

## Physical Therapy Management of Hip Pain in Adults with Scoliosis: A Case Series

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Received: 13 April 2023; Accepted: 25 April 2023

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### ABSTRACT

**Background and Purpose:** Adult scoliosis (AS) is a structural deformity of the spine in a skeletally mature patient and can cause asymmetrical loading on both the spine and the extremities. The purpose of this case series is to highlight physical therapy management of 3 adults with AS and hip pain by incorporating scoliosis specific exercise (PSSE) into their course of treatment.

**Case Description:** The three patients in this study all had structural scoliosis of the spine found on radiograph, complained of hip pain that limited their quality of life, and varied in ages: 31, 48 and 68 years. All three patients had prior treatment to address their hip conditions with only temporary relief. The patients were treated with a combination of PSSE to address their scoliosis and posture in addition to more traditional physical therapy modalities to manage their pain and tissue healing.

**Outcomes:** At the completion of physical therapy, all three patients reported a decrease in pain on VAS, improved scores on LEFS and reported meeting functional mobility goals in ADLS with self-management of symptoms.

**Discussion:** Scoliosis is an asymmetrical deformity in multiple planes of motion and therefore causes asymmetrical forces to the pelvis and hip leading to stress, soft tissue and intraarticular breakdown to the hips across an age span. Non-operative treatment of orthopedic sequelae in this population should include assessment and management of the spine and, if managed earlier in a lifespan, may help minimize permanent damage to the joint.

**Keywords:** Scoliosis, Hip Pain, Schroth Method, PSSE, Physical Therapy

### Background and Purpose

Adult scoliosis (AS) is defined as a structural deformity of the spine with a Cobb angle of more than 10 degrees in the frontal plane in a skeletally mature patient (Aebi, 2005; Schwab *et al.*, 2006; Weinstein *et al.*, 2008). The incidence of AS in the literature ranges from 13 – 68% of adults with incidence increasing with age (Schwab *et al.*, 2006; Kebaish *et al.*, 2011; Smith *et al.*, 2021). Patients with AS have a higher incidence of disability (Aebi, 2005; Schwab *et al.*, 2006; Bess *et al.*, 2016; de Kleuver *et*

*al.*, 2021) and depending on the type and severity of scoliosis, it is reported that disability levels in patients with the condition are as high as patients with diabetes, cancer and heart disease.(Bess *et al.*, 2016) Patients affected by AS not only seek care for pain and disability related to spinal pain and deformity but also for extremity pain due to the compensatory and asymmetrical forces on the extremities (Smith *et al.*, 2021). While there is extensive information in the literature on the operative and non-operative management of the spine in adults with scoliosis there is little discussion in the literature on the management of the non-operative orthopedic sequelae of adults with AS.

The purpose of this case series is to report on physical therapy management of hip pain in 3 adults with AS by incorporating scoliosis specific exercises into their course of treatment.

The presentation of AS can vary depending on severity and cause. Table 1 shows the classification of AS according to Aebi, (Aebi, 2005) and notes that adults with AS either acquire it as a result of a degenerative process that occurred after skeletal maturity or as an adult presentation of adolescent idiopathic scoliosis (AIS). This difference is worth noting as the typical patterns of scoliosis and the compensatory impact on the extremities and pelvis can vary greatly between the two, leading to difficulties in identifying the impact of scoliosis on the pelvis and hips.

The causes of AIS are discussed in several places in the literature (Burwell *et al.*, 2008; Weinstein *et al.*, 2008) with the current theory being that the initiation of AIS derives from a vertebral body growth plate pathology that then has a cascade of neuromuscular torsions and asymmetrical loading in multiple planes during adolescent growth that can lead to progressions of the curve (Burwell *et al.*, 2008; Grivas *et al.*, p. 28). Previous theories centered around asymmetric loading of the pelvis and hips being a driver for AIS (Burwell *et al.*, 2008; Weinstein *et al.*, 2008).

