Management of Morel-Lavallee Lesion Associated with Pelvic and/or Acetabular Fractures

Christian Luzius Steiner, Otmar Trentz, Ludwig Labler[1]

Abstract

Objective: Management of Morel-Lavallee soft tissue lesion (MLL) in patients with associated pelvic and/or acetabular fractures is still under discussion. Especially, the sequence of treatment of MLL soft tissue management and osteosynthesis of pelvic and acetabular injury remains controversial.

Methods: We report all consecutive patients with MLL associated with pelvic ring and/or acetabular fractures during an 8-year period at our hospital. Surgical access and techniques were analyzed concerning complications and outcome.

Results: Altogether, 20 patients were included in the study. One patient was treated conservatively and MLL healed without complications; 19 patients had an operative treatment of MLL. In 15 patients debridement was performed within one day after injury and in four patients with delay of 5 days at least. Ten patients had surgery for an associated pelvic ring or acetabular fracture. In four of them MLL was operated before, in six patients simultaneously to osteosynthesis. In three patients, the same surgical approach for osteosynthesis and debridement of MLL was used; none of them showed postoperative complications. Altogether, in nine operated patients (47.4%) MLL healed without any complications. Nine operated patients presented prolonged wound healing, however, during long term follow-up, all patients showed complete healing of the MLL. One patient died during resuscitive surgical procedures.

Conclusions: We recommend debridement for early and delayed treatment of MLL. Osteosynthesis during first debridement may be performed without adverse outcome. Identical surgical access for both procedures can be used. In case of repeated surgical debridement VAC® therapy may be a helpful tool for dead space reduction and wound conditioning.

Key Words
Pelvic and acetabular fractures · Soft tissue injuries and infection · Wound healing · Hip fracture · Pelvis

Eur J Trauma Emerg Surg 2008;34:554–60

DOI 10.1007/s00068-007-7056-y

Introduction

Morel-Lavallee described a closed degloving injury in the year 1853 as ''Décollement traumatique de la peau et des couches sous-jacents'' [1]. Letournel and Judet referred to degloving injuries occurring over the region of the greater trochanter as a Morel-Lavallee lesion (MLL) [2]. The combination of shearing and compressing forces creates a cavity that is filled with hematoma, resulting from the disruption of transaponeurotic vessels and a mixture of viable and necrotic fat. Closed degloving injuries represent a severe traumatic separation of the skin and subcutaneous tissue from the underlying fascia [3, 4]. The area of degloving can occur anywhere over the trunk, buttock, or thighs [2, 5, 6]. The diagnosis of these closed degloving injuries is based on physical examination. The presence of a soft fluctuant area is the characteristic physical finding. Variable cutaneous hemorrhages, decreased cutaneous sensation or local contusion marks are often associated in the area of degloving (Figure 1). If there should be uncertainty about the diagnosis, a needle

[1]Division of Trauma Surgery, Department of Surgery, University Hospital, Zürich, Switzerland.

Received: March 28, 2007; revision accepted: August 30, 2007;
Published Online: November 14, 2007

Figure 1. Clinical finding of Morel-Lavallee soft tissue lesion over trochanter extending to thigh and sacro-gluteal (Patient no. 7).

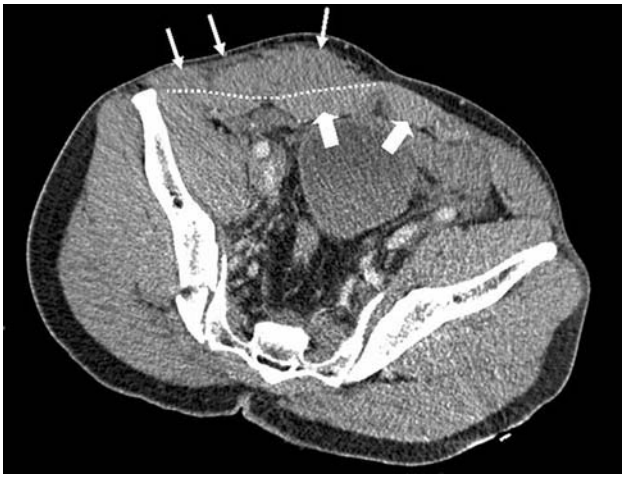

Figure 2. *Solid arrows* represent Morel-Lavallee soft tissue lesion over right hypogastric and inguinal region; *dotted lines* indicate Fascia layer and *open arrow* represents Musculus rectus abdominis (Patient no. 1).

aspiration of the area can be performed to confirm the presence of haematoma [7]. To diagnose or exclude an accompanying fracture a conventional radiography or CT scan is obligatory. Extensive cavity formation in case of MLL may be seen on CT scan (Figure 2).

