The Canine Scapula and the Healthy Function of the Canine Shoulder
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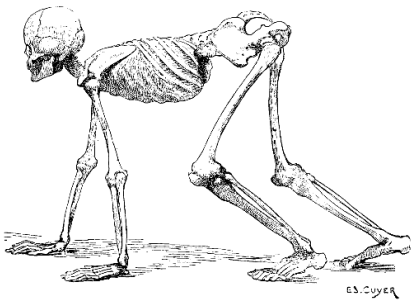
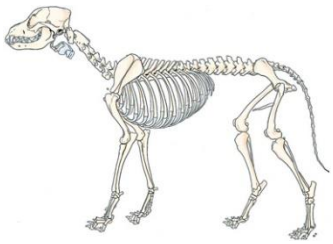
This paper concentrates on the structure and function of the canine shoulder, centering on the scapula. While it is impossible to separate and isolate any one part of the whole body, this paper will try to shed some understanding of the role of the scapula in the function of the canine shoulder, the muscles, nerves, and arteries proximal to the scapula that contribute to the strength and movement of the shoulder, and the potential problems that can arise from problems. Massage can contribute to the wholeness of the shoulder.

My dog runs and jumps with great power and energy in a way that I cannot. His four-on-the-floor motion depends on the drive of his hips and rear legs to propel him forward and his shoulders and front legs to give direction. Quadrupeds and bipeds both have two scapulae (shoulder blades) in a vertical plane, but if I were to get down on all fours, my scapulae would be in a horizontal plane.





As form follows function in nature, the design of the shoulder and the placement of the scapulae allow the flexible steering and strength required by four-legged creatures. The shape and position of the forequarters, consisting of the shoulders, the scapulae and the humerus (upper arm) and sternum (breastbone) are noticeably different in different types of animals and even in different breeds of dogs to serve its purpose in the movement of that animal.

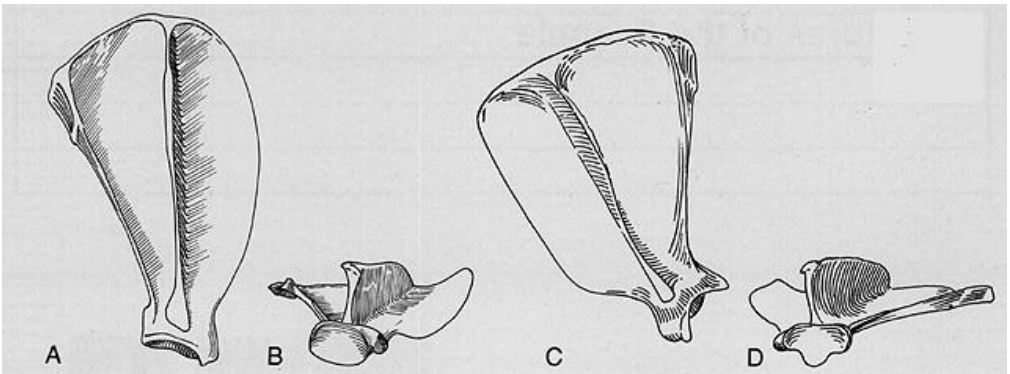


FIG. 20-2 Normal anatomy of the canine scapula: German shepherd scapula lateral view (*A*) and ventral view (*B*); dachshund scapula lateral view (*C*) and ventral view (*D*). Figures illustrate comparative anatomy and are not drawn to the same scale.

