Lumbar Anterior Derangement in a 15-year-old Female Pole Vaulter

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Abstract:
Introduction: Anterior derangement is a result of repeated or prolonged extension/hyperextension of the lumbar spine causing the nucleus pulposis to be displaced anteriorly. Hyperextension of the spine is seen most in certain sporting events such as gymnastics, dance and pole vaulting. **Case Description:** The purpose of this case report is to describe the examination techniques and differential diagnosis used in diagnosing a 15 year-old pole vaulter (MA) who came to physical therapy with a diagnosis of acute LBP of insidious onset after completing a pole vault jump. Chief complaints included decreased lumbar flexion ROM, minimal pain with ADL's, and increased pain with running and pole vaulting. Examination findings included major movement loss into lumbar flexion, tenderness to palpation over the right PSIS and a positive right SLR. Impairments included decreased lumbar flexion ROM and pain with running, prolonged sitting, and bed mobility, all which prevented her from participating in her sports activities. **Intervention:** Plan of care consisted of a combination of traditional physical therapy interventions, such as abdominal strengthening, aerobic conditioning and range of motion exercises, in conjunction with McKenzie flexion exercises 2-3 times a week for 4-6 weeks. **Conclusion:** MA was unable to abolish her LBP, but was able to control her pain through completion of her HEP. An underlying problem was suspected for the continuation of her pain, therefore MA was referred back to her primary physician for re-evaluation.

Key Words: physical therapy, McKenzie, anterior derangement, anterior disc herniation, lumbar spine, lumbar hyperextension injury, intervention, pole vault, and flexion exercise

Introduction:

Low back pain (LBP) is one of the most common causes of disability in the working population. It not only affects the working population, but all ages. Approximately 50-80% of adults will experience back pain at some point in their life. Back pain accounts for 3-5% of all primary care physician referral and consultation. The total cost of back pain is estimated to be 75-100 billion dollars every four years. This cost is greater than any other reported disease.[1]

Of all of the interventions used in treating LBP, there are few in which there is research that supports its use. Some examples of common interventions for treating LBP which have been used by physical therapists in which there is little to no evidence for include ultrasound, laser therapy, traction, heat modalities, electrical stimulation, transcutaneous electrical nerve stimulation (TENS) and bed rest.[2] There is some evidence to support the effectiveness of education, behavioral modification, manipulation and exercise to treat back pain.[1,2] Nonsteroidal anti-inflammatory drugs (NSAIDs) and over-the-counter (OTC) pain medication may help to temporarily reduce pain intensity or give temporary relief of pain with uncomplicated acute LBP, but there is no research showing long term benefits from taking these. Although NSAIDs and OTC pain medications do not heal the problem, they may play an important role in assisting with treatment by decreasing inflammation and pain intensity to allow the patient to participate in therapeutic exercises.[2,3,4]

Robin McKenzie is a physical therapist from New Zealand who developed a system for classification and treatment for mechanical LBP in the 1950's. In 1981, McKenzie published his first text, entitled *The Lumbar Spine, Mechanical Diagnosis and Therapy*,

describing his method for approaching the assessment and treatment of LBP. Today, that system is known as the McKenzie method. He later published a text in 1990 which looked at treating the cervical and thoracic spine with the same approach as the lumbar spine.[1,5]

According to McKenzie, there are three main classifications for the risk factors of LBP. The first classification is the individual and lifestyle, which includes the patient's history of back pain. The second classification is physical and biomechanical. This classification includes heavy or frequent lifting, body vibrations as experienced with driving, prolonged or frequent bending/twisting, and postural stresses including high spinal loads or awkward postures. The third classification is psychosocial and includes emotional and/or mental factors that may affect ones response to back pain or cause them to fall into one or both of the previous classifications.[1]

McKenzie describes three different syndromes when classifying back pain; postural syndrome, dysfunction and derangement. A postural syndrome is defined as mechanical deformation that is postural in origin. The pain is reported as intermittent and is produced by static positioning; not by movement. A dysfunction syndrome occurs when soft tissues have been shortened over time or contain contracted scar tissue. McKenzie's dysfunction syndrome may be used interchangeably with the term adaptive shortening. A derangement syndrome occurs when there is a disturbance of the normal resting position of the affected joint. The articular surfaces of two adjacent vertebrae are disturbed due to a change in the positioning or displacement of the nucleus pulposis. The displacement of the nucleus pulposis may also disturb the annular material, therefore resulting in an obstruction of movement and pain that will persist until the displacement is reduced.

