

MRI findings of prepatellar Morel-Lavallée effusions

Camilo G. Borrero · Norman Maxwell · Eoin Kavanagh

Received: 2 October 2007 / Revised: 9 December 2007 / Accepted: 26 December 2007
© ISS 2008

Abstract

Objective To describe MR imaging characteristics and treatment options for prepatellar closed degloving injuries or Morel-Lavallée effusions. Imaging features are discussed that may aid in the distinguishing of this entity from “housemaid’s knee” or prepatellar bursitis.

Materials and methods MR images of four young wrestlers were reviewed by two attending radiologists and one fellow, and correlative clinical data were collected using the electronic medical database.

Results MR images in all cases showed a unilocular, T2 hyperintense prepatellar collection extending beyond the normal boundaries of the prepatellar bursa. No necrotic fat or blood products were identified in the collections. Surgical pathology proving the absence of synovial tissue was available for one case, and differentiation of the collection from the adjacent bursa was confirmed visually by the surgeon in a second case.

Conclusion Although prepatellar hemorrhagic bursitis and Morel-Lavallée effusions share many imaging features, making a specific diagnosis in most cases is not necessary, as treatment is often similar for both entities.

Keywords Knee · Morel-Lavallée degloving injury · MRI

Introduction

Closed degloving injuries of the soft tissues overlying the hip and pelvis were first described by the French physician Maurice Morel-Lavallée in 1853 [1, 2]. These injuries have

been reported to involve the soft tissues adjacent to the greater trochanter, lower back, and buttock regions [3–6]. Typically, these injuries are manifested as fluid collections at the interface between the subcutaneous fat and underlying fascia, with variable appearances on MRI [4]. Although Morel-Lavallée lesions (MLLs) have been described in the knee in the orthopedic literature [6], to our knowledge, a case series describing the imaging findings of MLLs of the knee has never been reported in the radiology literature.

We describe the MR imaging features of prepatellar collections in four young wrestlers, with two cases proven with surgical inspection and pathological analysis and two cases suggested by imaging alone. Imaging features that might aid in distinguishing between prepatellar bursitis and MLL are suggested.

Case reports

Case 1

An 18-year-old male presented with left knee pain 4 months following an injury sustained while wrestling. The patient recalled falling on his left knee on a wrestling mat while being propelled in a forward direction. There was no visible cutaneous laceration at the time of injury. He subsequently complained of recurrent anterior knee pain and swelling. Examination showed a fluctuant swelling at the anterior aspect of the left knee, without any surrounding erythema. MRI was performed approximately 4 months after injury and showed a T2 hyperintense, unilocular collection draped over the patella and measuring 12.5 cm, 11.7 cm, and 7 mm in lateromedial, craniocaudal, and anteroposterior dimension, respectively (Fig. 1). The collection was situated between the subcutaneous fat and underlying fascia.

C. G. Borrero (✉) · N. Maxwell · E. Kavanagh
Department of Radiology, University of Pittsburgh Medical Center,
200 Lothrop Street, Pittsburgh, PA 15213, USA
e-mail: borrorocg@upmc.edu

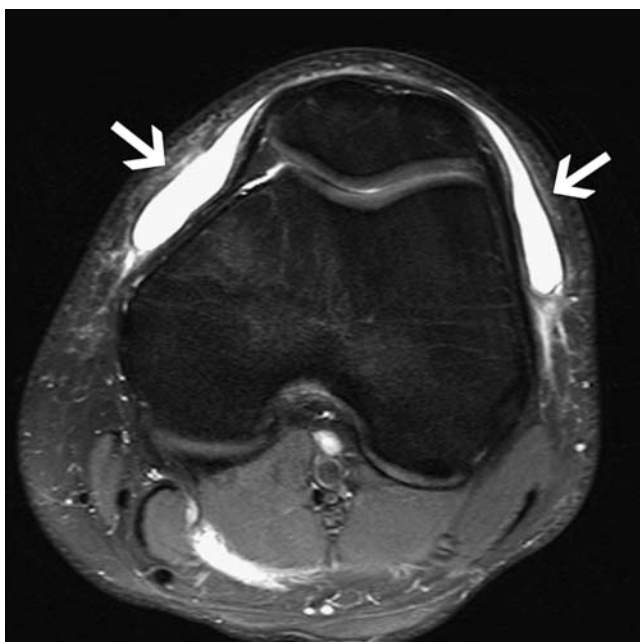


Fig. 1 T2-weighted MR image with fat saturation obtained 4 months following initial injury showed a unilocular, hyperintense collection draped over the patella in the potential space between subcutaneous fat and underlying patellar fascia (*arrows*). The medial and lateral margins extend to the level of the epicondyles, beyond the expected margins of the prepatellar bursa

