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Physical Therapy Management Of A Female Adolescent Softball Pitcher With Chronic Low Back And Hip Pain: A Case Report

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The patient and her mother received information on the institution's policies regarding the Health Insurance Portability and Accountability Act and signed an informed consent allowing the use of medical information for this case report.

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Abstract

Background and Purpose: Low back pain (LBP) is an epidemiological problem, particularly in Westernized countries, and is common among adolescents who participate in competitive sports. There are few comprehensive clinical trials addressing the prevalence of LBP in adolescent athletes and those in existence typically focus on only a few select sports. Physical therapy (PT) is shown to improve function and manage symptoms for adolescent athletes with muscle imbalance, hypermobility, and core weakness in outpatient rehabilitation, however there is a shortage of literature on young female pitchers with LBP. The purpose of this case report is to describe the PT management of an adolescent female pitcher with pain and functional deficits as a result of a repetitive motion contributing to the overuse of structures of the spine and hips.

Case Description: The patient is a 15 year-old female who demonstrates hip instability and hip and core weakness. As a result, she complains of LBP and left hip pain during her participation in cross country running, softball batting and pitching, and sitting for greater than 30 minutes. Interventions included therapeutic exercise, manual therapy, neuromuscular reeducation, electrical stimulation, and ice.

Outcomes: There was a decrease in pain and an increase in the patient's functional abilities from initial evaluation to discharge. She recovered the ability to participate in her chosen athletics, yet continued to have discomfort sitting for long periods of time.

Discussion: The patient was discharged to participate in her softball tournament as planned after 7 weeks of care. Her outcomes are consistent with current research that PT improves function and decreases symptoms of athletes who have overuse injuries.

Word count: 3,489

Background and Purpose

Background:

Low back pain (LBP) in young athletes who participate in sports requiring repetitive flexion/extension/rotation of the spine is common among females, especially during periods of rapid growth[1]. The etiology of LBP in children and adolescents is considerably different from the etiology of LBP in adult population. After ruling out more serious pathology such as malignancy, infection, or spondylolysis/ spondylolisthesis, most cases of adolescent LBP are non-specific in nature and limit functional ability[2]. In a prospective study of adolescent athletes with LBP Schmidt et al. reported markedly higher prevalence rates of LBP at 1-year and throughout the lifetime in competitive athletes compared with age-matched controls[3].

After an exhaustive literature review, no evidence was found discussing injuries in adolescent softball players. However, commonly reported injuries in NCAA women's softball included ankle ligament sprains, knee internal derangements, and overuse injuries of the shoulder and low back[4]. Further research was analyzed regarding ground reaction forces, kinematics, and muscle activation during NCAA windmill softball pitching. This data revealed as the windmill softball pitcher increased ball velocity, their vertical ground reaction forces also increased[5]. Based on the information collected by Oliver and Plummer on ground reaction forces, kinematics, and muscle activation during the windmill softball pitch, strength and conditioning of the gluteal muscle group bilaterally is crucial to preventing injury during this movement pattern[5]. This case report describes the examination, evaluation, and PT interventions for a female high school softball

pitcher with hip and core weakness, and bilateral hip hypermobility leading to low back and hip pain.

History

The patient was a 15 year-old Caucasian female. She was 5'10,'' and her body type would be considered ectomorphic. Her chief complaint was left sided LBP, which has been present for the past 18 months. Her pain was exacerbated with cross-country running and lessened when the season ended 3 months ago. In the past month her pain has been worse and more consistent. She took 3 weeks off from softball prior to initial PT evaluation, due to 9/10 pain with pitching and batting. Her medical history included attention deficit hyperactive disorder, asthma, and headaches. She denied a family history of LBP. Her mother took her to Boston Children's Hospital for x-rays and further tests, which were all negative. Initially she experienced only left sided LBP. She was experiencing bilateral lumbar and thoracic pain, and left hip pain. She describes her pain as sharp and shooting when swinging a bat or pitching. At rest she reports fairly constant throbbing pain and tightness. She denies radicular symptoms. She complains sitting has been more painful in the past month, and she is unable to sit through a full high school class period. She also reports difficulty sleeping, which has improved since she stopped pitching and batting. At the time of initial evaluation she was taking Aleve 2 times per day for 2 weeks and using moist heat to manage her symptoms. The patient and her mothers' goals for PT are to manage her symptoms, get her on a consistent strength and conditioning program, and allow her to pitch in an elite softball tournament, which will begin 7 weeks after start of care (SOC).

