

CASE REPORT

THE ROLE OF PRISM GLASS AND POSTURAL RESTORATION IN MANAGING A COLLEGIATE BASEBALL PLAYER WITH BILATERAL SACROILIAC JOINT DYSFUNCTION: A CASE REPORT

Jason H. Robey, MS, ATC, PRT¹Kyndall Boyle, PT, PhD, OCS, PRC¹

ABSTRACT

Background and Purpose: Sacroiliac joint dysfunction (SIJD) is a condition affecting 15-30% of patients with low back pain seen in outpatient clinics. Currently there is no well-defined standard of care. The purpose of this case report is to discuss the multidisciplinary management between an athletic trainer and an optometrist for an athlete with bilateral SIJ dysfunction and a visual midline shift syndrome.

Case Description: A 21-year-old collegiate baseball player reported to the athletic training room, presenting with low back pain of three day duration, with tenderness over both posterior superior iliac spines (PSIS) (left > right). His pain at its worse was a 7/10 on the Numeric Pain Scale (NPS). The pain increased to the point that it limited his activities of daily living (ADLs) including getting dressed, putting on his shoes, sleeping, and getting in and out of a car.

Interventions: The athlete was initially treated using traditional muscle energy techniques (MET) based intervention to correct SIJD, and lumbar stabilization exercises directed by a licensed athletic trainer, as well as manipulation by a chiropractor. Three weeks of treatment did not prove to be beneficial with only a minimal (1 point on the NPRS) decrease in pain. The athlete was then referred to the head athletic trainer for consultation who prescribed orthotics, for bilateral rear-foot valgus, and Postural Restoration (PR) therapeutic exercises. After two weeks of orthotic use and PR exercises the athlete's pain decreased one additional point on the NPRS. Due to lack of progress, an optometrist was then consulted. The neuro-optometrist prescribed 2 diopter base-down prisms to be worn two hours a day, for four weeks. After four weeks of prisms and new exercises, the athlete was asymptomatic and returned to full pain-free baseball participation without further complications.

Outcomes: The Oswestry Disability Index Questionnaire (ODI) was 48% at initial (severe disability), 40% at five weeks and 0% at discharge. The Numeric Pain Scale (NPS) score went from 7/10 to 0/10.

Discussion: The athlete demonstrated only minimal relief of symptoms following MET, therapeutic exercises, and chiropractic manipulation. Intervention using prism glasses and PR exercises, designed to optimize posture and correct his visual midline shift syndrome, led to complete resolution of his symptoms.

Key words: neuro-optometry, postural restoration, prisms, sacroiliac joint dysfunction

Evidence Level: 3B

CORRESPONDING AUTHOR

Jason H. Robey, MS, ATC, PRT
Athletic Training
425 Jack Branch Dr
Boone, NC 28608
Email: robeyjh@appstate.edu

¹ Appalachian State University, Boone, NC

INTRODUCTION

Sacroiliac joint dysfunction is a condition affecting 15-30% of patients with low back pain seen in outpatient clinics.^{1,2} Low back pain is the second most common cause of disability in the United States.³ An estimated 149 million days of work per year are lost³⁻⁵ because of LBP.⁶ Total costs estimated to be between \$100 and \$200 billion annually, with two-thirds are due to lost wages and productivity.^{3,7} More than 80% of the population will experience an episode of LBP at some time during their lives.^{3,8} Back pain is common in competitive athletes, with an estimated prevalence ranging from 1% to 30%.⁹⁻¹¹ Athletes in sports that require repeated hyperextension (gymnastics, volleyball, diving) have a higher incidence of LBP.^{9,10,12} Other sports that have an increased likelihood of LBP may include offensive linemen in football and throwing sports (baseball, quarterbacks, throwers in track & field).^{9,10}

Optimal sacroiliac joint (SIJ) function depends on optimal positioning and movement of six joints or articulations: the right and left sacroiliac joints, the L5-S1 articulation, the pubic symphysis, and both hip joints. Mal-positioning of the SIJ often results in pain and diminished function, which may be compounded in the active population.^{1,2} Treatment of sacroiliac joint dysfunction varies depending on the etiology, however currently there is no well-defined standard of care.^{1,2} Potential causes for SIJ pain range from rare events such as pyogenic infection,¹³ malignancy,¹⁴ to occurrences from bracing one's legs after a car accident,¹⁵ falls,¹⁵ athletic injuries,¹⁶ prolonged lifting and bending,¹⁷ and torsional strain.¹⁷ Traditionally described interventions include: pharmacological treatment (steroid injections),¹⁸ SIJ manipulation, muscle energy techniques, use of an SIJ belt, patient education regarding the pain cycle, moist heat, soft tissue massage, electrical stimulation and therapeutic exercises including activation of the transversus abdominus (in several positions), and aquatic therapy.^{1,2,18} A recent single case study on management of a patient with left (L) Sacroiliac Joint Dysfunction (SIJD) demonstrated benefit from Postural Restoration (PR) exercises designed to stretch the left posterior hip capsule, and activate the left hamstrings, adductor magnus, and anterior gluteus medius while simultaneously activating the right (R) gluteus maximus.¹⁹

Several investigators have focused on visual influences on the perception of self-motion (spontaneous or voluntary motion) and the control of posture.^{20,21} There is no known literature relating visual dysfunctions, such as a visual midline shift syndrome (VMSS), to sacroiliac joint dysfunction or the use of prisms (a wedge of glass in eyewear) to manage patients/athletes with SIJ pain. VMSS results from a dysfunction of the ambient visual process. The ambient (peripheral) visual process provides spatiotemporal orientation.²² It is delivered primarily from the peripheral part of the eyes and it sends information to the mid-brain to match up with sensorimotor information. This part of the system is preconscious. This process sends information to approximately 99% of the cerebral cortex to preprogram spatial information.²³ VMSS is caused by the distortions of the spatial system causing the individual to misperceive their position in their spatial environment. This causes a shift in their concept of their perceived visual midline.²⁴⁻²⁶ In order to correct this visual shift a neuro-optometrist may utilize prism glasses.

