Embryology

Lect16   Development of muscular system

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The formation of the muscular system begins about 4th week of embryonic development. The beginning cells are called Myoblasts. Most of our muscles develops from the mesodermal germ layer. Except some smooth muscle tissues (pupil, sweat glands and mammary gland differentiate from ectoderm)

The muscular system consist of;

1. Skeletal musculature
2. Cardiac musculature
3. Smooth musculature

   Skeletal muscles are derived from paraxial mesoderm
   This forms;

ω Somites from the occipital to the sacral regions

ω Somitomeres in the head

Smooth muscles differentiate from splanchnic mesoderm surrounding the gut and its derivatives.

   Cardiac muscles are derived from splanchnic mesoderm surrounding the heart tube

   Striated skeletal musculature

Musculature of the head, axial skeleton and body wall are formed by Somites and somitomeres

From the occipital region caudally, somites form and differentiate into;

►Sclerotome
►Dermatome
►Two muscle-forming regions

One in the dorsolateral region of the somite provides progenitor cells for limb and body wall musculature (hypomeric)

The other in the dorsalmedial region forms the myotome (epimeric musculature).

Dermomyotome

Sclerotome

C

Dorsal aorta

Neural tube

Sclerotome

Dermatome

Myotome

D
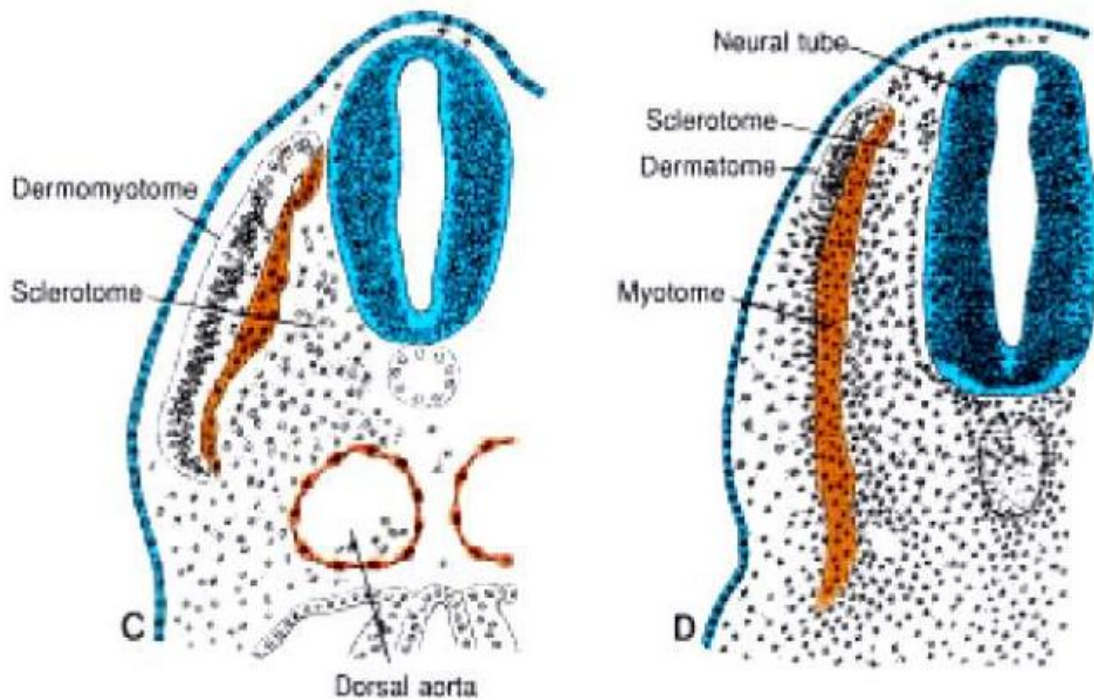
- Precursor cells, the myoblasts, fuse and form long, multinucleated muscle fibers
- Myofibrils soon appear in the cytoplasm, and by the end of the third month, cross- striations appear in skeletal muscle
- A similar process occurs in the seven somitomeres in the head region rostral to the occipital somites.

Patterning of muscle

Patterns of muscle formation are controlled by connective tissue into which myoblasts migrate

In the head region these connective tissues are derived from neural crest cells;

in cervical and occipital regions they differentiate from somatic mesoderm; and

In the body wall and limbs they originate from somatic mesoderm .

