Pharyngeal arches and pouches

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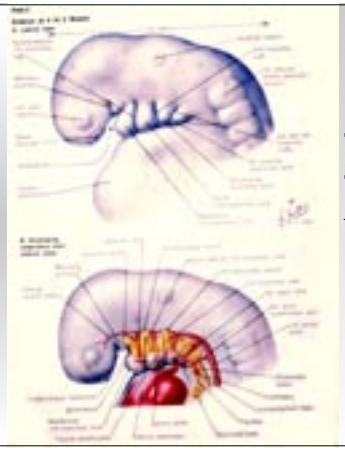
Pharyngeal arches: a definition

A **segmental series** of five paired swellings that surround the foregut between days 20 to 35 of embryonic development. These segments, which are unique to vertebrates, are "wedged" between the developing forebrain and heart.

Pharyngeal arches

- a.k.a. visceral or branchial arches
- Develop (and disappear as distinctively visible structures) in a rostro-caudal sequence
- Require neural crest cells for their development
- Even after they are no longer visible externally, they have a lasting impact on the anatomy of the head and neck and of the great vessels



5 Pharyngeal arches

5 Aortic arches

Arches numbered 1-6

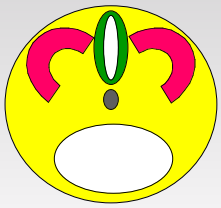
Arches, grooves, pouches, and membranes

Pharyngeal arches are unique to vertebrates (subphylum of chordates)

Sedentary

Passive, filter-feeding

Basic body plan of all chordates (incl. vertebrates)



Dorsal hollow neural tube
Segmented lateral mesoderm
Central notochord
Ventral digestive tube
(Pharyngeal gill slits)

Evolution of vertebrates involved:

- Development of organs of special sense in head region to detect prey
- Development of a large neural circuitry (the brain) to integrate input and responses
- Development of an effective feeding apparatus (jaws: pharyngeal arch derivatives)
- Development of an improved respiratory apparatus (gills: pharyngeal arch derivatives).

This required the recruitment of an existing group of cells: neural crest cells, for a new role.

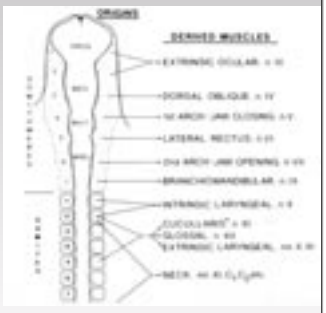
Pharyngeal cleft transient "gill-slit"

Mesenchyme in cephalic region derived from:

- Mesoderm
- Neural crest

Cephalic mesoderm

Prechordal plate origin ?



