Pelvis, Hip and Thigh
Anatomical Structures and Common Injuries

Anatomical Structures

• Pelvis
  – Provides a strong stable base on which the spine and the lower limbs work.
  – Designed to support downwards and forwards thrust transmitted by the trunk.
  – Weight bearing is transmitted through the pelvis in a reciprocal fashion in gait.

• Pelvis
  – Each half of the pelvis is made up of 3 bony elements - ischium, ilia and pubis.
  – Articulates posteriorly with the sacrum at the sacroiliac joint.
  – Articulates anteriorly at the pubic symphysis.
Pelvic Cavity Used for Storage

Sacrum
- Broader anteriorly than posteriorly and wider superior than inferior.
- Fits like the keystone between the ilia.
- Female sacrum is shorter and wider than the male sacrum.
- SI joints are ‘C’ shaped or like an inverted ‘L’.
- Cranial segment is shorter and vertical.

Sacroiliac Joints
- 2 Components
  - small synovial component along S1 to S3
  - Surrounded by interosseus SI ligaments causing a part syndesmosis.
- Irregular joint surfaces with depressions on the sacrum and elevations on the ilium.
- Nerve supply - Obturator, Superior Gluteal and the dorsal rami of S1 + S2.

Ligaments of the SI Joint
- **Ventral SI Ligament**
  - Thickening of the joint capsule
  - Resists anterior displacement of the sacral promontory
- **Interosseus SI Ligament**
  - Fills the space above and behind the synovial part of the joint.
  - Resists extensive SI movement.
  - Deep and superficial parts
Ligaments of the SI Joint

- **Dorsal Interosseus Ligament**
  - Overlying the interosseus SI ligament
  - Short cranial and longer caudal fibers
  - Caudal dorsal parts run from S3-4 to PSIS
  - Continuous with the Sacrotuberous ligament
  - Resists downward displacement of the sacrum

- **Sacrotuberous Ligament**
  - Blends with the dorsal SI ligament
  - PSIS, lower sacrum and upper part of the coccyx to insert into the ischial tuberosity.

- **Sacrospinous Ligament**
  - Lies anterior to the sacrotuberosus ligament
  - Arises from the ischial spine - broad attachment to the sacrum and coccyx
  - Resists anterior pelvic tilt.

**The Million Dollar Question**

Does the SI joint actually move?

**Two Schools of Thought**

- It doesn’t move
- It does move
What is the Truth?
• “The precise model for sacroiliac joint motion, and the axes over which these motions occur is largely unknown.” Porterfield and DeRosa
• Anatomical design and biomechanical factors preclude the joint from motion with only a small amount of rotation (1-4°) and translation (2-4mm) available.

What does this mean?
• The lack of mobility in the normal SI joint must guide our assessment and treatment.
• Tests that purport to assess position or movement by palpation are considered to be unreliable.
• Tests that stress the joint by forcing joint surfaces together are more reliable.

Can the SI joint be injured?
• SI joint dysfunction is a real disorder
• It is generally not produced by motion of the SI joint
• The high neural supply can refer pain from compressive or distractive forces
• SI joint pain must also be considered to potentially be referred FROM the lumbar spine

KINEMATICS OF LUMBO-PELVIC-HIP REGION
• Flexion coupled with posterioanterior translation
• Extension coupled with anterioposterior translation
• Right side flexion coupled with mediolateral translation
• Left side flexion coupled with mediolateral translation

Bogduk, 1997
• Only 3 degrees of pure rotation in lumbar spine
• All fibers in annulus aligned in direction of rotation
• Contralateral zygoapophyseal joints compressed
• Ipsilateral zygoapophyseal joints is under tension

Bogduk 1997
• 35% of resistance to rotation is due to disc
• 65% of resistance is due to posterior elements of neural arch
• L1-L3 rotation is coupled with contralateral side flexion
• L5-S1 pattern is ipsilateral
• L4-L5 is variable
Pelvis in Standing

- **Ground forces**
- Body Weight
- Non-weight bearing LE is flexion, abduction and lateral rotation and extension, adduction and medial rotation

Pubic Symphysis

- Two pubic bones separated by a fibro-cartilaginous disc.
- Reinforced by superior and arcuate pubic ligaments and the anterior interpubic ligament.
- Motion occurs vertically and antero-posteriorly.
- Upper limit of vertical motion is 2mm.
- Rotary motion is less than 1.5°.

