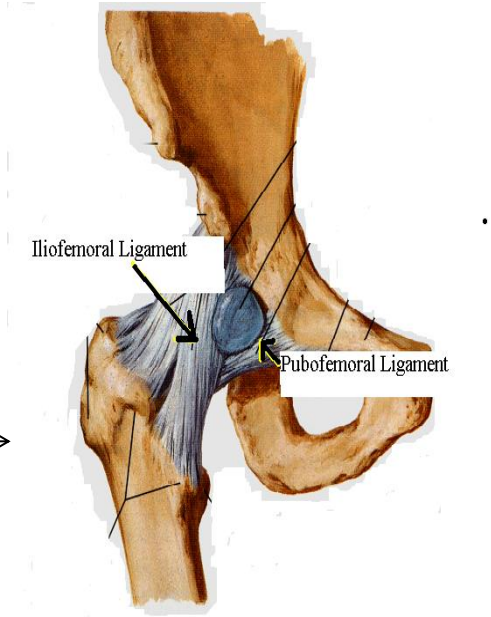
- Dense, relatively inelastic, fibrous capsule
- Attachments
  - Medially: Acetabular rim
  - Laterally: Base of femoral neck

  *2/3 of the femoral neck is intracapsular
- Thickest anterior/superior, thinnest posterior/inferior

# LIGAMENTS

- **Anterior Ligaments**
  - **Iliofemoral Ligament** (Y Ligament of Bigelow)
    - Runs from AIIS, fanning out to the intertrochanteric line
    - Limits **extension** & **external rotation**; inferior band can limit abduction; superior band can limit adduction
    - **The strongest** ligament of the hip
  - **Pubofemoral Ligament**
    - Runs from pubic ramus to the intertrochanteric fossa
    - Limits **extension** and **abduction**

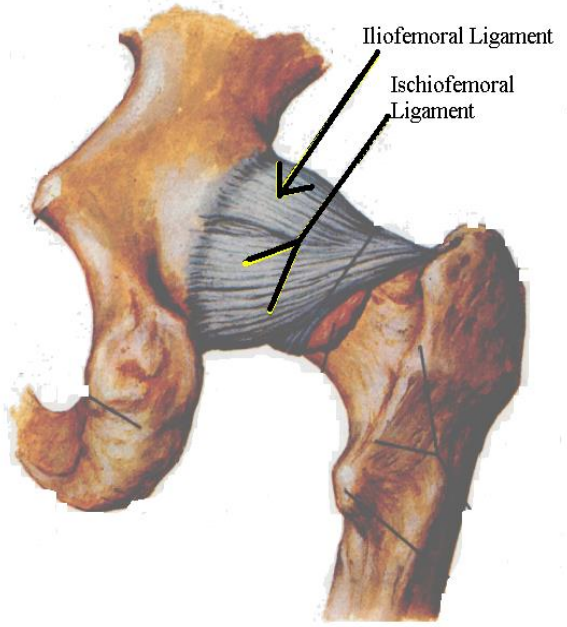
Anterior view



# LIGAMENTS

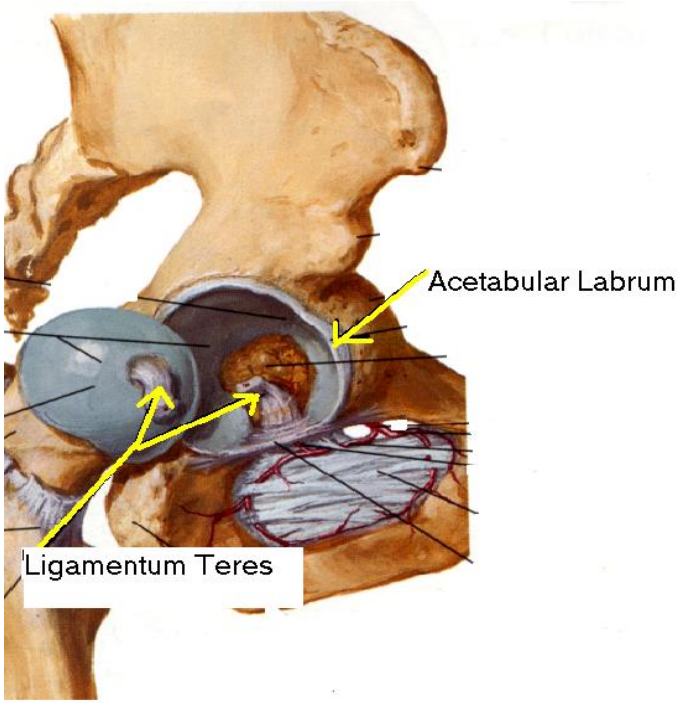
- **Posterior Ligaments**
  - Ischiofemoral Ligament
    - Runs from posterior surface of acetabulum to the medial surface of the greater trochanter
      - Some fibers blend with those of the zona orbicularis.
    - Limits **extension** and **internal rotation**.

Posterior view



# LIGAMENTS

- Intracapsular Ligament:
  - **Ligamentum Teres**
    - Triangular-shaped band arising from the acetabular fossa and transverse acetabular ligament to the fovea and femoral head



# BURSAE

- **Trochanteric**
- **Iliopsoas**(the largest bursa in the body)
- **Ischial**

# MUSCLES BY PRIMARY FUNCTION

- Flexion: Iliopsoas, Rectus Femoris, TFL
- Extension: Gluteus Maximus,Hamstrings
- Abduction: Gluteus Medius, Gluteus Minimus, TFL
- Adduction: Adductor Magnus, Longus, & Brevis, Gracilis
- External Rotation: Piriformis, Obturators, Gemelli
- Internal Rotation: Not the primary function of any muscle, however, some resent articles found that the Gluteus minimus is the prime mover for IR.