According to this classification system, eighty percent of patients with back pain are classified into the derangement syndrome.[1,5,6]

The derangement syndrome is characterized by responses to different postural loading strategies and movements. There can be a worsening response which causes peripheralization and/or worsening of the symptoms with an increase in the loss of motion, or the response can be a reduction, centralization or abolishment of symptoms with an improvement or restoration of motion.[1,5]

There are multiple characteristics that are found within the classification of derangement syndrome. Some of these characteristics include a variable pain pattern in which pain may rise gradually or suddenly, be constant or intermittent, and change in pattern from side to side or centralized to radiating pain. Inconsistency and change are two characteristics of a derangement. The patient's symptoms are often insidious in onset and pain is often accompanied by sudden disability. Any activity in which a posture is sustained can rapidly and progressively worsen or improve the symptoms. A derangement may cause temporary postural deformity such as changes in kyphosis, lordosis or cause a lateral shift. Symptoms are affected through postural loading strategies in the direction of the derangement. This can increase/decrease, centralize/peripheralize or produce/abolish the symptoms.[1,5]

Regarding lumbar derangements, there can be three types; posterior, anterior, or lateral. The type of derangement is named after the direction of the displacement of the tissue in the spine. Posterior and posterior-lateral derangements are most commonly found in patients with back pain.[1,5]

Flexion and extension are the two main movement which McKenzie discusses in either the cause or treatment of displaced tissue found within derangements. Flexion causes the intervertebral disc to be compressed anteriorly and stretches the posterior annulus. Flexion lengthens the vertebral canal, therefore placing tension on the spinal cord and peripheral nervous system. Posturing in full flexion causes an increase in intradiscal pressure by 80%. Prolonged or repeated flexion of the spine causes a posterior displacement of the nucleus pulposus which is called a posterior derangement.[1,5]

Extension causes the intervertebral disc to be compressed posteriorly, therefore causing the anterior annulus to become stretched. Extension reduces the size of the vertebral canal and intervertebral foramen causing a reduction of nuclear pressure up to 35%. Prolonged or repeated movement into extension causes an anterior displacement of the nucleus pulposus which is called an anterior derangement.1,5

The majority of patients with back pain who have derangement syndromes have posterior derangements or posterior-lateral derangements. Lumbar anterior derangements are the least common of the McKenzie derangements. Anterior derangements are a result of repeated or prolonged extension/hyperextension of the lumbar spine causing the nucleus pulopsis to be displaced anteriorly. This postural position is not common in our society. Hyperextension of the spine is seen most in certain sporting events such as gymnastics and dance.[7]

Because anterior derangements are so rarely seen, they may be more easily overlooked or misdiagnosed. Some conditions which would be included in the differential diagnosis of LBP as presented in an anterior derangement include: spinal stenosis, spondylolisthesis, sacroiliac (SI) joint dysfunction, or a posterior derangement.

Lumbar spinal stenosis is the narrowing of the spinal canal, therefore putting pressure on the spinal cord. This is more typically found in the older population above 60 years of age. The signs and symptoms include pain and cramping in the legs, radiating back and hip pain, parasthesias in the lower extremity, and possibly loss of bowel and bladder function (Cauda Equina Syndrome). Lumbar spinal stenosis presents with a flexion bias in which the patient's pain is decreased in sitting and with forward flexion.

Spondylolisthesis is the forward slipping of a vertebra. The most common site of this slippage is in the lower lumbar region (L4, L5). Spondylolisthesis presents with a flexion bias and is more commonly found in adolescent and young adult athletes who are very active in sports which involves repetitive lumbar hyper extension (such as gymnasts, weight lifting and/or as seen in pole vaulting). The signs and symptoms include increased LBP after exercise, increased lumbar lordosis, pain and/or weakness in unilateral or bilateral legs and thighs, tight hamstring muscles, low back stiffness and possibly decreased bowel and bladder function. Spondylolisthesis is confirmed through radiograph and clinical findings during evaluation.

