

# HD 17: PHARYNGEAL ARCHES AND POUCHES

Letty Moss-Salentijn DDS, PhD  
Robinson Professor of Dentistry (in Anatomy and Cell Biology)  
E-mail address: [lm23@columbia.edu](mailto:lm23@columbia.edu)

## READING ASSIGNMENT

Larsen 3<sup>rd</sup> Edition. **Chapter 12:** pp. 352; 358-365; pp. 371-378; pp. 396-398; 405-412;

## SUMMARY

The pharyngeal arches are a phylogenetically new acquisition in vertebrates. Five pairs of pharyngeal arches are transiently present in the period of 20-35 days of human embryonic development, but their derivatives have a major impact on the adult structures of the region, especially in the visceral neck. The cephalic neural crest plays a significant role in the development of the skeletal and connective tissues of the visceral neck.

There is a spatial and developmental relationship between the rhombomeres of the hindbrain and the pharyngeal arches, which is controlled by a Homeobox gene code. The components of each pharyngeal arch include an aortic arch artery, a specific cranial nerve (arch 1: CN V; arch 2: CN VII; arch 3: CN IX; arches 4 and 6: CN X and XII) and associated muscles, and a cartilage skeleton. The adult derivatives of each of these components are reviewed.

The transient structures that are known as pharyngeal grooves (separating pharyngeal arches from each other on the ectodermal side) and pharyngeal pouches (separating the pharyngeal arches on the endodermal side) disappear toward the end of the embryonic period. The first pharyngeal groove will give rise to the external auditory meatus of the adult ear. The other three grooves will disappear without having any further role in the development of adult structures.

The pharyngeal pouches develop into a series of structures that include the pharyngotympanic tube and middle ear cavity (pharyngeal pouches 1 and 2), palatine tonsil (pharyngeal pouch 2), thymus and inferior parathyroid glands (pharyngeal pouch 3), superior parathyroid glands and the ultimobranchial bodies of the thyroid gland (pharyngeal pouch 4).

The related development of the external ear by contributions of the first and second pharyngeal arches is reviewed, as is the development of the tongue, which is formed by contributions of first through fourth arches. Finally, the development of the thyroid gland, which is spatially related to the derivatives of the third and fourth pharyngeal pouches, is discussed briefly.

## LEARNING OBJECTIVES:

You should be able to

- List the developmental stages and the rostrocaudal sequence in which the pharyngeal arches are visible externally in the human embryo.
- Describe pharyngeal arches, pharyngeal pouches, pharyngeal grooves, pharyngeal membranes, and pharyngeal clefts.
- Describe the boundary between cephalic neural crest and trunk neural crest, and describe the significance of this distinction for the neural crest derivatives.
- Describe the developmental relationship between rhombomeres and pharyngeal arches, with reference to the expression of homeotic genes (without memorizing expressions of specific gene combinations for each segment).
- For each pharyngeal arch list the derivatives of its basic structural elements (artery, nerve, muscle, cartilage skeleton).
- List the derivatives of the first pharyngeal groove and describe the pattern of obliteration of pharyngeal grooves 2-4.
- List the derivatives of the different pharyngeal pouches.
- Describe briefly the development of external and middle ear.
- List the different swellings of and their significance in the development of external ear and tongue. You should be able to list the pharyngeal arches that contribute to these swellings.
- Describe the initial development of the thyroid gland, list the initial site of development and describe the pathway of the growing gland. Describe the thyroglossal duct.
- Describe the origin and developmental movements of the thymus and explain how the parathyroid glands, which develop from the third pouch become “inferior” while those that develop from the fourth pouch become “superior”.