Systems Review

The systems review of this patient revealed that all systems were unimpaired except for the musculoskeletal and neuromuscular systems. Impairments of the musculoskeletal system included gross strength impairments of the core and hip, gross range of motion (ROM) impairments of the left greater than right hip, gross symmetry impairments including left greater than right sided laxity and poor muscle quality. Impairments of the neuromuscular system included decreased balance in unilateral stance, poor coordination and form during squatting, 4/10 pain in the left hip and low back during locomotion, and compensatory body mechanics during transfers and locomotion.

Clinical Impressions 1

The patient's presentation of pain, musculoskeletal, and neuromuscular impairments is consistent with her medical diagnosis of LBP and ilio-tibial band tightness. The moderate to severe nature of her back and hip pain led to concern about possible malignancy, infection, spondylolisthesis, labral tear, impingement, or other pathology of the spine and/or hip. Further examination was performed at Boston Children's Hospital and infection, tumor, and fracture were ruled out as causes for LPB. Based on the negative nature of all additional testing, the patient does not require any additional referrals at this time. The patient was admitted to PT to undergo testing for ROM, strength, functional abilities, and to rule out differential diagnoses. The patient was a good candidate for a case report, as the nature of her injury challenged the decision making process including the need to determine the most appropriate interventions in time to allow her to participate in her softball tournament.

Examination

Pain

Pain was assessed using a numeric pain rating scale, which has been shown to be valid and reliable measure to assess the patient's perception of low back pain[6]. This measure was important to assess the patient's symptoms.

Range of Motion

Spine ROM was tested with the patient in standing using goniometric measurements following procedures outlined in *Measurement of Joint Motion: A Guide to Goniometry 4th Edition*, which have been shown to be reliable and valid measurements of assessing the joint range of motion[7,8]. ROM was measured with the patient in supine for hip flexion, external rotation (ER), internal rotation (IR), abduction, adduction, and knee extension and hip extension was measured in prone following reliable and valid procedures outlined in the same text[7,8].

Manual Muscle Testing

Manual muscle testing (MMT) was performed in sitting for hip flexion, hip ER, hip IR, and knee extension, sidelying for hip abduction and adduction, and prone for hip extension following procedures outlined in *Muscles: Testing and Function, with Posture and Pain*, which have been shown to be reliable and valid measurements to assess muscle strength[9].

Special Tests

A variety of special tests were used to rule out differential diagnoses and gain information about what type of joint movements recreated the patient's symptoms. The slump test is a reliable and valid test used to assess for nerve entrapment.[10,11] The passive

straight leg raise (SLR) test is a reliable and valid test used to assess hamstring length.[10,11] Lasegue's test is reliable and valid test to assess for dural tension This test was performed in conjunction with the passive SLR test by adding internal rotation of the hip.[11,12] The Thomas test is a reliable and valid test used to assess hip flexor tightness.[10,11,13] The Ober test is a reliable and valid test used to assess for ITB tightness.[11,14] The hip impingement test is a reliable and valid test to assess for impingement of structures of the hip.[10,11]

Joint Mobilization

Joint mobilizations of the spine and hip were performed following procedures outlined in *Manual Mobilization of the Joints Volumes I and II*. Joint mobilizations are reliable and valid tools used to assess for joint mobility.[15,16]

Palpation

Palpation of the structures of the hip and spine was performed with the patient in a variety of positions following procedures from *Palpation Techniques: Surface Anatomy for Physical Therapists*.[17]

Outcome Measures

The patient filled out The Lower Extremity Functional Scale and Oswestry Disability Index self-report questionnaires prior to her evaluation, which are reliable and valid measures for assessing lower extremity functional abilities and the degree of disability low back pain is causing respectively.[18,19,20]

Functional Testing

Functional testing of the hip was performed, which included single-leg stance, deep squat, and single leg squat to assess hip abductor function.[21]

Please refer to Table 1 for results of the initial evaluation.

