# Development of the Face and Palate Transcript

Early in embryonic development, during the third week post-fertilization, the embryo is a flat, disc-shaped organism made up of three layers of pluripotent cells called germ layers, which give rise to all the organs and tissues in the body: An inner layer called endoderm, a central layer called mesoderm, and an outer layer called ectoderm.

By week four of development, as a result of the folding of the embryo along the rostral-caudal axis and the lateral axis, it takes on a more recognizably human form. But to be honest, it still looks more like a shrimp than a baby.

At the head end of the shrimp-like creature, the neural tube expands greatly, forming the primitive forebrain, which produces a bulge known as the frontal prominence. Lateral to the neural tube is the paraxial mesoderm, which partially segments rostrally to form somidomirs and fully segments caudally to form somites, the first in the series being the occipital somites.

At this point, a small pit called the stomadium forms between the frontal prominence and the developing cardiac bulge, and it will eventually become the oral cavity. At the back of the stomadium, there's a two-layered membrane called a buccopharyngeal membrane made up of ectoderm and endoderm. The buccopharyngeal membrane initially separates the stomadium from the foregut but soon disintegrates, allowing free access between the stomadium and the foregut.

At the same time, six little bulges or thickenings of the mesoderm sprout from the primitive pharynx to become the branchial or pharyngeal arches. These arches are paired symmetrical bumps that form on each side of the embryo in a craniocaudal fashion, going from head to tail.

At the same time, neural crest cells from the midbrain and the first two rhombomirs migrate bilaterally to the region and infiltrate the mesoderm bumps where they support the development of embryonic connective tissue needed for craniofacial development, called ectomesenchyme.

The pharyngeal arches are separated externally by small clefts on the pharyngeal wall called branchial grooves and internally by corresponding depressions called pharyngeal pouches.

The first pharyngeal arch splits up into two processes: the maxillary process, which lies lateral to the stomadium and extends slightly above, and the mandibular process, which lies near the lower border of the stomadium. The mandibular processes on either side grow towards each other and merge into a single structure very early on.

Now, development of the face begins in week 4, when two patches of ectoderm on the frontal prominence start to proliferate, forming two thickenings known as the nasal placodes. During week five, the mesodermal cells surrounding each nasal placode proliferate rapidly to form a horseshoe-shaped swelling. The inner half is called the medial nasal process, and the outer half the lateral nasal process.

The region of the frontal prominence where these changes take place, and the nose will develop, is called the frontonasal process. As the mesoderm proliferates, the nasal placodes appear to sink downwards to form nasal pits. The base of the nasal pits is lined by the oral-nasal membrane, which separates it from the primitive oral cavity.

At the same time, the maxillary processes start to proliferate towards the center while remaining separated from the lateral nasal process by the naso-optic groove and the medial nasal process by the bucco-nasal groove.

By the end of week 6, the maxillary processes fuse with the medial nasal processes on each side, forming the upper lip. Around the same time, the two medial nasal processes come together, forming the inter-maxillary segment. Then, the inter-maxillary segment develops into the bridge of the nose, the philtrum or center of the upper lip, middle part of the maxillary bone, and the four upper incisor teeth, and the primary palate.

The naso-optic groove gets covered on top by ectodermal tissue, converting it into the nasal lacrimal duct. The lateral nasal processes develop into the lateral nasal wall, the mandibular processes form the lower jaw with all its teeth and the lower lip, and fuses with the maxillary processes to form the cheeks.

Now, as the external face is developing, there are some structures developing on the inside as well, most importantly the oral cavity, nasal cavity, and the palate. During weeks six and seven, the two nasal pits burrow deeper and backwards just above the stomadium, forming the nasal sacs behind the inter-maxillary segment.

By week 8, the oronasal membrane at the base of the nasal sac disintegrates, forming a primitive coena, which connects the nasal and oral cavities. Alongside this, a triangular plate of tissue, the primary palate, grows from the back of the inter-maxillary segment and extends till it reaches below the incisive foramen of the skull.

The maxillary processes then develop a pair of shelf-like processes called palatine shelves, which grow vertically downwards on either side of the developing tongue. As the mandibular process grows and expands, the tongue descends down, creating room for the palatine shelves to elevate into a horizontal position and then grow medially until they fuse with each other and with the primary palate in front. At the same time, the mesoderm and ectoderm of the frontal, nasal, and intermaxillary segments grow downwards in the midline to form the nasal septum, which fuses with the secondary palate.

The development of the secondary palate usually completes by week 12 of development, so the critical period for face and palate development is between month 2 and 3, or from week 6 to 12.

Alright, as a quick recap: Development of the face begins by week 4 of development from three main structures: the frontonasal process, maxillary process, and mandibular process. The frontonasal process gives rise to the medial and lateral nasal processes. The two medial nasal processes merge in the midline, forming the intermaxillary segment, which gives rise to the philtrum of the lip. The fusion of the maxillary processes with the intermaxillary segment on both sides completes the formation of the upper lip, and the mandibular process gives rise to the lower jaw.