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# IMPROVEMENT OF MRI DIAGNOSTICS IN HOFF'S DISEASE

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**Actuality.** Diagnosis of changes in the volume and structure of Goff's fat body is important due to the relationship of its pathology with pain in the anterior knee joint.

The purpose of the study is to improve the diagnosis of Hoff's disease based on a detailed study of the clinical anatomy of the infrapatellar fat body and generalization of the magnetic resonance picture in normal and pathological conditions.

**Material and methods.** Protocols of 80 magnetic resonance studies of knee joints with anterior knee pain syndrome were retrospectively selected without a clearly defined traumatic history and positive clinical tests indicating damage to intra- and periarticular elements with revealed structural changes in the fat body. The control group consisted of 25 studies of symptomatic knee joints. In all cases, the pathology was confirmed and corrected during therapeutic and diagnostic arthroscopy.

**Results.** The magnetic resonance picture of the normal structure of the infrapatellar fat body was determined, as well as pathological changes in the form of a rupture, local edema, diffuse edema, synovial proliferation and fibrosis. Depending on the localization and type of changes, 4 pathological syndromes were identified: "classic" Hoff's disease - 48 (60%) cases, infrapatellar fold syndrome - 10 (12.5%) cases, infrapatellar fold tear syndrome - 5 (6.25%) cases and impingement syndrome of the upper lateral adipose tissue - 17 (21.25%) cases. Conclusion. To identify pathology, careful synchronization of clinical and morphological changes is necessary. Accurate differentiation of syndromes is achieved by knowing the detailed anatomical and magnetic resonance features of the fat body in normal and pathological conditions, which allows diagnosing the cause of the development of pain in the anterior sections of the knee joint, establishing the correct diagnosis and choosing the optimal treatment tactics.

**Keywords:** Hoff's disease, impingement syndrome, infrapatellar fold, infrapatellar fat body, magnetic resonance imaging.

**Introduction**

Goff's fat body is an intracapsular extra-synovial structure that increases the area of the synovial surface and affects the distribution of intra-articular fluid. It is limited on all sides: in front - by its own ligament of the patella, upwards and anteriorly - by the lower surface of the patella, upwards and backwards - by the cartilage of the femoral block, posteriorly - by the anterior cruciate ligament and synovial membrane, downwards - by the tibia and anterior horns of the menisci, resting on the deep infrapatellar bag. In structure, Goff's body is similar to subcutaneous fat, since in addition to fat cells it contains a framework of fibrous cords, but with organized large thickenings called mucosal ligaments that form the infrapatellar fold. The dorsal part of the fiber in the transverse plane crosses a thin fibrous tourniquet - the anterior intermeniscal ligament, which connects the anterior horns of both menisci. The blood supply of the fat pad is diffuse, represented by an anastomotic network, which is formed from vertically oriented vessels arising from the upper and lower popliteal arteries, connected by smaller horizontal branches. There is a rich innervation of the structure by branches of the femoral, common peroneal and saphenous nerves, so any pathological changes in the fat body can be a source of pain in the anterior part of the knee joint. The fat body tends to change its configuration during movements in the knee joint, thereby providing mechanical cushioning and facilitating the distribution of synovial fluid. Diagnosis of changes in the volume and structure of adipose tissue is important due to the relationship of its pathology with pain in the anterior part of the knee joint, as well as a possible relationship with the early formation of osteoarthritis. There are various mechanisms of damage to the Hoff fat body, for example, as a result of an acute injury of the knee joint in combination with a rupture of the anterior cruciate ligament or the extensor ligamentous tendon apparatus. Chronic tissue damage is also possible with the formation of impingement syndrome, which is most often associated with a violation of the geometry of the patellofemoral joint. The most common in the literature is Hoff's disease, described by a. Hoffa in 1904, which occurs as a result of acute injury or chronic microtrauma of the fat pad and is accompanied by hemorrhage and aseptic inflammation with possible repetitive sprains or deformities. Adipose tissue is hypertrophied and infringed in the tibiofemoral joint, which leads to further inflammation, deposition of fibrin, hemosiderin, penetration of macrophages into the tissue and degeneration. lipocytes. In the

chronic phase, a fibroblastic reaction of cells occurs with the formation of fibrosis, which in rare cases can transform into areas of fibrous cartilage and calcification. However, three more pathological conditions of the fat body can be distinguished, having a similar etiology, regular pathogenesis, and similar morphological changes. These include infrapatellar fold syndrome, infrapatellar fold avulsion syndrome, and upper lateral fat impingement syndrome.

The purpose of the study is to improve the diagnosis of Hoff's disease based on a detailed study of the clinical anatomy of the infrapatellar fat body and generalization of the magnetic resonance picture in normal and pathological conditions.

