

## ERGONOMICS FOR THE SAFETY PROFESSIONAL

### **Lower Extremity – Legs, Knees, Ankles, Feet (Part 2 of 6)** **Dr. Patrick Carley, Professor, Doctorate of Physical Therapy**

When someone is asked about the legs in the backdrop of ergonomics, there is typically a look of confusion or that “I never really thought about it before” response. On average, we assume our legs will just do what we want them to do. Consequently, most people do not really think about it much, but legs are really the foundation of how we engage work every day!

From an ergonomic standpoint, our legs represent only about 25% of our total body weight but that means it holds up, controls, and supports the other 75% of the body (head – arms at 25% and trunk at 50% with a total of 75% for the head/arms/trunk referred to as the HAT).

With the HAT in mind, our legs will be relied on to help us stand throughout the day, shift our body weight to reach for tools and objects, support the HAT whenever material handling is engaged, and those same legs get us from the car to work, all around work, and then back home again. The legs are truly the unsung heroes involved in just about everything we do at work.

With that concept in mind, now we can build an ergonomic model for the legs with one end of the model focused on the hips and knees, which provide the strength and power for body movement and stability. So, conceptually, muscle strength and flexibility would be a major concern. Those muscles would be predominately the quads/hamstrings for the knees and Gluteus Maximus and Medius of the hips

The other end of that model captures the function of the feet and ankles interacting with the opposite but equal opposing forces of the ground. The major concern here is pressure with the ground (basically what is pushing against us because of gravity that localized at our foot surface, which is actually the inside of footwear and not the ground itself (that is if you are not standing barefoot at your workplace)).

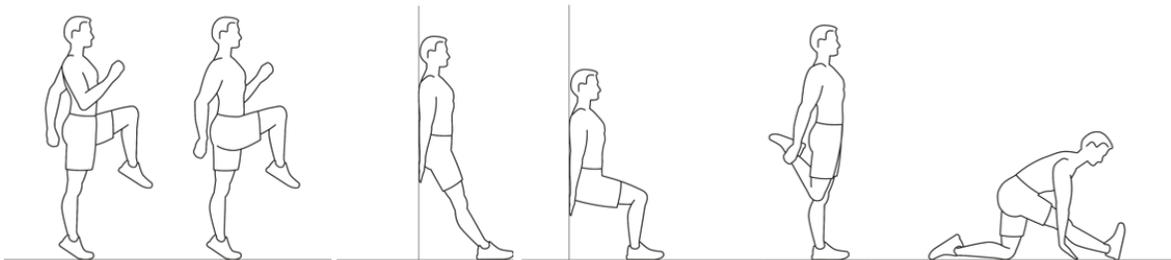
Not only do the feet need to deal with a substantial amount of pressure from the opposing ground throughout the workday, the muscles controlling the feet work all day long to continuously adjust for balance, reaching, and weight shifting from one leg to the other. The most significant muscle responsible for this task is the muscle located just under the Gastrocnemius (Gastrocs). It is rather thick but flat muscle called the Soleus, named after its appearance as a flat sandal. The most important thing about this muscle



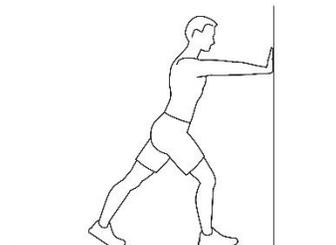
is that it is comprised of 80% slow-twitch muscle fibers, which makes it extremely fatigue resistant! Perfectly designed for its much-needed functional role in standing and working all day.

Now that the model is constructed for the legs, a rational ergonomic approach can be formulated to engage problems and improvements for the job the legs are doing all day.

1. Muscle flexibility is also a significant concern and to a lesser degree, muscle strength. Realistically, most people will maintain the strength in their legs throughout the functional activities of their daily routine. However, what most people do not do after they work their muscles throughout the day is getting the concept of keeping the muscles flexible.
2. Here are some very important stretches for the hips and knees that should be encouraged throughout the day when a machine is down, waiting for the next process, or during their break.



3. When it comes to the foot and ankle, there are two very important stretches to do to confirm adequate stretching at the calf to reduce influences on ankle and foot pain. Some of those can be described as tarsal tunnel syndrome or plantar fasciitis. Make sure to stretch both calf muscles that pull on the largest tendon in the body, which can withstand more than 1,000 pounds of force, according to the American Academy of Orthopedic Surgeons (AAOS).



4. Lastly but most importantly, reducing the pressure contact between the feet and ground (inside the footwear) is critical. Studies have shown repeatedly that polyurethane insoles spread out the pressure best thus reducing the forces on the foot surface NOT between the bottom of footwear and the ground. One particular Study, [Insole Program in the Manufacturing Setting](#) also demonstrated better muscle control and less muscle force when using dual layer memory foam insoles indicating less chance for leg fatigue



**Dr. Patrick Carley, Professor, Doctorate of Physical Therapy**

Dr. Carley is a consultant for MEGAComfort and is the Co-Founder of the Ergonomics Collaboration Group and Professor in the Doctor of Physical Therapy Program at American International College in Springfield MA. He teaches human biomechanics, gross anatomy, and ergonomics and has been assisting companies with various ergonomic projects for their workforce since 1991, including Hasbro Games, Boeing, Honda, US Tsubaki and Sonoco.