The spinal curves in patients with AIS have common patterns and can be classified by location, number of curves and the compensatory strategies of the hips and pelvis (Weinstein *et al.*, 2008; Balne *et al.*, 2020). Commonly seen compensatory strategies of pelvic shift and scapular protraction become important to the practitioner looking to manage hip and shoulder pain in these patients.

AS which results from a degenerative process (1, 3a. and 3b in [Table 1](#)) can have less predictable curve patterns, however pelvic obliquity is commonly seen, especially in those with lumbar degenerative scoliosis (Si *et al.*, 2020; Smith *et al.*, 2021).

## Theoretical Construct

Scoliosis is an asymmetrical deformity in multiple planes of motion and therefore causes asymmetrical forces to the pelvis and hip leading to stress, strain and degeneration of the intra and extra articular structures surrounding the hips across an age span. Non-operative treatment of orthopedic sequelae in this population should include assessment and management of the spine.

**Table1:** Classification of Adult Scoliosis.

Adult Scoliosis classification according to Aebi	1. Primarily degenerative	2. Adult presentation of AIS	3a. Secondary AS	3b. AS from metabolic bone disease
<b>Cause</b>	Asymmetric degeneration of the disc or facet joints of the spine leads to a cascade of faulty loading which in turn progresses the disease.	Adults that had AIS during skeletal growth and the impact of that deformity on the spine, soft tissue and compensatory areas continues to progress.	Asymmetries from other areas of body for example a LLD, pelvis obliquity, hip OA and neuromuscular asymmetries leading to changes in lumbosacral angle. This category may include degenerative changes secondary to AIS progression so can overlap with AIS.	Metabolic bone disease such as osteoporosis and OA of the spine that can cause asymmetric loading and a cascade of degeneration.
<b>Typical clinical presentation</b>	Single lumbar C shaped curve with pelvic obliquity.	When 2 curves: Right thoracic left lumbar curves with or without pelvic shift and rotation for compensation Single curves can be thoracolumbar with typical pelvic shift opposite convexity of curve or primary lumbar or primary thoracic - typically with pelvic shift and rotation opposite the lumbar curve or with the thoracic curve.	Can vary -if secondary to AIS will follow AIS pattern.	Can vary depending on cause - typically single lumbar C shaped curve with pelvic obliquity.

## Review of the Literature

The complex biomechanical relationship between the hip and spine is well observed (Officerski and MacNab, 1983; Radcliff *et al.*, 2013; Buckland *et al.*, 2015; Esposito *et al.*, 2016; Eguchi *et al.*, 2018; Nielsen and Goldstein, 2018; Rivière *et al.*, 2018; Burkus *et al.*, 2019; Morimoto *et al.*, 2019; Prather and van Dillen, 2019; Banno *et al.*, 2020; Si *et al.*, 2020; Smith *et al.*, 2021; Bortz *et al.*, 2022).

There is a wide range of studies on the biomechanical impact of AIS on the pelvis and hip in multiple planes both in standing and walking (Chen *et al.*, 1998; Kramers-de Quervain *et al.*, 2004; Mahaudens *et al.*, 2009; Yang *et al.*, 2013; Daryabor *et al.*, 2017; Wu *et al.*, 2019) that show asymmetrical

forces through the hip and pelvis as well as abnormalities in acetabular coverage, all with implication for degenerative changes and stress to the hip joint. Burkus, *et al.* (2019) and Markus, *et al.* (2018) used EOS imaging to show significant differences in proximal femoral parameters in patients with AIS in the coronal plane, while Nielsen and Goldstein, (2018) used EOS imaging to show the impact of sagittal plane changes on acetabular coverage. Gum, *et al.* (2007) looked at patterns of pelvic rotation in the transverse plane in patients with AIS. While many of those studies were done with adolescents with AIS, it is also likely that the impact of the asymmetrical loading could worsen over time and have impact on the adult population with AIS. Bortz, *et al.* (2022) in their retrospective study on the prevalence of hip pathology with AIS found a significantly higher incidence of hip diagnoses including dysplasia and recurrent dislocation and implicated an argument for coronal and sagittal realignment.

