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Foundations of Strength Testing:
Techniques for Hip Flexion, Abduction and External Rotation

Tuesday July 30th, 2024

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Introductions:

Dr. Daniel G. Stewart,

PT, DPT

Dr. Christi Williams,

PT, DPT, OCS, Cert. MDT

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PT, DSc, OCS

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Agenda

- Introduction to Hip Strength Testing: Hip Flexion, Abduction and External Rotation
- Overview of how to test the Hip
    - Flexion
    - Abduction
    - External Rotation
- Case Study- Analyzing the data
- Case Study- Possible rehab interventions
- Introduction of “Strength and Range of Motion Assessment for Today’s Student (The Abbreviated Guide)”

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Hip Flexion

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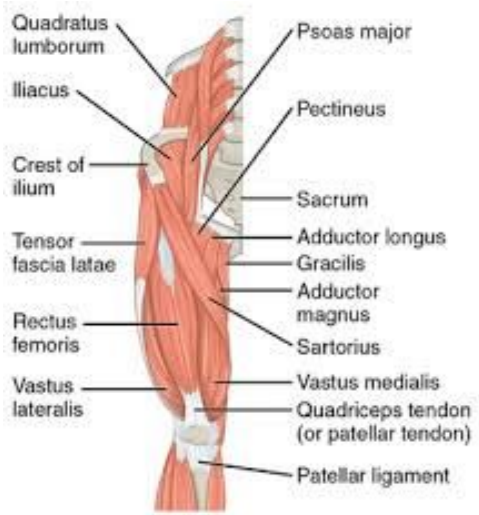
Hip Flexion



The hip flexor muscles are a group of muscles located near the top of the thighs that enable you to bend your hips, lift your legs, and bend forward. The primary hip flexors are the **iliacus, psoas major, rectus femoris, sartorius,** and **pectineus**:

Iliacus: Flexes and rotates the thigh, and runs from the inside of the pelvic bone to the thigh bone

Psoas major: Connects the legs to the spine, and runs from the spine to the thigh bone

Rectus femoris: Attaches the pelvis to the knee.

Sartorius: The longest muscle in the body

Pectineus: Also known as the groin muscle

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Hip Flexion

Seated w/o Strap

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Seated with Strap

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Supine

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- Can test in **Standing, Supine, Sitting, Side Lying**
- **Test at Ankle or Knee?**
- Testing at different angles: **Neutral, 90 degrees, End Range,** etc

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Hip Abduction

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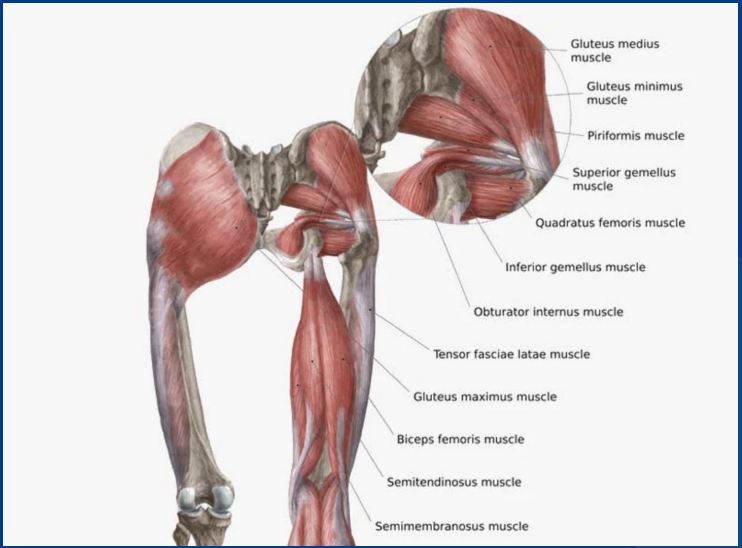
Hip Abduction



The primary hip abductor muscles are the gluteus medius, gluteus minimus, and tensor fasciae latae (TFL).

These muscles are located on the lateral thigh and are responsible for moving the leg away from the body and rotating it at the hip joint.