# EVALUATION
# Initial Physical Examination

# HISTORY

- Onset:
  - Traumatic/Sudden Episode:
  - Gradual Onset:
  - Insidious
    - Without certainty of cause, these injuries may be difficult to treat.
    - Be aware of other signs/symptoms that may warrant a lower quarter screening or referral to the appropriate medical professional.

# SYMPTOM DESCRIPTION

- Nature of Symptoms:
  - Stiffness.
  - Parasthesia.
  - Burning/Shooting.
  - Locking/Catching.
  - Weakness.
  - Feeling of Instability.

# SYMPTOM LOCATION

- Anterior/Groin
  - Hip joint, soft tissue, L1, L2, or L3 root levels.
- Medial/Adductor Region
  - Adductor musculature, Pubic bones articulations.
- Lateral/Greater Trochanter Region
  - Structures region of the greater trochanter, L5 root level.
- Buttock Region
  - Tissue in posterior region, Referred symptoms (Sxs) from the SI joint region, S1,or S2 root levels

***Be aware of c/o knee pain; particularly in the pediatric population.***

# MEDICAL HISTORY

- The hip, back or other lower extremity injuries.
- Childhood Disorders.

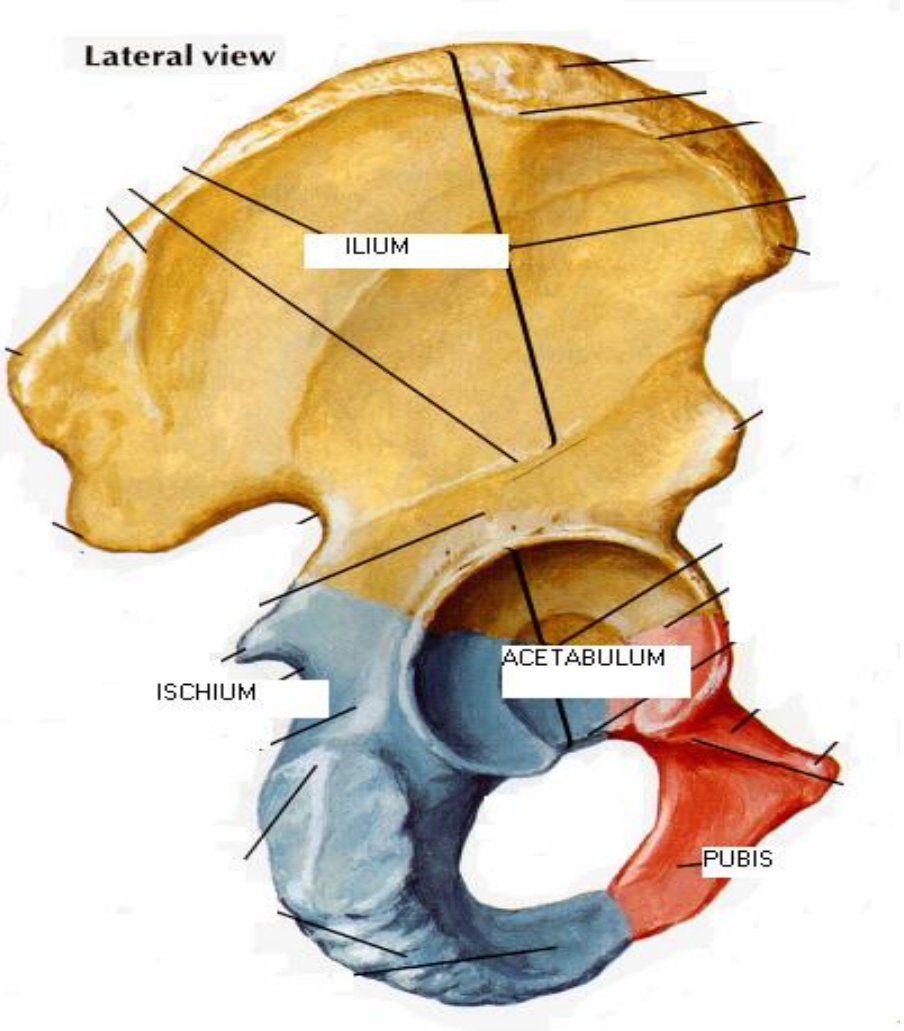
# PHYSICAL EXAMINATION OF THE HIP JOINT

# STATIC OBSERVATION

- Lower Extremity Alignment:
  - Potential compensation for biomechanical faults/abnormalities:
- Lumbar Spine Position
  - Hyperlordosis: may indicate tightness of hip flexors.
  - Decreased/flattened lordosis: may indicate tightness of hamstrings.
- Observe for muscle atrophy
  - Example: gluteal atrophy in long standing disorders

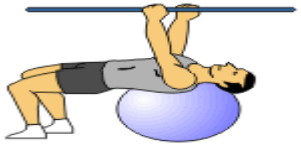
# STATIC OBSERVATION

- Pelvic Landmarks
  - Palpate the following
    - ASIS
    - PSIS
    - Iliac Crests
- Useful for implicating:
  - Leg length discrepancy
  - Sacroiliac joint involve