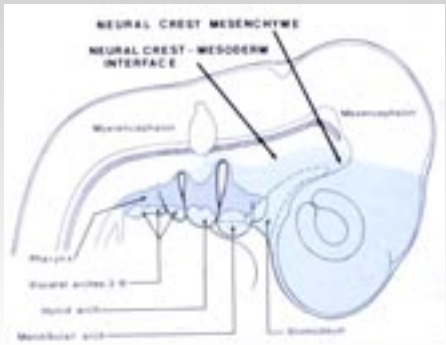
Somitomeres, not somites

Somitomeres

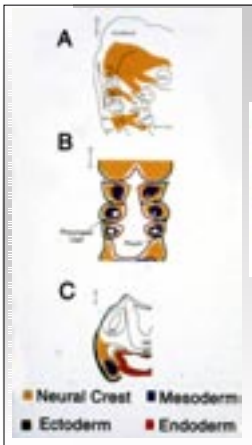
Somitogenesis

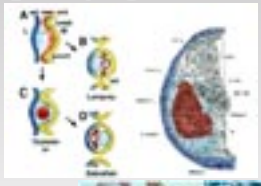
Cephalic somitomeres

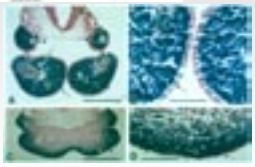
Neural crest and mesoderm in H&N area

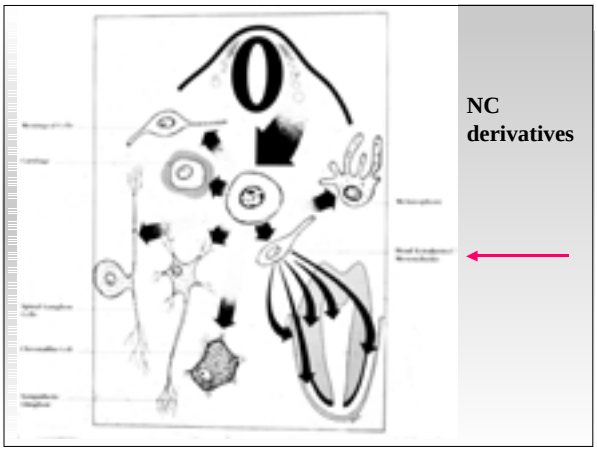


Neural crest in pharyngeal arches



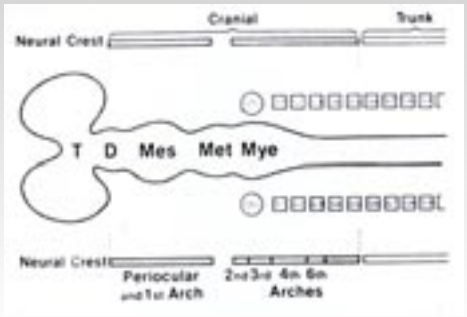




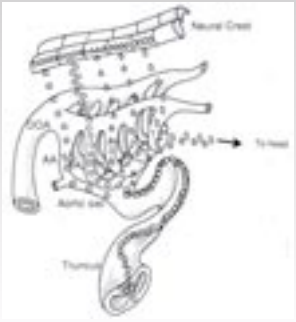


NC derivatives

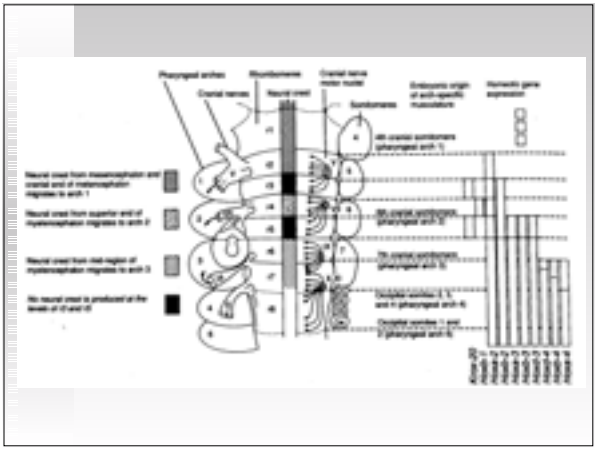
Extent of cephalic (cranial) neural crest



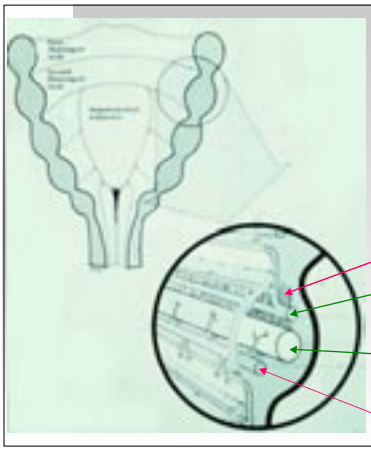
Neural crest involvement in the development of the heart



