

Head and Neck

These arches appear in the fourth and fifth weeks of development and contribute to the characteristic external appearance of the embryo (Fig. 15.3). Initially, they consist of bars of mesenchymal tissue separated by deep clefts known as **pharyngeal (branchial) clefts** (Figs. 15.3C ; see also Fig. 15.6). Simultaneously, with development of the arches and clefts, a number of outpocketings, the **pharyngeal pouches**, appear along the lateral walls of the pharyngeal gut, the most cranial part of the foregut (Fig. 15.4; see also Fig. 15.6). The pouches penetrate the surrounding mesenchyme, but do not establish an open communication with the external clefts (see Fig. 15.6). Hence, although development of pharyngeal arches, clefts, and pouches resembles formation of gills in fishes and amphibia, in the human embryo real gills (branchia) are never formed. Therefore, the term **pharyngeal** (arches, clefts, and pouches) has been adopted for the human embryo.

Pharyngeal arches not only contribute to formation of the neck, but also play an important role in formation of the face. At the end of the fourth week, the center of the face is formed by the stomodeum, surrounded by the first pair of pharyngeal arches (Fig. 15.5). When the embryo is 42 days old, five mesenchymal prominences can be recognized: the **mandibular prominences** (first pharyngeal arch), caudal to the stomodeum; the **maxillary prominences** (dorsal portion of the first pharyngeal arch), lateral to the stomodeum; and the **frontonasal prominence**, a slightly rounded elevation cranial to the stomodeum.

Development of the face is later complemented by formation of the **nasal prominences** (Fig. 15.5). In all cases, differentiation of structures derived from arches, pouches, clefts, and prominences is dependent upon epithelial-mesenchymal interactions.

Pharyngeal Arches

Each pharyngeal arch consists of a core of mesenchymal tissue covered on the outside by surface ectoderm and on the inside by epithelium of endodermal origin (Fig. 15.6). In addition to mesenchyme derived from paraxial and lateral plate mesoderm, the core of each arch receives substantial numbers of **neural crest cells**, which migrate into the arches to contribute to **skeletal components** of the face. The original mesoderm of the arches gives rise to the musculature of the face and neck. Thus, each pharyngeal arch is characterized by its own **muscular components**. The muscular components of each arch have their own **cranial nerve**, and wherever the muscle cells migrate, they carry their **nerve component** with them (Figs. 15.6 and 15.7). In addition, each arch has its own **arterial component** (Figs. 15.4 and 15.6).

FIRST PHARYNGEAL ARCH

The **first pharyngeal arch** consists of a dorsal portion, the **maxillary process**, which extends forward beneath the region of the eye, and a ventral portion, the **mandibular process**.

Mesenchyme of the maxillary process gives rise to the **premaxilla**, **maxilla**, **zygomatic bone**, and part of the **temporal bone** through membranous ossification (Fig. 15.8B). The **mandible is also formed by membranous ossification of mesenchymal tissue surrounding** Meckel's cartilage. In addition, the first arch contributes to formation of the bones of the middle ear.

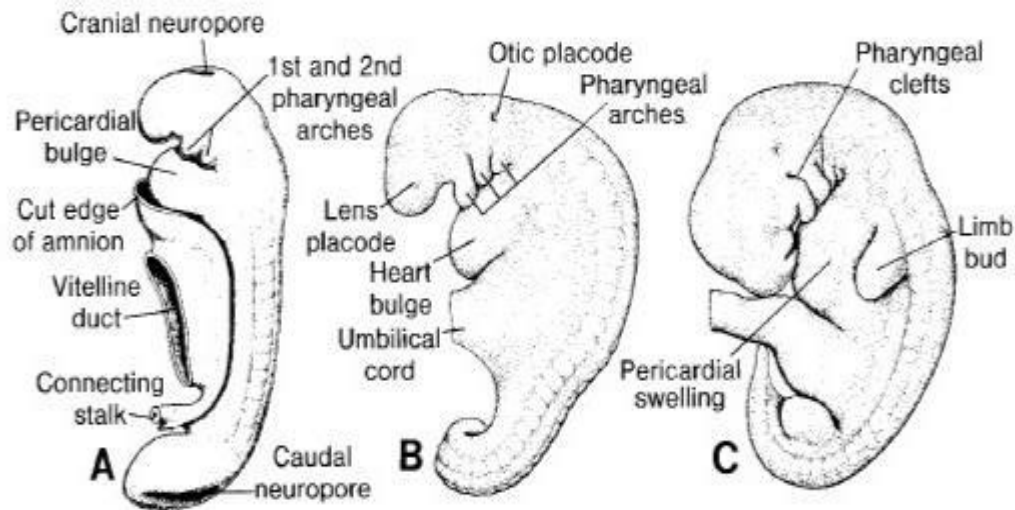


Figure 15.3 Development of the pharyngeal arches. A. 25 days. B. 28 days. C. 5 weeks.