Clinical Impressions 2

Evaluation:

The patient's core and hip weakness and hypermobility, along with the repetitive asymmetrical activity involved in pitching and batting, has likely lead to the impairments of LBP, hip pain, ITB tightness, and muscle asymmetries of the hips, back, and lower extremities. The patient has been playing through pain for 18 months, 5-6 days per week, which has likely made the asymmetries worse and led to compensatory strategies in order to continue participating in sports. Playing through pain has also led to muscle guarding, muscle tightness, and decreased mobility of the spine. These factors along with continued participation in sports has led to sensitivity and compression of the spine, which is leading to activity limitations including the inability of the patient to sit for prolonged periods of time and decreased volume of walking due to pain. The cross-country running also likely made the patient's symptoms worse due to larger compression forces through the spine. The patient is unable to sit through a 60 minutes class period and is unable to participate in softball and recreational activities. The patient continues to be a good candidate for a case report, as she has been playing through pain for a long period of time and is now under a time constraint to allow her to play in her tournament in 7 weeks.

Physical Therapy Diagnosis:

4C: Impaired muscle performance

Prognosis:

Based on age, activity level, motivation, family support, and progress since ceasing physical activity, the patient's prognosis for improvement with PT is good. The level of patient compliance with the rehabilitation program and allowing the appropriate amount of time for her body to recover will play a key role in the ability for the patient to make a full recovery to a symptom free state for sitting, ambulation, transfers, and participating in recreational activities of her choosing.

Place of Care:

The patient had a softball tournament set to take place 7 weeks after SOC in Europe. She planned to pitch and bat in this tournament regardless of her low back pain, even though it could lead to setbacks in the her rehabilitation. The patient did not appear willing to give up playing in the tournament. If she were willing to take a break from softball after her tournament until she were able to participate in a controlled high-level strength and conditioning program without symptoms, she would have a better prognosis. The plan of care involved the patient being seen two times per week over twenty 60-minute sessions of PT. Treatment included lumbar stabilization, hip stabilization, manual therapy on the hips and low back, passive and active stretching of the hips and back, modalities, patient education, and functional strengthening activities.

Procedural interventions:

Therapeutic exercise included AAROM (active assistive ROM), AROM (Active ROM), strength, and stabilization exercises. Neuromuscular Re-education included lumbar stabilization and education on pelvic neutral. Manual therapy included joint

mobilizations, soft tissue massage and muscle energy techniques. Therapeutic activities included functional training, posture, and body mechanics. Modalities that were used included moist heat, cold pack, and electrical stimulation. Other interventions will include instruction in home and gym programs.

Short Term Goals: In 3-4 weeks of SOC the patient will:

- Be independent and compliant with a home exercise program to improve ROM, basic strengthening, and symptom management.
- Be able to sit for 30 minutes with no symptoms in order to sit through a greater portion of her class periods.
- Increase hamstring length by 10 degrees bilaterally and have a negative Thomas test to improve functional abilities.
- Have full and pain free ROM of the spine to improve functional abilities.

Long Term Goals: In 8-10 weeks of SOC the patient will:

- Be independent with a full home and gym hip and core strengthening and mobility program.
- Be able to sit for greater than 60 minutes with no symptoms in order to sit through a whole class period.
- Have no difficulty with ADLs to improve functional abilities.
- Increase MMT by 1 full muscle grade for all hip and spine motions to improve functional abilities.
- Be able to participate in recreational activities with no restrictions.

Interventions

Coordination, Communication, Documentation:

The patient and her mother sought the opinion of multiple doctors and related information from the testing at Boston Children's Hospital. The note from the referring physician requested PT to evaluate and treat, work on core strengthening, hip flexion, ITB stretching, hamstring stretching, and paraspinal strengthening. Scheduling was done with the patient's mother present. The patient and her mother were given a thorough explanation of the findings from the initial evaluation. Twice during the episode of care, the patient's mother phoned the clinic to get an update and inquire if the patient could pitch in various softball events. The patient's mother was very persistent, but ultimately took the advice of the rehabilitation team to not allow her daughter to participate so she would have a better chance of participating in the tournament in Europe. They decided to seek chiropractic care along with PT treatment. Lines of communication with the other professionals working with the patient were open throughout the episode of care. Communication with the referring physician included a 1-month progress report including ROM, strength, and functional improvements, as well as a request to continue treatment. Documentation for this patient was kept via electronic medical records and a written flow sheet of exercises.