# GAIT OBSERVATION

- Examine for asymmetry and symptoms
- Examples:
  - Antalgic gait: Pain with weight bearing may indicate arthritic or other articular pathology.
  - Trendelenburg: Drop of pelvis to one side may suggest uncompensated abductor weakness.
  - Backward swing of trunk: May indicate hip extensor weakness on the stance leg or hip flexor weakness of the swing leg. **Assignment Video?**



# SELECTIVE TISSUE TENSION TESTING

- AROM
- PROM
- Resisted Testing

# AROM/PROM: NORMAL RANGES

- Extension: 10 to 20 degrees
- Flexion: approximately 125 degrees
- Abduction: 45 degrees
- Adduction: 30 degrees
- Internal Rotation: 45 degrees
- External Rotation: 45 degrees

*10 degrees of extension required for normal gait

**End feels are normally capsular/firm, except for flexion which is commonly that of soft tissue approximation

# CAPSULAR PATTERN

- **Limitation: IR > Flexion > Abduction.**
- **Indicative of entire capsular involvement**
  - Degenerative changes
    - IR is the earliest movement to become measurably restricted.
    - A difference of greater than 15 degrees between legs has been correlated with the presence of osteoarthritis.

# RESISTED TESTING
## (Kendall & McCreary)

- General Motion
  - Flexion –Extension
  - Adduction –Internal Rotation
  - Abduction –External Rotation
- Specific Muscles
  - Iliopsoas –Gluteus Maximus
  - TFL –Gluteus Medius

# Testing the Muscles of the Lower Extremity

1. Hip Flexion.
2. Hip Extension.
3. Hip abduction.
4. Hip flexion, abduction and external (lateral) rotation.

# Hip Flexion

1. *Prim mover /agonist:*

| | Origin | Insertion |
|---|---|---|
| ***Psoas major*** | *L1-L5 Ver. T.P* | *into Femur Lesser Troch.* |
| ***Iliacus*** | *Iliac Fossa(Up2/3)* *Iliac crest(inner lip)* | *into Femur L.Troch.* |

2. *Synergist / Accessory Muscles:*

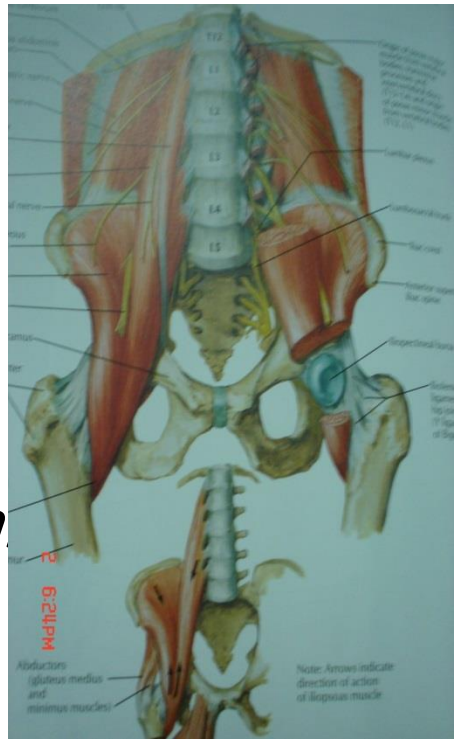
*Rectus Femoris (RF), and Sartorius, TFL.*

3. *Nerve supply:*

| Psoas major | Iliacus |
|---|---|
| ***nerve root from L2-L4*** | ***Femoral n*** |

4. *Range of motion:*

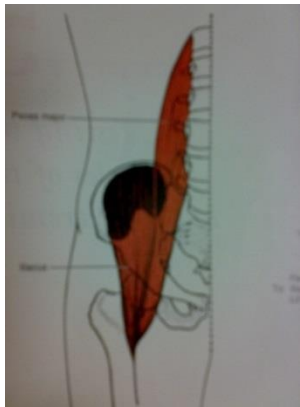
*from 0 to 120°*



# Hip Flexion

5. Fixation:
   1. **contraction of anterior abdominal muscles to fix lumbar spine and pelvis.**
   2. **weight of trunk.**

6. **Effect** of **weakness** and contracture:-**Video?**
   difficulty in: stair climbing, walking up or down the incline, getting up from a reclined position.
   **In marked weakness:** walking is difficult because the leg must brought forward by pelvic motion.
   Effect of contracture: A contracture is a tightening of muscle, tendons, ligaments, or skin that prevents normal movement:
   **Bilateral**- Increased lumbar lordosis.
   **Unilateral**- combined with hip abduction and external rot.
7. Factor Limiting of motion:
   - **With knee flexed**, contact of thigh on abdomen.
   - **With knee extended**, tension of Hamstring Ms.
8. Substitution:
   by Sartorius, and TFL (inter. Rot and abd).



# Hip Flexion

## 9. Procedures: in the Gym

**a- patient position (pt):** T he patient and the part to be tested should be positioned comfortably on a firm surface in the correct testing position

**b- Therapist Position:**

inner hand:

Outer hand:

Direction of Resistance :

Stabilization, which helps to prevent substitute movements and adds validity to the muscle test, can be provided manually or through the use of an external support such as a belt. The stabilization is applied to the proximal segment using counter pressure to the resistance.

