



# Applied anatomy of the thorax and abdomen

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## The thoracic spine

### The vertebra

The thoracic spine has a primary dorsal convexity (Fig. 1) associated with intrauterine life – a phylogenetic kyphosis – whereas the cervical and lumbar spine have a compensatory lordosis.

The 12 thoracic vertebrae are intermediate in size between those in the cervical and lumbar regions. They are composed of a vertebral body – a cylindrical ventral mass of bone – continuing posteriorly into a vertebral arch (Fig. 2). The typical thoracic vertebral body is heart-shaped in cross-section and has on each of its lateral aspects a superior and inferior costal facet for articulations with the ribs (costovertebral joints). The arch is constructed out of two pedicles and two short laminae, the latter uniting posteriorly to form the spinous process. Laminae and spinous processes lie obliquely covering each other like the tiles of a roof, so protecting the posterior cord posteriorly. The pedicles carry the articular and transverse processes.

The posterior aspect of the vertebral body and the arch enclose the vertebral foramen. The spinal cord at the thoracic level is rounder and smaller than at the cervical level, and in consequence the vertebral foramina are also smaller.

Where the pedicles and laminae unite the transverse process is found, slightly posterior to the articular process, pedicle and intervertebral foramen. There is also an oval facet for the ribs on all the transverse processes, except for T11 and T12, to which ribs are not attached.

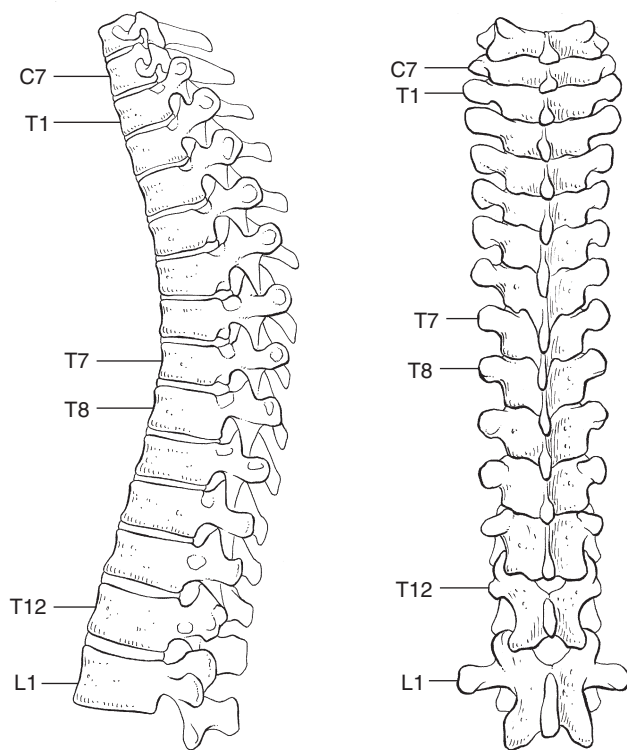
The spinous processes at mid-thorax are long and very steeply inclined: each transverse process is at a level one and a half vertebrae higher than the tip of the corresponding spinous process. In the upper and lower thorax, the spinous processes are less inclined; here, the corresponding transverse process is located approximately one level higher.

The oval intervertebral foramina are located behind the vertebral bodies and between the pedicles of the adjacent vertebrae and contain the segmental nerve roots. In the thoracic spine, these are situated mainly behind the inferoposterior aspect of the upper vertebral body and not just behind the disc. This makes a nerve root compression by a posterolateral displacement less likely at the thoracic level, whereas at the lumbar level nerve root compressions by posterolateral disc protrusions are quite common (Fig. 3, see [Standring, Fig. 42.27](#)).

The location of the intervertebral foramen depends on the level. In the upper and lower thoracic area, it is level with the tip of the spinous process of the vertebra above, i.e. level above. At mid-thorax there is a difference of about 1½ levels.

### The intervertebral disc

A fibrocartilaginous disc forms the articulation between two vertebral bodies. The anatomy and behaviour of discs are discussed in Chapter 31, Applied anatomy of the lumbar spine. However, it is worth noting here that thoracic discs are narrower and flatter than those in the cervical and lumbar spine. Disc size gradually increases from superior to inferior. The



**Fig 1** • Lateral (left) and posterior (right) views of the thoracic spine.

nucleus is rather small in the thorax. Therefore protrusions are usually of the annular type, and a nuclear protrusion is very rare in the thoracic spine.

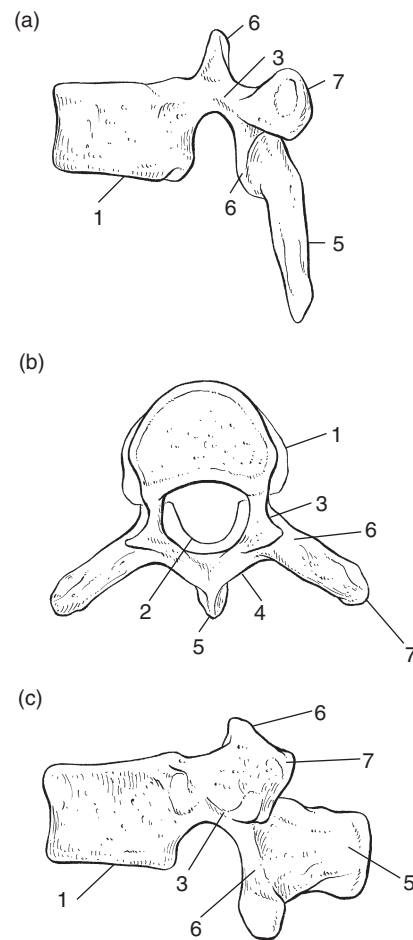
## The ligaments

The longitudinal ligaments run anteriorly and posteriorly on the vertebral bodies (Fig. 4, see *Standring*, Fig. 54.10). The anterior ligament covers the whole of the vertebral bodies' anterior aspect and some of their lateral aspect. It is firmly connected to the periosteum but only loosely to the discs. The posterior longitudinal ligament is strongly developed at the thoracic level and is wider than in the lumbar region, although it covers only a part of the posterior aspect of each vertebral body. It has some lateral expansions, which are firmly attached to the discs.

The ligamentum flavum, interposed between the laminae, extends laterally as far as the medial part of the inferior articular process. At each level the ligamentum flavum has lateral extensions to both sides to form the capsules of the facet joints (see *Standring*, Fig. 42.42). The transverse processes are connected to each other by the intertransverse ligaments. The supra- and interspinal ligaments bridge the gap between the spinous processes.

