

CT and MRI submission guidelines

Positioning the patient properly and following recommended scanning protocols for computed tomography (CT) and magnetic resonance imaging (MRI) are essential to obtaining diagnostic studies. Including excessive anatomy increases scatter radiation, which may cause additional image artifacts and degrade the images, add unnecessary exposure to the patient, and contribute to added radiation exposure to staff and public.

Interpretation fees are based on the anatomical regions imaged because all regions sent require interpretation. The more regions included in the submission, the higher the interpretation fees.

The protocols in this guide will help you obtain optimally positioned scans for the most effective diagnostic studies of the most common anatomic areas of interest (e.g., abdomen, thorax, skull, and cervical regions).



General considerations

Patient position

Position the patient to provide optimal imaging of the anatomic region. For example:

- When imaging the skull, position the patient in sternal recumbency, supporting the skull to eliminate rotation or obliquity of the skull.
- CT images are considered the gold standard for pulmonary evaluation; position the patient in sternal recumbency to provide the fullest pulmonary inspiration.
- If imaging the spine, position the patient in dorsal recumbency to reduce motion artifact from breathing.

In general, the limbs should not be included in the field of view (FOV), unless they are the primary region of interest. Artifacts that can mimic pathology or image degradation are often patient-based, such as limbs, IV lines with fluid or air, orthopedic devices, or other medical hardware in the scanner X-ray beam, and should be avoided when possible. For the thorax and abdomen, a “Superman” position is ideal, extending the thoracic and pelvic limbs outside of the field-of-view. For the skull and cervical regions, it is typically best to pull the thoracic limbs caudally away from the skull.

If you have questions about the best positioning for the region or lesion of interest, we are here to help. Our specialists are happy to assist you in preplanning before the patient arrives.

Field of view (FOV)

Optimal images are obtained if you reduce the FOV to include only the region of interest. A reduced FOV will minimize scatter radiation, improving image contrast and improving radiation safety for the patient and staff. Reduced FOV will also optimize image resolution by devoting available pixels to tissue rather than room air.

Slice thickness

Optimize slice thickness to the required resolution for the size of the lesion or body part.

Abdomen protocols

The patient should be placed in sternal recumbency to more closely replicate the normal anatomic positioning of the organs. If the patient is anesthetized, breathing motion will be limited and will not significantly affect the image quality. The pelvic limbs may be pulled caudally to prevent streak artifact from inclusion of the stifles and extraneous soft tissues.

Select a field of view that includes the anatomic area, with as little extraneous material as possible. For large dogs, this will likely be in the 25–30 cm range, with cats or small dogs in the 15–20 cm range.

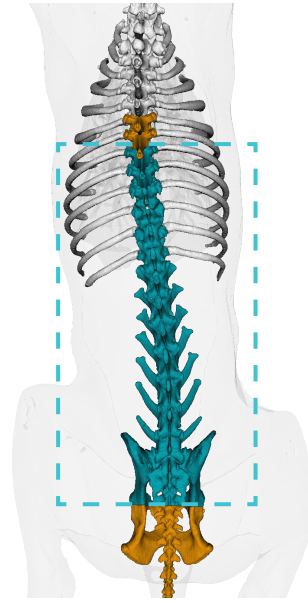
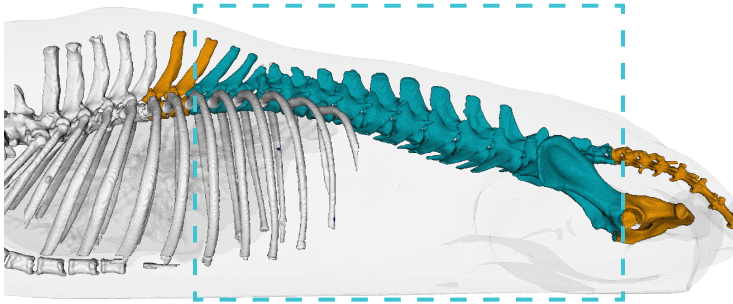
The landmarks are chosen to include the caudal aspect of the cardiac apex, to ensure complete inclusion of the diaphragm. The cranial landmark is the T6–T7 intervertebral disc space. As in abdominal radiography, the caudal landmark is a cranial margin of the acetabulum. This ensures inclusion of the urinary bladder in this patient. If there is concern for urethral or prostatic disease, including the entire pelvis is advised, as denoted in orange on the figures.

