OBJECTIVES

- Apply current evidence of anatomical and biomechanical relationships to evaluation, differential diagnosis, and management of extra-articular impingement syndromes, peri-trochanteric hip pain, and nerve entrapments of the hip region.

- Prioritize a systematic examination that can be used to differentiate extra-articular and intra-articular hip pathologies

- Understand indications for conservative and surgical management of
extra-articular impingement syndromes, peri-trochanteric hip pain, and nerve entrapments of the hip region.

- Implement therapeutic interventions that encompass mobilization, soft-tissue techniques, and innovative exercises based on evaluation findings in the management of extra-articular hip pain.

**HIP PAIN IS....... COMMON**

- 15% of adults over the age of 40 have a current complaint of hip pain (Thiem, 2013)

- 10-25% of population experience episodes of buttock pain (Meknas, 2011)

- The number of total hip arthoplasties performed annually is expected to increase 174% by 2030 (Kurtz, 2007)

**WHAT IS IMPINGEMENT?**

- Abutment of two boney structures

- “Pinching” of structures in between

- May result in injury
  - Compression
  - Ischemia
  - Repetitive Microtrauma
  - Inflammation
  - Tissue destruction

Evaluation and Treatment of Impingement Syndromes of the hip region requires an understanding of relationships of:
PATHOMECHANICS OF CAM IMPINGEMENT - “Bump” on the femoral head-neck junction contacts the anterior/superior aspect of the labrum/acetabular rim.

- Delamination
- Labral Tear
- Joint Degeneration
- Young (16-30) active males
- Over-coverage

PATHOMECHANICS OF PINCER

- Focal acetabular retroversion
- “Overcoverage” of femoral head
- Deterioration of Labrum
- Progressive acetabular destruction
- More common in middle age females

THE PATHOMECHANICS OF EXTRA-ARTICULAR IMPINGEMENT SYNDROMES OF THE HIP REGION

ISCHIOFEMORAL IMPINGEMENT

- Contact of Ischium to Lesser Trochanter

- Impinged structures
  - Quadratus femoris
  - Sciatic Nerve

DEFINING THE ISCHIAL-LESSER TROCHANTERIC SPACE

- The primary purpose of this study was to define changes in the ischial-
lesser trochanteric space associated with medial and lateral hip rotation

• A second purpose was to describe the position for a positive Ischiofemoral test

METHODS: CADAVER PREPARATION

• 25 hip joints from 14 embalmed cadavers • Lifespan range (46-91 years) • (7 male; 7 female)

• Each specimen was skeletonized leaving only the hip capsule and the sciatic nerve intact

• Hip joint capsule was released distally to allow unobstructed movement

• The cadavers were positioned prone and 0° flexion-extension/ abduction-adduction.

• The distance between the lesser trochanter and ischium was measured in 3 positions: 1) Neutral rotation 2) 40° medial rotation 3) 60° lateral rotation

• An Ischiofemoral Impingement test was then performed by laterally rotating the femur while the hip joint was positioned in 10° extension and 10° adduction. A positive test was defined when the lesser trochanter contacted the ischium.

RESULTS

• In neutral flexion/extension, the lesser trochanter approximates the ischium during lateral rotation.

• May help explain pathomechanics related to quadratus femoris pathology

• Offers validation to the Ishchio-femoral Impingement test
GREATER TROCHANTERIC IMPINGEMENT

- The purpose of this study was to describe greater trochanteric-ischial impingement and the relative hip position where the impingement occurs.

- 25 hip joints from 14 embalmed cadavers • Lifespan range (46-91 years) • Gender (7 male; 7 female)

- Presence of Greater Trochanteric Impingement was tested in 3 distinct positions

  TEST POSITION A: From 90° of flexion the hip was extended while maintaining a position of 30° abduction and 60° lateral rotation.

  TEST POSITION B: From 90° of flexion the hip was extended while maintaining a position of 0° abduction and 60° lateral rotation.

- A positive finding was defined when the greater trochanter came into contact with the ischium to prevent further hip extension.

- The angle of hip flexion for a positive test was recorded.

  TEST POSITION C: Patrick-FABER test

- Positive finding was contact between the greater trochanter and ischium

RESULTS

- A source of hip pain that has not been described is greater trochanteric-ischial impingement.

