Management of Missile Injuries of the Knee

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Abstract:

Background and Objectives: Iraq continues to be a troublesome area, missile injuries around the large joints of the extremity remains to be a challenging injury to the under resourced and poorly equipped unsafe hospitals. The aim of this study is to report our experience in the management of such injuries.

patients and methods: Thirteen patients (14 knees) with grade III Gustillo open fractures of the knee caused by war injury including bullets, shells of blast and missiles were treated by wound debridement, washout, repair of arterial injury after external or internal fixation of the fracture. Five patients (38%) required Dacron arterial graft for associated vascular injury, there was a case of permanent nerve damage (7%).

Results: The outcome was satisfactory in 6 patients (46%), fair in five (38%) and poor in the remaining (16%). One limb remained was ischemic; one case of infection required amputation. These patients underwent wound debridement, skeletal fixation and vascular and or plastic reconstruction.

Conclusion: There is high association of open war injuries of the knee with neurovascular injuries. Awareness of the associated vascular injury and team approach, is vital in the management of these injuries. Skeletal stabilization using any method deem to be appropriate is associated with good outcome provided appropriate early wound debridement is performed.

Key words: Open, Joint, Knee, Injuries, Bullets, Surgery, Shell.

Introduction:

Proper management of bullet wounds requires a working knowledge of physical factors involved in the creation of such injuries and the way in which they interact. American military surgeons repeatedly demonstrated that blood vessels. Remote from the bullet's course were disrupted, with wide separation of fascial planes [(1)]. Damage was most severe in tissues of greater density, such as fluid-filled structures or bone [(2)]. The extent of damage is attributed to the increased velocity, instability of the bullet in flight and in the tissues, and bone fragments as secondary missiles [(3)] . Contamination must always be suspected in gunshot injuries and may occur in many ways. Undoubtedly, these injuries poise a great challenge to the surgeons.

The high incidence and the management of these challenging injuries pose a threat to the inexperienced.

The aim of this study is to report our experience in the management of such injuries.

Patients and methods:

Between 2003 and 2010, thirteen male patients with mean age of 38 years (16-47 years), were treated in the Azadi teaching hospital of Kirkuk for knee injury. The injury was caused by gun shot in five patients (velocity of more than 1000m/sec) and by shaprnell of explosions in the remaining. The femur

was affected in six patients (46%), the tibia was affected in four patients (30%), both femur and tibia was affected (through the knee) in the remaining (24%). All these patients had accordingly open fracture. Five of these patients had Anderson-Gustillo Grade III-C (38%), two patients had Grade III-A (15%) and the remaining patients had grade III-B Gustillo open fractures (47%). The injuries were bilateral in one case (7%). All these patients were young and fit; they had primary debridement and fixation within 12 hours of injury, they were taken to operating theatre and underwent wound debridement and fixation, whenever required a vascular surgeon was consulted. Excluded from this survey, open fractures caused by injuries other than bullet or shrapnel's.

The arterial repair was carried out by a vascular surgeon who explored the femoral artery in the femoral triangle, to have a proximal control. The affected part of the artery was excised to remove the torn intima and the artery was repaired using Dacron graft. The arterial surgery was as followed

1. Excision of the damaged segment and Dacron graft with fasciotomy (five) (38%)
2. Direct repair of the popliteal artery was carried out in one patient.
3. Ligation of genicular artry (6 cases) (46%)
4. Unidentified arterial injury (one) (7%). This settled down spontaneously, the injury was most probably affecting the geneicular artery.

Internal fixation using plate and screws for 4 cases (30%), external fixation was used for seven patients (55%); two ring fixators (15). In one case external fixator was changed to internal fixation.

Results:

At a mean follow-up of 19.4 months (6-88 months), the following outcome measures were studied: The outcome was assessed following the following criteria; we have designed our own assessment of outcome measure:

Satisfactory (6 patients) (46%): Patient's leg is viable, has functional range of knee movement and the fracture(s) has healed

Fair (4 patients, five knee) (38%): when the results are satisfactory (as above), but the patient has pain of arthritis, shortening of less than 3 cm and restrictive stiffness of the knee.

