

Pharyngeal arches

L.Moss-Salentijn

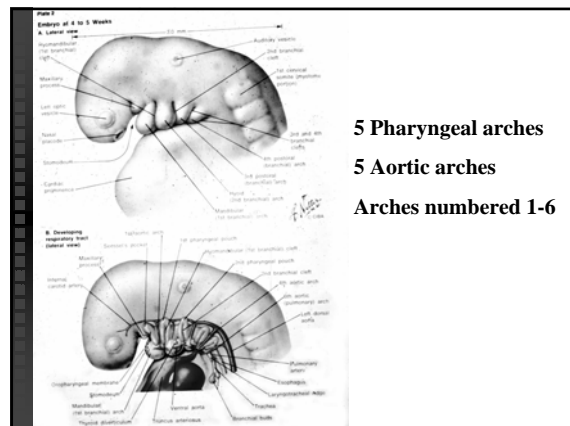
Pharyngeal arches: a definition

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.

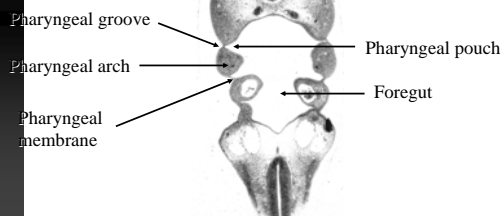


Pharyngeal arches

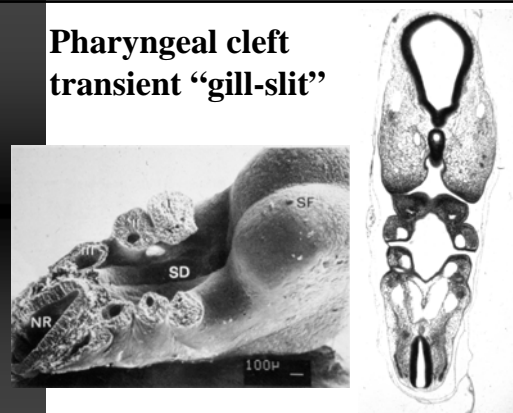
- a.k.a. visceral or branchial arches
- Develop (and disappear as distinctively visible structures) in a rostro-caudal sequence
- Require neural crest cells for their development
- Even after they are no longer visible externally, they have a lasting impact on the anatomy of the head and neck and of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

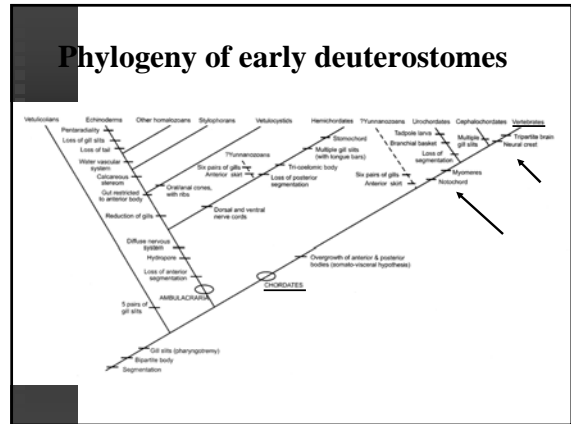
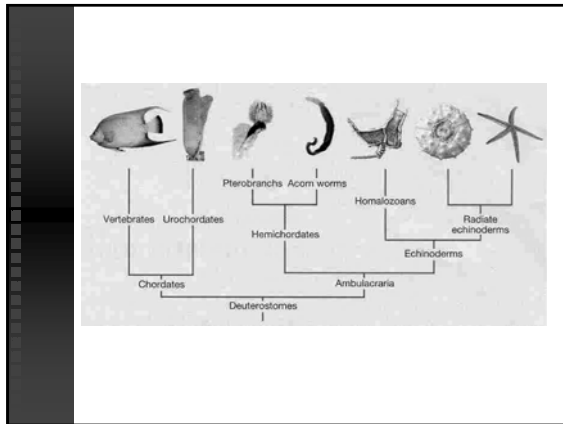


Arches, grooves, pouches, and membranes



Pharyngeal cleft transient “gill-slit”





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.

