

# [ CASE REPORT ]

JASON C. TONLEY, DPT, OCS<sup>1</sup> • STEVEN M. YUN, MPT, OCS<sup>1</sup> • RONALD J. KOICHEVAR, DPT, OCS<sup>2</sup>  
JEREMY A. DYE, MPT, OCS<sup>2</sup> • SHAWN FARROKHI, PT, PhD, DPT<sup>3</sup> • CHRISTOPHER M. POWERS, PT, PhD<sup>4</sup>

## Treatment of an Individual With Piriformis Syndrome Focusing on Hip Muscle Strengthening and Movement Reeducation: A Case Report

The piriformis originates from the anterior aspect of sacral vertebrae 2 through 4 and inserts on the greater trochanter. The sciatic nerve typically exits the greater sciatic notch just below the inferior border of the piriformis muscle. In about 7% to 21% of studied populations, the sciatic nerve (or a division of it), actually penetrates the muscle.<sup>3,12,15,30,32,33</sup>

Edwards<sup>14</sup> defines piriformis syndrome as neuritis of branches of the sciatic nerve caused by pressure of an injured or irritated piriformis muscle. Symptoms associated with piriformis syndrome typically consist of buttock pain that radiates into the hip, posterior aspect of the thigh, and the proximal portion of the lower leg.<sup>28,29</sup> In general, pain increases with sitting or squatting, but persons with piriformis syndrome may experience difficulty with walking or other functional activities.<sup>12,29</sup> Piriformis syndrome typically does not result in neurological deficits such as decreased deep tendon reflexes and myotomal weakness.<sup>29</sup>

Several authors attribute piriformis syndrome to a shortening or “spasm” of the piriformis that results in compression of the sciatic nerve.<sup>6,10,15,27,29,33</sup> The cause of spasm of the piriformis muscle has been most attributed to direct trauma, postsurgical injury, lumbar and sacroiliac joint pathologies, and overuse.<sup>15-17,27,29</sup> Given as such, the standard treatment for piriformis syndrome has focused on decreasing spasm or shortening of the piriformis muscle and any associated inflammation. Medical management of piriformis

• **STUDY DESIGN:** Case report.

• **OBJECTIVE:** To describe an alternative treatment approach for piriformis syndrome using a hip muscle strengthening program with movement reeducation.

• **BACKGROUND:** Interventions for piriformis syndrome typically consist of stretching and/or soft tissue massage to the piriformis muscle. The premise underlying this approach is that a shortening or “spasm” of the piriformis is responsible for the compression placed upon the sciatic nerve.

• **CASE DESCRIPTION:** The patient was a 30-year-old male with right buttock and posterior thigh pain for 2 years. Clinical findings upon examination included reproduction of symptoms with palpation and stretching of the piriformis. Movement analysis during a single-limb step-down revealed excessive hip adduction and internal rotation, which reproduced his symptoms. Strength assessment revealed weakness of the right hip abductor and external rotator muscles. The patient's treatment was limited to hip-strengthening

exercises and movement reeducation to correct the excessive hip adduction and internal rotation during functional tasks.

• **OUTCOMES:** Following the intervention, the patient reported 0/10 pain with all activities. The initial Lower Extremity Functional Scale questionnaire score of 65/80 improved to 80/80. Lower extremity kinematics for peak hip adduction and internal rotation improved from 15.9° and 12.8° to 5.8° and 5.9°, respectively, during a step-down task.

• **DISCUSSION:** This case highlights an alternative view of the pathomechanics of piriformis syndrome (overstretching as opposed to over-shortening) and illustrates the need for functional movement analysis as part of the examination of these patients.

• **LEVEL OF EVIDENCE:** Therapy, level 4.  
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• **KEY WORDS:** *biomechanics, gluteus, hip pain, radiculopathy, sciatica*

<sup>1</sup>Physical Therapist, Department of Physical Medicine and Rehabilitation, Kaiser Permanente West Los Angeles, Los Angeles, CA. <sup>2</sup>Physical Therapist, Department of Physical Medicine and Rehabilitation, Kaiser Permanente Los Angeles, Los Angeles, CA. <sup>3</sup>Assistant Professor, Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA. <sup>4</sup>Associate Professor and Co-Director, Musculoskeletal Biomechanics Research Laboratory, Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA. Jason Tonley and Steven Yun completed this case report as a requirement for the Kaiser Permanente Los Angeles Movement Science Fellowship. Dr. Powers acknowledges a financial interest in the SERF Strap that was used as part of this case report. Address correspondence to Dr Christopher M. Powers, Division of Biokinesiology and Physical Therapy, University of Southern California, 1540 E Alcazar St, CHP-155, Los Angeles, CA 90089-9006. E-mail: powers@usc.edu

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syndrome is reported in the literature to include injections,<sup>1,3,5,8,11,15,16,26,27,30</sup> prescription of nonsteroidal anti-inflammatory drugs and muscle relaxants,<sup>1,5,8,11,15,16,26,27</sup> surgical release,<sup>1,5,8,11,14,16</sup> and referral to physical therapy.<sup>1,5,11,15,20,27,30</sup> The most commonly reported physical therapy interventions include ultrasound,<sup>1,5,11,16,19</sup> soft tissue mobilization,<sup>1,5,11,15,16,19,30</sup> piriformis stretching,<sup>1,11,15,16,19,26,27,30</sup> hot packs or cold spray,<sup>5,11,15,16,19</sup> and various lumbar spine treatments.<sup>1,5,8,10,13,26,30</sup>