Hip abduction is an important part of walking and moving around, and these muscles are also necessary for stability when standing on one leg or walking.

The piriformis, sartorius, and superior fibers of the gluteus maximus are considered secondary hip abductors.

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Hip Abduction

Hip ABD with Strap

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Hip ABD without Strap

https://app.clinicalpattern.com/view/rom_mmt/ea37f38c8eac5740af1777e924626b84425746b01f93797f/?ctx=pt&lng=en

Hip ABD without Strap End Range

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- Can test in **Standing, Supine, Prone, Sitting, Side Lying**
- **Test at Ankle or Knee?**
- Testing at different angles: **Neutral, 45 degrees, End Range,** etc

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Hip External Rotation

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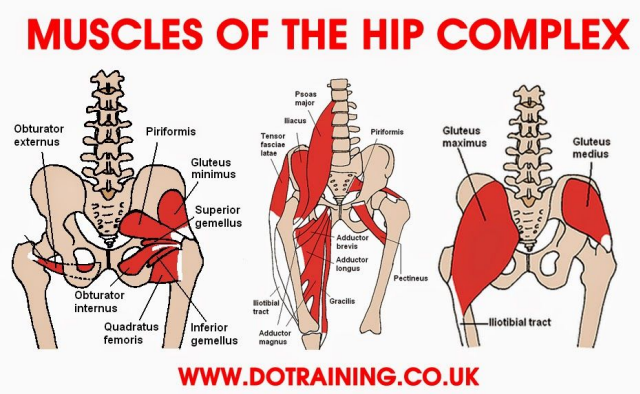
Hip External Rotation



The gluteus maximus, a large muscle in the buttocks and hip area, is the main muscle responsible for hip external rotation. When working together, other muscles also contribute to hip external rotation, including:

- **Piriformis**
- **Superior & Inferior Gemellus**
- **Obturator internus & Externus**
- **Quadratus femoris**

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Hip External Rotation

Hip ER w/o Strap Seated

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Hip ER with Strap Seated

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Hip ER w/o Strap Prone

https://app.clinicalpattern.com/view/rom_mmt/f96802bac9b068e22c3e097f46e45caf94046c890cbc340c/?ctx=pt&lng=en

- Can test in **Standing (0 or 90), Supine (90), Prone (0), Sitting (90), Side Lying (0 or 90)**
- Testing at different angles: **Neutral, 45 degrees, End Range,** etc

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Case Examples for use of HHD on Proximal Hip Musculature

Kevin Robinson, PT, DSc, OCS
Christi Williams, PT, DPT, OCS, Cert. MDT

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Initial eval of an 82-year-old male with recent history of falls performed on 7/25/2024

- PMH:
- Right hip arthroplasty performed on Feb. 15, 2024. This was complicated as patient fell at home Feb. 17, 2024, while going to bathroom. He fell backward into shower.
- Patient has a long history of lower back pain and has underwent surgical fusion S1 through T10, C3-T4, he has a pain pump that he states has helped a great deal with his lower back pain.
- He states that he has lost a lot of strength of his lower extremities, and he struggles to stand from a sitting position, ascend stairs and walk very far.
- On attempt to rise from a seated position, patient's hips moved into adduction (knees towards each other) and he struggled using arm rest to stand.
- Gait: short step lengths, poor foot clearance due to limited hip and knee flexion

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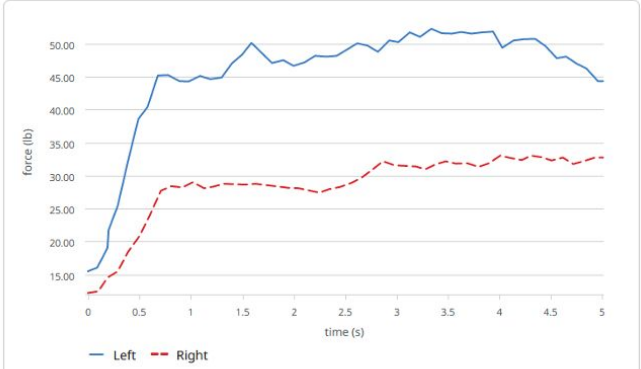
Full Report 7/25/24
10:08 AM

Hip Flexion Seated



Average Values

Left	46.17 lb
Right	28.80 lb

Peak Force (lb)

Left	52.24 lb
Right	33.02 lb
Strength Difference	19.22 lb
Percentage Difference	45.09%

Patient is 6’4” tall and weights 224 lbs. Based on his age, normative values would be 25% BW or 56lbs

Affected side, right.

