THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

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Quality Control of Deep Learning MR Image Reconstruction at 0.55 Tesla

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Background

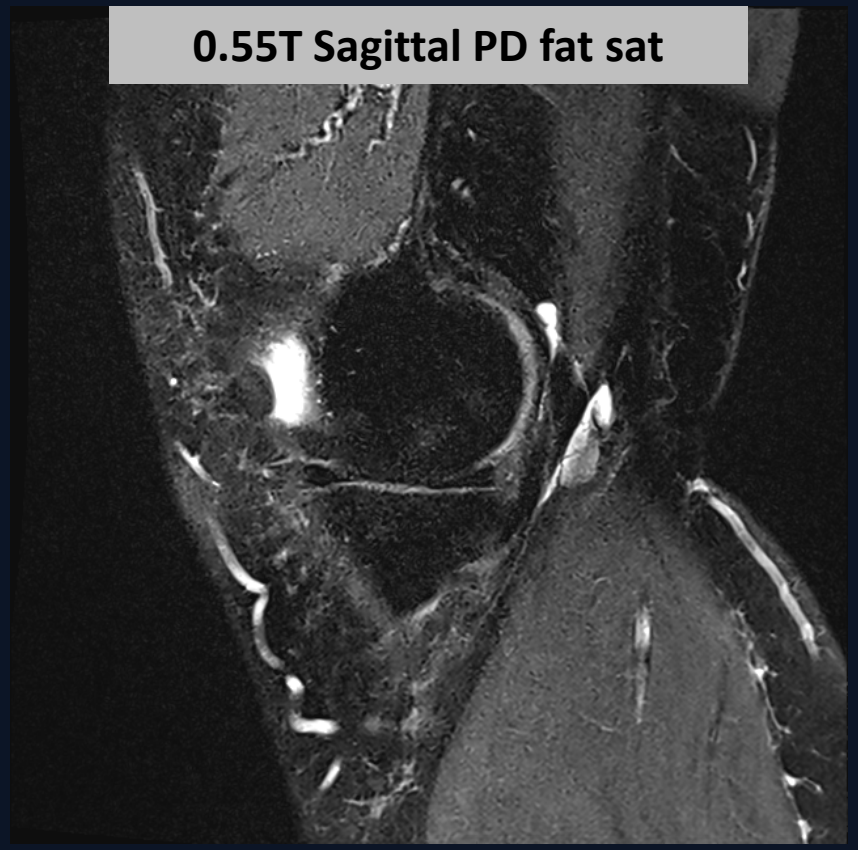
- Low-field MR images often lack interpretability due to a poor contrast-to-noise ratio (CNR) and SNR
  - Most studies involved early low field strength scanners
  - Modern low field MR utilizes multislice acquisition, Iterative denoising, spiral imaging, improved coils
- The integration of deep learning reconstruction (DL) into MR imaging reconstruction at 0.55T aims to enhance diagnostic accuracy by increasing SNR and spatial resolution