As noted above, a common assumption guiding physical therapy intervention for piriformis syndrome is that the piriformis is shortened or in spasm, creating compression of the sciatic nerve. Our alternate theory is that the piriformis muscle may be functioning in an elongated position or subjected to high eccentric loads during functional activities secondary to weak agonist muscles. For example, if the hip excessively adducts and internally rotates during weight-bearing tasks due to weakness of the gluteus maximus and/or gluteus medius, a greater eccentric load may be shifted to the piriformis muscle. Perpetual loading of the piriformis muscle through overlengthening and eccentric demand may result in sciatic nerve compression or irritation.

Interestingly, many authors have recognized hip abductor weakness as an associated finding with piriformis syndrome.<sup>1,2,3,5,8,13,17,27,32</sup> Yet only 2 of these reports included hip abduction strengthening as part of the treatment program,<sup>1,17</sup> with 1 of the 2 authors noting that hip abduction exercises “seemed to hasten recovery.”<sup>17</sup> Therefore, a treatment program addressing hip strength and movement reeducation to control the femur in the frontal and transverse planes during functional activities may play a role in the treatment of patients with piriformis syndrome who demonstrate excessive frontal and transverse plane motions at the hip.

The purpose of this case report was to describe an alternative treatment approach for piriformis syndrome that emphasizes hip muscle strengthening and movement reeducation. The patient in

this case had symptoms consistent with piriformis syndrome, weak hip abductors and external rotators, and excessive hip adduction and internal rotation during functional lower extremity activities.

## CASE DESCRIPTION

### General Demographics

THE PATIENT WAS A 30-YEAR-OLD male who worked as a real estate agent. He also reported that he was a part-time tennis instructor and participated in a weekly basketball league. Apart from his current symptoms, the patient also had a 15-year history of intermittent low back pain.

### History of Presenting Condition

The patient was initially seen by an orthopaedic surgeon and given a diagnosis of sciatica. At this visit, radiographs were obtained of his lumbar spine and hip, which revealed no abnormalities. The patient was subsequently referred to physical therapy.

The patient presented to physical therapy with a 2-year history of deep right buttock pain that radiated to the posterior thigh. The patient stated that the onset of his pain was insidious and denied any trauma that contributed to his current symptoms. The patient did not report any prior treatment for his buttock and thigh pain, but stated that he received intermittent chiropractic treatment for his low back symptoms.

### Presenting Complaints

The patient reported that his symptoms were exaggerated by playing basketball or tennis for 30 to 60 minutes. Stairs and squatting activities also were noted as aggravating activities. He reported that his pain was alleviated when he stopped participating in sports, but that it would be 4 to 6 days before symptoms would completely resolve. The patient's current activity level included participation in a weekly basketball league and teaching tennis 6 to 12 hours per week. He reported having to modify his tennis instruction

to avoid running activities. The patient's symptoms were limiting the number of tennis lessons he could give per week and his ability to play basketball. The patient's stated goals were to participate in his weekly basketball league and return to his normal regime of tennis lessons of 3 nights per week for 2 to 4 hours.

### Test and Measures

**Pain and Functional Status** The patient completed a visual analog scale (VAS), where 0 is no pain and 10 is the most pain possible, to assess his current level of pain.<sup>34</sup> The patient's baseline pain in his buttock and posterior thigh was 3/10 and reached a level of 9/10 after participation in 1 game of basketball. Prior to treatment, the patient completed the Lower Extremity Functional Scale to evaluate his functional status with regards to his buttock and posterior thigh symptoms. This self-assessment functional tool has been shown to be valid and reliable.<sup>4</sup> The patient's score on the Lower Extremity Functional Scale Questionnaire was 65/80, with 80 representing maximum function.

**Differential Diagnosis Screening** Active and passive examination of the lumbar spine and sacroiliac joint were performed to rule out spine and pelvic contributions to his symptoms. Active examination tests for the lumbar spine consisted of active range of motion (AROM), followed by AROM with overpressure in flexion, extension, and sidebending and rotation to the left and right. Passive testing was performed using both central and lateral posterior-to-anterior spring tests from the fifth lumbar to the tenth thoracic spinal segments. There was no reproduction of his buttock or thigh symptoms with active or passive testing to the lumbar spine. The sacroiliac joint was assessed using a cluster of tests, as described by Laslett.<sup>21</sup> All tests were negative with respect to the reproduction of symptoms.