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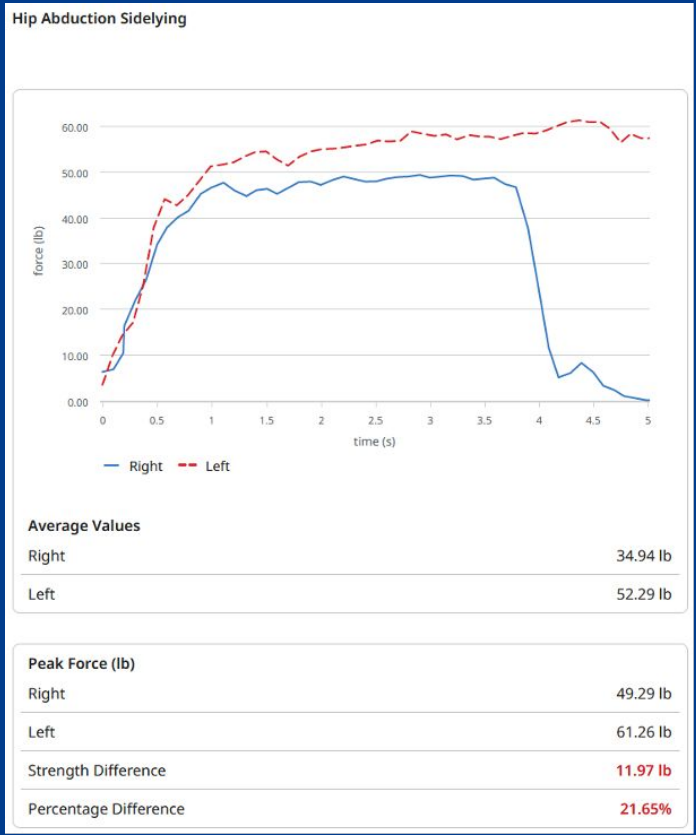

Hip Abduction, remember normative values for this motion is 56 lbs

Affected side, right.

- These two tests objectively show his strength deficits on the right side. This is one example of how HHD can demonstrate the degree of side-to-side weakness and be used with normative data to establish goals.
- How do you feel how either of these tests would have been measured using a 0-5 scale and MMT? How would a clinician demonstrate improvement using MMT?

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17-year-old patient who plays basketball for both his travel and high school teams. He presents with bilateral anterior knee pain, Left > Right

He has anterior knee pain that began in April 2024. Patient reports knee pain is limiting his ability to play as running, cutting and jumping are becoming more painful.

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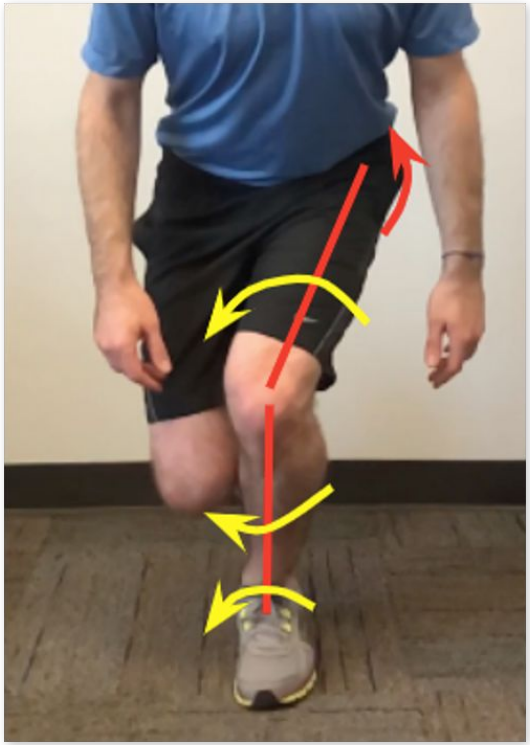
Failed Single Limb Squat



