Clinical Use of Low-Field MRI (0.25T)

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Objective

While low-field MRI (0.25T) is less powerful than high-field MRI (e.g. 3T):

- Low-field MRI is considerably cheaper, easier to install and has a lower maintenance cost.
- Low field MRI can produce standing images, which is not possible on high field MRI systems.

This pictorial poster aims to educate radiologists about the existence of low-field MRI and present studies we undertook to show the clinical usefulness of low-field MRI.

Low-field MRI (0.25T) in the supine position

Low-field MRI (0.25T) in standing position

Methods/Studies

Low-field MRI and high-field MRI were compared on patients with:

- Neurogenic claudication and sciatica patients (N=100): degenerative features were evaluated.
- Rheumatoid patients evaluated (N=21): inflammatory features were assessed.

Low-field MRI in supine and standing positions were performed on patients with:

- Neurogenic claudication (N=70): changes in dural sac cross-sectional area and sagittal anteroposterior were correlated with clinical symptoms.
- Adolescent Idiopathic Scoliosis patients (N=25, 18 controls): Cerebellar tonsillar position in standing and supine positions.

Results

- Excellent agreement between low-field and high-field MRI were found for severity of disc herniation (r= 0.92-0.94; p<0.05), central canal stenosis, (r = 0.89-0.91; p<0.05) lateral recess stenosis and exit foramen stenosis (r= 0.81-0.89; p<0.05).
- Good agreement for nerve root compression (L3-L4, L4-L5 or L5 to S1) (r= 0.71-0.76; p<0.05).
- Excellent agreement between low and high-field MRI systems for synovitis severity (r=0.80; p<0.00001) and synovial volume (r= 0.94; p<0.00001).
- Good and fair agreement for synovial perfusion parameters Synovial Emax (r= 0.6; p=0.002) and Eslope respectively (r= 0.5; p=0.02)

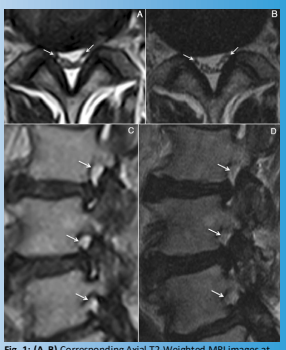

Fig. 1: (A, B) Corresponding Axial T2-Weighted MRI images at 0.25T (A) and 3.0T (B) showing descending nerve roots (arrows). **(C, D)** Corresponding Sagittal T2-Weighted MRI images at 0.25T (C) and 3.0T (D) showing exiting roots (arrows).

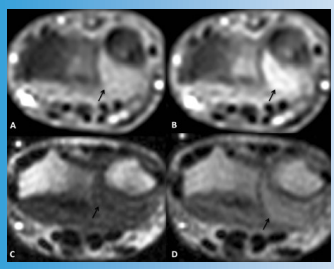

Fig. 2 (A, B) Axial T1-weighted fat-saturated image of the wrist following a DCE MRI dynamic study on a 3.0T MRI machine at early (A) and late (B) dynamic phases. There is an increase in enhancement at the distal radioulnar articulation (arrow). **(C, D)** Axial T1-weighted image of the wrist of the same patient following a DCE MRI dynamic study on a 0.25T MRI machine at early (C) and late (D) dynamic phases. There is an increase in enhancement at the distal radioulnar articulation (arrow). The area of synovial enhancement is similar between 0.25 and 3.0T.

- Dural scan canal area and anteroposterior diameter on standing MRI and percentage change between supine to standing showed better correlation (r= 0.55, 0.53, -0.44, -0.43; p<0.001) than supine MRI alone (r= 0.39, r=0.42; p<0.001) for walking distance.
- Significant correlation between dural sac caliber on standing MRI and leg pain scores (r= -0.20, r= -0.25; p<0.05).
- None of the 18 normal control subjects had cerebellar tonsillar descent on either supine or standing position.
- 48% of AIS patients had tonsillar descent in standing position compared to 28% in supine position.

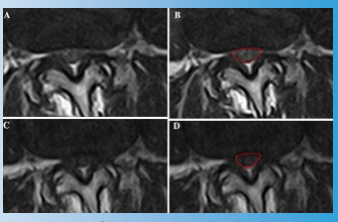

Fig. 3 A Illustration of dural sac cross-sectional area (DSCA) on axial image of a patient who has severe spinal canal stenosis. **B** DSCA is measured 65 mm^2 (red line) in supine position. **C** Dural sac is shrunken when standing. **D** DSCA is measured 46 mm^2 in standing position.

Conclusion

Low field MRI is comparable to high field MRI in many respects and can, with some systems, offer an additional benefit of weightbearing which can accentuate spinal canal stenosis and tonsillar descent.

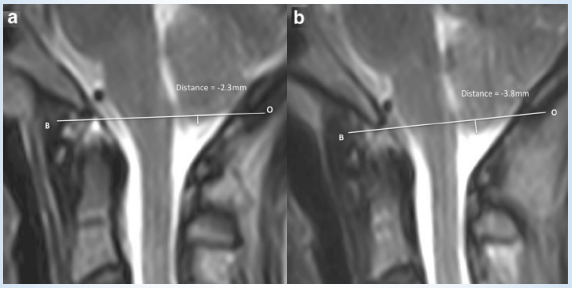

Fig. 5a Sagittal T2-weighted MRI of the cervico-occipital junction of an AIS subject. The tonsil is lowest at the paramedian region. The tip of cerebellar tonsil is below (2.3 mm) the BO line (drawn on the midline) in supine position. **b** Sagittal image of same patient as Fig. 5a, in an upright position at the paramedian region. The tip of cerebellar tonsil descends more than in the supine position.

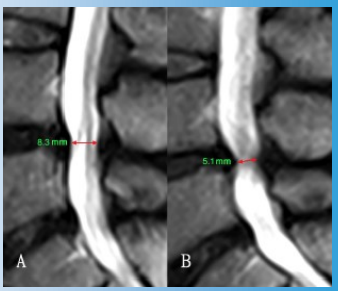

Fig. 4 Measurement of sagittal anteroposterior (AP) diameter of dural sac on mid-sagittal T2 images is illustrated in **A** supine position and **B** standing position

References

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