Open Tibial Shaft Fractures Treated By Primary External Fixation and Bone Graft

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Abstract

We prospective study undertaken between January 2007 and January 2011, 58 consecutive cases with compound tibial shaft fractures. All fractures were stabilized by external fixator device AO/ASIF type after failed the manipulation under anesthesia (MUA) to restore the osseous alignment. In 32 patients cancellous bone graft were used from the upper part of the tibia to enhance healing process, all these patients were followed for an average of 8 – 12 months.Our findings showed that stabilization of the fracture shaft tibia by external fixation with cancellous bone graft had significantly better result, than external fixation alone.We conclude that unilateral, uniplanar external fixation with early bone grafting from upper part of the tibia is considered the best method of management for unstable tibial shaft fracture in our community. The frame offered sufficient stability even in segmental fractures; application time is very short in the hands of the experienced surgeon. dynamization of the fixator must not be forgotten, and lastly we recommended that the external fixation is not only used as temporary form of immobilization but can be used as a definitive stabilizing procedure until consolidation of the fracture. It is safe, effective, cheap and available in almost all orthopedics units in Iraq.

Introduction

Broken leg is a common and frequent perplexing problem in our locality. The treatment of compound fracture tibial shaft has been an area of controversy in orthopedics for many years. The work and economic pressure often make it important to establish a treatment program that enables those patients to return to their normal lives with a functional painless range of motion as soon as possible. External fixation has gained acceptance as the preferred method of stabilization for sever open fractures and some closed one. Behrens et al [(1)]; Hierholizer et al [(2)] .Monopolar external fixation has been considered for use in tibial fractures with soft tissue injury because its ease of placement and the preservation of existing blood supplies to the tibiaThe present study assesses the effectiveness of unilateral, uniplanar external fixation as a definitive method of treatment for opened tibia shaft fractures with and without bone graft taken from upper part of the tibia. Various classification systemic have been proposed in an effort to grade the extended of initial injury and to offer useful prognostic clues to help in deciding the optimal management [(3, 4)].The most widely used in that of Gustilo and Anderson. [(3)]

Materials and method

In a prospective study undertaken between May admitted to orthopedic 2007 and January 2011 , 58 consecutive cases with compound tibial shaffracture, department , Al-kindy teaching hospital & Al-Harthia privet hospital , were treated with unilateral , uniplanar external fixator AO/ASIF types as a primary and definitive method of treatment. Patients who had associated fractures involving the knee or ankle or with fractures of the femur, the contra lateral tibia or the tarsal bones were excluded from the study.All patients were

evaluated by detailed history, through physical examination with nradiological and other laboratory investigations. We exclude all patients with medical illness from the study.There were 40 men (69 %) and 18 women (31 %) ranging in age fro14 to 65 years (median 30 years), who had sustained opened tibial shaft fractures. The severity of injury is graded according to a system described by modifiedGustiloAndersonclassification (Gustilo et al) [3]

Operative technique

Operation was performed in all cases after failed manipulation under anesthesia (MUA) . The soft tissue was thoroughly cleaned and wounds were debrided. The fractures were reduced and stabilized by external skeletal fixator using AO/ASIF tubular unilateral , unipolar frame with at least six schanz screws of 4.5 mm diameter with short threads (18 mm) , three schanzes in each major fragment in the sagittal plane, applied according to the technique recommended by Behrens et al [1] was used. An adequate skin incision was made at the site of insertion of each of the schanz. In 32 patients, bone grafting from upper end of the tibia was carried out at first two weeks post injury. Post operatively the leg was maintained in elevation. The patient received intravenous antibiotics (third generation cephalosporine) for 5-7 days. Active and passive ankle and knee movements were started within 24 hours post operatively and the patients were ambulatory with crutches in three to four days. Partial weight bearing were permitted from the beginning; the load was gradually increased and full weight bearing was allowed as soon as it was tolerated. Pin entry sites were cleaned daily and covered with povidone iodine. While they were still in the hospital patients were encouraged to become fully responsible for the care of their pin sites and fixator frame, and for their program of rehabilitation (Searls et al) [5]At the first radiological indication of periosteal callus formation, the external fixator was dynamized by loosening and tightening the clamps in a cross-wise order as described by Allgower et al [6] Each cancellous bone graft has been used in 32 patients within the first two weeks post injury.The fixator were removed after 8-12 weeks and plaster of paris cast applied above or below the knee (according to site of fracture) for further 8 -12 weeks. Patients were followed up every other week for three months, then monthly till the fracture consolidate.

