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# Diagnostic value of static MR imaging of soft tissue tumours including lesion size, borders and local extend

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*Introduction. The usefulness of MR imaging in the evaluation of the degree of soft tissue tumour malignancy is widely discussed. The aim of this study was to analyse the diagnostic value of MR imaging in the evaluation of local progression of soft tissue tumours and to analyse the usefulness of MR imaging in the differential diagnosis (malignant versus benign lesions).*
*Material and method. One hundred and ten patients with soft tissue tumours were examined by MR imaging (60 men and 50 women, aged 16 to 84 years). MR imaging was carried out with an Elscint 2T or 0.5T unit. Surface coils (passive) or circular polarized coils (active) depending on the location of the lesions were used with field vision from 20x24 cm or 40x40 cm, matrices 200x256, 256x256, or 22x315, layer thickness from 3 to 10mm, gap 20-30%. SE T1 sequences (TR = 500 – 800 ms, TE = 15 – 20 ms) and FSE T2 (TR = 2000 – 4500 ms, TE = 96 – 104 ms) were routinely used in at least two planes: transverse, frontal or sagittal, and SE T1 sequences were used after administration of gadolininum Gd-DTPA in 0.1m – 0.2 mmol/kg body weight doses. The tumour dimensions by MR image were compared with the results of histological examination of samples obtained during surgery (65 cases) – the statistical analysis was performed using Student's t-test, with statistically significant difference accepted at p = 0.05 or less. The borders of the lesions were assessed in the entire material and in the group of 65 patients treated surgically. The latter were compared with the results of histological examination after surgery, thus calculating MR sensitivity and specificity.*
*Conclusions. Static imaging is a valuable diagnostic method for preoperative assessment of the local progression of soft tissue tumours, however it is not suitable for differentiating malignant lesions from benign according to tumour size, borders and local extent.*

## Ocena wartości diagnostycznej statycznego badania MR guzów tkanek miękkich z uwzględnieniem: wielkości zmian, granic i rozległości miejscowej

*Wprowadzenie. Głównym zadaniem diagnostyki obrazowej w guzach tkanek miękkich jest dostarczenie informacji potrzebnych do oceny zaawansowania klinicznego. Drugim, ważnym zagadnieniem, szeroko dyskutowanym od końca lat osiemdziesiątych do dzisiaj, jest przydatność badania MR w ocenie stopnia złośliwości guza.*
*Cel pracy. Analiza wartości diagnostycznej badania MR w ocenie miejscowego zaawansowania guzów tkanek miękkich. Analiza przydatności badania MR w ocenie różnicowej guzów tkanek miękkich (zmiany łagodne lub złośliwe).*
*Materiał i metoda. Materiał stanowi 110 chorych z guzami tkanek miękkich, badanych metodą rezonansu magnetycznego, w tym 60 mężczyzn i 50 kobiet. Chorzy byli w wieku od 16 do 84 lat. U wszystkich pacjentów wykonano badanie metodą rezonansu magnetycznego, aparatem 2T lub 0.5T firmy Elscint. W zależności od lokalizacji zmian stosowano cewki powierzchniowe (bierne) lub polaryzowane kołowo (czynne), pola widzenia od 20x24 cm lub 40x40 cm do 44,0x35,0 cm, matryce: 200x256, 256x256 lub 252x315, grubość warstw od 3 do 10 mm, gap 20-30%. Rutynowo wykonywano sekwencje SE T1 (TR = 500-800 ms, TE = 15-20 ms) i FSE T2 (TR 2000-4500 ms, TE 96-104 ms),co najmniej w dwóch płaszczyznach: poprzecznej, czołowej lub/i strzałkowej; oraz sekwencje SE T1 po podaniu Gd-DTPA w dawce 0.1-0.2 mmol/kg cc.U wszystkich chorych oceniono cechy obrazu rezonansu magnetycznego.*
*W kolejnym etapie pracy dokonano oceny statystycznej (testem t Studenta) wymiarów guzów w badaniu MR, w porównaniu z danymi z badań histopatologicznych, wykonanych po operacji, w grupie 65 chorych. Za znamienną statystycznie różnicę przyjęto p mniejsze bądź równe 0,05. Granice zmian oceniono zarówno w całym materiale, jak i w grupie 69 chorych operowanych, w której porównano wyniki z badaniem histopatologicznym po operacji, obliczając czułość i specyficzność badania MR.*

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*Wnioski. 1) statyczne badanie MR jest wartościową metodą diagnostyczną w przedoperacyjnej ocenie zaawansowania miejscowego guzów tkanek miękkich; 2) w grupie guzów tkanek miękkich, w statycznym badaniu MR, nie jest możliwe różnicowanie zmian łagodnych i złośliwych na podstawie wymiarów, granic i rozległości miejscowej guza.*

**Key words:** static MR imaging, lesion size, local extend
**Słowa kluczowe:** statyczne badanie MR, wymiary zmian, rozległość miejscowa

## Introduction

The main task of imaging diagnosis in cases of soft tissue tumours is to provide data necessary for the evaluation of clinical progression.

