Helen Millson (M.Phil Sports Physio; M.C.S.P)

**Groin / Hips in the Youth**

SA Physio Congress Aug 2015

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**What is Youth?**

We believe now that CAM deformities develop around 12-13 years old (Agricola and Kemp – Aspetar 2014).

Athletes should be considered skeletally immature until at least their 21st birthday. (Sally et al., BJSM, 2015)

Secondary ossification centres of the pelvis, including the pubic apophysis, appear during puberty and fuse between the ages of 15 and 25 years.

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**Background**

We believe now that CAM deformities develop around 12-13 years old (Agricola and Kemp – Aspetar 2014).

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**Content**

1. Differential Diagnosis - Adult / Youth
2. Anatomy
3. Biomechanics
4. Hips
   - Overview / Solution ??!
5. Tests
6. Radiological Imaging
7. Surgery
8. Conservative Rx/ Rehab

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**Background General**

- Co-existence of multiple pathologies
- Lack of agreement of diagnostic criteria
- Non-specific nature of the signs and symptoms
- Lack of specific clinical tests

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**The Bermuda Triangle of Sports Medicine** (Bezzzini, BJSM 2011)

- Up to 70% of male soccer players experience hip and or groin pain during one season (Hanna et al., J Sci Med Sport. 2010)

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**1. Differential diagnosis**

The Latest International Evidence Summit 2013

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**Up to 70% of male soccer players experience hip and or groin pain during one season (Hanna et al., J Sci Med Sport. 2010)**

The Bermuda Triangle of Sports Medicine (Bezzzini, BJSM 2011)
Background

Consensus statement

Doha agreement meeting on terminology and definitions in groin pain in athletes

Differential diagnosis

Hip Joint

Other causes

Clinical examination based classification system

Differential diagnosis

Hip Joint

Other causes

Findings of multiple abnormal clinical entities tempt one to speculate that one clinical entity likely precedes other developing entities.

Differential diagnosis

Adult

Findings of multiple abnormal clinical entities tempt one to speculate that one clinical entity likely precedes other developing entities.

Differential diagnosis

Youth

Prevalence of groin injuries and association with growth spurt in pubertal elite Qatari soccer players

A prospective epidemiological study over two consecutive seasons

Youth

A young player = spectrum of skeletal maturity:

- The “growth spurt”
- The physis: weakest part of the muscle-tendon-bone complex

Youth

Apophyseal and physeal stress injuries:

- Overuse injuries
- Underreported in the literature

Youth

Comprehensive groin epidemiology is nonexistent:

- Prevalence: 7.5% (2% - 10%)
- Higher rate in early and normal matures
- Osteochondral injuries = 41.5% of all lower limb growth related injuries
Kicking and twisting movements place strain on fascial and musculo-skeletal structures that are fixed to a number of bony anatomical points in close proximity.

2. Anatomy

Anatomy

Hip Joint and Pubic joint

Anatomy in Theory

Figure 2.1 Anatomy of the groin area

Holmich P, BJSM 2007; Holmich et al., BJSM Aug 2013

Anatomy in Reality

Common Adductor

Pubic Symphysis

Robinson et al., 2006; Davis et al., BJSM 2011; Braver and Kahn 2012

Anatomy in Theory

The Groin Triangle

Palve et al., BJSM 2009;

Anatomy in Reality
**Adductor muscles**

Prime Mover and Stabiliser

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**Biomechanics**

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**Comment: Adductor muscles**

<table>
<thead>
<tr>
<th>Study</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Player was 17 TIMES more likely to get Adductor muscle strain, if Adductor strength was &lt;80% of Abductor strength</td>
<td>Tyler et al. 2001; O’Connor 2004</td>
</tr>
<tr>
<td>Squeeze test was significantly weaker (20%) in players with longstanding groin pain</td>
<td>Melbourne et al. 2009</td>
</tr>
<tr>
<td>Add: Abductor Ratio was 24% lower in groin pain athletes</td>
<td>Theborg et al. 2010</td>
</tr>
</tbody>
</table>

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**Study**

**Author**

New insights into the proximal tendons of adductor longus, adductor brevis and gracilis. | Davis et al., BJSM 2012 |

Normative Adductor Squeeze Test Values in Elite Junior Rugby Union Players. | Coughlan et al., Clinical Journal of Sport Medicine 2014 |

Importance of Adductor muscles. | Serner et al. BJSM 2014 |

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**Adults**

Adductor strength may be an important objective outcome for Prevention, Rehabilitation and to assess RTP readiness.

