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THE TREATMENT OF OPEN & CLOSED TIBIAL FRACTURES BY PRIMARY EXTERNAL FIXATION & BONE GRAFT

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Abstract

We prospectively studied 64 patients with fracture shaft tibia, 23 patients with closed tibial fracture and 41 patients with open type. All fractures were stabilized by external fixation device AO/ASIF type after failed manipulation under anesthesia (MUA) to restore the osseous alignment. In 28 patients cancellous bone graft were used after 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 results, than external fixation alone.

The use of external fixation device with bone graft, is safe, effective, cheap and available in almost all orthopaedic units n Iraq.

Introduction

Broken leg is a common and frequent perplexing problem in our locality. The treatment of fractured tibial shaft has been an area of controversy in orthopaedics for many years. The work and economic pressure often make it important to establish a treatment program that enable 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 severe open fractures and some closed one " Behrens and Searls 1986[1]& Hierholizer et al 1985[2]."

The present study assesses the effectiveness of unilateral, uniplanar external fixation as a definitive method of treatment for tibial shaft fractures (both opend and closed one) with or without bone graft taken from upper part of the tibia.

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Materials and Methods

In a prospective study undertaken between January 1999 and January 2001, 64 consecutive cases with tibial shaft fracture (opened and closed fractures), admitted to orthopaedic department, Basrah university hospital, were treated with unilateral, uniplanar external fixator AO/ASIF type 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 presents, were evaluated by detailed history, thorough physical examination with radiological and other laboratory investigations. We exclude all patients with medical illness from the study.

There were 57 men (89%) and 7 women (11%) ranging in age from 11 to 70 years median, 29 years), who had sustained 23 closed fractures and 41 open fractures; thirty one patients were injured in road traffics accidents, 19 by

bullet injury, 5 by blunt trauma, 5 by fall from height and 4 by mine injury.

The severity of soft tissue injuries is graded according to a system described by Ostren and Tscherene for closed fractures (Tscherene 1984)[3], and modified Gustilo-Anderson classification for open one (Gustilo and Mendoza 1984)[4].

Operative technique

Operation was performed in all cases after failed manipulation under anaesthesia (M.U.A.). The soft tissues were thoroughly cleaned and wounds were debrided. The fractures were reduced and stabilized by external fixation using AO/ASIF tubular unilateral, unipolar frame with at least six schanz screws of 4.5 mm diameter with short threads (18mm), three schanz in each major fragment in the sagittal plane, applied according to the technique recommended by the AO group. The safe corridor described by Behrens and Searls (1986)[1] was used. An adequate skin incision was made at the site of insertion of each of the screws.

In 28 patients, bone grafting from upper end of the tibia was carried out at first two weeks post injury. This applied to 9 of the 23 closed tibial fractures and to 19 of the 41 opened tibial fractures.

Post operatively the leg was maintained in elevation. The patient received intravenous antibiotics for 5-7 days.

Active and passive ankle and knee movements were started within 24 hours 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 entery 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 programme of rehabilitation (Sears et al 983)[5].

At the first radiological indication of periostal callus formation, the external fixator was dynamised by loosening and tightening the clamps in a cross-wise order as described by Allgower and Sequin (1986)[6].

Early cancellous bone graft has been used in 28 patients within the first two weeks post injury.

The fixators were removed after 8-12 weeks and P.O.P. 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 12 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. The lower third tibia fracture represented the highest incidence for both open and closed fractures. Thirteen patients 56.5% for closed fracture and 25 patients 61% for open one Table I.

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

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

The site of fibula fracture did not show significance on fracture healing in both groups since delayed and nonunion occur in both groups regardless of the state of fibula.

For closed fracture three patients (21.4%) developed nonunion in the group not supplemented by bone graft and no recorded cases for second group with early cancellous bone graft. As for open tibial fracture, 6 patients (27.3%) developed nonunion in the first group (no added bone graft), and one patient (5.3%) developed nonunion for second group with early cancellous bone graft.

Minor pin tract infections presenting as discharge with cellulites, were seen in 41 patients (64%). A short course of antibiotics was found useful; only one patient (1.6%) developed a ring sequestrum; this lesion was over drilled & then healed satisfactorily. Equinous deformity and ankle stiffness were seen in 9 patients (14%). In four patients (6.25%) malunion developed shortly after removal of external fixation. Refracture occurred in two patients (3.1%) caused by a manor injury two weeks after healing was considered to be complete. There were two patients (3.1%) who developed pin induced neuro vascular injuries.

