IJSPT

CASE REPORT

THE USE OF POSTURAL RESTORATION FOR TREATMENT OF CHRONIC ROTATOR CUFF PATHOLOGY: A CASE REPORT

Jacob L. Waldron, MS, ATC[1*]
Michael A. McKenney, MS, ATC[2]
Michelle N. Samuel, MS, ATC[1]
Tedd J. Girouard, MS, ATC[1]
Catherine L. Turner, PT, DPT[3]
Kara N. Radzak, PhD, ATC[1]

ABSTRACT

Background and Purpose: Postural Restoration Institute® (PRI) theories and rehabilitation techniques focus on restoring balance to anatomical systems. Common postural asymmetries can present in athletes as dysfunctions and limitations. The purpose of this case report was to examine the use of PRI exercises and theories to address pelvic alignment, along with core stabilization, during treatment of shoulder dysfunction in a collegiate volleyball player.

***Case Description*:** A 22-year-old female volleyball athlete reported unresolved right rotator cuff tendinopathy. She presented with bilateral rib cage flare, anterior pelvic tilt, and bilateral ROM differences in hip and shoulder internal and external rotation. PRI® special test findings included a positive left and right Adduction Drop Test (ADT), positive left Extension Drop, and Hruska Adduction Lift test (left = 2, right = 3) indicating posterior exterior chain (PEC) pattern of dysfunction. The traditional shoulder rehabilitation program from the previous season was eliminated and a PRI based intervention was performed. Intervention exercises included the 90/90 dead bug diaphragmatic breathing, 90/90 hamstring hip lift, and right sidelying respiratory left adductor pull back. Exercises were performed as three sets of ten diaphragmatic breathing repetitions, a minimum of three times weekly prior to activity.

***Outcomes*:** Likert scale ratings of pain decreased from a six pre-intervention to two. The left hip gained 10˚ of internal rotation and the right hip gained 14˚ of external rotation. Right shoulder internal rotation increased 15˚. Hruska Adduction Lift improved to a four bilaterally (right by day 24, and left by day 31). Left extension drop test was negative following day 17.

***Discussion*:** PRI® exercises focusing on core and pelvic stability translated to improved hip and shoulder ROM, and decreased shoulder pain associated with rotator cuff tendinopathy. By treating pelvic alignment with the PRI® exercises, the ROM imbalance and pain at the shoulder joint were addressed.

***Conclusion*:** Incorporating PRI exercises and theories into the rehabilitation program of a volleyball player was useful in addressing underlying imbalances throughout the kinetic chain.

Level of Evidence: **3b**

***Keywords:*:** Breathing exercises, Postural Restoration, rotator cuff pathology, shoulder, volleyball

[1] University of Nevada, Las Vegas, Department of Kinesiology and Nutrition Sciences, Las Vegas, NV, USA
[2] Northeastern University, Sports Performance, Boston, MA, USA
[3] University of Nevada, Las Vegas, Department of Physical Therapy, Las Vegas, NV, USA
* Mr. Waldron is now with the Arizona Diamondbacks organization.

Conflicts of Interest: The authors report no conflicts of interest related to the manuscript.

CORRESPONDING AUTHOR
Kara Radzak, PhD, LAT, ATC
E-mail: Kara.radzak@unlv.edu
Phone: 702-895-4421
University of Nevada, Las Vegas
4505 S Maryland Pkwy
Las Vegas, NV USA 89154

BACKGROUND AND PURPOSE

Many overhead athletes experience generalized shoulder pain due to repetitive terminal external rotation, with abduction and elevation. Common, and often successful, rehabilitation programs for shoulder pain focus on strengthening, mobility, and sport specific movements targeting the involved joint.[1] However, some athletes continue to report unresolved chronic shoulder injuries, indicating potential underlying dysfunction away from the primary anatomical site of pain generation.[2] These underlying pathologies could provide necessitate use of an alternative treatment approach for those athletes who are unresponsive to traditional treatment methods.

