

Magnetic Resonance Imaging Findings of Lower Extremity Morel-Lavellée Lesions in Pediatric Patients: A Preliminary Study

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Abstract

Objective: Morel-Lavellée lesions are the accumulation of fluid, blood, and debris caused by the decomposition of the skin and subcutaneous tissue after degloving trauma. This lesion is often located in the greater trochanter of the femur in adults. However, a small number of studies in pediatric patients have shown localization and signal differences. In this study, we aimed to describe the characteristic magnetic resonance imaging findings of Morel-Lavellée lesions located in the lower extremities in the pediatric patient group.

Methods: Patients who were diagnosed with subcutaneous fluid on lower extremity magnetic resonance imaging in pediatric patient groups were retrospectively reviewed from the hospital medical archive. Age, gender, trauma history, magnetic resonance imaging findings, and lesion contents were recorded.

Results: Thirteen patients between 10 and 18 years of age were included in the study. The most common localization was the knee, and all of the lesions in the knee were anteriorly located (11/13, 84.6%). In 10 patients, trauma was involved in the etiology, while the etiology of the remaining 3 patients was unknown. All of the lesions were thin-walled and most of them were ovoid (10/13, 76.9%).

Conclusion: Although Morel-Lavellée lesions are often described in the neighbors with the femur in adults, they should be considered in all localizations of the body that had a trauma. In the pediatric patient group, anterior knee involvement is frequently observed in the lower extremities and most of the patients regress with conservative treatment.

Keywords: closed degloving injury, lower extremity, Morel-Lavallée lesion, magnetic resonance imaging, pediatric

INTRODUCTION

Morel-Lavallée lesions (MLLs) are lymphatic, blood, and debris accumulations caused by rubbing of the skin and subcutaneous adipose tissue separation after a forceful trauma. Victor-Auguste Morel-Lavallée initially identified it in the area of the bony protrusion in 1863. This lesion is most commonly seen in individuals in their third and fourth decades in the area of the greater trochanter of the femur. However, there is little information about these lesions in children, and they are usually published as single case reports.^{1,2} As a result, the changes in signaling and localization between children and adults are still unclear. Because MLLs arise from the deep compartment of the subcutaneous adipose tissue, they contain intralesional fat and may thus be distinguished from hematoma and bursitis.³

While it is commonly seen in adults following a car collision, it is more commonly related to sports in children. Post-traumatic absorption is reduced in children because subcutaneous adipose tissue thickness is minimal.³ As a result, this lesion has a high vulnerability. In this study, we aimed to describe the characteristic magnetic resonance imaging (MRI) findings of MLL in the lower extremity in the pediatric patient group.

METHODS

Approval for this retrospective study was granted by the Institutional Review Board. Informed consent was waived because of the retrospective nature (ethics committee number: 34336249-604.01.02-E.30236, date: August 10, 2022, Erzincan Binali Yıldırım University).

Patients whose subcutaneous collection was seen in lower extremity MRI were retrospectively re-evaluated from the hospital medical archive between January 2010 and June 2018. The study comprised patients ranging in age from 0 to 18. Age, gender, trauma history, MRI findings, and the contents of the lesion were all documented.

Measurements were performed with routine images of a 1.5 Tesla MR system (Magnetom Aera, Siemens Healthcare, Erlanger, Germany) (proton-density (PD) - turbo spin-echo (TSE) fat-suppressed (FS)-TRA: field of view (FoV) read 180 mm, FoV phase 100%, slice thickness 4 mm, base resolution 320, Repetition Time (TR) 2870 ms, Time to Echo (TE) 30 ms, slice 25, dist factor 20%. T1-TSE-SAG: FoV read 180 mm, FoV phase 100%, slice thickness 4 mm, TR 444 ms, TE 9.7 ms, slice 23, dist factor 10%. PD-TSE-FS-SAG: FoV read 180 mm, FoV phase 100%, slice

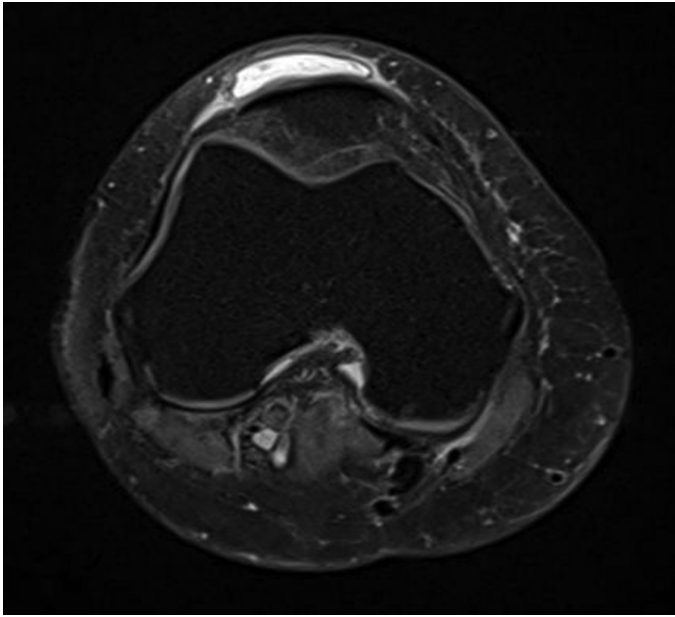


Figure 1. A 15-year-old male patient has a knee injury while playing basketball. Axial T2 fat-suppressed sequence, an ovoid, hyperintense subcutaneous collection with anterior medial retinaculum involvement is observed in the knee.

thickness 4 mm, TR 2700 ms, TE 38 ms, slice 25, dist factor 20%). Monitoring of fat deposits in a single section in the collections was considered sufficient to meet the Morel-Lavallée criterion (Figure 3).

