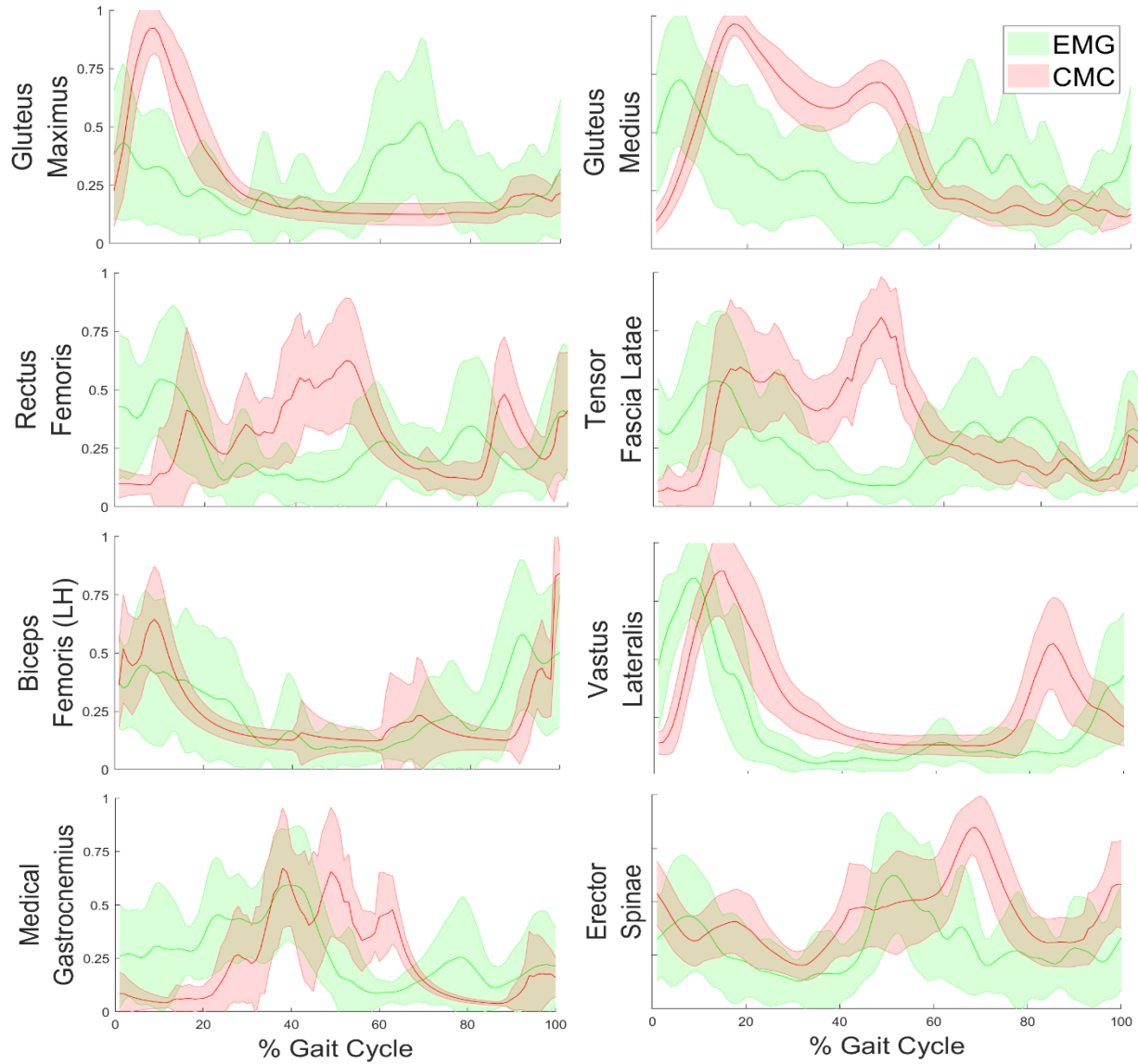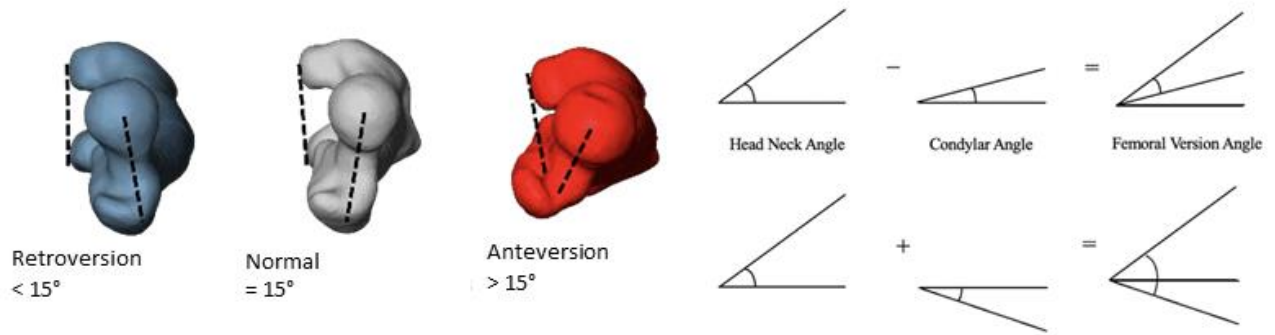**Supplementary Material**

**Supplementary Figure 1.** Muscle activations estimated through CMC modeling (red) and through surface EMG (green). Shaded area is ± 1 standard deviation. CMC = computed muscle control. Activation timing is similar between EMG and CMC across large muscles indicating that the model estimations are appropriate.

Supplementary Figure 2. Femoral version was measured for patients within a database of patients diagnosed with DDH in our clinical practice. Three-dimensional femur reconstructions were aligned in all planes to a baseline scaled OpenSim femur with a neutral axis for consistent orientation. With a musculoskeletal radiologist, and using the method of Murphy et al. (Murphy et al., 1987), we defined two axes, the head neck axis, and the posterior