

Anterior Hip & Groin Pain

Contemporary Diagnostic &
Management Strategies

Dr. Alison Grimaldi

PHYSIOTHERAPIST, RESEARCHER & EDUCATOR

Anterior Hip & Groin Pain Contemporary diagnostic & management strategies

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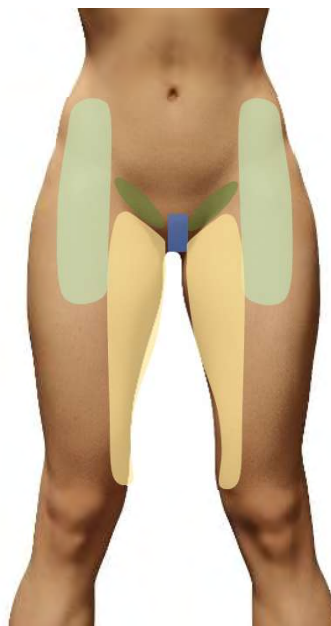
 @alisongrimaldi

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Anatomy of the anterior hip & groin



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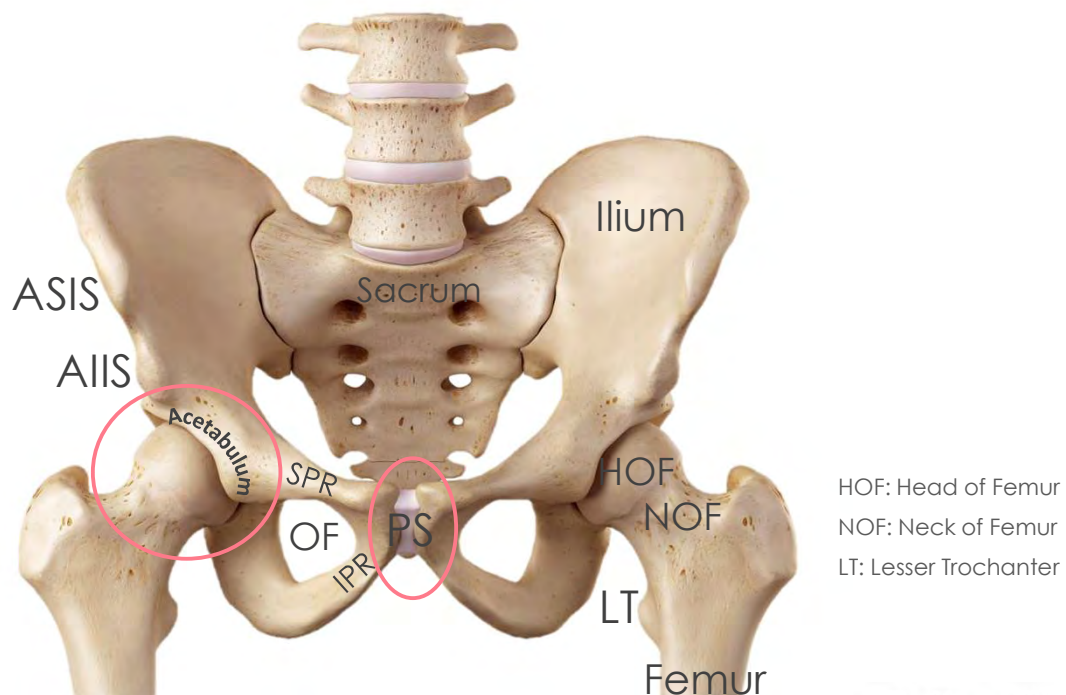
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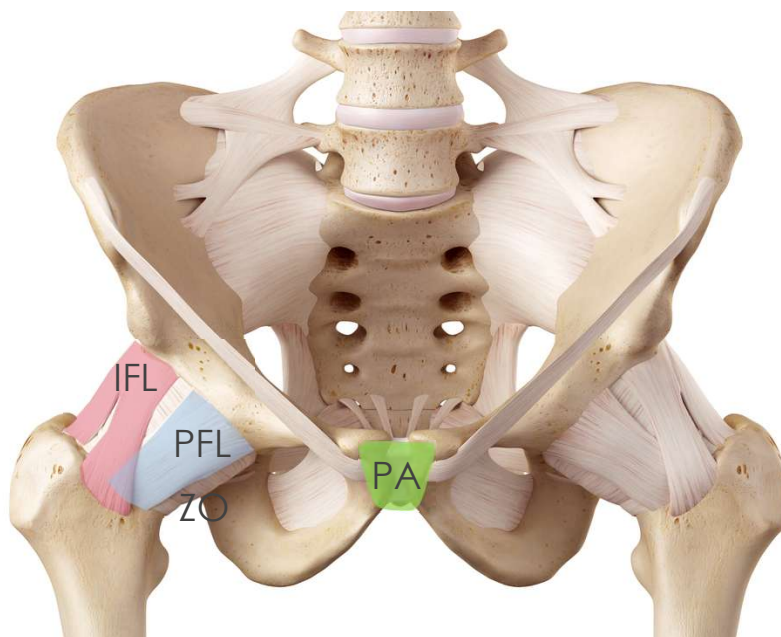
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ASIS: Anterior Superior Iliac Spine; AIIS: Anterior Inferior Iliac Spine; OF: Obturator Foramen; SPR: Superior Pubic Ramus; IPR: Inferior Pubic Ramus; PS: Pubic Symphysis

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PA: Pubic Aponeurosis; IFL: Iliofemoral Ligament; PFL: Pubofemoral Ligament; ZO: Zona Orbicularis

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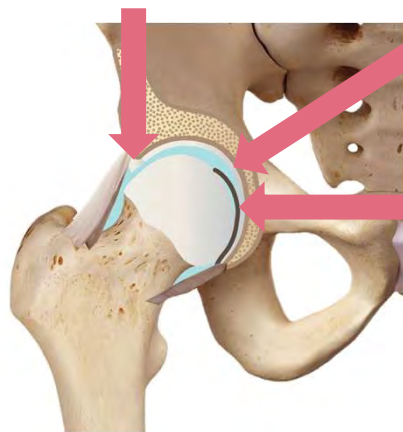
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Acetabular Labrum



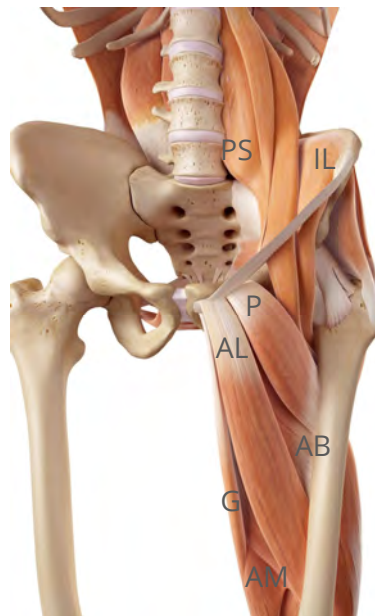
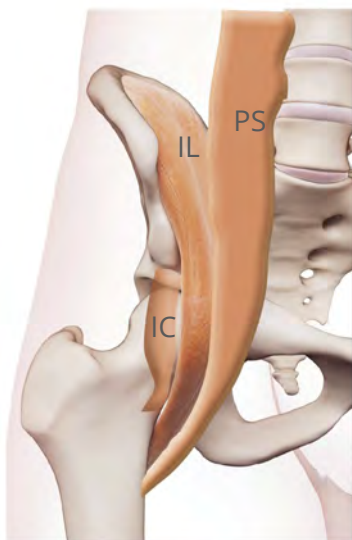
Cartilage

Ligamentum Teres

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Muscles



PS: Psoas; IL: Iliacus; IC: Iliocapsularis; P: Pectineus; AL: Adductor Longus; Adductor Brevis; AM: Adductor Magnus; G: Gracilis; EO: External Oblique; RA: Rectus Abdominis; RF: Rectus Femoris; SA: Sartorius

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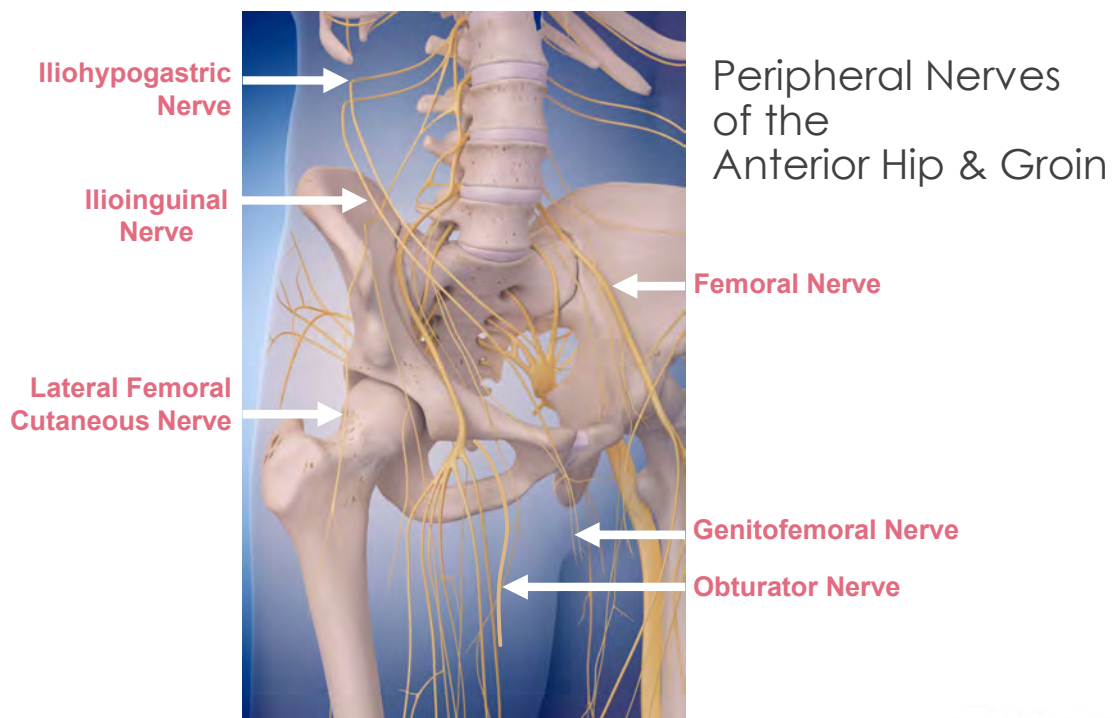
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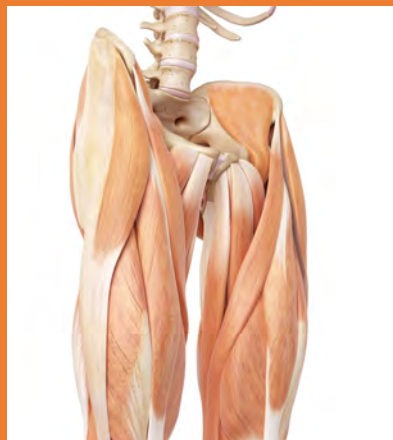
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When pain arises ...

Joint Related Pain & Bony Impingements



Soft Tissue Related Pain



Referred & Nerve Related Pain

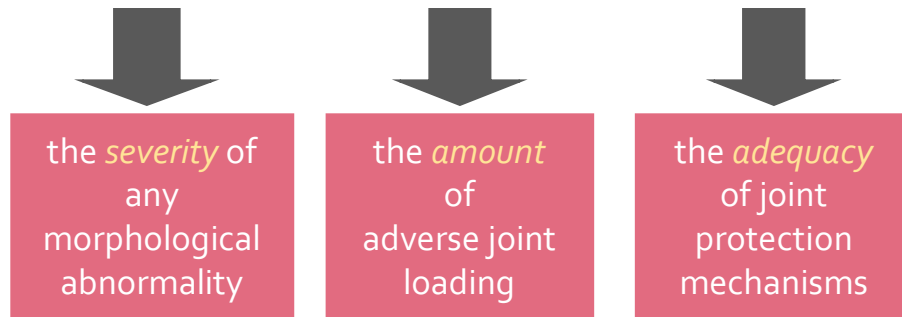


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Joint Related Pain & Bony Impingements

Risk of intra-articular pathology is thought to be affected by:



Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
Cam Morphology (FAI)	Overcoverage (FAI)	Congenital <i>Hypermobility</i>
Coxa Valga/Vara	Retroversion (FAI)	Acquired <i>Trauma</i>
Coxa Breva	Dysplasia <i>Type I & II</i>	<i>Iatrogenic</i>
Femoral Version		<i>Focal overload</i>
<i>Retroversion</i>		
<i>Anteversion</i>		

Anterior Hip & Groin Pain

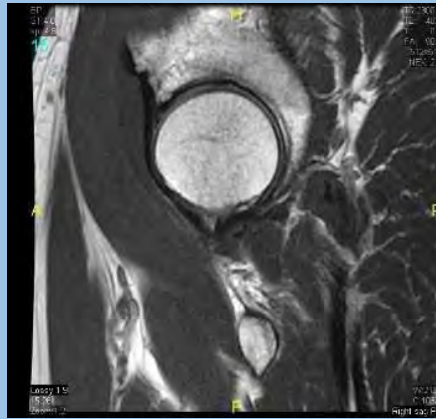
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Soft Tissue Related Pain

Iliopsoas Related Anterior Hip Pain



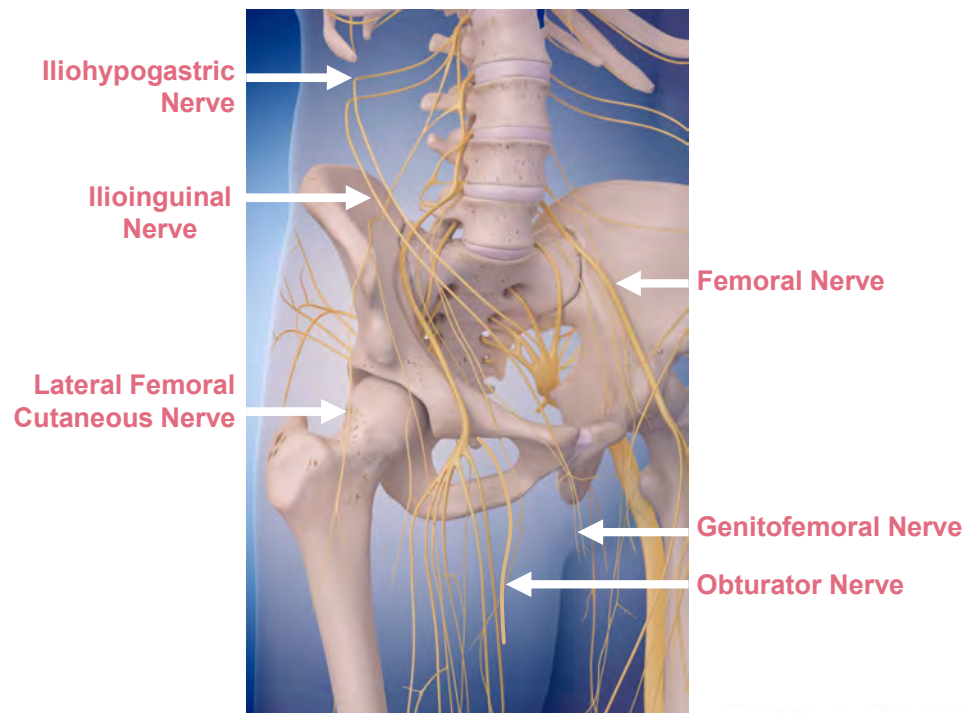
Groin Pain



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Referred & Nerve Related Pain



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Joint Related Pain & Bony Impingements



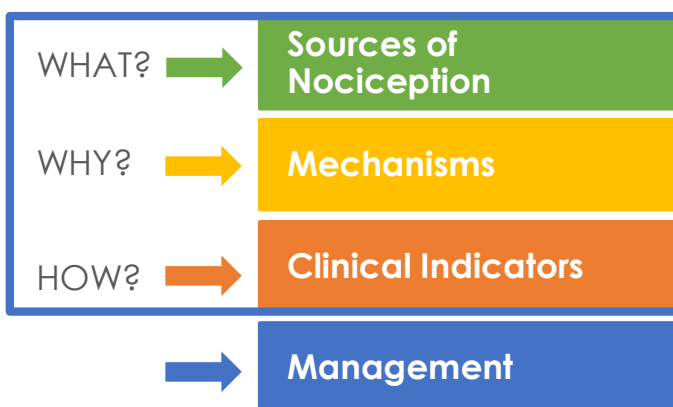
ANTERIOR HIP & GROIN PAIN

Joint Related Pain & Bony Impingements

Sources of Nociception & FAI
Module 1 – Lesson 2

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Joint Related Pain & Bony Impingements



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Clinical Indicators of IA Source

①

Interview Features

Mid-inguinal pain, 'C Sign',
Triangulation sign

Hip stiffness common
* Hip flexion & rotation

Catching, locking, clicking,
giving way

Pain at EOR *deep flexion,
extension,
abduction/circumduction

Pain with WB rotation or
change of direction

Ache after activity,
night ache

②

Physical Features

Restricted hip flexion & IR *

Restricted **FABER**
Reproduction of
usual pain



Deep anterior hip P on
FADDIR (Scours/quadrant) *



Thomas Test

Hip P +/- clicking



* Useful for ruling out * Useful for ruling in

Altman et al 1999, Birrell et al 2001, McCarthy & Busconi 1995, Reiman et al 2015, Thorborg et al 2018

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Sources of Nociception

Prevalence of pathology & relationship with hip

Prevalence	PAIN	NO PAIN
Labral Tear	62%	54%
Cartilage Defects	64%	12%
Bone Marrow Lesions	More common	
Synovitis - Effusion	More in female dancers	
Lig Teres Tear		55% dancers 22% athletes

Mayes et al 2016

Heerey et al. SRV/MA Br J Sports Med 2018;52:581-593

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Synovial Folds & Plicae

Pectinofoveal fold

Identifiable in 95% on MRA's & 99% on arthroscopy

(Blankenbaker et al 2009)

Potential source of intra-articular clicks

Repetitive clicking may contribute to joint synovitis



Jesse et al 2013

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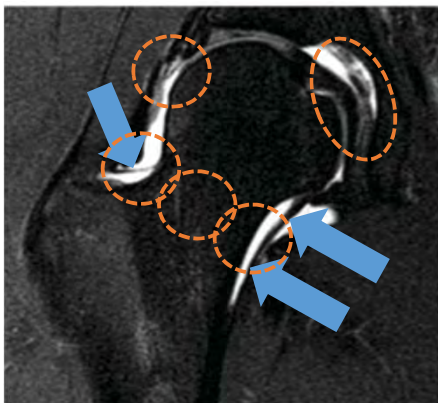
Synovial Folds & Plicae

3 main plicae:

1/ Labral

2/ Ligamentum

3/ Neck - Anterior, Medial (inf neck), Lateral (sup neck)



Bencardino et al 2011

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Another potential source of pain associated with cam morphology

- Fat pad sits at anterior head neck junction
- May impinge under acetabular rim in F/IR
- Highly vascularised & innervated
- May be capable of modulating inflammatory & destructive responses in OA

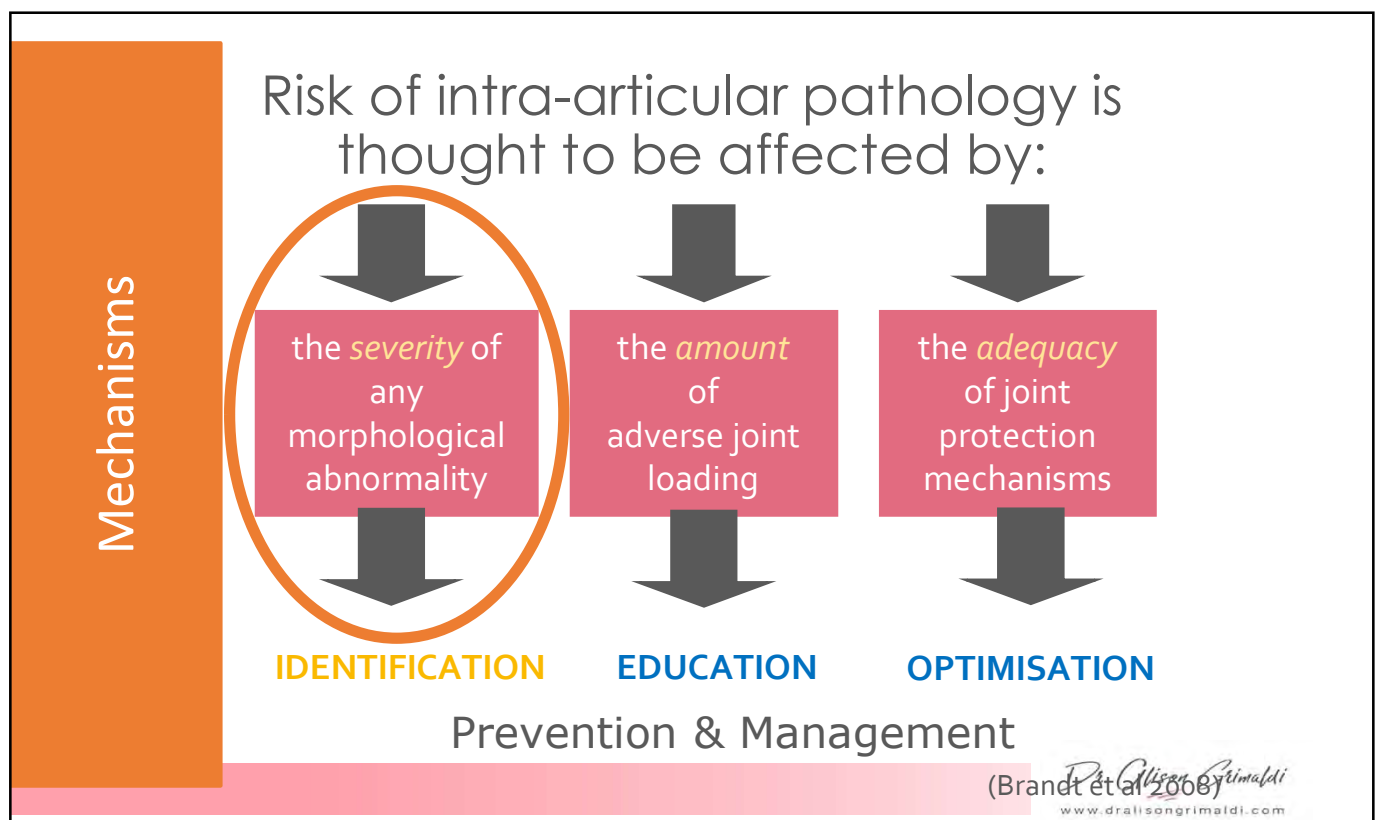


Study comparing surgical resection of fat pad and bone resection vs fat pad resection only
At 24/12: 16.0% vs 18.9% improvement in mHHS (nsd)

Jayasekera et al 2014

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Key Morphological Variants

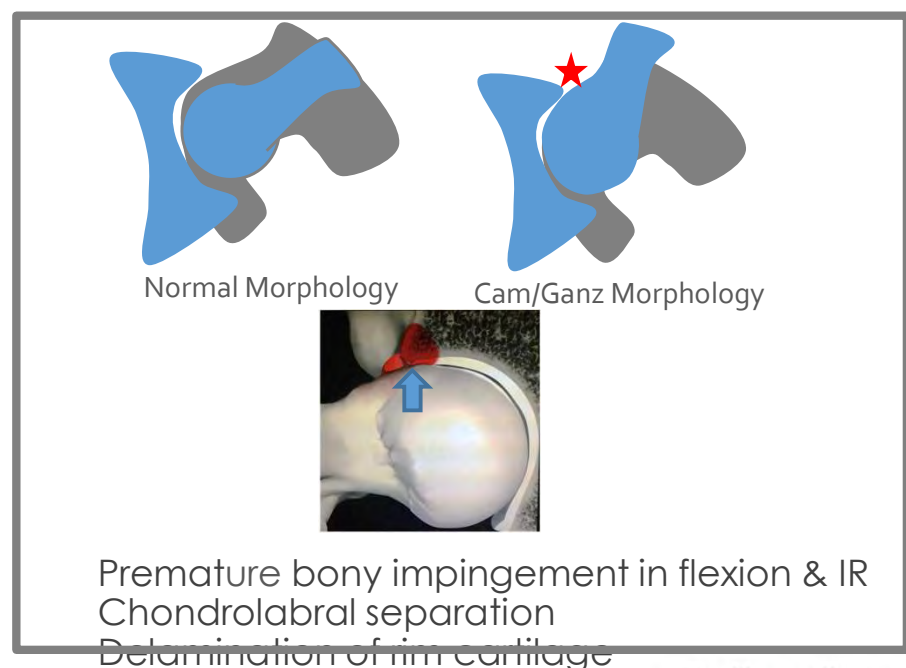
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Coxa Valga/Vara Coxa Breva	Dysplasia Type I & II	Acquired Trauma Iatrogenic Focal overload
Femoral Version Retroversion Anteversion		

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Morphology predisposing to FAI early in range

Cam Morphology

Influence at Anterior Hip



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What causes cam morphology?



Related to growth & loading

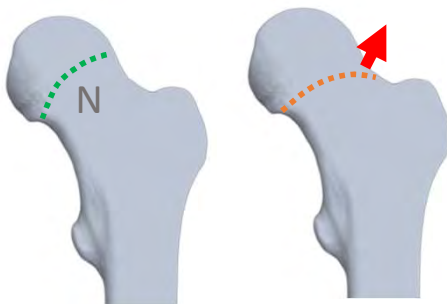
- Change in alpha angle occurs when the physis is open
- May present as early as age 10-12
- Increases until physis closes $\approx$ 16
- Much more common in males
- Much more common in athletes
Soccer/football codes, hockey, basketball

Zadpoor 2015; Roels et al 2014, Agricola et al 2014

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Risk of developing cam morphology is thought to be affected by:



Shape of the growth plate

Growth plate extension towards NOF



Type of loading

Hip ER
Hip F
Impact

Frequency of loading

4 or more training sessions/week



Zadpoor 2015; Roels et al 2014, Agricola et al 2014

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DIAGNOSIS OF CAM MORPHOLOGY

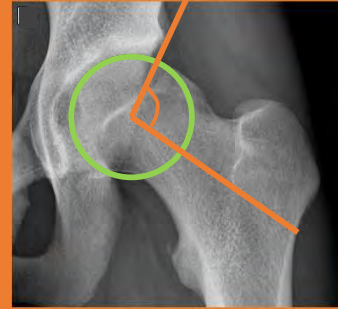
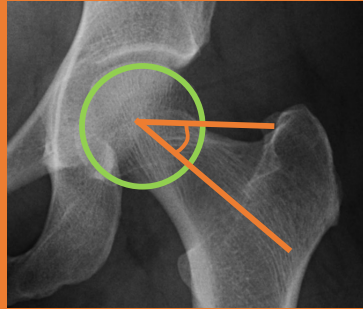
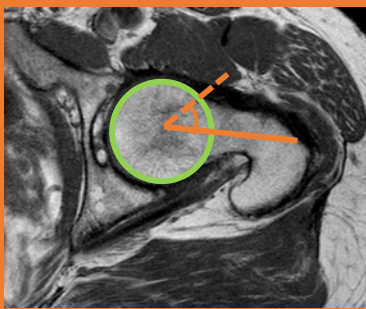
Alpha angle:

< 60°: Normal: low risk of hip OA

> 60°: Defined as cam lesion

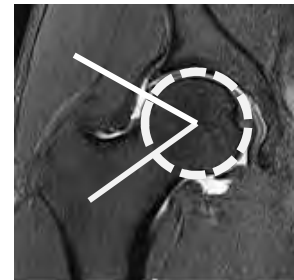
Agricola et al 2013

CAM MORPHOLOGY ≠ FAIS



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Diagnosis of FAIS



Symptoms + clinical signs

= Femoroacetabular Impingement Syndrome

+ imaging

Cam/Pincer/Mixed Morphology

Griffin et al. Warwick Agreement. Br J Sports Med 2016;50:1169–1176

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Is Cam Morphology associated with hip pain?



