

# Prefemoral Fat Pad Impingement Syndrome: Identification and Diagnosis

Maria J. Borja, MD, Jean Jose, DO, David Vecchione, MD, Paul D. Clifford, MD, and Bryson P. Lesniak, MD

## Abstract

Fat pad impingement syndrome refers to anterior knee pain caused by hemorrhage, inflammation, fibrosis and/or degeneration of the anterior knee fat pads. Symptomatic impingement of the prefemoral fat pad can be clinically significant but easily overlooked on magnetic resonance imaging, unless looked for. It should be evaluated in patients with persistent anterior knee pain, particularly if accompanied with mechanical symptoms and lack of intra-articular pathology.

Anterior knee pain is one of the most common presenting symptoms in orthopedics and primary care. It is the result of a complex patellofemoral compartment, which is passively stabilized by many ligaments, tendons, retinacula and osseous morphologies, and actively stabilized by the quadriceps muscle contractions.<sup>1</sup> Traumatic, congenital, and atrophic imbalances to this system of stabilization may result in abnormal patellar motion leading to chondromalacia and the painful impingement of surrounding structures.<sup>1</sup>

Fat pads are one of the most sensitive structures in the knee due to their extensive innervation and vascularization.<sup>2</sup> The anterior knee fat pads are intracapsular extrasynovial space fillers composed of well-defined adipose and fibrous tissues. These deformable structures easily adapt to the changing contours of the knee joint during movement, helping to distribute synovial fluid and acting as protective cushions between articular surfaces.<sup>2</sup>

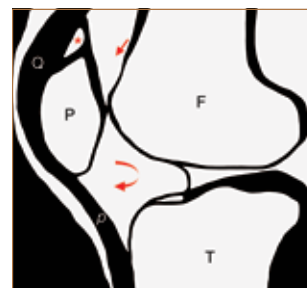
Fat pad impingement syndrome (FPIS) refers to anterior knee pain caused by hemorrhage, inflammation, fibrosis and/or degeneration of the anterior knee fat pads, resulting from alterations in joint mechanics caused by repeated microtrauma, major trauma, or other causes of patellofemoral instability.<sup>3,4</sup>

There are 3 major anterior knee fat pads, any of which may suffer symptomatic impingement<sup>5</sup>: anterior suprapatellar, posterior suprapatellar, and infrapatellar (Figures 1, 2). The anterior suprapatellar, or quadriceps, fat pad is located above the patella and posterior to the quadriceps tendon. The in-

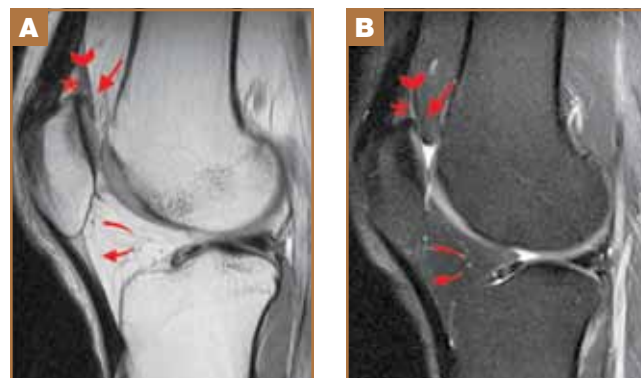
frapatellar, or Hoffa's, fat pad is located posterior to the patellar tendon and superior to the tibia. The posterior suprapatellar, or prefemoral, fat pad is anterior to the femur and is separated anteriorly from the quadriceps fat pad by the suprapatellar bursa.<sup>6</sup> Although a rare clinical finding and less known than the other 2, prefemoral fat pad impingement syndrome has been described in the orthopedic literature as a known contributor of knee pain.<sup>7</sup>

When chronically inflamed, adipose tissue can lead to the development of fatty fibrosis with associated pain, synovitis, and loss of range in motion. This is most common in Hoffa's and quadriceps fat pad,<sup>4,8</sup> but can be located elsewhere in the knee such as the prefemoral fat pad. Many disease entities involving the Hoffa's and quadriceps fat pads have been previously described.<sup>5</sup> Hoffa's fat pad alterations

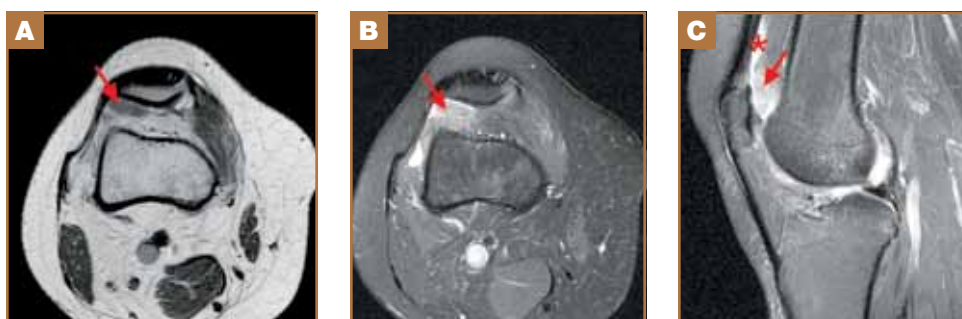
**Figure 1.** Sagittal diagram of the knee illustrating the quadriceps (asterisk), prefemoral (straight arrow), and Hoffa's (curved arrow) fat pads. Abbreviations: F, femur; P, patella; p, patellar tendon; Q, quadriceps tendon; T, tibia.