The presentation of a moving visual scene to a stationary observer can produce an illusion of translation (linearvection)^{27,28} or of rotation (circularvection).²⁹ Such moving visual environments result in postural readjustments of the observer.²¹ The positive contribution of vision to postural maintenance is widely recognized. Without vision, normal postures are more difficult to maintain³⁰ and novel postures may be impossible.²⁰ Furthermore, perturbing vision often disrupts posture. Vision also affects motor control. For example, visual input is important in timing the onset of leg extensor activity prior to landing from a jump,^{31,32} descending stairs,³³ and for controlling arm extensor activity in self-initiated forward falls.^{34,35} Visual disturbances are usually a result of a neurological event such as a mild traumatic brain injury (mTBI) or occur after a cerebral vascular accident (CVA). These disturbances are classified as either a Post Traumatic Vision Syndrome (PTVS) or Visual Midline Shift Syndrome (VMSS).

The use of specially designed yoked prisms can alter the visual input and allow individuals to begin spatial reorientation and correcting faulty posture.^{20,21,30-35} Prisms are wedge shaped lenses that are thicker (the base) on one side than the other. Prisms are used

in neuro-optometric rehabilitation in patients with visual dysfunctions, however, they are not commonly used in treating musculoskeletal conditions. This case study presents a unique rehabilitation paradigm using prism glasses to alter an athlete's visual perception, which appeared to assist in postural correction and contribute to resolution of his bilateral SIJD. This is the first case report to discuss the use of prism glasses and Postural Restoration therapeutic exercises for a VMSS in the management of bilateral SIJD. The purpose of this case report is to discuss the multidisciplinary management between an athletic trainer and an optometrist for an athlete with bilateral SIJ dysfunction and a visual midline shift syndrome.

CASE DESCRIPTION

History

A 21-year-old male collegiate baseball player presented to the team athletic trainer with complaints of low back pain (LBP). He reported pain over both right and left sacroiliac joints (SIJ)/posterior superior iliac spines (PSIS) with left being worse than the right. Pain over the SIJs is known as the Fortin Sign as indicative of pain arising from the SIJ.³⁶ His pain at its worse was a 7/10 on the Numeric Pain Scale (NPS). His history indicated no acute mechanism of injury, but his symptoms had progressively increased over a three-day period prior to evaluation. The pain increased to the point that it limited his activities of daily living (ADLs) including getting dressed, putting on his shoes, sleeping, and getting in and out of a car. He demonstrated a left anteriorly rotated innominate, acquired forward head posture (AFHP), flat thoracic back, hyperactive back extensors, and overactive hip flexors. His history of prior low back or pelvic injuries was unremarkable and he had not previously received treatment for his low back pain.

Clinical Assessment #1

The athlete in this case was right hand dominant and played first base. He did not use tobacco or any form of illegal drugs. The Oswestry Disability Index Questionnaire (ODI) was chosen as the functional self-reported outcome assessment tool. The ODI is a disease-specific disability measure that is used to establish a level of disability, stage a patient's acuity

status, and monitor change over time.³⁷ The minimally clinically important difference for the ODI is (8-12%) in change score of symptoms.³⁸ The athlete's initial ODI score was a 48%, which is classified as a severe disability. The athlete reported pain with trunk flexion and extension with a decrease in range of motion (ROM). He denied pain during bilateral side bending and rotation. He reported pain over both right and left sacroiliac joints (SIJ)/posterior superior iliac spines (PSIS) with left being worse than the right. Pain over the SIJs is known as the Fortin Sign and is indicative of pain arising from the SIJ.³⁶ Palpation of the anterior superior iliac spine (ASIS), PSIS, and sacral sulcus revealed bilateral anterior rotation with the left ASIS lower than the right ASIS and the left PSIS higher than the right PSIS. The athlete presented with a left iliac inflare, with a right-on-right sacral rotation, right rotation of 4th and 5th lumbar vertebrae, positive long sit test on right,^{39,40} and a positive seated flexion test.³⁹⁻⁴¹

Clinical Impression #1

The athlete was diagnosed with bilateral sacroiliac joint dysfunction with a bilateral anterior rotation, left greater than right, a left iliac inflare, and a right-on-right sacral rotation.

Intervention Program #1

Treatment was initiated consisting of muscle energy techniques (MET) in order to correct the above described pelvic and sacral asymmetries.^{39,40} To correct the anterior rotated innominate, treatment consisted of stretching the ipsilateral hip flexor, quadriceps, and adductors while strengthening ipsilateral gluteus muscles, hamstrings, and adductors.^{39,40} To correct for sacral rotation, the treatment consisted of stretching the ipsilateral quadratus lumborum, latissimus dorsi, and contralateral piriformis.^{39,40} Strengthening focused on core muscles with an emphasis on neuromuscular control and pelvic stabilization. These muscles included the abdominals (rectus abdominus, transversus abdominis, and internal/external obliques), the piriformis, quadriceps, gluteus maximus, medius, and minimus.^{39,40} Before evaluation by the team chiropractor, the athlete went through three days of treatment that consisted of strengthening, stretching and modalities. Strengthening included: gluteal strengthening with

side stepping, physioball squats 3 sets x 8 repetitions (reps), step-ups/ step-downs 3 sets x 10 reps and supine lumbar stabilization exercises. Stretching was performed on the hips in four directions, and modalities including moist heat pack and interferential electrical stimulation (80-150 mHz; continuous for 20 minutes) were utilized over both SIJs for pain control.

Clinical Assessment and Intervention #2

The athlete was then referred to a chiropractor for further assessment. Chiropractic care consisted of spinal and pelvic manipulations once a week for three weeks in conjunction with the previously established treatment.

