

Qualitative Comparison of Conventional and Oblique MRI for Detection of Herniated Spinal Discs

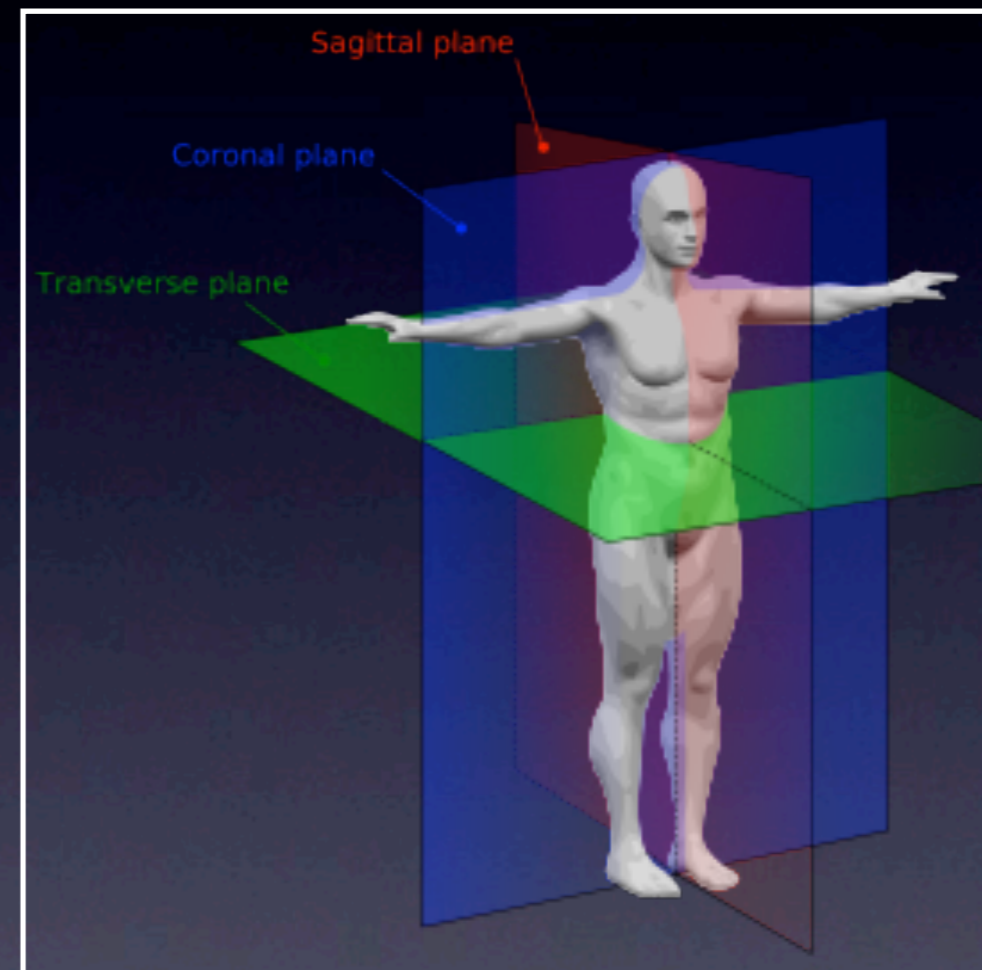
Doug Dean
Mid Project Presentation
ENGN 2500: Medical Image Analysis