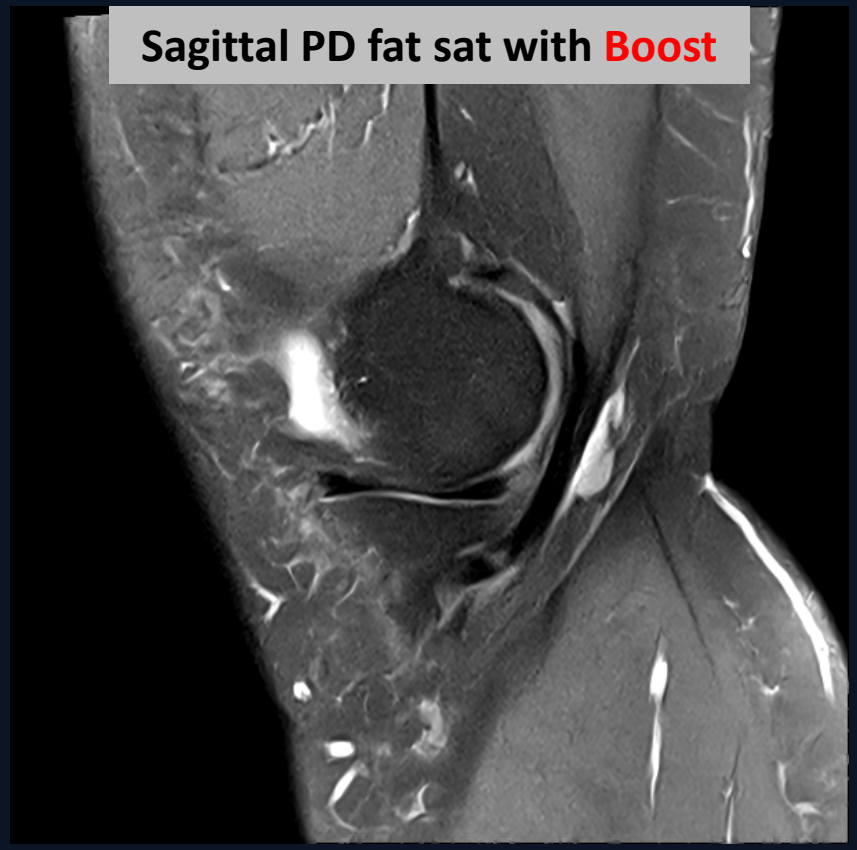
Advantages of low field strength MRI

- Lower cost – space, installation, operating
- Comfort: larger bore 80cm, reduced noise, lower SAR
- Able to image obese patients, patients with orthopedic implants
- Potentially guide procedures

Signal to noise ratio

0.55T – poor signal to noise ratio significantly improved with Deep Resolve Boost





Modern low field MR utilizes multislice acquisition, parallel imaging, iterative denoising, spiral imaging, improved coils. Deep Resolve Boost (deep learning) markedly improves SNR

Clinically-relevant unexpected image findings were encountered including challenges in pathology identification and variations in image quality

