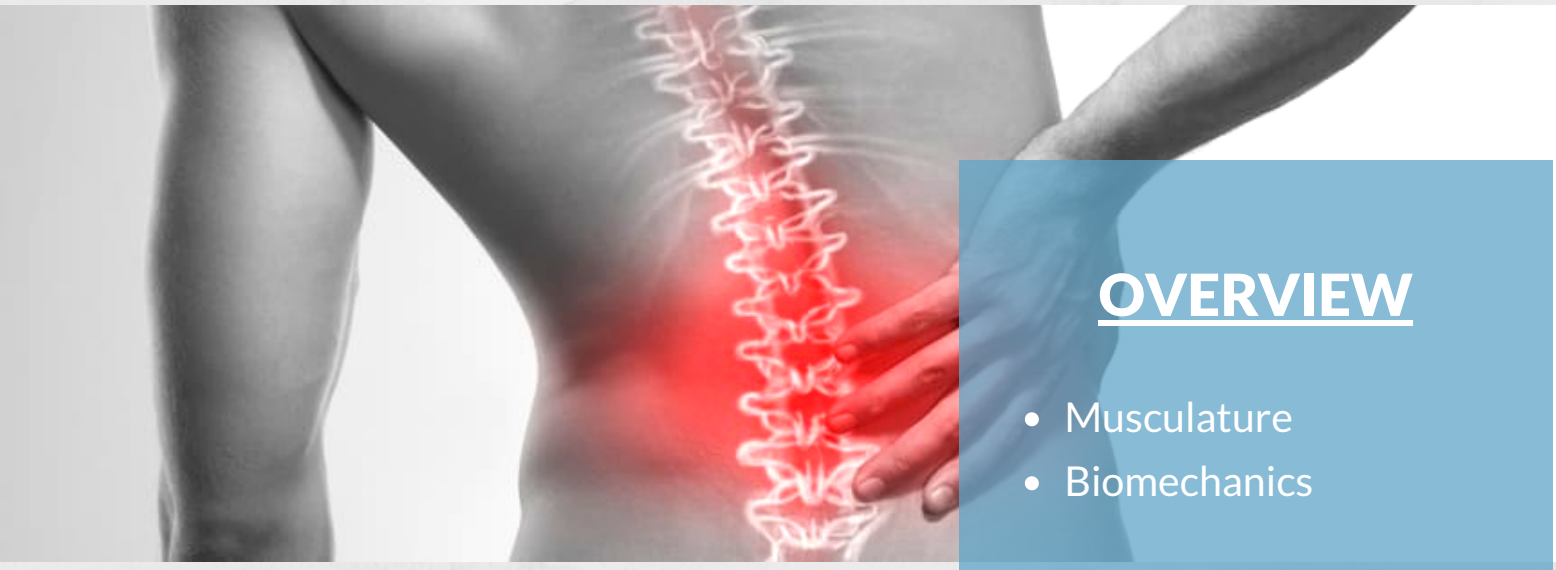
THE LOW BACK LOWDOWN



OVERVIEW

- Musculature
- Biomechanics

Muscles and Movement

In the Lowback Lowdown - Lumbar Spine Anatomy article we illustrated the bony, joint, and ligament anatomy of the lumbar spine. In this article, we will illustrate the musculature anatomy and discuss the biomechanics. In simple terms, we are talking about the meat and potatoes of the muscles and movement we experience on the lumbar spine day-in and day-out. We hope you learn a few new things along the way or that this will be a nice refresher for those of you with experience.

Musculature

Think of the lumbar spine musculature and its relevant mechanics are broken into 3 major regions or areas. From Top to Bottom, Outside to Inside (superior to inferior and superficial to deep for those anatomy junkies). The Trunk, the Lumbar Spine itself, and the Lumbopelvic Region. These are the three most identifiable regions for most people and also the more common sites where injuries and various pathologies arise from (will be discussed in a later article).

Brief Disclaimer

For those of you taking the time to read through this, we would like to be clear, this is most certainly not how undergraduate students learn about the anatomy and biomechanics of the lumbar spine. It takes a tremendous amount of time, studying, observation and practice to be able to break down the lumbar spine into just 5 articles. We hope to continue our lower back conversation in the future so let's get started.

