In-vivo MR-imaging of the Endplates of the Lumbar Spine

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Purpose: Annulus fibrosus, nucleus pulposus, and the endplates are the major structural components of the intervertebral discs; however the endplates are lesser recognised than the other two (1). Prior reports have discribed thickness measurements of the endplates using ultra-highfield magnetic resonance (MR) imaging (2). The purpose of this study was to visualize vertebral endplates using 3.0T MR imaging, to evaluate their quality, and to correlate it with findings on conventional MR sequences.

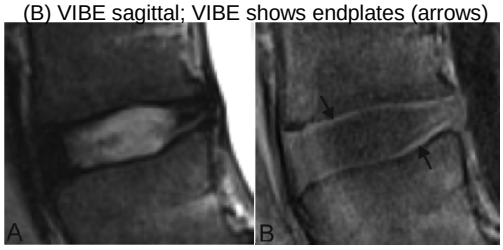
Methods: Anatomic specimens of 6 lumbar spines were scanned with a 3.0T MR scanner using a sagittal 3D gradient echo sequence (VIBE; volumetric interpolated brain examination) with a voxel size of 0.5x0.5x3.0mm^3. After MR imaging, histologic sections stained with Safranin-O were correlated with the MR images. Twentyfour endplates were identified side by side on both, histological and MR images. Additionally, the vertebral spines of 16 patients were scanned the same way as discribed above plus a sagittal T2-weighted turbo spinecho sequence. MR images were evaulated with regard to the quality of the 192 endplates (continuous, inhomogeneous, unrecognizable, hyperintense). Further disc degeneration (Pfirrmann score) and the presence of Schmorl nodes were assessed.

Results: The endplates could be visualized and identified on both, histological and MR images (Fig. 1); There was good correlation between the endplates on the histologic sections and MR images. Also the in-vivo visualization of the endplates was successful in all endplates; Table 1 shows the percentage of „continuous“ and „inhomogeneous“ endplates in the segments Th12/L1 to L5/S1. In total, more endplates were evaluated as „inhomogeneous“ than as „continuous“. There were significantly more endplates evaluated as „continuous“ in Th12/L1 and L5/S1 than in the other segments of the lumbar spine. In most of the discs with herniations (31%) „inhomogeneous“ endplates (83%) were found, only 17% demonstrated „continuous“ endplates. Additionally, in L2/3 6%, in L3/4 6%, in L4/5 6%, and in L5/S1 19% of the endplates showed considerable higher signalintensities („hyperintense“) than the rest. Five of 6 of the endplates that were evaluated as „hyperintense“ were adjacent to discs that were evaluated as Pfirrmann grade 4 degeneration. All endplates that were found in vertebral bodies with Schmorl nodes (29%) had „inhomogeneous“ endplates. In discs with degeneration grade Pfirrmann 1 and 2 „continuous“ endplates were more frequent than „inhomogeneous“ ones (continuous, 82% and 86%), while in discs with degeneration grade Pfirmann 3 and 4 „inhomogeneous“ endplates were more frequent than „continuous“ ones (continuous, 19% and 20%).

Table 1: quality of endplates by vertebral segment

	continuous	inhomogeneous
Th12/L1	64%	36%
L1/2	38%	63%
L2/3	38%	63%
L3/4	44%	56%
L4/5	38%	63%
L5/S1	69%	31%

Figure 1: Details of segment L3/4 on (A) T2 TSE, and (B) VIBE sagittal; VIBE shows endplates (arrows)



Conclusion:The visualization of the endplates is feasible with 3.0T MR imaging. The quality of the endplates was found to be different in different spinal segments, in the presence of Schmorl nodes, and higher grades of disc degeneration. Some endplates were found to have higher signal intensities than others. Further studies will have to investigate the clinical importance of these findings.

References

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