

Alleviating Knee Pain Using the BOSU® Balance Trainer

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Many people suffer from mild to severe knee pain that prevents them from engaging in activities they enjoy such as hiking, playing tennis, or simply walking. They blame the knee for their woes, yet the cause of their problem may not be the knees at all.

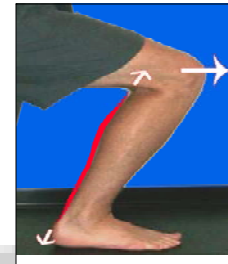
The muscles that help stabilize the knee as it moves all originate from either the foot and ankle, or from the lumbo-pelvic hip girdle. Hence, if the foot/ankle or hip complex is not working correctly, then the soft tissue structures that help support the knee will be adversely affected. As such, it is important to understand how the joints and muscles above and below the knees work.

Functional Anatomy of the Lower Kinetic Chain

The feet and ankles act as shock absorbers when the body interacts with a contact surface. They also help the body adapt to the terrain (i.e., the ground). There are many muscles of the lower leg (e.g., the calves, peroneals, anterior and posterior tibialis) that assist the foot and ankle with its many functions.

Most anatomy books state that the calf muscles (soleus and gastrocnemius) assist in plantar flexing the ankle and that the gastrocnemius also assists in flexing the knee. However, there is more to their function once you add ground reaction forces. For example, whenever the heel strikes the ground during gait, lunging or a squat, the lower leg (tibia) and knee continue to travel forward over the foot (dorsiflex) and the calf muscles begin to stretch (see Picture 1). These muscles are not getting looser as they stretch; on the contrary, they are actually lengthening under tension as they try to slow down the knee joint as it moves forward.

Picture 1: Increasing the tensile load to the calf muscles as they lengthen.



To better understand this, imagine stretching a rubber band with your fingers.

The more you pull it apart the more tension there is in the rubber band. Muscles work in a similar fashion. As they lengthen, tension increases to save joints that the muscles cross from excessive wear and tear. Therefore, the real function of the calf muscles is to slow down forces to the knee and ankle joints as they bend when the foot is in contact with the ground.

There are also muscles on the inside and outside of the lower leg (i.e., peroneals, tibialis anterior and posterior) that help slow down forces to the foot and ankle (and therefore the knee) as the foot strikes the ground. Most of these muscles wrap around and/or attach on the underside of the foot and some assist in holding up the arches of the foot. When the foot pronates to help the body absorb shock, the arches of the feet flatten out. As the arches flatten, they help lengthen the muscles of the lower leg (that wrap under them), thereby increasing the tension in these muscles and slowing forces to the ankle and knee joints.

The lumbo-pelvic hip girdle is where the lower spine, pelvis, and top of the legs come together. The main function of this area is to ensure the legs can move forward when we walk, lunge or squat and that the torso can follow on a stable base of support. Just as many of the muscles that attach to the foot control the lower leg (tibia), there are some larger muscles that originate from the lumbo-pelvic hip region (i.e., the gluteus maximus via the IT band and the hamstrings) that also control the tibia.

Most anatomy books state that the gluteus maximus assists in hip/leg extension and outward rotation of the leg. Once again though, the function of the gluteus maximus is completely different when ground reaction forces come into play. When the foot comes into contact with the ground and pronates, the tibia rotates inwardly over the foot. This inward rotation moves the insertion of the gluteus maximus (on the outside of the tibia) away from its origin near the base of the spine. This motion helps stretch the muscle under load, thereby putting more tension on it. This helps slow down the internal rotation of the tibia. Consequently, stress to the knee is kept to a minimum.

The hamstrings also affect knee function since they cross the knee. (They originate on the ischium and insert below the knee on the back of the tibia). According to text books, the hamstrings help flex the knee and extend the hips. However, once the heel strikes the ground the hamstrings actually help slow the tibia down as it moves forward over the foot. Therefore, the hamstrings can also help slow down forces to the knee as it bends under load. (see Picture 2).



Picture 2: Increasing the tensile load to the hamstrings as they lengthen.

How can the BOSU® Balance Trainer help alleviate knee pain?

Performing exercises on a flat surface limits the range of motion of the heel and foot. The heel stops when it hits the floor and the foot pronates until it flattens to the ground. Performing exercises on a BOSU Balance Trainer, however, enables the heel to press down further as the dome surface gives. Not only does this increase the foot and ankles' ability to dorsiflex, but it also turns on both the calf and hamstring muscles so they can help protect the knee as it flexes. Similarly, the soft dome allows the foot to pronate further than exercises performed on the ground. This increased range of motion in the foot and ankle means that the muscles of the lower leg stretch (work eccentrically) more and get more tension on them. The additional degree of pronation also helps increase tension on the gluteus maximus (as the tibia internally rotates) which can help protect the knee.

Using the BOSU® Balance Trainer to train muscles effectively

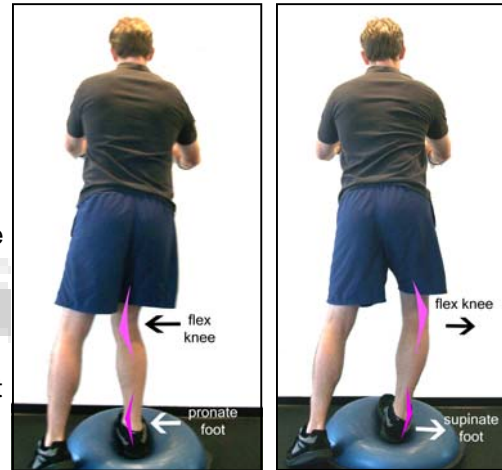
The video clip that accompanies this article demonstrates four exercises that are designed to increase the range of motion for the lower kinetic chain in all three planes of movement. Putting the body through these movements will help activate those muscles that are directly responsible for slowing down forces to the knee, thereby helping alleviate pain and improve function.