Trunk Musculature

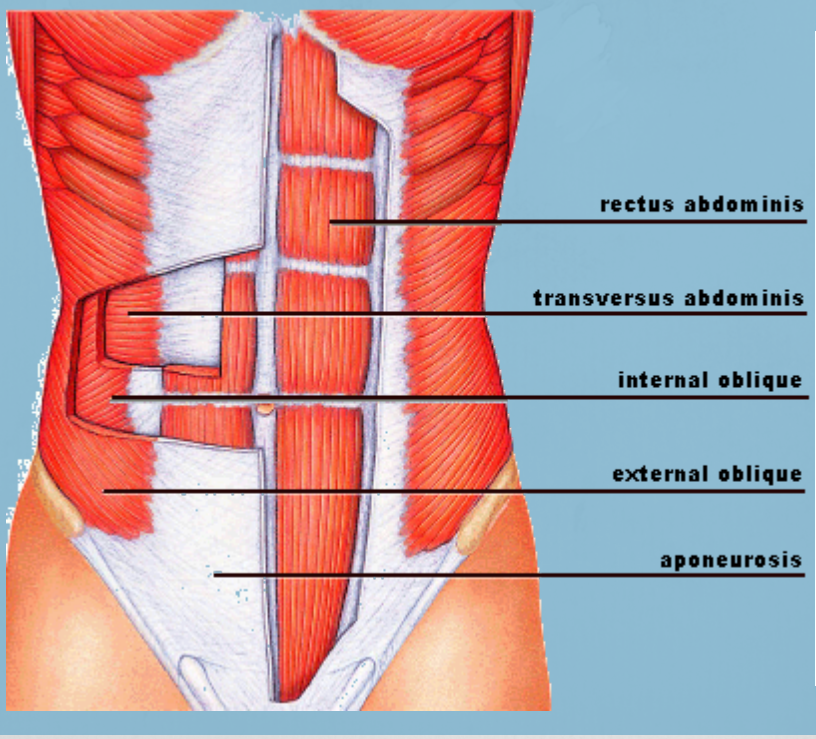
Let's begin with the Trunk. The trunk, for our purposes, will be narrowed down into 5 muscles that also happen to be prime movers and stabilizers for the lumbar spine. Maybe you have heard of them.

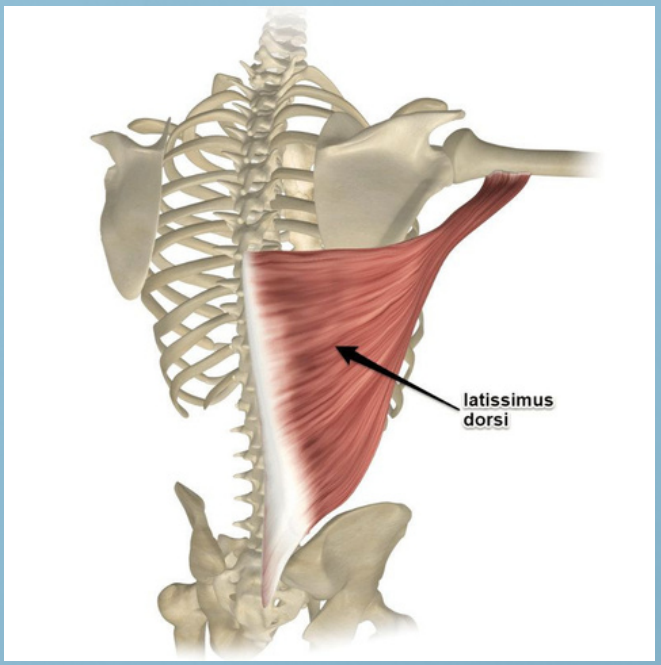
1. Rectus Abdominis
2. External Oblique
3. Transverse Abdominis
4. Internal Oblique
5. Latissimus Dorsi

These muscles perform some basic actions/functions (see Table 1). Primarily the trunk provides broad stabilization and performs larger movements. From snatches to Glute Ham Developers (GHDs) these larger trunk muscles allow us to brace or resist external loads placed on the lumbar spine. In addition to bracing and resisting external loads, these muscles help to transmit or transfer force in certain movement patterns such as throwing a baseball or chopping wood.

