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MRI Scanning on Benign Soft Tissue Tumors Radiology

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Malignant soft tissue tumors account for about 1% of malignant tumors in adults; among children they make up about 15% of malignancies [1]. Overall, the ratio of benign to malignant tumors is given as 100:1. Nevertheless, in the case of a clinically identified new soft tissue tumor, further diagnosis and therapy should be based on a standardized procedure in order to take advantage of prompt initiation of therapy even with less common malignancies. MRI plays an outstanding role in diagnosis, since the large initially large number of differential diagnoses can be narrowed further due to specific differences in the signal behavior of the tumor in the various MR sequences. In many cases a definitive diagnosis is possible which can spare the patient an invasive investigation by biopsy or even surgery [2]. This review focuses on the image-based description of selected tumor entities and their systematic characterization.

Fibroblastic/myofibroblastic tumors Nodular fasciitis, proliferative fasciitis, proliferative myositis, and myositis ossificans are benign solid fibrous changes, all of which are classified as variants of nodular fasciitis, although myositis ossificans is no longer classified as a chondro-osseous lesion [3]. Myositis ossificans occurs more commonly in the large muscles of the lower extremity, and is more likely in young adults. Often no trauma can be found, contrary to the assumptions based on the patient's history. In the course of time, myositis ossificans presents differently in imaging depending on the stage of development. In the first few weeks, calcifications can rarely be distinguished in conventional X-ray or CT. Two to three months later cloudy-irregular densifications develop which progress from peripheral to a central compression in a so-called "zonal pattern" and finally can be delimited centrally as an osteoid matrix, as a peripheral rim of lamellar bone. The MRI image changes analogously to the described histological changes [4]. In their early stages, the lesions are blurred, isointense on the T1 W, and heterogeneously hyperintense on the T2 W with diffuse surrounding soft tissue edema. As the calcifications in the periphery increase over time, the signal reduction becomes increasingly apparent. Both the T1w and T2w images show "mature" myositis ossificans as a well-circumscribed soft tissue mass, centrally fat-isointense and with low signal intensity in the periphery without surrounding edema. If central signal levels are also low, fibrosis, mineralization or hemosiderin may be the cause [5]. Early forms of myositis ossificans can absorb contrast agent and be misinterpreted as malignant sarcoma. This early stage often presents problems for the histopathologist, especially if initially the clinical picture suggests a progressive tumor and the diagnosis must be made only using a small biopsy [6].

T1 hypointense or isointense: Since most soft tissue tumors are iso- or hypointense compared to muscle structures, accordingly the number of potential differential diagnoses is large, ranging from benign lesions such as a ganglion to malignant conditions such as fibrosarcoma. Therefore a definite characterization based on a low SI in T1w alone is therefore not possible [7]. The next step involves further clarification by means of T2-weighted sequences.

T1 high signal: In general, the signal intensity should be determined on a non-fat saturated MR image. This is because some masses are equipotential to the muscles in the fat-saturated sequence, but relatively high signal to the muscles in the fat-saturated T1w image [8]. The factors that cause the attenuation of the T1 signal are fat, methemoglobin, protein-rich water, and melanin. Therefore, the differential diagnosis may include fat masses, hemorrhagic masses with methemoglobin components, protein-rich fluids, and melanoma or metastases of melanoma. Frequency-selective fat saturation (chemically specific) is important here because reversal recovery fat suppression is non-specific and suppresses not only fat, but also other substances with short T1 times [9].

T2 Low Intensity: Masses that show low signal intensity compared to skeletal muscle in the T2 emphasis sequence may contain fibrosis, hemosiderin, and calcification. In the T2w image, air and certain foreign objects are low signal. A variety of benign and malignant lesions can present with fibrosis, including scar tissue, uterine fibroids, and some fibrosarcomas [10].

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