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Contribution of the Pubofemoral Ligament to Hip Stability: A Biomechanical Study

E-Poster Abstract # 1808

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Disclosure

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ANK, RGS, EJ, SC, IJP – N/A

Background

- The capsule enclosing the hip joint significantly contributes to stability during dynamic and static motions, with additional assistance from the Ligamentum Teres

- Four ligaments comprise the hip capsule: medial and lateral arm of Iliofemoral ligament, Ischiofemoral ligament, Pubofemoral ligament

- To date, the proper biomechanical contribution of the Pubofemoral ligament to hip stability is not understood

Background

- Advanced knowledge of the biomechanical relationship of the hip capsular ligaments is required to understand their influence during joint motion and overall stability

- The purpose of this study was to determine the isolated function of the Pubofemoral ligament of the hip capsule and its contribution to hip stability in external/internal rotational motion during flexion greater than 30 degrees, and abduction

Methods

- 13 hips from 7 fresh-frozen pelvis-to-toe cadavers were skeletonized from the lumbar spine to the distal femur, preserving the hip capsular ligaments
- Each specimen underwent a standard physical examination of the hip, pelvis, and spine to ensure no occult pathological state existed
- The Ligamentum Teres was assessed arthroscopically to ensure it was intact

Methods

- All specimens underwent CT imaging evaluation of the pelvis and lower limbs to assess boney anatomy
  - The feet were fixed in a neutral position with 0 degrees abduction
  - Anatomic measures included: Femoral Neck Version, Acetabular Version measured at the 3 o'clock position, Femoral Neck Shaft Angle, Knee Varus/Valgus Angle, and CT Leg Length

- Specimens were positioned supine, with the pubic symphysis on the same horizontal plane as both anterior superior iliac spines. The specimens were secured with 4 holding pins.
  - A frame was designed to hold the lower extremity in each measurement position, while allowing unobstructed hip rotation

Methods

- A trained Physical Therapist manually performed all hip maximal internal and external rotations. The hip positions were a combination of abduction (0°, 20° abduction, 40° abduction) and flexion (30°, 60°, and 110° of flexion)
  - Position order was randomized
  - Three measurements of maximal internal and external rotation were recorded at each endpoint
- Following native testing, the Pubofemoral ligament was released at the inferior border, through the zona orbicularis, and adjacent to the labrum to the border of the Iliofemoral ligament
  - Testing sequence was repeated
- The Ligamentum Teres was released using an arthroscopic blade
  - Testing sequence was repeated
- **162 total measurements: 54 in native, 54 with Pubofemoral ligament cut, 54 with Pubofemoral ligament and Ligamentum Teres cut

