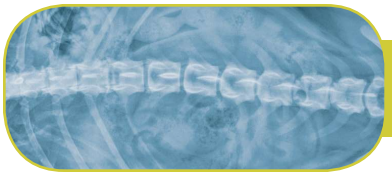
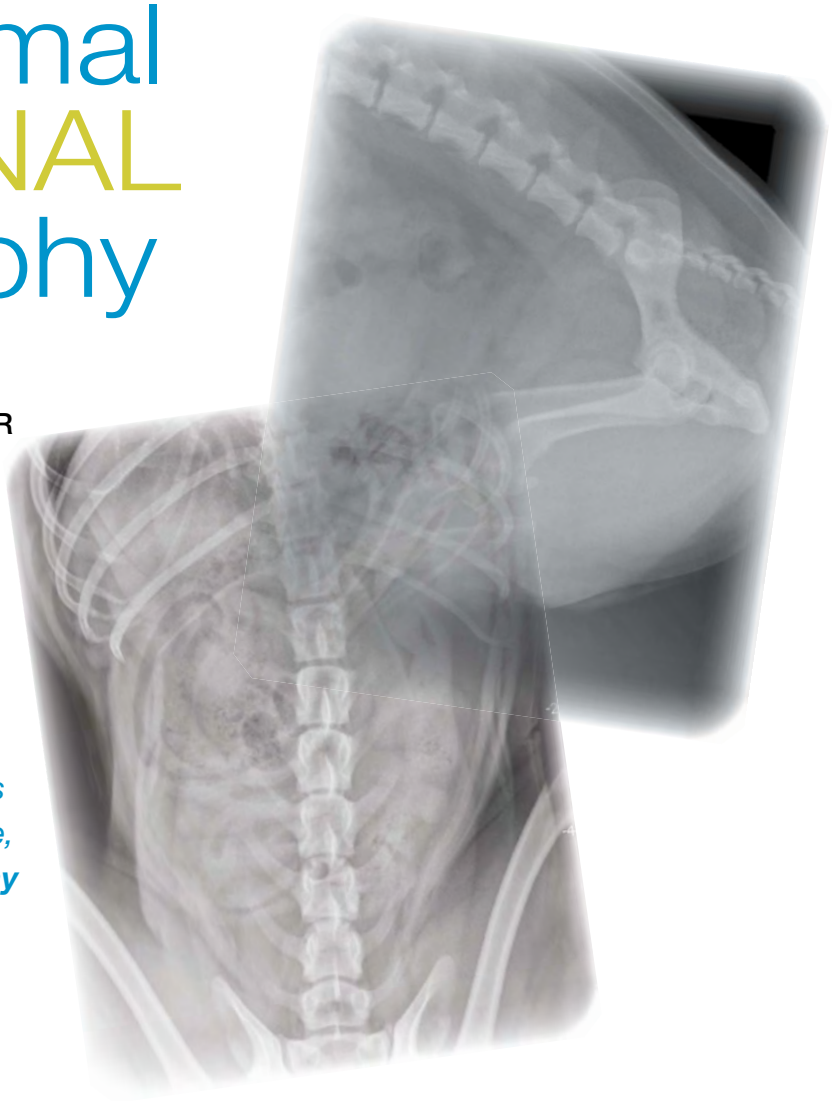


Small Animal ABDOMINAL Radiography

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



This is the second article in our Imaging Essentials series—a series focused on providing critical information on radiographic positions and techiniques. Read the first article, ***Small Animal Thoracic Radiography*** *(September/October 2011) at* ***todaysveterinarypractice.com.***

This article will review the 3 components of creating repeatable, high-quality abdominal radiographs of the dog and cat. These components include:

- Adequate technique
- Proper positioning
- Quality control of the final images.