The affected skin from direct trauma in combination with reduced soft tissue perfusion as a result of increased pressure in the cavity may result in epidermiolysis and necrosis. This may result in a soft tissue infection. Previous reports have documented their potential to be colonized with bacteria at the time of initial drainage, even though they are closed injuries [2, 5, 6]. A soft tissue infection has an impact of a potential osteosynthesis of an underlying osseous lesion [6, 8, 9].

Various methods have been suggested for the treatment of these degloved areas, including compression dressings, needle aspiration, injection of sclerosing agents such as tetracycline, deep fascial fenestration, percutaneous surgical drainage, and open surgical debridement [3, 5–7, 10–13].

Management of MLL in patients with associated pelvic and acetabular fractures is still under discussion. Especially, sequence of treatment of MLL and osteosynthesis of pelvic and/or acetabular injury remains controversial. This study reports our experience on patients with MLL associated pelvic and/or acetabular fractures.

Materials and Methods

The data pertaining to 20 consecutive patients with an acute Morel-Lavallee soft-tissue degloving injury were reviewed retrospectively; 800 patients with pelvic ring and/or acetabular fractures were admitted to trauma centres during an eight-year period between 1998 and 2006. All of the 20 patients with MLL had pelvic ring fractures; 5 (Nos. 1, 3, 4, 10, 16) of the 20 patients had an additional acetabular fracture. The incidence in our review of MLL in combination with pelvic ring fracture was 2.5% and in combination with acetabular fracture was 0.6%. The average age of the patients was 39 years (range, 13–73 years, SD 17.5). Fifteen of the patients were male. An 88-year-old patient with lateral compression pelvic injury and bilateral MLL over trochanteric region, suffering multiple injuries (ISS of 34) died after decision to ''therapia minima'' in the emergency room. While this patient fulfilled all our study criteria he was excluded. The severely injured patients were managed according to the Advanced Trauma Life Support® guidelines [14]. MLL was diagnosed in all patients on admission day. The diagnosis was based on physical findings consisting of a fluctuant area with variable dimension of ecchymosis around the pelvic girdle. None of the 20 patients had a full-thickness skin lesion. The locations of MLL in our study group are summarized in Table 1. Mechanisms of injury were car accidents in five patients (Nos. 4, 5, 7, 8, 11), motorbike accidents in four patients (Nos. 2, 13, 15, 17), bicycle accidents in three cases (Nos. 12, 14, 16), pedestrian accidents with a car in four patients (Nos. 3, 6, 19, 20) and four falls from great height (Nos. 1, 9, 10, 18).

Table 1. Locations of Morel-Lavallee soft tissue lesion.

Patient	Over trochanter	Over trochanter extending to thigh	Over trochanter extending to thigh and abdomen	Sacro-gluteal	Hypogastric or inguinal
1					+
2			+		
3					+
4				+	
5		+			
6	+			+	
7		+		+	
8					+
9				+	
10	+			+	
11		+			
12				+	
13				+	
14			+	+	
15		+			
16				+	
17		+			
18				+	
19	+				
20					+

Associated injuries to MLL in combination with pelvic ring and/or acetabular fracture are presented in Table 2. The mean injury severity score (ISS) of the 20 patients was 25.85 points (range, 9–50 points, SD 11.9) with a mean revised trauma score (RTS) of 7.159 (range, 4.094 to 7.841 points, SD 1.059) [15–17].

Operative treatment included centric incision over the full distance of lesion, debridement, extensive irrigation with saline solution and copious hemostasis in all operated patients. Irrigation was performed until the fluid was completely clear. If soft tissue situation after debridement and hemodynamic situation allowed, tending sutures and primary wound closure with drainage was performed in 11 patients (Nos. 1, 2, 3, 4, 8, 11, 15, 16, 17, 19, 20). If damage control procedures were necessary because of patient overall situation [18, 19] or in critical wound situations were primary closure of the wounds was not indicated, temporary packing (Nos. 5, 9, 18) or vacuum-assisted closure (VAC®) – therapy (Nos. 6, 7, 12, 14) were used [20–22]. Specimens of wound fluid for bacteriological examination were examined from 19 patients. Perioperative antibiotics as prophylaxis intravenously were admitted in all cases Table 3. A planned second-look operation was performed in 12 (63.2%) of 19 operated patients (Nos. 1, 2, 5, 6, 7, 10, 11, 12, 14, 15, 17, 18).

