
Early & Definitive Treatment of War Compound Fracture

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Abstract

Background: A good deal of war surgery is orthopedic surgery, (50-75%) of war injuries involve the limbs, that's because Soldier's at war use to be well protected by the armor for the chest & abdomen with a helmet for the head & part of the neck & a well protected vehicles for transport, the only expose part remain of the body are the limbs,, such patient may survive longer than patients with head, chest & abdomen injuries and may present to the hospital even days or weeks after injury with badly infected ,foul smelling wounds, Most of these wounds involve bones and/or joints ,, leading to what is known as open or a compound fracture .

Patients & Methods: One hindered and seven cases of war compound fractures were included in this paper, 37 female & 70 male studied from Jan 2006 – Aug,2007 in al-Yermouk teaching hospital. These injuries were caused by shells of a nearby bomb explosion, or a bullet injury from a near distance or a sniper shot due to shells mortar explosion our cases were treated first by early operative debridement for the wounds then bone stabilization for the fractures using different methods for splinting the fractures bone.

Result: Cases were divided into many groups according to Castillo classification. As the following: G i (20 cases) (18.64 %), G ii (54 cases) (50.46 %), G iii (33 cases) (30.80%), from the 107 cases, 75 cases of Lower limb (70.1%), and 32 cases upper limb forming about (29.90%).

Group one castillo G1, Mainly treated by P.O.P. splint (casting slabs) 15 cases ... 5 cases (skin traction).

Group two Castillo G11: 40 cases (74%) treated by External fixation 14 cases (26%) by internal fixation, 6 cases treated by plat & screw, 5 cases treated by rush nail & 3 cases treated by –K nail.

Group three Castillo G111 mainly by external fixation 29 cases, 4 cases internal fixation by locking K- nail.

Conclusion: One hindered and seven cases of war compound fractures were treated according to two steps, first by early surgical operative debridement, to do wound excision plus removal of foreign body, dirt, remnant of cloths, shells, and dead soft tissue, then the second steps fixation of fractures using different methods, in our research we found that external fixation is the best & safest methods (used in around 80% of the cases) to fix such a fractures, or we can used other different methods of fixation according to what is appropriate for each case.

Introduction

In war-affected areas, trauma surgeons will have to deal with limb wounds with fractures in a different principle than that governing bone healing in civilian blunt trauma. For any wound with a fracture, the advantages and disadvantages of each method of immobilization should be considered as unique entity, A fracture is a complete or incomplete break in a bone resulting from the application of excessive force^(1,2,3)

Classification of Fractures:⁽⁴⁾

Simple fractures "closed fractures" the skin has not been ruptured and remains intact. Compound fractures "open fractures" break the skin, exposing bone and causing additional soft tissue injury and possible infection.

A Single fracture means that one fracture only has occurred in one bone.

Multiple fractures, means more than one fracture occurring in the same bone

Complete fracture, if the break is completely through the bone Incomplete, "greenstick" fracture if it's partly across a bone shaft.

Fracture Classification according to the nature of the break., Types include linear, oblique, transverse, longitudinal & spiral fractures, Fractures can be classify according to the positions of bony fragments, as comminuted, displaced or non-displaced, impacted, overriding, angulated, avulsed, and segmental. Fractures can also classified as a fracture-dislocation when a fracture involves the

bony structures of any joint with associated dislocation of the same joint

Gustilo classification of Open Fracture^(5,6):-

I - Low energy- wound less than 1 cm, minimal contamination, comminution and soft-tissue damage, infection rat 0-2 %).

II - Wound greater than 1 cm (2-5cm) with moderate soft tissue damage, minimal periosteal stripping wound bed is moderately contaminated; (infected rate 2-5 %).

III- High energy –wound greater ((5- 10 or more)) with extensive soft tissue damage also subdivided into the following;

A - Severe soft-tissue damage and substantial contamination; coverage adequate, segmental fracture with displacement or fracture with diaphyseal segmental loss; no neuro-vascular injury (infection rate10 -15%).

