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CLINICAL SUGGESTION

CLINICAL APPLICATION OF THE RIGHT SIDELYING RESPIRATORY LEFT ADDUCTOR PULL BACK EXERCISE

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ABSTRACT

Problem: Lumbopelvic-femoral conditions are common and may be associated with asymmetrical musculoskeletal and respiratory impairments and postural mal-alignment called a Left Anterior Interior Chain (AIC) pattern. An inherent pattern of asymmetry involves the trunk/ribs/spine/pelvis/hip joints and includes the tendency to stand on the right leg and shift the center of gravity to the right which may result for example, in a tight left posterior hip capsule, poorly approximated left hip, long/weak left adductors, internal obliques (IO) and transverse abdominus (TA), short/strong/over active paraspinals and muscles on the right anterior outlet (adductors, levator ani and obturator internus), a left rib flare and a decreased respiratory diaphragm zone of apposition (ZOA).

The Solution: A therapeutic exercise technique that can address impairments associated with postural asymmetry may be beneficial in improving function, reducing and/or eliminating pain causation, and improving breathing. The Right Sidelying Left Respiratory Adductor Pull Back is an exercise designed to affect alignment of the lumbopelvic-femoral region by influencing the left posterior ischiofemoral ligament, ZOA and right anterior outlet and left anterior inlet (rectus femoris, sartorius), activating/shortening the left adductors, left IO/TA's and inhibiting/lengthening the paraspinals, bilaterally.

Discussion: The exercise technique is often used by Physical Therapists, Physical Therapist assistants and Athletic Trainers as an initial exercise to positively affect position/alignment of the lumbopelvic-femoral region, referred to as "repositioning," by clinicians who use it. Four published case studies have used similar exercises to address the above impairments associated with a Left AIC pattern and in each 100% improvement in function and pain intensity was described. This particular exercise technique is relatively new and warrants future research.

Keywords: Adductors, left AIC, postural restoration

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INTRODUCTION

Lumbopelvic-femoral conditions such as low back pain (LBP),[2] sacroiliac joint dysfunction (SIJD),[3] hip impingement,[4] and lateral hip pain such as trochanteric bursitis and/or gluteus medius tendonitis[5] occur in both a general and an athletically active population. Athletes may be at risk for some of these conditions such as hip impingement, because of the excessive stresses placed on their bodies during their sport.[4] Asthma is also seen in the general population, affecting an estimated 17 million Americans.[6,7] Exercise induced asthma (EIA) occurs in 30-70% of endurance athletes.[8] EIA may be common in endurance athletes because of the increased demand for breathing during sport. Impairments such as unilateral muscle weakness, muscle over activity, ligament/capsule shortness, decreased passive joint range of motion (ROM), a functional leg length discrepancy, and a decreased/suboptimal diaphragm position (zone of apposition) may also be associated with the above lumbo-pelvic-femoral conditions and EIA.[9-15] Many of the impairments associated with lumbopelvic-femoral conditions that are identified by clinicians such as physical therapists and/or athletic trainers, may be associated with postural asymmetry.

Left Anterior Interior Chain (Left AIC) Pattern

Boyle, Kouwenhoven and Boulay discussed a typical inherent pattern of postural asymmetry where individuals have a tendency to shift their body weight or center of gravity (COG) to the right with pelvis and lumbar vertebrae rotated right and upper thoracic vertebrae and pubic symphysis rotated left.[9,11,16,17] (Figure 1). This pattern has associated asymmetry of bone/joint position, muscle imbalance and possible patterns of compensation which may lead to ligamentous laxity (e.g. left anterior hip ligaments).[11,18] This pattern has been described as the Left Anterior Interior Chain (Left AIC) Pattern in order to place focus on a polyarticular chain of muscles that can become imbalanced and that may respond to interventions.[18] The Left AIC pattern is very similar to Florence Kendall's Right Handed Pattern[19] however it includes more detail and is not attributed to hand dominance, but rather organ (visceral) position, asymmetrical growth and development and neurologic patterned function.[20] A Right Anterior Interior Chain (R AIC) pattern would be the opposite, i.e. lumbar vertebrae rotated left and upper thoracic vertebrae rotated right. Kouwenhoven et al documented this pattern occurring in those individuals with their organ position reversed, called situs inversus totalis.[20] A polyarticular muscle chain is "muscles that overlap without a break in continuity and that cross more than one joint."[21] The left AIC includes the left hemi-diaphragm, iliopsoas, tensor fascia latae, vastus lateralis, and bicep femoris.[9,11,18,22,23] Rationale for the terminology left, in "Left AIC" is because the left-sided muscles are more active and in a suboptimal position compared to the same muscles on the right. The word anterior is used because the muscles are anterior to the spine. Interior is used because the muscles are posterior and deep to the rib cage and are not easily palpated. Chain represents muscles that have no break in continuity and therefore can functionally be considered one muscle.[18,23] In the author's experience,