Another important issue, widely discussed since the late 1980s, is the usefulness of MR imaging in the evaluation of the degree of tumour malignancy. Establishing characteristic parameters of sarcomas and non-malignant lesions in static MR examination is based on grading certain signs of soft tissue tumours according to their usefulness in differential diagnosis [1-10].

## Material and method

The material comprised 110 patients with soft tissue tumours subjected to magnetic resonance imaging (60 men; 50 women, age: 16-84 years).

In all cases of soft tissue tumours the diagnosis was based on biopsy and histological examination. In 69 patients surgical treatment was carried out. The remaining patients were treated conservatively.

In the entire material there were 79 cases of soft tissue sarcomas (malignant lesions): 49 primary tumours and 30 recurrences; and 31 non-malignant lesions (20 benign neoplasms and 11 non-neoplasmatic lesions).

The histological diagnoses (according to frequency) and the number of cases in the sarcoma group and the non-malignant group are presented in Table I and II.

Imaging was carried out using an Elscint 2T or 0.5T unit. Depending on the location of the lesions surface coils (passive) or circular polarized coils (active) were used. The field of view was from 20x24 cm or 40x40 cm to 44x35 cm, matrices were of 200x256, 256x256, 252x315 size, layer thickness was from 3 to 10 mm, gap 20-3%. Sequences SE T1 (TR = 500-800 ms, TE = 15--20 ms) and FSE T2 (TR 2000- 4504 ms, TE 96-104 ms) were routinely used in at least two planes: transverse, frontal and/or sagittal, and SE T1 sequences after Gd-DTPA administration in 0,1-0,2 mmol/kg body weight doses.

**Tab. I. Histological diagnosis of soft tissue sarcomas**

| Histological diagnosis | n |
|---|---|
| liposarcoma | 15 |
| sarcoma neurogenes | 13 |
| fibrohistiocytoma malignum | 12 |
| sarcoma synoviale | 11 |
| PNET | 5 |
| leiomyosarcoma | 5 |
| haemangiopericitoma | 4 |
| sarcoma epithelioides | 3 |
| rhabdomyosarcoma | 3 |
| fibrosarcoma | 2 |
| sarcoma Ewing | 2 |
| sarcoma fusocellulare | 2 |
| chondrosarcoma mesenchymale | 2 |
| total | 79 |

**Tab. II. Histological diagnosis of non-malignant lesions**

| Histological diagnosis | n |
|---|---|
| haemangioma | 5 |
| lipoma | 5 |
| fibromatosis agressiva | 5 |
| schwannoma benignum | 3 |
| neurofibroma | 3 |
| granulomata resorbtiva | 3 |
| ganglioneuroma | 2 |
| fibroma | 1 |
| synovitis villonodularis | 1 |
| myositis ossificans | 1 |
| haematoma | 1 |
| lymphangiomatosis | 1 |
| total | 31 |

In all patients the features of MR image listed in Table III were assessed.

In the final stage of the study I compared the tumour dimensions as stated in MR images and compared them with the data obtained from histological examinations performed after surgery (i.e. 65 cases). Statistical analysis was carried out by Student's t test. P value 0.05 or less was considered statistically significant.

In 2 cases multiple nodes were present, in 4 cases the tumour was removed only partially. These cases have been excluded from statistical analysis.

The lesion borders were evaluated in the entire material and in the group of 69 surgically treated patients, in the case of which the results were compared with histological findings, thus calculating MR imaging sensitivity and specificity.

## Results

### Tumour dimensions

All 110 patients were divided into three groups according to tumour size: up to 3 cm (14 tumours), 3-6 cm 18 tumours), over 6 cm (78 tumours). More detailed data incl. a division into soft tissue sarcomas and malignant tumours are presented in Table IV.

**Tab. III. MR image features in examination protocols**

| Tumour features in MR image | Detailed parameters |
|---|---|
| greatest tumour dimension | up to 3 cm<br>3 – 6 cm<br>over 6 cm |
| local extend | intracompartment<br>extracompartment |
| lesion borders | clear – cut<br>partly blurred<br>blurred |

In both groups of lesions (sarcomas and non-malignant tumours) in about 70% of cases the dimensions of the soft tissue tumours exceeded 6 cm. Similarly, in both groups the tumours ranging from 3 to 6 cm accounted for about 16% of cases. In the sarcoma group lesions not exceeding 3 cm were approx. 5% less frequent than in the non-malignant lesion groups.

In the comparative statistical analysis of the results of MR imaging and histological findings the mean dimension of the tumours was 103.7+/-69.97 – in MR imaging and 103.4/-62.92 – in histological examinations, p=0.98.

These results point to significant uniformity of MR and histological examinations in the assessment of tumour size.