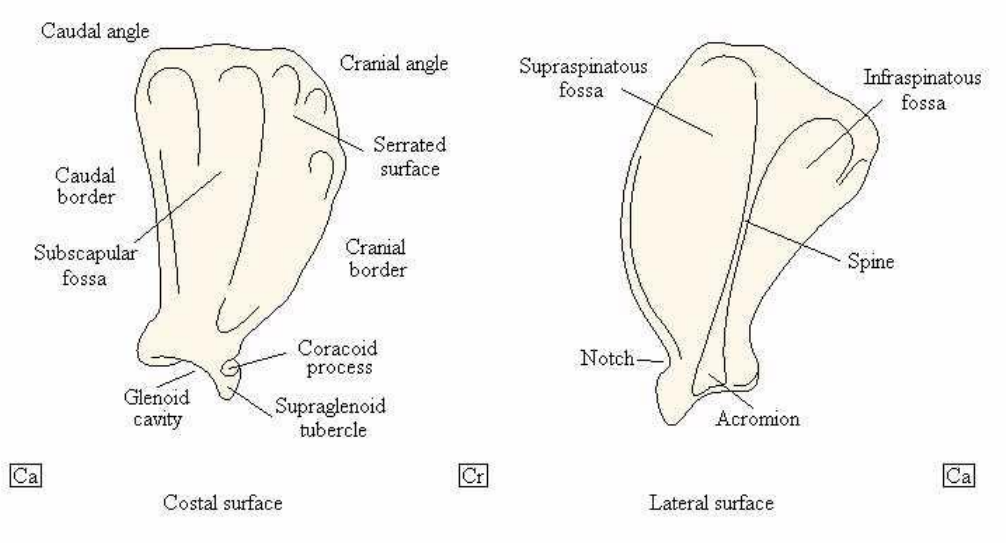
While the scapula is essential to the canine shoulder, the shoulder consists of many components including 25 muscles, each contributing to the wholeness of the canine body. Anytime the dog moves, even during sleep, the scapulae must move to adjust the forequarters. If the shoulder cannot do its job, all parts of the dog will suffer. The shoulder must be capable of flexion, extension, rotation, abduction and adduction Being able to painlessly and easily control direction with balance and purpose is essential to wellbeing.

Anatomy and Physiology of the Shoulders:

We can palpate the bones of the shoulder and find landmarks such as the highest point of the scapula, the point of the shoulder, the foremost point of the upper arm and the topmost point of the elbow. The spine of the scapula is easily palpated on most animals. The scapula may be harder to palpate if a dog has heavily muscled shoulders or a thick coat.

The dorsal aspect of the scapula does not articulate with any another bone. Lying alongside the thorax, the scapula is secured to the spinal column by four strong bands of muscle fascia from the first cervical to the ninth thoracic vertebra and to the first seven or eight ribs. Cartilage covers the dorsal aspect of the scapula following the curve of the thorax. With time this cartilage can calcify and become brittle.

We can palpate shoulder and feel the scapula as a flat bone with a spine down the middle and slight depressions or fossa on either side of the spine. These fossae provide the origin attachment points for the *supraspinatous* and *infraspinatous* muscles, intrinsic muscles which flex and extend the shoulder and prevent dislocation by stabilizing movement of the scapula relative to the ribs, vertebrae and forelimbs. The supraspinatous muscle is highly vulnerable to injury in the performance dog. If these muscles atrophy or shrink, the spine becomes more noticeable and the scapula loses its stability. Both muscles are innervated by the suprascapular nerve.



Scapular muscles are supplied with arterial blood by the superficial cervical artery and controlled by the suprascapular nerve. Like the *subscapular* muscle on the opposing surface these muscles are secured by tendons which stretch across the shoulder joint to insert on the lesser tubercle of the humerus. Strong ligaments hold the joint surface in apposition. The *serratus ventralis thoracic* muscle inserts on the serrated surface of the scapula to draw the scapula backwards and the chest upwards and is innervated by the long thoracic nerve. The *serratus ventralis thorac*ic and the *serratus ventralis cervix* muscles act like a supportive sling between the forelimbs.

The ventral and distal area of the scapula narrows along the neck of the scapula. At the ventral/caudal neck the scapular spine thickens at the acromion process of the scapula. Cranial to the acromion is a shallow socket inside the glenoid cavity. Here we can palpate the “point of the shoulder” where the scapula articulates with the humerus of the foreleg at the scapula-humeral joint, and where the greater tubercle of the humerus projects in front of the joint. The glenoid cavity forms the socket of the synovial shoulder joint, articulating with the head of the humerus, forming a ball-and-socket joint. Vital to the articulation of the humerus and the smooth movement the foreleg, this articular capsule is lined with hyaline cartilage and is rimmed with cartilage at the glenoid lip. Like the cartilage that lines the dorsal aspect of the scapula, this cartilage can calcify. This calcification and deterioration of the articular cartilage can cause pain on movement.

