



Tumors and tumor-like lesions of infrapatellar fat pad and surrounding tissues: A review of the literature

İnfrapatellar yağ yastıkçığı ve çevreleyen dokuların tümörleri ve tümör benzeri lezyonları:
Bir literatür gözden geçirmesi

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ABSTRACT

The infrapatellar fat pad (IFP) is an intracapsular structure with critical importance both mechanically and endocrinologically. Its dysfunction must be considered while clinically investigating the symptoms arising from the knee joint. Infrapatellar fat pad may be subject to trauma, impingement, inflammation or tumoral formations. Although tumors arising within or adjacent to IFP are not extremely rare, the literature can only provide limited information about them. This article aims to briefly review the current literature on tumors and tumor-like lesions of the IFP and surrounding tissues; focusing on diagnosis and treatment management.

Keywords: Fat pad; Hoffa; infrapatellar; knee joint; tumor.

ÖZ

İnfrapatellar yağ yastıkçığı (İYY) hem mekanik hem de endokrinolojik olarak büyük önem taşıyan intrakapsüler bir yapıdır. Onun fonksiyon bozuklukları, diz eklemi kaynaklı semptomlar klinik olarak araştırılırken mutlaka değerlendirilmelidir. İnfrapatellar yağ yastıkçığında travma, sıkışma, enflamasyon veya tümöral oluşumlar görülebilir. İnfrapatellar yağ yastıkçığının içinden veya bitişiğinden kaynaklanan tümörler çok nadir değilse de, literatür bunlar hakkında sınırlı bilgi sunabilmektedir. Bu yazıda İYY ve çevreleyen dokuların tümörleri ve tümör benzeri lezyonları güncel literatürde tanı ve tedavi yönetimine odaklanılarak kısaca gözden geçirildi.

Anahtar sözcükler: Yağ yastıkçığı; Hoffa; infrapatellar; diz eklemi; tümör.

The infrapatellar (Hoffa's) fat pad (IFP) is not only a mechanical support found in the anterior compartment of the knee that absorbs shock. It also has a nociceptive function, holds progenitor cells, and is a potential target in osteoarthritis with its endocrine functions; although the precise function is still unknown. Correspondingly, clinical manifestations of its dysfunction are often misdiagnosed. Given its unique anatomy and location within the knee joint; which is intracapsular and extrasynovial, the IFP may be subject to trauma, degeneration, inflammation and neoplasms. Disorders may be detected incidentally by magnetic resonance imaging (MRI) in some cases. It may also present with significant, but non-specific symptoms of anterior knee pain due to abundant innervation of the IFP.

Tumors and tumor-like conditions inside the knee joint, especially those that are in the IFP are rare and difficult to detect by conventional methods. Magnetic resonance imaging is a necessity for diagnosis in most of the cases. These lesions may arise primarily within the fat pad from fat lobules and fibrous cords; or result from secondary involvement of the surrounding tissues such as synovium, nervous and vascular tissues, menisci or ligaments. These two conditions have been classified by Jacobson et al.^[1] as intrinsic lesions and extrinsic involvement of the IFP, respectively.

In this article, we aimed to briefly review the current literature on tumors and tumor-like lesions of the IFP and surrounding tissues; focusing on diagnosis and treatment management.

INTRINSIC LESIONS OF THE INFRAPATELLAR FAT PAD

Intracapsular Osteochondroma

Despite the obscure etiology and inconsistent nomenclature in the English literature, intracapsular osteochondroma is commonly considered to be the end stage of Hoffa's disease, which is the transformation of fat pad to fibrocartilaginous tissue due to hemorrhage, inflammation, and fibrosis caused by acute or repetitive trauma, or a primary cartilaginous metaplasia without any history of trauma. In contrast with traditional, skeletal osteochondromas, intracapsular osteochondromas are very rare, affect older population, arise from soft tissue, and have no attachment to the bone. Extraskeletal osteochondromas include intracapsular osteochondromas, soft tissue chondromas, and synovial chondromatosis. Histologically, these tumors consist of well differentiated trabecular bone tissue with local hemosiderin pigmentations surrounded by hyaline cartilage and enchondral bone formation at the interface.^[2] Intracapsular osteochondromas usually develop slowly over many years.