Prospective Studies

1 prospective study of 200 over 4.4 years

Cam = RR 4.3 for developing hip pain

Khanna et al 2014

Cross-sectional cohort studies

Relationship between pain & cam unclear

- mixed findings

Yes: Allen et al 2009, Larson et al 2013

No: Anderson et al 2016, Gosvig et al 2008

Kapron et al 2015, Nardo et al 2015

Cam Morphology & relevance to development of hip OA

6 - 25% of people with cam morphology
will develop hip OA within 5 -19 years

Van Klij et al 2018

Alpha angle

➤ 78°: Pathological cam
Increased risk of adv OA
esp if hip IR <20°

> 85°: 33% chance of developing
OA in next 5 yrs



From early adulthood - 45 years of age, relationship unknown

Agricola et al 2013, Nicholls et al 2011, Van Klij et al 2018

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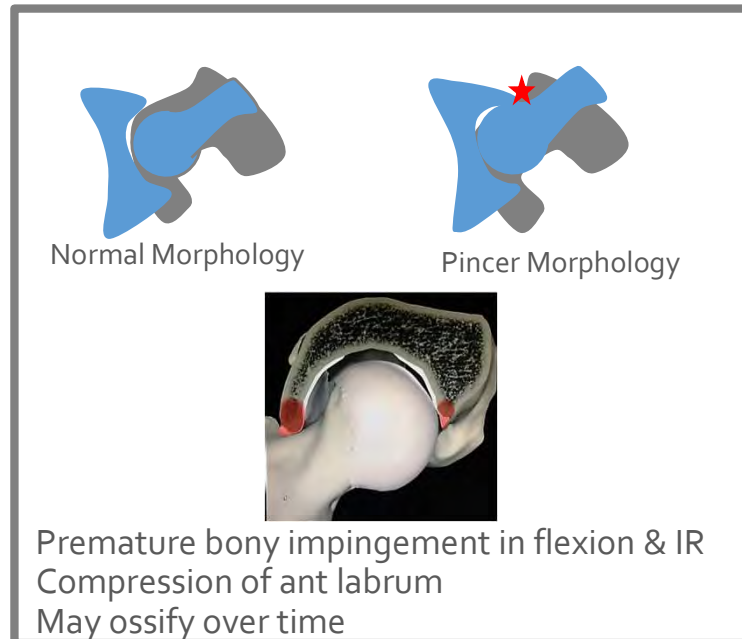
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Morphology predisposing to FAI early in range

Pincer Morphology

Influence at Anterior Hip



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Acetabular Retroversion



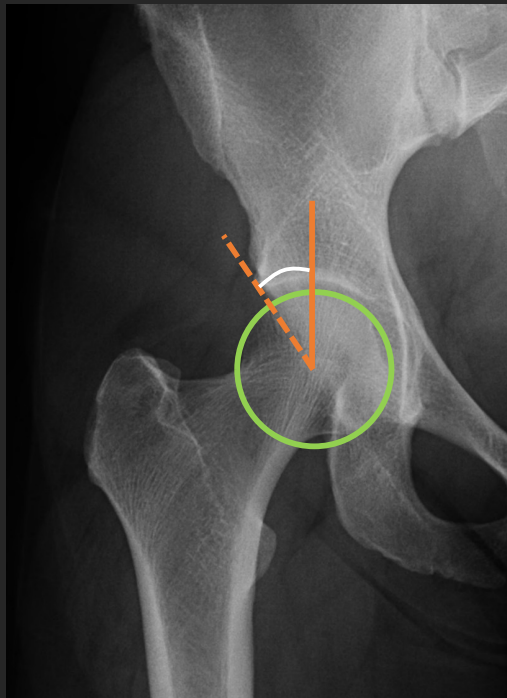
Cross-over sign; Prominence of Ischial Spine

Kalberer et al 2008

*Ensure well centred. Coccyx ~1cm above PS; no rotation

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DIAGNOSIS OF PINCER MORPHOLOGY

Centre-edge angle:

25-35°: Normal

35-40°: Borderline

>40°: Overcoverage

At risk of Pincer FAI

Agricola et al 2013

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Pincer Morphology & relevance to pain & risk of hip OA



No clear relationship established between
pincer morphology & pain

Pincer morphology does NOT increase risk of OA

May be protective

Agricola et al 2013, Saberi Hosnijeh et al 2016, Thomas et al 2014

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Remember ...

The majority of people with cam &/or pincer
morphology **WILL NOT** develop hip pain or OA

Risks of developing pain/OA may be increased by:

- the severity of cam morphology
- type and amount of physical activities performed
- lower muscle strength
- altered gait-pattern characteristics
- lower range of motion

Van Klij et al 2018



ADDRESS MODIFIABLE FACTORS

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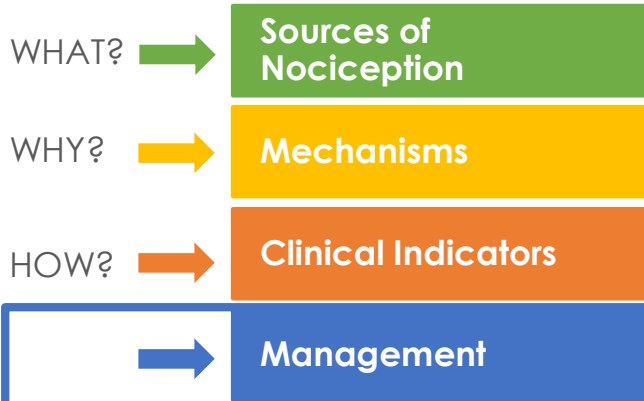
Joint Related Pain & Bony Impingements



ANTERIOR HIP & GROIN PAIN Joint Related Pain & Bony Impingements Management of FAIS Module 1 – Lesson 3

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Joint Related Pain & Bony Impingements



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Management of anterior hip pain associated with FAIS

Possible Options

Load Management

Surgery
+ Load Mx & Ex

Rehabilitative Exercise

Manual Therapy



What does the evidence support as best practice?

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Mansell et al 2018 RCT Hip Arthroscopy vs MT & Exercise

n=	80	Mean age 30	33 female;47 male
	91% active duty Army service members		
f/up	2 years		
Gp 1	Hip arthroscopy: Labral surgery, acetabuloplasty, femoroplasty + Post Op Rehab: 12-18 PT sessions over 6/52, then every 2-3 weeks Exercise – ROM/motor control - Progress to agility		
Gp 2	Physical Therapy 12 sessions PT over 6/52 Individualised manual therapy & exercise 6-8 exercises – ROM/motor control		

Mansell et al AJSM 2018;46(6):1306 - 1314

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Mansell et al 2018 RCT Hip Arthroscopy vs Physical Therapy

n=	38 Surgery; 40 PT * 28 of PT gp had surgery
1°	HOS ADL & Sports
2°	iHot33 Hip-Related QoL (100 = no pain & full fx) GROC – 15 point scale

Both groups improved
NSD between groups
Uncertainty??

58.1% all participants did not perceive a clinically meaningful change at 2 years

(GROC ≥ 3: somewhat/mod/good/great/very great deal better)

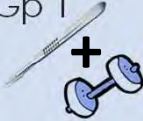
1/3 not fit for duty at 2 years

iHot33 Scores: increase from ≈ 30/100 to **40-50/100**

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FASHlon RCT Griffin et al 2018 Hip arthroscopy vs 'conservative care'

n=	348 Mean age 35 135 female; 213 male
f/up	12 months
Gp 1 	Hip arthroscopy: Labral/chondral surgery, bony reshaping + Post Op Rehab: varied, progressive phases
Gp 2 	Personalised Hip Therapy 5-6 sessions over 3-6/12 ; +/- 1 phone session a. Assessment of pain, function, ROM b. Education – Load Mx; Posture & Gait Mods c. Exercise – Individualised & progressed HEP d. Pain Relief (analgesics, NSAIDs) +/- Manual therapy, Orthotics, CSI

Griffin et al Lancet 2018;391;2225-35

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FASHlon RCT Griffin et al 2018 Hip arthroscopy vs conservative care

n=	171 Surgery; 177 PHT (14 PHT had surgery)
1°	iHot33: Hip-Related QoL 0-100 100 = no pain & full fx
Gp1 	39.2 (20.9) 19.6% → 58.8(27.2)
Gp 2 	35.6 (18.2) 14% → 49.7(25.5)

Both groups improved
Surgery with rehabilitation
greater improvement*

Adjusted mean difference
between groups = 6.8pts
better outcome for surgery
MCID = 6.1 (Mohtadi et al 2012)
= 10 (Kemp et al 2013)

5 serious adverse events
1 joint infection

Griffin et al Lancet 2018;391;2225-35 *statistical significance

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What this tells us ...

Both surgery with exercise & physical therapy interventions without surgery help
But not sure what natural Hx in these populations may have been – with no intervention or simple advice

On average, patients are left with moderate levels of Hip-Related QoL 50-60/100

Is 6.8 pts better on iHot worth the surgical intervention?



Who needs early surgery??

Need to establish which factors indicate early surgery may give improved long term outcomes

Still unclear if surgery has any preventative benefit re OA

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FAIT RCT Palmer et al 2019

Hip arthroscopy vs Physio & Activity Modification

n=	222	Mean age 36.2 (18-60)	66% female
f/up	8/12 so far; change in JSW at 38/12		
Gp 1	 Hip arthroscopy: Labral/chondral surgery, bony reshaping + Post Op Rehab: 4 sessions - Focussed on optimising ROM & graded return to activity - Active ROM, isometric exercise, stretching, ex bike - Progress to strengthening & low impact exercise - Impact tasks 6/52; sports-specific rehab as appropriate		
Gp 2	 Physio & Activity Modification: 6 sessions - included advice to avoid extremes of F, Abd, IR - focussed on muscle strengthening to improve core stability & movement control (no other specifics) - encouraged a home exercise program (adherence?)		

Palmer et al BMJ 2019;364:l185

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FAIT RCT Palmer et al 2019

Hip arthroscopy vs Physio & Activity Modification

Outcome Measures:

1°: HOS-ADL

Range 0-100, higher values=better outcomes;
clinically meaningful difference=9points

2°: HOS Sport subscale, NAHS, HAGOS, OHS, iHot-33,
EQ-5D-3L, PainDETECT, HADS
Hip joint range of motion



Surgery Gp significantly higher mean HOS-ADL scores

After adjusting for baseline HOS-ADL, age, sex and study site,
mean between-group difference was 10 points (6.4 – 13.6)

Outcome advantage diminished with age

Hip joint ROM significantly better in Surgery Gp for Flexion only

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FAIT RCT Palmer et al 2019 Hip arthroscopy vs Physio & Activity Modification

Outcome: Proportion of participants	Arthroscopic Surgery & Rehabilitation	Physiotherapist-provided Advice & Exercise
Complete data available	89% (n=100)	80% (n=88)
HOS-ADL scores higher than baseline scores	70%	50%
Improvement in HOS-ADL of at least 9 points (clinically important change)	51%	32%
Patient Acceptable Symptom State (PASS) of 87 points on HOS-ADL achieved	48%	19%
Expectation on improvement in the HOS-ADL achieved	31%	15%

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Palmer 2019 Limitations

- Used only an ADL score
- Did not present data for sports scores, only group differences
- Substantial loss to follow up: 11% surgical gp; 20% physio gp – risk of bias
- Physiotherapy protocol
 - lack of detail
 - low number of sessions
 - unknown compliance



'We need to talk about current best practice for the non-surgical Mx of FAIS'

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What advice do we give our patients?

With current evidence ...

PHYSICAL THERAPY INTERVENTIONS FIRST

Work on possible moderators of outcome:

- type and amount of physical activities performed
- lower muscle strength
- altered gait-pattern characteristics
- lower range of motion

Van Klij et al 2018

(Ongoing trials required to provide evidence)

LOAD MANAGEMENT

Flexion

& F/IR; F/Add
combinations

Reduce overall
exposure to EOR
flexion

Minimise:

- repetitive
- sustained
- loaded
- rapid

**movement into
EOR - *Flexion, IR**

(Any EOR may be
provocative – Abd, Ext)



Minimising impingement

Considerations for Load Management During Exercise

- Range of Motion
 - * Depth
 - * Pelvic position
- Leg Placement-abd/ER
- Amount of external load
- Speed of movement
- Volume/frequency
- Alternatives



What advice do we give our patients?

With current evidence ...

PHYSICAL THERAPY INTERVENTIONS FIRST

Work on possible moderators of outcome:

- type and amount of physical activities performed

- lower muscle strength

- altered gait-pattern characteristics

- lower range of motion

Van Klij et al 2018

(Ongoing trials required to provide evidence)

EXERCISE THERAPY

Aim: Address Impairments & Optimise Joint Protection



Freke et al 2016, 2018, Diamond et al 2015, 2016, Kemp et al 2014, 2016, Hatton et al 2014, King et al 2018, Lewis et al 2018

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What advice do we give our patients?

With current evidence ...

PHYSICAL THERAPY INTERVENTIONS FIRST

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Van Klij et al 2018

(Ongoing trials required to provide evidence)

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RANGE GAINING TECHNIQUES?

To address ROM restriction? To reduce Pain?

Known Impairments

Freke et al 2016 SRV: the best available evidence suggests that ROM is not impaired in individuals with symptomatic FAI and should not be the primary target for treatment regimes.

Mosler et al 2018: IR ROM unable to discriminate hips with cam morphology; relatively small mean differences in internal rotation ROM between asymptomatic hips with and without a cam.



3D CT Modeling:

Hips with FAI had decreased F, IR & ABD

How accurate are our clinical measures?

Mosler et al – IR measured in supine with plastic goniometer at 90° hip flexion

Kubiak-Langer et al 2007

Mosler et al 2018

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RANGE GAINING TECHNIQUES?

If there is a ROM restriction, do these techniques help?

Mansell et al 2018: $\approx \frac{3}{4}$ of the MT & Ex Gp → surgery

Rationale for MT	Pain with Test or ROM asymmetry	Paired Rx approach for Manual Therapy
	FABER	Prone FABER MWM; Kneeling self-mobes Fig 4 stretch; Prone FABER self-mobes
	Internal Rotation	IR MWM Half Kneel IR Self-mobes with distraction
	Quadruped Rock	Quadruped MWM Quadruped Self-mobes with distraction

No Re-Ax of ROM performed – benefit obtained?

Mansell Protocol: BMC Musculoskelet Disord. 2016;17:60

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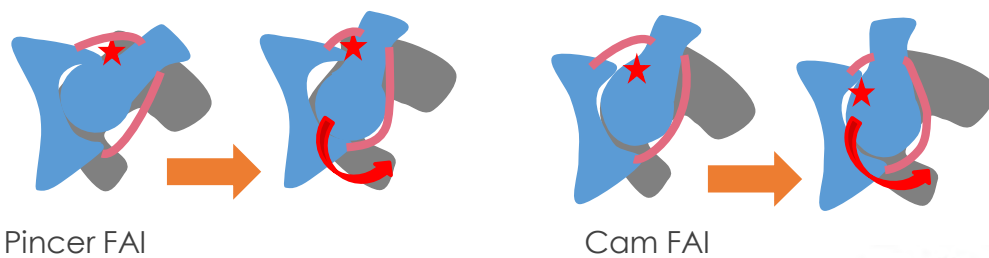
RANGE GAINING TECHNIQUES?

Rationale for Range Gaining: *Improve Functional Range Flexion & IR* – If the range restriction is bony, what does manual therapy or stretching achieve?

Increased length in the posterior capsule/ligs?

Allow the cam to move further into the acetabulum?

Is this a good idea?



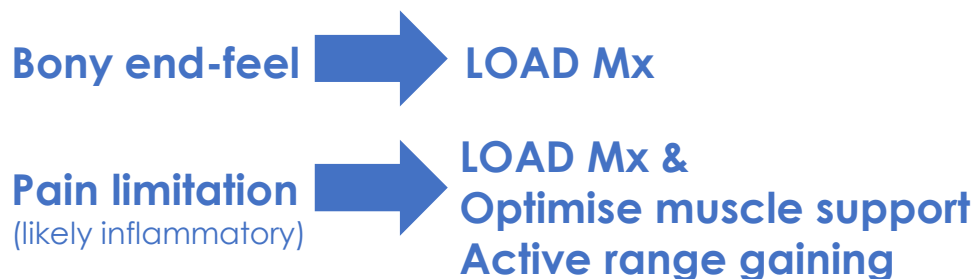
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FAI & Instability

FAI is associated with Posterior Hip Instability
– low energy sports-related posterior dislocation
Mayer et al 2016

Real time CT Imaging - all FAI subtypes & supraphysiological hip motions can lead to impingement and subluxation
Wassilew et al 2013



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FAI Key Points

Cam & Pincer Morphology predisposes to:

- FAI earlier in joint range & concurrent instability
- Rim pathology & FAIS (*Cam; Pincer?)

RCT evidence suggests hips are not 'fixed' by surgery

Need for optimisation of physical therapy interventions

Address individual impairments + manage joint loads

- Muscle function (more than just strength)
- Kinematics & kinetics – movement retraining
- ROM? How? Benefit of passive range gaining techniques is questionable

EDUCATION & EXERCISE

Joint Related Pain & Bony Impingements



ANTERIOR HIP & GROIN PAIN

Joint Related Pain & Bony Impingements

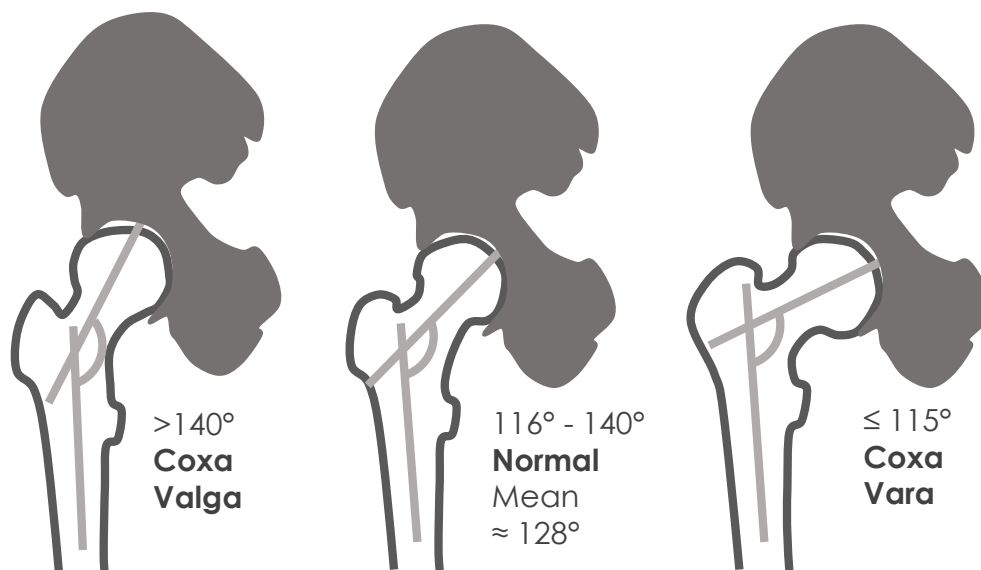
Femoral Morphology
Module 1 – Lesson 4

Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
Cam Morphology (FAI) ✓	Overcoverage (FAI) ✓	Congenital Hypermobility
Coxa Valga/Vara Coxa Breva	Retroversion (FAI)	Acquired Trauma Iatrogenic Focal overload
Femoral Version Retroversion Anteversion	Dysplasia Type I & II	

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Neck – Shaft Angle



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Coxa Breva – Short Neck



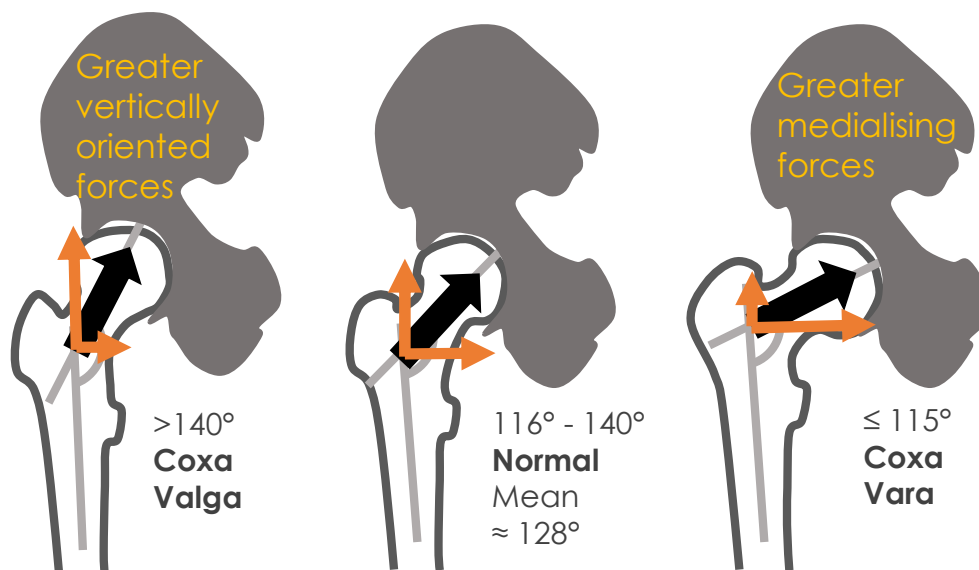
Usually associated with
Slipped Capital Femoral Epiphysis
or Avascular Necrosis

Eidelman et al 2016

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Influence of Neck – Shaft Angle



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Influence of Neck – Shaft Morphology



Coxa Valga & Brevia

May also increase risk of:

- anterior – inferior FAI
- &/or Ischio-femoral Impingement

Gluteus Medius & Minimus

- Mechanically disadvantaged
- Create more vertical force

May have greater impact when presents with other morphological issues, such as acetabular dysplasia

Tibor et al 2013

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Clinical Indicators of Neck-Shaft Variation



• Coxa Valga & Brevia

- Valga - ABD > ADD ROM
- Ipsilateral trunk lean in SLS
- 'Narrow hips' - GT's not much wider than pelvis



• Coxa Vara

- ADD > ABD ROM
(May experience GT impingement in ABD)
- 'Wider hips' – GT's sit relatively wider than pelvis

Imaging required to assess N-S angle
US may give some indication

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Anterior Hip & Groin Pain

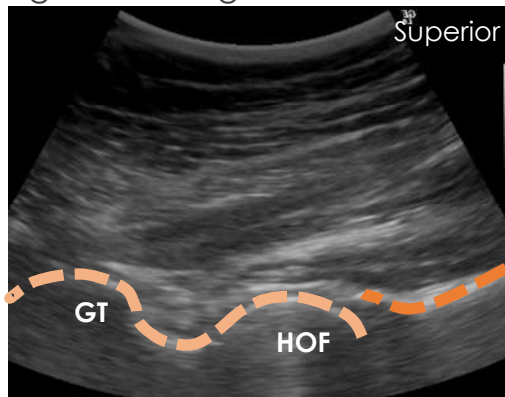
Contemporary Diagnostic & Management Strategies

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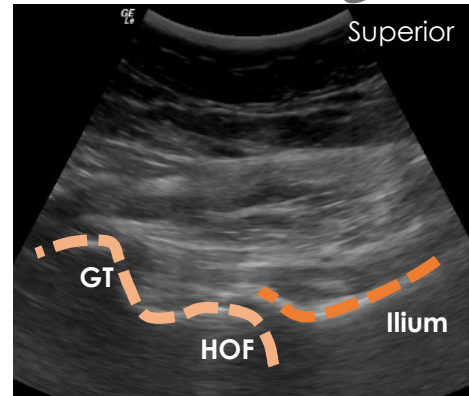
**More vertical neck
Less trochanteric offset**

More likely to have
higher N-S angle



**Less vertical neck
More trochanteric offset**

More likely to have
lower N-S angle

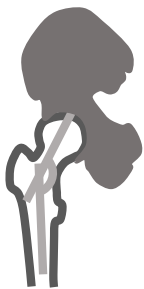


US: Longitudinal view at lateral hip

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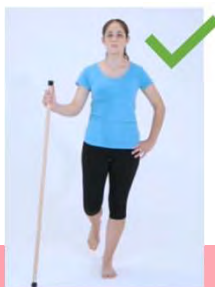
Neck-Shaft Variation – Implications for Mx



Exercise Considerations

Coxa Valga (Higher N-S angle)

- Will need higher abductor strength/bulk to support BW
- More likely to need hand support, single stick
- Working into ABD & with wider base is better for medialising forces
- Care with impact forces, particularly with excessive ADD



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Neck-Shaft Variation – Implications for Mx



Exercise Considerations

Coxa Vara

- Will achieve SLS with less abductor bulk/strength
- Inner range ABD may result in GT impingement superiorly +/- inferior shear

* External rotation will assist to clear greater trochanter. Good ER's important, also for inferior support



Elite dancers tend to have higher N-S angles which allows more freedom to move into higher ranges of abduction

Mayes et al 2017

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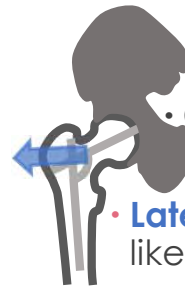
Neck-Shaft Variation – Implications for Mx

Manual Therapy for hip OA



• Coxa Valga

- **Longitudinal traction** likely to be most useful



• Coxa Vara

- **Lateral distraction** likely to be most useful



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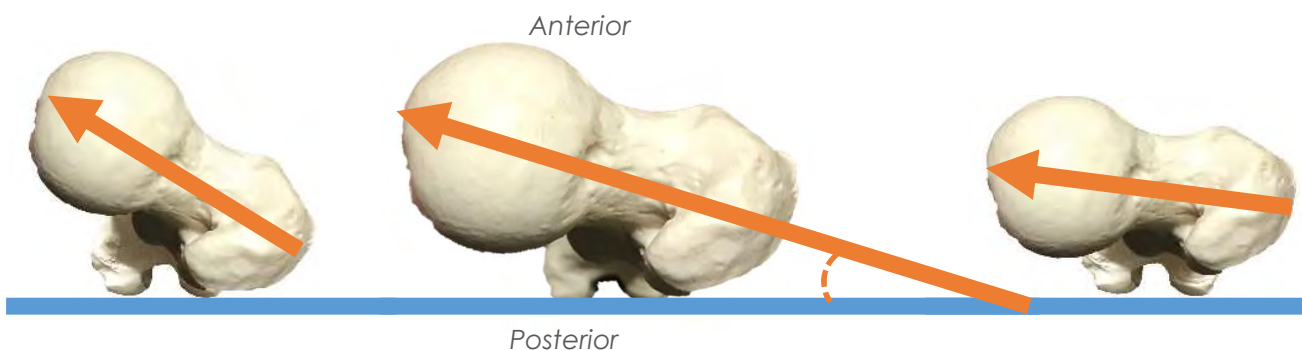
Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
Cam Morphology (FAI) ✓ Coxa Valga/Vara ✓ Coxa Breva ✓ Femoral Version Retroversion Anteversion	Overcoverage (FAI) ✓ Retroversion (FAI) Dysplasia Type I & II	Congenital Hypermobility Acquired Trauma Iatrogenic Focal overload

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Femoral Version & Malversion

Relationship between femoral neck & femoral condyles



Excessive Anteversion:
>20° Anteversion
(No firm cut offs)

Typical average values:
12 - 15° Anteversion

Retroversion:
<8° Anteversion

Botser et al 2012 : Low: <10°; Medium: 10° - 22°; High > 22°

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Femoral Morphology

Femoral Malversion
Retroversion
Anteversion



Excess
Anteversion

'Normal'
Morphology

Retroversion
(too little anteversion)

Femoral malversion is highly prevalent (52%)
in those with hip pain & FAI or dysplasia

Severe femoral malversion ($<0^\circ$ or $>35^\circ$)
present in 17% or 1 in 6 (Lerch et al 2018)

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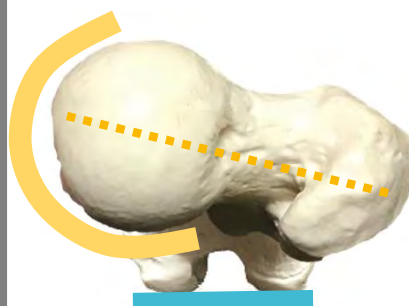
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Femoral Morphology

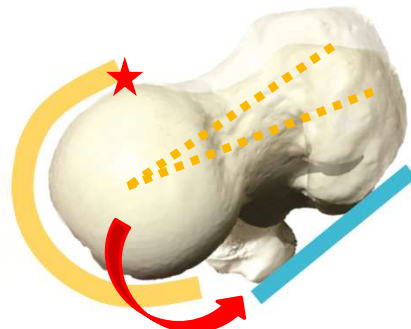
Femoral Version
Retroversion

Risk of:
Anterior
Impingement &
Posterior Overload/
Subluxation

Knee neutral



Internal Rotation



Premature bony impingement in flexion & *IR
May increase risk of chondrolabral pathology

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Clinical Indicators of Retroversion

Interview Features:

- Always stood & walked toes out
- May report hips feel stiff – Flexion & IR

Physical Features:



ER >> Normal
ER >> IR

FADDIR:
Limited

FABER:
Good ROM

Craig's Test
<8° at Neutral

Keep an eye out for posterior instability

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Clinical Indicators of Version Category

Physical Features: Uding et al 2019

ROM difference in prone 0°, highest correlation with MRI (r=0.63)
Slightly less correlation – IR ROM at 90° (sitting) & Craig's Test (r=0.61)

These tests can be used for screening of version category

Suggested:

Rotation ROM more useful than Craig's when high BMI

Craig's more useful than ROM when ms spasm or jt contracture

Clinical Categorisation: In those with full hip ROM (age 27-28)

Excess Anteversion	Normal	Retroversion
Reduced ER in both hip F & Ext IR 20°+ > ER	ER & IR within 20°	Reduced IR in both hip F & Ext ER 20°+ > IR

Souza & Powers 2009, Uding et al 2019

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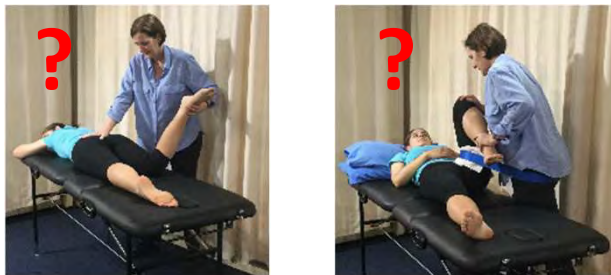
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Femoral Retroversion: Implications for Mx

Manage similarly to FAI

- Minimise time in positions of anterior impingement – F/IR
- Don't forget possibility of posterior instability
 - * Need good posterior cuff – deep external rotators
- Address individual impairments but avoid adverse joint loads
- Consider whether appropriate to aim to increase range

You may be pushing the joint past it's physiological range



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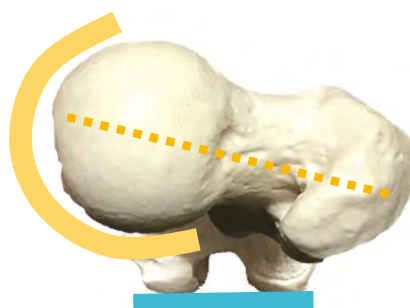
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Femoral Morphology