**Material and methods**

For the period from December 2016 to March 2019, protocols of 80 magnetic resonance (MR) examinations of the knee joints (42 right, 38 left) of 43 men and 37 women aged 12 to 57 years were retrospectively selected from the database of the diagnostic center with anterior knee pain syndrome without a clearly defined traumatic history and positive clinical tests indicating damage to intra- and periarticular elements, with revealed structural changes in the Hoff fat body. In all cases, in the period from 10 to 94 days, the pathology was confirmed and corrected by therapeutic and diagnostic arthroscopy due to the weak effect of conservative treatment or its absence. It should be noted that the study did not include a large group of patients with identified changes during MRI due to the achievement of a positive effect from conservative tactics and, accordingly, not requiring surgical correction. The control group consisted of 24 studies of asymptomatic knee joints in patients aged 12 to 32 years. The studies were carried out on a GE SIGNA EXPLORER MR tomograph with a magnetic field induction of 1.5 T using a quadrature knee coil GE, Model HD Knee according to the standard method using T1, T2 and PD weightings in three projections, using a fat suppression algorithm with a slice thickness of 4 mm or without it.

Statistical analysis Microsoft office excel 2013 was used to create an archival database and pivot tables. Visualization of the material was carried out using various types of charts and tables. Statistical analysis was carried out using the Statistica 10 software package. Qualitative features are presented as absolute value and relative frequency (%). Differences between the study groups were considered statistically significant if the level reached was $p<0.05$.

**Results**

Normal MR-picture, determined in patients of the control group. Goff's body fiber normally had clear even contours, was presented as a whole body without signs of deformation and compressing effects on the surrounding anatomical elements, without wedging of the upper and dorsal contours into the cavity of the patellofemoral and tibio -femoral fissures, respectively, with a possible visualization of vertical and horizontal thin synovial fissures (supra- and infra-hoffatic torsion, respectively), extending deep into the fiber by no more than a third. The above criteria of the norm were correlated with the data of previous studies a. ozkur et al. and M. Vahlensieck et al. Only the vertical fissure was determined in 9 (38%) cases, only the horizontal fissure - in 5 cases (21%), both fissures were determined in 2 (8%) cases, in 8 (33%) cases the fissure was not visualized. An important aspect of diagnosing the state of the fat body was the assessment of its structure, as well as the MR signal, which was normally homogeneous and corresponded to adipose tissue (hyperintense in T1- and T2-weighted images, hypointense during the fat suppression algorithm). The cellular framework consisted of thin longitudinally oriented linear sections of a low MR signal on all impulse sequences located in the horizontal plane, folded radially in the dorsal region with the formation of an infrapatellar fold. The MR anatomy of the latter varied in thickness (from 1 to 2.3 mm), in structure (from closely packed microstructures of a low MR signal to a dense longitudinally oriented thickened cord), and also in the place of attachment. In the region of the ventral third of the intercondylar notch of the femur - 15 (63%) cases, in the region of the middle third of the intercondylar notch of the femur - intimately to the anterior cruciate ligament - 5 (21%) cases, to the lower edge of the anterior cruciate ligament - 3 (12%) cases , to the root of the anterior horn of the lateral meniscus - 1 (4%) case). Also, in the sagittal plane in the dorsal region, a focal inclusion of a low MR signal with a thickness of 0.5 to 3 mm was determined, corresponding to the transverse section of the anterior intermeniscal ligament. MR picture of Hoff's disease According to MRI, the structural changes of the "classic" Hoff's disease could be differentiated as rupture, local edema, diffuse edema, synovial proliferation and fibrosis in a total of 49 (57%) patients (Fig. 1). The gap was defined as a linear zone of high signal intensity on fat-suppressed proton-weighted or T2-weighted images that did not correspond to the position or configuration of physiological clefts. Edema was differentiated as an increase in signal intensity in adipose tissue on fat-suppressed proton-weighted or T2-weighted images. Synovial

proliferation was defined as a rupture of adipose tissue extending to its own synovial surface with the formation of a node or widespread thickening of the synovial surface. Intrastructural fibrosis was considered as an area of reduced MR signal intensity that did not correspond to the normal physiological framework (anterior intermeniscal ligament, mucosal ligaments, infrapatellar fold). Three more pathological conditions (infrapatellar fold syndrome, infrapatellar fold avulsion syndrome, impingement syndrome of the upper lateral adipose tissue) were distinguished separately depending on the localization and morphology of the changes. Infrapatellar fold syndrome, which is difficult to distinguish by clinical and visual criteria from the "classic" Hoff's disease, was detected in 11 (13%) cases (Fig. 2).