Muscles groups that attach to the scapula and affiliated Stress Points (SP)

The scapulae, shoulders and front legs move by the benefit of several muscles which can be palpated proximal to the scapula. Extrinsic muscles attach to the axial skeleton. Intrinsic muscles extend between the bones on the limb. Trigger Points may be felt in the belly of the muscle as a knot. Pain may be referred to another area. Stress Points (SP) can be noticed as tight knots and heat when muscles are tight, usually at areas where multiple muscle groups attach. Relief

from tightness can be felt by gentle massage of the belly of the muscle as well as origin and insertion points.

As we palpate the superficial muscles, the extrinsic muscles, we can notice muscle tone and compare the corresponding muscles on either side for size and tone. Coat texture and pattern will give clues to the underlying structures, issues and circulation. Tension may be felt in opposite alternative muscles that try to compensate for injuries in other areas. Deeper muscles will sympathetically respond to massage of superficial muscles which they support. Frictioning perpendicular to the long axis of the shoulders and limbs can warm and help tight muscles relax.

The superficial *trapezius* and the deep *rhomboideus* muscles, located in the upper back/lower neck area maneuver the scapulae, upwards, forwards and backwards. The two dorsal halves of the thin, broad triangular shaped *trapezius* originate on the vertebral column from the third cervical vertebra to the ninth thoracic vertebrae and insert on the spine of the scapula to elevate the limb, bring it forward and support flexible and coordinated angle changes. The accessory nerve innervates the trapezius muscle.

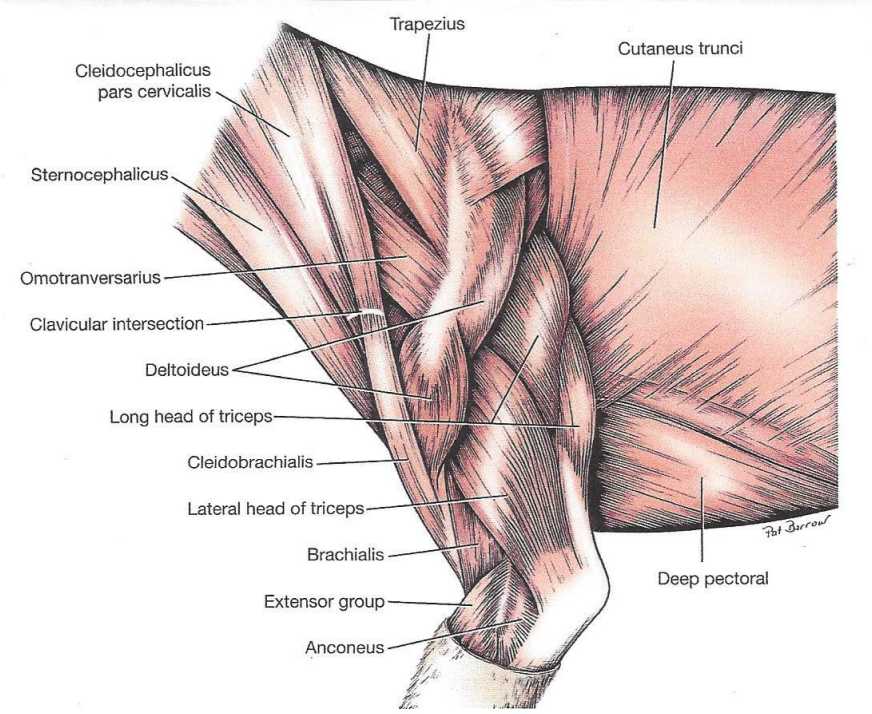


Fig. 2-15 Superficial muscles of left scapula and brachium.