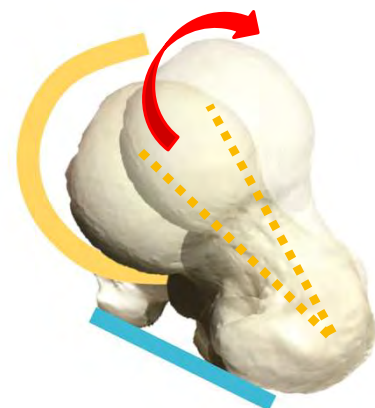
Femoral Version
Anteversion

Risk of:
Anterior Overload/
Subluxation &
Posterior
Impingement

Knee neutral



External Rotation



Risk for focal ant instability – extension & ER
May increase risk of chondrolabral pathology

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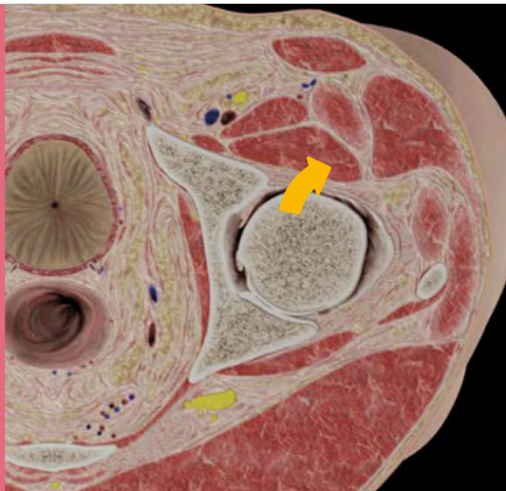
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Hip Pro III App



ER AT THE KNEE



10-15° of ER may cause subluxation in the anteverted hip – Martin Beck 2012

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Clinical Indicators of Anteversion

Interview Features:

- Hx of 'pigeon toe' walking (not always or can't recall)
- Restriction of hip turnout/cross-legged sitting (unless lax)

Physical Features: May stand/walk with toes in, if not compensated



IR >> Normal
IR >> ER



FADDIR:
May be P but
not limited IR
(unless OA)



FABER:
Limited +/-
apprehension



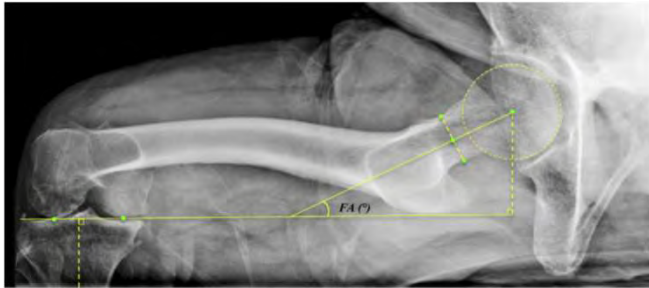
Craig's Test
>15° at Neutral

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Radiology

- Traditionally – CT rotation profiles – Radiation, cost, time
- More recently – MRI rotational profiles
 - No radiation but expensive & few clinics perform
- New – Modified Budin View – Single Plain XRay



Patient sitting
Hip & knee 90° F
Tibia perpendicular to the floor
Hip abducted 30°

Radiographic and CT methods showed excellent agreement
Valid and reliable technique. Much reduced radiation, low cost

- EOS scans – standing, full lower body, low dose X-Ray – 3D

Boissonneault et al 2017, Deschens et al 2010

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Femoral Anteversion: Implications for Mx

Manage similarly to anterior instability

- Minimise time in positions of end range hip extension /ER
- * Need good anterior support – deep hip flexors/GMin/anterior GMed
- Address individual impairments but avoid adverse joint loads
- Consider whether appropriate to aim to increase range - ER

You may be pushing the jt past it's physiological range



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Implications for exercise prescription

Not all exercises appropriate for all hips
Take care esp in group classes - screening



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Femoral Version Key Points

Femoral Retroversion

i) Usually present with:

- Toe-out postures
- ER > IR
- Limited FADDIR

ii) At risk of:

Anterior impingement & posterior instability in Hip Flexion & IR

Femoral Anteversion

i) Usually present with:

- Fem IR postures (toes in or out)
- IR > ER
- Limited FABER

ii) At risk of:

Anterior instability & posterior impingement in Hip Extension & ER

Considerations for load Mx, MT & Exercise

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Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
Cam Morphology (FAI) ✓	Overcoverage (FAI) ✓	Congenital Hypermobility
Coxa Valga/Vara ✓	Retroversion (FAI)	Acquired Trauma
Femoral Version ✓	Dysplasia Type I & II	Iatrogenic
Retroversion		Focal overload
Anteversion		

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Joint Related Pain & Bony Impingements



ANTERIOR HIP & GROIN PAIN

Joint Related Pain & Bony Impingements

Acetabular Dysplasia
Module 1 – Lesson 5

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Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
Cam Morphology (FAI) ✓	Overcoverage (FAI) ✓	Congenital Hypermobility
Coxa Valga/Vara ✓	Retroversion (FAI)	Acquired Trauma
Coxa Breva ✓	Dysplasia Type I & II	Iatrogenic
Femoral Version		Focal overload
Retroversion ✓		
Anteversion ✓		

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Acetabular Morphology

Acetabular Dysplasia Type I & II

SHEAR

CONCENTRATED IMPACT FORCES



Normal Morphology



Type 1 Unstable



Type 2 Too Short
Reduced WB area

Increased shear forces, higher rim loads
Increased capsular & chondrolabral loads

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Acetabular Morphology

Acetabular Dysplasia
Type I & II

Dysplasia

-Type 1 – Shallow

Increased acetabular index
(roof angle)

Inherently unstable

-Type 2 – Undercoverage

Reduced WB area



Shallow



Undercoverage

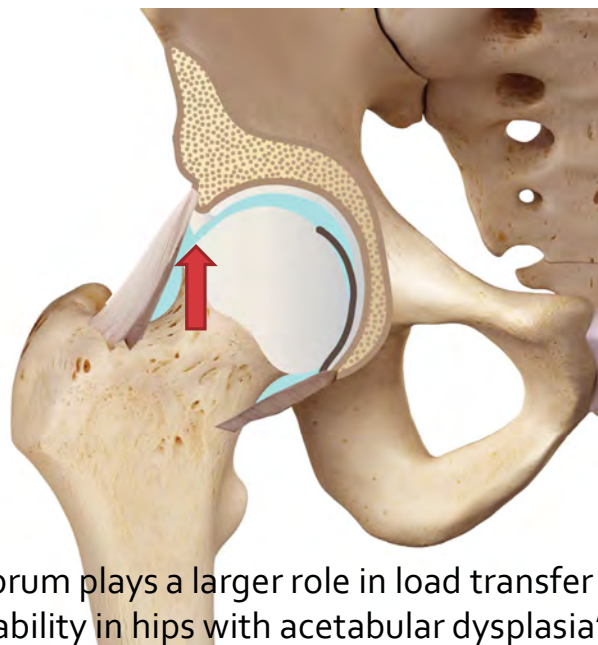
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Load bearing of the labrum:

Normal: 1-2%
Dysplasia: 4-11%
(LCEA <20°)

Henak et al 2011



'The labrum plays a larger role in load transfer and joint stability in hips with acetabular dysplasia'

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Dysplasia



- 5 x more likely to have capsular laxity (Phillipon 2012)
- Subject to abnormal shear
- Chondromalacia
- Eventual tearing or detachment of labrum from acetabular rim

OA

Ficat et al 1981, Klaue et al 1991, Dorrell & Catterall 1986, Garbos et al 2004, Agricola et al 2013, Bouyer et al 2016

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Dysplasia & Hip OA

Mild dysplasia CEA < 25°

OR for developing OA within 5 years
2.6 - 5.5 Agricola et al 2013

Acetabular Index (Roof Angle):
morphology most consistently
& strongly associated with:

- hip OA at baseline
- clinical severity of OA
- radiological progression
- risk of joint replacement

Bouyer et al 2016

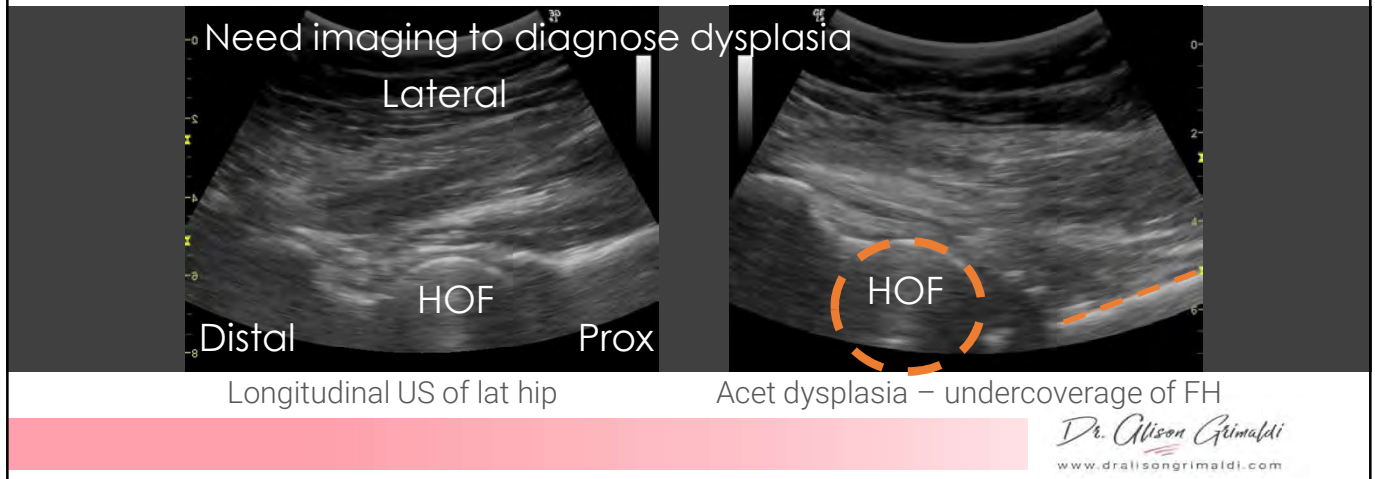


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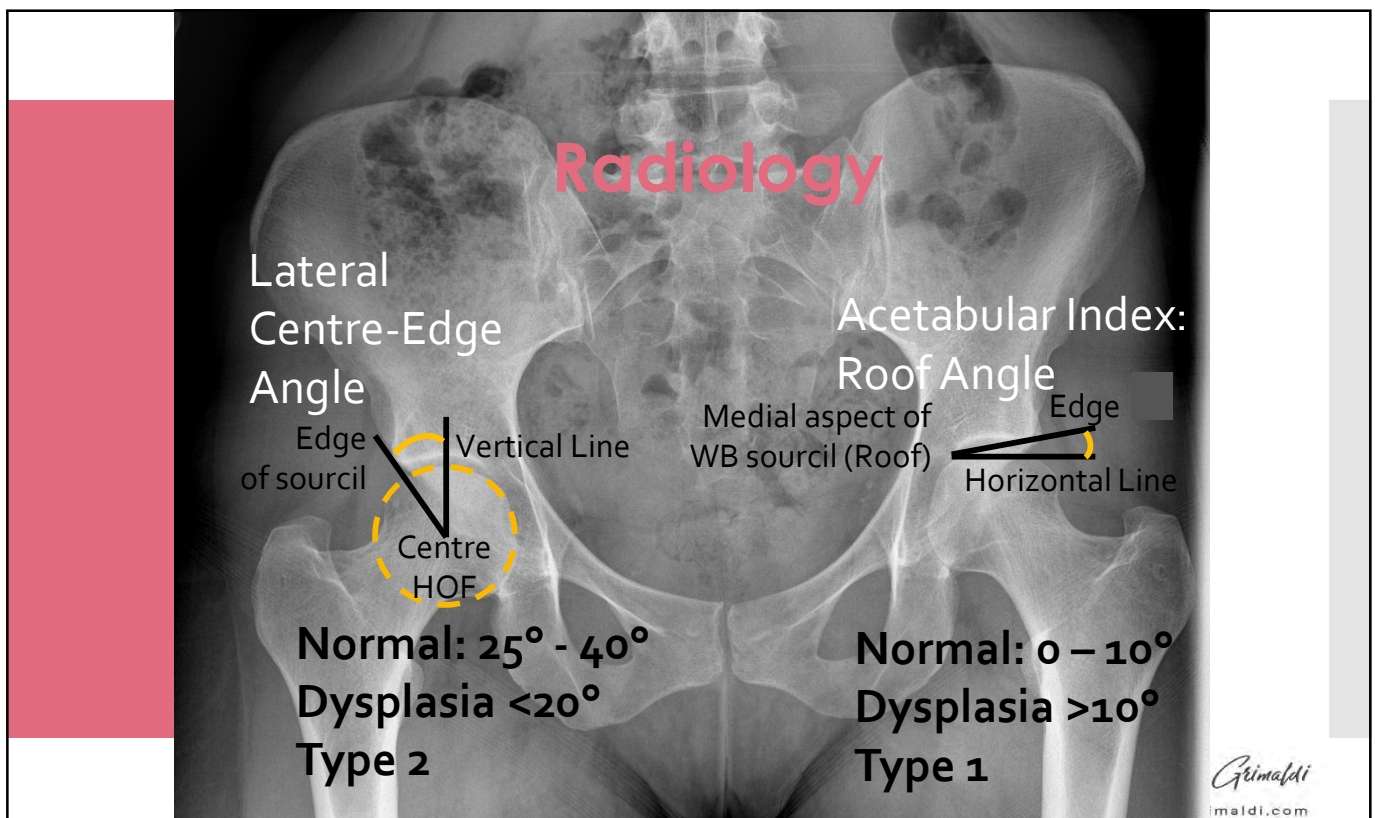
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Clinical Indicators of Acetabular Dysplasia

PHx, clicky hips, mechanical signs of instability
Pain on WB & activity, standing, *impact & shear
ROM usually > normal or restricted by pain/apprehension
Usually +ve on FADDIR, FABER & MTT if symptomatic



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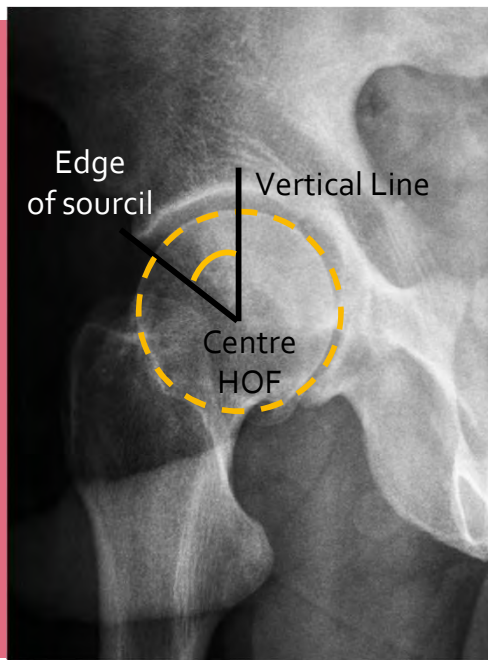
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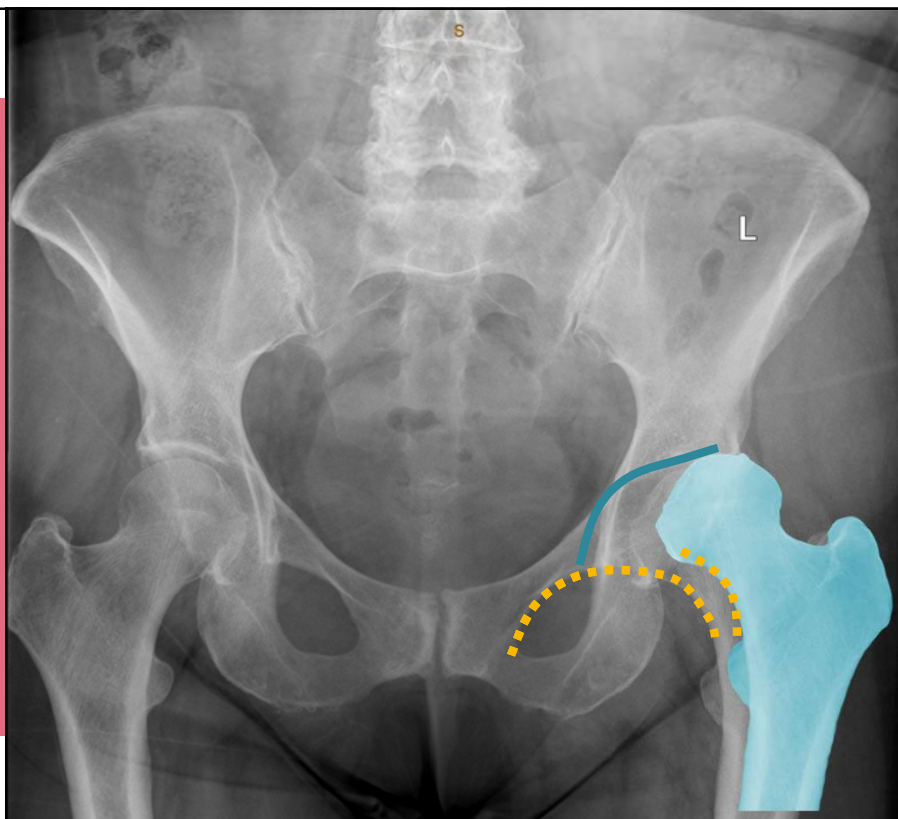


Anterior Centre Edge Angle

Measured on false profile view
Dysplasia $<20^\circ$

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Broken Shenton Line

Detects superior femoral head migration indicative of acetabular dysplasia
 $>5\text{mm}$ = subluxation

Rhee et al 2011
Jacobsen et al 2005

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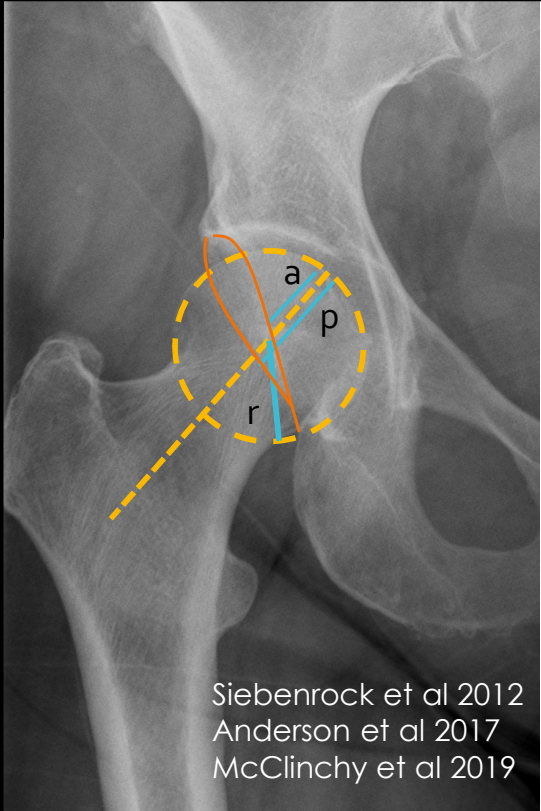
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Siebenrock et al 2012
Anderson et al 2017
McClincy et al 2019

Acetabular Wall Index

Anterior Wall Index = a/r
Posterior Wall Index = p/r

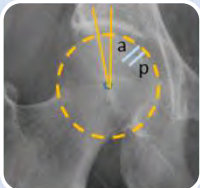
	Dysplastic	Normal	Deep Acetabulum
AWI	0.26	0.35	OC:0.43 RV: 0.42
PWI	1.03	1.13	OC:1.22 RV: 1.02

Dysplastic hips: Global undercoverage
Overcoverage: Global overcoverage
Retroversion: High AWI & low PWI
Ant overcoverage + Post undercoverage

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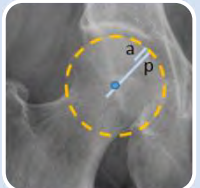
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May have structural acetabular undercoverage & instability with a normal centre-edge angle



Global Instability

Global undercoverage
Decreased AWI +/- PWI
LCEA <25°
+/- subluxation – broken Shenton's line



Anterior Instability

Anterior undercoverage
Excessive anteversion of acetabulum
Decreased AWI
Normal LCEA

Wilkin et al 2017

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Acetabular Dysplasia: Implications for Mx

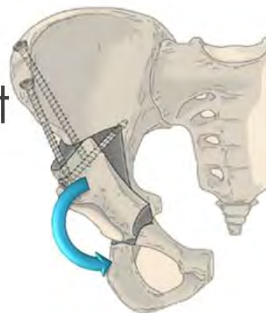
Load management & exercise

- Minimise time spent in EOR positions
 - rapid, repetitive, sustained, loaded
- Advice around weightbearing & impact loads
 - Prolonged standing – try wider base and avoid ant translation
 - Gait – control stride length/hip extension, adduction & impact
- * Optimise global joint stability
 - deep hip flexors, GMin, posterior cuff
- Neuromotor control and graduated strengthening
- Address individual impairments & avoid adverse jt loads
- Passive range gaining usually not appropriate
- Pain limited range regained through load Mx & controlled exercise
 - optimising control of COR of HOF

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Surgical management

Periacetabular
Osteotomy (PAO)



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Surgical Indications for PAO?

Massive surgery, not to be undertaken lightly

Joint preservation surgery – not appropriate if significant joint change

Usually reserved for unstable hips

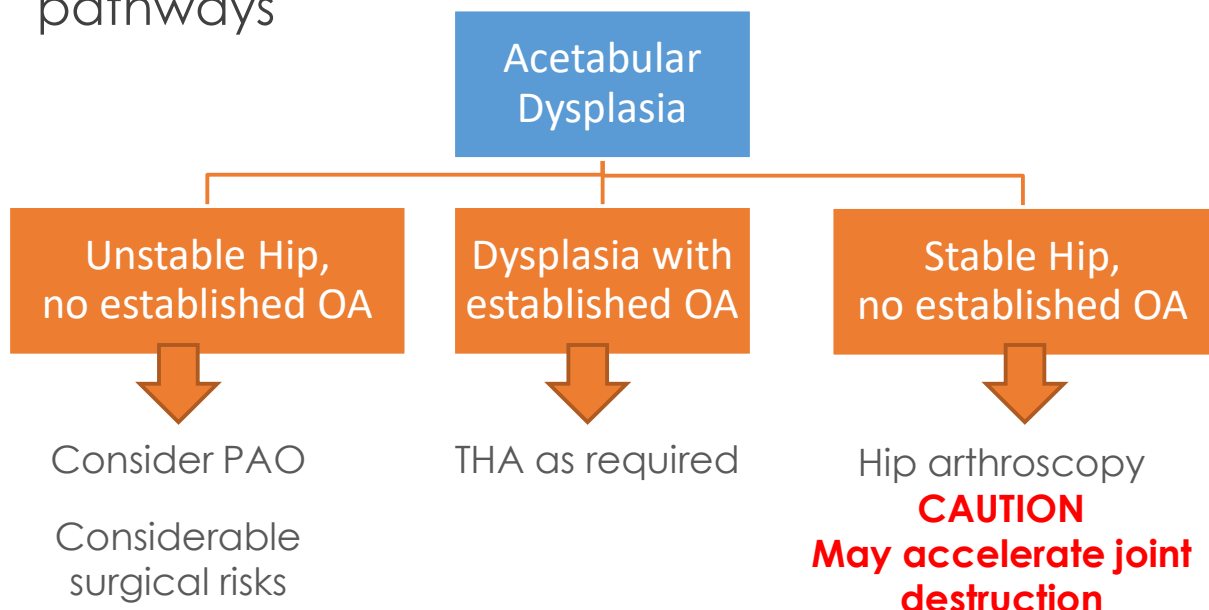
Stability depends on:

- Centre edge angle
- Roof angle (AI)
- AWI/PWI
- Neck-shaft angle
- Fem anteversion
- Labral integrity
- Lig Teres integrity
- Capsule-lig integrity

Signs of instability Low CE Angle with:

- Migration of HOF (anterior &/or lateral)
- High RA (>15 deg)
- Reduced AWI/PWI
- High neck-shaft angle
- High anteversion
- Labral hypertrophy - compensatory
- Torn Lig Teres

Surgical pathways



Load Mx & Exercise Therapy for all

Utility of Arthroscopy in the setting of dysplasia

Risk of iatrogenic instability associated with

- Joint distraction
- Capsulotomy and/or inappropriate capsular Mx
- Labral insufficiency/debridement
- Ligamentum teres attenuation/debridement
- Disruption of vacuum effect
- Iliopsoas release



compromise joint homeostasis & can perpetuate
hip instability

Adler & Giordano 2019

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Utility of Arthroscopy in the setting of dysplasia

Best arthroscopic outcomes might be achieved with

- minimalist techniques
- minimised traction times
- labral preservation
- chondral regeneration techniques
- ligamentum teres reconstruction
(still in early phase of development as a surgical technique)
- Limited capsular opening and repair after capsulotomy,
capsular plication

Adler & Giordano 2019

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Utility of Arthroscopy in the setting of dysplasia

Those with:

- LCEA < 20
- Broken Shenton Line
- Femoral neck-shaft angle of >140°
- Areas of grade 4 chondral lesions
- BMI > 23

Are poor candidates for hip arthroscopy

Adler & Giordano 2019

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Acetabular Dysplasia Key Points

Acetabular dysplasia:

- is a deficiency of the acetabulum
- increases the risk of instability
- increases the risk of chondrolabral damage
- predisposes to ligamentum teres injury/rupture
- increases need for muscular support

Defining acetabular shape is more complex than a simple LCEA
Anterior undercoverage & instability may exist in those with a normal LCEA

Many considerations around surgical interventions

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Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
Cam Morphology (FAI) ✓ Coxa Valga/Vara ✓ Coxa Breva ✓ Femoral Version Retroversion ✓ Anteversion ✓	Overcoverage (FAI) ✓ Retroversion (FAI) Dysplasia Type I & II ✓	Congenital Hypermobility Acquired Trauma Iatrogenic Focal overload

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Joint Related Pain & Bony Impingements



ANTERIOR HIP & GROIN PAIN

Joint Related Pain & Bony Impingements

Capsulolabral Deficiency - Part 1
Module 1 – Lesson 6

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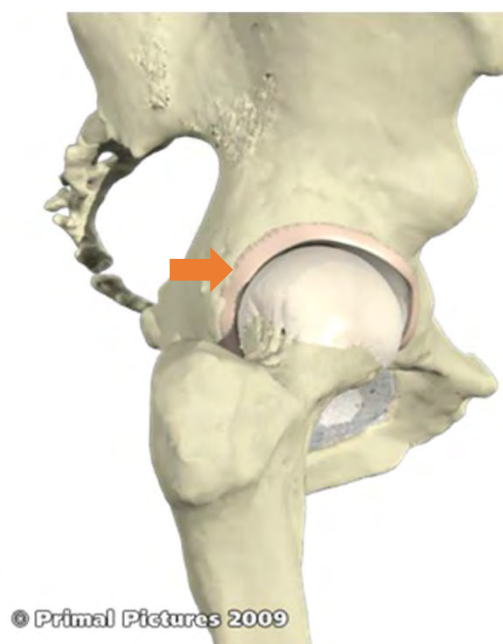
Key Morphological Variants

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Cam Morphology (FAI) ✓	Overcoverage (FAI) ✓	Labral Deficiency
Coxa Valga/Vara Coxa Breva ✓	Retroversion (FAI)	Congenital <i>Hypermobility</i>
Femoral Version <i>Retroversion</i> ✓ <i>Anteversion</i>	Dysplasia <i>Type I & II</i> ✓	Acquired Cap-lig Deficiency <i>Trauma</i> <i>Iatrogenic</i> <i>Focal overload</i>

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Labral
Deficiency

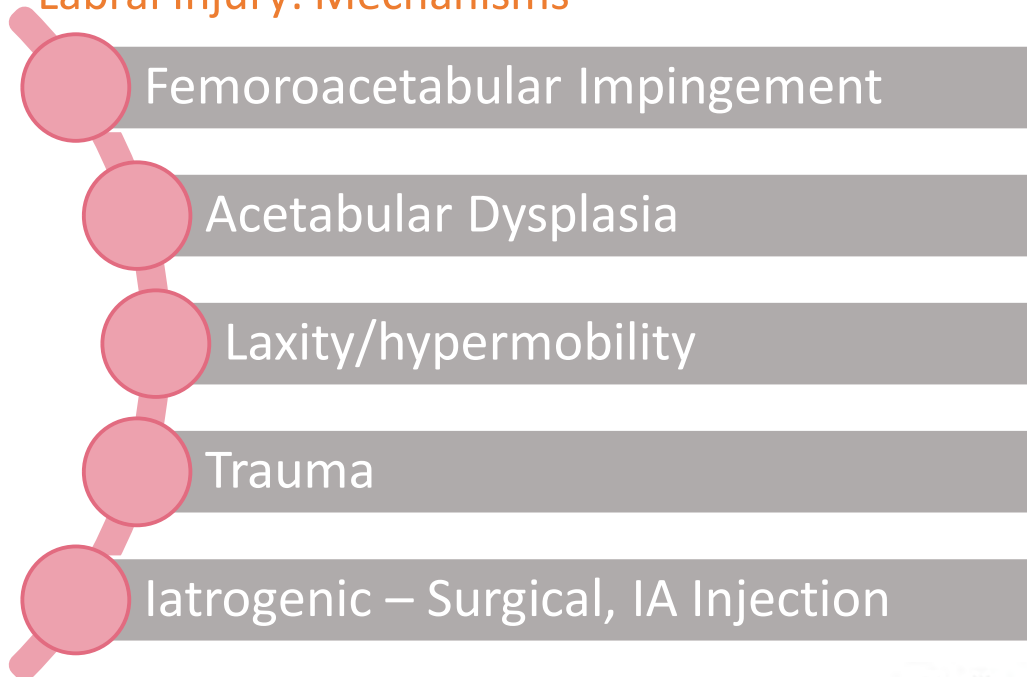
Acquired
Trauma
Focal
overload
Iatrogenic



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Labral Injury: Mechanisms



Does it
matter?