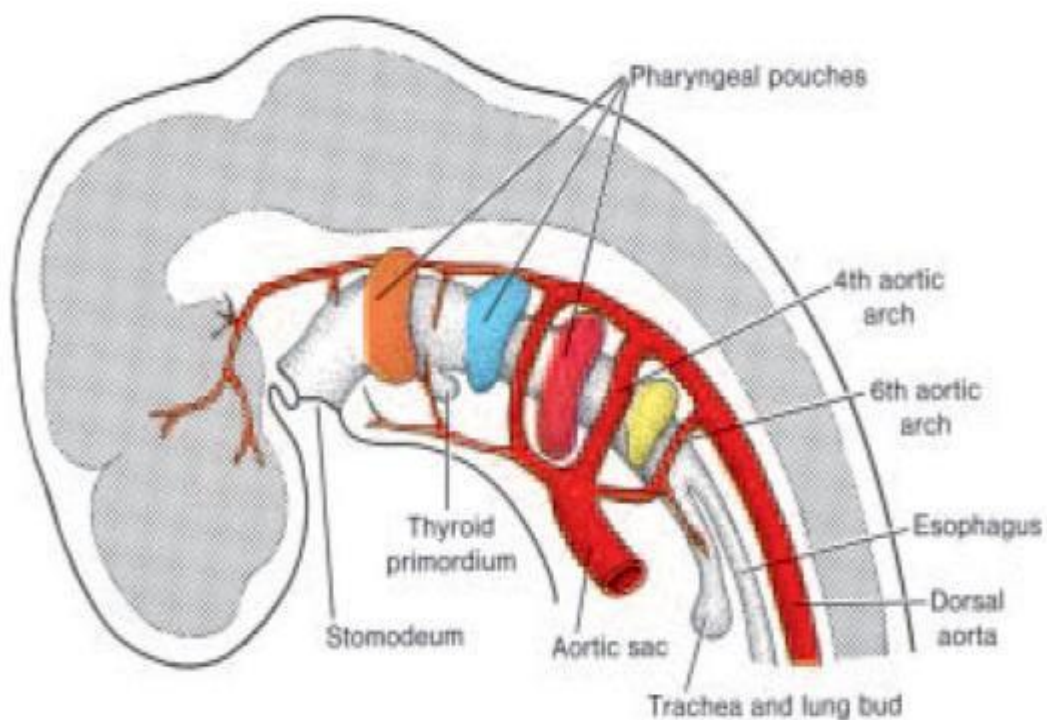


Figure 15.4 Pharyngeal pouches as outpocketings of the foregut and the primordium of the thyroid gland and aortic arches.

