This article is the first in a series of articles that will discuss various radiographic positions and techniques. The veterinary technician plays a critical role in the development and maintenance of a radiographic program at a veterinary practice. Thus, it is the responsibility of the technician to be familiar with the basics of:

- Anatomy and positioning
- Technique and image formation
- Quality control of images made within the radiographic suite.

The purpose of this article is to review the 3 basic components of creating high-quality thoracic radiographs of the dog and cat, including positioning, technique, and quality control of the final images.

With advances in imaging technology (computed and digital radiography), errors in technique are less common; however, if anatomy is not appropriately collimated and positioning is inadequate, all imaging studies can be rendered nondiagnostic.

A routine thoracic radiographic study includes 3 projections: right and left lateral images and a ventrodorsal (VD) or dorso-ventral (DV) image.
From a technical standpoint, thoracic radiographic exposure should be obtained using a high peak kilovoltage (kVp) (80–120 kVp) and low milliampere × second (mAs) (1–5 mAs) technique. This technique allows for latitude (long gray scale) images, which are important when evaluating the structures of the thorax.

Several examples would include:

• 82 kVp at 2 mAs for 15-cm dog for analog film (400 speed system) or
• 80 kVp at 5 mAs for a 15-cm dog for a digital plate radiographic system.

For any dog measuring 15 cm or greater (measured at the liver or thickest part of the thorax), a grid (8:1, 110 lines per inch) should be used. Grids are available from most radiology manufacturers and a grid tray comes with all radiology units. For almost all radiology units, a grid is sold with the radiographic machine and table.

The rotor for the anode and the low-voltage circuit for the focusing cup/electrons of the cathode should be coupled to a foot or hand switch so that accurate timing of the exposure at peak inspiration can be made (Table).
Routine Views

Lateral Images

Positioning

For a right and left lateral image, the patient is positioned on the table with the dependent side down and marked with a lead marker to indicate the dependent side in the collimated area as right (R) or left (L).

1. The thoracic limbs should be taped together evenly and pulled cranially so that the elbows and tissues of the triceps muscle are not superimposed over the cranial thorax (Figures 1 and 2).

2. To determine whether or not a patient is aligned in a lateral position and parallel to the table, use an imaginary plane through the sternum and dorsally through the spinous processes of the thoracic vertebra.

3. A foam wedge may be placed under the elbows in order to maintain laterality of the patient (sternum and vertebrae are equidistant to the table).

4. In order to keep the patient in a true lateral position, the pelvic limbs are also taped and pulled caudally.

Collimation

To set the collimation for the thoracic anatomic boundaries of a lateral image (right or left):

- **Vertical Line of the Collimation Light**: Palpate the caudal border of the scapula dorsally and place the vertical line at this point. This allows for the cardiac silhouette to be in the center of the image, giving a true representation of the cardiac size and shape.

- **Horizontal Line of the Collimation Light**: The horizontal line should be placed in an imaginary plane so as to bisect the thoracic cavity evenly between dorsal and ventral. Palpate the manubrium and place the cranial edge of the collimation beam at the cranial edge of the manubrium; this places the caudal edge of the beam at the level of the 13th rib head and T13. Remember to always include the sternum of the patient so as not to exclude vital anatomy:

  - **In large-breed dogs**, it may be necessary to exclude the spinous processes. A separate image might be necessary if indicated.

  - **In deep-chested breeds**, such as Great Danes, Doberman pinschers, or mastiffs, the cassette/detector plate may be turned vertically to encompass the entire thoracic cavity in the dorsal and ventral plane.

  - Turning the cassette/detector plate vertically does not allow for the entire thorax to be included; therefore, cranial and caudal views need to be taken, for completeness.

