

ANATOMY

THORAX

THORAX

BONES OF THORAX

Bones of the Thorax

Ribs

Sternum

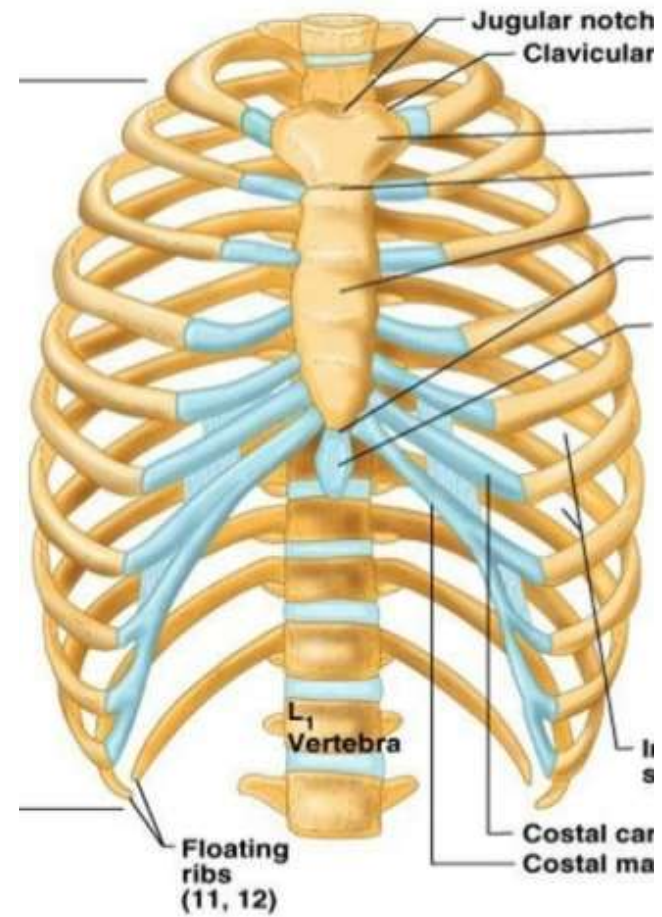
Thoracic Vertebrae

Bones of Thorax

Ribs

Sternum

Vertebrae



Thorax

RIBS

1 Rib Structure

1.1 Typical Ribs

1.2 Atypical Ribs

2 Articulations

2.1 Posterior

2.2 Anterior

3 Clinical Relevance: Rib Fractures

RIBS

Introduction

The ribs are a set of twelve bones which form the protective 'cage' of the **thorax**. They articulate with the vertebral column posteriorly, and terminate anteriorly as cartilage (known as costal cartilage).

- As part of the bony thorax, the ribs protect the internal thoracic organs. They also have a role in breathing – during **chest expansion** the ribcage moves to permit lung inflation.

RIBS

Rib Structure

- There are two classifications of ribs – Atypical and Typical. The typical ribs have a generalised structure, while the atypical ribs have variations on this structure.

Bones of Thorax

Typical and Atypical Ribs

Ribs

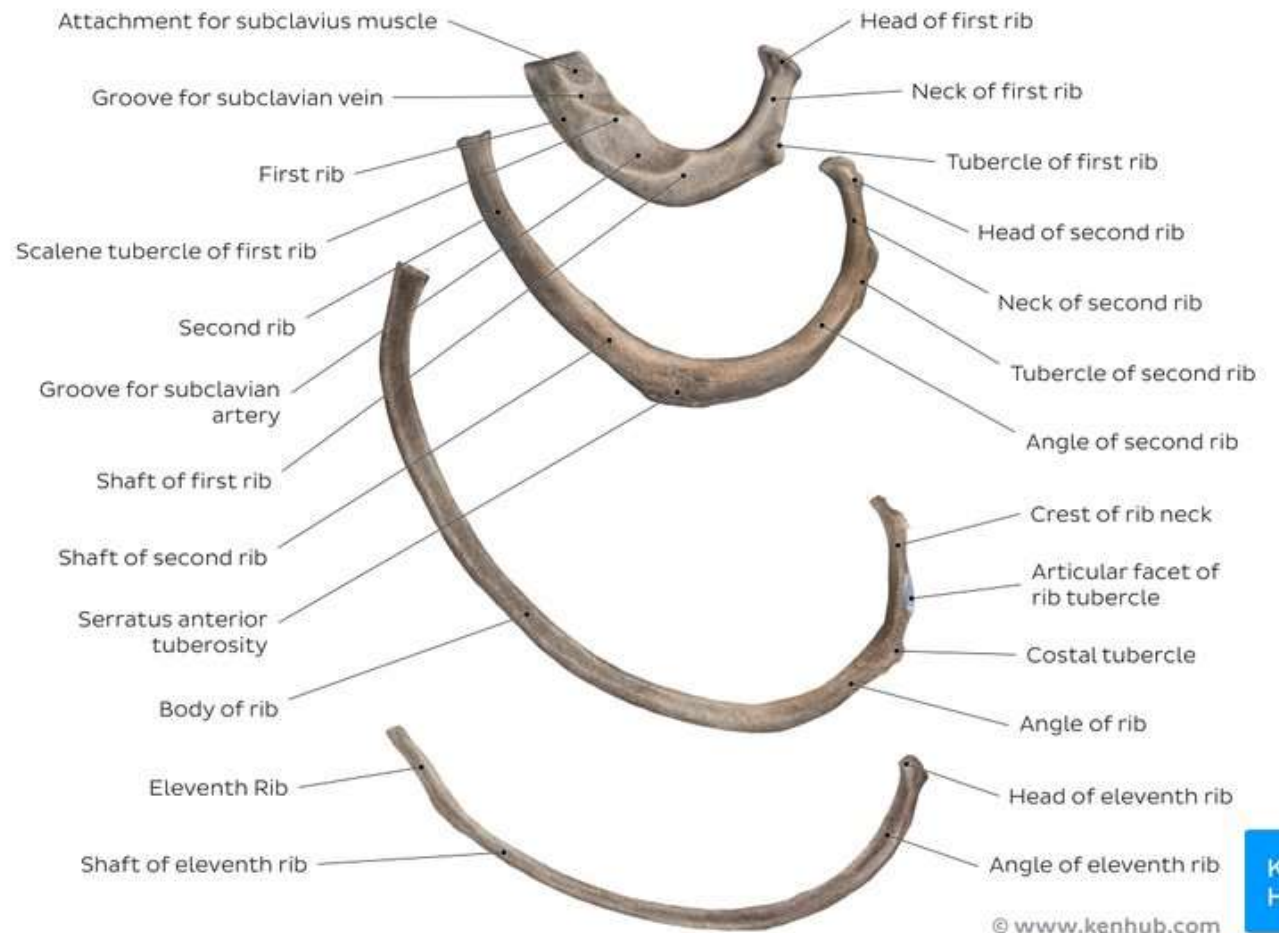
- **Typical Ribs 2-7**

- Head
- Neck
- Tubercle
- Angle
- Shaft
- Subcostal groove

- **Atypical Ribs 1, 8 -10**

- **Rib 1** - short, flat and supports Subclavian vessels
- **Ribs 1, 10-12** - articulate with only 1 vertebra
- **Ribs 11 and 12** – “floating ribs” – do not articulate with Transverse processes of Vertebrae or Sternum

Bones of Thorax





RIBS

Typical Ribs

The typical rib consists of a head, neck and body:

- The **head** is wedge shaped, and has two articular facets separated by a wedge of bone. One facet articulates with the numerically corresponding vertebrae, and the other articulates with the vertebrae above.
- The **neck** contains no bony prominences, but simply connects the head with the body. Where the neck meets the body there is a roughened tubercle, with a **facet for articulation with the transverse process** of the corresponding vertebrae.
- The body, or **shaft** of the rib is flat and curved. The internal surface of the shaft has a groove for the neurovascular supply of the thorax, protecting the vessels and nerves from damage.