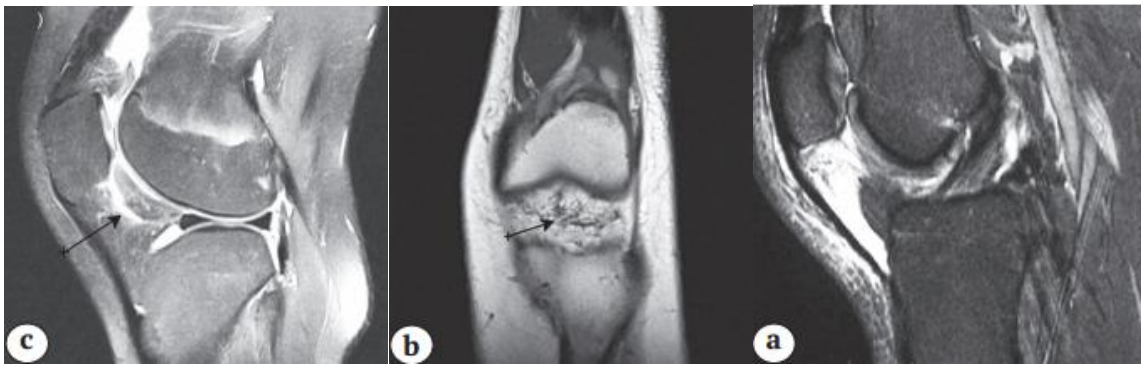


Fig. 1. MRI picture in Hoff's disease:

(a) T2-weighted MR image with fat suppression in the sagittal plane; significant diffuse edema of fatty tissue is determined; b — T1-weighted image in the coronal plane after 6 months, the formation of chaotically located areas of fibrosis (indicated by an arrow); c — proton-weighted image with fat suppression in the sagittal plane after 6 months, the formation of pathological synovial proliferation in the central regions (indicated by an arrow)

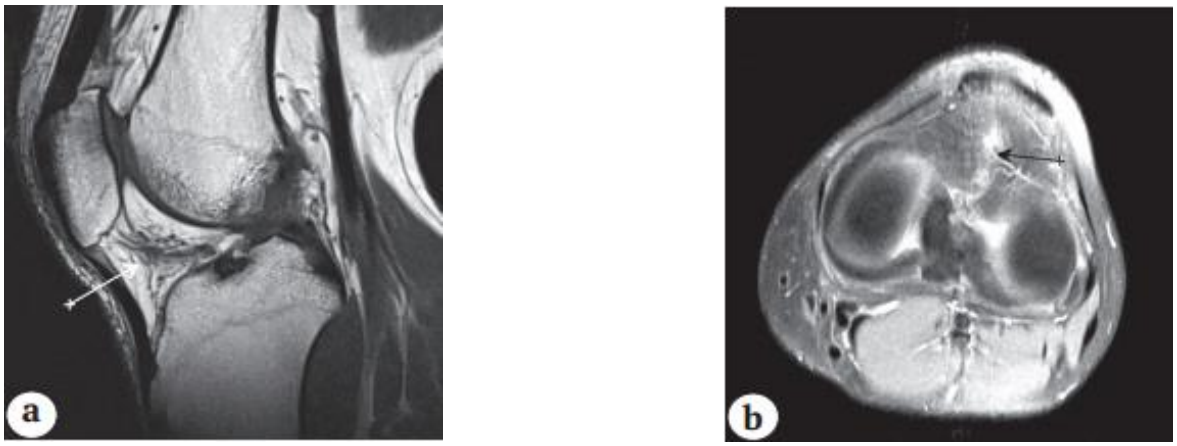


Fig. 2. MRI picture in infrapatellar fold syndrome:

a — T1-weighted image in the sagittal plane; gross cicatricial changes oriented along the mucosal ligaments and infrapatellar folds (indicated by an arrow); b – fat-suppressed proton-weighted image in the axial plane; cicatricial changes oriented along the mucosal ligaments and infrapatellar folds (indicated by an arrow)

But, according to MRI data, regular structural changes in the fiber were mainly localized in the area of passage of the mucosal ligaments and the infrapatellar fold and were parallel dense bands of fibrosis from front to back from the intercondylar notch to the lower edge of the patella, which was accompanied by an increase in volume, deformation and infringement of the fiber between the articular surfaces. . The syndrome of rupture of the infrapatellar fold, as a rule, is formed due to the detachment of the fibrous skeleton from the place of attachment to the intercondylar notch of the thigh, as a result of which instability and impingement of the fat body are formed. on tomograms in the sagittal plane, such a pathological condition was determined in 6 (7%) cases in the form of a lack of visualization of the attachment of the infrapatellar fold, retraction of the dorsal fat contour, and filling of the defect with intraarticular effusion (Fig. 3). Impingement syndrome of the upper lateral adipose tissue is quite common. Typical prerequisites for the formation of pathology are congenital anomalies of the structure, such as high standing of the patella, hypoplasia of the femoral block, weakness of the lateral ligamentous apparatus, increased lateralization of the tibial tuberosity, hypertrophy of the upper lateral adipose tissue, which is consistent with the data of literary sources. In our study, it differentiated in 20 (23%) cases, although it had a more blurred clinical and MR picture compared to the subtypes described above.

