

have *no necks or tubercles*, and are pointed at their anterior ends. The eleventh has a slight angle and a shallow costal groove. The twelfth has neither; it is much shorter than the eleventh, and its head is inclined slightly downward. Sometimes the twelfth rib is even shorter than the first.

Structure.—The ribs consist of highly vascular cancellous tissue, enclosed in a thin layer of compact bone.

Ossification.—Each rib, with the exception of the last two, is ossified from *four* centers; a primary center for the body, and three epiphysial centers, one for the head and one each for the articular and non-articular parts of the tubercle. The eleventh and twelfth ribs have each only *two* centers, those for the tubercles being wanting. Ossification begins near the angle toward the end of the second month of fetal life, and is seen first in the sixth and seventh ribs. The epiphyses for the head and tubercle make their appearance between the sixteenth and twentieth years, and are united to the body about the twenty-fifth year. Fawcett¹ states that “in all probability there is usually no epiphysis on the non-articular part of the tuberosity below the sixth or seventh rib.

The Costal Cartilages (Cartilagines Costales).

The **costal cartilages** (Fig. 115) are bars of hyaline cartilage which serve to prolong the ribs forward and contribute very materially to the elasticity of the walls of the thorax. The first seven pairs are connected with the sternum; the next three are each articulated with the lower border of the cartilage of the preceding rib; the last two have pointed extremities, which end in the wall of the abdomen. Like the ribs, the costal cartilages vary in their length, breadth, and direction. They increase in length from the first to the seventh, then gradually decrease to the twelfth. Their breadth, as well as that of the intervals between them, diminishes from the first to the last. They are broad at their attachments to the ribs, and taper toward their sternal extremities, excepting the first two, which are of the same breadth throughout, and the sixth, seventh, and eighth, which are enlarged where their margins are in contact. They also vary in direction: the first descends a little, the second is horizontal, the third ascends slightly, while the others are angular, following the course of the ribs for a short distance, and then ascending to the sternum or preceding cartilage. Each costal cartilage presents two surfaces, two borders, and two extremities.

Surfaces.—The **anterior surface** is convex, and looks forward and upward: that of the first gives attachment to the costoclavicular ligament and the Subclavius muscle; those of the first six or seven at their sternal ends, to the Pectoralis major. The others are covered by, and give partial attachment to, some of the flat muscles of the abdomen. The **posterior surface** is concave, and directed backward and downward; that of the first gives attachment to the Sternothyroideus, those of the third to the sixth inclusive to the Transversus thoracis, and the six or seven inferior ones to the Transversus abdominis and the diaphragm.

Borders.—Of the two borders the **superior** is concave, the **inferior** convex; they afford attachment to the Intercostales interni: the upper border of the sixth gives attachment also to the Pectoralis major. The inferior borders of the sixth, seventh, eighth, and ninth cartilages present heel-like projections at the points of greatest convexity. These projections carry smooth oblong facets which articulate respectively with facets on slight projections from the upper borders of the seventh, eighth, ninth, and tenth cartilages.

Extremities.—The **lateral end** of each cartilage is continuous with the osseous tissue of the rib to which it belongs. The **medial end** of the first is continuous with the sternum; the medial ends of the six succeeding ones are rounded and are received into shallow concavities on the lateral margins of the sternum. The medial ends of the eighth, ninth, and tenth costal cartilages are pointed, and are connected each with the cartilage immediately above. Those of the eleventh and twelfth are pointed and free. In old age the costal cartilages are prone to undergo superficial ossification.

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