## Facet joints

Each facet joint is composed of a superior and an inferior articular process, covered by hyaline cartilage and connected

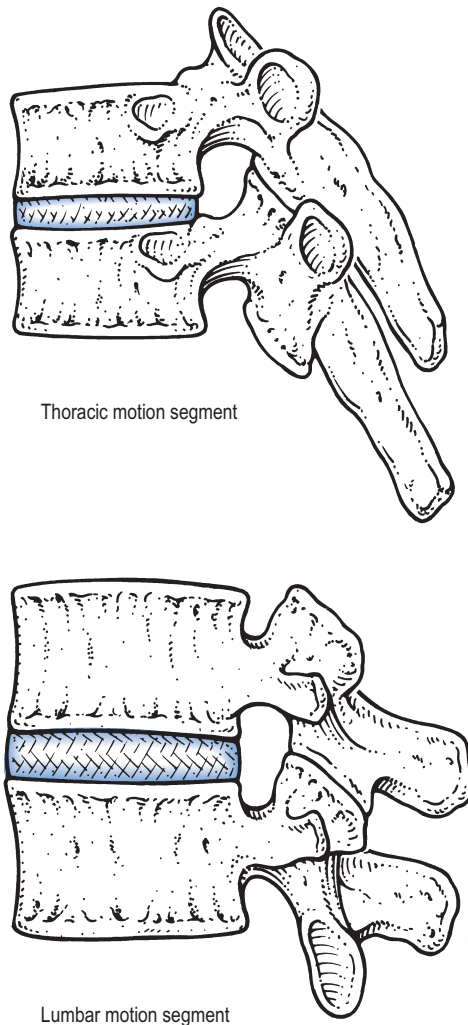


**Fig 2** • Lateral and cranial views of the sixth thoracic vertebra (a, b) and lateral view of the twelfth thoracic vertebra (c). 1, vertebral body; 2, vertebral arch; 3, pedicle; 4, lamina; 5, spinous process; 6, articular processes; 7, transverse process.

to each other by a joint capsule which possesses a true synovium. The articular surface of the superior articular process points backwards, slightly upwards and outwards. The facet of the inferior articular process faces forwards, slightly downwards and inwards. These articulations lock the vertebrae together while allowing movements of flexion–extension, bilateral side flexion and rotation.

## Content of the spinal canal

The spinal canal is formed by the vertebral foraminae of the successive vertebrae, the posterior aspects of the discs, the posterior longitudinal ligament, the ligamenta flava and the anterior capsules of the facet joints. In contrast to the cervical and lumbar regions, where the canal is triangular in cross-section and offers a large lateral extension to the nerve roots, the thoracic spinal canal is small and circular. It can be divided into three zones: the upper (T1–T3), and lower (T10–T12) zones are transitional, respectively, the cervical and the thoracic spine, and the thoracic and the lumbar spine. Between these is the mid-thoracic zone (T4–T9), where the spinal canal is at its narrowest (Fig. 5).



**Fig 3** • Thoracic discs are smaller and flatter than lumbar discs. The intervertebral foramen is located behind the vertebral body instead of behind the disc.

The spinal canal contains the dural tube, within which are the spinal cord, the spinal nerves and the epidural tissue (see [Standring, Fig. 43.3](#)).

### Dura mater

The dura mater, a blind-ended membrane arising from the occiput and ending at S2 level, has similar characteristics at all levels. It is free within the spinal canal, where it is only loosely attached to the adjacent posterior longitudinal ligament allowing the dura to move and to deform on all spinal movements.

The anterior part of the dura is largely innervated by a mesh of nerve fibres belonging to different and consecutive sinuvertebral nerves. This may be the anatomical explanation for the broad and large pain reference commonly found in dural irritation at the thoracic level.

### Spinal cord

The dura mater contains the spinal cord, which ends approximately at the L1 level. The spinal cord occupies the space of the spinal canal maximally at the thoracic level. This, together with its poor vascularization renders the thoracic spine very vulnerable to damage by extradural processes and vertebral trauma.

The cord depends for its blood supply on these arterial circles. The inner circle is of three longitudinal arterial channels, which run from the medulla oblongata to the conus medullaris. Their perforating arteries to the spinal cord are larger and more numerous at the cervical and lumbar level than at the thoracic level. Moreover, the inner arterial circle is characterized in the thoracic spine by a lack of anastomoses.

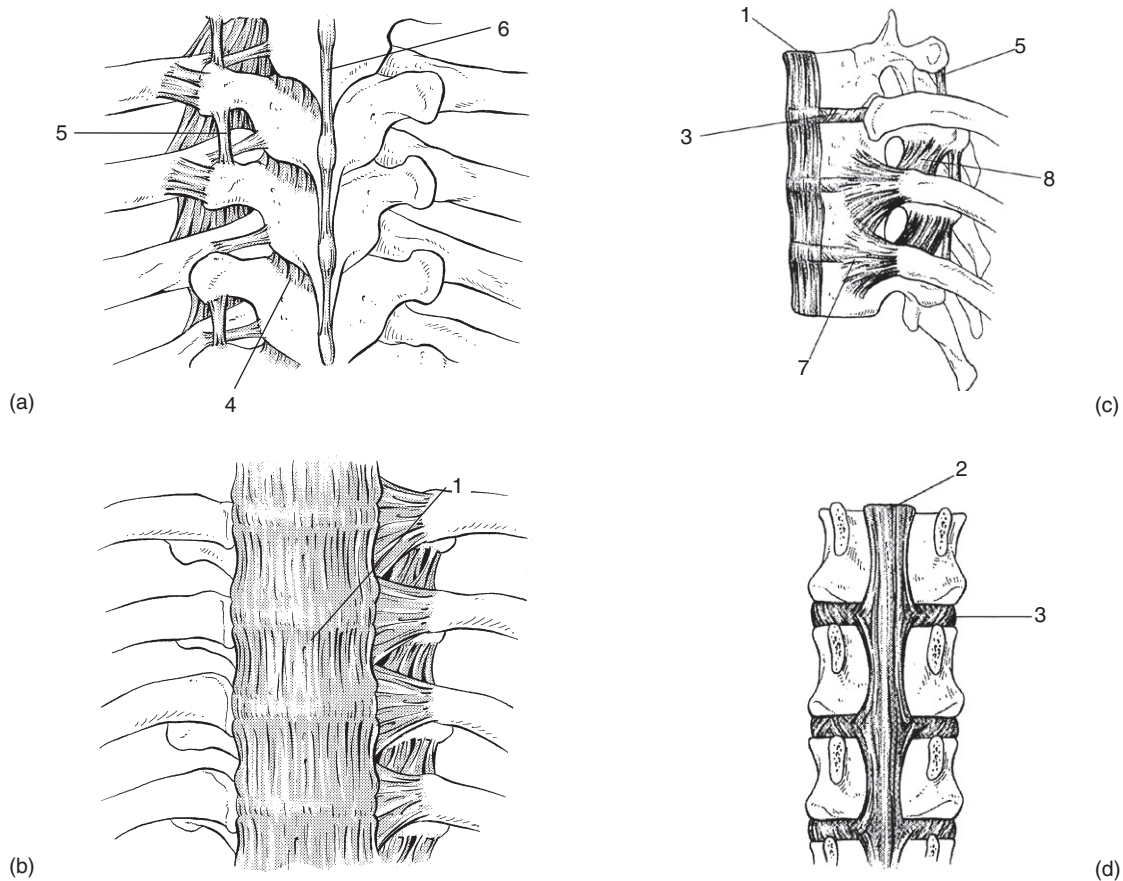
One of the two outer arterial circles is located in the extradural space, the other in the extravertebral tissues. These give rise to the 'medullary feeders', which arise at the cervical spine mainly from the vertebral arteries and in the thoracic and lumbar spine from the intercostal and lumbar arteries, which are segmental branches of the aorta. It is at mid and lower thorax that the spinal cord has the least profuse blood supply: the so-called critical vascular zone. When surgery is contemplated here, strict care must be taken not to impede blood flow.