Although clinical findings might consist of only anterior knee pain, in some patients, there is a palpable hard mass around the patellar tendon which restricts the range of motion. Radiography is valuable because intracapsular osteochondromas are relatively easy to be observed as well-delineated calcified masses in the infrapatellar area. Magnetic resonance imaging is useful for detecting Hoffa's disease before osteochondral metaplasia occurs.^[3] Mineralizing soft tissue sarcomas, such as synovial sarcomas, must be considered during differential diagnosis. Total resection of the mass is curative, with no recurrence reported in the longest follow-up study, which spanned 10 years.^[4]

Localized Tenosynovial Giant Cell Tumor (TSGCT)

Originally described as "pigmented villonodular synovitis" by Jaffe et al.^[5] in 1941, controversies in histological description and classification of TSGCTs still remain. It is a benign proliferative disorder of the synovium and tendon sheath, characterized with hemosiderin granules in multi-nucleated giant cells. Diffuse forms of TSGCT, also known as pigmented villonodular synovitis (PVS), typically present intraarticularly and are more aggressive; but localized forms, also known as localized PVS (LPVS), usually have a benign character and most commonly arise from synovium of digits.^[6] However, extrasynovial soft tissue forms of localized TSGCT are very rare

and mainly concern the knee joint. Half of the patients with localized TSGCT arising primarily within the IFP have a history of trauma but the exact etiology is still unknown.^[6] Patients usually present with a slowly progressing painless mass or pain that mimics patellar tendinopathy with restricted range of motion in the knee joint (Figure 1). Magnetic resonance imaging should always be performed, especially with gadolinium chelate enhancement if available, to assess diagnosis and surgical planning of these tumors. Magnetic resonance imaging shows a well-circumscribed soft tissue lesion with weak to intermediate variable signal intensity on T₁ and T₂-weighted sequences, due to hemosiderin deposition (Figure 2). Synovial sarcoma must be considered in differential diagnosis as it might be seen in the same region or might arise exceptionally with malignant progression of the primary tumor.^[7] In case of clinical doubt, biopsy must be performed (Figure 3a, b). Total excision with arthroscopic techniques or open surgery is recommended to be performed as early as possible to avoid secondary degenerative lesions.^[8] Total excision is usually curative with only 10% of recurrence reported in five years of follow-up with excellent functional results.^[9,10]

Synovial Lipoma

Synovial or intraarticular lipomas are solitary lesions that show slow progression, contain only fat tissue, and are exceedingly rare. These round, mobile yellow masses with well-defined borders and a surrounding fibrous capsule are typically located within the IFP. Patients present with non-specific anterior knee pain, and sometimes a visible mass that can erase the parapatellar sulci. Also, the tumor might become strangulated and cause severe pain. There are no findings on conventional radiography. Magnetic resonance imaging must be performed for diagnosis and surgical planning. On MRI, these

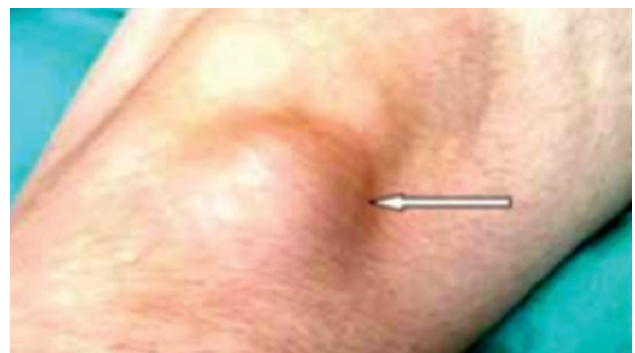


Figure 1. Localized tenosynovial giant cell tumor presenting as a painless mass is shown, lateral to patellar tendon (arrow).

