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Cam FAI Reduces Joint Stability And Leg Reach During Balance And Postural Control Tasks

Mohamad El Fateh Shatila¹, Etienne Joulin¹, Suhwan Park¹, Trevor B. Birmingham¹,
Ryan M. Degen MD FRCSC^{1,2}, K.C. Geoffrey Ng¹

¹Western University, London, ON, Canada

²London Health Sciences Centre, ON, Canada



Faculty Disclosure Information

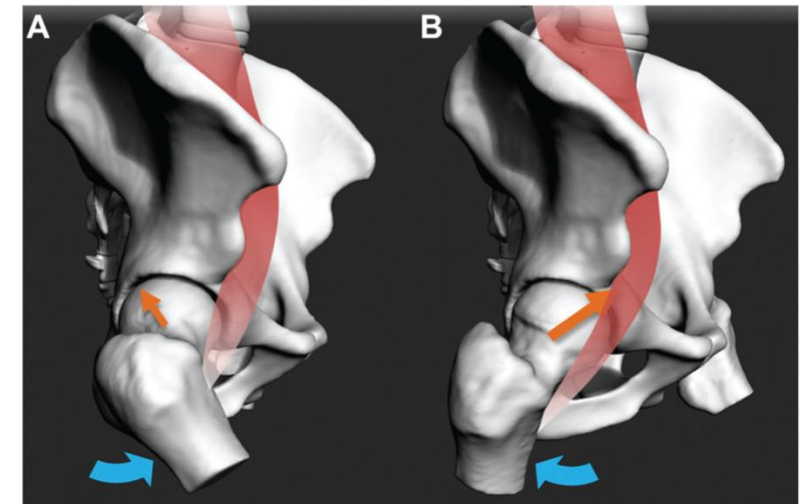
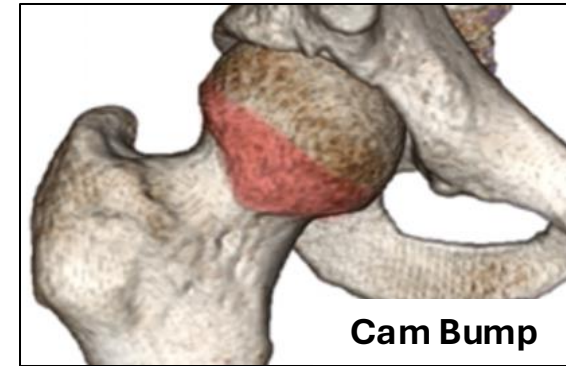
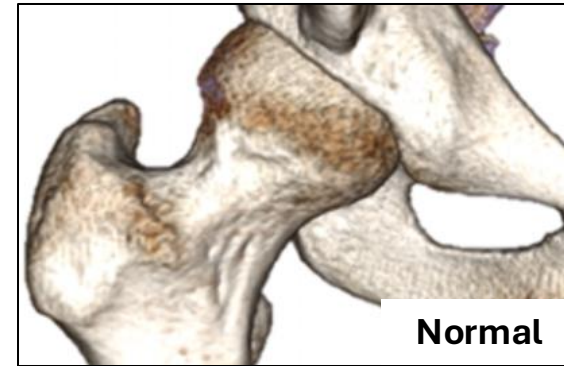
We have no relevant conflicts of interest.

Background



- *Cam-type femoroacetabular impingement (FAI):*
a leading cause of OA in young adults (1)
- Often asymptomatic, present in 20 % of population (2)
- Symptomatic — 1 in 4 exhibit OA evidence (3)
- Changes in movement to reduce joint loads (4,5)
- Although previous studies have examined symptomatic FAI during balance tasks:

➔ Further research is needed to determine how it affects **joint stability, postural control**, and the biomechanics of the **contralateral-unaffected hip** during dynamic tasks



1. Beaulé PE, et al. 2018

2. Mascarenhas VV, et al. 2016

3. Agricola R, et al. 2013

4. Ng KCG, et al. 2018

5. Ng KCG, Lamontagne M, et al. 2018

Objectives

- To compare biomechanical differences between the symptomatic-affected and contralateral-unaffected hips in cam FAI patients during balance tasks
- To assess postural control and balance performance by quantifying toe reach and compensatory movement strategies during single-leg stance tasks