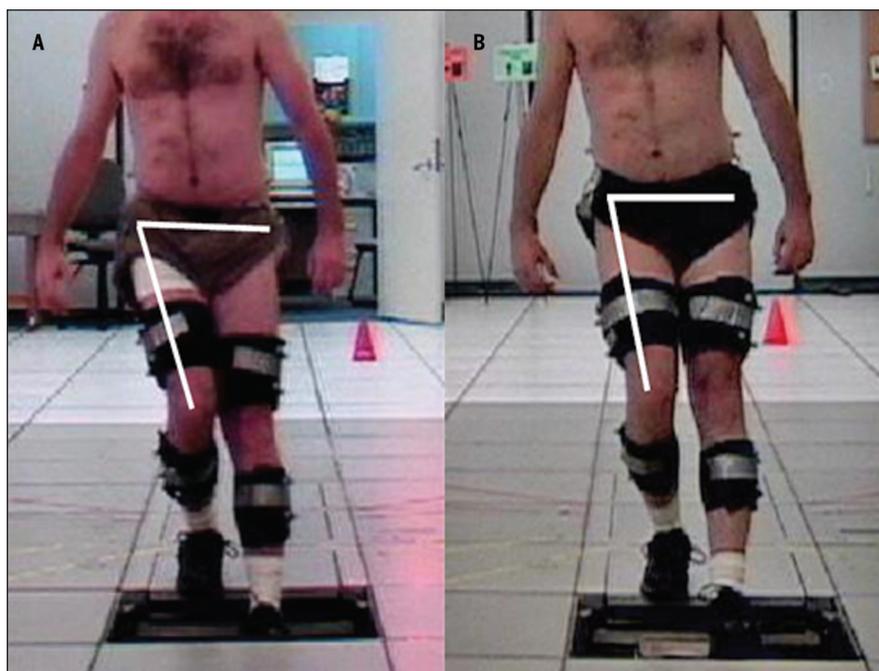
**Hip Joint Examination** Passive motion assessment of the hip joint revealed normal ranges for hip flexion, internal rotation, and external rotation without

reproduction of symptoms. Hip flexor muscle length was assessed using the Thomas test.<sup>18</sup> No restrictions were noted when the 1-joint hip flexor was assessed (ie, iliopsoas); however, restrictions ( $-12^\circ$ ) were evident when evaluating the 2-joint hip flexor (ie, rectus femoris).

Clinical tests were performed to assess for intra-articular hip joint pathology. The scour test, hip quadrant test, log roll test, FABER, and active straight leg test<sup>23</sup> were performed, and all were negative with respect to reproduction of the patient's symptoms. Clinical tests also were performed to assess for piriformis syndrome. These tests included the piriformis stretch test above and below  $60^\circ$  of hip flexion,<sup>2,5,15,16</sup> the flexion/adduction/internal rotation (FAIR) test,<sup>5,15,16</sup> and piriformis contraction test.<sup>2</sup> The piriformis stretch test below  $60^\circ$  was performed by maximally adducting and internally rotating the hip, with the hip flexed to  $45^\circ$ . The piriformis stretch test above  $60^\circ$  was performed by maximally adducting and externally rotating the hip, with the hip flexed to  $90^\circ$ . The FAIR test was performed by placing the patient in a sidelying position on the unaffected side, with the affected (superior) hip being moved passively into flexion, adduction, and internal rotation.<sup>15,16</sup> The piriformis contraction test was performed by placing the patient in the FAIR test position and having the patient elevate the knee off the table for 5 seconds.<sup>2</sup> The patient was found to have reproduction of buttock and thigh symptoms with both of the piriformis stretch tests, the FAIR test, and the piriformis contraction test.

Neurodynamic testing, as described by Butler,<sup>7</sup> was performed to assess the sciatic nerve. Reproduction of buttock pain occurred at  $50^\circ$  of hip flexion during the straight leg raise test. Assessment of the straight leg raise test with ankle dorsiflexion resulted in reproduction of lower back, buttock, and posterior thigh pain, with only  $10^\circ$  of hip flexion. Symptoms resolved with ankle plantar flexion.

Soft tissue palpation revealed tenderness of the piriformis muscle and tro-



**FIGURE 1.** Patient performing the step-down maneuver pretreatment (A) and posttreatment (B). Both photos were taken at the same knee flexion angle (as assessed by motion analysis). Pretreatment, the patient demonstrates a greater amount of hip internal rotation and adduction and contralateral hip drop.



**FIGURE 2.** The SERF Strap consist of a thin, elastic material that is secured to the proximal aspect of the leg, wraps in a spiral fashion around the thigh, and is anchored around the pelvis. The line of action of the SERF Strap pulls the hip into external rotation.

chanteric bursa. Palpation also resulted in the reproduction of buttock and posterior thigh pain.

**Muscle Strength** Manual muscle testing of the hip musculature was performed as described by Kendall et al.<sup>18</sup> Hip extensor strength was tested in the modified position, due to hip flexor tightness. Manual muscle test grades of 3+/5, 3+/5, and 4-/5 were given for the hip extensors, hip abductors, and external rotators, respectively.

**Dynamic Assessment** An observational gait analysis was performed as the pa-

tient walked at a self-selected pace. The patient demonstrated decreased hip extension bilaterally in terminal stance. He also demonstrated abnormal movements in both the frontal and transverse planes during the stance phase on the right: (a) right trunk lean during single-limb support, (b) increased hip adduction during loading response through terminal stance, (c) increased hip internal rotation during weight acceptance through terminal stance, and (d) contralateral pelvic drop during single-limb support.