MSK Imaging Case 1A: Meniscal tear

Changes management

Coronal PD fat sat

Horizontal medial meniscal tear

Coronal PD fat sat with Boost

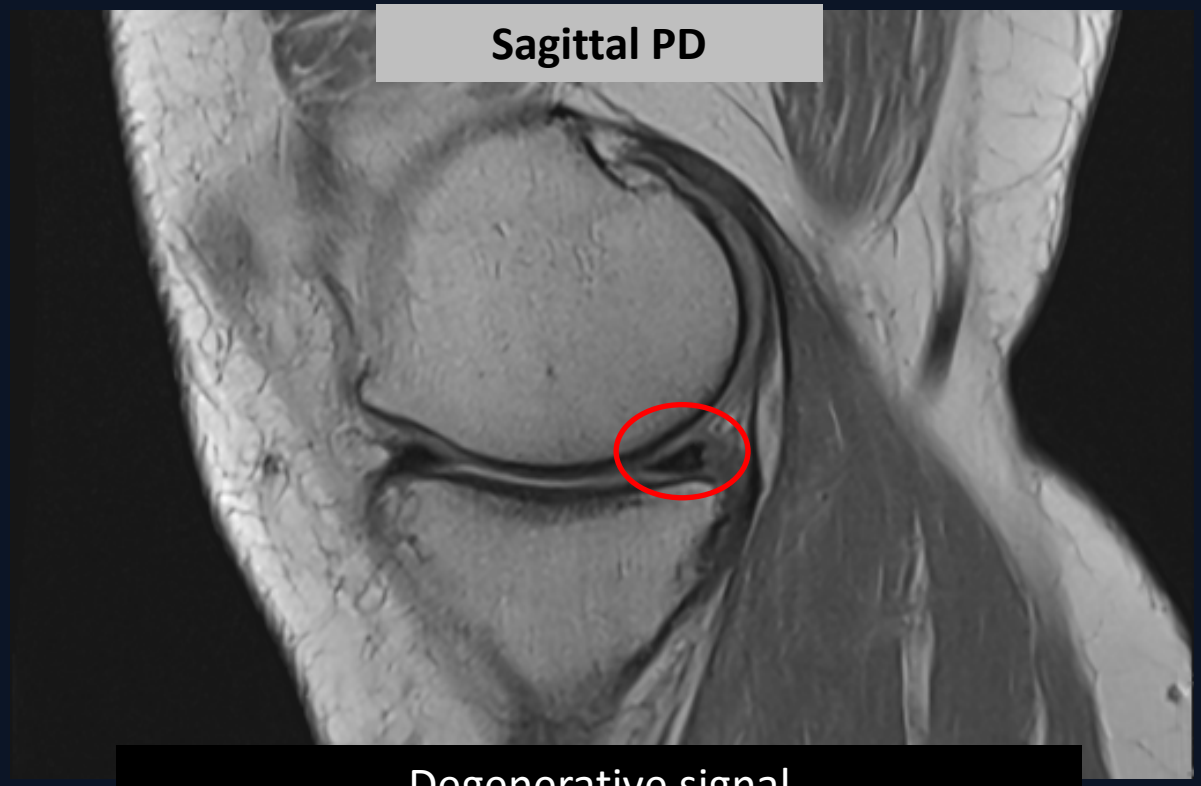
Medial meniscal tear is not visible

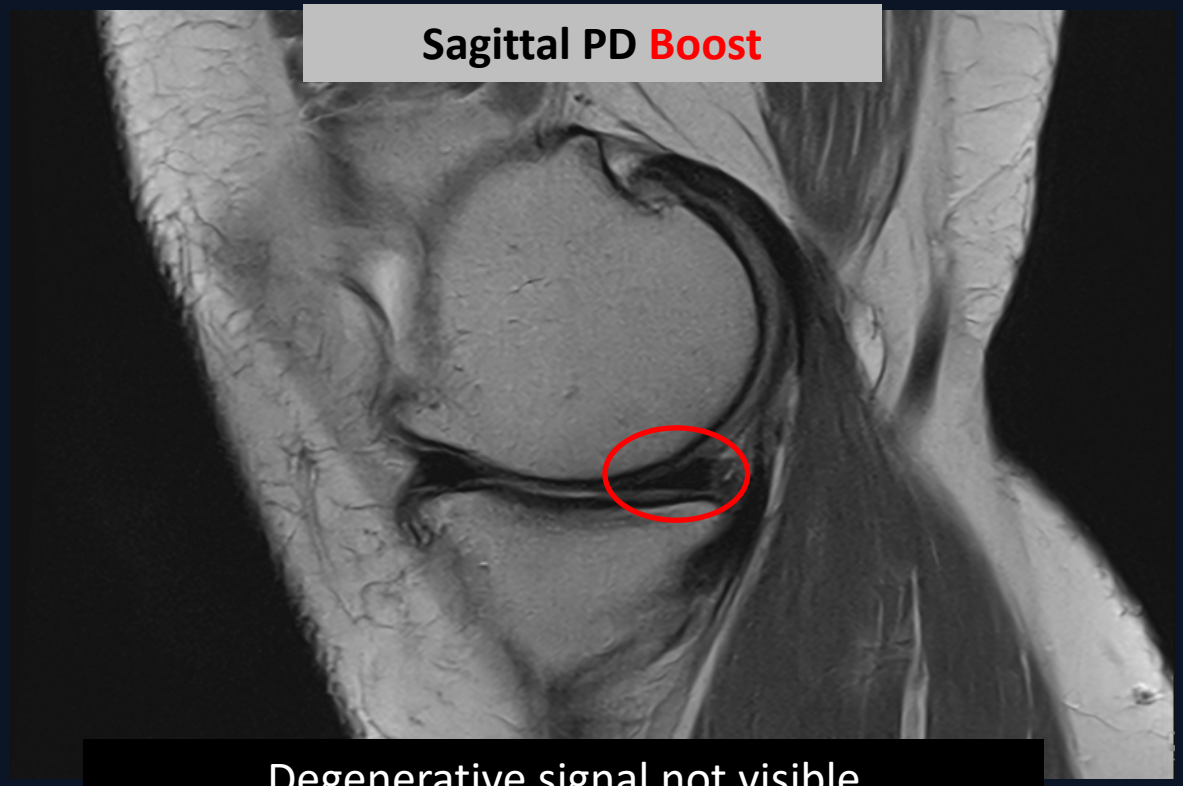
Coronal PD fat-saturated image demonstrates linear signal abnormality in medial meniscal body. Boost images failed to identify abnormal signal.

MSK Imaging Case 1B: Degenerative intrameniscal signal

Degenerative signal in posterior horn of the medial meniscus seen on sagittal PD fat-sat images but not on the Boost images