Poor (3) (16%): The presence of complications.

The following complications were encountered:

1. Infection (one case) (7%), did not settle with repeated debridement, washout and antibiotics, had above knee amputation
2. Malunion (1) (7%), requiring derotation osteotomy and fixation.
3. Ischemic leg (one case) (7%) requiring below knee amputation.

Table (1): Illustration of the cases, procedures and outcome

Age & sex	Site injured	Mechanism	Procedure	Outcome
25 M*	left knee, penetrating left femur and upper tibia genicular artery injury, ligation	Gun	Debridement, a flap of infrapatellar fat pad was used to seal-off the articular surface	Satisfactory
47 M	Lt knee, upper tibia, genicular artery injury, ligation	Shrapnel, explosion	Debridement, internal fixation	Satisfactory
32M	Rt knee, lower femur, associated femoral artery injury, Dacron graft	Gun	Debridement, repair of artery, external fixation of lower femur	Satisfactory
46M	Lt knee, lower femur, injury to a branch of the popliteal artery, repair	Gun	Ligation of artery, debridement, blade plate distal femur	satisfactory
23M	Right upper tibia, segmental, genicular artery injury, ligation	Explosion	Debridement, external fixator	Fair
16M	Lower femur, left, femoral arterial injury, Dacron graft	Explosion	External, changed to internal fixation	Poor
45M	Rt knee, femoral artery injury, lower femoral fracture, Dacron graft	Gun	Arterial repair, External fixation	Fair
31M	Rt lower femur, Lt articualr injury of the knee with comminution, foot drop on the right side Dacron graft	Explosion	Ex fix across the knee	Fair
24M	Upper tibia left, genicular artery injury, ligated	Explosion	Ring fixator	Fair
26M	Through the knee, popliteal artery, Dacron graft	Bullet	Debridement, arterial repair	Poor
28M	Through the knee destruction/, comminution, unidentified bleeder, ligated	Explosion	External fixation, fusion	Satisfactory
29M	Lt knee upper tibia, genicular artery, ligated	Explosion	explosion Debridement, ring fixator of upper tibia	Fair
25 M	Lt lower femur, femoral arterial injury, Dacron graft	Explosion	Debridement, internal fixation	Satisfactory

*Male

Figure (1): AP view of a bullet injury to the lower femur showing the comminution and the fixation.

Figure (2): Anteroposterior view of the left knee showing shrapnel and a comminuted open fracture of the tibia extending in to the articular surface.