According to MRI data, regular structural changes in the cellular tissue were located in the area of the upper lateral region between the lateral facet of the patella and the lateral surface of the femoral block (Fig. 4).

Fig. 3. MRI picture with rupture of the infrapatellar fold, T2-weighted image in the sagittal plane; a complete defect of the fold is determined in the area of attachment to the intercondylar notch, diffuse cicatricial changes in the fat body

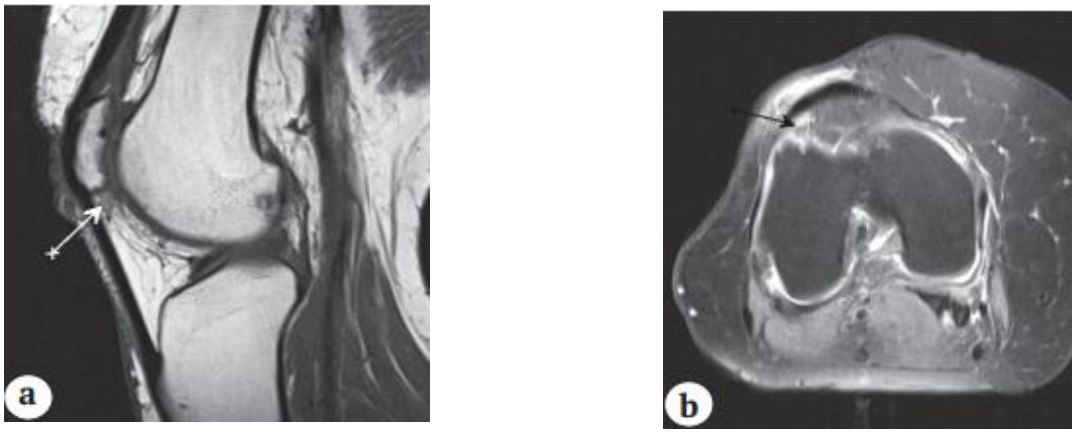


Fig. 4. MRI picture in impingement syndrome of the upper lateral adipose tissue: a — T1-weighted image in the sagittal plane; local fibrotic changes against the background of hypertrophy (indicated by an arrow); b, fat-suppressed proton-weighted image in the axial plane; local fibrous changes (indicated by an arrow)

**Discussion**

The clinical anatomy of the Hoff fat body and its relationship with the surrounding bone and soft tissue structures in normal conditions, with indication of the boundaries and signal MR characteristics, is described in most detail in the works of D. Saddik et al. and M.R. abreu et al.

Rupture, local edema, diffuse edema, synovial proliferation, and fibrosis are pathological changes in the fatty tissue of the knee joint, which were also studied in the M.R. Abreu et al. In the works of R. campagna et al. and Z. jibri et al., pathological changes in the form of local edema and fibrosis of adipose tissue are described. T.K. Subhawong et al., as well as a number of other authors, identified the impingement syndrome of the upper lateral adipose tissue as an independent pathology of the Goff fat body, linking it with changes in the patellofemoral joint. However, in our study, taking into account similar pathogenetic aspects, clinical picture and visual MRI with arthroscopic confirmation, it was decided to consider this type of pathology in combination with the others. Thus, due to the similarity of their pathogenesis, we propose to consider the above pathological changes as varieties of Hoff's disease, highlighting four morphological syndromes depending on localization. So, according to the results of this study, the most common pathology of adipose tissue was determined to be the "classic" Hoff's disease (57%), however, the impingement syndrome of the upper lateral adipose tissue, the syndrome of the infrapatellar fold, and the syndrome of detachment of the infrapatellar fold have an equally significant role in the development of pain. knee joint syndrome. As stated earlier, all MRI studies of the knee joints with pathological changes were retrospectively compared with the data of diagnostic and treatment arthroscopy. There were no discrepancies in diagnoses, since in all these cases the radiological signs of pathology were topically verified by us and correctly interpreted by the surgeon. Careful synchronization of clinical and morphological changes is necessary to identify the pathology of the Goff fat body. Accurate differentiation of syndromes is achieved by knowing the detailed anatomical and magnetic resonance features of the fat body in normal and pathological conditions, which allows diagnosing the cause of the development of pain in the anterior sections of the knee joint, establishing the correct diagnosis and choosing the optimal treatment tactics.

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