Does not change management

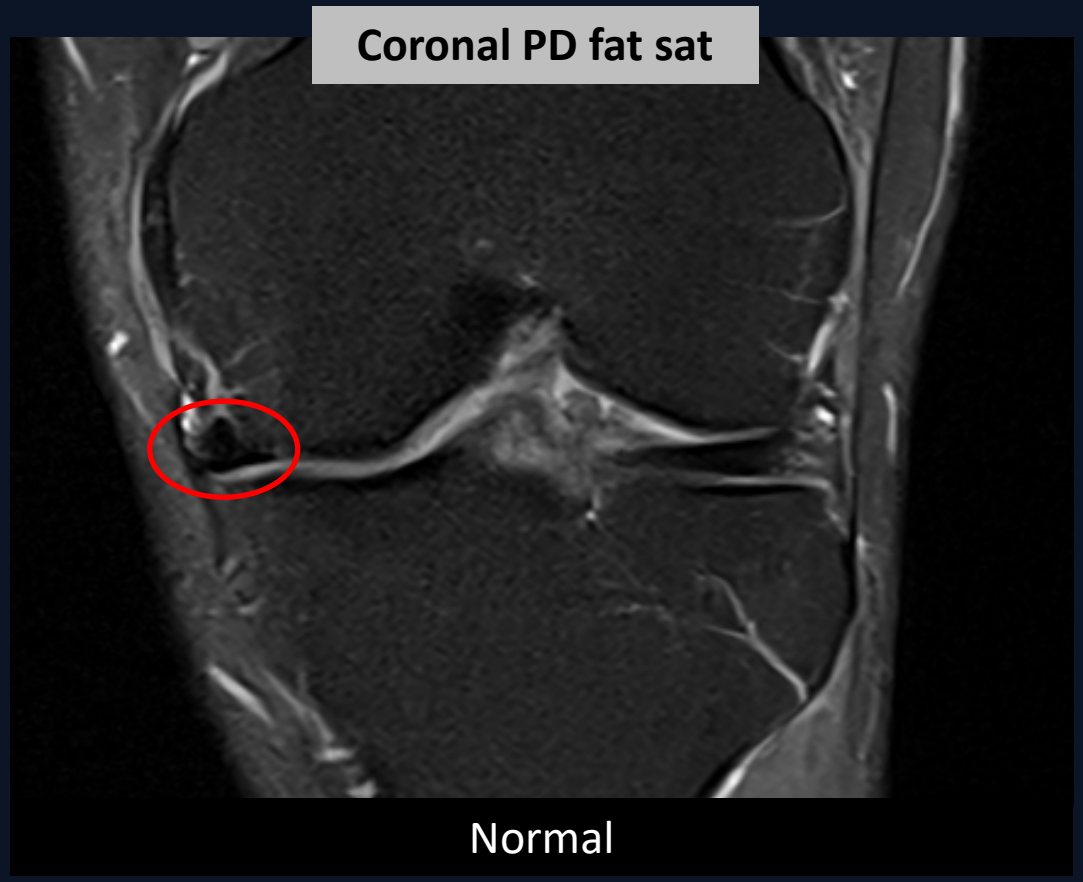




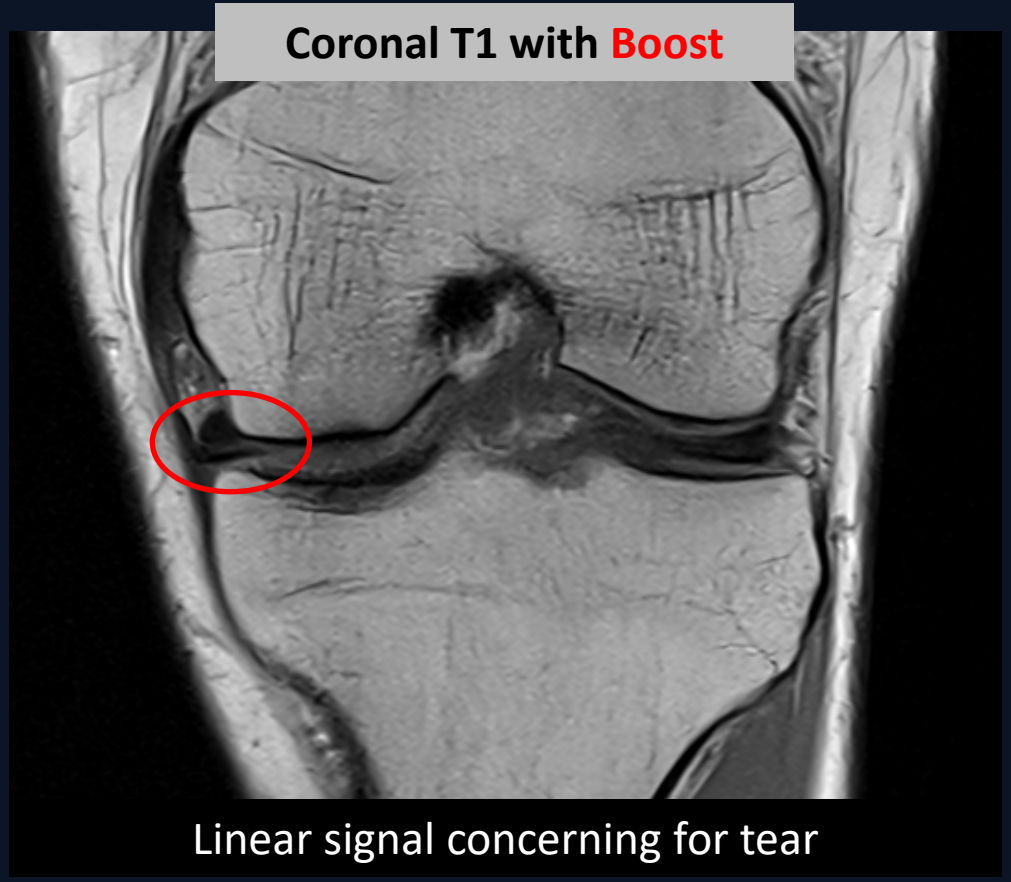
MSK Imaging Case 2: ?Meniscal tear

MRI findings indicated meniscal tear on T1 Boost images, while coronal PD fat-saturated images revealed no tear. The patient denies medial joint line pain.

