Embryology, Part 3

Development of the face and oral cavity

Kristine Krafts, MD
Outline

General overview of prenatal development

Embryonic period phase 1
- Formation of bilaminar disk
- Formation of trilaminar disk (gastrulation)

Embryonic period phase 2
- Formation of neural tube
- Differentiation of mesoderm
- Folding of embryo
- Formation of pharyngeal arches

Development of the face and oral cavity
- Face
- Pituitary gland
- Palate
- Tongue
- Thyroid
- Jaw bones

Part 3
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Part 3

We covered these in histology!
Face and Palate Objectives

1. Describe the main steps involved in the formation of the face (see Dr. Krafts’ summary online).

2. For each of the main structures of the face and palate (e.g., lower lip), list its origin (e.g., first arch), and intermediate prominence (e.g., mandibular prominence). See Dr. Krafts’ summary diagram online.

3. Describe the main steps involved in the formation of the palate (see Dr. Krafts’ summary online).
Tongue Objectives

1. Describe how the mucosa of the tongue is formed from the first four arches. Include the contribution (if any!) of the following structures: lingual swellings, tuberculum impar, hypopharyngeal eminence, foramen cecum, and copula.

2. List the nerves supplying general sensation to the anterior 2/3 and posterior 1/3 of the mucosa of the tongue.

3. Describe the origin and motor innervation of the muscles of the tongue.

4. Describe the location of the four types of papillae, and list the nerves supplying taste sensation to the papillae containing taste buds.
1. Describe how and when the mandible develops. Include the site of origin (between which nerve branches?), the role of Meckel’s cartilage, and the fate of the three secondary (growth cartilages).

2. Describe how and when the maxilla develops. Include the site of origin of bone formation, and the contribution of secondary cartilages.
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Development of the face and oral cavity
  • Face
Development of face begins in week 4.

The basic idea: structures from the sides/top grow towards each other and fuse together.
The whole face is derived from these three prominences.
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Ectoderm of frontal prominence thickens, forming olfactory placodes.

Center of placodes sinks (forming nasal pits), and edges proliferate (forming nasal processes).
Maxillary processes grow towards midline, pushing nasal pits and medial processes closer together.
Medial nasal processes fuse, forming middle portion of upper lip. This fusion also forms the nasal septum, the middle part of the maxilla, and the primary palate (all of which we’ll talk about shortly).
Maxillary process fuses with medial nasal process (obliterating bucconasal groove), forming lateral part of upper lip.
Maxillary process fuses with lateral nasal process (obliterating nasolacrimal duct), forming cheek and lateral part of nose.
Mandibular processes fuse, forming lower lip, chin, and the beginnings of the mandible.
Cleft Lip

Results from abnormal fusion of middle or lateral portion of lip

Median cleft lip

Bilateral cleft lip
Facial and mandibular clefts

Result from abnormal fusion of other processes (left)

Mandibular cleft

Oblique facial cleft
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Development of head, face and oral cavity
  • Face
  • Palate
Head-to-tail folding forms stomatodeum (oral cavity).

Nasal pit deepens, forming nasal sac. Primary palate forms.
Nasal cavity forms, oronasal membrane ruptures.

Head lifts away from thorax. Jaw and tongue move down and forward.
Secondary palate forms, and connects with primary palate.
Palatal shelves appear in week 7; secondary palate fully formed (and connected to primary palate) in month 3.
7 weeks

Palatal shelves

8 weeks

3rd month

FACE
PALATE
TONGUE
JAW

Nasal septum
Palatal shelves
Hard palate
Soft palate
Rugae
Epithelial seam
Alveolar ridge
### Cleft Palate

<table>
<thead>
<tr>
<th>FACE</th>
<th>PALATE</th>
<th>TONGUE</th>
<th>JAW</th>
</tr>
</thead>
</table>

Cleft Palate
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Development of head, face and oral cavity
  • Face
  • Palate
  • Tongue
Pharyngeal arches fuse in midline, form three swellings:

- Tuberculum impar appears and remains small
- Lingual swellings form anterior 2/3 of tongue
- Hypopharyngeal eminence forms posterior 1/3 of tongue

General sensation: \( V_3 \)

Mostly IX, tiny bit X
Three more structures to note:

- Copula (early structure that disappears quickly)
- Foramen cecum (thyroid descends from here)
- Terminal groove (line of fusion of oral and pharyngeal parts of the tongue)
The muscles of the tongue are derived from occipital somites, which migrate into the floor of mouth, carrying with them their nerve supply (XII).
## Development of the Tongue: Summary

<table>
<thead>
<tr>
<th>Origin</th>
<th>Intermediate structure</th>
<th>Final structure</th>
<th>Nerve</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arch 1</td>
<td>Lingual swellings</td>
<td>Mucosa of anterior 2/3 of tongue</td>
<td>$V_3$</td>
<td>General sensation</td>
</tr>
<tr>
<td>Arch 2</td>
<td>Copula</td>
<td>None (overgrown)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Arch 3</td>
<td>Large, ventral part of hypopharyngeal eminence</td>
<td>Mucosa of most of posterior 1/3 of tongue</td>
<td>$IX$</td>
<td>General sensation</td>
</tr>
<tr>
<td>Arch 4</td>
<td>Small, dorsal part of hypopharyngeal eminence</td>
<td>Mucosa of tiny, dorsal part of posterior 1/3 of tongue</td>
<td>$X$</td>
<td>General sensation</td>
</tr>
<tr>
<td>Somites</td>
<td>Myoblasts</td>
<td>Muscles of tongue</td>
<td>$XII$</td>
<td>Motor</td>
</tr>
</tbody>
</table>
Papillae and Taste Buds

- All papillae contain taste buds except filiform.
- Taste sensation is separate from general sensation!
- VII does taste for most of tongue.
- IX does small posterior area of tongue.
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Development of head, face and oral cavity
  • Face
  • Palate
  • Tongue
  • Jaw
The mandible develops by intramembranous ossification within the mandibular process. Begins around week 6; rudimentary mandible present by week 10.
Development of the Mandible

To form the ramus of the mandible, ossification moves away from Meckel’s cartilage and spreads posteriorly.

Meckel’s cartilage *might* contribute a *little* bit to bone growth anteriorly (through endochondral ossification)

Meckel’s cartilage forms the incus/malleus and two ligaments (the sphenomalleolar and sphenomandibular) – but the rest just degenerates!
Three secondary (growth) cartilages of the mandible

- **Condylar cartilage**
  - Appears in ramus at week 12; rapidly ossified.
  - Little piece remains until late teens (for endochondral bone growth).

- **Coronoid cartilage**
  - Develops at coronoid process; disappears long before birth.

- **Meckel’s cartilage**
  - Develops at anterior ends of Meckel’s cartilage (at what will be the mandibular symphysis).
  - Disappears within the first year of life.

- **Symphysial cartilage**
Development of the Maxilla

The maxilla develops by intramembranous ossification within the maxillary process. Begins around week 7; rudimentary structures in place by week 12.

Bone formation starts here!
Ossification spreads in all directions, including into the palate.

There’s no primary arch cartilage - but a secondary cartilage called the zygomatic cartilage briefly aids bone growth in fetal life.
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Development of head, face and oral cavity
  • Face (bones and muscles)
  • Palate
  • Tongue
  • Jaw