

ANHB3324 LECTURE 13 (20/05/2014)

The Embryology of the Head

- The head develops as the combination of two main components
 1. The brain – chondrocranium or neurocranium
 2. Anterior end of the gut tube – viscerocranium
- The neurocranium
 - Parts that are like vertebrae
 1. Develops in relation to the brain
 2. The brain is the superior end of the neural tube
 3. The notochord extends as far as the pituitary fossa of the skull
 4. The part of the skull between the foramen magnum and the pituitary fossa develops like a vertebra
 - Parts that grow out with special sensory nerves
 1. Nasal capsule – grows out with the olfactory nerves (smell)
 2. Optic capsules – grows out with the optic nerves and forms the orbits
 3. Otic capsules grow out with the vestibulocochlear nerves and form the bony parts of the ear (inner and middle)
 - Parts that develop as dermal bone – bone in the skin
- The viscerocranium
 - The viscerocranium forms the lower part of the face and develops around the opening of the gut tube (pharyngeal arches)
 - Even this part is closely connected to the brain as the pharyngeal arches are associated with neural crest ectoderm and grow in association with cranial nerves

Evolution of the Neurocranium & Viscerocranium

- Jawless fish
 - Neurocranium = braincase with capsules
 1. Nasal
 2. Optic
 3. Otic
 - Viscerocranium = mouth and gills (pharyngeal arches)
- Jawed fish – first gill arch becomes the jaws
- In land animals the same features are present – the gill arches have become upper and lower jaws, hyoid bone, and laryngeal cartilages
- Membrane (dermal) bone forms many of the superficial bones

Folding & the Importance of the Brain

- The rapid growth of the brain causes the head fold
- The head-fold forms the chest and the head, and brings the oral membrane to the right place for a mouth

The Four-Week Embryo

1. Segmental somites and developing vertebrae
2. Tail
3. Connecting stalk – umbilical cord
4. Large heart bulge
5. Limb buds look like paddles

- The head consists of
 1. Rapidly growing brain covered by the frontonasal process
 2. Pharyngeal (gill arches)
 - a. First arch has maxillary and mandibular swellings
 - b. Second (hyoid) arch
 - c. Third arch
 - d. Forth, fifth, and sixth arches
 3. Olfactory pits (from the nasal capsule) widely separated
 4. Optic cup situated laterally

Development of the Face

1. Frontonasal process
 2. Olfactory pits surrounded a nasal process
 3. Optic cup on the side
 4. Maxillary process
 5. Oral membrane
 6. Mandibular processes fuses across the midline
 7. Hyoid arch
- Maxillary processes grow medially
 1. Squeeze the nasal process closer together
 2. Bring the optic cups (eyes) to the front
 - The trigeminal nerve (CNV) – nerve of the first pharyngeal arch has three divisions that match the three main parts of the developing face
 1. Ophthalmic supplies the frontonasal process
 2. Maxillary supplies the maxillary process
 3. Mandibular supplies the mandibular process

Embryology of the Face

- The mandibular and maxillary swellings grow medially – pushing the nasal pits together and bringing the optic placodes towards the front
- The maxillary processes of the maxilla fuse to form the roof of the mouth
- If any of these parts fail to fuse it will produce facial clefts
- Distribution of the trigeminal nerve mirrors the development of the face

Pharyngeal Arches

- Each pharyngeal arch consists of – skeletal elements, muscles, nerves, blood vessels (aortic arches)

Pharyngeal Arch	Skeletal Elements	Muscles	Nerve
First Maxillary Mandibular	Maxilla Mandible	Muscles of mastication	CN 5 Trigeminal
Second Hyoid	Styloid process Body and lesser horns of hyoid	Muscles of the facial expression	CN 7 Facial
Third	Body and greater horns of the hyoid bone	Stylopharyngeus	CN 9 Glossopharyngeal

Forth, fifth, and sixth	Laryngeal cartilages	Palatine Pharyngeal Laryngeal Trapezius Sternomastoid	CN 10 Vagus (and cranial accessory) CN 11 Spinal accessory
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Pharyngeal Pouches & Clefts

- There are gaps between the arches and these form:
 1. The pouches – on the inside (endoderm)
 2. The clefts – on the outside (ectoderm)
- The thyroid gland develops as a single outgrowth from the floor of the mouth

Pouch or Cleft	Pouch	Cleft
1 (Below arch 1)	Eustation tube and middle ear	External auditory meatus
2	Palatine tonsils	These all disappear but are sometimes seen as cervical sinuses
3	Inferior parathyroids and thymus	
4	Superior parathyroid glands	