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Diffusion MRI To Examine Differences In Hip Muscle Fractional Anisotropy In FAI

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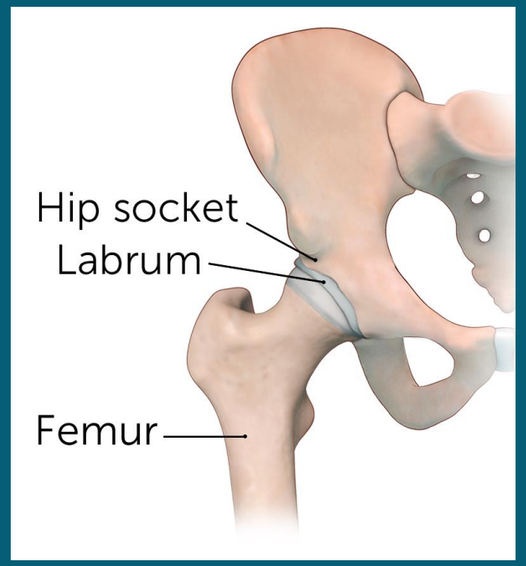
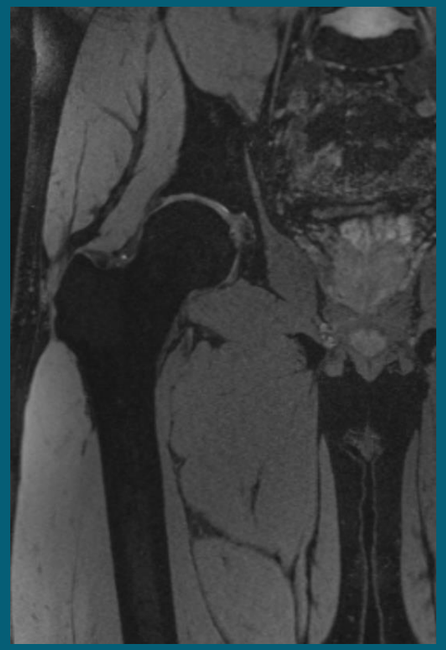
Faculty Disclosure Information