Most of the literature concerning degenerative scoliosis and hip pain centers around surgical implications and the focus is on spinal correction in the sagittal plane as a primary or first surgery in order to improve acetabular over coverage before hip replacement (Buckland *et al.*, 2015; Si *et al.*, 2020; Zhang *et al.*, 2020).

Non-surgical management of the orthopedic sequelae of patients with scoliosis is a topic that is underserved in the literature. Smith *et al* discussed the orthopedic disease burden in adult patients with symptomatic lumbar scoliosis and found a higher rate of orthopedic disease burden in patients with scoliosis with knee and hip arthroscopy having the highest incidence compared to their non-scoliosis peers (Smith *et al.*, 2021).

Hip pain is a commonly seen diagnosis in physical therapy and orthopedic clinics and can vary in diagnoses and causes range widely in variety across the life span. Some of the more common diagnoses that physical therapists see include OA, trochanteric bursitis, gluteus medius tendonitis, labral tears and FAI (Karrasch and Lynch, 2014; Chamberlain, 2021) . Often in the case of these diagnoses, especially in treating trochanteric bursitis as well as gluteus medius tears, the physical therapist is looking at biomechanical factors that stress the hip in their clinical decision-making process.

The Schroth method is one of seven major schools of scoliosis specific exercises (PSSE) recognized by the Society of Scoliosis Orthopedic Rehabilitation and Treatment (SOSORT) as an evidence-based non-operative approach to treating scoliosis (Berdishevsky *et al.*, 2016). There have been several studies of high evidence showing good results with the use of PSSE in treating mild and moderate curves in patients with AIS. (Monticone *et al.*, 2014; Schreiber *et al.*, 2015; Kuru *et al.*, 2016; Park and So, 2022) The Schroth method is based on the work of Katharina Schroth and is an exercise approach to posture

correction in all planes of movement using specific exercises to promote kinesthetic awareness of postural asymmetries with correction, and rotational angular breathing to address ribcage asymmetries and limitations, as well stabilization and functional exercise training to maintain corrective posture.

Along with the Adam's forward bend test, the scoliometer is a reliable tool to measure the presence of structural scoliosis (Côté *et al.*, 1998).

## Case 1

The patient is a 31-year-old female with a history of AIS that was not detected or treated until 2014 when she saw a chiropractor for upper back and neck tension. The x-ray series ordered showed scoliosis. She had had chiropractic and acupuncture care for the last several years to address progressively worsening bilateral hip, back and neck pain with temporary relief from both. She came to physical therapy to address her issues through exercises. She works full time at a desk job, and reports she sits at least 6 hours a day. She enjoyed being physically active however exercises tended to increase her pain, so she was unable to exercise and had even limited her walking and heavier household chores due to fear of pain.

## Review of Systems

The patient had a history of Lyme's disease and takes thyroid medication. At her initial visit she rated her pain as 4-6/10 on visual analog scale (VAS) in her low back, left hip anterior and lateral and, to a lesser degree, her shoulders and neck. Her pain was worse with prolonged sitting and standing and she reported her hips would tighten with prolonged walking. She described her hip pain as pinching in the front and aching laterally. She would get some relief with moist heat from her sauna and forward bend stretches. The lower extremity functional scale (LEFS) was used to assess hip and leg pain and her score was 60/80 (MDC 9 points at 90% confidence) (Binkley *et al.*, 1999).

## Examination

- Right thoracolumbar curve with positive Adams forward bend test and angle of trunk rotation (ATR) of 5 degrees right at T10 on scoliometer (Côté *et al.*, 1998).
- Range of Motion (ROM): hip and lumbar ROM excessive throughout.
- Negative scour and flexion abduction external rotation (FABERE) tests in bilateral hips for intraarticular and labral dysfunction, negative slump and straight leg raise tests for neural tension.

### *Observation of Standing Posture*

A right thoracolumbar prominence was observed in standing. Her left shoulder was elevated compared to the right and hips were shifted left by 4 cm (measured with plumbline off T1 to center of sacral base). There was an increased lumbosacral angle and anterior pelvic tilt in the sagittal plane, and a left rotation of the pelvis observed in standing and sitting (left anterior superior iliac spine (ASIS) positioned posterior and right ASIS positioned anterior).