Is the
labrum
important?



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Deepens socket
Seals joint
Mechanisms of chondral protection

Important role in vacuum effect, negative IAP

Protects cartilage by trapping intra-articular & interstitial fluid

Proprioceptive role



Ferguson et al 2000, 2003,
Henak et al 2011, Ranawat & Kelly 2005

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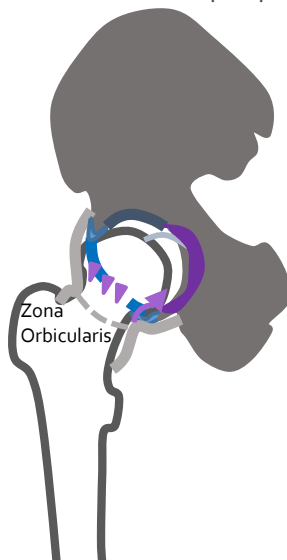
Mechanisms of chondral protection/nutrition

Synovial flow during gait: Field & Rajakulendran 2011

Flexion/Swing Phase

Sup-lat: Fluid central → periph

Inf-med: Fluid periph → central



Unidirectional synovial flow between compartments

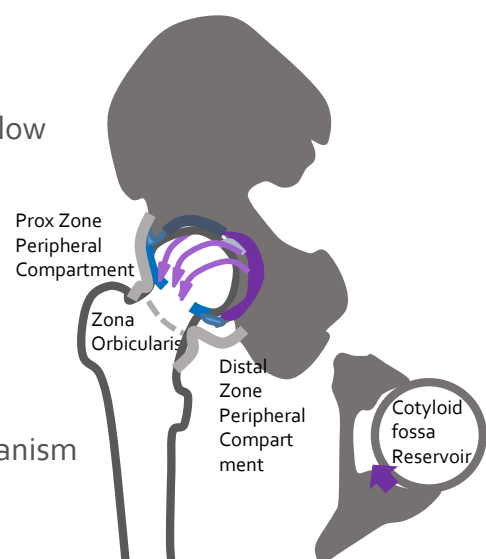
Zona Orbicularis acts like bellows

Intact labrum & negative IA pressure important for this mechanism

Ext/Stance Phase

Fluid trapped by labrum & TV Lig

Waterfall of fluid from cotyloid fossa



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Labral injury/debridement: Implications



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Labrectomy

- cartilage consolidation increased 21% due to lack of pressurized fluid
- increased shear stresses
- mean distraction force reduced by 70% with either partial or full resection

Labral tear

- IA fluid pressurization reduced by 25% (50% by partial resection)
- distraction force reduced by 24%
- increased FH translation and rotation

Bsat et al 2016, Ferguson et al 2000, 2003,
Nepple et al 2014, Philippon et al 2014

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Clinical Indicators & Mx of Labral pathology

Hip-joint related pain – deep anterior - anterolateral
Clinical tests best for ruling out joint pathology - FADDIR

Do we need imaging?

Will visualisation of a labral tear on imaging indicate
that this pathology is the source of pain?

Will surgery 'fix' the labrum?

Will surgery provide superior outcomes to physical
therapy interventions?

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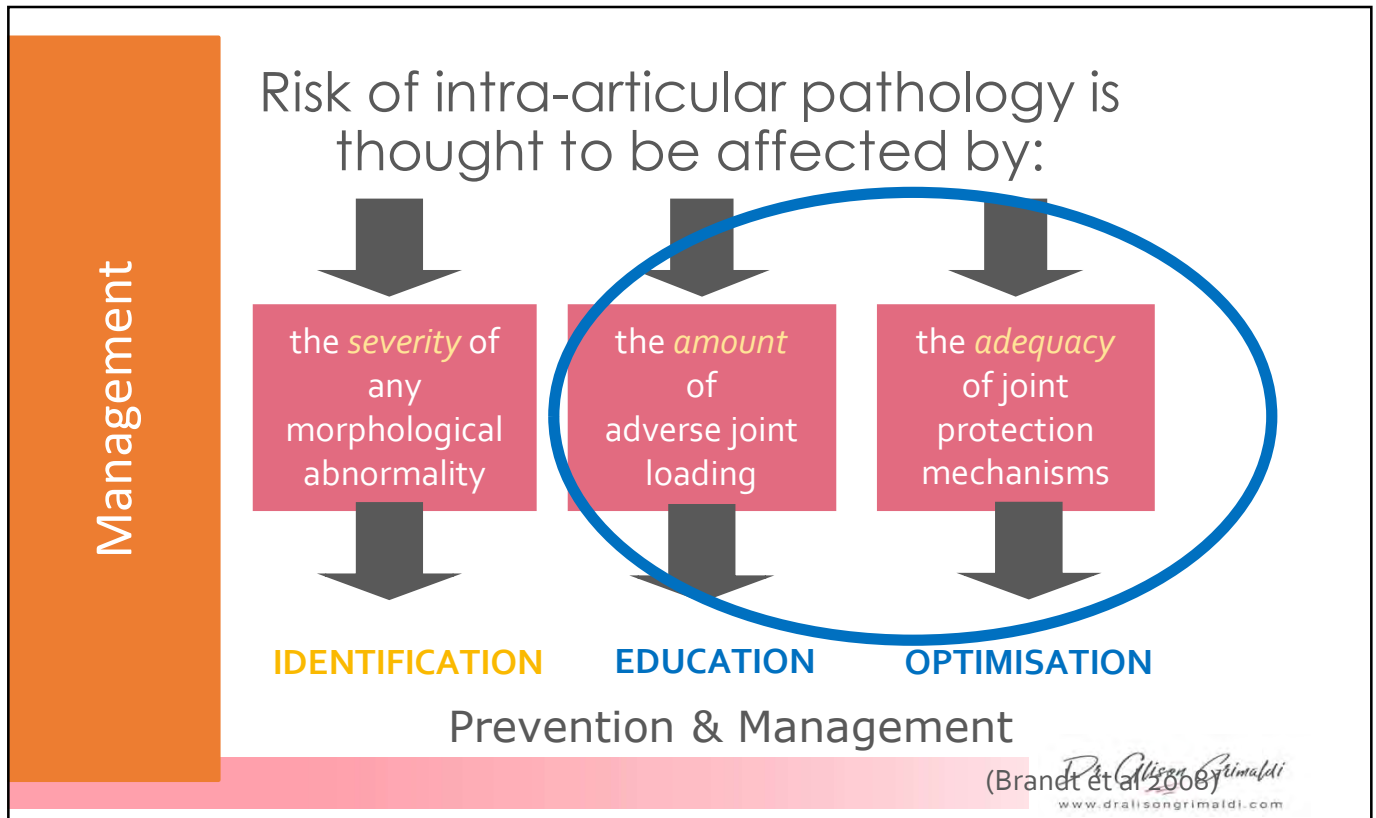
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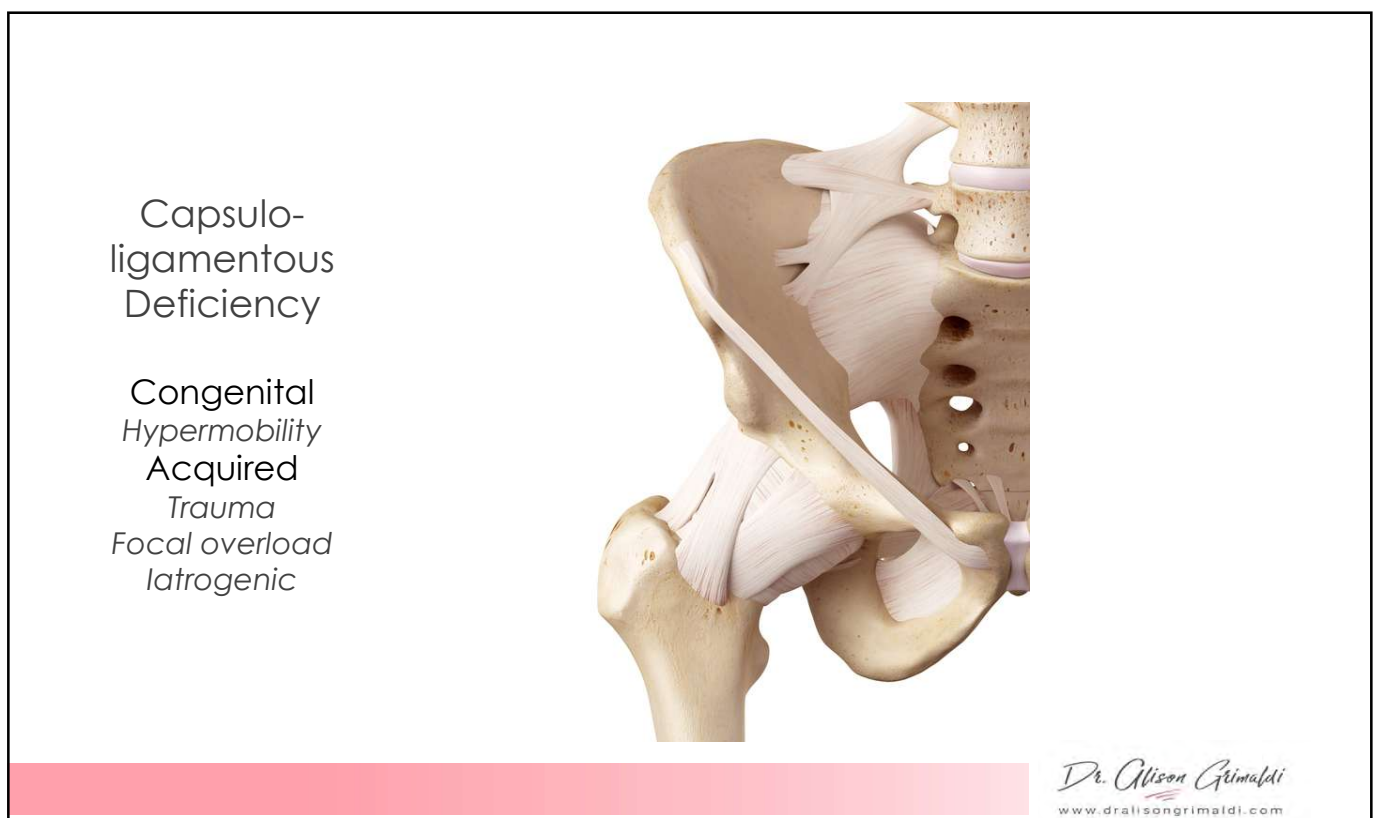
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Congenital Hypermobility - Terminology

Hypermobility Spectrum Disorder (HSD):

Individuals with hypermobility-related problems that do not have hEDS or any other Heritable Disorder of Connective Tissue (HDCT)

Hypermobile Ehlers-Danlos Syndrome (hEDS):

Individuals who fulfill each of 3 hEDS domains:

Domain 1: The presence of generalized joint hypermobility

Domain 2: At least 2 of:

(A) skin or fascia signs; pelvic floor concerns; Marfanoid features

(B) a family history

(C) ≥ 1 of the following:

- MSK pain in ≥ 2 limbs recurring daily for ≥ 3 months OR

- Widespread pain for ≥ 3 months OR

- Recurrent, atraumatic dislocations

Domain 3: Absence of other underlying Heritable CT Disorders

Hypermobility Syndromes Association

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Congenital Hypermobility

Clinical Indicators of Hypermobility

y

**A Five Part
Q to Screen
for**

**Hypermobility
Spectrum
Disorders**

**(Domain 1
Screening
Test)**

1. Can you now (or could you ever) place your hands flat on the floor without bending your knees?

2. Can you now (or could you ever) bend your thumb to touch your forearm?

3. As a child did you amuse your friends by contorting your body into strange shapes or could you do the splits?

4. As a child or teenager did your shoulder or kneecap dislocate on more than 1 occasion?

5. Do you consider yourself double-jointed?

2 or more positives have been shown to detect JH with 85% sensitivity and 90% specificity

Hakim & Grahame 2003

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Clinical Indicators of Hypermobility

Beighton 9 Point Hypermobility Score

Ability to:	Image	L	R	Both
Passively dorsiflex the 5 th MCP joint $\geq 90^\circ$		1	1	
Oppose the thumb to the volar aspect of the ipsilateral forearm		1	1	
Hyperextend the elbow $\geq 10^\circ$		1	1	
Hyperextend the knee $\geq 10^\circ$		1	1	
Place hands flat on the floor without bending the knees				1

(Domain 1 Screening Test)

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Local Implications of Hypermobility

Capsular laxity leads to microinstability of the hip ie :

- significant increase in joint rotation
- significant increase in femoral head translation
- abnormal movement path of femoral head centre

Leads to abnormal femoro-acetabular contact

Increased chondro-labral loads

Increased risk of joint degeneration

Han et al 2018 AJSM

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Wider potential impact of hypermobility

1. Isolated or widespread MSK symptoms & loss of physical function

2. Persistent pain & chronic fatigue

3. Other associations with:

- CV symptoms & dysautonomia (tachycardia, hypotension, syncope)
- Gut dysfunction (hernia, reflux, constipation, irritable bowel)
- Myopia, astigmatism
- Pelvic floor weakness, rectal and/or uterine prolapse
- Anxiety disorders, such as panic disorder and agoraphobia.

4. Heritable CT disorders may also explain: Multiple fractures, poor wound healing, cataracts, retinal detachment, heart valve disease, arterial vascular dissection / aneurysm, spontaneous rupture of viscera.

hypermobility.org/professionals-section

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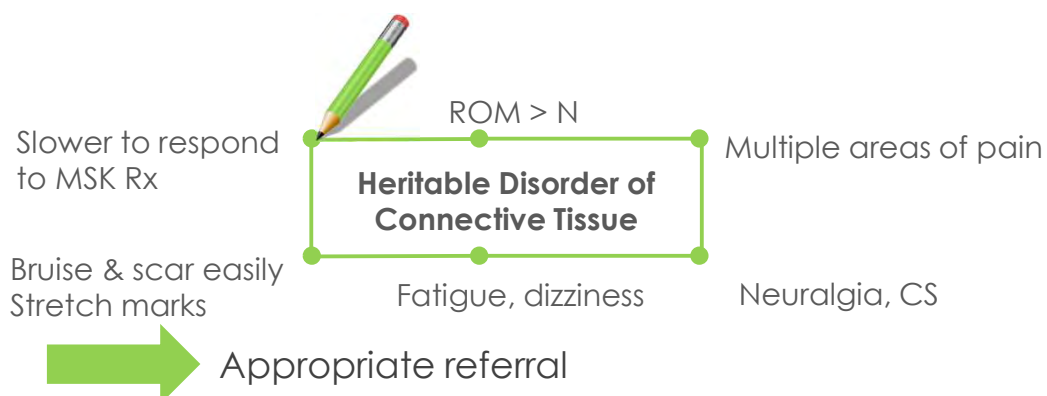
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Listen out for the symptoms



There may be more profound implications of being bendy
(heart, vascular, CCIInstability, Chiari Malformation)

You may be the first to join the dots



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HSD, hEDS: Implications for Mx

In the Mx of MSK-related pain in HSD, hEDS:

- optimise local joint support prior to general strength
- may be slower to recover esp post-surgical
- may be more likely to develop CS, CRPS, neuralgia
- will fatigue more quickly & take longer to recover
- pacing is important

Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
Cam Morphology (FAI) ✓	Overcoverage (FAI) ✓	Labral Deficiency ✓
Coxa Valga/Vara ✓	Retroversion (FAI)	Congenital Hypermobility
Coxa Breva ✓	Dysplasia Type I & II ✓	Acquired Cap-lig Deficiency
Femoral Version		Trauma
Retroversion ✓		Iatrogenic
Anteversion ✓		Focal overload

Joint Related Pain & Bony Impingements



ANTERIOR HIP & GROIN PAIN

Joint Related Pain & Bony Impingements

Capsulolabral Deficiency - Part 2
Module 1 – Lesson 7

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Key Morphological Variants

Femoral Morphology	Acetabular Morphology	Capsulo-labral Deficiency
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Femoral Version		Trauma
Retroversion ✓		Iatrogenic
Anteversion ✓		Focal overload

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Capsulo-ligamentous Disorders

Acquired
Trauma
Focal
overload
Iatrogenic

Acquired secondary to:

- Trauma – EOR overload or distraction force
- Focal Overload
 - 2° to Dysplasia or Fem anteversion
 - Functional overload
- Iatrogenic – Induced surgically



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Anterior Ligaments

Ligaments reinforce ≈ 60% capsule

Iliofemoral Ligament

- Lateral Arm
- Medial Arm

Limits

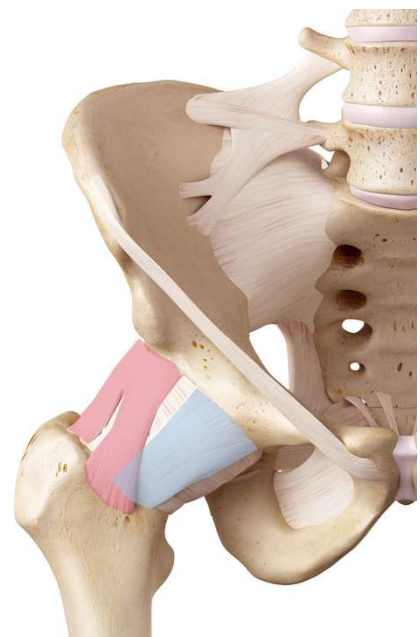
- Ext, ER, IR in Ext
- Ext, ER

Pubofemoral Ligament



- ER * in Ext
- Abduction

**Focal
overload
in Ext, ER, Abd**



Martin et al 2008, Sato et al 2012

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Zona Orbicularis

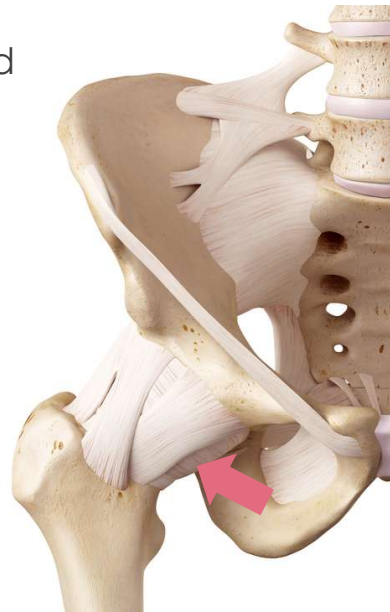
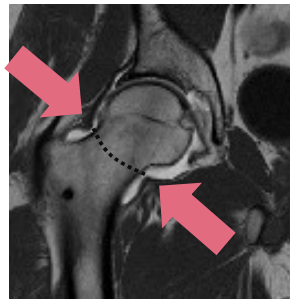
Wraps circumferentially around
femoral neck

Important role in synovial flow

Acts like an hourglass

Resists distraction

- Swing phase of gait
- Kicking



Ito et al 2009

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Iatrogenic Capsular Damage

T capsulotomy is common

Larger opening for osteoplasties

Many surgeons do not repair

Some perform capsulectomy

Post scope: may be left with
absence of portion of IFL &
anterior ZO



**Beware! It's possible for a patient's hip to sublux or
dislocate anteriorly post hip arthroscopy**

Chang et al 2013, Matsuda 2009, Ranawat et al 2009,
Sansone et al 2013, Wylie et al 2016, Yeung et al 2017

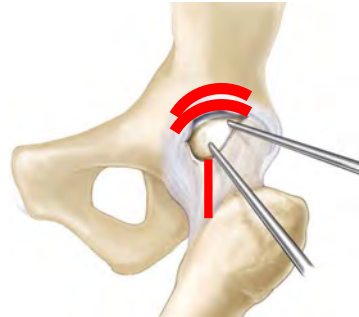
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Iatrogenic Instability Post Scope

Stability post-scope reduced by:

- Labral debridement
- Acetabular rim trimming
- Capsulotomy (damage to IFL)
- Prolonged traction (stretching capsule/ligs)
- Iliopsoas tendon release



Sansone et al 2013, Matsuda 2009, Ranawat et al 2009

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Effects of capsular repair post scope

Compared outcomes post scope with fully repaired vs partial repair of capsule

Improved outcomes if capsule is completely repaired:

- Patients who underwent CR of the hip capsule demonstrated superior sport-specific outcomes
- Revision rate: 13% in the PR group, 0 in full repair group

Repair critical for anterior stability in hip Ext & ER

Frank et al 2014

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Implications for Management

Ongoing hip pain post scope

➡ **Consider possible instability esp if:**

No capsular repair

Labral debridement

Acetabular rim trimming

Capsulotomy/ damage to IFem Lig

Prolonged traction/stretching capsule/ligs

Iliopsoas tendon release

Global Hypermobility

➡ **Optimise dynamic stability**
Some require surgical repair

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Clinical Indicators of Focal Anterior Instability

Interview Features:

Pt may report, clicking, popping, heaviness of leg, giving way, reduced balance

Physical Features:

Axial Distraction



Apprehension

Dial Test



Increased ROM
No firm end-feel
Poor recoil

Relocation Test



Less apprehension
Less pain
Increased ROM

FABER



Pain/Apprehension
SN:54; SP:90
Ranawat et al 2017

Ranawat et al 2017, Reiman et al 2019

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Clinical Indicators of Focal Anterior Instability

Physical Features: Diagnostic Utility Study

Apprehension/HE-ER Test



AB-HE-ER Test



Prone Instability Test



Reproduction of the patients anterior hip pain
Arthroscopically identified hip instability as a reference standard

AB-HEER test – moderately useful for ruling out instability

Prone Instability Test – moderately useful for ruling in anterior instability

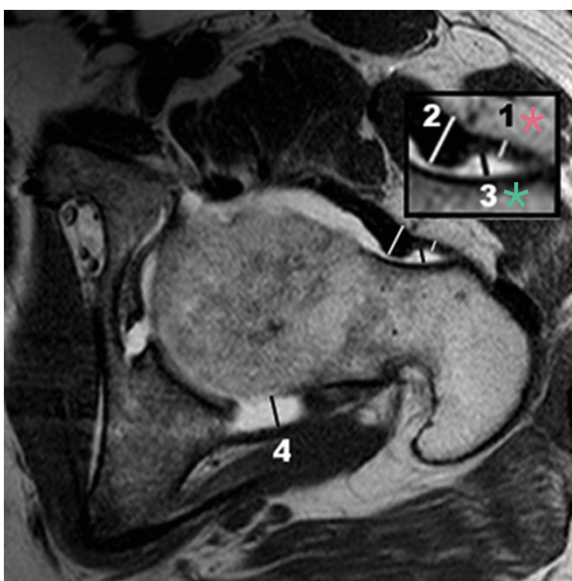
(Low quality evidence, one study only)

Hoppe et al 2017, Reiman et al 2019

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Radiological Indicators of Capsular Insufficiency



- Vacuum sign on Fluoroscopy
Canham et al. 2016

- Capsular Laxity on MRA

1. thinning of the joint capsule (<3 mm) lateral to the zona orbicularis (or absence post-op)
3. widening of the anterior hip joint recess (>5 mm)

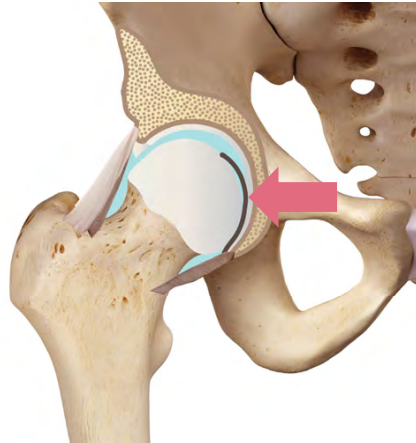
Magerkurth et al. 2016

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Ligamentum Teres

Originates from transverse acetabular ligament
Inserts into Fovea Capitis of femoral head



Cerezal et al 2010, RadioGraphics;30:1637–1651

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Ligamentum Teres

- Proprioception (still conjecture) & blood supply
- Possible role in synovial flow – ‘windscreen wiper effect’
- Secondary restraint (to capsular ligs), loaded particularly in extremes of range – F/ER; Ext/IR
- Forms a sling under HOF in deep Flexion-Abd



Prevents
subluxation
of HOF

Kivlan et al 2013, Martin et al 2012,2013, Philips et al 2012

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Ligamentum Teres – Mechanism of Injury?

Often associated with:

Bony factors

Neck-shaft angle $>140^\circ$

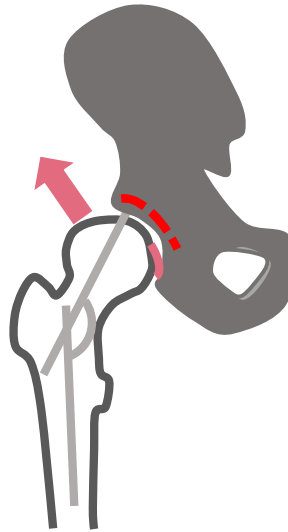
Centre edge angle $<23^\circ$

Higher roof angle $>13^\circ$

FAI

Soft tissue factors

Hypermobility



Increased shear force

Impingement & associated subluxation forces

Martin et al 2012, Botser et al 2011, Devitt et al 2017, O'Donnell & Arora 2017

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Ligamentum Teres – MOI?



Inferior shear in F/AB

especially with

-superior impingement

-inferior acetabular insufficiency

-capsular laxity



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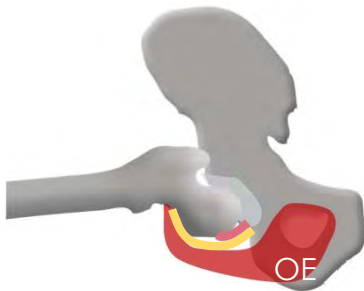
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Ligamentum Teres – MOI?



Be suspicious of LT injury in those with traumatic OE tear, esp if slow to settle. LT tear often missed on MRI

May be reason for failed non-surgical rehab for labral pathology
Kaya et al 2014



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Ligamentum Teres Tears in Athletes

Frequency of LT tears-imaging:

Dancers 55 %

Other Athletes 22 %

(Dancers also higher % with AD, borderline AD & coxa valga)

Dancers had larger OE than non-dancing athletes
Positive adaptation?

Mayes et al 2016, 2017, 2018

LT damage at hip arthroscopy:

≈ 70% of athletes with FAI vs 50% of others (usually PT Tear).

Higher incidence in athletes due to higher ranges & forces?

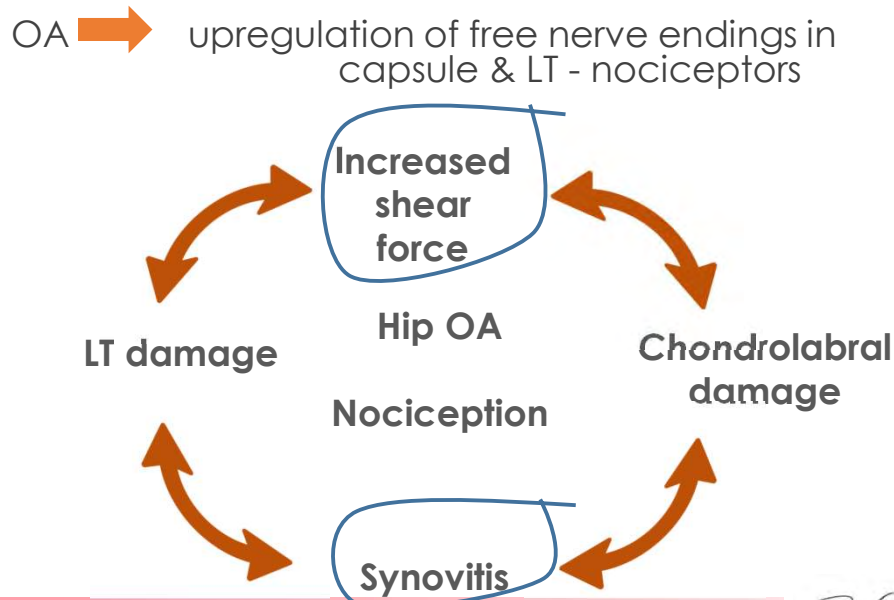


Botser et al 2011, Devitt et al 2017, O'Donnell & Arora 2017

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Ligamentum Teres Pathology, Pain & Hip OA



Moreas et al 2011, O'Donnell & Arora 2017

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Clinical Indicators of Ligamentum Teres Tear

Interview Features:

Take a careful Hx re trauma & sporting activities – forced/repetitive EOR; F/ABD/Rotn; distraction/drag
When symptomatic, often irritable hip, slower to settle

Often co-exist with chondro-labral damage & synovitis

May report mechanical symptoms, signs of instability, particularly in the presence of reduced bony or capsulo-ligamentous stability.

