

# Balancing Act: Muscle Imbalance Effects on Musculoskeletal Injuries

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**In the absence of an outright sprain, strain, or osseous abnormality, having the ability to detect flawed movements and muscle imbalance through functional assessment can be insightful for the patient and enable more detailed therapies.**



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## Abstract

**Overuse injuries affect persons of all ages and physical participation levels. These injuries involve repetitive overload causing damage and pain to various joints, affecting performance and ability to continue participation. Even when an injury diagnosis is apparent, functional assessment is useful in discovering the underlying mechanism.**

## Introduction

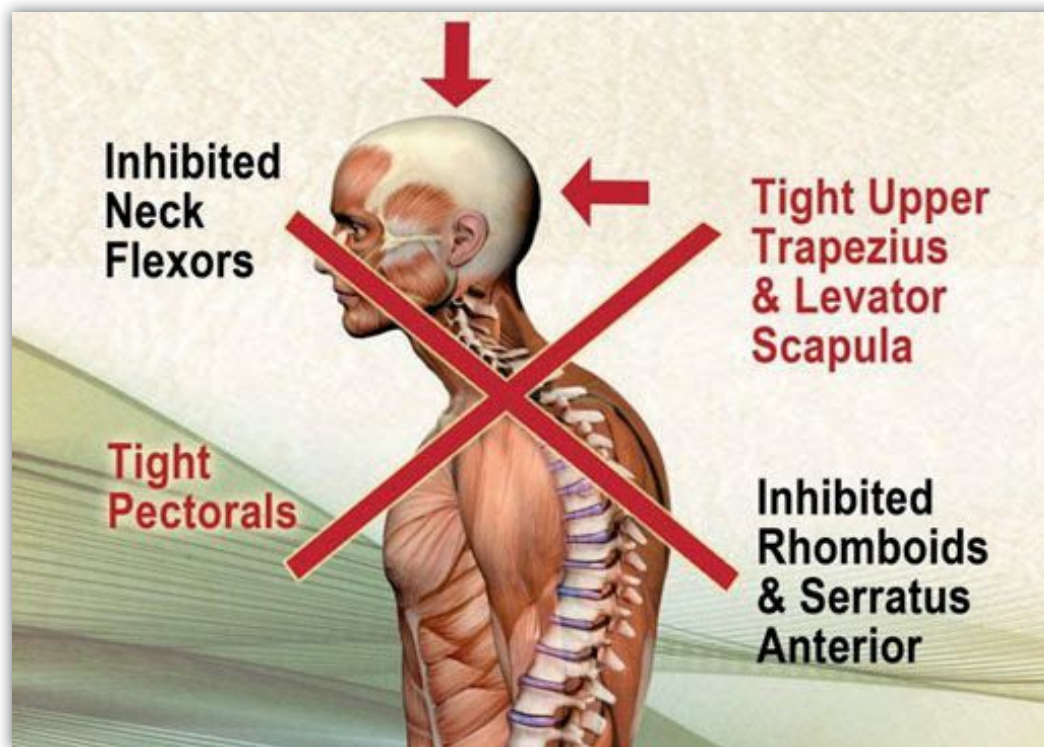
Overuse injuries involve repetitive motion resulting in microtrauma to muscle, tendon, bone, or bursa. Excessive loading and insufficient recovery increase risk of gradual breakdown at the cellular level. Subsequently, this produces painful arc of motion, which can affect any joint of the body. Various tendinopathies, physis injuries, and stress reactions may also be a result of this “failed healing response,” where a natural inflammatory response and injury resolution becomes disrupted.<sup>1</sup> While clinical presentation may elicit a particular diagnosis, such as patellar tendinopathy or rotator cuff tendinopathy, simply treating the downstream affect may not be wholly beneficial to our patients. Including functional assessment

as part of the physical exam may uncover underlying biomechanics and imbalances that ultimately set the athlete up for their injury. The purpose of this review is to outline the importance of basic functional testing for common joint complaints and continued injuries, which can offer insight for a prescribed home exercise program or describe the benefit of physical therapy.