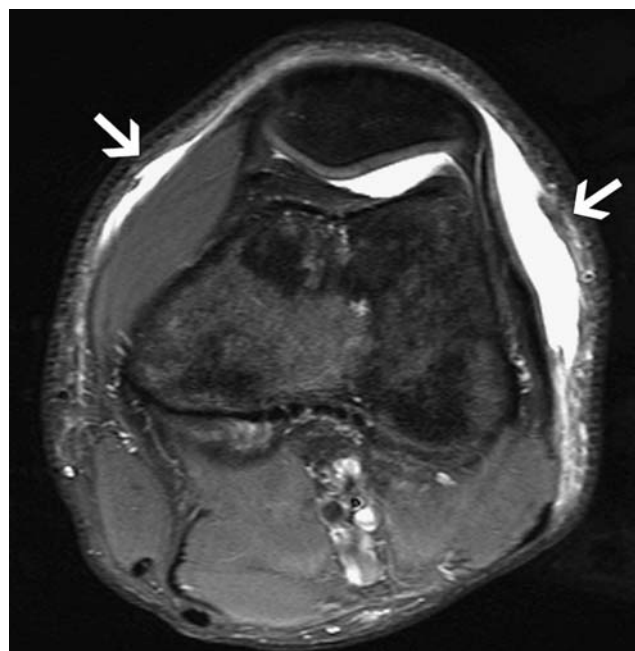


Fig. 2 T2-weighted MR image with fat saturation obtained 3 months following initial injury showed a unilocular, hyperintense collection draped over the patella in the potential space between subcutaneous fat and underlying patellar fascia (*arrows*). As in Fig. 1, the medial and lateral margins extend posteriorly to the level of the epicondyles, beyond the expected margins of the prepatellar bursa

Surgical management was chosen due to the fact that it was 4 months since the injury and the patient had persistent symptoms. Surgery was performed 1 month after the MRI. At surgery the fluid collection was noted to be separate from the prepatellar bursa and was drained by an incision at the superolateral aspect of the knee. The fluid was serous and drained freely to completion. Fluid samples were sent for microscopy, culture and sensitivity tests, the results of which proved negative. No samples for histological evaluation were gathered. The patient's post operative recovery was uncomplicated. At follow-up 6 months after surgery the patient remained asymptomatic and had returned to competitive wrestling.

Case 2

An 18-year-old male presented with left knee pain 3 months after an injury sustained while wrestling. At the time of injury the patient recalled falling on his left knee during a wrestling bout. There was no associated soft tissue laceration at the time of injury.

An MR image of the left knee obtained 3 months after initial injury showed a T2 hyperintense, unilocular collection between the subcutaneous fat and underlying fascia, measuring 13.6 cm, 6.0 cm, and 10 mm in lateromedial, craniocaudal, and anteroposterior dimension, respectively (Fig. 2). This patient was rested from active competition, and, after approximately 3 months, his symptoms had resolved. No operative

intervention was performed, and the patient returned to competitive wrestling and is currently asymptomatic.

Case 3

A 17-year-old male wrestler presented with right knee pain following an injury sustained while wrestling. His pain was noted to be specifically over the inferomedial aspect of the right knee. MRI performed 8 months after the injury showed a T2 hyperintense, unilocular collection between the subcutaneous fat and underlying fascia, measuring 11.7 cm, 11.8 cm, and 7 mm in lateromedial, craniocaudal, and anteroposterior dimension, respectively (Fig. 3). The patient and his family elected for surgical management due to persistent symptoms. At surgery an incision was made just medial to the patella, which yielded serous fluid, draining freely from the fluid collection. The superficial fluid collection was drained to completion. Fibrous bands within the collection were debrided, and the potential space was injected with 5 ml of 0.25% Marcaine (bupivacaine) with epinephrine to control hemostasis. The resected fibrous tissue was sent for pathological analysis which showed fibrofatty tissue with segments of nerves with myxoid change (Fig. 4). No synovial tissue was identified at histological analysis. Postoperatively, the patient made an excellent recovery, and a follow-up MR image 12 months after surgery showed complete resolution of the anterior fluid collection.