Physical Features: +ve Lig Teres test:

Hip Flexion 70°

Take to full Abd, then back 30°

Full IR & ER

Positive test is pain reproduction



O'Donnell 2013, 2017, 2018

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Management of the patient with hip pain & capsulolabral deficiency

Load Management

- Minimise time spent in end range positions - *Ext/ER; F/Abd
- Listen to joint response to load – want to avoid/minimise any inflammatory processes
 - Night ache, morning stiffness
 - FABER can be useful barometer

Exercise

- * Need good local muscular support
 - deep hip flexors, GMin, DER's
- Address individual impairments while avoiding adverse joint loads

Key Morphological Variants

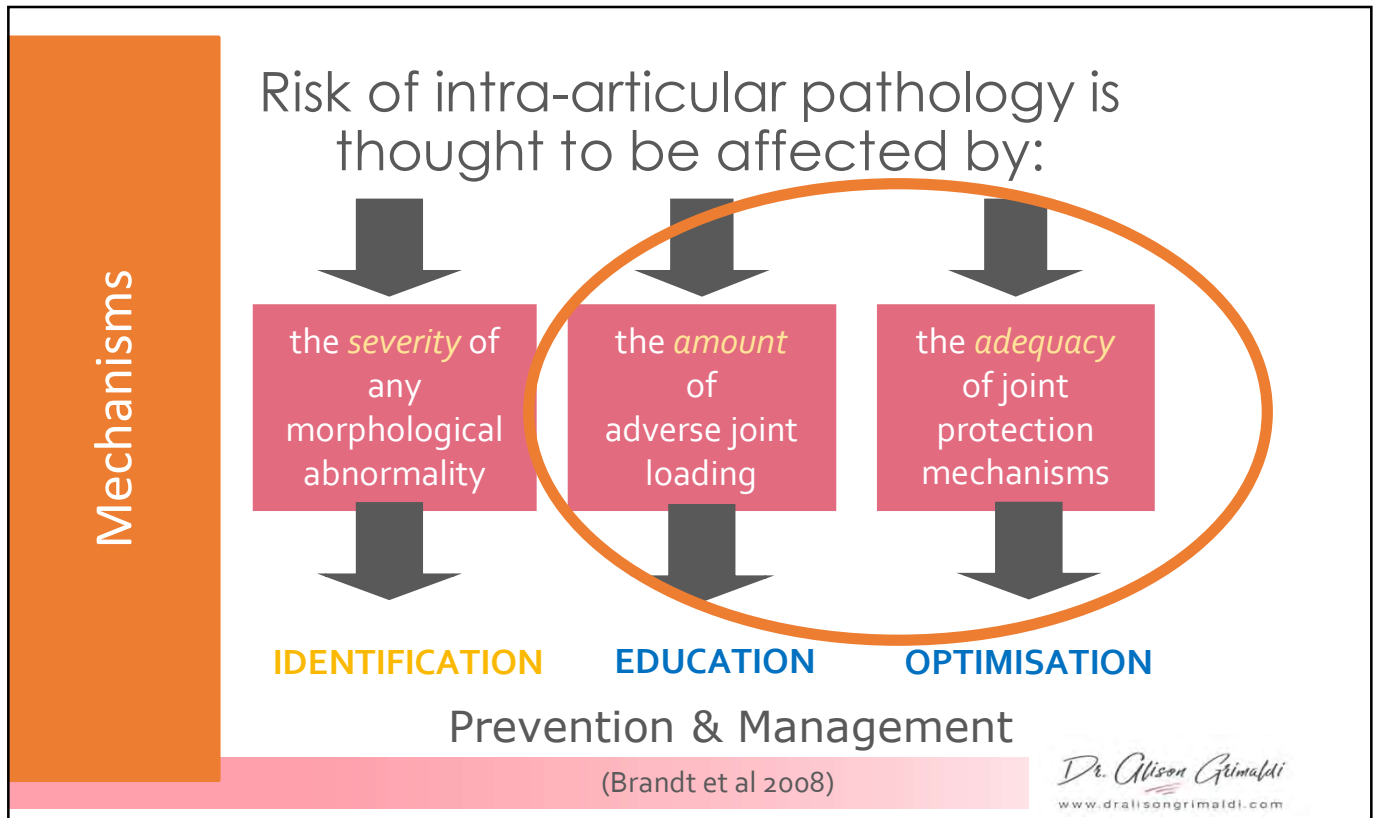
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Joint Related Pain & Bony Impingements

ANTERIOR HIP & GROIN PAIN

Joint Related Pain & Bony Impingements

Adverse Loading
& Joint Protection Mechanisms
Module 1 – Lesson 8

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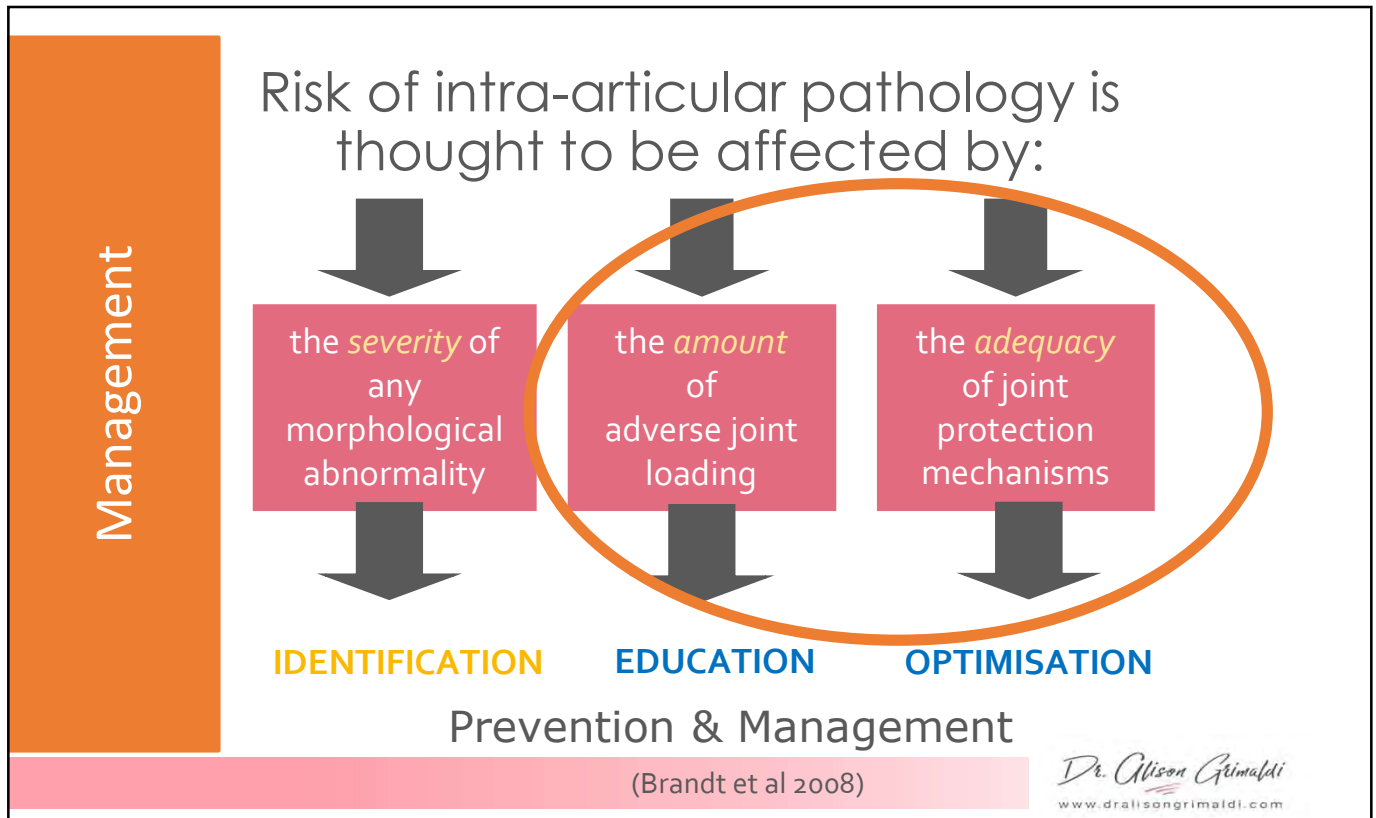
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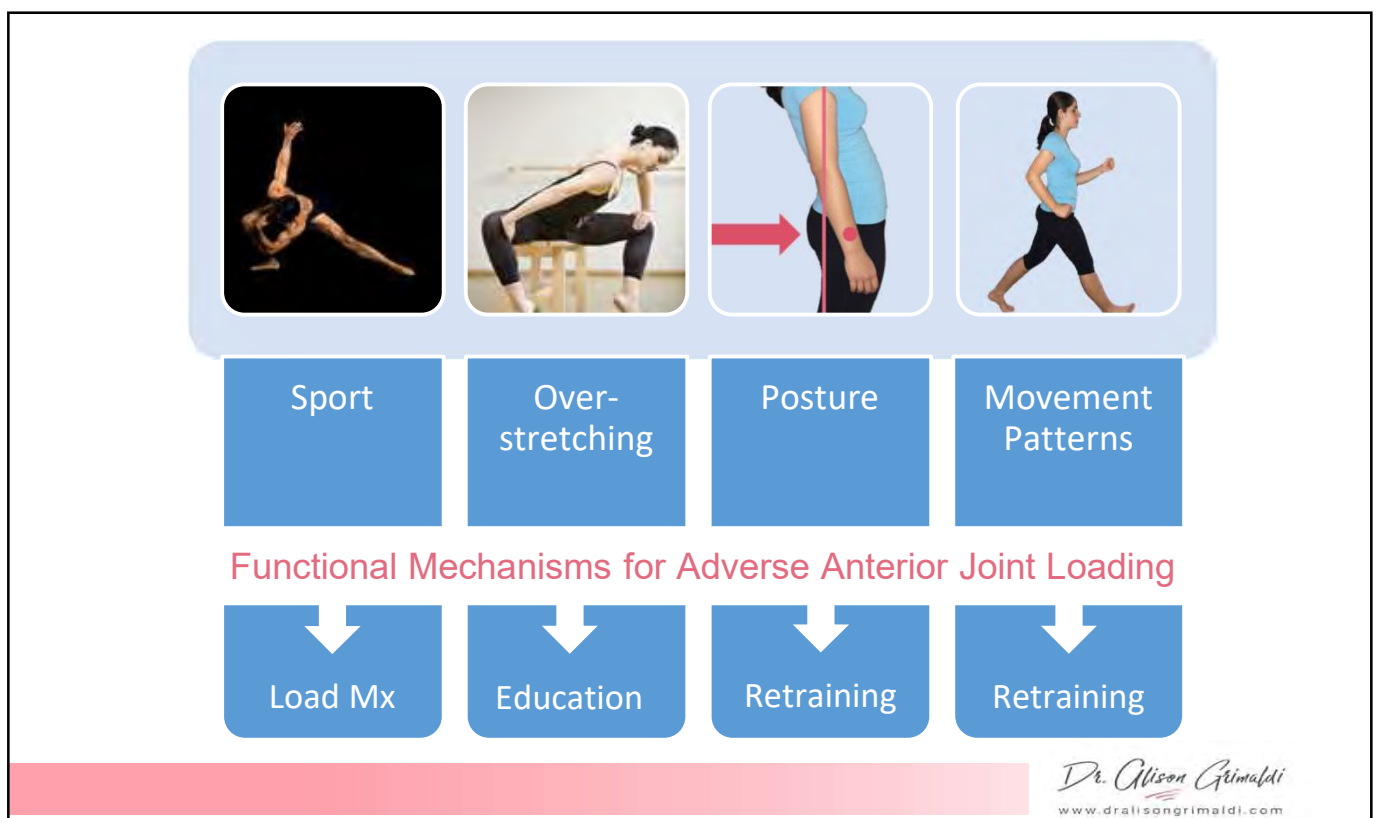
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Postures & hip joint loads



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Postures & hip joint loads



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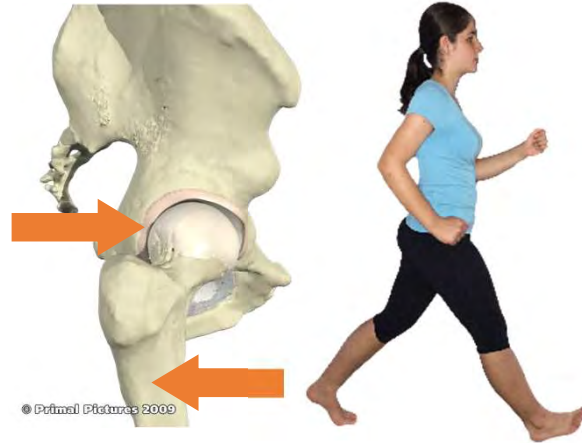
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Anterior hip joint loads in gait

Excessive hip extension
results in increased
anterior joint forces

Gait: Ant hip loads
increase ~20%BW, with 2°
increase in hip extension



Lewis et al 2007, 2009, 2010

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Anterior joint loads in gait



Walking with swayback posture

- higher peak hip extension angle
- higher hip flexor moment
- increased force transmission through anterior hip

Lewis & Sahrmann 2015

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Implications for Mx

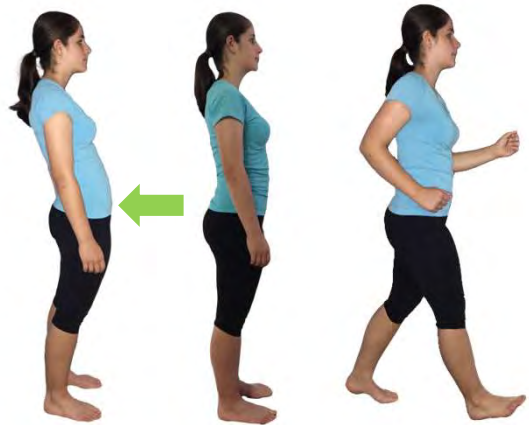


Posture & Gait Retraining

Changing posture during gait has been shown to have an immediate and lasting effect on hip pain and functional ability

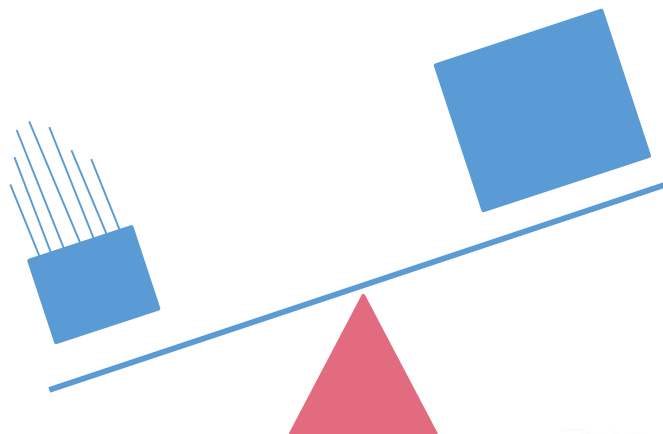
Case study

Lewis & Sahrman 2015



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The **rate** rather than the magnitude of loading may be more injurious to a joint
(Radin et al 1984)



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	Loaders	Non-Loaders
Gill & O'Connor 2003	high velocity	lower velocity
impact at heel strike		
hip flexion in early swing	delayed & less	early & more
ankle clearance	early & more	delayed & less
iliopsoas activation		
rec fem activation		

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Simple cues can be very effective

Strategies for reducing loads in gait

Lead with the knee

Take shorter steps

Land softly

Soften the knee

Up tall



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Hip loads influenced by:

- Cadence
- Stride length

Heiderscheit et al 2010

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Increasing cadence by 10%, reduces:

- step length
- COM vertical excursion
- braking impulse
- energy absorbed by hip (& knee)
- peak hip adduction
- hip adduction & IR moments

& ↑ late swing phase activation of GMax & GMed

Heiderscheit et al 2010, Chumanov et al 2012

*** If
appropriate
for the
individual**

Barton et al 2016,
BJSM for RV of
running retraining

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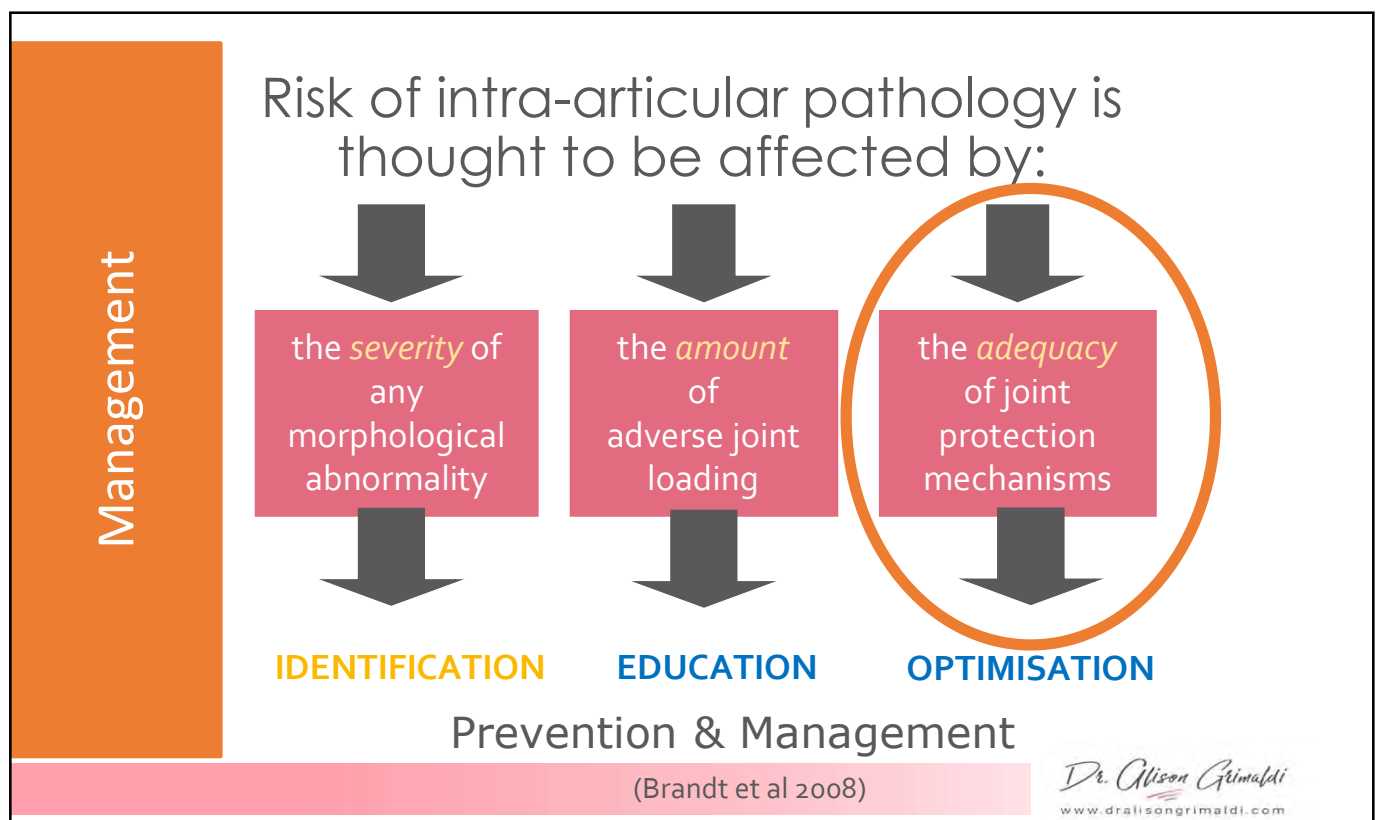
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Unnecessa
ry end
range
loading



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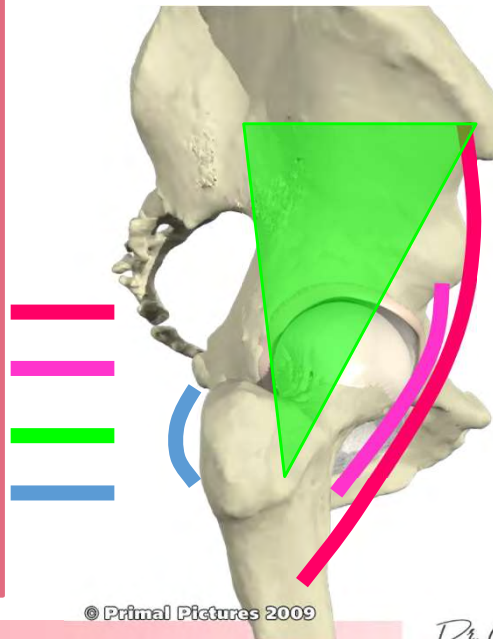
Muscles with primary joint-protective function

Iliopsoas

Iliocapsularis

Gluteus Minimus

Deep External Rotators



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Protective effect of hip flexors

Lewis, Sahrman, Moran 2009

Weakness of IP will increase joint loading esp in Ext

Reduced RF, Sart, & TFL only increased by **16.4 units**

Reduced IP force increased joint force by **140 units**

Weakened IP:



increased TFL
increased abd force
increased AL
increased overall joint force

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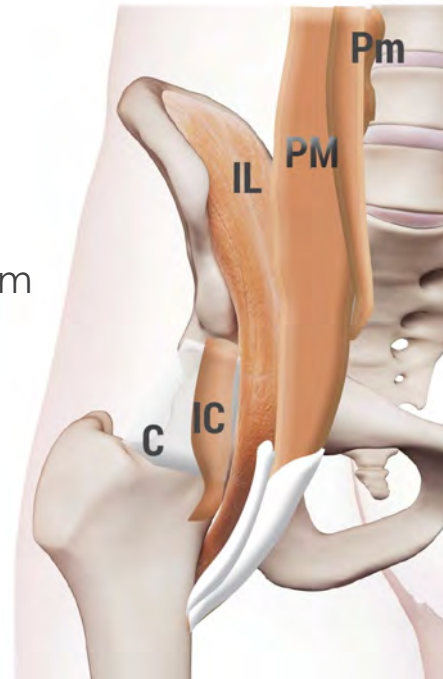
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Iliocapsularis

Hypertrophy evident in acetabular dysplasia

Long attachment to ant-med capsule $73.8(\pm 27.3)$; $16.1(\pm 4.4)$ mm



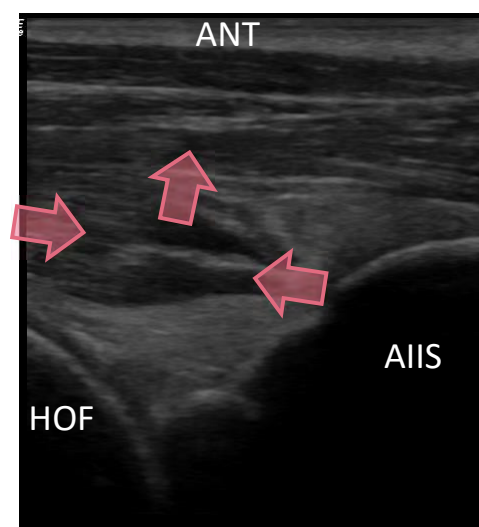
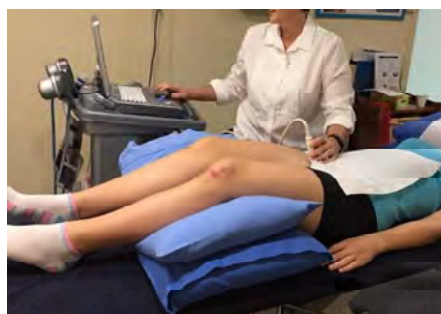
Walters et al 2014, Ward et al 2000

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Iliocapsularis

Important for capsular tensioning & perhaps 'lift' into flexion



Walters et al 2014, Ward et al 2000

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Anterior Hip & Groin Pain

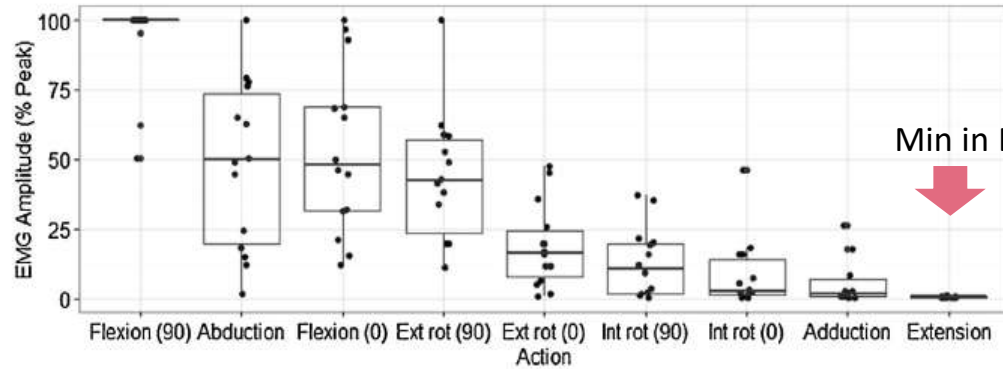
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Iliocapsularis EMG in bed based tests

Max in F @90°



Min in Ext @0°

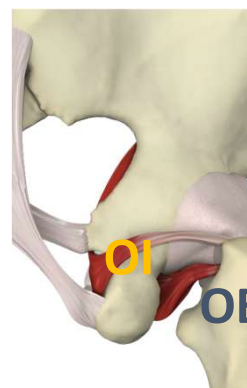
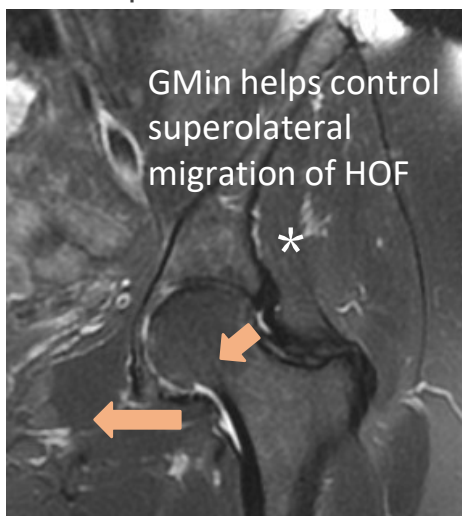


Lawrenson, Grimaldi, Crossley, Hodges, Vicenzino, Sewciw 2017

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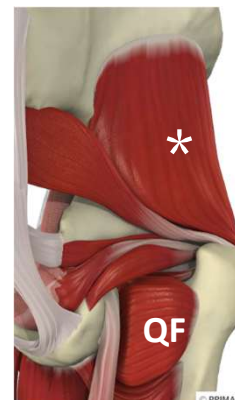
Gluteus Minimus Deep External Rotators



OE, QF sit under HOF, inferior support
* in abduction

ER's move max contact pressure medially
Reduce pressure on lateral edge of joint

Weißgraeber et al 2012



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Anterior Hip & Groin Pain

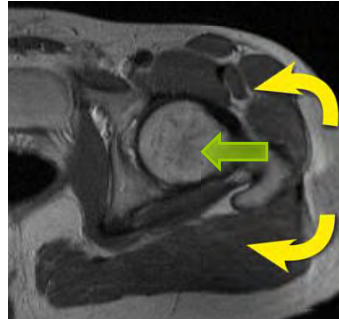
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Co-contraction
Ant & Post Cuff in
ABDUCTION

DEEP ROTATORS & JOINT PROTECTION



Deep IR's active

GMin

Semciw et al 2014

+

Deep ER's active

OI & QF

Hodges et al 2014

In ABD, superior capsule comes off tension
Increased requirement for muscle to maintain COR
Co-contraction should approximate HOF & help prevent superior migration of HOF

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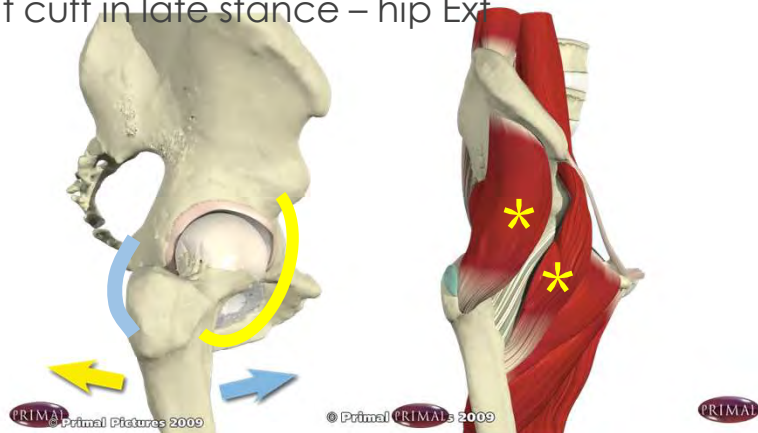
**Reciprical
stabilisation
in F/Ext**



STABILITY/JOINT PROTECTION IN GAIT:

Post cuff in early stance – hip F with impact load

Ant cuff in late stance – hip Ext



Andersson et al 1997: Iliopsoas active in end stance phase; Semciw et al 2014, 2015: Post GMin in early stance, Ant Glut Min highly active in hip extension & late stance

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Anterior Hip & Groin Pain

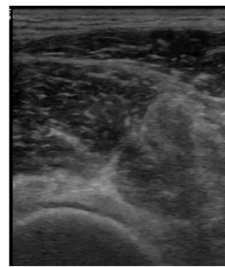
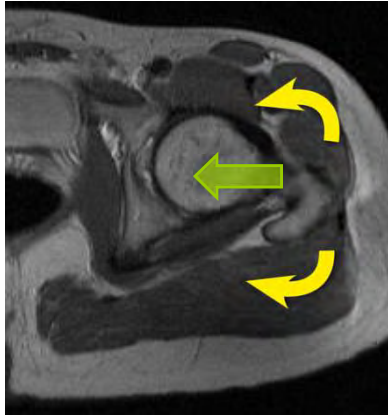
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Role of RTUS in Mx: Ax & Biofeedback for deep musculature

Commonly issues with
onset, offset &/or holding



Iliopsoas &
Iliocapsularis



Deep
Hip Cuff



Deep ER's

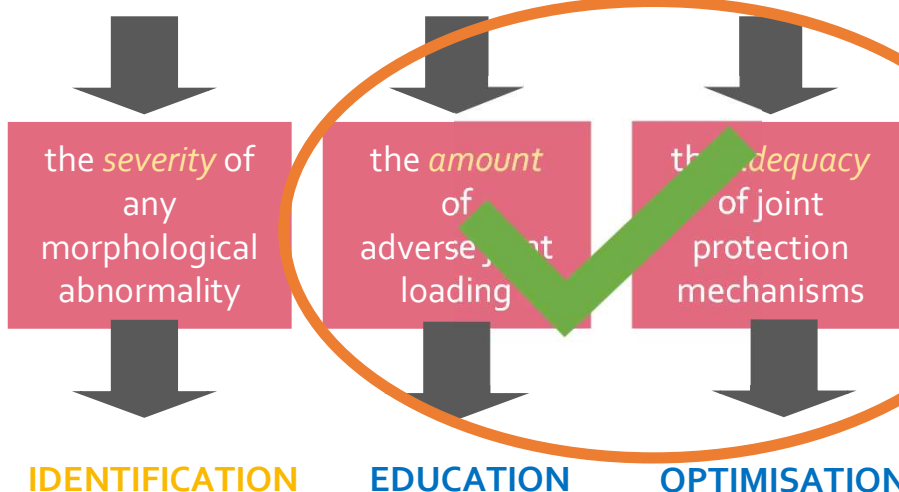


Graduated loading while considering optimal joint forces

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Risk of intra-articular pathology is
thought to be affected by:



Prevention & Management

(Brandt et al 2008)

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Joint Related Pain & Bony Impingements



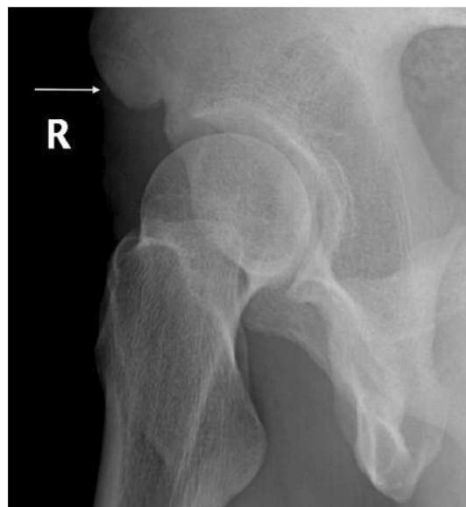
ANTERIOR HIP & GROIN PAIN Joint Related Pain & Bony Impingements Extra-articular Bony Impingement Module 1 – Lesson 9

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AIIS or Subspine Impingement

Prominent AIIS or subspine
region impinges against
femoral neck



Nakano et al 2017, Carton & Filan 2016

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AIS Prominence

Primary:

Associated with
retroversion

Secondary:

- Avulsion injury
- Traction apophysitis
- Pelvic osteotomy



Nakano et al 2017, Carton & Filan 2016

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Potential Implications of a Prominent AIIS

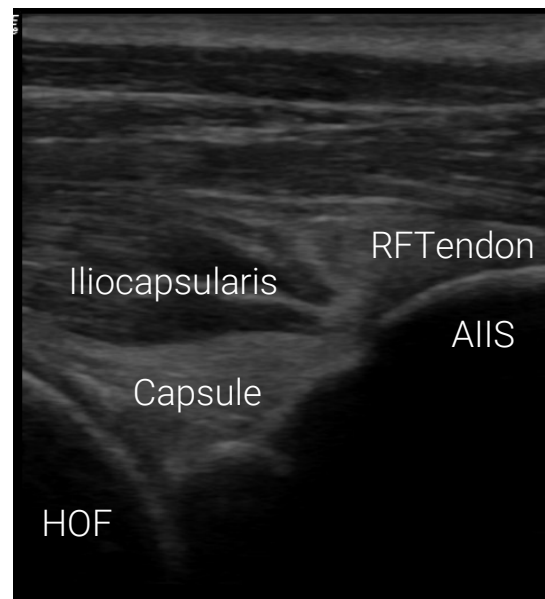
Soft tissues impinged in
hip flexion may
become painful and
damaged over time:

Rectus femoris tendon
(RFT) & prox muscle

Iliocapsularis

Capsule

Fat pad at head-neck
junction?



