Al-Mustaqbal University
College of Health and Medical Technologies
Radiological Techniques Department

Magnetic Resonance Imaging

First Semester

Lecture 16 : MRI of thoracic & lumbar spine

By

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Introduction :

Dorsal and lumbar spine MRIs are among the most common MRI procedures performed, this is because **the lower back is a common site of pain and injury.** Both dorsal and lumbar spine MRI can be a complex procedure, as it requires **the patient to be positioned in a specific way and the MRI technologist to be able to identify and image a variety of anatomical structures.**

Anatomical overview:

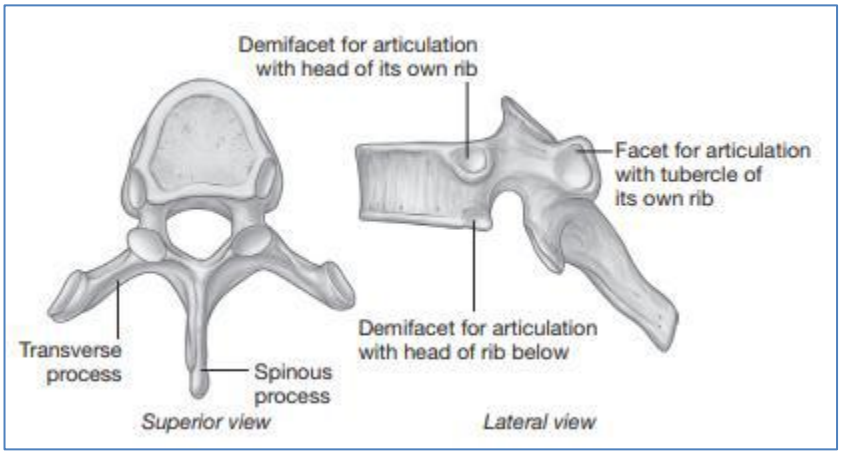
The thoracic spine (often shortened to T-spine) forms the middle part of the vertebral column. **It extends from below C7 of the cervical spine to above L1 of the lumbar spine.** There are 12 thoracic vertebra, **termed T1-T12**. The thoracic spine is unique due to its articulation with ribs via **costal facets**. The ribs restrict the movement of the thoracic spine somewhat. The thoracic spine is otherwise the most mobile of all spinal column segments. Relative to cervical and lumbar vertebrae, thoracic vertebrae have: (fig.1)

•medium-sized, heart shaped **vertebral bodies**.

•medium-sized round **vertebral canals**.

•prominent **transverse processes with costal facets**.

•**long spinous processes** angulating downwards.



(Fig.1) A portion of the thoracic vertebral column.

• **The MRI thoracic spine** protocol encompasses a set of MRI sequences for the routine assessment of the thoracic spine.

• Indications of thoracic spine MRI:

1-Myelopathy. **(is a condition describe by compression of the spinal cord. Like (spondylosis or degenerative disc disease, herniated discs, or thickening of ligaments.**

2-Herniated disc.

3-Primary malignancy.

4-Secondary malignancy.

5-Radiculopathy. **is a medical condition that occurs when a nerve root**

6-Syrinx.

7-Benign tumor.

8-Multiple sclerosis.

9-Scoliosis.

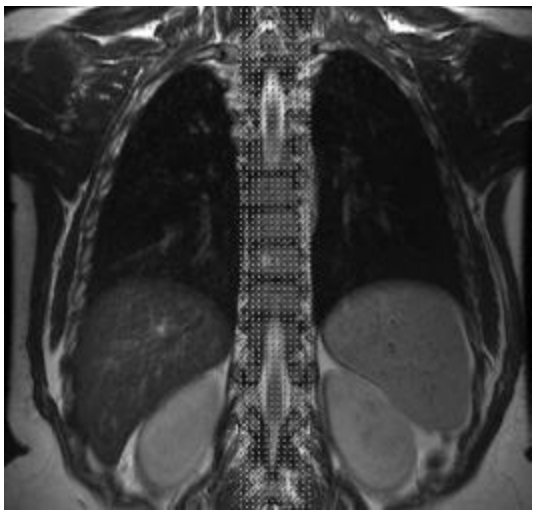
• MRI procedure (thoracic spine):

•Patient position:

1. **Place the phased array coil** on the magnet table and plug the phased array coil port.
2. **Position patient supine**, and either head or feet first. **A feet first position may be preferred by claustrophobic patients.**
3. **Place arms at the sides or above the head**, whichever is most comfortable for the patient.
4. Use accessories such as the knee bolster and blankets to make the patient as comfortable as possible.
5. **Place the axial alignment light** 2 cm above the xiphoid which is approximately T7.
6. Explicitly instruct the patient not to move during the scan, e.g.: don't shift hips or move legs.