Trunk Region Muscles		
Movement/Action	Muscle Performing	
Extension	Latissimus Dorsi	
Flexion	Rectus Abdominis	Internal Oblique
Rotation	External Oblique	Internal Oblique
Lateral Flexion	External Oblique	Internal Oblique
Stabilization*	Transverse Abdominis	

Table 1 (* refers to isometric and isokinetic actions enacted on the lumbar spine and the spinal column)





Lumbar Spine Musculature

On to the Lumbar Spine. The lumbar spine consists of both superficial and deep muscles. The superficial muscles drape over and attach to each vertebra while the deep muscles are located between each vertebra. The rotatores, erector spinae, interspinales, multifidus and intertransversarii extend the entire length of the spine to the base of the skull (prior to C1 C2 or Atlas and Axis respectively)

<u>Superficial Muscles:</u>

1. Iliocostalis Lumborum
2. Erector Spinae (longissimus)

<u>Deep Muscles:</u>

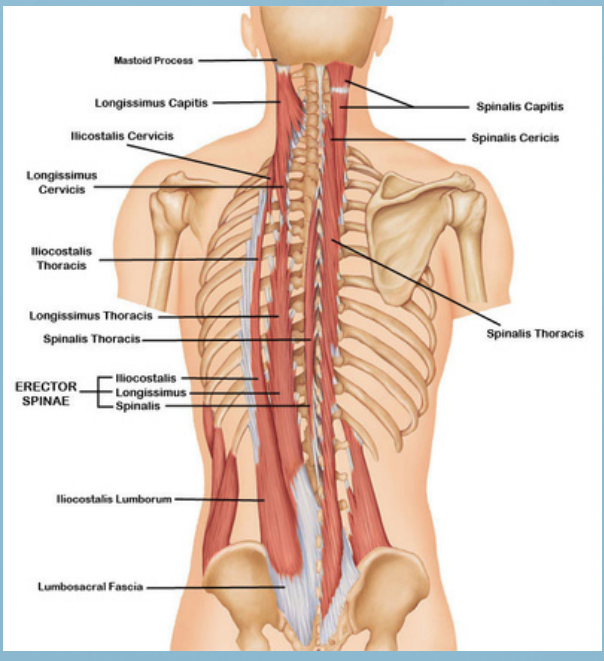
1. Multifidus
2. Rotatores
3. Interspinales
4. Intertransversarii

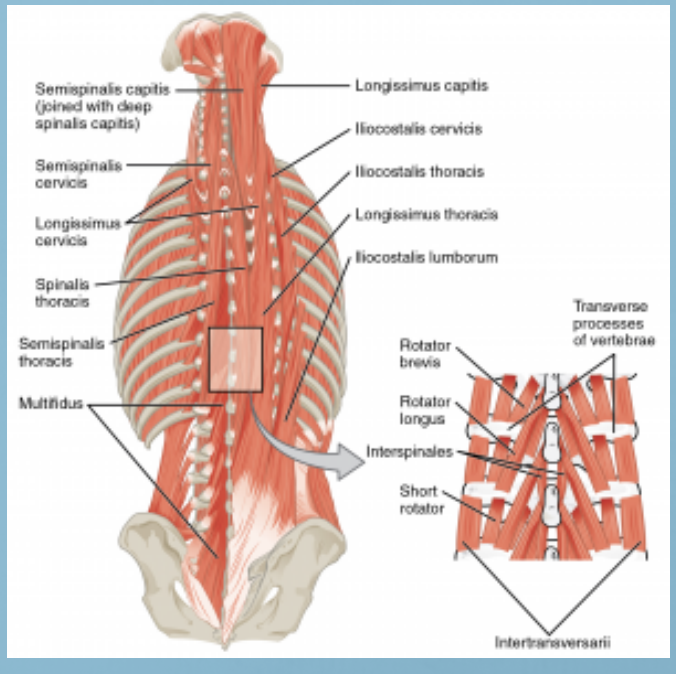
These muscles perform some basic actions/functions (see Table 2). In the lumbar spine these muscles help perform extension and hyperextension. The secondary purpose is to establish smaller movements to help stabilize or provide additional protection for the lumbar spine while performing these motions.