- The Patrick-FABER test may be a useful clinical test to assess for greater trochanteric-ischial impingement

CLINICAL SIGNIFICANCE

- Offers a model of pathomechanics that may explain the new source of hip pain that has not been
• The Patrick-FABER test may be a useful clinical test to assess for greater trochanteric-ischial impingement

• May impact Neural Mechanics

• Sciatic nerve may become impinged

**SUBSPINE IMPINGEMENT**

• Contact of the distal femoral neck to the Anterior Inferior Iliac Spine

• Previous Avulsion Injury or exotosis from repeated traction (Hetsroni, 2012)

Type I – above the rim of acetabulum

Type II – at the level of the acetabular rim

Type III – Below the level of the acetabular rim

Common Characteristics of Subspine Impingement

• Limited and painful hip flexion (D. Sa, 2014; Hapa, 2013; Hetsroni, 2012; Larson, 2011 ) • Provocation with 90° Flexion combined with Adduction and Internal Rotation (Pan, 2008)

**LABORATORY OBSERVATIONS SUBSPINE IMPINGEMENT**

• Space between the Anterior Inferior Iliac Spine and the distal aspect of the femoral neck decreases with:

• Hip flexion • Combination of Flexion, Adduction, and Medial Rotation

• Space between the Anterior Inferior Iliac Spine and the Anterior Facet of the Greater Trochanter
CLINICAL SIGNIFICANCE

• Anterior hip pain may be caused by impingement of the Anterior Inferior Iliac Spine and the distal aspect of the femoral neck or Anterior Facet of the Greater Trochanter

• Could contribute to: • Bone contusion • Synovitis (peripheral compartment) • Rectus Femoris Tendinopathy • Gluteus minimus tendinopathy

• Provocation Tests • Maximum Flexion • Flexion ADDuction Internal Rotation (FADDIR) • Dynamic Internal Rotation Impingement Test (DIRI)

PSOAS IMPINGEMENT

• Tightness of the iliopsoas may contribute to:

• Tendinopathy

• Bursitis

• Labral Pathology

THE PATHOMECHANICS OF PERI-TROCHANTERIC HIP PAIN AND NERVE ENTRAPMENTS

GREATER TROCHANTERIC PAIN SYNDROME

Chronic Pain overlying lateral aspect of the hip
• Gluteus medius/minimus tendinopathy

• Bursa

• Iliotibial band friction

• Females 2-4x likely

• Chronic adaptation to weak abductors/External rotators

NERVE INVOLVEMENT: PERIPHERAL ENTRAPMENT

Entrapments in the posterior hip region:

• Sciatic

• Pudendal

Entrapments in the anterior hip region:

• Obturator

• Femoral

• Lateral femoral cutaneous

• Iliinguinal-iliohypogastric

• Genitofemoral

OBTURATOR NERVE

• Entrapment due to thick fascia overlying the short adductor muscle

• Symptoms of paresthesias, numbness, and/or pain located the medial thigh 9

• Movements of abduction and extension increase the symptoms
OBTURATOR NERVE

- Entrapment due to thick fascia overlying the short adductor muscle
- Symptoms of paresthesias, numbness, and/or pain located the medial thigh
- Movements of abduction and extension increase the symptoms by stretching the obturator nerve.

FEMORAL NERVE

Entrapment occurs:

- Iliacus compartment
- Inguinal ligament

Clinical Presentation

- Quadriceps weakness
- Decrease patellar reflex
- Numbness and paraesthesia
- Proximal nerve injury can present with iliopsoas muscle weakness.

LATERAL FEMORAL CUTANEOUS NERVE

Entrapped as it perforates the inguinal ligament

- Obesity and pregnancy are risk factors
- Symptoms of tingling, stinging, or burning sensation in the anterior lateral thigh with associated to numbness or hypersensitivity to touch
SCIATIC NERVE ENTRAPMENT

Symptoms: • Buttock pain: 81% • Inability to sit greater than 30 minutes: 76% • Parasthesis: 57% • Pain distal to the knee: 30%

Sciatic nerve compression by:

• Fibrovascular scar bands

• Piriformis

• Obturator Internus

• Quadratus Femoris


Ischial Tunnel Syndrome - Entrapment of the sciatic nerve near the ischium or proximal hamstring.

• The insertion of the hamstring tendon can be thickened due to trauma or partial hamstring avulsion

• Symptoms radiating down the posterior thigh to the popliteal fossa aggravated by running

PUDENDAL NERVE • The pudendal nerve exits the pelvis through the greater sciatic foramen between the piriformis and superior gemellus muscles.

• It crosses the sacrospinous ligament near the ischial spine.

• The nerve then enters Alcock’s canal, which is formed by the obturator fascia and sacrotuberous ligament.