Treatment paradigms by Ron Hruska at Postural Restoration Institute® (PRI) integrate posture-based intervention programs for the management of musculoskeletal injuries and asymmetries assumed to be present due to postural adaptations.[3,4] PRI theorizes that common postural asymmetries can present in athletes as dysfunctions and movement limitations and incorporates multiple systems (musculoskeletal, nervous, and respiratory) to influence movement patterns.[3,4] Postural restoration treatment (PR) aims to restore balance and variability to these anatomical systems.[3,4] Once these dysfunctional adaptations are corrected, patients can perform activities with greater efficiency, even without direct intervention to the affected joint or region.[3,4] In theory, if these postural adaptations are corrected, then dysfunction is decreased throughout other systems in the body. Despite the increased use of PRI theories by sports medicine clinicians, there is limited, but promising, published evidence on PR treatment outcomes.[5-7] The purpose of the current case report is to evaluate the use of a PR treatment intervention to address chronic shoulder pathology that failed to be alleviated using traditional intervention methods.

CASE DESCRIPTION

A 22-year-old, female, Division I volleyball player, with 14 years of competitive experience, was seen for generalized right shoulder pain mid-way through the fall competitive season (in-season). She sought treatment due to her rehabilitation plan from the previous volleyball season no longer effectively treating her chief complaints of right shoulder pain and rotator cuff weakness/fatigue. She was diagnosed during the previous competitive season (season one) with right rotator cuff tendonitis. Previous medical history revealed no prior orthopedic surgery, but the athlete reported hip dysplasia that required her to be in a Pavlik harness for two months after birth by cesarean section due to breech positioning. No other previous orthopedic issues were documented prior to the shoulder pain. She was treated throughout season one with a traditional rotator cuff tendonitis rehabilitation plan, which included strengthening, mobility, and range-of-motion (ROM) exercises. She was given a list of thirteen exercises and completed the program by choosing any four exercises at 3 sets of 10 repetitions, four times a week (Table 1). She was instructed to cycle through the exercise options and not repeat the same exercise in consecutive days. Modalities supplemented the program for pain modulation including interferential stimulation, thermal therapy, and cryotherapy. The athlete reported continued use of the rehabilitation plan.

The athlete's playing time increased from the season one to season two, the competitive season in which the case report took place. Despite being a middle blocker, she had multiple games during season two where she played the full rotation and served for herself throughout the whole year. Differences in game activity between seasons are presented in Table 2. Strength and conditioning session participation was team based in both years and remained relatively

Table 1. *Traditional Treatment Plan and Volleyball Warm-Up*

Traditional Rehabilitation Exercises to Address Rotator Cuff Tendinopathy*
Shoulder flexion, extension, abduction & adduction with elastic resistance band
Dumbbell shoulder press
Shoulder front raises
Standing, bilateral Y's, I's, T's with 3-5 pound dumbbells
Seated dumbbell shoulder external rotation
Dumbbell proprioceptive neuromuscular facilitation D1 & D2 patterns
Body Blade through proprioceptive neuromuscular facilitation patterns
Body Blade shoulder flexion
Rows with elastic resistance band
Latissimus dorsi pull down with elastic resistance band
Dumbbell weighted shoulder flexion with manual perturbations
Scapular push up
90/90 plyometric ball toss with clinician as partner
Volleyball Warm-Up Exercises with Elastic Resistance Band*,†
Scapular rows
Combination movement of high row followed by shoulder ER to 90°
Thumb down (empty can) shoulder V-raises
Shoulder internal rotation, elbow at side
Shoulder external rotation, elbow at side
Simulated arm swings each side

*Performed during season one, †Performed during season two

Table 2. *Volleyball Performance Statistics for Subject*

	Season One	Season Two
Volleyball Match Sets Played	121	130
Assists Per Set	0.07	0.22
Total Digs	74	160
Digs Per Set	0.61	1.23
Serve Receptions	3	207
Aces Per Set	0.17	0.14
Blocks Per Set	1.07	1.00
Total Attacks	723	667
Kills Per Set	2.21	1.90

consistent with the previous year's volume. She was seeking new treatment options mid-season two, as she felt her shoulder pain was hindering her performance. Her treatment goal was to play pain-free.