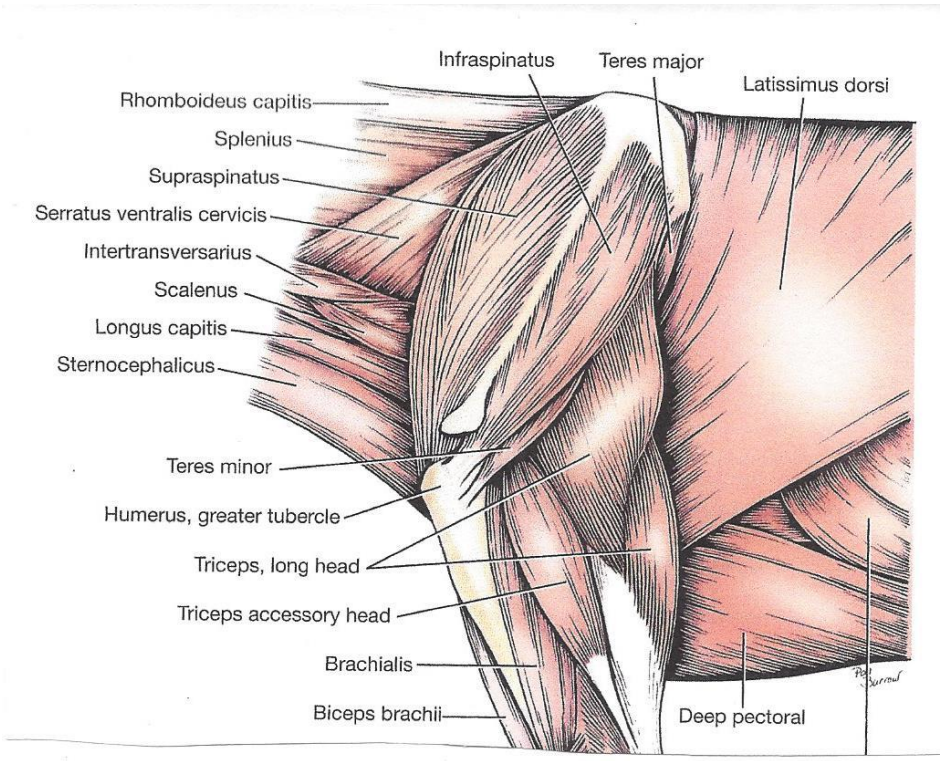


Fig. 2-16 Deeper muscles of left scapula

The underlying *rhomboideus* originates widely from the nuchal crest of the occipital bone, and along the upper neck to the sixth or seventh thoracic vertebra and inserts along the dorsal, distal/cranial scapula. This deep and wide muscle can lift and move the foreleg and shoulder forward and backward while holding the scapula close to the rib cage. The ventral branches of the cervical and thoracic spinal nerves innervate the rhomboid muscle.

Strong *trapezius* and *rhomboideus* muscles enable strong and stable forward momentum and lift for jumps. Injuries to these muscle groups may be felt in other muscles by referral. SP 6, 7 and 8 may run from the scapula to the withers. If the dog lowers his back on palpation, the depth of the reaction to pressure may give us insight into the depth of the affected muscle.

The upper shoulder deltoid or *deltoidius* muscle is an intrinsic or superficial muscle which abducts the shoulder and assists foreleg flexion, originating centrally on the posterior scapular spine where it is attached by a strong, wide tendon-like fascia called an aponeurosis, that gives the deltoid muscle a wide, strong area of attachment on the scapula. We may be able to palpate the deltoid attachment on the scapula where it runs over the infraspinatus that can be seen beneath the aponeurosis. The deltoid continues distally to its insertion point on the humerus tuberosity. SP 10 may be felt at this point. The deltoid muscle is innervated by the axillary nerve.

