

## Subjective acceptance of 7T: initial experience in the first 210 subjects

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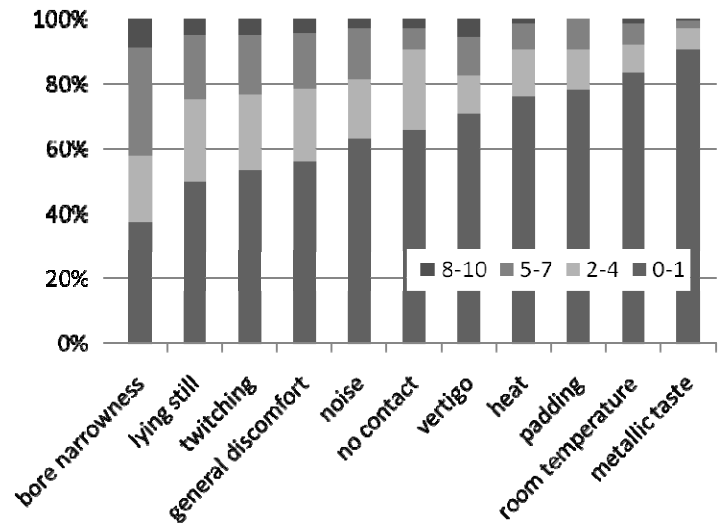
**Introduction:** The introduction of ultra high field magnetic resonance (MR) imaging systems for clinical human imaging leads to a raised consciousness regarding subjective patient acceptance and appearance of side-effects. Long-term effects of high fields have been studied extensively in animals without any negative result, suggesting human health would not be endangered. Short-term effects, on the other hand, have been described with non-serious consequences for humans. These effects are often linked to exposition to a magnetic field (or gradient) and reversible after leaving the field (or discontinuation of movement), which is in concordance with the reported experiences of the first 56 subjects in our 7T scanner [1]. The results here are an update of our collected data including the first 210 human subjects undergoing a 7T MRI exam.

**Methods:** The ethics committee authorized the examination of humans at our clinically-oriented research site as part of fundamental research on high field MR. Volunteers and patients were informed about possible side effects, contraindications were carefully examined, and written consent was obtained. Scans were performed on a whole-body 7 Tesla scanner (Magnetom 7T, Siemens Medical Solutions, Erlangen, Germany; bore 60 cm diameter and 3.5 m long). For imaging, either a CP head or knee coil (Invivo, Gainesville, Florida, USA), an 8-channel head coil, or a 10cm-diameter single loop coil (both: Rapid Biomedical, Wurzburg, Germany) were used. The non-motorized patient table was moved very slowly into the bore by hand to minimize side-effects. Communication and supervision were ensured through a two-way speaker system, an emergency squeeze-ball, or a physician supervising from inside the scanner room. After the examination, an extensive questionnaire was filled out by the subjects with the help of a physician. The timing of the effects was differentiated between those occurring during movement into the bore and those during stationary active imaging. All potential sources of discomfort and side effects were rated on a 10-point scale (0=not unpleasant at all / no sensation, 5=tolerable / medium sensation, and 10=very unpleasant / strongest sensation).

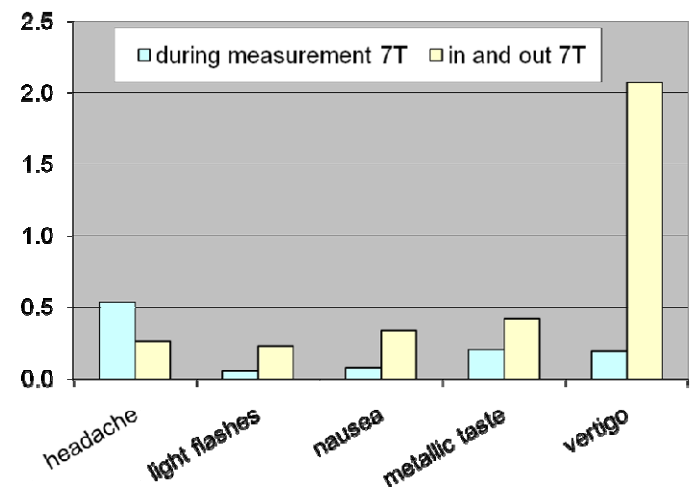
**Results:** Region of interest was the head (n=151), knee (n=34), wrist (n=8), ankle (n=10), and breast (n=7). All 210 subjects (98 women, 112 men, mean age 38.7 years) completed the examination (mean examination time 73 min including initial manual shimming) except four: sensation of light flashes and of pressure around the head n=1; feeling of nausea, which initially commenced during movement into the bore and did not subside with cessation of table motion n=2; nausea when the table was moved out to check the RF coil between scans n=1. According to the post-exam questionnaire, 189 volunteers would undergo the examination again to support clinical science, 21 only in the case of personal medical necessity. The examination was accepted overall with a rating of 2.3; individual sources of discomfort are presented in Fig. 1. Sensations during movement into and out of the bore were felt by 126 subjects: dizziness (n=100), nausea (n=21), metallic taste (n=19), anxiety (n=12), headache (n=10), and light flashes (n=9). During the measurements, only 72 volunteers had symptoms. After completing the examination and leaving the scanner room, 132 volunteers had a transient feeling of dizziness or sleepiness, while six expressed back pain.

**Discussion:** The lengthy duration of the examination was the most important reason for 21/210 subjects not being willing to undergo a 7T examination again without personal medical need. We believe that the willingness to undergo such an examination will improve if personal medical benefit is expected to emerge from it. The bore's narrowness together with lying still for a prolonged time were rated the most disturbing factors. No critical situation occurred; we believe that a reasonably detailed dialogue before the examination might help in lowering the sensation of anxiety. We will continue to collect questionnaires from all examined subjects at 7T.

[1] J.M. Theysohn, et al., ISMRM Workshop on Advances in High-Field MR (2007), Asilomar.



**Fig. 1:** Distribution of discomfort levels in percent of 210 subjects (10-point scale). Bore narrowness and lying still generated the greatest discomfort. Vertigo was the most prominent effect associated with the high magnetic field.



**Fig. 2:** Mean intensity of side-effects in 210 subjects (10-point scale). Vertigo during introduction into the scanner (yellow) was rated most intense (2.1=very weak sensation).