Clinical Assessment and Intervention #3

After three weeks of intervention by both athletic trainer and the chiropractor, the patient had only minimal relief. His NPS decrease from (7/10 to 6/10) was less than the minimal clinically important difference (MCID) of 2.³⁸ The head athletic trainer was then contacted for consultation and he performed additional examination tests/measures. The left Ober's Test was positive with hip flexor and abductor tone noted, right Ober's Test was negative.⁴² Passive hip range of motion (ROM) was assessed in sitting and revealed the following: left hip internal rotation (IR) was noted as less than right and right hip external rotation (ER) was noted as less than left. Bilateral rib flares (external rotation/elevation), left worse than right, were noted upon visual observation and palpation.

The positive left and negative right Ober's Test and passive hip ROM measures were interpreted by the athletic trainer as an indication of an anteriorly rotated innominate on the left.^{1,43} With this position the right hip is positioned in IR and adduction (add). When the right hip needs to move in a way requiring more IR and add, the right SIJ may move to help achieve this range of motion.⁴⁴ This may result in the right innominate moving excessively on the sacrum creating instability on the right side.^{1,44} The gluteus maximus, because it crosses the SIJ could provide force closure across the joint to help increase stability of the joint.^{45,46} The left hip/femur which would be oriented inward often compensates by moving into ER and abduction (Abd). Left hip ER/Abd over

time may result in adaptive shortening of the left posterior capsule/ischiofemoral ligament.^{19,47} When the left hip needs to move in a way requiring more external rotation and abduction, the SIJ may move to help achieve this range of motion.⁴⁴ This may result in the left innominate to move excessively on the sacrum creating strain and instability on the left side. Muscles that would help to oppose the left hip ER/Abd would be muscles that internally rotate such as the anterior gluteus medius (antglutmed) and the ischiocondylar portion of the adductor magnus (IC AM).^{1,19} The anterior tilt and forward rotation could also contribute to more rib elevation/external rotation on the left side. Muscles that would help bring the ribs down on the left side would include the left internal obliques (IO) and the transversus abdominus (TA). The clinical reasoning for this athlete was to return the pelvis, hips and ribs to a neutral state, and to increase stability/force closure of the SIJs. The exercises included: Right Side Lying Adductor Pull Back, Supine Right Gluteus Maximus with Right AF ER, Left Side-lying Knee to Knee, Supine Hook-lying Right Gluteus Maximus with Left Gluteus Medius, and Supine Hook-lying Left Gluteus Maximus with Right Gluteus Medius.⁴⁸ All of the exercises are designed to inhibit the paraspinals by maintaining a "back rounded" or flexed position/posterior pelvic tilt. Additionally, the Right Sidelying Adductor Pull Back would help to pull the pelvis back on the left via left hamstring and adductor activation.⁴⁸ It also brings the left ribs closer to the left innominate which would help reduce the left rib flare/ER and optimize the zone of apposition (ZOA) of the respiratory diaphragm.^{1,49,50} Additionally, it positions the left hip into IR/add, and the right hip into ER/ABD. The left ADD/IR is intended to assist in lengthening the left posterior capsule/ischiofemoral ligament. The supine Right Gluteus Maximus with Right AF ER activates the right gluteus maximus for force closure and activates the left ischiocondylar adductor magnus and anterior gluteus medius for left hip IR to avoid left SIJ instability. The remaining exercises activated the right or left GM, antglutmed, adductors, and abdominals (IO/TA). The head athletic trainer then prescribed lumbar-pelvic-femoral therapeutic exercises (developed by the Postural Restoration Institute™)⁴⁸ to address the left SIJ pain. Five reps of each exercise, to be done twice a day

for two weeks. Additionally, the athlete was fitted for custom orthotics by a certified pedorthist. Postural Restoration (PR) exercises focused on addressing pathomechanics associated with SIJ dysfunction via activation of specific muscles such as left adductor, left hamstring, left anterior gluteus medius, and right gluteus maximus (transverse plane) with inhibition of paraspinal muscles.^{1,19}

After five weeks of treatment, including two weeks of custom orthotic wear and PR exercises, the athlete experienced minimal improvements. The athlete completed another ODI questionnaire where he scored 40%, which is classified as a moderate disability. The 8% improvement however, reached the minimal clinical important difference (MCID) of 8-12%.⁵¹ The exercises appeared to aid the athlete in improved function; however his improvement did not seem to be maintained during activity. As a result of the lack of success from previous treatments, the head athletic trainer decided that further evaluation and intervention was warranted.

Clinical Assessment #4

Because correcting pelvic position and adding orthotics did not completely resolve the athlete's discomfort, additional evaluation involving higher up the kinetic chain was required. According to the Postural Restoration Institute®, the next step would be to conduct an eye screen.^{24,25} The eye screen (Table 1), revealed an anterior visual midline shift syndrome (AVMSS) which is also known as a horizontal midline shift (Table 2). A Visual Midline Shift Syndrome (VMSS) results from dysfunction of the ambient visual process. Ambient visual process allows individuals to know where they are in space and provides general information used for balance, movement, coordination and posture.⁵² A VMSS triggered by distortions of the spatial system causes an individual to misperceive their position in their spatial environment, which results in a shift in their concept of perceived visual midline. The person will therefore compensate by leaning to one side, forward and/ or backward.²⁴⁻²⁶ With an AVMSS, the horizontal midline is below eye level. No vertical midline

Table 1. Test to determine if a patient has a "normal" visual midline or whether a visual midline shift is present.

VMSS Testing
<ul style="list-style-type: none"> ✗ Patient is supine with the legs in a hook-lying position ✗ Use a wand, pencil, or finger and place it in a horizontal position at approximately 16" above the patient's head ✗ Bring the wand down in a vertical fashion and instruct the patient to tell the examiner when the wand appears to be at eye level ✗ Next, hold the wand beneath the patient's chin and move the wand up in a vertical fashion ✗ Instruct the patient to tell the examiner when the wand appears to be at eye level

Table 2. With normal response the wand will be at the level of the patient's eyes. The results will help determine whether an "anterior or posterior" midline shift is present.