Discussion

Fracture shaft tibia is a common and frequently perplexing problem in our locality. Fractures of the tibia constitute 22.4% of all fractures that require hospital admission.

The use of the AO tubular external fixation for open tibial fracture is not new. It is a simple, safe and 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[8].

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 fracture and some closed one[9].

Some workers abolish the use of one-plane unilateral frame claming that it is inadequate and introduce what is called quadrilateral frames[16]. still we believe that the unilateral frame is adequate, reliable, safe and effective choice for management of tibial shaft fracture, is parallel to the results of Thakur and Pantanker (1991)[8], Behrens and Searls (1984)[5] and Hamdan (1998)[10] that the unilateral, uniplanar external fixation provided good early stability. We also agree with Behrens and Johnson (1985)[1] with the use of AO tubular components, as 90% of all tibial fractures can be stabilized with a one plane, unilateral frame.

The poor rate of union may be due to: the tibia is subcutaneous through out its length, relatively poor blood supply, severity of initial injury, extensive debridement which is required in severe open fractures, comminuted fractures and fractures associated with bone loss and displacement of more than 50% of the width of the tibia.

We agree with Karlstrom and Olerud (1983)[12]. Andrew & commander (1987)[13]. Who suggested the use of early cancellous bone graft as the best method of management of fracture tibial shaft especially open one.

We agree with Fischer et al(1988)[14] for timing of bone graft; we recommend cancellous bone graft perfomed after 2-3 weeks rather than during 1st week in order to give time for vascularization of soft tissues.

Autogenous cancellous bone graft arises as good option facilitate fracture healing, providing that stability is established and maintained between the two fracture site.

Regarding the site of fracture and its effect on fracture healing: our results showed that three patients out of thirteen (23%) developed nonunion in which fracture involves lower third for the closed fracture. While five patients out of twenty five (20%) develop nonunion in which open fracture involved the lower third, Only one patient (10%) developed nonunion and fracture involved middle third of the tibia. This results strongly indicates that lower third of tibia is the common site for nonunion.

These results are against Nicoll (1964)[15]. Houglund and States series (1967)[2], in which the number of cases of delayed union is almost exactly the same in upper middle and lower fracture and the level of fracture was not significant in the prognosis.

Regarding state of fibula and its effect on the fracture healing; our results 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 in both groups, open and closed fractures. This result is parallel to Nicoll (1964)[15] who found that the presence or absence of a fibular fracture did not influence the prognosis. And against Teitz and Carter and Frankel (1980)[16], who reported inhibited fracture healing in 26% of closed tibia fractures associated with intact fibula in patients over the age of 20 year. While Rosenthal, Macphail and Oritz (1977)[13] have formed the opinion that open fracture and intact fibula give a better prognosis for union.

Pin loosening and infection are the notorious complications and are reason why external fixation has sometime fallen into disrepute[16]. pin tract infection is present in a variety of ways varying from mild erythema about the pin remedied by local wound care, to superficial infection requiring antibiotics, local wound care and occasional pin removal, to osteomylitis requiring sequestrectomy[5].

In our study: 41 patients (64%) developed pin tract infection; these were treated by antibiotics and local wound care. Three of them by removal of pin. One patient (1.6%) who developed infected ring sequestrum 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 Brown and Hughe's series (1982)[3], (42%) by Edge and Denham (1981)[17], (12%) by Behrens and Searls studies (1986)[1], (35.6%) by Thakur and Patankar studies (1991)[9], and (49%) by Hamdan 1998[10].

The high incidence of pin tract infection is probably related to: lack of local hygiene, low educational standard, excessive movement, early weight bearing, improper pin insertion and type of the shanz. We observe that shanz screw with a short thread (18mm) anchoring the far cortex has less chance for infection than Shanz screw with long thread in both cortices specially if thread protruded out side the skin.

