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Management of Morel-Lavallee lesion of the knee: Twenty-seven cases in the National Football League

Samir G. Tejwani
University of Pittsburgh

Steven B. Cohen
Thomas Jefferson University

James P. Bradley
Burke and Bradley Orthopaedics, Pittsburgh, PA

` Morel-Lavallee Lesion of the Knee

Twenty-Seven Cases in the National Football League

Samir G. Tejwani, MD[*]

Steven B. Cohen, MD[‡]

James P. Bradley, MD[†]

[*] University of Pittsburgh, Center for Sports Medicine, Pittsburgh, Pennsylvania

[‡] Rothman Institute Orthopaedics, Thomas Jefferson University, Philadelphia, Pennsylvania

[†] Burke and Bradley Orthopaedics, Pittsburgh, Pennsylvania

Abstract

Background: The Morel-Lavallee Lesion (MLL) is a closed degloving injury most commonly described in the region of the hip joint after blunt trauma. We have observed that the MLL also occurs in the knee as a result of shearing trauma during football, and is a distinct lesion from prepatellar bursitis and quadriceps contusion.

Purpose: To review our experience with MLL of the knee in the elite contact athlete, in order to construct an evidence-based diagnostic and treatment algorithm.

Methods: Twenty-seven knees in 24 players were identified from one National Football League team's annual injury database as having sustained a MLL between 1993 and 2006. Their charts were retrospectively reviewed for demographic information, injury history, physical examination, treatment, outcome and time missed from participation.

Results: The most common mechanism of injury was a shearing blow to the knee on the playing surface (81%). The most common motion deficit was active knee flexion (41%). The consistent examination finding was a large area of palpable fluctuance extending from the patella to the mid-thigh, with variable medial and lateral extension. The MRI characteristically demonstrated normal musculature, with fluid in the potential space between the subcutaneous fat and underlying quadriceps fascia, extending to the mid-coronal plane and mid-thigh. The average time for resolution of the fluid collection and achievement of full active knee flexion was 16.3 ± 18.0 days. The average number of practices missed was 1.5 ± 1.5. The average number of games missed was 0.1 ± 0.3. Fourteen knees (52%) were treated successfully with compression wrap, cryotherapy and motion exercises alone. Thirteen knees (48%) were treated with at least one aspiration, and six knees (22%) were treated with multiple aspirations for recurrent serosanguinous fluid collections. The average amount of fluid yielded was 46 ± 29 ml from the first aspiration, and 77 ± 53 ml for each subsequent aspiration. In three cases (11%), the MLL was successfully treated with Doxycycline sclerodesis after three aspirations failed to resolve the recurrent fluid collections; return to play was immediate thereafter in each case. There were no infections or adverse affects observed after any aspiration or sclerodesis.

Conclusion: In football, MLL of the knee usually occurs from a shearing blow to the playing field. Diagnosis is confirmed when examination reveals a large suprapatellar area of palpable fluctuance, and MRI demonstrates a subcutaneous fluid collection extending to the mid-coronal plane and into the thigh proximally. Elite athletes are typically able to return to practice and game play long before complete resolution of the lesion. Recurrent fluid collections can occur, necessitating aspiration in approximately half the cases for successful treatment. Recalcitrant fluid collections can be safely and expeditiously treated with Doxycycline sclerodesis. Protective knee padding may decrease the incidence of MLL.

Keywords: Morel-Lavallee Lesion, Closed Degloving, Knee, Football

Introduction

The Morel-Lavallee Lesion (MLL) is a post-traumatic soft tissue injury first described by the French Physician Maurice Morel-Lavallee in 1853. The lesions most commonly occur in association with pelvic and acetabular fractures, but can also occur from low-velocity crush injury.[21,35] Deforming forces of pressure and shear result in a closed soft-tissue degloving injury, in which the skin and subcutaneous tissue are separated from the underlying fascia, disrupting the perforating vessels. The space created can fill with blood, lymph and necrotic fat, potentially leading to bacterial colonization and infection. Pseudocysts can form at the site of the original lesion, resulting in recurrent fluid accumulation.[11,19-21] Missed diagnosis can lead to delayed presentation as a contour deformity due to local tissue necrosis.[14] Morel-Lavallee lesions have most commonly been reported to involve the soft-tissues surrounding the greater trochanter, the flank and the buttock.[11,12,21,34,35] To our knowledge, MLL of the knee has not been reported as a result from athletic competition.

