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SHORT COMMUNICATION

Early Development of the Human Face

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Abstract

The skull is composed of two main parts: the viscerocranium, which forms the facial structure, and the neurocranium, which houses the brain. Facial development is a complex process and must be easily understood so that surgeons and public healthcare practitioners can recognize and properly manage any birth defects. In this short article, we aim to review facial development in a simple way that can be easily followed by medical and healthcare professionals. Facial development begins early in the fetus's life in the womb with the appearance of five mesodermal ridges (processes) surrounding the stomodeum. Key structures involved in facial development include the frontonasal process, along with paired maxillary and mandibular processes. These processes fuse together to form the base of the cheek on each side and leave a rima oris. Any error in fusion can lead to various congenital facial deformities which must be treated as soon as possible.

Key Words: *Cleft lip; Maxillofacial development; Face; Microstomia; Macrostomia; Congenital anomalies*

Introduction

The skull consists of 22 bones and is divided into two main parts: the neurocranium, which surrounds and protects the brain, and the facial skeleton, which forms the viscerocranium of the skull [1]. The face is one of the most complex anatomical structures in the human body, and research in this area is constantly revealing new insights into the intricate interplay between its various structures including bones, ligaments, muscles, and nerves [2]. Understanding the anatomy of different parts of the human body including the face is key to sound medical and surgical practice in order to mitigate potential complications and improve patient outcomes [3]. In this short review, we aim to illustrate facial development, outline the various congenital anomalies encountered, and explain the possible embryological causes. This may help practitioners understand the face more easily.

Development of the Face

Facial development goes through several developmental processes [4] as follows: The first sign of facial development is the division of the ventral portion of the first pharyngeal arch into two processes: the maxillary process and the mandibular process, above and below the primitive mouth called stomodeum, respectively (Figure 1). Meanwhile, another process called the frontonasal process appears through the proliferation of the mesoderm covering the forebrain. Thus, at the beginning of the fifth week of fetal life, the face develops

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from five mesodermal processes (or ridges) in the middle layer. These processes are the frontonasal process, cranial to the stomodeum; two maxillary processes, one on each side of the stomodeum; and two mandibular processes, one on each side, caudal to the stomodeum (Figure 2).

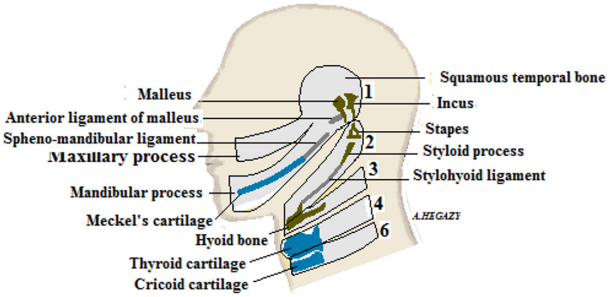

Figure 1) *Skeletal derivatives of pharyngeal arches.*

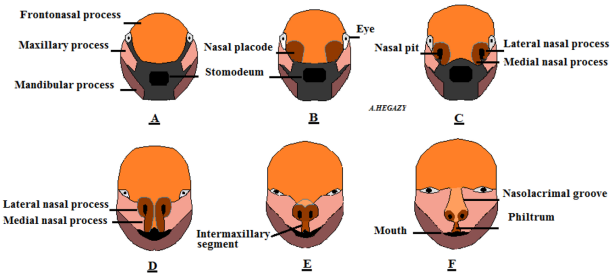

Figure 2) *Development of the face.*

The frontonasal process grows downward toward the stomodeum. Its upper part forms the forehead, covering the frontal lobes of the brain, while its lower part presents two ectoderm thicknesses (thicknesses of the ectoderm that cover it; one on each side) called the nasal placodes (or discs). Each of the placodes is then depressed to form a nasal pit. This pit divides the placodes into two elevated processes, the lateral nasal process and the medial nasal process. The lateral nasal process, on each side, forms the ala of the nose, while the two medial processes join to form the median nasal process (also called intermaxillary segment) (Figure 2).

The maxillary processes (one on each side) grow in the middle above the stomodeum to fuse with the lateral nasal process. At the fusion line, the nasolacrimal duct is formed. The maxillary process then extends to fuse with the medial nasal process, forming the primitive upper jaw. As the maxillary processes on both sides grow further, the medial processes are compressed together toward the midline to form the intermaxillary segment (or median nasal process).

