Gluteus Medius Dysfunction and Rehabilitation

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Declaration of Interest

- No relevant financial or nonfinancial relationships exist with this presentation today.
Why the Gluteus Medius?
Sports
Not just sports
Gluteus Medius in everyday activity
As seen on TV

**What to do:**
- Medius- jumping jacks
- Maximus- lunges
- Minimus- squats

**The Exercises:**
- Gluteus Medius
  - Side-lying
  - Hip Abduction
  - Lateral Band Walk
- Gluteus Maximus
  - One Leg Squats
  - One Leg Lunges
  - Donkey Kicks
- Gluteus Minimus
  - Side Plank
  - Hip Abduction
  - Hip Hitch
Gluteus Medius Anatomy
Gluteus Medius function

- The Gluteus Medius (GM) muscle is the main abductor of the hip joint.
  - The anterior fibers of the GM are involved in hip abduction and internal rotation
  - The middle fibers of the GM are involved only in hip abduction
  - The posterior fibers of the GM are involved in hip abduction, external rotation and assist in extension.

Gluteus Medius

- The GM is the widest among the hip abductors, corresponding to 60% of the total cross sectional area of the hip abductors.
  
  Monteiro, RL et al. J Sport Rehab. 2015

- The GM weakness can result in compensatory excessive use of the tensor fascia lata (TFL).
- Increased use of the TFL, which helps to IR the hip, may lead to further GM atrophy and LE abnormal movement.
Regional Anatomy
Anatomy

Gluteus Medius

**Origin**
- External surface of ilium between anterior and posterior gluteal line

**Insertion**
- Greater Trochanter of Femur

**Action**
1. Abduction of Femur (entire muscle) (frontal plane and transverse plane)
2. Medially/Internal Rotation of Femur (anterior fibers)
3. Lateral Rotation of Femur (posterior fibers)
4. Depression of Pelvis
Dynamic Control Proximally

- Unilateral contraction of the lumbar extensors and abdominal obliques causes lateral trunk flexion
- Gluteus Medius helps prevent excessive contralateral hip drop
- Gluteus Maximus helps control hip IR
- Working together to help minimize dynamic knee valgus

Weakness of the Gluteus Medius

- With a decrease in stabilization and control of the GM, it has been associated with numerous diagnoses:
  - Hip osteoarthritis
  - Patellofemoral Pain Syndrome
  - Anterior Cruciate Ligament Sprain/tear
  - Ankle Instability
  - Gait Disorders
  - Low Back Pain
  - Iliotibial Band Syndrome
Atrophy and fatty infiltration of the gluteal muscles has been connected to hip osteoarthritis (OA).
This atrophy could lead to difficulties in functional activities involving unilateral stance such as gait or negotiating stairs. (Marshall, AR et al. J Back Musculo Rehab 2016)
Studies have shown a significant difference in hip abductor muscle strength in the hip OA vs controls.
The weakness is also seen more on the involved side vs the uninvolved side. (Marshall, AR et al. J Back Musculo Rehab 2016)
Gait and Hip OA

- Not only is sagittal plane motion less in the severe Hip OA group vs control, but transverse and frontal plane motions are also less. In comparison moderate hip OA and controls only had differences in sagittal plane motion. (Rutherford DJ. J Electromyography Kinesiology 2015)

- Gait patterns to reduce pain commonly seen are a reduced walking speed, decrease in hip extension, and bending of the trunk to the affected side.

- Trunk lean to the affected side contributes further to hip abductor weakness.
Patellofemoral Pain Syndrome (PFPS)

- Delay in response (per EMG) has been shown for the GM in patients with PFPS vs controls.
- GM altered activation has been shown in patients with anterior knee pain for ascending and descending stairs (Brindle et al, 2013)
- Altered timing has been associated with greater hip IR and hip adduction
PFPS

- Q Angle changes have been reported, potentially causing genu valgum and it causes the patella to track more laterally.

- Females with PFPS have shown increased peak hip IR Motion, and decreased lateral muscle strength.
- Delay in GM and gluteus maximus firing have been well documented (Wilson et al 2011)
Low Back Pain (LBP)

- GM weakness has been shown in research with patients with chronic non specific LBP vs controls. Trendelenburg sign is also more prevalent in subjects with LBP vs controls.  
  (Cooper N. 2016)
- Higher prevalence of GM trigger points
- Increased co activation of bilateral GM reported in LBP group  
- Active hip abduction test can be used as a screen for development of LBP with prolonged standing.  
Ankle Instability

- GM is linked to ankle inversion sprains (Physical Therapy in Sport 15(2014)15-19)
- Chronic ankle instability has been linked to poor neuromuscular control from the GM and gluteus maximus as well as muscle fatigue.
Gluteus Medius and Scapular Activation

- During the pitching motion in baseball, it is the movement of the proximal LE segments that influence the shoulder and ultimately ball speed.
- The pelvis needs to possess stability for fluid force transfer.
- **Phase 1** (foot contact to maximal ER of the shoulder)
- **Phase 2** (“acceleration phase – going from max ER to ball release)
- **Phase 3** (ball release to maximal IR of the shoulder)
- The most significant relationship between GM and scapular stabilizers was in phase 2.
Phases

Phase 1

Phase 2

Phase 3
Scapular Stability

- Decreases in hip abduction has been reported in 49% of athletes with arthroscopically diagnosed posterior superior labral tears (Burkhart SS. 2000)
- Also been shown that pitchers have decreased hip abduction strength and IR in their stance leg vs positional players.
GM & Running

- During the loading phase, the GM produces the largest mean peak force to assist in absorbing the ground reaction forces.
- With increases in speed from 3 m/s to about 7 m/s requires a shift from an ankle to a hip strategy.
- Greater GM amplitude in females vs males
- Increasing cadence by 10% significantly increases GM amplitude in late swing not stance. This pre-activation of GM can help to tension the lateral hip stabilizing mechanism. (Semciw A, et al. J electromyography and kinesiology 2016)
What do we do to help?