SI joint dysfunction has many causes. Some include joint laxity, pregnancy, degenerative arthritis, or any condition which altars the gait pattern in such that it puts increased stress on the SI joint. Some conditions that could cause increased stress on the SI joint during gait may include a leg length discrepancy, hip pain, knee pain, or foot and ankle pain. The signs and symptoms of SI joint dysfunction include LBP and posterior hip pain at the posterior superior iliac spine (PSIS), stiffness and/or a burning sensation at the pelvis, increased pain with standing and walking and decreased pain when lying down. SI joint dysfunction causes pain at the SI region and also may mimic LBP.[5,8,9]

Both anterior and posterior derangements present with a painful arc and trouble with transitional movements. Limitation in lumbar extension ROM is characteristic of a posterior derangement, whereas limitation into lumbar flexion is characteristic of an anterior derangement.[1] Both derangements are worse in sitting, but the difference is that patients with an anterior derangement do not get worse the longer they remain sitting as a patient with a posterior derangement would. With an anterior derangement, there may be pain at initiation of sitting, but the sustained flexed position does not make them worse. The anterior structures of the spine are not as highly innervated with nocioceptors as the posterior structures are, therefore when an anterior derangement occurs; pain is not the chief complaint. Loss of lumbar ROM into extension is the main characteristic of a patient who falls into the anterior derangement category, thus the chief complaint of the patient as well. This patient will still present with pain, but changes in pain as the tissue is being restored will not be seen as much as with posterior derangements. Examination of lumbar ROM is the key to assessing improvement with patients with an anterior derangement.[7]

Repeated lumbar extension and hyperextension occurs during pole vaulting. There are several different stages within pole vaulting. The take-off phase requires the participant to be in a position of extreme spinal extension with side bending and rotation to the right.[10] During this phase, the thoracic and lumbar vertebrae quickly move from a neutral position to 40^{o} of extension.[11] This is the point in which the pole vaulter plants their pole in the box and begins to leave foot contact with the ground.[12] During this phase, impact forces up to ten times one's body weight may be applied. During the lumbar hyperextension, shear forces are applied to the lumbar spine.[11,13] The image in

Figure 1 shows is representative of the take-off phase. It is in this phase of pole vaulting in which the pole vaulter experiences extreme lumbar extension accompanied by lumbar side bending and rotation to the right.

The purpose of this case report is to describe the examination techniques and differential diagnosis used in diagnosing a 15 year old pole vaulter, named MA, who came to physical therapy with a medical diagnosis of acute LBP of insidious onset. This case report also serves to describe, in detail, the McKenzie-based intervention for treating an Anterior Derangement. This research has been approved by the Institutional Review Board at The Sage Colleges in Troy, NY.

Case Description:

MA is a 15 year old female high school track and field athlete, whose primary sport is pole vaulting, who was referred to the physical therapy clinic with a diagnosis of LBP. She is very active in sports. Her primary sport is basketball, but she just began to participate in track and field during the spring prior. Pole vaulting was new to her and she did not have any professional training in the sport other than what she received from her high school coaches. MA had no prior history of LBP or any other sports-related injury. All other past medical history was unremarkable. According to MA she felt LBP shortly after completing a pole vaulting jump. Her pain was not severe, but she noticed that the jump did not "feel right" to her. She suspected that she had either jumped or landed incorrectly and that the pain would subside after a day or so. Her pain remained minimal with everyday activities but increased dramatically with running and pole vaulting. Besides complaints of pain, MA noticed a sudden decrease in her ability to

touch her toes during hamstring stretching prior to participating in physical activities. MA was then reported to outpatient physical therapy to treat her LBP.

Examination:

At the initial examination MA's chief complaints were pain 2/10 pain, according to the Verbal Analog Scale[14], at rest which increases to 8/10 with jumping, running, prolonged sitting and rolling over in bed. Her pain was worse first thing in the morning and decreases as the day progresses. Her major concern was that she noticed that she experienced a sudden decrease in her ability to touch her toes during pre-exercise stretching. No diagnostic tests were taken prior to referral to physical therapy.