• In the posterior aspect of the Alcock’s canal, the pudendal nerve gives rise to the inferior rectal nerve, perineal nerve, and dorsal nerves of the penis or clitoris.
EVALUATION OF EXTRA-ARTICULAR HIP PATHOLOGY

https://youtu.be/IhvVoKGyl8E


CLINICAL EXAM OF THE HIP

• Gait
• Standing
• Sitting
• Supine
• Side Laying
• Prone

GAIT ASSESSMENT: OUT TOEING GAIT

LONG-STRIDE WALKING (LSW) TEST

• This test actively takes the patient into terminal hip extension.

• Provoke impingement between the lesser trochanter and ischium during terminal hip extension.
• Positive test if the posterior pain was reproducible lateral to the ischium during extension while pain is alleviated when walking with short strides or hip abduction

POSTURAL ALIGNMENT

LUMBAR RANGE OF MOTION

PELVIC LANDMARKS

STANDING FLEXION TEST

SINGLE LIMB BALANCE TEST

• Hip Abduction and External Rotation pain and/or weakness • >2cm Shift (belly button moves lateral (Lequesne et al. 2007)

• Sensitivity 100% • Specificity 97.3%

THE SEATED PALPATION TEST

SEATED PIRIFORMIS STRETCH TEST

• The patient is in the seated position with knee extension.

• The examiner passively moves the flexed hip into adduction with internal rotation while palpating 1cm lateral to the ischium (middle finger) and proximally at the sciatic notch (index finger).

ACTIVE HAMSTRING TEST

(A) The patient performs an active knee flexion against resistance with the knee at 90 degrees. Normal strength without pain may be observed.

(B) The patient performs an active knee flexion against resistance with the knee at 30 degrees. Weakness and recreation of the symptoms in this position is a positive test.
SUPINE

• Palpation (abdomen and Adductor Tubercle)

• ROM: Abduction, Adduction, Flexion

• Repeated Lumbar Flexion

• Long Sit

• SI Provocation Tests

• Iliopsoas Contracture (Thomas Test)

• Straight Leg Raise

• FADDIR

• FABER

• DIRI/DEXRI/Posterior Impingement

• Dial Test

SIDE LAYING

• Palpation: Greater Trochanter Facets (Posterior-Bursa, Middle-G Med, Anterior-G Min)

• Strength/Muscle Tests of Abductors

• Passive Adduction (TFL, Gmed, Gmax)

• Active Piriformis Test - The patient drives the heel into the examining table thus initiating external hip rotation while actively abducting and externally rotating against resistance.
• Ischiofemoral Impingement Test - the patient in a lateral position and the examiner passively takes the patient’s hip into extension. The IFI test is intended to provoke impingement in extension with a neutral or adducted hip (recreating the posterior pain lateral to the ischium). Pain is relieved with an abducted hip

• FADDIR (alternate position)

• Lateral Rim Impingement Test

• Posterior Rim Impingement Test

• Apprehension Test

**PRONE**

• Palpation: Sacroiliac joint, Quadratus Femoris, Hamstrings

• Rectus Femoris Contracture (Ely’s Test)

• Femoral Version Test

• Strength/Muscle tests: Gluteus Maximus, Hamstrings

• Femoral Anteversion Test (Craig’s Test)

**DIAGNOSTIC TESTING AND IMAGING**

• Radiographs
• 3D CT Scan
• MRI
• Diagnostic Injection
SURGICAL OPTIONS

- Arthroscopy/Endoscopy debridement
- Psoas Release
- Sciatic Nerve Release
- Bursectomy
- Gluteus Medius Repair

REHABILITATION CONSIDERATIONS

Neuromuscular Re-Education

Impingement Avoidance

Nerve Glides

- With the patient in a sitting position, the patient holds with both hands under the knee.

- (A) Cervical extension, knee flexion and dorsiflexion.

- (B) Cervical flexion, knee extension (under the limit for each phase), plantar flexion.

- The patient can apply lumbar flexion and extension during the exercise.

Sciatic Nerve Mobilizations

- Passive hip circumductions

- begin at 45 degrees of hip flexion
• Move to maximum external rotation

• Engaging the greater trochanter against the ischium to mobilize the sciatic nerve lateral.

Piriformis Stretching

• in seated position, the patient crosses the leg that will be stretched with the foot positioned next to the knee.

• The patient pulls the knee towards the contralateral shoulder.

