

# SMALL ANIMAL SPINAL RADIOGRAPHY SERIES

## THORACIC SPINE RADIOGRAPHY

Danielle Mauragis, CVT, and Clifford R. Berry, DVM, Diplomate ACVR

**Imaging Essentials** provides comprehensive information on small animal radiography techniques. This article is the second in a 3-part series covering **cervical, thoracic, and lumbar spine radiography**.

The following anatomic areas have been addressed in previous columns; these articles are available at [todaysveterinarypractice.com](http://todaysveterinarypractice.com) (search “Imaging Essentials”).

- Thorax
- Scapula, shoulder, and humerus
- Abdomen
- Elbow and antebrachium
- Pelvis
- Carpus and manus
- Stifle joint and crus
- Tarsus and pes



**S** **pinal radiographs** are indicated for:

- Evaluation of traumatic injuries
- Neck and back pain
- Pain or neurologic issues associated with thoracic or pelvic limb lameness isolated to these regions.

Each radiographic projection is a separate study and should be radiographed as such. High quality, correctly positioned and collimated radiographs are required in order to provide an accurate assessment of the area of interest, especially for surgical planning.

### MEASURING THE THORACIC SPINE

Measure the thickest portion of the spine that is within the area of collimation.

### FOLLOW THESE PRECAUTIONS

As a general rule, general anesthesia or heavy sedation is necessary to evaluate the spine because, in most cases, spinal images taken in nonsedated patients are nondiagnostic. In addition, the presence or absence of disk space narrowing cannot be determined from a nonsedated animal's radiographs due to unavoidable positioning artifacts.

If a back injury (fracture) is suspected, **DO NOT** flex or extend the spine of the injured dog or cat, and **DO NOT** turn the patient for an orthogonal image. If possible, a horizontal beam image is done for the ventrodorsal projection.

**ROUTINE VIEWS**

**Lateral and ventrodorsal views** are considered the minimum orthogonal radiographs for the spine. Due to the angled, divergent nature of the x-ray beam, the area of the spine in the center of the field of collimation will be the area that provides the correct anatomic detail and intervertebral disk space widths.

A routine thoracic spine study includes:

1. **Lateral** image of the *thoracic* spine
2. **Ventrodorsal** image of the *thoracic* spine
3. **Lateral** image of the *thoracolumbar* spine
4. **Ventrodorsal** image of the *thoracolumbar* spine.

**Lateral Projection: Thoracic Spine**

For the lateral projection, position the patient in lateral recumbency (**Figure 1**).

- Tape the thoracic limbs together evenly and pull cranially, keeping the sternum and vertebrae equidistant to the table.
- A foam wedge may be placed under the cubital joints and/or sternum in order to maintain laterality of the patient; wedges are typically needed for large-breed and/or barrel-chested dogs.
- Tape the pelvic limbs together evenly and pull caudally, keeping the patient in lateral position.
- The thoracic spine should be aligned with the horizontal line of the collimated field of view (FOV). To accomplish this alignment, the pelvis of the dog or cat may need to be shifted ventrally.

To determine whether or not the patient is aligned in a lateral position and parallel to the table, gauge the superimposition of the iliac wings by palpating the wings to ensure they are even.