Instruction to patient: "I'm going to test the strength of one of the muscles that bends your hip"

**c- Grading system:**

Normal(5), Good(4), Fair(3), Poor(2), Trace(1), Zero(0)

make sure patient tolerates maximal resistance plus hold 3 sec.

**e- Palpation site:**

# Hip Extension

**1. Prim mover / agonist:**

| | Origin | Insertion |
|---|---|---|
| *Gluteus Maximus* | Ilium (post. Gluteal line) | into Femur gluteal tuberosity. |
| | Sacrum dorsal (post.) surface of lower part. | |
| *Hamstrings:* | | |
| **Semitendinosus** | Ischial tuberosity | Tibia (medial shaft) |
| **Semimembranosus** | Ischial tuberosity | Tibia (medial condyle, post aspect) |
| **Biceps femoris** | Ischial tuberosity | Fibula |

**2. Synergist / Accessory Muscles:**

Adductor magnus (inferior part), Gluteus medius (post. Part)

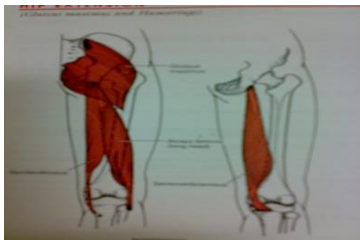
**3. Nerve supply:**

| **Gluteus Maximus** | **Hamstrings** |
|---|---|
| Inferior gluteal n. (L5-S2) | Sciatic n.(L5-S2) |

4. **Range of motion:**

from 0 to $20^0$ degrees (Hyper)

from $120^0$ to 0 (athletic)



# Hip extension

5. Fixation

a. Contraction of ilio costalis lumborum and quadratus lumborum muscle.

b. Weight of trunk.

6. **Effect** of **weakness** and contracture:-**Video?**

**Effect of weakness**: Bilaterally makes walking difficult, difficult in raising the trunk from foreword-bent position.
patient must push themselves to an upright position by using their arms during walk.

**Effect of contracture**: walking with Hyper extension deformity.

7. Factor Limiting of motion:

a. Tension of Iliofemoral ligament.

b. Tension of hip flexor muscles.

8. Substitution:

By extending lumbar spine. Therapist must support the pelvis.

# Hip Extension

9. Procedures: For: **1. Gluet. Max. and Hamst. Ms.**
**2. Isolation Test (Glut. Max.)**

*a- patient position (pt):*

**b- Therapist Position:**

inner hand:

Outer hand: Direction of Resistance :

Instruction to patient:

**c- grading system:**

Normal(5), Good(4), Fair(3), Poor(2), Trace(1), Zero(0)

make sure patient tolerates maximal resistance pluse hold 3 sec.

**e. Palpation site:**

# Hip abduction

## 1. Prim mover/ agonist:

| | *Origin* | *Insertion* |
|---|---|---|
| Gluteus Medius | *Ilium (Outer Surface)* | *into Femur Greater Troch (Lat).* |

## 2. Synergist / Accessory Muscles:

*Rectus Femoris (RF), Sartorius, TFL,*

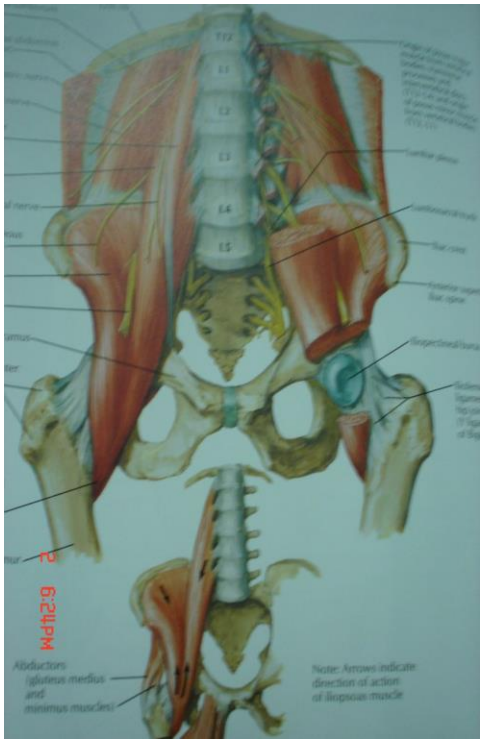
## 3. Nerve supply:

***Gluteus Medius***

*Superior gluteal n.(L4-S1)*

## 4. Range of motion:

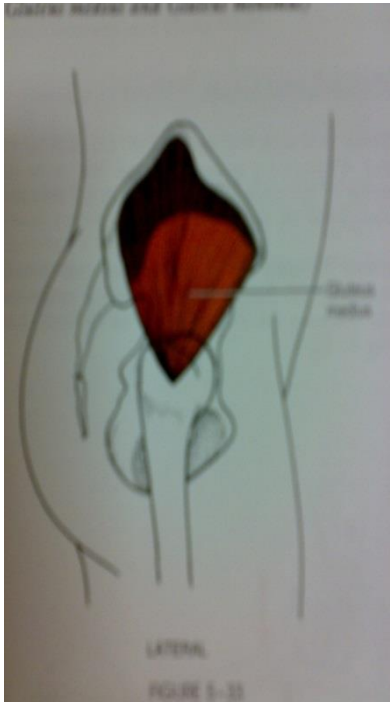
*from 0 to 45 degrees*



# Hip abduction

5. **Fixation:**
   a. Contraction of lateral abdominal muscles and latissimus dorsi.
   b. Weight of trunk
6. **Effect** of **weakness** and contracture:-**Video?**

   **Effect of weakness: unilateral- waddling gate (Trendlingburgh test)**



7. **Factor Limiting of motion:**

   a- Tension of distal band of Iliofemoral ligament and pubo-capsular ligament.
   b- Tension of hip adductor muscle.