Historical treatment of a MLL involved open serial debridement with subsequent healing by secondary intention.[11,19] Recently, there has been a trend towards less invasive approaches. Successful treatments for MLL in the thigh, buttock and flank have included elastic compression bandage; percutaneous drainage with debridement, irrigation and suction drainage; and liposuction or drainage followed by pressure therapy.[12,18,34,35] These approaches aim to minimize iatrogenic soft-tissue trauma and disruption of the remaining vascular supply to the skin over the lesion, while achieving rapid healing and favorable cosmesis.[13] In cases of recalcitrant fluid collections caused by pseudocyst formation, talc sclerodesis has been effectively utilized.[22]

We report on our experience with MLL of the knee sustained from participation in National Football League. The principles of our management approach are in general accordance with published literature on post-traumatic MLL in the hip region. However, closed degloving injury of the knee in the elite contact athlete poses unique challenges, particularly when requiring invasive management for expeditious resolution and return to play. We aim to create an evidence-based diagnostic and treatment algorithm based upon the data presented.

Methods

Twenty-seven knees in 24 players were identified from one National Football League team's annual injury database as having sustained a MLL between 1993 and 2006. Their charts, comprised of detailed examination and treatment notes from the team physician and training staff, were retrospectively reviewed. Demographic information gathered included side of injury, age at injury, player position, mechanism of injury, time to evaluation, physical examination findings and treatment course. Outcome data acquired included time missed before return to practice and games, time to resolution of the fluid collection and time before presence of full knee motion. This information was used to create an algorithm for the diagnosis and treatment of MLL of the knee in the contact athlete.

Results

Twenty-seven knees in 24 football players were found to have sustained a MLL between 1993 and 2006. Fourteen players injured the left knee and 13 injured the right knee. Average age at the time of injury was 26.2 ± 2.8 years (range 21-31, n=24). All injuries occurred in game situations. Fifteen (62%) players were injured on Defense, nine (38%) on Offense. The most common player position was Linebacker (n=6), followed by Defensive End (n=4), Wide Receiver (n=3), Defensive Tackle (n=2), Tight End (n=2), Quarterback (n=2), Offensive Lineman (n=2), Defensive Back (n=1), Cornerback (n=1), and Safety (n=1). [Table 1] The mechanism of knee injury was shearing blow to the playing surface in 22 cases (81%) and direct blow from another player in 5 cases (19%). No players were wearing knee pads at the time of injury.

The average time from injury to evaluation by the head team physician and training staff was 3.0 ± 4.9 days (range 0-15, n=27). Eighteen knees (67%) were evaluated on the day of the injury. Nine knees (33%) were not evaluated on the day of injury, but were evaluated when the player later presented for evaluation in the training room with complaints of thigh and knee pain, ecchymosis, swelling and stiffness. One player reported being aware of a small fluid collection in his distal thigh for 15 days, but only sought medical attention after a direct blow from the playing surface created the sensation of the fluid "spreading" proximally and laterally in his subcutaneous tissues. Sixteen (59%) of the knees had full active range-of-motion upon evaluation while 11 (41%) were limited in flexion only. Of the 11 knees limited in active flexion, the average loss of flexion was 28 ± 15.2 degrees (range 10-45) in 5 cases, and could not be assessed secondary to pain with flexion in 6 cases.

When questioned, all players reported tightness in the anterior thigh with increasing knee flexion beyond 90 degrees, regardless of the flexion deficit present. All players were found to have varying degrees of thigh and knee swelling, ecchymosis and palpable extraarticular suprapatellar fluctuance upon initial evaluation. All players were fully-weightbearing upon initial evaluation. Physical examination did not demonstrate any laxity to ligamentous stress testing in any knees. Radiographs were not routinely obtained. MRI of the knee was obtained in two cases. [Figures 1-7]

All knees were treated initially with ice, compression wrap on the thigh and knee, and immediate active and passive range-of-motion exercises for the hip and knee. In more recent cases, players were also treated with a vasopneumatic cryotherapy device (Game Ready Inc., Berkeley, CA). For all knees, the average time for resolution of the fluid collection in the MLL, as verified by palpation and inspection, and achievement of full active knee flexion was 16.3 ± 18.0 days (range 2-93, n=27). The average number of practices missed was 1.5 ± 1.5 (range 0-5, n=27). The average number of games missed was 0.1 ± 0.3 (range 0-1, n=27).