### Nerve roots and innervation

As at the cervical and lumbar levels, the thoracic spinal nerves emerge from the cord as a ventral and a posterior ramus, which join together to form the short spinal nerve root. The lateral part of the spinal canal that envelops the nerve root is the radicular canal. It is formed anteriorly by the posteroinferior aspect of the upper vertebra and a small part of the intervertebral disc, both covered by the posterior longitudinal ligament. The posterior boundary is formed by the lamina and the superior articular facet. The intraspinal course of the upper thoracic nerve roots is almost horizontal, as in the cervical spine. Therefore, a nerve root can only become compressed by its corresponding disc. However, the more caudal it is in the spine, the more oblique is the nerve root's course. The T12 nerve root within the spinal canal is at the height of the eleventh vertebral body, and therefore courses downwards, outwards and slightly anteriorly behind the T11 disc and the T12 vertebral body, to leave the foramen at the inferior margin of body T12. As a consequence, the lowest thoracic nerve roots can be compressed by disc lesions of two consecutive levels (T12 root by T11 or T12 disc).

The nerve leaves the spinal canal through the intervertebral foramen just behind the inferior vertebral margin and the costovertebral joints. Because the intervertebral foramina are quite large at these levels, osseous interference with the nerve roots is seldom encountered in the thoracic spine.

Beyond the intervertebral foramen, the nerve root divides into a large ventral and a smaller dorsal branch ([Fig. 6](#)). The latter gives rise to a medial and a lateral branch, which innervate mainly the skin of the posterior thorax and upper lumbar region; they also give branches to the erector spinae muscles. The ventral rami do not form plexuses at the thoracic level but retain their segmental distribution as intercostal nerves, having



**Fig 4 •** Ligaments of the thoracic spine: posterior (a), anterior (b), lateral (c) and posterior with vertebral arch removed (d). 1, anterior longitudinal ligament; 2, posterior longitudinal ligament; 3, intervertebral disc; 4, ligamentum flavum; 5, intertransverse ligament; 6, supra- and interspinal ligament; 7, radiate ligament; 8, costotransverse ligament.

their course in the costal sulcus of the corresponding rib in which they lie dorsocaudal to the blood vessels. They innervate the costotransverse joints, the chest wall, the parietal pleura, the skin of the thorax and the intercostal muscles (see *Standing, Fig. 54.16*). As at the lumbar and cervical levels, innervation of the spinal canal is by the sinuvertebral nerve, which arises from the nerve root and re-enters the epidural space. It gives branches to the nervous network of the anterior and posterior longitudinal ligaments. Branches to the dura mater cross the midline and innervate several consecutive levels to about four segments cranial and caudal to their points of entrance. This explains why pressure to the dura mater may give rise to pain felt multisegmentally and even bilaterally (see p. 426).

## The thoracic cage

The thorax is a complex system of bony, cartilaginous, ligamentous, muscular and tendinous structures. Superficial to the thoracic wall are bony and musculotendinous structures, connecting the upper limb to the trunk. These structures belong to the shoulder girdle and are discussed in the online chapter, *Applied anatomy of the shoulder girdle*.

The cranial border of the cage is the superior thoracic aperture. It is bounded by the first thoracic vertebra, the first ribs,

the clavicles and the upper edge of the manubrium. The aperture does not lie in a horizontal plane but is inclined ventrally downwards. Inferiorly, the thorax is separated from the abdomen by the diaphragm.

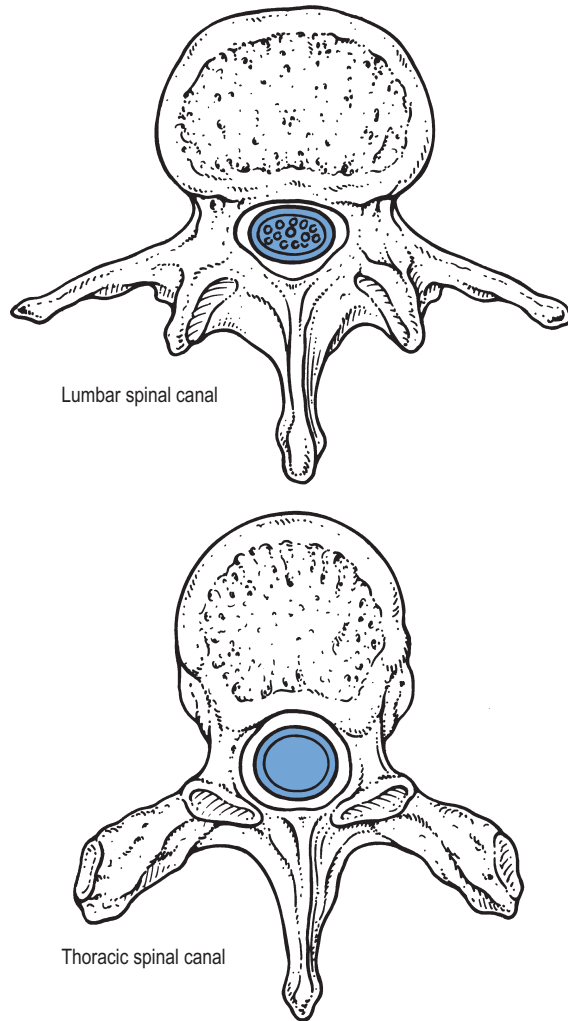
## Bony structures

Twelve pairs of ribs, together with the sternum, the clavicle and the thoracic spine, form the bony part of the thoracic cage (*Fig. 7*). Because the thoracic spine is kyphotic, with the apex of the kyphosis at T7, the thoracic cage is widest in sagittal diameter at this level.