Bones of Thorax

Typical Rib

Typical ribs

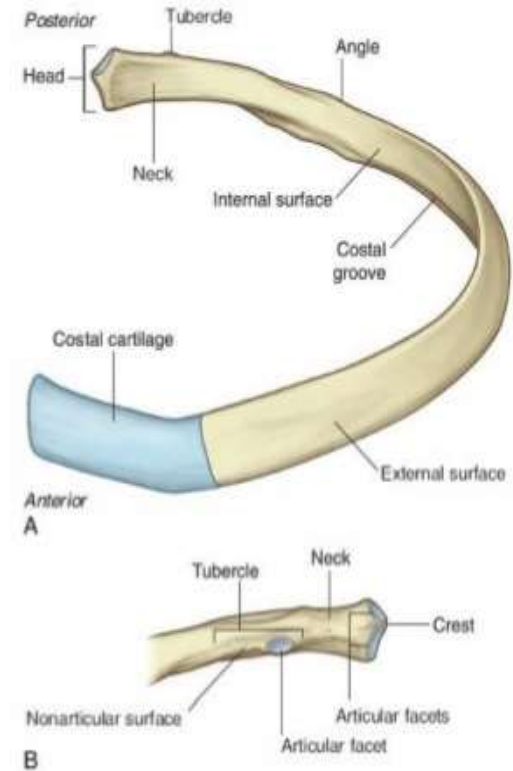
A. Head :

- presents two articular surfaces separated by a crest.
- Superior smaller facet
- Inferior larger facet

B. Neck

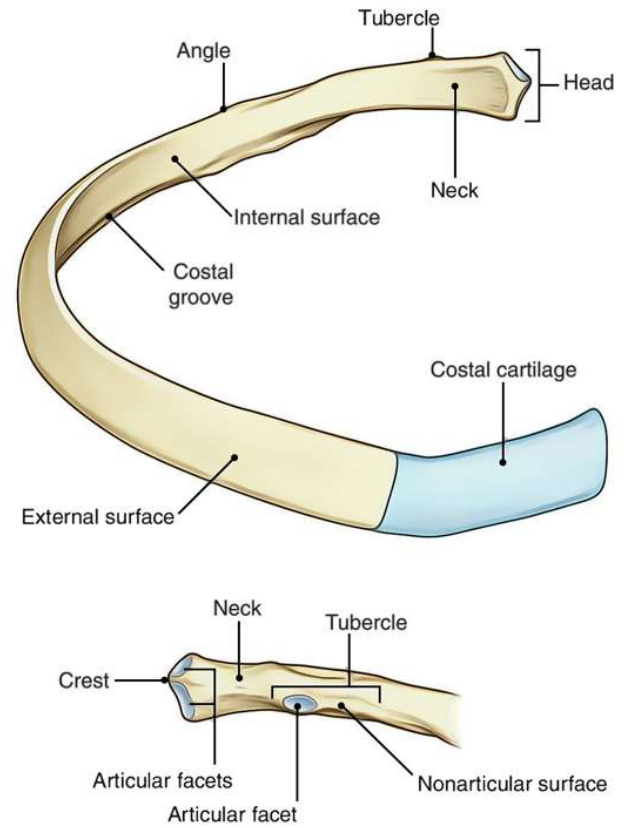
C. Tubercle

- consists of two regions , an articular part and a nonarticular part.
- The articular part is medial and has an oval facet for articulation with a corresponding facet on the transverse process of the associated vertebra.
- The raised nonarticular part is roughened by ligament attachments.



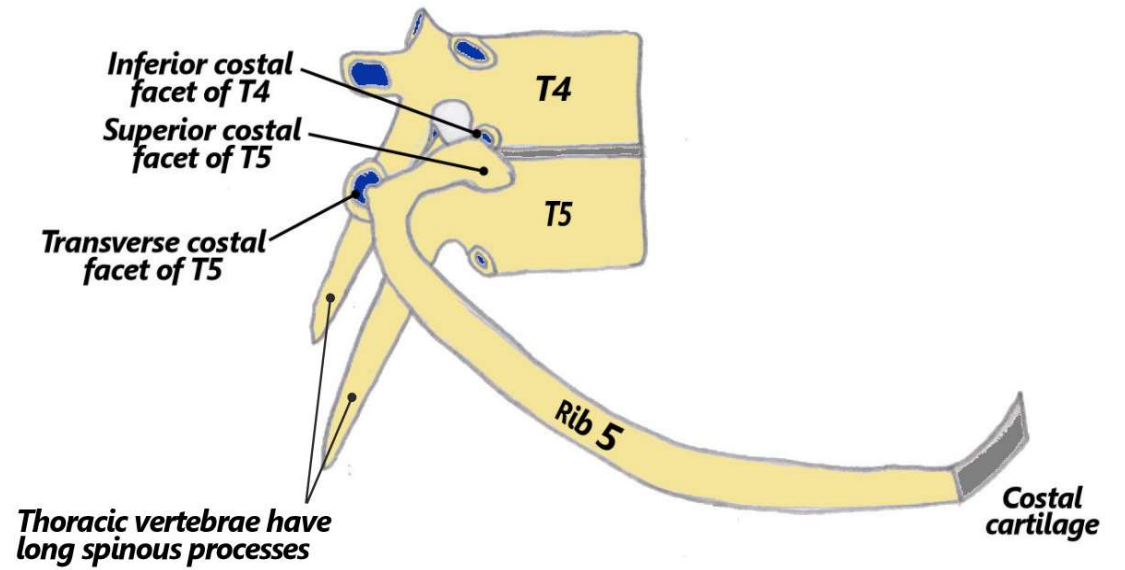
Bones of Thorax

Typical Rib



Bones of Thorax

Typical Rib





RIB

Atypical Ribs

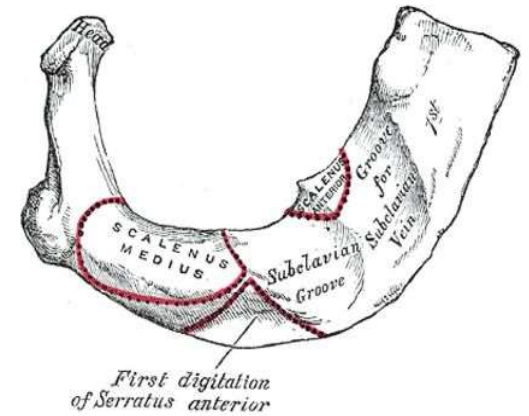
- Ribs 1, 2, 10, 11 and 12 can be described as 'atypical' – they have features that are not common to all the ribs.
- **Rib 1** is shorter and wider than the other ribs. It only has one facet on its head for articulation with its corresponding vertebrae (there isn't a thoracic vertebrae above it). The superior surface is marked by two grooves, which make way for the subclavian vessels.
- **Rib 2** is thinner and longer than rib 1, and has two articular facets on the head as normal. It has a roughened area on its upper surface, where the [serratus anterior](#) muscle attaches.
- **Rib 10** only has one facet – for articulation with its numerically corresponding vertebrae.
- **Ribs 11 and 12** have no neck, and only contain one facet, which is for articulation with their corresponding vertebrae.