### *Clinical Impression*

The postural asymmetries and compensatory patterns associated with the patient's scoliosis were placing stress on her low back, left hip and neck and shoulders. Her curve pattern is consistent with an AIS thoracolumbar curve to the right with a compensatory pelvic shift to the left. In regard to her hip pain, the clinical impression is that the left pelvic shift with slight left rotation combined with an excessive anterior pelvic tilt were placing stress on the hip capsule medially and anteriorly as well as on the gluteus medius muscles.

### *Intervention*

Because the patient's goal was to learn therapeutic exercises to improve her posture and address her scoliosis, the treatment approach focused on PSSE using the Schroth method integrated with core stabilization exercises. The patient was seen once a week for 2 months for therapeutic exercise progressions, PSSE and education.



**Figure 1:** Modified prone on knees, a Schroth PSSE ther ex, followed by Bird Dog for stabilization for patient in Case 1.

Summary of exercises and intervention are included in [Table 2](#).

### **Outcomes**

The patient was highly motivated and adherent to her program and reported relief in hip pain and tightness after the second week. By the end of her treatment, she reported resolution of all her pain complaints except occasional low back pain with heavy lifting. She had met her goals of pain free exercise. LEFS = 76/80, pain on VAS 2/10 when present. She was able to actively correct posture to show neutral sagittal plane pelvic alignment as well as symmetrical frontal and transverse plane alignment and reported she was able to frequently remind herself during the course of activities of daily living and exercises to actively self-correct to this improved posture. The patient was contacted six months after discharge by email to see if she was still performing her exercises and maintaining her level of function. She reported continued compliance and success and reported her functional status and pain levels remained as they had upon discharge.

### **Case 2**

The patient is a 48-year-old female with a history of AIS that was detected as an adolescent but not treated. She began to seek orthopedic care in 2018 at age 44 when she had increasing pain in her back and hips as well as growing concern over her asymmetries. Xray at that time showed 31 degree right thoracic curve and 38 degree left lumbar curve. She did a course of PT in this office in 2018 having heard of the Schroth method and PSSE. She did well at the time with reasonable management of her symptoms. However, she was not able to keep up with her exercise program due to demands of parenting and work followed by hardships with pandemic shut down in 2020. She returned to the office in 2022 with worsening right hip and buttock pain looking to restart PSSE to help her manage her symptoms. She had seen an orthopedist several months prior for her pain and had an x-ray of her spine, and MRI of her right hip. She was diagnosed with a right labral tear of the hip and was given cortisone injections to her right hip twice with temporary relief for 2 weeks each time. Her chief complaint upon return to physical therapy was constant right hip pain in her groin, lateral and posterior hip.

### **Review of Systems**

She rated her pain 5-7/10 on VAS and described it as constant, dull burning pain. Her pain limited her from standing for long periods and prevented rising from a squat position on right. The pain interfered with sleep and walking for exercise. She received temporary relief from heat, TENS and

massage. In addition to her past medical history of AIS she also reported a bunion surgery at age 15. Her LEFS score was 62/80

### *Examination*

- Right thoracic curve with 5-degree ATR at T8, left lumbar curve with 6-degree ATR at L3.
- Negative slump test, negative SLR for neural tissue tension.
- Positive scour test, positive FABERE right hip, positive internal rotation over pressure (IROP) (Wong, Cogan and Zhang, 2022) for intraarticular hip pathology.
- Palpation: Tenderness and tissue tension of right gluteus medius and piriformis compared to left. Tenderness at the right glut medius insertion.
- Hip ROM within functional limits (WFL) with pain at end ranges of external rotation (ER) (buttock), internal rotation (IR) and flexion (groin).
- Positive Thomas test for hip flexor tightness.
- Manual muscle test (MMT) right hip abduction = 3+/4-/5 with pain, left hip within normal limits (WNL).