Figure 1. *Standing in a Left Anterior Interior Chain (LAIC) pattern. Note: Center of gravity shifted to the right, left pelvis in forward rotation/anterior pelvic tilt, right pelvis in backward rotation/posterior pelvic tilt, right hip IR/Add, left hip ER/Abd, and right shoulder lower than left.*

rarely, if ever does a right AIC occur due to the typical anatomical positioning of the liver and heart.

Examination findings associated with a Left AIC pattern include impairments seen with visual observations, joint ROM, muscle performance and special tests. Possible visual observations may include observation of the patient/athlete preferring to: stand on their right leg with their left hemi-pelvis in forward rotation/anterior pelvic tilt (APT) and right hemi-pelvis in backward rotation, right hip in internal rotation (IR) and adduction (Add) and left hip often in external rotation (ER) and abduction (Abd). Additionally, they tend to use their right leg more during the transition from sitting to standing, and they prefer to sit, lie or sleep on either side with their left knee forward/in front of the right knee. (Figure 2) Visual observation of a patient/athlete with this postural pattern may also include: the right shoulder lower than their left with associated right thoracic abduction and left thoracic adduction, an increase in rib external rotation/flare on the left (which indicates a reduced zone of apposition [ZOA] of the left hemi-diaphragm). Additionally a greater left infrasternal angle, and a functional leg length difference (LLD) may be seen. The infrasternal angle is defined as "the angle between the lower borders of the costal cartilages of the two sides as they approach the sternum."[24] (Figure 3) A decreased ability to shift the left femur as far back (behind the right knee) as the right in either sitting or sidelying, decreased frontal plane control of the trunk and pelvis, and inability to do upright activities without compensation may also be seen. (Figures 4 & 5).

Figure 2. *Sleeping in a Left Anterior Interior Chain Pattern: Left hip in IR/Add and right hip in ER/Abd.*

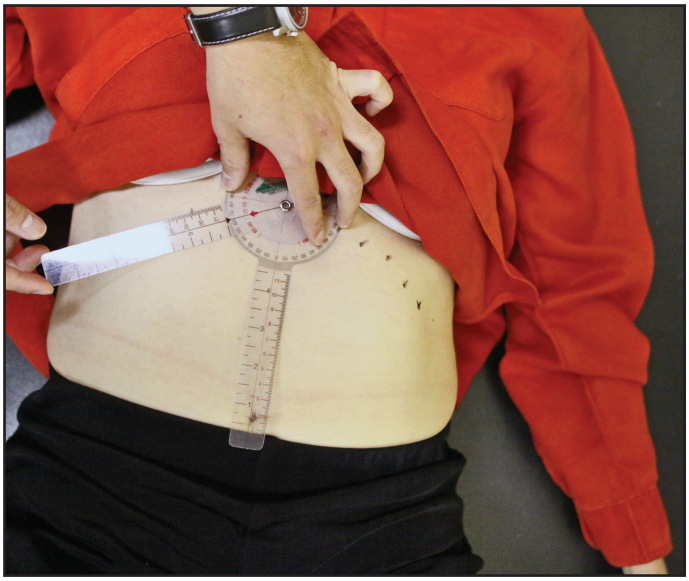

Figure 3. *Infrasternal goniometric angle measurment, showing angle from lower borders of rib costal cartilages to xyphoid process of sternum.*

Figure 4. *Active left hip shift (note position of relative internal rotation/adduction) in sitting.*

Figure 5. *Active right hip shift (note position of relative internal rotation/adduction) in sitting (greater than demonstrated in previous figure on the left).*