Results

Follow up time ranged from 6 – 36 months (mean 14 months). Frame rigidity was achieved in all fractures and the fractures sites were painless within 3 -4 days after the operation. This was achieved by the use of multi-directional schanz screws and, although the fixator was unilateral and unipolar, it was comfortable for patients with broken tibia.High energy trauma represent the major causes of fracture account about (81%);twenty eight patients(48.3%) were injured in road traffic accident ,19 patients(32.7%) by bullet injury , 3 patients (5.2%) by blunt trauma , and 8 patients (13.8%) by fall from height{table I}.The lower third tibia fracture represented the highest incidence 22 patients (37.9%){table II

There is strong correlation between the severity of injury, and incidence of delayed and non union, the incidence of delayed and nonunion is directly related to the severity of injury.

Table III demonstrate the difference between those patients who had bone graft and those patients without it and also demonstrate the effect of fibula. There is high incidence of delayed and non union among those did not subjected to bone graft as compared with second group who subjected to bone graft.

The site of fibula did not show significant on fracture healing in both groups since delayed and non union occur in both

groups regardless the state of fibula.Five out of 26 patients (19.2%) developed non union in first group (no added bone graft), and three out of 32 patients (8.3 %) develop non union for second group with early cancellous bone graft.Minor pin tract infections presenting as discharge with cellulites, were seen in 34 patients (58.6 %). A short course of antibiotics was found useful, only one patient (1.7 %) developed a ring sequestrum, this lesion was over drilled and then healed satisfactorily. Equinous deformity and ankle stiffness were seen in seven patients (12.1 %). In6 patients (10.4%) malunion developed shortly after removal of external fixation. Re-fracture was occurring in two weeks after healing was considered to be complete. There was two patients (3.5 %) developed pin induce neurovascular injuries {table IV}.

Table I: Mechanism of injury.

Mechanism of	Injury	No. of patients	Percentage
High energy Trauma	RTA	28	48.3
	Bullet	19	32.7
Low energy Trauma	Blunt	3	5.2
	Falling from height	8	13.8
Total		58	100%

Table II: site of fracture

Site of fracture	No. of patients	Percentage
Upper 1/3	9	15.52
Middle 1/3	15	25.96
Lower 1/3	22	37.93
Bifocal *	12	20.69

*With the lower third is almost involved.

Table III: Correlation of bone graft, state of fibula with delayed and non union

Bone graft	**Sub* type fracture**	**No. of cases**	**fracture configuration**			**State fibula**	**Of**	**Delayed**	**Union**	**Non**	**Union**
			Comminuted	**Obliqueue**	**Transverse**	**#**	**Intact**	**No.**	**Percent**	**No.**	**Percent**
No	I	4	-	3	1	1	3	-	-	-	-
	II	6	-	4	2	2	4	2	33.3	-	-
	IIIa	13	11	2	-	10	3	7	53.84	3	23.07
	IIIb	3	3	-	-	3	-	3	100	2	66.66
	IIIc	-	-	-	-	-	-	-	-	-	-
Yes	I	3	-	2	1	1	2	-	-	-	-
	II	7	-	4	3	3	4	-	-	-	-
	IIIa	17	17	-	-	15	2	5	29.41	2	11.76
	IIIb	5	5	-	-	5	-	3	60	1	20
	IIIc	-	-	-	-	-	-	-	-	-	-

*According to Gustilo classification.