condylar axis. The head neck axis was defined as the line between the centers of the femoral head and the femoral neck; the posterior condylar axis was defined as the line connecting the posterior femoral condyles. We measured each axis to the horizontal and subtracted the condylar angle from the femoral head neck angle if the angles were measured in the same direction and added it to the femoral head neck angle if the angles were measured in opposite directions. The average and standard deviation values (14.56±10.69) matched other reports of FV in patients with DDH (Li et al., 2014; Sankar et al., 2018; Wells, Nepple, et al., 2017).
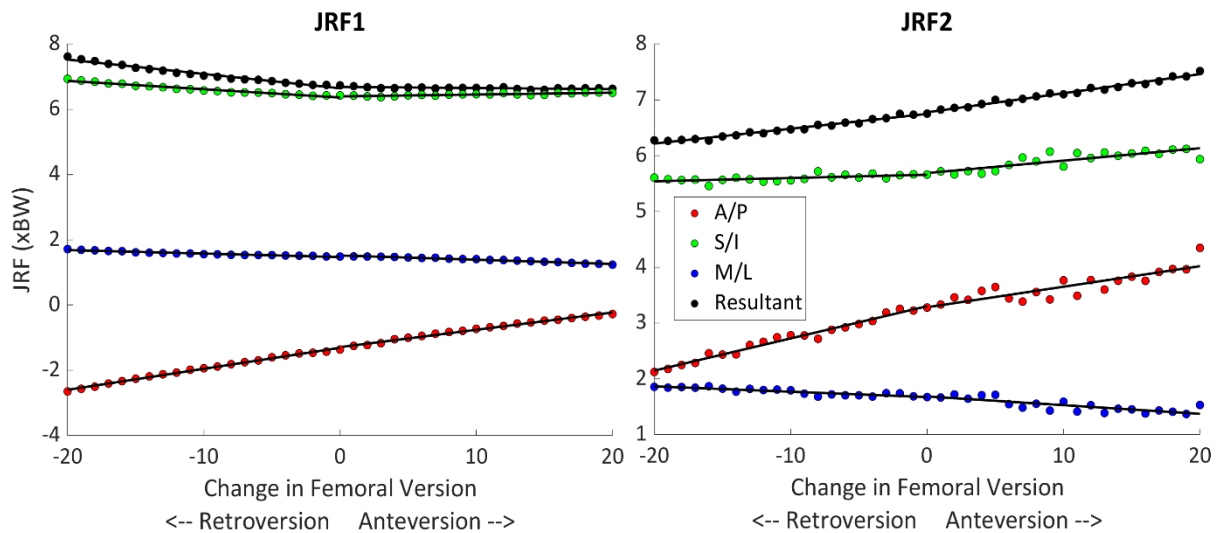

Supplementary Figure 3. Slopes of lines fit to change in FV values vs. JRF points were used to predict changes in JRFs with changes in FV. Lines are shown for a representative subject.