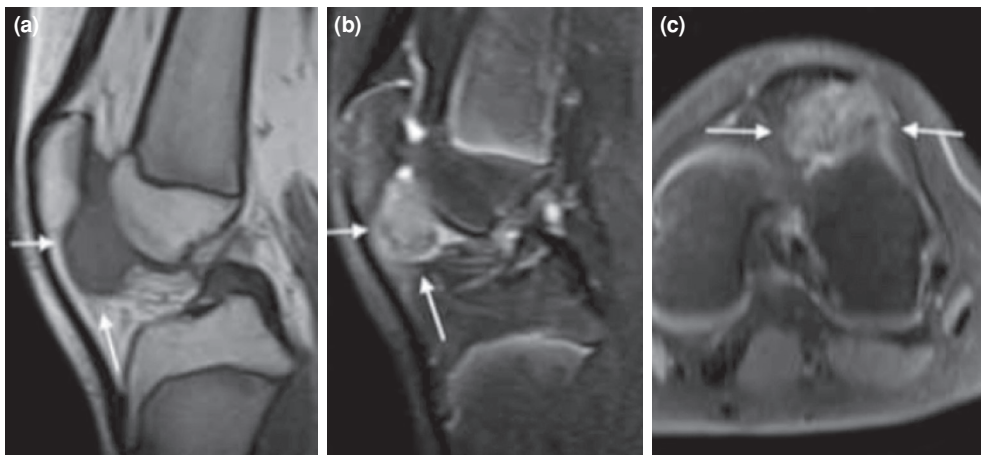


Figure 2. (a) T₁ weighted, (b) T₂ weighted with fat saturated sagittal plane, and (c) proton density with fat saturated axial plane images demonstrate soft tissue mass (arrows) in superolateral part of Hoffa's fat pad. Variable signal intensity due to hemosiderin deposition is shown within the well-defined lesion.

tumors show typical features of lipomatous masses with hyperintensity on T₁ and T₂-weighted images, and low signal intensity on fat-suppressed sequences. Hypointensity on T₁-weighted images does not rule out lipoma as it can mean there is a myxoid degeneration within the tumor.^[11] Although arthroscopic techniques are helpful for both diagnosis and excision; in most cases, the tumor is too large for arthroscopic en bloc resection, so arthrotomy might be indicated. Recurrence is unexpected, as in other lipomas.

Traumatic and Postoperative Lesions

Fat pad scars due to acute or chronic trauma and earlier operation may cause signal changes on MRI. These lesions are seen on MRI as hypointense masses in the fat pad with confluent margins.

Post-arthroscopic fibrosis appears as edematous and hypervascularized bands within the fat pad on MRI. History of acute trauma and operation may mistakenly lead to consider these changes as tumors. Chronic traumatic changes on the other hand; are part of an inflammatory process that may advance to intracapsular osteochondroma, which is a primary lesion inside the fat pad.^[12]

Following anterior cruciate ligament reconstruction, a nodular soft tissue mass just anterior to the graft may manifest as a complication that causes local pain and impingement. This mass is called a cyclops lesion and seen on MRI as a hypointense mass in the fat pad, reflecting its fibrous component, at the level of the graft.

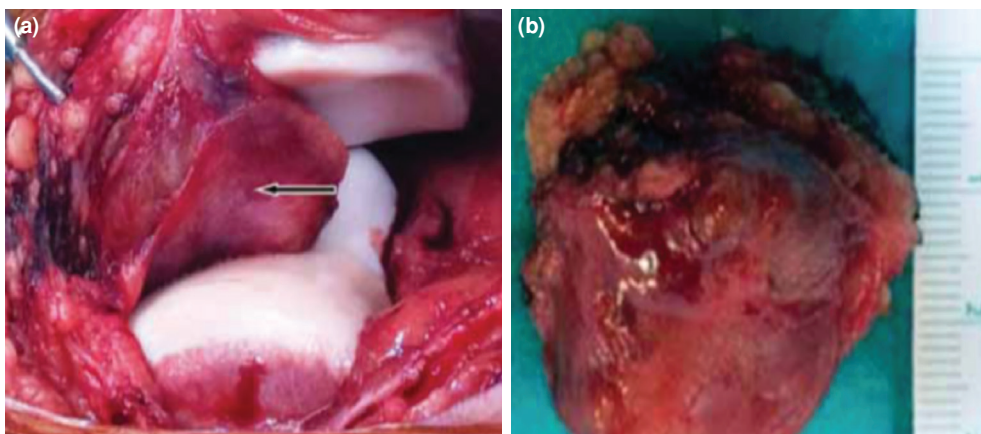


Figure 3. (a) Tenosynovial giant cell tumor in infrapatellar fat pad during total excision with open surgery is shown (arrow). (b) Tumor after excision is seen in reddish-brown color due to hemosiderin deposition.

EXTRINSIC INVOLVEMENT OF THE INFRAPATELLAR FAT PAD

Meniscal Cysts and Ganglia

Cysts and ganglia are the most common masses that occur adjacent to the IFP, though still being relatively rare in clinical practice.^[13] These are mostly asymptomatic; however, some patients might experience pain, swelling and locking symptoms of the knee. Meniscal cysts are caused by meniscal tears, which precede fluid extravasation into the parameniscal soft tissue. On MRI, these cysts are round shaped, homogenous lesions hypointense on T₁, hyperintense on T₂ weighted images, and most commonly located close to a high grade meniscal lesion. If conservative treatment fails, surgical excision, or even meniscectomy might be indicated. When these cysts are seen next to a normal meniscus, they are usually viscous fluid filled ganglia arising from joint capsule, ligaments, tendon sheaths, subchondral bone or very rarely from IFP recess.^[14] Infrapatellar fat pad edema might be seen as a result of fluid leakage through the cyst. They are mostly asymptomatic but might require surgical excision in case of pain and swelling.^[13]