•Scout slice placement: -

1-Coronal localizer to obtain sagittal slice.



-Alignment:

Parallel to the long axis of the spinal cord.

- Coverage:

A-Superior to inferior: Seventh cervical vertebra to first lumbar vertebra.

B-Lateral to medial: Vertebral pedicles on each side.

C-Posterior to anterior: Spinous processes to prevertebral tissues.

-Sagittal slices can be used to demonstrate: -

1-Vertebral alignment.

2-Syrinx.

3-Cord displacement within the canal due to cord herniation or intradural mass.

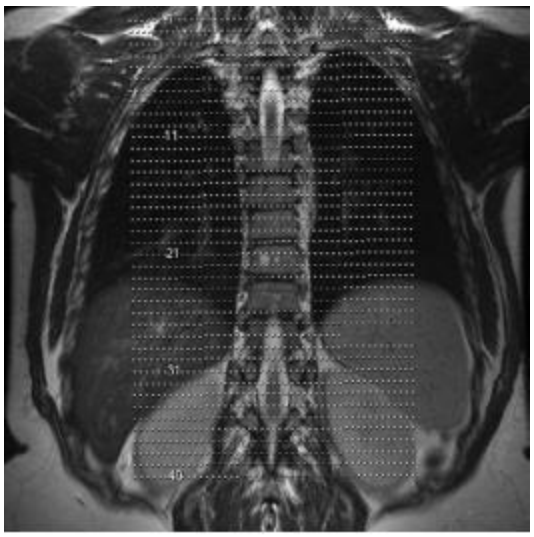
4-End plate disruption.

5-Herniated disc.

6-Space occupying lesions within the spinal canal.

7-Conus medullaris. **Location**: The conus medullaris is situated at the terminal end of the spinal cord, which extends from the brainstem down to the lumbar region. While the spinal cord itself ends around L1-L2, the conus medullaris is just above the cauda equina, a bundle of spinal nerves that continue down the vertebral canal.

2-Coronal localizer to obtain axial slice



-Alignment:

Perpendicular to the long axis of the thoracic cord.

- Coverage:

A-Superior to inferior: As required by the radiologist, covering from the pedicles of one vertebra above and below the vertebrae of interest, e.g. if T8‑10 is of interest, scan from the pedicles of T7 to T11.

B-Lateral to medial: Intervertebral foramina on each side.

C-Posterior to anterior: Spinous processes to prevertebral tissues.

-Axial slices can be used to demonstrate the following:

1- Herniated disc.

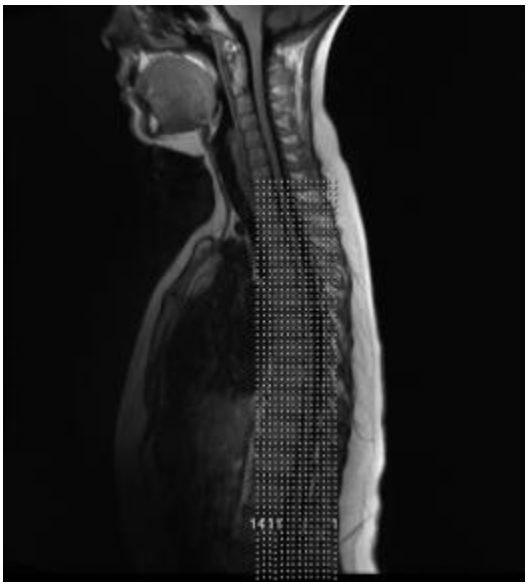
2-Canal stenosis.

3-Space occupying lesions within the spinal canal.

4-Paravertebral extension of masses into the soft tissues.

5-Syrinx.

3-Sagittal localizer to obtain coronal slice



- Alignment:

Parallel to the long axis of the spinal cord.

- Coverage:

A-Superior to inferior: Seventh cervical vertebra to the first lumbar vertebra.

B-Lateral to medial: Transverse processes on each side.

C-Posterior to anterior: Entire vertebral foramen to midway through the vertebral bodies of C7 and L1.

-Coronal slices can be used to demonstrate the following:

1-Scoliosis.

2-Space-occupying lesions within the spinal canal.

3-Syrinx.

4-Compression laterally on the nerve roots.