Patient/client related instruction:

The patient was instructed to hold off from playing softball, running, or participating in any type of twisting activity. The patient and her mother were educated

on the findings of the initial evaluation including impairments, functional limitations, disabilities, plan of care, risk factors for developing a larger problem or dysfunction, and the benefits of a stretching and strengthening program. Patient education regarding proper technique with all exercises was provided throughout the episode of care.

Procedural interventions:

During the first visit, the patient was evaluated and given basic stretching and strengthening exercises were given to her to be done in a pain free range. Weekly interventions are listed in Table 2 and were focused on pain control, strength training, and neuromuscular reeducation to address the impairments noted during the initial evaluation. Progressions followed the strength training protocol established in the clinic and patient response to intervention. The program developed was individualized to assess the patient's pain, movement patterns, strength, and ROM. The active and resistance exercises and progressions used in this procedure were based on the protocols outlined in Kisner and Colby.[22] All stretches performed were performed in sets of 3 with 30-second holds. Progressions of repetitions included starting with 2 sets of 10 (2x10) repetitions, and were increased to 2x12, 2x15, 3x10, 3x12, 3x15. Then weight or difficulty of the activity was increased and repetitions were decreased. Timed activities began with 3 sets of 30-second holds and were progressed by 5 seconds per visit up to 1 minute. The above guidelines for repetitions and length of holds are based on The American College of Sports Medicines standards and guidelines.[23]

During the first week moist heat was used to heat up muscle tissues prior to physical therapy interventions. Once the patient's pain levels decreased, a warm up on a

stationary bike, set on a hill program with level of difficulty determined by the patient, and a dynamic warm up were performed in order to heat up muscle tissues and allow the neuromuscular system to become engaged prior to performing more complex tasks. Any time there was pain with an activity, the patient was instructed to discontinue that activity, which explains why certain activities were not performed at each visit. Greater increases in intensity and repetitions occurred after the 6th visit when the patient was no longer having pain with any of the therapeutic exercises she was performing. It was not until the 7th visit that more aggressive core strengthening exercises were added to the patient's exercise program. The patient responded well to these exercises and reported decreased levels of discomfort after they were initiated. Further core stabilization exercises were added the following visit, including double arm D2 PNF pattern exercises with resistance in order to simulate the twisting motion of the core that occurs with batting and pitching.[24] Verbal cues for core activation were important for gaining the patient's focus on this muscle group upon introduction of each new core stabilization activity. On the 9th visit the patient was given a comprehensive strength and conditioning log. This log included exercises to be done on alternating days. Each day included an equal distribution of core stabilization and hip strengthening exercises along with stretches and a warmup. The patient consistently attended scheduled PT visits and appeared to be compliant with her home exercise program.

During each visit, the patient received about 10-15 minutes of soft tissue massage to the thoracic spine, lumbar spine, gluteal region, and lateral quadriceps.[24] The focus and duration of the soft tissue massage was based on the patient's symptoms that day. Posterior-anterior (PA) passive accessory intervertebral joint mobilizations (PAIVMs) of

the lumbar spine were initiated during the first visit and continued until the 8th visit when she no longer had pain in this area.[24] PAIVMs were initially grade I and II and progressed to grade III during the 5th-8th visits.[15] Hip joint mobilizations were performed during visit 3 and were discontinued after this visit, as they did not seem to make a difference in the patient's symptoms. Ice was used during the first visit to decrease inflammation. Electrical stimulation procedures included 15 minutes of quad-polar interferential current (IFC) treatment at a frequency of 80-150 Hz in conjunction with ice. This treatment was performed during visits 2-7 secondary to pain and muscle spasm. The use of electrical stimulation is supported by recent literature exploring reduction chronic, non-specific low back pain.[25]