Arch segmentation and rhombomeres



Segmental components of arches



Connective tissues - nc

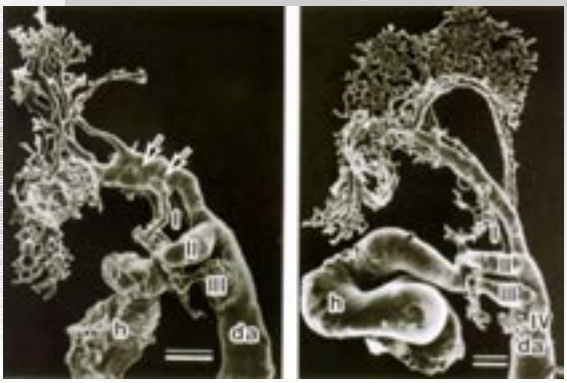
Muscle – mesoderm

Branchiomeric nerve – nc,ectoderm,neurectoderm

Skeletal bar- nc - (cartilage) last to form

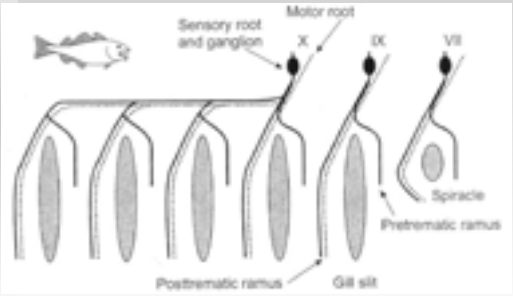
Artery – mesoderm- first to appear

Aortic arch development



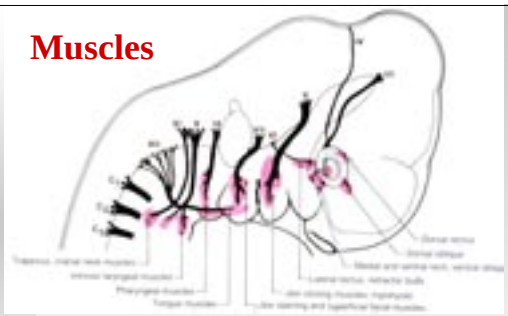
Aortic arch development cont'd

Branchiomeric nerves : pre- and posttrematic rami



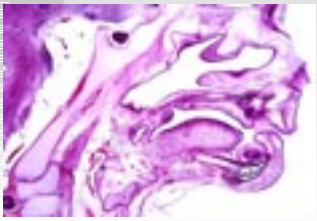
Dual afferent innervation in each arch

Muscles

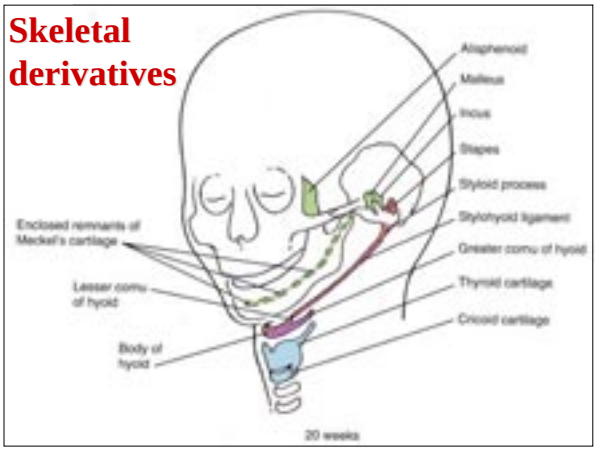


Arch 1: Muscles of mastication (V)
Arch 2: Muscles of facial expression (VII)
Arch 3: Stylopharyngeus muscle (IX)
Arch 4-6: Laryngeal muscles (X-XI)