**Youth**

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**Groin Pain:**

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**Other areas**

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**Overuse.**

**Pelvic Floor**

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**Diagnosis of Acute Groin injuries. Serner et al., AJSM 2015**

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**Other areas**

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**Diagnosis of Acute Groin injuries. Serner et al., AJSM 2015**

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**Pelvic Floor**

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**Diagnosis of Acute Groin injuries. Serner et al., AJSM 2015**

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**Pelvic Floor**

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- Numerous similarities to ACL.

N.B. Ligamentum Teres

The Functional Lines

Symphysis Pubis / “Osteitis Pubis”

Adult

Youth

Overload

Youth

Pubic Joint

Pain

Overload

Tightness

Weakness

Dysfunction

P. Bruiner FA Presentation Sep 2013
A common pattern was a co-existence of hip joint pathology, PBSI and Add-related groin pain.

**Angle of torsion alters:**

1. Functional role of hip muscles

**Caution**

Assymmetric Hip Rotation in Professional baseball pitchers.

McCutcheon et al., Orthop J Sp Med 2014

**Correlation of clinical and MRI findings in elite female ballet dancers.**

Duthon et al., Arthroscopy. 2013

The gymnasts' hip and groin: an MRI study in asymptomatic elite athletes.

Papavasiliou et al., Skeletal Radiol. 2014.

**Hips: Youth**

**Screening**

**Hip Morphology**

**N.B.**

Maintain / Improve hip ROM

????????

**Adaptation?**

**Table 3. Normal Range of Motion of the Hip Joint (Adapted from Vecsey, 2002 [26])**

<table>
<thead>
<tr>
<th>Hip Motion</th>
<th>Range of Motion (Degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>130 (downwards)</td>
</tr>
<tr>
<td>Extension</td>
<td>20 (backwards)</td>
</tr>
<tr>
<td>Adduction</td>
<td>45</td>
</tr>
<tr>
<td>Abduction</td>
<td>25</td>
</tr>
<tr>
<td>Internal rotation</td>
<td>30</td>
</tr>
<tr>
<td>External rotation</td>
<td>40</td>
</tr>
</tbody>
</table>
Damien Griffin: Aspetar Conference Nov 2014:
Intrinsic and extrinsic factors contributing to hip joint stress

**Anatomy**

**Biomechanics**

**Adul**t  
Youth

**Posture**

**Screening**

**A 10 degree increase in anterior pelvic tilt, resulted in a significant loss of 6-9 degrees of hip internal rotation and increase in FAI.**

**Effect on other joints**

**Anatomical Anatomy vs Functional Anatomy**
Take Home Message: Anatomy

Understand the role the hip / groin plays in a combination of movement patterns and dysfunctions.

Groin and Hips

Anatomy

Youth: Groin / Hip

Background

“Some athletes are immature… skeletally”

Drew MK. BJSM 2015

Underage athletes have been shown to pose approximately double the risk of adults in an Australian Rules football population. Maturation is related to age, gender, race and the environment, with injury rates increasing throughout the adolescent period.

Risk factors

7 – 18 years

Spending hours ++ in organised sports

65% were overuse injuries

Specialise in a single sport

PHV – Peak height velocity

Very low incidence in the age groups <U-14

Growth spurt period is associated to a greater chance of groin and pelvic injuries.

Apophyseal injuries:

- Peak incidence during PHV.
- AHS is the most susceptible apophysis.
Youth

Major Factors:

1) Overload
2) Epiphyseal injuries
3) Avulsion injury
4) CAM Deformity ("FAI")

Mechanisms of overuse injury

In the skeletally immature athlete, the tissues most vulnerable to injury are the cartilaginous growth centers, the physes and apophyses, which account for 15% of all youth sports injuries.

Pubic Bone overload

What is the mechanism of injury?

Limited Hip ROM?

Increased RA tone

Pubic Bone overload

Decreased Lumbo-pelvic stability

Weak Adductors / increased Adductor tone

Increased RA tone

Ilio-Psoas Dysfunction

The importance of documenting training and competition workloads of football.

Unfused growth centre is structurally the weakest link in the bone-tendon-muscle unit.
3) Avulsion injury

Avulsion fractures are most common in the pelvis and lower extremities.