Results
<ul style="list-style-type: none"> ✗ If the wand is determined to be at eye level but is actually above this is known as a Posterior Visual Midline Shift ✗ Persons with this shift in visual midline tend to thrust their weight forward and assume a position of more flexion while walking or when seated ✗ If the wand is determined to be at eye level but is actually below this is known as an Anterior Visual Midline Shift (Fig. 2) ✗ Persons with this shift in visual midline distortion experience an extended posture or a tendency to lean backward either while seated or while walking

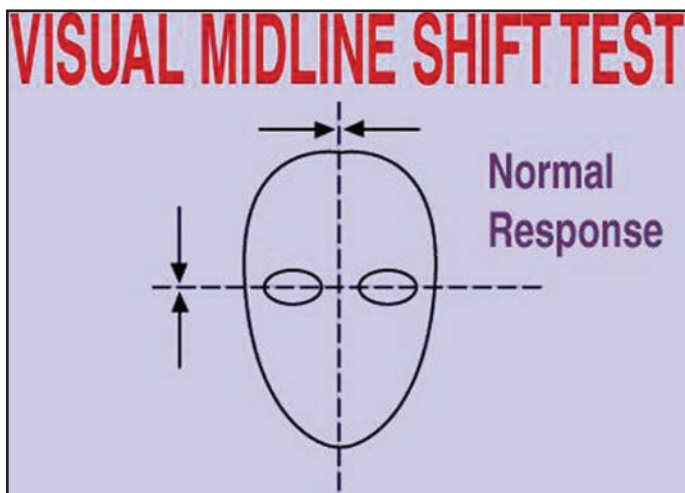


Figure 1. Normal visual midline without any form of a shift

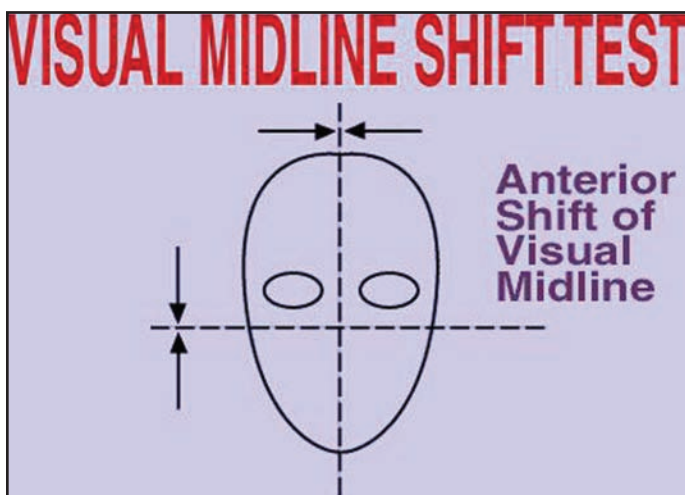


Figure 2. Anterior shift of visual midline

shift was noted. (Figures 1 and 2) A vertical (lateral) visual midline is where the midline shifts to the left or the right of the nose resulting in leaning to one side.²⁴⁻²⁶ Subsequently, the athlete was referred to a neuro-optometrist who employs prisms for therapy. Thus, due to the AVMSS diagnosis, the neuro-optometrist fitted the athlete with a pair of 2-diopter base-down prism (glasses).

Intervention Program #4

The athlete wore the 2-diopter base-down prisms for two hours a day for four weeks while performing therapeutic exercises and baseball fielding drills. A diopter is a reciprocal meter. A reciprocal meter is a measure of the power of a lens or optical system in bringing rays into focus. The dioptric power of a

thin lens is the reciprocal of the distance between the center of the lens and its focal point as measured in meters. A 2-diopter lens can focus light rays at a point 0.5 meters away from itself. A base-down prism is a wedge-shaped lens that is thicker on one edge than the other. The thicker edge (base) is turned down. Prisms bend light (opposite direction from its thicker end) so the base-down prism turns the light upward thus causing the eye to also move up. This prism is used to measure an eye misalignment and/ or treat a binocular dysfunction (eye teaming problem where both the right and left eyes have difficulty working together).

Prisms are sometimes added to glasses to help improve eyesight due to a misalignment or visual field loss. The addition of prism glasses was believed to alter the athlete's vision, which eliminated the AVMSS and allowed his body to return to a neutral state.

Exercises believed necessary to optimize utilization of prism glasses require the patient to work on squatting (Squat with Midtrap- 5x 2x/day) (Figure 3), reaching (PRI Wall Squat with Balloon- 5x 2x/day) (Figure 4) thoracic flexion activity (Retro Stair, 10 steps 2x/day) (Figure 5) and Retro Walking (Figure 6)- (0 steps at 2x/day).²⁵ These exercises were performed with the prism glasses on, and were designed for neuromuscular re-education of the athlete. They each encouraged spinal flexion and rib depression/ internal rotation, which are thought to help inhibit the paraspinals while activating the abdominals. The Retro Stair Descent and Retro Walking also encouraged reciprocal and alternating motion, shifting of the hips into and out of Add/IR while breathing.²⁵

After four weeks of wearing the prism glasses with PR exercises and baseball drills for two hours a day, the athlete completed another ODI. This time the athlete's score dropped to 0%, which is considered indicative of no disability. Nine weeks after his initial evaluation, he was 100% pain free; he discontinued the use of prisms and was cleared to return to full activity.