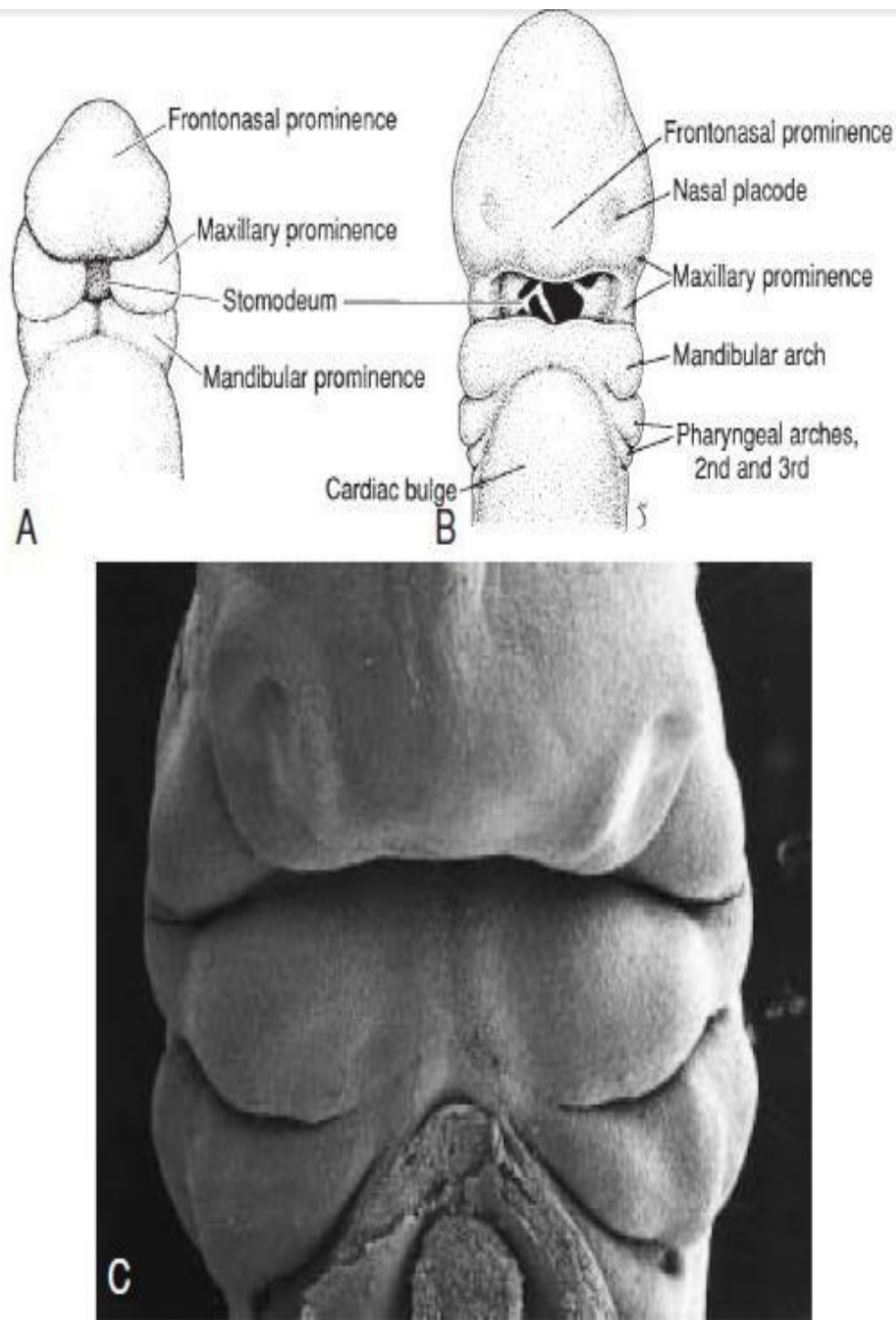


Figure 15.5 A. Frontal view of an embryo of approximately 24 days. The stomodeum, temporarily closed by the buccopharyngeal membrane, is surrounded by five mesenchymal prominences. B. Frontal view of a slightly older embryo showing rupture of the buccopharyngeal membrane and formation of the nasal placodes on the frontonasal prominence. C. Scanning electron micrograph of a human embryo similar to that shown in B.

