Localizing unilateral lumbosacral radicular pain through Diffusion Tensor MR Imaging

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Introduction

Unilateral lumbosacral radicular pain is common, yet **pinpoint**ing its **precise anatomical origin** can be **challenging** [1]. In fact, although many patients with this pain do exhibit radiculopathy—often stemming from mechanical compression such as a herniated disc—others may not [1]. **Diffusion tensor imaging (DTI)** enables 3D visualization of lumbosacral nerves (LSN) and **can detect subtle microstructural LSN damage**, particularly when conventional MRI appears normal [2]. **For instance, fractional anisotropy** derived from DTI can differentiate between symptomatic and contralateral asymptomatic nerve roots [1]. **Nonetheless, the optimal diffusion MRI protocol** for reliably identifying symptomatic nerve roots and clarifying the relationship between DTI parameters and patient-reported symptoms **remains unclear** [1]. Therefore, **the goal of this study is** to investigate all the acquisition parameters that influence the imaging of the LSN and to **propose the most relevant DTI protocol for assessing LSN**. Moreover, we aim to develop computational tools for accurately processing the acquired data in a semi-automatic way. Last but not least, **fiber tractography (FT) will be applied**, as it has demonstrated superior intra- and inter-rater reliability for fractional anisotropy, especially when combined with tractography-based approaches [3].

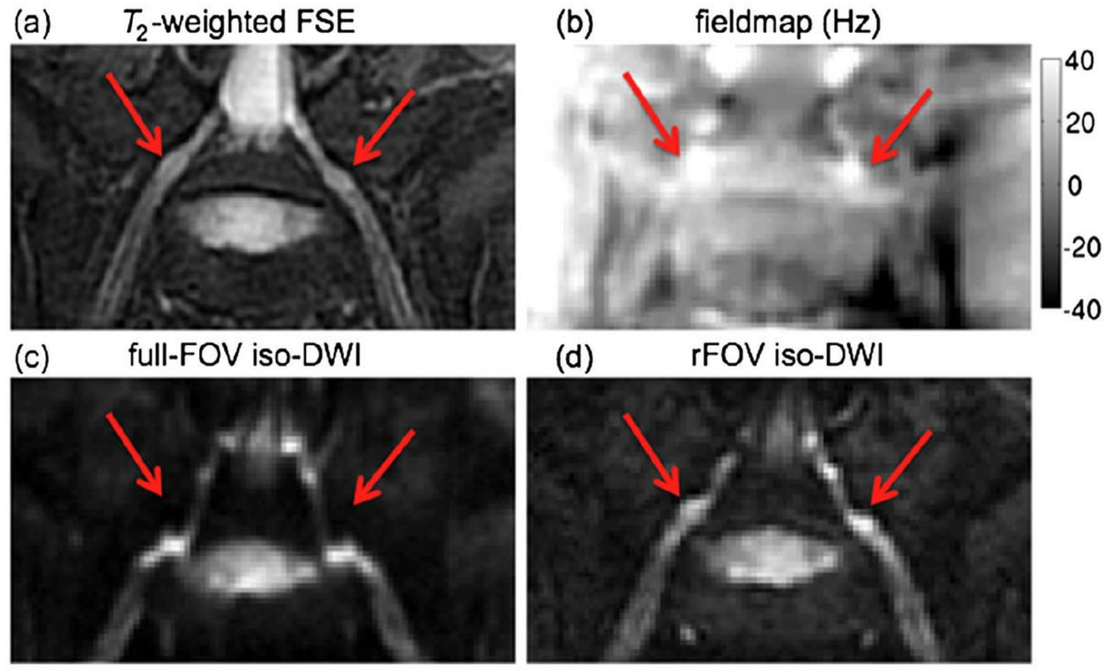

Figure 1 [12]