Bones of Thorax

Atypical Ribs

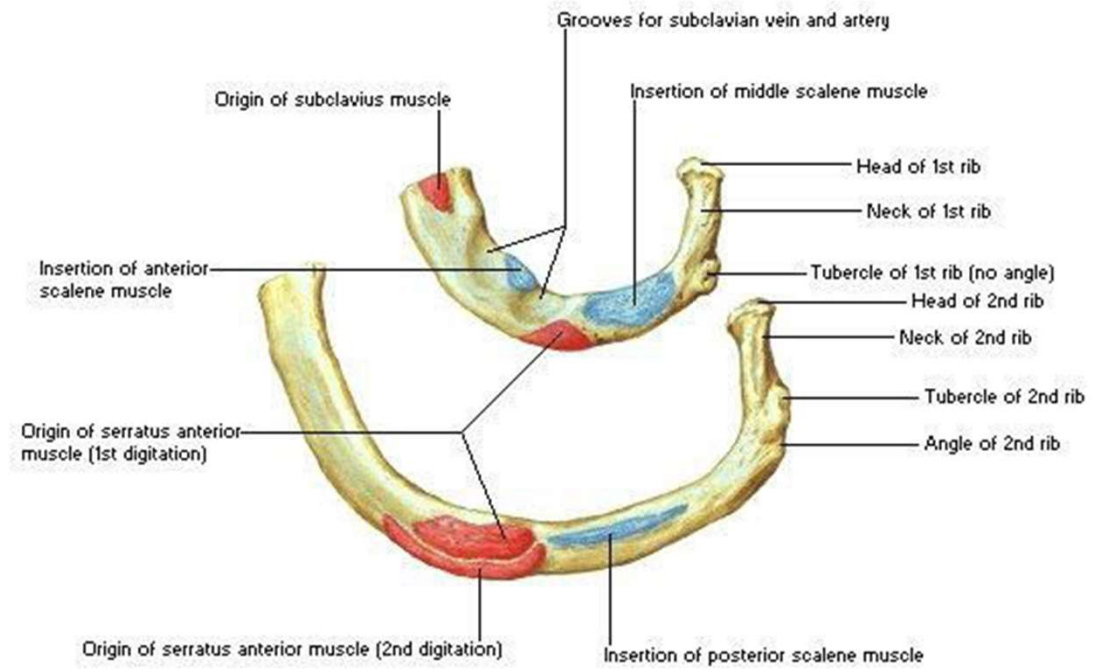
ATYPICAL RIBS (1, 2, 10-12)

- Have features that are different to typical ribs
- **Rib 1**
 - Short and broad
 - Only **one articulating facet** on its head
 - **Grooves for underlying structures** such as the subclavian artery
- **Rib 2**
 - Has formations for the **attachment of some thoracic muscles**
- **Ribs 10-12**
 - Have only **one articulating facet** like the first rib
 - 11 and 12 are **short**, have **no necks** and **no tubercles**



Bones of Thorax

Atypical Ribs

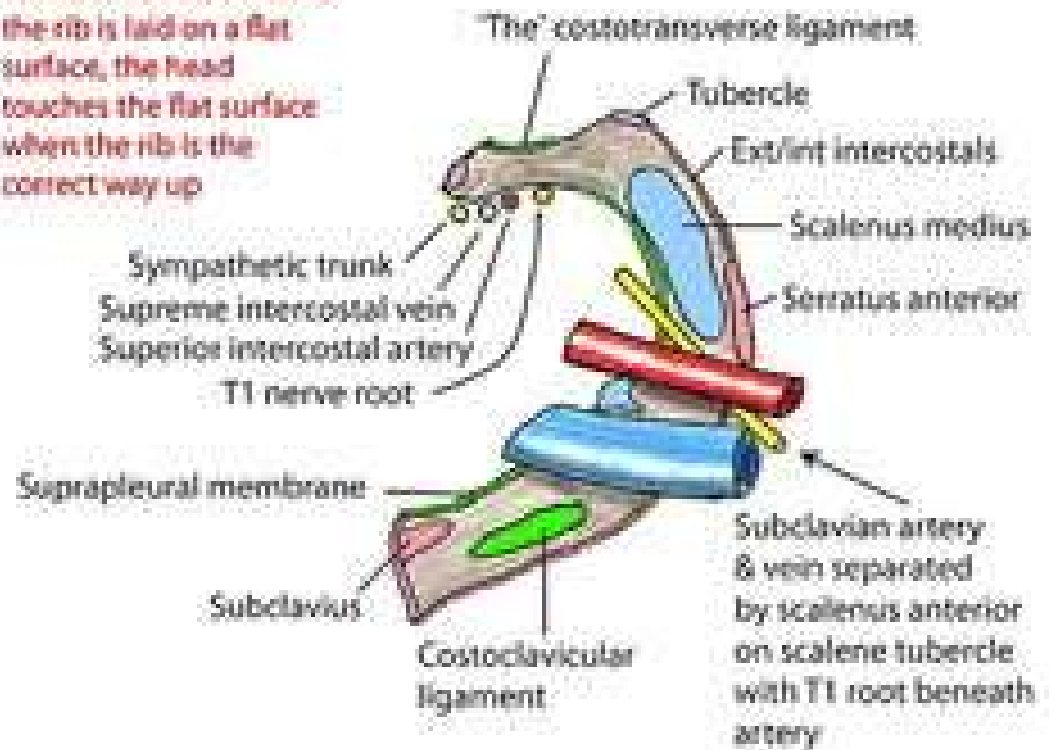


Bones of Thorax

First Rib

THE FIRST RIB

The under surface of the 1st rib is smoother. When the rib is laid on a flat surface, the head touches the flat surface when the rib is the correct way up



RIBS

Articulations

- The majority of the ribs have an Anterior and Posterior articulation.