CLINICAL IMPRESSION #1

The subject's chief complaint of chronic shoulder pain, despite continued rehabilitation for over one year, indicated that the rotator cuff tendinitis was likely not resolved. Furthermore, it was believed that underlying pathologies needed to be explored.

EXAMINATION

During the season two examination to globally evaluate the shoulder girdle, the subject presented with bilateral rib cage flare and anterior pelvic tilt during standing shoulder flexion in the scapular plane. Range of motion (ROM) evaluation revealed hip and shoulder internal and external rotation asymmetries (Table 3). Manual muscle testing performed on the shoulder revealed the subject's strength was 5/5, bilaterally, in all planes of motion. The subject had positive test results for Hawkins-Kennedy and Neer Impingement special tests on the involved shoulder; all other orthopedic special tests were unremarkable. PRI® recommended special tests performed by the PRI trained clinician included: Adduction Drop Test (ADT), Extension Drop Test (EDT), and Hruska Adduction Lift Test (HAdLT).

The ADT (Figure 1) and EDT (Figure 2) were performed as described by Masek.[8] The ADT has the subject placed in a side-lying position with the both legs positioned in 90˚ of hip and knee flexion (Figure 1).[4] The clinician stands behind the subject to passively flex, abduct, and extend the hip, while the knee remains in 90˚ of flexion.[4] The hand of the clinician

Figure 1. *Positive Adduction Drop Test (ADT).*

Figure 2. *Extension Drop Test (EDT) A: Negative EDT, B: Positive EDT.*

Table 3. *Active Range of Motion Measures*

	Pre-Intervention		Treatment Day 10		Treatment Day 17		Treatment Day 24		Treatment Day 31		Treatment Day 38	
	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
Hip Range of Motion												
Flexion	100°	110°	104°	110°	106°	111°	107°	112°	108°	112°	108°	111°
Extension	10°	6°	10°	8°	12°	11°	12°	13°	12°	14°	11°	14°
Adduction	18°	20°	20°	21°	21°	21°	22°	23°	22°	23°	23°	24°
Abduction	34°	29°	37°	30°	42°	36°	45°	42°	49°	47°	49°	48°
Internal Rotation	23°	38°	26°	36°	27°	35°	28°	34°	32°	33°	33°	35°
External Rotation	35°	20°	35°	22°	36°	25°	35°	27°	34°	32°	34°	34°
Shoulder Range of Motion*												
Extension	50°	47°	52°	50°	54°	52°	56°	56°	58°	56°	59°	58°
Internal Rotation	60°	50°	61°	55°	64°	58°	65°	60°	66°	62°	66°	65°
External Rotation	84°	95°	85°	95°	86°	96°	85°	96°	87°	95°	88°	94°

*The right shoulder was the involved, painful limb

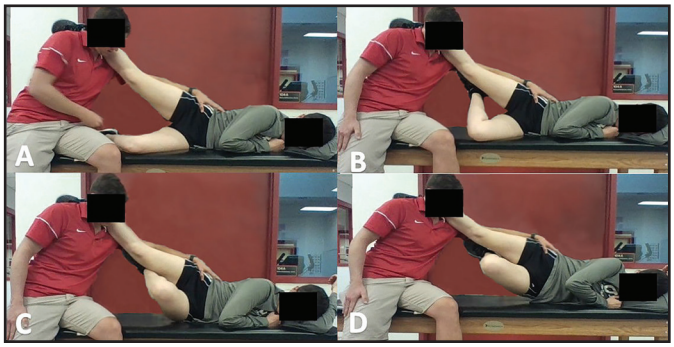

Figure 3. *Right Hruska Adduction Lift test (HAdLT) A: Grade zero, B: Grade one, C: Grade two, D: Grade three.*

not completing passive ROM maintains the position of the top innominate.[4] A positive test is indicated when the knee of the upper leg is unable to contact the table when the knee is release and hip position is maintained; this finding indicates a restriction of the piriformis muscle or transverse ligament, or impact of the posterior inferior femoral neck on the posterior interior rim of the acetabulum blocking adduction.[4] The subject was found to have a positive left and right ADT.