Outline

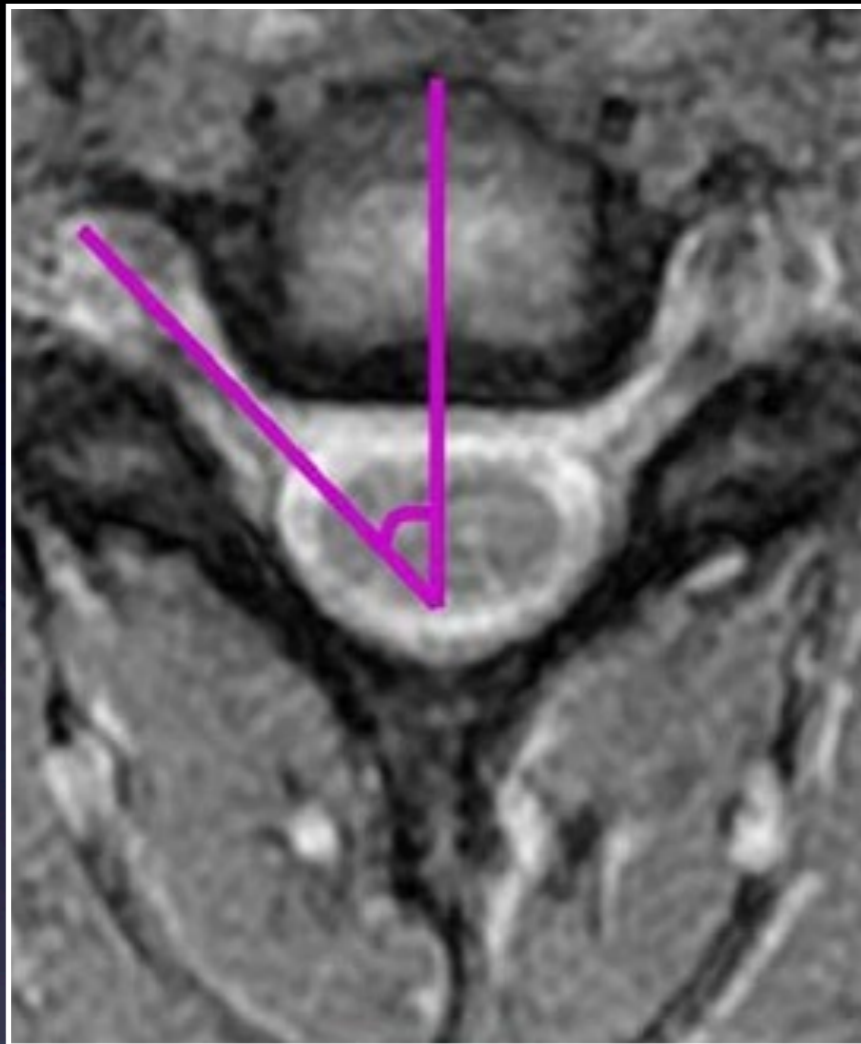
- Brief Review of the Problem
- What has been done
 - Data Collection
 - Results
- Plan for completing project
 - What more needs to be done
 - Timeline

Review of Problem

- Difficult to identify herniated discs and spinal stenosis using conventional (2D) MRI techniques
- These conventional methods result in patients condition being misdiagnosed.