Posterior Articulation

All of the twelve ribs articulate posteriorly with the **vertebrae** of the spine. Each rib forms two joints:

- **Costotransverse joint** – Between the tubercle of the rib, and the transverse costal facet of the corresponding vertebrae.
- **Costovertebral joint** – Between the head of the rib, superior costal facet of the corresponding vertebrae, and the inferior costal facet of the vertebrae above

RIBS

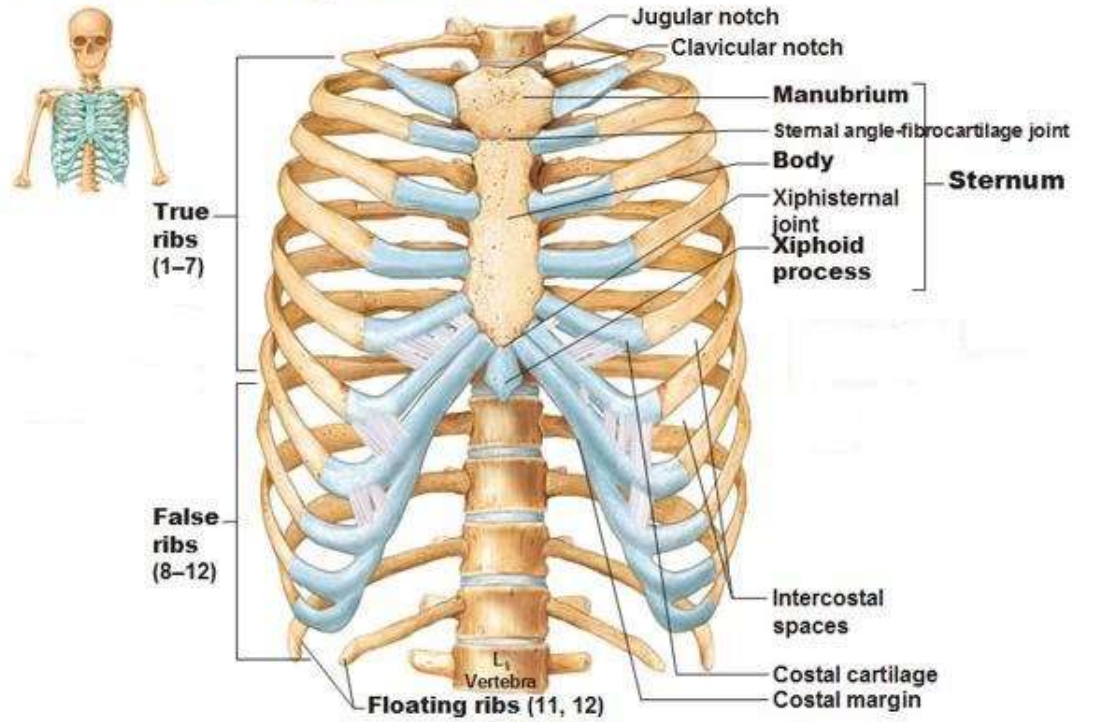
Anterior

- The anterior attachment of the ribs vary:
- **Ribs 1-7** attach independently to the sternum.
- **Ribs 8 – 10** attach to the costal cartilages superior to them.
- **Ribs 11 and 12** do not have an anterior attachment and end in the abdominal musculature. Because of this, they are sometimes called 'floating ribs'

Bones of Thorax

True and False Rib

The Thoracic Cage: Anterior view





RIBS

Clinical Relevance: Rib Fractures

- Rib fractures most commonly occur in the middle ribs, as a consequence of **crushing** injuries or direct trauma. A common complication of a rib fracture is further **soft tissue injury** from the broken fragments. Structures most at risk of damage are the lungs, spleen or diaphragm.
- If two or more fractures occur in two or more adjacent ribs, the affected area is no longer under control of the thoracic muscles. It displays a paradoxical movement during lung inflation and deflation. This condition is known as **flail chest**. It impairs full expansion of the ribcage, thus affecting the oxygen content of the blood. Flail chest is treated by fixing the affected ribs, preventing their paradoxical movement

Bones of Thorax

Ribs

Sternum

Thoracic Vertebrae

Sternum

1 Parts of the Sternum

1.1 Manubrium

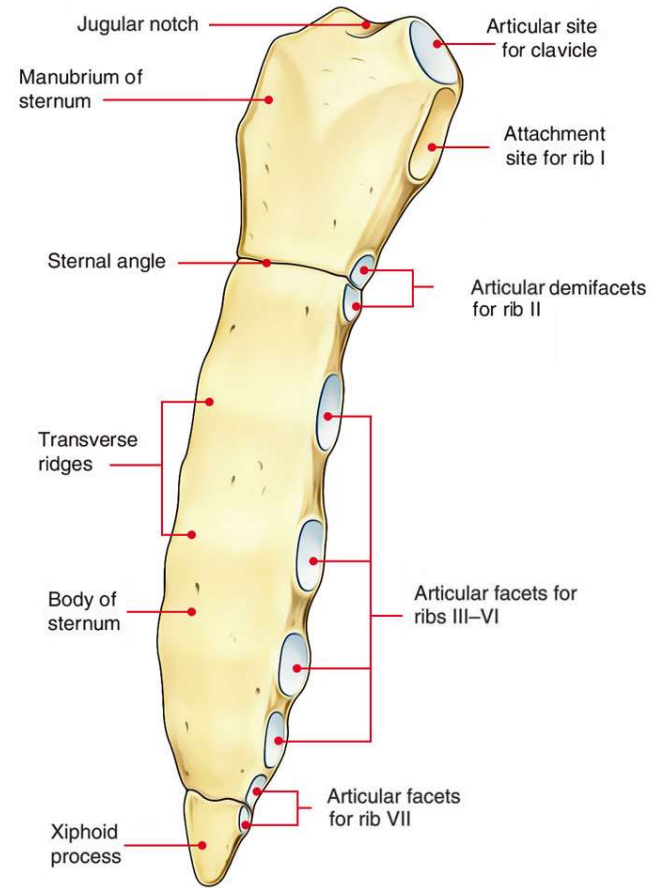
1.2 Body

1.3 Xiphoid Process

2 Clinical Relevance: Fractures of the Sternum

Bones of Thorax

Sternum



Sternum

Introduction

- The sternum (or breastbone) is a flat bone located at the **anterior aspect** of the thorax. It lies in the midline of the chest and has a 'T' shape.
- As part of the bony thoracic wall, the sternum helps **protect** the internal thoracic viscera – such as the heart, lungs and oesophagus.



Sternum

Parts of the Sternum

- The sternum can be divided into three parts; **Manubrium, Body** and **Xiphoid process**. In children, these elements are joined by cartilage. The cartilage ossifies to bone during adulthood.



Sternum

Manubrium

- The **manubrium** is the most superior portion of the sternum. It is **trapezoid** in shape.
- The superior aspect of the manubrium is concave, producing a depression known as the **jugular notch** – this is visible underneath the skin. Either side of the jugular notch, there is a large fossa lined with cartilage. These fossae articulate with the medial ends of the clavicles, forming the **sternoclavicular joints**.
- On the lateral edges of the manubrium, there is a **facet** (cartilage lined depression in the bone), for articulation with the costal cartilage of the 1st rib, and a **demifacet** (half-facet) for articulation with part of the costal cartilage of the 2nd rib.
- Inferiorly, the manubrium articulates with the body of the sternum, forming the **sternal angle**. This can be felt as a transverse ridge of bone on the anterior aspect of the sternum. The sternal angle is commonly used as an aid to count ribs, as it marks the level of the 2nd costal cartilage.