## Shoulder

Shoulder impingement is an umbrella term malady that involves extrinsic or intrinsic forces on the multiple constructs that comprise shoulder motion, accounting for 44-65% of shoulder complaints.<sup>2</sup> Specifically, subacromial impingement refers to a narrowing of the subacromial space, a common issue with overhead athletes. Shoulder range of motion involves static stabilizers such as the glenoid labrum and joint capsule, but also dynamic stabilizers such as the rotator cuff tendons and periscapular muscles. A characteristic pattern of functional muscle imbalance, described as ‘Upper Crossed’ Syndrome’ (Figure 1) includes weakness of lower and middle trapezius, serratus anterior, infraspinatus, and deltoid in

Figure 1. Upper Crossed Syndrome



contrast to tightness of upper trapezius, pectorals, and levator scapula.<sup>2</sup>

Subacromial impingement featuring this agonist and antagonist scapular function imbalance, has shown to cause compression of the subacromial space and alterations in shoulder kinematics and muscle activation.<sup>3</sup> Furthermore, postural patterns which create a scapula in protraction and anterior tilt is suggested to increase compression of the subacromial space.<sup>4</sup> Evaluation centers around commonly used impingement special testing with Neer's, Kennedy-Hawkins, and Empty Can. Addition of specific scapular tests can be helpful in function assessment. Scapular assistance test evaluates serratus anterior and inferior trapezius muscles. Scapular retraction test is useful to stabilize the scapula and determining effect of scapular movement on painful arc of motion.

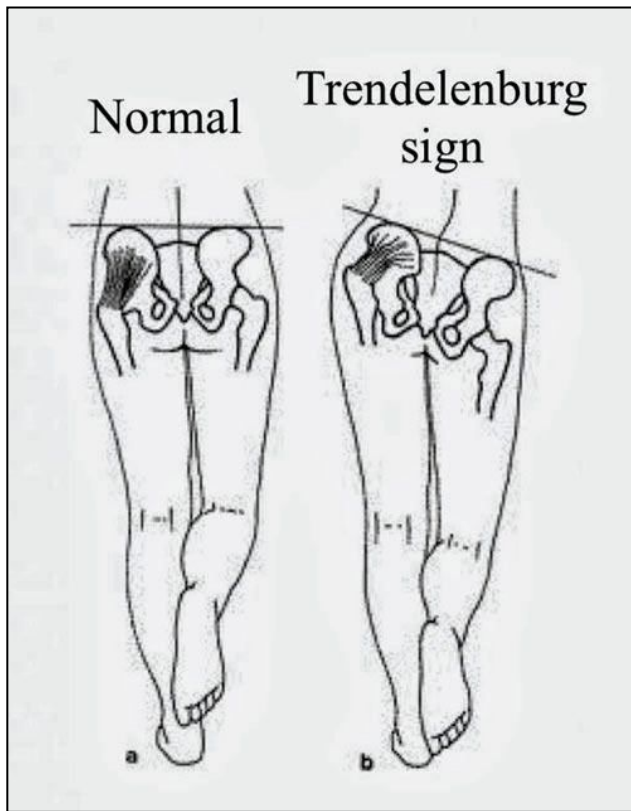
Recent literature has questioned the importance of scapular motion, or an actual subacromial space impingement altogether. A systematic review concluded that there is insufficient evidence to support or refute scapular stabilizer strengthening in shoulder impingement syndrome.<sup>6</sup> However, using scapular motion assessment as part of the armamentarium in shoulder evaluation can prove

to be helpful in guiding a treatment plan for your patient, as well as aid in explanation for patient. Specifically, aiming at scapular stabilizing.

## Hip

Low back pain is the most common musculoskeletal complaint, accounting for about 65 million years lived with disability around the world, annually.<sup>7</sup> Etiologies for low back pain vary, but common treatment plan centers around physical therapy with exercise for lumbar, abdominal, and lower extremity strengthening. As part of the multi-plane movement of the pelvic girdle, the hip joint is the structural link between the lower extremities and the axial skeleton. The joint itself can disperse forces of 1.5 to 5.0 times body weight, depending on the movement.<sup>8</sup> With these large amounts of energy, variations in gait or stance can certainly create overuse injuries and pain. Various studies have highlighted the kinetic chain theory, which explains that injuries migrate from distal to proximal structures. For instance, Nader et al. has several supporting articles describing unilateral hip extensor weakness and hip flexor imbalance in association with development of low back pain, specifically

Figure 2. Trendelenburg Sign



in female athletes.<sup>9</sup> Similarly, gluteus medius weakness and tenderness has been a common association with patients with chronic low back pain, which was also evident in a higher prevalence of a positive Trendelenburg sign (Figure 2).<sup>10</sup>

