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The Morel-Lavallée Lesion: Diagnosis and Management

John A. Scolaro, MD, MA
Tom Chao, MD
David P. Zamorano, MD

Abstract

The Morel-Lavallée lesion is a closed soft-tissue degloving injury commonly associated with high-energy trauma. The thigh, hip, and pelvic region are the most commonly affected locations. Timely identification and management of a Morel-Lavallée lesion is crucial because distracting injuries in the polytraumatized patient can result in a missed or delayed diagnosis. Bacterial colonization of these closed soft-tissue injuries has resulted in their association with high rates of perioperative infection. Recently, MRI has been used to characterize and classify these lesions. Definitive management is dictated by the size, location, and age of the injury and ranges from percutaneous drainage to open débridement and irrigation. Chronic lesions may lead to the development of pseudocysts and contour deformities of the extremity.

From the Department of Orthopaedic Surgery, University of California, Irvine, Orange, CA (Dr. Scolaro), Kern County Medical Center, Bakersfield, CA (Dr. Chao), and the Orthopaedic Trauma Service, St. Alphonsus Medical Center, Boise, ID (Dr. Zamorano).

Dr. Scolaro is a member of a speakers' bureau or has made paid presentations on behalf of Smith & Nephew and serves as a paid consultant to Globus Medical, Smith & Nephew, and Stryker. Dr. Zamorano or an immediate family member is a member of a speakers' bureau or has made paid presentations on behalf of Synthes and AO North America and serves as a paid consultant to Smith & Nephew. Neither Dr. Chao nor any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article.

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The Morel-Lavallée lesion (MLL) is a closed traumatic soft-tissue degloving injury. The French physician, Victor-Auguste-François Morel-Lavallée, first described the lesion in 1863.[1] The injury is characterized by the separation of the hypodermis from the underlying fascia and commonly occurs when a shearing force is applied to the soft tissue. This insult disrupts the perforating vascular and lymphatic structures of the soft-tissue envelope, resulting in a characteristic hemolymphatic fluid collection between the tissue layers. The MLL can have a considerable effect on the management of orthopaedic injuries. In the polytrauma patient, a delayed diagnosis of these lesions is possible because more obvious injuries distract from its presence. Undesirable consequences such as infection, pseudocyst formation, and cosmetic deformity can result from improper or untimely diagnosis and management.

Pathologic and Anatomic Features

Tangential forces imparted to the skeletal soft-tissue envelope produce shear that can separate the subdermal fat from the superficial fascia (Figure 1). The injured vasculature and lymphatics within the well-perfused hypodermis drain into the potential space created between the two tissue planes. A collection of blood, serosanguinous fluid, and necrotic fat ensues. Inflammatory and metabolic products contained in this fluid potentiate cellular permeability and further leakage from the vessels and lymphatics into the created space. It is hypothesized that this self-perpetuating cycle is the reason for the continued growth and development often seen with these lesions.[2] Macroscopic evaluations of the contents of MLLs demonstrate a combination of blood clot, fibrin, and normal and necrotic fat

