Gluteus medius strengthening and the use of the Donatelli Drop Leg Test in the athlete

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Abstract

Objectives: To evaluate and strengthen the posterior segment of the gluteus medius.

Design: A technical description of a novel examination and rehabilitation protocol.

Setting: The gluteus medius, primarily a hip abductor, serves several important functions in the athlete. Weakness of the gluteus medius has been linked to injuries in the shoulder and iliotibial band, as well as ankle instability. Though previously treated as a homogenous muscle, recent studies of the gluteus medius show three segments with distinct function and activation — the anterior, middle, and posterior. Current rehabilitation protocol focuses primarily on the anterior and middle segments, neglecting the posterior.

Conclusion: We propose a three-stage protocol for strengthening and rehabilitation of the injured athlete and the Drop Leg Test, which can be used to identify weakness in the posterior segment of the gluteus medius.

1. Introduction

The gluteus medius serves as an integral component in the kinetic chain of the athlete (Stoddan, Langendorfer, Fleisig, & Andrews, 2006), and is now commonly described separately and as having several anatomic subdivisions (Neumann, 2002). Gottschalk et al. previously reported three separate segments — anterior, middle and posterior — based on cadaveric dissection and biomechanical studies (Gottschalk, Kourosh, & Leveau, 1989). The anterior and middle segments of the gluteus medius contain fibers running vertically from the anterior iliac crest to the greater trochanter. The posterior segment contains fibers running horizontally in line with the femoral neck. The posterior fibers have been described to function as the primary segment active in stabilizing the femoral head in the acetabulum during weight transfer (Gottschalk et al., 1989), and to contribute to external rotation of the femur relative to the stable pelvis (Neumann, 2002; Powers, 2010).

Neumann reported the importance of the posterior segment of the gluteus medius in lunging and jumping by showing that the gluteus maximus produced less external hip rotational torque at hip flexion angles greater than 60°. With greater hip flexion a shift of the anterior fibers of the gluteus maximus anterior to the hip joint axis of rotation turns the anterior gluteus maximus into an internal rotator rather a femur stabilizer (Neumann, 2002). In this situation, the posterior fibers of the gluteus medius act with the deep external rotators to provide control (Powers, 2010).

Through EMG analysis, O'Dwyer et al. have shown differing activation of the various segments of the gluteus medius during isometric contraction (O'Dwyer, Sainsbury, & O'Sullivan, 2011). O'Sullivan et al. furthered the analysis and suggested a need for variation in rehabilitation protocols by showing differing segmental activation with various weight bearing exercises (O'Sullivan, Smith, & Sainsbury, 2010).

Compromise of the gluteus medius has been linked most commonly to ankle inversion and knee injuries including patellofemoral tendinitis, iliotibial band syndrome, anterior cruciate ligament tears, and medial collateral ligament tears (Beckman & Buchanan, 1995; Earl, Hertel, & Denegar, 2005; Fredericson, Cookingham, Chaudhari, Dowdell, Oestreicher, & Sahrmann, 2000; Friel, McLean, Myers, & Caceres, 2006; Powers, 2010; Schmitz, Riemann, & Thompson, 2002). Powers et al. described an increased knee valgus posture and a shift of the center of mass as a means of biomechanical compensation for hip abductor weakness (Powers, 2010).

The majority of current gluteus medius rehabilitation protocols utilize exercises with the hip in slight flexion, including the clam, closed chain lateral lunges, and side lying abduction without...
extension. A shortened lever arm with hip extension changes the gluteus medius angle of pull, thus requiring the abductor muscle to develop greater force and recruit all segments to counterbalance the effect of gravity (Neumann, 2002). Additionally, Philippon reported significant gluteus medius weakness and concurrent iliopsoas tendonitis in patients undergoing flexion rehabilitation activities (Philippon, Decker, Giphart, Torry, Wahoff, & LaPrade, 2011).

The purpose of the Drop Leg Test is to establish a manual muscle test more specific for the inclusion of posterior fibers of the gluteus medius. The authors propose that the Drop Leg Test isolates weakness of the posterior fibers of the gluteus medius because of the emphasis on extension and abduction with the leg in neutral position. As the gluteus maximus is a primary external rotator of the femur with the leg in neutral position, hip abduction with extension reduces the gluteus maximus role as an external rotator and thus emphasizes the posterior fibers of the gluteus medius.

Here we propose a three-stage protocol with emphasis on the posterior fibers of the gluteus medius. In order to evaluate these fibers, we propose the Drop Leg Test.

2. Materials and methods

The Drop Leg Test (Fig. 1) is performed from the side lying position. The clinician passively abducts the leg to the end of the hip abduction range of motion and then extends the hip 20°. While holding the leg in the abducted and extended position, the patient is asked to maintain this leg position while the clinician lets go. A shortened lever arm with hip extension changes the gluteus medius angle of pull, thus requiring the abductor muscle to develop greater force, recruiting more fibers to counterbalance the effect of gravity (Neumann, 2002). The senior author of this paper has performed the Drop Leg Test on hundreds of patients that expose significant muscle deficits that would have been missed by testing in flexion or neutral position. With weakness of the posterior segment of the muscle, the patient will be unable to hold the leg in the abducted and extended position and the leg will drop 2–12 inches until the muscle lever arm is elongated and the muscle is capable of developing enough strength to stop the fall of the leg. If the limb drops several inches and the patient is able to hold the leg in abduction and extension, a manual muscle test may be performed to further determine the muscle deficits.