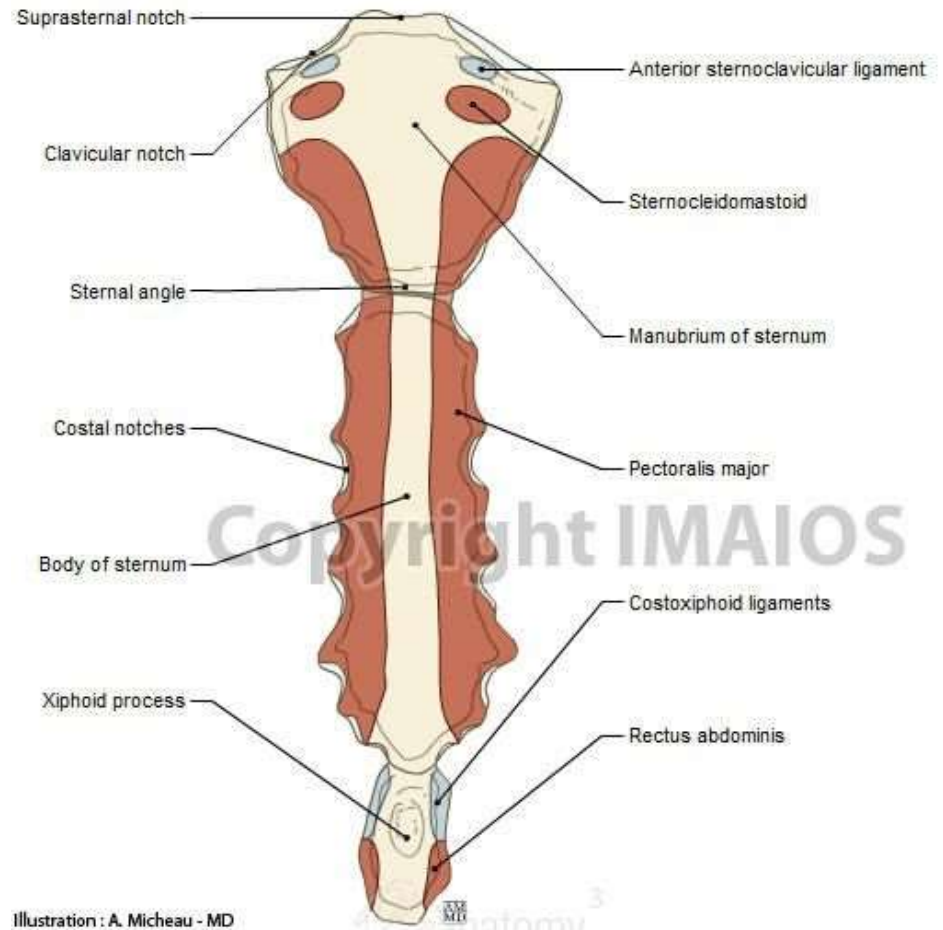
Sternum

Body

- The **body** is flat and elongated – the largest part of the sternum. It articulates with the manubrium superiorly (manubriosternal joint) and the xiphoid process inferiorly (xiphisternal joint).
- The lateral edges of the body are marked by numerous **articular facets** (cartilage lined depressions in the bone). These articular facets articulate with the costal cartilages of ribs 3-6. There are smaller facets for articulation with parts of the second and seventh ribs – known as demifacets.

Bones of Thorax

Sternum



Bones of Thorax

Xiphoid Process

- The **xiphoid process** is the most inferior and smallest part of the sternum. It is variable in shape and size, located at the level of the T10 vertebrae. The xiphoid process is largely cartilaginous in structure, and completely ossifies late in life – around the age of 40.
- In some individuals, the xiphoid process articulates with part of the costal cartilage of the seventh rib.



Sternum

Clinical Relevance: Fractures of the Sternum

- Sternal fractures are associated with severe blunt trauma to the chest, such as in a vehicular accident. They are relatively uncommon.
- Typically, the sternum will break into several pieces – this type of fracture is classified as a **comminuted** fracture. The most common site of fracture is the **manubriosternal joint** – where the manubrium meets the body of the sternum. Despite the degree of damage to the sternum, the fragments are not usually displaced due to the attachment of the [pectoralis muscles](#).

Sternum

Clinical Relevance

Sternal fractures have a high mortality rate (25-45%). This is not due to the fracture itself, but usually as a result of heart and lung injuries, which are likely to occur simultaneously with the primary trauma. Because of this, it is crucial to check patients with sternal fractures for visceral injury. X-ray, CT and ultrasound are common investigations.



THORAX

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Ribs

Sternum

Thoracic Vertebrae

Thoracic Vertebrae

1 Characteristic Features

2 Joints

3 Ligaments

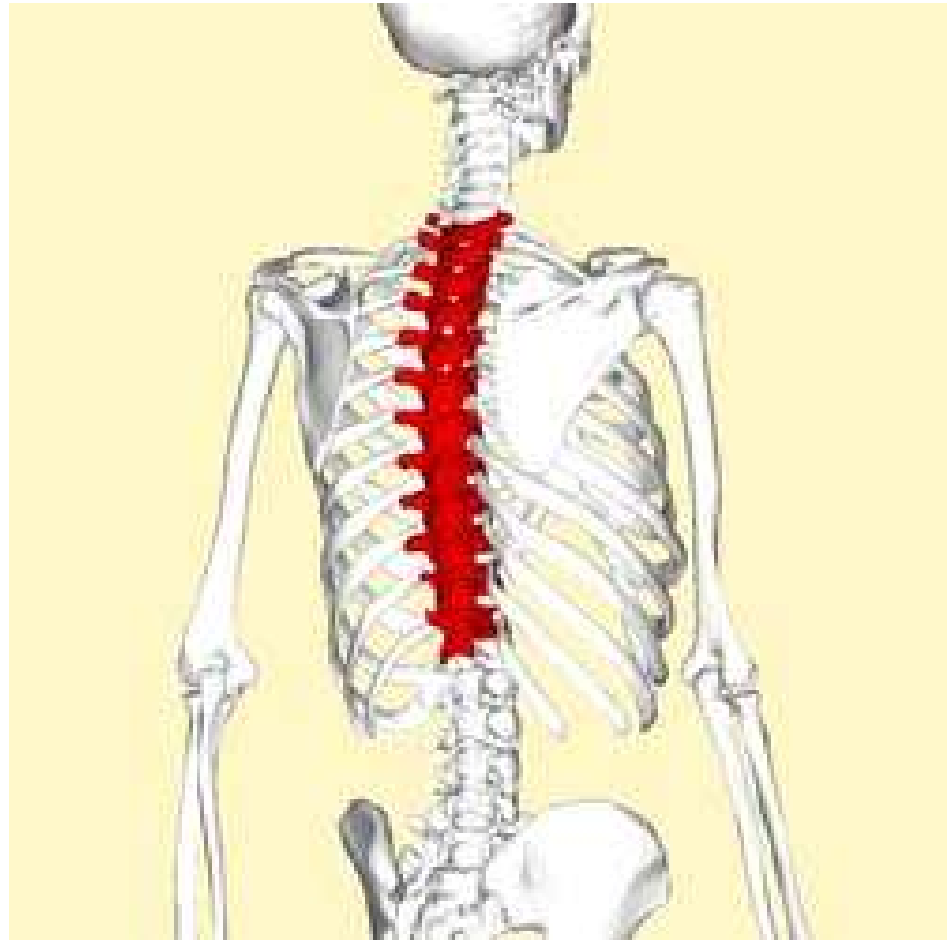
4 Clinical Relevance: Thoracic Kyphosis

Thoracic Vertebrae

- The thoracic spine is the second segment of the [vertebral column](#), located between the cervical and lumbar vertebral segments. It consists of twelve vertebrae, which are separated by intervertebral discs.
- Along with the sternum and ribs, the thoracic spine forms part of the thoracic cage. This bony structure helps protect the internal viscera – such as the heart, lungs and oesophagus.
- This article will look at the osteology of the thoracic vertebrae, examining their characteristic features, joints and clinical correlations

