14.11: Axial Muscles of the Abdominal Wall and Thorax

Learning Objectives

- Identify the intrinsic skeletal muscles of the back and neck, and the skeletal muscles of the abdominal wall and thorax
- Identify the movement and function of the intrinsic skeletal muscles of the back and neck, and the skeletal muscles of the abdominal wall and thorax

It is a complex job to balance the body on two feet and walk upright. The muscles of the vertebral column, thorax, and abdominal wall extend, flex, and stabilize different parts of the body's trunk. The deep muscles of the core of the body help maintain posture as well as carry out other functions. The brain sends out electrical impulses to these various muscle groups to control posture by alternate contraction and relaxation. This is necessary so that no single muscle group becomes fatigued too quickly. If any one group fails to function, body posture will be compromised.

Muscles of the Abdomen

There are four pairs of abdominal muscles that cover the anterior and lateral abdominal region and meet at the anterior midline. These muscles of the anterolateral abdominal wall can be divided into four groups: the external obliques, the internal obliques, the transversus abdominis, and the rectus abdominis (Figure 1, Figure 2, and Table 1).
Figure 1. Muscles of the Abdomen. The anterior abdominal muscles include the medially located rectus femoris, which is covered by a sheet of connective tissue called the linea alba. On the flanks of the body, medial to the rectus femoris, the abdominal wall is composed of three layers. The external oblique muscles form the outermost layer, while the internal oblique muscles form the middle layer, and the transverses abdominus forms the innermost layer.

Table 1. Muscles of the Abdomen

<table>
<thead>
<tr>
<th>Movement</th>
<th>Target</th>
<th>Target motion direction</th>
<th>Prime mover</th>
<th>Origin</th>
<th>Insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twisting at waist; also bending to the side</td>
<td>Vertebral column</td>
<td>Supination; lateral flexion</td>
<td>External obliques; internal obliques</td>
<td>Ribs 5–12; ilium</td>
<td>Ribs 7–10; linea alba; ilium</td>
</tr>
<tr>
<td>Squeezing abdomen during forceful exhalations, defecation, urination, and childbirth</td>
<td>Abdominal cavity</td>
<td>Compression</td>
<td>Transversus abdominus</td>
<td>Ilium; ribs 5–10</td>
<td>Sternum; linea alba; pubis</td>
</tr>
<tr>
<td>Sitting up</td>
<td>Vertebral column</td>
<td>Flexion</td>
<td>Rectus abdominis</td>
<td>Pubis</td>
<td>Sternum; ribs 5 and 7</td>
</tr>
<tr>
<td>Bending to the side</td>
<td>Vertebral column</td>
<td>Lateral flexion</td>
<td>Quadratus lumborum</td>
<td>Ilium; ribs 5–10</td>
<td>Rib 12; vertebrae L1–L4</td>
</tr>
</tbody>
</table>

Figure 2. Muscles of the Abdomen. The muscles of the lower back move the lumbar spine but also assist in femur movements.
There are three flat skeletal muscles in the antero-lateral wall of the abdomen. The external oblique, closest to the surface, extend inferiorly and medially, in the direction of sliding one’s four fingers into pants pockets. Perpendicular to it is the intermediate internal oblique, extending superiorly and medially, the direction the thumbs usually go when the other fingers are in the pants pocket. The deep muscle, the transversus abdominis, is arranged transversely around the abdomen, similar to the front of a belt on a pair of pants. This arrangement of three bands of muscles in different orientations allows various movements and rotations of the trunk. The three layers of muscle also help to protect the internal abdominal organs in an area where there is no bone.

The linea alba is a white, fibrous band that is made of the bilateral rectus sheaths that join at the anterior midline of the body. These enclose the rectus abdominis muscles (a pair of long, linear muscles, commonly called the “sit-up” muscles) that originate at the pubic crest and symphysis, and extend the length of the body’s trunk. Each muscle is segmented by three transverse bands of collagen fibers called the tendinous intersections. This results in the look of “six-pack abs,” as each segment hypertrophies on individuals at the gym who do many sit-ups.

The posterior abdominal wall is formed by the lumbar vertebrae, parts of the ilia of the hip bones, psoas major and iliacus muscles, and quadratus lumborum muscle. This part of the core plays a key role in stabilizing the rest of the body and maintaining posture.

Career Connections: Physical Therapists

Those who have a muscle or joint injury will most likely be sent to a physical therapist (PT) after seeing their regular doctor. PTs have a master’s degree or doctorate, and are highly trained experts in the mechanics of body movements. Many PTs also specialize in sports injuries.

