Management of Tibial Fracture due to High Velocity Speed War Injuries

Zaid Wajeeh Al-Shahwanii,
MBChB, FICMS (Ortho.)

Abstract:

Background: Fractures of tibia are very common in patients with war trauma, because the only expose part remain of the body are the limbs

Objective: To evaluate the use of external fixation device as the initial and definitive method of treatment of these fractures

Methods: Fifty-nine high-velocity tibial war injuries fractures (11 closed and 48 open) in 51 patients were treated with the external fixation devices of different varieties (mainly AO, Orthofix, Strayker), in al Yarmouk teaching hospital between 2005 and 2006. Open wounds were debried and tension free primary closure using interrupted nylon sutures was attempted wherever appropriate. In others, either split thickness skin grafting or local gastrocnemius flaps were used. Early weight bearing with range of motion exercises of ankle and knee joints were encouraged.

Results: Average fracture healing time was 6.25 months (range 4–8.5 months). Based on Johner and Wruh's Criteria, there were (37 excellent 62.7%), (18 good 30%), (2 fair 3.3%), and (2 poor results 3.3%). Complications included pin tract infection (17 case 28.8%), knee joint stiffness (9 cases 15%), shortening (7 cases 11.8%), and ankle joint stiffness (4 cases 6.7%).

Conclusion: External fixation provided early and definitive fixation for high-velocity speed tibial fractures with good results.

Keywords: External fixation, tibial fractures, war injuries

Introduction:

Fractures of tibia are very common in patients with trauma [1]. In war injuries ((50- 75%))of 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 patient 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 Their treatment, prognosis, and outcome are mainly determined by the mechanism of injury, degree of resulting comminution, soft tissue injury and displacement [2]

. Fractures produced by indirect trauma have a better prognosis than those produced by direct trauma [3, 4].

The risk of delayed union and nonunion in closed [1, 4] and open treatment is increased with comminution [5]. Open fractures have a higher infection rate than closed fractures [6] and the rate increases with the increasing severity of the soft tissue injury [7, 8]. Minimally displaced fractures allow more simple treatment than displaced fractures [1]. Therefore high-energy injuries have added to the number and complexity of fractures of long bones, especially those of tibia and so have the treatment modalities addressing them. We evaluated the use of External fixation device as the initial and definitive mode of fracture stabilization & treatment of these fractures.

Patients and Methods:

From April /2004 to june/2005, 59 high-energy war tibial fractures in 51 patients (41 male, 10 female) with a female/male ratio= 1: 4.1 were treated primarily with External fixation device. Gastiluo Grade II & III open and/or comminuted tibial fractures were the major choosing criteria. Exclusion criteria included, low energy fractures; grade 3C open fractures, and patients who found the devices psychologically unacceptable.

All open wounds were irrigated copiously with normal saline followed by debridement of all the devitalized bone and soft tissue. Antibiotic treatment was initiated in the emergency room with Cefazolin given intravenously for all open fractures and additional gentamycin for Grade III open fractures. The antibiotics were given for 5 days in type I and II wounds and for 7days for type III wounds. Tension free primary closure using interrupted nylon sutures was attempted wherever appropriate. If safe closure could not be accomplished, the size of the wound was minimized by mobilization of the adjacent tissues over the bone with or without additional split thickness skin grafting. All the Grade IIIA fractures were closed successfully with no wound complications. Of the Grade IIIB fractures, 3 wounds could be successfully approximated and six cases required a gastrocnemius flap. Two patients with a Grade IIIB comminuted fracture presented late after injury with wound infection. A thorough debridement of all the devitalized bone, soft tissue and the infected material was done with primary approximation of bone and soft tissues. The wounds however were not primarily closed, but allowed to heal by secondary intention.

The final application of External fixator's devices involved the use of pre-assembled frames to save the operative time. We generally used three schanze pins in the proximal segment & three

schanze pins in the distal segment with two pins inserted in the segmental piece if present. Pins insertion site hygiene was meticulously taught to the patient these pins are attached to one or two barr through a universal clamps. Immediate postoperative regimen consisted of range of motion exercises of ankle and knee. Partial weight bearing was commenced within two weeks progressing to full weight bearing within the limits of pain. The patients were assessed clinically and radiologically for alignment, bone contact, and later, callus formation, in the outpatient clinic. If in three to six weeks time no callus response was evident, compression at the fracture site was performed. The fixators were removed under analgesia and sedation in the outpatient clinic. The leg was protected in a patella-tendon bearing cast for further 4 weeks.

