Thoracolumbar Spine MRI

Scan Coverage and Planning

The thoracolumbar spine (TL Spine) is the more complex area of the CNS to scan clinically, as the coverage is much broader since both the full thoracic spine and lumbar spine are included. There are various protocol for scanning the TL spine that can vary quite a bit from clinician to clinician, so it is best to establish clinician preference ahead of time. The most important image to acquire accurately is the sagittal, since this is where pathology is initially identified, and the image from which axial sequences are planned. Poor quality sagittal images will hinder identifying pathology, which can greatly extend scan and anesthesia time. There are two primary paths for TL spine scanning in regards to sagittal imaging: Whole Spine or Separate.

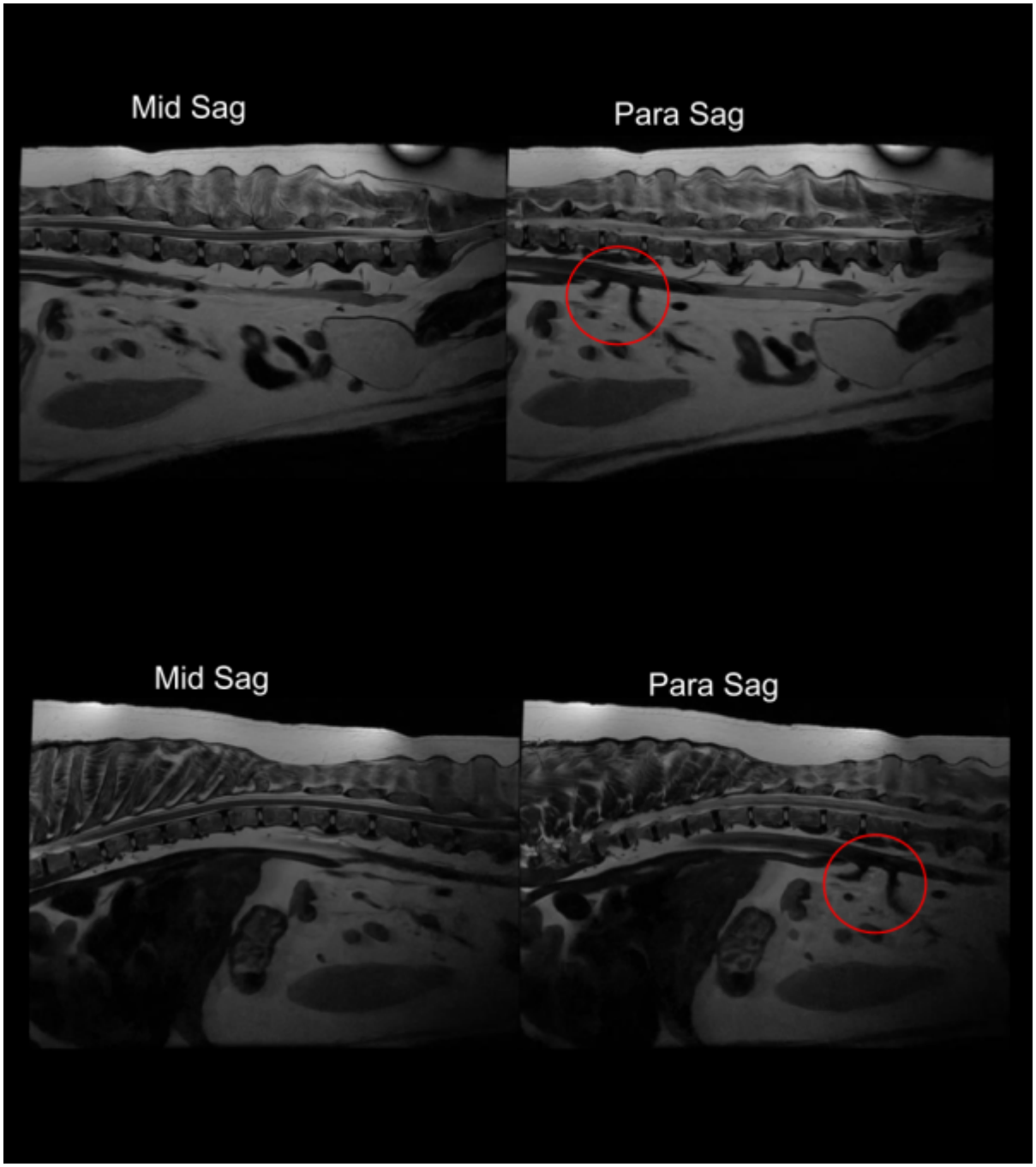
Whole Spine Coverage

With Whole Spine coverage, the FOV for sagittal series should extend from T3 to S2. **Be sure to plan an ODD number of slices to ensure there is at least one true mid-sagittal image.** There are several difficulties and limitations with whole spine imaging:

1. The maximum FOV for scanners varies, and may be limited by the size of the dog, so whole spine coverage is only appropriate for small to medium breeds
2. The maximum number of coils that may be active at a time may be limited (GE)
3. Positioning becomes more difficult, as slight curvatures of the spine will limit the accuracy of sagittal imaging, necessitating repositioning, or very thin slices.
4. The scanning technologist will have to do a lot of 'zoom/pan' at the time of scanning to locate pathology and plan axials

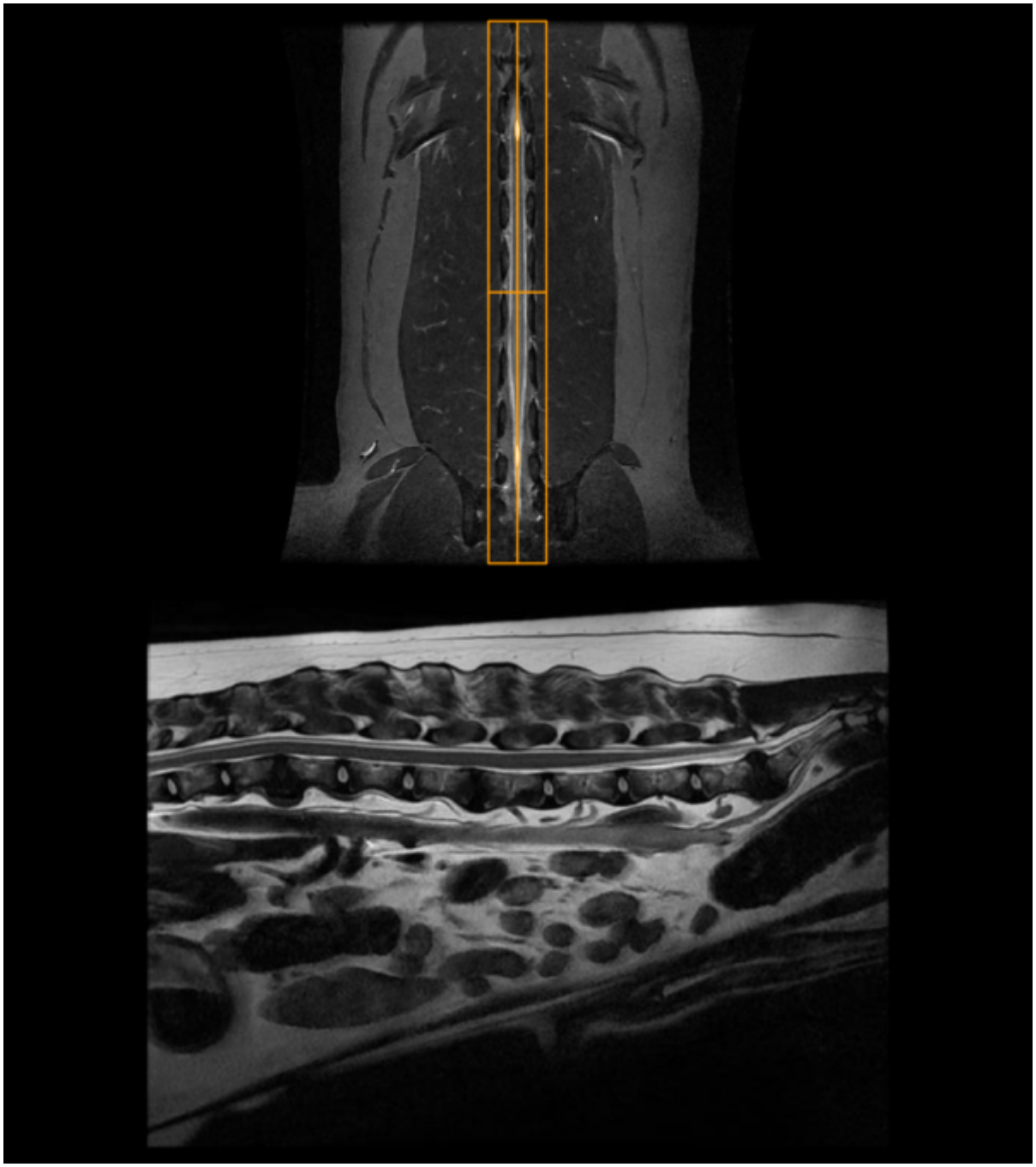
Separate Thoracic and Lumbar

With separate Thoracic and Lumbar sagittal acquisitions, there are different coverages to consider. For a typical Lumbar sagittal, the FOV should extend from T11 to S2. For a typical Thoracic sagittal, the FOV should extend from T3 to L3. Much like all sagittal planning in the spine, **be sure to use and ODD number of slices**. One important consideration for separate sagittal acquisitions is that it is necessary to ensure overlap between the two acquisitions, and accurate counting of the vertebrae. a reliable anatomic marker for ensuring overlap is the mesenteric arteries coming off from the aorta. If they are present on both Lumbar and Thoracic series, then overlap is guaranteed. It is important to note that these vessels may not be on the mid sagittal slice, but rather a parasagittal image, as shown below. The mesenteric arteries are circled in red.



Sagittal Plane

On a dorsal image, plan the slices parallel with the spinal cord, with the slices extending at least out to the transverse processes of the vertebrae. See above for the different FOV options for Separate or Whole Spine imaging.