Lumbar Spine Muscle Actions

Movement/Action	Muscles Performing			
Extension & Hyperextension	Rotatores	Iliocostalis Lumborum	Erector Spinae	Interspinales
Rotation	Rotatores	Multifidus	Erector Spinae	
Lateral Flexion	Iliocostalis Lumborum	Erector Spinae	Intertransversarii	
Stabilization*	Rotatores	Multifidus	Interspinales	Intertransversarii

Table 2 (* refers to isometric and isokinetic actions enacted on the lumbar spine and the spinal column)





Lumbopelvic Musculature

Finally, musculature that is related to the lumbopelvic region. This can get tricky and admittedly, this area is exactly what it sounds like, the lumbar spine meeting up with the pelvis, or the relationship between the lumbar spine, sacrum and hip (illium). The muscles of this region are located deep to the abdomen and anterior to the lumbar spine.

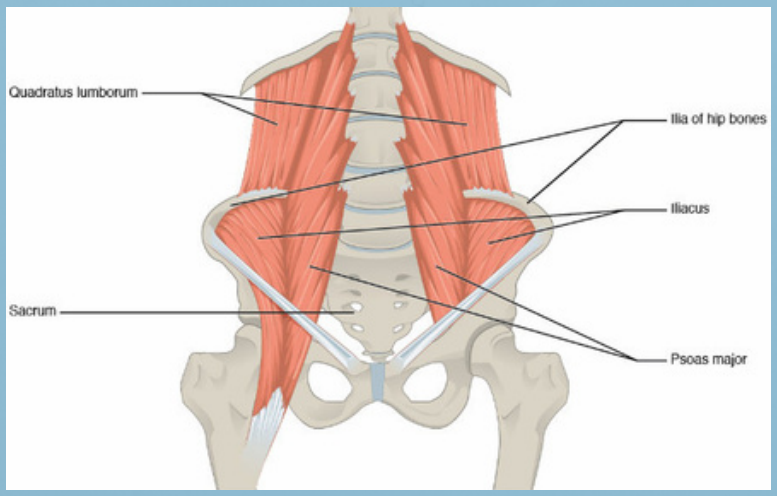
1. Diaphragm
2. Quadratus Lumborum
3. Iliopsoas
    a. Iliacus
    b. Psoas Major
    c. Psoas Minor

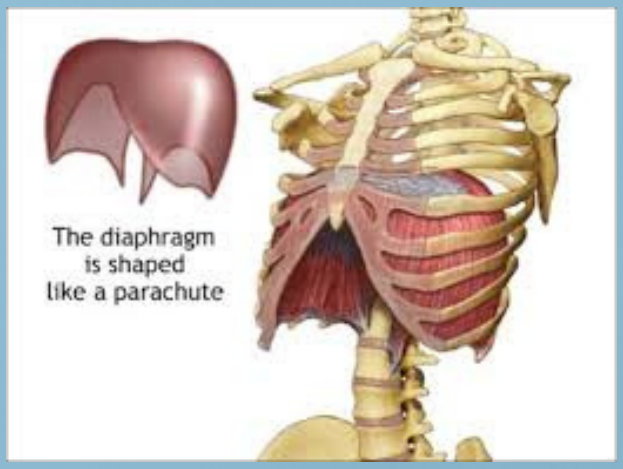
These muscles perform more specific actions/functions (see Table 3). The primary function of the musculature is to provide flexion of the hip/pelvis and assist in stabilizing the lumbar spine. What makes the lumbopelvic region so interesting is the diaphragm. We could write a whole other article about that structure. The lumbopelvic region and pelvic girdle form a spherical shape and with the function of the diaphragm adds additional pressure (stability/protection) to the lumbar spine when breathing and "activating" the lumbopelvic musculature.