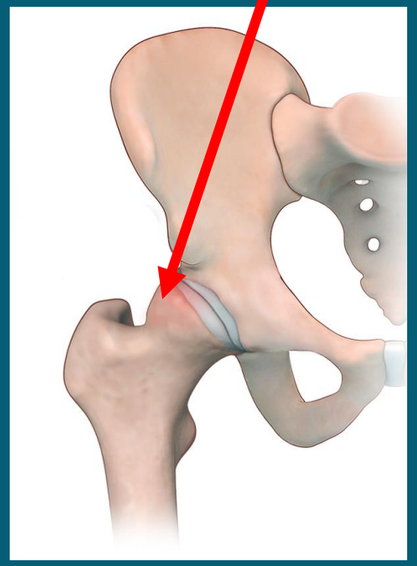
- Nothing to disclosure

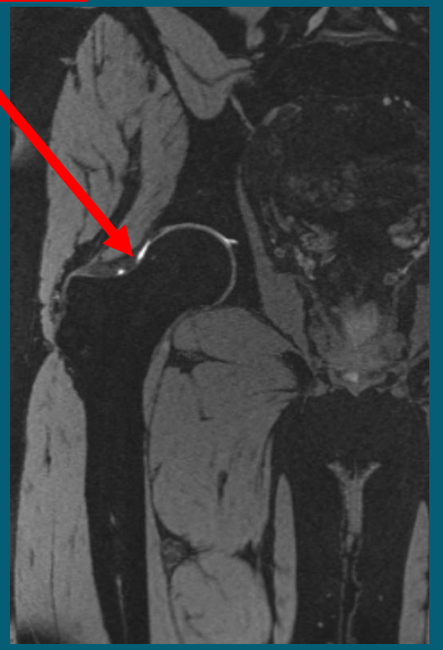
Background





Healthy Hip

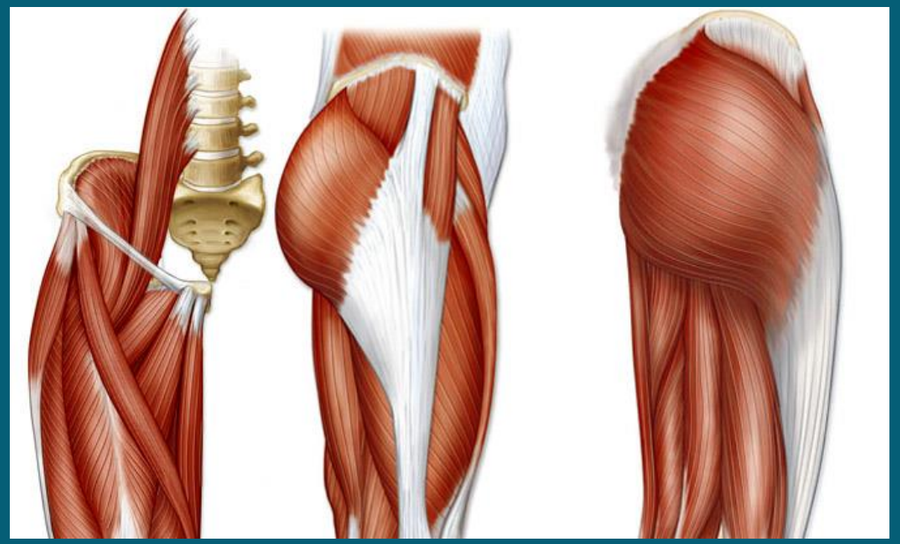




Cam Impingement

To personalize interventions for FAI, it is important to look beyond the cam bump and investigate the muscles, specifically the muscle microarchitecture

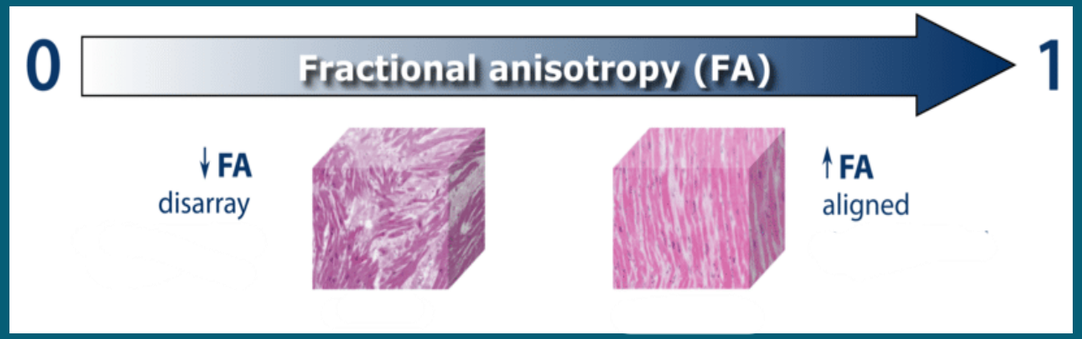
Background



MUSCLE
MICROARCHITECTURE

dMRI

Fractional Anisotropy



Apparent Diffusion Coefficient

a measurement of the random motion of water molecules in tissue

Higher FA, Lower ADC = more microstructural organization

Hypothesis and Aims

Hypothesis: FAI patients will have differences in muscle microarchitecture when compared to healthy control subjects as well as between their symptomatic and asymptomatic hips

1

Objective #1: To investigate bony parameters of FAI-symptomatic, FAI asymptomatic, and control hips

2

Objective #2: To investigate muscle microarchitecture in study groups using dMRI sequences to scan FAI patients and healthy control subjects to examine differences

Methods

- Patients aged 16-40, awaiting surgery
  - **n=15**
- Healthy controls matched for age, sex, BMI
  - **n=15**

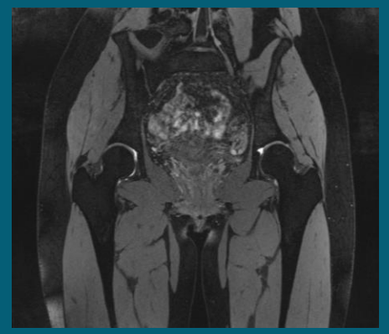
FAI Symptomatic Hip	FAI Contralateral Asymptomatic Hip	Healthy Controls
n = 15 (8M + 7F)	n = 15 (8M + 7F)	n = 15 (8M + 7F)
Age = 27 ± 8 years	Age = 27 ± 8 years	Age = 27 ± 8 years
BMI = 24 ± 5	BMI = 24 ± 5	BMI = 23 ± 4

Imaging:

1

Participants had 3T MRI to CFMM image their lower spine and hips

- T2 3D-DESS: muscle atlas
- Diffusion-weighted imaging: diffusion values



Bony Measurements:

2

Cam:
- Alpha angle at 3:00 and 1:30

Neck Parameters:
- Femoral neck shaft angle
- Medial proximal femoral angle

Coverage Parameters:
- Lateral center edge angle
- Acetabular version at 1:00, 2:00, 3:00

Spine/Pelvic Parameters:
- Pelvic incidence

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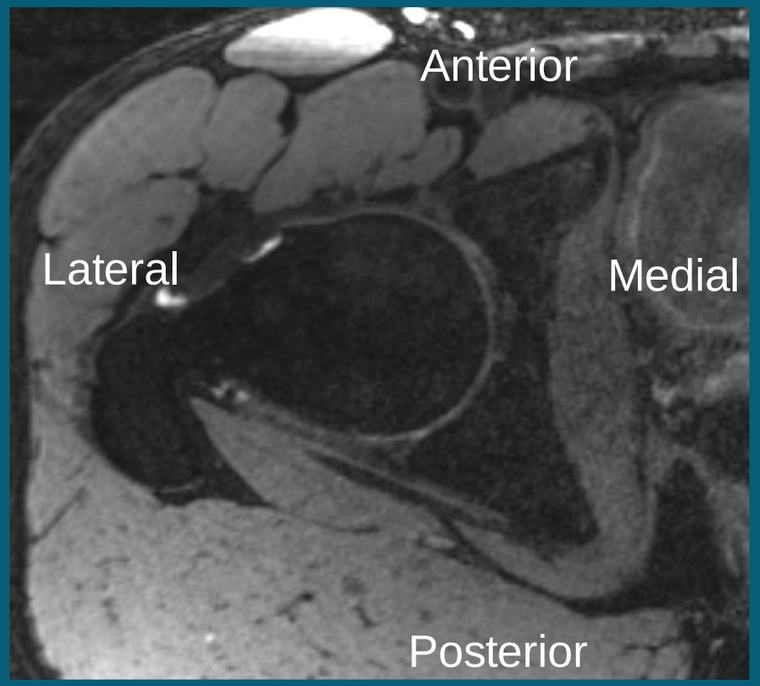
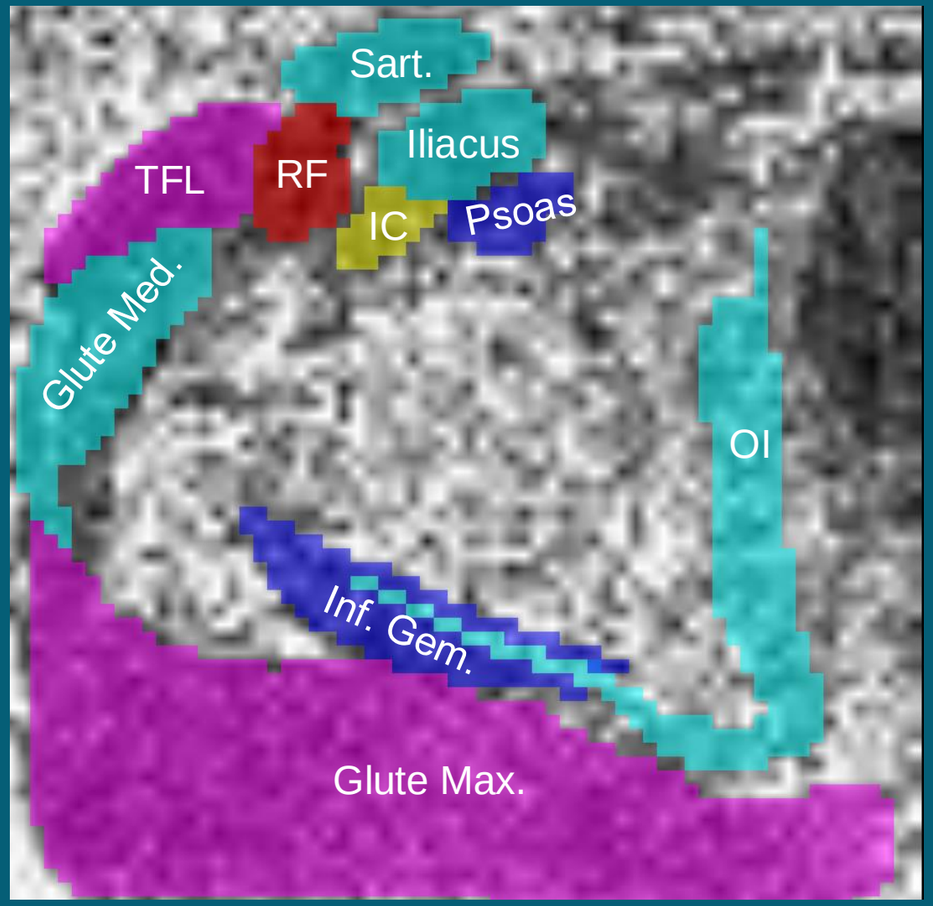
Methods