### *Observation of Standing Posture*

Anterior pelvic tilt from neutral with 3 cm lateral pelvic shift with to the right from midline. Posterior rotation of right innominate with inferior right PSIS and superior right ASIS compared to left. Left lumbar and right thoracic prominences observed with elevated and protracted right shoulder compared to the left.

### *Clinical Impression*

The patient exhibited positive findings for intraarticular hip pathology by diagnostic imaging as well as positive clinical findings. She also demonstrated significant tissue tension and tenderness around her gluteus medius, and piriformis muscles indicating stress and dysfunction of those areas. While the patient has had temporary relief from modalities, injections and massage to those areas to mitigate her symptoms they continued to return. The patient demonstrated a curve pattern consistent with AIS with right thoracic and left lumbar curves with a compensatory right hip shift. Clinical impression is that the right lateral pelvic shift and rotation that is compensatory for the left lumbar rotation is stressing her right hip joint as well as surrounding muscles and over time has caused changes in the articular cartilage as well as the surrounding soft tissue.



## Intervention

The patient was treated once a week for five weeks with a combination of PSSE and stabilization exercise to help her address her posture, lumbar stabilization and pelvic correction strategies as well as patient education and manual techniques to alleviate her tissue tension when needed (Fig. 2). Because her goals were to reduce her pain in addition to restore function through exercise, a combination of manual therapy and treatment modalities for pain and tissue healing were incorporated into her treatment plan. Treatment summarized on Table 2.



Figure 2: Sample of exercises with Case 2.

## Outcomes

The patient reports 0-3/10 on VAS, with noticeable increase in tolerance for walking, exercise and ADLs. She is now able to walk at her local gym indoor track for exercise and was recently able to stand at school function for her kids all day without an increase in pain. She is able to sleep on either side without awakening from pain. She reports that she continues to feel tenuous about heavy lifting and when she does get pain it is located in the sacroiliac joint on the right. She is independent and adherent with her home exercise program (HEP) for posture correction as well as lumbar stabilization. She is able to actively self-correct seated and standing postures to minimize lateral shift of pelvis visually and without pain. Her final LEFS score was 70/80. The patient was contacted via email two months after discharge for follow up. She reported the overall improved function was maintained with some variability in her pain which she attributed to returning to a desk job.

## Case 3

The patient is a 68-year-old female with complaints of left hip, mid back and right shoulder pain. She has a history of total hip replacement (THR) in both hips, the right done in 2016 and the left in 2019. She reports that her hip pain was severe 6 months ago. She returned to the surgeon who gave her cortisone injections to the hip two times without relief. He then ordered an x-ray of her lumbar spine that

revealed degenerative scoliosis (Cobb angle measured as 20 degrees right lumbar) which was a new diagnosis for her. Physical therapy was suggested by her orthopedist; however, the patient first tried an exercise approach on her own that included Pilates to improve her spinal stability. She was pleasantly surprised to notice improvement in her hip pain with the exercise approach and decided to seek out scoliosis specific physical therapy to further reduce her hip pain.

### *Review of Systems*

The patient complained of pain in her right shoulder, mid back and left hip rated 5-8/10, 4/10 and 4-7/ 10 respectively on VAS. Her hip pain was worse with prolonged walking and limited walking for exercise more than a ½ mile, sleeping on her left side, and gardening. Her LEFS score was 68/70. Her right shoulder pain was worse with sleeping on her right side, reaching overhead and reaching behind to don her coat. Her mid back pain was worse with sitting. She had, as mentioned, a history for bilateral THR and cataract x2 as well as osteoporosis. On x- ray it is noted that both hip replacements required extra hardware due to bone density loss. She was normally active and exercises regularly with yoga, Pilates and once a week weight lifting, all of which she continued but modified due to pain. Her only medication is a mild SSRI.