Slice thicknesses are chosen based on a patient's size to optimize signal-to-noise ratio (providing a balance of good contrast resolution and detail). For cats and small dogs, a smaller thickness is advised—approximately 1 mm slice thickness. For larger dogs, a larger slice thickness is recommended—approximately 2–3 mm. This provides adequate anatomic detail, while limiting signal noise.

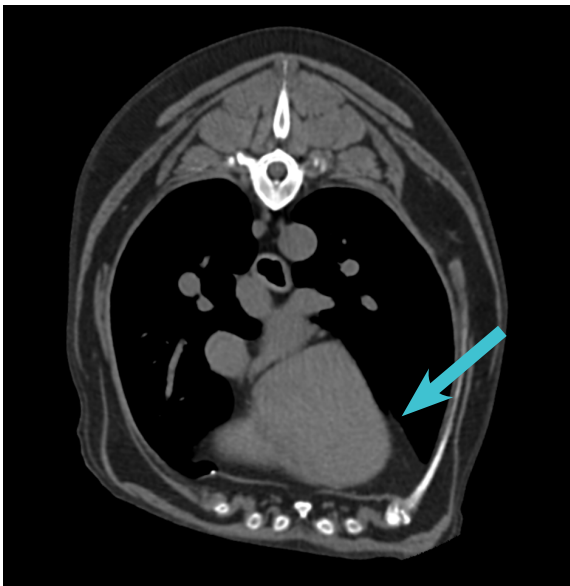
Abdomen table

Slice thickness (mm) ->		0.30	0.50	0.60	0.80	1.00	1.25	1.50	2.00	2.50	3.00	3.50	3.80	5.00
Z-Direction (cm)	4	DO NOT USE				120	96	80	60	48	40	34	32	24
	5					150	120	100	75	60	50	43	39	30
	6					180	144	120	90	72	60	51	47	36
	7					210	168	140	105	84	70	60	55	42
	8					240	192	160	120	96	80	69	63	48
	9					270	216	180	135	108	90	77	71	54
	10					300	240	200	150	120	100	86	79	60
	11					330	264	220	165	132	110	94	87	66
	12					360	288	240	180	144	120	103	95	72
	13					390	312	260	195	156	130	11	103	78
	14					420	336	280	210	168	140	120	111	84
	15					450	360	300	225	180	150	129	118	90
	16					480	384	320	240	192	160	137	126	96
	17					510	408	340	255	204	170	146	134	102
	18					540	432	360	270	216	180	154	142	108
	19					570	456	380	285	228	190	163	150	114
	20					600	480	400	300	240	200	171	158	120
	21					630	504	420	315	252	210	180	166	126
	22					660	528	440	330	264	220	189	174	132
	23					690	552	460	345	276	230	197	182	138
← CATS ← MEDIUM DOGS → LARGE DOGS →														
Reconsider slice thickness														

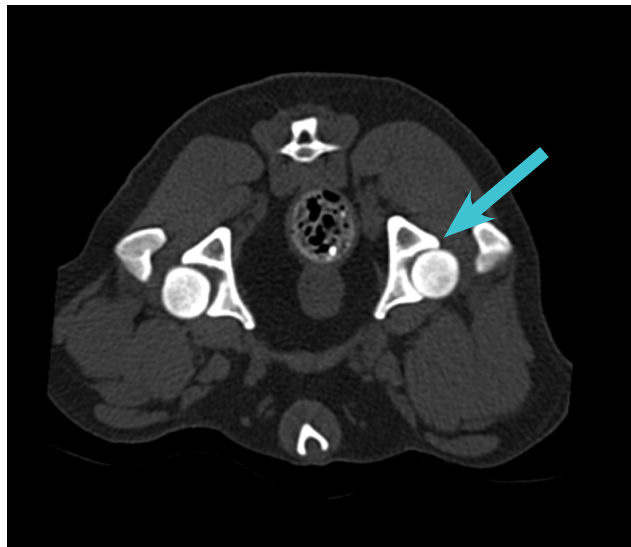
Abdomen images*



Structures in teal should be included in an abdominal protocol. Structures in orange are acceptable margins. Areas outside the colored regions are excessive and may incur additional interpretation fees.