Methods

1. Study Design:

- 15 cam-FAI patients elected for surgery
 - Symptomatic-affected side
 - Contralateral-asymptomatic-
unaffected side
- 15 healthy controls (Age, Sex, & BMI-matched)
- Recruitment at Fowler Kennedy Sports Medicine Clinic (FKSMC, Western University)
- Inclusion: 16-40 years. Exclusion: previous history of hip pathology, trauma, surgeries



2. Medical Imaging (3T MRI)

- Participants underwent MRI at the Center of Functional and Metabolic Mapping (CFMM, Western University)
- Hip, pelvic, and spine bone measurements

	Cam-FAI		Healthy controls
Age	27 ± 8 years		25 ± 7 years
BMI	24 ± 5 kg/m ²		23 ± 4 kg/m ²
M:F	8:7		6:9
	Affected	Unaffected	
3:00 AA	64 ± 8	52 ± 9	46 ± 6
1:30 AA	71 ± 8	62 ± 11	56 ± 9

Methods

3. Motion capture

3D biomechanics data (angles, moments) collected at the Wolf Orthopaedic Biomechanics Laboratory (WOBL, Western University):

1. 12-camera motion capture system (Eagle, Motion Analysis)
2. Three floor-mounted force plates (AMTI)
3. Modified Helen-Hayes markerset

Functional Tasks:

- Hurdle-stance (3x)
- Hurdle-swing (3x)
- Star Excursion Balance Test (SEBT)

Statistical Analysis:

Waveform analysis using statistical non-parametric mapping (SnPM, MATLAB):

1. Mann-Whitney U (indep. comparisons)
2. Wilcoxon signed-rank (same-group comparisons)

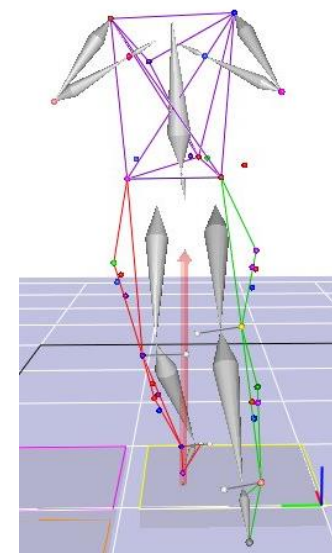
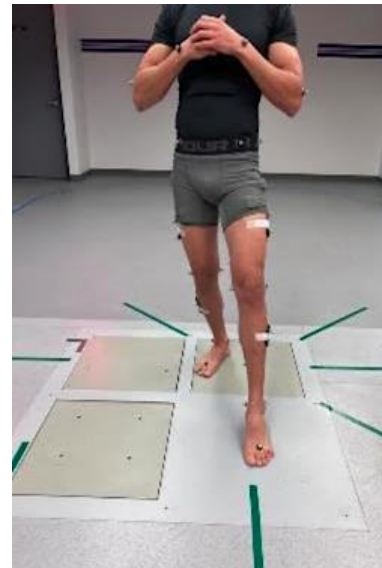
Marker Tracking &
Segment Building



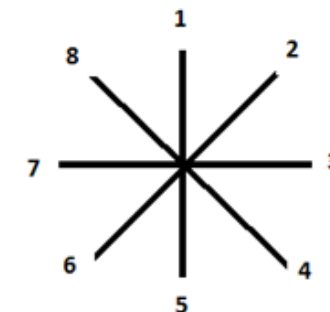
Joint Angles &
Moments Calculation



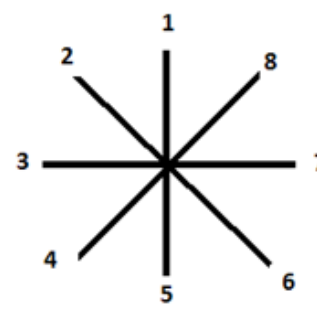
SEBT reach distances were normalized by leg length



