Hip and Spine Basics

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The Lumbo-Pelvic Hip Girdle

The structures of the hips, pelvis and lumbar spine endure substantial stress from movements such as squatting and lunging. While these exercises are essential to developing the strength, flexibility and coordination required to participate in many functional activities, they can also cause lower-back and hip pain if there's musculoskeletal dysfunction. Understanding the biomechanics of the bones and muscles of the lumbo-pelvic hip girdle can help you identify dysfunctions in your clients, which is the first step toward fixing those problems.

Biomechanics of the Bones

The pelvis can rotate forward 10 degrees, which helps stabilize the sacroiliac joints (where the pelvis meets the base of the spine) and the lumbar spine in general (Gajdosik et al. 1985). This stability results in part from the shape and movement of the top of the pelvis (the ilium) as it rotates forward toward the sacrum (the base of the spine) during weight- bearing movement to help "lock" or "close" the joint space—like one piece of a jigsaw puzzle fitting neatly together with another.

As the pelvis rotates forward, the top of the sacrum also tips forward, encouraging the lower back to arch (Price & Bratcher 2010). This arching of the lower back, called lumbar lordosis, helps "lock" or "close" the vertebrae of the lumbar spine together, increasing stability.

These movements of the pelvis and lumbar spine are essential to stabilizing the lumbo-pelvic hip girdle when functional movements occur producing hip flexion during a squat, as the pelvis rotates forward and the lower back arches. These spinal and pelvic movements boost the integrity of the hips, pelvis and lower back, thereby maximizing structural support and minimizing risk of injury.

One of the most common musculoskeletal imbalances of the lumbo-pelvic hip girdle is an excessive anterior pelvic tilt (Price & Bratcher 2010). This is characterized by a noticeable downward tilting at the front of the pelvis and a more-than-normal rising-up at

the back (Kendall et al. 2005). If left unaddressed, this musculoskeletal imbalance can affect movement and potentially cause injuries during weight-bearing activities that stress the hips and lower back.

Biomechanics of the Muscles

One of the most important and overlooked functions of the muscles in the lumbo-pelvic hip region is their ability to slow and regulate the force with which the bones of the pelvis and spine “lock” together during movement. Muscles do this by lengthening under tension (like rubber bands stretching) to ensure that the skeletal structures of the pelvis and lower back do not “crash” into each other as they move. However, musculoskeletal imbalances and muscle dysfunction or other soft-tissue dysfunction can prevent muscles from functioning as they should. When that happens, the bony structures of the body are not controlled as they move, causing stress to the joints. Persistent muscle dysfunction can affect the integrity of the joints, leading to inflammation, degeneration, pain and injury.

What Causes Muscle Dysfunction in the Lumbo-Pelvic Hip Girdle

Many factors can disrupt function in the lumbo-pelvic hip region. Here are the most common:

- excessive anterior pelvic tilt and excessive lumbar lordosis
- joint dysfunction, degenerative changes like arthritis, and inflammation that causes muscles to tighten and restrict movement in order to protect areas that are either swollen or at risk of injury
- restricted blood supply or poor oxygenation from lack of movement and prolonged static postures such as sitting, sleeping and standing still
- faulty movement patterns (acute from recent injury/trauma, or chronic from previous injury.)
- myofascial adhesions and restrictions caused by scar tissue from previous injuries or surgeries
- musculoskeletal imbalances in other parts of the body, such as the feet, ankles, knees, thoracic spine, shoulder girdle, neck and head (Clark & Lucett 2011; Price & Bratcher 2010)

Muscles of the Lumbo-Pelvic Girdle

Gluteus maximus. Contractions of the gluteus maximus muscle extend the hips, pushing them forward and rotating the legs outward (Gray 1995). The glutes also slow the hips as they flex and the pelvis as it rotates forward during movements like squatting

and lunging (Price & Bratcher 2010). Tension in the gluteus maximus muscle as it lengthens during these movements decelerates stress to the joints that the muscle crosses (hips, sacroiliac joints and disks of the lumbar spine).