The EDT has the subject positioned on the end of the table with both knees to the chest, mirroring the setup of Thomas test (Figure 2).[4] The tested leg is passively lowered by the clinician while holding the subject's untested leg close enough to the chest to maintain contact of low back with the table.[4] The clinician then lowers the testing limb downward, ensuring that the hip does not abduct, which results in a false negative position.[4] A positive test is present when the testing leg thigh is unable to touch the table, indicative of a restriction in hip extension.[4] The subject demonstrated a positive left EDT.

The HAdLT (Figure 3) is performed with the subject positioned in sidelying with the back slightly rounded forward.[4,9] The ankle of the upper leg rests on the clinician's shoulder, which indicates the side being tested.[4,9] For example, if the subject is lying on his/her right side with his/her left leg on the clinician's shoulder it would be considered a Left HAdLT. In this position the hip should be in a neutral alignment and the knee fully extended. This test is graded by the clinician's evaluation of the movements accomplished successfully. The progression of movement is as follows: 1) the subject was asked to raise the ankle of the flexed lower leg to knee of the leg resting on the shoulder of the clinician, 2) the knee of the lower leg is raised off the table while the ankle maintains contact with the knee, and 3) the subject was asked to raise the lower hip of the table while maintaining the first two positions.[4,9] If at any time during this movement the athlete was unable to accomplish or hold the previous position the test was stopped.[4,9]

The HAdLT test is graded on a zero to five scale and the ability to accomplish the movements is the criteria for grading. For a zero grade the subject is unable to raise the lower leg to the knee presenting as obturator weakness. Grade one occurs when the subject can raise the ankle, but is unable to raise the knee. This reflects weakness in the external rotator muscles of femoral acetabular (FA) joint more commonly, or weakness of the active extremity stabilizing muscles of the acetabular femoral (AF) joint. The FA and AF joint are the same joint, distinguished by the leading listed bone moving on the second listed bone. Grade two is the ability to raise the lower knee while maintaining ankle positioning. The current subject received a two grade on her left side, indicating instability of the AF joint and weakness of adductor magnus, and obturators; or there being a forward rotated pelvis with FA joint internal weakness.[4] Grade three rating indicates the subject is able to hold Grade two while slightly raising his/her hip off the table.[4] The current subject received a grade three on her right side. Inability to do this reflects weakness of the FA joint stabilizers on the extended leg, and the possibility of bilateral AF joint stabilizers weakness.[4] Grade four rating is the subject's ability to raise the hip off the table to the level of his/her shoulder and the clinician's shoulder.[4] The inability to accomplish this task reflects a weakness in lumbopelvic strength and a general weakness of the obliques bilateraly.[4] Grade five rating is the ability to raise his/her hip above the clinician's shoulder and his/her own shoulder.[4] The inability to accomplish this task reflects the lack of strength and proprioceptive ability to shift his/her hips.[4]

Clinical Impression #2

Evaluation findings, particularly the positive ADT bilaterally, indicated a Posterior Exterior Chain (PEC) pattern. The PEC pattern, unlike many of the movement patterns defined by PRI®, is a bilateral pelvic alignment compensation. In this pattern, both ilia

are anteriorly tilted increasing lordotic curvature in the lower back. This pelvic tilt is commonly associated with a bilateral rib cage flare; which in turn creates an inability to expand the lower portion of ribs to full capacity while taking a deep breath, as well as abdominal oblique disuse. Successful PR-based intervention would reduce asymmetries in hip and shoulder internal and external rotation ROM, and result in negative PRI special test findings.