Fourteen knees (52%) were treated successfully with cryotherapy, compression wrap, and motion exercises alone. In this subset, the average time of resolution of the fluid

collection in the MLL and achievement of full active knee flexion was 10.6 ± 9.2 days (range 2-29, n=14). The average number of practices missed was 1.0 ± 1.2 (range 0-3, n=14). There were no games missed.

Thirteen knees (48%) were treated with at least one aspiration. The average number of total aspirations in this subset was 2.7 ± 3.1 (range 1-12, n=13). Six knees (22%) were treated with multiple aspirations, which were performed over an average of 23.7 ± 28.5 days (range 5-80, n=6). Aspiration of the MLL was routinely performed under sterile conditions in the peripheral region of the area of palpable fluctuance in the thigh or suprapatellar region, using a 14 gage needle. The fluid was found to be serosanguinous or bloody in all cases and was not routinely sent for culture or hematologic analysis. The average amount of fluid yielded was 46 ± 29 ml (range 12-120, n=13 knees) from the first aspiration, and 77 ± 53 ml (range 48-300, n=20 aspirations in 6 knees) for each subsequent aspiration. Players whose knees were aspirated missed an average of 2.0 ± 1.6 practices (range 0-5, n=13) and 0.2 ± 0.4 games (range 0-1, n=13). [Table 2] There were no infections or adverse affects observed after any aspiration.

In three cases (11%), the MLL was treated with Doxycycline sclerodesis. In each of these injuries the sclerodesis was performed after three aspirations failed to resolve the recurrent fluid collections associated with the MLL. When performing the sclerodesis, the lesion was first aspirated using a 14 gage needle, under sterile conditions, thereby evacuating the cavity. The needle was then left in place as the syringe was removed, and 100 mg of Doxycycline reconstituted in 5 ml of sterile injectable normal saline (20mg/ml) was injected into the MLL using a new syringe. The knee was subsequently wrapped with a compressive bandage. All three players returned immediately to play and had no fluid collections recur thereafter. There were no infections or adverse affects observed after any of the sclerodesis procedures.

Discussion

We have observed that MLL of the knee in football universally occurs from a direct shearing blow. The vast majority of these injuries occurred when the knee struck the playing surface. None of the players injured were wearing knee pads, suggesting a possible protective roll with their use. The MLL did not always manifest itself immediately and was often discounted by players, as demonstrated by the average time of 3 days between injury and evaluation by the medical staff. In cases of delayed diagnosis, an insidious progression of fluid accumulation resulted in progressive swelling, ecchymosis and thigh tightness with knee flexion, prompting the player to seek evaluation. In our experience, making the diagnosis and distinguishing MLL of the knee from prepatellar bursitis and quadriceps contusion can be done by taking a careful history and performing a thorough examination. The diagnosis of MLL can be confirmed with ultrasound, CT or MRI, although imaging was not typically necessary in our experience.[26-29]

The hallmark physical examination finding of MLL of the knee is a large suprapatellar area of palpable fluctuance, often extending to the mid-thigh medially and laterally. Decreased cutaneous sensation can also be observed in the skin overlying the lesion. Chronic accumulation of lymph fluid that possesses low coagulation properties and high molecular concentration has been shown to occur in the potential space of a MLL.[22] When present, we observed these large subcutaneous fluid collections to be up to 300cc in size and located in the suprapatellar region and mid-thigh, indicating involvement of an area distinct from the prepatellar bursa. In an anatomic dissection study of the prepatellar soft tissues of 61 cadaver knees, Dye et al demonstrated that 93% of specimens had three specific spaces anterior to the patella that could be termed bursae, and potentially be involved in prepatellar bursitis.[6] None of these bursae were found to extend to the mid-coronal plane medially or laterally, or to the mid-thigh proximally. In our limited use of MRI in the management of MLL of the knee, the fluid collections were present between the subcutaneous fat and underlying quadriceps fascia, with peripheral extension to the mid-coronal plane and mid-thigh. This area of extension was well beyond the region of the prepatellar bursae, and would not be consistent with prepatellar bursitis.

Diaz et al reported on severe quadriceps muscle contusions in three athletes, two of which were professional football players.[5] Physical examination consistently demonstrated diffuse swelling of the thigh, which was typically tense. Neither diffuse ecchymosis nor a focal area of palpable fluctuance was present. In all three cases MRI demonstrated hematoma and edema within one single muscle belly of the vastus musculature; this presentation clearly differs from MRI findings in MLL of the knee, where the fluid collection is superficial to the vastus fascia, and the underlying quadriceps musculature is normal.