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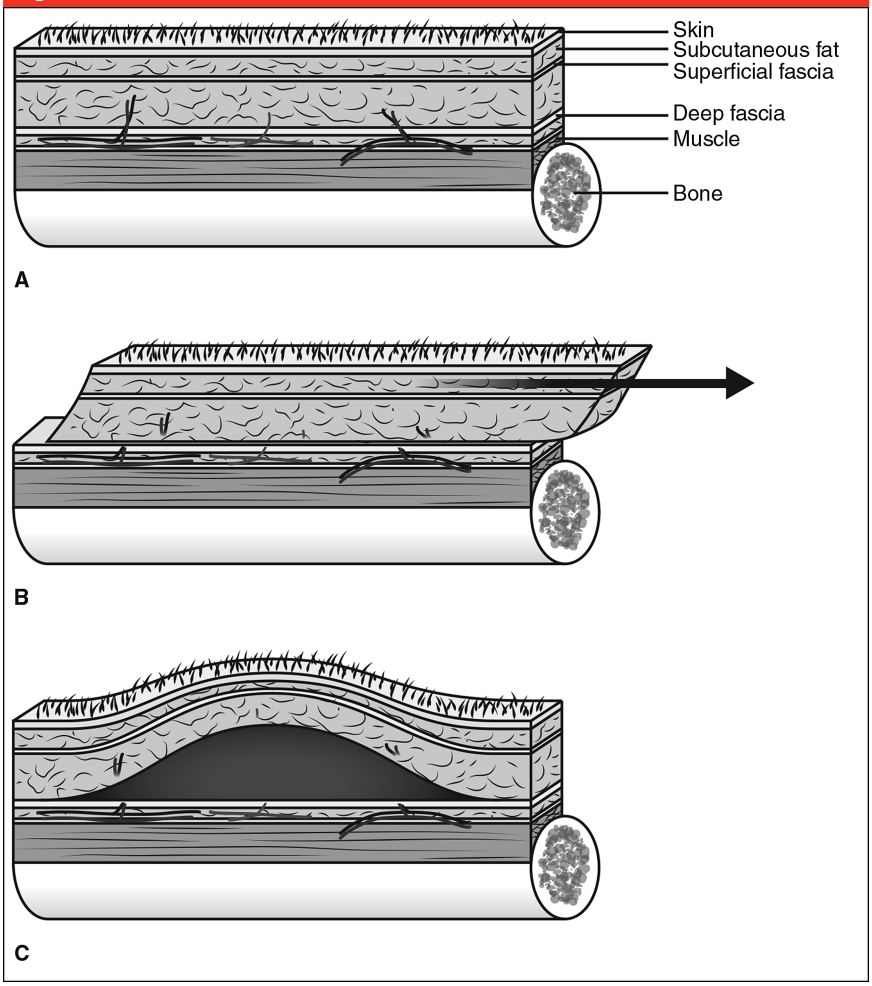
Figure 1



A through **C,** Illustrations of a cross-section of tissue from skin to bone demonstrating how the soft-tissue layers between skin and bone are affected by a Morel-Lavallée injury. **A,** Normal layers of skin, tissue, and bone. **B,** Shear forces lead to the separation of the superficial and deep fascial layers. **C,** Fluid extravasation from the injured vasculature leads to a hemolymphatic collection within the created space.

globules. Bacterial colonization has been reported in up to 46% of sampled lesions; this incidence was reported to be independent of the time from injury to surgical débridement.[3]

In general, lesion evolution is divided into four stages. During the first stage, the dermis is separated from the underlying fascia. Next, exsanguination from the lymphatics and vasculature from the injured subdermal plexus produces a fluid collection mixture of blood, lymph, and fatty debris. After this stage, over time, these components are replaced by serosanguinous fluid as the lesion enlarges. If left untreated during the acute stage, local inflammation leads to the fourth stage of pseudocapsule formation and lesion maturation as the body attempts to sequester the fluid-filled space.

MLLs frequently occur in the peritrochanteric region along the proximal lateral thigh. The increased incidence of lesions in this area results from the prominence and large surface area of the trochanteric region, the mobility of the skin in the area, and the dense capillary network within the soft tissue of the proximal thigh and gluteal region. Although commonly found in this area, MLLs can be found elsewhere on the body[4] (Figure 2). Vanhegan et al[5] reviewed more than 200 MLLs reported in the literature and noted their presence in the following regions: the greater trochanter/hip (30.4%), thigh (20.1%), pelvis (18.6%), knee (15.7%), gluteal region (6.4%), lumbosacral area (3.4%), abdominal area (1.4%), calf/lower leg (1.5%), and head (0.5%).

The presence of an MLL is particularly relevant to the orthopaedic surgeon because of the possible increased risk of perioperative infection associated with its presence. The frequent occurrence of MLLs near the pelvis make them particularly relevant to pelvic and acetabular surgery. Suzuki et al[6] reported that the presence of an MLL was an independent significant risk factor (odds ratio, 8.4; 95% confidence interval, 1.3 to 56.8; $P = 0.029$) for postoperative surgical site infection following pelvic and acetabular surgery. Alternatively, in a larger series of patients, Sagi et al[7] did not find that the presence of an MLL increased the risk of deep wound infection following pelvic and/or acetabular surgery. Both studies were retrospective and evaluated all causes of infection following pelvic and acetabular surgery. Scant information was provided by either study regarding the protocol for lesion management.