ABDOMINAL RADIOGRAPHIC EXPOSURE

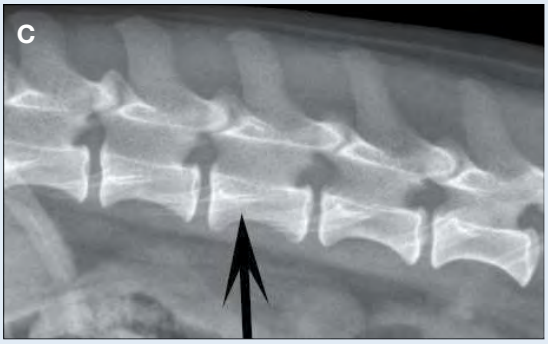
For radiographic imaging, dogs and cats are measured at the thickest part of their bodies, typically at the liver or cranial abdomen.

Dogs measuring less than 15 cm: For a dog measuring 14 cm, a reasonable starting technique would be 68 kVp and 8 mAs for a 400 film-screen analog film system. For a digital plate, a starting technique would be 72 kVp and 10 mAs.

Dogs measuring 15 cm or greater: For any dog measuring greater than or equal to 15 cm, a grid (8:1, 110 lines per inch) should be used to reduce scatter radiation from degrading the final image quality. Based on the type of grid used, the technique will need to be adjusted.

Figure 1. Radiographic Studies of Small to Medium Dogs

*(**A**) Dog in right lateral recumbency with pelvic limbs taped and pulled caudally and 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 xiphoid process. The hand is positioned to denote the caudal border of the image at the level of the greater trochanter. This abdomen fits on a single cassette or as a single lateral image. (**B**) Right lateral abdominal radiograph of a small dog; notice the cranial location of the collimated image (cranial to the diaphragmatic cupola) and the caudal collimated area to the level of the greater trochanter. The image is noted to be lateral based on the superimposition of the transverse processes (Nike swoosh) and superimposition of the wings of the ilium and rib heads.*



*(**C**) Close-up image showing the superimposed transverse processes from the lateral image in B (black arrow); the Nike swooshes are superimposed, although there is slight rotation of the transverse processes. This degree of obliquity would be considered acceptable. (**D**) Dog in ventrodorsal recumbency with pelvic limbs taped and pulled caudally. The light marks the caudal border of the image that is collimated to the level of the greater trochanter of the femurs.*

For any given mAs setting, the higher the mA station used, the faster the time station that can be used.

Even in the abdomen, motion can be a problem. Therefore, keeping the time station faster than 1/30 of a second is important. Adjustments in the technique will need to be made depending on the animal's body condition. However, for a dog of healthy body weight that measures 14 cm, the previously discussed technique should be an appropriate starting point for building a technique chart.

The overall image should be evaluated for radiographic contrast (film blackness outside the patient versus shades of gray and white within the patient) and subject contrast (edge detail within the abdomen where fat will contrast with soft tissue borders for normal serosal detail).

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 in the collimated area as right (R) or left (L) based on the dependent side (**Figures 1**, above, **and 2**, page 56).

1. The pelvic limbs should be evenly taped together and pulled caudally to ensure that the stifles are not within the abdomen.
2. Palpate and use the iliac crests to determine whether the patient is aligned in a lateral position and parallel to the table. The iliac crests should be even and superimposed.
3. A foam wedge may be placed under the stifles in order to maintain laterality of the patient. To avoid artifacts, do not place sponges under the

*(**E**) Ventrodorsal radiograph; notice the cranial and caudal locations of the field of view for a ventrodorsal image. Additionally, the caudal thoracic ribs and pelvic structures are symmetrical and the spinous processes of the caudal thoracic and lumbar spine are noted to have a focal "teardrop."*

sternum or cranial abdomen

4. In order to keep the patient in a true lateral position, the thoracic limbs should be taped evenly together and pulled cranially.

Collimation

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

1. **Positioning:** Unlike thoracic positioning, abdominal positioning has no set place for the vertical line of the collimator light (field of view) due to the various sizes of patients. Therefore, the edges of the collimation beam are your cranial, caudal, ventral, and dorsal borders.
2. **Collimator light:** Be sure the collimator light is adjusted to match the same size of the cassette or detector by using the corresponding numbers next to the collimator knobs (**Figure 3**, page 57). From here, the collimator light can be decreased to the patient's size to ensure proper patient collimation and minimized scatter radiation.
3. **Cranial border:** The cranial border of the collimator light should be placed cranial to the liver. This is accomplished by palpating the xiphoid process of the sternum and placing the light 2 finger widths cranial to the xiphoid process (**Figure 2B**, page 56).
4. **Caudal border:** The caudal border of the collimator light should reach the level of the greater trochanter of the femur. If the caudal beam does not reach the trochanter, then it becomes necessary to take a cranial and caudal image for each projection (right lateral, left lateral, and ventrodorsal; **Figure 2**, page 56).