Changes management



Normal



Linear signal concerning for tear

MSK Imaging Case 3: Meniscal tear morphology

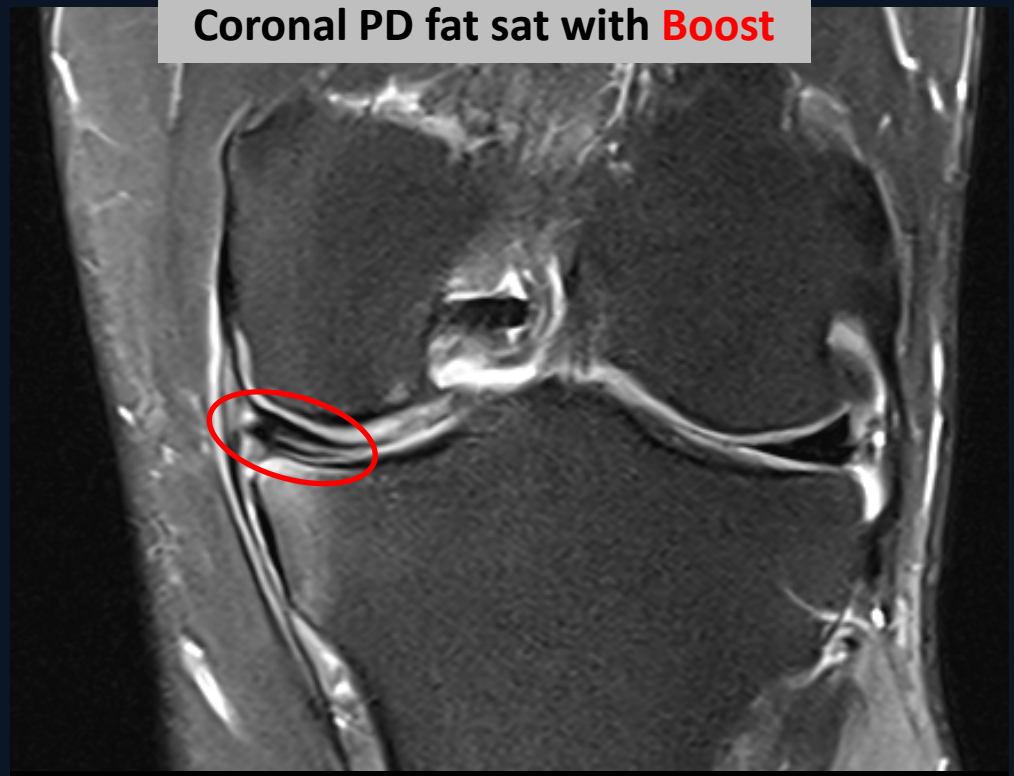
MRI revealed a complex tear extending to the meniscal periphery. Boost images revealed a horizontal tear with smooth margins, and without extension to the periphery

Does not change management

Coronal PD fat sat

Complex medial meniscal tear

Coronal PD fat sat with Boost



Horizontal meniscal tear with smooth margins

Body Imaging Case

44F with Crohn's disease s/p subtotal colectomy. MRI exam was requested for possible flare.

Recent Study (0.55 T)

Comparable Remote Study (1.5 T)

Coronal T2 image at 0.55 T has low SNR and poor in-plane resolution, likely attributable to the large field of view and K-space undersampling

Discussion

- Low-field MR systems offer reduced cost, improved patient comfort, and potential for excellent image quality
  - Beneficial in orthopedic implant imaging
  - Promising results in lung imaging and potential for MRI-guided intervention
- Increased interest in low-field MR imaging results in growing volume of publications
- Several recent studies comparing 0.55T with high field strength scanners in MSK imaging demonstrated diagnostic image quality and comparable diagnostic performance

Conclusion

- Integration of Deep Learning into MR imaging at 0.55 Tesla aims to enhance diagnostic accuracy by improving SNR and spatial resolution
- We encountered several cases with diagnostic discrepancies, which could affect management
- Robust research is needed to prevent diagnostic errors

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