8. **Substitution:**

   By "hike hip" by approximating pelvis to thorax, hip external rot. and flexion, and by TFL.

# Hip abduction

9. Procedures:

*a- patient position (pt):*

**b- Therapist Position**:

inner hand:

Outer hand: Direction of Resistance :

Instruction to patient:

**c- grading system**:

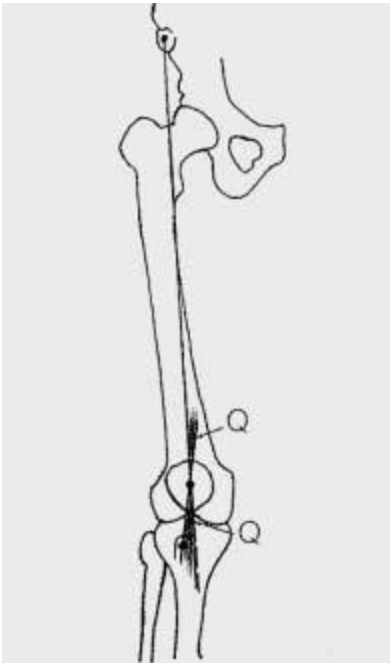
Normal(5), Good(4), Fair(3), Poor(2), Trace(1), Zero(0)

make sure patient tolerates maximal resistance plus hold 3 sec.

**e. Palpation site:**

# Gluteus Medius Weakness

- May result in excessive medial rotation of femur during stance
- May result in excessive valgus at knee
- May increase Q angle
- May result in tracking and alignment problems



# Hip flexion, abduction, and external (lateral) rotation with knee flexion

1. **Prim mover/agonist:**

| | *Origin* | *Insertion* |
|---|---|---|
| ***Sartorius*** | *ASIS (Ilium)* | *Tibia (proximal medial aspect).* |

2. **Synergist / Accessory Muscles:**

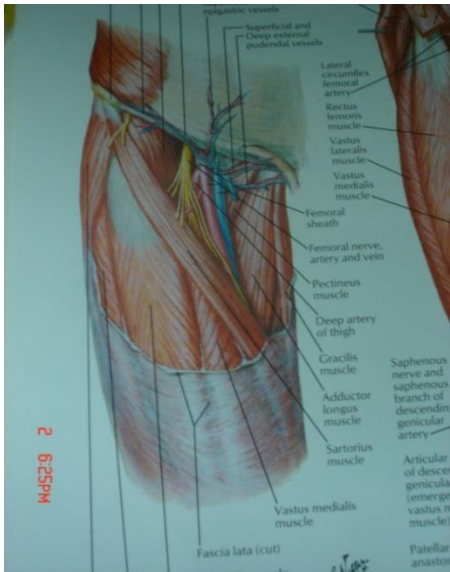
   hip and knee flexors. hip external rot. and hip abd.

3. **Nerve supply:**

   Femoral n.(L2-L3)

4. **Range of motion:**

   *NO ROM because of two-joint muscle.*



# Hip flexion, abduction, and external (lateral) rotation with knee flexion

5. **Fixation:**
   a. Contraction of abdominal muscles to fix pelvis.
   b. Weight of trunk.

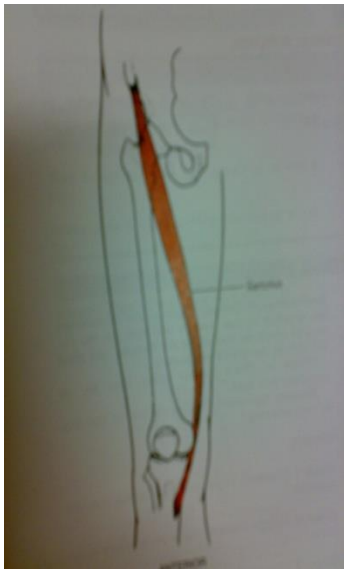
6. **Effect** of **weakness** and contracture:-**Video?**

Effect of weakness: antro-medial instability of the knee joint.

Effect of contracture: flexion, abduction and lat. Rot. Deformity of the hip with knee flexion.

7. **Factor Limiting of motion:**
   Non, because incomplete range of motion.

8. **Substitution:**
   By the Iliopsoas or the Rectus Femoris.



# Hip flexion, abduction, and external (lateral) rotation with knee flexion

9. Procedures:

**a- patient position (pt):**

**b- Therapist Position:**

inner hand:

Outer hand: Direction of Resistance :

Instruction to patient:

**c- grading system:**

Normal(5), Good(4), Fair(3), Poor(2), Trace(1), Zero(0)

make sure patient tolerates maximal resistance plus hold 3 sec.

**e. Palpation site:**

# ALTERNATIVE TEST FOR GLUTEUS MEDIUS: ***TRENDELENBURG SIGN***

- Procedure: **subject assumes unilateral stance without upper extremity assistance. Examiner observes patient from behind.**
- Interpretation:
  - Normal: Hip on opposite side should rise slightly.
  - Abnormal
    - Dropping of pelvis on the opposite side.
    - Shifting center of gravity over stance leg.