The McKenzie protocol[1,5] was followed for the initial examination. She showed a major movement loss into lumbar flexion. The patient reported that she was able to flex forward and touch her palms to the floor prior to her injury. This was used as a reference point for normal lumbar flexion ROM for this patient. At initial evaluation, she lacked 9 inches from full lumbar flexion in which the patient was standing with both feet together and flat on the ground with knees straight. Distance was measured from her 3rd digit to the surface of the ground. Pain was 8/10 at the right PSIS and central lumbar region was reported by the patient during lumbar flexion. Lumbar extension and side gliding/side gliding were assessed to have minimal to nil movement loss.

Other tests and measures were performed that are not specific to the McKenzie protocol for assessing LBP, but are included within the McKenzie evaluation to aide in differential diagnosis. These include assessing response to palpation of the painful region and straight leg raise (SLR) test. The patient was tender to palpation over the right PSIS and demonstrated a positive right SLR.[8]

Evaluation:

The patient's impairments include decreased lumbar flexion ROM, pain with running, prolonged sitting, and bed mobility. MA presented with a positive right SLR and tender to palpation. A positive SLR test is indicative of an underlying herniated disc.[8] Her functional limitations include her inability to return to her sports activities (basketball and track and field).

Diagnosis:

The patient fits into the Guide to Physical Therapist's Practice Preferred Practice Pattern 4F: impairments in joint mobility, motor function, muscle performance and ROM associated with spinal disorders.[15]

Prognosis:

At initial evaluation, MA's prognosis was to fully restore her lumbar ROM, reduce her pain with ADL's and eventually return to pole vaulting after completing physical therapy sessions 2-3x/week for 4-6 weeks.

Plan of Care:

According to the exact McKenzie protocol, specific long term and short term goals are not established. McKenzie assesses the effectiveness of the treatment according to the patient's response to activity through self reported pain. The McKenzie lumbar evaluation was modified by the outpatient clinic to include specific attainable short term goals (STG) and long term goals (LTG).

The patient's goals were as follows:

STG: (1) Independent with HEP (2-3wks), **(2)** Improve lumbar flexion AROM to minimal movement loss (2-3wks)**; LTG: (1)** Decrease LBP to at most 2/10 with running

and jumping activities (4-6wks)**, (2)** Pain-free with bed mobility (4-6wks). MA was scheduled for physical therapy 2-3 times a week for 4-6 weeks. Interventions recommended included passive range of motion(PROM)/ stretching, active range of motion(AROM), isometrics, posture, home exercise program(HEP), Nustep, treadmill, recumbent bike, elliptical, universal multi-station Gym, Shuttle Cardio-Muscular Conditioner, McKenzie Protocol, body mechanics, trunk stabilization, ADL's, Swiss Ball, and moist hot pack (MHP).

Intervention:

The interventions over the 11 visits that the patient was treated can be found in Table 1. MA's treatment consisted of a mixture of typical McKenzie protocol in conjunction with more traditional physical therapy interventions. This approach was chosen by the evaluating and treating therapist to best address MA's impairments and functional limitations. MA was instructed by the physical therapist to cease all running activities during her time attending physical therapy. MA's intervention focused on a flexion bias, due to the nature of her injury. Initial treatments consisted of repeated flexion in lying (FIL), flexion in standing (FIS), flexion in sitting (FISitting), and FIL with overpressure(OP) given by the therapist. These exercises were performed in sets of 10 repetitions. According to McKenzie, it is important to repeat these movements in sets of 10 repetitions frequently throughout the day. It is the repeated movement in the specific direction that is key to McKenzie's treatment method. MA was given a HEP consisting of repeated FIL and repeated FISitting. These exercises were to be performed 10 times each at 2-3 hour intervals throughout her day (with a goal of performing her HEP 6-8 times each day).