Outcomes

Upon initial evaluation the patient reported pain that restricted her from participating in recreational activities and sitting through full class periods. By the last treatment session, prior to the patient's departure for Europe, the patient had achieved all of her short and long term goals, except increasing MMT by one full muscle grade for all hip and spine motions and being able to participate in recreational activities with no restrictions. Although her MMT grades were not one full muscle grade higher for all hip and spine motions, she had made progress in terms of strength and her functional abilities were improved to a point where she felt she would able to participate in her tournament. (Table 1) At reevaluation the patient reported the ability sit for 60 minutes without symptoms, which would make her travel to Europe more tolerable and would allow her to sit through a whole high school class period. The patient had not yet tested her ability to

participate in the recreational activities of her choosing beyond light volumes of pitching and batting consisting of less than 10 repetitions. The patient and her mother were satisfied with the level of care provided, and were optimistic about the patient's ability to participate in her upcoming tournament.

Discussion

At the end of the episode of care the patient had received 13 treatment sessions lasting approximately 75 minutes each. The time constraint the patient and her mother placed on her rehabilitation due to her softball tournament likely had a negative effect on overall patient outcomes. Also, the perception of the patient that improvements were directly correlated to her ability to pitch and bat may have had an impact on her subjective reports of improvement and level of confidence in the rehabilitation process. The patient participated in recreational lacrosse activities involving twisting during week 4 of her treatment and was disappointed that she had pain with this movement. She also participated in batting practice and threw a few pitches during week 6, prior to being cleared to do so, and had low levels of pain with these activities. This demonstrates noncompliance with the recommendations of the rehabilitation team, and may have had adverse effects on the patient's rehabilitation.

The patient did not return to therapy after her softball tournament, therefore we were unable to collect data for outcome measures and for discharge from PT. This resulted in a limited data collection, especially in terms of self-report questionnaires. It would have been beneficial to attain the results of these surveys because, based on the re-evaluation measured collected, the patient had made significant improvements with

therapy. These results would have given us better subjective information of how the patient felt she had improved.

The delay in introducing higher-level core exercises into the patient's home and gym program may have had an adverse effect on the patient's pain levels. Once the patient began higher-level core strengthening exercises, her pain levels decreased significantly. This indicated that a balance between core and hip strengthening for a patient with both low and back hip pain was beneficial. A greater variety of functional exercises, including exercises that mimic the motions used in softball pitching and batting may have been useful to keep the patient more motivated and engaged and improve task specific muscle reeducation.

Further studies exploring muscle activations of the lower extremity in greater depth, and their role in the effectiveness of the windmill softball pitch in relation to low back and hip injury are warranted[5]. Preventive efforts for women's softball pitchers focusing on neuromuscular training programs, position-specific throwing programs, and mechanisms of low back injury would likely reduce injury rates in this population. Further research on the development and effects of these preventive efforts would be beneficial.[4]

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458 **Table 1. Tests and measure performed at initial evaluation and re-evaluation.**

Measurements	**Initial Evaluation**		**Re-evaluation**	
Range of Motion	Left	Right	Left	Right
Hip flexion	Painful at >100 degrees	WNL	WNL	WNL
Hip ER	WNL with moderate muscle tightness	WNL with mild muscle tightness	WNL mild muscle tightness	WNL marked muscle tightness
Hip IR	Hypermobile	Mild hypermobility	Mild hypermobility	Mild hypermobility
Hip extension	WNL	WNL	WNL	WNL
Hip abduction	WNL	WNL	WNL	WNL
Hip adduction	WNL	WNL	WNL	WNL
Knee extension	WNL	WNL	WNL	WNL
Trunk flexion	90%	90% with moderate thoracic pain	100%	100%
Trunk extension	90% feels stuck/tight	90% feels stuck/tight	95% feels stuck/tight	95% feels stuck/tight
Trunk lateral flexion	75%; tight	75%; pain	90%	100%
Trunk rotation	90%	90%	100%	100%
Manual Muscle Testing	Left	Right	Left	Right
Hip flexion	4/5	4+/5	4+/5	4+/5
Hip ER	4/5	4+/5	4+/5	4+/5
Hip IR	4+/5	4+/5	4+/5	4+/5
Hip extension	4/5	4+/5	4+/5	4+/5
Hip abduction	4-/5	4+/5	4/5	4+/5
Hip adduction	4-/5	4+/5	4/5	4+/5
Knee extension	4+/5	4+/5	4+/5	4+/5
Slump Test	Negative; moderate muscle tightness	Negative; mild muscle tightness	Negative; mild muscle tightness	Negative; marked muscle tightness