**Figure 2.** Sagittal proton density (A) and sagittal T2-weighted fat suppressed (B) MR images show the normal quadriceps (asterisk), prefemoral (straight arrow), and Hoffa's (curved arrow) fat pads. Note: the chevron indicates the suprapatellar pouch.



**Authors' Disclosure Statement:** The authors report no actual or potential conflict of interest in relation to this article.



**Figure 3.** Axial proton density (A), axial proton density fat suppressed (B), and sagittal T2-weighted fat suppressed (C) MR images demonstrate edema within the prefemoral fat pad, with scarring and mass like protrusion into the suprapatellar pouch (straight arrow), in this patient with symptomatic prefemoral fat pad impingement syndrome. Note: the asterisk indicates a small joint effusion.

can be associated with anterior cruciate ligament tears, while quadriceps FPIS is most likely related to altered patellofemoral biomechanics.<sup>5</sup> The relationship between anterior knee pain, abnormal joint movement, and fibro-inflammatory changes in the prefemoral fat pad has not been clearly and completely described to date. Although some authors claim that prefemoral FPIS is less prevalent than Hoffa’s or quadriceps FPIS,<sup>5</sup> there is limited literature regarding this condition and therefore it is usually underdiagnosed.<sup>2</sup>

### Clinical Presentation

Prefemoral FPIS can be debilitating, making early diagnosis critical to implementing adequate management.<sup>2</sup> Patients may report anterior knee pain proximal to the superior pole of the patella. In addition, intermittent mechanical symptoms can occur if the fibrotic fat pad snaps over the femoral condyles, typically described as a catching sensation during motion,<sup>7</sup> which is exacerbated by knee extension and prolonged standing. Clinically, the differential diagnosis is broad, including meniscal tear, osteochondral lesion, plica syndrome, chondromalacia patellae, quadriceps tendonitis, and patellar dislocation.

### Imaging

Imaging plays an important role in the evaluation of anterior knee pain and FPIS, particularly in determining the extent and location of pathology, and in identifying predisposing factors.<sup>1,3</sup> To our knowledge, little has been written about the imaging of specifically the prefemoral FPIS; however all of the FPIS share similar imaging characteristics given their histological equivalence, varying only in location. Radiographs, ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) findings have been previously described, but MRI is the most useful imaging modality overall in diagnosing FPIS.

Prefemoral FPIS is associated with an edematous and enlarged fat pad,<sup>7</sup> with superficial non-encapsulated fibrous changes. It often presents with a mass-like protrusion of fatty tissue into the suprapatellar pouch and a small joint effusion.<sup>6</sup> These findings are most easily evident on MRI, which dem-

onstrates a prominent fat pad with low signal in T1-weighted images and high signal in fluid sensitive sequences, most pronounced in the anteroinferior aspect of the fat pad and along the anterior margin of the lateral femoral condyle.<sup>7</sup> Fluid signal is also seen in the suprapatellar pouch consistent with joint effusion (Figure 3).

Fluid intensity within the anterior knee fat pads and mass effect on the suprapatellar recess on MRI has been significantly associated with

anterior knee pain.<sup>8</sup> Similarly, fat pad hypertrophy,<sup>4</sup> increased signal in T2-weighted images due to edema and hemorrhage, joint effusion and mass effect on the patellar tendon have also been described in Hoffa’s FPIS.<sup>6</sup>

In subacute and chronic cases of fat pad impingement, usually due to continuous and repeated microtrauma, the fat undergoes fibrosis, and the fibrin and hemosiderin may appear low on T1- and T2-weighted images.<sup>6</sup> Rarely, chronic fat pad impingement may cause ossification of the fibrous tissue; however, this is more common in Hoffa’s FPIS.<sup>4</sup> Similar to fibrosis, the ossified tissue may appear low in signal on MRI, therefore correlation with CT or x-ray is needed for better differentiation.<sup>6</sup>

Compared with CT, MRI is useful in identifying osteoarthrogenous injury and alterations in joint relationships that can eventually lead to FPIS. Although still under investigation, dynamic cine MRI and functional MRI have great potential as future diagnostic tools in imaging of friction syndromes.<sup>3</sup>

CT has improved resolution and depiction of fascial boundaries,<sup>9</sup> but is not sensitive in detecting early inflammatory changes within the anterior knee fat pads. CT has been used to study the infrapatellar fat pad deformation during motion with multi-angle 3D images in order to better illustrate musculoskeletal functions and alterations of the knee.<sup>9</sup> It has helped characterize abnormalities such as patellar lateralization or chondromalacia, which eventually lead to impingement syndromes.<sup>3</sup> Also, it has been proven useful in differentiating intra-articular loose bodies from fragmented fat, which may be equivocal with MRI.<sup>4</sup>