The derivatives of the intermaxillary segment (medial nasal process) (Figure 3) include:

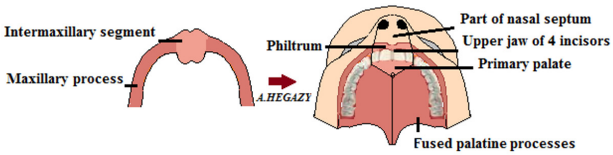

Figure 3) *Derivatives of intermaxillary segment.*

- The middle part of the nose (part of the nasal septum).
- The middle part of the upper lip, called the philtrum.
- The middle part of the maxilla bearing the four upper incisors.
- The anterior middle part of the palate, which is called the primary palate.

Therefore, the primitive maxilla consists of the intermaxillary segment (which forms the middle part) and the maxillary processes on either side (which form the lateral parts).

The mandibular processes (on each side) grow below the stomodeum, to merge with each other in the midline, to form the primitive mandible and with the maxillary process on each side, above, to form the cheek.

The cheek develops through the fusion of the maxillary and mandibular processes, and the degree of this fusion determines the width of the mouth opening.

The nasolacrimal duct develops at the line of fusion between the maxillary with the lateral nasal processes, where a strip of ectodermal tissue separates and sinks into the underlying mesoderm, then becomes canalized to form the nasolacrimal duct.

Each primitive jaw is then divided (separated) by a U-shaped alveolar groove into two parts: the outer part, called the lip, and the inner part, called the gingiva. The development of the facial muscles arises from the mesoderm of the second pharyngeal arch and is therefore innervated by the facial nerve (7th cranial nerve).

Congenital Facial Anomalies Include:

1. Cleft upper lip (Cleft lip): includes

A. Unilateral cleft of upper lip: occurs due to failure of fusion between the maxillary process and the medial nasal process on one side.

B. Bilateral cleft of upper lip: occurs due to failure of fusion between the maxillary process and the medial nasal process on both sides.

C. Median cleft of upper lip: occurs due to failure of fusion between the medial nasal processes. It is associated with the absence of the philtrum.

2. Median cleft of the lower lip: occurs due to incomplete fusion between the two mandibular processes.

3. Oblique facial cleft: occurs due to failure of fusion between the maxillary process and the lateral nasal process on one side.

4. Abnormally small mouth opening (Microstomia): occurs due to excessive fusion of the maxillary and mandibular processes on both sides.

5. Abnormally large mouth (Macrostomia): occurs due to incomplete fusion of the maxillary and mandibular processes on both sides.

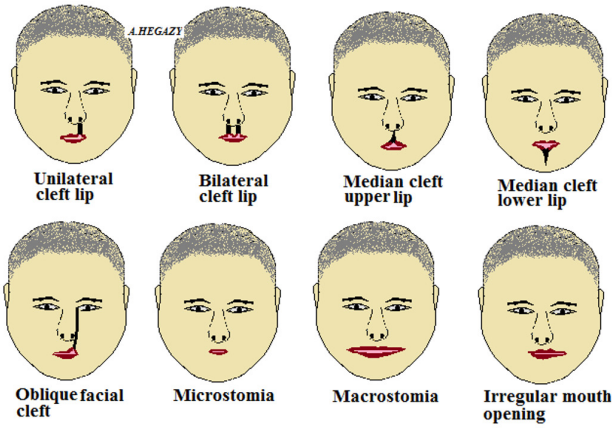

Figure 4) *Congenital anomalies of the face.*

6. Congenital mouth asymmetry (Irregular mouth opening): occurs because the maxillary and mandibular processes do not fuse equally on both sides [4] (Figure 4).

Congenital craniofacial anomalies often present with disorders in oral feeding and speech [5-7]. Therefore, affected newborns should be treated as soon as possible. These congenital facial deformities are usually repaired between 3 to 5 months after birth [8].

Conclusion

Facial development begins early in the fetus's life in the womb with the appearance of 5 mesodermal ridges (processes) surrounding the stomodeum. These processes include a frontonasal process, two maxillary processes, and two mandibular processes. These processes fuse together to form the cheek on each side and leave an opening for the mouth. Any defect in these processes can lead to congenital malformations that must be corrected as soon as possible after birth.

Acknowledgement

All figures are drawn by the author (AAH).

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