Bones of Thorax

Thoracic Vertebrae



Thoracic Vertebrae

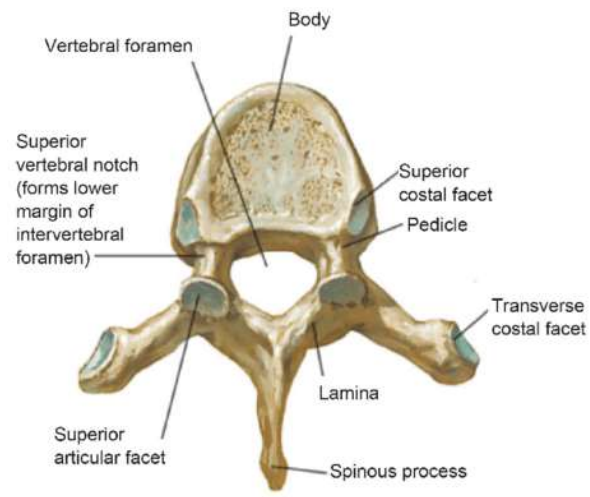
Characteristic Features

The thoracic vertebrae have four features which distinguish them from other vertebrae:

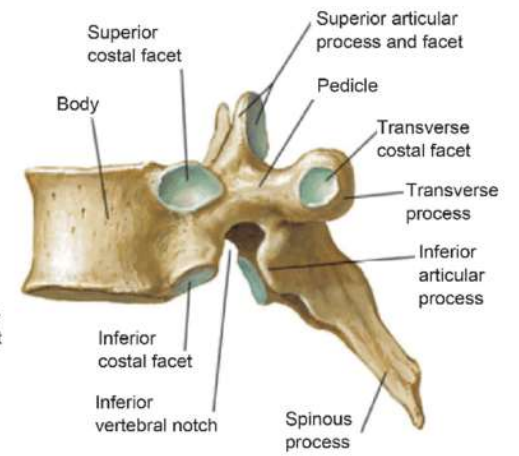
- Vertebral body is **heart shaped**.
- Presence of **demi-facets** on the sides of each vertebral body – these articulate with the heads of the ribs.
- Presence of **costal facets** on the transverse processes – these articulate with the tubercles of the ribs. They are present on T1-T10 only.
- The **spinous processes** are long and slant inferiorly. This offers increased protection to the spinal cord, preventing an object such as a knife entering the spinal canal.

Thoracic Vertebrae

Overview



T6 vertebra:
superior view



T6 vertebra:
lateral view

Thoracic Vertebrae

Superior and Inferior Costal Facets

- The superior and inferior costal facets are located on the sides of each vertebral body. They consist of **cartilage** lined depressions, which articulate with the heads of the ribs. The superior facet articulates with the head of the adjacent rib, and the inferior facet articulates with the head of the rib below
- In the majority of the vertebrae (T2-T9) these facets are **demi-facets**. There are some atypical vertebrae that possess whole facets.

Thoracic Vertebrae

Atypical Vertebrae

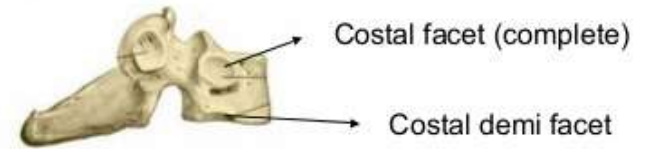
- The atypical thoracic vertebrae display variation in the size, location and number of their superior and inferior costal facets.
- **T1** – Superior facet is not a demifacet, as this is the only vertebrae to articulate with the 1st rib.
- **T10** – A single pair of whole facets is present which articulate with the 10th rib. These facets are located across both the vertebral body and the pedicle.
- **T11** and **T12** – Each have a single pair of entire costal facets, which are located on the pedicles.

Thoracic Vertebrae

Atypical Vertebrae

Atypical thoracic vertebrae

1st thoracic vertebra



9th thoracic vertebra

TV1 - Complete costal for own rib.; Inferior costal demifacet on body for rib 2.

10th thoracic vertebra

TV 10 Complete costal facet on pedicle and body.; May have costal facet on transverse process.

11th thoracic vertebra

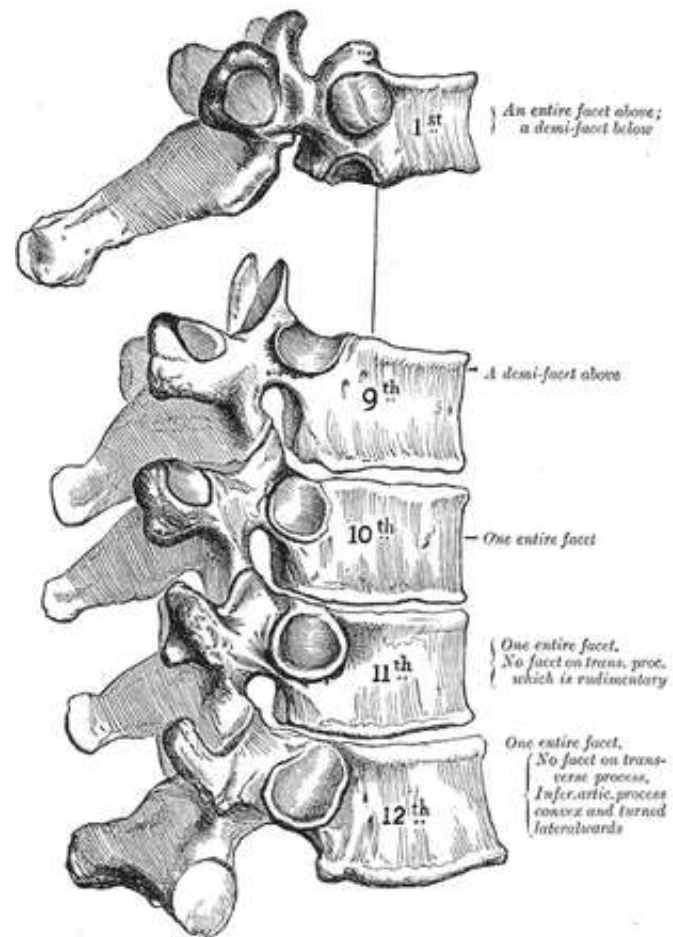
TV 11, 12 - Costal facet on each pedicle.; No costal facets on transverse processes.

12th thoracic vertebra



Thoracic Vertebrae

Articulating surface



Thoracic Vertebrae

Joints

- The joints of the thoracic spine can be divided into two groups – those that are present throughout the vertebral column, and those unique to the thoracic spine.
- **Present throughout Vertebral Column**
- There are two types of joints present throughout the vertebral column:
 - **Between vertebral bodies** – adjacent vertebral bodies are joined by intervertebral discs, made of fibrocartilage. This is a type of cartilaginous joint, known as a symphysis.
 - **Between vertebral arches** – formed by the articulation of superior and inferior articular processes from adjacent vertebrae. It is a synovial type joint.