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Clinical Indicators of AIIS Impingement

Interview Features:

- Will present similarly to FAI Syndrome
- Pain usually deep anterolaterally in deep flexion; F/IR
- May report restricted ROM
- May have a Hx of 'Hip Flexor Injury', avulsion, apophysitis, PAO, participation in high load sports

Physical Assessment Features:



Pain & restriction
EOR Flexion



FADDIR +ve



Pain/weakness on
resisted ASLR

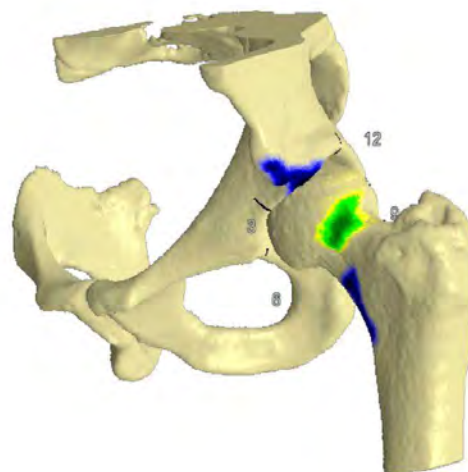


TOP AIIS

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Radiology

- XRay:
AP pelvis &
false-profile view
- CT
3D Reconstruction
Dynamic animation
may reveal impingement is AIIS
rather than FAI – implications
for surgical intervention



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AIIS/Subspine Impingement: Implications for Mx

Load Mx:

- Similar to FAIS – minimise exposure to impingement

Exercise Therapy:

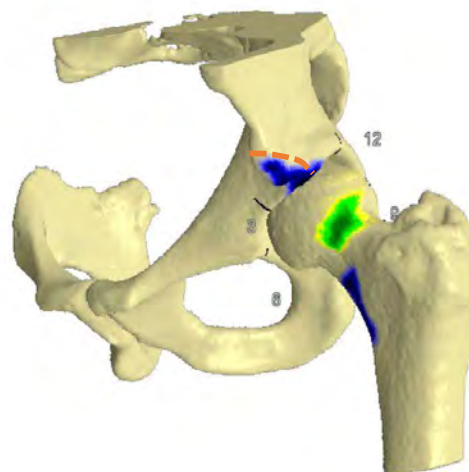
- Control excessive anterior pelvic tilt
 - Improve abs (RA) and lengthen hip flexors
- Graduated reloading of hip flexors
 - *Iliocapsularis
 - Rectus Femoris, once good deep flexor function

AIIS/Subspine Impingement: Surgical Decompression

May involve:

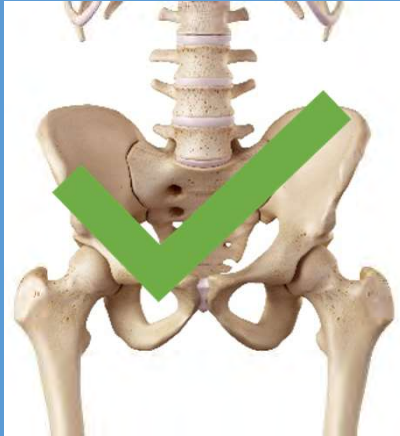
Partial resection or
iatrogenic damage
and delayed rupture of
Rec Fem &/or
Iliocapsularis origin

Extensive release of
anterior capsule from
acetabular rim

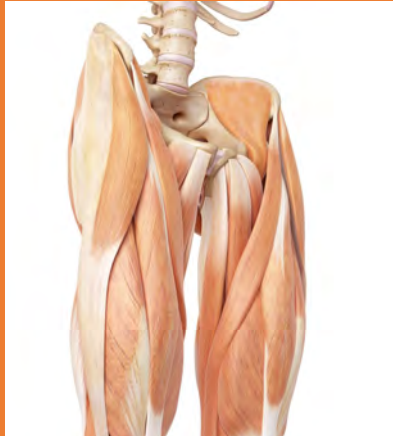


Focus Modules

Joint Related Pain & Bony Impingements



Soft Tissue Related Pain



Referred & Nerve Related Pain



Soft Tissue Related Pain



ANTERIOR HIP & GROIN PAIN Soft Tissue Related Pain

Muscle, Tendon, Bursa
Module 2 – Lesson 1

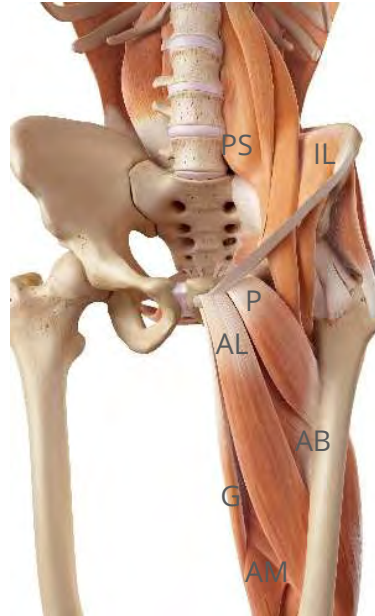
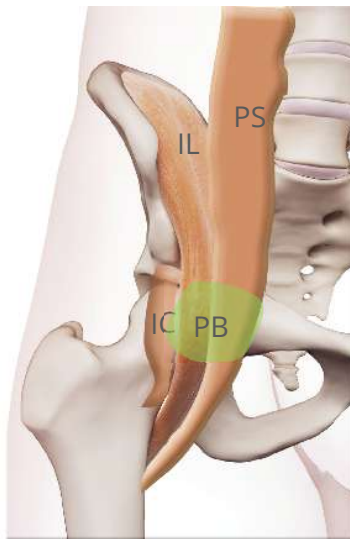
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Muscles, Tendons, Iliopsoas Bursa



PS: Psoas; IL: Iliacus; IC: Iliocapsularis; P: Pectineus; AL: Adductor Longus; Adductor Brevis; AM: Adductor Magnus; G: Gracilis; EO: External Oblique; RA: Rectus Abdominis; RF: Rectus Femoris; SA: Sartorius

PB: Psoas/Iliopsoas/Iliopectineal Bursa – sits between iliopsoas & hip joint

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Acute adductor injuries in athletes

Of 111 injuries (71 athletes):

46 isolated & 25 multiple

62 adductor longus

18 adductor brevis

17 pectineus

9 obturator externus

4 gracilis

1 adductor magnus

'Acute adductor injuries generally occur in isolation from other muscle groups'



Serner et al 2018

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Acute adductor injuries in athletes

Adductor Longus Injury:

Most common – 87% of injuries

37 isolated injuries

23(92%) of multiple injuries

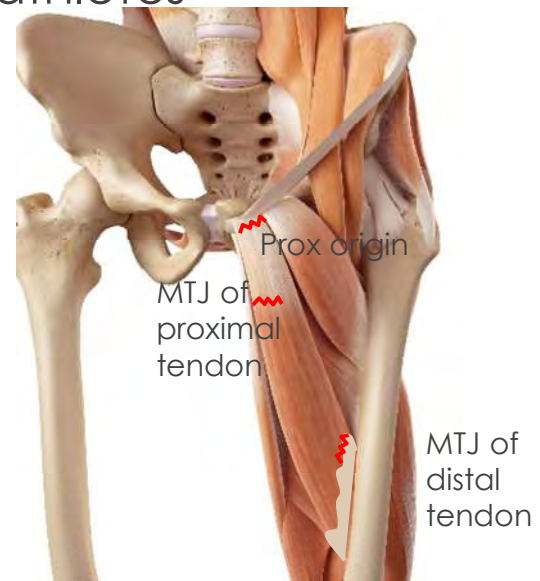
Location of Injury:

Proximal tendon origin (26%)

- 12/16 complete avulsions

MTJ of the proximal tendon (26%)

MTJ of the distal tendon (37%)



Serner et al 2018

MTJ: Musculotendinous junction

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Mechanism of Injury – Hip Adductors

Injury situation	Total	Adductor longus	Adductor brevis	Pectineus	Obturator externus	Gracilis	Adductor magnus
Kicking	17 (24)	15 (24)	4 (22)	3 (18)	3 (33)	1 (25)	1 (100)
Change of direction	17 (24)	14 (23)	3 (17)	4 (24)	1 (11)	-	-
Reaching/stretch	12 (17)	12 (19)	4 (22)	3 (18)	2 (22)	1 (25)	-
Running/Sprinting	8 (11)	7 (11)	2 (11)	3 (18)	-	2 (50)	-
Jumping	7 (10)	7 (11)	2 (11)	2 (12)	-	-	-
Tackling	7 (10)	5 (8)	1 (6)	1 (6)	2 (22)	-	-
Sliding	2 (3)	2 (3)	1 (6)	1 (6)	-	-	-
Pulled by opponent	1 (1)	-	1 (6)	-	1 (11)	-	-

Data: n (%). n = 71. In athletes with multiple adductor injuries, the injury situation is reported for each involved muscle.

Serner et al 2018

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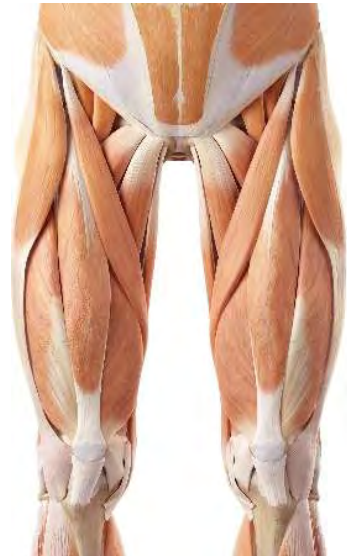
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Acute hip flexor injuries in athletes



PS: Psoas; IL: Iliacus; IC: Iliocapsularis; MTJ: Musculotendinous junction

Of 33 injuries:
 16 rectus femoris
 12 iliacus
 7 psoas major
 4 sartorius
 1 TFL

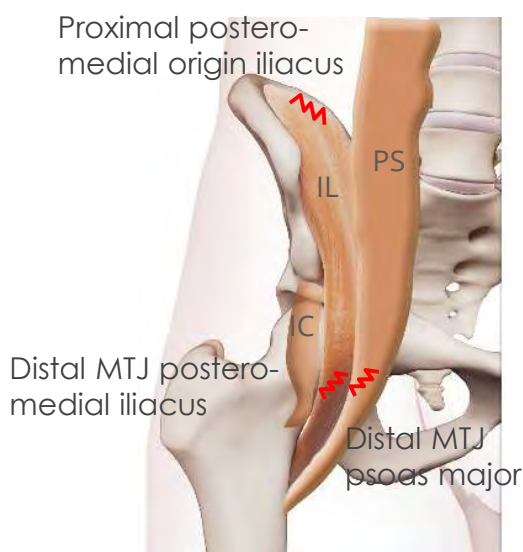


Serner et al 2018

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Acute hip flexor injuries in athletes



Distal MTJ postero-medial iliacus

PS

IL

IC

Distal MTJ psoas major

Iliopsoas injury:

40% of hip flexor injuries
 Iliacus more common than psoas; 50% isolated iliacus injuries; only 1 isolated psoas injury

Location of injury:

Distal MTJ Iliacus
 Distal MTJ psoas major
 Origin iliacus - 4
 Tendons Iliacus & psoas – 1

Serner et al 2018

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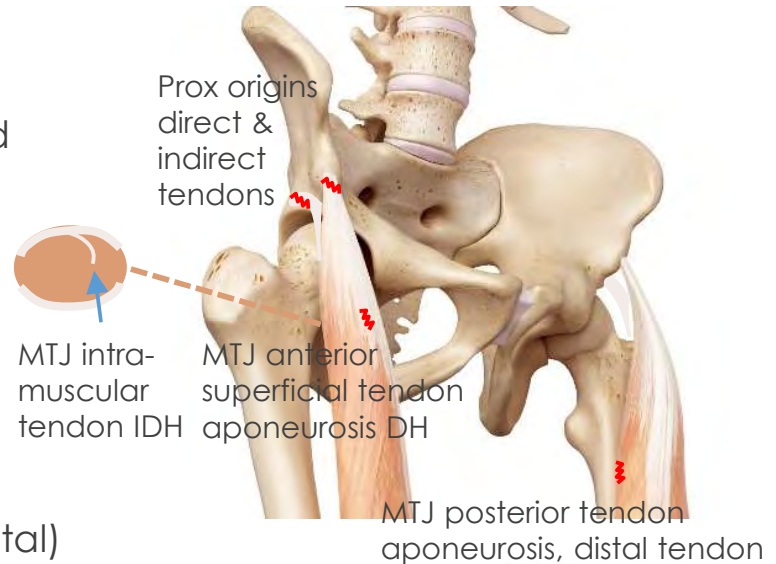
Acute hip flexor injuries in athletes

Rectus Femoris injury:

48% of hip flexor injuries
All but one case, isolated
1 combined with iliacus

Location of injury:

94% Prox tendons
Indirect > Direct head
56% IM Indirect tendon
MTJ anterior tendon - DH
MTJ posterior tendon (distal)



Serner et al 2018

MTJ: Musculotendinous junction; DH: Direct head of Rectus Femoris; IDH: Indirect head of Rectus Femoris

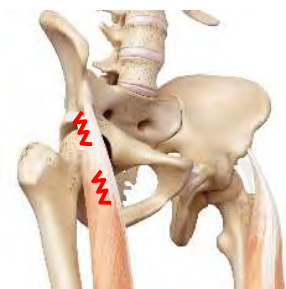
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Mechanism of Injury – Hip Flexors



Rectus Femoris:
Kicking, Sprinting



Iliopsoas:
Change of Direction



Serner et al 2018

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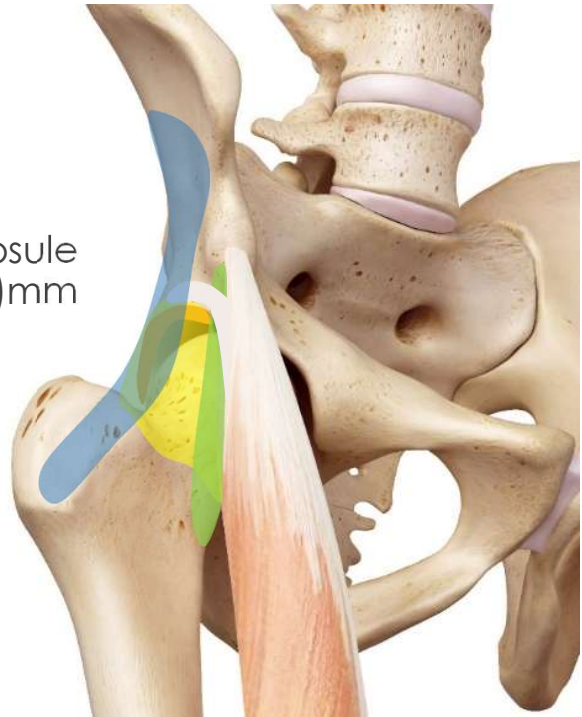
Rectus Femoris The capsular connection

Indirect/Reflected Head

Attachment to anterosuperior capsule
- 26.1 (7.6–39.8)mm x 10.1 (5.3–16.5)mm

Named as part of the
'Stability Arc' of the anterior hip

- RF Reflected Head
- Iliocapsularis
- Gluteus Minimus



Cooper et al 2015, Walters et al 2014, Philippon et al 2014

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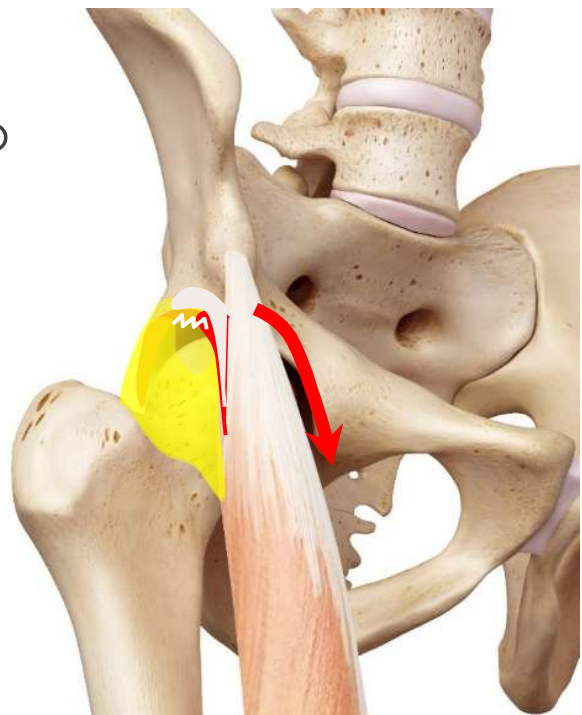
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'HALTAR' - the SLAP lesion of the hip

Hip **A**ntero-superior **L**abral
Tear with **A**vulsion of the
Rectus femoris

Avulsion of the reflected
head may result in

- capsular rupture
- labral tear
- chondrolabral separation



Foot et al 2013, Hosalkar et al 2012, Ouellette et al 2006

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Rectus Femoris Tendinopathy

Gradual and progressive pain onset

MOI: increase in or excessive training volume – kicking, sprint starts, jumping, eccentric loading

Clinical Indicators

- tenderness AHS/subspine
- pain on active loading
 - SLR
 - Isometric Hip flexion
 - Isometric Knee ext - prone
 - Isometric Knee ext - Mod Thomas test

Consider effect on joint

Dragoni & Bernetti 2016, Pesquer et al 2016



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Management of Rectus Femoris Overload

Load Management

Manage general training loads

Reduce specific loads - traction force on rectus femoris

- hip extension + knee flexion – stretching unhelpful
 - eccentric loads provocative
- postures & movement habits – *swayback posture

Exercise Therapy

- Optimise function of adjacent joint stabilisers
 - iliocapsularis & gluteus minimus
- Targeted strengthening initially with isolated seated knee extension & hip flexion with knee flexed (no SLR)– progress to multi-joint movements as tolerated, eccentric last

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Soft Tissue Related Pain

Iliopsoas Related
Anterior Hip Pain



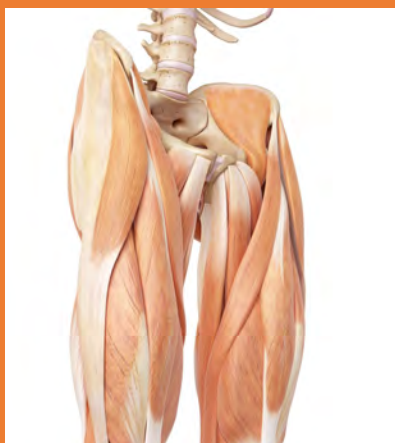
Groin Pain



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Soft Tissue Related Pain



ANTERIOR HIP & GROIN PAIN Soft Tissue Related Pain

Iliopsoas Related Hip Pain
Module 2 – Lesson 2

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Iliopsoas Related Hip Pain

WHAT? →

What is it?

WHY? →

Mechanisms

HOW? →

Clinical Indicators

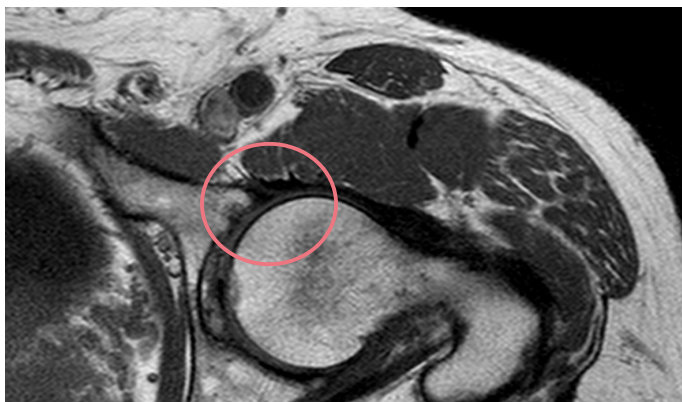
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Management



Iliopsoas-Related Hip Pain

Pain associated with Iliopsoas tendon impingement or friction against the acetabular rim or femoral head– native or prosthetic



Anterior Hip & Groin Pain

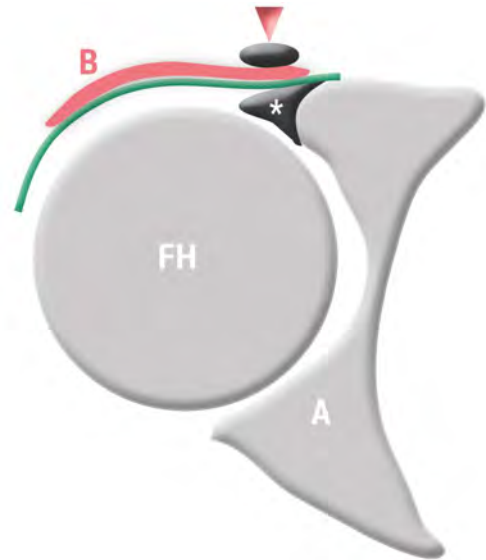
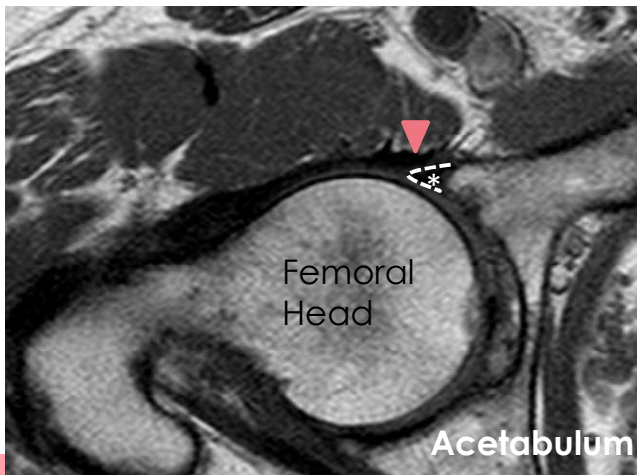
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Potential sources of nociception

Psoas Tendon ▼
Iliopectineal bursa
Capsule & synovium
Acetabular labrum*



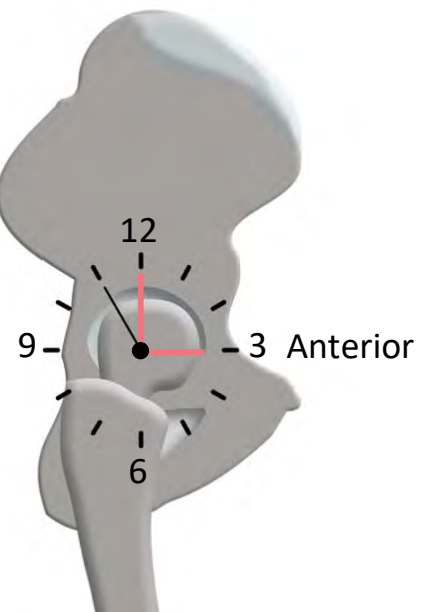
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Potential pathologies associated with IRHP

Iliopsoas Tendinopathy
Iliopectineal bursitis/bursal distention
Synovitis
Acetabular labral tear/pathology
at 3 o'clock, direct anterior

➔ Iliopsoas Impingement



Alpert et al 2009, Domb et al 2011

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Potential mechanisms of iliopsoas-related hip pain

Compression

Iliopsoas Tendon
Iliopectineal bursa
Capsule & synovium
Acetabular labrum

Influenced by:

Joint position
Structure
Joint stability
Movement Patterns
Volume of activity –
esp rapid increases in
activities that impose
compressive loading

Effect of hip position – range of hip flexion/extension

Sagittal Plane MRI

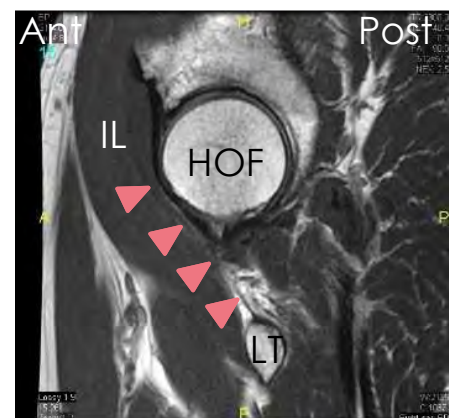
15-60° Hip Flexion

Pulley transferred to
pelvic brim after loss
of contact with HOF

0-15° Hip Flexion

Maximum pressure HOF
HOF acts as pulley
Tendon stabilises HOF
Posterosuperior force

Above 60° Hip Flexion
No bony contact



Ant: Anterior; Post:
Posterior; HOF: Head of
Femur; IL: Iliacus; LT: Lesser
Trochanter

Structural factors increasing prominence
of the HOF/acetabulum:



FAI



OA



Prominent
prosthesis

Henderson & Lachiewicz 2012, Mardones 2016

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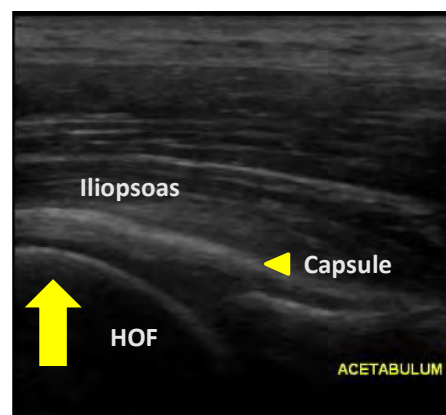
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Factors increasing prominence of the HOF

Anterior translation
associated with anterior
instability

Increased requirement
for dynamic stability
mechanisms

Longitudinal US at Anterior Hip



Prox

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Postural & movement factors increasing impingement of Psoas tendon



Increased hip extension:

Sway posture
&/or longer stride length

Lordotic posture with short iliopsoas:

Moderate- large stride length

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Clinical Indicators of IRHP

Interview Features:

- Anterior hip pain – usually mid-inguinal, may extend prox/distal
- May report clicking or snapping at the anterior hip
- May co-exist with FAI or Instability

Physical Features: (Poor predictors of hip flexor pathology Serner et al 2016)



Often +ve on FADDIR/Q



Pain on active &/or resisted hip flexion



Mod Thomas Test: Pain on stretch & resistance



+/- +ve snapping hip test

+/- TOP Iliopsoas – useful for ruling out acute M-T tears

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Anterior Snapping Hip Test

Hip flexion
abduction
ER



Active
eccentric
lowering



Relative
extension
adduction
IR



Preset tendon
lateral to
iliopectineal
eminence & HOF



Tendon is thought
to snap medially
over iliopectineal
eminence or HOF



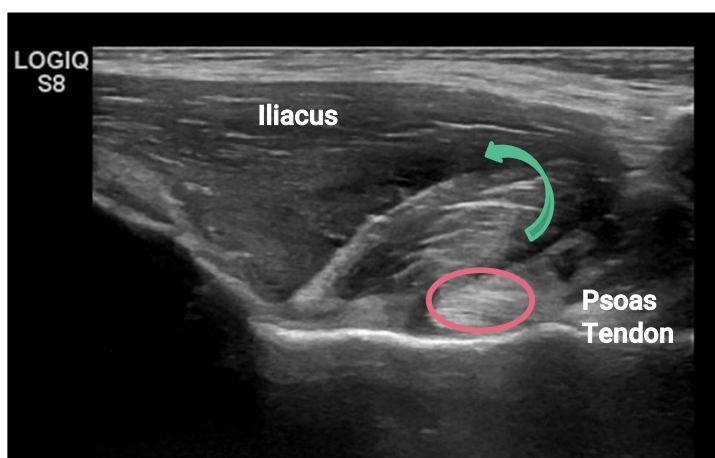
Johnston et al 1998

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Anterior Snapping Hip Test

OR..... Tendon rolls over muscle belly & snaps back down onto pelvic brim



Normal: Iliacus
muscle belly holds
down psoas tendon



Snapping hip: Psoas
tendon lifts, then traps
deep bundle iliacus
before snapping
around, onto pelvis

Deslandes et al 2008, Winston et al 2007

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Effect of pelvic position?