Standing on LEFT limb

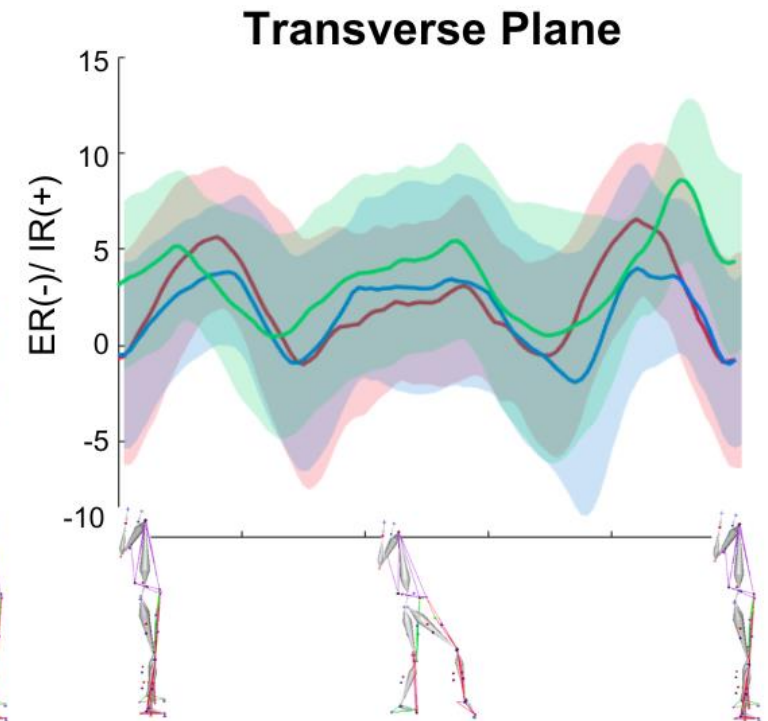
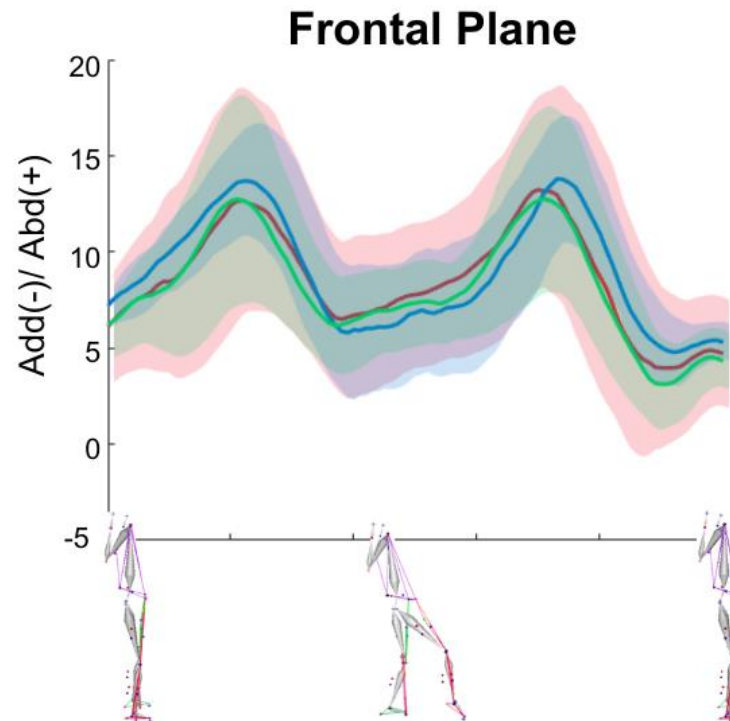
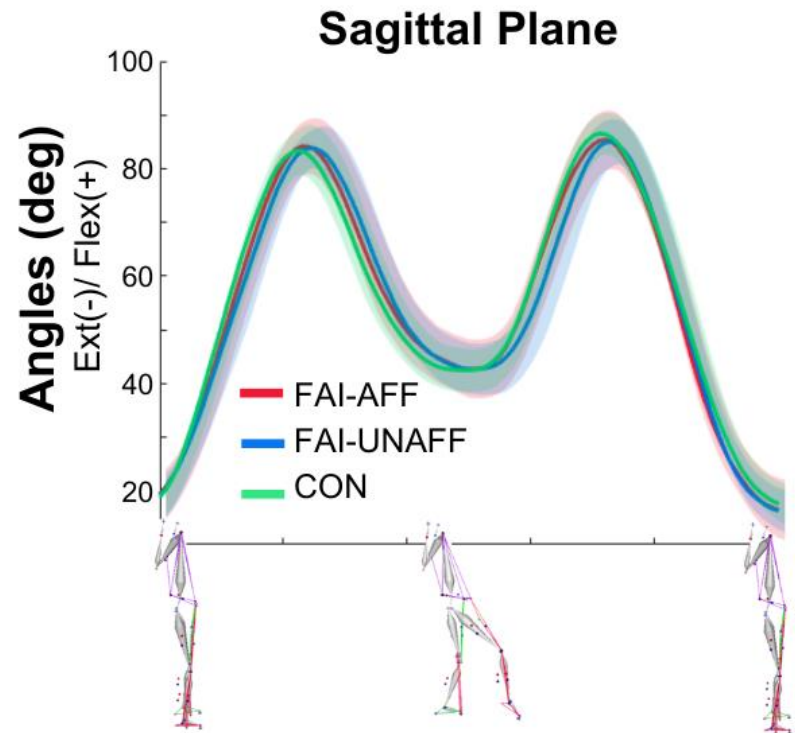