Invasive treatment of MLL of the hip region was initially proposed in order to prevent potential bacterial superinfection and subsequent chronic recurrent fluid accumulations.[34,35] Hak et al reported on 24 patients with MLLs over the greater

trochanter, in the flank and in the lumbodorsal region.[11] The lesions were treated with serial open debridement and left open to heal by secondary intention. Cultures from the closed internal degloving injury were positive in 11 of 24 cases (46%); the incidence of positive cultures was not dependent on the time from injury to debridement. This aggressive approach was effective, but is not practical for the elite contact athlete who desires expeditious return to play with minimal residual functional deficit.

Harma et al described the treatment of five MLLs located in the flank, buttock and gluteal regions with compressive elastic bandages or corsets.[12] One patient was aspirated because of a wide fluctuating lesion; the culture was negative but the lesion recurred early. All lesions eventually healed between 4 to 12 weeks without any infections or necrosis. Compressive bandages were recommended as treatment for MLL without a large associated fluid collection. Similarly, over half (52%) of our players with MLL of the knee were treated successfully with compression wrapping alone, in an average of approximately 10 days. These lesions likely represented the less severe variants in our study, with relatively small fluid collections present.

The Football players who sustained a MLL of the knee with a large fluid collection posed a unique challenge. Our treatment goals of resolution of the fluid collection, prevention of recurrent fluid collection, achievement of full active knee flexion, and rapid return to play were challenged by the likelihood that compression wrapping alone would be ineffective, particularly in the short term. In these cases we elected to perform aspiration of the fluid collection followed by compressive wrapping, although minimally invasive surgical drainage is an alternative approach that we did not utilize. We chose not to perform open drainage initially, but regarded that treatment option as a last resort, given the need for hospitalization, prolonged suction drainage, and an extended treatment course. However, that method has been proven to be effective in the hip region, and could theoretically be utilized in a MLL of the knee when not dealing with an elite contact athlete who desires rapid return to play.

Tseng and Tornetta reported on the percutaneous management of 19 patients with MLLs in the region of the greater trochanter; 15 had associated pelvic or acetabular fractures.[34] Drainage was performed through two to three 2-cm incisions at the periphery of the lesions. A plastic brush was used to debride the injured fatty tissue, which was washed from the wound with plastic lavage. A Hemovac drain was placed within the lesion and was removed when drainage was less than 30ml over twenty-four hours, which occurred between 3 and 8 days later in. A cephalosporin was administered intravenously while the drain was in place, and for twenty-four hours after in was removed. Three of 19 patients had positive wound cultures necessitating specific antibiotic therapy. No patient required subsequent debridement of skin, and, at a minimum of six months, no deep infection had occurred. No later recurrent fluid collections were reported in any patients, suggesting success with this method of treatment.

The first player we diagnosed with a MLL of the knee required 13 aspirations prior to successful resolution of his recurrent fluid collections; sclerodesis was not attempted at that time as we were yet to gain familiarity with that technique. Five subsequent players

required multiple aspirations for resolution of their lesions. Additionally, one player reported a unique history of being struck in the region of an existing MLL of the knee, which caused a sensation of fluid spreading to the proximal and lateral thigh; this was consistent with further peripheral delamination of the subcutaneous fat from the underlying fascia with expansion of the potential space of the lesion. Our desire to more effectively treat these challenging cases stimulated our interest in sclerodesis.

Luria et al reported the use of sterile talc sclerodesis to treat posttraumatic pseudocysts secondary to persistent MLLs in four patients.[22] The patients ranged in age from 20 to 73 and had pseudocysts in the thigh and buttocks for an average of three months. Under fluoroscopic guidance a 12-French pigtail catheter was placed percutaneously in the pseudocyst cavity. Contrast was injected to delineate the cavity, and the cavity fluid was subsequently suctioned and cultured. Five grams of sterile talc diluted in 50ml of sterile saline were then introduced into the lesions and removed after 5 minutes. Compressive dressing and continuous wall suction was applied. When drainage was less than 150 ml a day, a bulb vacuum drainage system was applied, for an average of 12 days. All persistent pseudocysts showed cessation of fluid accumulation in the treated space without recurrence, suggesting overall efficacy of this treatment method. There was one infection which necessitated IV antibiotics and a second administration of talc 12 days after the first treatment due to persistent drainage.