Prone Eccentrics/Contract Relax

• Offers new perspective on how to treat the deep rotators and associated neurovascular structures

• Stretching/manual therapy without causing impingement

Neuromotor Training

• Hip Medial Rotation

• Hip Abduction

FUTURE CONSIDERATIONS

• Examine structural relationships to impingement syndromes:

  • dimensions of the structures

  • version angles

• Clinimetric Evaluation of provocation tests on patients

  • Comparing to imaging

  • Comparing to arthroscopic/endoscopic surgical findings

• Biomechanical analysis of the hip and pelvic region
• During common movement patterns

• During athletic movements

REFERENCES


Hip vs Lumbosacral Spine

Extra vs Intra-Articular

Traumatic

Impingement

Hypermobility

Hypomobility

Eval and Treat Lumbosacral Pathology

Eval and Treat Extra-Articular Pathology
## Lumbar Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standing</strong></td>
<td></td>
</tr>
<tr>
<td>Postural assessment</td>
<td>Shift/Scoliosis</td>
</tr>
<tr>
<td>Lumbar ROM</td>
<td>Provocation with: Flexion</td>
</tr>
<tr>
<td><strong>Supine</strong></td>
<td>Knees to Chest</td>
</tr>
<tr>
<td><strong>Prone</strong></td>
<td>Spring Testing</td>
</tr>
<tr>
<td>Press-Ups</td>
<td>Repeated Lumbar extension</td>
</tr>
<tr>
<td>Palpation</td>
<td>Lumber extensor muscle spasm</td>
</tr>
</tbody>
</table>
## SI Joint Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standing</strong></td>
<td></td>
</tr>
<tr>
<td>Pelvic Landmarks</td>
<td>Asymmetry of:</td>
</tr>
<tr>
<td></td>
<td>• iliac crest</td>
</tr>
<tr>
<td></td>
<td>• ASIS/PSIS</td>
</tr>
<tr>
<td>Standing Flexion Test</td>
<td>Asymmetrical movement of ASIS</td>
</tr>
<tr>
<td><strong>Supine</strong></td>
<td></td>
</tr>
<tr>
<td>Spring Testing</td>
<td>Provocation with posterior to anterior force on sacrum</td>
</tr>
<tr>
<td>Palpation</td>
<td>Tenderness of the SI joint</td>
</tr>
<tr>
<td><strong>Prone</strong></td>
<td></td>
</tr>
<tr>
<td>SI Compression</td>
<td>Pain with applied force to ASIS to compress SI joint</td>
</tr>
<tr>
<td>SI Distraction</td>
<td>Pain with applied ASIS to distract SI joint</td>
</tr>
<tr>
<td>Long Sit Test</td>
<td>A relative change in leg length</td>
</tr>
<tr>
<td>FABERS</td>
<td>Posterior pain for SI joint pain</td>
</tr>
</tbody>
</table>
## Femoroacetabular Impingement Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gait</strong></td>
<td>Excessive Out Toeing</td>
</tr>
<tr>
<td></td>
<td>Femoral retroversion</td>
</tr>
<tr>
<td><strong>Seated</strong></td>
<td>Hip Rotational ROM</td>
</tr>
<tr>
<td></td>
<td>Painful/Loss of Internal Rotation</td>
</tr>
<tr>
<td><strong>Supine</strong></td>
<td>Dynamic Impingement Tests</td>
</tr>
<tr>
<td></td>
<td>Provocation of symptoms</td>
</tr>
<tr>
<td></td>
<td>• DIRI/DEXRI</td>
</tr>
<tr>
<td></td>
<td>• Posterior Impingement</td>
</tr>
<tr>
<td><strong>Side Laying</strong></td>
<td>FADDIR</td>
</tr>
<tr>
<td></td>
<td>Lateral Rim Impingement</td>
</tr>
<tr>
<td></td>
<td>Provocation of symptoms</td>
</tr>
<tr>
<td></td>
<td>Tenderness of the SI joint</td>
</tr>
<tr>
<td><strong>Prone</strong></td>
<td>Craig Test</td>
</tr>
<tr>
<td></td>
<td>Femoral retroversion</td>
</tr>
<tr>
<td></td>
<td>&lt; 15° of hip internal rotation with trochanter in neutral</td>
</tr>
</tbody>
</table>
### Ischiofemoral Impingement Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait</td>
<td>Long Stride Test</td>
</tr>
<tr>
<td></td>
<td>Provocation of Symptoms</td>
</tr>
<tr>
<td>Side Laying</td>
<td>Ischiofemoral Impingement Test</td>
</tr>
<tr>
<td></td>
<td>Provocation of symptoms</td>
</tr>
<tr>
<td>Prone</td>
<td>Palpation</td>
</tr>
<tr>
<td></td>
<td>Painful lateral to the ischium over the quadratus femoris</td>
</tr>
</tbody>
</table>