Healing of the Morel-Lavallee degloving injury was predefined as inconspicuous skin over the former lesion region and the disappearance of skin mobility 6 months after injury. Complication in treatment of the MLL was predefined as prolonged healing because of persisting fluctuation, necrosis, fistulation or colonization of the soft tissue with micro-organism.

Results

Altogether 20 patients were included in the study. One patient (No. 13) was treated conservatively where MLL healed without any complications; 19 of the 20 patients had an operative treatment of MLL. The types of associated pelvic and acetabular fractures are summarized in Table 4.

Fifteen (78.9%) patients (Nos. 1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 14, 15, 17, 18, 20) had an operative treatment of MLL within 24 h after injury. Four (21.1%) patients (Nos. 4, 8, 16, 19) had an operative treatment of MLL with delay of 5 days at least. Reasons for subsequent operative treatment of MLL were manifold and summarized in Table 5. A 25-year-young patient (No. 9) died in spite of damage control operation including pelvic stabilization and packing of MLL after a fall over 10 m (ISS 41 points) due to hemorrhagic shock on admission day.

Six (Nos. 2, 5, 7, 9, 11, 14) of the twenty pelvic ring fractures were fixed surgically, in two patients (Nos. 7, 11) the MLL was treated in an earlier intervention and in four patients (Nos. 2, 5, 9, 14) during the surgical treatment of the pelvic ring injury. In only one patient (No. 2) same surgical approach was used for debridement of MLL and internal fixation.

Two (Nos. 3, 10) of the five acetabular fractures were fixed surgically; treatment of MLL was performed before acetabular reconstruction in both patients. In both cases a different surgical approach for osteosynthesis was used than for debridement of soft tissue lesion.

Table 2. Associated injuries in patients with combination of MLL with pelvic ring and/or acetabular fracture.

Patient	ISS[a]	AIS[b]					
		Head/cervical/ cervical spine	Face	Thorax/thoracic spine	Abdomen/lumbar spine	Extremities/ pelvis	Integument
1	17	2				3	2
2	29				3	4	2
3	13					3	2
4	27	3	1		3	3	2
5	50			5	4	3	2
6	17			1	3	2	2
7	29	1	1	4		3	2
8	9		1			2	2
9	41	3		4	4	3	2
10	22	3	1			3	2
11	34	3	1		3	4	2
12	17			3		2	2
13	13					3	2
14	45				5	4	2
15	41	3		4	4	3	2
16	34	4		3		3	2
17	27	3			3	3	2
18	17				3	2	2
19	13					3	2
20	22			3	3	2	2

[a]Injury severity score [15]
[b]Abbreviated injury score [27]

Table 3. Perioperativ antibiotics.

Antibiotic	Number	Patients no.
Amoxicillin/Clavulanacid	4	2, 3, 19, 20
Cefuroxim	8	8, 10, 11, 12, 14, 15, 17, 18
Cefazolin	5	1, 4, 5, 6, 9
Gentamycin, Clindamycin	1	7
Trimethoprim/Sulfamethoxazol	1	16

Two patients (Nos. 1, 4) had surgery for acetabular and pelvic ring fracture, MLL was treated in the same intervention through identical surgical incision. All osteosyntheses – beside patient No. 7 – were performed with standard reconstruction plates; a distance osteosynthesis was used in patient No. 7.

The other ten patients (50%) had no surgery for an associated pelvic ring or acetabular fracture, but nine (Nos. 6, 8, 12, 15, 16, 17, 18, 19, 20) of them had operative treatment of MLL.

Average time from injury to the first surgical debridement in the 19 patients was 2.5 days (range 1–13 days). All lesions showed negative bacteriological culture at the time of initial debridement.

Twelve out of nineteen patients had a second-look operation (Nos. 1, 2, 5, 6, 7, 10, 11, 12, 14, 15, 17, 18). Only two (Nos. 7, 14) patients with second-look operations had a high number of re-operations (No. 7: eleven debridements, No. 14: twenty-nine debridements) due to severe soft tissue infection or necrosis. The average number of second-look operations in the remaining ten patients was 1.6 (range 1–4).