3



Transverse View



15 Muscles of Interest

Extensors & Abductors

Gluteus Maximus
Gluteus Medius
Gluteus Minimus
Tensor Fascia Latae

Lateral Rotators

Piriformis
Superior Gemellus
Inferior Gemellus
Obturator Internus
Quadratus Femoris
Obturator Externus

Flexors

Sartorius
Rectus Femoris
Iliacus
Psoas

Anterior Stabilizer

Iliocapsularis

Diffusion-weighted sequence used to segment muscles and extract fractional anisotropy (FA) and apparent diffusion coefficient (ADC) values for 15 muscles

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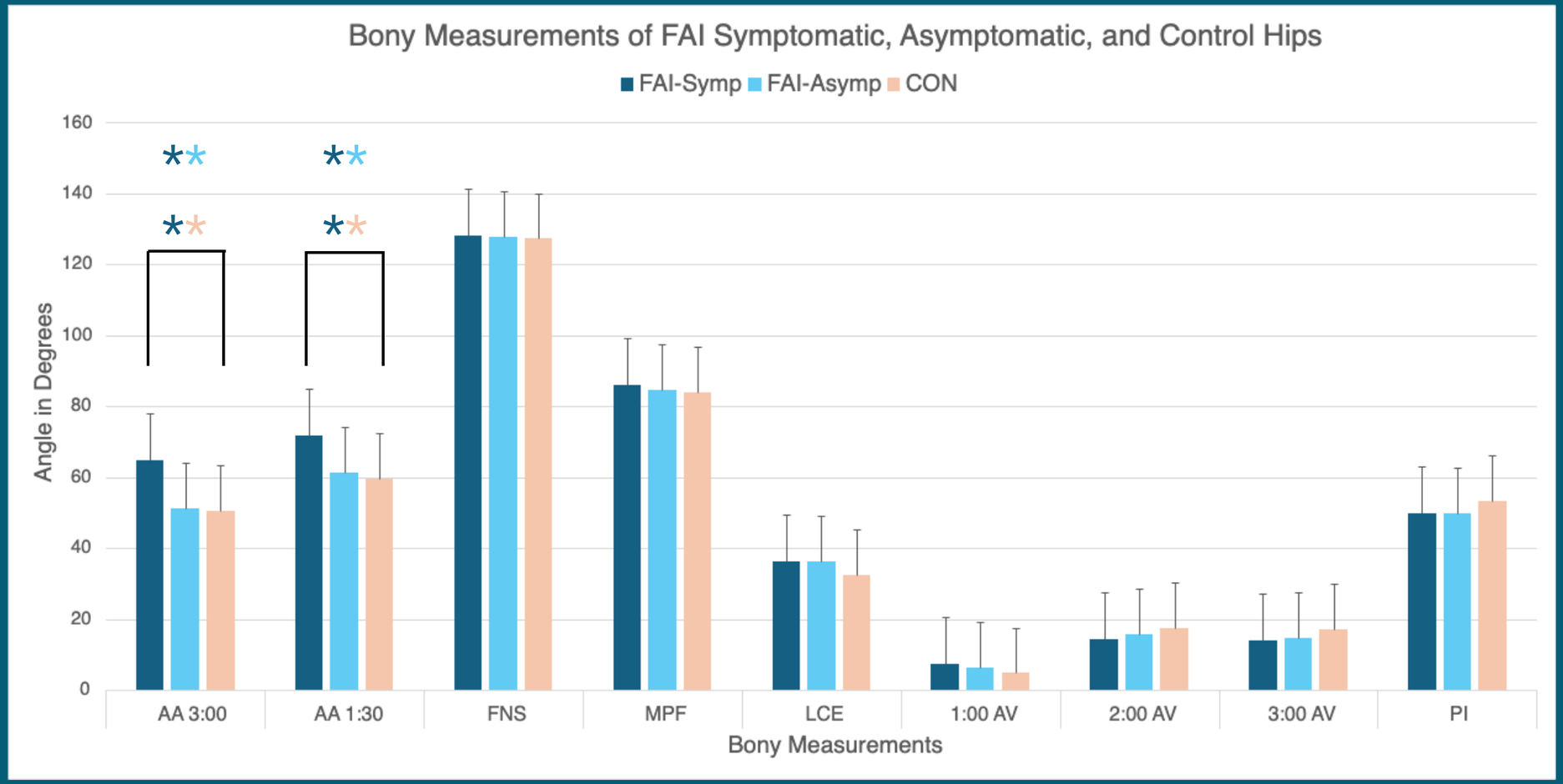
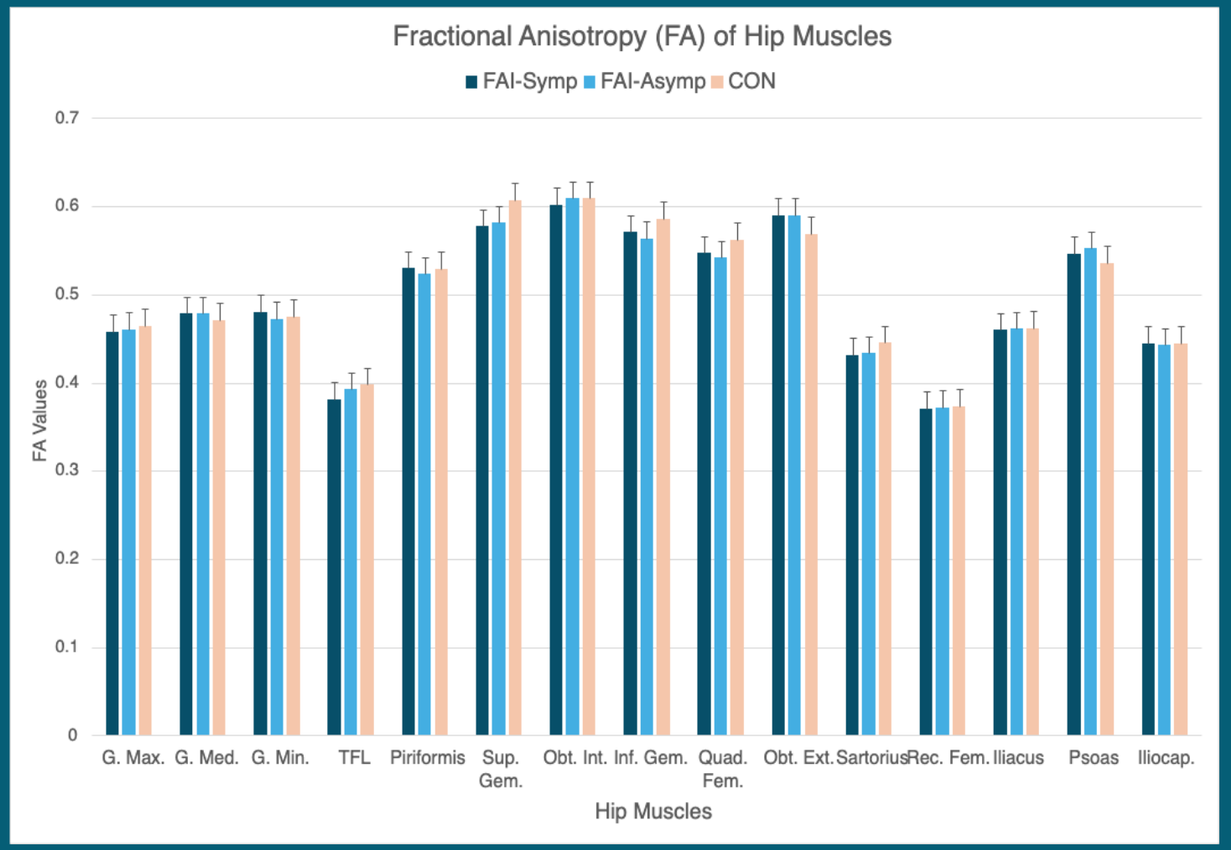
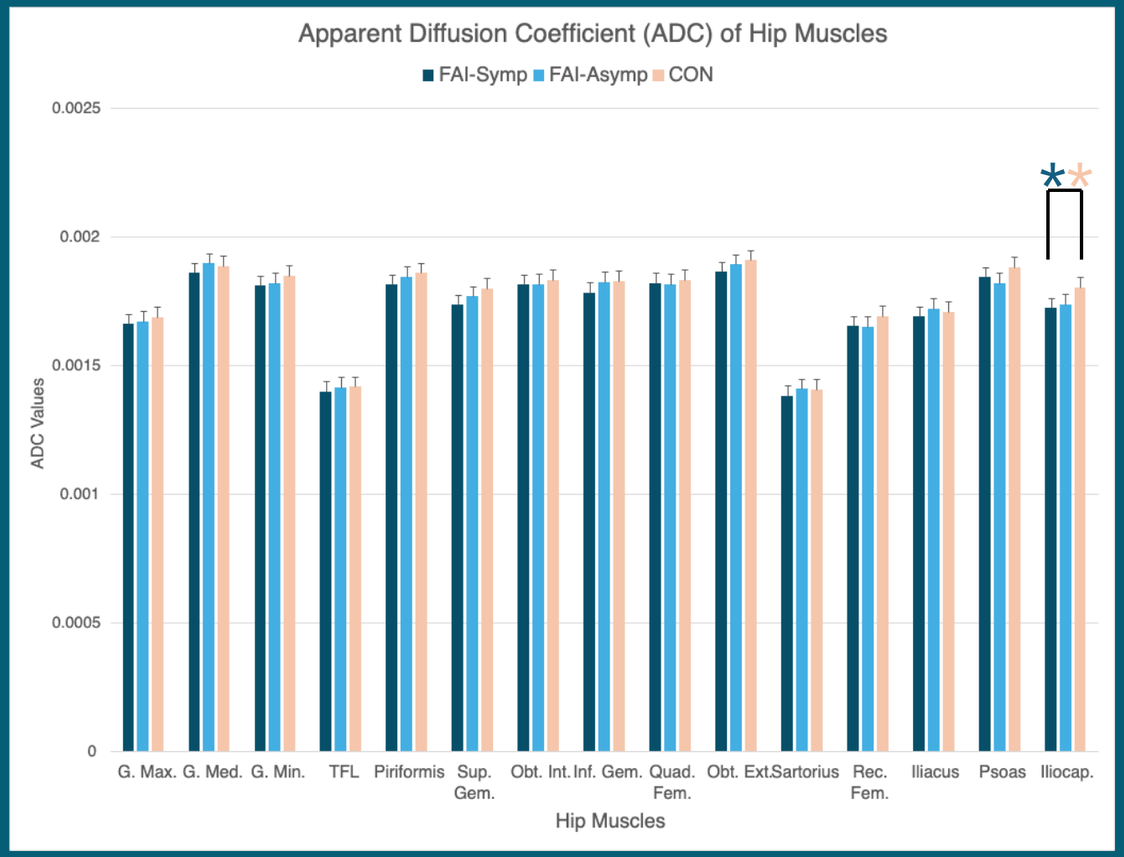
Results


