

## Volume interpolated breathhold examination (VIBE) and software-assisted MR-guided RFA for the treatment of malignant liver tumors: Initial clinical results

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### TARGET AUDIENCE

Radiologists interested in MR guided radiofrequency ablation and computer aided therapy.

### PURPOSE

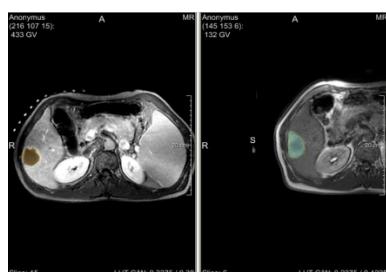
To evaluate feasibility and effectiveness of software-assisted monitoring of MR guided Radiofrequencyablation (RFA) of malignant liver tumors.

### METHODS

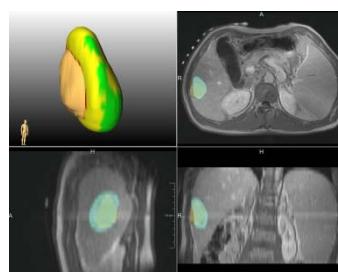
MR-guided RFA of n=10 primary and n=18 secondary malignant liver tumors was performed for n=20 patients in an interventional MR unit (MagnetomEspree 1.5T, Siemens Medical Solutions, Forchheim). The tumor size was between 10 and 60 mm. Monopolar and bipolar internally-cooled MR compatible RF electrodes were used (Valleylab,Cool-tip, Burlington, MA and Celon AG, ProSurge, Teltow). Therapy monitoring was assisted by a software comparing tumor and tumor ablation state until complete tumor destruction within a given safety margin of 1 cm (MeVisSafir, FraunhoferMevis, Bremen). Therefore MR data were immediately transferred via DICOM to a MeVis workstation.

### RESULTS

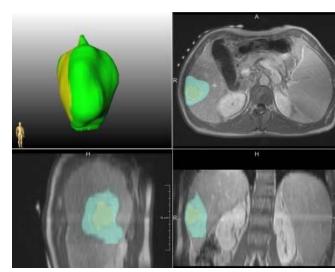
MR-guided RF ablation by using MeVisSafir was technically successful in 20/20 (100%) patients as assessed at the end of each session. Complete coagulation was intended in 27/28 tumors by using the software-assistant. To achieve complete coagulation 1/28 tumors required a second session. MeVisSafir was able to monitor the extent of coagulation necrosis and to determine the safety margin. Furthermore, it was supportive in guiding overlapping ablations for complete tumor coagulation for larger liver tumors (>30mm). (Fig. 1-3)



**Figure 1:** Left image shows pre-interventional tumor segmentation, right image shows post-interventional Segmentation with VIBE



**Figure 2:** software-assisted color coded scheme of tumor and incomplete coagulation after initial RF electrode positioning. View in axial, coronal and sagittal angulation with VIBE. Lateral side shows area of incomplete ablated tumor (brown color).



**Figure 3:** software-assisted color coded scheme of complete tumor ablation after multiple overlapping ablations with VIBE. Green coded area demonstrates coagulation with a safety margin of 1 cm to the tumor surface.

### DISCUSSION

The robustness of the manually segmentation and registration has shown good results for the therapy monitoring of MR guided RFA of malignant liver tumors in combination with VIBE. But, the one-click segmentation has to be improved to reduce the duration of the analysis process until you can redo another overlapping ablation step especially for a large tumors.

Further clinical evaluation is needed to have long term results for complete ablation. This may be useful to evaluate the accuracy of the registration because of a correct safety margin and possible variations of a determined safety margin of 1 cm in case of lower image quality. The software assistant is helpful for planning, navigation and assessment of MR guided tumor ablation. Additional information about temperature, e.g. with temperature sensitive sequences during RFA could be integrated for the assessment. Furthermore, a simulation of ablation for each tumor entity as a pre-interventional planning process is a future step to improve the clinical safety and outcome of MR-guided RFA of large malignant liver tumors.

### CONCLUSION

Software-assisted MR-guided RFA of liver malignancies is feasible, safe and effective for larger malignant liver tumors.