Hip Joint

- Best example of a ball and socket joint.
- Stability comes from the shape and position of the bones - trabecular pattern.
- Capsule is reinforced by the iliofemoral, ischiofemoral and pubofemoral ligaments.
- Iliopsoas tendon blends with the anterior capsule.
- Capsule is strongest superiorly and weakest posteriorly.

Pattern of Trabeculae in the Femur

Musculoskeletal Imbalance

- Postural changes due to muscle tightness
- Poor co-ordination or early fatigue due to muscle weakness
- Diminished load bearing capabilities of the skeletal structures associated with the postural changes.
- Leg length discrepancy.
- Problems arising from prolonged pronation/supination of the subtalar joint.

Mechanism of Injury

- Musculoskeletal imbalance
- Poor muscular co-ordination
- Fatigue
- Incomplete rehabilitation of previous injury
- Repeated minor trauma
Poor Muscular Co-ordination

- Vastus medialis oblique dysfunction
- ‘Snapping hip’ with tight psoas tendon
- Loss of normal quads/hams ratio with excessive development of quads
- Weakness, contracted or stretched muscles, excessive development or poor neuromuscular co-ordination.

Fatigue

- Affects performance and may predispose to injury.
- May prolong recovery time at the neuromuscular junction leading to
  - decreased effectiveness of muscle activation
  - delayed clearing of metabolites
  - decreased ability to generate tension
- Manifests with decreased strength, power, endurance and gross motor skill performance
- Increasing risk of injury.

Assessment and Evaluation of the Hip Joint

Subjective Assessment

- Presenting complaint
- Location of symptoms
- Onset and duration of symptoms
- Nature and behavior of symptoms
- Past history of problem and similar problems
- Previous treatment and results
- Other relevant history
- Activities of daily living

Objective Assessment

- Initial Observation: Posture
  - Gait: stride length, antalgic gait, stance phase other variations.
  - Balance: equal weight bearing both sides, ability to fully weight bear on one limb.
  - Lumbar Spine RoM: clearing test to exclude possibility of referred pain.
  - Squat: squat test excludes the knees as sources of pain.
  - Hop Test: dynamic activities requiring power, strength, co-ordination and confidence.
Standing: Posture

- Differences in height of the iliac crests
- Rotation of on hemi pelvis
- Hip joint posture
- Knee joint posture
- Intrinsic lower limb posture
  - Femoral ante version
  - Tibial varum
  - Forefoot/rear foot varus or valgus

With the Patient Lying Supine

- Palpation of the anterior structures.
  - ASIS, iliac crests, greater trochanters, pubic tubercles, inguinal area, anterior and medial thigh musculature.
- Leg length measurements.
  - Real and apparent leg length.

With the Patient in Side Lying

- Palpation of the lateral and posterior structures including sciatic notch, ischial tuberosity, greater trochanter and muscles including TFL.
- Active, passive and resisted movement tests.
- Ober's test.

With the Patient in Prone Lying

- Palpation of the posterior structures including PSIS, coccyx, sacrum and lumbar spine, soft tissues such as piriformis and gluteal muscles.

With the Patient in Prone Lying

- Active, passive and resisted hip extension, internal and external rotation and knee flexion/extension.
- Femoral nerve stretch to exclude possibility of dural irritation in anterior pain affecting the groin region.
**Special Tests**

- **Thomas Test**
  - Used to test the flexibility of the anterior soft tissue structures, particularly psoas and rectus femoris.

- **Ober’s Test**
  - Used to determine the extensibility of the IT band.

- **Faber Test**
  - Flexion, abduction and external rotation test
  - Used to assess the mobility of the hip joint, particularly the anteromedial capsule.
  - Also stresses the ipsilateral sacroiliac joint.