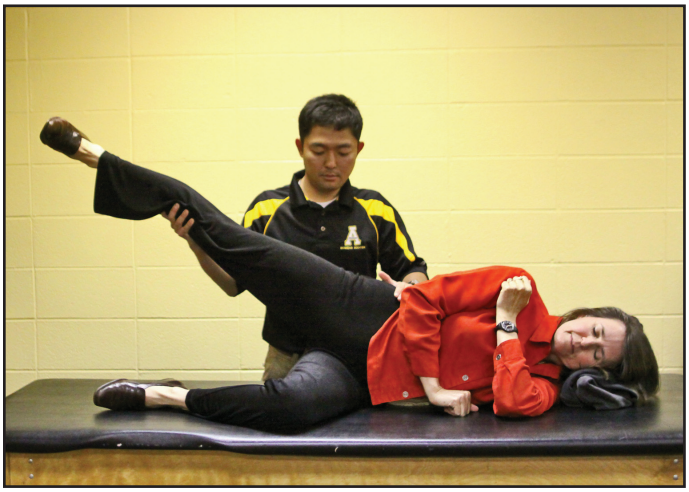

Figure 6. *Passive Right Hip Abduction (compare to next figure and note, less than left).*

Figure 7. *Passive Left Hip Abduction (greater than right).*

Active right hip shift (internal rotation/adduction) hip shift in sitting (greater than left)

Joint ROM impairments associated with a Left AIC may include: decreased left passive hip internal rotation (IR) compared to the right (sitting) and decreased right passive hip abduction compared to the left (sidelying) (Figures 6 and 7). Passive hip abduction (without side bending of the trunk) may be decreased on the right side because of short and strong adductors.

Muscle performance impairments may include muscles that are weak/long, strong/overactive and/or tight/short. Weak and/or long muscles may include the left hip adductors, medial hamstrings and/or abdominals (internal obliques, transversus abdominis). Overactive, strong and/or tight/short muscles may include the left hip external rotators (ERs), rectus femoris, paraspinals, left hemi-diaphragm and muscles of the anterior pelvic outlet. The left hemi-diaphragm in a left AIC pattern may be more posturally oriented than respiratory oriented (reduced ZOA). Reduced ZOA is associated with low back pain, shortness of breath, decreased exercise tolerance and reduced intra-abdominal pressure.[12,25,26] Muscles of the anterior pelvic outlet include the right adductors, levator ani and obturator internus.

Special tests used to examine an athlete that may have a left AIC may include the Active Straight Leg Raise Test (ASLR),[27] the Ober's Test,[9,11,15,22,23] and the Thomas test. Results may include: a positive left Ober's Test *and* a positive left Modified Thomas Test (intact anterior hip ligaments)[13] or a positive left Ober's Test *and* a negative left Thomas Test (possible over stretched/lax left anterior hip ligaments), and a positive left passive trunk rotation test performed in supine hooklying (decreased passive right trunk rotation).

THE SOLUTION

Description of the Non-manual Technique

An active therapeutic exercise that addresses postural asymmetry related to the Left AIC pattern and attempts to restore proper bony and soft tissue position of the trunk and pelvis would seem to be desirable for patients/athletes. Patients/athletes with subjective complaints and objective exam findings associated with asymmetry, would perform the exercise with the intent to reduce pain and/or breathing difficulty. (Figure 8) The Right Sidelying Respiratory Left Adductor Pull Back exercise developed by the Postural Restoration Institute ® was designed to "reposition" the lumbopelvic-femoral region of the body.[18,28,29] For the purpose of this clinical suggestion, reposition is defined as, "The return of something, such as a bone, to its proper position, To place or put in a new position.[1] Repositioning of the body is believed to occur when a patient/client/athlete performs a non-manual technique for the purpose of changing the body from a suboptimal position towards a more optimal position in order to reduce impairments and improve function.[18] Non-manual techniques are defined as, "specific processes incorporating muscle position, the two respiration phases, and appropriate concomitant muscle activity. These processes facilitate isolated muscle activation for muscle