Lumbopelvic Region Muscle Actions

Movement/Action	Muscles Performing		
Flexion	Iliacus	Psoas Major	Psoas Minor
Extension	Quadratus Lumborum		
Lateral Flexion	Quadratus Lumborum		
Stabilization*	Diaphragm		

Table 3 (* refers to isometric and isokinetic actions enacted on the lumbar spine and the spinal column)





Biomechanics

Let's review and illustrate general motions that the lumbar spine performs. Simply stated, these motions are flexion, extension, hyperextension, lateral flexion (or lateral bending), and rotation. This article will not be diving into the specific ranges and degrees of motion, if you would like more information please see the references listed at the end of this article. Please note Images 1-6 for visual representation.

Images 1-6

Flexion (1)

Extension (2)

Hyperextension (3)

Lateral Flexion (4)

Rotation *standing* (5)

Rotation *seated* (6)

Load Basics

Now to review the loads that can be applied on the spine. There are two types of loads the spine has to deal with, there are naturally present loads (such as gravity and our body's weight/mass) and there are external loads (such as weight training, or loads we have to move from one point to another). Both of these loads exert pressure on the intervertebral discs. We briefly discussed these discs in the first anatomy article, remember the spongy things between your vertebrae? Anyways they act like springs to support loads (see image 7).

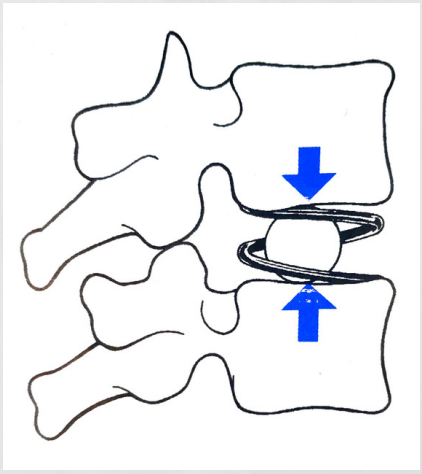


Image 7

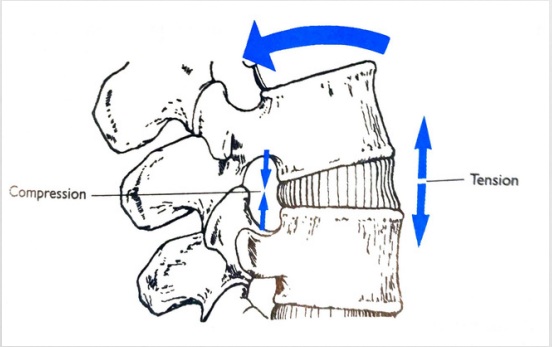


Image 8

In addition, when we move about these discs also exhibit both compression and tension forces depending on how you move and the orientation of the vertebrae. see image 8 for example of extension in the spine and what it does to the discs. These forces change depending on the body's position and movement demands

Loads

On to naturally present loads. I would like to ask you to sit up if you are not currently doing so, yes I have a point. One's own body weight or mass presents a constant load on the intervertebral discs due to gravity and the body's position (refer to image 7). These loads change from laying down, sitting, and standing. Laying down is the least amount (about 75kg) followed by standing (about 100kg) and the greatest load sitting/leaning forward (about 275kg) see image 9. In addition, the spine is naturally in a forward-leaning position and therefore the muscles we discussed are in a constant state of extension providing tension to the spine.