Thoracic Vertebrae

Joints

Unique to Thoracic Spine

- The articulations between the vertebrae and the ribs are unique to the thoracic spine. For each rib, there are two separate articulations – **costovertebral and costotransverse**.

Each **costovertebral joint** consists of the head of the rib articulating with:

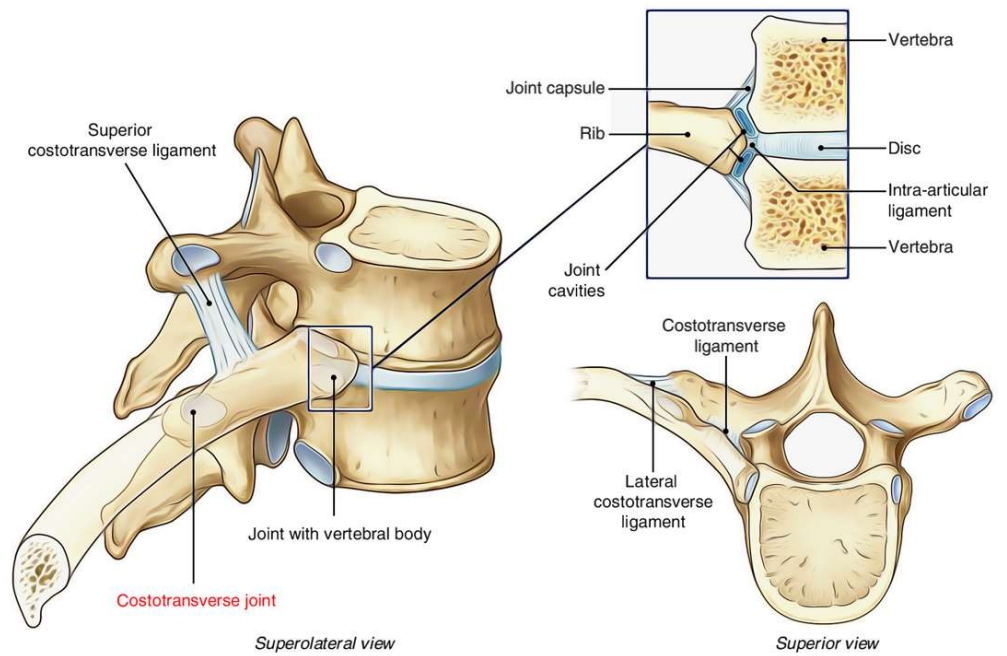
- Superior costal facet of the corresponding vertebra
- Inferior costal facet of the superior vertebra
- Intervertebral disc separating the two vertebrae
- Within this joint, the intra-articular ligament of head of rib attaches the rib head to the intervertebral disc. Only slight gliding movements can occur at these joints, due to the close articulation of their components.

Thoracic Vertebrae

The **costotransverse** joints are formed by the articulation of transverse processes of a thoracic vertebra and the tubercle of the adjacent rib. They are present in all vertebrae except T11 and T12.

Thoracic Vertebrae

Costovertebral joint



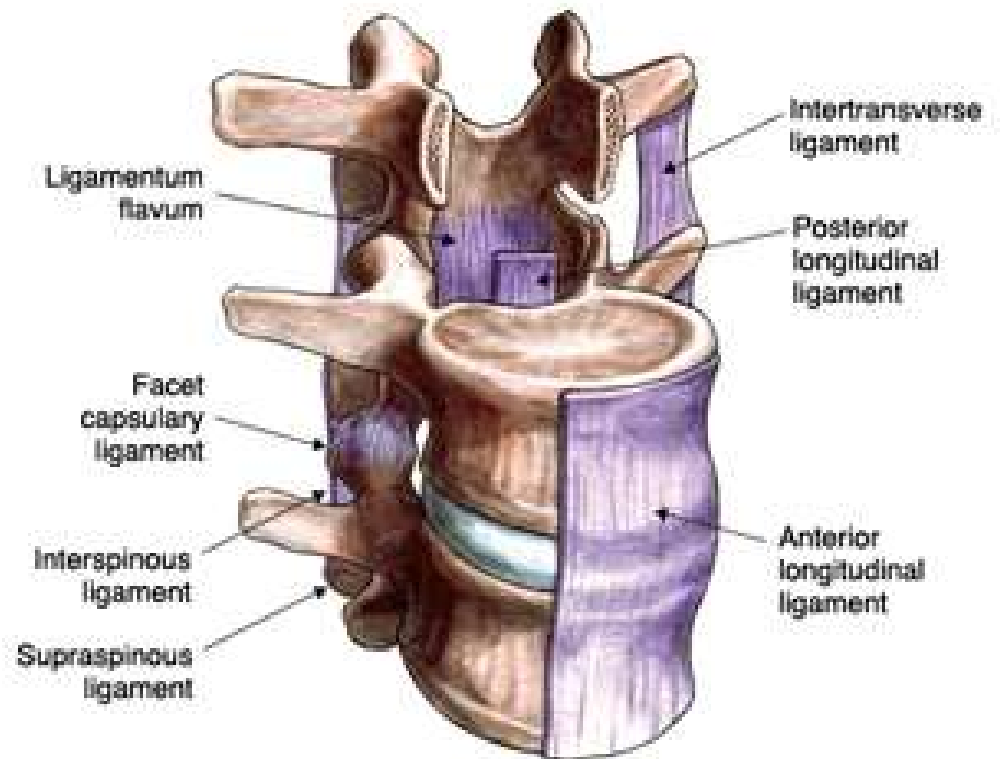
Thoracic Vertebrae

Ligaments

- The thoracic spine is strengthened by the presence of numerous ligaments.
- **Present Throughout Vertebral Column**
- **Anterior and posterior longitudinal ligaments:** Long ligaments that run the length of the vertebral column, covering the vertebral bodies and intervertebral discs.
- **Ligamentum flavum:** Connects the laminae of adjacent vertebrae.
- **Interspinous ligament:** Connects the spinous processes of adjacent vertebrae.
- **Supraspinous ligament:** Connects the tips of adjacent spinous processes.

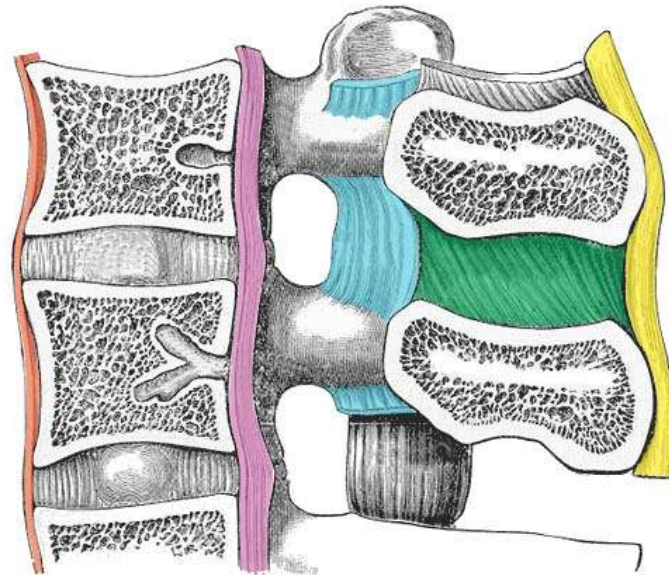
Thoracic Vertebrae

Ligaments



Thoracic Vertebrae

Ligaments



- Anterior longit. ligament
- Posterior longit. ligament
- Ligamentum flavum
- Interspinous ligament
- Nuchal ligament