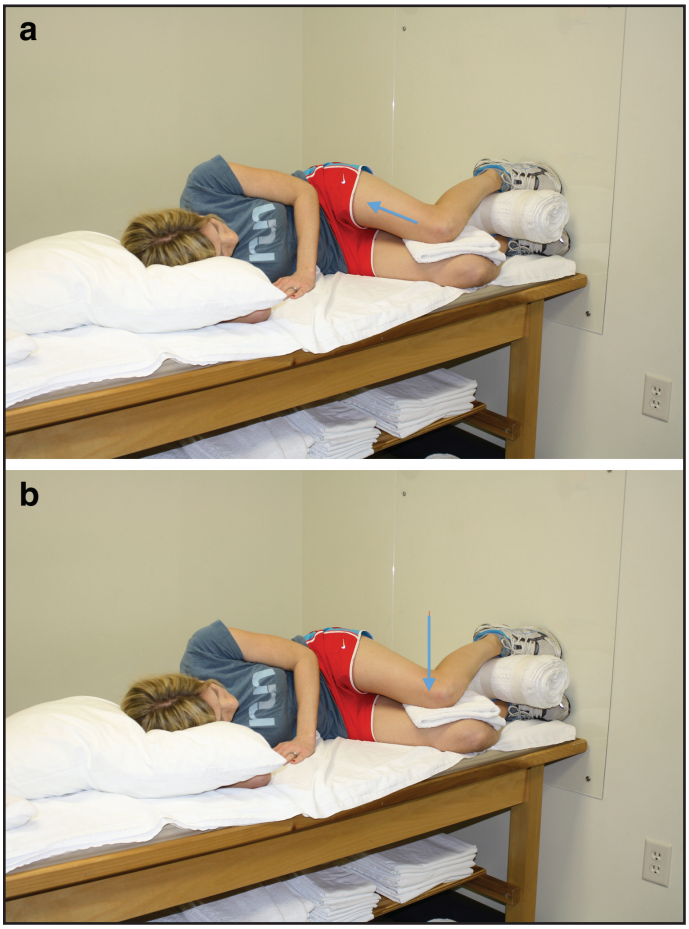

Figure 8. *Right Sidelying Respiratory Left Adductor Pull Back.*

1. *Lie on your right side with your feet on a wall with your hips and knees at a 90-degree angle, ankles and knees together and your back rounded. Place a pillow under your head and keep your back and neck relaxed.*
2. *Place an appropriate size bolster between your feet and a towel between your knees. Your left knee should be lower than your left hip and ankle.*
3. *Push your right foot into wall.*
4. *Begin by inhaling slowly through your nose as you pull back your left leg. (Figure 8a)*
5. *Exhale through your mouth as you squeeze your left knee down into the towel for 3 seconds.*
6. *Inhale again as you pull back your left leg further. You should begin to feel your left inner thigh engage.*
7. *Exhale and squeeze your left knee down. (Figure 8b)*
8. *Continue the sequence until you have completed 4-5 breaths in and out. Attempt to pull back your left leg further each time you inhale.*
9. *Relax your knees back to the starting position and repeat the sequence 4 more times.*

inhibition, and integrate desired neuromuscular function while preventing compensation."[15,18]

The Right Sidelying Respiratory Left Adductor Pull Back exercise is designed to move the acetabulum into an optimal position so that femoral motion can occur under a correctly positioned acetabulum (anatomical neutral), rather than femoral motion occurring under an acetabulum that is in a forward position, due to the hip joint being in a position of relative flexion (as with an anterior pelvic tilt) or into hip ER (as with anterior rotation of the pelvis in the transverse plane).

The exercise is performed with the patient/client in right sidelying with their hips and knees in approximately 90˚ of flexion and the lumbar spine in flexion (relative posterior pelvic tilt). This position should allow spinal flexion and the paraspinals to be relaxed/inhibited/lengthened to oppose an APT. The feet touch a wall (to allow distal stability for proximal movement), and the head rests comfortably on one to two pillows (to allow neck muscles to be relaxed/inhibited). The left hand rests on the plinth/mat or floor and a towel/bolster/pillow or blanket that is large enough to allow the left foot to be higher than the left knee (to allow passive left hip femoral acetabular internal rotation [FA IR]) is placed between the ankles/feet . The patient/athlete is then instructed to inhale through their nose while simultaneously moving their left femur back into left hip IR and adduction (acetabulum (A) moving on femoral (F) head or [AF IR]). This motion helps to approximate the left femoral head into the acetabulum which may help to correct a functionally long leg as a result of loose anterior hip ligaments (pubofemoral/iliofemoral) so that their left knee moves behind their right knee, without changing the sagittal position of the hip. When the left hip moves into internal rotation and adduction it should put the left posterior hip capsule and ischiofemoral ligament in a lengthened position. The ischiofemoral ligament is a spiral ligament, and thus is affected by rotational movements. It arises from the ischial part of the acetabular rim and spirals superiorly/laterally to the neck of the femur just medial to the base of the greater trochanter.[30] When the hip is flexed, internal rotation is limited by tension in the capsule and ischiofemoral ligament.[31] The left hip motion should also lengthen/inhibit muscles of the right anterior outlet (adductors, levator ani, obturator internus) and muscles of the left anterior inlet (rectus

