The Neuromuscular Re-education of Core Stabilizers

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Abstract

This paper discusses how Pilates can contribute to the neuromuscular reeducation of two core muscles: the deep fibers of the quadratus lumborum and the psoas. Having been diagnosed with Ankylosing Spondylitis 10 years ago, this autoimmune disease has caused inflammation of my left sacroiliac joint. The surrounding muscles, specifically the erector spinae and superficial fibers of the quadratus lumborum became overused and tight as a protective mechanism. Over time these muscles pulled the spine into functional scoliosis and restricted the core muscles, specifically the deep fibers of the quadratus lumborum and psoas, from working properly. With the help of Joanne Macza, a physical therapist, and exercises from the Body Arts and Science International (BASI) Pilates repertoire, I was able to retrain these particular core stabilizers. I will also discuss how Pilates can further assist in combating the longterm prognosis of ankylosing spondylitis.
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Core Stabilizing Muscles

The deeper core muscles include the transversus abdominis (TA), the multifidus, the pelvic floor and diaphragm. Additional core muscles include the rectus abdominis, internal and external obliques, erector spinae: iliocostalis, longissimus, and spinalis, as well as the quadratus lumborum (QL) and psoas. These muscles have many functions. They support posture and contribute to flexion, extension, lateral flexion, and rotation of the spine. The core also protects the spine against external forces, acting as shock absorbers. The QL and erector spinae assist in lateral flexion and extension. The psoas participates in flexion of the hip joint and external rotation.
Ankylosing Spondylitis

Ankylosing spondylitis is a chronic inflammatory disease that affects the spine and sacroiliac joints. It can also affect other joints such as the hips, knees, shoulders and even feet. As the disease progresses, back movement becomes limited and the vertebrae could fuse together, typically in a state of flexion. Joints between the spine and ribs could be affected restricting the mobility of the chest making it difficult to breathe deeply. In 40% of cases, the eyes can develop episodes of inflammation called acute iritis. AS is more prevalent in men is is typically diagnosed between the ages of 20 and 40.

It is believed that the HLA-B27 gene plays an important role in developing ankylosing spondylitis. The majority of people who possess the HLA-B27 gene never develop the disorder, but many people with AS have the gene (over 95% of caucasians with AS). According to Spondylitis Association of American, AS is most likely caused by a combination of both genetic and environmental factors. There is no known cure for ankylosing spondylitis, but NSAIDs (non-steroidal anti-inflammatory drugs) are typically used to reduce symptoms. A diet low in starch and high in proteins and vegetables is also thought to help in some cases.

Case History

I was diagnosed with ankylosing spondylitis when I was 18 years old. Upon diagnosis, I was placed on NSAIDs daily. The medication removed symptoms immediately. However, approximately 24 hours after taking the medication my body would begin to experience the symptoms once again.
This included muscle tightness of the back, trouble expanding the thorax during deep breathing, as well as SI inflammation and pain. Approximately 2 times a year I would experience an intense “flare up” lasting about 2 weeks despite taking the medication daily. Symptoms were magnified and included difficulty getting out of the bed, car, and walking. I would typically see a masseuse and continue exercising. In general, the symptoms tended to increase during periods of inactivity.

In the past 2-3 years intense muscle spasms have occurred in the left QL and erector spinae. The spasms would occur approximately 3-6 times a year during left unilateral flexion and forward flexion. During a sneeze the spasm would also be felt in surrounding muscles that attached to the sacrum. In August 2013 I experienced one of the worst flare-ups and ongoing QL spasms to date. I decided to seek additional help. I visited an AS specialist, a chiropractor, a masseuse, a physical therapist, and naturopathic doctor. I had finally found some additional answers for which I had been seeking. I needed a starch-free, dairy-free, sugar-free diet. This diet would greatly reduce the inflammation I was experiencing. However, after years of flare-ups my left SI joint lost some mobility resulting in the erector spinae and the superficial fibers of the QL to become overused. They were so tight that they pulled my spine into functional scoliosis. This caused a negative movement pattern that prevented the core muscles (specifically the deep fibers of the psoas and QL) from naturally firing throughout daily activities. Clearly there was muscular imbalance. Visually the back muscles were much more prominent on the left versus the right.
Physical Therapy

I worked with Joanne Macza over a number of weeks to re-educate the core in order to prevent the QL (superficial fibers) and erector spinae from overworking. The goal was to get the deep core muscles to automatically and unconsciously fire in a positive movement pattern. During my visits, she performed a variety of functional tests to examine how my core responded. Some of these included a lumbar protective mechanism test, elbow flexion test, and soft tissue & joint restriction tests. Joanne also examined my gate looking for irregularities in muscle tone and transverse pelvis rotation.