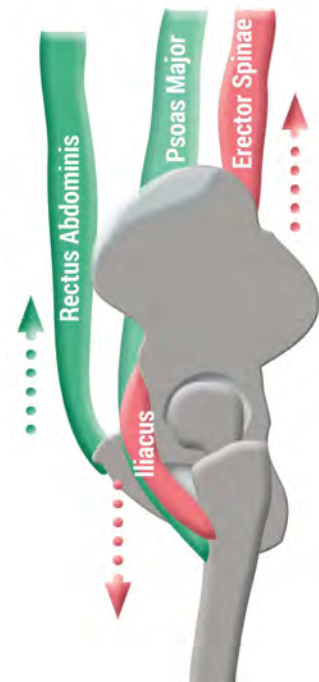
Iliacus & ES = Anterior pelvic tilt/Lx Ext

Rectus Abdominis = PPT/Lx Flexion

Psoas Major – variable effect depending on start position

Iliacus may be delayed enough by posterior pelvic tilt prior to hip flexion, to allow psoas tendon to escape from beneath iliatus muscle belly

Maintaining neutral pelvic position appears to assist in avoidance of snapping hip.



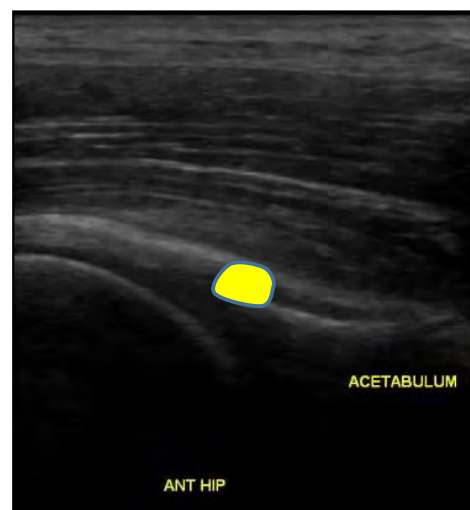
Park et al 2013, 2014

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Other causes of psoas snapping

- Bifid tendon
- Snapping over paralabral cyst



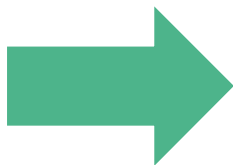
Deslandes et al 2008

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Premise of current Mx approach:

THOSE WITH ILIOPSOAS IMPINGEMENT
OR ANTERIOR SNAPPING HIP HAVE
SHORT HIP FLEXORS



Stretch
Surgically release
??????



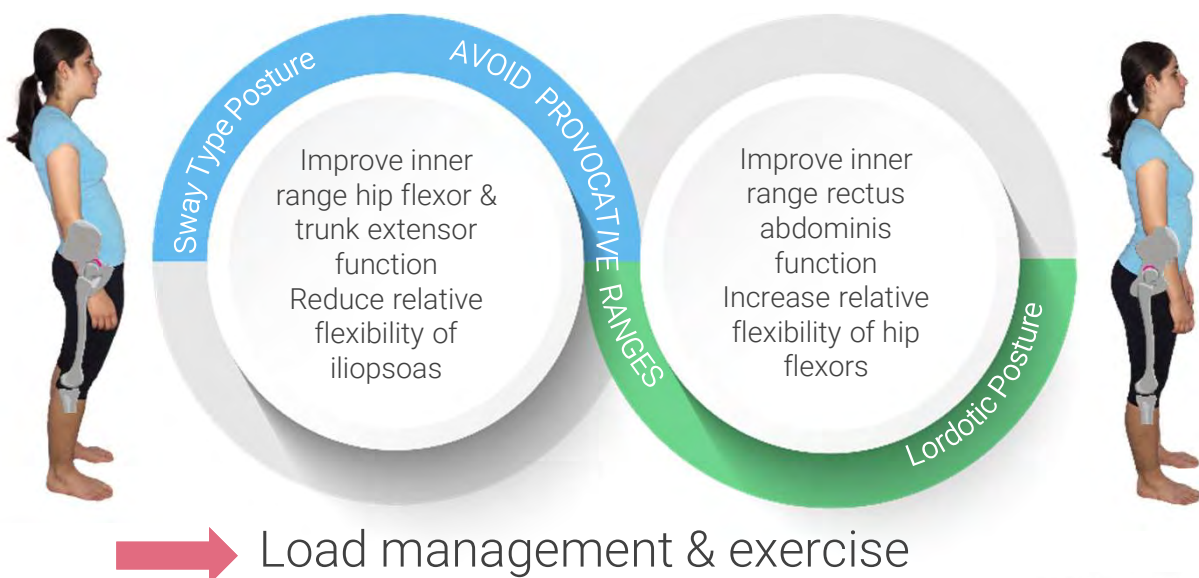
Johnston et al 1998, 1999, Keskula et al 1999, Lewis 2010

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Management of IRHP

*Optimise sagittal plane load sharing



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Load Management

Reduce

- sustained
- repetitive
- loaded
- rapid



EOR
Hip Ext

Modify Technique, Volume,
Training schedule

Posture & Gait Retraining



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Low level
hip flexor -
lumbopelvic
training

- Optimise kinematic control
- Optimise relative flexibility/ antagonist balance



Sways - long hip flexors

- Maintain neutral
- Avoid posterior pelvic tilt
- Bias concentric phase

Lordotics - short hip flexors

- Maintain neutral
- Avoid ant pelvic tilt during extension
- Bias eccentric phase

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Effect of contraction mode on muscle fascicle length – evidence from hamstrings

Eccentric loading

Significant increase in BFLH fascicle length over 28 days training



Concentric loading

Significant decrease in BFLH fascicle length over 28 days training



Lengthening consistently achieved by eccentric loading – seated ecc curl, Nordic curl, eccentric Hip Extension

Timmins et al 2016, Bourne et al 2017

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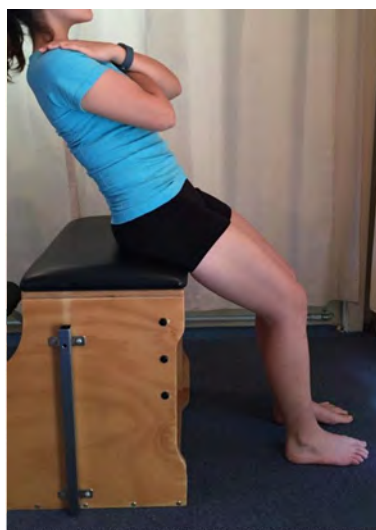
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Lordotics:

Train to lengthen under load

Eccentric-only or eccentric biased loading

Eccentric Lean Backs



Eccentric Leg Lowers

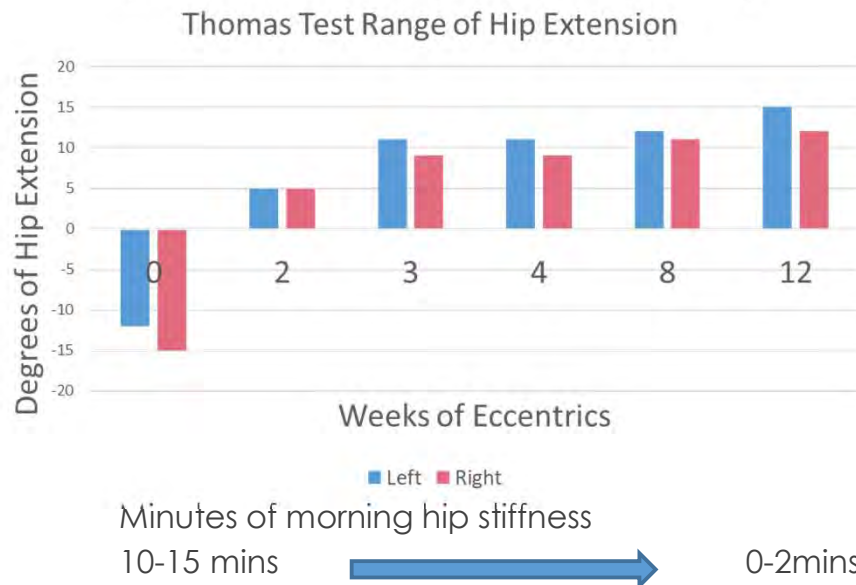


Increase difficulty with thigh stabilisation & load, as tolerated

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Case Study: anterior hip pain & tight hip flexors



Case study of 1. Research to be done.

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IRHP Key Points

- IRHP is most commonly associated with excessive compression or combinations of high compressive & tensile loads
- Compression of the tendon and underlying joint structures may occur in association with
 - long hip flexors & higher ranges of hip extension
 - short hip flexors & normal-high ranges of hip extension
- Hip flexor stretching is unlikely to be helpful
- For those with long hip flexors – reduce postural & dynamic extension and improve hip flexor and L-P function
- For those with short hip flexors – learn to dissociate pelvis from femur, shorten RA & lengthen hip flexors – eccentric might be best

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For further reading on this topic, visit ebooks at www.dralisongrimaldi.com

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Soft Tissue Related Pain



ANTERIOR HIP & GROIN PAIN Soft Tissue Related Pain

Groin Pain – Part 1
Module 2 – Lesson 3

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Groin Pain Clinical Entities

- a. Adductor Related GP
- b. Pubic Related GP
- c. Inguinal Related GP (Iliopsoas RGP)

WHAT?



What is it?

WHY?



Mechanisms

HOW?



Clinical Indicators



Management

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Groin Pain

- Prevalent in sport * football codes & ice hockey
- 2nd most common injury in football codes, after hamstring injury
- High rates of re-injury (20-25% Orchard et al 2013)
- Re-injuries $\approx$ 2x as long out of sport (Werner et al., 2009)
- Few risk factors identified:
 - previous injury
 - higher standard of play
 - lower adductor strength

Maffey & Emery 2007, Ryan et al 2014, Whittaker et al 2015

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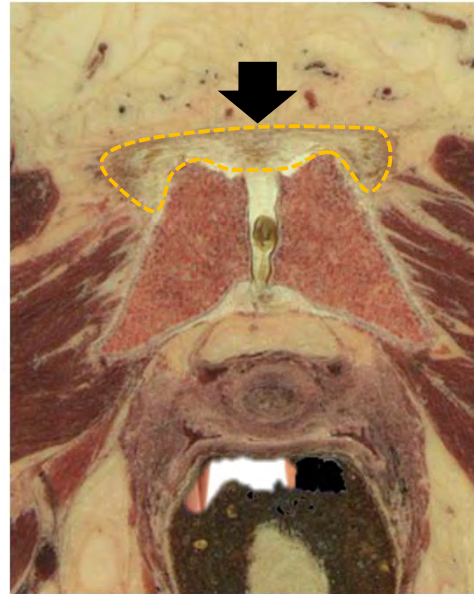
Adductor Connections

Strong fibrous connections into the pubic aponeurosis that sits directly anterior to PS

Fibrous connections exist between:

- L & R adductor longus (AL)
- AL & both ipsilateral & contralateral abdominals
- AL & rectus abdominis (RA)
- tendons, PS capsule & disc

Spread of symptoms into connected tissues common



Robinson et al 2007, Robertson et al 2009

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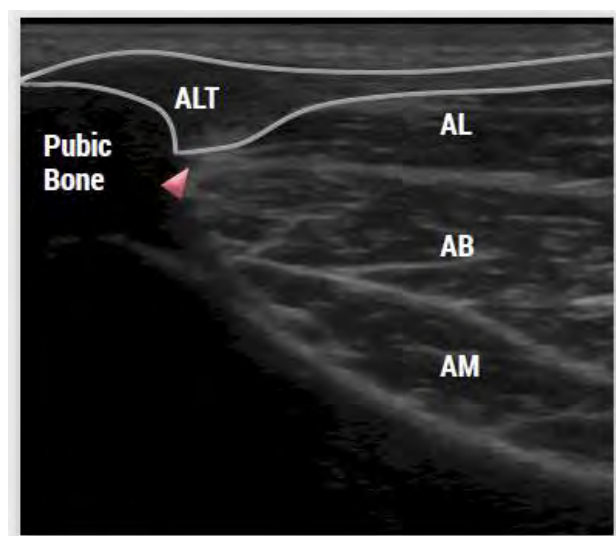
Adductor Connections

AL inserts via both a tendinous & muscular insertion

Muscular insertion has a short transition zone onto the bone

Females more tendinous, males may have more muscular attachment

Does this put males at higher risk of injury??



Davis et al 2011, Strauss et al 2007, Tuite et al 1988

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Adductor Connections

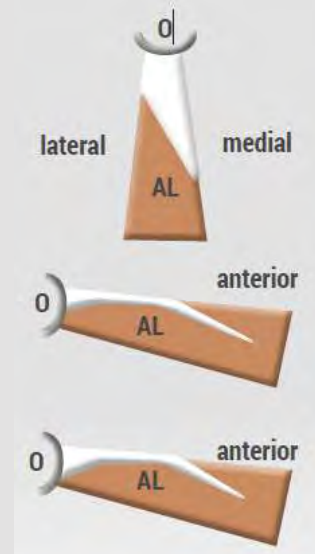
AL tendon

- lies superficially on the muscle
- medially, extends further distally
- substantial intramuscular tendon
 - 11-13cm in length; $\geq 20\%$ fem length

Intramuscular tendons may provide extra strength & stability for transmission of large mechanical forces

May fail under high load

Some adductor muscle strains likely to be intramuscular tendon or MTJ injuries

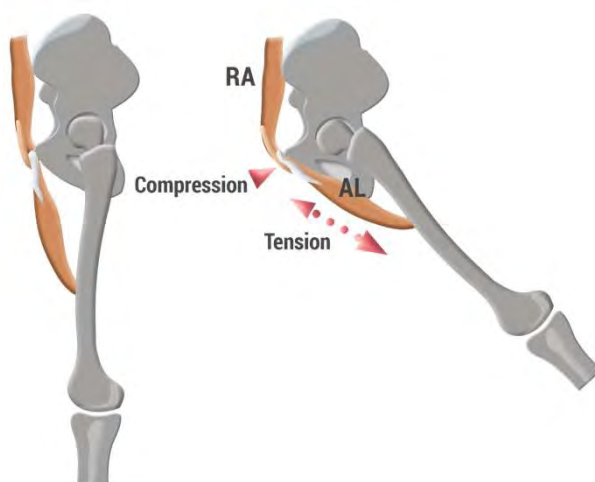


Davis et al 2011

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Potential sources & mechanisms of adductor-related groin pain



Hip Extension/Abduction

Tendon wraps around pelvic ramus



Compression & Tension

Adductor M-T Junction
Adductor tendons

*Adductor longus

Connections into Pubic aponeurosis & abdominals

Cook & Purdam 2012

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Potential mechanisms of adductor-related groin pain

Combinations of large range, high speed and high repetition of movement into/out of hip extension/abduction

e.g. Instep Kick:

End of wind up phase:

Hip in maximal extension

AL at max rate of lengthening

AL at max activation

At 65% of swing phase:

Moving forward & into Abduction

Max length of AL



High tensile & compressive loads across adductors & connections

Charnock et al. 2009

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Mechanisms of acute AL injury

*Rapid muscle activation during lengthening

Most injuries were in non-contact situations (71%) & following a quick reaction to a change in play (53%)

Injury actions were:

- change of direction (35%) – Closed chain action
- kicking (29%) – Open chain action
- reaching (24%) - Closed chain action
- jumping (12%) – Open chain action

Closed Chain MOI (59%):

- Hip Ext & Abd with ER

Open Chain MOI (41%):

- Change from Hip Ext to F & Abd to Add with ER

Andreas Serner et al 2018 Br J Sports Med

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Clinical Entities Definitions

Adductor-related groin pain

– Most common

Definition:

Adductor tenderness AND pain on resisted adduction testing

Inguinal-related groin pain

Definition:

Pain in the inguinal canal region AND tenderness of the inguinal canal AND no palpable inguinal hernia. Pain on resistance of the abdominal muscles OR on Valsalva/cough/sneeze.

Pubic-related groin pain

Definition:

Tenderness of the pubic symphysis & adjacent bone



Weir et al 2015

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Clinical Indicators of Adductor Related GP

Interview Features:

- Pain in the adductor region, * proximally
- Aggravated by running esp change of direction, kicking
- Loss acceleration, power, speed & stride length

Physical Features:



Squeeze tests useful +LR for predicting pathology in acute but not long standing ARGP



Palpation useful for ruling out ARGP



BKFO reduced ROM

Drew et al 2014, Serner et al 2016/17, Kloskowska et al 2016, Mosler et al 2015

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Copenhagen 5 second squeeze test as a quick indicator of load tolerance

Scores correlate well with HAGOS-Sport
Pain 6-10 = worst (lowest) HAGOS score
Responsive to change over time

Useful for screening, monitoring & directing Mx



STOP



ATTENTION



GO

Traffic light approach for helping direct Mx & sports participation



Sustained for 5 secs

Numeric Pain Rating

Thorborg et al 2017

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Clinical Indicators of Pubic Related GP

Interview Features:

- Pain in the pubic region
- Agg by running esp COD, kicking, Split lunge/wide squat, hop
- Loss acceleration, power, speed & stride length

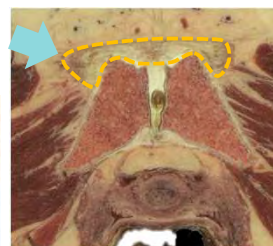
Physical Features:

Positive Squeeze = global distress of structures of anterior pubic region (Falvey et al 2016)



+ve Squeeze tests. In LSQP, +ve squeeze increases likelihood of pubic bone marrow oedema

Falvey et al 2016, Verrall et al 2005



Palpation of PA useful for ruling out PA Tears



Pain on 'Pubic Symphysis Stress Test'

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Groin Pain Impairments

ADDUCTOR WEAKNESS is

➤ a significant risk factor for developing groin pain

(Whittaker et al. 2015)

➤ a consistent impairment in those with ARGP

(Kloskowska et al. 2016, Mosler et al. 2015)

BUT ...

Are adductor strength test results a direct reflection of adductor muscle capacity?



No studies exploring adductor muscle size or quality in those with groin pain or how this effects risk of developing groin pain

Application of a pelvic belt results in

↑ adduction strength

↓ groin pain

(Mens et al 2006)

↑ Adductor strength despite absence of any isolated adductor strengthening during rehabilitation

(King et al 2018)

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Adductor strength tests may be more accurately interpreted as tests of **Load tolerance (painful)** or **Load transfer (painfree)** across the anterior pubic region

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Adductor EMG & Groin Pain

Reduced EMG

High Load Test:



EMG
Adductor Longus

Lovell et al 2012

Increased EMG

Low Load Test:



EMG
Adductor Longus

Morrissey et al 2012

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BKFO ROM & Groin Pain



BKFO in athletes with groin pain

But not a risk factor for injury

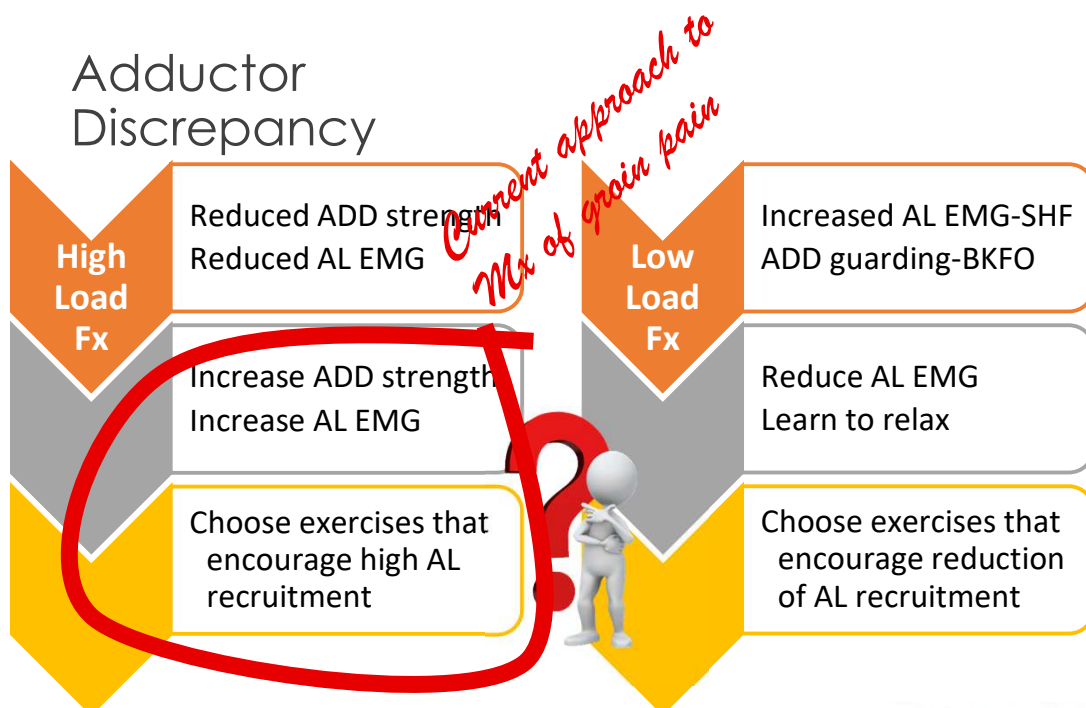
Kloskowska et al 2016, Mosler et al 2015

Response, rather than mechanism

May reflect a protective upregulation of adductor longus activity



Adductor Discrepancy

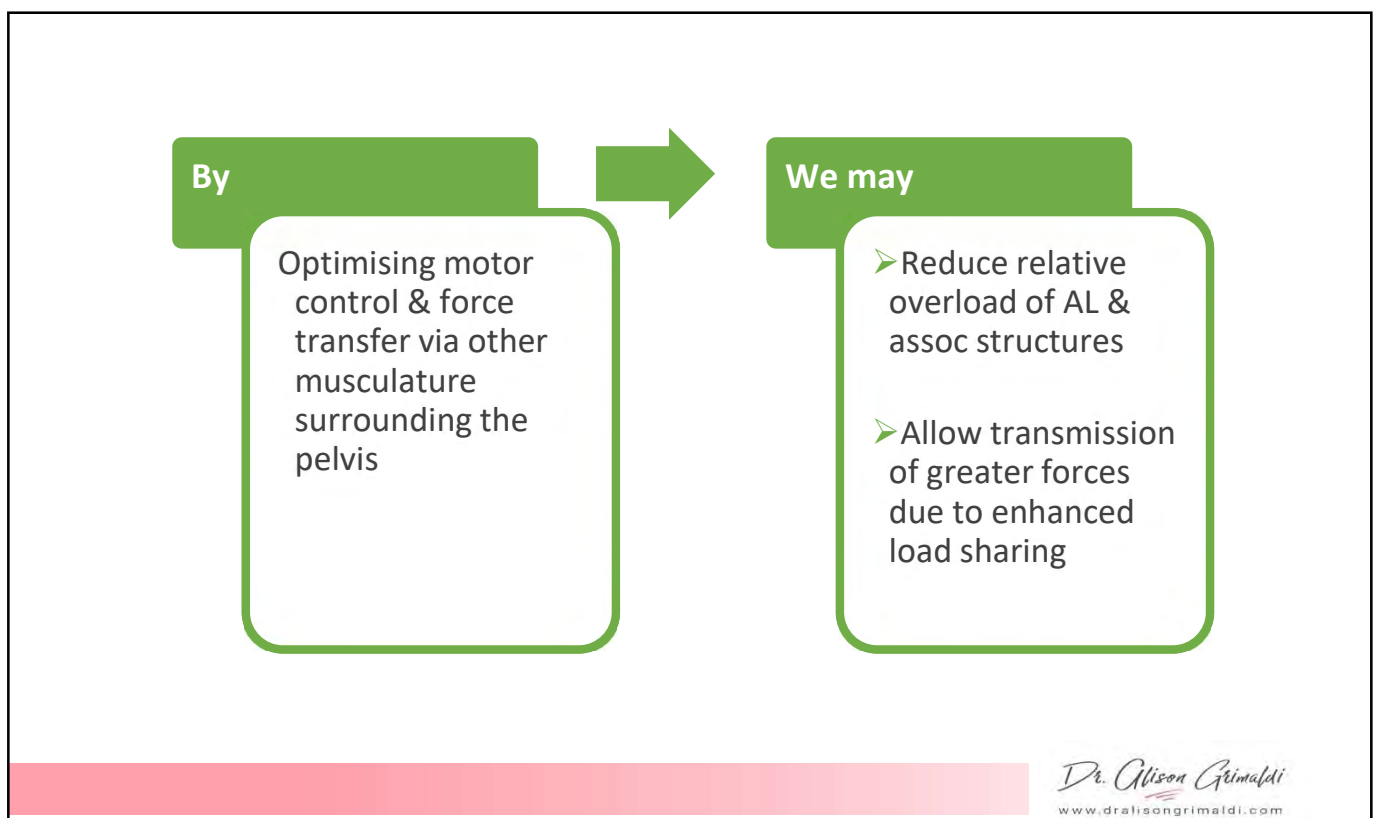
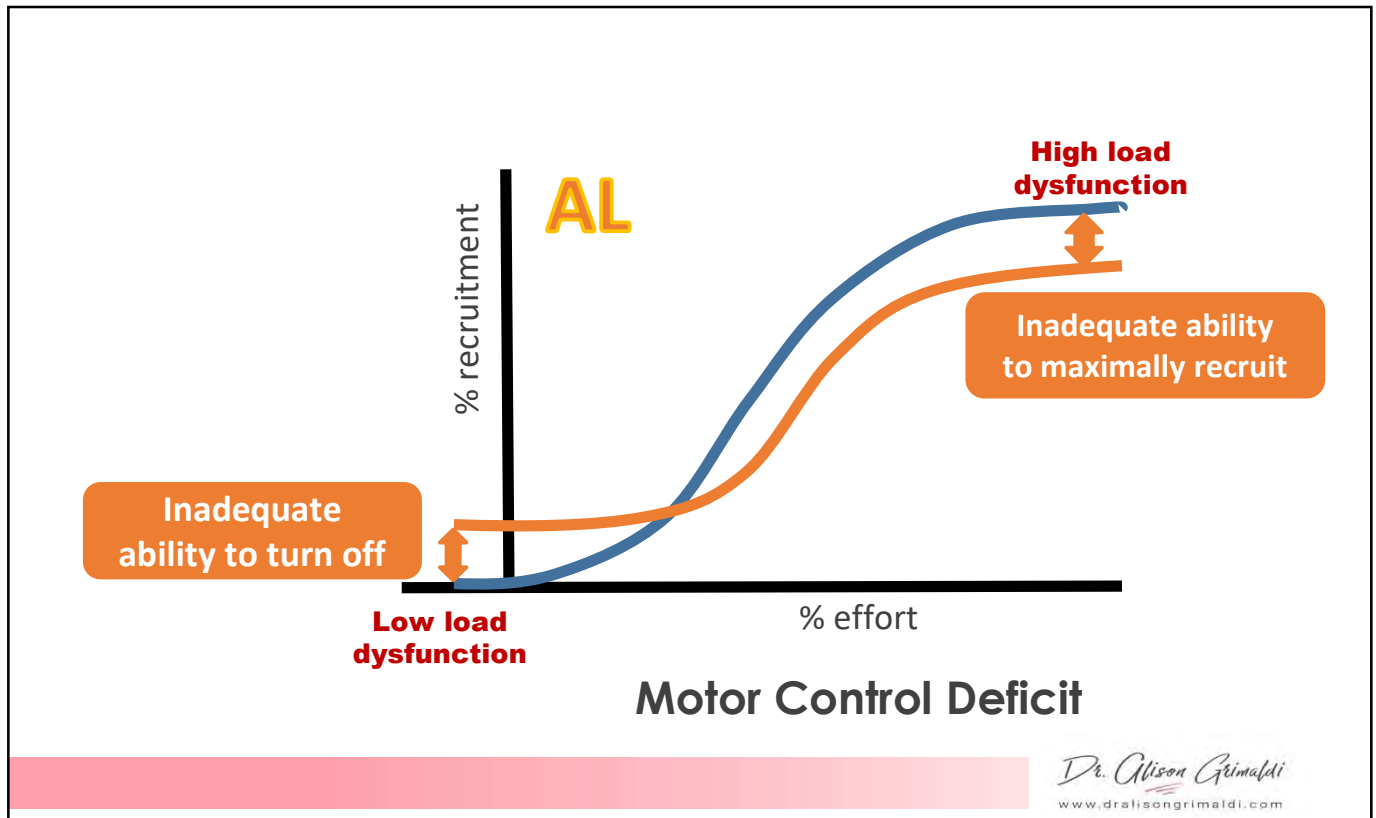


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Other Impairments

- LSGP: delay in transversus abdominis onset during ASLR
Cowan et al 2004
- LSARGP: lower resting muscle thickness of transversus abdominis
Jansen et al 2010
- GP (OP): Isokinetic dynamometry - lower concentric back extensor & eccentric abdominal strength
Mohammad et al 2014
- Smaller Lumbar Multifidus size may increase risk of more severe groin injury
Hides et al 2011



Much more research is required, but muscles that influence lumbopelvic position and movement are important in load transfer across the anterior pelvis

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Groin Pain Clinical Entities

- a. Adductor Related GP
- b. Pubic Related GP
- c. Inguinal Related GP (Iliopsoas RGP)

WHAT?