The sternum (*Fig. 8*) is composed of an upper part (manubrium), a mid-portion (body) and a caudal part (xiphoid). Because of the overall slightly oblique alignment of the sternum the caudal end projects further anteriorly.

The upper part of the manubrium has a depression, the jugular incisura, lying between the sternal heads of both sternocleidomastoid muscles. Its superolateral sides are the sternal joint surfaces of the sternoclavicular joints.

A synchondrosis joins manubrium and body. It protrudes slightly anteriorly and is known as the sternal angle of Louis – an important landmark because the second rib is attached to the sternum at this level. At the caudal end, another

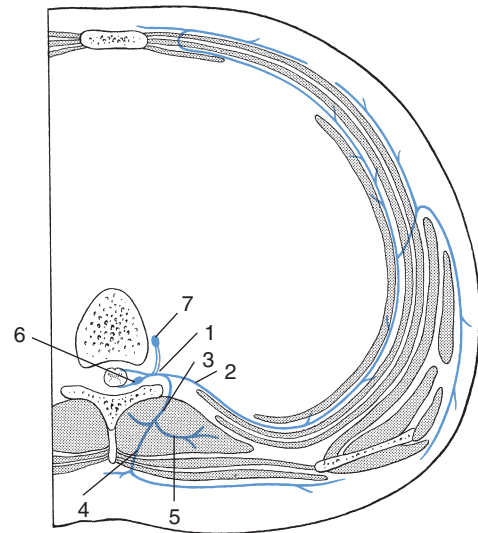


**Fig 5** • The small and round thoracic spinal canal is largely occupied by spinal cord and dura.

synchondrosis connects the xiphoid process to the sternum; it is reinforced by the costoxiphoid ligaments.

The thoracic cage contains twelve pairs of ribs. Each rib consists of a head, a neck and a body (Fig. 9). The head consists of the slightly enlarged posterior end, normally carrying two hemifacets for the costovertebral joints. The first, eleventh and twelfth ribs have only one full facet here. The body is separated from the head by a thinner part: the neck. At the junction with the corpus of the rib a tubercle is present, on which another joint surface lies (Fig. 10). This is part of the costotransverse joint lying between the rib and transverse process (Fig. 11). The two lowest ribs have no articular facet on their tubercle. The costovertebral and the costotransverse joints are true synovial joints. The anterior portion of the capsule of the costovertebral joint is locally reinforced by the radiate ligament, which courses between both adjacent vertebrae and the rib. The capsules of the costotransverse joints are locally reinforced by the costotransverse ligaments.

A few centimetres beyond the vertebral column, where the curve of the rib is most pronounced, is the costal angle (see Fig. 9).



**Fig 6** • Spinal and intercostal nerve supply: 1, nerve root; 2, ventral ramus and intercostal nerve; 3, dorsal ramus; 4, medial branch; 5, lateral branch; 6, spinal ganglion; 7, sympathetic ganglion.

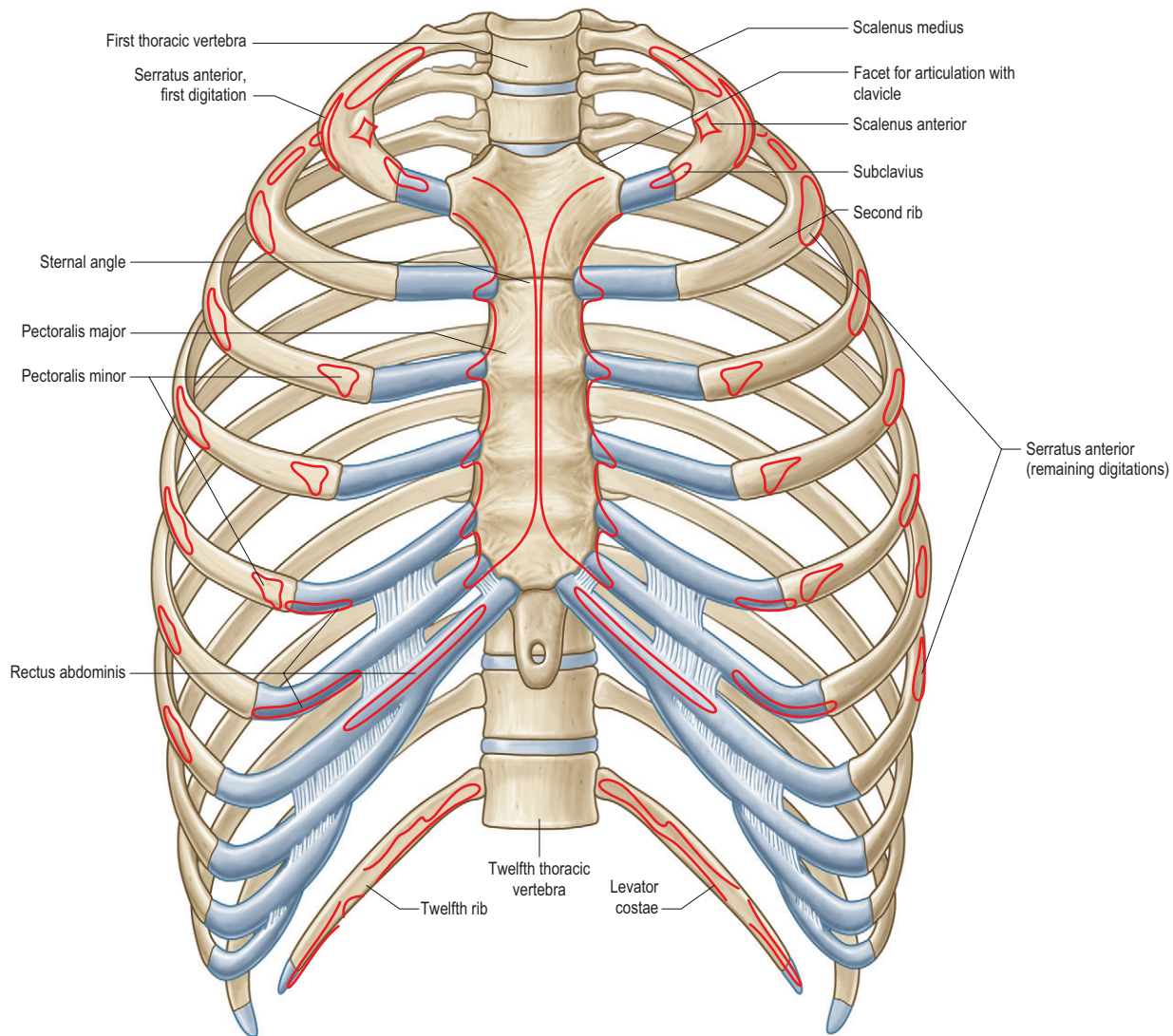
Except for the first and second ribs, all ribs have a groove for the intercostal nerve and blood vessels at their lower margin, which is at the outer aspect confined by a sharp bony edge.

