

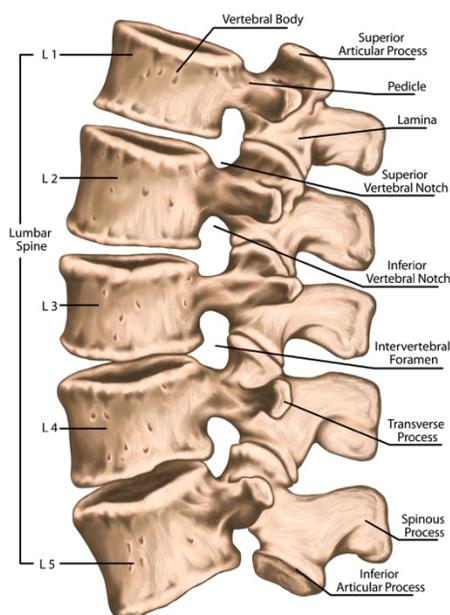
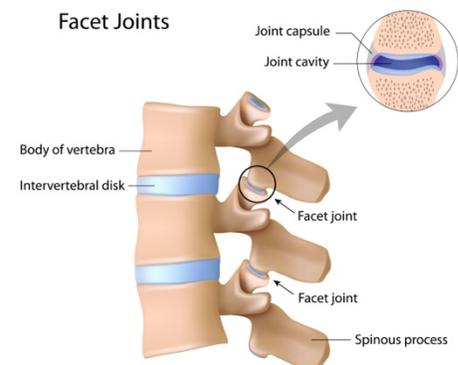
ERGONOMICS FOR THE SAFETY PROFESSIONAL

Upper Extremity - Structure of Back and Trunk (Part 3 of 6)

Dr. Patrick Carley, Professor, Doctor of Physical Therapy

The etymology of the word “Ergonomics” began in the 1950’s but it originates from the core part of the word “Ergon” or work. When we complete the word, ergonomics, we are really implying the “pattern or distribution of work”. Keeping that in mind, it is not only the pattern of work itself but also the pattern of how things work that interact with ergonomics. The back and trunk are not only fundamental to the discussion of ergonomics, but it is also fundamental as to how the human body interacts with work.

Taking a close look at the structure of the back truly begins with the basic elements of the spine. It comes in three articulating sections; cervical, thoracic, and lumbar. The cervical vertebrae are smaller and do not have to be large since collectively are only supporting the weight of the head, which averages 10 to 11 pounds. Since the four major senses (sight, smell, taste, and hearing) are localized within the head, the spine allows for a considerable amount of motion. The facets (joints) of the cervical vertebrae will help guide the motions with the upper part good for rotation and as they go lower, they will begin permitting for more movement in flexion, extension, lateral bending left and right. There is a lot of muscle tissue that adds to more capacity control and moderate those greater degrees of motion.

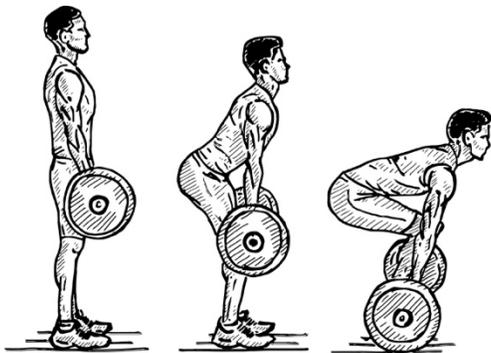


The thoracic portion supports the structures above and the ribs limiting the amount of movement associated with this section. As you can suspect, there is not a lot of muscle tissue in the thoracic spine because of that lack of significant motion. The lumbar vertebrae are bigger, wider, and have very prominent spines. They support all the weight above, which now include the organs and contents in the abdomen. The lumbar facets (joints) face inwardly to hug the joints from the lumbar vertebrae above it as if to intentionally control motion. The spines are thicker acting as anchors for thicker muscles to attach assisting to control motion. Another interesting fact is that the spinal muscles have a predominance of Type I – Slow Twitch fibers typically making them not very strong but very fatigue resistant able to adjust and maintain our standing positions all day.

Once the basic concept of the back is constructed, it becomes easier to apply the anatomical model to the biomechanical model, which is essentially how do you want to use the back and trunk during work. This brings in one of Newton's Laws of Motion: for every action there is an opposite and equal reaction. This is applied to lever or moment arms we learned while playing on the old see-saw. If there were a large and a small child, they could still have fun if the large child moved in closer to the axis of motion to shorten the lever or moment arm effect lessening the impact of the heavier weight.



Ergonomically, this is a critical concept since lifting items further away from you causes the back muscles to exert more force due to their fixed closeness to the spinal axis. Since we cannot change the spinal muscles distance from the spine, we need to constantly remember to shorten the lever arm getting items as close to us as possible. Thus, reducing the amount of force required from the back muscles, much like the see-saw example. Being aware of distance from the material to be handle will reduce the risk of back and trunk injuries.



From a physiological perspective, we can learn a lot from people who use their back and trunk for exercising and competitive activities of lifting heavy weights like power lifting. They automatically get as close to a weight as possible, but they do something rather unique and intuitive, but it takes some practice. Before material handling, lifting weights, or even changing the dog's dish, they will lift their heads into extension – not looking down. This technique will automatically contract your back muscles preparing the trunk muscles to work and stabilize the spine. Wearing a good pair of dual layer memory foam insoles between your feet and footwear will also

help in absorbing forces from concrete floors. No need to worry about bending the knees anymore, just remind yourself that lifting your head will better prepare the back and trunk for safe, effective work.

There is a lot of talk about the "core" of the trunk much like the core of an apple. Again, it would involve muscles closest to the spine such as the back muscles and the iliopsoas muscle, which is in the front of the spine. The abdominal muscles will help the trunk stabilize during movement, standing balance, and material handling but to a much lesser degree. They tend to be broad, thin muscular structures that are best designed to keep the 25 feet of intestines in place. Just keep in mind, to bring objects as close as possible before lifting, lift slowly at first, and bring your head into extension. Lastly, vertical loads on the spine and trunk can support up to 1,000 to 1,500 pounds before suffering any permanent damage. If you use the back and trunk as designed and understood from an ergonomic perspective, the back and trunk are quite strong and durable.



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.