Fig. 3 T2-weighted MR image with fat saturation obtained 8 months following initial injury showed a unilocular, hyperintense collection draped over the patella in the potential space between subcutaneous fat and underlying patellar fascia (*arrows*). The medial and lateral margins extend to the level of the epicondyles, beyond the expected margins of the prepatellar bursa. No foci of necrotic fat are identified within the collection

Case 4

A 15-year-old male nationally ranked wrestler presented with a 3-week history of right knee pain following a match. His pain was particularly severe along the anteromedial aspect of the knee. This region was fluctuant on physical

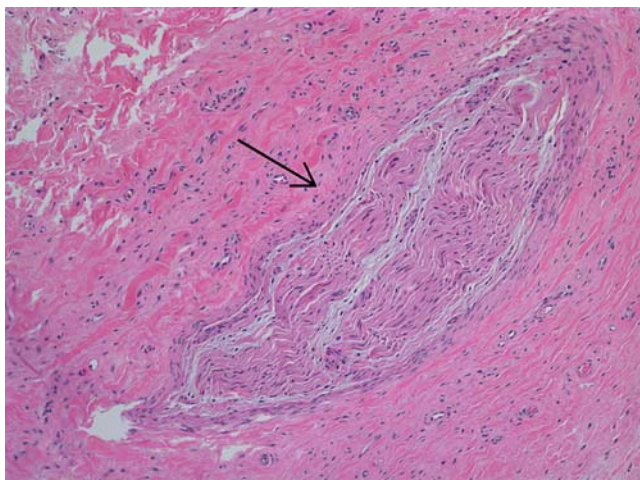


Fig. 4 Surgical histological specimen showed an absence of synovial tissue. The *arrow* points to myxoid degeneration within a nerve. The nerve is surrounded by broad areas of fibrous tissue



Fig. 5 Axial T2-weighted MR image with fat saturation obtained 6 weeks following initial injury showed a hyperintense collection draped over the patella and extending to the level of the femoral epicondyles (*arrows*). As the MR was obtained only 6 weeks following injury, moderate subcutaneous edema and stranding is evident along the anterolateral aspect of the knee

examination. An MR image obtained 6 weeks after initial presentation showed a T2 hyperintense, unilocular collection between the subcutaneous fat and underlying fascia, measuring 10.5 cm, 4.7 cm, and 1.3 cm in lateromedial, craniocaudal, and anteroposterior dimension respectively. Because of the relative acuity of imaging following the trauma, moderate subcutaneous edema and stranding were evident along the anterolateral aspect of the knee (Fig. 5). As in case 2, a conservative approach to treatment was taken. After approximately 6 months of simple compression and resting of the knee, no significant fluctuance could be appreciated on physical examination. The patient is currently asymptomatic.

Discussion

Initially described in 1853 by Maurice Morel-Lavallée, closed degloving injuries develop as a result of a blunt tangential force which separates the hypodermis from the underlying fascia [1–3, 7]. The sheared hemolymphatic supply of the tissue then fills the perifascial plane with blood, lymph and necrotic fat. The hemolymphatic tissue is surrounded by granulation tissue which may be organized into a fibrous pseudocapsule which prevents reabsorption of fluid and may lead to clinical presentation months to years following an injury.

MLLs have typically been described along the lateral thigh, buttock, and lower back. More recently, authors have described cases of MLLs involving the knees of football players as well as the abdominal wall of patients following liposuction and abdominoplasty [8]. Several authors have noted a gender discrepancy in the incidence of MLLs, ascribing the increased incidence in women to differences in the anchorage of skin to underlying fascia, and in the anatomy of the fat compartments, which are larger and looser in women [9].

Although a history of trauma is helpful in directing the clinician to the appropriate diagnosis, patients may sometimes not recall any specific event, and the diagnosis of MLL may initially be missed or the lesion mistaken for a tumor. Hudson et al. reviewed 16 MLL cases and found the diagnosis was missed in one-third of cases [2]. Three of 16 pediatric patients reviewed by Hak et al. failed to recall a traumatic event [1]. Lastly, Mellado et al. reported a delay between the traumatic episode and the MRI study between 3 months and up to 34 years [3, 4].