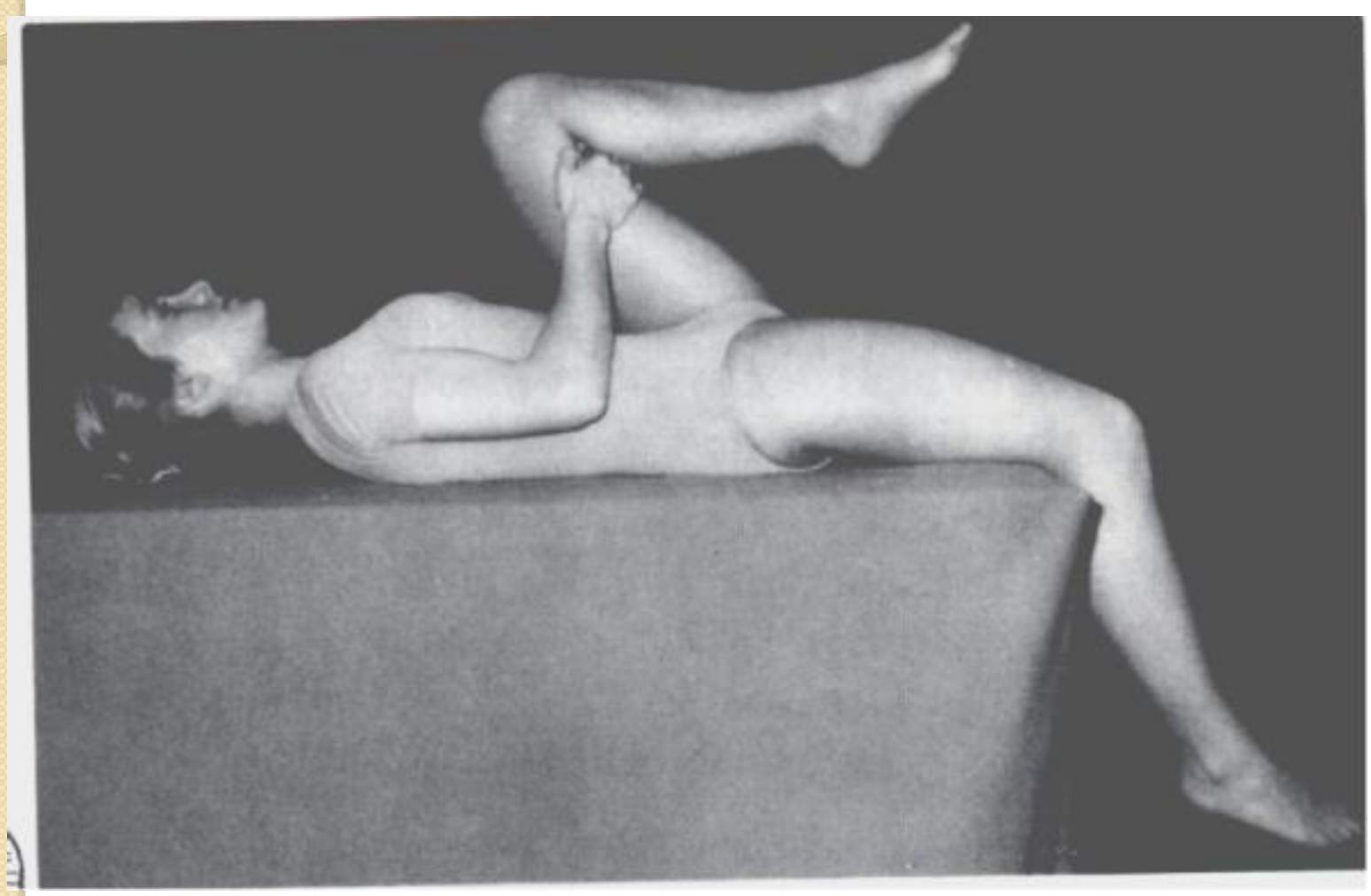
    *These findings indicate abductor weakness of stance leg.