We can feel the movement of the deltoid muscle when we assist the foreleg stretch as well as the *triceps* muscle at the proximal end which flexes the shoulder joint and extends and locks the elbow joint at the distal end. The subscapular artery supplies blood to the deltoid muscle. The deltoid muscle is innervated by the axillary nerve which runs laterally and caudal to the shoulder limb, beneath and perpendicular to the scapula. The axillary nerve also supplies all flexors of the shoulder joint including the teres major and minor, and subscapularis muscles.

The triceps has four heads, but the proximal head of the triceps muscle flexes the shoulder and the distal heads extend and lock the elbow joint. SP 13 may be felt where the triceps inserts at the mid posterior scapula. SP 14 may be felt the insertion point at the point of the elbow.

The *lattissimus dorsi* lies caudal to the scapula and originates behind the neck on the thoracic/lumbar spine and runs laterally over the ribs to inset on the medial teres major tuberosity of the humerus and the teres major tendon to draw the leg backward, pull the body forward and control lateral flexion. A shorter stride may be noticed on the affected side. SP 11 may be felt at the posterior edge of the scapula. SP 12 may be felt close to the lower edge of the triceps.

Also covered by the deltoid muscle, the teres minor muscle is a small wedge-shaped muscle that helps to flex the shoulder and rotate the shoulder laterally and stabilize the shoulder to prevent it from rotating medially when weight bearing. The teres minor originates on the distal caudal border of the scapula, inserts on the minor tuberosity of the humerus and is also innervated by the axillary nerve.

Teres major also originates on the scapula on the caudal angle and adjacent caudal border and the caudal surface of the subscapularis and also helps to flex the shoulder, rotate it medially, and prevents lateral rotation when weight bearing and also inserts on the major tuberosity of the humerus and is also innervated by the axillary nerve. The teres major works in conjunction with the latissimus dorsi.

One more muscle works in this group to adduct, extend, and stabilize the shoulder is the coracobrachialis, a small, spindle shaped muscle that inserts on the lesser tubercle of the humerus on the medial side proximal to the teres minor, but originates on the coracoid process of the scapula and is innervated by the musculocutaneous nerve. From this origin point on the scapula by a long tendon

The superficial *pectoralus*, cranial and caudal, the chest muscles between the front legs, originating on the cranial sternum and inserts anterior to the head of the humerus to adduct and stabilize the front legs. SP 15 may be felt anterior to the sternum. SP 16 may be felt at the medial humerus insertion point. The deep pectoral muscle adducts and draws the forelegs backwards. SP 17 may be felt by this muscle's origin over the sternum if the muscle is stressed.

Another muscle that runs beneath the neck muscles to the sternum and forelegs is important to shoulder movement. The *omotransversarius* originates at the transverse wing of the atlas, the first cervical vertebra (the atlas) and inserts to the scapular spine near the acromion to rotate the bottom of the scapula forward while opposing muscles are trying to hold it in place during forward movement, innervated by the accessory nerve. A dog performing a focused heel with head facing its handler will need to shorten its stride because it not be able to extend its forelegs. This abnormal head position places stress on these muscles. Similarly, when a dog is performing a hurdle jump and tries to turn toward the handler during the return jump, the shoulders will be pulled sideways and the forelegs poorly positioned to absorb the impact with the potential for injury.

The important point to remember is that the scapulae are not fixed or immobile, but pulled back by the *trapezius* and forward by the *omotransversarius*, *serratus* and many other muscles that assist in movement, rotation, extension, and stabilization.

Nerves of the Shoulder Region

Many important nerves are part of the central nervous system, as the brain exchanges signals through the spinal cord exiting between vertebra. These nerves travel down the shoulder region, down the limb all the way to the digits. Can you imagine the route that the nerve impulse follows up and back when you quick the tip of your dog's toenail?

Not all nerves control muscles. The lateral thoracic nerves innervate the local cutaneous trunci muscles, the superficial muscles that can cause the thoracic skin to twitch.