PET PARTICULARS—Lateral & Ventrodorsal Views

In deep-chested breeds, such as Great Danes, Doberman pinschers, or mastiffs, the cassette/detector plate may be turned vertically (**Figure 3**) to encompass the entire abdominal cavity in the dorsal and ventral plane. Again, cranial and caudal exposures with central overlap will be required to cover the entire abdomen on a given view. In the long, large-breed dog you may need to take 3 overlapped views: cranial, mid abdomen, and caudal.

5. **Horizontal line:** The horizontal line of the collimator light should be placed in an imaginary plane so as to bisect the abdominal cavity into equal dorsal and ventral parts. Remember to always include the sternum and xiphoid process in order to include cranial abdominal anatomy. If the dog is thin or deep chested, the caudal abdominal horizontal line will be higher (more dorsal) than after taking the cranial abdominal lateral view.

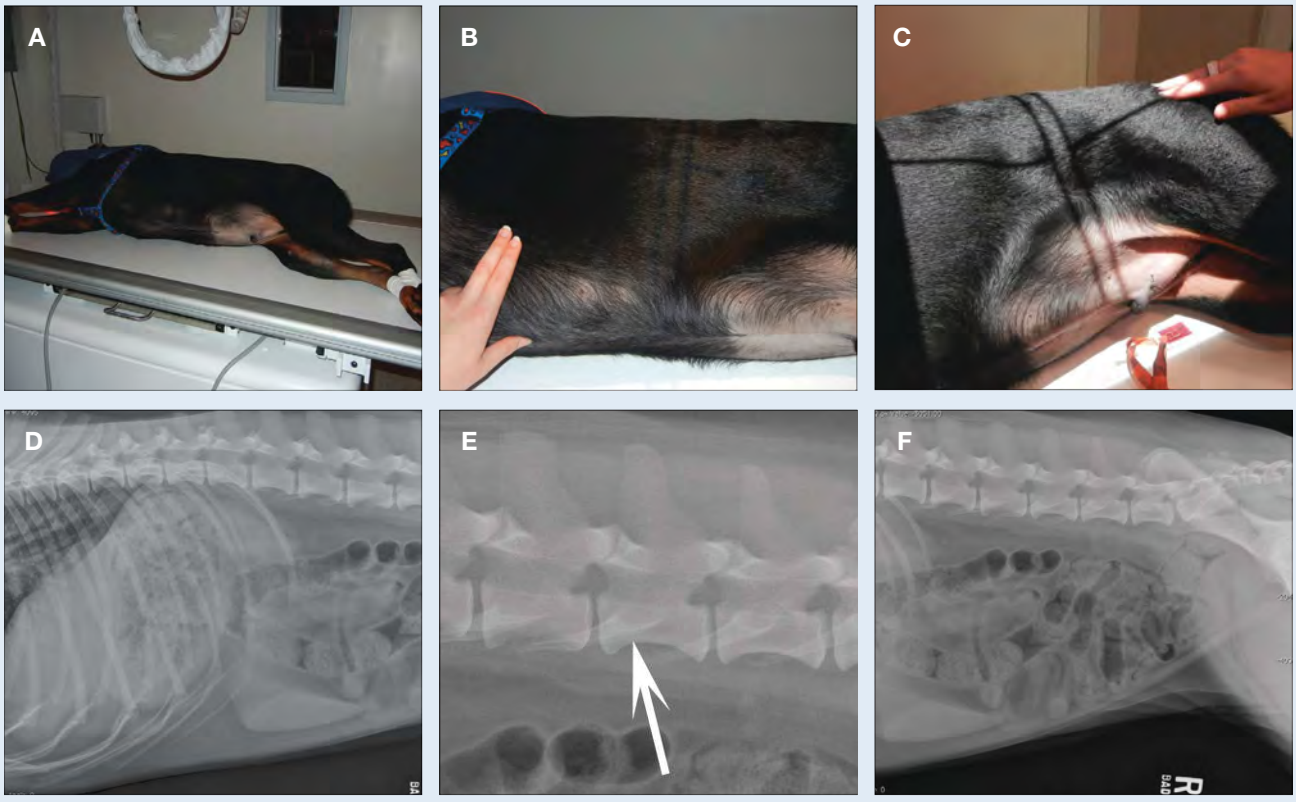


Figure 2. Lateral Radiographs of a Large Dog

A large dog positioned in right lateral recumbency. Since the entire abdomen will not fit onto 1 image for a given projection (right or left lateral or ventrodorsal), it must be divided into several projections.

*(**A**) Entire dog positioned for a set of right lateral radiographs. (**B**) Collimator and hand denoting the cranial boundary for the abdominal radiograph. (**C**) Collimator and hand denoting the caudal boundary for the right caudal lateral abdominal radiograph at the level of the greater trochanter. (**D**) Right lateral cranial abdominal radiograph; note the superimposition of the rib heads (thoracic vertebrae) and transverse processes of the lumbar vertebrae (Nike swoosh). (**E**) Close-up of the superimposed transverse processes (white arrow). (**F**) Right lateral of the caudal abdomen from the dog in D; there is overlap of the 2 images (includes L1–L3) and the caudal abdominal radiograph has been collimated to the level of the greater trochanters. Note the superimposition of the iliac wings and the transverse processes of the lumbar vertebrae. (**G**) Left lateral radiograph of the cranial abdomen; note how the gas has shifted from a fundic position on a right lateral radiograph to a pyloric position on this left lateral radiograph.*

Ventrodorsal Images

Positioning

For the ventrodorsal view, the patient should be placed in dorsal recumbency (**Figures 1 and 4,** page 57).

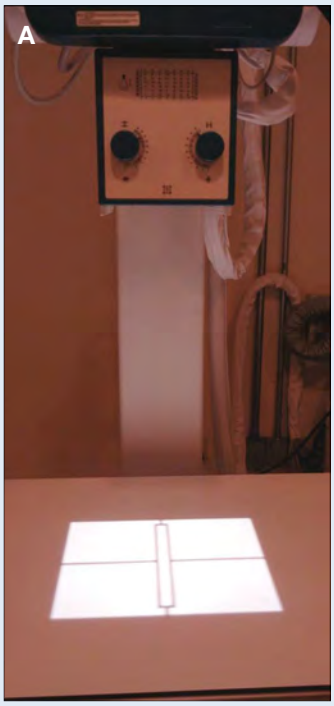
1. Using a V-trough helps keep the patient's spine and sternum aligned and superimposed.
2. The pelvic limbs are pulled caudally and secured.
3. The thoracic limbs are evenly taped together and pulled forward with the patients muzzle placed between the limbs to help keep the whole vertebral column straight cranially.

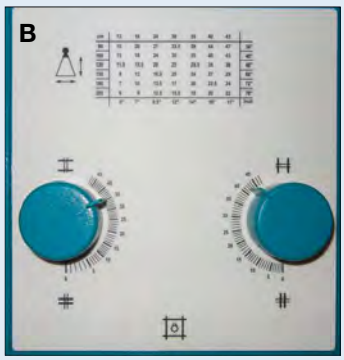
The technique described in Step 3 does not work well for brachycephalic breeds, such as English bulldogs or pugs, that might have issues with upper airway disease or obstruction or chondrodystrophic breeds, such as dachshunds or basset hounds, because they are physically unable to do so. When presented with these breeds of patients, ensure that the head and neck are straight in front of the body and not obliqued to the left or right.