Results

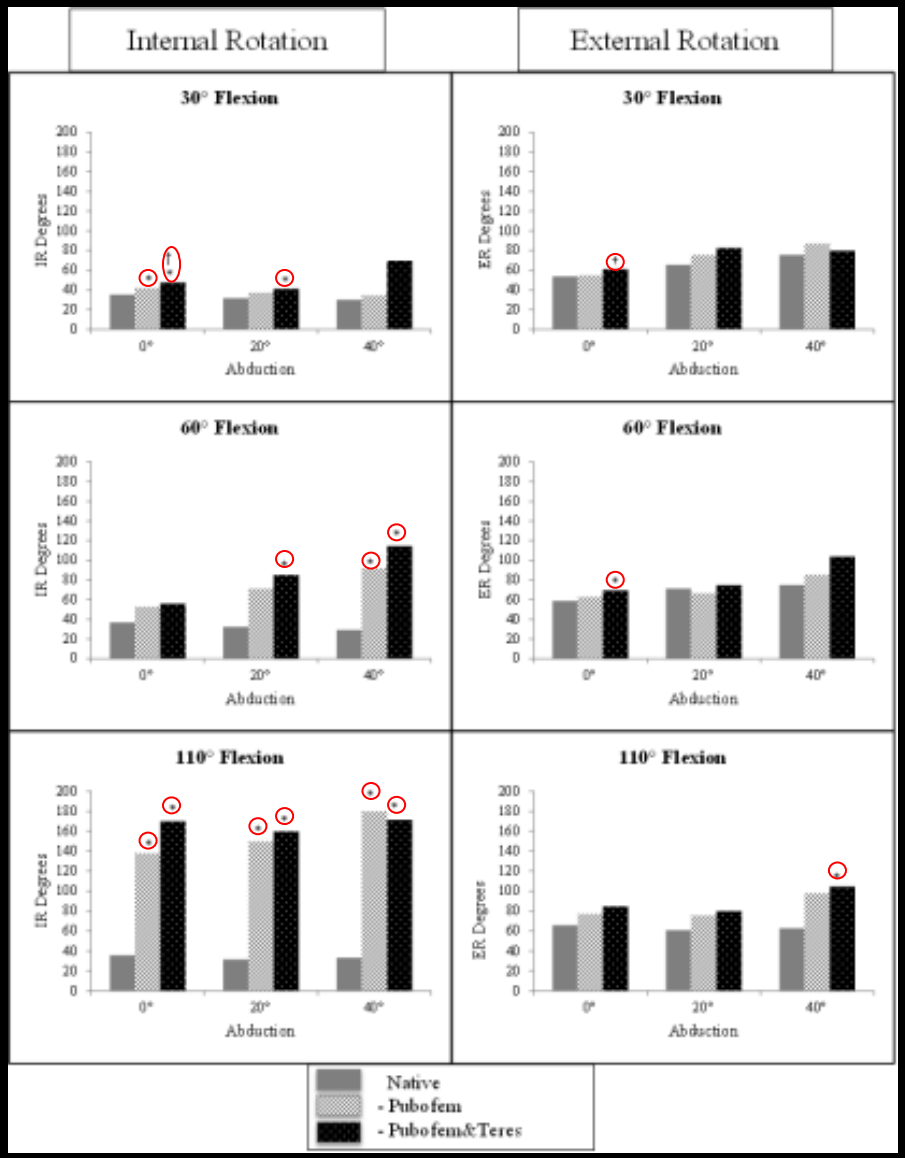
- Cadaveric specimen specifications

Cadaver	Age	Sex	MCKIBBIN	FNV	AV	FNSA	KA	CT Leg Length	FNA
1R	70.0	M	50.4	28.1	22.3	123.0	17.2	79.01 cm	10.9
2L	60.0	M	33.8	12.3	21.5	127.4	-2.2	86.3 cm	14.5
2R		M	38.5	11.9	26.6	128.4	6.9	86.6 cm	5.0
3L	65.0	M	17.5	-0.4	17.9	131.0	-17.0	85.3	16.6
3R		M	4.1	-7.2	11.3	128.3	-14.8	84.4	7.6
4L	37.0	M	24.5	10.4	14.1	139.9	-9.2	79.3	19.6
4R		M	9.6	0.5	9.1	126.1	-13.8	78.8	14.3
5L	51.0	M	38.7	32.5	6.2	124.8	0.0	76.8	32.5
5R		M	46.3	33.2	13.1	129.8	0.0	77.0	33.2
6L	38.0	F	29.8	9.7	20.1	131.5	-13.6	76.7	23.3
6R		F	32.5	19.8	12.7	127.9	3.5	77.1	16.3
7L	72.0	F	12.2	8.2	4.0	123.2	3.1	78.8	5.1
7R		F	4.2	3.1	1.1	134.4	-6.8	79.8	9.9
Average			26.3	12.5	13.8	128.9	-3.6	79.4	16.1