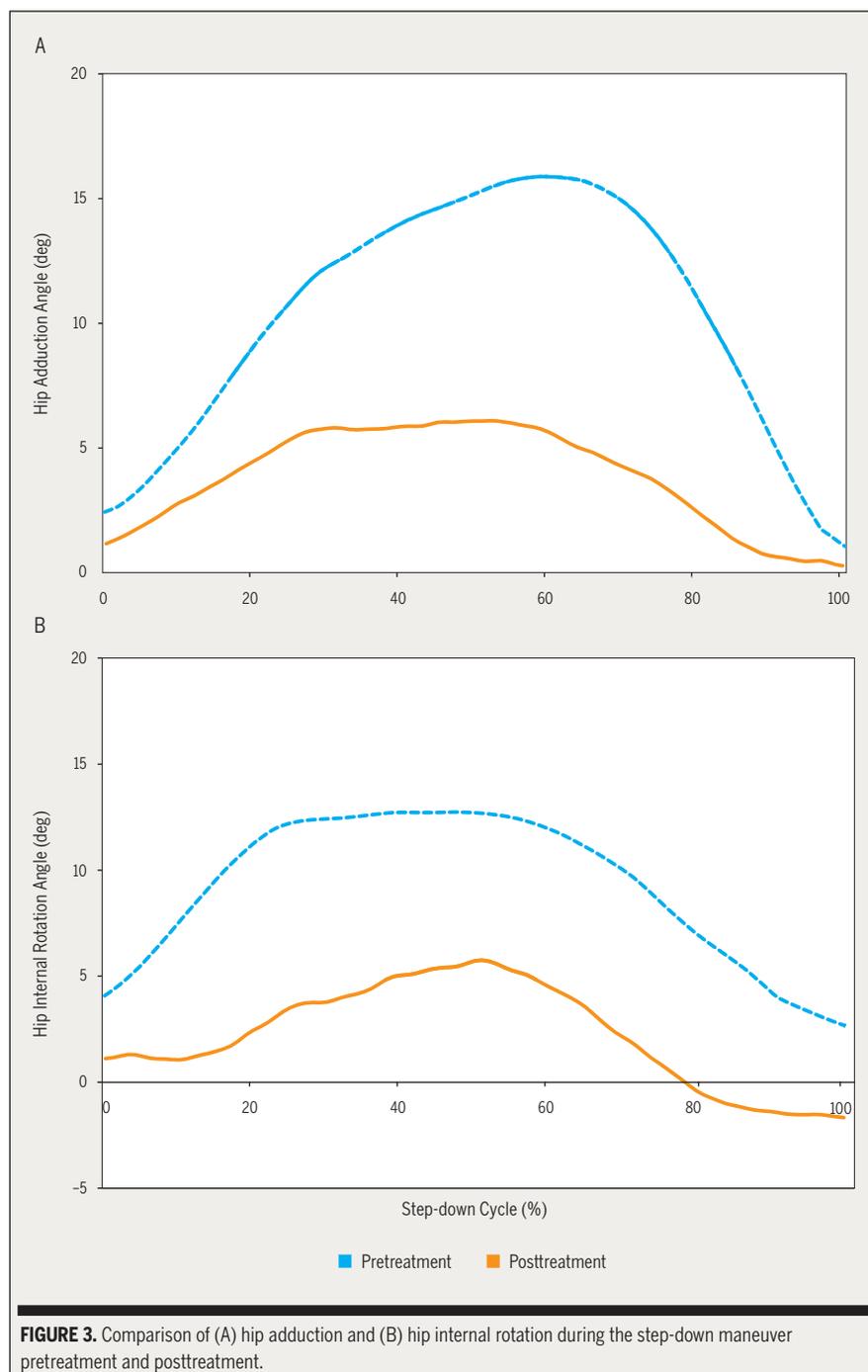
The patient also was evaluated while

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performing a step-down maneuver, as described by Souza and Powers.<sup>31</sup> The step-down task was selected because it is a single-limb activity, thereby placing greater demands on the lower-extremity musculature. The step-down test involved the patient stepping down slowly from a 20.4-cm step using the affected limb over a 2-second period. During this test, the patient demonstrated a contralateral pelvic drop, increased hip adduction, and increased hip internal rotation (FIGURE 1A). The patient also reported an increase in symptoms during this test (7/10 on the VAS). The patient was then provided verbal and visual instructions in an attempt to correct the excessive hip adduction and internal rotation during the step-down test. A repeated assessment of the step-down test was then performed without significant change in hip motion or symptoms. A hip-strapping device (SERF Strap; DonJoy Orthopedics Inc, Vista, CA) was then applied to the patient to assist with hip control while performing this maneuver. The SERF Strap consists of a thin elastic material that is secured to the proximal aspect of the leg, wraps in a spiral fashion around the thigh, and is anchored around the pelvis (FIGURE 2). The line of action of the SERF Strap pulls the hip into external rotation, with the intent of limiting excessive hip adduction and internal rotation during functional activities. The patient was observed to have decreased hip adduction and internal rotation, and reported decreased pain (4/10) when repeating the step-down test with the SERF Strap. We believe that the decrease in pain, combined with improved hip kinematics, could be interpreted as a diagnostic indicator that abnormal movement patterns at the hip were a contributing factor to his symptoms.

### Biomechanical Evaluation

In addition to the clinical information obtained during the physical examination, the subject underwent a preintervention and postintervention biomechanical evaluation at the Musculoskeletal Bio-



**FIGURE 3.** Comparison of (A) hip adduction and (B) hip internal rotation during the step-down maneuver pretreatment and posttreatment.

mechanics Research Laboratory at the University of Southern California. The purpose of this testing was to provide objective data to compare the subject's lower extremity kinematics before and after the intervention.