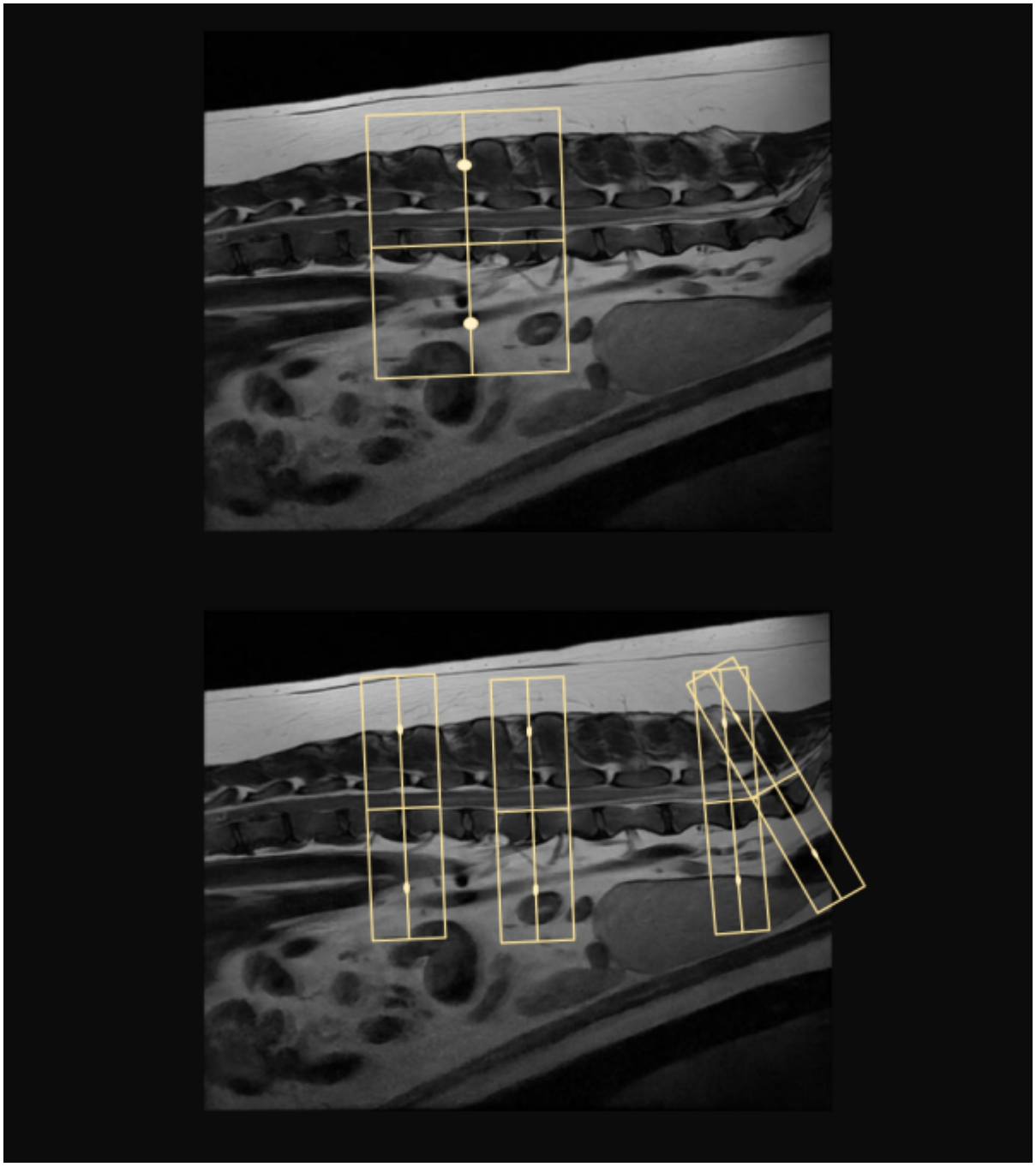
Axial Plane

On a mid-sagittal image, plan axial slices perpendicular to the spinal cord. Unlike the cervical spine, the angle for the intervertebral disc and the spinal cord are very well aligned and can be considered equivalent. There are two variations of axial acquisitions, **Single Stack or Multi Stack**. This is largely up to clinician preference, but there are some good practices to consider.

- **Multi Stack**: With disc disease, extrusions tend to be fairly localized, though in rare cases may extend cranially or caudally. Multi Stack is often appropriate and more time efficient for this, especially when assessing a large number of discs. It is good practice to use 3-7 slices, centered on the disc, for each disc. where pathology is suspected, it is also good practice to use enough axial slices to extend to the mid-body of the vertebrae above and below the suspected disc extrusion to catch any disc material not well visualized on a sagittal image. On the Multi Stack plan shown below, note the angle required at the LS junction; significant slice overlap will cause