Maximum voluntary isometric contraction (MVC) has been determined for a variety of common hip rehabilitation exercises (Ekstrom, Donatelli, & Carp, 2007; Philippon et al., 2011). We propose a three-phase protocol (Table 1) based on MVC of the gluteus medius muscle with emphasis on the posterior segment. Phase one produces 20–35% gluteus medius MVC, phase two produces 40–45% gluteus medius MVC, and phase three produces 45–74% gluteus medius MVC.

The phased exercise program below is unique in that the exercises emphasize external rotation in order to strengthen the posterior fibers of the gluteus medius, the deep rotators, and also the gluteus maximus, while de-emphasizing hip flexion. The authors of this paper have noted irritation of the iliopsoas muscle in many patients that complain of hip dysfunction, an observation also made by Philippon et al. (2011), which the proposed protocol seeks to minimize. Running and plyometric exercise should not be initiated until the patient demonstrates a stable trunk and a strong base (hips and lower extremities). Traditionally, running and plyometrics constitute the final stage of rehabilitation before returning to sport.

2.1. Phase one

Exercises are initiated with phase one (Fig. 2) and include the double leg bridge, external rotation while kneeling on a stool, single leg stance, and resisted hip extension while prone. Double leg bridge, an isometric hold, is performed for 5–15 s and is repeated five to ten times once to twice daily. Remaining phase one exercises are performed with appropriate resistance to allow for six to eight repetitions in two sets, with the goal of fifteen repetitions in three sets. Once this goal is achieved weight can be added and commenced with six to eight repetitions.

2.2. Phase two

Phase two (Fig. 3) includes strengthening with the quadrupled four arm/leg lift, lateral step ups, two-way hip standing on a step, and external rotation standing with pulleys. The quadrupled four arm/leg lift is performed for 5–15 s and repeated five to ten times once to twice daily. Remaining phase two exercises are performed with an amount of resistance to allow for six to eight repetitions in two sets with the goal of fifteen repetitions in three sets. Once this goal is achieved weight can be added and commenced with six to eight repetitions.

2.3. Phase three

Phase three exercises (Fig. 4) include the single leg bridge, wall slides, and side bridges. Exercises are performed with an amount of resistance to allow for six to eight repetitions in two sets with the

| Table 1 |
| Rehabilitation protocol. |

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<td>- Quadrupled fours arm/leg lift</td>
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<td>- Single leg bridge</td>
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Fig. 2. Phase one exercises include the double leg bridge (A), external rotation while kneeling on a stool (B), single leg stance (C) and resisted hip extension while prone (D).

Fig. 3. Phase two exercises include quadrupled four arm/leg lift (A), lateral step up (B), two-way hip standing on a step (C) and external rotation standing with pulleys (D).
Injuries to the knee, ankle, shoulder, and iliotibial band have been linked to gluteus medius weakness. Nicholas, Strizak, and Veras (1976) retrospectively studied patients with foot and ankle injuries and found consistent decreases in gluteus medius strength on Cybex testing. Beckman and Buchanan (1995) noted that patients classified as having hypermobile ankles presented with gluteus medius weakness. A lack of dynamic hip stabilizers thus may not allow for normal compensation of small sudden ankle alterations.

In the overhead athlete the importance of the gluteus medius is noted in several phases of pitch. During the wind up phase, gluteus medius activation (Bolgla & Uhl, 2005). While many patients may achieve excellent results with this commonly used weight bearing exercise, iliopsoas tendonitis may pose a problem. In our experience, significant increases in posterior segmental strength have been achieved using the two-way hip exercise with pulleys and wall slides. External rotation exercises over the side of the table have been shown to provide the best results but are the most difficult to perform, thus making them a less desirable option.

The Drop Leg Test described here offers a specific manual muscle test for weakness of the posterior fibers of the gluteus medius muscle. Compared to the commonly utilized Trendelenburg test, the Drop Leg Test is a more specific test for weakness of the posterior fibers of the gluteus medius since it elicits weakness that may be masked by the larger anterior and middle segments. This focus on the posterior segment differentiates the Drop Leg Test and provides supplementation to the Trendelenburg test by isolating zone specific weakness. With the Drop Leg Test, a combination of hip abduction and extension reduces the lever arm of the gluteus medius, changing its angle of pull and recruiting the posterior fibers, current rehabilitation protocols can be improved.
4. Conclusion

Strengthening of the gluteus medius improves lower extremity power, reduces future risk in the uninjured athlete, and improves rehabilitation in the injured athlete. Knowledge of the differing segments of the gluteus medius and their positions of greatest activation as well as rehabilitation protocol that emphasizes the individual action of these segments improves outcomes and limits sequelae. Though currently rarely targeted in rehabilitation protocol, the posterior fibers of the gluteus medius are unique and contribute to overall performance of the muscle. The Drop Leg Test offers a means by which to easily evaluate these fibers and supplements the commonly used Trendelenburg Test.

Conflict of interest
No conflicts of interest exist.

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References