What is it?

WHY?



Mechanisms

HOW?



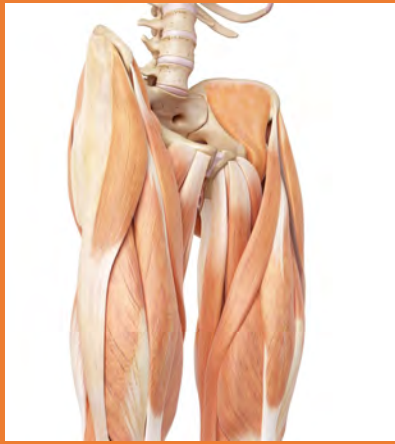
Clinical Indicators



Management

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Soft Tissue Related Pain



ANTERIOR HIP & GROIN PAIN Soft Tissue Related Pain

Groin Pain – Part 2
Module 2 – Lesson 4

Management of Groin Pain

Evidence for Mx of groin pain

- insufficient
- generally of poor quality with high risk of bias
- inadequate reporting of the details of non-surgical interventions

Charlton et al 2017, King et al 2015,
Machotka et al 2009, Serner et al 2015

Management of Groin Pain

Only 2 ex RCT's, both using the same exercise programme

Hölmich et al 1999

Effectiveness of active physical training as treatment for long-standing adductor-related groin pain in athletes: randomised trial

Lancet 1999; **353**: 439-43

Per Hölmich, Pernille Ulstrup, Lisbeth Ulstrup, Inge Lis Kanstrup, Michael Bachmann Nielsen, Anders Munch Bjerg, Kim Krogsgaard

Weir et al 2011

Manual Therapy 16 (2011) 148–154

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original article

Manual or exercise therapy for long-standing adductor-related groin pain: A randomised controlled clinical trial

A. Weir^{a,b,*}, J.A.C.G. Jansen^b, I.G.L. van de Port^b, H.B.A. Van de Sande^c, J.L. Tol^a, F.J.G. Backx^b

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The Hölmich Groin Rehab Programme



First 2/52:

Module 1

- Static Add 0°
- Static Add 45°
both 10 x 30s
- Sit-ups straight
- Sit-ups oblique
- Folding Knife
with static add
5 x 10 reps
- Balance Board
5mins
- SL slide board
10mins ea leg
- 90 mins daily**

Holmich et al 1999

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Management of Groin Pain

Hölmich et al 1999 RCT:

Active Training

3 x week, 8 – 12 weeks
24 – 36 Physio sessions
Supervised group exercise
90mins
+ HEP on other days
No stretching

VS

Passive Therapy

2 x week, 8 – 12 weeks
16 – 24 Physio sessions
Individual Rx
Laser & Tens
Friction of the tendon
Stretching (daily)

Hölmich et al 1999 Outcomes

Success Criteria:

- a. No tenderness on palpation of adductors
- b. -ve squeeze test
- c. No pain on Return To Sport

Rx Outcome	No. criteria met	AT		PT
Excellent	3	23	>>	4
Good	2	2		6
Fair	1	3		6
Poor	0	6	<<	18
RTS	18.5 wks (range 13–26)	79% @ 18.5/52		14%

**AT group achieved same increases in ROM
with NO stretching**

Management of Groin Pain

Weir et al 2011:

Active Training

Hölmich programme

3 Physio visits to supply prog

HEP 3 x week, min 8 weeks

No stretching

Return to running prog

Weir et al 2011 Outcomes

Success Criteria:

a. No tenderness on palpation of adductors

b. -ve squeeze test

c. No pain on Return To Sport

Rx Outcome	No. criteria met	AT	MMT
Excellent	3	5	7
Good	2	7	7
Fair	1	4	1
Poor	0	6	11
RTS		55% @18.5/52	50% @12.5/52

No difference between groups

Conclusion: 'neither treatment was very effective'

How do we optimise outcomes?

More supervised sessions?

Greater volume of exercise?

Different exercises?

Expert clinicians seem to be divided on the use of adductor loading, particularly early in rehab



Images from PhysiApp

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Loading across the pubic region



382♂, athletic groin pain
Injury to the pubic aponeurosis
in 240 (62.8%)

Most common diagnosis

**Recommend avoiding
high-load adduction**

Falvey et al 2016, King et al 2018

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King et al 2018 – Large Cohort Study

205 patients with athletic groin pain
(25% withdrew, no controls)

Rehabilitation focused on intersegmental control

No isolated adductor strengthening

King et al. Br J Sports Med 2018;52:1054-1062

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King et al 2018 – Exercise Streams

Sagittal			Frontal/Transverse	
Streams		Segment		Streams
Abdominal Double Leg Squat Deadlift		Thorax on Pelvis		Abdominal Lateral Hip Strength
Hip Flexor Double Leg Squat Lunge Deadlift		Pelvis on Femur		Lateral Hip Control Lateral Hip Strength Plyometric
Double Leg Squat Lunge Deadlift		Femur on Tibia		Lateral Hip Control Lateral Hip Strength
Plyometric		Tibia on Foot		Lateral Hip Strength

King et al. Br J Sports Med 2018;52:1054-1062

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Focus:
intersegmental
control &
strength



Level 1

STREAMS

- Hip flexor
- Lat Hip Control
- Abdominal
- DL Squat
- Lat Hip Strength
- Deadlift
- Lunge
- Plyometric

3-4 sets
5-6 reps
4 x/week

King et al. Br J Sports Med 2018;52:1054-1062

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King et al 2018 – Large Cohort Study

Rehabilitation focused on intersegmental control

No isolated adductor strengthening

Outcomes:

73% (150/205) RTP in mean 9.9 weeks (± 3.5)

Mean 5.1 (± 1.5) appointments prior to RTP, 12-16 days apart

Significant improvements in:

- HAGOS scores (ES: 0.6–1.7)
- Add squeeze test in all 3 positions (ES: 0.49–0.68)

Change in 3D Kinematics during a change of direction task

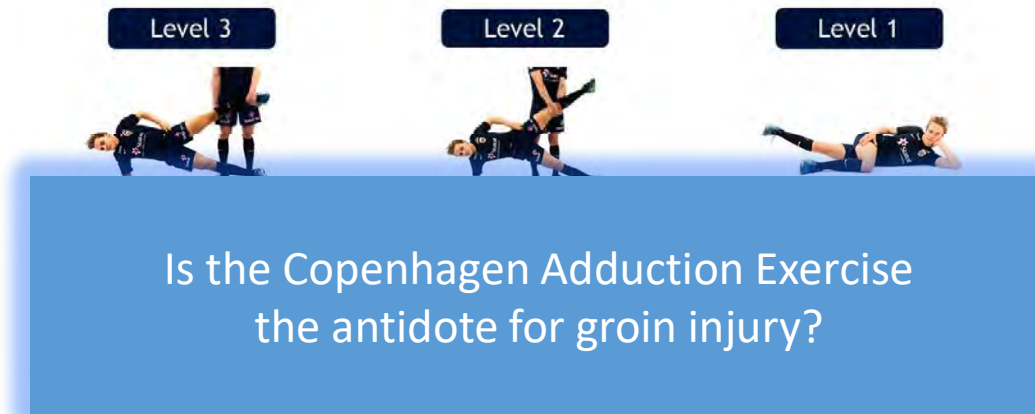
- Reduced trunk side flexion
- Increased pelvic rotation in direction of travel
- Changes to variables associated with improved cutting performance (Falvey et al 2016)

King et al. Br J Sports Med 2018;52:1054-1062

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What about prevention of groin injury?



Twitter Post: Addition of isolated ADD Ex to normal training resulted in '41% reduction in risk of **groin problems** for players performing the programme!'

Harøy et al 2018 Br J Sports Med

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Injury Definitions In Harøy study

Groin Problem defined as:

- any hip or groin symptoms e.g. 'pain, ache, stiffness, clicking/catching or other complaints related to the groin'
- reduced training participation, training volume or performance due to groin problems

Substantial Groin Problem defined as:

- moderate or severe reductions in training volume or football performance, or a complete inability to participate due to groin problems.

Harøy et al 2018 Br J Sports Med

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Outcomes

Control Group

Groin problems: 67%

Substantial

Groin problems: 37%

Time loss %: 33

Significant
difference

OR:0.59

No significant
difference

OR:0.82

No reduction
in time loss

Intervention Group

Groin problems: 55%

Substantial

Groin problems: 28%

Time loss %: 41

Low compliance in 125/247
50%

Why?: 5 min ex within training

Harøy et al 2018 Br J Sports Med

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Groin Pain Key Points

Groin Pain continues to be prevalent & recurrent



NO MAGIC BULLET

Minimising risk & optimising recovery is likely to require:

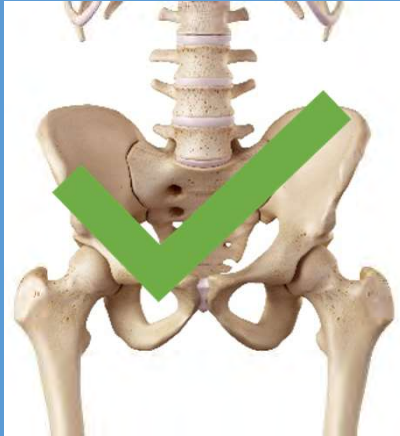
- attention to more than a single muscle group
- focus on mechanisms of load transfer across the pubic region
- attention to individual impairments & mechanisms that may increase risk of anterior overload – structural/kinematic/behavioural

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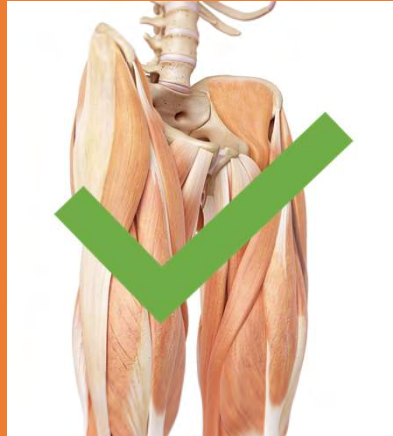
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Focus Modules

Joint Related Pain & Bony Impingements



Soft Tissue Related Pain



Referred & Nerve Related Pain



Referred & Nerve Related Pain



ANTERIOR HIP & GROIN PAIN Referred & Nerve Related Pain

Module 3 – Lesson 1

Lumbar related anterior hip & groin pain

Radicular Pain

Arising from nerve root
impingement/irritation

Sharp, shooting pains or burning

+/- additional deep, dull ache

+/- paraesthesia, changes in reflexes
& motor function

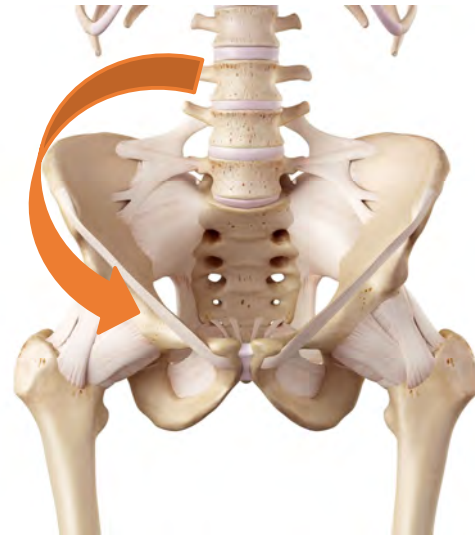
Somatic Pain

Referred from other structures such
as facet joints & intervertebral discs

Dull, aching or gnawing pain

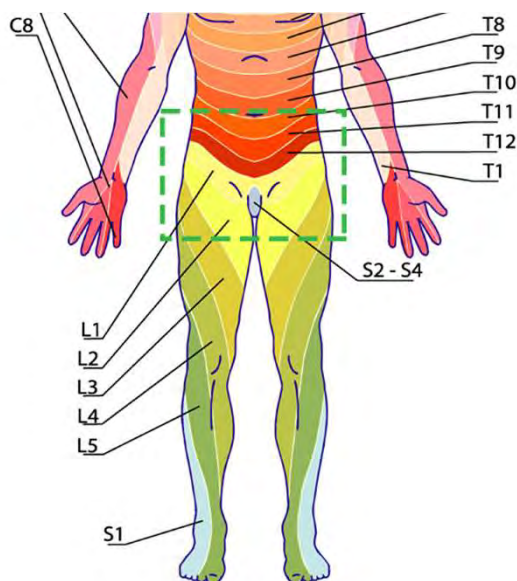
Area of pain often wide and difficult
to localise

No paraesthesia or loss of reflexes



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Radicular Pain



Dermatomes

T12 – L2 main levels referring to
anterior hip & groin

Note: Dermatomal distribution is
rarely this defined. Up to 2/3rds
have symptoms that do not
correlate with defined territorial
distributions

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Somatic Referral



Groin (L3 - S1)

Anterior Thigh (L3 - S1)



**Don't forget to
assess the
spine!**

Gellhorn, Katz, & Suri, 2013

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Iliohypogastric N

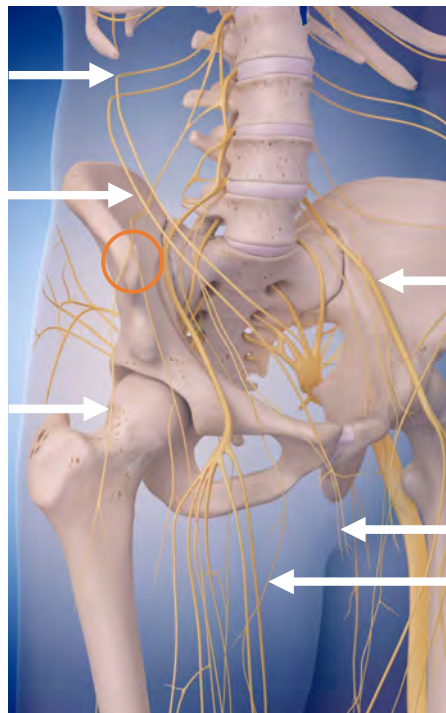
L1-2; Motor Supply: Abdominals; Skin: lat hip & above pubis

Ilioinguinal N

L1-2; Motor Supply: IO, TA (low); Skin: inguinal, genitals

Lateral Femoral Cutaneous N

L2-3; Skin: Lateral thigh



Peripheral Nerves of the Anterior Hip & Groin

Femoral N

L2-4; Motor Supply: iliacus, pectineus, sartorius, quads; Skin: Anterior thigh

Genitofemoral N Genital branch

Femoral branch

L1-2; Skin: Anterior scrotum/labia majora, lateral femoral triangle

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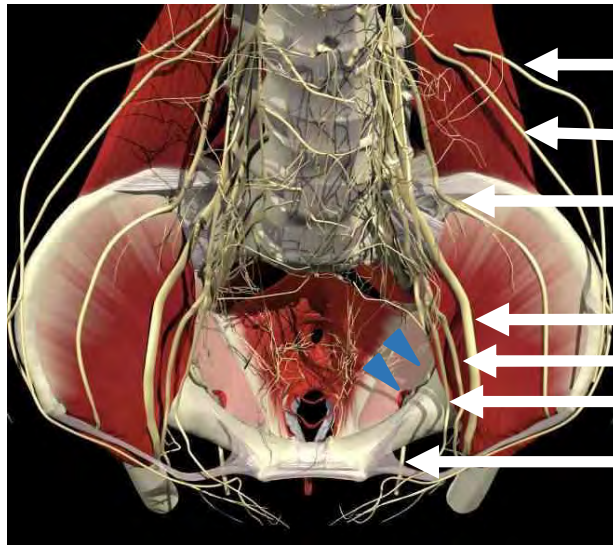


Image from Primal Pictures

Nerves of the anterior hip & groin

Iliohypogastric N L1 (T12)

Ilioinguinal N L1

Lateral Femoral Cutaneous N L2-3

- emerges through lateral psoas

- passes above inguinal ligament

Femoral N L2,3,4

Genitofemoral N L1,2 - Femoral branch

Genitofemoral N - Genital branch

Obturator N – L2,3,4; Motor Supply:

Anterior Branch:AL,AB,Gracilis (Pect)

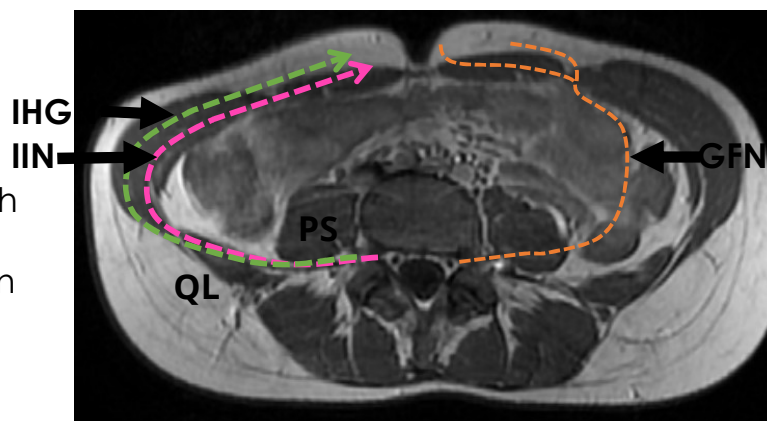
Posterior Branch:AM,OE

Skin: Medial thigh

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The anterior branch of the iliohypogastric nerve exits the abdominal wall and runs just above the inguinal ligament to supply a small area of skin above the pubic symphysis



Both exit through or between Psoas & QL, then travel through abdominal wall

Exits through Psoas. GBr: runs through inguinal canal; FBr: runs under inguinal lig to skin

The ilioinguinal nerve enters the inguinal canal and then divides into its terminal cutaneous branches

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Anterior Hip & Groin Pain

Contemporary Diagnostic & Management Strategies

Dr. Alison Grimaldi

PHYSIOTHERAPIST, RESEARCHER & EDUCATOR

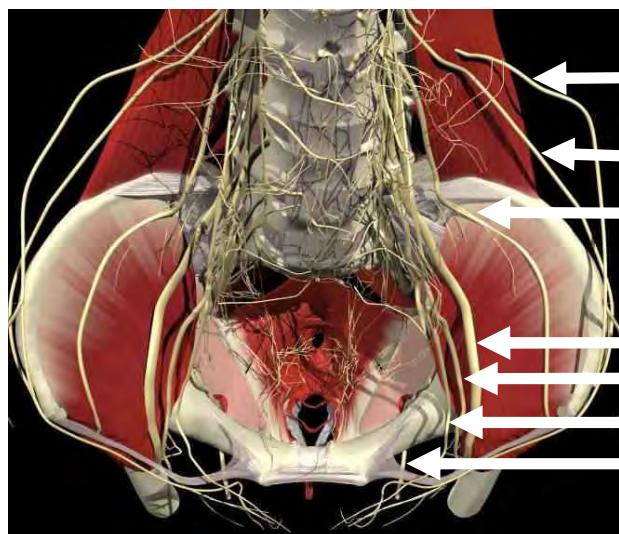


Image from Primal Pictures

Elkins et al 2017, McCrory & Bell 1999, Salas & O'Donnell 2016, Reda et al 2018, Shadhu et al 2018

Possible entrapment zones:

Paraspinal: IHN, IIN, GFN
Through abdo wall: IHN, IIN, GFN
Within pelvis
Through inguinal canal: IIN, GFN
Through obturator foramen: ON
Between OE & pectineus: ON

Possible Mechanisms:

Iatrogenic – hernia repair, abdo wall incisions, lumbar surgery, hip arthroscopy
Pregnancy
Endometriosis
Trauma
Muscle dysfunction/hypertonicity
Tumour/cysts

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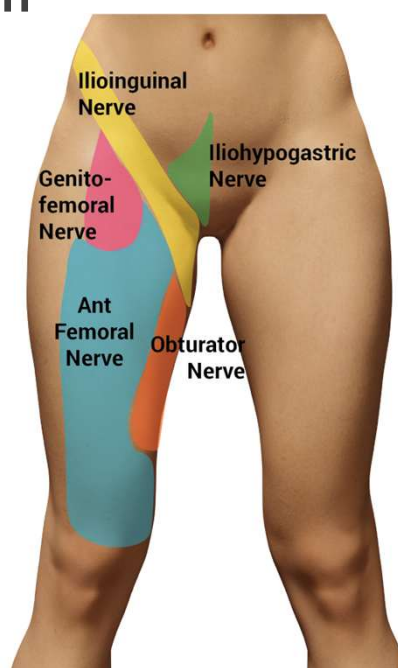
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Clinical Indicators of Nerve Related Anterior Hip & Groin Pain

Interview Features:

Symptoms in the area of nerve supply, however:

- There is much overlap & territories are not distinct
- Spread of symptoms may occur due to remote neuroinflammatory processes



Iliohypogastric

Ilioinguinal

Genitofemoral

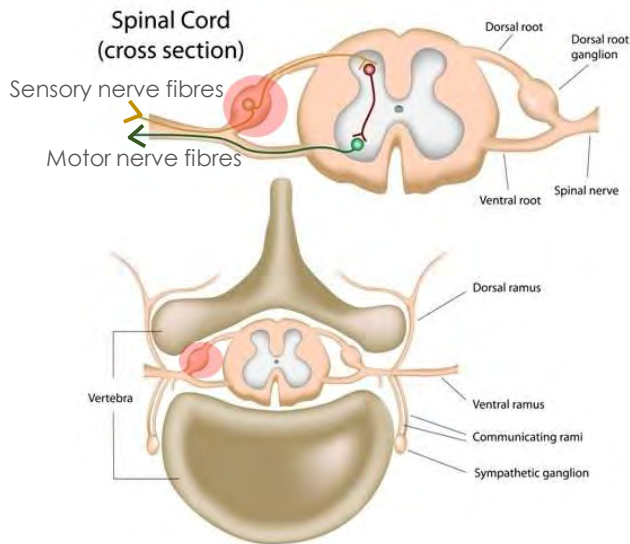
Obturator

Femoral

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Remote effects of peripheral nerve entrapment



Evidence has shown immune-mediated inflammation at DRG, 2° to peripheral nerve entrapment

Dorsal root ganglion (DRG) contains cell bodies of afferent nerve fibres from multiple spinal levels

Neuroinflammatory responses can also occur in the spinal cord (esp dorsal horn) & higher pain centres

Effects may spread to the contralateral dorsal horn & DRG

Explain extraterritorial spread of symptoms

Explain mirror pain

Schmid et al 2013, 2018

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Clinical Indicators of Nerve Related Anterior Hip & Groin Pain

Interview Features:

- Nature of pain – burning, shooting, deep aching
- May also report – itching, prickling, skin crawling...
- May experience spontaneous pain (AIGS)
- Paraesthesia, numbness, weakness (flexors,*add's)

Physical Features: (Conduct neuro exam as required)

Prone Knee Bend



Femoral Nerve Slump



Modified Thomas Test



Reproduction of pain &/or paraesthesia in hip extension
Altered by head position + hip abd for Obturator Nerve

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Neurodynamic Testing

Negative neurodynamic tests do NOT exclude the presence of nerve dysfunction

➔ patients with more severe nerve damage are less likely to test +ve on NDT

Exaggerated responses to NDT may be due to generalised sensitisation, rather than sensitisation of peripheral nerves

NDT are not diagnostic for neuropathy but detect heightened neural mechanosensitivity



Baselgia et al 2016, Boyd et al 2010, Schmid et al 2018

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Assessing nerve health

-ve light touch,
motor or nerve
condition tests
DO NOT rule out
entrapment
neuropathy

Schmid 2016, Schmid et al 2018

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Assessing nerve health

Large Fibre Nerve Tests	Small Fibre Nerve Tests
Light touch	Pin-prick sensitivity
Vibrometry	Warm/Cold testing
Texture discrimination	Quantitative Sensory testing
Two point discrimination	Sympathetic Reflex Testing
Reflexes	Laser or heat evoked potentials
Muscle testing	Skin biopsy
Electrodiagnostic testing	

Schmid 2016, Schmid et al 2018

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Management

No evidence for non-invasive interventions

Best options

- Neurodynamic treatments
- Optimise health of adjacent soft tissues – abdominal wall, iliopsoas, obturators/adductors
- Trial lumbar manual therapy T12 - L4 region

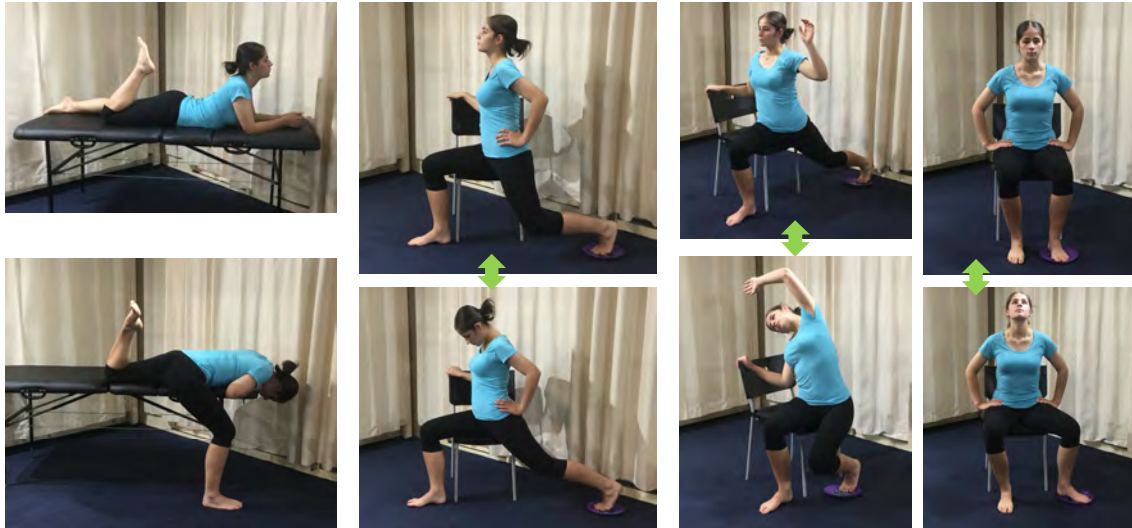
Medical options:

- Nerve block
- Radiofrequency neurotomy
- Surgical release of entrapment

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Examples of neurodynamic exercises



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Effects of neurodynamic treatments

There is no evidence that neurodynamic treatments increase nerve excursion, however there is evidence that such treatments:

- Produce short lasting hypoalgesia
- Aid dispersal of intraneural oedema
- Stimulate anti-inflammatory effects within DRG & higher pain centres
- Activate endogenous opioid analgesic pathways
- Facilitate peripheral nerve regeneration

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Referred & Nerve Related Pain Key Points

Consider if

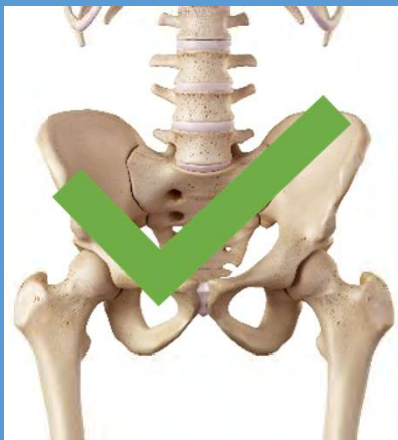
- neurogenic features in patient interview
- Hx, signs or symptoms of lumbar component/source
- problem arose after abdominal (C/S, hernia repair, laparoscopy) or pelvic surgery (prolapse surgery, bladder surgery), hip arthroscopy, pregnancy
- issues with endometriosis – can invade inguinal canal
- other trauma to abdominal wall or groin

Ax: Sensory testing (pin-prick, warm/cold); Assess neurodynamic tests but no defined tests for smaller nerves – may need US guided blocks for diagnosis

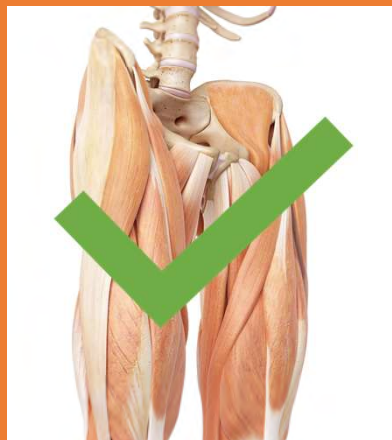
Mx: Try to optimise health of interfaces & neurodynamic treatments can assist in reducing local and remote effects

Focus Modules

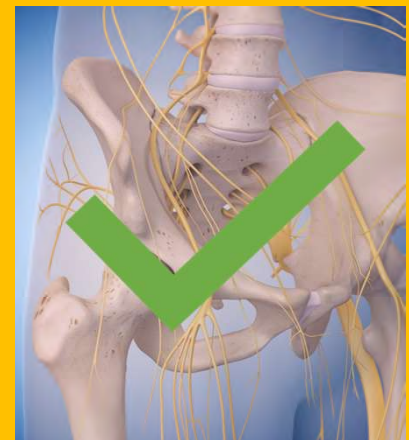
Joint Related Pain & Bony Impingements



Soft Tissue Related Pain



Referred & Nerve Related Pain



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