

# Utility of Musculoskeletal Ultrasound in the Diagnosis and Treatment of Suprapatellar Fat Pad Impingement: A Case Report

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## Abstract

We report a case of suprapatellar fat pad impingement diagnosed and treated using musculoskeletal ultrasound. This report describes the utility of musculoskeletal ultrasound in making the diagnosis of suprapatellar fat pad impingement, which may potentially present as anterior knee pain, and more specifically, anterior superior knee pain. The importance of recognizing this entity on musculoskeletal ultrasound, especially when the imaging findings are subtle on prior MR imaging, is emphasized. Unconvincing suprapatellar fat pad edema on MR imaging, for example, should not preclude consideration of this entity at targeted ultrasound of the anterior knee in a patient with anterior knee pain. Furthermore, once the diagnosis is made using ultrasound, the suprapatellar fat pad impingement can be immediately and effectively treated with ultrasound-guided injection of steroid and anesthetic.

**Keywords:** Suprapatellar fat pad impingement; Quadriceps fat pad; Anterior knee pain; Ultrasound guidance; Hoffa's disease

## Case Report

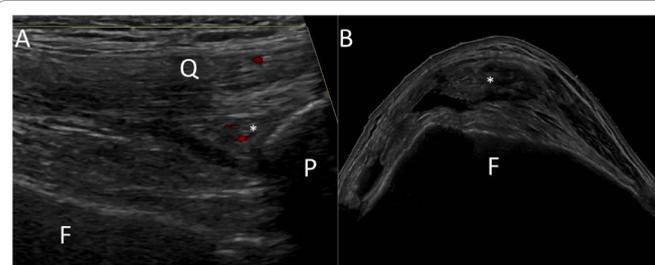
A 54 year-old man presented with a multi-year history of right antero-superior and antero-medial knee pain, primarily described as dull and aching, exacerbated by ambulating down stairs, bending, or twisting, and alleviated by rest. He did not endorse a history of antecedent trauma. Physical examination revealed mild right quadriceps muscle atrophy, and palpation elicited pain localized primarily to the suprapatellar region, but to a lesser degree in the superior aspect of Hoffa's fat pad. Provocative knee maneuvers demonstrated positive Apley compression (suggests meniscal pathology) and patellar grind (suggests patellofemoral syndrome) tests, without evidence of joint instability [1,2]. Three prior intra-articular knee joint injections did not provide symptomatic relief.



**Figure 1:** Anteroposterior (A) and lateral (B) right knee radiographs, showing normal radiographic appearance of the right knee.



**Figure 2:** Sagittal proton density (A) and T2 fat saturated (B) images through the right knee obtained by non-contrast 3 Tesla magnetic resonance imaging, demonstrate subtle obscuration of fat (\*) on proton density and minimal edema on T2 (\*). Hoffa's fat pad (H) is within normal limits. Incidental note is made of mild associated patellofemoral chondrosis (arrows).



**Figure 3:** Longitudinal color Doppler image using an 11-MHz linear transducer (A) of the right suprapatellar region demonstrates a hypoechogenic, mildly enlarged suprapatellar fat pad (\*) with increased vascularity in this region on Doppler imaging. Transverse grayscale expanded view image using an 11 MHz linear transducer (B) of the right suprapatellar region demonstrates a hypoechogenic, mildly enlarged suprapatellar fat pad (\*). Q, Quadriceps tendon; F, femur; P, patella.

Following the initial examination at our institution, radiographs were performed and were reported as normal (Figure 1). Non-contrast magnetic resonance (MR) imaging of the right knee subsequently demonstrated no internal derangement but did reveal subtle obscuration of fat in the suprapatellar fat pad, best seen on fat sensitive sequences with minimal associated edema on fluid sensitive sequences. No signal abnormality was appreciated within Hoffa's fat pad (Figure 2). The patient's pain was primarily localized to the suprapatellar fat pad region by the orthopedic surgeon, prompting the clinical diagnosis of suprapatellar fat pad impingement syndrome. Musculoskeletal radiology was consulted to perform both a diagnostic musculoskeletal ultrasound evaluation and targeted therapeutic injection of the suprapatellar fat pad.