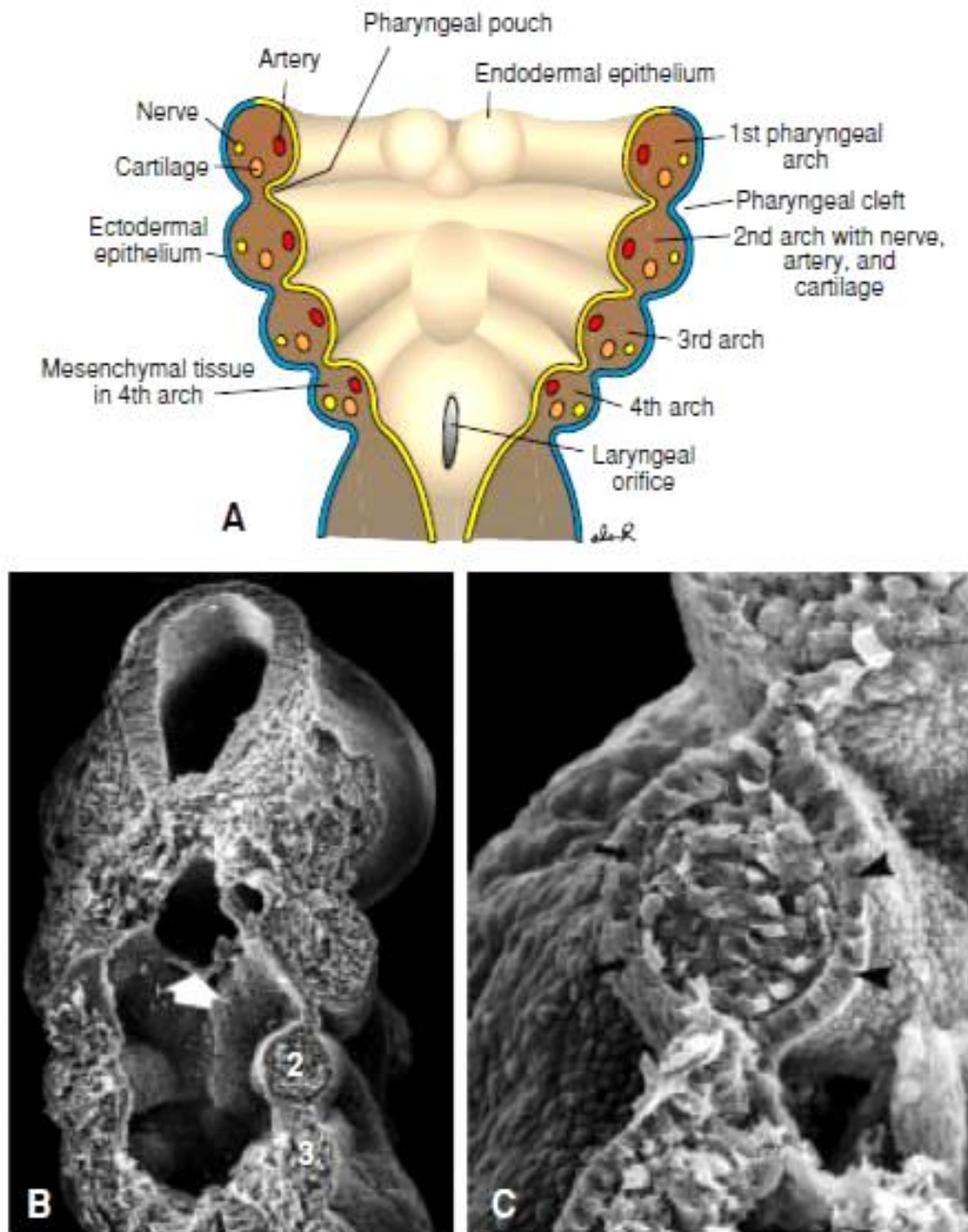


Figure 15.6 A. Pharyngeal arches. Each arch contains a cartilaginous component, a cranial nerve, an artery, and a muscular component. B. Scanning electron micrograph of the pharyngeal region of a mouse embryo, showing the pharyngeal arches, pouches, and clefts. The first three arches (I, II, and III) are visible. A remnant of the buccopharyngeal membrane (arrow) is present at the entrance to the oral cavity. C. Higher magnification of the pharyngeal arches of a mouse embryo. Pharyngeal arches consist of a core of mesoderm lined by endoderm internally (arrowheads) and ectoderm externally (arrows). Pouches and clefts occur between the arches, where endoderm and ectoderm appose each other.