The brachial plexus is a grouping of nerves where the last three cervical nerves nerves C-6, C-7, and C-8 and the first two thoracic nerves T-1 to T-2 descend ventrally. The nerves descending from the brachial plexus, along the scapulae and down the humerus include the **suprascapular nerve, subscapular nerve, axillary nerve**, **musculocutaneous nerve, radial nerve, and the median nerve.** Radial nerve injuries may cause paralysis of the muscles it supplies. The forelimb will not be able to support the forequarters because the radial nerve cannot send the signal for the brachial triceps to extend the elbow.

The axillary nerve, as well as the axillary artery, are located proximal to the scapula.

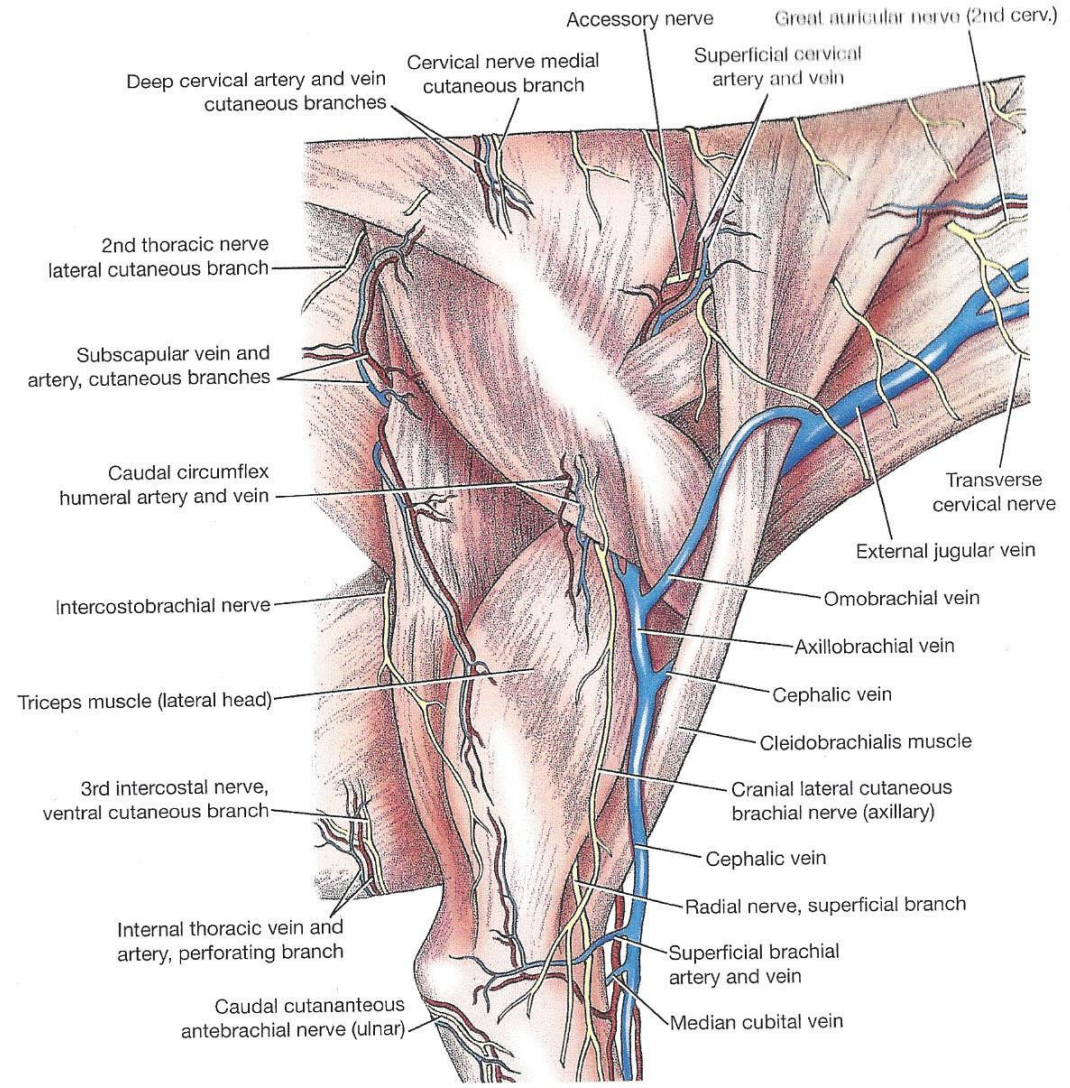


Fig. 3-3 Superficial structures of scapula and brachium, lateral view.