Left: This image is at the level of the cranial margin of an abdominal protocol. This image should include a portion of the apex of the heart (arrow) to ensure the entire diaphragm and liver are included.



Right: This image is at the level of the caudal margin of an abdominal protocol. This image should include the midportion of the hips (arrow).

Thorax protocols

How you position the thorax depends on the reason for the study. In general, sternal recumbency provides for better and more physiologic lung inflation, which is preferable for dorsal thoracic lesions. Lesions of the spine or body wall may be best captured with the patient in dorsal recumbency, to reduce respiratory motion artifact and compression of the lesion. The thoracic limbs are positioned cranially, alongside the cervical spine.

The cranial and caudal landmarks are chosen to ensure inclusion of the thoracic inlet and the entirety of the caudal lung lobes. Because of the shape of the diaphragm, this means including a small portion of the cranial abdomen.

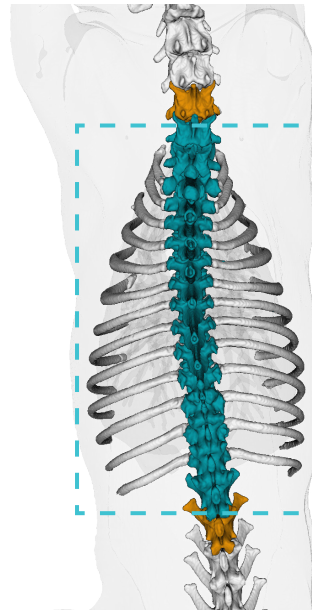
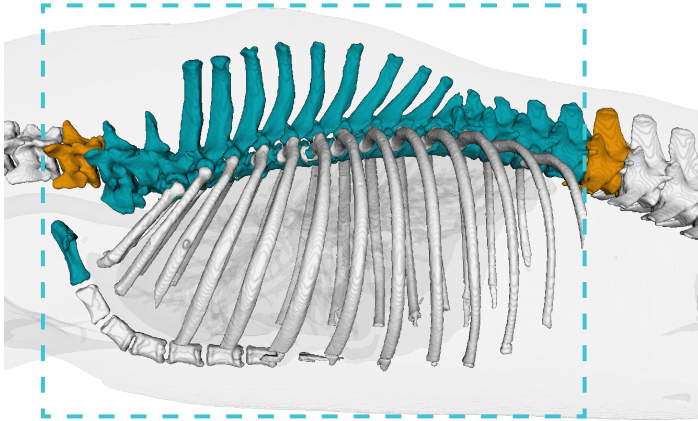
Select a field of view that includes all of the anatomic area, including the skin surface, with as few external structures (CT table, room air) as possible. For large dogs, this may be in the 40 cm range. For cats or toy breed dogs, 15 cm may be adequate.

The selection of slice thickness depends on the size of the patient, with cats and small dogs requiring a smaller slice thickness and larger dogs requiring a larger slice thickness.