Jawless fishes - lampreys

- Mesoderm
- Neural crest

ORIGINS

STOMODONTOMERES

1 PROS

2 MES

3 MET

4 MET

5 MES

6 MES

MESODONTOMERES

1 MET

2 MET

3 MET

4 MET

5 MET

6 MET

DERIVED MUSCLES

EXTRINSIC OCULAR, n III

DORSAL OBLIQUE, n IV

1st ARCH - JAW CLOSING, n V

LATERAL RECTUS, n VI

2nd ARCH - JAW OPENING, n VII

BRANCHIOCHORDAL, n IX

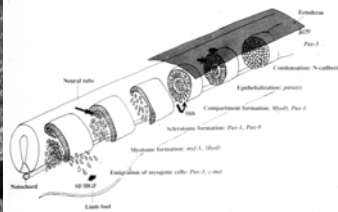
INTRINSIC LARYNGEAL, n X

CUCULLARIS, n XI

GLOSSAL, n XII

EXTRINSIC LARYNGEAL, nn XI, XII

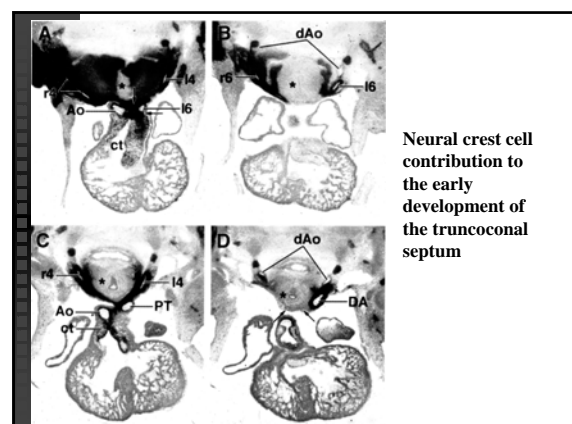
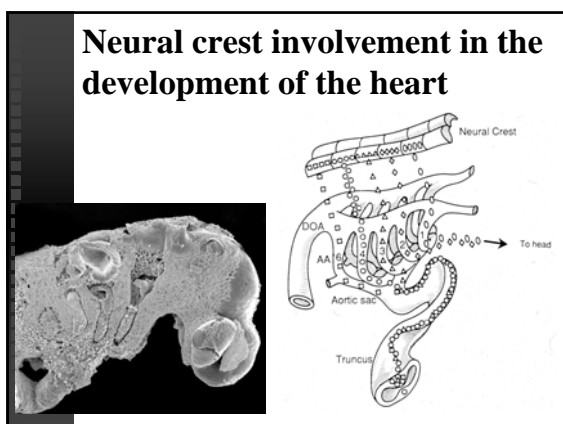
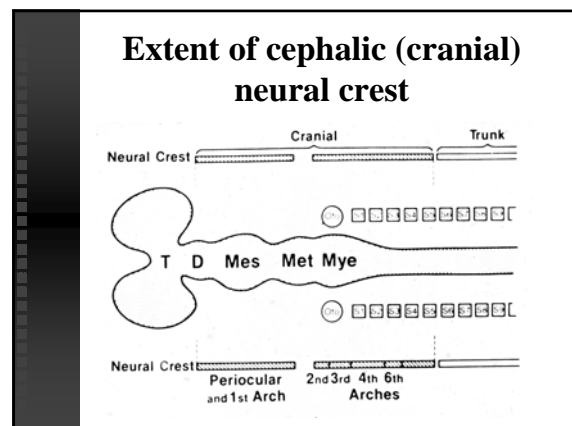
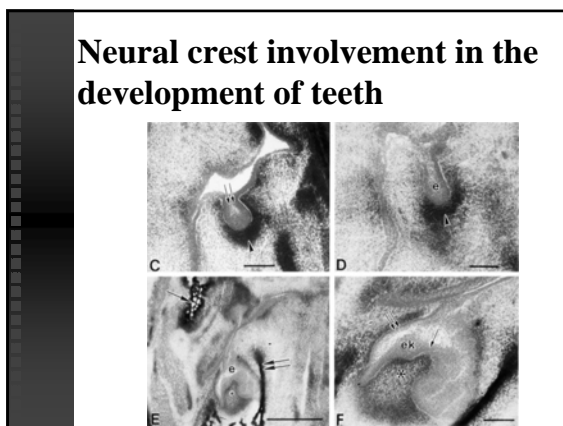
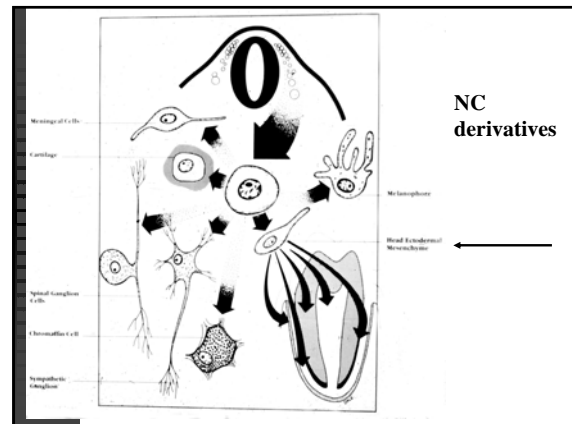
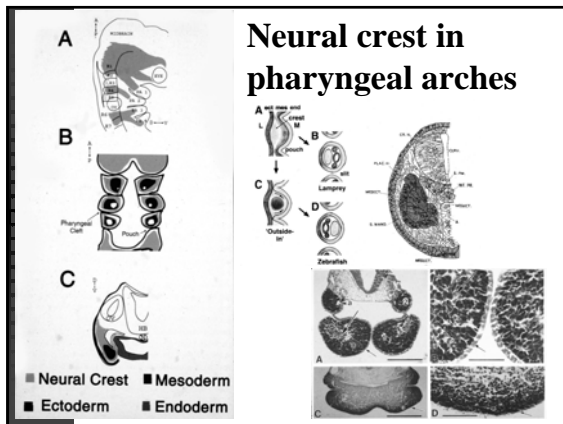
NECK, nn XI, XII, C1-C6