Pubis

What are the new findings?

- The maturation of this apophysis starts at 16 years of age and continues up to approximately 21 years in male participants.

How might it impact on clinical practice in the near future?

- The diagnosis of pubic apophyseal injuries needs to be considered in adolescent athletes reporting adductor-related groin pain. An athlete in his early 20s should be considered as skeletally immature.
- Signs of apophyseal plate stress may be assessed with CT scan, however, the risk of exposure to ionizing radiation in this age group makes this ill advised. More modern MRI proximal adductor injuries are a promising alternative.
- Conservative treatment should be the first line of management to allow physiologic maturation.

Sailly et al., BJSM June 2015

Avulsion injury

Pubis

Apophyseal avulsions from the symphysis pubis and the inferior pubic rami at the origins of the adductors (adductor longus, adductor brevis, adductor magnus, gracilis) and the rectus abdominis are secondary to either microtrauma or repeated micro-trauma or repeated traction with excessive rotation of the body.

Sailly et al., BJSM June 2015

Avulsion fracture

AlIS

Lesser Trochanter

Avulsion fracture of the lesser trochanter: an unusual cause of hip pain in an adolescent Vazquez et al., CJEM 2013

An adolescent athlete with groin pain Thing et al., BMJ 2014

Sailly et al., BJSM June 2015

Greater Trochanter

Avulsion fracture
Iliac Crest

Aponeurotic insertion of IO, EO and TA
Sudden torsion of the body eg Tennis, Soccer
Apophysis of iliac crest starts to ossify at 15yrs and fuses at 18 yrs

Ischial Tuberosity

Excessive eccentric contraction of Hamstrings.
Intense sport load – sprinting, gym, dance.

4) CAM Deformity (“FAI”)

We believe now that CAM deformities develop around 12-13 years old (Agricola and Kemp – Aspetar 2014).
ER and flexion increase weight bearing through the femoral neck and lateral femoral head, around the growth plate

“FAI” prevalence in general population is 15%, while in male athletes it can be as high as 75%


Aspetar - Oct 2014

Type of hip pain patient:
Cam FAI
Cam lesion not FAI
FAI refers to pain and pathology that occur when cam lesion impinges on acellular structures in susceptible people.
Prof Griffin:

FAI **morphology** does not mean **symptomatology** but more likely in athletes because of
- Loads
- Hip positions

The formation of a cam deformity may therefore be a result of structural adaptation to high-impact sporting activities during growth, when the skeleton is highly sensitive to mechanical loading.

**Conclusion**: Patients with cam-type FAI and an alpha angle of 65° or more are at increased risk of substantial cartilage damage while increasing acetabular coverage appears to have a protective effect.

Overcoverage Pincer might even be protective effect on development ??

**Igor Tak et al., IJSM 2015**

The relationship between the frequency of football practice during skeletal growth and the presence of a cam deformity in adult elite football players.

**CONCLUSION**: A higher prevalence of cam deformity was found in players who report starting high-frequency football training before 12 years of age. This supports a dose-response relationship of football during skeletal growth, which should be investigated further with the ultimate aim to develop strategies to prevent the formation of a cam deformity.

Pathologic changes seen on MRI were **symptomatic in less than two thirds of the dancers.**

**Instability, Impingement, or Combinations or both**

**Instability, Impingement, or Combinations or both**

**South American Hip**

How might it impact on clinical practice in the near future?

- This information indicates a need to develop interventions with potential to improve patient-reported outcomes in people with hip chondropathy, particularly at a time point where recovery has been assumed to be complete.
- Chondropathy appears to be a marker of early degenerative hip disease and treatment strategies should include those such as education, maintenance of physical activity and fitness, pain coping skills and weight management.
- Clinicians can have a high degree of suspicion that individuals with hip pain and femoroacetabular impingement or labral pathology may also have chondropathy.

HOW and WHY the patho-anatomy of FAI leads to future hip injuries?

Further research is required

? Impact on incidence of OA

N.B. Can the Alpha Angle Assessment of Cam Impingement Predict Acetabular Cartilage Delamination? Beaul et al BJSM 2012

Yuan et al., AJSM 2013

Screening hips in asymptomatic patients to detect the hip at risk of future pathological changes secondary to impingement during high risk activities

Surgery???

More Specific research required!

Prevention of the formation of a cam deformity might be possible by adjusting the type, duration or frequency of loads that are applied to the hip during skeletal growth.