HHD for Hip Abduction:

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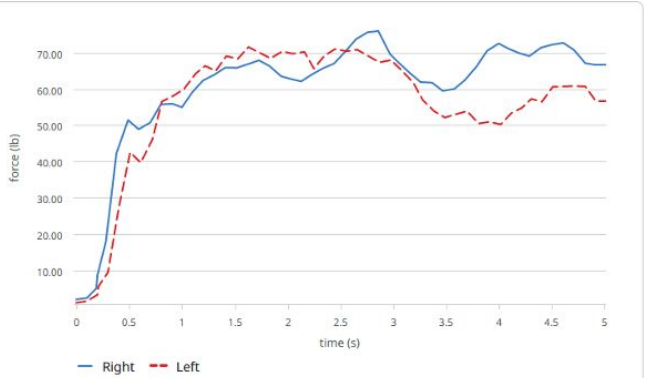
Full Report 7/25/24 12:27 PM

Hip Abduction Sidelying



Average Values

Right	61.45 lb
Left	56.72 lb

Peak Force (lb)

Right	75.93 lb
Left	71.53 lb
Strength Difference	4.40 lb
Percentage Difference	5.97%

- Patient is 17 years old and weighs 184 lbs. Normative data is 40% BW (73.6 lbs.) general population and 50% BW for athletes (92 lbs.)
- So, just looking at peak force, his values are very close for a general population, but for an athletic population he has work to do.
- How do you feel how either of these tests would have been measured using a 0-5 scale and MMT? How would a clinician demonstrate improvement using MMT?

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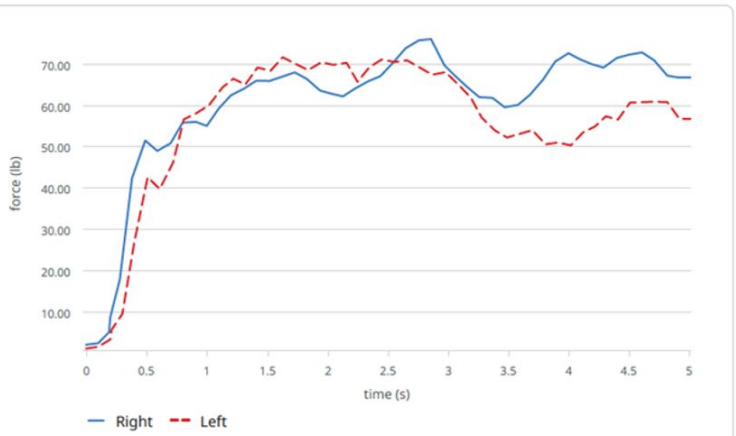

Average Values

Right	61.45 lb
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Peak Force (lb)

Right	75.93 lb
Left	71.53 lb
Strength Difference	4.40 lb
Percentage Difference	5.97%

In looking further at the strength data, notice the average force values.

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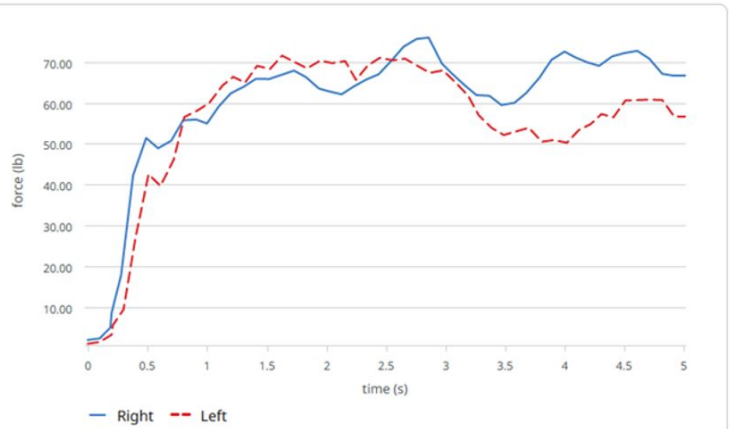