Three-dimensional motion analysis was performed using a computer-aided

video motion analysis system (Vicon, Oxford, UK). Kinematic data were sampled at 120 Hz. Reflective markers (14-mm spheres) placed on specific anatomical landmarks were used to determine lower extremity joint motions in the sagittal, frontal, and transverse planes. Data were obtained while the patient performed the

step-down maneuver. The subject was instructed to stand on his right lower extremity while performing a step-down in 2 seconds and to return to the starting position in 2 seconds. The depth of the step for the step-down maneuver was set at 18 cm (approximately 10% of the patient's total body height). The speed of the movement was guided with a metronome set at 60 beats per minute. When averaged across 5 repetitions, peak hip adduction and internal rotation were 15.9° and 12.8°, respectively (FIGURE 3). These values were considered excessive, based on the normative data previously published by Souza and Powers.<sup>31</sup>

### Assessment

Given the subjective and objective information obtained during our examination, it was our impression that the patient demonstrated significant impairments specific to the hip region. More specifically, our patient presented with weakness of the hip extensors, abductors, and external rotators, limited control of the hip and pelvis during functional movement testing, and reproduction of symptoms with passive stretching and activation of the piriformis muscle. We theorized that weakness of the gluteus maximus and gluteus medius was contributing to abnormal movement patterns at the hip, thereby subjecting the piriformis to excessive lengthening or eccentric loading during functional activities. In turn, we believed that the excessive lengthening of the piriformis was compressing the sciatic nerve. The fact that the application of the SERF Strap resulted in a simultaneous improvement in hip motion and buttock pain supported our hypothesis. Therefore, it was our belief that an intervention focused on addressing the hip muscle weakness and abnormal movement patterns would alleviate the patient's pain and improve his functional status.

### Intervention

**Foundations for Treatment** The patient attended physical therapy 8 times over



**FIGURE 4.** Phase 1 exercises included (A) bridge with Thera-Band resistance, and (B) clam with Thera-Band resistance.

a 3-month period. He was educated regarding his condition and the intended treatment approach. In addition, realistic goal setting was discussed.

The patient's physical therapy program focused on strengthening the hip abductors, extensors, and external rotators, as well as movement reeducation. Exercises were progressed over 3 phases. The first phase consisted of non-weight-bearing exercises to emphasize isolated muscle recruitment. The second phase of the program consisted of weight-bearing exercises, and the third phase consisted of dynamic and ballistic training (ie, plyometrics). Throughout each stage, the patient received feedback regarding his movement pattern and was encouraged to perform his exercises in a way that would minimize lengthening of the piriformis (ie, movement reeducation). In particular, the patient was instructed to minimize the amount of hip adduction and internal rotation during the weight-bearing phase of his program. This was accomplished using verbal and tactile cueing.

When the patient could complete the proposed exercises and repetitions in each

phase, the program would progress to the next phase. The patient was given a home exercise program that he was instructed to perform once a day. The home exercise program paralleled the exercises given in the clinic. The patient was instructed to perform all exercises in a manner that would not reproduce his symptoms.

**Phase 1: Isolated Muscle Recruitment (Weeks 0-4)** The patient was seen for 2 visits during this period. He was given 2 exercises: bilateral bridging to target his hip extensors and sidelying clams to target his hip abductors and external rotators. For all exercises during this phase the patient was instructed to emphasize motion at the hip joint and to avoid excessive pelvis/trunk motion.

The bilateral bridge was performed with Thera-Band wrapped around his thighs just proximal to the knee (FIGURE 4A). The patient was instructed to elevate his pelvis, while simultaneously abducting and externally rotating his hips. The patient also was instructed to not allow his thighs to adduct and internally rotate while lowering the pelvis.

Initially, the sidelying clam exercise was performed without resistance, with the hip and knee in 45° of flexion with his feet together (FIGURE 4B). The patient was instructed to raise his knee "up and back," which was achieved through hip abduction and external rotation. When the patient was able to perform 3 sets of 15 repetitions of the clam exercises without resistance, the exercise was progressed by adding resistance with the use of Thera-Band wrapped around the thigh just proximal to the knee.

**Phase 2: Weight-Bearing Strengthening (Weeks 4-9)** The patient was seen for 3 visits during this phase of his rehabilitation. Initially, the patient began with double-limb weight-bearing exercises and was progressed to single-limb movements to increase the demands on the hip musculature.

At the third visit, the initial exercise during this phase was a squat maneuver with Thera-Band resistance applied around the thighs just proximal to the

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**FIGURE 5.** Phase 2 exercises included (A) squat with Thera-Band resistance, (B) side-step with Thera-Band resistance, (C) single-limb sit to stand, and (D) step-down.



**FIGURE 6.** Phase 3 exercises included (A) forward lunge, (B) lunge at 45°, (C) double-limb jump/lands position, and (D) double-limb jump/single-limb land.

knees (**FIGURE 5A**). The patient was initially instructed to perform the squat to a depth of 45° and then was progressed to 75°. The patient also was instructed on a sidestepping exercise with Thera-

Band (**FIGURE 5B**). The patient started in a squat position of 45° of hip and knee flexion, and was instructed to take steps to the right and left along a 10-m walkway by abducting and externally rotating

his hips. The patient was instructed to maintain control of the hip in the frontal and transverse planes (ie, knees over toes), and to keep the trunk erect during this exercise.