Results:

The age range 16-61; mean ± SD 33.64±12.45 years. Nearby terrorist explosion, bomb cars & vehicles, or mortar shells & high energy snipers bullets were responsible for majority of cases (51case 86%). In 6 cases (10%) the cause was from road traffic accident & 2 cases (3.3%) due to falling from height 15 cases (24%) of the fractures were segmental & 4 case (6.7%) was bilateral, 37cases (62.7%) had multiple traumas. There were 48 cases (81%) open fractures and 11cases (18.5%) closed fractures. Using the Gustilo and Anderson[8] classification, 6 cases (10.2%) were Grade I, 12 cases (20.3%) were Grade II, 32 cases (54.2%) were Grade IIIA & 9 cases (15.3%) were Grade IIIB P <0.05. There were 20 cases (33.9%) proximal metaphyseal 28 cases (47.5%) were diaphyseal and 11 cases (18.6%) were distal metaphyseal fractures P <0.056 Table 1.

Fifty-one patients with 59 fractures were followed up until union and for a further period of 12 months. Patients were assessed for pain and functional limitations, and examined for angular and rotational mal-alignment and range of motion. Leg lengths were measured clinically

Pin tract infection occurred in 17 (28.5%) of cases. Twelve resolved by systemic antibiotics for 7 days, in another 4, soft tissue release around the offending pin was done and in one the schanze pin had to be completely removed and reapplied. One case of pin fracture occurred in a case of segmental fracture, which was replaced with no further complications. Five (7.3 %) patients had angulations of 5° at the fracture site, and nine had shortening between 1-2 centimeters of the fractured leg. Stiffness around the ankle occurred in two cases. Knee range of motion was satisfactory in almost all cases. There were no cases of osteomyelitis or neurologic or vascular complications among these patients. When there was early evidence of callus formation in the follow up X-rays, union was clinically verified by the absence of pain and motion while fully weight bearing on the tibia with the device still attached and destabilized (we loosen the clamps attaching the pins to the bars of he proximal set of pins) with full weight bearing for 4 weeks duration before removing of the device ((dynamization)).

If pain or angulations occurred, the external fixator was readjusted and immobilization continued until the above criteria were met. A patella-tendon bearing cast was used for an additional 3 to 4 weeks. Union was determined to be the time when fracture healing occurred and all forms of immobilization or support were discontinued. Union occurred at an average of 6.25 months (range 4–8.5 months) Based on Johner and Wruhs criteria [(2),] the final results were rated as 37 excellent, 18 good, 2 fair & 2 poor Fig 1.

Table 1: Socio-demographic information, the type, site of fractured, & type of operation.

	No.*	%	χ^2, P-value
Type of fracture	59	100	17.35
Open	48	81.4	0.0000311
Closed	11	18.6	
Site of fractures	59	100	
Diphysial	28	47.5	11.03
Proximal	20	33.9	0.00401
Distal	11	18.6	
Castillo-class	59	100	
GI	6	10.2	6.95
GII	12	20.3	0.0309
GIIIA	32	54.2	
GIIIB	9	15.3	
Sex	51	100	13.1
Male	41	80.4	0.0029
Female	10	19.6	
	Range	Mean	SD
Age	16-61 years	33.64 ±	12.45
Healing time/month	4-8 months	6 ±	1.07

* Number of patient was 51, number of fractures was 59, 8 patients had bilateral fractures, χ^2 Chi-Square

A B C

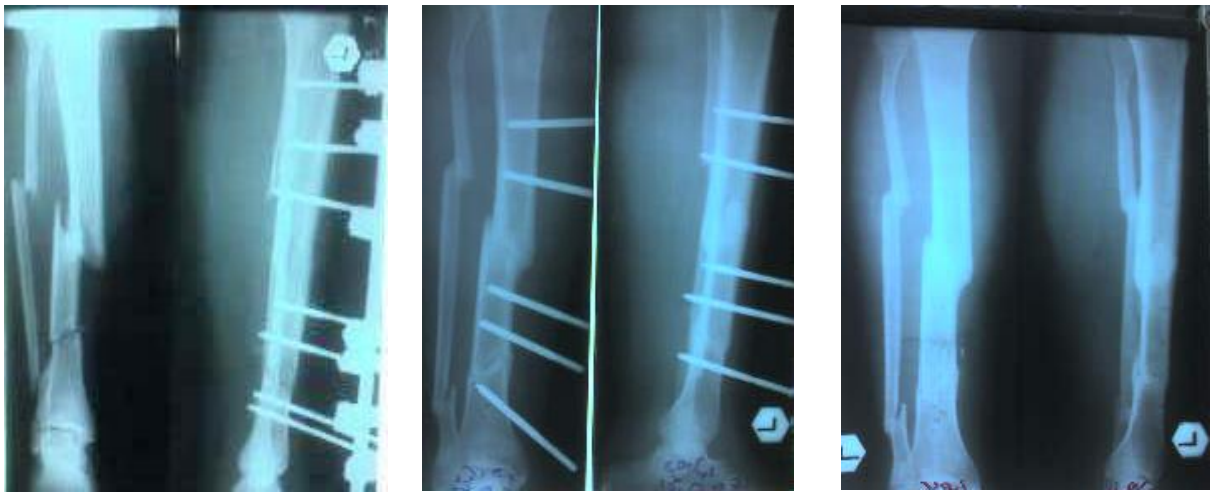

Figure 1: Open comminuted Fractures PA & lateral views; A before & immediately after surgery, B 4-months later, C 8 months after operation