Clinical Presentation

The MLL may present acutely or may appear days following injury, and presentation depends on multiple factors. The extent and rate of hemolymphatic accumulation within

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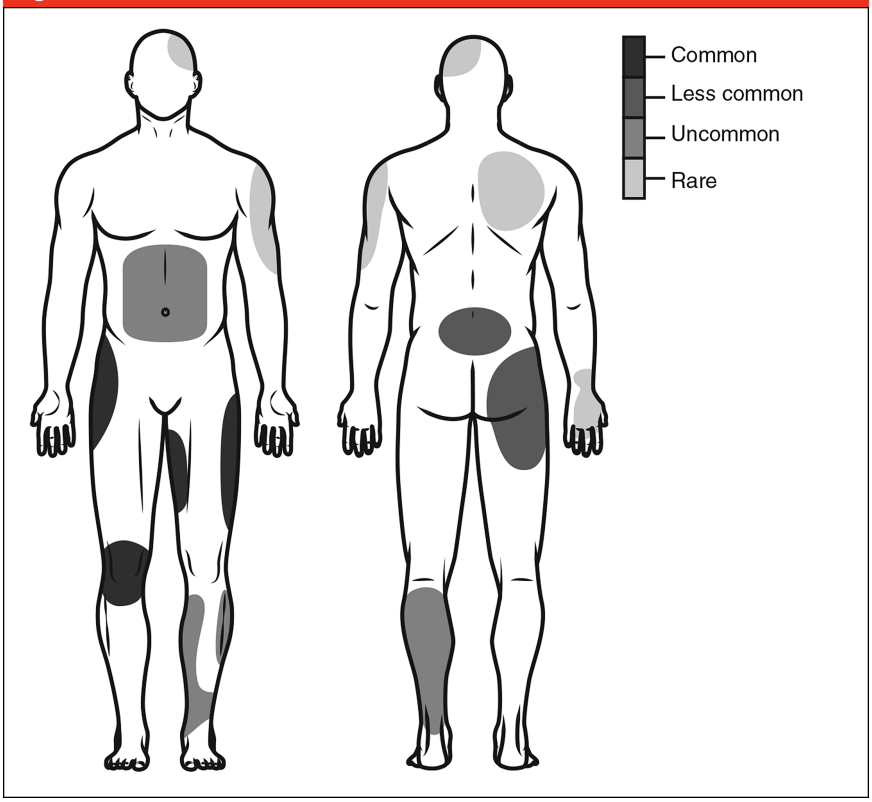
Figure 2



Illustrations demonstrating the areas of the body in which Morel-Lavallée lesions have reportedly occurred. The pelvic and lower-extremity regions demonstrate the highest susceptibility to this injury.

Figure 3

A

B

Axial CT images demonstrating Morel-Lavallée lesions. **A,** Immediate postinjury changes can be seen in the soft tissues (asterisk) adjacent to a comminuted iliac wing in a patient with a pelvic ring and acetabular injury. **B,** A small contained Morel-Lavallée lesion (asterisk) is shown in a patient with a pelvic ring disruption.

the cavity, as well as the patient's body habitus, frequently determine the clinical identification of an MLL. Fractures of the proximal femur, pelvis, and acetabulum may occur simultaneously with these soft-tissue degloving injuries. This association is related to the high-energy nature of injuries to this body region. Letournel and Judet[8] reported that MLLs were found in 8.3% of their series of 245 acetabular fractures. Other authors have suggested that the incidence of MLLs associated with pelvic and acetabular fractures may be even higher than originally reported because lesions of smaller volume likely were overlooked.[3]

Clinically, the injured area may demonstrate areas of ecchymosis, soft-tissue swelling, fluctuance, or skin hypermobility. Superficial discoloration of the skin may be delayed for several days, so the diagnosis initially may go unrecognized. Hudson[9] estimated that as many as one-third of MLLs go undiagnosed at the time of acute trauma. As time elapses, the area may become painful and firm, indicating capsule formation. Chronic lesions may mimic other soft-tissue diagnoses, including neoplasm. If improper management occurs, late evolution of the lesion also can lead to infection or necrosis of the soft-tissue envelope.