### Table. How to Determine Whether Radiograph Was Taken at Peak Inspiration

<table>
<thead>
<tr>
<th>Patient Size</th>
<th>Lateral</th>
<th>Ventrodorsal/Dorsoventral</th>
</tr>
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<tbody>
<tr>
<td>Small-breed dogs (hardest to</td>
<td></td>
<td></td>
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<tr>
<td>consistently catch on peak</td>
<td>• Diaphragmatic crura at level of T10 (</td>
<td>• Costophrenic angle (Figure 4) at level of</td>
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<tr>
<td>inspiration)</td>
<td>minimum); preferably at T12</td>
<td>10th rib (minimum); preferably at 12th rib</td>
</tr>
<tr>
<td></td>
<td>• Cupula at T8</td>
<td>• Diaphragmatic cupula (center) at T8</td>
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<tr>
<td></td>
<td>• May see overlap between the borders of the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cardiac silhouette and diaphragm</td>
<td></td>
</tr>
<tr>
<td>Medium-breed dogs Large-breed</td>
<td>• Diaphragmatic crura at T12–T13 (cats,</td>
<td>• Costophrenic angle located at T10–T11</td>
</tr>
<tr>
<td>dogs Cats</td>
<td>T1–L1)</td>
<td>• Diaphragmatic cupula at T10</td>
</tr>
<tr>
<td></td>
<td>• Cupula at T10</td>
<td>• Separation of heart and diaphragm</td>
</tr>
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<td></td>
<td>• Separation of heart and diaphragm</td>
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</table>

Figure 3. (A) Dog in ventrodorsal recumbency with thoracic limbs taped and pulled cranially. The light marks the cranial border of the image that is collimated to the level just cranial to the thoracic inlet. (B) Ventrodorsal lateral thoracic radiograph of the dog in Figure 3A; notice the cranial location of the thoracic limbs relative to the thoracic inlet.
Ventrodorsal Images

Positioning

For the ventrodorsal view, the patient should be placed in dorsal recumbency.

1. Using a V-trough helps keep the patient’s spine and sternum aligned.
2. The thoracic limbs are taped together evenly and pulled forward with the patient’s muzzle placed between the limbs (Figure 3, page 47).
3. The pelvic limbs are pulled caudally and secured.

The technique described in Step 2 does not work well for:

- **Brachycephalic breeds**, such as English bulldogs or pugs, that might have issues with upper airway disease or obstruction
- **Chondrodystrophic breeds**, such as dachshunds or basset hounds, because they are physically unable to do so.

When presented with these types of patients ensure that the head and neck are straight out in front of the body and not oblique to the left or right.

Collimation

To set collimation for the ventrodorsal view, the landmarks are the same as the lateral projection:

- **Vertical Line of the Collimator Light**: Place the vertical line at the caudal border of the scapula. This allows the cardiac silhouette to be in the center of the image.

Figure 6. (A) Dog in ventrodorsal recumbency with the thoracic limbs taped in the humanoid position, down along the dog’s side. This position results in the scapulae rotating externally and cranially instead of being superimposed over the cranial lung lobes. The light marks the cranial border of the image that is collimated to the level just cranial to the thoracic inlet. (B) Ventrodorsal thoracic radiograph corresponding to the dog in Figure 6A; notice the externally rotated scapulae (arrows) and lack of superimposition over the cranial lung fields (compared with Figure 5).
Horizontal Line of the Collimator Light: The horizontal line should be placed directly over the sternum so as to bisect the thoracic cavity from left and right lateral. Palpate and place the edge of the collimation beam at the cranial edge of the manubrium; this places the caudal edge of the beam to the 13th rib head at the level of the thoracic spine.

- In large-breed dogs (e.g., Great Dane), it will be necessary to take a cranial and caudal projection.

Dorsoventral Images
Positioning & Collimation
The dorsoventral radiograph is one of the hardest radiographs to position consistently. The dorsoventral image best visualizes lesions in the caudodorsal lung lobes.
1. The dog is either in:
   - Ventral recumbency without the legs taped, resulting in a “sphinx” position (Figure 4) or
   - A frog-leg position (pelvic limbs).
   The comfort of the patient is of utmost importance.
2. The thoracic limbs are pulled cranial and abducted.
3. The anatomic landmarks are the same as for a ventrodorsal image.