# FLEXIBILITY TESTS

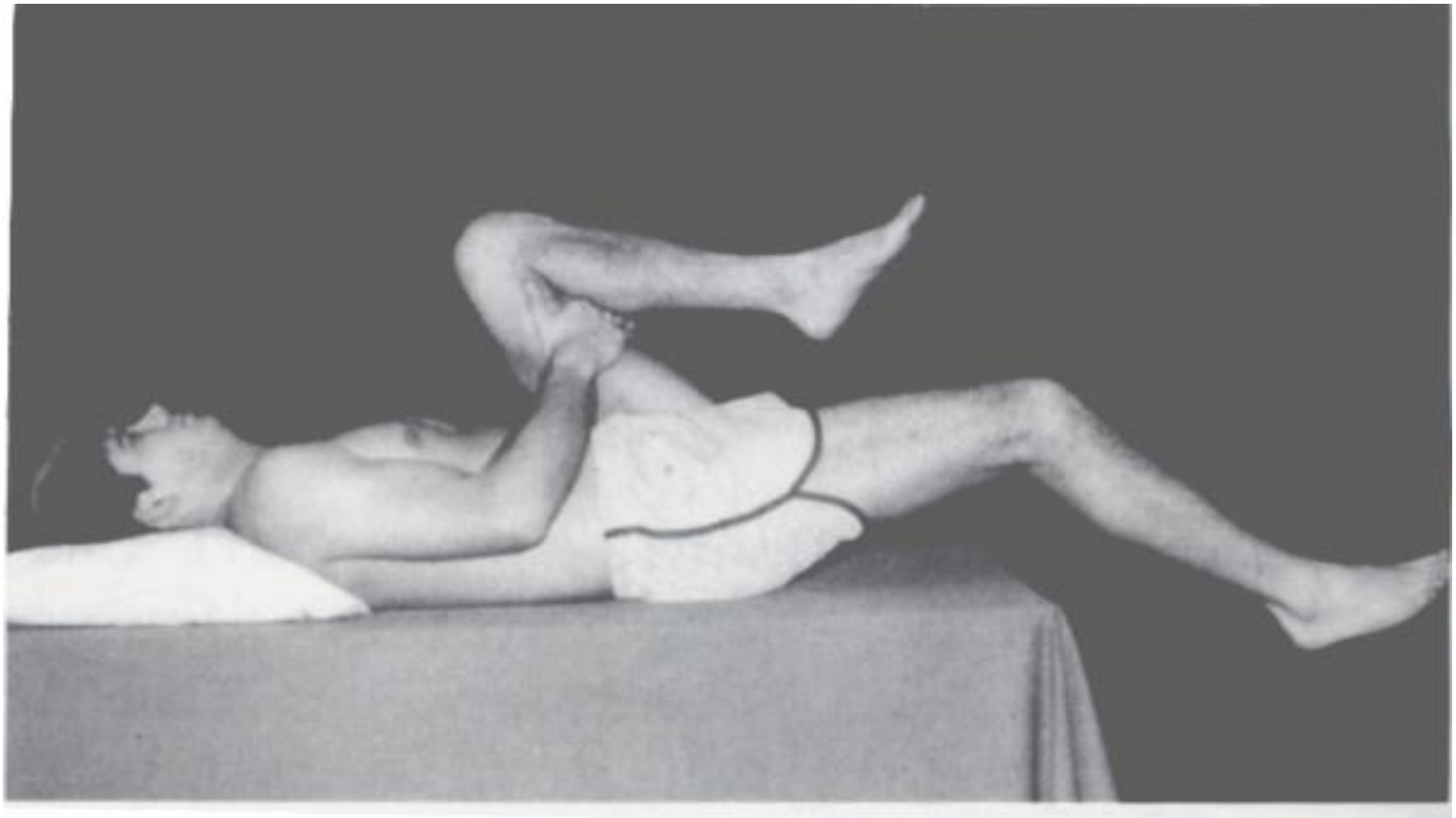
# FLEXIBILITY

- **Thomas Test**:
  - Procedure: Patient in supine, both knees brought to chest. Patient holds unaffected leg, keeping their back flat against the table. The tests leg is allowed to drop into extension. Next the knee is allowed to drop into flexion
  - Interpretation:
    - Hip should extend to 0 degrees; if this is not achieved, tightness of one-joint hip flexors is indicated
    - If able to achieve full hip extension, but note 80 degrees of knee flexion, then tightness of the two joint hip flexors (**rectus femoris**) is indicated
    - Abduction of the hip and/or external rotation of the tibia indicate **ITB tightness**

# THOMAS TEST: NORMAL ILIOPSOAS AND RECTUS FEMORIS



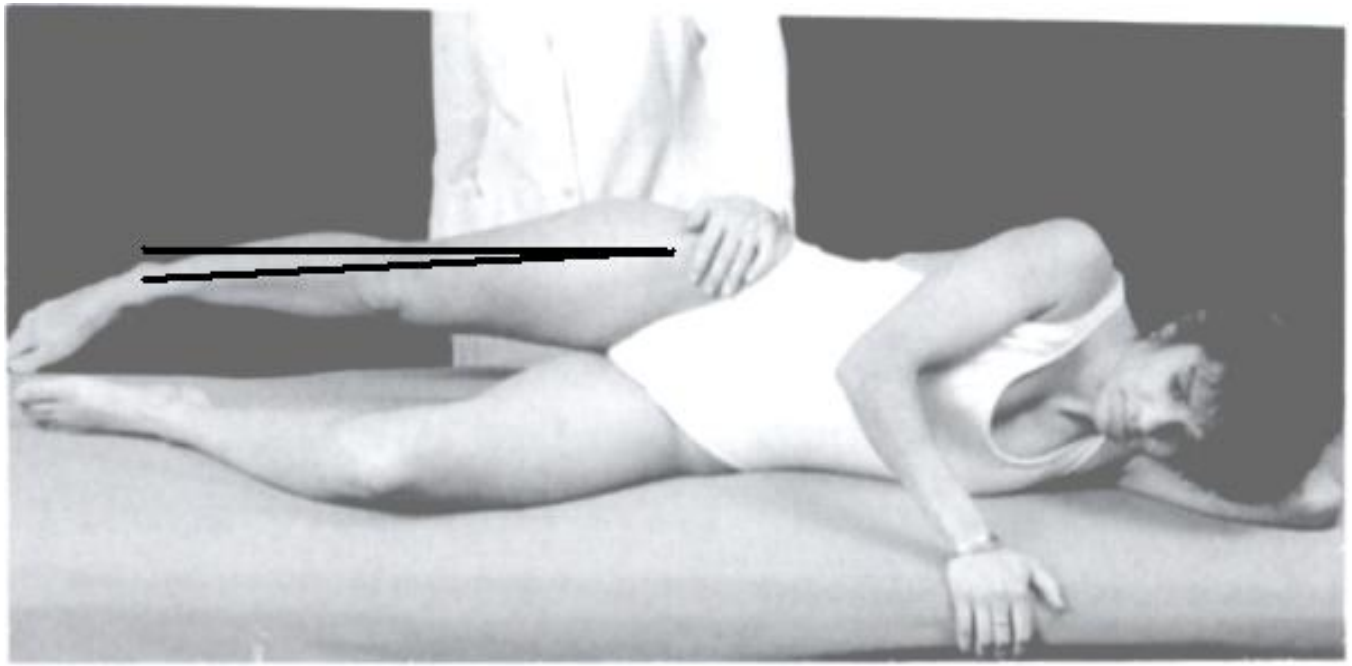
# THOMAS TEST: TIGHT ILIOPSOAS AND RECTUS FEMORIS