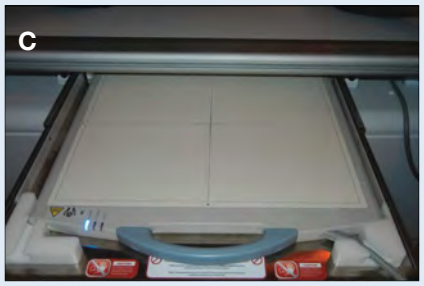
Collimation

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

1. **Cranial border:** The cranial border of the col-







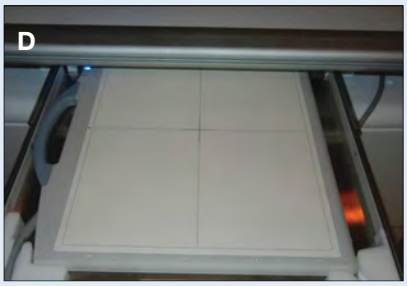


Figure 3. Collimator Settings

*(**A**) Picture of the detector and collimator knobs set to size showing the numbers; the initial abdominal field of view is set to the size of the cassette based on the collimator numbers on the light collimator housing. (**B**) After this the field of view (close-up of collimator) is decreased to appropriate levels based on the size of the dog. (**C & D**) If the dog is a large or giant breed, you may need to switch the cassette or digital plate from a horizontal position (**C**, long axis of the dog) to a vertical position (**D**, longer part of the cassette or digital plate is now perpendicular to the long axis of the dog).*

limator light should be placed cranial to the liver. Again, palpate the xiphoid process of the sternum and place the edge of the collimator light 2 finger widths cranial to it (**Figures 1 and 4**).

2. **Caudal border:** The caudal border of the collimator light aligned with the long axis should be placed at the level of the greater trochanter of the femur. If the caudal beam does not reach the greater trochanter, then it becomes necessary to take a cranial and caudal projection.
3. **Horizontal line:** The horizontal line along the long axis of the dog or cat's body should be placed in an imaginary plane on the midline of the abdomen in order to bisect the abdominal cavity into equidistant left and right sides.

Dorsoventral Images

The dorsoventral radiograph is one of the hardest radiographs to position consistently (**Figure 5**, page 58). The dorsoventral projection is typically used when performing contrast studies, such as upper and lower gastrointestinal imaging or gastrograms, and when gastric dilatation-volvulus is suspected. It also specifically evaluates the fundic portion of the stomach.

1. The dog is either in:
   - Ventral recumbency without the legs taped, resulting in a "sphinx" position
   - 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, although the dog will be shorter in the craniocaudal direction.

ADDITIONAL ABDOMINAL VIEWS

Lateral View with Pelvic Limbs Pulled Cranially

This view is obtained in addition to the routine radiographs for better visualization of radiopaque calculi that might be present within the urethra of a male dog or any

Figure 4. Ventrodorsal Radiographs of a Large Dog

*Cranial (**A**) and caudal (**B**) ventrodorsal (VD) radiographs of a large dog; note the overlap of structures between the 2 images (caudal part of the VD cranial image and cranial part of the VD caudal image). Also note the straight positioning of the caudal thoracic and lumbar spine, resulting in equal amounts of the abdomen on the right and left side of each image.*

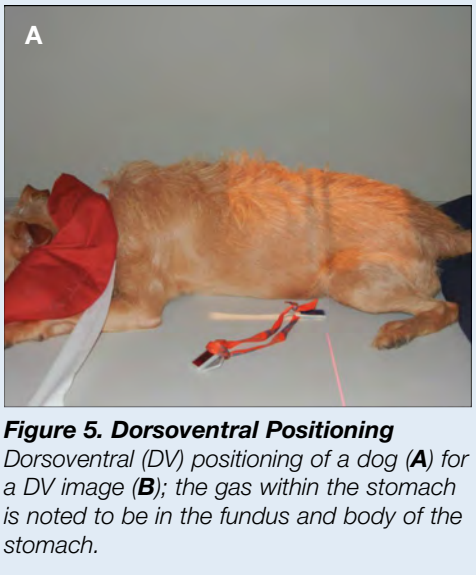


Figure 5. Dorsoventral Positioning
*Dorsoventral (DV) positioning of a dog (**A**) for a DV image (**B**); the gas within the stomach is noted to be in the fundus and body of the stomach.*

perineal abnormalities of the dog or cat. Visualization of radiopaque urethral calculi proximal to the os penis within the membranous urethra can be hindered when the pelvic limbs are pulled caudally.