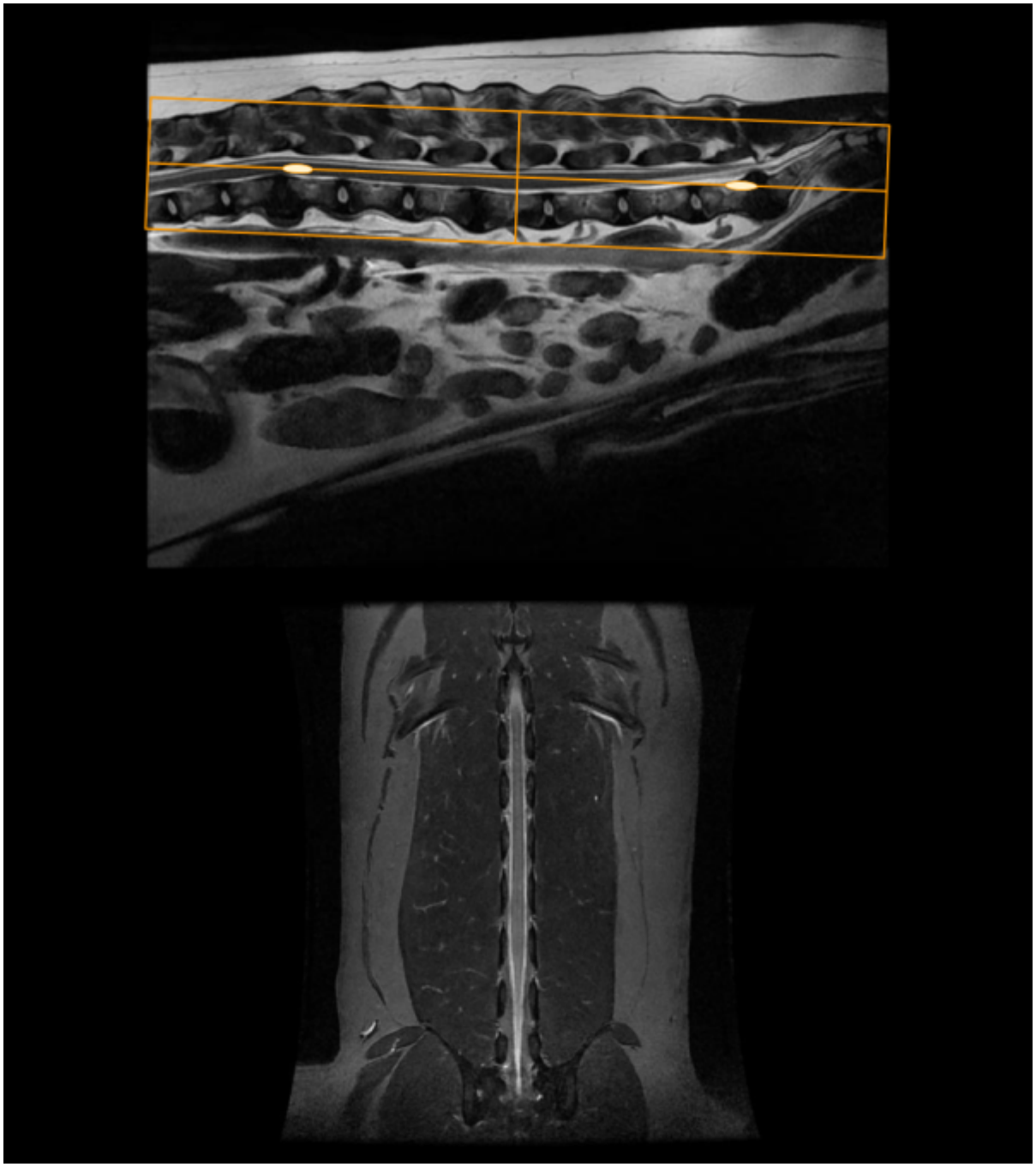
artifact, and in some cases may need to be consolidated into a Single Stack.

- **Single Stack**: With spinal cord pathology such as FCE or myelopathy, disc assessment is less important. Single Stack is most appropriate in this situation. It is good practice to acquire the axial stack from normal cord-to-normal cord if possible.



Dorsal Plane

On a mid sagittal image, plan the slices parallel with the spinal cord. Slices should extend from the aorta dorsally up to the spinous process of the vertebrae. Where there is noted pathology, adjust the angle of the slices a bit for the best visualization.



Typical Scan Protocol

The protocol below represents a full thoracolumbar exam. There is a lot of variation depending on the clinical question and clinician preference. The **minimum** recommended sequences depend on pathology, so no sequences are in bold. **It is highly recommended to include at least 1 sequence, either T2 or STIR, in the dorsal plane and at least 1 sequence with fat saturation post contrast**

Sagittal T2 Lumbar
Sagittal T2 Thoracic
Sagittal STIR Lumbar
Sagittal STIR Thoracic
Sagittal T1 Lumbar
Sagittal T1 Thoracic