Table IV: frequency of complication

Complications	No.	Percentage
Pin tract infection	34	58.6
Equines deformity	7	12.1
Anterior tibial artery	2	3.5
Malunion	6	10.4
Infected ring sequestrum	1	1.7
Re-fracture	1	1.7

Discussion

Compound fracture shaft tibia is a common and frequently perplexing problem in our locality. Fracture of the tibia reported (19 %) of all fractures hospital admission. The use of the AO tubular external fixation for open tibial shaft fracture is not a new subject. It is simple, safe and a satisfactory method of fixation for that particular fracture (probably the commonest). It improves the functional result of severely injured limb. [7], and there are indications that it aids in soft tissue healing and in preventing wound infection.After a century of doubt regarding the safety and the proper indications for external fixation, it has recently gained acceptance as the preferred method of stabilization for severe open tibial shaft fracture.Some workers abounded the use of one plane unilateral frame claiming that it is inadequate and introduce what is called quadrilateral frames[8]. Still we believe that the unilateral frame is adequate, reliable, safe and effective choice for management tibial shaft fracture, this is parallel to result of Shakur and Pantanker (1991)[9], Behrens et al[1] and Hamdan [8]that the unilateral, uniplanar external fixation provided good early stability , we also agree with Behrens et al [10] with the use of AO tubular components, as 90% of all tibial fractures can be stabilized with a one plane , unilateral frame.Regarding non union, 5 patients (19.2 %) developed non union in the group not supplemented by bone graft and 3 patients (8.3%) develop non union for second group with early cancellous bone graft.The poor rate of union may be due to: the tibia is subcutaneous throughout its length, relatively poor blood supply, severity of initial injury, extensive debridement which is required in severe open fractures, comminuted fracture and fractures associated with bone loss and displacement of more than 50% of the width of the tibia, the rigid pins and frames which cause unloading at the fracture site and weakening of the cortex. Since the prolong use of external fixation may lead to delayed union, De Bastiani et al [11], smoking (patients with history of smoking are more prone to nonunion) [12].We agree with Karlstrom et al [13]. Thakur [9]. Andrew et al [14], whom suggested the use of early cancellous bone graft as the best method of management of fracture shaft tibia especially open type. We agree with Fischer et al [15] for timing of bone graft, we recommend cancellous bone graft performed after 2-3 weeks is better than 1st week in order to give time for vascularization soft tissues.Autogenous cancellous bone graft arise as good option to facilitate fracture healing, providing that stability is established and maintained between the two fractursite.Regarding the site of fracture and its effect on fracture healing; Our result showed that 6 patients out of 8 (75 %) developed non union in which fracture involves lower third tibial fracture, and only two patients (25 %) developed non union in fracture involved middle third of the tibia. This results strongly indicate that lower third of tibia is the common site for nonunion. These