Pre-procedure diagnostic ultrasound in the region of pain

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**Figure 4:** Longitudinal grayscale image of the right suprapatellar region using an 11 MHz linear transducer demonstrates an echogenic needle (arrow) with its tip inserted at the hypoechoic, mildly enlarged suprapatellar fat pad (\*). P- Patella.

in the suprapatellar region revealed an enlarged and hypoechoic suprapatellar fat pad, suggesting infiltration or scarring within the normally hyperechoic fat pad, and mildly increased Doppler flow (Figure 3) suggestive of associated inflammation. Additionally, the patient endorsed pain in this specific region. The skin site was prepped and draped in the usual sterile fashion. 1% xylocaine was used for local subcutaneous anesthesia. A 1.5 inch, 25-gauge needle was used to access the suprapatellar fat pad under direct ultrasound guidance. Intra-procedural ultrasound images demonstrated the tip of the needle within the suprapatellar fat pad (Figure 4). Subsequently, 1 milliliter of 80 milligrams methylprednisolone acetate injectable suspension and 4 milliliters of 0.5% ropivacaine were injected into the suprapatellar fat pad. The patient tolerated the procedure well without immediate complication, and was discharged home in good condition. The patient reported complete resolution of anterior knee pain immediately following the procedure, however the pain recurred after approximately one month that he attributed to “change in leg exercises”. The patient returned for a second ultrasound-guided injection using the same methods, 10 weeks after the initial procedure. Again, he had immediate symptomatic relief and remained pain free at 4 month follow-up.

## Discussion

Anterior knee pain is one of the most common clinical presentations at a busy, outpatient orthopedic clinic [3]. Identifying the specific cause of anterior knee pain is often difficult but crucial in determining appropriate next steps including therapeutic options. Fat pad impingement syndromes can involve any of the three distinct but anatomically similar fat pads in the anterior knee, but most often involve the suprapatellar and super lateral Hoffa’s fat pads [4,5]. These fat pads normally act to promote both joint lubrication and joint stability [6]. When impinged due to patellar maltracking such as patella alta/baja, lateral patellar subluxation, or lateral patellar tilt, these fat pads demonstrate obscuration of normal fat and increased vascularity in these regions. These findings, whether manifested on MR imaging or targeted ultrasound, should alert the radiologist to an underlying patellar tracking anomaly and prompt a discussion with the referring provider and/or the patient with regards to therapeutic fat pad injection with steroid and anesthetic. Ultrasound in particular can allow for both the diagnosis and treatment of fat pad impingement on a single patient visit. We present a case of suprapatellar fat pad impingement suggested initially on MR imaging, confirmed on targeted diagnostic ultrasound, and successfully treated with steroid and anesthetic injection with immediate complete resolution of anterior knee pain.

## Demographics, Etiology, and Clinical Findings

Suprapatellar fat pad impingement syndrome is seen in 4.2%-13.8% of the population, with a male preponderance [5,7,8]. As with any syndrome, imaging findings may be suggestive or compatible with the clinical entity, but the diagnosis is ultimately clinical. No significant correlation has been demonstrated between suprapatellar fat pad impingement with adjacent anatomic knee abnormalities, inflammatory arthropathy, body habitus, overuse, occupation, or sports injuries [5,7,8]. However, the causes of suprapatellar fat pad impingement syndrome may be similar to those involving the infrapatellar fat pad, or Hoffa’s fat pad, known as Hoffa’s disease, thought to be caused by acute and/or repetitive localized trauma resulting in hemorrhage, edema, inflammation, and scarring [4,9,10]. Also, fat pad nerve fibers secrete substance P, which induces fat pad inflammation, vasodilation, and edema [11-13]. Close apposition of these fat pads to the highly innervated synovium, is hypothesized to result in localized anterior knee pain. Pathologic findings at biopsy have been reported to show myxoid degeneration, inflammation, and fibrosis [14-16].