“Conventional MRI”: Images acquired along one of three anatomical planes

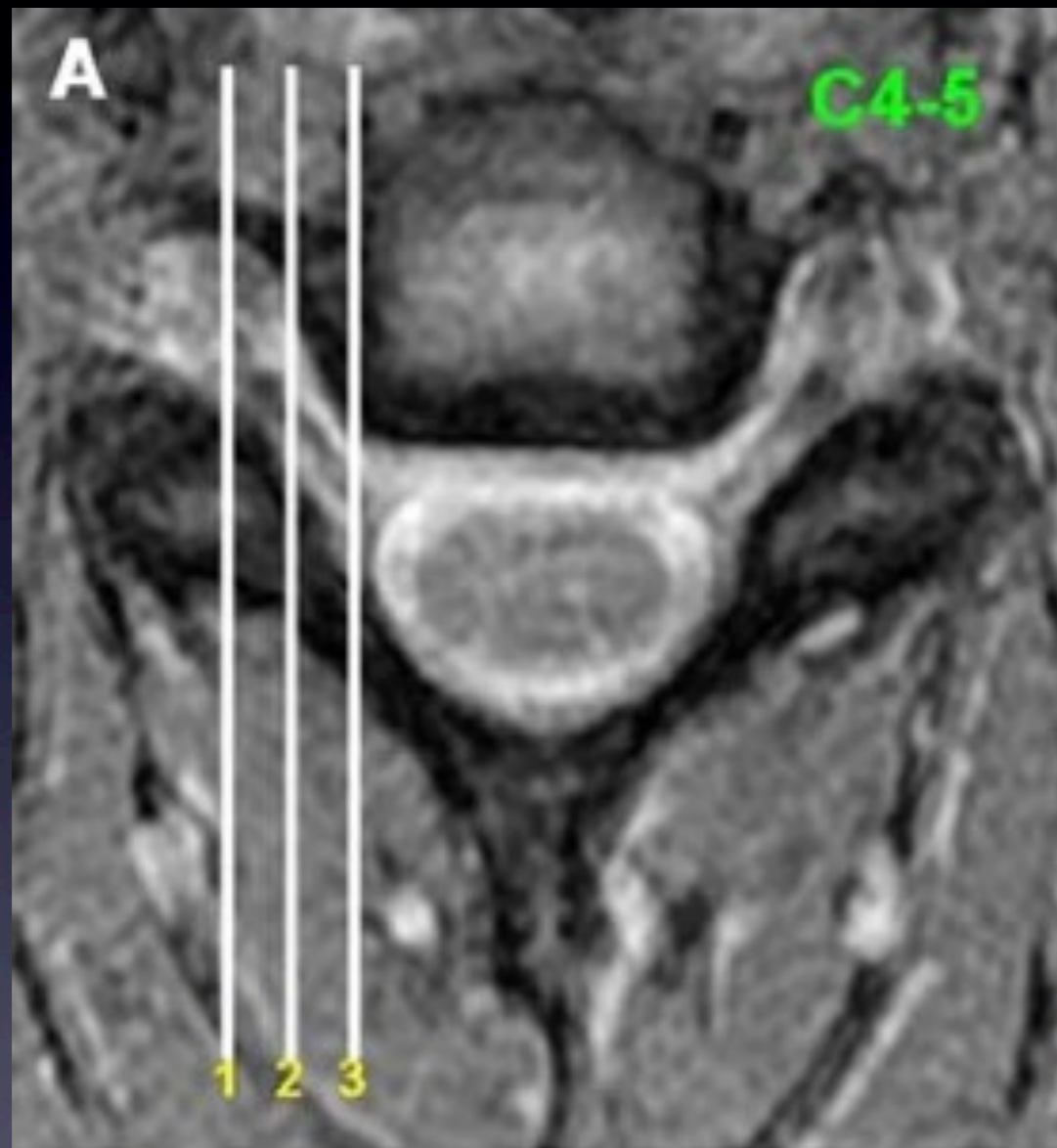


Axial, T2-weighted Image:
Cervical Foramen is
directed at 45 degrees
with respect to coronal
plane.