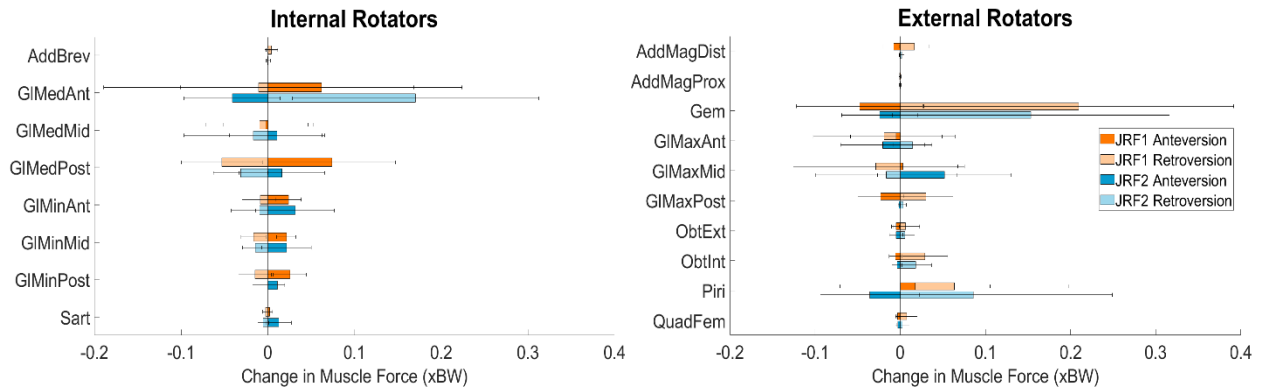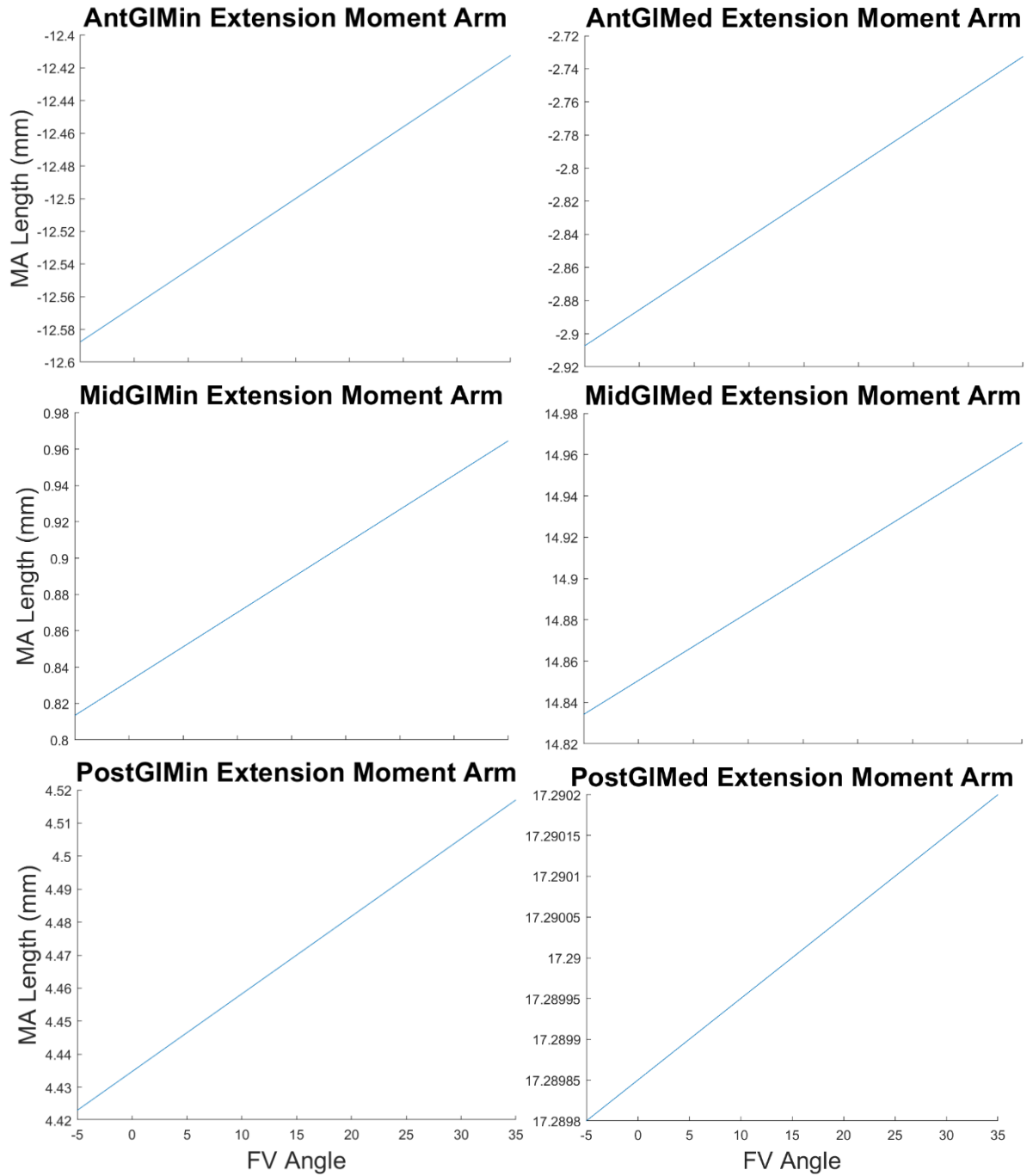
Supplementary Figure 4. Average and standard deviation change in internal and external rotator muscles of the hip with 15° FV change away from the normal