If you injured your shoulder while you were kayaking, the first thing a physical therapist would do during your first visit is to assess the functionality of the joint. The range of motion of a particular joint refers to the normal movements the joint performs. The PT will ask you to abduct and adduct, circumduct, and flex and extend the arm. The PT will note the shoulder’s degree of function, and based on the assessment of the injury, will create an appropriate physical therapy plan.

The first step in physical therapy will probably be applying a heat pack to the injured site, which acts much like a warm-up to draw blood to the area, to enhance healing. You will be instructed to do a series of exercises to continue the therapy at home, followed by icing, to decrease inflammation and swelling, which will continue for several weeks. When physical therapy is complete, the PT will do an exit exam and send a detailed report on the improved range of motion and return of normal limb function to your doctor. Gradually, as the injury heals, the shoulder will begin to function correctly. A PT works closely with patients to help them get back to their normal level of physical activity.

Muscles of the Thorax

The muscles of the chest serve to facilitate breathing by changing the size of the thoracic cavity (Table 2). When you inhale, your chest rises because the cavity expands. Alternately, when you exhale, your chest falls because the thoracic cavity decreases in size.
Table 2. Muscles of the Thorax

<table>
<thead>
<tr>
<th>Movement</th>
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<th>Origin</th>
<th>Insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation; exhalation</td>
<td>Thoracic cavity</td>
<td>Compression; expansion</td>
<td>Diaphragm</td>
<td>Sternum; ribs 6–12; lumbar vertebrae</td>
<td>Central tendon</td>
</tr>
<tr>
<td>Inhalation; exhalation</td>
<td>Ribs</td>
<td>Elevation (expands thoracic cavity)</td>
<td>External intercostals</td>
<td>Rib superior to each intercostal muscle</td>
<td>Rib inferior to each muscle</td>
</tr>
<tr>
<td>Forced exhalation</td>
<td>Ribs</td>
<td>Movement along superior/inferior axis to bring ribs closer together</td>
<td>Internal intercostals</td>
<td>Rib inferior to each intercostal muscle</td>
<td>Rib superior to each intercostal muscle</td>
</tr>
</tbody>
</table>

The Diaphragm

The change in volume of the thoracic cavity during breathing is due to the alternate contraction and relaxation of the diaphragm (Figure 3). It separates the thoracic and abdominal cavities, and is dome-shaped at rest. The superior surface of the diaphragm is convex, creating the elevated floor of the thoracic cavity. The inferior surface is concave, creating the curved roof of the abdominal cavity.

Defecating, urination, and even childbirth involve cooperation between the diaphragm and abdominal muscles (this cooperation is referred to as the “Valsalva maneuver”). You hold your breath by a steady contraction of the diaphragm; this stabilizes the volume and pressure of the peritoneal cavity. When the abdominal muscles contract, the pressure cannot push the diaphragm up, so it increases pressure on the intestinal tract (defecation), urinary tract (urination), or reproductive tract (childbirth).

The inferior surface of the pericardial sac and the inferior surfaces of the pleural membranes (parietal pleura) fuse onto the central tendon of the diaphragm. To the sides of the tendon are the skeletal muscle portions of the diaphragm, which...
insert into the tendon while having a number of origins including the xiphoid process of the sternum anteriorly, the inferior six ribs and their cartilages laterally, and the lumbar vertebrae and 12th ribs posteriorly.

The diaphragm also includes three openings for the passage of structures between the thorax and the abdomen. The inferior vena cava passes through the caval opening, and the esophagus and attached nerves pass through the esophageal hiatus. The aorta, thoracic duct, and azygous vein pass through the aortic hiatus of the posterior diaphragm.

The Intercostal Muscles

There are three sets of muscles, called intercostal muscles, which span each of the intercostal spaces. The principal role of the intercostal muscles is to assist in breathing by changing the dimensions of the rib cage (Figure 4).

Figure 4. Intercostal Muscles. The external intercostals are located laterally on the sides of the body. The internal intercostals are located medially near the sternum. The innermost intercostals are located deep to both the internal and external intercostals.

The 11 pairs of superficial external intercostal muscles aid in inspiration of air during breathing because when they contract, they raise the rib cage, which expands it. The 11 pairs of internal intercostal muscles, just under the externals, are used for expiration because they draw the ribs together to constrict the rib cage. The innermost intercostal muscles are the deepest, and they act as synergists for the action of the internal intercostals.

