Additional Radiographic Views of the Thoracic Limb in Dogs

Kansas State University
H. T. Meier, DVM
D. S. Biller, DVM, DACVR
M. Lora-Michiels, MV
J. J. Hoskinson, DVM, DACVR

ABSTRACT: Some lesions of the canine appendicular skeleton are challenging to diagnose with the use of routine radiographic views. Additional views can be used to identify difficult lesions. Most papers in the reviewed literature usually describe a single region of interest such as the elbow or coxofemoral joint. This article provides a useful collection of selected additional radiographic views of the canine thoracic limb. The paper also reviews routine radiographic views and common indications or diseases in need of radiographic evaluation and provides a written and photographic description of how to obtain these additional views.

Routine radiography of the canine appendicular skeleton can be effective for demonstrating clinically significant findings. Indications for performing extremity radiography include lameness, soft tissue swelling, neurologic or orthopedic-related ataxia, a history of trauma, and pain on manipulation or palpation of a focal region. Routine radiographic views typically include mediolateral and craniocaudal or dorsopalmar views.

Additional views, however, may be warranted to identify lesions that are not well visualized on routine radiography (Table 1). For example, additional views may be performed to visualize focal osseous regions such as the greater tubercle of the humerus or the medial coronoid process of the ulna. Practical applications of these additional views include determining the origin of mineralization within soft tissues, identifying developmental abnormalities (e.g., osteochondral lesions), and better evaluating and describing fractures. It is important for practitioners to remember that radiographic lesions may not be visualized even if there are clinical signs present because of the origin or early stage of a disease process. This article provides written descriptions, patient positioning photographs, and normal and abnormal radiographs of additional

*Dr. Lora-Michiels is now affiliated with North Carolina State University.
views of the canine thoracic limb to demonstrate clinical utility.

**SCAPULA**

The routine radiographic views for the scapula include mediolateral and caudocranial views.\(^1,2\) Scapular fractures and neoplasia are among the common abnormalities requiring radiography. A complete history and physical examination are necessary to determine which region of interest should be radiographically assessed. For example, if a patient sustained trauma to the scapula after being hit by a car, then radiography of that region would be indicated. A routine dorsally displaced mediolateral view may be obtained by placing the patient in lateral recumbency and caudally extending the contralateral limb while dorsally displacing the affected limb (Figure 1).\(^1\) This view will allow better nonsuperimposed visualization of the lateral portion of the scapula. Additionally, a routine caudocranial position view may be attempted. The patient should be placed in dorsal recumbency. The sagittal plane of the thorax should be rotated 30° away from the affected limb while cra-

<table>
<thead>
<tr>
<th>Joint</th>
<th>View</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shoulder</strong></td>
<td>Caudocranial (limb cranially or caudally extended), dorsally displaced mediolateral views</td>
<td>Scapular fractures or neoplasia</td>
</tr>
<tr>
<td></td>
<td>Cranioproximal-craniodistal or craniodistal-craniproximal view of the proximal humerus</td>
<td>Mineralization of ligamentous/tendinous structures</td>
</tr>
<tr>
<td></td>
<td>Mediolateral views (limb internally or externally rotated)</td>
<td>Osteochondrosis, subluxation or luxation</td>
</tr>
<tr>
<td><strong>Elbow</strong></td>
<td>Craniocaudal oblique, mediolateral oblique, hyperextended mediolateral, hyperflexed mediolateral views</td>
<td>Osteochondrosis, fragmented coronoid process, ununited anconeal process, fractures, neoplasia, ligamentous instability, subluxation</td>
</tr>
<tr>
<td><strong>Carpus</strong></td>
<td>Dorsopalmar oblique, hyperextended mediolateral, hyperflexed mediolateral, dorsopalmar (medial or lateral) bending forced views</td>
<td>Fractures, mass lesions, ligamentous instability, degenerative changes</td>
</tr>
</tbody>
</table>

Figure 1—(A) Demonstration of patient positioning for a routine lateral view of the scapula. The unaffected limb is caudally extended (white arrow), while the affected limb (black arrow) is dorsally displaced. The scapula will be oriented dorsal to the spine (white arrowhead). (B) Lateral radiographic view of the scapula. Note the fracture line visualized through the body and spine of the scapula.
nially extending the affected limb.³

Routine radiography of the scapula, however, may not adequately visualize fractures because of superimposition of osseous structures. An additional distoproximal (axial) view may be necessary to further evaluate the scapula. This view can be used to demonstrate incomplete, nonarticular scapular fractures. Anatomic structures visualized using this view include the scapular spine, supraspinous and infraspinous fossa, and the greater tubercle of the humerus. The patient should be placed in dorsal recumbency. Thoracic limbs should be pulled caudally so the humerus is at a 90° angle with the scapular spine. The scapula should be perpendicular to the table top in both a lateromedial and cranio-caudal direction (Figure 2).⁴

**SHOULDER**

Routine radiographic views for the shoulder include mediolateral and caudocranial views.¹ Osteochondrosis, subluxation (congenital or acquired), luxation, fractures, neoplasia, and mineralization of ligamentous or tendinous structures are common abnormalities requiring shoulder radiography.