B - Same as above + soft tissue is inadequate for cover and requires rotational flap free flap usually associated with major nerve injury (infection rat 15-25).

C - Same as the above + arterial injury (infection rat 25-50 %).

Material & Methods:

107 cases of war compound fractures, were included in this paper, 37 female & 70 male studied from Jan 2006 – Aug 2007 in al-Yermouk teaching hospital, these cases were treated first by early operative debridement for the wounds, then a bone

stabilization for the fractures using different methods for splinting the fractures bone ^(6,7).

The primary treatment includes:-

A. Early Operative Debridement include ;- ⁽⁷⁾

- 1- Exploration of the wound to define the zone of injury.
- 2- Removal of devitalized tissue as non-viable skin and muscle, and mechanical lavage for any foreign article's as clothes, missiles & shells, mud & dirt.

3- Fasciotomy should be performed & evacuation of haematoma

4- Removal of Small & medium-sized a-vascular bone fragments

5- The initial primary traumatic wound should be left open while operative extension of the initial wound may be primarily, sutured.

6- Extensive soft tissue damage should be reinspected and additional debridement performed within 24-48 hours

B. Bone stabilization



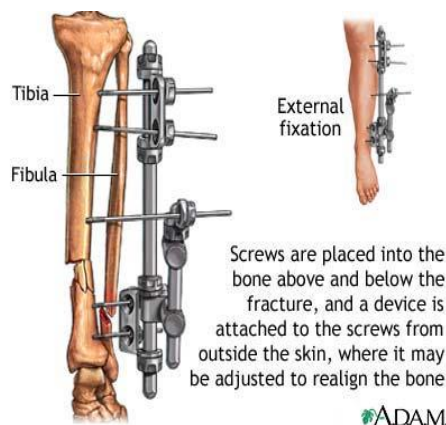
1) External Fixator ^(8,9,10,11)

Give very good results when correctly applied for the correct indications in most of the cases but it are not the only way to treat all fractures in war surgery. External fixation is the primary form of initial long-bone fracture stabilization for Iraqi US and allied soldiers treated in battlefield hospitals., Military use of external fixation is similar to current use in civilian trauma centers as a means of temporary limb stabilization..

The difference is that the wounded warrior is transported to a site of definitive care after initial stabilization at a battlefield hospital.

While the civilian injured patient continue its treatment in the same trauma center usually. Once the patient is in a stable environment, the receiving surgeon can either continue with external fixation specially if extended periods of time are needed to deride wounds adequately, or select a different treatment method for definitive treatment as intra-medullary nailing (IM-nailing)

Types of external fixation



Indication of external fixation:

1. Open compound fracture.
2. Multiple fractures.
3. Fracture + vascular injuries.
4. Fracture pelvis.
5. Periarticular fracture.
6. Bone sliding & bone lengthening.
7. Pathological # as bone Tu. Osteomyelitis.

Advantage of external fixation:

- 1: easily applied considering the safety corridors.
- 2: no soft tissue stripping.
- 3: easily removed.
- 4: Ease the patient transfer & movement.
- 5: Free & Mobil joint above & the joint below.
- 6: Help other specialties to interfer. (Plastic & neuro-surgery).

Disadvantage of external fixator:

- 1: Pin tract infection.
- 2: Mal –union.
- 3: Non-union.
- 4: injury to neuro-vascular bundle.
- 5: fracture through pin tract
- 6: broken pin.
- 7: loosening of the clamps.

2) **Plaster of Paris** War wounds with fractures are, basically immobilized using plaster of Paris (POP), in the forms of slabs, cylinder casts and bridge-POPs to provide adequate immobilization, Slabs are the usual initial means of fracture stabilization. Cylinder casts can be applied once skin closure has been obtained & odema of soft tissue subside or even on clean granulating wounds (Trueta method). They allow early patient mobilization. Disadvantage is the immobilization of proximal and distal joints. Hip spica Patients with hip or femur fracture can be managed with hip spica as an alternative to traction. Spica, which can easily be applied, is a good way of evacuating beds in rush periods. Bridge of POPs In case of relatively small wounds, POP windows allow dressing to be carried out. Larger wounds can be satisfactorily managed by this.