INTERVENTION

The timeline reported in this case study began midway in season two with pre-intervention measurements and initial implementation of the program. The final follow-up measurements were performed 38 days later. At that time the athlete was unable to complete the intervention program three times during the remaining two weeks of regular season because of a partial Achilles tendon rupture shifting the focus of care. While she continued to play the remainder of the season, ankle pain management and strengthening was priority became the priority of rehabilitation.

The athlete's former traditional shoulder rehabilitation program was eliminated at the onset of PR treatment program. A heat pack on the right shoulder was used by the athlete prior to competition and practices as part of her own warm-up routine. Additionally, the athlete completed a traditional, team-based volleyball bilateral shoulder warm-up routine at one set of fifteen repetitions prior to practice and competition (Table 1).

Information gained from the pre-intervention assessments of the athlete allowed for a development and implementation of a PR intervention program (Table 3). This included one adapted intervention using PRI® theories and two specifically recommended interventions by PRI®. The interventions included an adapted 90/90 dead bug diaphragmatic breathing, 90/90 hip shift with hemi-bridge, and right side-lying respiratory left adductor pull back (Figure 4). The exercise order was chosen to address the sagittal plane compensations, followed by frontal plane compensations. Each intervention exercise was performed in three sets of ten repetitions of diaphragmatic breathing. The subject was instructed and given direct feedback for an initial two-week period. Feedback consisted of tactile and verbal cues while completing the intervention program. Cues correcting her positioning and breathing patterns were used to ensure proper form and muscle activation was achieved. After two weeks, she was allowed to perform the intervention program without direct supervision, while still reporting completion. The intervention program was completed three times a week prior to activity, at minimum, with a full reassessment at the start of each week.

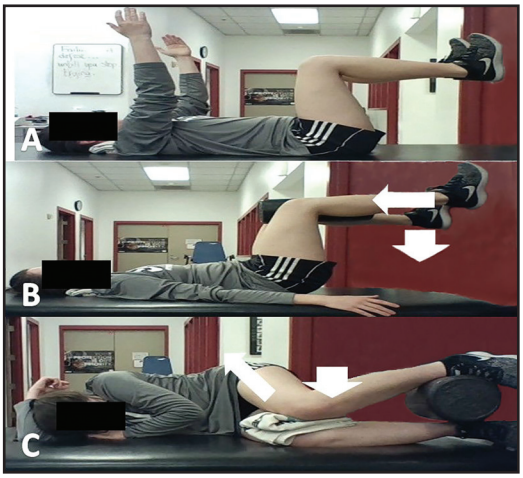

Figure 4. *Postural Restoration Treatment Intervention Exercises A: 90/90 Dead bug diaphragmatic breathing, B: 90/90 Hip shift with hemi-bridge, C: Right side lying respiratory left adductor pull back.*

PR Treatment Intervention Exercises

For the 90/90 dead bug position, the athlete positioned herself into 90° of hip flexion, 90° of knee flexion, feet shoulder width apart, 90° of shoulder flexion, and a rolled towel under her neck to open the airway (Figure 4A). The athlete was instructed to inhale as much air in as she could using her abdominal and diaphragm musculature. She was told to pull the air down into her belly and torso achieving maximum lung volume every inhalation. This allowed her diaphragm to create a negative pressure in the thorax cavity and force air into the lungs.[4,10] When she exhaled through her mouth, she was cued to imagine she was blowing a balloon up. As she exhaled, the lower portion of the rib cage would position itself down and rotated toward midline. This breathing pattern helps engage the core musculature and the diaphragm to expand the lungs to achieve maximum volume with each breath.[4,10] PRI recommends the physical use of a balloon to engage

core musculature throughout the breathing pattern.[4] However, this exercise was adapted to visualizing a balloon due to inaccessibility.

The PRI® recommended 90/90 hip shift with hemi-bridge was completed as described previously, with minor modifications (Figure 4B).[4,6,11] The modifications included a rolled towel placed underneath her neck to aid in opening her airway, the breathing was completed without a balloon, and a foam roller with the same diameter was placed between her legs instead of a small ball due to lack of recommended equipment. This exercise was completed bilaterally because the pre-intervention examination showed an anteriorly tilted pelvis on both the left and right side. The positioning is the same and the movements are reversed for the right side compared to the left. These movements include a downward drive of the heels to contract the hamstring, activation of the adductor of both legs to hold the foam roller in place, and then a slight lift off of the contralateral leg that was being targeted. For example, if the subject is targeting the left hamstring the right heel would lift slightly off the wall.