Standing on RIGHT limb



Dieter Schuddinck, 2012

Hurdle-swing

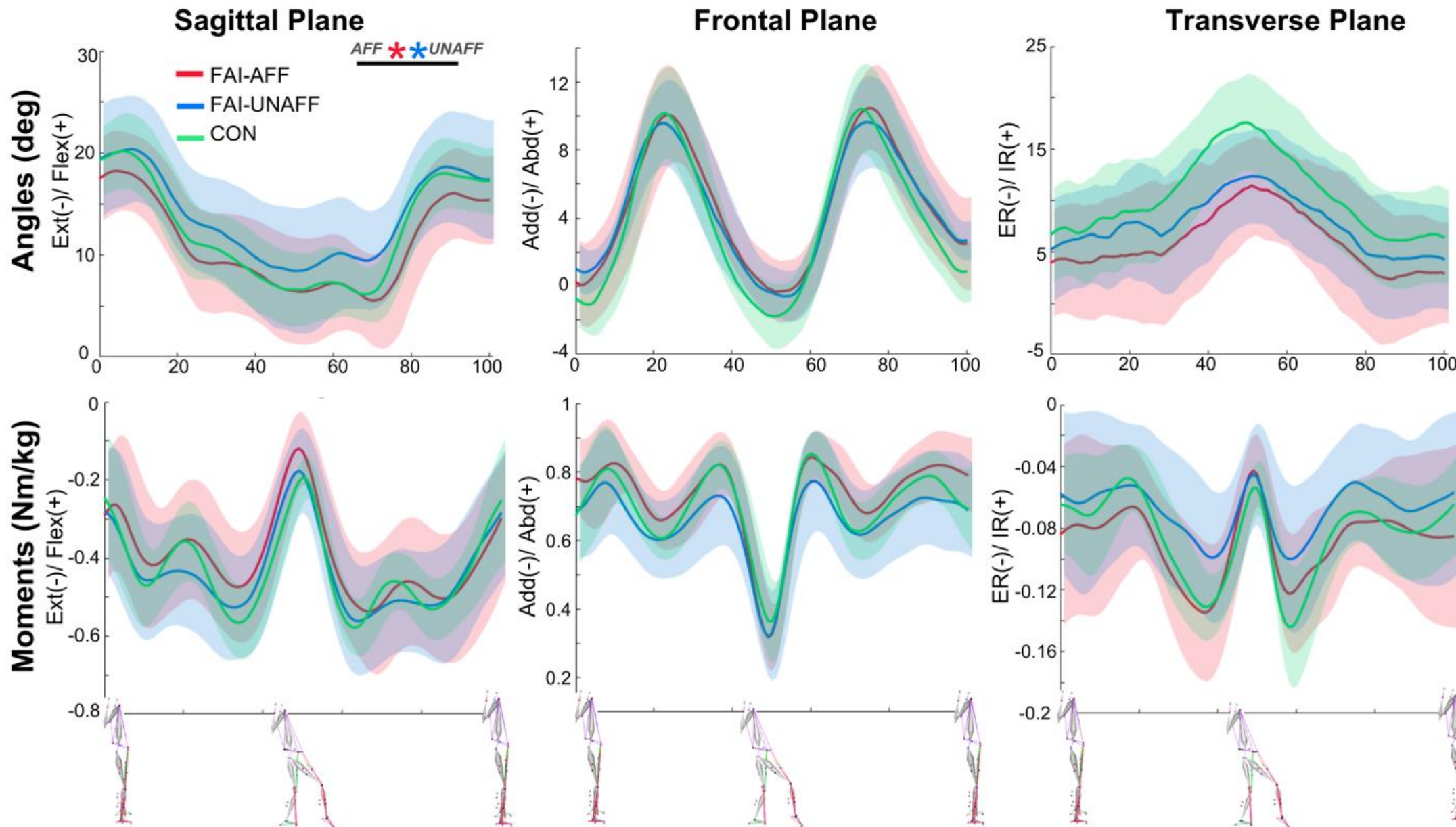


FAI-UNAFF \uparrow ABDUCTION
before crossing & after return

FAI-AFF \downarrow IR after crossing &
