Pelvis and hip joints: from anatomy to sports trauma

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We will discuss

1. **Uniqueness** and source of complexity in diagnosing and managing pain syndromes at the pelvis and hip joints.

2. **Musculo-skeletal anatomy** of the pelvis and hip joints.

3. **Sports-related injuries** at the pelvis and hip joints:
   - Femoro-acetabular impingement (FAI)
   - Snapping hip disorders
   - Tendon/apophyseal avulsions (ASIS, AIIS, Ischium)
   - Chronic tendinopathies (adductors, abductors, hamstrings)
   - Stress fractures
   - Posterior inguinal wall insufficiency (sportsman hernia)
Pelvis and hip joint pain syndromes: Uniqueness and diagnostic complexity
Background

- The musculoskeletal portion of the pelvis and hip joints is considered one of the most challenging fields in sports trauma in terms of:

1. Establishment of accurate diagnosis.
2. Providing optimal management (either operative or non-operative).
3. Understanding phases of rehabilitation.
4. Deciding if and when return to sports activities is advisable.

- This area is considered the fastest growing field in sports trauma in terms of number of studies published in recent years, surgical techniques developed, and outcome studies, compared to other joints such as the knee, ankle, shoulder.
Why is diagnosis and management of pain at the pelvis and hip so complex?

1. **Multiple source for pain:**

   - **Multiple joints**: sacro-iliac, symphysis pubis, lumbo-sacral, hip joint;

   - **Multiple layers of muscles** (some of which cross two joints): Rectus femoris, Iliopsoas, Sartorius, hip abductors, hip adductors, TFL/ITB, Hamstrings;

   - **Lower abdominal structures** (muscles and others): Rectus abdominis, oblique muscles, inguinal canal, genitalia;

   - **Nerves**: lumbo-sacral plexus, and specifically the Sciatic and Femoral nerves and their branches.
Why is diagnosis and management of pain at the pelvis and hip so complex?

2. The hip joint is a “deep-seated” joint (very different from the knee, shoulder, ankle, elbow, etc):

   - **Knee**: direct force on the meniscus, patellofemoral joint, retropatellar fat pad, etc.

   - **Shoulder**: direct force on the GT, ACJ, LBT, etc.

   - **Hip**: Since the joint is covered by multiple layers of muscles, as well a very thick joint capsule, it is impossible to apply direct force on intra-articular sources for pain, such as: articular cartilage, labrum, Ligamentum Teres. “Solution”: more frequent use of diagnostic injections along with advanced imaging and high index of suspicion.
Why is diagnosis and management of pain at the pelvis and hip so complex?

3. *Intra-osseous pathologies* in the hip area are not uncommon in young athletic population and **should be diagnosed ASAP**:

- Femoral neck stress fractures;

- AVN of the femoral head;

- Transient osteoporosis of the hip;

- Never forget tumors and infections in the D.D.!
Why is diagnosis and management of pain at the pelvis and hip so complex?

4. In terms of **arthroscopic surgical solutions**, it is considered a much “youngest” field compared to other joints. Long-term outcome studies of surgery, as well as phases of rehab and optimal timing for return to competitive activity are still needed, and this is still being learned and investigated.
Pelvis and hip joint:
Basic musculoskeletal anatomy
Basic musculoskeletal anatomy of the pelvis and hip joint

- **Bony structures:**

![Image of bony structures in the pelvis and hip joint]
Basic musculoskeletal anatomy of the pelvis and hip joint

- Intra-articular hip joint anatomy:

1. Hyaline cartilage surfaces (femoral head & acetabulum)

2. Acetabular labrum

3. Ligamentum Teres and cotyloid fossa
- **Hip joint capsule:**

Has 2 roles:
1. Providing joint stability.
2. Providing vascular supply for the femoral head and acetabulum.

Has 3 parts:
1. Iliofemoral ligament (anterior+lateral)
2. Pubofemoral ligament (medial)
3. Ischiofemoral ligament (posterior)
Basic musculoskeletal anatomy of the pelvis and hip joint

- **Non-synovial joints at the pelvis:**
Basic musculoskeletal anatomy of the pelvis and hip joint

- **Apophyseal prominences of the pelvis:**

  ASIS (Insertion of Sartorius)

  AIIS (Insertion of direct head of Rectus Femoris)

  Ischium (Insertion of Hamstrings)

  Iliac crest (Insertion of lower lumbar spine muscles)
Basic musculoskeletal anatomy of the pelvis and hip joint

- **Musculo-tendinous anatomy of anterior aspect of the hip:**

  Deep anterior, overlying capsule: Iliopsoas, Iliocapsularis, Glut. minimus

  Mid-anterior: Rectus femoris (reflected and direct heads).