As MLLs may occasionally go undiagnosed, the radiologist must be aware of both their acute and chronic appearances and the implications for treatment. The appearance of the MLL depends on the age and amount of blood, fat, and lymph tissue within it. In the acute to subacute setting, blood clot and debris may be found within an ovoid cavity of T2 hyperintense fluid. As the hematoma becomes organized, deoxyhemoglobin is converted into methemoglobin, which may appear increased or intermediate in signal intensity on T1-weighted images. The periphery of the hematoma becomes laden with hemosiderin, thereby producing a T1 and T2 hypointense concentric ring. Later, as blood products are lysed, clot evolves into homogeneously T2 hyperintense seroma with a T1 and T2 hypointense fibrous pseudocapsule. Mellado et al. described three basic appearances: (1) homogeneous central hypointensity and water-like T2 hyperintensity relative to skeletal muscle, compatible with seroma; (2) homogeneous central T1 and T2 hyperintensity with a hypointense pseudocapsule; and (3) variable central T1 and T2 hyperintensity, depending on the degree of internal granulation tissue, methemoglobin, hemosiderin, fibrin, and fat necrosis [4]. Hak et al. suggested that the fibrous pseudocapsule prevents reabsorption of serosanguinous fluid and may indicate that percutaneous aspiration and/or debridement will be required for optimal treatment [1].

Mild enhancement of the fibrous pseudocapsule, as well as internal contents of MLLs, has been described and is thought to be related to the presence of residual capillaries in the space filled by the lesion [1, 4, 5]. The variable enhancement occasionally seen in these lesions may lead the radiologist to the diagnosis of a soft tissue tumor. The acute angle margin from the peeling back of subcutaneous

fat from fascia, history of trauma, and characteristic location may help the radiologist in distinguishing MLLs from a neoplasm.

The main differential diagnosis considered in the cases described is “housemaid’s knee” or prepatellar bursitis, a condition documented in multiple professions including housemaids, wrestlers, football linemen, and tile layers [6]. As the clinical features and affected populations are so similar in both MLL effusions and prepatellar bursitis, we sought to look for MR imaging features that might distinguish between these two entities.

An MRI cadaveric correlative study of the prepatellar bursa in nine cadaveric knees found the mean dimensions of the prepatellar bursa in the craniocaudal, lateromedial, and anteroposterior planes were 39.7 mm, 40.5 mm, and 3.2 mm, respectively [7]. The prepatellar bursa was noted to have multiple compartments, based on histological analysis, with a trilaminar appearance being found in seven of nine knees (78%), and a bilaminar appearance in two of the nine knees (22%). Lateral extension of the bursa over the patella was observed in three knees (33%), and medial extension in one knee (11%). In the four cases described, the average size of the MLL in craniocaudal, lateromedial, and anteroposterior planes was 85.0 mm, 121.1 mm, and 9.3 mm, respectively. When compared with a normal bursa or even a mildly swollen bursa, the four cases presented above suggest that the fluid associated with most prepatellar MLLs will cover a larger area in both craniocaudal and medial-lateral dimensions. A study of 27 National Football League (NFL) players with prepatellar collections asserted that most cases of bursitis and MLL could be distinguished on clinical ground alone [8]. Although none of the collections was biopsy proven, the authors asserted that the collections were often located in the supra-patellar region and mid-anterior thigh, indicating an area distinct from the prepatellar bursa. They refer to a cadaveric study by Dye et al. on 61 *normal* prepatellar bursae that showed that none extended beyond the mid-coronal plane medially or laterally or to the mid-thigh proximally [9]. The utility of size criteria to distinguish bursitis from MLL is debatable, however, as cases of hemorrhagic prepatellar bursitis measuring up to 30 cm × 15 cm × 15 cm have been described [6]. Owing to the very few surgically proven cases of prepatellar MLL effusions and bursitis with correlative MR imaging, no study, as yet, has established the spectrum of possible attainable sizes, much less analyzed a possible difference in average size.

Whereas size criteria and physical examination may prove futile in certain cases, follow-up imaging and clinical response may be useful in distinguishing between these two entities. In a more long-term setting, once blood products have been reabsorbed or drained, it is possible that most cases of prepatellar bursitis will decrease in size to

assume normal dimensions, provided that the causative biomechanical stress of repeated kneeling is avoided. Chronic MLL effusions, on the other hand, might not be expected to decrease in size, due to the presence of a fibrous pseudocapsule. If a pseudocapsule can be identified on enhanced MR images, then the radiologist may, therefore, be able to aid the clinician in prognostication. Another method that may help one to distinguish bursitis from MLL would be a simple steroid injection. As MLLs have no synovial lining, as illustrated by case 3, a response to steroid injection should not be anticipated to the degree expected with true cases of prepatellar bursitis.