The Statistical Package for the Social Sciences (SPSS) for Windows 20 (IBM SPSS Inc., Chicago, Ill, USA) tool was used to analyze the study data. The Kolmogorov–Smirnov test validated the data's normal distribution. The mean and standard deviation of normally distributed numerical data are displayed. The median is used to display data that does not have a normal distribution. To compare numerical variables between groups, the Student's *t*-test and the Mann–Whitney *U*-test were utilized. To explore any correlations between variables, Pearson's and Spearman's correlation analyses were utilized. The success of the diagnostic procedures studied was measured using positive predictive value, negative predictive value, and receiver operating characteristic analyses. A statistically significant value of $P < .05$ was used.

MAIN POINTS

- MLL are lymphatic, blood and rash accumulations caused by friction of the skin and separation of subcutaneous adipose tissue.
- Although MLL lesions are commonly seen after traffic accident-like severe trauma in adults, they have been identified in children mostly as a result of sports activities.
- The gold standard for the diagnosis of MLL is MRI.
- Since MLL lesions are caused by the deep division of subcutaneous adipose tissue, they can be distinguished from hematomas and bursitis due to the fact that they contain intralesional fat.
- MLL is most commonly seen in the anterior knee on the lower extremity in the pediatric population and presents as thin-walled and mostly oval.

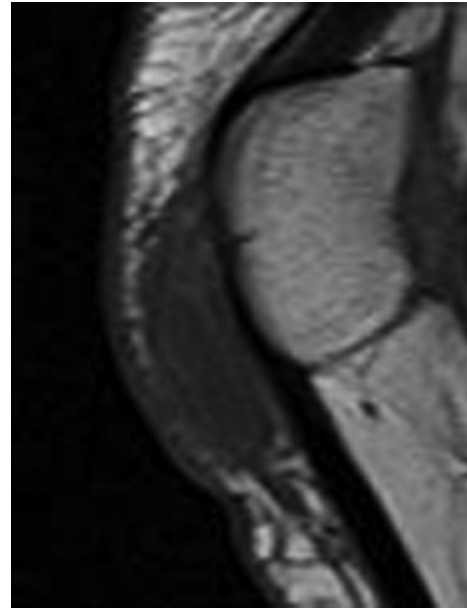


Figure 2. T1AG is hypointense and well-circumscribed since it does not contain hemorrhage.

RESULTS

The study comprised 13 patients aged 10–18 years who had collections in their lower limbs and met the criteria. The average age was 15 years old. Septation was found in 9 (69%) of the lesions, with 10 patients being male and 3 patients being female (10/13, 76.9%). While there is an internal blood degradation product in three lesions (23%), there is none in others (Figure 2).

The orthopedics clinic referred 10 patients (10/13, 77%), while the pediatrics clinic referred 3 patients (3/13, 23%). On direct x-ray,

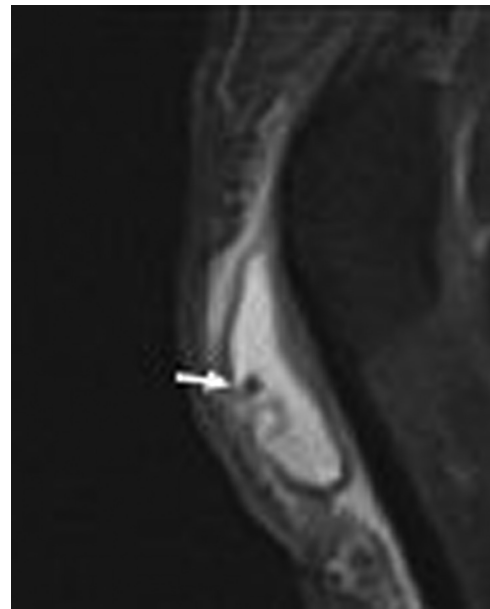


Figure 3. In the sagittal T2 fat-suppressed sequence, there is a fat droplet (white arrow) showing signal suppression secondary to the lipomatous content (figure 2 and figure 3 do not pass through the same section).

11 patients (11/13, 85%) had soft tissue edema, while 2 patients (2/13, 15%) had no findings. In all of the patients, there was no evidence of bone pathology.