### *Examination*

- ATR left at T11 was 5 degrees, right lumbar ATR was 5 degrees at L3.
- Negative slump and SLR for neural tension.
- Hip ROM on the right was WFL without pain at end ranges. Left hip flexion and abduction were 85% of normal, with pain at end range external rotation which was limited to 75% of normal.
- Left hip strength was limited in abduction to 3+-4-/5 on MMT and slight contralateral hip drop noted on SLS of the left leg showing mild Trendelenburg sign. Left hip extension was 4/5.
- The left hip shows adhered scar laterally which patient reports she was told was from extra hardware placed in her THR. She is tender to palpation along her gluteus medius insertion and muscle belly as well as the incision.
- The right shoulder was limited in flexion and ER due to pain and had positive Neer's and Hawkin/Kennedy signs. MMT of external rotation was 4/5 and painful.

### *Observation of Standing Posture*

Observed posterior pelvic tilt with flat lumbar spine in the sagittal plane. Right lumbar prominence and left thoracolumbar prominences were visualized. The left iliac crest was elevated

compared to the right. The pelvis was shifted right 2 cm from midline and the right innominate was posteriorly rotated compared to the left. The right shoulder was protracted and elevated compared to the left.

### *Clinical Impression*

This patient's hip pain was consistent with gluteus medius tendinopathy. Her pelvic compensatory pattern of right rotation and right shift followed the right rotation of her lumbar spine but also caused the obliquity of a right tilt causing slight functional drop of her right side, stressing her left gluteus medius tendon which was already compromised from scar tissue. (The role of the gluteus medius is to stabilize the pelvis from contralateral drop in the frontal plane during stance phase). Previous injections to the hip were unsuccessful as they did not address the stress to the hip from the spinal deformity, however spinal stabilization exercises had provided some relief, indicating that future work in fine tuning posture correction and spinal stability were reasonable approaches to her plan of care.

### *Intervention*

The patient was treated 1-2 x/ week for 12 weeks. Because the patient had already experienced some success with introductions to core strengthening exercises, treatments included lumbar stabilization and hip strengthening exercises as well as active self-correction and age appropriate PSSE for scoliosis posture education. Additional education included body mechanics review with household chores and ADLs. Manual techniques including joint mobilization of the hip and shoulder, PROM, Graston technique, and muscle energy techniques were applied to the hip and pelvis to improve joint and soft tissue mobility. Modalities including ultrasound, ice and electrical stimulation were used to manage shoulder pain.

### *Outcomes*

The patient reported significant improvement in walking tolerance for exercise in that she was no longer limited in her walking distance due to pain. She was occasionally able to sleep on her left side for the first time in over 8 months. Her pain was rated 0-2 / 10 on VAS in her left hip. her LEFS score was 75/80. She was independent in her HEP and felt comfortable with her active self-corrections of sitting and standing postures. She continues to complain of mid back pain with sitting and while her right shoulder pain has improved, she continues to have some limitations in reaching and will continue physical therapy with hopes of continued improvements in those areas. The patient was seen for two months following discharge of the hip diagnosis for treatment of the shoulder and continued to report

that her hip was relatively pain free with walking and ADLs and that she continued to perform her exercises regularly.

## Discussion

This case series demonstrates the physical therapy management of three different patients with scoliosis and hip pain across an age span. While all three patients presented with different manifestations of soft tissue pathology / diagnoses in their hip joint, the underlying cause of the stress to their hips was presumed to be the structural asymmetry from the spine. The clinical decision-making that went into their treatment integrated scoliosis specific exercises to help correct posture and reduce stress on the joint. In addition, standard physical therapy modalities and techniques were utilized to manage their specific symptoms as needed. It is interesting to note that all three patients in this series had prior treatment of some sort for their hip pain that was unsuccessful and all three cases reached a more successful outcome when their scoliosis was specifically addressed in management of their hip conditions. Of further interest is the progression of the severity and permanence of the hip conditions as followed from the youngest patient to the most senior one, indicating that the sooner biomechanical stresses to the hip from scoliosis can be detected, the more likely the possibility of avoiding more permanent damage to the joint as the patient ages. While AIS is commonly detected in adolescents developing with the condition, younger patients do not usually complain of pain. Presumably this is because these patients have had less stress to their spine and surrounding tissue and also their tissue are more pliable. Physical therapy in children and teens with AIS is more aimed at posture correction and minimizing progression of the curve.