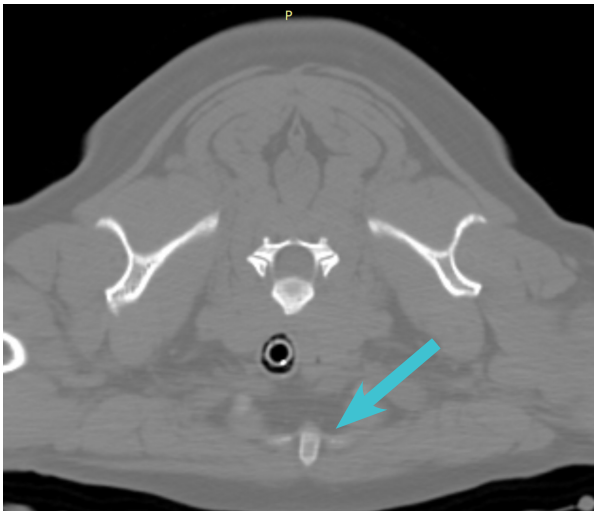
Thorax table

Slice thickness (mm) ->		0.30	0.50	0.60	0.80	1.00	1.25	1.50	2.00	2.50	3.00	3.50	3.80	5.00
Z-Direction (cm)	4	DO NOT USE				120	96	80	60	48	40	34	32	24
	5					150	120	100	75	60	50	43	39	30
	6					180	144	120	90	72	60	51	47	36
	7					210	168	140	105	84	70	60	55	42
	8					240	192	160	120	96	80	69	63	48
	9					270	216	180	135	108	90	77	71	54
	10					300	240	200	150	120	100	86	79	60
	11					330	264	220	165	132	110	94	87	66
	12					360	288	240	180	144	120	103	95	72
	13					390	312	260	195	156	130	11	103	78
	14					420	336	280	210	168	140	120	111	84
	15					450	360	300	225	180	150	129	118	90
	16					480	384	320	240	192	160	137	126	96
	17					510	408	340	255	204	170	146	134	102
	18					540	432	360	270	216	180	154	142	108
	19					570	456	380	285	228	190	163	150	114
	20					600	480	400	300	240	200	171	158	120
	21					630	504	420	315	252	210	180	166	126
	22					660	528	440	330	264	220	189	174	132
23	690	552	460	345	276	230	197	182	138					
← CATS ← MEDIUM DOGS → LARGE DOGS →														
Reconsider slice thickness														

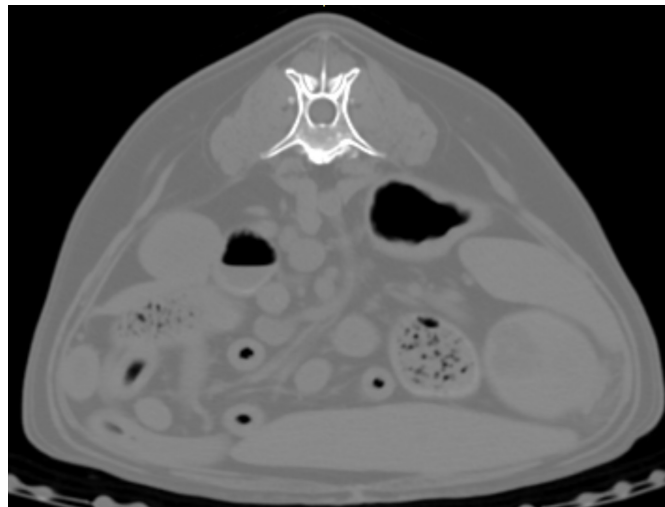
Thorax images



Structures in teal should be included in a thoracic protocol.
Structures in orange are acceptable margins.
Areas outside the colored regions are excessive and may incur additional interpretation fees.



Left: This image is at the level of the cranial margin of a thoracic protocol. This image will show the cranial manubrium (arrow).



Right: This image is at the level of the caudal margin of a thoracic protocol. This image will have no lung. The appearance of the last slice varies, based on lung volume, body conformation, etc.

Skull protocols

Scans of the skull and brain are typically performed with the patient in sternal recumbency to support the skull and allow for straighter positioning. A ventral lesion may be imaged in dorsal recumbency if needed.

The cranial extent of the scan must include the nasal philtrum and the rostral tip of the mandibles. The caudal landmark extends to C2 to ensure inclusion of the caudal brain stem and the atlanto-occipital junction.