Skeletal elements



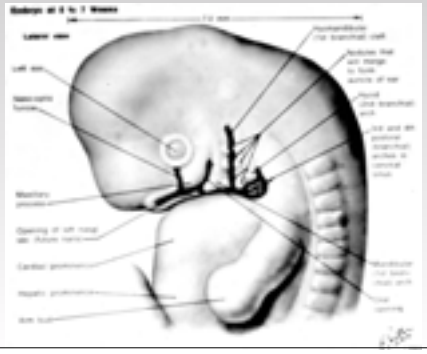
Skeletal derivatives



Fate of pharyngeal grooves 2-4

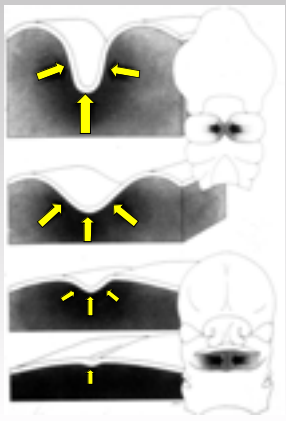
Covered by rapid outgrowth of 2nd arch "operculum."

External ear receives contributions from arches 1 and 2

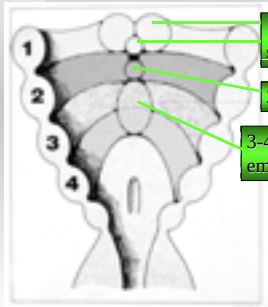


External ear development by merging of 6 auricular hillocks

External ear and tongue development require merging: the elimination of a groove between facial processes by differential growth



Endodermal swellings on arches 1-4 contribute to the tongue



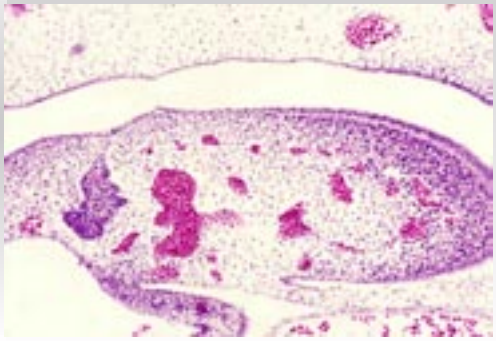
1. Paired lingual swellings and single median tuberculum impar

