Radiographic Interpretation of the Canine Shoulder

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▲ **FIGURE 1** Lateral radiograph of a normal shoulder showing the biceps origin (**blue circle**) and course (**blue bar**)

Shoulder lameness is common in juvenile and adult dogs. Lameness may be caused by degenerative, infectious, neoplastic, or developmental growth disorders. Radiographically identifying lesions can help clinicians categorize associated conditions.

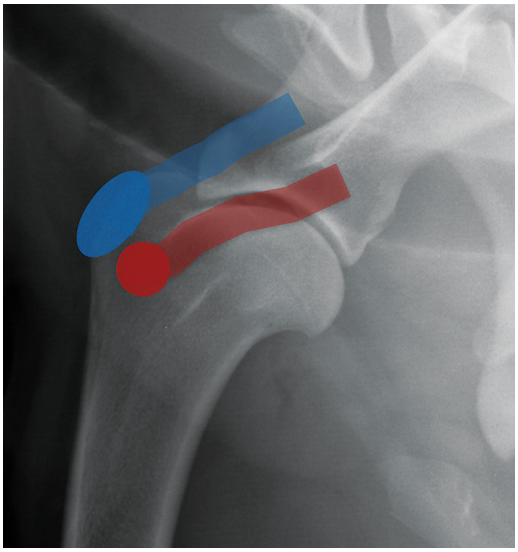
A complete radiographic series, including lateral, caudocranial +/- cranioproximal–craniodistal oblique (skyline) views, should be obtained when evaluating patients with shoulder lameness. Accurate diagnosis requires radiographs that are correctly positioned and exposed. Sedation is recommended for patients undergoing orthopedic radiography.

Anatomy

Before radiography, the clinician should review the anatomy of the canine shoulder. The shoulder consists of a simple ball-and-socket joint between the humeral head and the glenoid cavity and is surrounded by a fibrous joint capsule. The adjacent musculature stabilizes the joint and extends and/or flexes the thoracic limb. The joint is extended by the supraspinatus and infraspinatus muscles and flexed by the triceps muscle, with concurrent flexion and extension of the elbow by the biceps and triceps muscles, respectively.[1]

The proximal biceps tendon originates from the supraglenoid tubercle and traverses the cranial aspect of the proximal humerus in the intertubercular groove, where, at the musculotendinous junction, it forms the biceps muscle. Mineralization may occur at any point along the length of the tendon but is commonly noted both superimposed with the groove and at the tendon origin (***Figure 1***).[1]

The supraspinatus tendon is a broad tendon that arises from the supraspinatus muscle and is attached to the lateral aspect of the greater tubercle. Tendinopathy of



▲ **FIGURE 2** Lateral radiograph of a normal shoulder showing the supraspinatus insertion (**blue oval**) and tendon course (**blue bar**) as well as the infraspinatus insertion (**red circle**) and tendon course (**red bar**)

TABLE

COMMON DISEASES OF THE CANINE SHOULDER

Lesion Type	Condition
Primary lesions	Tendinopathy Osteochondrosis Osteochondritis dissecans Osteosarcoma Infectious/septic arthritis Traumatic luxation
Secondary lesions	Degenerative joint disease (osteoarthritis)

this tendon is common and manifests radiographically as mineralization within the tendon, typically slightly cranial to the greater tubercle. The infraspinatus tendon is affected less commonly. This tendon arises from the infraspinatus muscle and attaches on the lateral greater tubercle, slightly distolateral to the supraspinatus tendon, and runs in an oblique plane in a caudoproximal-to-craniodistal direction (***Figure 2***).[1]

Common Diseases

Tendinopathies typically occur in older, active, and working dogs, typically of large breeds. Pain usually can be elicited on flexion, extension, and palpation of the shoulder. Disease occurs most commonly in the proximal biceps and supraspinatus tendons but can also affect the infraspinatus tendon (***Table***).

The most common site of osteochondrosis in dogs is the caudal aspect of the humeral head. Osteochondrosis typically occurs in young (<3 years of age), large-breed dogs and appears radiographically as a flattening of the caudal humeral head. A free mineral fragment may be visualized near the flattened region or more distally in the joint capsule. Free fragments are rarely seen in the intertubercular groove.