Derivatives of precursors muscle cells

By the end of the 5th week prospective muscle cells are collected into two parts:

¬Epimere (small dorsal portion) – innervated by the dorsal primary ramus

¬Hypomere (larger ventral part) – innervated by the ventral primary ramus

Myoblasts of the epimeres form the extensor muscles of the vertebral column, and those of the hypomeres give rise to muscles of the limbs and body wall.

Transverse section through the thoracic region of a 5-week embryo
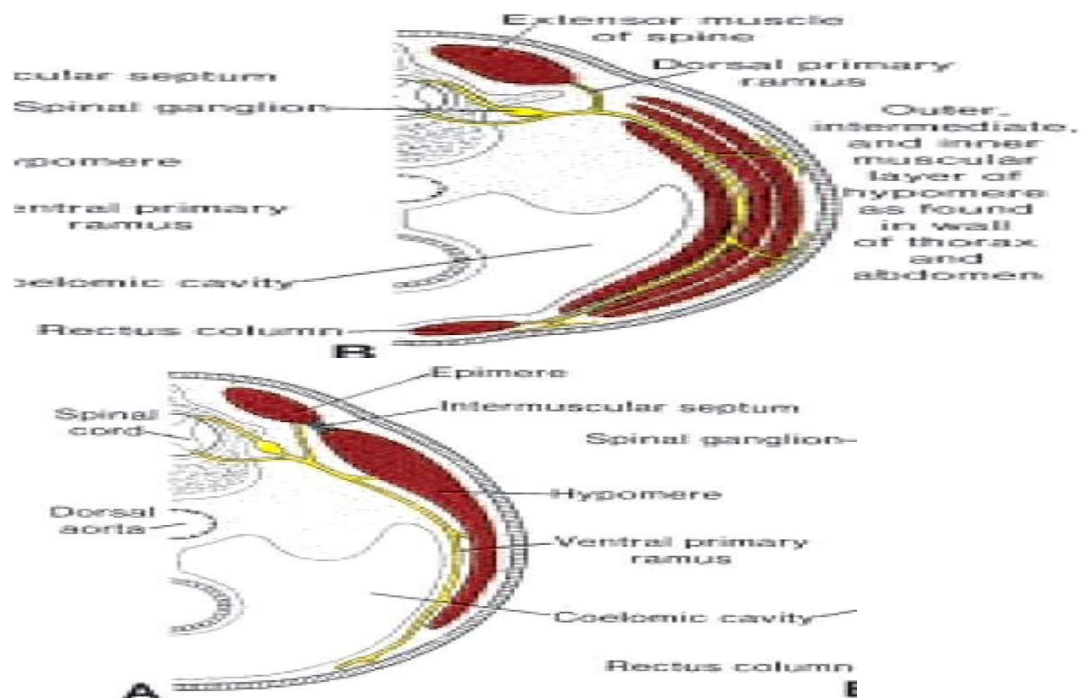
Myoblasts from cervical hypomeres form the geniohyoid, and prevertebral muscles.

Those from thoracic segments split into three layers, which in the thorax are represented by;

⌉External Intercostal

⌉Internal Intercostal

⌉Innermost Intercostal

In the abdominal wall these three muscle layers consist of the external oblique, the internal oblique, and the transversus abdominis muscles.

- Myoblasts from the hypoblast of lumbar segments form the quadrates lumborum muscle
- ☐ Those from sacral and coccygeal regions form the pelvic diaphragm and striated muscles of the anus.

    A ventral longitudinal column arises at the ventral tip of the hypomeres.

    This column is represented by the rectus abdominis muscle and the infrahyoid musculature.

    Head musculature

All voluntary muscles of the head region are derived from paraxial mesoderm (somitomeres and somites);

Including muscle of the tongue, eye (except that of the iris, which is derived from optic cup ectoderm), and that associated with the pharyngeal (visceral) arches.

Patterns of muscle formation in the head are directed by connective tissue elements (Neural crest cells) .

Limb musculature

Connective tissue dictates the pattern of muscle formation in the limb

Derived from the somatic mesoderm

The mesenchyme is derived from dorsolateral cells of the somites that migrate into the limb bud to form the muscles. With elongation of the limb buds, the muscle tissue splits into flexor and extensor components .

The upper limb buds lie opposite the lower five cervical and upper two thoracic segments, and the lower limb buds lie opposite the lower four lumbar and upper two sacral segments.