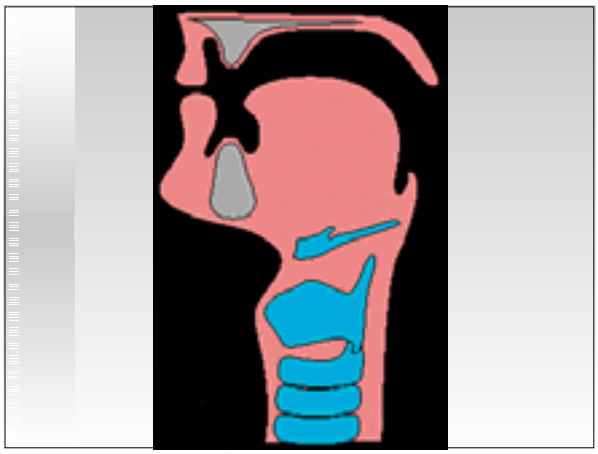
2. Single median copula

3-4. Combined median hypobranchial eminence

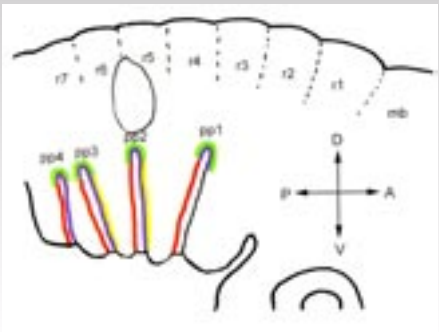
Merging of lingual swellings

Thyroid gland development Thyroglossal duct

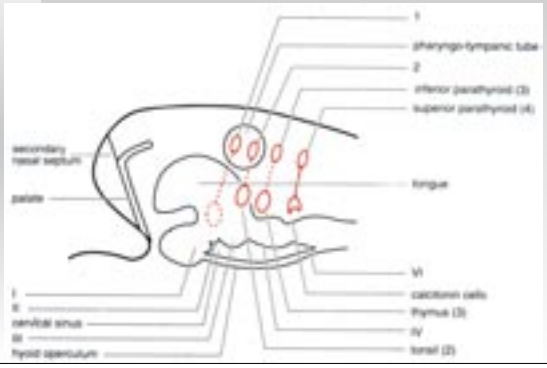




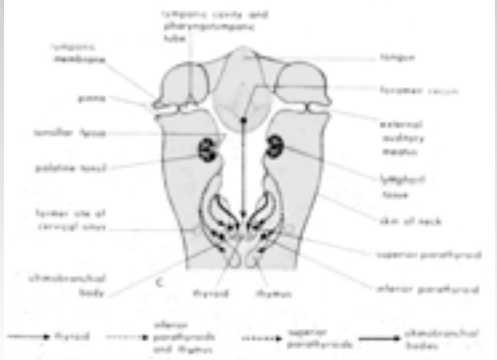
Endoderm plays key role in morpho-genesis of pharyngeal region

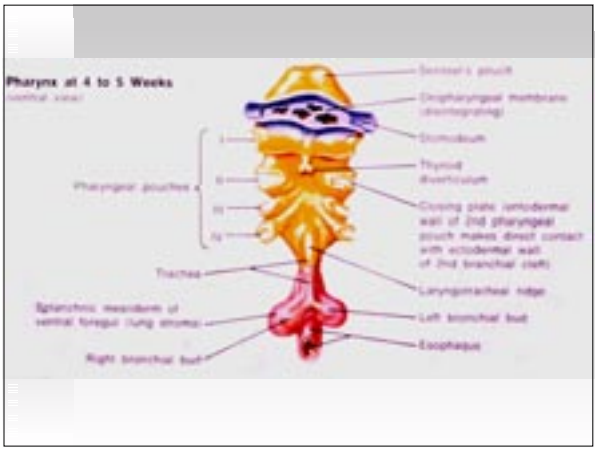


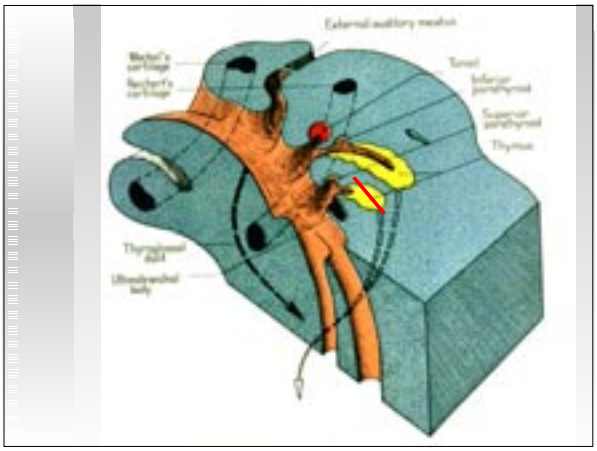
Derivatives of dorsal and ventral parts of pharyngeal pouches

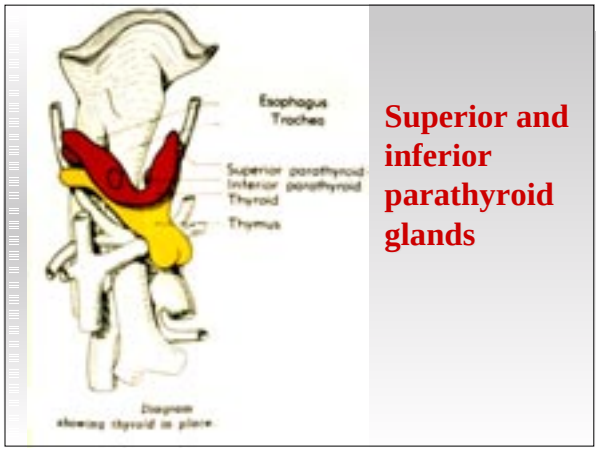


Fate of 1st pharyngeal groove and pouch









Superior and inferior parathyroid glands