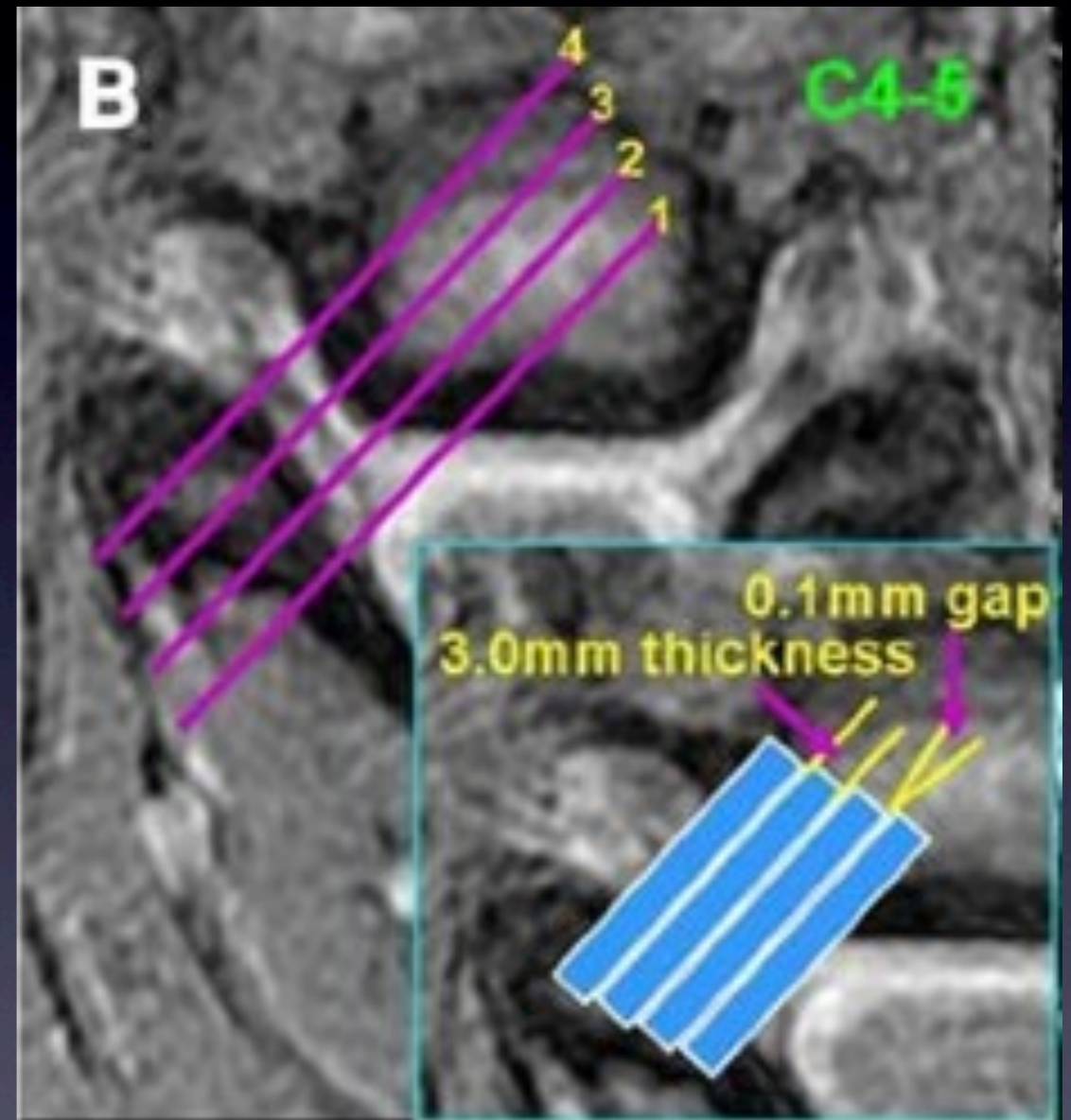


3D reconstructive CT Image
shows that the cervical
foramina are directed
downward around 10-15
degrees with respect to
axial plane

Orientation of Images



Conventional MRI: Sagittal Protocol



Oblique MRI: Sagittal Protocol

Timeline

- Week 1 (4/11-4/16)
 - Work on developing MR imaging protocols and sequences
 - Recruit volunteers (~4-5 volunteers)
- Week 2 (4/17-4/23)
 - Continue developing imaging sequences and begin data acquisition at the MRI facility
 - Will be assisted by Dr. Deoni
- Week 3&4 (4/24-5/7)
 - Continue data acquisition if needed (early in the week)
 - Analysis of Images: Hand contours of ROI's and comparison of MRI protocols
 - Mid Project Presentation: Describe the imaging protocols, present data that had been acquired from previous week, describe what still needs to be done.
- Week 5&6 (5/8-5/16)
 - Continue analysis of MRI protocols. Determine which technique is best for detection of cervical foramina. Base these conclusions on the SNR and CNR measurements as well as the segmentation
 - Final Project Presentation

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Pulse Sequences (Imaging Protocol)

The following imaging sequences have been developed on the MR scanner (used in Shim, Lee, Park, et al):

- Fast Spin Echo Sequence:
 - Sagittal T₁ weighted images:
 - TR: 500ms
 - TE: 10ms
 - Matrix Size: 320x224
 - Echo Train Length: 3
 - FOV: 240mm
 - NEX: 4
 - Sagittal T₂ weighted images:
 - TR: 3500ms
 - TE: 110ms
 - Matrix Size: 320x224
 - Echo Train Length: 30
 - FOV: 240mm
 - NEX: 4
 - Axial T₂ weighted images:
 - TR: 4000ms
 - TE: 110ms
 - Matrix Size: 320x224
 - Echo Train Length: 18
 - FOV: 160mm
 - NEX: 4