•MRI Sequences (thoracic spine)

Sequence	TR	TE	FA	ETL	Slice thickness
Sagittal (T2) (FSE)	3500	102	-	16	4mm
Sagittal (T1) (SE)	400	Min	-	-	4mm
Sagittal (STIR)	3000	85	-	8	4mm/TI=150
Axial (T2) (FSE)	3000	102	-	32	4mm
Axial (T1) (Dual SE)	350	Min	-	2	3mm
Corona (T1) (Dual SE)	500	13	-	2	3mm
Axial & sagittal (T1) (FSE) (FS) (post GAD)	550	Min	-	4	5mm

-Optional sequences:

1-Chemical shift imaging (T1 GRE) (IP) & (OP) (Sagittal plane).

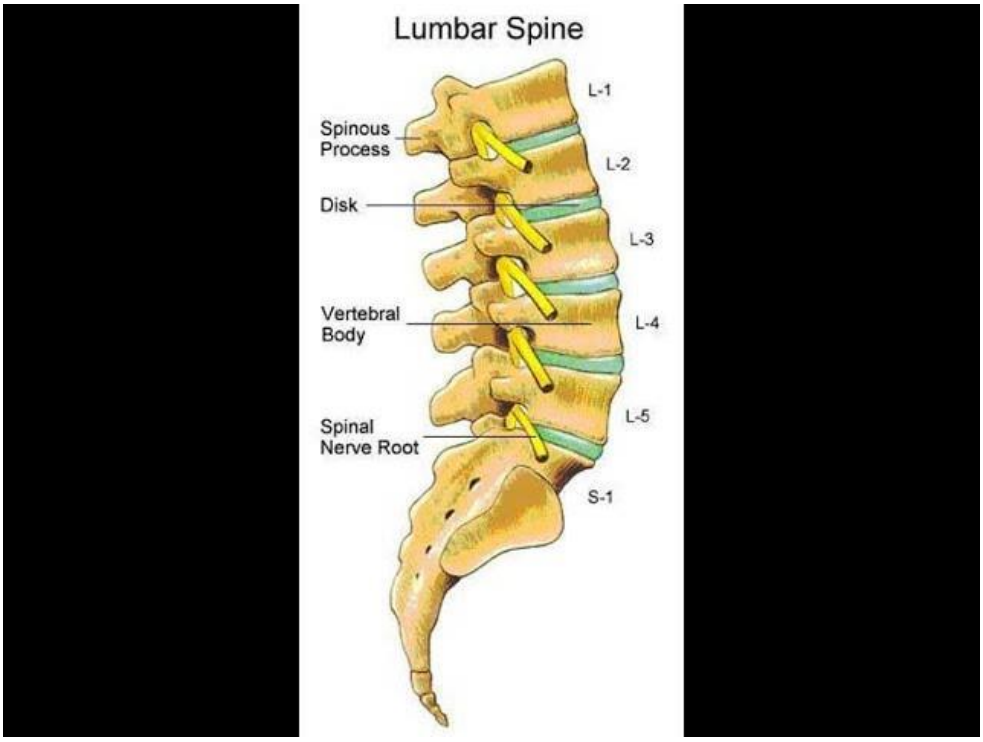
-Purpose: Tissue characterization of bone tumor.

2-DWI (Sagittal plane).

-Purpose: Evaluation of spinal ischemia.

•Lumbar spine:

The lumbar spine (often shortened to L-spine) consists of **five adjacent vertebrae of the lower vertebral column**, in some cases it is possible to find 4 or 6 vertebrae as an anatomical variant. They participate in **the lumbar lordosis**, a natural curve in the spine, that is convex anteriorly. Articulations of the facet (zygapophyseal) joints permit flexion/extension and abduction movements. Rotation is greatly limited, and may occur only slightly at the lumbosacral joints. (fig.2)



(Fig.2) Lumbar spine

•**The MRI lumbar spine protocol** encompasses a set of MRI sequences for the routine assessment of the lumbar spine.

•Indications of lumbar spine MRI:

1-Disc prolapse with cord or nerve root compression.

2-Syrinx.

3-Discitis. **condition characterized by inflammation or infection of the intervertebral discs in the spine.**

4-Evaluation of conus in patients with appropriate symptoms.

5-Arachnoiditis. **the inflammation of the arachnoid, which is one of the membranes that surround and protect the spinal cord and nerve roots within the spinal canal.**

•MRI procedure (lumbar spine)

•Patient position:

1. Place the **phased array coil** on the magnet table and plug the phased array coil port.
2. Patient should be in supine-position.
3. A feet-first orientation may be preferred by anxious patients.
4. Adjust the patient so that the anatomy of interest is center over the selected coil.

5. Use accessories such as the knee bolster, to flatten the lumbar curve and bring it closer to the coil, and blankets to make the patient as comfortable as possible.