One patient (No. 9) died in spite of damage control operation. The MLL healed without any complication in nine (47.4%) (Nos. 1, 2, 3, 4, 5, 6, 15, 18, 20) of the nineteen operated patients. Only one (No. 4) of these nine had a delayed operative treatment of MLL.

In nine (47.4%) patients (Nos. 7, 8, 10, 11, 12, 14, 16, 17, 19) of the nineteen operated patients one of the predefined complications has been found, Table 6. Three (33%) of these nine patients (Nos. 8, 16, 19) had a delayed operative treatment of MLL.

Three of nine patients with complicated healing (Nos. 7, 10, 12) showed infection of the soft tissue with positive cultures of specimens taken from the wound during the first second-look operation.

A 43-year-old patient (No. 7) after a car accident in a foreign country with type C pelvis injury and femur fracture at MLL side was treated with external fixator and intramedullary nailing after open debridement of MLL. Nine days after injury on admission in our unit this patient presented a deep tissue infection over MLL region (*Enterobacter cloacae, Acinobacter baumannii, Pseudomonas aeruginosa*), with additionally femoral posttraumatic osteitis. The femoral nail was removed; the femoral canal was reamed and temporarily fixed with external fixator. After repeated debridements and VAC® therapy for wound conditioning secondary

closure of the wound was achieved. In an infection-free situation internal fixation of the pelvic fracture was performed through a separate surgical approach 17 days after trauma and the femoral fracture was definite stabilized by plating 25 days after trauma.

A 27-year-old patient (No. 10) with MLL femorogluteal after fall from 10 m had *Escherichia coli* microorganism taken from specimens taken during second-look operation of MLL. Surgery for the isolated acetabulum fracture was performed through a separate approach. Uneventful wound healing was reached under antibiotic therapy, without further surgical treatment.

A 73-year-old patient (No. 12) with MLL sacrogluteal after bicycle accident had deep tissue infection with staphylococcus aureus after open debridement and temporary packing. The sacrum fracture was treated conservatively. Wound healing after VAC® therapy with wound conditioning with three second-look operations was achieved after 19 days.

Antibiotic treatment was necessary in all above-mentioned patients, adjusted on the basis of the bacteriological findings and proceeded till an infection-free situation was achieved.

All of the 18 surviving operated patients had an inconspicuous wound at discharge after mean hospitalisation time of 28.7 days (range 5–94 days, SD 19.8).

Eighteen of nineteen surviving patients were included in the follow-up; follow-up is missing in one patient (No. 1) who was transferred to country of origin after a 3-week hospitalization in our clinic. The average follow-up time in these 18 patients was 45.16 months (range 13.8–102.5 months, SD 22.6). All of them reached healing of the MLL tissue damage.

Table 4. Classification of pelvic ring and acetabular fractures.

Patient	Pelvic ring fracture			Acetabular fracture		
	A[a]	B[a]	C[a]	A[b]	B[b]	C[b]
1			+	+		
2	+					
3		+			+	
4		+				+
5			+			
6		+				
7			+			
8	+					
9			+			
10	+					+
11		+				
12	+					
13		+				
14			+			
15	+					
16		+		+		
17		+				
18		+				
19		+				
20	+					

[a]AO classification of pelvic fractures [28]
[b]AO classification of acetabular fractures [29]

Table 5. Reasons for subsequent operative treatment of MLL.

Cause for delayed operative treatment	Delay (days)	Patients no.
Repatriation after accident in foreign country	5	4
Intact pregnancy	13	8
Persisting fluctuation	6	16
Skin necrosis with fistula formation	9	19

Table 6. Complications.

Type of Complication	Number	Patients no.
Persisting fluctuation	3	8, 16, 17
Soft tissue necrosis	3	11, 14, 19
Infection		
Enterobacter cloacae, Acinobacter baumannii, Pseudomonas aeruginosa	1	7
Escherichia coli	1	10
Staphylococcus aureus	1	12

Discussion

Morel-Lavallee lesion is a rare but major soft tissue injury around pelvic girdle.

