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ORIGINAL ARTICLE

Percutaneous Quilting Technique for the Treatment of Morel-Lavallée Lesion

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Abstract

Objective This study looks at the outcome of percutaneous quilting technique for the treatment of closed degloving injuries or Morel-Lavallée lesions (MLL).

Design Prospective single-centre nonrandomized case series.

Participants Patients with MLL visiting our hospital between January 2012 and May 2018.

Method The method involves percutaneous single-stage suturing of skin and deep fascia with heavy, non-absorbable, non-braided sutures starting from periphery to centre.

Outcome Measures Resolution of the lesion.

Results Twenty-two patients with MLL treated, which included 18 males and 4 females with an average age of 22 (range 16–52). Lesions varied in length from 12 to 60 cm. The average time gap from the injury to drainage of the lesion was 7 days (range 2–60 days). We followed these cases weekly for 4 weeks and then once a month until 6 months and then at the end of the year. All 22 cases healed uneventfully.

Conclusion Percutaneous drainage along with suturing of the skin and subcutaneous tissue to deep fascia prevents the discordant movement and obliterates the dead space-aiding apposition of the layers. This is a simple and effective procedure with low recurrence rates that addresses the primary pathology of MLL.

Level of Evidence Therapeutic level IV.

Keywords Morel-Lavallée lesion · Percutaneous draining · Quilting technique · Degloving injury · Discordant movement · Shear injury · Fluctuant swelling · Post-traumatic degloving · Hypermobile skin · Quilting sutures

Introduction

Closed degloving injury or Morel-Lavallée lesion (MLL) was first described by the French physician Maurice Morel-Lavallée in 1853 in a patient who fell from a moving train [1]. This injury is initiated by the deforming forces of pressure and shear, which leads to the separation of relatively mobile skin and subcutaneous tissue from less yielding fascia along with disruption of perforating vessels. Following this shear injury, a potential dead space is created which is filled by blood, lymph, serosanguinous fluid, and necrotic fat that overwhelms the absorptive capacity of relatively hypo-vascular injured tissue around the space [2]. Ongoing discordant movement between separated surfaces of tissue prevents tissue adherence, which promotes seroma accumulation and slow continuous expansion of the lesion [3]. The lesion is most commonly described around greater trochanter, but similar lesions have been reported in the other locations, including the buttock, proximal medial thigh, knee, scapular region, lower lumbar spine, abdominal wall, and calf. Several treatment methods have been suggested for this lesion, including conservative methods like compression bandages [4], aspiration [5], and sclerosants [6]. The surgical techniques described include open and

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percutaneous debridement [7], excision [8], and negative pressure wound therapy and quilting sutures [9]. However, there is no consensus on the optimal management of these lesions [10, 11]. Most of the methods focus on the removal of fluid and pseudocyst removal rather than treating the underlying pathology, namely separation of skin from the deep fascia. It results in discordant movement between these tissue layers preventing adherence of the layers. We postulated that the fundamental problem is the separation of skin from the deep fascia, and once this is addressed the risk of recurrence may be minimized.

Materials and Methods

Twenty-two patients with MLL treated in our hospital between January 2012 and May 2018 were enrolled in the study. The diagnosis was made by clinical examination and ultrasound in all the cases. All patients with MLL above 10 cm diameter were included irrespective of site. This was a prospective single-centre case series. All the surgeries were performed by the senior surgeon (final author). In our series, there were 18 males and four females with an average age of 22 (range 16–52). Twenty-one cases were following high-speed road accidents, and one was a patient who fell off a bicycle. The average time gap from the injury to drainage of the lesion was 7 days (range 2–60 days). Blood investigations, including total count and ESR, were done in every case. The clinical diagnosis was made by a combination of history of trauma and the presence of a fluctuant swelling. The skin over the lesion was intact, hypermobile but bruised in all cases. The clinical diagnosis was further confirmed by an ultrasound scan. Lesions varied in length from 12 to 60 cm measured along the long axis on the ultrasound scan. We obtained MR scans in selected cases to rule out any underlying ligament injuries. Trochanter and lateral thigh (16) accounted for the majority of lesions followed by the knee (4) and elbow (2). The associated fractures included the pelvis (2), acetabulum (2), femur shaft (2), distal femur (3), proximal tibia (1), and distal radius (1). Six of these cases needed surgical fixation of bones through the MLL. The decision for the timing of definitive fixation of fracture was mostly a clinical one. In long bone fractures, we performed the fixation first, so that we have a stable bony strut around which we could repair the MLL. In case of pelvic and acetabular fractures, with an overlying MLL, we performed percutaneous quilting and waited till the skin over the lesion appeared intact and adherent to the underlying tissue without any residual collection. In these cases, we performed the fracture fixation 7–14 days from the drainage of these lesions. One case with femoral fracture had clinical features of fat embolism syndrome. This was treated on a ventilator, and the MLL was operated on day 7, once he was stable.