femoris, sartorius). The left posterior hip capsule may become tight/short as a result of compensation for a Left AIC.[9,11,18,23] This motion requires the muscles that adduct and internally rotate the hip to be active: left adductor magnus and left medial hamstrings (semimembranosus and semitendinosus). Recruitment/activation of these muscles may help to shorten and strengthen them if they are long and/or weak. This motion should also bring the left pelvis (anterior/lateral crest) closer to the left anterior inferior ribs, which should oppose a left rib flare/ER/elevated position. Additionally, this position will promote an increase in the left hemi- diaphragm's ZOA because the left anterior superior iliac spine (ASIS) goes posteriorly and left lower ribs approximate the left ASIS resulting in better positional left ZOA. Internal obliques can also be in a more optimal position as they are lengthened with a left rib flare/ER and shortened during the non-manual technique. (Figure 8a)

The next step is to instruct the patient/athlete to exhale through their mouth as they squeeze down into the towel for three seconds. This promotes more hip adduction where the left femur moves on the left acetabulum in an internal rotation direction. Then the patient/athlete is instructed to repeat the process of pulling their left femur back even more upon inhalation followed by exhalation until they reach their ROM endpoint which is usually three cycles. This position also helps to promote neuromuscular re-education to maintain an increased left diaphragm ZOA via rib/spine/pelvis position being maintained during inhalation without allowing spinal extension/lumbar lordosis, APT and rib elevation/ER to occur. During the inhalation, the diaphragm contracts, which forces the left pelvic floor fulcrum (levator ani muscle group and coccygeus) to open the left posterior pelvic outlet so that upright left hip (AF IR) will be more easily obtained and not be limited by the pelvis. (Figure 8b) This non-manual technique/ therapeutic exercise done on the side, with spinal flexion and optimal slow breathing can also help to promote relaxation/ parasympathetic activity. A summary of the problem (impairments, dysfunctions) and the solution to each is provided in Tables 1 and 2.

Table 1. *Lumbopelvic-Femoral Diagnoses that may be associated with a Left Anterior Interior Chain Pattern.*[11]

Diagnoses that may be associated with a Left Anterior Interior Chain Pattern
Right and/or Left Sacroiliac joint dysfunction (SIJD)
Right and/or Left Hip Impingement
Lateral Hip Pain/Trochanteric Bursitis
Deep Buttock Pain/HS Strain/Ischial Apophysitis
Low Back Pain (LBP)

DISCUSSION

Use in Rehabilitation

The Right Sidelying Respiratory Left Adductor Pull Back exercise is often one of the first techniques used on a patient or athlete who presents with postural asymmetry (Left AIC pattern). There are a few instances however where a left posterior capsule stretch and/or mobilization may be needed prior to doing the technique. One indication may be if the patient/athlete however lies with their pelvis back/posterior and has difficulty even getting their pelvis perpendicular to the table. Another indication may be if they are unable to pull their femur back (hip IR/Add). When having a patient/athlete perform the technique, it is critical that they are aware of and can feel their left adductor contract. Some patients/athletes will feel the left adductors immediately and will experience an uncomfortable "cramping" in their proximal adductors/groin region. This would be a desirable response and the clinician can let the patient/athlete know that the cramping is normal and will usually dissipate with proper breathing and with more fluent dynamics. Other patients/athletes will not feel the adductors working at all and are not even aware of them contracting. Sometimes touching/tapping on their adductors helps, sometimes repeating the exercise a few times allows them to gain more hip IR/Add ROM and eventually they begin to feel their adductors. If however, they still cannot feel the adductors activate then a left hip posterior capsule stretch of some kind may be indicated or switching to a sitting position may help the patient/athlete perceive a left adductor contraction.

Rarely if ever is the Right Sidelying Respiratory Left Adductor Pull Back technique the only therapeutic exercise that is prescribed over the course of care for a patient/athlete. It is good to reposition the trunk/pelvis/hips however, and then the patient/athlete may

Table 2. *A list of problems (dysfunctions and impairments) and the corresponding possible solutions related to the use of the Right Sidelying Respiratory Left Adductor Pull Back Exercise*