- What does the research say for what we do everyday?
- Clam shell
- Bridges
- Lateral Shuffle
- Lateral Step Up/Down
- Squats
- Pelvic Drop
- PNF patterns
Research Values

- Activation from 0% to 20% MVIC – low level
- Activation from 21%-40% MVIC – moderate level
- Activation from 41%-60% - high level
- Greater than 60% - very high level
Proprioceptive Neuromuscular Facilitation (PNF)

- All 4 patterns (D1E, D1F, D2E and D2F) were used with resistance from tubing at the ankle
- The D2F pattern was the only one that activated the GM at a high level (49.8 MVIC)
- The other three motions all scored in the moderate category
- Regardless of the PNF pattern the magnitudes of muscle development of the GM was nearly equivalent in the stance and moving limbs.  
Single Limb Balance

- Different angles of slope were tested to assess mean muscle activation.
- The slope condition was a mediolateral angle to create the form of ankle inversion.
- Angles of 0°, 5°, 10°, 15°, 20°, 25° were tested.
- Muscles tested (GM, the hamstring, Biceps Femoris, Medial and Lateral Gastrocnemius).
- GM, hamstring, medial gastrocnemius muscles showed an increase as the angles increased.
- GM and medial gastrocnemius were in the high category.
- **At zero degrees the GM had MVIC levels in the moderate level** (Lee SY. J Physical Therapy Science 2016)
Bridges

- 4 different bridge techniques tested
- Double leg bridge on stable and unstable surfaces (feet on exercise ball)
- Single leg bridge on stable and unstable surfaces (foot on blue side of BOSU)
- Biggest difference was seen for the GM from the double leg bridge to the single leg bridge (21.4% vs 40%).
- There was no significant difference with surface conditions. (Youdas, JW, et al. Physiotherapy Theory and Practice, 2015)
Resisted Side Stepping

- Side stepping done with a resistance band at the ankles.
- 2 postures tested: upright standing vs squat
- Starting position was with each foot aligned with the sides of a 12 inch floor tile, and for the test the subject was instructed to side step the distance of one tile (feet then were 24 inches apart).
- The squat position was self selected
- Squat position created moderate GM activation in the squat position, stance limb greater than swing.

# Side Stepping

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<thead>
<tr>
<th>Posture</th>
<th>Front View</th>
<th>Side View</th>
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<tbody>
<tr>
<td>Upright standing</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
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<tr>
<td>Squat</td>
<td><img src="image3.png" alt="Image" /></td>
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Pelvic Drop

- 3 different test positions
- Medial (15°) and lateral (20°) rotation of the hips as well as neutral
- Medial rotation and neutral positions showed significantly higher GM activation than the lateral rotation.
- *Have to be careful with the patient with PFPS with the medial hip rotation due to the stress it can cause to the retropatellar surface.

Unilateral Weight Bearing Exercises

- 4 exercises tested
- Unilateral wall squat, unilateral mini squat, lateral step down and front step down
- GM activity was significantly the most during the wall squat (26.5% MVIC) vs the other three activities.
- Potentially was the highest due to the shifting of the body’s center of mass posterior to the base of support, requiring greater muscle activation.

Other Exercises

- Unilateral prone bridge (plank) with one leg elevated (WB limb 103% MVIC, non WB 75%)
- Side plank (74% MVIC) and side plank with hip abduction (WB limb 103%)
- Standing hip abduction exercise for the WB limb had moderated levels where the NWB limb was low.
- Clamshells: hip neutral position and increased hip flexion angle tends to show greater MVIC
- Sidelying Hip abduction with medial rotation had higher activation than lateral rotation.
Exercises to limit TFL

- Unilateral Bridge
- Squat
- Sidestep
- Clamshell
- Quadruped on elbows with knee extended
- Quadruped on elbows with knee flexed
- Side lying hip abduction had statistically significant values higher than TFL, but hip hike was relatively equal. (Selkowitz DM, et al. 2013)
In Conclusion

- Key: Need to be aware of the load of the exercise that you are choosing for your patient and where they are at in the process and what demands they need to return to function.
- Muscular activation greater than 40% MVIC may be needed for strength gains, it has been reported that muscle activity less than 25% may be more important in developing muscular endurance.
Thank You!
References

References

References

- Harput G, Howard JS, Mattacola C. Comparison of muscle activation levels between healthy individuals and persons who have undergone anterior cruciate ligament reconstruction during different phases of weight bearing exercises. JOSPT. 46(11)984-992.