Dynamic ultrasound scanning during isometric quadriceps contraction with compression of the parapatellar recesses can help detect small joint effusions. Ultrasound can also help evaluate fat pad edema and hyperemia, but can be limited in the evaluation of the prefemoral fat pad due to the overlying suprapatellar bursa.<sup>3</sup>

### Differential Diagnosis

The imaging differential diagnosis of prefemoral FPIS includes intra-articular lipoma and lipoma arborescens. These are easily differentiated using MRI.<sup>7</sup> Lipoma arborescens is an

intra-articular process, characterized on MRI by large effusion and extensive fat signal intensity villous synovitis within the suprapatellar pouch. Intra-articular lipoma, a rare entity, is characterized by a fat signal intensity mass with a thin fibrous capsule that usually shows no internal edema or fibrosis. The soft tissues surrounding the lipoma are usually normal, compared with FPI where there is edema and fibrosis.

## Management

Initial management of prefemoral fat pad impingement is conservative; ice, anti-inflammatory medications, and modification of painful activities are key to decreasing the inflammation and thereby the size of the impinging fat pad. Quadriceps and hip flexor muscle stretching can be implemented to decrease the downward pressure of the patella on the fat pad.<sup>2</sup> If the patient continues to report anterior knee pain, arthroscopic evaluation should be considered. During arthroscopy a fatty tissue mass-like lesion covered by synovium with a fibrous connection to the prefemoral fat pad may be found anteriorly along the distal lateral femoral condyle, protruding into the suprapatellar pouch.<sup>7</sup> Both the fat pad and the mass-like protruding fatty tissue should be resected and sent for pathology to confirm findings. Postoperative follow-up should result in resolution of symptoms following fat pad resection.

## Conclusion

Symptomatic impingement of the prefemoral fat pad can be clinically significant but easily overlooked on MRI, unless specifically looked for. It should be evaluated in patients with persistent anterior knee pain, particularly if accompanied with mechanical symptoms and lack of intra-articular pathology.

Dr. Borja is Radiology Resident; Dr. Jose is Assistant Professor of Clinical Radiology, Musculoskeletal Section; Dr. Vecchione is Orthopedic Resident; Dr. Clifford is Associate Professor of Clinical Radiology; and Dr. Lesniak is Assistant Professor, UHealth Sports Medicine Division, Department of Orthopedics, Jackson Memorial Hospital, University of Miami Miller School of Medicine, Florida.

Address correspondence to: Maria J. Borja, Department of Radiology, Jackson Memorial Hospital, 1611 NW 12th Ave, W Wing #279, Miami, FL 33136 (tel, 305-585-5778; fax, 305-585-5743; e-mail, MBorja2@med.miami.edu).

*Am J Orthop.* 2013;42(1):E9-E11. Copyright Frontline Medical Communications Inc. 2013. All rights reserved.

## References

1. Chung CB, Skaf A, Roger B, Campos J, Stump X, Resnick D. Patellar tendon-lateral femoral condyle friction syndrome: MR imaging in 42 patients. *Skeletal Radiol.* 2001;30(12):694-697.
2. Brukner P, Khan K. Anterior Knee Pain. *Clinical Sports Medicine.* 3 ed. Australia: McGraw-Hill; 2006:464-494.
3. Faletti C, De Stefano N, Giudice G, Larciprete M. Knee impingement syndromes. *Eur J Radiol.* 1998;27(Suppl 1):S60-S69.
4. Saddik D, McNally EG, Richardson M. MRI of Hoffa's fat pad. *Skeletal Radiol.* 2004;33(8):433-444.
5. Resnick DL, Khang HS, Pretterklieber ML. Internal derangements of Joints. 2nd ed. Philadelphia, PA: Elsevier; 2007: chapter 25.
6. Jacobson JA, Lenchik L, Ruhoy MK, Schweitzer ME, Resnick D. MR imaging of the infrapatellar fat pad of Hoffa. *Radiographics.* 1997;17(3):675-691.
7. Kim YM, Shin HD, Yang JY, Kim KC, Kwon ST, Kim JM. Prefemoral fat pad: impingement and a mass-like protrusion on the lateral femoral condyle causing mechanical symptoms. A case report. *Knee Surg Sports Traumatol Arthrosc.* 2007;15(6):786-789.
8. Roth C, Jacobson J, Jamadar D, Caoili E, Morag Y, Housner J. Quadriceps fat pad signal intensity and enlargement on MRI: prevalence and associated findings. *AJR Am J Roentgenol.* 2004;182(6):1383-1387.
9. Stevenson K, Schweitzer M, Hamarneh G. Multi-Angle Deformation Analysis of Hoffa's Fat Pad. In proceedings of Society of Photo-optical Instrumentation Engineers Medical Imaging 2006: Physiology, Function, and Structure for Medical Image. Amini AA, Manduca A, eds. Vol. 6143 pp. 614329-1- 614329-9.

---

*This paper will be judged for the Resident Writer's Award.*

---