The figure consists of seven schematic diagrams illustrating the early development of a chick embryo. The top row shows the initial cleavage stages: a single-cell stage (top left), a two-cell stage (top middle) with labels PROS, MES, MET, and MYEL, and a three-cell stage (top right) with labels MES, MET, MYEL, and PROS. The bottom row shows the embryo at later stages: a four-cell stage (bottom left), a five-cell stage (bottom middle) with labels MES, MET, MYEL, and PROS, and a hatched embryo (bottom right) with labels MES, MET, MYEL, and PROS. The diagrams illustrate the formation of the yolk sac, amnion, and the embryo itself.

Diagram illustrating the head region of a developing embryo, showing the neural crest mesenchyme and its derivatives. The diagram labels the following structures:

- NEURAL CREST MESENCHYME
- NEURAL CREST - MESODERM INTERFACE
- Myelencephalon
- Mesencephalon
- Pharynx
- Visceral arches 3-6
- Hyoid arch
- Mandibular arch
- Stomodeum



Arch segmentation and rhombomeres

Arch segmentation and rhombomeres

mes

r1/2

r3

r4

r5

r6

r7

r8

s2

tc

nc

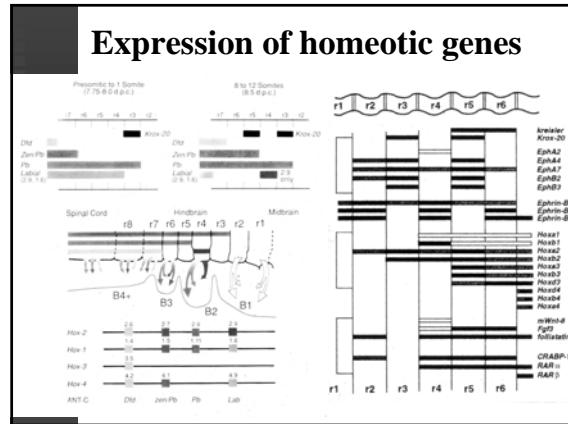
rb

OV

■ Sites of *Bmp-4* expression

■ Noggin expressing neural crest

■ Neural crest not expressing Noggin



The diagram illustrates the segmentation of the pharyngeal arches in a vertebrate head. The top part shows a schematic of the head with labels for the 'First pharyngeal arch', 'Second pharyngeal arch', and 'Hyobranchial rudiment'. The bottom part is a circular inset providing a detailed view of the arch structure, with labels for the 'Muscle - mesoderm', 'Branchiomeric nerve - nc, ectoderm, neur ectoderm', 'Skeletal bar - nc - (cartilage) last to form', and 'Artery - mesoderm - first to appear'.

Aortic arch development

The figure consists of two scanning electron micrographs (SEM) showing the development of the aortic arch. The left image shows an early stage with labels I, II, III, h, and da. The right image shows a later stage with labels I, II, III, IV, h, and da. Both images include scale bars.

Branchiomereric nerves: rhombomeric origins

A

B

■ oculomotor

■ r1 trochlear

■ r2/3 trigeminal

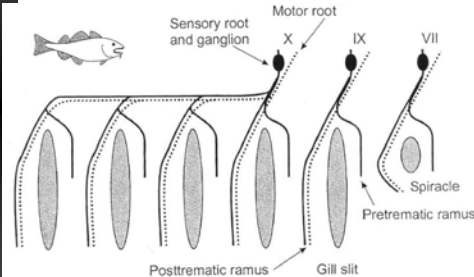
■ r4/5 facial/labial

■ r6 glossopharyngeal

■ r7/8 vagus/accessory/hypoglossal

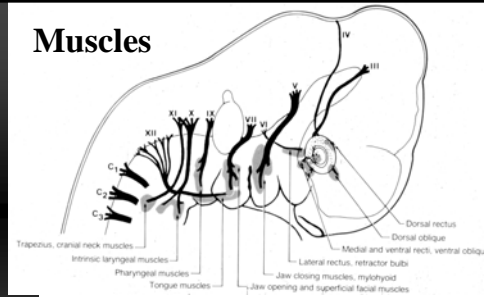
■ spinal cord

Branchiomic nerves : pre- and posttrematic rami



Dual afferent innervation in each arch

Muscles



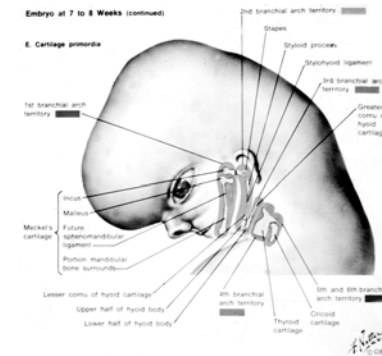
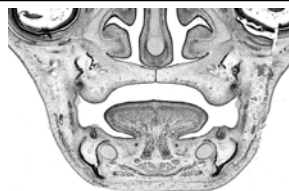
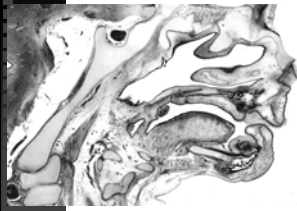
Arch 1: Muscles of mastication (V)

Arch 2: Muscles of facial expression (VII)

Arch 3: Stylopharyngeus muscle (IX)

Arch 4-6: Laryngeal muscles (X-XI)

Skeletal elements



Skeletal derivatives