The PRI® recommended right sidelying respiratory left adductor pull back was completed as described previously,[4,12] with minor modifications (Figure 4C). Modifications included the rolled towel underneath her neck and a foam roller. For this exercise the clinician must ensure the bolster between the feet causes the left knee to fall below the left hip. This exercise's main goal is to shift the femoral head more congruently into the socket of the acetabulum.[4,12] This is done by activating and cueing the subject to first pull their left femur back towards their left ilium.[12] Once this is done, he/she is instructed to hold that position and drive their left knee down into the towel placed between the knees.[12] This pull back and downward drive of the left knee will activate the left adductor, gluteus medius, semimembranosus, and semitendinosus muscles.[12]

Outcome Measures

Measures to evaluate overall progress of the intervention program included both subject and clinician reported outcome measures. A 10-point Likert-pain scale rating was used as a patient reported outcome. This rating was reported verbally by the athlete after each completion of the intervention program. Clinician reported outcome measures comprised of PRI recommended special tests, including the ADT, EDT, and HAdL, and hip and shoulder active ROM.

The ADT was completed bilaterally after each completion of the intervention program. This ensured that proper pelvic neutrality was achieved by the athlete. This special test was chosen because of the direct feedback obtained by the clinician about the exercises' effect on pelvic alignment.

The shoulder ROM measurements were taken bilaterally and included flexion, extension, internal rotation, external rotation, abduction. Hip included the same ROM listed for shoulder along with adduction. All ROM measurements were taken by the same clinician as described in Starkey et al.,[13] with the exception of shoulder extension. Shoulder extension was modified and measured from a standing position with her elbow flexed to 90° then actively moved posteriorly into extension.

OUTCOME

The verbal, Likert pain scale rating for the subject showed an overall decrease from pre-intervention (6/10). Pain was reported to be a 2/10 or lower from day 11 of the intervention to the end of the evaluation period. The athlete's ROM improved throughout the intervention program as seen in Table 3. Shoulder forward flexion and abduction were not included in this table as the athlete had 0-180° of ROM, bilaterally, throughout the course of intervention. Her right shoulder gained 15° of internal rotation. The athlete's left hip gained 10° of internal rotation, while her right hip gained 14° of external rotation.

PRI® recommended special tests indicate improvement throughout the intervention program. ADT was negative following each treatment session, indicating treatment success. The right EDT was negative for the athlete pre-intervention and did not change. The left EDT was positive pre-intervention, and improved to negative following intervention day 17. The Right HAdLT improved to a four on intervention day 31, while the Left HAdLT improved to a four on intervention day 24.

During the exit physical upon the completion of the athlete's collegiate playing career, an MRI was performed on her right shoulder. Diagnostic imaging

indicated minor blunting and fraying of the postero-inferior labrum, and mild diffuse tendinosis along the rotator crescent. These findings are consistent with the subject's chronic tendinopathy and confirmed no major underlying pathological damage as the cause of the right shoulder pain.

DISCUSSION

The presentation of the PEC pattern in this athlete was typical, as described by PRI®. PEC is theorized to cause the right and left hip to position in external rotation, abduction, and flexion resulting in bilateral rib cage flare and anterior pelvic tilt.[3,4,14,15] Current literature has shown that lumbopelvic and core weakness/instability negatively affects the upper extremity in patients, resulting in dysfunction.[16,17] The PEC pattern present in this athlete reflected lumbopelvic and core weakness/instability. This information gained from the assessment led to the clinical reasoning that underlying lumbopelvic and core weakness/instability was contributing to the athlete's shoulder dysfunction. Thus, by using PR treatment to address the lumbopelvic and core weakness/instability the subject's shoulder pain could potentially be addressed.