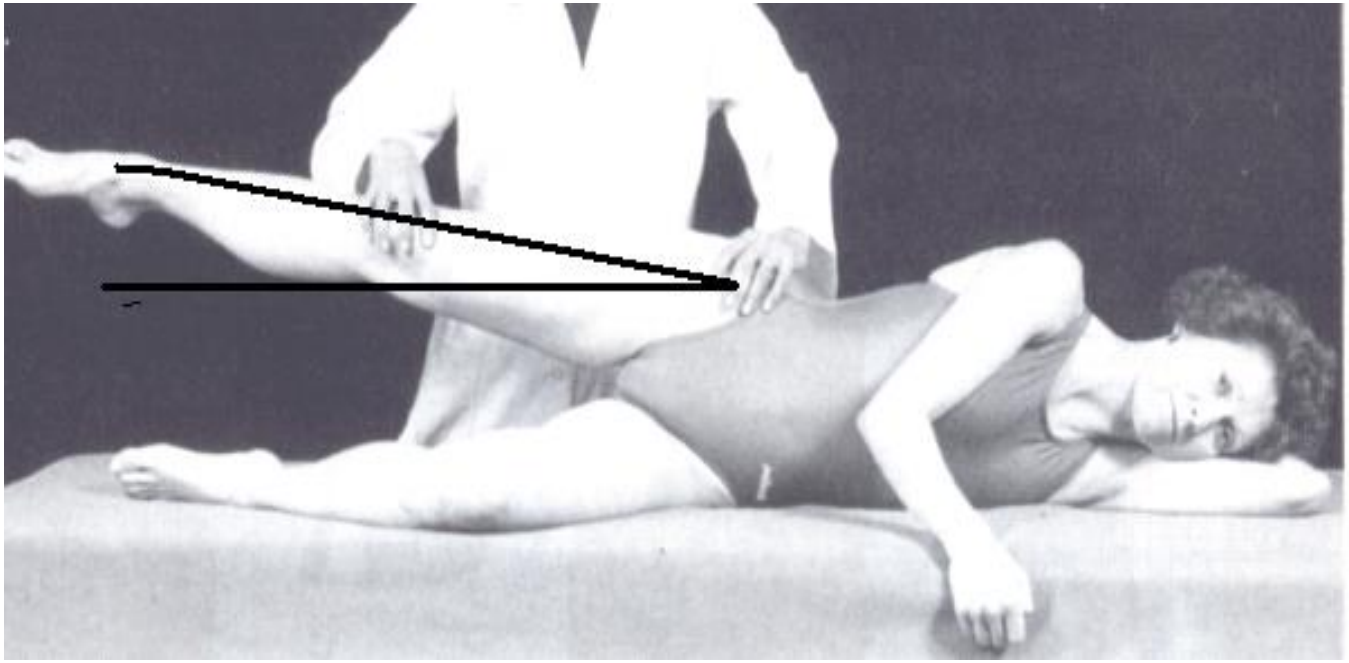
# FLEXIBILITY

- **Ober's Test**:
  - Procedure: Patient in side-lying with test side up. The knee may extended or flexed to 90 or 30 degrees. The hip is maintained in slight extension. The test leg is abducted, then allowed to lower toward the table with the pelvis stabilized.
  - Interpretation:
    - Normal: able to adduct parallel to the examining surface.
    - Inability to adduct to parallel indicates tightness of the ITB.

# OBER'S TEST: NORMAL ITB/TFL



# OBER'S TEST: TIGHT ITB/TFL



# FLEXIBILITY

- Hamstring Flexibility
  1. Passive Straight Leg Raise(PSLR)
     - Normal: should achieve at least 80 degrees of hip flexion.
     - Reproduction at 45 degrees or less may indicate lumbar radiculopathy.
  2. Popliteal Angle
     - Patient is supine with test leg's hip flexed to 90 degrees
     - The knee is passively extended
     - Interpretation
       - Normal: Angle of flexion should be 15 to 20 degrees or less
       - Abnormal: If angle of flexion is greater than 15 to 20 degrees, this is indicative of hamstring tightness

# ELY'S TEST

- Procedure: Patient in prone. The knee of tested leg is flexed by the examiner.
- Interpretation:
  - Normal: Able to fully flex the knee without creating hip flexion.
  - Abnormal: Flexion of the hip prior to full knee flexion indicates Rectus Femoris tightness.

# Next lecture

1. Hip Abduction from flexed position
2. Hip Adduction
3. Hip External (lateral) Rotation
4. Hip Interna (medial) Rotation

Thank You