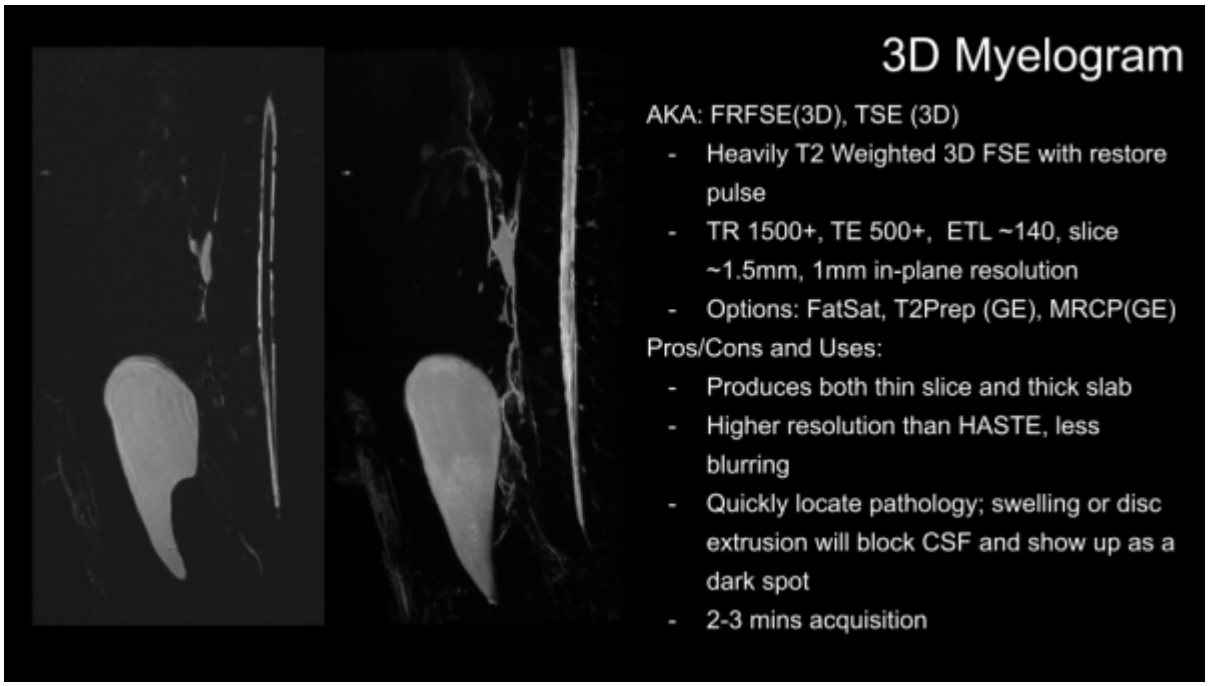
Axial T2 ROI
Axial T1 ROI
Contrast
Sagittal T1 ROI
Axial T1 ROI