Muscles of the Pelvic Floor and Perineum

Figure 5. Muscles of the Pelvic Floor. The pelvic floor muscles support the pelvic organs, resist intra-abdominal pressure, and work as sphincters for the urethra,
rectum, and vagina.

The pelvic floor is a muscular sheet that defines the inferior portion of the pelvic cavity. The pelvic diaphragm, spanning anteriorly to posteriorly from the pubis to the coccyx, comprises the levator ani and the ischiococcygeus. Its openings include the anal canal and urethra, and the vagina in women.

The large levator ani consists of two skeletal muscles, the pubococcygeus and the iliococcygeus (Figure 5). The levator ani is considered the most important muscle of the pelvic floor because it supports the pelvic viscera. It resists the pressure produced by contraction of the abdominal muscles so that the pressure is applied to the colon to aid in defecation and to the uterus to aid in childbirth (assisted by the ischiococcygeus, which pulls the coccyx anteriorly). This muscle also creates skeletal muscle sphincters at the urethra and anus.

The perineum is the diamond-shaped space between the pubic symphysis (anteriorly), the coccyx (posteriorly), and the ischial tuberosities (laterally), lying just inferior to the pelvic diaphragm (levator ani and coccygeus). Divided transversely into triangles, the anterior is the urogenital triangle, which includes the external genitals. The posterior is the anal triangle, which contains the anus (Figure 6). The perineum is also divided into superficial and deep layers with some of the muscles common to men and women (Table 3). Women also have the compressor urethrae and the sphincter urethrovaginalis, which function to close the vagina. In men, there is the deep transverse perineal muscle that plays a role in ejaculation.

![Figure 6. Muscles of the Perineum. The perineum muscles play roles in urination in both sexes, ejaculation in men, and vaginal contraction in women.](https://bio.libretexts.org/Courses/Lumen_Learning/Book%3A_Anatomy_and_Physiology_I_(Lumen)/14%3A_Module_12_-_The…buttocks))

Table 3. Muscles of the Perineum Common to Men and Women

<table>
<thead>
<tr>
<th>Movement</th>
<th>Target</th>
<th>Target motion</th>
<th>Prime mover</th>
<th>Origin</th>
<th>Insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defecation; urination; birth; coughing</td>
<td>Abdominal cavity</td>
<td>Superior (resists pressure during abdominal compression)</td>
<td>Levator and pubococcygeus; elevator ani iliococcygeus</td>
<td>Pubis; ischium</td>
<td>Urethra; anal canal; perineal body; coccyx</td>
</tr>
</tbody>
</table>

**Superficial muscles**

| None—supports perineal body | Perineal body | None | Superficial transverse | Ischium | Perineal body |

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<tr>
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<th>Prime mover</th>
<th>Origin</th>
<th>Insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>maintaining anus at center of perineum</td>
<td></td>
<td></td>
<td>perineal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involuntary response that compresses urethra when excreting urine in both sexes or while ejaculating in males</td>
<td>Urethra</td>
<td>Compression</td>
<td>Bulbospongious</td>
<td>Perineal body</td>
<td>Perineal membrane; corpus spongiosum of penis; deep fascia of penis; clitoris in female</td>
</tr>
<tr>
<td>Compresses veins to maintain erection of penis in males; erection of clitoris in females</td>
<td>Veins of penis and clitoris</td>
<td>Compression</td>
<td>Ischiocavernosus</td>
<td>Ischium; ischial rami; pubic rami</td>
<td>Pubic symphysis; corpus cavernosum of penis in male; clitoris of female</td>
</tr>
<tr>
<td>Deep muscles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voluntarily compresses urethra during urination</td>
<td>Urethra</td>
<td>Compression</td>
<td>External urethral sphincter</td>
<td>Ischial rami; pubic rami</td>
<td>Male: median raphe; female: vaginal wall</td>
</tr>
<tr>
<td>Closes anus</td>
<td>Anus</td>
<td>Sphincter</td>
<td>External anal sphincter</td>
<td>Anococcygeal ligament</td>
<td>Perineal body</td>
</tr>
</tbody>
</table>

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Videos: Muscles and Bones of the Thoracic Wall

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Bones of the Thoracic Wall

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Self-Check Questions

Take the quiz below to check your understanding of the Axial Muscles of the Abdominal Wall and Thorax:

http://oea.herokuapp.com/assessments/204

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