All ribs are different from each other in size, width and curvature. The first rib is the shortest. Its anteromedial part lies beneath the medial end of the clavicle. It has two sulci, separated from each other by a tubercle to which the scalenus anterior muscle inserts. Important neurovascular structures are situated medial and lateral to this tubercle. The second rib is much longer. The medial end of the cartilage lies at the same level as the manubriosternal synchondrosis. Since the first rib can hardly be palpated, the second rib is usually the first bony structure caudal to the clavicle which can be easily defined, even in circumstances where the sternal angle is not pronounced. Therefore, it is an important landmark. The rib length increases further caudally, until the seventh rib, after which they become progressively shorter.

The attachment of the ribs to the sternum is variable. The upper five, six or seven ribs have their own cartilaginous connection. The length of this varies from about 2 cm for the first rib to about 10 cm for the seventh rib. The cartilage of the eighth rib ends by blending with the seventh. The same situation pertains for the ninth and the tenth ribs, so giving rise to a common band of cartilage and connective tissue. The eleventh and twelfth ribs remain unattached anteriorly but end with a small piece of cartilage (see Standring, Fig. 54.13).

## Contractile structures

The muscular and tendinous elements of the thoracic cage are the intercostals and the diaphragm. Superficial to the thoracic cage are the erector spinae muscles, levator scapulae, trapezius, rhomboid, pectoralis minor, subclavius and serratus anterior



**Fig 7 •** The thoracic cage. From Standring, *Gray's Anatomy*, 40th edn. Churchill Livingstone/Elsevier, Philadelphia, 2009 with permission.

muscles. The other associated structures, such as the pectoralis major and latissimus dorsi, are discussed in Chapter 14.

### The intercostal muscles

The intercostal muscles connect the ribs to each other and are the primary respiratory muscles. Three different structures can be distinguished: the external and internal intercostals and the intimi (see Standring, Fig. 54.16).

The external intercostal muscles take origin from the lower margin of the upper rib, just superficial to the costal sulcus. Their direction is from cranioposterior to caudoanterior; insertion is into the superficial aspect of the upper margin of the lower rib. Their posterior edges are level with the neck of the rib (Fig. 12). The anterior margins are at the junction of the rib and its cartilage; thus, in the most medial part of the intercostal space, an external intercostal is not present. Due to the oblique course of the fibres and the fact that leverage is greatest on the lower of the two ribs, on contraction the muscle

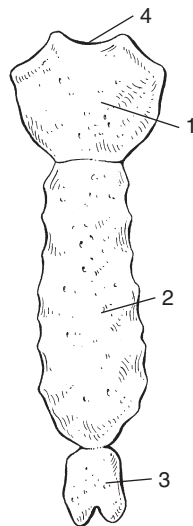
pulls the lower rib towards the upper rib, which results in inspiration.

The internal intercostals originate from the internal aspect of the upper margin of the lower rib and insert on the inner aspect of the sulcus of the upper rib. The course of their fibres is from caudoposterior to cranioanterior. Their anterior margins are at the edge of the sternum, the posterior margin at the costal angle. They pull the upper rib downwards in forced expiration.

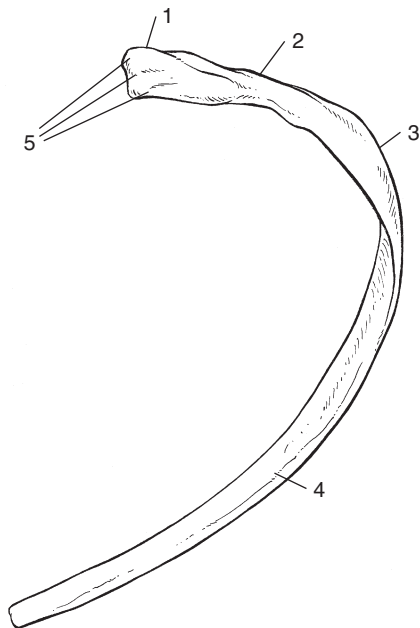
Between the internal and external intercostals lie the intimi. These take origin on the upper aspect of the lower rib and insert just medially to the origin of the external intercostal muscles. Their direction and function are the same as for the internal intercostal muscles.

### The diaphragm (C3–C4)

The diaphragm is a dome-shaped musculotendinous structure which separates the thorax from the abdomen (Fig. 13, see



**Fig 8** • The sternum: 1, manubrium; 2, body of sternum; 3, xiphoid; 4, jugular incisura.



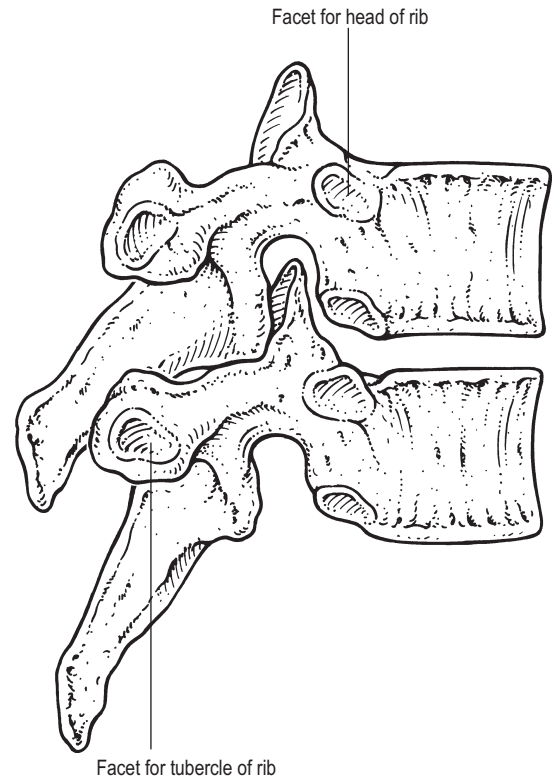
**Fig 9** • Rib structure: 1, costal head; 2, costal neck; 3, costal angle; 4, costal body; 5, facet surfaces.