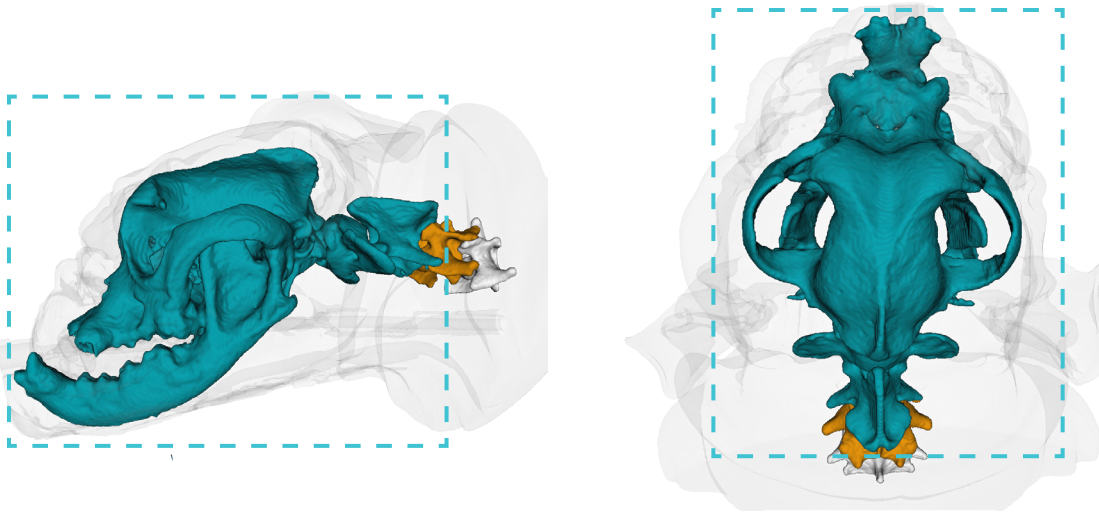
Field of view (FOV) depends on the size of the patient. The entire skull should be included, but including excess room air or the CT table will increase scatter. For large dogs, 25 cm will likely be sufficient. Cats and small dogs require a smaller FOV.

Because of the small or thin structures often evaluated in the skull (e.g., auditory ossicles, sinus structures, and nasal turbinates), a smaller slice thickness is advisable for all patients. This may be as small as a 0.3 mm slice thickness in small patients. Slice thicknesses should not exceed 2 mm for any patient to ensure that the small structures are adequately evaluated.

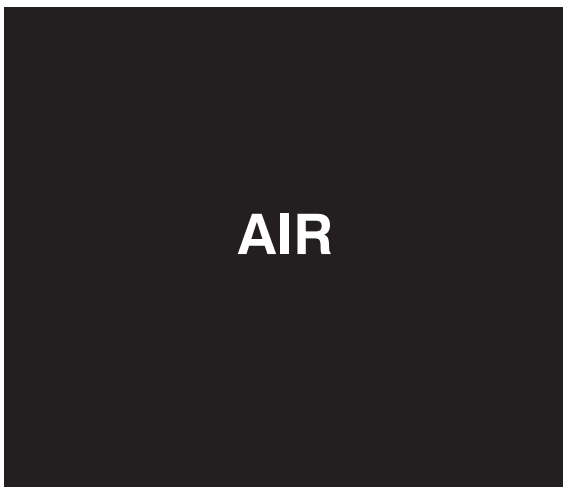
Skull table

Slice thickness (mm) ->		0.30	0.50	0.60	0.80	1.00	1.25	1.50	2.00	2.50	3.00	3.50	3.80	5.00
Z-Direction (cm)	4	400	240	200	150	120	96	80	60	48	40	DO NOT USE		
	5	500	300	250	188	150	120	100	75	60	50			
	6	600	360	300	225	180	144	120	90	72	60			
	7	700	420	350	263	210	168	140	105	84	70			
	8	800	480	400	300	240	192	160	120		80			
	9	900	540	450	338	270	216	180	135		90			
	10	1000	600	500	375	300	240	200	150		100			
	11	1100	660	550	413	330	264	220	165		110			
	12	1200	720	600	450	360	288	240	180		120			
	13	1300	780	650	488	390	312	260	195		130			
	14	1400	840	700	525	420	336	280	210		140			
15	1500	900	750	563	450	360	300	225	180	150				
		← CATS			← MEDIUM DOGS →			LARGE DOGS →			Reconsider slice thickness			