Average Values	
Right	61.45 lb
Left	56.72 lb

Peak Force (lb)	
Right	75.93 lb
Left	71.53 lb
Strength Difference	4.40 lb
Percentage Difference	5.97%

- Remember, this assessment was done while the patient was rested. How do you think these values will change with fatigue?
- This would add more to the valgus collapse further affecting the patella-femoral joint.

Typical curves for weakness with similar RFP slope

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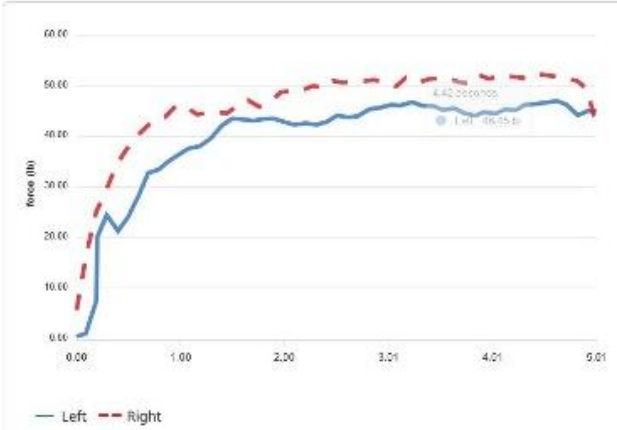
Hip Abduction Sidelying



Average Values

Left	40.36 lb
Right	46.90 lb

Peak Force (lb)

Left	47.06 lb
Right	52.51 lb
Strength Difference	5.45 lb
Percentage Difference	10.95%

The “Picture” tells so much more

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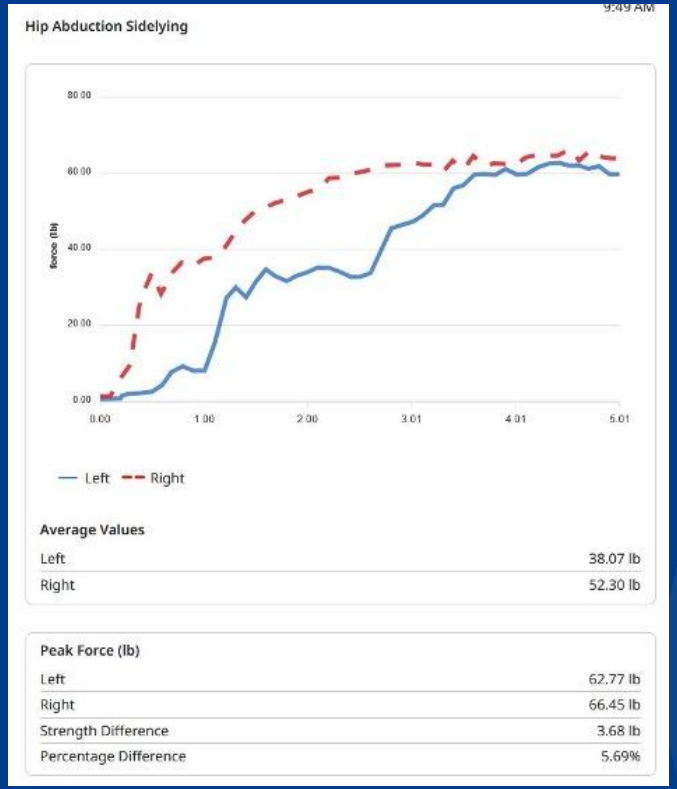

- Poor recruitment of Gluteus Medius with delayed RFP on left side (blue)
- Do you think this would have been found using 0-5 MMT?