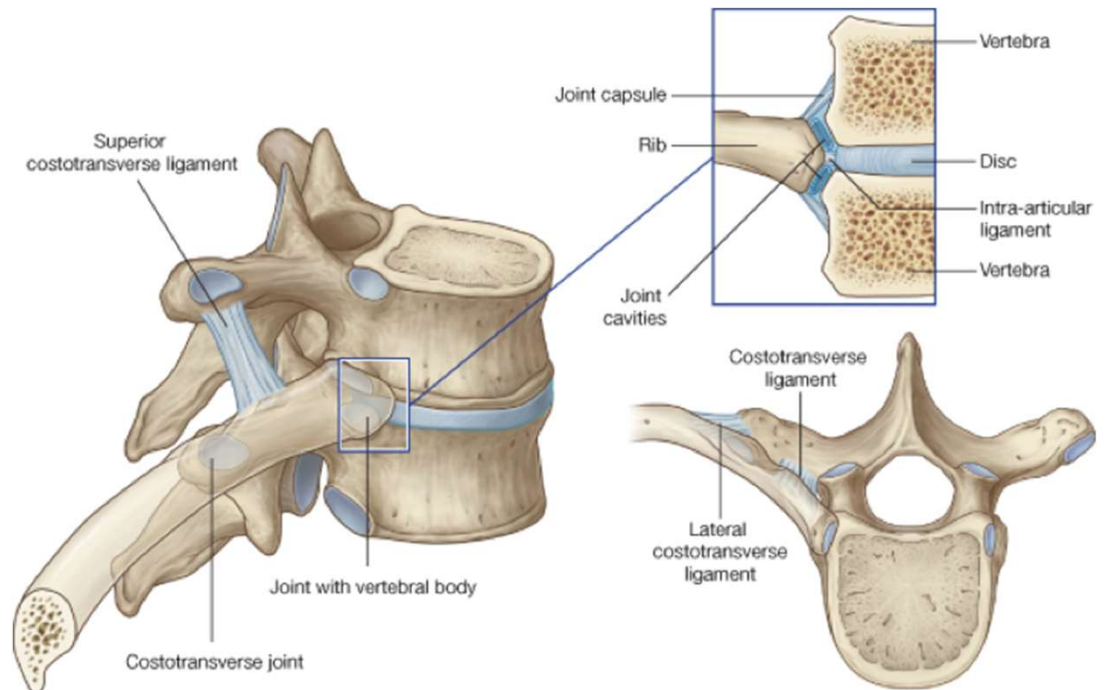
Thoracic Vertebrae

Unique to Thoracic Spine

- A number of small ligaments also support the costovertebral joints:
- **Radiate ligament of head of rib** – Fans outwards from the head of the rib to the bodies of the two vertebrae and intervertebral disc.
- **Costotransverse ligament** – Connects the neck of the rib and the transverse process.
- **Lateral costotransverse ligament** – Extends from the transverse process to the tubercle of the rib.
- **Superior costotransverse ligament** – Passes from the upper border of the neck of the rib to the transverse process of the vertebra superior to it.

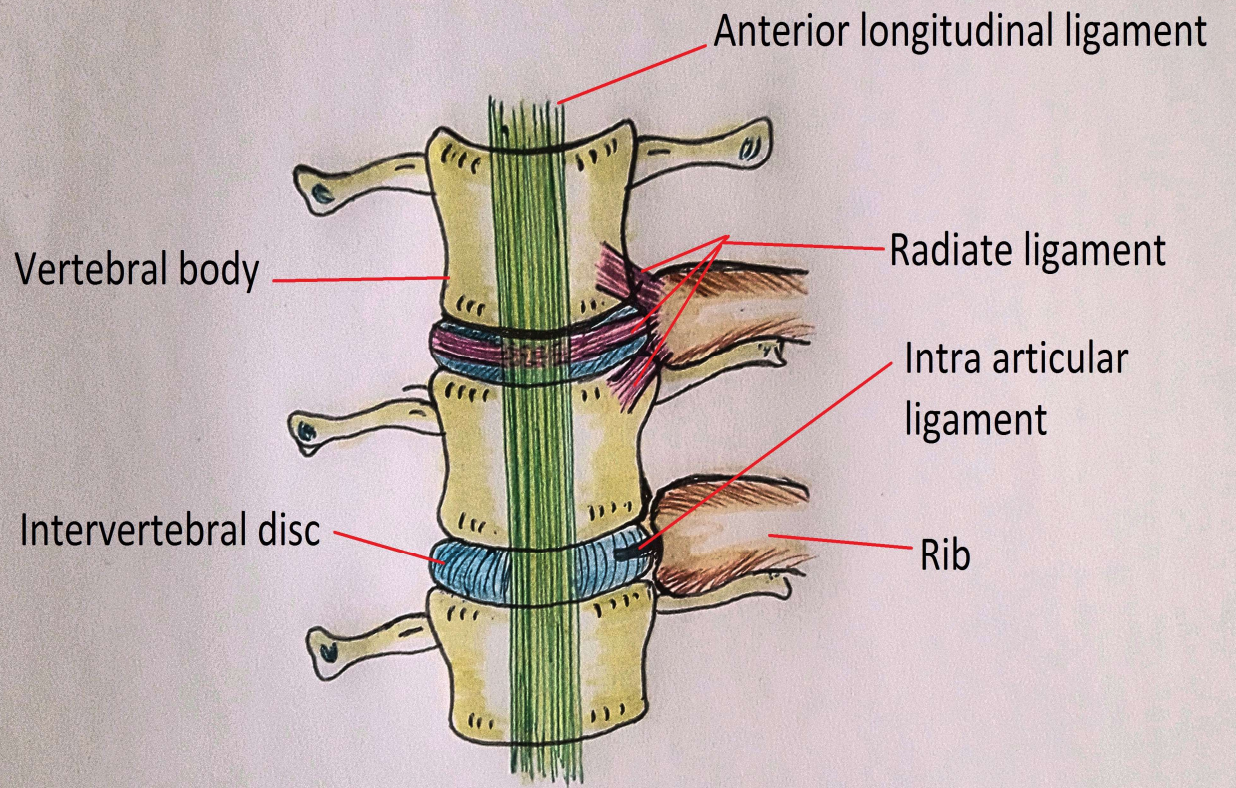
Thoracic Vertebrae

Ligaments



Thoracic Vertebrae

Ligaments



Thoracic Vertebrae

Clinical Relevance: Thoracic Kyphosis

- Kyphosis is an excessive curvature of the thoracic spine, causing the back to appear “hunched”. It may occur for a number of reasons early in life. These include poor posture, abnormally wedge-shaped shaped vertebrae (Scheuermann’s kyphosis), and fusing of vertebrae during development.
- Various diseases can also lead to kyphosis in adults. The most common cause is **osteoporosis** – a condition whereby bone mass is lost (mostly in older people). This leaves the spine less able to support the weight of the body, thus resulting in characteristic kyphosis.

Q

What is the characteristic feature of thoracic spine

- A. Body is kidney shape
- B. Bifid Spinous process
- C. Long and slanted spinous process
- D. Transverse Foramina

