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Quantitative volumetric assessment of percutaneous image-guided microwave ablations for colorectal liver metastases

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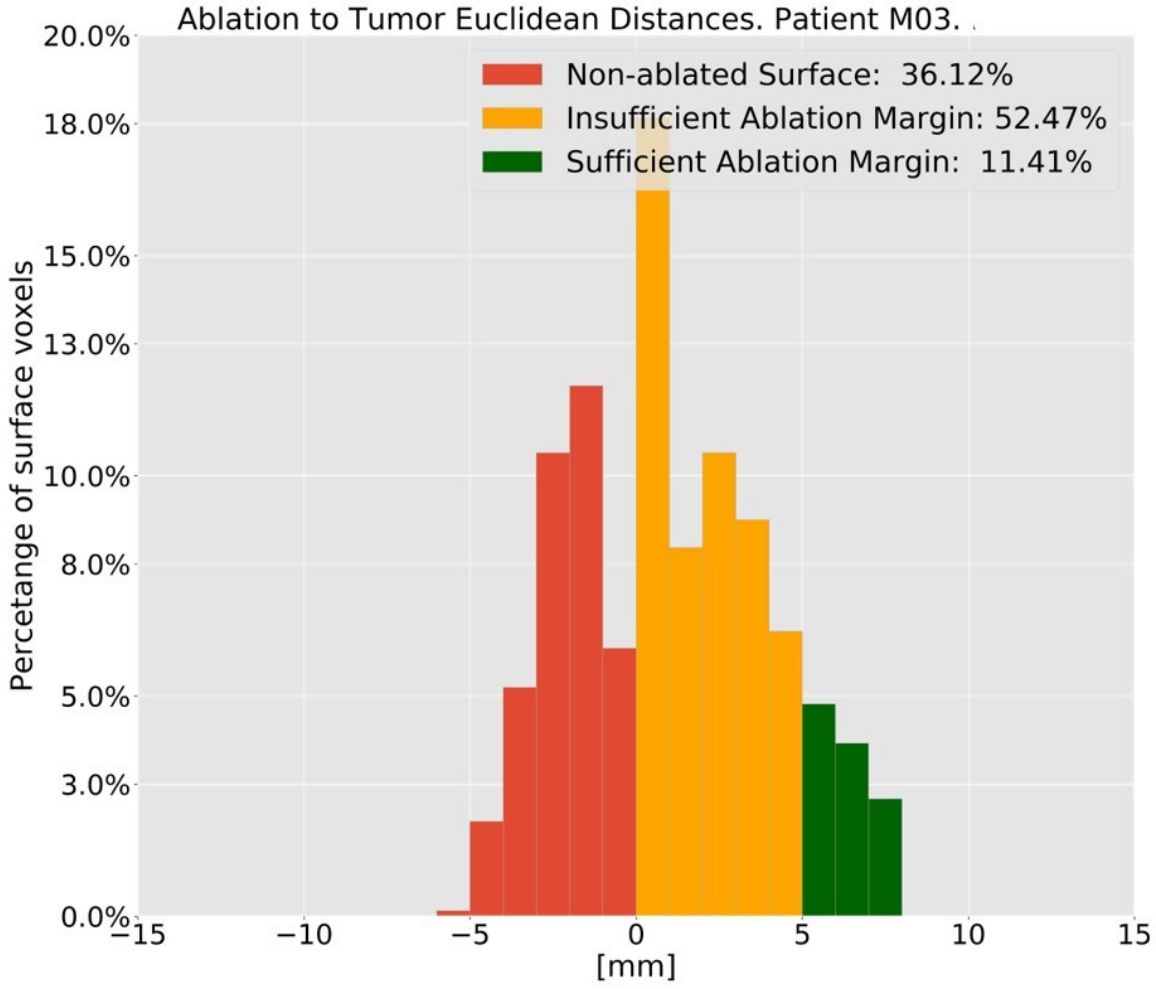
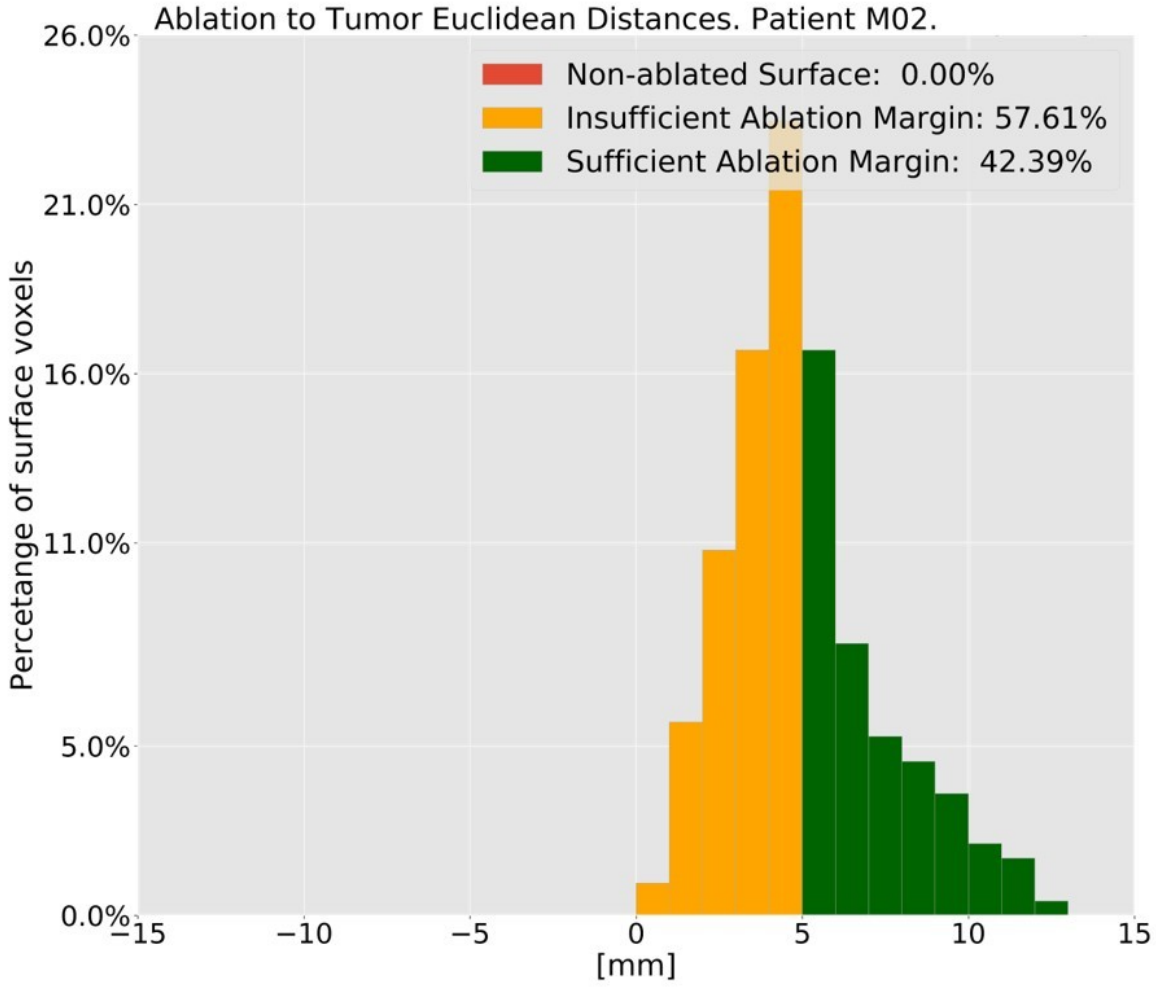
Introduction
Thermal ablations are becoming an increasingly common alternative treatment to surgery in patients with hepatic tumors. In image-guided percutaneous ablations of liver tumors, the technical post-interventional success of ablation treatment is defined by achieving complete tumor destruction and an ablation margin of at least 5 mm. In the current setting, the ablation-tumor coverage is visually evaluated by an interventional radiologist. To address this limitation, we have developed a set of quantitative methods for evaluating the volumetric coverage of ablations. In this work, we present the quantitative ablation evaluation method and preliminary results after applying it to a retrospective cohort of 100 patients that were treated with image-guided percutaneous ablations for colorectal liver metastases.

Methods
A customized software for semi-automatic segmentation of tumors and ablations has been developed and integrated into a navigation system for percutaneous ablations. From the resulting segmentations, the euclidean surface distances and volume coverages are computed and further employed as quantitative evaluation metrics. We are currently evaluating these metrics on the MAVERRIC cohort (clinicaltrials.gov: NCT02642185). The study included 100 patients with 1-5 tumors < 31 mm in diameter, treated with microwave ablation under CT-image guidance. In total, 173 tumors were treated.

Result
Out of 173 lesions, 65 lesions where excluded due to missing ablation validation scans, which is mainly due to the constraints in applicable contrast agent. We present here 2 examples from the analysis, consisting of insufficiently and sufficiently volumetric ablation coverage. The tumor with insufficient margin had a recurrence, whereas the tumor with sufficient margin had none at 6 months.



Histogram of the surface distances between the tumor and the ablation volume. Insufficiently ablated case.



Histograms of the surface distances between the tumor and the ablation volume. Sufficiently ablated case.

Discussion & Conclusion

This work proposes quantitative evaluation methods for measuring the coverage of liver metastases ablations. A more precise measurement of the ablation margins and volumes could be utilized to stratify patients with increased risk of local tumor recurrence.

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