  Superficial anterior: Sartorius
Basic musculoskeletal anatomy of the pelvis and hip joint

- Musculo-tendinous anatomy of medial aspect of the hip:

Medial: Pectineus, Adductors.
Basic musculoskeletal anatomy of the pelvis and hip joint

- **Musculo-tendinous anatomy of lateral and posterolateral aspects of the hip:**

  Lateral and posterolateral: Gluteus medius, TFL/ITB, Gluteus maximus.
Basic musculoskeletal anatomy of the pelvis and hip joint

- **Musculo-tendinous anatomy of posterior aspect of the hip:**

  **Deep posterior:** Piriformis and short external rotators.

  **Superficial posterior:** Hamstrings, Gluteus maximus.
Basic musculoskeletal anatomy of the pelvis and hip joint

- **Musculo-tendinous anatomy of lower abdominal wall:**

  Rectus abdominis

  Oblique muscles

  Apponeurosis overlying symphysis pubis
Pelvis and hip joint: Sports-related injuries
Definition: “Abnormal contacts between the femoral head-neck and the acetabular rim/labrum when the hip is in motion”

Lead to activity-related hip and groin pain and can result in progressive joint cartilage wear.

Considered a potential cause for the development of hip arthrosis.

Two morphological variants which are believed to result in such abnormal intra-articular mechanics have been described:

1. Aspheric femoral head (“Cam-type” impingement).
2. Acetabular rim over-coverage (“Rim-type” or “Pincer-type” impingement).

Commonly, both types are believed to co-exist to a certain extent.
Femoroacetabular impingement (FAI)

- Abnormal contact mechanics:

Flexion IR.avi
**Femoroacetabular impingement (FAI)**

- **Physical examination:**

**Hallmark:** “Hip impingement sign” = Anterior hip and groin pain during passive FADIR (Flexion-Adduction-Internal rotation) maneuver.

Often – “C-sign”, indicating pain distribution.
**Femoroacetabular impingement (FAI)**

- **Important diagnostic tool:**

  Intra-articular injection of a local-anesthetic, followed by repeating the physical exam provocative test (FADIR). Assist in confirming intra-articular source for the pain.
Femoroacetabular impingement (FAI)

- **Imaging:**

![Images of femoroacetabular impingement](image1.png) ![Images of femoroacetabular impingement](image2.png)
Femoroacetabular impingement (FAI)

- **Treatment options:**
  - Activity modification
  - Physical therapy
  - Analgesics

**Surgery, aimed for:**
1. *Labral repair* (to preserve “negative pressure seal” mechanism).
2. *Femoral head-neck osteochondroplasty* (to recreate head sphericity and eliminate impingement).
3. *Focal rim trimming* (to decrease impingement resulting from over-coverage).
Case example: Bilateral FAI in a young soccer player

Bilateral arthroscopic hip surgery (separate procedures):

1. **Labral repair.**

2. **Femoral head-neck osteochondroplasty** (to recreate head sphericity).
Femoroacetabular impingement (FAI)

Surgery, aimed for:
Improving hip kinematics decreasing further impingement decreasing risk for ongoing chondrolabral damage.

Snapping hip disorders (internal vs. external)

- **Internal snapping hip (coxa saltans interna):** A condition where pain in the groin is elicited dynamically in conjunction with iliopsoas tendon snapping when the hip extends and internally rotates from a flexed, abducted, and externally rotated position (= circumduction maneuver). The tendon snapping can be over the iliopectineal eminence, the femoral head, loose body, or a para-labral cyst.

- **External snapping hip (coxa saltans externa):** A condition where the posterior band of the ITB or the anterior band of the Gluteus maximus facia is snapping over the posterior edge of the greater trochanter when the hip moves from flexion to extension with or without rotation.

- **An unusual cause for “external snap”:** Ischiofemoral impingement. Impingement of the Quadratus femoris between the lesser trochanter and Ischium during extension and external rotation (during walking).
Internal snapping hip (iliopsoas snapping)

- The snap is **clearly heard**.

- More common in females (and in dancers).

- Source for pain: inflamed iliopsoas tendon, or a chondro-labral injury.

- Possibly related to hip anteversion (mild dysplasia). This anteversion can also be a source for overload on the antero-superior labrum.

- Physical examination: The snap can be reproduced with hip circumduction.
Internal snapping hip (iliopsoas snapping)

- Treatment options:

1. Snapping without pain should be treated with stretching only and no surgery!!!

2. Activity modification, stretching and core strengthening, injections.
**Internal snapping hip (iliopsoas snapping)**

- **Treatment options:**

3. Iliopsoas surgical release at the lesser trochanter or at the joint level.

External snapping hip (ITB/ Gluteus maximus)

- The snap **can be clearly seen** (sometimes misinterpreted as joint subluxation).

- Source for snap: either the posterior aspect of the ITB or the anterior aspect of the Gluteus maximus facia. The snap is over the greater trochanter.

- The snapping occurs when the hip moves from flexion to extension with or without rotation.

- Physical examination: The snap can be reproduced by moving the hip from flexion to extension when the patient is in the lateral decubitus position.
External snapping hip (ITB/ Gluteus maximus)

- Treatment options:

1. Activity modification, stretching, and core stability.


- Downsides of surgery: possible deformity and abductors overload in the absence of part of the ITB. Therefore, some investigators described releasing the Gluteus maximus insertion at the “linea aspera” on the femur, instead of removing part of the ITB.
**Tendon-apophyseal avulsions**

Occurs when muscle is stronger than physis, usually during eccentric overload. Three common tendon apophyseal avulsions in the pelvis:

1. **ASIS** – avulsion of the Sartorius. Related to kicking (soccer).