After several sessions of strictly flexion-based exercises, a flexion biased HEP and patient education, the therapist added abdominal strengthening exercises and specific lower extremity stretching. These exercises are not part of the McKenzie protocol, but were added to address MA's positive SLR and tight hamstring and piriformis muscles noted during the initial evaluation and treatments. The hamstring stretch was performed in the supine position with the hip at 90 degrees of flexion. MA was instructed to assist in holding her hip at 90 degrees and to actively extend her knee. When she was at her end knee extension AROM, she was then instructed to actively dorsiflex (DF) and plantarflex (PF) her ankle. This exercise provided both a stretch to her hamstring and also served as a sciatic nerve glide. The piriformis stretch was also performed in supine. MA was instructed to "hug" the knee of the side being stretched and bring it across her body and as close to her chest as possible until a stretch was felt in her gluteal region. Both of these stretched were held for 15 seconds and repeated 10 times a set.

Because MA's LBP was concentrated mainly on her right side at the right PSIS after several treatment sessions and good reported compliance with her flexion HEP, side gliding in standing (SGIS) to the right were added to the flexion exercises. This particular exercise addresses a lateral displacement of the disc, whereas the flexion exercises address the anterior displacement of the disc.

Midway through her treatment, MA suddenly lost ROM into lumbar extension. When this occurred, she was unable to extend past neutral without experiencing an increase in pain at her right PSIS. At initial evaluation, her lumbar extension ROM was WNL. The cause of this sudden loss of ROM is unknown. The physical therapy assistant (PTA) working with her at this time made a clinical decision to try repeated extension in

lying (EIL) with the thought that this would help to "loosen her back up", therefore increasing her extension ROM. This activity did help her to temporarily increase her lumbar extension ROM, but in turn caused a decrease in her lumbar flexion ROM. Prior to this intervention she was able to touch her fingertips to the floor. After repeated EIL she was -2.5" from touching the floor. After MA's 8th treatment session, she was scheduled to have a lumbar spine radiograph to look for a possible spondylolisthesis. The radiograph came back normal. As a result, MA's treatment plan of care continued with a flexion bias as prior, with no further continuation of lumbar extension exercises.

In order to progress her into running, jogging on the Shuttle leg press machine was added. Jogging on the Shuttle allowed her to gradually introduce running, but in a gravity eliminated position. This was then followed by jogging on a trampoline. Jogging on a trampoline decreased the ground forces that would be placed up through MA's pelvis and lumbar spine during running, but positioned her in to work with and against gravity. The next progression to returning to running was walking on the treadmill. Once she was able to successfully walk on the treadmill without a significant increase in her pain, the speed was increased to a slow jog, During this progression into jogging, MA's interventions continued to include aerobic exercise on the upright bike, McKenzie flexion exercises, piriformis stretching, bilateral hamstring stretching with added dorsiflexion/plantarflexion, and continuation of her HEP.

Outcomes:

MA was discharged from outpatient physical therapy after completing 11 treatment sessions. She had restored full lumbar flexion active ROM and no positive neural tension test. MA responded well to the McKenzie flexion exercises. She was able to rapidly

restore her lumbar flexion ROM, yet continued to complain of 1/10 pain at rest and with ADL's. She was able to abolish her pain at rest and with ADL's with compliance with her HEP. However, she continued to have LBP (3-4/10) in the right PSIS region with running and lateral trunk rotational movements. With anterior derangement, restoration of ROM is the key to treatment, not pain reduction. This led us to question if there was some other reason for her pain. After 11 treatment sessions, the exact cause of her pain was unable to be completely determined. With anterior derangement, restoration of ROM is the key to treatment, not pain reduction. This led us to question if there was some other reason for her pain. MA met her goals for independence with her HEP and improved lumbar flexion ROM, but did not meet her goal to be pain-free with all bed mobility or to decrease her LBP to 2/10 at most with running and jumping activities. As a result of her being unable to meet her long term goals for pain reduction, MA was discharged from physical therapy and referred back to her primary physician for further evaluation and diagnostic testing. MA made no further contact with the physical therapy clinic concerning her back pain. Follow-up communication on behalf of the best interest of the patient was attempted with no further information provided.