OUTCOME

The athlete's NPS went from a 7/10 to a 6/10 after three weeks of rehab while performing traditional exercises, which did not meet a MCID of a 2.³⁸ The NPS then dropped to a 5/10 after five total weeks of rehab including PR exercises and orthotics. This



Figure 3. Squat with Midtrap- allows for spinal flexion and rib depression/internal rotation which help inhibit paraspinal tone while activating the abdominals. Midtrap activity promotes scapular positioning on depressed ribs.

change in the NPS just met the MCID. Finally the NPS dropped to a 0/10 after nine weeks of rehab with the addition of prism glasses. The NPS change score by discharge was a seven (7/10 to a 0/10), representing a 100% improvement in pain intensity and exceeding the MCID (2 points) by 5 points. The ODI went from a 48% (severe disability) to 40% (moderate disability) after five weeks of rehab. This 8% change score represented a 17% improvement in function and just met the MCID (8-12%). The ODI then went from the 40% to 0% after nine weeks. This represented a 100% improvement in function and far exceeded the MCID which is reported from 10-20%.³⁸

DISCUSSION

This case report describes the multi-disciplinary management of a collegiate baseball player with bilateral sacroiliac joint dysfunction. He was treated by four individuals representing three professions in three



Figure 4. PRI Wall Squat with Balloon- encourages spinal flexion and rib depression/internal rotation. The balloon encourages increased abdominal activation which inhibits paraspinals activity while the reach promotes trunk rotation to re-orientate the spine to back towards the left.

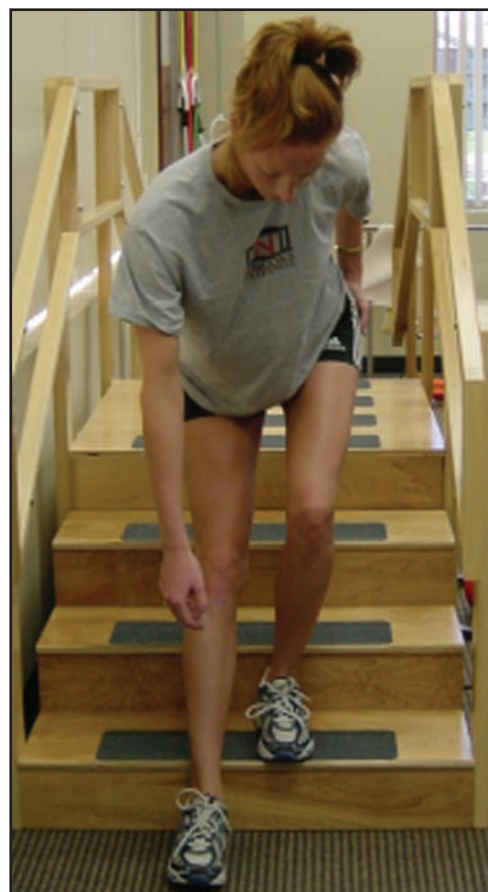


Figure 5. Retro Stairs- initiates spinal flexion, rib depression and encourages reciprocal shifting of the hips into ADD/ IR while breathing. The stairs increase activation of the gluteals and the hamstrings during hip extension.



Figure 6. *Retro Walking- Also promotes spinal flexion, rib depression and encourages reciprocal shifting of the hips into ADD/ IR while breathing.*

phases of interventions. The first phase included traditional interventions prescribed by an Athletic Trainer (MET, lower extremity/trunk strengthening and stretching) and chiropractic manipulation. The second phase included less commonly used lumbar-pelvic-femoral therapeutic exercises developed by the Postural Restoration Institute™ (PRI), as well as custom orthotics made by a pedorthist. The third phase included prescription of prism glasses by a neuro-optometrist along with the PR exercises. The magnitude of improvement after the prescription of PR therapeutic exercises and orthotics was clinically meaningful (ODI decreased from 48% to 40%) but still remained at an unacceptable level for the athlete to return to symptom free collegiate baseball. The greatest magnitude of improvement occurred after the use of prisms along with PR exercises (ODI decreased from 40% to 0% demonstrating a complete resolution of symptoms. This case report illustrates what appears to be the importance

of managing an individual with complaints of SIJD (who does not achieve expected outcomes with traditional intervention) with an orthotist and perhaps more importantly with a neuro-optometrist. It highlights the potential importance of a clinician such as an athletic trainer or physical therapist to consider examination of visual dysfunction such as a VMSS when expected outcomes of a patient/athlete are not being achieved so that proper referral can occur.

First Intervention Phase

Both traditional interventions used for this case study including the MET⁵³ and chiropractic manipulation⁵⁴ have some evidence to support their use. The bony palpation used to assess faulty position of the sacrum however has poor reliability⁵⁵ and although MET interventions can reduce pain and improve function⁵⁴ they do not change bony position.⁵⁶ Literature support for specific therapeutic exercises for management of SIJD is also minimal, (low level evidence such as case studies, case series) and higher levels of evidence are lacking. Specific TA exercises prescribed in different positions are supported by the current evidence, and although this athlete did not specifically perform the abdominal drawing in maneuver in order to activate his TA, he did perform supine exercises with alternating arms and legs utilized to strengthen core muscles which may have resulted in TA activation. The minimal improvement of the athlete's pain may be attributed to the combination of these interventions. Focus on activation of the deep core musculature, spinal stabilizers, may be more beneficial. Strengthening should begin locally then progress globally for greater stabilization. There is no literature support for the additional exercises this athlete was prescribed. However, these exercises were chosen as a result of what is traditionally utilized for treating SIJD.

Second Intervention Phase

The PR exercises prescribed and/or very similar to those prescribed for the athlete in this case study have some limited evidence to support their use.^{19,47,57} These exercises were designed to lengthen the left posterior hip capsule/ischiofemoral ligament, activate the TA, IO, right GM, left antglutmed and/or left IC AM. In previous case reports the patients abolished all pain and maximized full function as measured by the Numeric Pain Scale (NPS) and the Oswestry Dis-

Table 3. Interventions prescribed for the baseball player by the different clinicians.