*Lumbar Protective Mechanism Test*

One foot is placed in front of the other. The therapist pushes against your torso and you brace. Both sides are tested. When my left foot was forward, the core was unable to maintain lumbar stability.

*Elbow Flexion Test*

This is done standing hip width apart with your elbows at your sides, arms bent at 90 degrees, palms up, hands shoulder distance apart. Joanne pressed down on the palms. She was testing the timing of the core contracting versus the global muscles. The core should fire first, then the global muscles. I did fine with this test week one, but she noted that improvements could still be made.

*Hip Flexion Test*

Lying supine with one leg at tabletop in a braced position, Joanne pulled my thigh in the sagittal plane away from my torso. The reaction time on the left was clearly slower than that of my right. The neuromuscular transmission needed to increase its speed on the left side to match that of my right side.

*Soft Tissue & Joint Restriction Test*

Joanne was looking for restrictions in both soft tissue and joints. Restrictions can affect movement patterns leading to compensations. She found both soft tissue restrictions in the QL and erector spinae and left SI joint restrictions.
**Gate Analysis**

Analysis of my gate revealed a decreased stride length most likely as a protective measure against sacroiliac joint pain. The overuse of the erector spinae and the superficial QL fibers were also evident through differences in muscle tone. The left was more prominent.

Joanne used massage throughout the sessions to minimize the fascia restrictions, re-establish soft tissue mobilization, and to maximize hip and SI joint movement. My at-home therapy program included using the foam roller and pinky ball to release fascia as well as a number of exercises that included BASI repertoire. These exercises would help to retrain my core muscles and restore balance.

**BASI Exercises**

A number of BASI exercises were included in my program. These included tabletop position (with resistance), leg changes, gluteal side lying series, prone hip extension (precursor for swimming), and single leg stretch (with the trunk down). Most of these exercises were given during week one of therapy and I was instructed to continue as the weeks progressed. Each exercise was done 5-7x/week for approximately 4 weeks.

*Tabletop with resistance (week 1)*

This exercise was done supine with legs at 90 degrees in the “tabletop” position. The spine and pelvis were both in a neutral position. With the navel pulled in, I pressed my hands firmly into my legs and held for 10 seconds. This was repeated approximately 10 times. I was instructed to focus more attention to the left side of my body. This would help to re-establish the neuromuscular transmission. Tabletop is typically a preparatory position but by adding resistance I was able to more intensely activate the core.
Leg Changes (week 1)

This is also done supine in a neutral spine position. The knees are bent with the arms by the sides. Navel to spine. Lift one leg to tabletop. As that leg lowers, the other one lifts. Continue to alternate for 10 repetitions.

Gluteal Side Lying Series (week 1)

This series includes the side leg lift, forward and lift, and forward with drops.

Side leg lift - Lying on your side, head rests on the arm. Spine is in a neutral position. The bottom leg is at 90 degrees of hip flexion while the top leg is relaxed and straight at hip height and in line with the trunk. Exhale lift the leg slightly higher than the hip and inhale return to hip height.

Forward and lift – In the same set up, exhale move the top leg forward to 90 degrees of hip flexion, slight lift and lower the leg. Inhale return to starting position with the leg straight in line with the trunk.

Forward with drops – Again, similar set up. Lying on your side, head rests on the arm, neutral spine position, the bottom leg is at 90 degrees of hip flexion. The top leg is straight at 90 degrees of hip flexion. Exhale lower and lift the leg five times. Repeat with an inhale.