Osteochondritis dissecans is a disease that affects young dogs in which failure of endochondral ossification leads to retention and thickening of cartilaginous tissue. The cartilage may form a flap and/or free fragments in the joint.

Degenerative joint disease affects the entire joint, but the caudal humeral head is a common site of osteophytosis development. Degenerative joint disease appears radiographically as well-defined, irregularly shaped new bone formation on the caudal

aspect of the glenoid cavity or the caudal humeral head. In many dogs, a small, separate, triangular center of ossification may be present and associated with the caudodistal scapula (caudal glenoid cavity; ***Figure 3***).[2] This should not be confused for degenerative joint disease.

Less common diseases should be considered when the presentation is not straightforward. The proximal humerus is a common site for osteosarcoma. On radiographs, its appearance is highly variable, but the classic presentation shows moth-eaten–to–permeative lysis of the cortex with palisading-to-amorphous new bone formation, often along the caudal cortex. Any lesion with a lytic component in the proximal humerus should be considered suggestive of osteosarcoma. Metastatic disease more commonly appears as lesions within the metaphysis of long bones, such as near the nutrient foramen.

Infectious/septic arthritis of the shoulder joint is an uncommon disease that typically affects young, large-breed dogs. These patients often have a predisposing cause for systemic sepsis. Radiographs often show a patchy pattern of lucencies (from gas-producing bacteria) superimposed on the joint and surrounding tissues. Staged sampling of periarticular tissues should precede arthrocentesis to avoid bacterial contamination of the joint capsule.

Traumatic shoulder luxations are uncommon and are typically diagnosed on physical examination. A caudocranial radiograph with the limb in abduction can be obtained to identify medial joint capsule tearing. This radiograph must be interpreted with caution, however, as some degree of joint widening may be normal secondary to positioning because limb extension causes traction on the medial aspect of the joint.

▲ **FIGURE 3** Lateral radiograph of a mature shoulder with a separate center of ossification in the caudodistal scapula (**black arrow**). Minimal osteophytosis of the caudal aspect of the humeral head (**white arrow**) is also present.

Any lesion with a lytic component in the proximal humerus should be considered suggestive of osteosarcoma.

STEP-BY-STEP
RADIOGRAPHIC INTERPRETATION OF THE SHOULDER

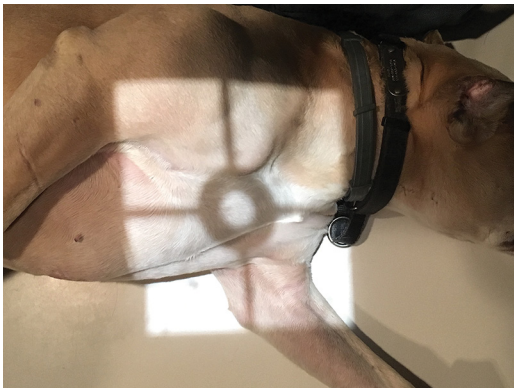
STEP 1

Obtain lateral views of the shoulder (***Figures 4*** and ***5***). Place the patient on the table with the affected side down, then extend the scapulohumeral joint cranially and ventrally (***Figure 6***). Pull the contralateral limb caudally to minimize superimposition. Supination of the imaged limb may allow for increased conspicuity of humeral head lesions.

▲ **FIGURE 4** Lateral radiograph of a normal mature shoulder joint showing the supraglenoid tubercle of the scapula (**asterisk**) and greater tubercle of the humerus (**plus sign**)

▲ **FIGURE 5** Lateral radiograph of a normal immature shoulder joint. Note the normal proximal humeral physis.

Accurate diagnosis requires radiographs that are correctly positioned and exposed.