2. **AIIS** – avulsion of the direct head of the Rectus femoris. Related to kicking (soccer).

Tendon-apophyseal avulsions

Treatment:

1. Nonoperative treatment results in good recovery and return to all activities within a few weeks in the majority of cases.

2. Rare indications for surgery:
   - Hamstrings avulsion gap of more than 3-4cm.
   - Sciatic nerve irritation by a scar tissue after hamstrings avulsion.
   - Prominent bone formation at the buttock after hamstrings avulsion.
   - AIIS avulsion leading to “spur deformity” and hip impingement in flexion.
The anterior inferior iliac spine (AIIS) in patients with hip impingement:
Hetsroni I, Poultsides L, Bedi A, Larson CM, Kelly BT. Anterior inferior iliac spine morphology correlates with hip range of motion: a classification system and dynamic model. CORR 2013:471(8);2497-2503.

- Demonstrated the reproducibility of arthroscopic AIIS decompression in a series of 10 young adult males.

- Function significantly improved after surgery.
Chronic tendinopathies at the pelvis area

Definition: “Degenerative process within the tendon as a result of aging and prolonged overuse, leading to micro-tears, pain, and chronic inflammation.”

Examples:
1. **CHAT** = chronic hip adductor tendinopathy. (Common in soccer players). **Pain:** located at the **Groin** (insertion of the adductor longus to the pubic bone).

2. **Hamstrings** tendinopathy at the Ischium insertion. (Common in runners). **Pain:** located at the **upper posterior thigh** (insertion of hamstrings to Ischium).

3. **GTPS** (Greater Trochanteric Pain Syndrome) – related to Gluteus medius tendinopathy. (Common in middle-age women).

4. Others? Iliopsoas...
Chronic tendinopathies at the pelvis area

**Diagnosis:**

Pain on direct palpation.

Pain when applying force against resistance.

Imaging: X-rays, US, MRI.

**Treatment:**

Activity modification, stretching, core stability.

Injections (ultrasound-guided, if needed).

Rarely surgery, for either release (CHAT) or repair (Hamstrings, Gluteus med.).
Femoral neck stress fracture:

1. Symptoms: Groin pain. Suspect when history reveals a non-gradual increase in running distance, or in female runners with nutrition imbalance.

2. Imaging: X-rays, MRI, Bone scan.

3. Tension vs. compression type.

4. Intra-articular. Therefore, high risk of nonunion and severe disability if not diagnosed ASAP and treated as needed.
Stress fractures and stress reactions at the pelvis

Femoral neck stress fracture:

Treatment:

1. **Stop running immediately!!! Consider PWB with crutches.**

2. Aqua-running possible.


5. In “tension type”: surgery is commonly recommended (internal fixation with screws) to avoid displacement of the fragments and subsequent non-union or AVN of the femoral head.

6. Repeat MRI after 3 months before resuming running.
Stress fractures at the pelvis

Sacral stress fracture:

1. Symptoms: Low-back pain. Suspect when history reveals a non-gradual increase in running distance, or in female runners with nutrition imbalance.

2. Imaging: X-rays, MRI, Bone scan.

3. Should not lead to displacement or significant long-term disability.

4. Treatment: Activity modification (6-12 weeks), consider low-intensity ultra-sound.

5. Surgery is not indicated.
Stress fractures at the pelvis

Pubic bone stress fracture:

1. Symptoms: Groin pain or near the symphysis pubis. Suspect when history reveals a non-gradual increase in running distance, or in female runners with nutrition imbalance.

2. Imaging: X-rays, MRI, Bone scan.

3. Should not lead to displacement or significant long-term disability.

4. Treatment: Activity modification (6-12 weeks), consider low-intensity ultra-sound.

5. Surgery is not indicated.
Stress fractures at the pelvis

As a general rule for stress fractures work-up - consider:

1. CBC
2. TSH
3. Calcium, Phosphate, Alkaline phosphatase
4. PTH
5. Vitamin D
Aponeurosis syndrome

Also termed:

1. Sportsman’s hernia.
2. Gilmor’s hernia.
3. PIWI = posterior inguinal wall insufficiency

- May be diagnosed with dynamic ultra-sound.
- May require surgical repair.
- May co-exist with FAI, and therefore examine thoroughly and use diagnostic tests (intra-articular injection) and imaging as needed.
Summary and take-home message

1. The pelvis is a complex structure and has multiple potential sources for pain in athletes.

2. Accurate diagnosis frequently requires multiple diagnostic tests and advanced imaging.

3. Multiple sources for pain may co-exist (adductor tendinopathy and FAI, etc.).

4. Remember: Low lumbar spine may cause radicular symptoms to the hip.

5. Remember: Hip joint pathology can present as knee pain due to similar nerve innervations.


5. Always remember that athletes may present with a non-sports related source for their symptoms, such as tumors, infections, metabolic diseases, and others.
Thank you