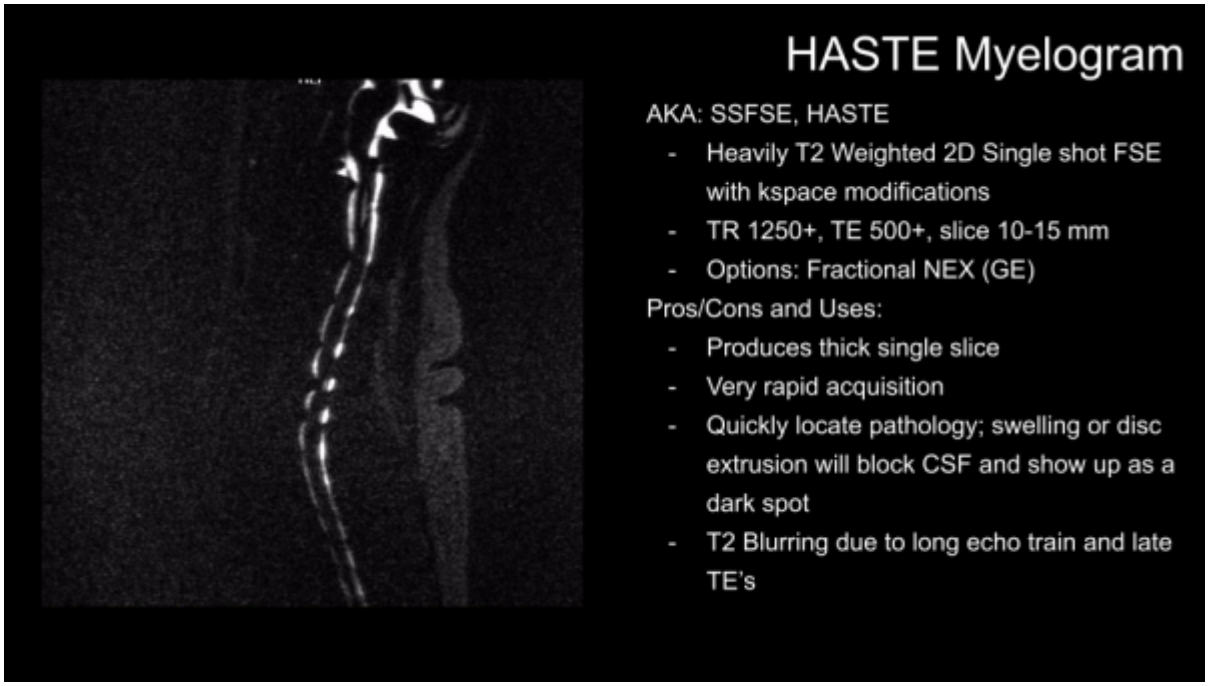
Tips and Tricks

Optional Sequences

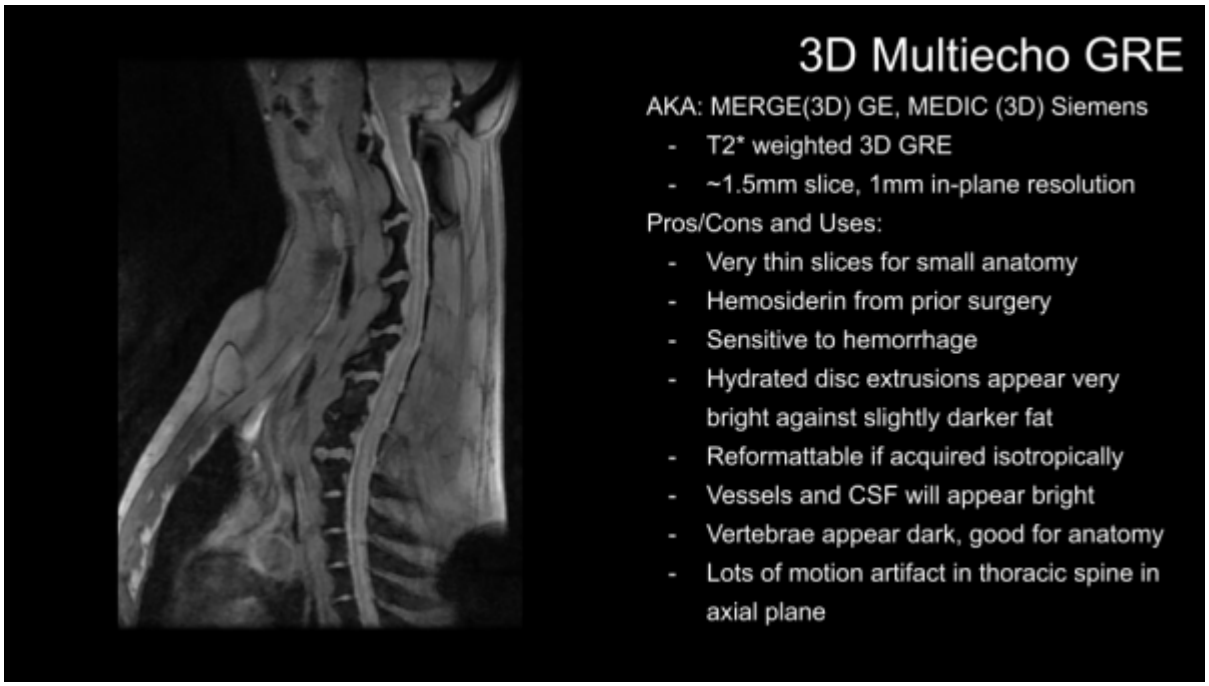
There is a wide scope of pulse sequences that will find utility in the thoracolumbar spine, depending on patient size, clinical question, and pathology. Some are used frequently even though they are not included in the Typical Protocol above, others are good to know about for specific clinical scenarios.

Myelography





T2* Weighting



T2 Weighting

Most modern scanners will have an option for a Driven Equilibrium pulse sequence that incorporates and additional -90 degree pulse to 'flip back' the transverse magnetization along the Z axis. This has the effect of speeding up longitudinal recovery even for very long T1 tissues like CSF, meaning that it isn't necessary to have very long TR's. When performing a T2 weighted sequence with this modification, TR can be as low as 1500ms in some cases, while maintaining high signal from CSF. On a GE scanner this option is known as **Fast Recovery FSE (FR-FSE)** and can be found in most GE spine protocols. On a Siemens scanner, this is known as **Restore**, and may be a check box on the

contrast tab, or may be found in Siemens spine protocols. These options can shorten scan time, especially when only a few slices are needed, as is the case with sagittal spine imaging.