Discussion Section:

Typically, extension is the directional preference that is used when using the McKenzie method for treating LBP because the majority of people perform forward lumbar flexion hundreds of times as a part of their daily routine.[5] This case is unique because the patient performed repetitive hyperextension of her lumbar spine as a result of her chosen sport of pole vaulting.[13] Due to the repetitive hyperextension motion, the patient sustained an anterior derangement of her lower lumbar spine. The main signs and

symptoms of an anterior derangement include limitations with forward lumbar flexion ROM with normal lumbar extension ROM. According to McKenzie's treatment for this type of derangement, a flexion regimen is used.[1,5]

There is not much literature regarding the sub-classification of anterior derangements. EbscoHost, CINHAL, Cochrane Library, Elsevier Science Direct, and MEDLINE search engines were all used to search for research pertaining to anterior derangement. The key search words used included: McKenzie, anterior derangement, low back pain, hyperextension, physical therapy and intervention. These words/phrases were all used alone or in conjunction with each other. This is due to the majority of the population experience repetitive flexion activities throughout their day. It is a small population which experience repetitive lumbar hyperextension.

The patient states that she was compliant in her HEP with adequate number of repetitions of flexion throughout the day (RFIS/RFIL X10, 6-8x/day). Although her technique was good, as measures through observation during treatment sessions, she may not have reached optimal end range at home. Due to her increased joint mobility, she may have required more overpressure while performing her HEP.

The patient was very active in activities involving lumbar extension prior to coming to physical therapy. A possible cause for the decrease in ROM that occurred midway through MA's treatment could be the instruction to avoid extension and the focus on repetitive flexion activities. She was also instructed to stop all running activities (basketball and track & field activities). This sudden decrease in activity could also be responsible for her decrease in flexibility/ROM. A third possibility for her decrease in lumbar extension ROM could be an underlying instability issue. At her last PT visit, SI

joint laxity on the right was discovered through palpation and joint play assessment. This may have been an underlying issue with surfaced during intervention to treat her anterior disc displacement.

An injury is not only physical, but it may also be psychological.[16] The psychological aspect of injury may be especially apparent with an athlete. Hardy and Crace discuss a five-stage process that athletes tend to follow after an injury resulting in a significant period of time out of their sport. The five stages consist of (1) denial, (2) anger, (3) bargaining/ rationalization, (4) depression, and (5) acceptance and reorganization. Denial consists of the initial shock that the athlete may experience immediately after the injury. They are in denial of the significance of their injury and the time that will be needed for recovery. The next step is anger at themselves or towards other people. The intensity of anger varies from person to person, but it is usually stronger in athletes whose personal identity is centered on their participation in their chosen sport. Their inability to participate for a period of time causes them to feel a loss of identity. Next, the athlete may attempt to bargain or rationalize with themselves in an attempt to avoid the reality of the situation. An example of this would be to do a good deed for another person if they recover quickly. Once the athlete had confronted reality, they may or may not progress to the fourth stage, depression. If the athlete is in this stage, they become depressed for many different reasons. Some reasons may be because they are unable to participate in their sport, they may feel that they have lost their identity as an athlete, and/or they are unsure of their ability to return to their sport after treatment. The last step in this process is acceptance. In this stage, the athlete accepts that they are

injured and their focus is now more optimistic and directed on what needs to be done to enable them to return to their sport.[17]

MA was very active in sports (basketball and track & field). Physical therapy and her primary MD suggested that she stop all running activities for the duration of her physical therapy. Although the cessation of running activities was crucial to her recovery, this was deleterious to her psychologically. She was very upset that she could no longer run, and as a result she became extremely frustrated. Every day she would ask if she could return to running. MA stated that she was compliant with her HEP and that she was avoiding all activities pertaining to her sport as instructed to. Her main goal now was not only to abolish her LBP, but to be able to return to running activities so she could attend basketball camp at the end of the summer. There was a period of a few treatments sessions in which she showed no signs of progress, but no signs of regression either. MA became extremely frustrated during this time period. Hardy and Crace also discuss how setbacks or delays in progressions can lead to further emotional disturbance.[17]