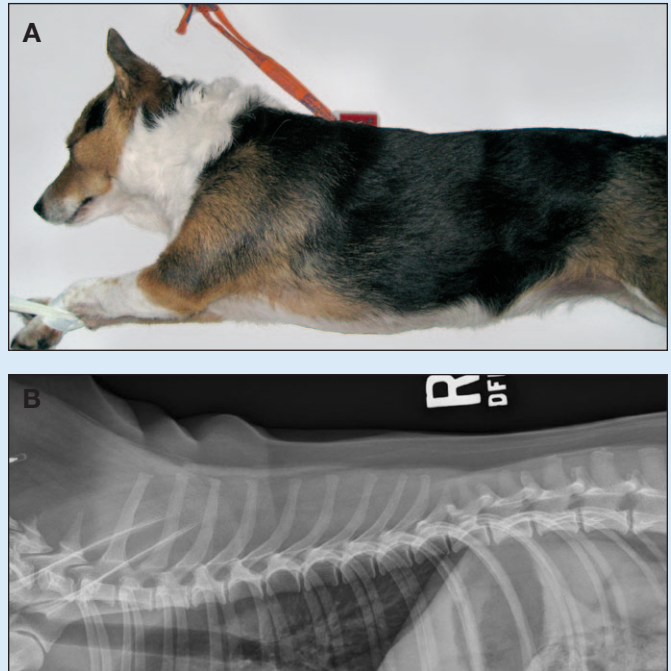
**Lateral Collimation**

For the lateral projection, the FOV should:

- **Include** the dorsum just above the spinous processes
- **Exclude** the sternum and ventral third of the thoracic cavity.

For all patients:

- Palpate the vertebrae of the thoracic spine by following the ribs dorsally to where they meet



**Figure 1.** Dog positioned for lateral projection of the thoracic spine (A) and corresponding radiograph (B).

the vertebral bodies; place the horizontal line of the FOV at this plane.

- Accommodate the contour of the thoracic spine from a ventral position cranially to a more dorsal position caudally.
- Place the radiographic marker to the caudal right or left of the patient to keep it from overlapping with important anatomic areas.

**Ventrodorsal Projection: Thoracic Spine**

For the ventrodorsal projection, position the patient in dorsal recumbency (**Figure 2**).

- If a trough is used, place the entire thoracic spine within the trough to eliminate edge artifacts.
- Extend the skull and neck and align with the manubrium; the skull and cervical spine should also be aligned in a straight line cranially.
- Align the sternum over the thoracic spine; it

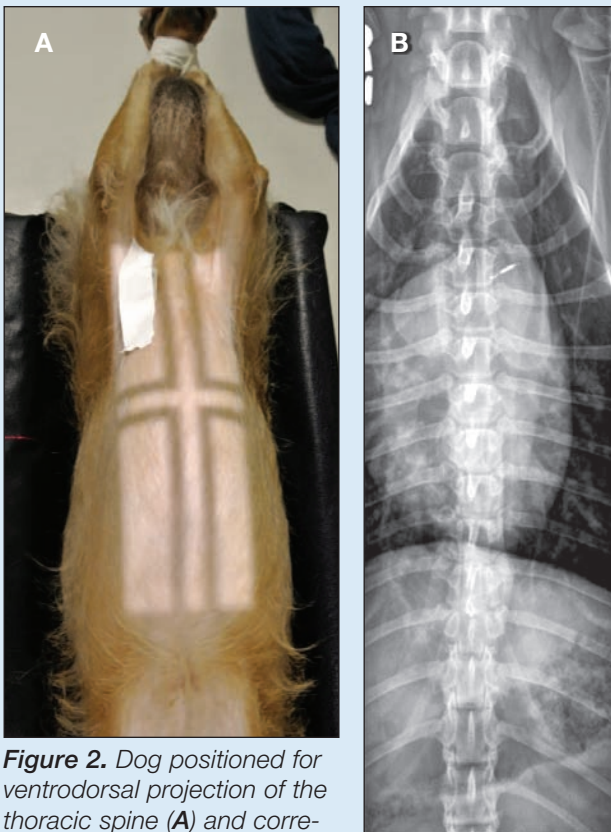
should be superimposed onto the thoracic spine on the final image.

- Tape the thoracic limbs either together or individually and pull cranially.
- Tape the pelvic limbs individually and pull caudally.

**Ventrodorsal Collimation**

For the ventrodorsal projection, the FOV should:

- **Include** the thoracic vertebral bodies,



**Figure 2.** Dog positioned for ventrodorsal projection of the thoracic spine (A) and corresponding radiograph (B).

with only the rib head and proximal rib bodies visualized.

- **Exclude** the lateral body wall and mid zone to peripheral portion of the middle and caudal lung fields.

For all patients:

- Palpate the manubrium and the xiphoid of the sternum; collimate just cranial to the manubrium and 3 finger widths caudal to the xiphoid.
- Place the center of the FOV halfway in between these landmarks, with the horizontal line of the FOV placed midline.
- Place the radiographic marker on the soft tissues of the ventrum at the most lateral edge of the collimated FOV.