before return

FAI-UNAFF \downarrow IR consistently
during swing

Hurdle-stance



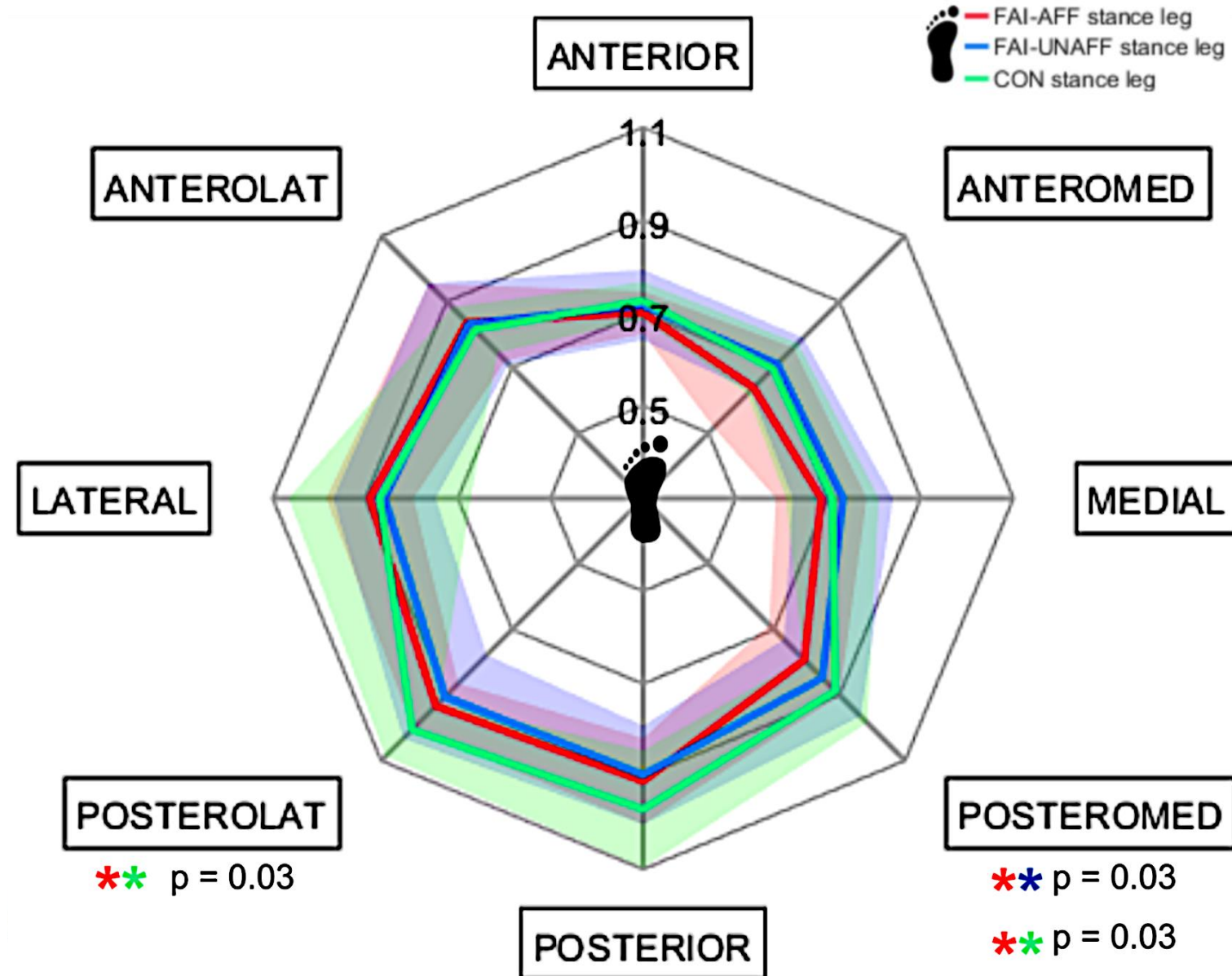
FAI-UNAFF ↑ FLEXION vs. AFF
(65-85%)* (* $p < 0.05$)