As documented in the literature with surgical pathology, the MLL effusion is defined as a posttraumatic collection in the potential space between subcutaneous fat and underlying fascia [1–12]. The collection may contain a mix of serosanguinous fluid, blood products and, importantly, necrotic fat and lymphatic debris [3, 6, 11]. If necrotic fat is present and no synovial tissue is identified on surgical pathology, then a diagnosis of MLL is made. We therefore sought to find in all patients whether fat could be identified within the collections. All collections had a smooth contour and contained homogeneously T2 hyperintense and T1 hypointense fluid with no loose bodies or internal debris. Although small globules of fat and lymph present at pathology may prove difficult to visualize within MLLs, due to spatial resolution limitations or the presence of blood products, this finding may prove useful and should be sought by the radiologist.

The surgical literature on prepatellar MLL effusions suggests that simple compression and rest should suffice to treat most lesions [8]. If a larger lesion is unresponsive to compression, then drainage may be required. Some of the surgical literature initially advocated open debridement of MLL effusions, with subsequent healing via secondary intention [8]. Aggressive management was aimed at preventing infection and pseudocyst formation [8]. Less invasive treatment methods have become increasingly popular and justified on the grounds that iatrogenic injury to the remaining subcutaneous vascular supply is minimized and overall cosmesis improved [8]. These treatment options include serial percutaneous aspirations and suction drainage. In refractory cases, talc or doxycycline sclerodesis has been successfully employed [8].

In conclusion, MLLs of the knee have become increasingly recognized in contact sports such as wrestling and

football and may present a difficult diagnostic and treatment dilemma. We describe MRI findings which may help radiologists distinguish this entity from prepatellar bursitis and hope to raise awareness regarding percutaneous treatment options. Ultimately, the specificity of the imaging findings suggested remains speculative until a study with multiple follow-up MR studies and pathological correlation compares and contrasts the natural history of both MLL effusions and prepatellar bursitis. Aside from MR imaging appearances, the musculoskeletal radiologist should be aware of the common locations and clinical history associated with degloving injuries.

References

- Hak DJ, Olson SA, Matta JM. Diagnosis and management of closed internal degloving injuries associated with pelvic and acetabular fractures: the Morel-Lavallée lesion. *J Trauma* 1997; 42: 1046–1051.
- Hudson DA, Knottenbelt JD, Krige JE. Closed degloving injuries: results following conservative surgery. *Plast Reconstr Surg* 1992; 89: 853–855.
- Mellado JM, Bencardino JT. Morel-Lavallée lesion: review with emphasis on MR imaging. *Magn Reson Imaging Clin N Am* 2005; 13: 775–782.
- Mellado JM, Perez del Palomar L, Diaz L, Ramos A, Sauri A. Long-standing Morel-Lavallée lesions of the trochanteric region and proximal thigh: MRI features in five patients. *AJR Am J Roentgenol* 2004; 182: 1289–1294.
- Parra JA, Fernandez MA, Encinas B, Rico M. Morel-Lavallée effusions in the thigh. *Skeletal Radiol* 1997; 26: 239–241.
- Donahue F, Turkel D, Mnaymneh W, Ghandur-Mnaymneh L. Hemorrhagic prepatellar bursitis. *Skelet Radiol* 1996; 25: 298–301.
- Aguiar RO, Viegas FC, Fernandez RY, Trudel D, Parviz H, Resnick D. The prepatellar bursa: cadaveric investigation of regional anatomy with MRI after sonographically guided bursography. *AJR Am J Roentgenol* 2007; 188: W355–W358.
- Tejwani SG, Cohen SB, Bradley JP. Management of Morel-Lavallée lesion of the knee: twenty-seven cases in the national football league. *Am J Sports Med* 2007; 35: 1162–1167.
- Dye SF, Campagna-Pinto D, Dye CC, Eisman T. Soft-tissue anatomy anterior to the human patella. *J Bone Joint Surg Am* 2003; 85: 1012–1017.
- Powers ML, Hatem SF, Sundaram M. Morel-Lavallée lesion. *Orthopedics* 2007; 30: 250, 322–323.
- Zecha PJ, Missotten FEM. Pseudocyst formation after abdominoplasty—extravasations of Morel-Lavallée. *Br J Plast Surg* 1999; 52: 500–502.
- Puig J, Pelaez I, Baños J, et al. Long-standing Morel-Lavallée lesion in the proximal thigh: ultrasound and MR findings with surgical and histopathological correlation. *Australas Radiol* 2006; 50: 594–600.