There is an abundance of literature that discusses the biomechanical impact of scoliosis on the hip (Gum *et al.*, 2007; Kotwicki *et al.*, 2008; Radcliff *et al.*, 2013; Buckland *et al.*, 2015; Esposito *et al.*, 2016; Márkus *et al.*, 2018, 2018; Nielsen and Goldstein, 2018; Banno *et al.*, 2020; Si *et al.*, 2020; Zhang *et al.*, 2020; Smith *et al.*, 2021; Bortz *et al.*, 2022), yet only one study that discusses the orthopedic extremity disease burden from scoliosis (Smith *et al.*, 2021).

The lack of literature is indicative of the difficulty and complexity involved in non-operative management of scoliosis and in particular AS where the etiology can be varied and the impact on the extremities more complicated.

There are several limitations of this study that should be noted. The use of multiple and varied treatment modalities to treat each patient's hip pain besides the PSSE introduces uncertainty of which method was most effective. As mentioned above, these patients had received prior treatments that gave

them very temporary relief, but all reported more long-term relief with the self-management tool of PSSE. An additional limitation is that posture assessment and correction of posture, especially in a three-dimensional plane, is difficult to quantify. Besides the use of a plumbline to assess frontal plane shift, the posture corrections in the transverse and sagittal planes were based on visual inspection and therapist - patient feedback. The use of the scoliometer is a reliable tool for assessing the angle of trunk rotation in the transverse plane, however for adults with structural scoliosis, the goal is not to correct the structural curve, but more to minimize over compensatory postures that lead to pain and worsening posture. Future studies using digitized postural screening would be useful in providing more quantifiable data in this area of study.

Despite these limitations, it is hopeful that this case series brings awareness for the need to address postural compensatory patterns in patients with scoliosis who present with hip pain and other orthopedic sequelae.

**Table 2:** Summary of Interventions and outcomes.

Case	Clinical Impression	Interventions	Outcomes/Changes
1.	31-year-old female right TL curve with left hip shift. Negative intraarticular findings.	PSSE and lumbar stabilization: Supine Schroth, Bridges Prone on knees with belt and stool, scapular pull ups, short hangs, plank, bird dog, active self-corrections sitting and standing, Sidelying Schroth, side plank, Standing Schroth with poles, standing active self-correction, St Andrews, standing band walks.	VAS 4-6/10 -2/10 LEFS 60/80-76/80  Goals met for pain free exercise.
2.	48-year-old female right thoracic, left lumbar right hip shift. Positive intra-articular findings.	PSSE, Lumbar stabilization, manual therapy: short hang with pull up band assist, prone on knees, seated and standing Schroth with poles, Schroth walk, hip flexor stretches, bridges, bird dog, step ups, lunges, home sacral corrections. Graston technique to GM tendon, MET to pelvis and sacrum.	VAS 5-7/10-0-3/10 LEFS 62/80-70/80 Posture Assessment:  Significantly Improved pain levels, walking and standing tolerance, exercise tolerance and ADLS with some continued pain with strenuous activity.
3.	68-year-old female with adult degenerative scoliosis and h/o THR with sxs cw gluteus medius tendinopathy.	PSSE, lumbar stabilization, manual therapy, modalities, education: prone on knees with stool, active self-correction seated and standing, supine seated and standing Schroth with poles, bridges, bird dog, rows, B ER with band, standing hip abduction with band, band walks. Manual therapy and Graston technique to improve joint and soft tissue mobility, modalities to reduce pain in shoulder.	VAS 4-7/10 - 0-2/10 LEFS 68/80-75/80 Posture Assessment:  Improvements in hip pain, walking distances and sleep. Continued work to be done on shoulder and mid back pain.

**Acknowledgements:** Special thanks to my physical therapy and faculty colleagues Laura Loftus DPT, Holly Franzen-Korzendorfer PT, PhD, CWS, FACCWS and James Raugh PT, DSc, SCS, ATC for their support and advice as well as Marist librarian Elizabeth Clark and writing editor Grace Murphy.

**Patient Consent:** The consent to publish this information was obtained from the patients.

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