Fig. 1 MLL involving the anterolateral left thigh. The first incision is placed in the proximal third of the lesion, and a suction tip (black arrow) is used as a guide to mark out the margins (white arrow)

Fig. 2 Sutures catching both skin and deep fascia (black arrow) are placed along the margins of the MLL. A suction tip (white arrow) is used as a probe to confirm that sutures each suture engages both layers

Patients were evaluated at the end of the treatment for any recurrence, infection, and any iatrogenic injuries.

Surgical Technique

The lesion was aspirated first, and the specimen was sent for culture and sensitivity. Two 1 cm incisions, one centred over proximal third and the other centred over the distal third were made over the lesion. The circumferential margin of the lesion was marked with a suction tip passed through the incisions (Fig. 1). The suction tip was used to feel where the lesion ended, and this was marked on the skin using a marker pen. The lesion was then irrigated with normal saline through a wide-bore nasogastric tube inserted into the lesion and suction was applied though a suction catheter in the second incision. Lavage was performed until the fluid was clear. Depending on the size of the lesion, this would take between 5 and 10 min. Deep bites were then taken involving the skin and deep fascia with heavy non-absorbable non-braided sutures (1.0 Ethilon™ sutures) starting from the periphery to centre. A suction drain tip passed through the stab wounds was used for tactile feedback to ensure that the sutures engaged the deep fascia to the skin (Fig. 2). We placed sutures at approximately 2 cm intervals. Once all the sutures were in place, a drain was passed through the suction tip (Fig. 3). We noticed in the initial cases that if the drain is

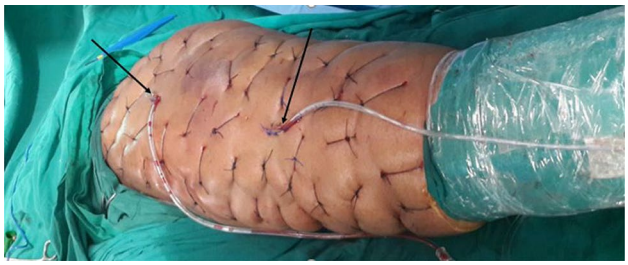

Fig. 3 Suturing of MLL has been completed with two drains (black arrow) left in situ

placed before sutures are completed; it would get caught in the sutures. Placing the drain through the suction tip helps to avoid this problem and can be done once all the sutures are in place. We used a closed suction drain in all the cases. The drain was removed once it was less than 25 ml over 24 h (Table 1). The surgical fixation was performed 7–14 days from the drainage through the MLL (Fig. 4). The quilting sutures were removed usually around day 16 (Table 1) after the surgery once the skin felt adherent to the underlying fascia.

The surgeon should avoid placing sutures where the neurovascular bundle is close to the skin like the anterior groin. Fortunately, most MLL occur around the more convex areas of the extremity like lateral thigh, anterior knee, and trochanter which are away from major neurovascular structures.

Results

We followed these cases weekly for 4 weeks and then once a month until 6 months and then at the end of a year. There were no cases lost to follow up. All 22 cases healed uneventfully with no recurrence, reoperations, infections, or iatrogenic injuries or skin necrosis.

Discussion

Morel-Lavallée lesions are closed post-traumatic degloving soft-tissue injuries. The skin and subcutaneous tissues are dependent on the blood vessels and lymphatics penetrating from below through the muscle and fascia. The shearing stress leads to disruption of lymph and blood vessels. The rate of filling and composition of potential dead space filling is dependent upon the duration of injury, number, and type of disrupted vessels.

Clinical manifestation of MLL varies according to the nature and extent of the injury. Some patients complain of pain over the injury site with or without reduced mobility, whereas others have no obvious symptoms. A soft-fluctuant swelling with hypermobile skin is a typical finding on physical examination. Bruising, ecchymosis, laceration, and/or contusion may be found [12].

Ultrasound (US) findings [13] have been found to be very useful when used along with the clinical history to diagnose MLL. US is relatively cheap and can be performed by the bedside in a poly-traumatized patient. However, it is an operator-dependent procedure [14]. On US, MLL has a characteristic location between the deep fat and overlying fascia with heterogeneous echogenicity (Fig. 5) dependent on the stage of evolution of blood products. The lesions are compressible without flow on colour Doppler [15].

Magnetic resonance imaging (MRI) has the advantage to show tissue planes (Fig. 6), composition characteristics [16], and any associated soft-tissue ligamentous injuries better compared to US. An MRI-based classification of MLL has been proposed recently [17]. However, the relevance of this from a prognostic and therapeutic point of view is unclear at present.