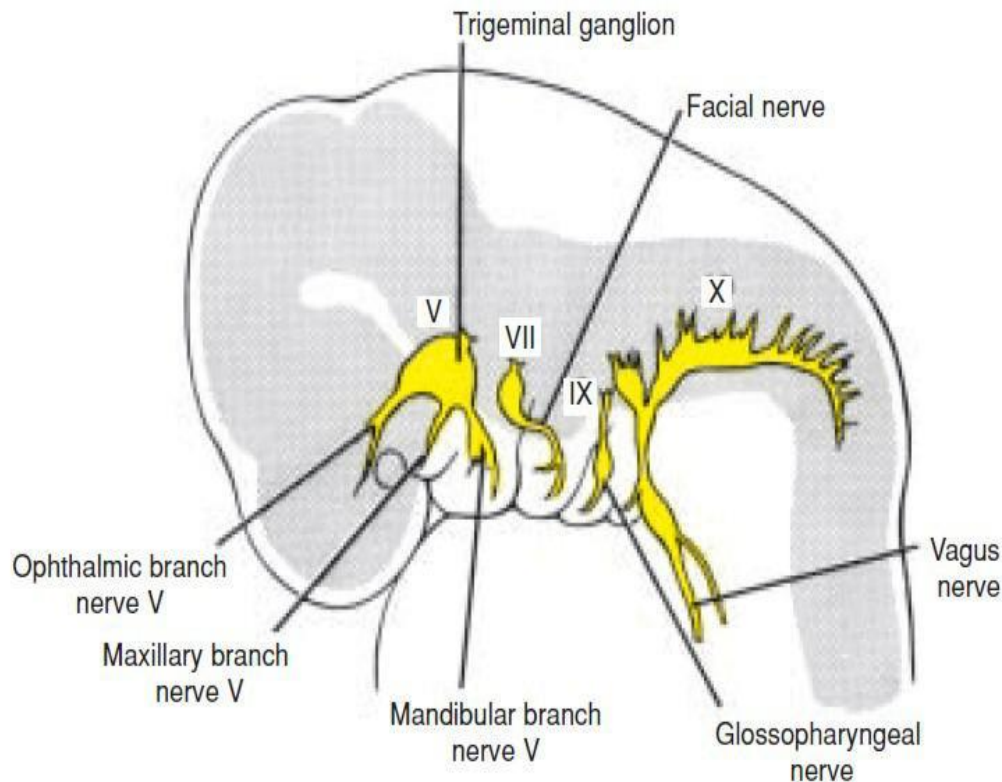


Figure 15.7 Each pharyngeal arch is supplied by its own cranial nerve. The trigeminal nerve supplying the first pharyngeal arch has three branches: the ophthalmic, maxillary, and mandibular. The nerve of the second arch is the facial nerve; that of the third, the glossopharyngeal nerve. The musculature of the fourth arch is supplied by the superior laryngeal branch of the vagus nerve, and that of the sixth arch, by the recurrent branch of the vagus nerve.

SECOND PHARYNGEAL ARCH

The cartilage of the **second** or **hyoid arch** (**Reichert's cartilage**) (Fig. 15.8B)

THIRD PHARYNGEAL ARCH

The **cartilage** of the third pharyngeal arch produces the **lower part of the body** and **greater horn of the hyoid bone** (Fig. 15.9).

FOURTH AND SIXTH PHARYNGEAL ARCHES

Cartilaginous components of the fourth and sixth pharyngeal arches fuse to form the **thyroid, cricoid, arytenoid, corniculate, and cuneiform cartilages**. of the **larynx** (Fig. 15.9).