Table 1: Johner and Wruh's Criteria for evaluation of Final Results

Criteria	Excellent	Good	Fair	Poor
Non union/infection	None	None	None	Yes
Neurovascular injury	None	Minimal	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%	
Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Mild limp	Significant
Actives				
Strenuous	Possible	Limited	Severely limited	Impossible
Study results	37	18	2	2

Discussion:

External fixation has been a hallmark for the treatment of open fractures of the tibia. With current techniques, success rates of 90% have been reported by several authors.[1,2] Over the past 5 decades, several techniques for treating open fractures of the tibia have evolved, but studies comparing the relative efficacy of various treatments have been poor, prejudicial, or poorly controlled. It is clear, however, that differences between various techniques are not particularly great.

Currently, the 3 techniques most commonly used are external fixation, nonreamed nailing, and reamed nailing. Proponents of each technique cite statistical analyses documenting the efficacy of their chosen treatment modality, but such analyses are an inadequate way of choosing treatment options. It is the severity of the complication, not a statistic that determines the rationale of a surgeon's choice. Further, statistical analysis of rates of complications misses the human side of these injuries.

External tibial fixation remains a mainstay of open fracture treatment. Several authors[1,3-6] have tried to compare external fixation with "modern" nailing techniques.(locking-intramedullary nailing) Unfortunately,, the reoperation rate following traditional as well as newer techniques for either malunion, nonunion, or failed implants is high. In a literature review of 987 consecutive externally fixed tibias, the reoperation rate to achieve union was 39%, [2] which is similar to results for newer reamed and non-reamed techniques. [2]

External fixation still The best mode of treatment indicated in high-energy war tibial fractures, as Because of the tenuous soft-tissue coverage of the tibia, plate fixation has typically

been associated with an unacceptably high prevalence of wound complications, especially when it has been performed for more severe fractures in addition to the high risk of bone infection [2, 9]. Tibial nailing though in popular use also has its own share of complications, as Malunion occurs after up to 37% of tibial nailing procedures (10) and it is particularly common following fractures of the proximal third of the tibia, Severe comminution further adds to the complication. Eight (12%) proximal tibial comminuted fractures were treated with external fixator with only one case of malunion. Intramedullary nail insertion is also shown to interfere with circulation in the diaphyseal cortex [12, 13]. Current debate concerns the use of reamed and un-reamed intramedullary nailing because both techniques, to varying degrees negatively affect the circulation of cortical bone [14, 15].In patients with an open fracture, this has significant implications. When the intramedullary blood supply is destroyed, it leads to necrosis of diaphyseal bone. The vascular system will reconstitute in 2 to 3 weeks, during which time the presence of dead bone and an open fracture wound may increase the risk for infection. Although External fixator provided a temporary measure with the additional morbidity associated with pin tract infections. Early weight bearing could be encouraged.

The external fixation device is stable and enables the patient to bear weight on the affected limb straight away even in very comminuted fractures[17] as we can increase the rigidity of the device by increasing the number of pins & number of bars connecting ,or apply more than one device in two or three plans.

The external fixation is minimally invasive with little interference in the biology of fracture while at the same time providing optimal skeletal stability. It also provides opportunity for wound care and management of open fractures. The timing of soft tissue coverage is a subject of controversy. The standard teaching has been that open fractures remain open until the patients is returned to the operating room for a secondary debridement to ensure that adequate debridement of necrotic tissue from the wound has done prior to wound closure [18].This recommendation recently has been challenged, with authors advocating primary closure of open wounds in some cases. Starker et al [19], used primary suturing and Ilizarov fixation in the treatment of open tibial fractures with good results. Delong and associates [20], reported on the study of open fractures with immediate primary closure of the open fracture wound after a thorough debridement. Early wound closure either by primary suture or other means of wound covers after a thorough debridement was the hallmark of this series.

Our protocol encouraged patient to partially weight bearing within 10-15 days progressing to full weight bearing within the limits of pain (usually within the two week). General condition of the patient and the presence of other associated injuries also influenced the decision to weight bearing.

We recommend the usage of external fixation device to provide primary definitive fixation for high-energy war tibial fractures. As it ease the change of dressing ,facilitate joint above & joint below movement ,early weight bearing even in severely comminuted fractures ,facilitate plastic & neurosurgery interference, it ease transport & mobilization of the patient. It promotes early functional recovery, eliminating fracture disease. Dynamization and correction of deformities in any plane is accomplished using special external fixation devices.

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Department of surgery, Orthopedic Division, Al-Mustansiriya Medical of College