*Standing, Fig. 54.14*). It is pierced by structures passing from thorax to the abdomen and vice versa.

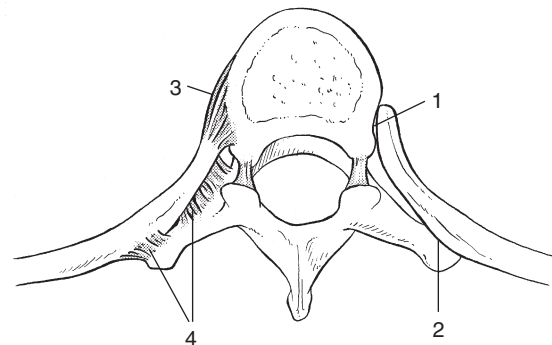
Its short origin is from the inner aspect of the caudal bony thoracic aperture and can be divided into three different parts, all of which insert into a central tendinous structure that forms the roof of the dome.

The sternal part is attached to the posterior aspect of the xiphoid process and inserts anteriorly at the middle of the central tendon.

The costal part originates from the internal aspect of the six lowermost ribs and their cartilages. It inserts into the lateral part of the central tendon.



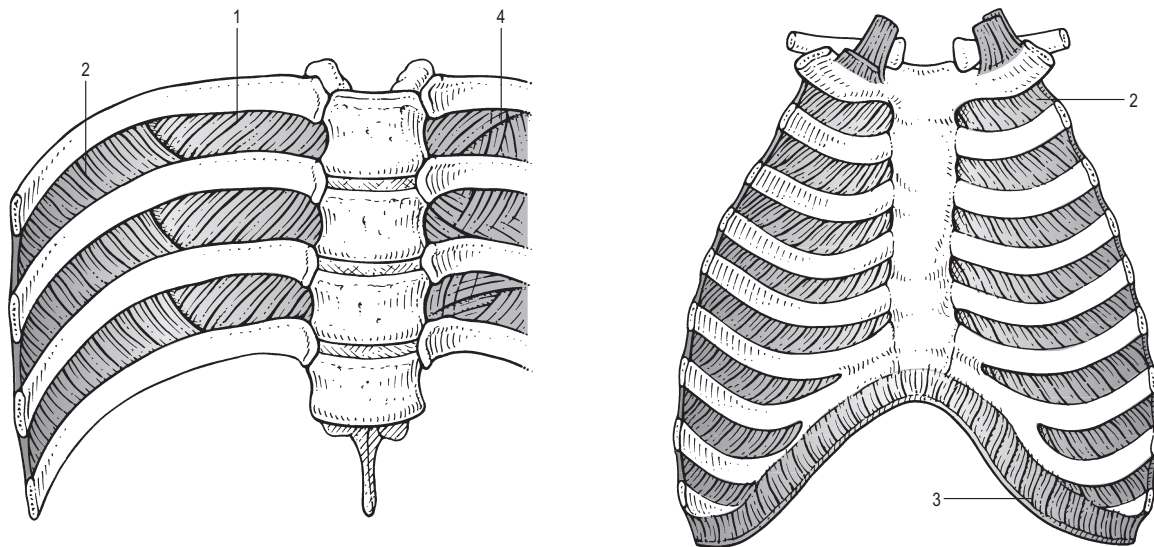
**Fig 10** • Articular facets for the rib joints on the vertebral body and transverse process.



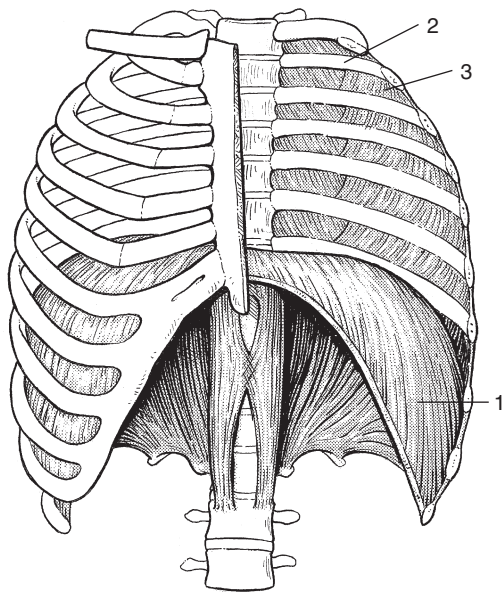
**Fig 11** • The rib joints. 1, costovertebral joint; 2, costotransverse joint; 3, radiate ligament; 4, costotransverse ligaments.

The origin of the lumbar part is slightly different on the two sides of the midline. To the left, the origin is from the anterior part of the three upper lumbar vertebral bodies; to the right, from the four upper lumbar vertebrae. These tendinous structures create an arch for the aorta and thoracic duct in front of the spine. Anterolaterally to the left, there is an opening in the muscular fibres for the oesophagus. The fibres of lumbar origin insert into the posterior aspect of the central tendon. To the right of the midline posteriorly is an aperture for the passage of the vena cava inferior.

Contraction of the diaphragm pulls the central tendon downwards, so producing diaphragmatic inspiration. The



**Fig 12 •** The intercostal muscles: 1, external intercostal muscles; 2, internal intercostal muscles; 3, diaphragm; 4, endothoracic fascia.



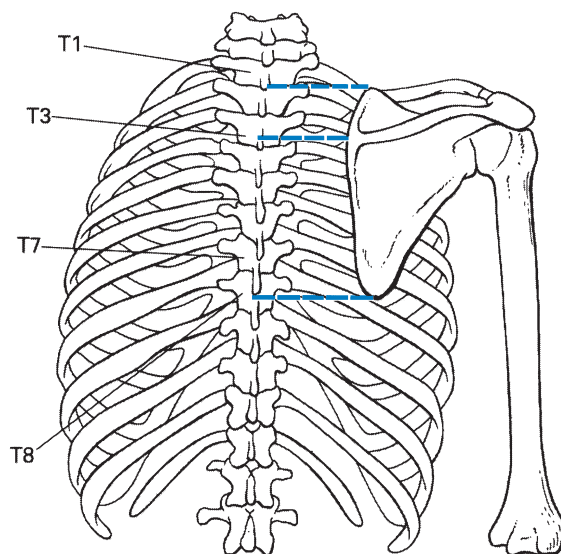
**Fig 13 •** 1, diaphragm; 2, external intercostal muscles; 3, internal intercostal muscles.

diaphragm also provides a flexible barrier between thorax and abdomen.