↓ IR bilaterally

FAI-AFF ↓ EXT moments throughout

Star Excursion Balance Test

- **Similar reach distances** in the anterior, medial, and anterolateral directions between the three groups
- **FAI-AFF group** had shorter **posteromedial** (0.77) and **posterolateral** (0.92) reach compared to CON (0.87, $p = 0.03$; and 1.00, $p = 0.03$, respectively)
- FAI had shorter bilateral reach in all posterior directions



Discussion



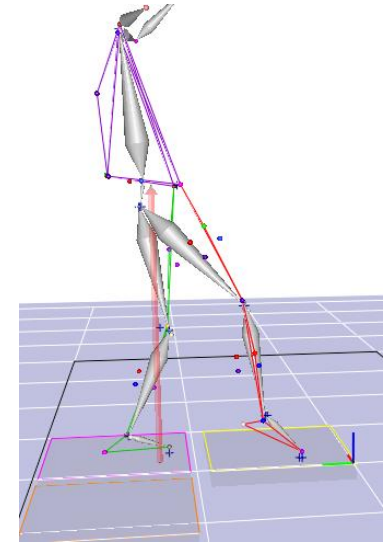
HURDLE-STEP:

1. **Restricted Mobility & Contralateral Compensation:**

The unaffected hip \uparrow flexion angles, compensating for restricted motion on the affected side

2. **Altered Abductor & Joint Mechanics:**

FAI patients \uparrow hip abduction bilaterally during both swing and stance phases while \downarrow EXT. moments, which may serve to minimize pain (4,5,6)



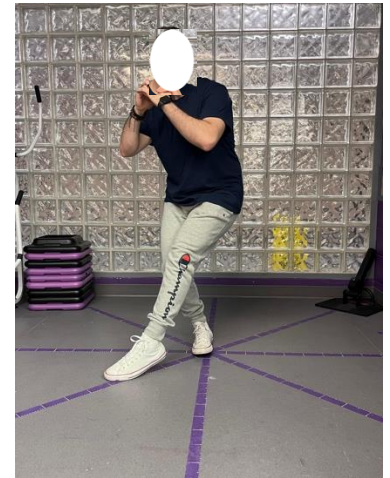
SEBT:

1. **Difficulty in Combined Extension & Int. Rotation:**

Reaching anterolaterally is challenging for the planted-affected side, often requiring heel lift

2. **Impaired Bilateral Function:**

FAI group show limited bilateral reach in posteromedial and posterolateral directions, suggesting limited postural control and joint stability



Conclusion



- **Bilateral Adaptations:** Cam FAI alters biomechanics in both the affected and unaffected hips during balance tasks, including decreased ROM and altered abductor mechanisms, reflecting impaired joint stability and postural control



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References

1. Beaulé PE, Grammatopoulos G, Speirs A, Geoffrey Ng KC, Carsen S, Frei H, et al. Unravelling the hip pistol grip/cam deformity: Origins to joint degeneration. *J Orthop Res Off Publ Orthop Res Soc*. 2018 Dec;36(12):3125–35.
2. Mascarenhas VV, Rego P, Dantas P, Morais F, McWilliams J, Collado D, Marques H, Gaspar A, Soldado F, Consciência JG. Imaging prevalence of femoroacetabular impingement in symptomatic patients, athletes, and asymptomatic individuals: A systematic review. *Eur J Radiol*. 2016 Jan;85(1):73-95.
3. Agricola R, Waarsing JH, Arden NK, Carr AJ, Bierma-Zeinstra SMA, Thomas GE, et al. Cam impingement of the hip—a risk factor for hip osteoarthritis. *Nat Rev Rheumatol*. 2013 Oct;9(10):630–4.
4. Ng KCG, Mantovani G, Modenese L, Beaulé PE, Lamontagne M. Altered Walking and Muscle Patterns Reduce Hip Contact Forces in Individuals With Symptomatic Cam Femoroacetabular Impingement. *Am J Sports Med*. 2018 Sep;46(11):2615–23.
5. Ng KCG, Lamontagne M, Jeffers JRT, Grammatopoulos G, Beaulé PE. Anatomic Predictors of Sagittal Hip and Pelvic Motions in Patients With a Cam Deformity. *Am J Sports Med*. 2018;46(6):1331-1342.
6. Frasson VB, Vaz MA, Morales AB, Torresan A, Telöken MA, Gusmão PDF, et al. Hip muscle weakness and reduced joint range of motion in patients with femoroacetabular impingement syndrome: a case-control study. *Braz J Phys Ther*. 2018 Nov 20;24(1):39.