results are against Nicoll [16] ,Hoaglund and state series[17], in which the number of cases of delayed union is almost exactly the same in the upper, middle and lower fractures and the level of fracture was not significant in the prognosis.Regarding state of fibula and its effect on the fracture healing ;our result showed that there is no correlation between the state of fibula and rate of fracture healing, since delayed and nonunion occur whether fibula is intact or broken. This result is parallel to Nicoll [16] who found that the presence or absence of a fibular fracture did not influence the prognosis, and Teitz et al [18]. While Rosenthal et al [19] have formed the opinion that open fracture and intact fibula give a better prognosis for union. Pin loosening and infection is the notorious complications and are reason why external fixation had sometime fallen into disrepute [8]. Pin tract infection is present in a variety of ways varies from mild erythema about the pin remedies by local wound care , to superficial infection requiring antibiotics, local wound care and occasionally pin removal, to osteomylitis requiring sequesterectomy. [20]In our study; 34 patients (58.8%) developed pin tract infection these were treated by antibiotics, local wound care , 4 (11.8%) of them by removal of pin, one patient (1.7 %) who developed infected ring sequestrectomy was over drilled and then healed satisfactorily. Unfortunately, our incidence of pin tract infection was very high as compared with other studies. (27 %) by Court et al series[21], (42%) by Edge et al[22],(12%) by Behrens et al[1], (35.6%) by Thakur et al[9] , and (49%) by Hamdan[8], and up to (32.2%) in Tornetta [23] and Shannon[24]. We agree with Alberts et al [25] who found that the use of monoplanar external fixation often leads to higher rates of complications including pin tract infection and John study [26] who find 50.7% developed pin tract infection. In our study no patient developed chronic osteomylitis , while about 4.2 % developed chronic osteomylitis in Tornetta [23],Schandelmaier[27] and Tu YK et al[28],and 1.6% in Lerner et al study[29] The high incidence of pin tract infection probably related to lack of local hygiene, low education standard, excessive movement, early weight bearing, improper pin insertion, and type of the shanz. We observe that the shanz screw with a short thread (18 mm) anchoring The far cortex has less chance for infection than shanz screw with long thread in both cortices especially if thread protruded outside the skin. Our suggestion that pin tract problems can be reduced or even eliminated by three ways. Firstly, by the reduction of soft tissue irritation around the pin. Secondly , by the pre-drilling of each pin tract with a sharp drill bit protecting by drill sleeve (Green et al) [30] , and Thirdly, by effective pin and frame care, together with transfer of the major responsibility for their care to the patients (Searls et al)[5].Ankle joint stiffness is another common complication particularly equinous deformity of the ankle joint, especially when the fracture involving the distal third of the tibia. In our study, 7 patients (12.1 %) developed this deformity; the functional out come after the removal of the appliance was good. Our result was little higher compared to the result reported by Thakur et al [9] which was 10.9%, and was low compared to the 30.7% reported by Nesbakken et al[31] and 45% by Hamdan[8].The probable causes of equinous deformity are; low education standard, lack of proper physiotherapy, improper pin insertion through the tendons or muscles bellies, no application of foot plate with its connecting piece and multiple transfixing pins. We agree with Behrens et al [10], Behrena and Searls [1], that the ankle joint be splinted in about 5-10 degree of dorsiflexion early in the treatment period to avoid a rapidly developing equinous contracture. Re-fracture is one of complication reported by our study, one patients (1.7 %) developed re- fracture 1-2 weeks after healing was considered to be completed, caused by

minor injury. Our result was similar to what reported by De Bastiani, when orthofix was used for tibial fracture effecting 3% of patients [11] and low to what reported by Thakur et al[9], when represented 11% and 6% by Krettek all[32] Malunion developed in6 patients (10.4 %) shortly after removal of external fixation, all of them, the fracture site involve the lower third, three of them with varus deformity ,two with antero-posterior deformity and last one with valgus deformity. Our result is lower if compared with Court – Brown et al [21], who reported 10 malunion in their series of 17 grade IIIB fracture treated by external fixation and 40% by Clifford et al study [33] The anterior tibial artery and deep peroneal nerve at the junction of the third and fourth quarters of the leg are the structures most often involved during insertion of external fixation [20]. In our study two patients (10.4 %) developed anterior tibial artery injury during insertion of shanz at level of middle third of the tibia and none of the patient developed nerve injury, this result is higher as compared with Behrens et al[1] in which no pin induced neurovascular injury. Unfortunately the cause of vascular injury is a technical error by the surgeon during insertion of the shanzes in which the surgeon inserted the pin beyond the distal cortex and retracted to predetermined position, this technique is dangerous specially in middle third of the cortex in which the anterior tibial artery and deep peroneal nerve cross the lateral tibial cortex along the interosseous membrane making them vulnerable to injury. We agree Behrens et al [1] and Edwards [34] that external fixators were considered to be the preferred method for obtaining bone stability , and with Green [35] who suggest that vigorous adherence to the basic principles of external fixation ,major complications as injury to neurovascular structures and iatrogenic joint stiffness have virtually disappear. Thus the surgeon must be familiar with the cross- section anatomy of the leg (corridor), and with relatively safe zone and dangerous zone for pin insertion. Conclude that unilateral, uniplanar external fixation with early bone grafting from upper part of the tibia is considered the best method of management for unstable tibial shaft fracture in our community. The framoffered sufficient stability even in segmental fractures; application time is very short in the hands of the experienced surgeon. dynamization of the fixator must not be forgotten, and lastly we recommended that the external fixation is not only used as temporary form of immobilization but can be used as a definitive stabilizing procedure until consolidation of the fracture.

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