The psychosocial and emotional aspects may have also affected how well she was able to rehab. Although she may have still experienced pain with certain activities, the patient may have been more apt to inadequately report her pain levels, therefore falsifying our reports and speeding up her progress. She would hesitate to give a response when asked about her pain level with an activity. Due to her determination to get better, she may have also overdone it while performing her HEP. Compliance is mostly an issue of the patient not performing adequate repetitions or frequency of the HEP, in this case, the patient may have been doing too much, therefore possibly hindering her recovery as well. This is a sign of poor adjustment and poor acceptance of

her injury and the necessary processes needed before she is able to return to running and participating in sports.[18]

The McKenzie method for evaluation of patients with LBP is becoming more widely used by physical therapists.[1,5] According to a test-retest examination of the interexaminer reliability of the use of the McKenzie method for evaluation of LBP, it was concluded that there is good interexaminer reliability which are statistically significant only when the examiner is trained in the McKenzie method. Many of the clinicians who are using all or parts of the McKenzie method may not be trained in using this method properly. In the case with MA, the physical therapist was trained in the McKenzie method, but the PTA who also worked with MA was only educated in the introductory level course. Although the research addresses the reliability of the evaluation findings, there is the question about whether the level of training effects the treatment. Do all therapists who treat patient using the McKenzie method need to be trained in this method in order to best treat the patient?

A second limitation is the lack of research concerning treatment of anterior derangements due its rareness and possible misdiagnosis. An anterior derangement may be misdiagnosed as a posterior derangement by an untrained clinician, therefore resulting in being treated with an extension bias. This would cause the patient's condition to worsen. Also, due to the lack of pain fibers anteriorly in the spine, pain is not the main complaint with patients with an anterior derangement. Loss of trunk motion, in conjunction with LBP, is the chief complaint.

Future research should look at more closely at the process of the differential diagnosis of LBP in young athletes and the trend in LBP with increased sports activities

at a young age. There is a rise in the number of overuse injuries in young athletes. Many young athletes participate in multiple sports with little no to time off in-between sports seasons. The high level of physiologic stress in conjunction with little to no recovery time in children and adolescents' whose bone and muscle structures are not fully developed puts them at a higher risk for overuse injuries. One third of injuries in pediatric athletes include LBP, hamstring muscle strain, anterior knee pain and Achilles tendonitis.[19] An additional question in which future research may address is, "Does overall joint laxity lead to an increased risk for disc herniation? Does it play a role in the few individuals who have anterior derangements of the lumbar and/or thoracic spine?"

Conclusion:

Although MA was unable to abolish her LBP, she was able to recognize the cause of her pain and was able to control her pain through completion of her HEP. Once her anterior derangement was treated, there may have been an underlying problem which was causing her right PSIS pain during running and twisting activities. Because she was not pain free after 11 physical therapy sessions, MA was referred back to her primary physician for re-evaluation.

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Table 1: McKenzie and Traditional Physical Therapy Interventions for MA

Intervention		Visit # 1	2	3	4	5	6	7	8	9	10	11
McKenzie Flexion	Flexion in lying	x	x	x	x	x	x	x	x	x	x	x
	Flexion in sitting	x		x							x	
	Flexion in standing		x			x		x	x		x	x
McKenzie Rotation/Lateral	Sustained lumbar rotation		x				x					
	Right side glide in standing						x					
McKenzie Extension	Extension in lying						x		x			
Aerobic	Upright bicycle			x	x	x		x		x	x	x
	Eliptical				x				x			
	Nustep					x						
	Trampoline jog								x			
	Shuttle jog								x	x		
	Treadmill (walk)										x	x
	Treadmill (jog)										x	x
Stretching	Piriformis stretch				x	x	x	x	x	x	x	x
	Hamstring stretch with plantarflex/dorsiflexion						x	x	x	x	x	x
	Sustained supine trunk rot											x
Strengthening	Abdominal strengthening			x				x	x			
	Shuttle double leg press					x						
	Wall mini-squats								x	x		
	Therapy ball bridge with hamstring curl								x	x		

Key: **X**: Intervention performed **X**: Intervention increased symptoms **X**: Intervention decreased symptoms

Figure 1: The above diagram depicts the lumbar hyperextension which occurs during the take-off phase of pole vaulting.