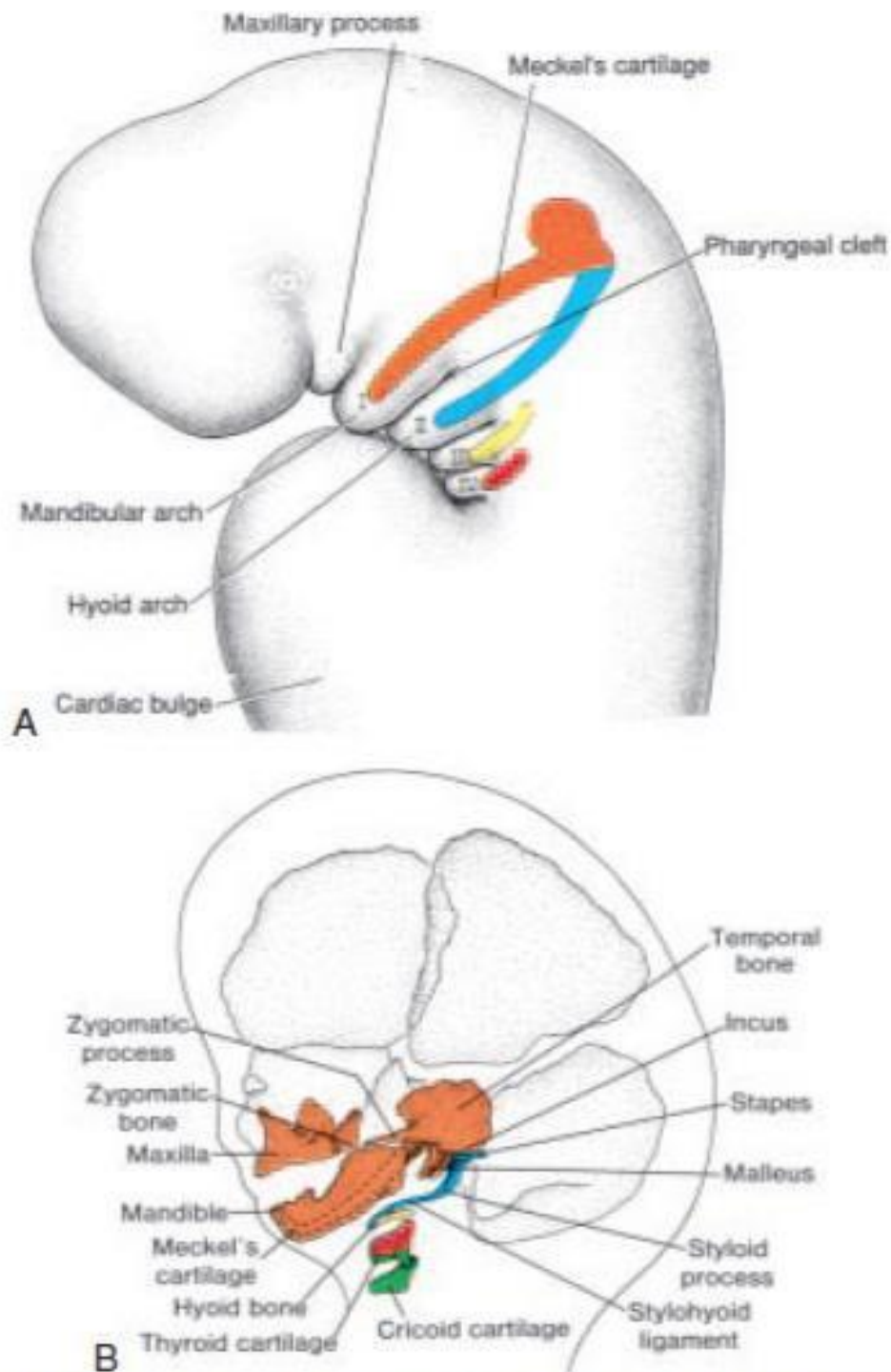


Figure 15.8 A. Lateral view of the head and neck region of a 4-week embryo demonstrating the cartilages of the pharyngeal arches participating in formation of the bones of the face and neck. **B.** Various components of the pharyngeal arches later in development. Some of the components ossify; others disappear or become ligamentous. The maxillary process and Meckel's cartilage are replaced by the maxilla and mandible, respectively, which develop by membranous ossification.

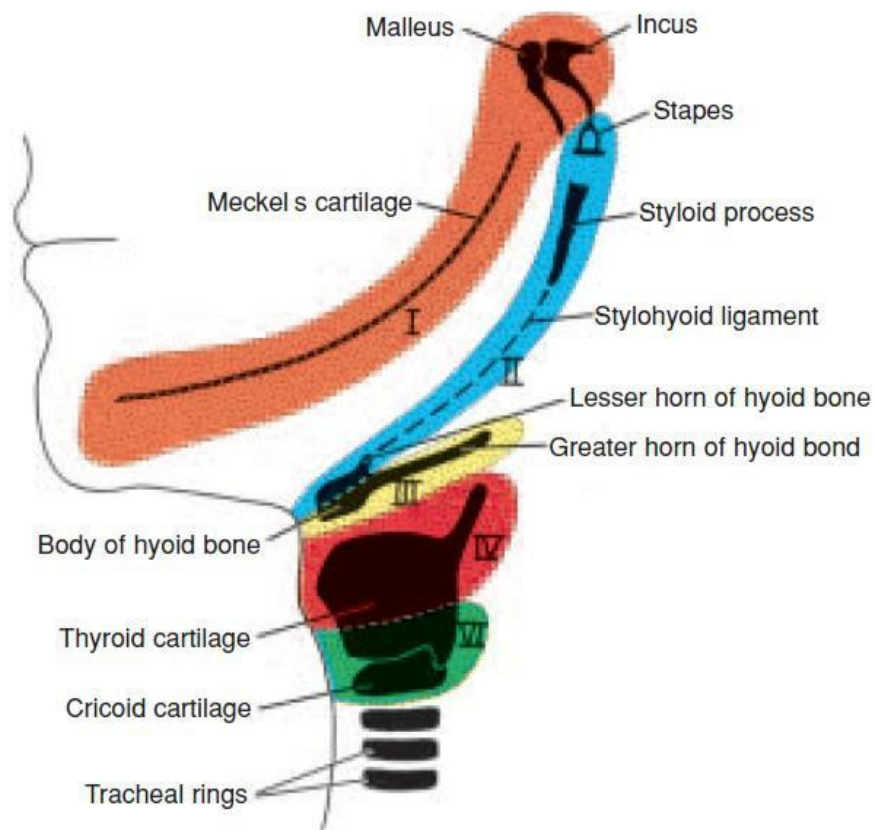


Figure 15.9 Definitive structures formed by the cartilaginous components of the various pharyngeal arches.