Structuring the athlete's intervention to target the pelvis's dysfunctional patterns was the main focus of the program. The adapted 90/90 dead bug diaphragmatic breathing was used to activate the core muscles, postural stabilization muscles, address the sagittal plane needs and prime the breathing pattern of the athlete for the remainder of the intervention program. During activity the body has increased respiratory demands to meet the basic needs of the athlete. This respiration increases activation of postural stabilization muscles.[10,18] The 90/90 dead bug was always completed first, to cue the athlete to focus on core activation and the diagrammatic breathing pattern throughout her therapeutic exercises.

The 90/90 hip shift with hemi-bridge targeted the anterior pelvic tilt and activation of the adductor muscle group. This athlete's ADT showed a bilateral anterior tilted pelvis. The 90/90 hip shift was used to target unilateral hamstring activation.[11] The ipsilateral activation of the hamstring pulls on the ischial tuberosity creating a posterior translation of the pelvis. This unilateral activation decreases lumbar lordosis and increases anterior rib depression.[10] Once the pelvis is in a more neutral position the femoral head should adduct more freely because it will not come in contact with the cotyloid rim of the acetabulum.[11] The right sidelying left adductor pull back targeted the external rotation of the pelvis and congruence of femoral head into the acetabulum. This intervention promotes hip adduction and left femoral internal rotation on acetabulum.[12] During the inhalation process the diaphragm forces the pelvic floor to open the AF joint specifically, easily allowing internal rotation, decreasing limitation of movement, and addressing the frontal plane compensations.[12]

The PRI based intervention program's significant effect on symptom resolution could be attributed to the ROM gained at both the hip and shoulder. Rates of shoulder injuries in baseball pitchers are inversely correlated to hip rotational ROM and decreased hip rotation ROM has been correlated to increased shoulder external rotational torque.[19,20] The athlete in this case study drastically improved her left hip internal rotation ROM over the course of the PRI intervention. In theory, this hip ROM improvement may have decreased the torque on her shoulder, and thus decreased right shoulder joint musculature demands.

A possible confounding factor noted in this case was the athlete's hip dysplasia at birth. Having minor dysplasia that goes undetected or is improperly treated in infant and adolescent years can lead to greater morbidities later in life.[21] These morbidities result from abnormal hip biomechanics leading to more anatomical abnormalities because of the improper movement patterns.[21] Whether the athlete's hip dysplasia was truly corrected as an infant, and if the irregular movements developed subsequently due to her sport or movements being expressed as dysfunctional postural patterns are related to this previous medical history is unknown.

There are some potential limitations to the current case report. In this specific case report, outcome measures to assess shoulder strength, beyond manual muscle testing, or fatigue of the athlete were not evaluated. The use of hand-held dynamometry would have enhanced the assessment of strength. The athlete did subjectively report that throughout her intervention shoulder fatigue decreased as she progressed further into the program. This information though not

assessed shows an area for future studies to assess the effects of postural restoration interventions on shoulder fatigue and strength. The current case used a single-item patient-reported outcome (Likert scale) to evaluate pain. However, a validated multi-item scale, such as the Disabilities of the Arm, Shoulder and Hand (DASH), would have provided a more complete view of the subject's pain and function. Lastly, well designed research evaluating the PRI interventions are necessary, as case reported are limited in their generalizability and assessment of causal relationships.

CONCLUSION

The results of this case report suggest that PRI® exercises focusing on core and pelvic stability can translate to improved ROM and decreased shoulder pain associated with rotator cuff tendinopathy, even when traditional interventions are removed. PR based interventions address postural asymmetries in the kinetic chain that present as movement dysfunction. By treating pelvic alignment with the PRI® exercises and theories, shoulder pain and ROM measures in this overhead athlete were improved.