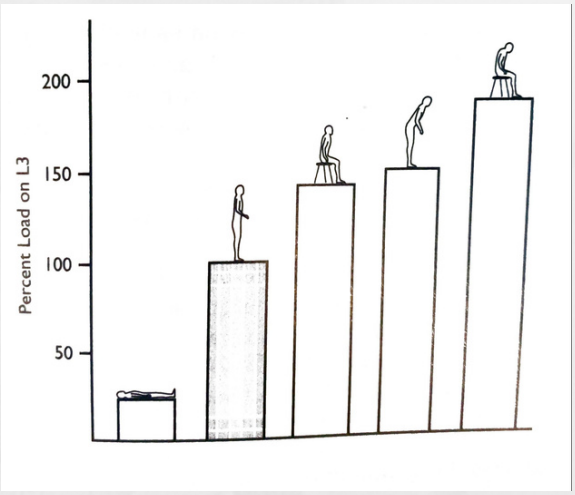


Image 9

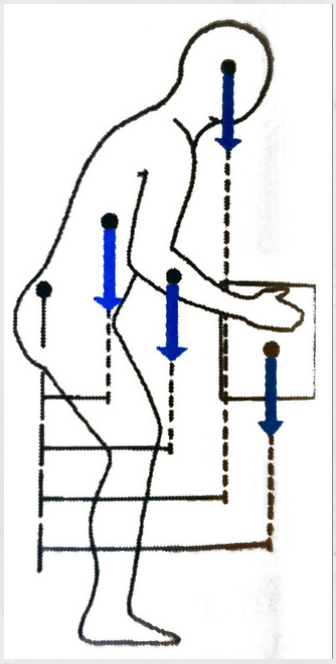


Image 10

The second type of load the lumbar spine experiences is external loads. Now, I want you to think about a time where you picked up a box of holiday decorations that were heavier than you thought or a time where you were deadlifting and swore you had that last rep...until you didn't. The box and the bar are identified as external loads or additional loads added to the body. Unlike the previous example, we are adding external weight plus distance away from the body to the equation. In short, the heavier something is and the further away it is from the body, the more difficult it will be to lift, See image 10 for a visual representation. If you think about it, therefore quite possibly the worst way to lift is rotating or twisting and lifting something from the ground.

Intraabdominal Pressure

When we lift external loads our body creates intraabdominal pressure (you may have heard of abdominal bracing, or have seen people wearing lifting belts to achieve this). Intraabdominal pressure contributes to the stiffness or bracing of the lumbar spine. This increase in pressure against the abdominal walls and the lumbar spine (anteriorly) helps to further prevent the lumbar spine from buckling under additional loads (both from the top-down and bottom-up). (see image 11)

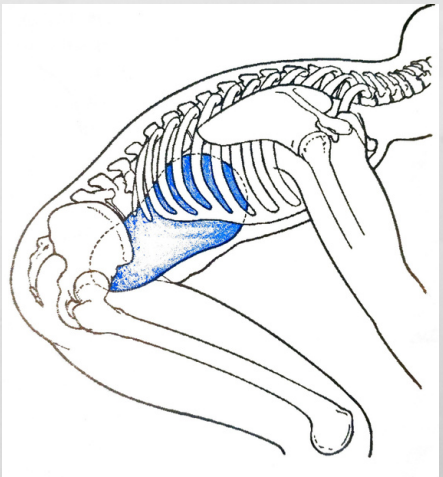


Image 11

Conclusion

So, there you have it. A crash course in Muscular anatomy and biomechanics of the lumbar spine. We hope you learned something new, a refresher for those with some experience, or maybe another way to observe or think about the lumbar spine and its biomechanics. If you have any questions and comments or want to carry on a discussion of this topic we are always happy and willing to do so. All you have to do is email us (see contact info below) or come see us in the clinic on campus. If you would like to study or know more about this topic you can look up our references (also listed below).

Now that we have the basics out of the way we can get into the fun stuff.! In the next edition of the Low Back Low Down, my colleague will be illustrating and defining lumbar spine injuries and some injury pathology. We hope you continue reading! If you need any further assistance you can find us online at **RecWell Athletic Training** and schedule a clinic visit at Ritchie Coliseum or Telehealth visit.

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References

Hall, S. J. (2007). Basic Biomechanics (5 ed.). New York: McGraw Hill. Retrieved 2021

Seeley, R., Stephens, T. D., & Tate, P. (2008). Anatomy & Physiology (8 ed.). New York: McGraw Hill. Retrieved 2021

Starkey, C., Brown, S. D., & Rayn, J. (2010). Examination of Orthopedic and Athletic Injuries (3 ed.). Philadelphia: F.A Davis Company. Retrieved 2021

Thompson, J. C. (2010). Netter's Concise Orthopaedic Anatomy (2 ed.). Philadelphia: Saunders Elsevier. Retrieved 2021