Igor Tak et al., BJSM 2015

<table>
<thead>
<tr>
<th>Author</th>
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<tr>
<td>Agricola et al.</td>
<td>AJSM 2012</td>
<td>The Development of CAM-type deformity in adolescent and young male soccer players</td>
<td>CAM type deformities were recognisable and present in the age of 13 years and were more prevalent in soccer players than their non-athletic peers, influenced by high impact sport. Long term follow ups and more studies required to determine the relationship between type and severity of articular damage and the longer term risk of developing clinically significant hip OA.</td>
</tr>
<tr>
<td>Sankar et al.</td>
<td>J Am Acad Orthop Surg., 2013</td>
<td>FAI: Defining the condition and its role in the pathophysiology in OA</td>
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<td>Nishimura et al.</td>
<td>AJSM 2013</td>
<td>Growth Prevalence of Cam-Type Deformity and Hip Pain in Elite Ice</td>
<td>The data suggest that playing ice hockey at an elite level during childhood is associated with an increased risk for cam-type deformity and hip pain after physeal closure.</td>
</tr>
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<td>Thompson et al.</td>
<td>AJSM 2013</td>
<td>Ice Hockey Goalie/Ex after Treatment for FAI Impingement</td>
<td>Nonrecurrence of CAM deformity at 2 years after femoral neck osteoplasty.</td>
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<td>Decreased ROM is associated with Structural Hip Deformity in Asymptomatic Adolescent Athletes</td>
<td>8% of asymptomatic teenagers had limited internal rotation. 66% had radiographic findings of FAI. 2/3rd asymptomatic</td>
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<td>Nappi et al.</td>
<td>AJSM 2013</td>
<td>Mechanical Factors explain development of CAM-type Deformity</td>
<td>Specific loading patterns were to stimulate the development of CAM-type deformity. Reveals mechanobiological mechanisms that trigger the development of CAM-type deformity. Prevention!</td>
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Many studies on CAM deformity

Surgical Treatment of symptomatic FAI - if relief and improved kinematics

Improved kinematics reduce elongation of native hip and alter progression of OA changes with asymptomatic FAI deformity.

Risk of Hip OA in males participating in high impact sports may be due to underlying CAM type FAI and continued high levels of exercise.

N.B. What can we do?

We should now seriously start to consider activity modification for children in this stage of development.

Agricola and Kemp BJSM 2014

What can we do?

Author | Journal | Article | Comments |
<table>
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Risk of Hip OA in males participating in high impact sports may be due to underlying CAM type FAI and continued high levels of exercise.
**HIP: Other pathologies**

<table>
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<th>NB Non-Sports-Related Pathologies</th>
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<tbody>
<tr>
<td>- Slipped capital femoral epiphysis (SCFE),</td>
</tr>
<tr>
<td>- Leg–Calvé–Perthes disease (LCPD),</td>
</tr>
<tr>
<td>- Benign and malignant bone and soft tissue tumors</td>
</tr>
<tr>
<td>- Juvenile idiopathic arthritis (JIA).</td>
</tr>
</tbody>
</table>

### Study: Overuse injuries of the hip in adolescents.

**Author:** Zambelli et al., Rev Med Suiss 2010

**Comment:** The concept of overload is explained as the inability of the hip to ensure its centrity during activities that could lead to the occurrence of any degenerative disorders.

### Study: Children with hip pain should be seen by a specialist.

**Author:** Hirn et al., J Pediatr Orthop 2013

**Comment:** SCFE is typically seen in overweight boys, but may also occur in normal weight teenagers. Early imaging is crucial, since slip is more disabling if late diagnosis and treatment strategy.

### Study: Hip pathologies in the adolescent.

**Author:** Giordano et al., AJSM 2007

**Comment:** Over past 20 years, improvements in imaging modalities and technical innovations have led to greater diagnostic insights and creative new treatment strategies. Hip joint pain is most common clinical entity and is most likely related to FAI, labral tears and OA.

### Study: Assessment and treatment of hip pain in the adolescent athlete.

**Author:** Riemann et al., BJSM 2011

**Comment:** Hip joint pathologies are a leading cause of groin pain in the sporting population.

### Study: Hip Joint Pathology as a leading cause of Groin Pain in the sporting population.

**Author:** Verral et al., 2001/04

**Comment:** Hip joint pain is most common clinical entity and is most likely related to FAI, labral tears and OA. However, sports medicine management of hip pain is challenging and treatment of hip joint pain is complex.