Clinician	Intervention	Dosage
One	Muscle Energy Techniques Ant. Rotated innominate; right-on-right sacral rotation; and a left inflare	3 repetitions 10 second hold time Twice daily
	Exercises: sumo walks, physioball squats step-ups/ step-downs, and dead bug	8 repetitions 3 sets 10 repetitions 3 sets Twice daily
	Stretching: 4-way hip stretch Moist heat; interfertial electrical stimulation	3 x 15 sec hold 20 minutes
Two	Exercises to activate adductors, hamstrings, gluteus medius, gluteus maximus	5 repetitions 4-5 breaths – hold time Twice daily
	Exercises to inhibit the paraspinal muscles	5 repetitions 4-5 breaths – hold time Twice daily
Three	2 Diopter Base-down Prisms	2 hours/ day with exercises For 4 weeks
	Exercises to encourage spinal flexion, rib depression/ internal rotation, and activation of abdominal muscles	5 repetitions 4-5 breaths – hold time Twice daily
	Exercises to encourage reciprocal and alternating motion, shifting of the hips during gait, and respirations	10 steps Twice daily
Sumo walks: are performed with thera-band around the patient's ankles. The patient is asked to squat into a partial squat stance and initiate side shuffling against the resistance of the band. Physioball squats: a physioball is placed between the patient and a wall, at the level of the patient's waist. The patient is then asked to perform a quarter-squat, flexing the knees to about 45°. Step-ups: the patient is asked to step-up onto an 18" box with the involved side first and back down with the involved side coming down last. Step-downs: the patient stands on a 6" box and is asked to slowly step-down with the uninvolved leg.		

ability Index (ODI). The patients went from an 8-9/10 pain to a 0/10 pain, and from a 20-40% ODI to a 0% ODI. The magnitude of these changes far exceeded the minimal clinical important difference (MCID).^{19,58} However, these are case reports of level 3b evidence and no controlled research trials exist.

Third Intervention Phase

This phase consisted of the use of prism glasses along with additional PR exercises. The authors are unaware of any literature that discusses the combined use of these two types of interventions for bilateral SIJD and a VMSS. There is some evidence however regarding prism use for patients with faulty

posture and a VMSS.^{24-26,52,59} VMSS frequently occurs in conjunction with individuals who have sustained a mild traumatic brain injury (mTBI) or cerebrovascular accident (CVA). This athlete's VMSS may have been induced by visual compensation necessary for the hitting and fielding postures that emphasize extension and rotation of the spine. Visual tract fibers from the eyes are delivered to various areas of the midbrain and superior colliculus, where the incoming information is matched with other sensory-motor input delivered from kinesthetic, proprioceptive, vestibular, and tactile sources.²⁴⁻²⁶ The cerebellum monitors the information and formats the information into a feed-forward system that deliv-

Table 4. Numeric Pain and Oswestry Disability Index scores over the course of treatment.

	Baseline (initial evaluation)	Intervention #1 Initial 3 weeks of intervention (weeks 1-3 post evaluation)	Intervention #2 2 additional weeks of treatment (weeks 4-5)	Intervention #3 4 additional weeks of treatment (weeks 6-9)
NPS Score	7/10	6/10	5/10	0/10
ODI Score	48%	40%	40%	0%

NPS= Numeric Pain Score. Measures a patient's pain intensity from 0-10, with 0 equaling no pain and 10 being worst imaginable pain.

ODI=Oswestry Disability Index. A disease-specific disability measure that is used to establish a level of disability. ODI scoring 0-20% (minimal disability), 21-40% (moderate disability), 41-60% (severe disability), 61-80% (crippled), 81-100% (bed bound).

ers input to other higher organization centers in the cortex for stabilization and anticipation of action.²⁴⁻²⁶ In the absence of sensory-motor feedback, the feed-forward system to the occipital cortex would retain only a sensory message that provides limited spatial relevancy. The ambient visual process creates a relative balance between the mismatch of information received at the midbrain and thus expands or contracts space internally in an attempt to understand the dysfunction. This expansion and contraction of space for individuals with neurological dysfunctions is observed in their postural and movement pattern. The ambient process then, through a feed-forward mechanism to the occipital cortex, projects the expansion or contraction of space externally and causes distortion of the higher sensory spatial environment. The mismatch of information and resulting distortion of space is termed the VMSS.²⁴⁻²⁶

Individuals with an anterior visual midline shift have a tendency to extend their spine and thrust their weight backwards leading to excessive lumbar lordosis, kyphosis of the thoracic spine, and hyperactivity of the lumbar paravertebrals. This athlete presented with faulty posture similar to postural impairments that have been previously described in the literature for individuals diagnosed with VMSS or post traumatic vision syndrome (PTVS).^{20,21,26,30-35,52,59} The athlete in this case demonstrated a left anterior rotated innominate, forward head posture (FHP), thoracic kyphosis, hyperactive spinal extensors, and overactive hip flexors. Patients, as well as the athlete in this case, will often compensate by moving their head

forward and they perceive themselves “walking down a hill” (Figure 7). These patients/athletes are often managed with base-down prisms in the 2 to 4 diopter range.²⁴⁻²⁶ Using specially designed yoked prisms, the brain’s perception of midline will shift to a more centered position enabling individuals to reorient themselves spatially. The prism glasses change light input as if the object were in a different spatial direction. Base-down prisms expand near space and compress far space, countering the distortion of the downward tilt of the floor seen with individuals who look down, have an anteriorly rotated pelvis, or who have active hip flexors.²⁴⁻²⁶ Prism glasses were prescribed for this athlete in order to correct his visual