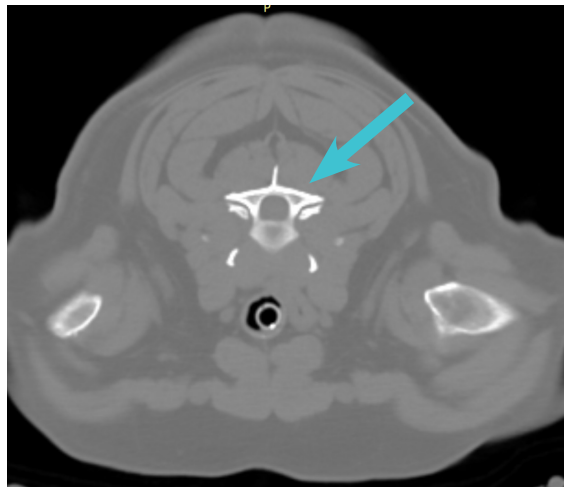
Skull images



Structures in teal should be included in a head protocol. Structures in orange are acceptable margins. Areas outside the colored regions are excessive and may incur additional interpretation fees.



Left: This image may be an air slice to ensure the nares and/or rostral mandible is included. With oral masses, surround the mass with gauze to set off the margins.



Right: This image is at the level of the caudal margin of a head protocol. This image includes C2-3 (arrow).

Cervical region protocols

Positioning may depend on the lesion of interest. Sternal recumbency may be helpful to ensure straight positioning of the spine. However, dorsal recumbency is also acceptable, particularly if a radiolucent trough or similar positioning device is used to position the spine. If the lesion of interest is in the cervical soft tissues, such as a possible thyroid tumor, dorsal positioning may allow decreased compression of the surrounding structures. The thoracic limbs should be positioned caudally away from the cervical spine and along the thorax.

The cranial landmark includes the caudal zygomatic arch and possibly the temporomandibular joints to ensure that the foramen magnum is included. The caudal landmark extends to T2, and this should include the relevant anatomy for both cranial and caudal cervical neurolocalization (C1–C5 lesions or C6–T2 lesions).

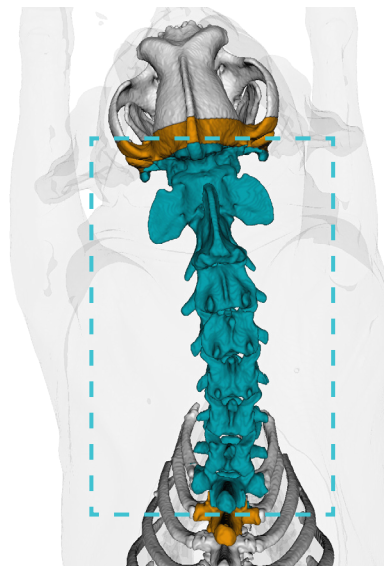
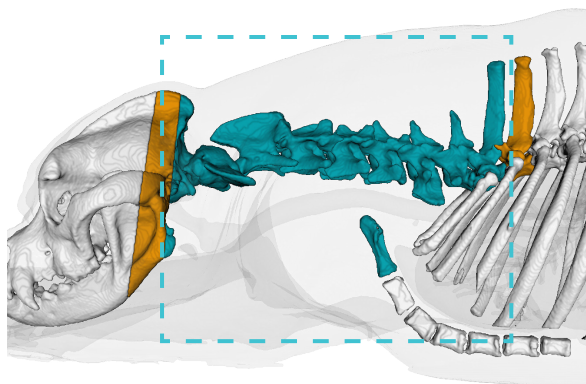
Field of view (FOV) is selected to include the entire neck, including cutaneous structures. Including excessive room air or positioning devices will degrade the image. For large dogs, a 20–25 cm FOV will likely be sufficient. Small dogs and cats may need a 15 cm FOV.

Like the abdomen, slice thickness depends on the patient's size. A smaller slice thickness will increase the spatial resolution (detail), particularly of osseous structures, but this is at the expense of signal-to-noise ratio, which may cause a grainy image. For larger patients, a larger slice thickness is advised.