### Ischial-Trochanteric Impingement Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine</td>
<td>FABER</td>
</tr>
<tr>
<td></td>
<td>Provocation of Symptoms in buttock region</td>
</tr>
<tr>
<td>Prone</td>
<td>Palpation</td>
</tr>
<tr>
<td></td>
<td>Painful lateral to the ischium over the quadratus femoris</td>
</tr>
</tbody>
</table>
## Subspine Impingement Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine ROM</td>
<td>Provocation with flexion</td>
</tr>
<tr>
<td>FADDIR</td>
<td>Provocation with flexion</td>
</tr>
</tbody>
</table>

## Psoas Impingement Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine Hip Flexor Contracture Test</td>
<td>Pain and/or inability to have posterior thigh touch the table</td>
</tr>
<tr>
<td>FADDIR</td>
<td>Provocation of symptoms</td>
</tr>
<tr>
<td>Resisted Straight Leg Raise</td>
<td>Pain and weakness</td>
</tr>
</tbody>
</table>
Sciatic Nerve Entrapment at the External Rotators Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seated</strong></td>
<td></td>
</tr>
<tr>
<td>Seated Palpation</td>
<td>Tenderness in the area of piriformis, obturator, gemelli and quadratus femoris muscles</td>
</tr>
<tr>
<td>Seated Piriformis Stretch</td>
<td>Provocation of symptoms</td>
</tr>
<tr>
<td><strong>Side Laying</strong></td>
<td></td>
</tr>
<tr>
<td>Active Piriformis Test</td>
<td>Provocation of symptoms</td>
</tr>
</tbody>
</table>
Sciatric Nerve Entrapment at the Ischium
Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seated</td>
<td></td>
</tr>
<tr>
<td>Seated Palpation</td>
<td>Tenderness in the area of piriformis, obturator, gemelli and quadratus femoris muscles</td>
</tr>
<tr>
<td>Seated Piriformis Stretch</td>
<td>Provocation of symptoms</td>
</tr>
<tr>
<td>Supine</td>
<td></td>
</tr>
<tr>
<td>Straight Leg Raise</td>
<td>Provocation of parathesia or burning in sciatic nerve distribution</td>
</tr>
</tbody>
</table>
# Pudendal Nerve Entrapment Summary

## Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seated</strong></td>
<td><strong>Seated Palpation</strong> Tenderness near obturator internus and soft-tissue medial to the ischium with reproduction of pain in genital and/or anorectal region.</td>
</tr>
</tbody>
</table>
# Hamstring Tendinopathy

## Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gait</strong></td>
<td></td>
</tr>
<tr>
<td>Shortened stride length</td>
<td>Decreased swing and hip extension on terminal stance</td>
</tr>
<tr>
<td><strong>Supine</strong></td>
<td><strong>Straight Leg Raise</strong></td>
</tr>
<tr>
<td></td>
<td>Provocation of symptoms (no parathesia)</td>
</tr>
<tr>
<td><strong>Standing</strong></td>
<td></td>
</tr>
<tr>
<td>Single Leg Stance</td>
<td>Painful at the ischium origin</td>
</tr>
<tr>
<td>Resisted Hip Extension</td>
<td>Painful and weak</td>
</tr>
<tr>
<td>Resisted Knee flexion</td>
<td>Painful and weak</td>
</tr>
</tbody>
</table>
# Greater Trochanteric Pain Syndrome

## Summary Findings

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gait</strong></td>
<td></td>
</tr>
<tr>
<td>Pelvic Tilt (frontal plane deviations)</td>
<td>Trendelenburg gait</td>
</tr>
<tr>
<td><strong>Standing</strong></td>
<td></td>
</tr>
<tr>
<td>Single Leg Stance</td>
<td>Pain with 30 seconds</td>
</tr>
<tr>
<td><strong>Side Laying</strong></td>
<td></td>
</tr>
<tr>
<td>Palpation of Greater Trochanter</td>
<td>Provocation of symptoms</td>
</tr>
<tr>
<td>Strength/Muscle Tests</td>
<td>Painful and weak</td>
</tr>
<tr>
<td>Passive Adduction</td>
<td></td>
</tr>
</tbody>
</table>