Bony Measurements of FAI Symptomatic, Asymptomatic, and Control Hips
FAI-Symp
FAI-Asymp
CON
160
140
120
100
80
60
40
20
0
Angle in Degrees
**
**
**
**
AA 3:00
AA 1:30
FNS
MPF
LCE
1:00 AV
2:00 AV
3:00 AV
PI
Bony Measurements

Results





FAI-symptomatic had lower iliocapsularis ADC compared to controls (p=0.04)

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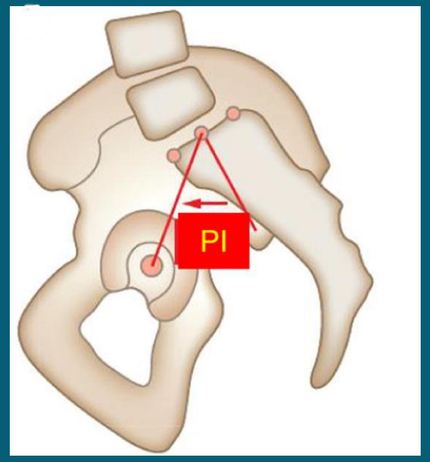
Results

Muscle (FA)	Significant Predictors	p-value	Total R^2
Gluteus Medius	3:00 AV	0.001 *	26%
	PI	0.13	29%
Gluteus Minimus	3:00 AV	0.001 *	24%
	PI	0.11	26%
Inferior Gemellus	1:00 AV	0.003 *	16%
	PI	0.09	24%
	AA 1:30	0.09	28%
	LCE	0.18	30%

Pelvic Incidence: predictive role in the FA and ADC for some large extensors, abductors, flexors and stabilizers of the hip

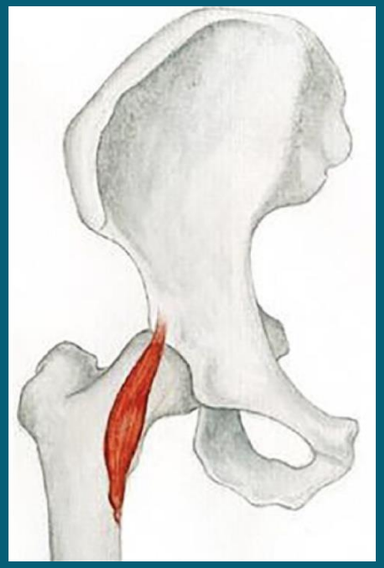
Muscle (ADC)	Significant Predictors	p-value	Total R^2
Gluteus Maximus	PI	0.001 *	9%
	MPF	0.13	23%
	AA 1:30	0.13	26%
Gluteus Medius	PI	0.004 *	21%
	2:00 AV	0.01 *	33%
	AA 1:30	0.13	37%
Gluteus Minimus	PI	0.002 *	16%
	3:00 AV	0.07	31%
	AA 1:30	0.16	34%
Iliacus	3:00 AV	0.01 *	20%
	PI	0.03 *	20%
	LCE	0.06	22%
	AA 3:00	0.15	29%
Psoas	LCE	0.008 *	28%
	PI	0.06	32%
	FNS	0.08	34%
	AA 1:30	0.16	36%
Iliocapsularis	PI	0.002 *	16%
	LCE	0.08	33%

Discussion



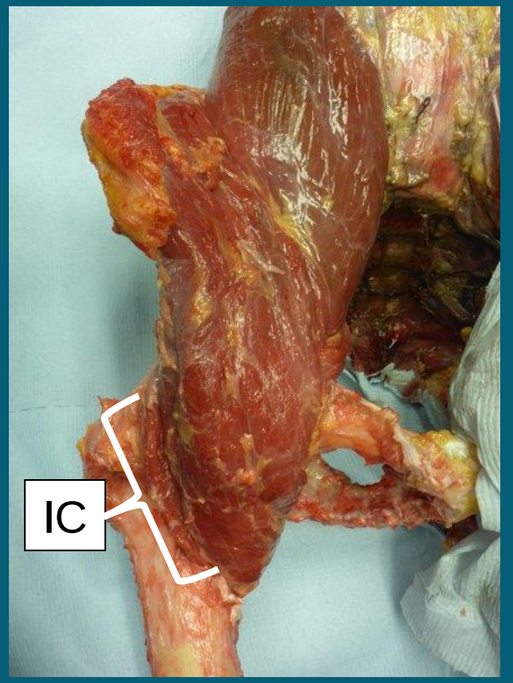
Pelvic incidence (PI) reflects the relationship between the pelvis and spine, influencing spinal alignment and posture

Lower ADC values might indicate more organized, healthy muscle tissue



MOST IMPORTANT FINDING

Symptomatic FAI had lower ADC values for their iliocapsularis muscle. This suggests that this small anterior muscle plays a crucial role in hip stability during mechanical impingement.



Conclusion and Clinical Significance

There are differences that exist in muscle microarchitecture between FAI hips and healthy control hips, as well as between FAI symptomatic and asymptomatic hips **that can be examined using dMRI.**

There are also relationships between bone and muscle in FAI that might impact muscle adaptions and therefore, muscle microarchitecture.

Clinically, the iliocapsularis (and iliopsoas) are sometimes disrupted during arthroscopic surgery disrupting these muscles capacity to stabilize the hip and/or adversely affecting postoperative recovery, highlighting the importance to keep these muscles intact during surgery.

References

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