Results

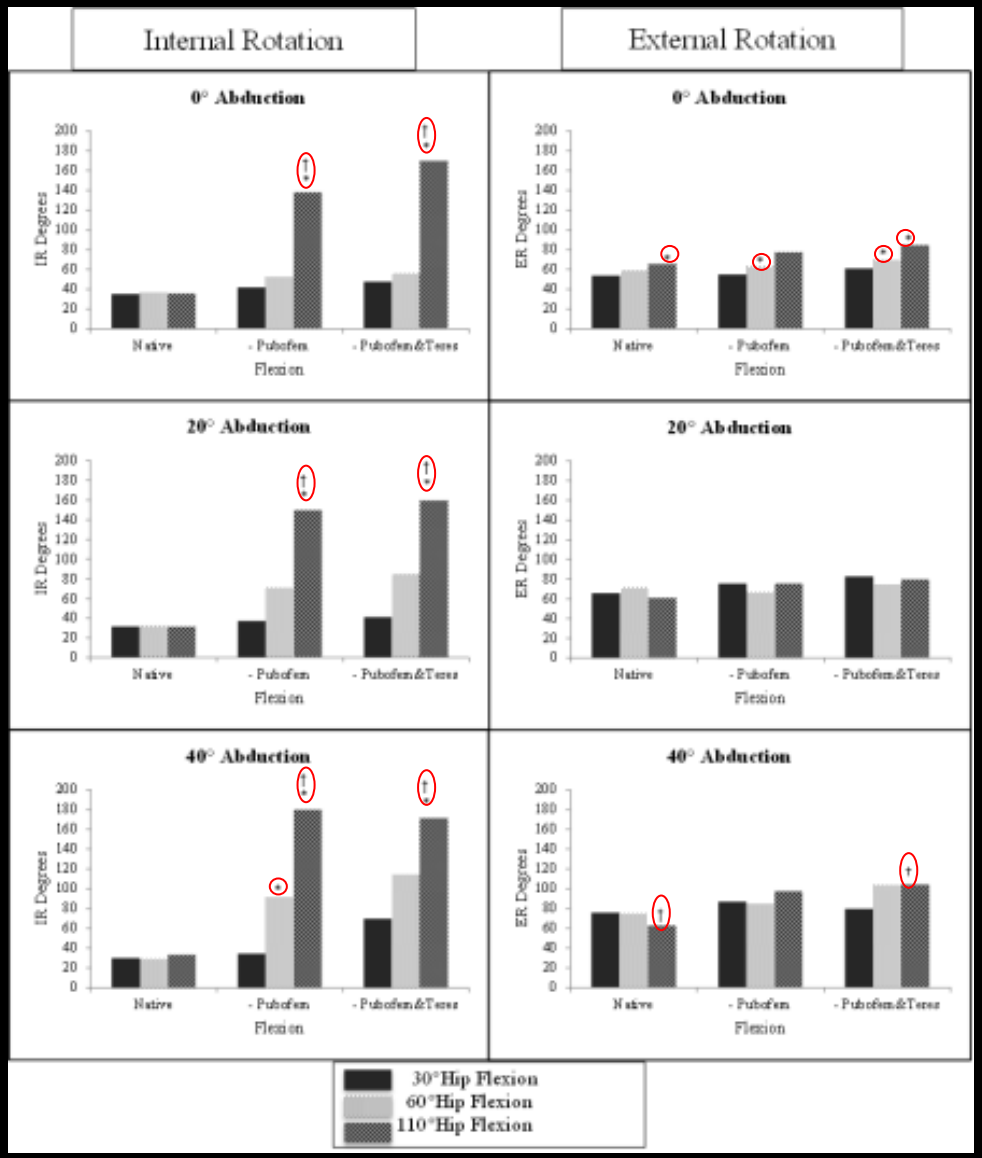
- The average of the three measure of internal and external rotation was used for analysis
- Repeated measures ANOVA by ligamentous state (Native vs –Pubofem, vs –Pubofem&Teres) were run for internal and external rotation at each position of flexion and abduction
  - When a main effect of internal or external rotation was found, post-hoc independent t-test analyses were performed

Results



Control of Hip Rotation Comparing Ligamentous State with Increased Abduction at 30°, 60°, and 110° Flexion

* p<0.05 compared to Native state, † p<0.05 compared to pubofemoral ligament released state. Native is all ligaments intact, -pubofem refers to the released pubofemoral ligament, and -pubofem&teres refers to the released pubofemoral ligament and ligamentum teres.



Control of Hip Rotation within Ligamentous State Comparing Increased Flexion at 0°, 20°, and 40° Abduction

* p<0.05 compared to 30° Flexion, † p<0.05 compared to 60° Flexion. Native is all ligaments intact, -pubofem refers to the released pubofemoral ligament, and -pubofem&teres refers to the released pubofemoral ligament and ligamentum teres.

Conclusion

- The Pubofemoral ligament maintains a key function in limiting hip internal rotation in the position of increasing hip flexion beyond 30° and abduction. The cadaveric study concludes previous attempts at understanding the anatomical and biomechanical function of the capsular ligaments and their role in hip stability.

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