HIP MUSCLE FUNCTION AND HIP PATHOLOGY

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Gluteus Medius

Gluteus Minimus
MEASUREMENT OF MUSCLE FUNCTION

MUSCLE SIZE

Quantitative measures -> MRI
MEASUREMENT OF MUSCLE FUNCTION

MUSCLE SIZE

Quantitative measures -> MRI

- Quantify muscle size and adiposity
MEASUREMENT OF MUSCLE FUNCTION

EMG

Surface electrodes

Fine wire electrodes

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<th>Abduction</th>
<th>Internal rotation</th>
<th>External rotation</th>
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MEASUREMENT OF MUSCLE FUNCTION

EMG

Surface electrodes

Fine wire electrodes

Records Myoelectric activity

Recorded as Volts

Generally expressed relative to another task (e.g. %MVIC)

Can provide real-time information about muscle function
MEASUREMENT OF MUSCLE FUNCTION

EMG
MEASUREMENT OF MUSCLE FUNCTION

How clear is our understanding of hip muscle function in young adults with hip pain?
How clear is our understanding of hip muscle function in young adults with hip pain?

Not clear at all!!!
HIP DYSPLASIA

ILIOCAPSULARIS\(^1\)

- Small muscle of the anterior hip - large capsular attachment
- Role?
  - Anterior hip stability
  - Minimise capsular impingement

Short communication

Iliocapsularis: Technical application of fine-wire electromyography, and direction specific action during maximum voluntary isometric contractions

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HIP DYSPLASIA

ILIOCAPSULARIS

*Hip dysplasia vs control*

- Retrospective imaging audit
- Age
  - *Dysplasia = 34 ± 10 years*
  - *Control = 54 ± 12 years*

Note: not matched for age
HIP DYSPLASIA

ILIOLAPULARIS

*Hip dysplasia vs control*

- *Iliocap to Rec fem ratio*
  - *Width*
  - *Length*
  - *Circumference*
  - *CSA*
HIP DYSPLASIA

ILIOCAPSULARIS

*Hip dysplasia vs control*

- Significantly greater IC to RF ratio in dysplasia
- ↓ Passive stability ≈ ↑ active stability
- Caution: controls were older. Is this an association with age?
HIP DYSPLASIA

GLUTEUS MEDIUS

Anterior and middle segments

- Large torque producers
- Control of coronal plane motion

HIP DYSPLASIA

GLUTEUS MEDIUS

Anterior and middle segments
- Large torque producers
- Control of coronal plane motion

Posterior segment
- Small
- Hip joint stability

HIP DYSPLASIA

GLUTEUS MEDIUS

Asymptomatic vs symptomatic limb

- Retrospective imaging audit (CT scans)
- Unilateral dysplastic hips (19 participants)
- Age 47 years (range 35–61 years)

Liu et al., BMC Musculoskeletal Disorders 2012, 13:101
http://www.biomedcentral.com/1471-2474/13/1/101

RESEARCH ARTICLE

Changes of gluteus medius muscle in the adult patients with unilateral developmental dysplasia of the hip

RuiYu Liu¹, XiaoDong Wen¹, ZhiQin Tong², KunZheng Wang¹* and ChunSheng Wang¹
HIP DYSPLASIA

GLUTEUS MEDIUS

Asymptomatic vs symptomatic limb

• CSA

≈20% less CSA of GMed on symptomatic side

Implications for strength training in this populations?

Caution: Cross-sectional study
Need prospective research

Liu, et al., BMC musculoskeletal disorders 2012
ILIOCAPSULARIS

Pincer vs control

- Retrospective imaging audit
- Age
  - Pincer = $33 \pm 11$ years
  - Control = $54 \pm 12$ years

Note: not matched for age!
**PINCER MORPHOLOGY**

**ILIOPAPRIS**

*Pincer vs control*¹

- Significantly less IC to RF ratio in Pincer
- ↑ Passive stability ≈ ↓ active stability
- Caution: controls were older. Is this an association with age?

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**PINCER vs DYSPLASIA**

**ILIOCAPSULARIS**

Pincer vs Dysplasia$^{1,2}$

- Retrospective imaging audit (CT scans)
- Matched in Age
  - Dysplasia = 34 ± 10 years
  - Pincer = 33 ± 11 years

PINCER vs DYSPLASIA

ILIOCAPSULARIS

Pincer vs Dysplasia¹,²

- Pincer = ↓ IC thickness, width, CSA
- ↑ Passive stability = ↓ active stability

PINCER vs DYSPLASIA

EMG STUDIES
LABRAL TEARS

ANTERIOR HIP MUSCLES

Labral tears vs control

- MRI diagnosed labral tear
- Pre-surgical: hip arthroscopy
- Age 35 years (20-53)

No difference in anterior hip muscle size

Note: less hip flexion strength in symptomatic group

Muscle quality may not be as good??