Problem	Solution or Relative positional change
Center of Gravity (COG) shifted to the right	COG shifted to the left
Sitting or sleeping position with left knee forward/in front of the right knee	Sitting or sleeping position with left knee behind the right knee
More difficulty using left leg for sit to stand versus right leg	Increase the ability to use left leg to go from sit to stand
Right Hip in IR/Add, Left hip ER/Abd	Left Hip IR/Add, R hip ER/Abd
Forward Rotation/Right Rotation of the left side of the pelvis	Backward Rotation/Left Rotation of the left side of the pelvis
Possible increase in lumbar lordosis/anterior pelvic tilt (APT)	Decrease lumbar lordosis/APT
Overactive/hypertonic left Posterior Pelvic Outlet muscles	Inhibit left Posterior Pelvic Outlet using Intraabdominal pressure (IAP)
Suboptimal/decreased IAP	Increase IAP
Decreased left Zone of Apposition (ZOA)	Optimize/increase left ZOA
Left rib elevation/external rotation and Decreased Left Diaphragm ZOA	Left rib depression/internal rotation and increased left diaphragm ZOA
Tight/short left posterior hip capsule/ischiofemoral ligament	Affect length of left posterior hip capsule/ligament
Laxity of Pubofemoral &/or iliofemoral ligament	Increase stability of hip via anterior gluteus medius and Ischiocondylar AM
Functional leg length difference (L > R)	Approximate left femoral head into acetabulum
Over active/tight left hip external rotators	Inhibit/lengthen left hip external rotators
Weak/long hip adductors and medial HS	Strengthen/shorten hip adductors & medial HS
Weak long abdominals (Internal Oblique(IO)/Transverse Abdominus (TA)	Strengthen/shorten abdominals (IO/TA)
Increased/wide left infrasternal angle (ISA) vs. right	Decreased left ISA
Over active/hypertonic/tight paraspinals	Inhibit/lengthen/relax paraspinals
Positive (+) Ober's Test	Reposition for Negative (-) Ober's Test
Positive Left Ober's Test and Negative Thomas Test	Reposition for (-) Ober's Test
Inability to do upright activities without compensation	Do sidelying activity to avoid compensations occurring with upright activities
Left thoracic adduction	Left thoracic abduction
Decreased passive hip abduction (abd) ROM in sidelying	Increase passive hip abd in sidelying (inhibit right adductors)

likely need neuromuscular re-education to maintain the newly achieved position and to eventually allow dynamic upright movement without compensation. A home exercise program (HEP) may include the Right Sidelying Respiratory Left Adductor Pull Back technique done twice daily, five repetitions (approximately three inhalation and three exhalation equals one repetition), one set, for two-three weeks.

The expectation is that impairments will change very quickly, even on the initial visit (after performing five repetitions of the technique), supporting the possibility of a neuromuscular rather than true length change. For example, if the Left Ober's Test is positive, then the expectation would be for the Ober's Test to become negative, as was seen with the 90/90 Left Hemi-bridge with Balloon non-manual technique.[22] Recently published research by Tenney et al discussed the Ober's Test as a reflection of triplanar position of the pelvis/hip joints and not simply iliotibial band length. Activation/contraction of hamstrings/abdominals (five repetitions) for individuals with a positive Ober's Test, seemed to immediately move/change the pelvic/hip position and therefore resulted in a negative Ober's Test (more hip adduction).[22]

If a functionally long leg associated with anterior hip ligament laxity is found on examination, then the expectation would be for the legs to become equal even within one visit. The ischiocondylar adductor

magnus by virtue of its proximal and distal attachment sites has a good mechanical advantage to approximate the femoral head into the acetabulum, which may explain the change from an apparently long left leg to equally appearing leg lengths after the technique is performed.

Additional therapeutic exercises are prescribed over the patient/athlete's follow-up visits to address their individual needs such as exercises to strengthen lumbopelvic-femoral region and/or core muscles (diaphragm, pelvic floor, internal oblique, transversus abdominis, multifidi)[32] or to activate additional muscles (such as the left anterior gluteus medius, internal oblique and transversus abdominis and/or the right gluteus maximus) to neuromuscularly re-educate the patient/athlete to be able to increase their motor control and be able to maintain the optimal postural position/alignment.[11]