Synovial Chondromatosis

Like the intracapsular osteochondroma, synovial chondromatosis is a form of extraskeletal chondroma. These lesions originate from a metaplasia of the synovial membrane, which results in development of hyaline cartilage.^[15] Knee is the most effected joint, but lesions located adjacent to the IFP are very rare with only few case reports published to date. It is two times more common in males than females with a peak incidence at fifth decade of life.^[16] Radiological findings might resemble intracapsular osteochondromas, or might be absent due to lack of calcification in earlier stages. Computed tomography or MRI should be used for differential diagnosis. On MRI, characteristics of chondroid mineralization with "ring-and-arc" pattern might be observed which is suggestive of synovial chondromatosis.^[17] Care must be taken to differentiate these lesions from synovial chondrosarcoma. The latter shows irregular calcification and is generally extraarticular. If there is any diagnostic doubt, biopsy is indicated.

Surgical excision is the treatment of choice which includes excision of the nodule or an excision with extensive synovectomy although neither of these techniques has been shown to succeed in preventing recurrence.^[18]

Intraarticular Malignancy

Intraarticular malignancies involving the IFP mostly result from a secondary invasion. Although primary malignancies are rare, it is crucial to consider synovial sarcomas in differential diagnosis of IFP tumors, as they have been reported to be very hard, or even impossible to differentiate from intracapsular chondromas.^[19] Magnetic resonance imaging findings may not provide proper evaluation; although with gadolinium chelate administration, malignant tumors will likely demonstrate central, rather than peripheral enhancement.^[19] If diagnosis is not clear, pathological examination following needle biopsy will be required.

RARER LESIONS

Even though these lesions, except for ganglia/cysts and traumatic, post-surgical changes described above, are rare, there are even rarer conditions such as hemangioma, fibroma, neurofibroma, and angiomyxolipoma which should be mentioned.

Synovial hemangiomas arising adjacent to the IFP have been reported in only nine cases in the literature.^[20] Symptoms and MRI findings are non-specific. Magnetic resonance imaging shows a nodular lesion with irregular margin and heterogeneous intensity due to abnormal vessel formation in the IFP. These heterogenous signals are also seen in localized giant cell tumors due to hemosiderin deposition; thus the latter condition should be excluded. A red blood cell scintigraphy may be used to confirm the diagnosis. Unlike the forms that arise from elsewhere in the knee, lesions occurring in the IFP are not associated with chronic repetitive intraarticular hemorrhage and hemosiderotic synovitis, because they do not have intraarticular extension. Open excision has satisfactory results.

Fibromas arising adjacent to the IFP are extremely rare with only a few cases described to date.^[21] Clinically and macroscopically, these lesions resemble giant cell tumors of the tendon sheath. Microscopically, multi-nucleated giant cells and hemosiderin-laden macrophages are usually absent in most types of fibromas. Total excision of the tumor is thought to be curative most of the time with no recurrence.

Neurofibromas are relatively common benign soft tissue tumors arising from non-myelinating Schwann cells of nerve sheaths; however, their intraarticular localization adjacent to the IFP, even though it has rich innervations of nerve fibers, is very rare.^[22] Magnetic resonance imaging findings are not specific

and might resemble that of a ganglion cyst; thus, for diagnosis, pathological examination is necessary.

Angiomyolipoma of the IFP is very similar to intraarticular lipoma but it has only been described once in the literature.^[23] It holds an abundance of blood vessels with periadventitial myxoid stroma which is diagnostic.

Conclusion

Anterior knee pain and locking symptoms of knee joint are very common in orthopedic experience. Although tumors or tumor-like conditions arising within or adjacent to the IFP are relatively rare, they should be considered during differential diagnosis of patients presenting with these aforementioned symptoms. A detailed knowledge of patient history (e.g. trauma and systemic disease) is mandatory for initial evaluation as most of the masses are related to earlier trauma, surgery or systemic disease. Once these have been excluded, radiographic studies should be used to differentiate lesions with or without calcification. Magnetic resonance imaging with gadolinium chelate enhancement is needed to further characterize the lesions, most importantly shedding light on their potentially malignant characteristics.

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