The gluteal side lying series strengthens the gluteus medius and minimus muscles, among other hip abductors. These muscles help to stabilize the pelvis. If the abductors are weak, the gluteus maximus can take over and create a dysfunction or imbalance with the pelvis. I can add ankle weights or a Theraband around my legs to increase the challenge of this exercise.
Prone Hip Extension (Week 1)

This exercise is a precursor for Swimming. Lying prone, navel to spine, extend one leg without a rotation or anterior tilt occurring in the pelvis. Hold 5-10 seconds with 5-10 repetitions. Week one I was unable to extend my left leg without pelvic rotation. This exercise can eventually progress into Swimming. With the trunk extended, the arms and legs alternate in the sagittal plane while maintaining pelvic and trunk stability. The addition of the trunk adds to the demand of the core.

Single Leg Stretch – trunk down (week 2)

Single leg stretch was added on week 2 as a more challenging version of leg changes. The shoulder girdle and head remain on mat as a modification. The legs begin at tabletop then one leg slowly extends keeping the feet at the same height and parallel to mat. Alternate legs. The core works more as the legs extend further from the center of gravity. As the weeks progress, I will progress to the original Single Leg Stretch choreography: head and chest lifted with two hands on each knee.
The Results

Throughout the weeks Joanne retested my core strength. She noted great improvement in all tests: the lumbar protective mechanism, elbow flexion, hip flexion, soft tissue & joint restriction tests, as well as gait analysis. The myofascial work released the superficial fibers of the QL and erector spinae. This is turn greatly reduced the functional scoliosis and reestablished muscular symmetry. The deeper fibers of the QL and psoas were now functioning close to “normal,” meaning they performed almost identically to the right side. Personally, I noticed the great improvement in the prone hip extension exercise. I could extend the left leg approximately 10-20 degrees without pelvic rotation. This was similar to the right leg. I also noticed an improvement in the gluteal side lying series. I did not fatigue as quickly and I could increase my repetitions. Finally, I have not experienced any muscle spasms.

Pilates as a Lifetime Prescription

Ankylosing spondylitis is disease that currently has no cure. Pain can be managed through diet, medication, and exercise. Now that I have successfully retrained my core stabilizers and minimized my functional scoliosis I can introduce greater challenges. Due to the nature of the disease, I will incorporate exercises that work against the prognosis. AS tends to lead to spinal fusion in a flexed position. It can also cause issues with the joints between the spine and ribs restricting the mobility of the chest. There are a number of exercises from the BASI repertoire that can be used to combat the affects of the disease.

Lateral breathing

The simple act of lateral breathing can help maintain the joint mobility between the spine and ribs. This technique emphasizes breathing into the back and sides of the ribcage while maintaining an inward pull of the abdominal wall. In normal breathing patterns, approximately 88 joints are involved. Lateral breathing can increase the number of participating joints and hopefully maintain a healthy mobility of the thoracic cavity during inhalation.
Back Extension exercises

BASI's repertoire is divided into a 12 block system. One of the blocks is “Back Extension.” While all of the exercises in this block work to increase back strength, there are a number of exercises that will challenge my spinal mobility to a greater extent. From the matwork this includes Single leg kick, Double leg kick, Rocking prep, Rocking, Swan basic, and Swan dive. The matwork is fantastic since I may not always have immediate access to the Pilates equipment. However, other great exercises could be Swan on Floor (Wunda Chair), Breaststroke (Reformer), and especially Prone 2 and Hanging Back, both performed on the Cadillac. I could also lay backwards over the Ladder Barrel with one foot hooked under a rung for stability. That would be a great way to decompress the spine with support. Eventually I could increase the challenge with the Swan on the Ladder Barrel.

In addition to these exercises, I also need to be aware of my posture. Stacking the spine while sitting or picking up an object will ensure that the correct core muscles are working. This will also prevent the negative movement pattern of the QL and erector spinae from once again becoming overused.

Pilates will have a permanent place in my exercise regimen. It is my prescription for maintaining joint mobility and strength. I am looking forward to a lifelong journey with Pilates and combating the negative affects of Ankylosing Spondylitis.
References

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