Multiplanar Lower Leg Stretch

This is a dynamic stretch that helps increase the range of motion at the foot, ankle and knee to help prepare for the weight bearing kinetic chain exercises that follow.

Directions: Push heel down into the dome of the BOSU® Balance Trainer (BT) while bending knee forward and pronating foot. Push heel down into the dome of the BT while bending knee forward and supinating foot.

Note: The above exercise can be performed in bare feet to increase the demand. However, be aware that this dramatically increases the range of motion at every joint. So, it might not be a good idea for someone who typically wears orthotics or arch supports.

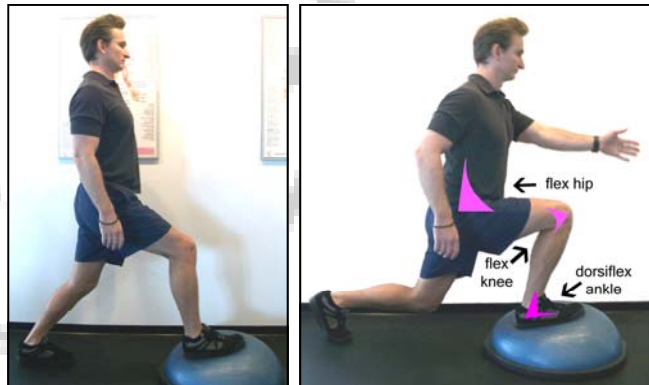


Lunge with Forward Reach

This is a sagittal plane lunge designed to increase dorsiflexion at the ankle and increase knee flexion. This exercise increases the tensile load to the posterior calf, hamstrings and quadriceps as the ankle and knee move away from each other.

Directions: Begin in a split stance with 1 foot on the dome of the BT and the other foot on the floor. Lunge down and reach forward while pushing the heel down, bending the knee and hip, and transferring weight over the foot. This will engage the hamstrings, calves, quads and glutes.

Note: The above exercise can be performed in bare feet to increase the demand. However, be aware that this dramatically increases the range of motion at every joint. So, it might not be a good idea for someone who typically wears orthotics or arch supports.



Lunge with Transverse Reach across Body

This is a transverse plane lunge designed to increase internal rotation of the tibia and femur, and pronation at the foot and ankle. This exercise increases the tensile load to the gluteus maximus, gluteus medius and gluteus minimus.

Directions: Begin in a split stance with one foot on the dome of the BT and the other foot on the floor.

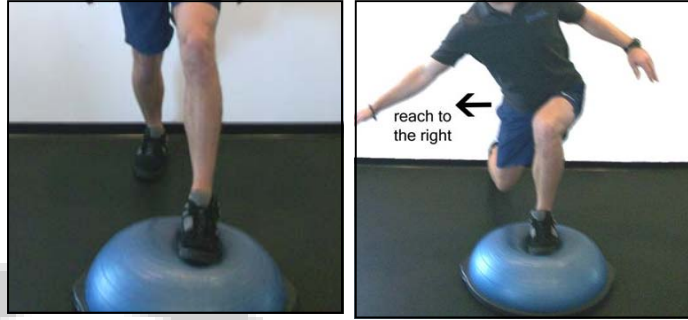
Lunge down and reach forward across front leg. While lunging, push heel down, let foot pronate and move knee toward midline of the body. This helps counter balance the arm reaching across to the other side of the body, and helps engage the gluteal complex.

Note: The above exercise can be performed in bare feet to increase the demand. However, be aware that this dramatically increases the range of motion at every joint. So, it might not be a good idea for someone who typically wears orthotics or arch supports.



Lunge with Side Reach to Open Side

This is a frontal plane lunge designed to increase adduction of the hip/leg complex. This exercise increases the tensile load to the abductors as the femur goes into adduction and away from the side of the hip. It also increases the tensile load to the adductors as the pubic bone moves away from the inside of the weight bearing leg.



Directions: Begin in a split stance with one foot on the dome of the BT and the other foot on the floor. Lunge down and reach away from the front leg. While lunging, push heel down, let foot pronate and move knee toward midline of the body. Feel body weight transfer toward reaching hand. This helps to engage the abductors, adductors and muscles of the lower leg.

Note: The above exercise can be performed in bare feet to increase the demand. However, be aware that this dramatically increases the range of motion at every joint. So, it might not be a good idea for someone who typically wears orthotics or arch supports.

Justin Price is co-owner of The BioMechanics, a private training facility located in San Diego, CA, that specializes in providing exercise alternatives for sufferers of chronic pain. He is also the co-creator of The BioMechanics Method which is a method for pain reduction that combines structural assessment, movement analysis, corrective exercise and life coaching that teaches trainers how to help clients alleviate chronic pain and improve their function. He was named International Personal Trainer of the Year in 2006 by the worlds' leading organization of health and fitness professionals, IDEA Health and Fitness Association, and has helped thousands of people around the world overcome pain and injury through his methods. For more information about Justin or The BioMechanics Method go to www.TheBioMechanics.com.

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