However, if the gluteus maximus muscle cannot function correctly in an eccentric manner, the hips may flex incorrectly and the pelvis may rotate forward excessively, causing undue stress, pain and possibly injury in the lumbo-pelvic hip girdle. The glutes are an important muscle for transitional movements like sit-to-stand transfers (Millington 1992) and ascending stairs during ambulation (Harper 2018). If there is weakness in the glutes the individual may have difficulty with these activities, limiting independent living.

Hip flexors. Contractions of the hip flexors (psoas and iliacus) bend the hips so the torso comes toward the leg, or vice versa, and rotate the leg outward (Gray 1995). However, weight-bearing movements cause the hip flexors to function very differently. As the hips travel behind the body during walking, running and lunging, the hip flexors lengthen under tension to slow extension of the hips and legs (Price & Bratcher 2010). However, if the hip flexors cannot lengthen effectively during this movement, then the pelvis rotates forward excessively while the lower back overarches. These movements can cause tremendous stress to the sacroiliac joints (where the pelvis meets the lower back) and to the intervertebral disks of the lumbar spine.

Hamstrings. One of the major functions of hamstring contractions is assisting with bending the knees and extending the hips (Gray 1995). However, another important function of the hamstrings is to lengthen under tension in order to slow down the hips as they flex and the pelvis as it rotates forward. Lengthening of these muscles also helps slow down the knees as they straighten (Price & Bratcher 2010). These additional functions of the hamstrings decelerate stress to the hip/leg, spine and pelvis joints during movements such as lifting or rowing. Biomechanically, tight hamstrings can lead to increased knee and hip flexion, leading to increased anterior pelvic tilt and increased force on the lumbar spine. Simply put, If the hamstrings cannot lengthen effectively during these movements, pain and injury can result from these restrictions in lumbopelvic posture.

Using Corrective Exercise Technique

Corrective exercises should start with self-myofascial release of all major muscles in the lumbo-pelvic hip girdle: glutes, hip rotators, adductors, abductors, hamstrings,

quadriceps, spinal erectors, hip flexors and abdominals. Your goal is to improve circulation, decrease adhesions, loosen scar tissue, eliminate excessive tension and release endorphins to help break the pain cycle (Inkster 2015; Price 2013).

The next step is to introduce stretching exercises, progressing from isolated strategies to integrated movements that mimic common exercises, such as sitting into a squat position to help lower the body correctly, or doing a split kneeling hip-flexor/lunge stretch.

Dynamic stretching: Consider BackHab or other walking variations. I specifically like walking leg curls (butt kicks) to stretch out tight hip flexors. I also like a slow march (exaggerated or 3-count march) “knee up, straighten knee, take a step” which helps with dynamic hamstring stretching.

Static stretching: If the patient has enough knee flexion, I will use a noodle or buoyant cuff at the ankle to stretch the hip flexors. Hamstring stretches can also be performed with cuff or noodle. If the pool has stairs to enter/exit, usually complete with a handrail, can be another option if the patient does not have enough.

Once release and stretching have been performed successfully, you can integrate strengthening movements into the client’s program.

I like the Aqualogix fins for both static resisted- range of motion exercises and dynamic strengthening (again BackHab is my favorite.) I will also use pool noodles or buoyant cuffs for strengthening. However, the individual must have adequate core strength to counteract the change in center of buoyancy and prevent lumbosacral substitution.

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Independent Review:

This article is well constructed containing basic information from an anatomical and biomechanical viewpoint. It provides an analysis of normal movement of the lumbopelvic complex and anomalies that could result in injury and pain. In my book (Diagnostic Aquatic Systems Integration: Specialized Interventions) sacroiliac biomechanics are analyzed in depth with regards to nutation and counternutation. A highlight of the article is the application of anatomical and biomechanical terminology in a way that would be well understood by the reader. The selection of exercises and activities is yet another highlight.

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