The diagnosis of an MLL ideally is made by physical examination of the patient, but advanced imaging modalities can be used to provide additional information. Typically, CT of the area of interest is obtained, especially when a pelvic or acetabular injury is present (Figure 3). Small and large lesions often can be identified in this manner.

Six distinct lesion patterns have been described. Lesion age and MRI imaging are used to distinguish each type[10] (Figure 4). The six radiographic features used in the classification of each lesion include shape, lesion appearance, T1-weighted MRI characteristics, T2-weighted MRI characteristics, and the presence and enhancement of a capsule and lesion. In general, each type is correlated with the increasing complexity and chronicity of the lesion[2] (Table 1). The fluid-filled pocket, if present, is often identifiable on T1- and T2-weighted MRI sequences. Many lesions occupy an expansive surface area; the average size is reported to be 30 ×12 cm.[11] MRI characteristics can help to define lesion age. Acute lesions are hypointense on T1-weighted images and

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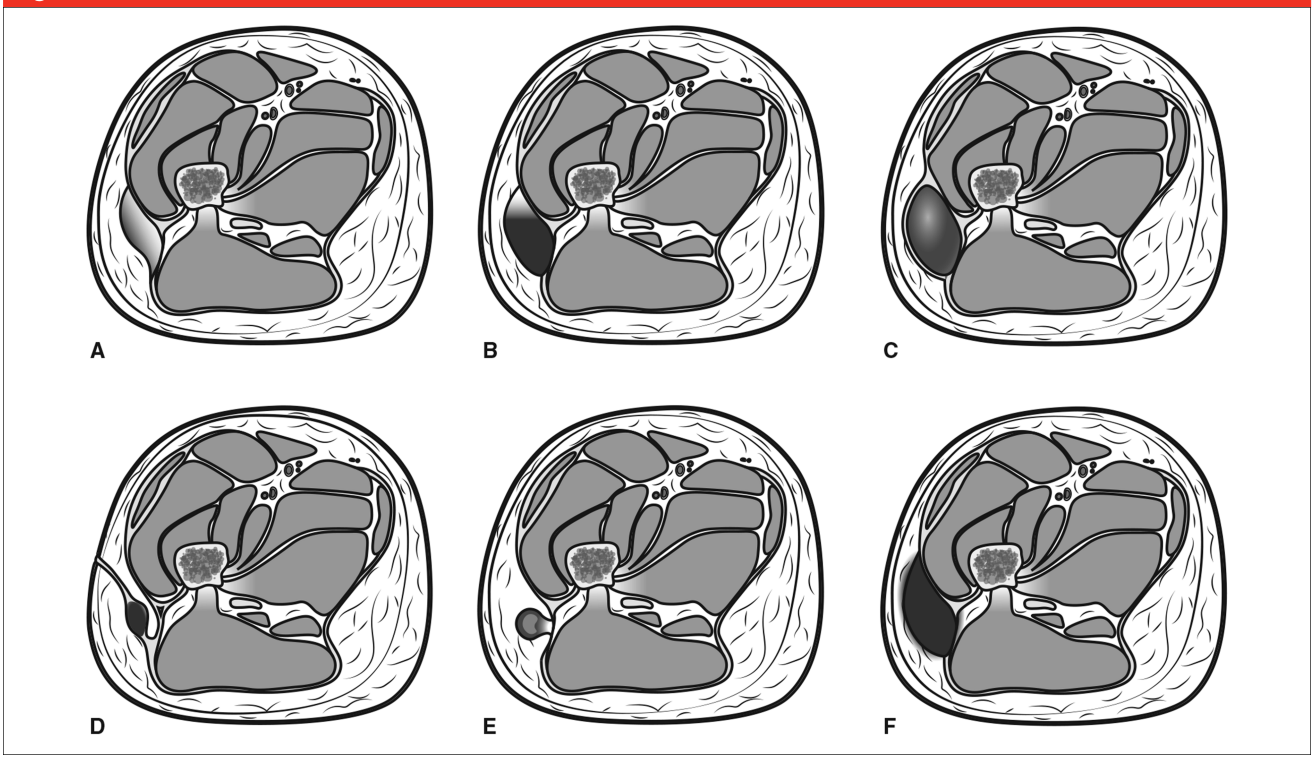
Figure 4