At the fourth visit, single-limb sit-to-stand and step-up/step-down exercises were initiated. The single-limb sit-to-stand exercise was performed in a manner similar to the squat, in that the patient was cued verbally to maintain proper lower extremity alignment in the frontal and transverse planes during the exercise and to avoid trunk sidebending (**FIGURE 5C**). The patient initially performed the exercise from a 70-cm high surface, as measured from the floor to the top of a treatment table. Once he was able to demonstrate adequate control of hip motions in the frontal and transverse planes for 3 sets of 15 repetitions, the exercise was progressed by lowering the surface in 4-cm increments to a final height of 58 cm.

For the step-up/step-down exercise, the patient used a 20-cm-high step stool. He was instructed to perform the step-down exercise by touching his heel to the ground and returning slowly to the start position over a 3-second period (**FIGURE 5D**). Proper lower extremity alignment during the ascending and descending portions of the movement was monitored during each repetition. Initially, he performed the exercise with contralateral upper extremity support. When he was able to demonstrate adequate control of hip motions in the frontal and transverse planes for 3 sets of 15 repetitions, the exercise was progressed by removing the upper extremity support.

**Phase 3: Functional Training (Weeks 9-14)** The patient was seen for 3 visits during this phase of his rehabilitation. Progression to phase 3 took place when he demonstrated adequate control of his hip motions in the frontal and transverse planes, for 3 sets of 15 repetitions, during the phase 2 single-limb support exercises. As part of phase 3, the patient performed lunges at a 45° knee flexion angle to the

left and right, double-limb vertical jumps with double-limb landings, and double-limb vertical jumps with single-limb landings, alternating right and left sides. Progression was achieved by performing all exercise with an increased rate of speed. This was done to replicate the sport-specific demands the patient would be placing on his lower extremity upon discharge.

At the sixth visit, the patient initially performed forward lunges (FIGURE 6A). Instruction for this exercise included proper alignment of the lower extremity (ie, not to allow his knee to pass beyond his foot) and to flex his lead knee to a depth of 75°. The patient was able to demonstrate adequate control of the femur in the frontal and transverse planes for 3 sets of 15 repetitions and was subsequently progressed to lateral lunges at a 45° angle to the left and right (FIGURE 6B).

At the seventh visit, the patient was instructed to perform maximal effort double-limb take-off jumps with double-limb landings to a deep squat with 90° of knee flexion without hip adduction or internal rotation (FIGURE 6C).

At the eighth visit, the patient demonstrated adequate control of his hip motions in the frontal and transverse planes with double-limb take-offs and landings for 3 sets of 15 repetitions and was progressed to maximal-effort double-limb take-off jumps with right and left single-limb landings (FIGURE 6D). The patient was cued verbally to perform all single-limb landings without excessive hip adduction or internal rotation.

## OUTCOMES

THE PATIENT WAS RE-EVALUATED 14 weeks after the initiation of treatment. All posttreatment assessments were performed as described above.

### Pain and Functional Status

The patient achieved a follow-up score of 80/80 on his Lower Extremity Functional Scale questionnaire. He reported a 0/10 pain in his buttock and posterior thigh

during daily tasks, and while participating in his sporting activities. Subjectively, the patient reported that he was able to return to playing basketball and instructing tennis without limitation.

### Hip Joint Examination

Re-evaluation of the patient's hip demonstrated no pain with the piriformis muscle stretch tests, a negative FAIR test, and no pain with soft tissue palpation. Reassessment of straight leg raise was 50°, with no reproduction of symptoms. Straight leg raise with dorsiflexion was 40°, with reproduction of symptoms in the buttock region. As with the initial evaluation, pain resolved with plantar flexion of the ankle.

### Muscle Strength

Re-evaluation of hip muscle performance revealed improved strength of the previously tested hip musculature. Postintervention manual muscle test grades of 4+/5 were given to the hip extensors, abductors, and external rotators.

### Dynamic Reassessment

Observational movement analysis revealed improved kinematics postintervention. In general, decreases in contralateral pelvic drop, hip adduction, and hip internal rotation were noted during the stance phase of gait. The patient demonstrated similar improvements during the step-down test (FIGURE 1B).

### Biomechanical Reassessment

Postintervention biomechanical analysis of the step-down test was performed as described above. When compared to the preintervention values, peak hip adduction improved from 15.9° to 5.8° and hip internal rotation improved from 12.8° to 5.9° (FIGURE 3B).

### Follow-up

The patient was contacted 1 year following discharge to assess his functional status. He reported that he remained pain free and continued to participate in all physical activities including his weekly

basketball league and tennis instruction without limitation. The patient was asked to complete a follow-up Lower Extremity Functional Scale in which he scored 80/80.