Hamstring length	Moderate tightness	Mild tightness	Mild tightness	Marked tightness
Lesague test	Negative	Negative	Negative	Negative
Ober test	Positive	Positive	Positive	Positive
Thomas test	Negative	Negative	Negative	Negative
Hip impingement test	Negative	Negative	Negative	Negative
Palpation	Moderately spasm and TTP superior/ lateral glueals, piriformis, and QL.	No TTP, marked muscle tightness of superior/ lateral gluteals, piriformis, and QL	No TTP	No TTP
Joint mobilization	Mild TTP with grade 1 PA mobilizations of L2-L5		No TTP with grade 3 mobilizations L2-L5	
Pain (Numeric Pain Rating Scale)	Consistent bilateral low back and hip pain. 9/10 with activity (particularly pitching and batting), 6/10 at rest		Left sided low back pain localized to PSIS area. 3/10 with activity, 0/10 at rest	
Functional abilities	Patient experiences 4/10 pain with weightbearing exercise and 7/10 pain after sitting for > 15 minutes and while lifting items weighing > 20 pounds. She experiences 9/10 pain while pitching or batting. Functional hip and core strength is moderately to severely impaired.		Patient has no symptoms with high-intensity weightbearing exercise (no plyometrics attempted) and can sit for 45 minutes with no symptoms. She has 2/10 pain when lifting items weighing 50 pounds. Patient participated in batting practice and pitched 10 balls with no symptoms. Functional hip and core strength is mildly impaired.	
Lower Extremity Functional Scale	88/200		Unable to retain results at re-evaluation	
Oswestry Disability Index	44%		Unable to retain results at re-evaluation	

459 * > = greater than
460 **WNL = within normal limits
461 ***ER = external rotation
462 ****IR = Internal rotation
463 *****TTP = tenderness to palpation
464 ******QL = quadratus lumborum
465 *******PA = Posterior anterior
466 *******PSIS= posterior superior iliac spine

Table 2: Procedural Interventions

Intervention	Week 1	Week 2	Week 3	Week 4	Week 5	
Warmup						
Moist Heat	X					
Bike		X	X	X	X	
Dynamic Warmup			X	X	X	
Stretching						
Figure 4	X	X	X	On SB	On SB	
Hamstring	X	X	X	X	X	
Piriformis	X	X	X			
Active and Resistance Exercises						
Pelvic Tilts	X	X				
Glute bridges	X	X	Single leg	On SB	On SB	
Clamshells	X	X	HEP			
Sidelying hip abduction	X	X	X	HEP		
Single leg stance	X	X	X	On foam	On foam	Wit
Sit to stand		0#	5#	5#	8#	
Step ups			8”	8”	8”	
Step downs		2”	2”	4”	4”	
Side stepping			GTB	GTB	GTB	
Hip 4 ways						
Planks				30 seconds	40 seconds	50
Side planks						30
Scaption				3#	3#	
Resisted belly press				X	X	
Triceps push down					30#	
Latissimus pull down					30#	
D2 PNF pattern					X	
Soft Tissue Massage						
Lumbar	X	X	X	X	X	
Thoracic		X				
Glutes		X	X	X		
Lateral quads			X	X	X	
Joint Mobilizations						
Lumbar PA	X	X	X	X		
Hip		X				

distraction/ inferior glides						
Modalities						
Electrical Stimulation	X	X	X	X		
Ice	X	X	X	X	X	

Modifications in difficulty and resistance are noted on the chart in place of X's. HEP indicates activity was discharged to home exercise program.

*HEP = home exercise program

**SB = swiss ball

***GTB = green theraband

****BTB = blue theraband

*****PA = posterior anterior