In MLL, interestingly, both US and MRI have been advocated as investigations of choice [18, 19] by different authors based on their experiences. Overall, there are more articles supporting MRI as the investigation of choice. The main limiting factor of MRI is the cost.

We agree with Tseng et al. [7] and Zairi et al. [20] that the diagnosis may be made from history and clinical examination in most cases. The US helps in confirming the diagnosis and the extent of the lesion [21]. MRI even though is the investigation of choice, from a practical point of view, it is not always possible as many patients are in considerable discomfort from the long bone or pelvi-acetabular fractures with some of them in splints which are MR incompatible.

Conservative treatment modalities used include observation, aspiration, compression bandage, and sclerosants, alone or in combination. Observation alone has been a mixed bag in terms of results with a varying success rate of 20–80% [10, 22]. Aspiration has been tried as a treatment option with a success rate between 44 and 81% [10, 23]. Simple aspiration has not been advocated when the fluid collection is more than 50 ml because of an unacceptable failure rate [10] of 80%. Another limitation of this method is its failure to remove necrotic fat from the lesion, causing inflammatory reactions to persist culminating in the chronic lesion and pseudo-capsule formation [24].

Some authors have recommended sclerosants like doxycycline, talc, and alcohol. Sclerosants promote fibroblast growth and adherence between the layers. Infection and skin necrosis [25] have been well documented as the potential complications of this therapy.

Minimally invasive techniques have been advocated to decrease the postoperative complications associated with open surgical management of more extensive wounds such as recurrence, skin necrosis, and scars. These techniques preserve the subdermal vascular plexus and reduce the risk

Table 1 Patient demographics

Age	Sex	Comorbidity	Mode of injury	Location	Other injury	ESR	Size of lesion in ultra sound (cm)	Days to surgery	Culture	Removal of drain	Removal of sutures
22	M	NIL	RTA	Knee		24	15	5	Negative	2	13
18	F	NIL	RTA	Trochanter	Distal femur	41	12	2	Negative	3	16
52	M	DIABETES	Bicycle	Lateral thigh		13	15	2	Negative	3	14
30	M	NIL	RTA	Elbow		NA	12	3	Negative	2	16
18	M	NIL	RTA	Knee		17	17	3	Negative	2	20
17	M	NIL	RTA	Trochanter	Distal femur	45	20	14	*S. aureus*	4	17
20	M	NIL	RTA	Trochanter	Acetabulum	39	15	4	Negative	2	14
18	M	NIL	RTA	Lateral thigh		20	25	3	Negative	2	15
30	F	NIL	RTA	Lateral thigh	Proximal tibia	37	20	2	Negative	2	17
16	M	NIL	RTA	Knee		20	16	5	Negative	2	20
17	M	NIL	RTA	Elbow		NA	13	4	Negative	2	14
26	M	NIL	RTA	Lateral thigh	Femur shaft, fat embolism	51	20	7	Negative	4	17
22	M	NIL	RTA	Trochanter		25	15	5	Negative	2	15
18	M	NIL	RTA	Trochanter		19	17	4	Negative	2	18
19	F	NIL	RTA	Trochanter	Distal femur	30	17	5	Negative	2	13
24	M	EPILEPSY	RTA	Trochanter		23	20	5	Negative	2	15
18	M	NIL	RTA	Knee	Meniscal tear	41	14	2	Negative	2	16
26	M	NIL	RTA	Trochanter and thigh		53	60	5	Negative	2	13
17	F	NIL	RTA	Trochanter		25	16	2	Negative	2	14
23	M	NIL	RTA	Lateral thigh	Femur shaft	45	30	2	Negative	2	16
23	M	NIL	RTA	Trochanter	Pelvis	60	22	60	Negative	4	17
20	M	NIL	RTA	Trochanter		26	16	12	Negative	3	17

Fig. 4 Two weeks after percutaneous quilting of MLL, incision through first window of ilioinguinal approach (black arrow) is performed across the upper part MLL to fix sacroiliac joint fracture

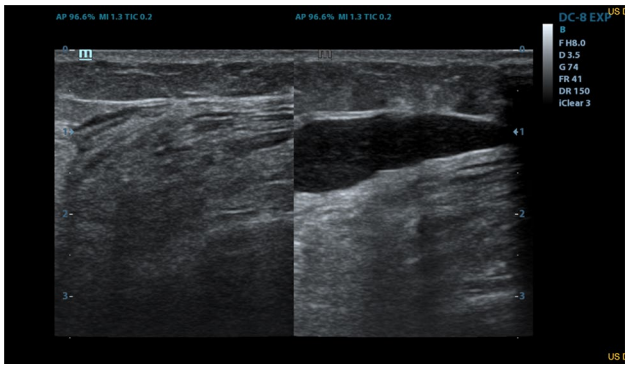

Fig. 5 High-resolution US images with compression (left) and without compression (right) showing a well-circumscribed compressible fluid collection in the deep subcutaneous plane