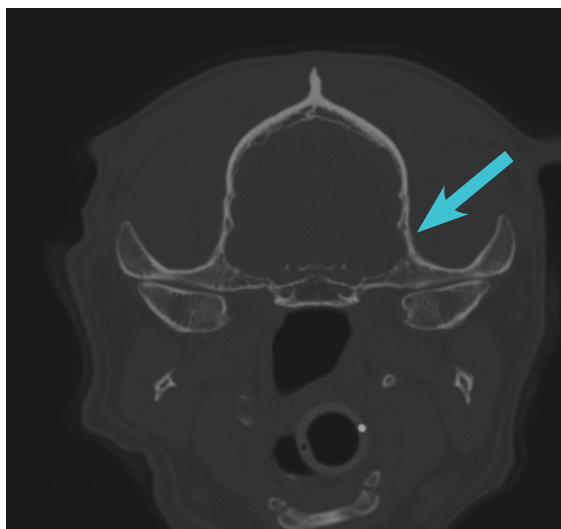
Cervical region table

Slice thickness (mm) ->		0.30	0.50	0.60	0.80	1.00	1.25	1.50	2.00	2.50	3.00	3.50	3.80	5.00
Z-Direction (cm)	4	DO NOT USE				120	96	80	60	48	40	34	32	24
	5					150	120	100	75	60	50	43	39	30
	6					180	144	120	90	72	60	51	47	36
	7					210	168	140	105	84	70	60	55	42
	8					240	192	160	120	96	80	69	63	48
	9					270	216	180	135	108	90	77	71	54
	10					300	240	200	150	120	100	86	79	60
	11					330	264	220	165	132	110	94	87	66
	12					360	288	240	180	144	120	103	95	72
	13					390	312	260	195	156	130	11	103	78
	14					420	336	280	210	168	140	120	111	84
	15					450	360	300	225	180	150	129	118	90
	16					480	384	320	240	192	160	137	126	96
	17					510	408	340	255	204	170	146	134	102
	18					540	432	360	270	216	180	154	142	108
	19					570	456	380	285	228	190	163	150	114
	20					600	480	400	300	240	200	171	158	120
	21					630	504	420	315	252	210	180	166	126
	22					660	528	440	330	264	220	189	174	132
	23					690	552	460	345	276	230	197	182	138
← CATS ← MEDIUM DOGS → LARGE DOGS →												Reconsider slice thickness		

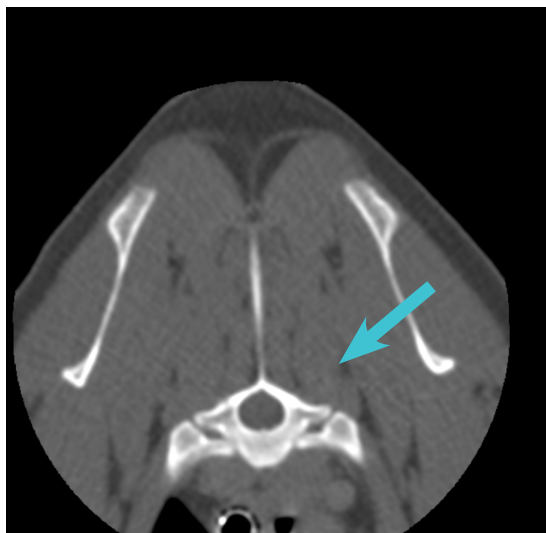
Cervical region images



Structures in teal should be included in a cervical region protocol. Structures in orange are acceptable margins. Areas outside the colored regions are excessive and may incur additional interpretation fees.



Left: This image is at the level of the cranial margin of a cervical region protocol. The image should show no more than half of the temporomandibular joint (arrow).



Right: This image is at the level of the caudal margin of a cervical region protocol. This image includes a variable amount of scapula, depending on the limb position, and T1–2 (arrow).

For additional information about CT/MRI submission requirements, see CT/MRI Study Definitions at idexx.com/files/telemedicine-ct-mri-study-definitions.pdf.

IDEXX Telemedicine Consultants

We're here to help you 24 hours a day, 7 days a week.

For assistance call **1-800-726-1212**, email telemedicinesupport@idexx.com, or visit idexx.com/telemedicine.

*Structure images were created using ITK-SNAP software (itksnap.org).

Yushkevich PA, Piven J, Hazlett HC, Smith RG, Ho S, Gee JC, Gerig G. User-guided 3D active contour segmentation of anatomical structures: Significantly improved efficiency and reliability. *Neuroimage*, 2006 Jul 1;31(3):1116-28.