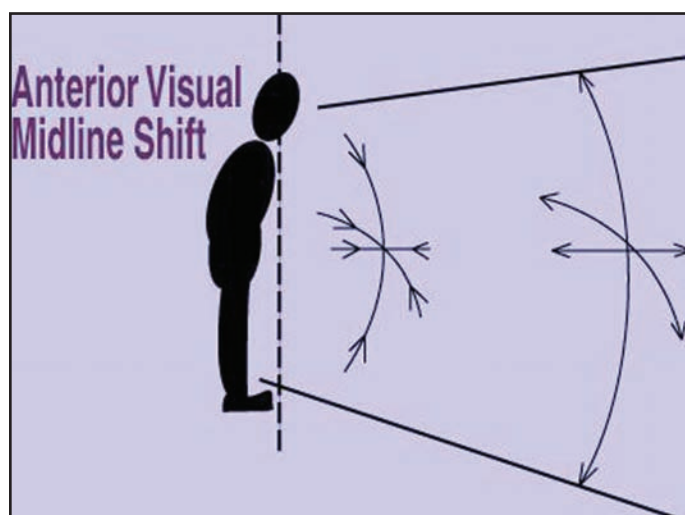


Figure 7. Postural orientation of anterior visual midline shift syndrome. During gait the patient will extend and thrust their weight backwards to prevent falling forward.

distortion and at the same time appeared to contribute to relaxation/inhibition of his paravertebrals and hip flexors. When paraspinal and hip flexor musculature are relaxed and hamstring muscles are engaged, the pelvis can be in a more neutral position versus an anterior tilted position.^{24,25,48}

CONCLUSION

This case report presents a case in which a visual examination and/or referral to a neuro-optometrist was utilized for an athlete with SIJ dysfunction that did not make sufficient progress with therapeutic exercises, manual therapy, modalities and orthotic prescription alone. Appropriate intervention to address a possible VMSS can be prescribed by the neuro-optometrist and/or additional therapeutic exercises can be utilized to address the postural issues. Future research to investigate the correlation between visual impairments, a VMSS, and neuromuscular dysfunction is warranted. Research to investigate the efficacy of neuro-optometric interventions such as prisms and therapeutic exercises compared to traditional rehabilitation or corrective techniques is also warranted. In this case, the addition of prism eye wear along with four PR exercises appeared to substantially contribute to resolution of pain and restoration of function in a collegiate baseball player seen for bilateral sacroiliac joint dysfunction.

REFERENCES

1. Boyle KL. Conservative management for patients with sacroiliac joint dysfunction. In: Norasteh AA, ed. *Low back pain*. Rijeka, Croatia: Intech; 2012:293-332.
2. Cohen SP. Sacroiliac joint pain: a comprehensive review of anatomy, diagnosis, and treatment. *Anesth Analg*. 2005;101:1440-1453.
3. Freburger JK, Holmes GM, Agans RP, et al. The rising prevalence of chronic low back pain. *Arch Intern Med*. 2009;169(3):251-258.
4. Ricci JA, Stewart WF, Chee E, Leotta C, Foley C, Hochberg MC. Back pain exacerbations and lost productive times costs in United States workers. *Spine*. 2006;31(26):3052-3060.
5. Stewart WF, Ricci JA, Chee E, Morganstein D, Lipton R. Lost productive time and cost due to common pain conditions in the US workforce. *JAMA*. 2003;290(18):2443-2454.
6. Guo HR, Tanaka S, Halperin WE, Cameron LL. Back pain prevalence in US industry and estimates of lost workdays. *Am J Public Health*. 1999;89(7):1029-1035.
7. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. *J Bone Joint Surg Am*. 2006;88(suppl 2):21-24.
8. Rubin DI. Epidemiology and risk factors for spine pain. *Neurol Clin*. 2007;25(2):353-371.
9. Daniels JM, Pontius G, El-Amin S, Gabriel K. Evaluation of low back pain in athletes. *Sports Health*. 2011;3(4):336-345.
10. Bono CM. Current concepts review: low back pain in athletes. *J Bone Joint Surg Am*. 2004;86(2):392-396.
11. Tall RL, DeVault W. Review spinal injury in sport: epidemiologic considerations. *Clin Sports Med*. 1993;12(3):441-448.
12. Curtis C, d'Hemecourt P. Review diagnosis and management of back pain in adolescents. *Adolesc Med State Art Rev*. 2007;18(1):140-164.
13. Dunn EJ, Bryan DM, Nugent JT, Robinson RA. Pyogenic infections of the sacro-iliac joint. *Clin Orthop*. 1976;118:113-117.
14. Humphrey SM, Inman RD. Metastatic adenocarcinoma mimicking unilateral sacroiliitis. *J Rheumatol*. 1995;22:970-972.
15. Fortin JD. Sacroiliac joint dysfunction: a new perspective. *J Back Musculoskelet Rehabil*. 1993;3:31-43.
16. Baquie P, Brukner P. Injuries presenting to an Australian sports medicine center: a 12-month study. *Clin J Sport Med*. 1997;7:28-31.
17. LeBlanc Ke. Sacroiliac sprain: an overlooked cause of back pain. *Am Fam Physician*. 1992;46:1459-1463.
18. Vandelder P, Szadek K, Cohen SP, et al. Evidence-based interventional pain medicine according to clinical diagnoses: sacroiliac joint pain. *Pain Practice*. 2010;10(5):470-478.
19. Boyle K. Managing a female patient with left back pain and sacroiliac joint pain with therapeutic exercise. *Physiother Can*. 2010;63(2):154-163.
20. Lee DN, Lishman JR. Visual proprioceptive control of stance. *J Human Movmt Studies*. 1975;1:87-95.
21. Soechting JF, Berthoz A. Dynamic role of vision in the control of posture in man. *Exp Brain Res*. 1979;36:551-561.
22. Padula WV, Munitz R, Magrun WM. *Neuro-visual processing rehabilitation: an interdisciplinary approach*. Santa Ana, CA: Optometric Extension Program Foundation, Inc.; 2012.
23. Padula W, Argyris S, Ray J. Visual evoked potentials evaluating post-trauma vision syndrome in patients with traumatic injuries. *Brain Injury*. 1994;8:125-133.
24. Hruska R. Advanced integration: oculi vision rehab. Lincoln, NE: Postural Restoration Institute; 2007.