## Imaging Findings

Suprapatellar fat pad impingement is radiographically occult. MR imaging is characterized by obscuration of fat/low T1 signal, and associated fat pad edema/high T2 signal. In more advanced cases, there may be mass effect upon the suprapatellar joint recess, and fat pad enhancement on post-contrast imaging [5,7,8,14]. Similar MR imaging findings are seen in Hoffa’s disease, further suggesting that suprapatellar fat pad impingement and Hoffa’s disease are analogous disease processes [4,8].

Ultrasound reveals enlargement of the fat pad, obscuration of normal fat manifest as decreased echogenicity within the fat pad, and increased vascularity due to concomitant inflammation [5,14]. Additionally, when compared to MR imaging or CT, ultrasound is a cost-effective and mobile modality, and allows for concurrent localization of the patient’s pain to the anterior and superior knee. Furthermore, targeted therapy can be performed at the time of diagnosis using ultrasound.

## Treatment and Prognosis

Treatment of suprapatellar fat pad impingement is primarily non-surgical and focuses on managing the patient’s symptoms. Options include physical therapy, taping, muscle training, gait training, and fat pad injections with corticosteroids and anesthetic [11]. When conservative techniques fail, advanced and intractable cases have been treated effectively with surgery [15]. Operative treatments include fat pad excision, debridement of hypertrophic fibrosis, anterior interval release, synovectomy, infrapatellar plica release, and denervation of the inferior patellar pole [11].

Sonographic guidance for joint related injections is overall accepted to have improved accuracy, decreased pain scores, increased responder rate to treatment, and reduction in overall cost per year than blind technique [17]. Improved injection placement accuracy also improves safety in that misplaced steroid injections can result in undesired articular cartilage atrophy, crystal synovitis, and post-injection pain [17,18]. Prior reports have anecdotally shown symptomatic improvement of anterior knee pain in a limited number of patients after corticosteroid and local anesthetic injection of the suprapatellar fat pad, both under CT and sonographic guidance [5,8,14,16].

Few reports on suprapatellar fat pad injection include Sirvanci

et al. who described four patients with successful CT-guided steroid injections of the suprapatellar fat pad, with complete resolution of pain although follow-up time was not discussed [16]. Van Le et al. and Tsavalas et al. both report a single case in which suprapatellar fat pad impingement identified on MR imaging in patients with anterior knee pain was successfully treated with steroid and local anesthetic injection under sonographic guidance, Van Le et al. with 4 months of follow-up [5,14.] Our case report is the first to confirm that symptomatic relief was not due to intraarticular infiltration of the steroid, since the patient had multiple prior knee joint injections without relief. Ours is also only the second report to provide short-term follow-up with symptomatic relief for four months.

Differential diagnosis for anterior knee pain in addition to suprapatellar fat pad impingement includes Hoffa's disease, patellar chondrosis, peri-patellar bursitis, or meniscal tear. Assessment with ultrasound can easily detect bursitis, which is seen as a fluid filled space near a joint, in this case the patella, with or without a thickened wall and/or hyperemia. Hoffa's disease is sonographically similar to suprapatellar fat pad impingement demonstrating hyperechoic, edematous fat, but in a different anatomic location. Direct visualization of a meniscal tear and patellar chondrosis is limited with ultrasound, however the absence of other abnormality should prompt possible MR imaging. In musculoskeletal ultrasound, comparison to the contralateral side is almost always useful in determining if a structure appears abnormal, and is also easier and more practical to perform than with MR imaging or radiographs.

## Conclusion

Fat pad impingement syndromes are an important part of the differential diagnosis of anterior knee pain. We emphasize the utility of musculoskeletal ultrasound in both the diagnosis and treatment of fat pad impingement syndromes. And, as far as we know, we are the first to describe a case of suprapatellar fat pad impingement primarily determined by musculoskeletal ultrasound and simultaneously treated with ultrasound-guided steroid and anesthetic injection with complete resolution of pain. Our findings are in concordance with previous reports demonstrating the potential therapeutic value of suprapatellar fat pad steroid and anesthetic injection.

When compared to MR or CT imaging, ultrasound advantages include cost effectiveness, location of pain to the suprapatellar region, lack of ionizing radiation, and allows for simultaneous ultrasound-guided therapy in a single patient visit.

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