Oblique views are indicated for better evaluation of subtle osteochondral lesions. Occasionally, sclerosis of the caudal aspect of the humeral head will be visualized without associated evidence of subchondral lucency or flattening. In these instances, oblique views can be obtained by placing the patient in a lateral position with the affected shoulder close to the cassette. The affected limb should be cranially extended with the antebrachium supinated while the contralateral limb is caudally extended. The x-ray beam should be centered at the scapulohumeral joint (Figure 3).⁵ The antebrachium can also be pronated if a lesion is not well visualized radiographically on the previous oblique view.

Mineralization of the supraspinatus or bicipital tendons should be considered with patients that present with non-specific, chronic, thoracic limb, weight-bearing lameness. Some patients may have focal detectable pain on palpation of the proximal humerus, especially with bicipital tenosynovitis. Therefore, two additional skyline (tangential) views can help identify mineralization of these tendinous structures. Anatomic structures visualized with these skyline views include the greater tubercle of the humerus, intertubercular groove, and head of the humerus. A cranioproximal-craniodistal view can be used to assess for supraspinatus tendon mineralization. This view can be obtained by placing the animal in sternal recumbency. The affected shoulder and elbow should be hyperflexed while the radius and ulna are positioned close to the thoracic wall. The cassette should be positioned over the antebrachium and parallel with the table. It is essential that the humeral head is positioned over the film and not obliqued so that distortion of the intertubercular groove can be minimized. The x-ray beam should be vertically centered over the cranial aspect of the shoulder (Figure 4).⁶ A craniodistal-cranio-proximal (flexed) view can be used to assess mineralization of the bicipital tendon. The patient should be positioned in dorsal recumbency with the affected joint hyperflexed and externally rotated 30°. This view will isolate the intertubercular groove of the humerus.⁷

Animals that present with shoulder luxations or subluxations usually carry the affected limb while flexing the elbow. Thus clinical signs and physical examination

---

**Figure 2A**

(A) Demonstration of patient positioning for a distoproximal view of the scapula. The patient should be placed in dorsal recumbency with the head to the left of the image. The affected limb is caudally extended and aligned perpendicular to the table (arrow). (B) Distoproximal radiographic view of the scapula. (A = supraspinous fossa; B = spine of the scapula; C = infraspinous fossa; D = greater tubercle of the humerus.) (C) Note the fracture of the supraspinous fossa and spine of the scapula (arrow).
are usually diagnostic. Shoulder radiography using oblique and stressed views can definitively diagnose poorly detectable shoulder joint subluxation. The patient should be placed in lateral recumbency while internally or externally rotating the affected humerus.\textsuperscript{8} Additionally, one study\textsuperscript{9} evaluated stress to the normal shoulder joint compared to surgically excised (medially) unstable joints using lateral and caudocranial radiographic positions. In this study, shoulder joints were stressed in lateral recumbency using a passive stress device placed in the axilla. Proximal directional force of approximately 11 kg was applied. The caudocranial stress procedure was performed with the same force applied medially to the humeral head. This study demonstrated a significant widening in joint space measurement on the postoperative shoulder joint radiographs when compared with the normal shoulder joint. This result was most significant when the patient was in lateral recumbency.\textsuperscript{9}

**ELBOW**

Routine radiographic views of the elbow joint include mediolateral and craniocaudal views.\textsuperscript{1,2} Etiologies such as osteochondrosis, fragmented coronoid process, ununited anconeal process, elbow subluxation, fractures, neoplasia, and ligamentous instability leading to osteoarthrosis are common abnormalities diagnosed radiographically.

![Figure 3A](image1.png)  ![Figure 3B](image2.png)

**Figure 3**—(A) Lateral radiographic view of the scapulohumeral joint. (B) Pronated scapulo-humeral joint from Figure 3A. Note the subchondral lucent defect surrounded by sclerosis along the caudal aspect of the humeral head (arrow). This abnormal finding is better appreciated using this additional view when compared with Figure 3A. Findings are consistent with osteochondrosis of the humeral head.