The most common localization was the knee, and all lesions in the knee were anterior (11/13, 84.6%). Medial retinaculum was observed in 6 patients with anterior location (Figure 1), and lateral retinaculum location was observed in 5 patients. The other 2 patients had hip localization. While trauma was included in the etiology in 10 patients, the etiology of 3 patients was unknown. A history of sports-related trauma was found in 9 out of 10 patients (90%). The lesions were all thin-walled, with the majority of them being oval (10/13, 76.9%). In 9 cases (9/13, 69%), partial or complete capsule structure was seen. One knee lesion had a full-thickness anterior cruciate ligament rupture with bone marrow edema, while another had a medial retinaculum tear. Other lesions revealed no further abnormalities.

Only 1 patient (1/13, 8%) had a history of fine-needle aspiration and antibiotic treatment, while 12 patients (12/13, 92%) had a history of conservative care.

DISCUSSION

Although prior classifications for MLLs recommended MRI categorization based on lesion morphology, presence of capsule, and general characteristics of the signal, it has not proven to be beneficial in the management and prognosis of MLL. As a result, no standardized application exists in this area.^{1,2}

Although MLL lesions are commonly encountered in adults after severe trauma in a car accident, they have been described mostly in children in affluent countries as a result of sports activities such as football. The knee is the most common site of involvement, whereas the hip is the second most common site of involvement.^{1,4,5}

Morel-Lavallée lesion may not be detected until there is a high level of clinical suspicion, and one-third of patients may be missed during the initial evaluation. As a result, pediatricians, general care providers, and sports medicine physicians should be aware of this diagnosis, particularly in young patients with sports injuries. A large suprapatellar palpable fluctuation area, frequently extending medially and laterally to the mid-femur, is the differentiating physical examination finding in MLL of the knee. Morel-Lavallée lesion of the knee can be distinguished from prepatellar bursitis and quadriceps contusions with a comprehensive history and thorough examination.^{1,4,5}

There is very little information about pediatric MLL in the literature, and there are just 2 research on the subject. In a research by Rapp et al.³ 21 patients were included, and lesions in the lower and upper extremities were examined in this investigation. In 19 cases, the most common localization was the knee. The lesion was described in the hip and proximal humerus in the remaining 2 cases. Furthermore, except for 2 lesions, all of the lesions in this investigation retreated spontaneously during follow-up, and the capsule structure was created 3 weeks after the shock. Due to a lack of clinical data, we were unable to calculate the duration between lesion formation and trauma in our investigation. As a result, its connection to capsule formation could not be determined. The healing time of the lesions could not be determined due to a lack of clinical data. Kushare et al.¹ included 38 patients in their investigation, which focused solely on lower

extremity injuries, similar to ours. While 76% of lesions (29/38) were found below the knee, 24% (9/38) were found in the hip and pelvic region. In this regard, it is clear that this study, with a larger study population, is comparable to ours in terms of MLL distribution in the lower extremities.

In all of the literature, radiographs taken in patients with a history of trauma were described as normal, with the exception of soft tissue edema. This suggests that the injuries are mostly isolated soft tissue injuries and the doctor is probably trying to rule out any trauma-related bone anomalies.^{1,6,7} The gold standard for diagnosing MLL is an MRI. Seroma, subacute hematoma, and chronic organized hematoma are the most prevalent components within the lesion, and they are hypointense on T1-weighted imaging and hyperintense on T2-weighted images. Ultrasound, which is the most common imaging modality for non-deeply placed MLL, has been indicated in several studies as a method of choice. However, because ultrasound examinations were performed on just a small percentage of the patients in our study, no assessment could be made in this area.^{7,8}

In all but one of the patients in our investigation, a conservative treatment history was recorded, and in one of the patients, a history of aspiration with a minimally invasive surgery after antibiotic treatment was obtained. Although it is comparable to adults in terms of the absence of intervention, Kushare et al.¹ said in his cohort study that a little more intervention was required in comparison to adults.^{5,9,10} In this regard, there is some discrepancy between the 2 studies.

The hip is the most common location for lesions in adults in the literature, although the localization and signal characteristics of the knee are similar to those in our study. It will be better known when the lesion capsule is generated, how it regresses, and how the lesion signal features differ from the adult population if a cohort research is conducted with a bigger population in the literature.

Limitations

Despite the fact that the number of patients in all trials is small, it is more prominent in ours. As a result, we had to work with a population that was too small to conduct extensive analysis. In this scenario, it created a statistical problem for us.

Some of the highly traumatized patients were unable to be identified with MLL because they regressed after receiving conservative care, with subcutaneous hematoma being considered after the fracture was ruled out in the emergency room. This condition made it impossible for us to expand our patient base.

Due to a lack of clinical information, the lesions could not be followed up.

CONCLUSION

Morel-Lavallée lesions are typically recorded in adults close to the femur, but they should be evaluated in trauma patients in other locations of the body. The most common involvement in the lower extremities in pediatric patients is anterior knee involvement.

Ethics Committee Approval: Ethics committee approval for this study was obtained from the Ethics Committee of Erzincan Binali Yıldırım Üniversitesi Faculty of Medicine (Date: August 10, 2022, Decision No: 34336 249-6 04.01.02-E.3023).

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Declaration of Interests: The authors declare that they have no competing interest.

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