Other data that can be gained from the force curve

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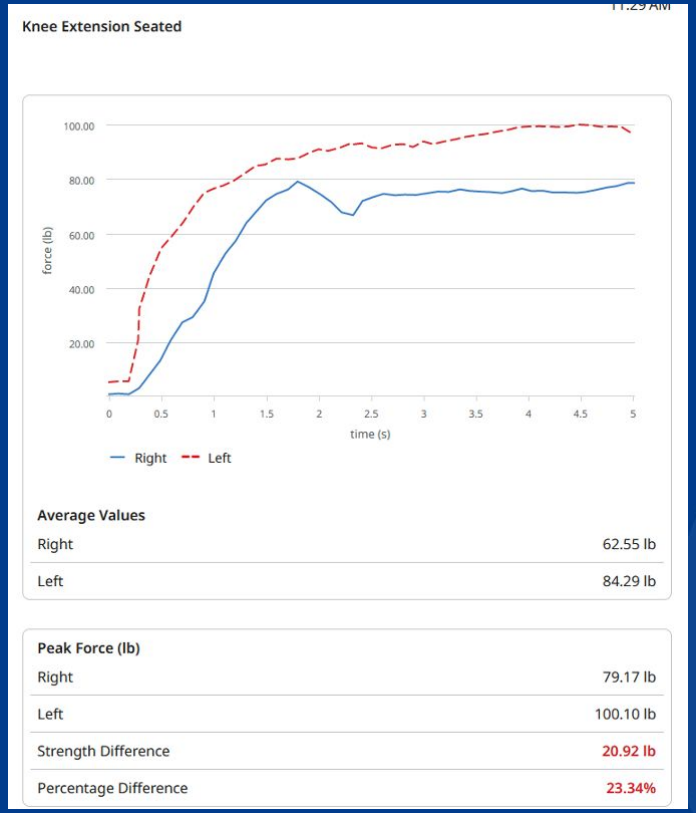

This shows a delay in reaching peak force.

This is a motor recruitment issue so our focus would be on rate of recruitment, not just strength.

This is data from a return to sport eval following an ACL repair

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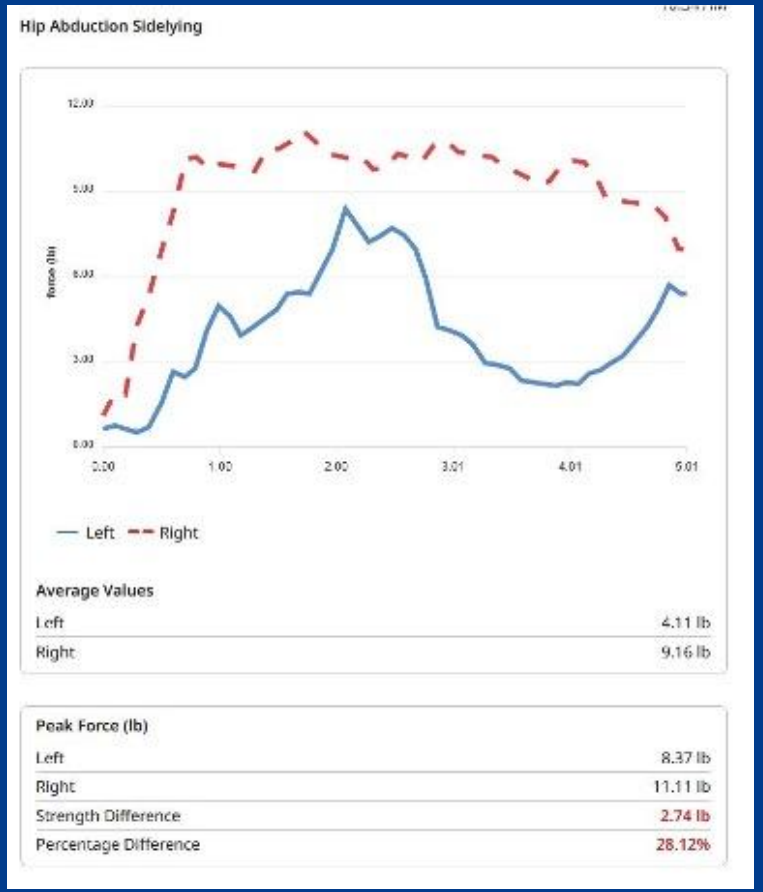
Example of poor muscle recruitment, with delayed RFP and unable to maintain force