Sclerodesis is a treatment also commonly employed in the treatment of malignant pleural effusions. Instillation of compounds including bleomycin, tetracycline, doxycycline or talc have been used to cause pleural scarring, thereby preventing fluid recurrent accumulation and associated cardio-pulmonary complications. No significant adverse effects have been noted, and permanent control of effusions can be achieved in a majority of cases.[8,10,17,30,31,36] While previously performed through a thoracostomy, talc pleurodesis is now safely and effectively performed thoracoscopically.[8,17] Both tetracycline and doxycycline have also been safe and highly effective in sclerosis of malignant pericardial effusions and benign lymphoepithelial cysts of the parotid gland, suggesting that application to a MLL could yield similar results.[4,7,23,24]

The MLL typically contains serosanguinous fluid comprised of blood, lymph and necrotic fat. These characteristics are similar to those of lymphoceles, which have been successfully treated with percutaneous sclerotherapy in numerous institutions; tetracycline, doxycycline, talc, bleomycin, povidone-iodine, ethanol and fibrin glue have all been safe and effective.[1,2,3,9,15,16,25,32,33] Caliendo et al reported on 21 postoperative lymphoceles that were treated with doxycycline sclerotherapy.[1] These cystic collections of lymph fluid were first treated with percutaneous tube drainage for an average of 11 days. Once drainage had ceased to less than 30 ml per day and CT or ultrasound had demonstrated near complete or total resolution of the lymphocele, 500 mg of doxycycline combined with 5ml of 1% lidocaine was instilled into the cavity with a syringe, after any excess fluid was first removed through the tube. After one hour the sclerosing agent was aspirated from the cavity and the tube was removed. Primary success was achieved in 17 of 21 cases. Three of four recurrent lymphoceles were treated successfully with repeat drainage and sclerotherapy, while one lymphocele underwent successful surgical repair.

There were no complications related to doxycycline sclerosis. Similarly, we treated three cases of recalcitrant fluid collections secondary to unresolved MLL of the knee with doxycycline sclerodesis. There were no subsequent recurrent fluid collections or adverse affects, and each player was able to return to play without any further time missed. Based on data available in the treatment of lymphoceles, there are likely multiple alternatives to doxycycline for use in sclerodesis of the MLL.

In conclusion, during the evaluation of a contact athlete who suffers a shearing knee injury, one must include MLL in the differential diagnosis. The MLL, distinct from prepatellar bursitis and quadriceps contusion, is a delamination of the skin and subcutaneous fat from the underlying quadriceps fascia, with rupture of the perforating vessels. Large, recurrent fluid collections can occur in the potential space created. In addition to direct blow, the history may reveal an insidious accumulation of fluid and progressive difficulty with knee flexion. Delayed diagnosis is not uncommon. The hallmark examination finding is a suprapatellar area of palpable fluctuance, with extension into the thigh. While MRI is not necessary for the diagnosis, it characteristically demonstrates subcutaneous fluid extending to the mid-coronal plane and mid-thigh, beyond the area of the prepatellar bursae. In cases with small fluid collections and full range-of-motion, we recommend a compressive wrap, vasopneumatic cryotherapy and immediate motion exercises with an emphasis on knee flexion. In cases with large fluid collections and loss of active knee flexion, we recommend attempting up to 3 aspirations as needed; compression wrapping and vasopneumatic cryotherapy should also be used. If serial aspiration is unsuccessful, doxycycline sclerodesis can be safely performed. We did not observe any bacterial infection in MLL of the knee and do not believe fluid culture or antibiotic therapy is required for successful treatment. In general, the elite contact athlete can be expected to return to play long before resolution of the MLL. Further delamination and lesion expansion secondary to contact is a risk with return to play prior to complete resolution of the MLL. Knee padding may have a role in the prevention of MLL in football.

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Tables

TABLE 1: Case distribution of MLL of the knee from 1993 to 2006, by player position.

Position	Cases
Linebacker	6
Defensive End	4
Wide Receiver	3
Defensive Tackle	2
Tight End	2
Quarterback	2
Offensive Lineman	2
Defensive Back	1
Cornerback	1
Safety	1

TABLE 2: Treatment outcome as expressed in days to lesion resolution, practices missed and games missed for all players with a MLL of the knee, players treated without aspiration, and players treated with aspiration.

OUTCOME	ALL (n=27)	NO ASPIRATION (n=14)	ASPIRATION (n=13)
Days to Resolution	16.3 ± 18.0	10.6 ± 9.2	23.7 ± 28.5
Practices Missed	1.5 ± 1.5	1.0 ± 1.2	2.0 ± 1.6
Games Missed	0.1 ± 0.3	0 ± 0	0.2 ± 0.4

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