

Maximum instrument length for MR-guided minimal-invasive interventions of the lumbar spine in open high-field MRI

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Introduction

For the establishment of new minimal-invasive interventions with MR-guided real time imaging [1-3], special methods and instruments are adapted to the MR-environment [4,5]. The length of the instrument depends thereby from space within the scanner. For MR-guided minimal-invasive interventions on the lumbar spine, the space for rigid instruments, needed for those kinds of interventions, is analysed.

Methods

In an open high field MRI (Philips Panorama HFO, 1.0 Tesla) with an opening of 40x160cm (length-x-width) MR-guided punctions on the lumbar spine (n=88) were carried out. Thereon, the shortest distance between vertebral body L5 and skin surface was measured from the image data. For patients with a girth of 63-126 cm, a space for rigid instrument was defined. In this case, the height of the body in prone position and the width of the body in lateral position were varied in a step range of 1 cm. The instrument's angle was also considered from 0° to 75° with a step range of 15° (Fig. 1, right). The vertebral body L5 was always in the isocenter.

Results

The vertebral body L5 was an average of 76 (±13) mm from the body surface away. With increasing body volume, the space intended for the instruments decreases. For interventions with steep instrument angle (<45°), the lateral position of the patient offers more space, whereas for interventions with flat instrument's angle (>45°) and a girth less than 110 cm, the prone position offers more space for instruments. For a girth of more than 110 cm the maximum possible instrument's length is greater in lateral position (Fig. 1 left).

Conclusion

The greater the girth of the patient, the shorter the instruments have to be. The opening's size of the scanner used in the study is comparable with other producers of similar scanners. The results can therefore be transferred to other scanners.

Fig 1: Maximum possible instrument's length depending on girth (lefts) with corresponding betting (rights).

References

1. Streitparth, F., et al., MR-guided laser ablation of osteoid osteoma in an open high-field system (1.0 T). *Cardiovascular and interventional radiology*, 2009. **32**(2): p. 320-325.
2. Chopra, S.S., et al., Laparoscopic radiofrequency ablation of liver tumors: Comparison of MR guidance versus conventional laparoscopic ultrasound for needle positioning in a phantom model. *Minimally Invasive Therapy and Allied Technologies*, 2011. **20**(4): p. 212-217.
3. de Bucourt, M., et al., Minimally Invasive Magnetic Resonance Imaging-Guided Free-Hand Aspiration of Symptomatic Nerve Route Compressing Lumbosacral Cysts Using a 1.0-Tesla Open Magnetic Resonance Imaging System. *Cardiovascular and interventional radiology*, 2011: p. 1-7.
4. Bock, M. and F.K. Wacker, MR-guided intravascular interventions: Techniques and applications. *Journal of Magnetic Resonance Imaging*, 2008. **27**(2): p. 326-338.
5. Streitparth, F., et al., MR-guided discography using an open 1 Tesla MRI system. *European radiology*, 2011: p. 1-7.