The significance of the soft-tissue injury may not be initially apparent. Hudson et al. reported a delay in the diagnosis for one-third of the patients in their series [3, 7]. In our series we diagnosed this specific soft tissue injury in all of the 20 patients within 1-day after injury.

Hak et al. [6] reviewed the diagnostic methods, which include clinical signs as well as needle aspiration. Lesions also may be visible on CT scan [23]. In our group diagnosis based on physical findings, no needle aspiration was performed. Larger cavities filled with hematoma were visible on CT scan.

The majority of authors suggest, once the lesion is identified, the hematoma must be evacuated and any necrotic tissue must be removed as neglected lesion can become infected, complicating management [2, 3, 5, 6, 11, 13, 24]. Harma et al. [4] propose in their series

with five patients a conservative management of the lesions. Tsur et al. [25] describe in case report with two patients that needle puncture and pressure therapy may be sufficient for therapy. In our study group only one patient (5.3%) of 19 surviving patients was treated conservatively where MLL healed without any complications.

Less invasive surgery was first recommended by Hudson et al. [3]; in their prospective study with 16 patients percutaneous surgical drainage was performed; as well Tseng et al. propose in their series with 19 patients an early percutaneous surgical drainage, to avoid further violation to the remaining vascular supply to the skin by open debridement [7, 26]. Open debridement was recommended for cases that are diagnosed delayed [2, 3, 5, 6, 11, 13, 24]. Hak et al. [6] showed in their series with 24 patients in 46% positive culture at the time of the initial debridement, which was after 13 days in average. Over a MLL skin is by definition intact but is damaged by the energetic local impact, so infection comes from circulating bacteria or translocation. Therefore, a certain period of time must pass before lesion becomes colonized. Tseng et al. [7] postulated that if diagnosis of MLL is made early there may be lower rate of infected lesions. The low rate of infection in only three patients (15.8%) in our study may be a result of early first surgical debridement on an average of 2.5 days (range 1–13 days) after injury. Unattended none of the four patients with delayed debridement (after 5–13 days after injury) had positive cultures of specimens taken from the wound. The absence of infection in the group with delayed debridement stays in contrast of others studies, which argue an increasing rate of soft tissue infection by deleted operative treatment [2, 5, 6]. A cause therefore is indistinct, furthermore is this number of four patients not significant.

Ten of the twenty patients had surgery for an associated pelvic and/or acetabulum fracture. In four patients MLL was treated in a previously operation than fracture fixation and in six patients at the same time. In three cases the same surgical approach for internal fracture fixation and operative treatment of MLL was used and none of patients had signs of infection.

We conclude that treatment of MLL should be performed by incision over the whole length of lesion, with debridement, extensive irrigation, tending sutures and placement of wound drainage. A non-operative treatment of MLL should be an exception and might be applied for small MLL with out need of further pelvis osteosynthesis. If operative fixation of displaced pelvic ring or acetabulum injuries is indicated, open debridement of MLL can be performed before or during osteosynthesis. Identical surgical access for osteosynthesis and for debridement of MLL can be used without increased infection rate. If MLL is away of osteosynthesis approach two incision are proposed. In case of repeated surgical debridement due to positive culture of the wound or uncertain soft tissue conditions VAC® therapy may be a helpful tool for dead space reduction and wound conditioning.