### Other clinically important muscles

The following clinically important muscular structures, although inserting on the thoracic cage, belong to the shoulder girdle. They are discussed thoroughly in the online chapter, *Applied anatomy of the shoulder girdle*:

- Trapezius
- Rhomboid minor and major
- Levator scapulae
- Serratus posterior inferior



**Fig 14 •** The shoulder in neutral position: landmarks.

- Subclavius
- Pectoralis minor
- Serratus anterior
- Pectoralis major
- Latissimus dorsi.

### Landmarks

With the shoulder in neutral position, the superior angle of the scapula is level with the first thoracic vertebra and the posterior end of the first rib (Fig. 14). The inferior angle corresponds to the interspinal level between T7 and T8, whereas the spine



of the scapula lies at the level of the T3 spinous process. The medial border of the scapula is approximately 5–6 cm from the midline.

## Movements of the thoracic spine and cage

The thoracic vertebral column constitutes the most rigid part of the spine, but nevertheless allows some movement in flexion–extension (in a sagittal plane), side flexion (in a frontal plane) and rotation (in a horizontal plane).

Flexion–extension movements take place mainly in the lower thoracic segments, whereas side flexion takes place at all thoracic levels but is slightly increased towards the caudal thoracic area. Rotation takes place mainly at the joints of the upper half of the thoracic spine.

Rotation is stopped by the posterior ligaments, essentially by the ligamentum flavum, together with the capsules of the facet joints. This gives rise to an elastic ligamentous end-feel on passive rotation. The degree of vertebral rotation is nevertheless limited by the close and multiple connections between the thoracic spine and the rest of the thoracic cage. Because many of the costal cartilages and ligaments lose part of their elasticity with ageing, the range of rotation is considerably decreased in elderly subjects.

On extension, the disc is compressed posteriorly and widens anteriorly, and the nucleus pulposus moves anteriorly. Extension is arrested by the spinous and articular processes, together with tension of the anterior longitudinal ligament as this is stretched. An elastic end-feel is the result. The posterior longitudinal ligament, the ligamentum flavum and the interspinous ligaments relax.

Flexion ends with tension in the interspinous ligament, the ligamentum flavum, the capsules of the facet joints and the posterior longitudinal ligament. Side flexion is limited by the impact of the ipsilateral articular processes and by the contralateral ligamentum flavum and intertransverse ligaments.

As in the cervical spine, there is a coupling characteristic to movement: on side flexion there is always some degree of axial rotation in such a way that the spinous processes move toward the concavity of the lateral curvature. Thus, on side flexion to the right, a rotation to the left occurs. This ‘side coupling’ is mainly confined to the upper thorax.

## The abdominal wall

The abdominal wall is mainly a musculotendinous structure with some posterior and inferior bony elements (thoracolumbar spine and pelvis – see Chapter 31 and online chapter *Applied anatomy of the sacroiliac joint*) (see Standring, Fig. 61.2). The rectus abdominis muscle, situated bilateral to the midline between the thoracic cage and the pubic symphysis, takes origin from the superficial aspect of the rib cartilage of the fifth, sixth and seventh ribs and inserts into the upper surface of the pubic symphysis and pubic bone (Fig. 15). It is anchored in a fibrous sheath both anteriorly and posteriorly (see below).

The muscle assists in anterior flexion of the trunk on the pelvis and vice versa.

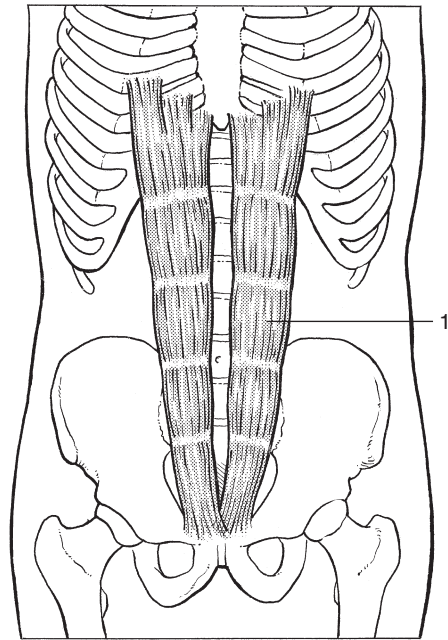


Fig 15 • Rectus abdominis, 1.

### External oblique

This is the most superficial muscle of the lateral abdominal wall and takes origin from the outer surface of the seven lowermost ribs.

Its uppermost attachments alternate with those of the serratus anterior and the lower ones with the costal origin of the latissimus dorsi. The fibres course in a caudomedial direction and insert into the external edge of the anterior two-thirds of the iliac crest, into the inguinal ligament and the lateral border of the rectus sheath (Fig. 16).

Contraction causes anterior flexion of the trunk on the pelvis, rotation of the trunk to the opposite side and ipsilateral side flexion.

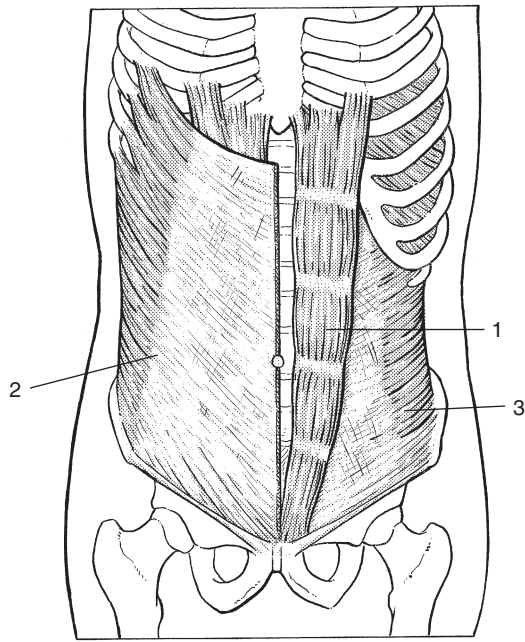
### Internal oblique

This lies deep to the external oblique and superficial to the transversus abdominis muscle (Fig. 17). It originates from the superior aspect of the anterior two-thirds of the iliac crest, from the ventral part of the lumbar fascia and from the lateral two-thirds of the inguinal ligament. The fibres have a cranio-medial course. They insert into the lower aspect of the three lower ribs and the rectus sheath.