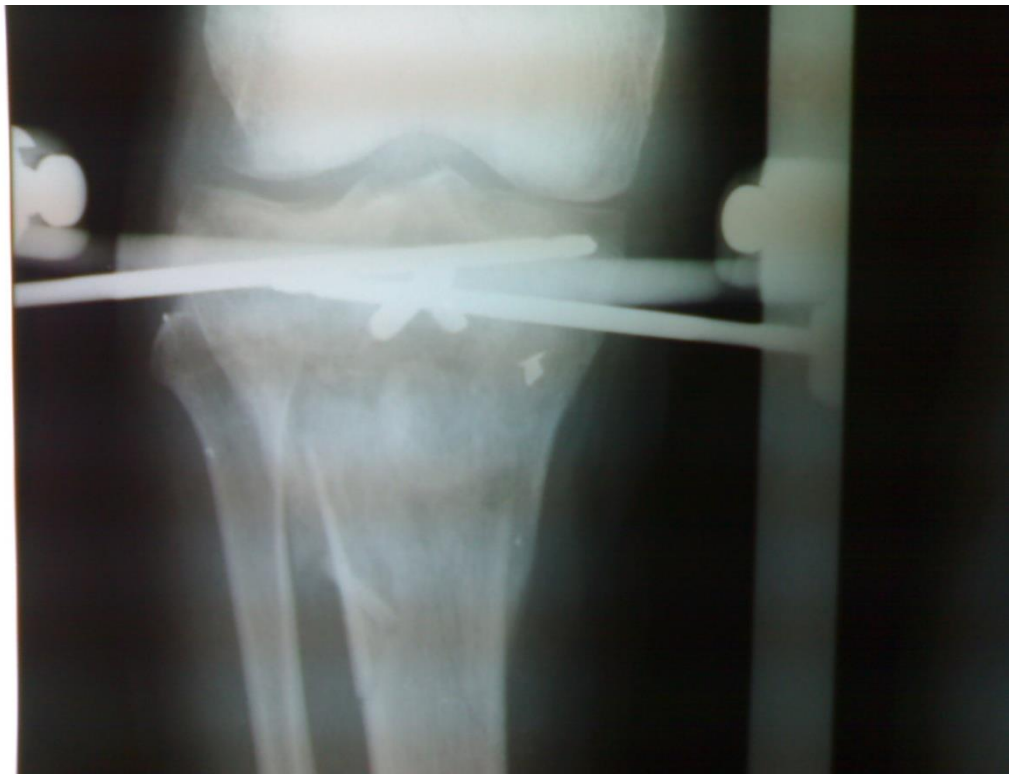

Figure (3): Hoffman fixator used to stabilize the comminuted fracture, articular fracture is fixed with partially threaded cancellous screws.

Figure (4): An image of the fixator.

Discussion:

Skeletal missile and shrapnel injuries are usually high energy injuries associated with high incidence of complications. The complications are related to the fracture(s), sustained, complications of implants used and the debilitating effect on the nearby joint. Often there is loss of function.

There is a higher incidence of delayed union, non-union and malunion of fractures sustained following high energy injuries, compared to low energy injuries. The shrapnel and explosion injuries are often high energy [1, 7]. In the current series, there was one case of malunion; the detrimental effect of the injuries is on the knee joint. Five of the patients in the current series had restrictive stiffness of the knee joint (38%).

Regarding the method of fixation, the current concept is that of damage control surgery; this is to perform a short and easy procedure(s) using temporizing external fixator. Damage control concept aims at reducing the catabolic state in multiple injured patients external fixation is easy and quick to use. Definitive primary fixation and reconstructive procedures, is time consuming, and has to be deferred until, the patient is not in the catabolic state; hence the policy (damage control) [5].

Definitive fixation is performed usually in the first two weeks of the injury. It is uncommon to use external fixation as a definitive method for fixation because of the associated high complications compared to internal fixation [4]. Internal fixation was used in 4 of the current series (30%). None of the patients had external fixation crossing the knee joint, the overall degree of disability in our series was less than reported in literature [4, 5]. A stable construct is difficult to achieve with external fixation when the fracture is in and around the joints, ring fixator may be of use. External fixation across a joint may provide stability, however it is associated with high incidence of stiffness of the joint. Fracture stabilization around and in the knee joint may necessitate internal fixation using screws and plates or intramedullary locked nail. The concern for the use of internal fixation in open fractures caused by shrapnel injuries (Gustilo III) is deep wound infection. The incidence of this was (7%) in our series. We adopt thorough early deep wound debridement, down to bone with copious irrigation of saline.

There is a high association of missile penetrating injuries with femoral/popliteal artery injury [6, 7]. Low index of suspicion of vascular injury caused by penetrating shrapnel or bullet and putting in place means to diagnose and address them, is associated with relatively a good outcome. We had a case of amputation below the knee performed for failed arterial surgery.

Conclusion:

There is high association of open war injuries of the knee with neurovascular injuries. Awareness of the associated vascular injury and team approach is vital in the management of these injuries. Early deep wound debridement and washout, is vital. Internal fixation may become the only implant to provide stability and to reduce the incidence of stiffness of the joint; it is a safe practice. Long term use of external fixation across the knee joint need to be avoided because of the associated with joint stiffness.

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