References

1. Morel-Lavallee. Decollements traumatiques de la peau et des couches sous-jacentes. Arch Gen Med 1863;1:20–38, 172–200, 300–32.
2. Letournel E, Judet R. Fractures of the acetabulum. In: Elson RA, 2nd edn. Berlin: Springer; 1993:337, 363–97.
3. Hudson DA, Knottenbelt JD, Krige JEJ. Closed degloving injuries: results following conservative surgery. Plast Reconstr Surg 1992;89:853–5.
4. Harma A, Inan M, Ertem K. The Morel-Lavallee Lesion: a conservative approach to closed degloving injuries. Acta Orthop Traumatol Turc 2004;38:270–3.
5. Kottmeier SA, Wilson SC, Born CT, Hanks GA, Iannacone WM, DeLong WG. Surgical management of soft tissue lesions associated with pelvic ring injury. Clin Orthop Relat Res 1996;329:46–53.
6. Hak DJ, Olson SA, Matta JM. Diagnosis and management of closed internal degloving injuries associated with pelvic and acetabular fractures: the Morel-Lavallee lesion. J Trauma 1997;42:1046–51.
7. Tseng S, Tornetta P. Percutaneous management of Morel-Lavallee lesions. J Bone Joint Surg 2006;88:92–6.
8. Parra JA, Fernandez MA, Encinas B, Rico M. Morel-Lavallee effusions in the thigh. Skeletal Radiol 1997;26:239–41.
9. Tscherne H, Pohlemann T. Unfallchirurgie. Bd. 7: Becken und Acetabulum. Springer, Berlin, 1998;S112–5.
10. Letts RM. Degloving injuries in children. J Pediatr Orthop 1986;6:93–7.
11. Helfet DL, Schmeling GJ. Complications. In: Tile M (ed) Fractures of the pelvis and acetabulum. 2nd edn. Williams and Wilkins, Baltimore 1995, pp 451–67.
12. Kudsk KA, Sheldon GF, Walton RL. Degloving injuries of the extremities and torso. J Trauma 1981;21:835–9.
13. Matta J. Surgical treatment of acetabular fractures. In: Browner BD, Jupiter JB, Levine AM, Trafton PG (eds) Skeletal trauma. WB Saunders, Philadelphia 1992, pp 899–922.
14. Collicott PE, Hughes I. Training in advanced trauma support. JAMA 1980;293:1156–9.
15. Baker SP, O'Neill B, Haddon W Jr, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974;14:187–96.
16. Champion HR, Copes WS, Sacco WJ, Lawnick MM, Keast SL, Bain LW Jr, Flanagan ME, Frey CF. The major trauma outcome study: establishing national norms for trauma care. J Trauma 1990;30:1356–65.
17. Champion HR, Copes WS, Sacco WJ, Lawnick MM, Bain LW, Gann DS, Gennarelli T, Mackenzie E, Schwaitzberg S. A new characterization of injury severity. J Trauma 1990;30:539–45.

18. Rotondo MF, Schwab CW, McGonigal MD, Phillips GR 3rd, Fruchterman TM, Kauder DR, Latenser BA, Angood PA. Damage control: an approach for improved survival in exsanguinating penetrating abdominal injury. J Trauma 1993;35:375–82.
19. Shapiro MB, Jenkins DH, Schwab CW, Rotondo MF. Damage control: collective review. J Trauma 2000;49:969–78.
20. Argenta LC, Morykwas MJ. Vacuum-assisted closure: a new method for wound control and treatment: clinical experience. Ann Plast Surg 1997;38:563–76.
21. Morykwas MJ, Argenta LC, Shelton-Brown EI, McGuirt W. Vacuum-assisted closure: a new method for wound control and treatment: animal studies and basic foundation. Ann Plast Surg 1997;38:553–62.
22. Labler L, Trentz O. The use of vacuum assisted closure (VAC) in soft tissue injuries after high energy pelvic trauma. Langenbecks Arch Surg 2006; Epub ahead of print.
23. Parra JA, Fernandez MA, Encinas B, Rico M. Morel-Lavallee effusions in the thigh. Skeletal Radiol 1997;26:239–41.
24. Routt ML Jr, Simonian PT, Ballmer F. A rational approach to pelvic trauma. Resuscitation and early definitive stabilization. Clin Orthop Relat Res 1995;318:61–74.
25. Tsur A, Galin A, Kogan L, Loberant N. Morel-Lavallee syndrom after crush injury. Harefuah 2006;145:111–3.
26. Cormack GC, Lamberty BG. The blood supply of thigh skin. Plast Reconstr Surg 1985;75:342–54.
27. Aspects of Automotive Safety. Rating the severity of tissue damage. I. The abbreviated scale. JAMA 1971;215:277–80.
28. Pohlemann T. Pelvic ring injuries: assessment and concepts of surgical management. In: Ruedi TP, Murphy WM (eds) AO principles of fracture management. Thieme, Stuttgart 2000, pp 391–412.
29. Helfet DI, Barlett CS. Acetabular fractures: evaluation/classification/treatment concepts and approaches. In: Ruedi TP, Murphy WM (eds) AO principles of fracture management. Thieme, Stuttgart 2000, pp 415–39.

Address for Correspondence
Christian Luzius Steiner, MD
Division of Trauma Surgery
University Hospital
Rämistrasse 100
8091 Zürich
Switzerland
Phone (+41/44) 255-1111, Fax -4406
e-mail: christian.steiner@usz.ch