-
25. Hruska R. Interdisciplinary integration: vision vestibular integration. Lincoln, NE: Postural Restoration Institute; 2010.
 26. Padula WV. *Neuro-optometric rehabilitation*. 3rd ed 1988.
 27. Berthoz A, Pavard B, Young LR. Perception of linear horizontal self-motion induced by peripheral vision (linear vection): basic characteristics and visual-vestibular interactions. *Exp Brain Res*. 1975;23:471-489.
 28. Chu HNW. *Dynamic response of human linear vection*. Boston, MIT; 1976.
 29. Dichgans J, Held R, Young L, Brandt T. Moving visual scenes influence the apparent direction of gravity. *Science*. 1972;178:1217-1219.
 30. Miles WR. Static equilibrium as a useful test of motor control. *J Indust Hyg*. 1922;3:316-331.
 31. McKinley PA, Smith JL. Visual and vestibular contributions to prelanding emg during jump-down in cats. *Exp Brain Res*. 1983;52:439-448.
 32. McKinley PA, Smith JL, Gregor RJ. Responses of elbow extensors to landing forces during jump-downs in cats. *Exp Brain Res*. 1983;49:218-228.
 33. Freedman W, Wannstedt G, Herman R. EMG patterns and forces developed during step down. *Am J Phys Med*. 1976;55:275-290.
 34. Dietz V, Noth J. Pre-innervation and stretch responses of triceps brachii in man falling with and without visual control. *Brain Res*. 1978;142:576-579.
 35. Kerr B, Condon SM, McDonald LA. Cognitive spatial processing and the regulation of posture. *Q J Exp Psychol*. 1985;11(5):617-622.
 36. Fortin JD, Falco FJ. The Fortin finger test: an indicator of sacroiliac pain. *Am J Orthop*. 1997;26:477-480.
 37. Delitto A, Erhard RE, Bowling RW. A treatment-based classification approach to low back syndrome: identifying and staging patients for conservative management. *Phys Ther*. 1995;75(470-489).
 38. Ostelo RWJG, de Vet HCW. Clinically important outcomes in low back pain. *Best Prac Res Clin Rheumatol*. 2005;19(4):593-607.
 39. Greenman PE. *Principles of manual medicine*. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.
 40. Mitchell FL, Mitchell PKG. *The muscle energy manual volume III: evaluation and treatment of the pelvis and sacrum*. Michigan: MET Press; 2001.
 41. Chaitow L. *Muscle energy techniques*. 3rd ed. New York, N.Y.C: Churchill Livingstone; 2006.
 42. Konin JG, Wiksten DL, Isear JA, Brader H. *Special tests for orthopedic examination*. 3rd ed. Thorofare, NJ: Slack Incorporated; 2006.
 43. Tenney HR, Boyle KL, Debord A. Influence of hamstring and abdominal muscle activation on a positive ober's test in people with lumbopelvic pain. *Physther Can*. 2012;in press.
 44. Bussey MD, Bell ML, Milosavljevic S. The influence of hip abduction and external rotation on sacroiliac motion. *Man Ther*. 2009;5:1-6.
 45. Richardson CA, Snijders CJ, Hides JA, Damen L, Pas MS, Storm J. The relation between the transversus abdominis muscles, sacroiliac joint mechanics and low back pain. *Spine*. 2002;27(4):399-405.
 46. Gibbons S. The integration of the psoas major and the deep sacral gluteus maximus muscles into the lumbar cylinder model. Paper presented at: World Congress on Manual Therapy 2005.
 47. 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.
 48. Hruska R. Myokinematic restoration: an integrated approach to treatment of patterned lumbo-pelvic-femoral pathomechanics. Lincoln, NE: Postural Restoration Institute; 2006.
 49. DeTroyer A EM. Respiratory Anatomy of the Respiratory Muscles. *Clin Chest Med*. 1988;9(2): 175-193.
 50. Boyle K, Olinick J, Lewis C. The Value of Blowing Up a Balloon. *N Am J Sports Phys Ther*. 2010;5(3): 179-188.
 51. Fritz JM, Irrgang JJ. A comparison of a modified oswestry disability questionnaire and the quebec back pain disability scale. *Phys Ther*. 2001;81(776-788).
 52. Padula WV, Argyris S. Post trauma vision syndrome and visual midline shift syndrome. *NeuroRehabil*. 1996;6:165-171.
 53. Hall J, Cleland JA, Palmer JA. The Effects of Manual Physical Therapy and Therapeutic Exercise on Peripartum Posterior Pelvic Pain: Two Case Reports. *J Manipulative Phys Ther*. 2005;13(2):94-102.
 54. Shearar KA, Colloca CJ, White HL. A randomized clinical trial of manual versus mechanical force manipulation in the treatment of sacroiliac joint syndrome. *J Manipulative Phys Ther*. 2005;28(7): 493-501.
 55. van Kessel-Cobelens AM, Verhagen AP, Mens JM, Snijders CJ, Koes BW. Pregnancy related pelvic girdle pain: intertester reliability of 3 tests to determine asymmetric mobility of the sacroiliac joints. *J Manipulative Phys Ther*. 2008;31(2):130-136.
 56. Tulberg T, Blomberg S, Branth B, Johnson R. Manipulation does not alter the position of the sacroiliac joint. A roentgen stereophotogrammetric analysis. *Spine*. 2008;31(2):123-127.
-

-
57. 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.
58. Demske J BK. Management of a Female with Low Back Pain and Right Leg Pain with Pelvic Repositioning Exercises [abstract]. *J Orthop Sports Phys Ther.* 2005;35(1):A64.
59. Matheron E, Le T-T, Yang Q, Kapoula Z. Effects of a two-diopter vertical prism on posture. *Neurosci Lett.* 2007;423:236-240.