ADDITIONAL VIEWS
Humanoid Projection
In a conventional ventrodorsal projection (with the thoracic limbs pulled cranial), the caudal portion of the scapulae are superimposed over the cranial lung fields (Figure 5). The humanoid projection obtains no summation of the scapula with the cranial lung fields.

Figure 7. Dog in ventral recumbency with the radiograph cassette (detector plate) placed along the lateral thorax. This view will help differentiate fluid (remains ventral on exposure) and air accumulation (remains dorsal on exposure) in the pleural space, pulmonary parenchyma, or mediastinum.

1. To determine fluid or free air distribution, position the patient as if performing a ventrodorsal view (i.e., dorsal recumbency).
2. To visualize the cranial mediastinum, position the patient as if performing a dorsoventral view.
3. Place the cassette/detector against the lateral body wall, making sure to mark the dependent side L or R.
4. The landmarks are the same as the lateral projection (Figure 7).

QUALITY CONTROL
For quality control of any diagnostic image, keep a simple 4-step approach in mind:
1. Determine if the technique is appropriate.
2. Ascertain if the appropriate anatomy is present within the image.
3. Check the positioning for laterality and straightness.
4. Determine if projection was taken at peak of inspiration.

Patient in lateral recumbency showing correct use of tape and sandbags; the dog is muzzled due to its history of biting (see Dog Bites: Protecting Your Staff & Clients, page 66)
Technique & Anatomy
Given that the desired technique has been attained, make sure that the appropriate anatomy is included. The laterals, ventrodorsal, dorsoventral, humanoid, and horizontal beam projections should:
- Extend from the cranial margin of the manubrium to the caudal margin of the lung margin/diaphragmatic crus.
- Not exclude the sternum on the lateral or lateral aspect of the ribs on the ventrodorsal view.

Positioning
If the technique exceeds quality standards and the correct anatomy is present, check patient positioning.
- **For the lateral projection**, use superimposition of the rib heads throughout the thoracic spine to determine if a patient is in a true lateral position (Figures 1B and 2B).
- **For the ventrodorsal projection**, each thoracic spinous process is viewed end-on and has a distinct diamond or tear-dropped shape without the ability to see the sternum and the thoracic vertebrae as separate structures.
- **For the dorsoventral projection**, positioning is similar to the ventrodorsal in that the thoracic spinous process is viewed end-on and has a distinct diamond or tear-dropped shape without the ability to see the sternum and the thoracic vertebrae as separate structures.

Peak Inspiration for Image Acquisition
Finally, determine if the projection was taken at the peak of inspiration:
- **For the lateral view**, the caudal aspect of the cardiac silhouette will not be superimposed over the diaphragm and there is an upside down triangle that is visualized using the caudal vena cava, diaphragm, and caudal border of the heart as the margins.
- **For the ventrodorsal view**, the cupola or central portion of the diaphragm will be separated from the caudal border of the cardiac silhouette. The lateral margins of the diaphragmatic crura will come to the 11th or 12th intercostal space and the right and left cranial lung lobes will extend to the level of the thoracic inlet.
- The exception to these rules is the extremely obese patient that cannot take a deep inspiratory breath.

**SUMMARY**
Thoracic radiographs are often used as a first-line test for possible intrathoracic disease. High-quality, correctly positioned radiographs are required in order to provide as accurate an assessment as possible.

In addition, a 3-view thorax (right lateral, left lateral, and dorsoventral or ventrodorsal view) is considered the standard of care in veterinary medicine. Following a consistent, repeatable pattern for obtaining thoracic radiographs ensures that the quality of the images will always be diagnostic.

kVp = peak kilovoltage;
mAs = milliampere × second

**Suggested Reading**