Automated multimodal segmentation of paraspinal muscles based on chemical shift encoding-based water/fat-separated images

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INTRODUCTION

- Chronic lower back pain (LBP) is the most prevalent musculoskeletal disorder among adults [1,2]
- Paraspinal muscle atrophy and fatty infiltration can accurately indicate LBP through extraction of proton density fat fraction (PDFF) maps from chemical shift encoding-based water-fat MRI
- Objective: to effectively exploit multimodal water-fat MRI data and deep learning for paraspinal muscle segmentation

METHODS

Data: 54 MRI datasets of healthy volunteers acquired from a 3T Philips Ingenia system containing axial water, fat and T2* images [3] (40/14 - train/test split)

3D U-Net trained on 40 water-fat and T2* images fused into 3 channels at the input (a) compared to late fusion approach of 3 encoder paths fused at the bottleneck of the U-Net (b) to better handle multimodal data complexity.

RESULTS

Late fusion improves the segmentation performance and reduces the overestimation of erector spinae muscles.

The proposed method outperforms the current PSOAS segmentation results reported in the literature [4] (red dots – mean DSC).

DL-based segmentation benefits from multimodal data, where feature extraction using late fusion outperforms early data merging!

[4] Baum et al. ER Exp, 2(1), 1-5, 2018