Appendicular Muscles

Very early in development, the appendicular musculature is divided into two distinctive masses: a dorsal mass that lies along the upper side of the appendicular skeleton and a ventral mass that lies beneath the appendicular skeleton. This division is very clear in the embryos and adults of fish. The dorsal mass elevates (abducts) the fin and the ventral mass depresses (adducts) the fin.

In tetrapods, the muscles of the limbs also develop from dorsal and ventral masses, and these masses can be seen in their embryos. However, this relationship between the location of the muscles relative to the appendage is obscured in adult tetrapods where each muscle mass divide into many separate elements. So, when morphologists refer to the dorsal and ventral masses of the limb muscles they are referring to the early embryonic positions of these muscles. Nonetheless, the collection of muscles that develop from the dorsal muscle mass are homologous to the abductor of the fish fin and the muscles that develop from the ventral muscle mass are homologous to the adductor of the fish fin.

Muscles in a limb develop either from the axial skeleton that migrate into the limb or form within the limb. Muscles that form within a limb may stay in the limb or migrate out to attach to the axial skeleton. One example of a muscle of a limb that starts its development in the limb and migrates out is the latissimus dorsi. This muscle attaches to the humerus of the pectoral limb and attaches to epaxial muscles in amphibians and vertebrae in reptiles and mammals.

Muscles do not necessarily retain their dorsal and ventral orientation throughout their evolution. A muscle may shift from its originally dorsal and ventral position. Recall the supracoracoideus muscle is located ventral to the front limb in tetrapods with a sprawl posture where it helps to support the body. During the evolution of mammals, the supracoracoideus shifted to a dorsal position and became the supraspinatus and infraspinatus muscles. This change in position is correlated with a change in posture during mammalian evolution. Mammals changed their posture to an upright posture with the limbs tucked underneath the trunk. Along with this change in posture were many changes to the pectoral girdle: the virtual loss of the coracoid and the formation of the supraspinous fossa on the scapula for the supraspinous muscle. It is interesting that early
in development of mammals, the supraspinous and infraspinous muscles still start out as ventrally placed muscles.

Another example of re-assembly of appendicular muscles is found in the pelvic limb, and correlated with a shift from a sprawling posture to the ‘limb-tuck-under-trunk’ posture of mammals. Primitively, as seen for example in a living lizard, the pelvic limb muscles are arranged into dorsal and ventral sheets that are each composed of many separate elements. We can label these different parts of the dorsal and ventral sheets by the nerves that innervate them. Dorsally, there are femoral and peroneal parts and ventrally there are the obturator and tibial parts. Thus, the nerves that innervate these muscles are the femoral nerve, peroneal nerve, obturator nerve and tibial nerve.

To make a long story short, during the evolution of these parts of the limb muscles, the different dorsal and ventral parts separate and rearrange into anterior and posterior parts.
Then, there was a regrouping of some parts with the basic effect that the division between muscle masses changed from a dorsal-ventral division to an anterior-posterior division.

This regrouping makes sense when you consider the change in posture from a primitive tetrapod such as a reptile and a mammal. In primitive tetrapods, the appendicular muscles serve to: 1) support the trunk on the limbs and 2) lift the limbs during movement. Most of the propulsive force is contributed by: a) lateral undulations of the trunk that can throw the limbs forward and b) by muscles that originate from the tail and insert onto the femur.

One muscle in particular, the caudofemoralis is a primary retractor of the femur and since the hind limb tends to produce more propulsive force than the forelimb, it generates a significant amount of propulsion. Recall that the pelvic girdle, unlike the pectoral girdle, has a firm attachment to the vertebral column through the ribs of the sacral vertebrae.
In mammals, the propulsive force comes from the re-arranged pelvic appendicular muscles, not from the caudofemoralis muscle. This muscle is very minor in mammals (tail-wagging).

Thus,

![Diagram of lifting and supporting actions](image)

In mammals, much of the **supportive** function is achieved not by muscles, but instead by tucking the limbs underneath the trunk.

Speaking of supportive functions of muscles, we can also look at the evolution of the muscles of the pectoral girdle. Recall that the pectoral girdle does not have a direct contact with the vertebral column unlike the pelvic girdle. Instead, the trunk is supported between the two halves of the pectoral girdle by a ‘muscular sling’ composed of muscles from each of the three main groups of skeletal muscles.

A single branchiomeric muscle, the **trapezius**, is one of these shoulder muscles. This muscle is homologous to the cucullaris muscle that you have seen in the shark. In the shark, this muscle is clearly associated with the branchial skeleton. Two axial muscles, the **serratus ventralis** and **rhomboideus** are integral parts of this muscular sling. The **pectoralis** muscle is an appendicular (ventral) muscle that forms the final component of the muscular sling.