### Lateral Projection: Thoracolumbar Junction

Due to x-ray beam divergence, it is necessary to include a projection of the thoracolumbar (T-L) junction for a spinal radiographic survey that includes the thoracic and lumbar spine.

For the thoracolumbar junction lateral projection, position the patient in lateral recumbency (**Figure 3**).

- Tape the thoracic limbs together evenly and pull cranially in the same manner as a lateral thoracic radiograph, keeping the sternum and vertebrae equidistant to the table.
- A foam wedge may be placed under the elbows in order to maintain laterality of the patient.
- Tape the pelvic limbs together evenly and pull caudally, keeping the patient in lateral position.

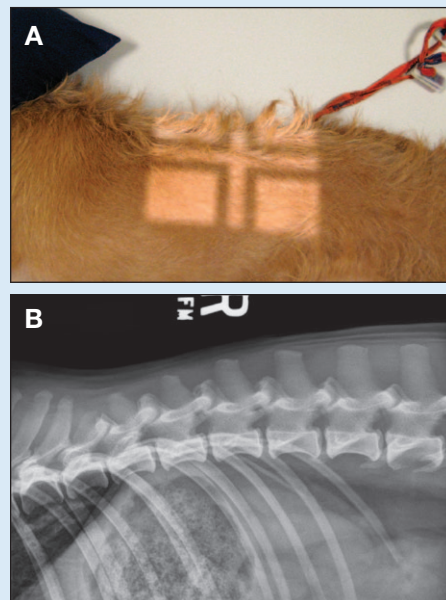
To determine whether or not the patient is aligned in a lateral position and parallel to the table, gauge the superimposition of the iliac wings by palpating the wings to ensure evenness.

### Lateral Collimation

For the lateral projection, the FOV should **include** T10 through L3, including spinous

processes of the respective vertebrae.

- Palpate the junction between the last thoracic vertebral body (T13) and the first lumbar vertebra (L1) by following the caudal border of the last rib dorsally to the point where it joins the vertebral column.
- Place the center of the FOV 2 finger widths caudal to this space.
- Place the radiographic marker to the caudal right or left of the patient to keep it from overlapping with important anatomic areas.



**Figure 3.** Dog positioned for lateral projection of the thoracolumbar spine (A) and corresponding radiograph (B).

### Ventrodorsal Projection: Thoracolumbar Junction

For the thoracolumbar junction ventrodorsal projection, position the patient in dorsal recumbency (**Figure 4**).

- If a trough is used, place the entire thoracic spine within the trough to eliminate edge artifacts.
- Extend the skull and neck and align with the manubrium.
- Align the sternum over the thoracic spine; it should be superimposed with the thoracic spine on the final image.
- Tape the thoracic limbs either together or individually and pull cranially.
- Tape the pelvic limbs individually and pull caudally.