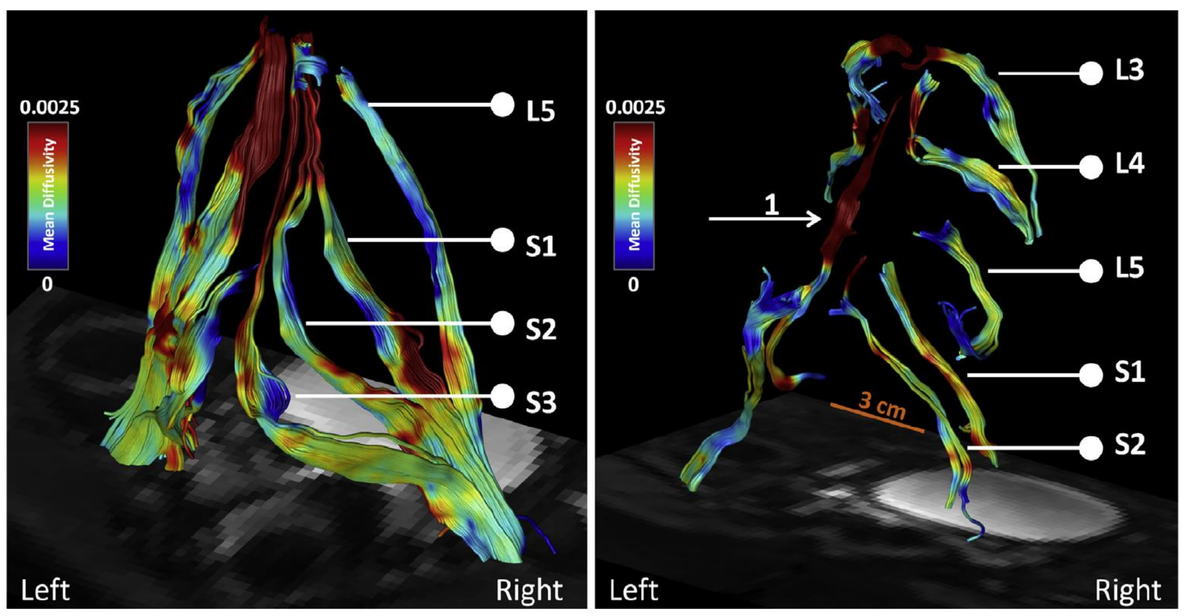

Figure 2 [4]

Methods

Sixty (60) subjects will be recruited in our study: thirty (30) human controls (HC) and thirty (30) patients suffering from unilateral lumbosacral radicular pain. The HC subjects will be well-matched in terms of age with the patients' cohort. The MRI scannings will take place at the **3T PRISMA (SIEMENS) scanner** in the CRC Human Imaging department. **The MRI protocol** will include two types of sequences: T2w (2D sagital and 3D axial) and DTI sequences. We will explore the use of many b-values, and the extent to which the Field-Of-View (FOV) can be reduced, towards suggesting a clincally feasible DWI protocol (figure 2). Reducing the FOV in the phase-encoding direction enables both an in-plane LSN imaging and a decrease in the sensitivity to geometric distortions [2]. The goal is to accurately image L3, L4, L5, and S1 LSN (figure 2). Among the proposed by the community DWI protocols, we will investigate are the DWI-RESOLVE [5], the non-coplanar excitation and refocusing pulses associated with outer volume suppression [6], the ZOOMit [7], another reduced FOV DWI acquisition by Haakman et al. [8], the generalized Q-space sampling imaging (GQI), and the Q-ball imaging (QBI) [9].

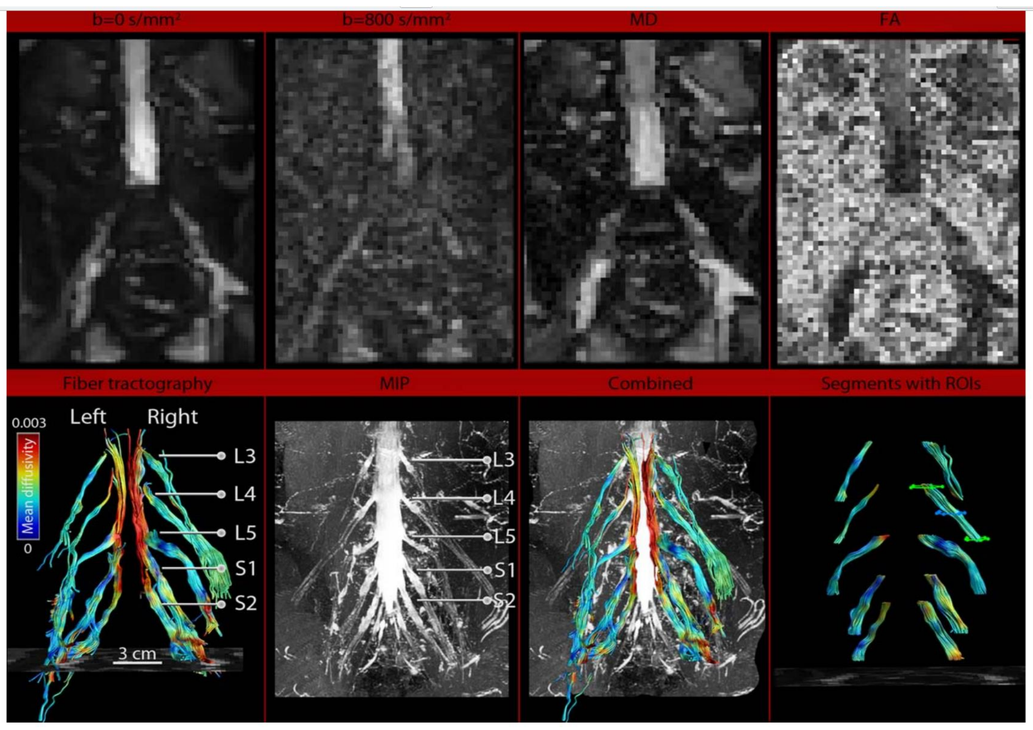

Figure 3 [8]

References

1. Pesesse et al., Journal of Magnetic Resonance Imaging (2024).
2. Karampinos et al., NMR in Biomedicine (2013)
3. Van der Jaqt et al., Neuroimage (2012)
4. Haakma et al., The journal of urology (2014)
5. Abdulaal et al., Quantitative Imaging in Medicine and Surgery (2022)
6. Budzik et al., European Radiology (2013)
7. Samson et al., PLoS One (2016)
8. Haakma et al ., Journal of Magnetic Resonance Imaging (2018)
9. Suo et a., Frontiers in Neuroscience (2021)

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