Illustrations of the classification of the Morel-Lavallée lesion by Mellado and Bencardino.[2] **A,** Type 1, simple seroma. **B,** Type 2, subacute hematoma. **C,** Type 3, mature organized hematoma. **D,** Type 4, closed fatty laceration complicated by perifascial dissection. **E,** Type 5, perifascial nodular lesion. **F,** Type 6, infected lesion with sinus tract, septations, and capsular formation.

hyperintense on T2-weighted sequences. Subacute lesions are homogenously hyperintense on T1- and T2-weighted sequences, with a peripheral capsule that is hypointense on both T1- and T2-weighted sequences.[2] Not uncommonly, the area may demonstrate heterogeneous composition, depending on the varied age of its contents, because old hematoma settles and serous fluid accumulates within the empty space. Other atypical MRI features include perifascial dissection, fatty layer lacerations, and the development of multiple septations.

Treatment

The MLL can be managed with close observation without intervention, percutaneous drainage, or open débridement and irrigation.[12] Treatment is based on the lesion size, severity, and proximity to an intended surgical incision for coexisting injury. Alternative interventions, such as serial aspiration, compression banding, liposuction, and the administration of sclerosing agents, also have been suggested to limit additional soft-tissue injury and minimize recurrence.

Early surgical débridement of MLLs is performed to remove material that can serve as a medium for bacterial colonization. Past reports have documented evidence of bacterial contamination from fluid aspirates despite the closed nature of the injury.[3] A formal open débridement has been proven to be effective, but this approach compromises the subdermal vascular plexus, the only remaining blood supply to the superficial tissue, potentially endangering this tissue (Figure 5). Carlson et al[13] reported using a standardized formal open approach that emphasized dead space closure to treat 24 symptomatic MLLs. The authors reported no recurrences, no infections, and minor superficial skin loss in two patients.

A more limited approach using smaller incisions has shown proven effectiveness. Hudson et al[14] reported using a limited incision over the lesion, copious irrigation, and lesion aspiration, followed by compression bandaging. Tseng and Tornetta[11] performed a similar technique in 19 patients who had an MLL with surgical drainage within 3 days of initial injury. In this study, 15 patients had a concurrent pelvic or acetabular fracture. The authors describe using a pair of 2-cm incisions strategically placed

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Table 1

Comparison of MRI Characteristics Related to the Six Subtypes of Morel-Lavallée Lesions

Type	Shape	Description	T1-weighted Image	T2-weighted Image	Capsule	Enhancement
1	Laminar	Seroma-like	Decreased	Increased	Occasional	Absent
2	Oval	Hematoma-like	Increased	Increased	Thick	Variable
3	Oval	Chronic organizing	Intermediate	Heterogeneous	Thick	Internal and peripheral
4	Linear	Closed laceration	Hypointense	Hyperintense	Absent	Variable
5	Round	Pseudonodular	Variable	Variable	Thick or thin	Internal and peripheral
6	Variable	Infected ± sinus tract	Variable	Variable	Thick	Internal and peripheral

Reproduced with permission from Mellado JM, Bencardino JT: Morel-Lavallée lesion: Review with emphasis on MR imaging. *Magn Reson Imaging Clin N Am* 2005;13(4):775-782.