FV of 15°. Orange indicates JRF1 (early stance); blue indicates JRF2 (late stance).
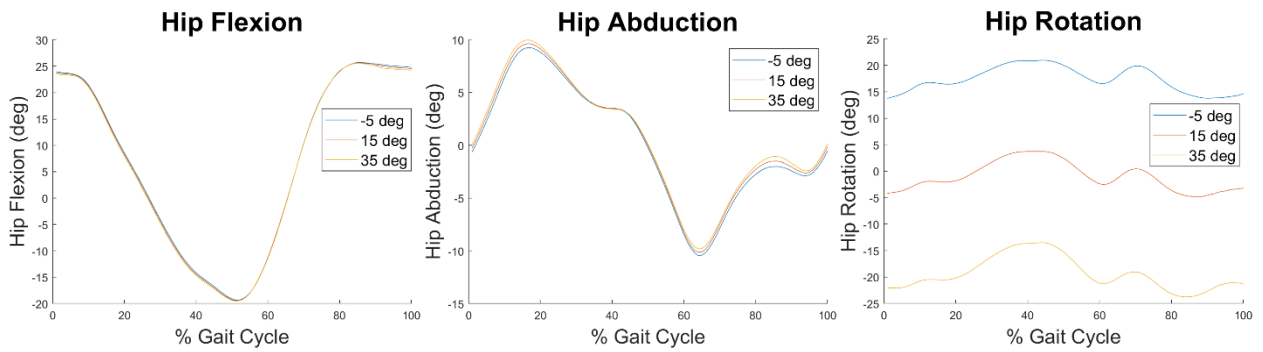
Supplementary Figure 5. Hip angles across the gait cycle with varying FV angles averaged for all 14 subjects.