← Gluteus Medius tear on Left side (blue)

C5 Disc Herniation on Right side

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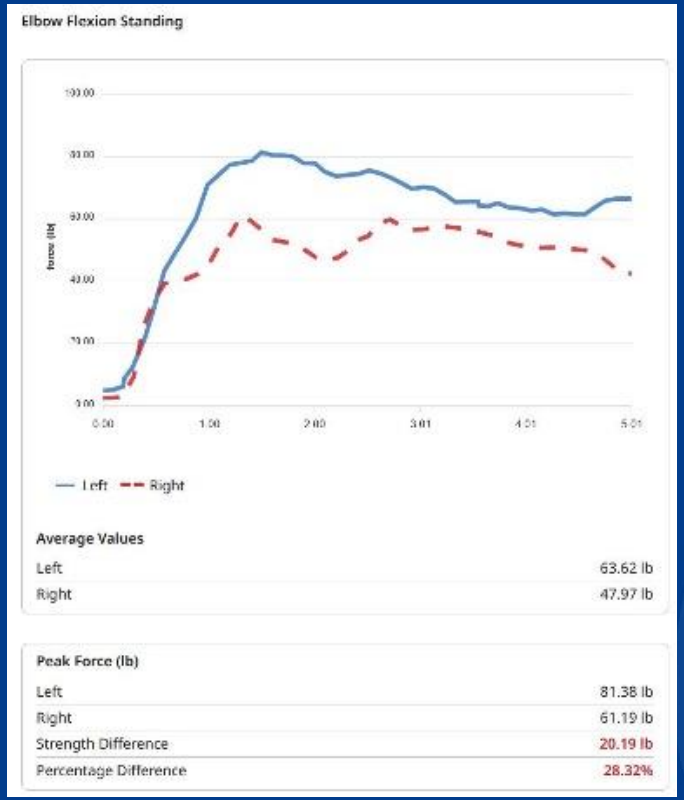

The involved side (right) was still able to produce 61.19 lbs of peak force. This weakness was not appreciated by his neurologist during the office exam.

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These two cases show the value and clinical application of HHD with proximal hip strength assessment. I feel that as clinicians, we “over” estimate the patients’ strength using a 0-5 MMT. Using stabilization belts and HHD, a clinician can quickly and objectively assess the proximal hip musculature and determine the appropriate rehab program focusing on either strength or rate of force recruitment.

Strength and Range of Motion Assessment for Today's Student

(The Abbreviated Guide)

Kevin Robinson, PT, DSc, OCS
Christi Williams, PT, DPT, OCS, Cert. MDT

Fig. 1.1.36. Hip abduction (gluteus medius) HHD positioning using a belt

Hip Abduction from Extended Position – Gluteus Medius

Hand-Held Dynamometry

Patient Position	• Sidelying • Hip extended to 10° to isolate gluteus medius muscle • Knee fully extended
Stabilization Belt	• The belt is secured around the treatment table and adjusted in length so that once the dynamometry unit is in place, resistance to hip abduction will begin at the neutral position
Clinician	• Stands on the side of the test limb • Places dynamometry unit on the lateral side of the distal end of the femur (just proximal to the knee)
Force Application	• Patient abducts the hip (maintaining the extended position) until resistance is felt from the belt and then applies strong resistance against the dynamometer for 5 seconds
Substitutions	• Moving out of the 10° hip extension position by flexing the hip or unstacking the hips, externally rotating the hip