Although physical therapists, physical therapy assistants, and athletic trainers currently utilize the Right Sidelying Respiratory Left Adductor Pull Back technique for a myriad of musculoskeletal conditions, there is little research published on the efficacy of the technique. This may be because it is relatively new. Although it was developed and used in treatment by Ron Hruska PT, MPA beginning in 1993, it was not presented in continuing education courses until 2002. There are however four published case studies with three similar technique/exercises[9,15,33,34] and many un-published cases where the technique was prescribed as part of a home exercise program. The authors of these case studies addressed impairments related to postural asymmetry/Left AIC pattern and reported remarkable improvements in both function and pain intensity. The additional exercises have been described to manage facets of the left AIC presentation, including the sidelying scissor slide exercise,[9,34] the sidelying left posterior hip capsule stretch[15] and the 90/90 left Hemibridge with hip shift and Balloon.[9,15,33] Although beyond the scope of this clinical suggestion, each of these exercise techniques requires spinal flexion, paraspinal inhibition, left hip AF IR/Add motion with concomitant right hip AF ER/Abd, left adductor and hamstring activation, right abductor lengthening/inhibition, and left posterior capsule lengthening. In the case report by Robey for an athlete with thoracic outlet syndrome, in addition to the 90/90 Left Hemibridge with Balloon, two additional exercises were used that were designed to optimize the left ZOA, the Seated Resisted Serratus Punch with Left Hamstrings and the Paraspinal Release with Left Hamstrings.[33] In all four case reports, the patient and/or athlete reported a 100% decrease in pain on the numeric pain scale (e.g. 8-9/10 to a 0/10) by discharge and a 100% improvement in function on the Oswestry Disability Index (ODI) (e.g. 20-40% to 0%) or the Northwick Park Neck Pain Questionnaire (NPNPQ) (55.5% to 0%) by discharge. Although it is impossible to determine how much impact the use of similar techniques had on these single patient outcomes, similar impairments existed and beneficial outcomes were reported with exercises designed to address the impairments.

In an additional study using one similar technique (a 90/90 Left Hemibridge with Balloon) to address 13 subjects with lumbopelvic-femoral pain and a common Left AIC impairment (defined by a positive Ober's Test), the subjects reported a significant and clinically meaningful reduction in pain after one session of five repetitions.[22] The 90/90 exercise is similar to the exercise discussed in this Clinical Commentary, the Right Sidelying Respiratory Adductor Pull Back, as it activates the left adductor and moves the hip in to L AF IR, however it is done on the back rather than the side.

CONCLUSION

Despite the Right Sidelying Respiratory Left Adductor Pull Back's use for a variety of musculoskeletal dysfunctions, there is little data published on the efficacy of the exercise. The exercise technique appears to be feasible for many patients/athletes as long as they are able to comfortably lie in a right sidelying position. Additionally, the exercise is user friendly in that it does not require any special equipment. The Right Sidelying Respiratory Left Adductor Pull Back is the fourth exercise descried in the literature that is directed toward optimizing the position of the diaphragm, specifically the left zone of apposition (ZOA). A suboptimal ZOA is known to be associated with low back pain[10] and poor intra-abdominal pressure.[35] Future research is needed to investigate the immediate and long term influence of the Right

Sidelying Respiratory Left Adductor Pull Back on many conditions associated with postural asymmetry (L AIC) as measured by a change in the impairment or a change in function and/or pain.