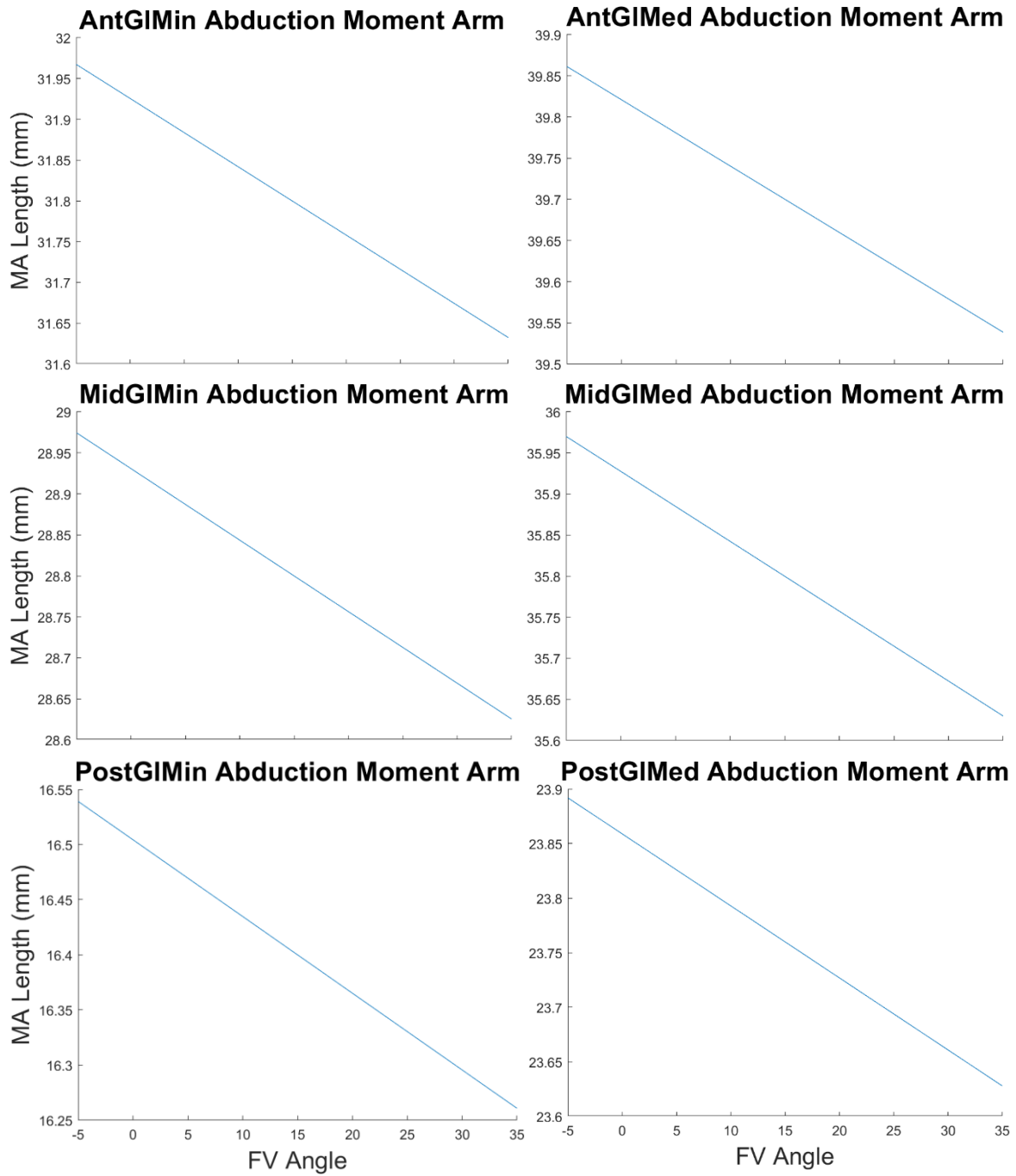
Supplementary Figure 6a. Abduction moment arms for the gluteus medius and minimus, the primary abductor muscles, across all FV angles.