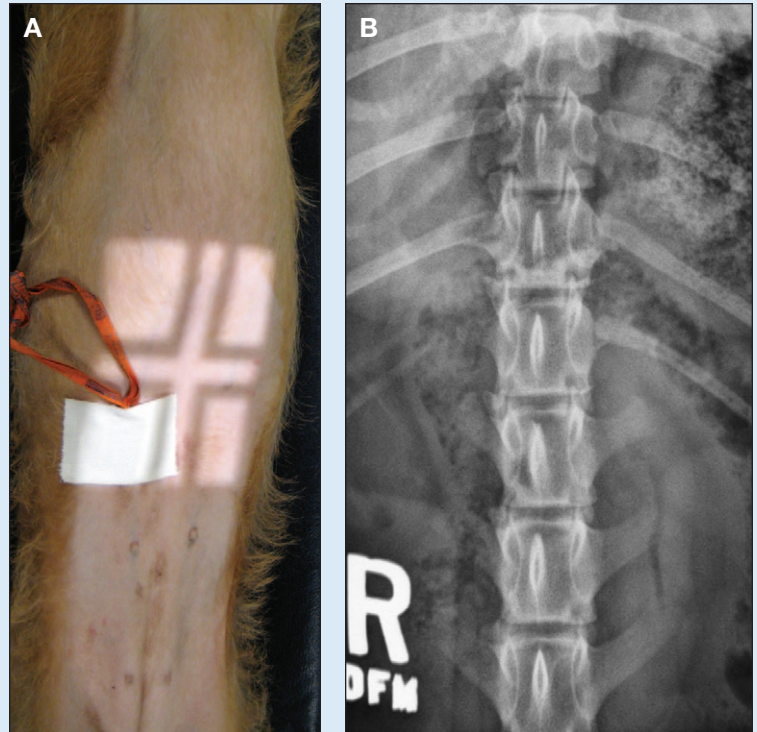
### Ventrodorsal Collimation

For the ventrodorsal projection, the FOV should:

- **Include** the thoracic vertebral bodies, with only the immediate rib heads and soft tissues visualized.
- **Exclude** the lateral body wall and lungs of the thoracic cavity.

For all patients:

- Palpate the xiphoid of the sternum and the curve of the last rib in the lateral body wall.
- Place the center of the FOV halfway in between these landmarks, with the horizontal line of the



**Figure 4.** Dog positioned for ventrodorsal projection of the thoracolumbar spine (A) and corresponding radiograph (B).

- FOV placed midline.
- Place the radiographic marker on the soft tissues of the ventrum at the most lateral edge of the collimated FOV.

## ADDITIONAL VIEWS

### Ventrodorsal Oblique Projection: Thoracic Spine

Subtle lesions, fractures, and intervertebral disk disease are a few of the conditions that may require a ventrodorsal oblique projection of the spine (**Figure 5**).

- From the straight ventrodorsal position of the thoracic spine, obliquely rotate the patient to the left approximately 10° to 15°; then take the radiograph.
- Rotate the patient to the right approximately 10° to 15° and take a second radiograph.

**Collimate** as described for the ventrodorsal projection of the thoracic spine (page 60). The ventrodorsal oblique thoracic spine projection requires a larger collimated FOV on the lateral aspect due to the curvature of the spine in that region.

### QUALITY CONTROL

To make certain the desired technique has been achieved, use the following guidelines to determine whether the appropriate anatomy is included in the images.

### Thoracic Spine

For the **lateral projection** of the thoracic spine:

- The **cranial border** should include the caudal aspect of

the cervical spine (C7).

- The **caudal border** should, at least, include lumbar vertebra 1 (L1).
- For the lateral position, the rib heads should be superimposed at the vertebral body level.

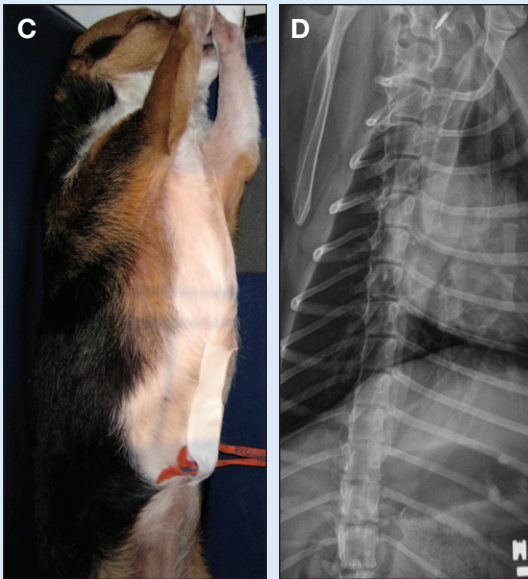
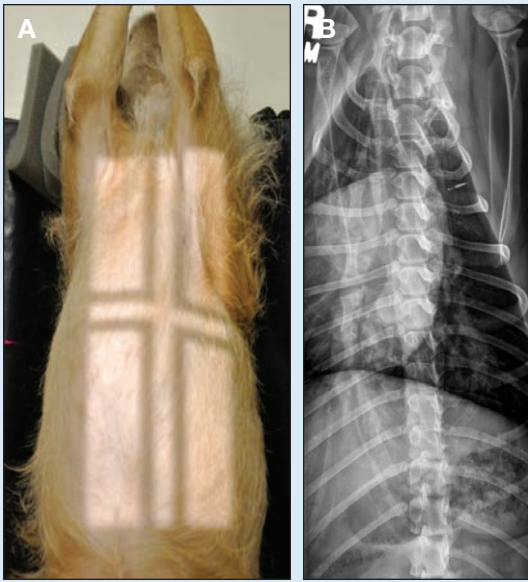
For the **ventrodorsal projection** of the thoracic spine:

- The **cranial border** should include the caudal aspect of the cervical spine at the level of C7.
- The **caudal border** should, at least, include lumbar vertebra 1 (L1).
- The spinous processes should be superimposed over the thoracic vertebral bodies.

### Thoracolumbar Junction

For the **lateral projection** of the thoracolumbar junction:

- The **cranial border** should include the caudal aspect of the thoracic spine near the level of thoracic vertebra 11 (T11).
- The **caudal border** should, at least, include lumbar vertebra 3 (L3).



**Figure 5.** Dog positioned for ventrodorsal oblique projection of the thoracic spine, with the sternum obliqued toward the right (A) and corresponding radiograph (B). Ventrodorsal oblique projection of the thoracic spine, with the sternum obliqued toward the left (C) and corresponding radiograph (D).

For quality control of any diagnostic image, follow a simple 3-step approach:

1. Is the **technique** adequate (appropriate exposure and development factors)?
2. Is the correct **anatomy** present within the image?
3. Is the **positioning** anatomically correct and straight?

- For a true lateral position, the rib heads should be superimposed at the vertebral body level.

For the **ventrodorsal projection** of the thoracolumbar junction:

- The **cranial border** should include the caudal aspect of the thoracic spine at the level of T11.
- The **caudal border** should, at least, include L3.
- The spinous processes should be superimposed over the thoracic and lumbar vertebral bodies.
- In a straight dorsoventral projection, the dorsal spinous processes should have a tear drop appearance. ■

#### Suggested Reading

- Burk RL, Feeney DA. *Small Animal Radiology and Ultrasonography: A Diagnostic Atlas and Text*, 3rd ed. Philadelphia: Saunders Elsevier, 2003.
- Keely JK, McAllister H, Graham JP. *Diagnostic Radiology and Ultrasonography of the Dog and Cat*, 5th ed. Philadelphia: Saunders Elsevier, 2011.
- Sirois M, Anthony E, Mauragis D. *Handbook of Radiographic Positioning for Veterinary Technicians*. Clifton Park, NY: Delmar Cengage Learning, 2010.
- Thrall DE (ed). *Textbook of Veterinary Radiology*, 5th ed. Philadelphia: Saunders Elsevier, 2008.
- Thrall DE, Robertson ID. *Atlas of Normal Radiographic Anatomy and Anatomic Variants in the Dog and Cat*. Philadelphia: Elsevier Saunders, 2011.



#### **Danielle Mauragis,**

CVT, is a radiology technician at University of Florida College of Veterinary Medicine. She teaches veterinary students all aspects of the physics of diagnostic imaging, quality control of radiographs, positioning of small and large animals, and radiation safety. Ms.

Mauragis coauthored the *Handbook of Radiographic Positioning for Veterinary Technicians* (2009) and was the recipient of the Florida Veterinary Medical Association's 2011 Certified Veterinary Technician of the Year Award. This award recognizes an individual for the many outstanding contributions that person has made to the overall success of a veterinary practice operated or staffed by an FVMA member veterinarian.



#### **Clifford R. Berry, DVM,**

Diplomate ACVR, is a professor in diagnostic imaging at the University of Florida College of Veterinary Medicine. His research interests include cross-sectional imaging of the thorax, nuclear medicine applications in veterinary medicine, and molecular imaging applications of imaging in human and veterinary medicine. Dr. Berry has been a faculty member at North Carolina State University and University of Missouri. He received his DVM from University of Florida and completed a radiology residency at University of California–Davis.