3) **Traction either Skin or Skeletal traction**

AdvantageIs a simple and safe method for fracture holding, especially for the lower limb, It can be used for initial and definitive stabilization and allows easy wound access and joint mobilization; It gives a rapid callus formation

Disadvantages long bed rest, leading to respiratory & urinary infection plus bed sore,, Difficult access to the buttock and posterior aspect of thigh and leg,, Male-union (difficulties in getting a perfect alignment of the fracture)

Traction can be applied in different forms: *gallows traction* for femur fractures in babies up to 3 years or 15 kg of body weight,

Skin traction usually used for older children & adult patient (temporary traction while Skeletal or pin-Traction usually used for pelvis, femur & tibial fracture specially those in need for long duration of traction for various reason .particularly applies to wounds of the calf and heel.

In summary: Historically & in Recent conflicts the methods used for bone stabilization in war compounds fractures are: A) Casting, B) Traction either (skin or skeletal) ,,C) External fixation with or without minimal internal fixation, ,D) Internal fixation (interlocking k- nail) if the condition allow.

Materials & Methods:

107 cases of war compound # were included in this paper,, 37 female & 70 male studied from Jan 2006 – Aug.2007 in al-Yermouk teaching hospital,,(age from 10 years – 65 years),, 32 cases.((29.90%)) involve the upper limb(22 humerus, 10 cases forearm fractures), ((70.1 %)75 cases of Lower limb (24 fractures femur ,51 case fractures tibia & fibula).

SITE OF INJURIES	No. of cases
UPPER LIMBS (29.9%)	22 # humerus 10 # forearms
LOWER LIMBS (70.1%)	24# feumer 51 # tibia & fibula
TOTAL OF CASES	107

Cases were divide into; Castillo class. G1\ 20 cases ((18.64 %)), G11\ 54 cases ((50.46 %)), G111\33 cases (30.80%).

Group one castillo G1. mainly treated by P.O.P. splint (casting „slabs“ ,, 15 case(75 %),,,5 cases (skin traction 25 %)

Group two Castillo G11: Mainly treated by External fixation. .40 cases (74%), internal fixation 14 cases (26%) (6 cases plat & screw, 5 cases rush nail, 3 cases-K-nail)

Group three Castillo G 111. Mainly by external fixation 29 cases (87%).4 cases (13%) Internal fixation by locking K- nail

Castillo class.	No. of cases	Types of treatment
G I	20 Cases (18.6%)	P.O.P splint in 15 cases Skin traction in 4 cases
G II	54 cases (50.4 %)	External fixation 40 cases Internal fixation 14 cases
GIII	33cases (29.9 %)	External fixation 29cases Internal fixation 4 cases

Criteria	Excellent	Good	Fair	Poor
Non union/infection	None	None	None	Yes
Neurovascular injury	None	Non	Moderate	Severe
Deformity				
Varus/valgus	None	2-5	6-10	>10
Pro/recurvatum	0-5	6-10	11-20	>20
Flotation	0-5	6-10	11-20	>20
Shortening	0-5mm	6-10mm	11-20mm	>20mm
Mobility				
Knee	Full	>80%	>75%	<75%
Ankle	Full	>75%	>50%	<50%
Subtler	>75%	>50%	>50%	
Shoulder & elbow	Full	>80%	>75	
Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Mild limp	Significant
Activity & Strenuous	Possible	Limited	Severely limited	Impossible
Study results	63	32	9	7

Results:

(Johner and Wruh's Criteria for Evaluation of Final Results) According to Johner and Wruh's Criteria for evaluation of Final Results..there were about 95 cases with an excellent to Good result that is 90% of the with good healing union ,no obvious deformity i.e shortening, varus or valgus, with no restriction of movement or stiffness in the joint above or joint below.