Supplementary Figure 6b. Extension moment arms for the gluteus medius and minimus, the primary abductor muscles, across all FV angles.

Supplementary Table 1
Average ± standard deviation baseline force values (xBW) for all primary movers of the hip in early (JRF1) and late (JRF2) stance.

Muscle	Abbreviation	Baseline Force	
		JRF1	JRF2
Adductor brevis	AddBrev	0.02 ± 0.00	0.04 ± 0.01
Adductor longus	AddLong	0.03 ± 0.01	0.08 ± 0.03
Adductor magnus (distal portion)	AddMagDist	0.02 ± 0.01	0.02 ± 0.00
Adductor magnus (proximal portion)	AddMagProx	0.01 ± 0.00	0.02 ± 0.00
Biceps femoris long head	BFLH	0.08 ± 0.05	0.02 ± 0.00
Gemellus	Gem	0.06 ± 0.09	0.04 ± 0.06
Gluteus maximus (anterior fibers)	GlMaxAnt	0.20 ± 0.14	0.02 ± 0.02
Gluteus maximus (middle fibers)	GlMaxMid	0.19 ± 0.13	0.03 ± 0.01
Gluteus maximus (posterior fibers)	GlMaxPost	0.03 ± 0.02	0.02 ± 0.00
Gluteus medius (anterior fibers)	GlMedAnt	1.49 ± 0.20	1.08 ± 0.25
Gluteus medius (middle fibers)	GlMedMid	0.57 ± 0.18	0.26 ± 0.12
Gluteus medius (posterior fibers)	GlMedPost	0.50 ± 0.24	0.16 ± 0.10
Gluteus minimus (anterior fibers)	GlMinAnt	0.21 ± 0.12	0.21 ± 0.08
Gluteus minimus (middle fibers)	GlMinMid	0.19 ± 0.10	0.10 ± 0.04
Gluteus minimus (posterior fibers)	GlMinPost	0.12 ± 0.07	0.03 ± 0.02
Gracilis	Grac	0.02 ± 0.00	0.03 ± 0.01
Iliacus	Iliacus	0.07 ± 0.06	1.00 ± 0.27
Obturator externus	ObtExt	0.03 ± 0.01	0.09 ± 0.05
Obturator internus	ObtInt	0.01 ± 0.01	0.02 ± 0.01
Pectineus	Pect	0.01 ± 0.00	0.01 ± 0.00
Piriformis	Piri	0.26 ± 0.13	0.07 ± 0.05
Psoas	Psoas	0.07 ± 0.02	0.75 ± 0.40
Quadratus femoris	QuadFem	0.00 ± 0.00	0.01 ± 0.01
Rectus femoris	RecFem	0.24 ± 0.16	0.71 ± 0.37
Sartorius	Sart	0.02 ± 0.00	0.09 ± 0.04
Semimembranosus	SemiMem	0.31 ± 0.21	0.08 ± 0.11
Semitendinosus	SemiTen	0.04 ± 0.01	0.02 ± 0.01
Tensor fascia latae	TFL	0.22 ± 0.13	0.35 ± 0.09