### Study: Ongoing studies re Hip pathologies.

**Author:**.Cardinal et al., Knee Surg Sports Traumatol Arthrosc. 2013

**Comment:** Various methods to evaluate the Gluteus medius and hip abduction function are described and debated. The concept of overload is explained as the inability of the hip to ensure its centrity during activities that could lead to the occurrence of any degenerative disorders.

### Management: Groin / Hips

#### Groin / Hips Tests

1. **Significant Tests**
   - 1. Trendelenburg test:
   - 2. Adductor Squeeze Test
   - 3. Bent Knee fall out test
   - 4. Impingement test
   - 5. Glut strengthening / sequence

2. **Investigations**
   - 1. Adductor squeeze test values and hip joint range of motion in Gaelic football athletes with long-standing groin pain.

3. **Conservative Management**

#### Groin / Hips References

**Significant Tests**


**Conservative Management**

- Thorborg, K. et al. (2014). BJSM.
Further research is required when assessing the clinical usefulness of these tests.

## Summary: Tests

A battery of tests should be performed, with a clinical focus.

## 2. Investigations

### Investigations

- X-ray
- Bone scan
- CT scan / CT spect
- MRI / MR arthrogram
- Hemiography
- Ultrasound
- Diagnostic LA injection into hip
- Hip arthroscopy

## Radiological Imaging

- 72% of male elite soccer athletes demonstrated some evidence of radiographic abnormality (Gerhardt et al. 2012)

  **How much bone stress is normal??????**

- Need trials where clinical entities are correlated with systemic investigation.

## 3. Conservative Management

Experienced clinical judgement remains a critical element in the diagnostic pathway.
Physiotherapy / Rehab

Know your sport!!

Cricket
Peak Vertical GRF is approx. 6 bowler’s BW at front foot strike

Conservative Management

Role of the physio

Symptoms
Pathology
Dysfunction


Know the Risk factors: Screening

Screening: Tyler TF et al. The association of hip strength and flexibility with the incidence of adductor strains in professional ice hockey players. AJSM 29(2), 2001; Thorborg K et al. M imbalance. AJSM 2011; Hides J et al. Screening the lumbopelvic muscles for a relationship to injury of the quadriceps, hamstrings, and adductor muscles among elite Australian Football league players. JOSPT. 2011

Aspetar

Screening: Tyler TF et al. The association of hip strength and flexibility with the incidence of adductor strains in professional ice hockey players. AJSM 29(2), 2001; Thorborg K et al. M imbalance. AJSM 2011; Hides J et al. Screening the lumbopelvic muscles for a relationship to injury of the quadriceps, hamstrings, and adductor muscles among elite Australian Football league players. JOSPT. 2011

Implications for clinical practice

Sooooooo:

- Screen.
- Look for movement dysfunction patterns and compensatory muscle patterning.
- Tailor exercises for the individual patient.
- Off load the Pubic Joint.

Local and Global

Identify and reduce the sources of increased load on the pelvis

Brukner and Kahn 2012

Know the Risk factors: Screening

Jackie Whittaker PhD, BScPT, FCAMPT

Aspetar

Screening: Tyler TF et al. The association of hip strength and flexibility with the incidence of adductor strains in professional ice hockey players. AJSM 29(2), 2001; Thorborg K et al. M imbalance. AJSM 2011; Hides J et al. Screening the lumbopelvic muscles for a relationship to injury of the quadriceps, hamstrings, and adductor muscles among elite Australian Football league players. JOSPT. 2011

 Tailor exercises for the individual patient.
 Look for movement dysfunction patterns and compensatory muscle patterning.
 Off load the Pubic Joint.
Rehab Adductor Muscles

Pointers

Neuromotor Control

Proprioception

Pointers

Summary – Conservative Rx

- Understand Anatomy vs Functional Anatomy
- Minimise pre-existing risk factors and compensatory strategies
- Gradual progression based on objective functional and clinical markers

Pointers

Monitor Progress – ongoing – throughout season

Groin and Hips - Overview

Youth…………..

Solution ???

Developmental changes in puberty should be carefully monitored to reduce the risk of injury.

Load management is key and must be monitored

Dr Adam Weir
Well researched studies are needed with practical outcome.

Prevention of Groin/Hip problems

Any Questions?