REFERENCES

1. Corpus KT, Camp CL, Dines DM, Altchek DW, Dines JS. Evaluation and treatment of internal impingement of the shoulder in overhead athletes. *World J Orthop.* 2016;7(12):776-784.
2. Pogetti LS, Nakagawa TH, Contecote GP, Camargo PR. Core stability, shoulder peak torque and function in throwing athletes with and without shoulder pain. *Phys Ther Sport.* 2018;34:36-42.
3. Boyle KL. Postural Restoration. *Musculoskeletal Physiotherapy Australia InTouch Magazine.* 2007:13-15.
4. Hruska R. Myokinematic Restoration Course Manual. Postural Restoration Institue; 2017.
5. Robey JH, Boyle K. The role of prism glass and postural restoration in managing a collegiate baseball player with bilateral sacroiliac joint dysfunction: A case report. *Int J Sports Phys Ther.* 2013;8(5):716-728.
6. Robey JH, Boyle KL. Bilateral functional thoracic outlet syndrome in a collegiate football player. *N Am J Sports Phys Ther: NAJSPT.* 2009;4(4):170-181.
7. Spence H. Case study report: postural restoration: an effective physical therapy approach to patient treatment. *Tech Reg Anesth Pain Manag.* 2008;12(2):102-104.
8. Masek J. Femoroacetabular Impingement Mechanisms, Diagnosis and Treatment Options Using Postural Restoration: Part 2. *Sport Ex Med.* 2015;65:18-25.
9. Cantrell M. Refining Your Ability to Execute an Accurate Hruska Adduction Lift Test (HAdLT). https://www-posturalrestoration-com-files.s3.amazonaws.com/fa32-4171601-Refining_Your_Ability_to_Execute_an_Accurate_Hruska_Adduction_Lift_Test.pdf?versionId=KAB20zmUwmE6YlO4YYpr6ubixHgtQJDO. Accessed August 30, 2019.
10. Boyle KL, Olinick J, Lewis C. The value of blowing up a balloon. *N Am J Sports Phys Ther: N Am J Sports Phys Ther.* 2010;5(3):179-188.
11. 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.
12. Boyle KL. Clinical application of the right sidelying respiratory left adductor pull back exercise. *Int J Sports Phys Ther.* 2013;8(3):349-358.
13. Starkey C, Brown SD, Ryan JL, Starkey C. *Examination of orthopedic and athletic injuries.* Ed. 3. ed. Philadelphia: F.A. Davis Co.; 2010.
14. Petrich S. Understanding the L AIC Pattern. 2016; http://www.sarahpetrich.com/uploads/2/6/0/4/26041402/understanding_the_pec_pattern_1.pdf. Accessed August 30, 2019.
15. Petrich S. Understanding the R BC Pattern. 2016; http://www.sarahpetrich.com/uploads/2/6/0/4/26041402/understanding_the_r_bc_pattern.pdf. Accessed August 30, 2019.
16. Brumitt J, Dale RB. Integrating shoulder and core exercises when rehabilitating athletes performing overhead activities. *N Am J Sports Phys Ther.* 2009;4(3):132-138.
17. Endo Y, Sakamoto M. Correlation of shoulder and elbow injuries with muscle tightness, core stability, and balance by longitudinal measurements in junior high school baseball players. *J Phys Ther Sci.* 2014;26(5):689-693.
18. Hodges PW, Butler JE, McKenzie DK, Gandevia SC. Contraction of the human diaphragm during rapid postural adjustments. *J Physiol.* 1997;505 (Pt 2):539-548.
19. Laudner K, Wong R, Onuki T, Lynall R, Meister K. The relationship between clinically measured hip rotational motion and shoulder biomechanics during the pitching motion. *J Sci Med Sport.* 2015;18(5):581-584.
20. Scher S, Anderson K, Weber N, Bajorek J, Rand K, Bey MJ. Associations among hip and shoulder range of motion and shoulder injury in professional baseball players. *J Athl Train.* 2010;45(2):191-197.
21. Pun S. Hip dysplasia in the young adult caused by residual childhood and adolescent-onset dysplasia. *Curr Rev Musculoskelet Med.* 2016;9(4):427-434.