- **Hip Quadrant Test**
  - Combined flex/add with or without compression and/or internal rotation.
  - Used to assess the hip joint, the posterior capsule, posterior musculature and the ligament of the femoral head.

- **Femoral Nerve Stretch**
  - Performed in prone.
  - The hip is extended, the knee flexed and the ankle dorsiflexed.
  - Assess normal tension in the dura of the femoral nerve roots.
Summary

- Palpation of tissue
- Measure range of motion - all movements
- Measure muscle power - all muscles acting on joint
- Measure leg length - real and apparent
- Assess pain intensity and location
- Assess neural involvement

Sacroiliac Joint Tests

- Tests of force closure of the SI joint
- Refer to ‘Sacroiliac Joint Pain’ by Dreyfus et al
- Pelvic Rock Test
- Gaenslen’s Sign
- Neither are reliable but are commonly used

SOFT TISSUE INJURIES TO THE HIP AND THIGH REGIONS

Hip Pointer

- Contusion of the iliac crest resulting from a fall against a hard surface or object.
- Blood gathers in the sub-periosteal space adjacent to the iliac crest.
- Severe pain results from stretched periosteum and pressure on surrounding tissues.
- Pain is so severe that the patient may not be able to take a breath and panic.

Signs and Symptoms

- develop significant local swelling and bruising
- difficulties in walking due to muscle spasm.
- very few serious complications.
- Pain may last weeks.

Treatment

- P.R.I.C.E.
- PUS, ITF.
- NSAIDs
- Trunk mobility exercises.
- Return to sport within 1-2 weeks with doughnut padding for protection.
**Haematoma**

- Thigh muscles commonly affected - anterior and lateral compartments.
- Results from a collision or blow with blunt object.
- Significant bleeding into surrounding tissues.
- Inter/intramuscular haematoma established.
- 2nd damage results from disrupted blood supply.

**Treatment**

- P. R. I. C. E.
- Crutch walking - PWB.
- Gentle active/passive exercises within the limits of pain to reduce reactive spasm.
- Regain full stretch, breakdown adhesions, realign fibres (DTF).
- Return when normal flexibility and strength are achieved.

**Groin Injuries**

**Groin Pain**

- Muscles affected: sartorius, rectus femoris, adductors, abductors, iliopsoas.
- 85% of groin injury are acute.
- Result from external rotation of the hip with abduction and the foot firmly planted.
- Other structures: Low back, pubic symphysis, bursitis.
- Associated with football players of all standards.

**Pathology**

- Twisting, running, jumping
- Muscles most often involved:
  - Adductor longus
  - Iliopsoas
  - Gracilis
  - Sartorius

**Pathology**

- Strain – pulled muscle
- Tendinitis – inflammation of a tendon
- Avulsion fractures
- Stress fracture near the pubic crest or femoral neck
Causes

• Sudden change in direction
• Kicking across your body
• Slipping while changing directions
• Overuse

Signs and Symptoms

• Pain
  – tender on palpation
  – pain elicited by resisted isometric work
  – pain elicited by stretching of affected muscles.
• Loss of normal gait pattern
• Inability to continue with sport

Treatment

• Ice for 20 to 30 minutes every 3 to 4 hours
• NSAID
• Supportive bandage
• Stretching e.g. butterfly stretch
• Patience. Wait until...
  – full range of motion
  – full strength
  – run with no pain
  – change direction with no pain

Hernia

• Hernia must be ruled out of any injury to the groin area.
• Hernia is a protrusion of the abdominal contents through the peritoneum.
• Pain on coughing, sneezing may indicate hernia.

Tendonitis

• Chronic overload of tendons causes microscopic lesions of the musculotendinous junction which leads to inflammation.
• Occurs when collagen is stressed beyond its yield point.
• Muscles most affected: adductors, hamstrings, tensor fascia latae.

Someone has to administer the hernia test
Treatment

- Decrease activity level and reduce stress on tendons.
- Ice and gentle stretching.