•Scout slice placement: -

1-Coronal localizer for sagittal slice

- Alignment:

Parallel to the long axis of the spinal cord.

- Coverage:

A-Superior to inferior: Conus to second sacral vertebra.

Coverage should include the twelfth thoracic vertebra, even if the conus is below this level.

B-Lateral to medial: Vertebral pedicles on each side.

C-Posterior to anterior: Spinous processes to prevertebral tissues.

- Sagittal slices can be used to demonstrate the following:

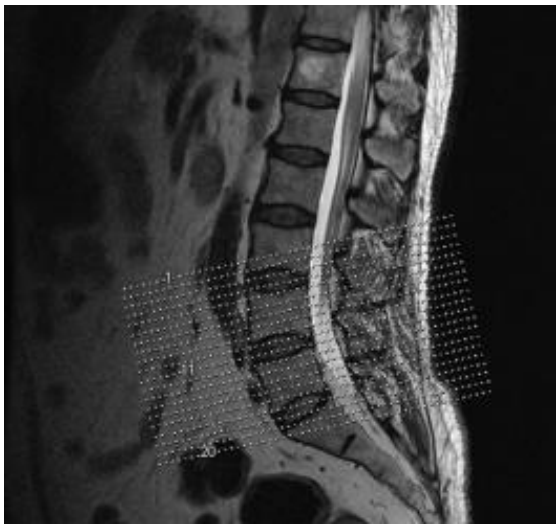
1-Vertebral alignment.

2-Canal stenosis.

3-End plate and cortical disruption.

4-Defects of the pars interarticularis.

2-Sagittal localizer for axial slice



Axial block series planned sagittal localizer.

Axial, planned to each on a intervertebral disc.

-Alignment:

Alignment may vary between sites. Two possibilities are available:

1-As a single block: - in plane with the intervertebral discs.

2- Using multiple angles: - aligned individually to each intervertebral disc space.

-Coverage:

A-Superior to inferior: Pedicle of the third lumbar vertebra to the pedicle of the first sacral segment for a single block, or from pedicle to pedicle for each individual vertebra.

B- Lateral to medial: Intervertebral foramina on each side.

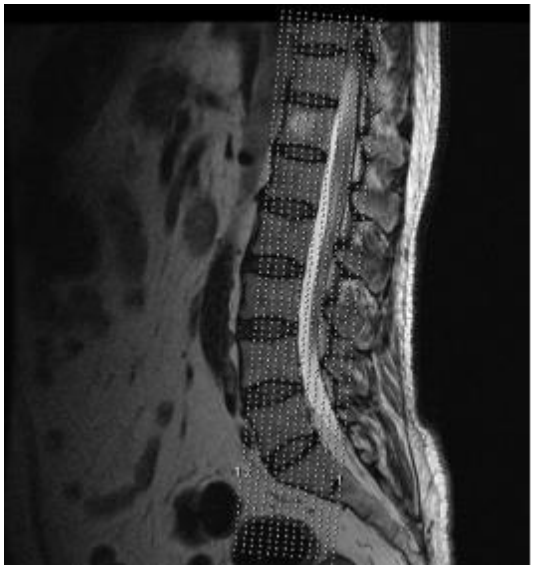
C- Posterior to anterior: Medial sacral crest to the prevertebral tissues.

- Axial slices can be used to demonstrate the following:

1-Space-occupying lesions within the spinal canal.

2-Paravertebral extension of masses into the soft tissue.

3-Sagittal localizer for coronal slice



-Alignment:

Parallel to the long axis of the cauda equina. Some obliquity will most likely be required to achieve this.

- Coverage:

A-Superior to inferior: Conus to second sacral vertebra.

Coverage should include the twelfth thoracic vertebra, even if the conus is tethered below this level.

B-Lateral to medial: Transverse processes on each side.

C-Posterior to anterior: Entire vertebral foramen to midway through the vertebral bodies.

- Coronal slices can be used to demonstrate the following:

1-Scoliosis.

2- Space-occupying lesions within the cauda equina.

-Note: We can use the axial localizer to obtain a coronal oblique slice.

•MRI Sequences (Lumbar spine)

Sequence	TR	TE	FA	ETL	Slice thickness
Sagittal (T2) (FSE)	3600	102	-	16	4mm
Sagittal (T1) (Dual SE)	600	Min	-	2	4mm
Sagittal (STIR)	3000	50	-	8	4mm/TI=150
Axial (T2) (FSE)	3000	102	-	12	4mm
Axial (T1) (SE)	350	Min	-	-	4mm
Corona (T1) (Dual SE)	500	13	-	2	3mm
Axial (T1) (FSE) (post GAD)	600	Min	-	4	4mm