Arteries and Veins of the Shoulder Region

Arteries carry blood away from the heart to supply oxygen, hormones and other nutrients to the shoulder area primarily through the axillary artery which runs medial to the scapula branches into the subscapular artery which runs dorsally along the caudal border of the scapula to conduct blood flow to the **thoracodorsal artery** which supplies the latissimus dorsi muscle alongside the **thoracodorsal nerve** from the brachial plexus.

These arteries run distally down the forelimb branching into capillaries to supply all the fascia of the limb from the shoulder to the digits. Prior to reaching the humeral area, the axillary artery branches into the lateral thoracic artery and becomes the brachial artery to the biceps and triceps. After exchanging oxygen and other nutrients with the peripheral fascia, the blood returns to the heart via the veins moving back up the forelimb and medial to the scapula through the subscapular vein to collect returning blood flow in the jugular vein on its way back to the heart. Massage of the shoulder and forelimb can assist this down and back up circulation of blood and lymph fluid.

Lymph nodes and drainage in the shoulder region

Lymph is excess tissue fluid that is picked up by lymph vessels and returned to peripheral blood circulation. Lymph contains nutrients, hormones and other substance that have entered the tissues from the capillaries and assist the immune response of the body by transporting nutrients to tissues and wastes away from tissues. Lymph vessels pass through nodes where lymph can pick up lymphocytes which can pick up microorganisms and transport them away by phagocytosis. Lymph nodes filter the lymph fluid. Lymph vessels do not have muscles so they depend upon body movement to move the lymph fluid along and prevent build up or edema. Gentle compression and a slight pumping motion followed by effleurage or stroking can aid the distribution of lymph throughout the body, especially over identifiable “nodes.” One node that can be palpated is the pre-scapular lymph node, located in the subcutaneous tissue just medial to the scapular-humeral joint on either side. These nodes are often encased in fat and may feel slightly softer than other tissue. The axillary lymph nodes are dorsal to the deep pectoral muscle and caudal to the large axillary vein coming from under the forearm, but may be difficult to palpate if they are not enlarged. Most of the lymph vessels flowing way from the thoracic wall and deep tissues of the limb drain into this node. Size, texture, firmness, and comparison to each side can be noted. Abnormal lymph nodes may be enlarged, hard, warm or painful.

The Scapula and Shoulder at work

The slope of the scapula is determined by the supporting muscles and the thorax. Angulation or “lay back” is the front-to-back inclination of the shoulder blade compared to the line of the vertebrae. Angulation can be assessed when touching both the point of the shoulder and the top of the scapula or the withers. This angulation of the shoulder is more pronounced in working/herding breeds than in dogs more specifically bred to be pets. The greatest amount of work in supporting the dog falls to the forequarters for directional thrust, supporting the body weight during stride, and absorbing the impact as the step or jump is completed. Placement and angulation of shoulder and forearm give the dog reach, and the slightly sloping pastern and well cushioned pads absorb the shock as the foot hits the ground. Tight muscles or injuries can shorten angulation, decrease the limb’s ability to absorb shock and cause or worsen injuries.

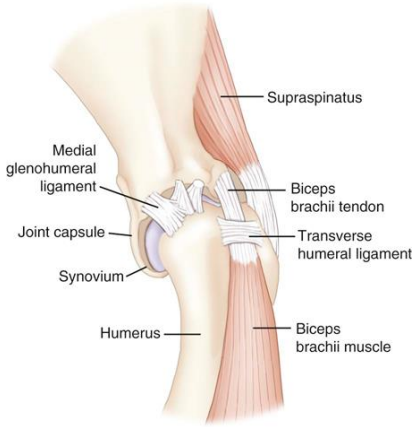
Fred Lanting, in *The Shoulder in the Working Dog* states, “A dog with better angles (yet strong ligaments in pasterns, elbows, and shoulders) can spread that shock over an imperceptibly longer period of time, during which the muscles slow the impact while the bones go through their “folding up” action relative to each other, then release that stored energy by straightening out again (bouncing back). Trotting creates very nearly the same sort of shock that jumping does, only far less violent.”