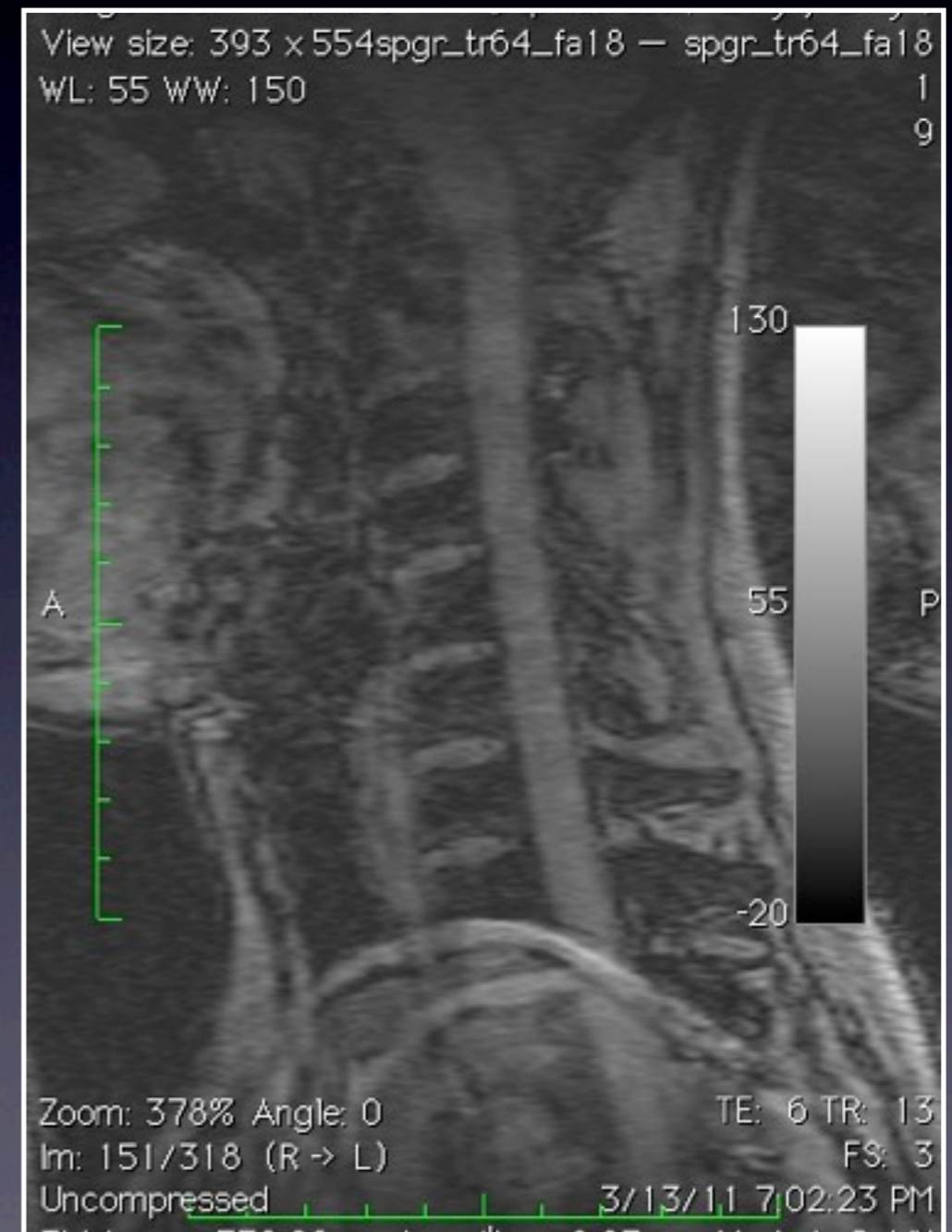
Slice Thickness: 3.0mm
Spacing: 0.5mm

Recruitment

- 5 adults have been recruited
 - Age range: 35-56
 - 2-3 of them have had either back pain or other back problems in the past
 - Currently trying to schedule them to come in for a scan. This has been dependent upon their working schedules and the schedule of the MRI scanner
- Participants are able to comfortably relax in the scanner, either watch a movie, listen to music or sleep