After taking the normal lateral radiograph, pull the pelvic limbs cranially so the stifle joints are touching the ventral abdomen (**Figure 6**). A sandbag works very well to keep the legs in position (make sure not to include the sandbag in the field of collimation). The collimation should include cranial from the iliac crest to the caudal-most skin margin at the ischiatic tuberosity or perineum.

Horizontal Beam Projections

Horizontal beam lateral or dorsal projections are used for assessing free air within the abdominal cavity. These views are dependent on the ability of the radiology machine tube to be manipulated in a 90° angle. In addition, using a positioning trough makes these views easier to obtain.

1. **Lateral recumbency:** Position the patient in left lateral recumbency; then wait 10 minutes before taking the radiograph. This allows time for free air to rise to the top of the body wall. Left lateral recumbency assures that air within the pylorus is not mistaken for free air. Place the cassette on the lateral aspect of the abdomen and label the dependent side (**Figure 7**).
2. **Dorsal recumbency:** Place the patient in dorsal recumbency as if taking a ventrodorsal view; then wait 10 minutes to allow free air to rise to the ventral part of the abdomen. Place the cassette on the lateral aspect of the abdomen and label the dependent side.

QUALITY CONTROL OF ABDOMINAL IMAGES

For quality control of any diagnostic image, keep a simple 3-step approach in mind:

1. Determine if the technique is appropriate: all portions of the abdominal viscera should be adequately exposed with sharp contrast between the air and the patient.
2. Ascertain if the appropriate anatomy is present within the image. Make sure that there is anatomic overlap if the dog is split into cranial and caudal images.
3. Check the positioning for laterality and straightness.

The laterals, ventrodorsal, and dorsoventral projections should:

- Extend from the cranial margin of the liver (cranial-most lung–diaphragm interface) to the caudal aspect of the abdomen as measured by the greater trochanter of the femurs.
- Include the caudal sternum and xiphoid process on the lateral images or lateral aspect of the ribs and body wall on the ventrodorsal view.

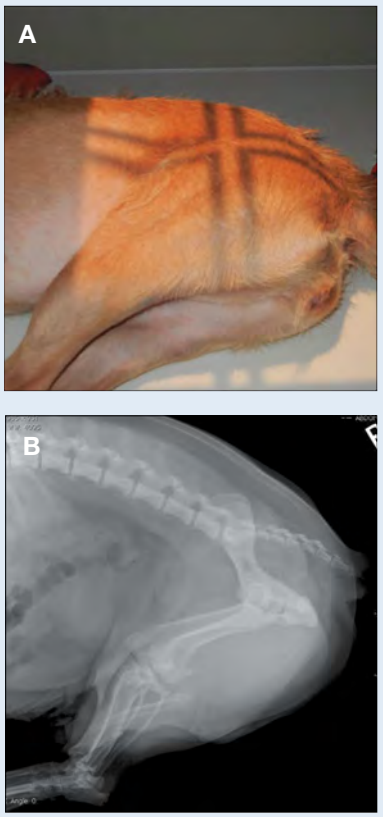


Figure 6. Lateral View with Pelvic Limbs Pulled Cranially
*(**A**) Placement of the dog for a cranially or flexed position of the pelvic limbs with the image centered on the perineum so as to evaluate the length of the male urethra.*

*(**B**) Flexed lateral radiographic image from a male dog; this view could also be used to evaluate any perineal abnormalities in the dog or cat.*