over the proximal and distal extent of the lesion. Simultaneous cavity access was achieved through these portals. A brush and pulsed irrigation were used to débride necrotic and loculated material. Following the procedure, a percutaneous drain was placed and set to wall suction. The drain was removed after 2 weeks or after output was noted to be <30 mL over 24 hours. All patients in this series healed without complication, demonstrating the safety and efficacy of this novel strategy.[11]

Percutaneous measures directed at the elimination of fluid and dead space have been shown to be effective in the management of MLLs, especially in smaller lesions or in combination with adjunctive measures. Serial needle aspirations and compressive bandaging have been described. The management of MLLs by aspiration alone was reported in a series of 27 National Football League players, 14 of whom received additional compression bandaging, cryotherapy, and physical therapy. The authors did not describe the final outcome of the treated lesions but reported the resolution of knee stiffness secondary to swelling at an average of 10 days.[15]

Large studies comparing the effectiveness of open treatment of MLLs to that of less invasive treatment do not exist. Shen et al[16] performed a systematic review of 21 articles reporting on a total of 153 patients treated for peripelvic MLLs. The authors reported superior outcomes with surgical treatment of MLLs compared with nonsurgical management. No single technique was identified as superior for acute MLL. Chronic MLLs were treated best with open resection of the fibrous capsule and débridement. Nickerson et al[17] presented retrospective data on 87 lesions treated with open management (n = 41), percutaneous aspiration (n = 25), or nonsurgical methods (n = 21). The follow-up ranged from 7 days to 10 years (mean, 12 months). The overall rate of recurrence was 56% (14 of 25 patients) in the percutaneous group, 19% (4 of 21 patients) in the nonsurgical group, and 15% (6 of 41 patients) in the surgical group. For patients followed for more than 1 year (n = 42), the risk of lesion recurrence based on a Kaplan-Meier estimator was 44% in the percutaneous group, 11% in the nonsurgical group, and 16% in the open débridement group ($P = 0.003$). The study did find that recurrence was more likely for lesions in which the fluid aspirate was >50 mL in the percutaneous group, suggesting that larger lesions may be better addressed with open débridement.

Chronic MLLs may lead to the development of cosmetic deformities resulting from pseudocyst formation and the persistence of the underlying dead space. These deformities can be treated successfully with sclerotherapy, using agents such as talcum powder or doxycycline.[18,19] Cosmetic deformity can be addressed by liposuction or other surgical means, if needed.[20]

Figure 5

Intraoperative photograph demonstrating the formal open débridement of a Morel-Lavallée lesion that involved the flank and buttock of a patient with an associated pelvic ring disruption. (Copyright Jonathan Eastman, MD, Sacramento, CA.)

Our preference is to assess each MLL individually with clinical examination and advanced CT imaging. If the lesion resides in the area of an anticipated surgical incision or is adjacent to an open wound, débridement and irrigation are performed through limited open incisions. Surgical drains are left in place until the output is <30 mL over 24 hours. If the MLL is remote from a skeletal

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injury, is not fluctuant on palpation, and is not painful or bothersome to the patient, nonsurgical management is undertaken. In our experience, percutaneous methods have been found to result in unacceptably high rates of recurrence and even bacterial colonization. Symptomatic chronic lesions are referred to the plastic surgery service for open surgical excision and tissue rearrangement.

Summary

MLLs are closed soft-tissue degloving injuries that result in the separation of the hypodermis from the underlying fascia. These injuries commonly occur about the hips and pelvis and along fractures and may increase the risk of postoperative infection. Multiple reports in the literature have detailed approaches for the management of MLLs, but the literature on the topic is limited by the infrequency and heterogeneity of these lesions. Treatment of the MLL is based on lesion size, location, and proximity to the site of anticipated surgical procedures. Smaller lesions may be amenable to nonsurgical management or focused aspiration. Large or symptomatic MLLs, especially when located in the proximity of intended surgical incisions, should be addressed with débridement and irrigation through a single incision or multiple incisions to reduce the risk of undesired sequelae.

References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 6, 7, 11, 14, 16, and 17 are level III studies. References 1, 3, 15, 18, and 19 are level IV studies. References 5, 9, 13, and 20 are level V expert opinion.

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