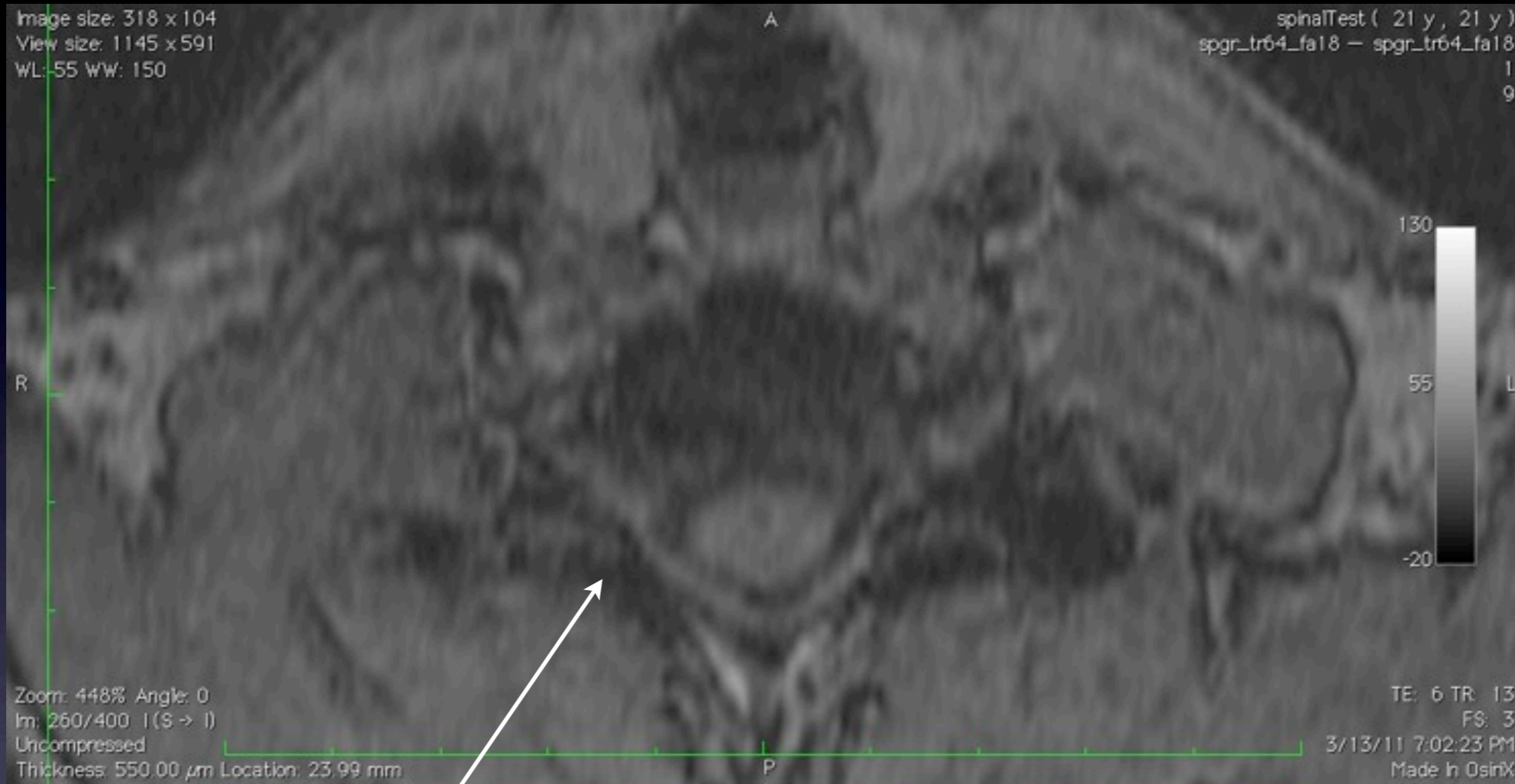
Preliminary Images/ Data

- Data from 1 participant collected
- Data acquisition with these particular sequences take a very long time. Unable to acquire a full volume of data because of this.
- Scanning takes place in evening hours and is dependent upon schedules of participants
- Scans have been “scheduled” for Friday and Saturday and the beginning of next week



More Images





Foramen

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Future Work and Project Completion

- Finish Data acquisition (4-5 more participants)
- Have doctors contour the foramen and look for stenosis or herniation with the different MR protocols
- Compare which protocol (conventional or oblique) gives better results for looking at the neural foramen

Updated Timeline Until End of Project

- Rest of this Week and Next week (4/28-5/7)
 - Continue data acquisition. Planning on scanning this Friday evening and Saturday. Plan on finishing data acquisition by Wednesday (5/4)
 - Send/Meet with Doctors for for hand contours of the foramen.
- 5/7-5/16
 - Continue analysis of MRI protocols. Determine which technique is best for detection of cervical foramina. Base these conclusions on the SNR and CNR measurements as well as the hand contours from the Radiologists and Orthopedic Surgeon.
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References

- Shim JH, Park CK, Lee JH et al (2009) A comparison of angled sagittal MRI and conventional MRI in the diagnosis of herniated disc and stenosis in the cervical foramen. *Eur Spine J* 18:1009– 1116
- Bischoff RJ, Rodriguez RP, Gupta K, Righi A, Dalton JE, Whitecloud TS (1993) A comparison of computed tomography-myelography, magnetic resonance imaging, and myelography in the diagnosis of herniated nucleus pulposus and spinal stenosis. *J Spinal Disord* 6:289–295. doi: 10.1097/00002517-199306040- 00002
- Humphreys SC, An HS, Erk JC, Coppes M, Lim TH, Estkowski L (1998) Oblique MRI as a useful adjunct in evaluation of cervical foraminal impingement. *J Spinal Disord* 11:295–299. doi: 10.1097/00002517-199808000-00005
- Edelman RR, Stark DD, Saini S, Ferrucci JT Jr, Dinsmore RE, Ladd W et al (1986) Oblique planes of section in MR imaging. *Radiology* 159:807–810