Advanced dynamic MR imaging of the cervical spine using the new NeuroSwing® positioning system in healthy volunteers and patients

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Introduction

A major problem of functional investigation techniques is insufficient spatial and time resolution as well as missing standardization. The newly developed NeuroSwing® positioning system with integrated surface coils enables cervical imaging with higher spatial resolution and allows dynamic MR imaging of the cervical spine in ante flexion, retro flexion, lateral flexion and rotation. The aim of this study was the functional MR investigation of the cervical spine in healthy volunteers and patients using the new NeuroSwing® positioning system as an integrated concept, which includes a newly developed external energy-operated device and an optimized software [1].

Material and Methods

40 presumably healthy volunteers without any medical history of previous spinal affections and 20 patients were enrolled in this study. Dynamic MR imaging of the cervical spine was performed using a 1.5Tsystem (Siemens Magnetom Sonata) and the following protocol was applied: 3D-HASTE, True FISP, TSE (T1/T2-weighted). The examinations were performed in neutral position, ante and retro flexion, lateral flexion and rotation. All 3D-data sets were post processed (Leonardo workstation, Siemens Medical Solutions). High resolution MR-Myelography, endoscopy of the subarachnoidal space and volumetry were performed. The examination time for each functional position varied between 3-10 minutes.**Results**

Functional range of movement was comparable with physiological measurements [2]. In 14 volunteers cryptic lesions such as anterolisthesis, retrolisthesis and ligamtal lesions were detected which were invisible on standard MR imaging [Fig. 1]. In symptomatic or critical care patients functional imaging of the cervical spine was performed in less than a minute. Real time imaging using TrueFISP provided sufficient information about disc, subarachnoidal space and vertebrae and True-FISP (200ms/image) was used for fast screening. Spondylolisthesis was detected and could be measured using TSE or 2D-FLASH, ligamental lesion were best visualized by using 3D-MEDIC. 3D-HASTE data-sets allowed high resolution 3D-visualization of the CSF within the nerve roots in an endoscopic view. Advanced dynamic MR imaging of the cervical spine using the new NeuroSwing® positioning system allowed reproducible investigations in arbitrary functional positions [3].

Conclusion

By the use of advanced functional imaging techniques such as the NeuroSwing® positioning system cryptic lesions could be detected in healthy volunteers and patients. Additionally, in patients advanced functional imaging allowed improved visualization of nerve roots, ligaments and vertebral joints and thus preoperative management and presurgical planning in severe degenerative diseases can be optimized.

Literature: [1] K.E.W. Eberhardt et. al.: Electromedica 02/2002, [2] J. Dvorak et. al.: Manuelle Medizin, 1997, [3] K.E.W. Eberhardt et. al.: Radiology, Suppl. (RSNA 2003).

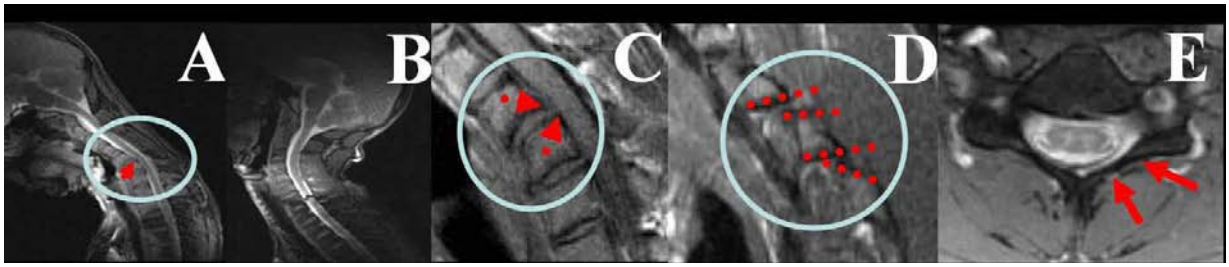

Fig. 1: Former whiplash injury of a young male volunteer with a cryptic lesion.
Real time imaging (TrueFISP) detects pathological movement in ante flexion (marked). A: ante flexion. B: retro flexion. 2D-FLASH (C, D) visualized a subluxation and a anterolisthesis (red lines mark an increasing angle between the superior and inferior process of the facet joints, D). 2D-MEDIC demonstrates a lesion of the flavum ligament (E).