

Feasibility of 3Tesla MR-guided biopsy of soft tissue tumors: site selection by the use of dynamic contrast enhanced (DCE) MR, diffusion weighted imaging (DWI), and multivoxel 1H-MR spectroscopy (1H-MRS)

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Target audience: Accurate diagnosis of soft tissue tumors requires an optimized biopsy technique for preoperative histology. The results of this study can be helpful for musculoskeletal and interventional radiologists.

Purpose: To optimize MR-guided biopsy of soft tissue tumors, by selecting the biopsy region using a dynamic contrast-enhanced sequence (DCE), diffusion-weighted imaging (DWI), and multi-voxel ¹H-MR spectroscopy (¹H-MRS).

Methods: Institutional Review Board approval and written, informed consent were obtained. In 52 patients with suspected soft tissue tumors, preoperative staging MR with subsequent guided core needle biopsy, using functional sequences, was prospectively performed at 3 Tesla. Final surgical histology was available in 49/52 patients (28m, 21f; mean age 54; range 19-90 years). In 46/49 patients, a DCE sequence (contrast agents: Gd-BOPTA and Gd-DOTA) was conducted over 3 min, with a temporal resolution of 7.3 sec during the first 72 sec. In 46/49 patients, DWI was applied using DWI-MSh FH (b-value: 0-800), and the apparent diffusion coefficient (ADC) was calculated. Multivoxel ¹H spectroscopy could be conducted in 33/49 patients with tumors of a sufficient size. Three to five biopsy samples were obtained with a 14G biopsy needle through a 13G coaxial needle. In patients where DWI and 1H spectroscopy were available, we assessed whether the most suspicious regions matched the DCE results.

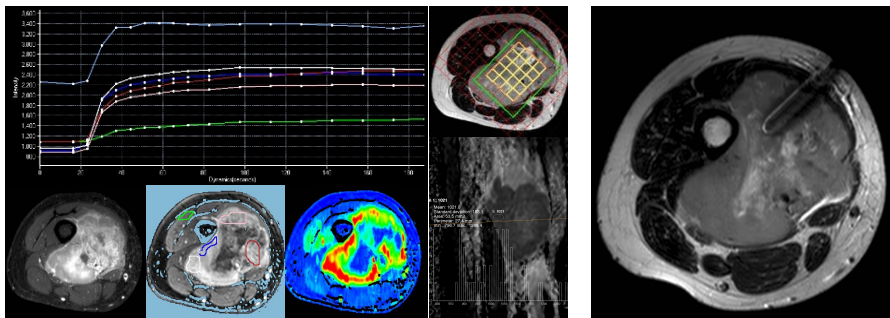


Figure 1 (left): MRI of G3 sarcoma, with dynamic contrast-enhancement curves (upper row) in the tumor, non-involved muscle (green), and artery (bright blue); axial static post-contrast T1w image; ROI placements on dynamic sequence; and color-coded wash-in (bottom row).

Placement of multivoxel spectroscopy, and sagittal diffusion-weighted sequence (middle column).

Figure 2 (right): T2w biopsy sequence, depicting the needle position.

Results: DCE was used for region-targeting in 40 cases with heterogeneous enhancement. In two cases, the site of the lowest ADC on DWI was chosen, and, in four cases, with homogeneous tumor enhancement on all sequences, the biopsy was taken from an arbitrary part of the tumor. In three small tumors, no region selection was necessary. Final histopathology of the surgical specimen revealed 27 malignant tumors of different grades, 14 benign entities, seven tumors of intermediate dignity, and one superinfected hematoma. Diagnostic yield was 97.8% (48/49). The accuracy in predicting the dignity in this preliminary study was 100% (48/48), the accuracy in providing a definitive tissue diagnosis was 89.3%, and the accuracy in predicting the grade of the tumor was 93.6%. The diffusion-weighted sequence was of limited value for the selection of the biopsy area. Spectroscopy was available in only 33 patients, and revealed a promising area match with DCE, but, due to technical restraints, cannot be recommended for biopsy-targeting in its present form.

Discussion: Image-guided biopsies of soft tissue tumors should aim to include the most malignant tumor area¹. This can be challenging in large and heterogeneous lesions, which may consist of different histologic grades. In our study, we introduced a DCE-targeted, MR-guided core biopsy technique for soft tissue tumors at 3 Tesla, which can be performed immediately after the mandatory preoperative staging MRI, and is targeted using a DCE staging sequence². In the few patients who could not receive contrast agent, DWI and spectroscopy were used. The diagnostic yield, and the accuracy of differentiating between benign, intermediate, and malignant tumors, are comparable to those published for open incisional biopsy, which is still considered to provide the highest diagnostic accuracy³.

Conclusion: Our preliminary study indicates that biopsy of soft tissue tumors can be performed accurately and safely with DCE-targeted MR-guidance at 3 Tesla, using a DCE staging sequence in a combined staging/biopsy MRI.

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