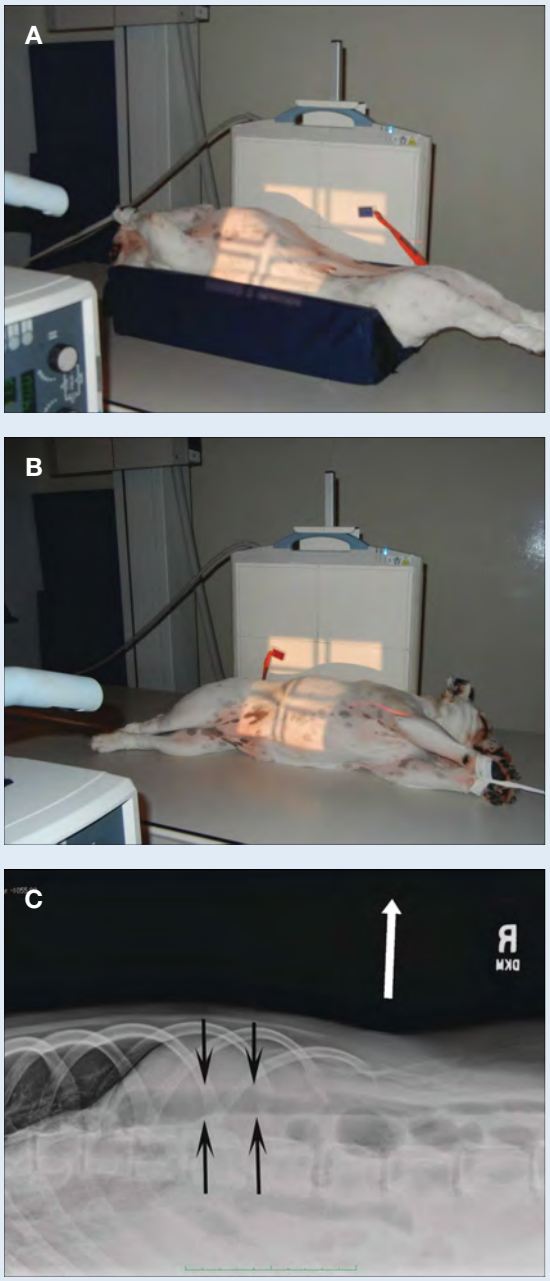


Figure 7. Horizontal Beam Positioning
*Placement of a dog for horizontal beam radiographs, including dorsal recumbency (**A**) and left lateral recumbency (**B**). Horizontal beam radiographs are useful for determining if there is peritoneal gas present that is not contained within a hollow viscus.*

*A left lateral horizontal beam image (**C**) where free air (black arrows) is documented in the peritoneal cavity away from gas within small intestinal segments.*

If technique exceeds quality standards and the correct anatomy is present, then check patient positioning.

- **For lateral projections,** use superimposition of the transverse processes throughout the lumbar spine to determine if a patient is in a true lateral position. The transverse processes appear as Nike swooshes and should be superimposed over each other (**Figure 1**). The wings of the ilia will also be superimposed.

PET PARTICULARS—Quality Control

When viewing lateral projections, remember that in the larger dog, due to magnification, the iliac wing and crest furthermost away from the cassette or detector will appear larger than the iliac wing and crest closest to the cassette.

- **For ventrodorsal projections,** each caudal thoracic and lumbar spinous process is viewed end-on and has a distinct diamond or tear-dropped shape as does the lumbar spinous processes (**Figure 4**).
- **For dorsoventral projections,** positioning is similar to the ventrodorsal projection in that the lumbar and thoracic spinous processes are viewed end-on and have a distinct diamond or tear-dropped shape. However, the pelvis will be oblique as the patient has not been stretched as in a ventrodorsal image (**Figure 5**).

SUMMARY

Abdominal radiographs are often used as a first-line screening test for possible intra-abdominal disease. High-quality, correctly positioned radiographs are required in order to provide as accurate an assessment as possible. An abdominal series containing no less than right lateral, left lateral, and ventrodorsal view is considered the standard of care in veterinary medicine. Following a consistent, repeatable pattern for obtaining abdominal radiographs ensures that the quality of the images should be considered diagnostic. ■

Suggested Reading
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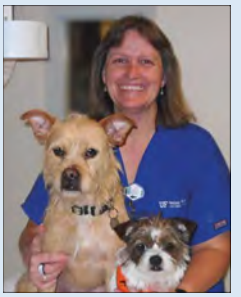

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