### Local extent

In the entiree group of 110 patients extracompartmental lesions were found in 66 cases and intracompartmental lesions in 44 cases. Among extracompartmental tumours in 52 out of 79 cases (65.8%) soft tissue sarcomas were diagnosed, and in 14 out of 31 cases (45.2%) the diagnosis was: non-malignant tumours.

### Lesion borders

In the group of 79 sarcoma cases clear – cut borders were seen in 35 cases (44.3%), blurred borders in 32 (40.5%), partly blurred in 12 (15.2%) cases.

In the group of 31 non-malignant lesions clear-cut borders were seen in 17 (54,8%), blurred in 6 (19.4%), partly blurred in 8 (25.8%) cases.

The results of the assessment of tumour borders in soft tissues in 69 surgically treated cases are presented in Table V.

The sensitivity of MR imaging in the assessment of tumour borders was: 85.3% in the group with clear-cut borders, 77.8% in the group with partly blurred borders and 100% in the group with blurred borders. The specificity of MR imaging in the assessment of clear-cut borders was 82.3%, in partly blurred 88.1% and in completely blurred borders 82%.

## Discussion

After a comparative analysis of the results of imaging and histological examination it was found that MR was useful and reliable in the assessment of tumour size. In the available literature no analogous comparison of these methods was found as concerning tumour size assessment.

Several of authors have analysed tumour size in the context of differential diagnosis of benign versus malignant lesions, with varied results. One group of authors [2, 3, 11, 12] regarded tumour size as a good differentiating factor. In a group of sarcomas Berquist [2] found that 87% lesions were exceeding 5 cm, but the size of 50% of benign lesions also exceeded 5 cm. This is insufficient to state that tumour size is of any differential diagnostic value. A more convincing observation was stressed by Berquist [2] as well as by Tung [12] i.e. that in the group of lesions smaller than 3 cm, the probability of benign lesions is 88%. In Tung's material the sensitivity and specificity of tumour malignancy assessment for lesions exceeding 5 cm were respectively 74% and 59%.

Another group of authors failed to confirm the usefulness of tumour size assessment for differential diagnosis [1, 13].

In the present material I also failed to find significant differences in the size of non-malignant lesions and sarcomas.

Another parameter studied was the local extend of tumours.

In the present study extracompartment location of the tumours was found in 66% of sarcomas and 45% of non-malignant lesions. De Schepper [3] noted similar proportions in his material of 164 patients (69 sarcomas and 95 benign lesions) with extracompartment location in

**Tab. IV. Dimensions of soft tissue tumours in the group of 110 patients**

| | Lesion dimensions | | |
|---|---|---|---|
| | up to 3 cm<br>n / % | 3–6 cm<br>n / % | over 6 cm<br>n / % |
| soft tissue sarcomas | 9 / 11.4 | 13 / 16.5 | 57 / 72.2 |
| non-malignant tumours | 5 / 16.1 | 5 / 16.1 | 21 / 67.8 |

**Tab. V. The group of 69 surgical patients – assessment of tumours borders by MR images, compared with histological examination after the operation**

| | | Lesion borders | | |
|---|---|---|---|---|
| | | clear – cut | partly blurred | Blurred |
| MR+HP examinations (agreement of results) | n | 29 | 21 | 8 |
| histological examination (result disagreeing with MR) | n | 5 | 6 | 0 |

75% of sarcoma cases and 62% of benign lesions. This parameter cannot be regarded as useful in the differential diagnosis of soft tissue lesions.

In the light of the analysis of the sensitivity and specificity of MR imaging for the assessment of tumour borders the method was found to be useful for the detection of evident tumour infiltrations of surrounding tissues. Small areas of tumour invasion (partly blurred borders) could remain unrecognized in static imaging. The absence of high sensitivity and specificity of MR imaging in the analysis of clear-cut and partly blurred borders is probably caused by the presence of perilesional oedema which was usually difficult to differentiate against partly blurred borders. No such comparisons have been found in available literature.

On the other hand, many authors have studied the problem of borders as a parameter for differentiation between benign and malignant lesions [1-3, 8-13, 15].

The results varied, often being divergent, and, except for Berquist [2], they failed to confirm the usefulness of the image of borders as a differentiating sign. In the material of Berquist, however, 44% of benign and 15% of malignant tumours had smooth borders, 18% of benign and 85% of malignant tumours had blurred borders, and 40% of benign tumours had partly blurred borders. In my opinion these results confirm the prognostic value of border image in differential diagnosis.

In the present material, similarly as in materials reported by other authors quoted above [1, 3, 5, 8-11, 13, 14], the usefulness of tumour borders for differential diagnosis has not been confirmed.

## Conclusions

1. Static MR imaging is a valuable diagnostic method of pre-operative assessment of local progression of soft tissue tumours.
2. Static MR imaging is not suitable for differentiating between benign and malignant lesions on the basis of tumour dimensions and their local extent.

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