## DISCUSSION

THE PURPOSE OF THIS CASE REPORT was to describe an alternative treatment approach for piriformis syndrome, focusing on hip muscle strengthening and movement reeducation. Previous clinical reports addressing piriformis syndrome have focused on multiple, concurrent treatment interventions and have emphasized stretching,<sup>1,11,15,16,19,26,27,30</sup> soft tissue mobilization,<sup>1,5,11,15,16,19,30</sup> electrophysical agents,<sup>1,5,11,16,19</sup> and medication and injections.<sup>1,3,5,8,11,15,16,26,27,30</sup> The overriding premise behind such interventions is that a shortened piriformis is responsible for creating compression on the sciatic nerve.<sup>5,9,11,15,27,29,33</sup> Although 2 previous authors addressed hip abductor weakness and 1 author noted that hip abductor strengthening “seemed to hasten recovery,”<sup>1,17</sup> these authors offered no mechanism as to why strengthening would be effective. After a review of the published literature, no studies were found that mentioned our proposed mechanism of injury or treatment approach.

The current case report suggests that piriformis syndrome can be managed without stretching, electrophysical agents, or soft tissue mobilization. Given that the piriformis attaches to the greater trochanter, we hypothesized that the excessive motions of hip adduction and internal rotation observed during functional movement tests were putting strain on this muscle resulting in compression of the sciatic nerve. Following this line of thought, we believed that if the abnormal movement patterns could be corrected by strengthening of the hip/pelvic musculature along with movement reeducation, strain on the piriformis could be minimized, resulting in less

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compression on the sciatic nerve. By addressing the proposed functional cause of the piriformis irritation, as opposed to focusing on the muscle itself, we were able to achieve a long-term successful outcome for this patient.

The intervention described in this case report focused on functional exercises aimed at strengthening the hip extensors, abductors, and external rotators, as well as correction of faulty movement patterns. In this respect, we feel that the key muscle was the gluteus maximus. Apart from being a strong hip extensor and external rotator, the upper half of this muscle also functions as a hip abductor.<sup>22</sup> Given that the gluteus maximus is a primary external rotator of the hip,<sup>26</sup> we feel that improved performance of this muscle served 2 functions: (1) to decrease the demand on the piriformis through agonist activity and (2) to prevent hip motion that would cause increased strain on the piriformis. At discharge, observed improvements in hip strength corresponded to improvements in hip kinematics. In particular, kinematic data revealed a reduction in the amount of hip internal rotation (6.9°) and hip adduction (10.1°) with the step-down test. In addition, the patient demonstrated a 30° improvement in the straight leg raise test with ankle dorsiflexion (10°-40°). We speculate that this may have been the result of decreased irritability of the sciatic nerve.

Our patient reached his goal of returning to his prior level of sport involvement with no complaints of pain during or after his basketball games or tennis. In addition to the cessation of his buttock and thigh pain, the patient reported full resolution of his low back pain, a compelling outcome that may or may not have any correlation to his increase in functional hip stability.

Despite these outcomes, care must be taken in establishing cause and effect based on a single case report. That being stated, the likelihood of post-treatment outcomes being the result of spontaneous time-related recovery are

unlikely, given the chronicity of the patient's symptoms. Although we hypothesize that improved gluteus maximus and gluteus medius strength and movement reeducation were the primary reasons underlying the clinical outcomes noted in this case report, it is possible that the patient's improvements were the result of an increase in piriformis strength, thereby allowing this muscle to better withstand the loads placed upon it during functional activities. Furthermore, care must be taken in assuming the changes observed in our patient were due solely to increases in hip muscle strength. First, strength assessments were made using subjective measures of muscle performance testing as opposed to more objective methods (ie, dynamometry). Second, a recent study by Mizner and colleagues suggests that changes in movement patterns may be independent of muscle strength.<sup>25</sup> As such, future research should be directed at better understanding the relationship between muscle performance deficits and altered movement patterns in relationship to piriformis syndrome.

### CONCLUSION

**T**HIS CASE REPORT DESCRIBES THE management of a patient with complaints and findings consistent with piriformis syndrome, who responded favorably to an intervention program focused on strengthening of the hip musculature and correction of faulty lower extremity movement patterns. Clinically relevant improvements were observed without treatment strategies commonly used to treat piriformis syndrome (stretching, soft tissue mobilization, injections). Therefore, physical therapy interventions focusing on strengthening of hip musculature to reduce excessive hip motions may be indicated for patients presenting with piriformis syndrome. Despite the outcomes presented in this case report, care must be taken in establishing cause and effect based on a single patient. ●