![Figure 4A](image3.png)  ![Figure 4B](image4.png)

**Figure 4**—(A) Demonstration of patient positioning for a cranioproximal-craniodistal skyline view. (B) Cranioproximal-craniodistal skyline radiographic view of the proximal humerus. Note the supraspinatus tendon mineralization cranial to the greater tubercle of the humerus. (1 = greater tubercle of the humerus; 2 = head of the humerus.)
Common clinical signs in patients that present with fragmented coronoid process include pain on extension and flexion of the elbow and lateral rotation of the paw. Routine views do not usually lead to a definitive diagnosis of fragmented coronoid process; therefore, additional craniocaudal or mediolateral oblique views are used. These additional views will allow better visualization of the medial coronoid process of the ulna. To obtain craniocaudal oblique views, the patient should be placed in sternal recumbency and the affected limb should be cranially extended as far as possible. The x-ray tube should be directed craniocaudally approximately 10° to 20° on the elbow to better evaluate the joint surfaces. The affected limb can either be supinated 30° for the lateral oblique or pronated 30° for the medial oblique (Figure 5). The caudomedial-craniolateral oblique view has been shown to be most effective in evaluating the medial coronoid process of the ulna. The mediolateral oblique views can be obtained by placing the patient in lateral recumbency with the limb maximally extended and supinated approximately 15° (Figure 6). Clinical signs such as slight
limping, abduction of the distal extremity, and swelling of the elbow joint are common with patients that present for ununited anconeal process. Additional projections such as mediolateral hyperflexed views are far more effective for visualizing the nonsuperimposed anconeal process of the ulna.\textsuperscript{1,10–12,15–19} A hyperextended view can be performed to evaluate for joint incongruity. Both the hyperflexed and hyperextended mediolateral views are also used to demonstrate periarticular osteoarthrosis and elbow joint congruity.\textsuperscript{8,15,20} These views can be obtained by placing the patient in lateral recumbency and centering the x-ray beam on a hyperextended or hyperflexed elbow joint (Figure 7).

**Carpus**

Routine radiography of the carpus includes lateral, dorsopalmar, and oblique views.\textsuperscript{1,2} Carpal radiography can be used to diagnose common abnormalities such as fractures, ligamentous instability, mass lesions, and degenerative changes.

When animals present with clinical signs of non-weight-bearing lameness, pain on carpal palpation, and/or concurrent joint swelling, carpal radiographs should be obtained. Hyperflexed and hyperextended mediolateral views of the carpus can be performed to evaluate the joint spaces and osseous margins for visualization of degenerative changes or fractures (Figure 8).\textsuperscript{1} Lateral and medial bending forces can also be applied to open the joint, which may identify ligamentous abnormalities.\textsuperscript{8} These views will demonstrate widening of the medial or lateral region of the joint if ligamentous instability is present. To obtain these views, the patient should be placed in sternal recumbency with the affected limb extended cranially. The carpus should be placed on the cassette. The lateral region of the carpus can be evaluated by gently bending the carpus medially (with a wooden spoon). A stress view can be obtained to assess the medial region of the joint using this same technique (Figure 9).

**CONCLUSION**

Additional views of the canine appendicular skeleton may be needed to diagnose challenging lesions that routine
radiographic views do not readily identify because of superimposition of osseous structures. Alternate views will show osseous margins that are not typically seen on standard views. The additional views described for common orthopedic lesions of the thoracic limb may help provide a definitive diagnosis.

REFERENCES

1. Which region of the scapula is not visualized on the distoproximal (axial) view?
   a. supraspinous fossa  
   b. spine of the scapula  
   c. infraspinous fossa  
   d. supraglenoid tubercle  
   e. greater tubercle of the humerus

2. What are common indications for radiography of the shoulder joint?
   a. osteochondrosis
   b. mineralization of tendinous structures
   c. fracture
   d. neoplasia
   e. all of the above

3. Which radiographic view is best for visualizing mineralization of the supraspinatus tendon?
   a. mediolateral view
   b. cranioproximal-craniodistal view
   c. craniocaudal view
   d. craniodistal-cranioproximal view

4. An animal presents with forelimb lameness. On physical examination, laxity is detected at the lateral portion of the elbow joint. Which stress view will best visualize this lesion?
   a. mediolateral flexed view
   b. mediolateral hyperextended view
   c. craniocaudal view with bending force applied laterally
   d. craniocaudal view with bending force applied medially

5. Which view is most effective in evaluating the medial coronoid process?
   a. craniocaudal view
   b. caudomedial-craniolateral oblique view
   c. mediolateral view
   d. craniomedial-caudolateral oblique view

6. Which view allows the best visualization of the carpal joint spaces?
   a. dorsopalmar view
   b. hyperflexed mediolateral view
   c. hyperextended mediolateral view
   d. dorsopalmar oblique view

7. Why may additional views demonstrate an osseous lesion better than routine views?
   a. less superimposition of osseous structures
   b. tangential x-ray beam directed at the osseous lesion
   c. less soft tissue superimposition
   d. a and b

8. What additional views can be obtained to better visualize a subtle osteochondral lesion of the humeral head?
   a. craniocaudal oblique views
   b. mediolateral oblique views
   c. skyline views
   d. stress views

9. What artifact will be produced if the cassette is not parallel with the antebrachium?
   a. magnification
   b. distortion
   c. grid line visualization
   d. motion

10. What common clinical signs are present with a fragmented coronoid process?
    a. medial rotation of paw
    b. lateral rotation of paw
    c. extension of paw
    d. a and c
    e. b and c