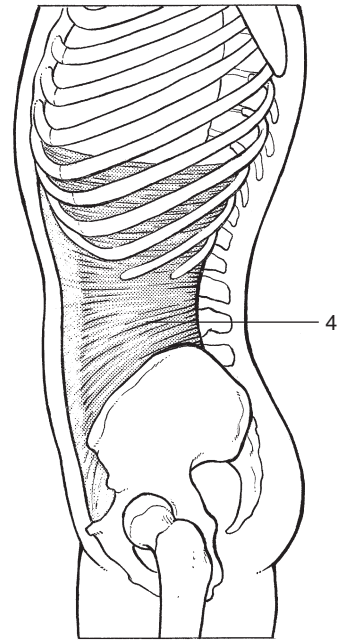
Contraction causes an anterior flexion and an ipsilateral rotation and side flexion of the trunk.

### Transversus abdominis

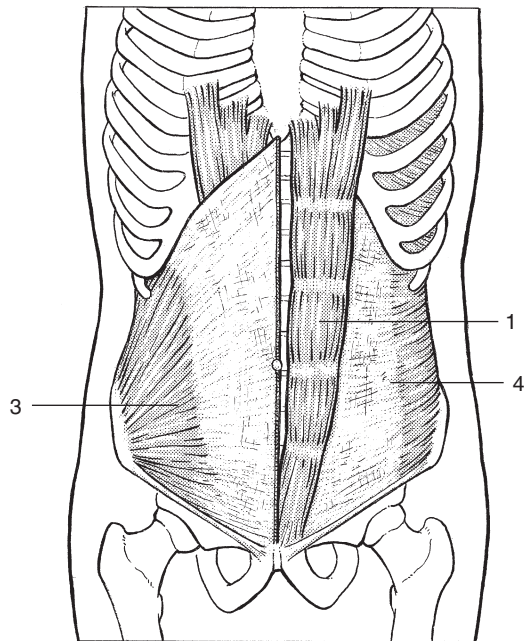
The origin is from the internal aspect of the six lowermost ribs, from the lumbar fascia, from the internal surface of the iliac crest and from the lateral third of the inguinal ligament. The direction of its fibres is horizontal (Fig. 18) and insertion is into the sheath of the rectus. It assists in contraction of the abdominal wall and may have some function in lumbar stabilization.



**Fig 16** • Rectus abdominis, 1; external oblique, 2; transversus abdominis, 3.



**Fig 18** • Transversus abdominis, 4.



**Fig 17** • Rectus abdominis, 1; internal oblique, 3; transversus abdominis, 4.

*The ilioinguinal region*

This is the lower ventral part of the abdominal wall. Here the internal and external oblique muscles, the transversus abdominis and the inguinal ligament merge to form the inguinal

canal. The last contains the spermatic cord in the male, the round ligament of the uterus in the female and the ilioinguinal nerve in both sexes (see *Standring, Fig. 61.13*). The canal extends downwards and medially, parallel and a little above the inguinal ligament. The boundaries are: in front, the aponeurosis of the external oblique and muscular fibres of the internal oblique in its lateral one-third; behind, the reflected inguinal ligament and the transversalis fascia; above, the arched fibres of the internal oblique and the transversus abdominis; below, the union of the transversalis fascia with the inguinal ligament.

Protrusion of peritoneum and/or intestine into the inguinal canal is known as a direct or indirect inguinal hernia (see p. e253 of the online chapter *Groin pain*).

*Rectus sheath*

The fascia of the rectus abdominis muscle is reinforced by the aponeuroses of the oblique abdominis muscles, which merge in the midline to form the dense fibrous linea alba. In the upper part, the anterior portion of the sheath is formed by the insertion of the external oblique and the internal oblique muscle, which splits, to form a deep and superficial layer. The posterior part is the deep layer of the internal oblique muscle and the insertion of the transversus abdominis. In the lower part, from about halfway between the umbilicus and symphysis, layers of the flat muscles pass anterior to the rectus; behind the rectus is only diaphragmatic fascia (see *Standring, Fig. 61.8*).


A summary of the muscles of the thorax and trunk is provided in *Table 1*.

**Table 1 Summary of the muscles of the thorax and trunk**

| Structure and muscle        | Function   | Peripheral innervation                          | Spinal innervation |
|-----------------------------|--|---|--------------------|
| <b>Thoracic cage</b>        |  |   |                    |
| External intercostal        | Inspiration  | Corresponding intercostal nerve                 |                    |
| Internal intercostal        | Expiration   | Corresponding intercostal nerve                 |                    |
| Intimi intercostal          | Expiration   | Corresponding intercostal nerve                 |                    |
| Diaphragm                   | Inspiration<br>Abdominal pressure  | Phrenic nerve                                   | C4 (C3–C5)         |
| <b>Scapulothoracic</b>      |  |   |                    |
| Trapezius                   | Elevates scapula<br>Adducts scapula  | Accessory nerve and branches of cervical plexus | C2–C4              |
| Rhomboid                    | Elevates scapula<br>Adducts scapula  | Dorsal scapular nerve                           | C5                 |
| Levator scapulae            | Elevates scapula   | Dorsal scapular nerve and cervical plexus       | C5                 |
| Serratus posterior inferior | Pulls lower ribs downwards and dorsally  | Intercostal nerves                              | T9–T12             |
| Subclavius                  | Depresses scapula  | Branch of superior trunk of brachial plexus     | C5                 |
| Serratus anterior           | Rotates scapula<br>Fixates scapula   | Long thoracic nerve                             | C5–C7              |
| Pectoralis minor            | Depresses scapula<br>Adducts scapula   | Medial pectoral nerve                           | C8–T1              |
| <b>Abdomen</b>              |  |   |                    |
| Rectus abdominis            | Abdominal pressure<br>Flexion of trunk   | Middle and caudal intercostal nerves            | T6–T11             |
| External oblique            | Contralateral rotation of trunk<br>Flexion of trunk<br>Ipsilateral side flexion of trunk | Intercostal nerves                              | T5–T12             |
| Internal oblique            | Ipsilateral rotation of trunk<br>Flexion of trunk<br>Ipsilateral side flexion of trunk   | Intercostal nerves                              | T10–T12            |
| Transversus abdominis       | Abdominal pressure   | Intercostal nerves                              | T7–T12             |

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