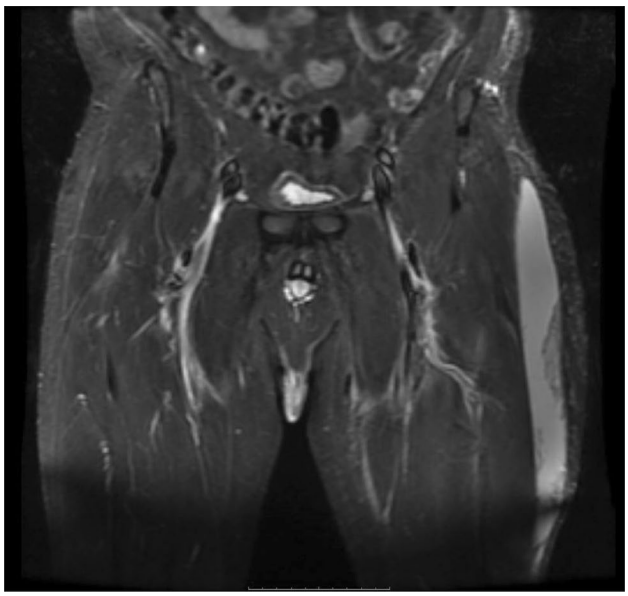

Fig. 6 Coronal MR inversion recovery (IR) image showing a large elliptical fluid collection in the deep subcutaneous plane along the whole of the lateral thigh. The lesion is predominantly IR hyperintense with heterogeneous intermediate signal areas which are suggestive of blood products

of skin necrosis. The methods include acute drainage [12] of ML lesion through a small incision along with the compression dressing.

Open debridement helps to clear the necrotic tissue with ease and addressed the problem of dead space, but limitations include potentially disfiguring surgery, need for redebridement, and a higher complication rate [26]. Among the open methods, quilting technique has been advocated to reduce post-abdominoplasty seroma formation [27]. Recently, there have been two reports, although with a relatively small number of cases, where techniques with quilting-type sutures have been used. Reid et al. [28] presented a case report where they used tension sutures along with vacuum drainage. Liu et al. [29] treated eight cases with a technique similar to ours, but they used an arthroscope to ensure that the skin was reattached to the fascia.

We started using percutaneous quilting technique in 2012 and presented our results in the Indian Orthopedics Association National conference in December 2016. Rather than a relatively costly arthroscope, we found a suction tip very effective for tactile feedback to ensure that each suture was engaging both layers.

Mikic [22] has reported one of the most extensive series of patients of ML lesion with 85 patients over 20 years. In this series, he compared the different modalities of treatment available across the time, including conservative, aspiration, incision, and drainage and more extensive surgical procedures including open excision of the bursal wall through the centre of the lesion and cutaneo-fascial suturing. Clinical outcome was graded as good, fair, and poor based on length of treatment, pain, complications, functional limitation, and cosmetic effects. Among treatment modalities, surgical treatment provided 95% good results as compared to 74% poor in conservative methods.

In our series of 22 cases of MLL, we had excellent clinical results, with none of the cases showing any signs of recurrence, infections, skin necrosis, or iatrogenic injuries. Other than lavaging with saline, we did not use a brush or a shaver to debride the lesions. We had only one case with bacteriological growth in contrast to Tseng et al. [7] and Hak et al. [30] who reported culture positivity in 19% and 46%, respectively. We feel that this may be, because we addressed these lesions relatively early.

We feel that the most common reason for recurrence is the persistence of dead space, which allows the accumulation of fluid. None of our cases had recurrence as we successfully managed to close the dead space by the percutaneous quilting-type sutures reattaching the separated skin to the deep fascia. We kept a gap of about 2 cm between the sutures. We did not notice skin necrosis in any of our cases, even though we accept that this is a theoretical risk. The main limitation of this procedure is that it cannot be performed around areas where neurovascular structures are

close by. The procedure can be done with standard instruments available at any primary healthcare centre, and there is no need for vacuum dressings, arthroscope, or compression bandages.

Conclusion

In our study, we have tried to address the primary pathology of MLL. To our knowledge, this is one of the largest series from a single centre. Percutaneous drainage, along with suturing of the skin and subcutaneous tissue to deep fascia, prevents the discordant movement and obliterates the dead space-aiding apposition of the layers. We feel that percutaneous quilting technique is a simple and effective procedure with low recurrence rates.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they or their immediate family do not have any conflict of interest regarding this study.

Ethical standard statement 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.

Informed consent Informed consent was obtained from all individual participants included in the study.

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