Includes ROM with goniometer & inclinometer

Fig. 1.1.16.
PROM hip abduction measured with a goniometer in supine

Fig. 1.1.17.
PROM hip adduction measured with a goniometer in supine

Fig. 1.1.18.
AROM hip abduction measured with a goniometer in sidelying

Fig. 1.1.19.
AROM hip abduction measured with an inclinometer in sidelying

Fig. 1.1.20.
AROM hip adduction measured with a goniometer in sidelying

Fig. 1.1.21.
AROM hip adduction measured with an inclinometer in sidelying

Fig. 1.1.14.
PROM hip flexion measured with a goniometer in supine

Hip Flexion Range of Motion

Patient Position	Goniometer Alignment	Normal Values (AAOS)
Standard position for PROM: • Supine • Allow knee of test limb to passively flex, taking tension off hamstrings • Opposite limb extended straight and resting on the table to stabilize the pelvis **Positioning against gravity for AROM:** • Short sitting or standing • Monitor sitting posture and/or standing balance if measuring against gravity	**Fulcrum:** Greater trochanter **Stationary:** Midline of pelvis **Moving:** Lateral epicondyle of femur **Note:** Monitor pelvis position throughout the measurement. The end range of hip flexion is when further movement of the femur causes posterior tilting of the pelvis.	**Flexion:** 120°

Palpation & MMT

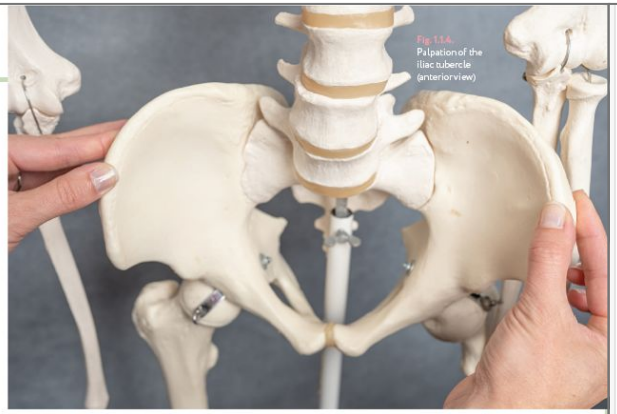

Fig. 1.1.4.
Palpation of the iliac tubercle (anterior view)

Fig. 1.1.5.
Palpation of the iliac tubercle (lateral view)

Iliac Tubercle:
The iliac tubercle can be found by moving superiorly from the ASIS along the iliac crest. The iliac tubercle is the widest portion of the crest and is located approximately three finger breadths anteriorly from the top (most superior portion) of the iliac crest.

Hip Extension

Manual Muscle Test Grades 3-5

Primary Muscles Tested	**Gluteus Maximus - Inferior Gluteal n. L5-S2** Others: Hamstrings, Adductor Magnus (posterior fibers), Gluteus Medius (posterior fibers)
ROM	20°
Patient Position	• Prone on table with knee flexed to 90° • Note: flexing the knee 90° helps to isolate the gluteus maximus by placing the hamstrings in a shortened position, thus making them less able to assist with hip extension (active insufficiency) • Arms relaxed and not gripping table
Clinician	• Stands on the side of test limb • Passively extends hip through available ROM • Asks the patient to repeat the motion and hold at end range
Force Application	• Clinician applies resistance in a downward direction at the distal femur (just proximal to the knee)
Stabilization	• Clinician stabilizes at the iliac crest to maintain pelvic alignment
Substitutions	• Lifting pelvis off table, extending or flexing the knee

5/5	Patient holds against maximum resistance
4/5	Patient holds against moderate resistance
3/5	Patient moves through full ROM against gravity but cannot take any additional resistance from clinician

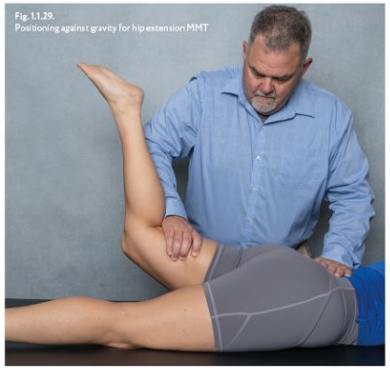

Fig. 1.1.29.
Positioning against gravity for hip extension MMT