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Functional MRI methods for imaging of patients with low back pain

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin, Göteborgs universitet, kommer att offentligen försvaras i hörsal Karl Isaksson, Medicinaregatan 16, den 22 November 2024, klockan 09.00.

av **Leif Torén**

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Avhandlingen baseras på följande delarbeten

I. **L. Torén**, H. Hebelka, I. Kasperska, H. Brisby, and K. Lagerstrand. *With axial Loading during MRI diurnal T2-value changes in lumbar discs are neglectable: a cross sectional study.* BMC Musculoskeletal Disorders, 2018. doi: 10.1186/s12891-018-1930-0

II. H. Hebelka, **L. Torén**, K. Lagerstrand, and H. Brisby. *Axial loading during MRI reveals deviant characteristics within posterior IVD regions between low back pain patients and controls.* European Spine Journal, 2018. doi: 10.1007/s00586-018-5774-y

III. **L. Torén**, K. Lagerstrand, C. Waldenberg, H. Brisby, and H. Hebelka. *MRI during spinal loading reveals intervertebral disc behavior corresponding to discogram findings of annular fissures and pain provocation.* SPINE, 2020. doi:10.1097/BRS.0000000000003631

IV. **L. Torén**, K. Lagerstrand, C. Waldenberg, H. Brisby, and H. Hebelka. *Different load induced alterations in intervertebral discs between low back pain patients and controls: a T2-map study*. SPINE, 2024. doi: 10.1097/BRS.0000000000005028

V. **L. Torén**, H. Brisby, K. Lagerstrand, and H. Hebelka. *Load-induced quantitative alterations in posterior parts of intervertebral discs in low back pain patients with load induced pain during MRI.* In manuscript

SAHLGRENSKA AKADEMIN
INSTITUTIONEN FÖR KLINISKA VETENSKAPER

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Functional MRI methods for imaging of patients with low back pain

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Background. Non-specific low back pain (LBP) is the leading symptom causing disability over time. It is associated with degenerative alterations in intervertebral discs (IVDs). Magnetic resonance imaging (MRI) can only identify the source of pain in up to 10% of the individuals.

Aim. To combine axial loading during MRI in the supine position and quantitative IVD analysis to determine if differences could be found between LBP patients and controls, if the load-induced pattern varied with IVD-fissure morphology, and, if any specific load-induced pattern linked to load-induced pain could be identified.

Method. Study 1: The diurnal effect on T2 values during loading was examined (six volunteers) with T2 mapping. Study 2: Load-induced alterations in 24 LBP patients and 12 controls were explored with T2 mapping. Study 3: MRI images with and without loading on 30 LBP patients were quantitatively evaluated and correlated to fissure morphology, captured by CT discography. Study 4: Load-induced alterations in 178 LBP patients and 74 controls, stratified by lumbar level, were determined with T2 mapping. Study 5: 178 LBP patients with pain-suspected IVDs were stratified by pain reaction during MRI according to whether axial loading aggravated the pain. Load-induced T2-value alterations were compared between the groups.

Results: No diurnal variation of T2 values was detected. Highly varying, significant load-induced differences between patients and controls, both globally and regionally were found, even when stratifying for lumbar level. The load-induced pattern of T2-value alterations was found to vary with annular fissure extension and width and was different in patients with and without aggravated pain.

Conclusion. The combination of axial loading and quantitative MRI sequences could be used to distinguish among different load-induced IVD alterations in LBP patients and controls. Findings suggested different degenerative patterns between patients and controls and indicated different load-induced behavior in IVDs between patients with and without aggravated pain during loading. The combination of axial loading and quantitative sequences was regarded as a promising tool for further use in the ongoing effort to identify biomarkers that are more specific for LBP.

Keywords: Low back pain, T2 mapping, axial loading, annular fissure, intervertebral disc degeneration.

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