Only in 9 cases we notice a sever stiffness in the flexion movement of the knee joint, especially in those cases with external fixation schanze pins situated near the knee joint if it were used for treatment of the of compound fracture of lower segment of a femur ,few cases also presented by stiff shoulder if an external fixation schanz pins were situated near that shoulder joint, In 7 cases were presented with poor result due to an end result of non –union at the fractures site due to bone loss, infection, or due to in proper methods of fixation, intact fellow bone .these cases were treated later as a non union cases with bone graft & a proper fixation .

Discussion

Open fracture is an operative emergency⁽³⁾, The primary treatment includes an early operative procedure and bone stabilization. Debridement includes operative debridement, exploration of the wound to define the zone of injury, removal of devitalized tissue, and lavage for additional mechanical debridement of the wound. Clearly non-viable skin and muscle should be debrided. Fasciotomy should be performed. Small to medium-sized avascular bone fragments and other foreign bodies should be removed. The surgeon should be aware that the risk of infection is greater with necrotic bone in the wound. The initial irrigation and debridement should be followed by stabilization of the bone injury upon the initial debridement and stabilization of the fracture, the traumatic wound should be treated. The initial primary traumatic wound should be left open, while operative extension of the initial wound may be primarily sutured. Extensive soft tissue damage should be reinspected and additional debridement performed within 24-48 hours. The aim of the repeated debridement is to remove all

necrotic tissue and substrate for infection. When the soft tissue bed is stable and no necrotic tissue is seen, delayed closure or coverage of the fracture can be performed. This objective can be achieved within five to seven days from initial debridement. In war time compound fractures, however is considered primarily contaminated, and the basic principle in the treatment of war time wounds is that the development of anaerobic infection is prevented while leaving the wound open.

The objective of the surgeon is to achieve correct length and axis of the extremities, and sound stabilization of the fracture, in general with the use of an external fixator^(8,9,11,12).

Which offers a number of advantages in the treatment of open fractures. The advantages of external fixator are reduction of so-called 'dead' area, prevention of further soft tissue damage, and reduced risk of infection. In case of articular fractures, the AO suggests a combination of minimal osteosynthesis and external fixation⁽¹³⁾. It is typically used as a static form of immobilization to maintain skeletal alignment. External fixation has also been associated with some difficulties, e.g., pin-track infection, limited life-span and loosening of external fixator pins, and need of fixator revision or of conversion to another form of treatment. From the 107 cases 69 cases (65%) were treated by external fixation, 18 cases were treated by internal fixation (16.5 %), either ((plat & screw or rush nail or locking k-nail)). 15 cases (13.5%) Plaster of paris splint & 5 cases (5%), treated by skin traction specially the children with young age group. the result were as follow:

- A) 63 cases presented with excellent as there is no obvious shortening or deformity ,or stiff near joint,
- B) 32cases presented with good result ,, as 20 cases ended with shortening of about 2-3 cm of the affected lower limb + some limitation of close joint movement .mainly ankle & knee joint movement.
- C) 9 cases presented with fair result _as they were presented with sever stiffness in the movement of the knee joint specially the flexion movement.
- D) 7 cases presented with poor result as ended with non union due to bone loss in 3 case+4 cases due to

chronic osteomyelitis result according to Johner & Wruth criteria for evaluation of final result .
from such a results we found that the External fixation still play the main methods of fixation for the compound war fractures form all the other methods of fixation due to all the advantages that were discuss above .specially in adult patient .

Conclusion

A good deal of war surgery is orthopedic surgery^(2,3), as most of the compound war fractures (Open fractures) were considered as an operative emergency^(5,6,7). The primary treatment includes a) an early operative procedure,. In this paper we prove the importance of external fixator in the treatment of compound fractures due to war injuries as an excellent Surgical stabilization of the fracture that is because through osteosynthesis is not allowed due to the risk of infection and increased necrosis of the soft tissues.

For this reason, external fixation is the most frequent step in the treatment of fractures resulting from wounds caused by firearm or explosion^{3,4}. Indications for its use have been fully defined^{8,9} to a lesser extent rush nail for fractures forarms ,a interlocking nail for compound fractures tibia & femuer has recently found some place in treating such a cases .

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