

Phantom Study of a Novel Stereotactic Prostate Biopsy System Integrating Preinterventional MRI and Live US Fusion

Introduction and Objective: To determine the targeting error of a novel stereotactic prostate biopsy system, which integrates preinterventional MRI with periinterventional ultrasound for perineal navigated prostate biopsies.

Materials and Methods: We performed stereotactic biopsies on 5 prostate phantoms (one CIRS 053-MM and four CIRS 066). Phantom 053-MM incorporates three MRI- and TRUS-visible lesions, while lesions within phantom 066 are only detectable on MRI. In both phantoms the 0.5cc volume lesions are randomly placed. The phantoms were examined by 3T-MRI preinterventionally. Then 3 stereotactic biopsies from one lesion in phantom 053-MM and from all ultrasound-invisible lesions in the 066 phantoms were taken under live-fusion-imaging guidance. During intervention a mix of blue ink and gadobutrol was injected into each biopsy channel. Afterwards another 3T-MRI was obtained again. These MRI images were then fused again with the intraoperative TRUS-data. Thus, the targeting error (TE) between the planned and performed biopsy cores could be measured. Additionally, the procedural targeting error (PTE) between the virtually planned biopsy trajectory and the manually registered three-dimensional needle position of every single biopsy core taken was calculated.

Results: The overall targeting error (TE) of the 39 biopsy-cores taken was 0.83mm (SD: 0.48mm) with the highest TE in the sagittal plane (1.09 ± 0.54 mm), followed by the coronal (0.72 ± 0.43 mm) and axial (0.69 ± 0.34 mm) planes. The procedural targeting error, which is provided intraoperatively, was 0.26mm in average (SD: 0.46mm). Comparing PTE and TE, there was no statistically significant difference ($p=0.39$).

Conclusions: The targeting error of stereotactic biopsies using our novel perineal prostate biopsy system (BiopSee[®], MedCom, Germany) is below 1mm and can be estimated *in vivo* by the automatically calculated procedural targeting error. Thus, stereotactic prostate biopsies guided by the combination of MRI and ultrasound allow effective and precise examination of MRI-lesions.