### REFERENCES

1. Barton PM. Piriformis syndrome: a rational approach to management. *Pain*. 1991;47:345-352.
2. Beatty RA. The piriformis muscle syndrome: a simple diagnostic maneuver. *Neurosurgery*. 1994;34:512-514; discussion 514.
3. Benzon HT, Katz JA, Benzon HA, Iqbal MS. Piriformis syndrome: anatomic considerations, a new injection technique, and a review of the literature. *Anesthesiology*. 2003;98:1442-1448.
4. Binkley JM, Stratford PW, Lott SA, Riddle DL. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application. North American Orthopaedic Rehabilitation Research Network. *Phys Ther*. 1999;79:371-383.
5. Boyajian-O'Neill LA, McClain RL, Coleman MK, Thomas PP. Diagnosis and management of piriformis syndrome: an osteopathic approach. *J Am Osteopath Assoc*. 2008;108:657-664.
6. Broadhurst N. Piriformis syndrome and buttock pain. *Aust Fam Physician*. 1990;19:1754.
7. Butler D. *The Sensitive Nervous System*. Adelaide, Australia: NOI Group Publications; 2000.
8. Byrd JW. Piriformis syndrome. *Oper Tech Sports Med*. 2005;13:71-79.
9. Cameron HU, Noftal F. The piriformis syndrome. *Can J Surg*. 1988;31:210.
10. Carter AT. Piriformis syndrome: a hidden cause of sciatic pain. *Athl Training*. 1988;23:243-245.
11. Childers MK, Wilson DJ, Gnatz SM, Conway RR, Sherman AK. Botulinum toxin type A use in piriformis muscle syndrome: a pilot study. *Am J Phys Med Rehabil*. 2002;81:751-759. <http://dx.doi.org/10.1097/01.PHM.0000027426.98000.57>
12. Douglas S. Sciatic pain and piriformis syndrome. *Nurse Pract*. 1997;22:166-168, 170, 172 passim.
13. Durrani Z, Winnie AP. Piriformis muscle syndrome: an underdiagnosed cause of sciatica. *J Pain Symptom Manage*. 1991;6:374-379.
14. Edwards FO. Piriformis syndrome. In: *Academy of Applied Osteopathy Yearbook*. Carmel, CA: Academy of Applied Osteopathy; 1962:39-41.
15. Fishman LM, Dombi GW, Michaelsen C, et al. Piriformis syndrome: diagnosis, treatment, and outcome--a 10-year study. *Arch Phys Med Rehabil*. 2002;83:295-301.
16. Fishman LM, Konnoth C, Rozner B. Botulinum neurotoxin type B and physical therapy in the treatment of piriformis syndrome: a dose-finding study. *Am J Phys Med Rehabil*. 2004;83:42-50; quiz 51-43. <http://dx.doi.org/10.1097/01.PHM.0000104669.86076.30>
17. Hallin RP. Sciatic pain and the piriformis muscle. *Postgrad Med*. 1983;74:69-72.
18. Kendall FP, McCreary EK, Provance PG, Rodgers MM, Romani WA. *Muscles: Testing and Function with Posture and Pain*. 5th ed. Baltimore, MD: Lippincott, Williams, & Wilkins; 2005.

19. Keskula DR, Tamburello M. Conservative Management of Piriformis Syndrome. *J Athl Train*. 1992;27:102-110.
20. Kuncewicz E, Gajewska E, Sobieska M, Samborski W. Piriformis muscle syndrome. *Ann Acad Med Stetin*. 2006;52:99-101; discussion 101.
21. Laslett M, Aprill CN, McDonald B, Young SB. Diagnosis of sacroiliac joint pain: validity of individual provocation tests and composites of tests. *Man Ther*. 2005;10:207-218. <http://dx.doi.org/10.1016/j.math.2005.01.003>
22. Lyons K, Perry J, Gronley JK, Barnes L, Antonelli D. Timing and relative intensity of hip extensor and abductor muscle action during level and stair ambulation. An EMG study. *Phys Ther*. 1983;63:1597-1605.
23. Martin RL, Enseki KR, Draovitch P, Trapuzzano T, Philippon MJ. Acetabular labral tears of the hip: examination and diagnostic challenges. *J Orthop Sports Phys Ther*. 2006;36:503-515. <http://dx.doi.org/10.2519/jospt.2006.2135>
24. Mayrand N, Fortin J, Descarreaux M, Normand

- MC. Diagnosis and management of posttraumatic piriformis syndrome: a case study. *J Manipulative Physiol Ther*. 2006;29:486-491. <http://dx.doi.org/10.1016/j.jmpt.2006.06.006>
25. Mizner RL, Kawaguchi JK, Chmielewski TL. Muscle strength in the lower extremity does not predict postinstruction improvements in the landing patterns of female athletes. *J Orthop Sports Phys Ther*. 2008;38:353-361. <http://dx.doi.org/10.2519/jospt.2008.2726>
26. Neumann DA. *Kinesiology of the Musculoskeletal System: Foundations for Physical Rehabilitation*. St Louis, MO: Mosby; 2002.
27. Pace JB, Nagle D. Piriformis syndrome. *Western J Med*. 1976;124:435-439.
28. Papadopoulos SM, McGillicuddy JE, Albers JW. Unusual cause of 'piriformis muscle syndrome'. *Arch Neurol*. 1990;47:1144-1146.
29. Parziale JR, Hudgins TH, Fishman LM. The piriformis syndrome: a review paper. *Am J Orthop*. 1996;25:819-823.
30. Retzlaff EW, Berry AH, Haight AS, et al. The

- piriformis muscle syndrome. *J Am Osteopath Assoc*. 1974;73:799-807.
31. Souza RB, Powers CM. Differences in hip kinematics, muscle strength, and muscle activation between subjects with and without patellofemoral pain. *J Orthop Sports Phys Ther*. 2009;39:12-19. <http://dx.doi.org/10.2519/jospt.2009.2885>
32. Steiner C, Staubs C, Ganon M, Buhlinger C. Piriformis syndrome: pathogenesis, diagnosis, and treatment. *J Am Osteopath Assoc*. 1987;87:318-323.
33. TePoorten BA. The piriformis muscle. *J Am Osteopath Assoc*. 1969;69:150-160.
34. Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. *J Clin Nurs*. 2005;14:798-804. <http://dx.doi.org/10.1111/j.1365-2702.2005.01121.x>



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