▲ **FIGURE 6** Positioning for a medial-lateral radiograph of the left shoulder with the patient in lateral recumbency with the side of interest down

STEP 2

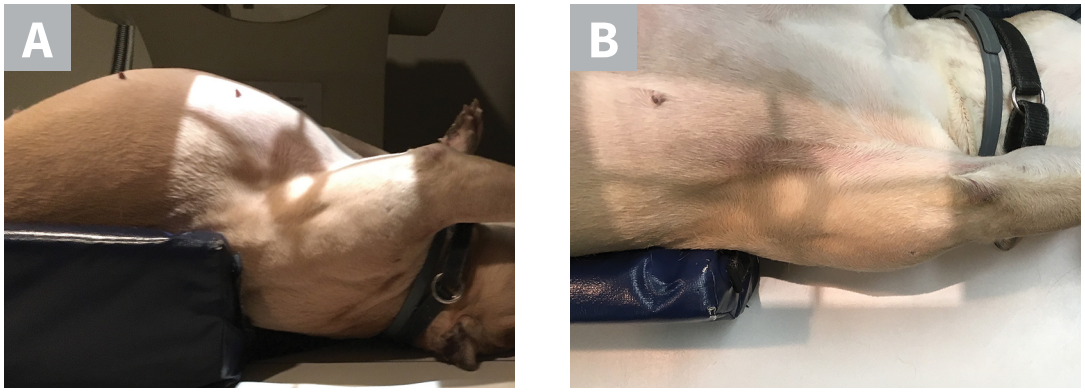
Obtain caudocranial views of the shoulder (***Figures 7*** and ***8***). Place the patient in dorsal recumbency with the thoracic limb extended cranially and parallel to the table (***Figure 9***). This position may be especially uncomfortable for patients with shoulder pain.

Author Insight

Use sedation appropriately to ensure patient comfort, facilitate correct positioning, and decrease radiographic exposure to the patient and team.

▲ **FIGURE 7** Caudocranial radiograph of a normal mature shoulder joint

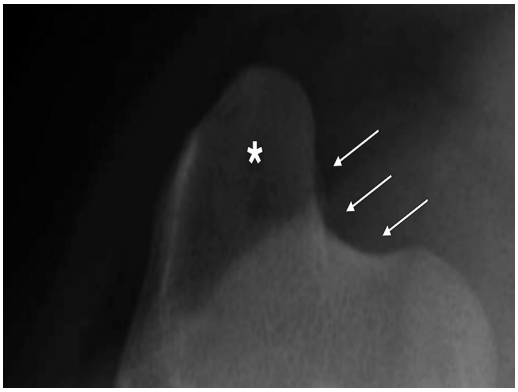
▲ **FIGURE 8** Caudocranial radiograph of a normal immature shoulder joint



▲ **FIGURE 9** Positioning for a caudocranial radiograph of the left shoulder with the limb extended cranially

STEP 3

To highlight the biceps groove, obtain a cranioproximal–craniodistal oblique (skyline) view (***Figure 10***). Place the patient in dorsal or ventral recumbency with the shoulder flexed, then abduct the thoracic limb to avoid shoulder joint superimposition with the antebrachium (***Figure 11***) or extend the antebrachium caudally beside the patient's thoracic wall. Angle the radiographic beam tangential to the bicipital groove. Multiple attempts may be necessary to obtain this view.



▲ **FIGURE 10** Skyline radiograph of a normal mature shoulder joint. Note the greater tubercle (**asterisk**) and intertubercular groove (**arrows**).

▲ **FIGURE 11** Positioning for a skyline radiograph of the right shoulder. The distal limb is pulled laterally to prevent superimposition with the shoulder joint.

STEP 4

Review the radiographs for common shoulder pathology (***Table***, page 76). For common presentations, focus on the cranial and caudal aspects of the joint. Consider the patient's signalment, especially age.

Author Insights

Use an anatomic location-based (eg, cranial or caudal joint) or disease-based approach to guide interpretation.

Be familiar with normal variants in bone, including chondrodystrophoid alterations and separate centers of ossification of the glenoid cavity.

STEP 5

Categorize the lesion as primary or secondary, and make the radiographic diagnosis. If the diagnosis remains unclear, consider sending the radiographs to a local radiologist or a teleradiologist or an orthopedic surgeon for interpretation. Additional imaging (eg, MRI, CT, ultrasonography) may also be required.

References

1. Evans HE, de Lahunta A. Intrinsic muscles. In: Evans HE, de Lahunta A. *Miller's Anatomy of the Dog*. 4th ed. St. Louis, MO: Elsevier Saunders; 2013:235-237.
2. Coulson A. Skeletal system: forelimb. In: Coulson A, Lewis N. *An Atlas of Interpretative Radiographic Anatomy of the Dog and Cat*. Oxford, UK: Blackwell Sciences Ltd; 2002:39.