The shoulder will be vulnerable to injury if a dog is physically compromised or poorly conditioned. Muscles, joints and ligaments may not be able to control and stabilize the scapulae and forelimbs resulting in medial shoulder syndrome (MSS) and medial shoulder instability (MSI) resulting in lameness in the affected limb. The craniomedial joint capsule, medial glenohumeral ligament, subscapularis tendon, supraspinatus tendon, labrum, and less commonly the biceps tendon and associated cartilage may also be affected.

When approaching a jump, the dog must angulate the scapulae to lift the forequarters to lift more than half its weight while simultaneously tucking the forelimbs. After the jump, the forelimbs must be extended and properly angulated with joints flexible enough absorb the shock of impact. Considering the structure of the shoulders from the scapula to the paws, a great amount of strength, flexibility and coordination is necessary to avoid injury.

Performance dogs repeat extreme and strenuous movements that can lead to injuries of the shoulder. Some causes of shoulder injuries are slipping on wet surfaces or slips on the dog walk, teeter, or A-frame during agility exercises. Performance decline over time may be the result of cumulative microtrauma to the ligaments, tendons, and joint capsule.

Performance dogs repeat extreme and strenuous movements that can lead to injuries of the shoulder. Bicipital tenosynovitis (BT) involves the biceps brachii muscle and the associated tendon that crosses the shoulder joint. Poor landing after a jump, quick turns, hyper extension of the leg overstretching the muscle, or muscle, joint or tendon degeneration can lead to inflammation muscle tears, instability and injury. The dog will not want to jump and have difficulty with quick turns. On observing the dog in motion, there may be evident lameness or shortened stride. Palpation of the biceps may be painful.



Normal canine shoulder anatomy (medial view).

The supraspinatus tendon is a common site of injuries similar to those mentioned above from tears, calcifying tendinitis or tendinosis (micro-tears), and tendinosis as a result of overuse leading to inflammation, instability and further injuries.

Contracture of the infraspinatus muscle is a rare condition generally found in large breed working dogs and other very active dogs. This condition is related to trauma and may lead to osteofascial compartment syndrome which happens when inflammation causes the muscle to expand building up pressure preventing circulation and causing nerve damage and muscle death.

If shoulder injuries are not addressed, they may decline into more conditions that will require veterinary care such as degenerative arthritis secondary to fracture, osteochondritis dissecans (OCD), or chronic shoulder luxation. Occasionally, in the presence of a severe articular fracture, surgery such as shoulder arthrodesis may be used if fracture repair is not possible.

The Benefit of Massage

The problems mentioned above are often difficult to identify, even by modern MRI and CT scans. While massage practitioners may not be allowed to diagnose, they can detect and draw attention to subtle imbalances and difficulties. By recognizing potential problems in the early stages, the dog can tap into its own self-healing mechanism and the owner can seek veterinary help while letting the dog rest and recover.

Whenever the dog moves a front limb the 25 muscles of the shoulder must stabilize and move the scapulae. After hard work, these muscles may become tight and sore. A tight muscle will restrict circulation and surrounding fascia will feel tight and cold. The fascia around a relaxed muscle will feel soft, moveable and warm. Massage can warm and help muscles relax, increase circulation and facilitate healing. We must be careful to stabilize the scapula close to the ribcage during manipulation and forelimb stretching because of the way it is attached by muscles only. The scapula should always rotate in the direction that the limb

stretches. When the dog's body feels safe, supported, and stabilized they can allow their muscles to relax and heal.

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