LABRAL TEARS

EMG STUDY

Labral tears vs control

• Clinical symptoms
• MRI confirmation
• Age 33 (± 9) years
• Lunge task
  – EMG recorded during descent and ascent

Do Neuromuscular Alterations Exist for Patients With Acetabular Labral Tears During Function?
Maureen K. Dwyer, Ph.D., A.T.C., Cara L. Lewis, P.T., Ph.D., Alfred W. Hammer, M.D., and Joseph C. McCarthy, M.D.
LABRAL TEARS

EMG STUDY

Labral tears vs control

GMax = less activity compared to control

No difference with
- Adductor longus
- Gluteus medius
- Rectus femoris

Do Neuromuscular Alterations Exist for Patients With Acetabular Labral Tears During Function?
Maureen K. Dwyer, Ph.D., A.T.C., Cara L. Lewis, P.T., Ph.D., Alfred W. Hanmer, M.D., and Joseph C. McCarthy, M.D.
CAM MORPHOLOGY

MRI STUDIES
**CAM MORPHOLOGY**

**EMG STUDIES**

**Walking**

- **Two studies**¹,²

  - ↑ GMax Activity
  - Control hip flexion?  
    - Or  
    - Weak/ inefficient?

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¹ Rutherford, et al., *Orthopaedic Journal of Sports Medicine* 2018  
CAM MORPHOLOGY

EMG STUDIES

Walking

• Two studies$^{1,2}$

↑ GMax Activity

Control hip flexion? Or Weak/ inefficient?

Differences in Hip Joint Biomechanics and Muscle Activation in Individuals With Femoroacetabular Impingement Compared With Healthy, Asymptomatic Individuals

Is Level-Ground Gait Analysis Enough?

Derek J. Rutherford, PT, PhD, Janice Moreside, PT, PhD, and Ivan Wong, MD

Investigation performed at the Joint Action Research Laboratory, School of Physiotherapy, Dalhousie University, Halifax, Nova Scotia, Canada

Minimal differences in other muscles

Need more demanding tasks!

1 Rutherford, et al., *Orthopaedic Journal of Sports Medicine* 2018
CAM MORPHOLOGY

EMG STUDIES

Walking

• Control

Highly variable activity between participants

Coordination of Deep Hip Muscle Activity Is Altered in Symptomatic Femoroacetabular Impingement

Laura E. Diamond, 1 Wolbert Van den Hoorn, 2 Kim L. Bennell, 3 Tim V. Wrigley, 1 Rana S. Hinman, 1 John O’Donnell, 3 Paul W. Hodges 2

1 Rutherford, et al., Orthopaedic Journal of Sports Medicine 2018
CAM MORPHOLOGY

EMG STUDIES

Walking²

- Cam (+ pincer)

Less variability with deep hip rotators (esp swing)

More constrained?

Coordination of Deep Hip Muscle Activity Is Altered in Symptomatic Femoroacetabular Impingement

Laura E. Diamond,¹ Wolbert Van den Hoorn,² Kim L. Bennell,³ Tim V. Wrigley,¹ Rana S. Hinman,¹ John O’Donnell,³ Paul W. Hodges²

1 Rutherford, et al., Orthopaedic Journal of Sports Medicine 2018
MUSCLE CONSIDERATIONS

Muscle size

- Deep anterior hip muscle size may be associated with acetabular coverage\(^1,2\)
- Evidence of a reduction in Gmed muscle size in people with hip dysplasia\(^3\)
- Evidence of no anterior hip muscle atrophy in people with labral tears\(^4\)

Limitations

- No research in people with CAM morphology
- No understanding of changes over time
- No understanding of the association with muscle size and symptoms

3. Liu, et al., BMC musculoskeletal disorders 2012
YOUNG ADULTS WITH HIP PAIN

MUSCLE CONSIDERATIONS

Muscle function (EMG)

• Symptomatic labral tears - Evidence of reduced Gmax activity during a lunge\(^1\)

• Cam morphology - Gait: evidence of increased Gmax activity\(^2\) and altered deep hip muscle coordination\(^3\)

Limitations

• No research on gluteus minimus or anterior hip muscles (e.g. iliocapsularis)

• Need more demanding tasks - squat, run, kick ........

1. Dwyer, et al., Arthroscopy 2016
YOUNG ADULTS WITH HIP PAIN

WATCH THIS SPACE!
Our understanding of hip muscle function in young adults with hip pain has a long way to go.

Current evidence suggests that:

• Not all muscles are affected equally over time (e.g. different grades of pathology)
• Muscle function varies across different pathological conditions (e.g. dysplasia vs pincer)

Rehabilitation may require a targeted approach, depending on the type and stage of pathology.