If more severe:
- NSAIDs
- DTF
- Rest
- Stretching

Bursitis

- There are 13 bursae in the hip region.
- They become inflamed, swollen and thickened when irritated.
- Most commonly affected:
  - Ischial
  - Trochanteric
  - Psoas

Trochanteric Bursitis

- Lies between the tendon of gluteus maximus and the posterolateral surface of the greater trochanter.
- Irritated by movement of the ITB during flexion (moves forward) and extension (moves backward)
- Worsened by any loss of pelvic mobility.
- Increased supination at heel strike in gait may increase ITB loading and increase bursitis.
- Muscle imbalance between adductors and abductors may also contribute.

Signs and Symptoms

- Gradual onset of pain at the lateral hip and thigh with occasional radiation to knee.
- Pain elicited by passive flexion, adduction and medial rotation of the affected hip.
- Pain increases when walking, worsens running, increased by crossing legs or getting into a car.
- Positive Ober’s test.

Quadriceps

- Forceful contraction met by unsuspected resistance leads to injury.
- Immediate pain localised to the area.
- May be palpable defect.
- Large haematoma.
- Knee flex. and hip extension is limited by pain and spasm.
- Reflex inhibition of quadriceps as a whole.

Treatment

- Identify the cause of the irritation.
- Treat symptoms -> relief but not cure.
- Change training schedule.
- Podiatrist referral.
- Ice massage, electrotherapy, stretch gluteus max and ITB, strengthen abductors.
- Injection with anaesthetic or corticosteroid.
Treatment

• Acute stage:
  – P. R. I. C. E.
  – PWB with crutches
  – Gentle ROM activities
  – DTFs and massage
  – Electrotherapy
  – Active contraction as pain allows
  – Add resistance as able - bike, rowing machine, hydrotherapy, functional activities.

Hamstrings

• Musculotendinous junction most common STI in the thigh.
• Sudden forced change in length under tension.
• Sprinters injury -> hip flexion and knee extension -> high load on lengthened state.
• High incidence in older athletes or with lack of warm-up.

Signs and Symptoms

• Swelling, pain, spasm, inhibition of movement.

  1st Degree
  – tender on palpation
  – minimal swelling
  – no defect

  2nd Degree
  – partial disruption of the musculotendinous junction
  – muscle spasm, pain and swelling, haematoma

  3rd Degree
  – marked pain, gross swelling
  – complete disruption of MT junction
  – palpable defect

Treatment

• Determined by symptoms.
• P. R. I. C. E.
• Rehab aimed at regaining full flexibility.
• Prevent shortening -> early stretching -> assists in alignment of scar tissue.
• Strengthen through full ROM.
• Gradual functional loading.
Complications of Hamstring Injuries

- Referred pain from lumbar region.
- Meniscal knee problems.
- Adhesions of lateral popliteal nerve.
- Abnormal quads power.
- Dural adhesions.
- Disparate growth rates.
- Trigger points.
- Poor gait/ running style.

ITB Syndrome

- Mechanical dysfunction of pelvis -> tightness of the ITB.
- This tightness may cause friction as the ITB passes over the greater trochanter.
- Results in pain and inflammation.
- Treated as for tendonitis.

Piriformis Syndrome

- Piriformis may irritate the sciatic nerve as the nerve passes above it or through the muscle (15% of pop. SC. passes through).
- Syndrome more common in women than men (ratio 6:1).
- If the muscle is inflamed, shortened or in spasm it will impinge on the sciatic nerve.

Signs and Symptoms

- Deep localised buttock pain at the sciatic notch.
- Pain, tingling or numbness down the leg.
- Active resisted lateral rotation and passive stretch into internal rotation causes pain, especially with the hip at 90° flex.
- No relevant signs from lumbar spine or sacroiliac joints.

Treatment

- Pain relief and stretching of the muscle.
- Rest, NSAID’s, electrotherapy.
- Stretch as pain allows - slump stretching when there is tethering of the sciatic nerve.
- Massage and DTFs - painful but effective.
- Return to sport as flexibility allows.

HAEMATOMA
Common Sites of Bursitis

Ober’s Test for the ITB

Iliotibial Band Syndrome

Piriformis Syndrome