Physical exam maneuvers for hip evaluation commonly consists of range of motion, strength, FABER and FADIR maneuvers. However, adding in functional assessment with gait, step-up, step-down, single-leg squat, and double-leg squat can be quite useful in evaluation. To this point, a recent study in hip biomechanics remarked on several differences during a single-leg squat in patients with femoroacetabular impingement syndrome (FAI). Those with FAI demonstrated more exaggerated differences on single-leg squat, exhibiting less peak hip adduction, lower peak hip joint abduction and extension moments, and a slower overall squat when compared to those without pain and compared to double-leg squat.<sup>11</sup> Functional assessments should occur

regardless of age or physical activity level; this is particularly important when considering our elderly patients and the utility of a 'Get Up and Go' test. Avoidance of hip fracture and associated morbidity and mortality is also at the foundation for recommending an additional two days of balance training for physical activity guidelines, for patients over the age of 65.

### Knee

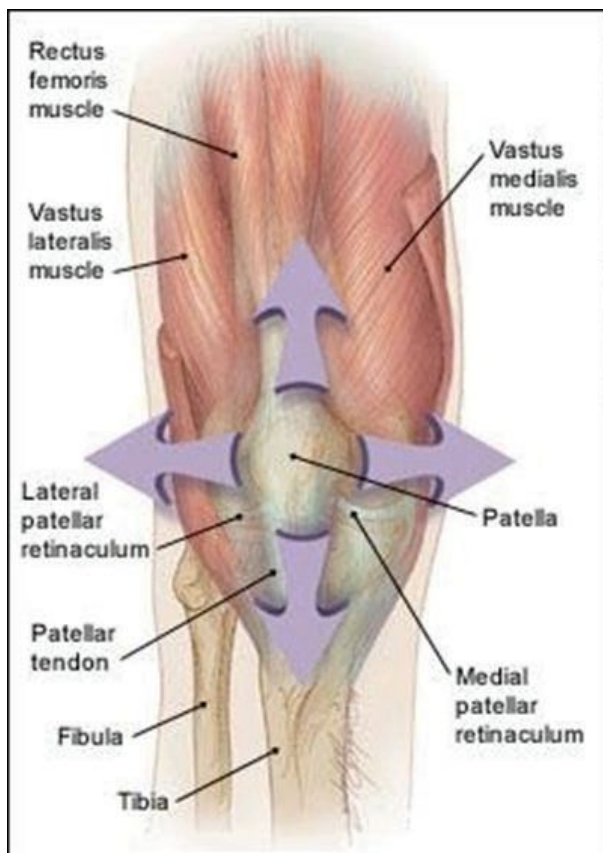
Knee pain is the second most common reason for chronic pain. One of the more common diagnoses of knee pain is patellofemoral pain syndrome (PFPS), with a general population prevalence of 22.7%. In the absence of specific tendinopathy, ligamentous injury, or arthroses, patellofemoral syndrome is an anterior knee syndrome that has historically been multifactorial. One suggested risk factor for development of PFPS is weakened quadriceps.<sup>12</sup> Previously held theories of height, weight, BMI, and Q-angle do not pan out as risk factors for PFPS.<sup>13</sup> The knee as a hinged joint, has nearly all its flexors and extensors as two-joint muscles (Figure 3).

Therefore, in the absence of outright injury, it is important to evaluate dynamic motion of the knee, with assessment of hip and ankle motion. Weak muscle activation in the hips have shown to be positively correlated with PFPS. Asymmetric gluteus medius activation was a clinically relevant factor in pain severity.<sup>14</sup> Similarly, delayed vastus medialis activation showed a positive relationship with patellar tracking disorder in patients diagnosed with PFPS.<sup>15</sup> Appreciation of improper form or weakness in the one of the other joints can be helpful in establishing causation and a treatment plan. Again, this is a good opportunity to move beyond typical special testing of the knee, and include similar functional assessments as described above, namely gait, single-leg squat, double-leg squat, step-up, and step-down.

### Conclusion

Establishing comfort with proper physical exam and special testing of these joints is

Figure 3. Knee Forces



important in proper diagnosis of ailments. An understanding of biomechanical demands of the patient may help identify risk for overuse injury. However, in the absence of an outright sprain, strain, or osseous abnormality, having the ability to detect flawed movements and muscle imbalance through functional assessment can be insightful for the patient and enable more detailed therapies. Additionally, having specific direction for physical therapy can improve patient adherence, and thereby increase successful outcomes.

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## Disclosure

None reported.

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