REFERENCES

1. Farlex. The Free Dictionary. 2013; http://www.thefreedictionary.com/reposition. Accessed May 2, 2013.
2. Andersson GBJ. Epidemiological featuresof chronic low-back pain. *The Lancet.* 1999;354(9178):581-585.
3. Maignes JY, Aivaliklis A, Pfefer F. Results of sacroiliac joint double block and value of sacroiliac pain provocation tests in 54 patients with low back pain. *Spine.* 1996;21:1889-1892.
4. Kapron AL, Anderson AE, Aoki SK, et al. Radiographic prevalence of femoroacetabular impingement in collegiate football players: AAOS exhibit selection. *J Bone Joint Surg Am.* 2011;93(19): e111(111-110).
5. Lievense A, Bierma-Zeinstra S, Schouten B, et al. Prognosis of trochanteric pain in primary care. *Br J Gen Pract.* 2005;55(512):199-204.
6. Poppius H, Muittari A, Kreus KE, et al. Exercise asthma and disodium cromoglycate. *BMJ.* 1970;4:337-339.
7. Asthma and Allery Foundation of America (AAFA). *Asthma Facts and Figures* 1999.
8. Weiler JM, Ryan EJ. Asthma in United States olympic athletes who participated in the 1998 olympic winter games. *J Allergy Clin Immunol Pract.* 2000;106(2):267-271.
9. Boyle K. Management of a Female with Left Low Back Pain and Sacroiliac Joint Pain with therapeutic Exercise: A Case Report. *Physiother Can.* 2011;63(2):154-163.
10. Kolar P, Sulc J, Kyncl M, et al. Postural function of the diaphragm in persons with and without chronic low back pain. *J Orthop Sports Phys Ther.* 2012;52(4):352-362.
11. Boyle K. Conservative Management for Patients with Sacroiliac Joint Dysfunction. In: Norasteh AA, ed. *Low Back Pain*. Rijeka, Croatia: InTech; 2012:293-332.
12. Boyle K, Olinick J, Lewis C. The Value of Blowing Up a Balloon. *N Am J Sports Phys Ther.* 2010;5(3):179-188.
13. Boyle K, Jansa S, Lauseng C, et al. Management of a woman diagnosed with trochanteric bursitis with the use of a Protonics® neuromuscular system. *Journal on the Section of Women's Health.* 2003;27(1):12-17.
14. Defrin R, Benyamin BS, Aldubi RD, et al. Conservative correction of leg-length discrepancies of 10mm or less for the relief of chronic low back pain. *Arch Phys med Rehabil.* 2005;86(11):2075-2080.
15. Boyle K, Demske J. Management of a female with chronic sciatica and low back pain: a case report. *Physiother Theory Pract.* 2009;25 (1):44.
16. Kouwenhoven JW, Vincken KL, Bartels LW, et al. Analysis of preexistent vertebral rotation in the normal spine. *Spine.* 2006;31(13):1467-1472.
17. Boulay C, Tardieu C, Benaim C, et al. Three-dimensional study of pelvic asymmetry on anatomical specimens and its clinical perspectives. *J Anat.* 2006;208:21-33.
18. Boyle K. *Ethnography of the postural restoration subculture: a posture based approach to patient/client management* [Dissertation]. Fort Lauderdale, FL, Nova Southeastern University; 2006.
19. Kendall FP, McCreary EK, Provance PG, et al. *Muscles Testing and Function with Posture and Pain*. 5th ed. Philadelphia: Lippincott Williams and Wilkins; 2005.
20. Kouwenhoven JM, Bartels LW, Vincken KL, et al. The relation between organ anatomy and pre-existent vertebral rotation in the normal spine. *Spine.* 2007;32(10):1123-1128.
21. Mezieres F. Methodes Orthopediques and La Fonction du Sympathique. *Cahiers de la Methode Naturelle.* 1973:52-53.
22. Tenney HR, Boyle KL, Debord A. Influence of hamstring and abdominal muscle activation on a positive Ober's test in people with lumbopelvic pain. *Physiother Can.* 2013;65(1):4-11.
23. Boyle K, Plew M, Tenney R, et al. Management of sacroiliac joint dysfunction with lumbopelvic-femoral exercises: a case series. *Spine.* 2013:in review.
24. MediLexicon. Medical Definitions. 2013; http://www.medilexicon.com/medicaldictionary.php?t=4165. Accessed May 2, 2013.
25. Kolar P, Sulc J, Kyncl M. Stabilizing function of the diaphragm: dynamic MRI and synchronized spirometric assessment. *J Appl Physiol.* 2009;109(1064-1071).
26. Lando Yaroslav, Boiselle PM, Shade D, et al. Effect of Lung Volume Reduction Surgery of Diaphragm Length in Severe Chronic Obstructive Pulmonary Disease. *Am J Respir Crit Care Med.* 1999;159(3): 796-805.
27. O-Sullivan PB. Altered Motor Control strategies in Subjects With Sacroiliac Joint Pain During the Active Straight-Leg-Raise Test. *Spine.* 2002;27(1):E1-E8.
28. *Myokinematic Restoration CD*. Lincoln, NE: Postural Restoration Institute; 2013.

29. *Myokinematic Restoration An Integrated Approach to Treatment of Patterned Lumbo-Pelvic-Femoral Pathomechanics* [Course manual]. Elon, NC: PRI;2005.
30. Anatomy Expert. 3D Ligaments of the hip joint. 2013; http://www.anatomyexpert.com/structure_detail/15413/105/. Accessed May 2, 2013.
31. Anderson J. *Grant's At;as pf Amatp,u*. 7 ed: Williams and Wilkins co.; 1978.
32. Lee D. *The Pelvic Girdle*. 3rd ed. New York, NY: Churchill Livingstone; 2004.
33. Robey J, Boyle K. Bilateral Functional Thoracic Outlet Syndrome in a College Football Player. *N Am J Sports Phys Ther.* 2009;4(4):170-181.
34. Spence H. Case study report: postural restoration: an effective physical therapy approach to patient treatment. *Techniques in Regional Anesthesia and Pain Management.* 2008;12:102-104.
35. Hodges P, Holm KA, Holm S, et al. Intervertebral stiffness of the spine is increased by evoked contraction of transversus abdominis and the diaphragm: in vivo porcine studies. *Spine.* 2003;28(23):2594-2601.