We suggest that pin tract problems can be reduced or even eliminated by three ways. Firstly, by the reduction of soft tissue irriation around the pin. Secondly, by the pre-drilling of each pin tract with a sharp drill bit protected by drill sleve (Green and Matthews 1981)[6]. Thirdly, by effective pin and frame care, together with the transfer of the major responsibility for their care to the patients (Searls et al, 1983)[2].

Ankle joint stiffness is another common complication particularly equinous deformity of the ankle joint, specially when fracture involved the distal third of the tibia.

In our study, nine patients (14%) developed this deformity, the functional outcome after the removal of the appliance was good. Our result was a

little higher as compared to the (10.9%) reported by Thakur and patanker 1991[9], and was low compared to the 30.7% reported by Nesbakken et al (1988), (20.8%) of Clifford et al (1988)[7] and (45%) by Hamdan (1988)[10].

The probable causes of equinous deformity are:- low education standard, lack of proper physiotherapy, improper pin insertion though tendons or muscle bellies, no application of foot plate with its corresponding connecting piece and its corresponding connecting piece and multiple transfixing pins. We agree with Behrens & Johnson 1985[3] and Behrens & Searls (1986)[1], that the ankle joint be splinted in about 5-10 degrees of dorsioflexion early in the treatment period to avoid a rapidly developing equinous contraction.

Refracture is one of the complications reported in our study; two patients (3.1%) developed refracture 1-2 weeks after healing was considered to be completed, caused by a minor injury. Our result was similar to that reported by De Bastiani, where orthofix was used for tibial fracture effecting 3% of patients. De Bastiani, Al degheri and Brivio (1984)[18], and lower than reported by Thakur & Patonker 1991[9], (11%) and 6% by Krettek, Haas and Tscherne 1991[8].

Malunion developed in four patients (6.25%) shortly after removal of external fixation; in all of them the fracture site invoved the lower third, two of them with varus deformity, one with valgus deformity and last one with anteroposterior deformity. Our result is lower than that of Court-Brown et al (1982)[19], who reported 10 malunion in their series of 17 grade III_B fracture treated by external fixation and 40% by Clifford, The anterior tibial artery and deep peroneal nerve at the junction of the third and fourth quarter of the leg are the structures most often involved during insertion of external fixator pins[5]. in our study two patients (3.1%) developed anterior tibial artery injury during insertion of shanz at level of middle third of the tibia and none of the patients developed nerve injury, this result is higher as compared with Behrens and Searls (1986)[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 shanz in which the surgeon inserted the pin beyond the distal cortex and reacted 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 with Green (1981)[20] who suggest that vigorous adherence to the basic principles of external fixation, major complications as injuries to neurovascular structures and iatrogenic joint stiffness have virtually disappeared. Thus the surgeon must be familiar with the cross-sectional anatomy of the leg (corridor), and with relatively safe zone and dangerous zone for pin insertion.

We conclude that unilateral, uniplanar external frame fixation with early bone grafting is 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 from of immobilization but can be used as a definitive stabilizing procedure until consolidation of the fracture.

Table I: site of fracture

Type of fracture	Site of fracture	No.	%	Nonunion	
				No.	%
Closed fracture/ 23 cases	Upper	2	8.7	-	
	Middle	8	34.8	-	
	Lower	9	39.1	2	22.2
	Bifocal*	4	17.4	1	25
Open fracture/ 41 cases	Upper	6	14.6	-	
	Middle	10	24.4	1	10
	Lower	16	39	3	18.75
	Bifocal*	9	22	3	33.3

* With the lower third is always involved.

Table II: Correlation of bone graft, state of fibula with delayed and nonunion in closed fracture

Bone graft	Subtype*	No. of cases	Fracture configuration			State of fibula		Delayed union		Nonunion	
			Comminuted	Oblique	Transverse	Fracture	Intact	No.	%	No.	%
No	T0	3	-	3	-	-	3	-	-	-	-
	T1	4	1	3	-	1	3	-	-	-	-
	T2	3	2	-	1	2	1	2	66.6	1	33.3
	T3	4	3	-	1	3	1	3	75	2	50
Yes	T0	-	-	-	-	-	-	-	-	-	-
	T1	2	-	2	-	-	2	-	-	-	-
	T2	3	2	1	-	3	-	1	33.3	-	-
	T3	4	3	-	1	3	1	1	25	-	-

* according to Tscherene classification

Table III: Correlation of bone graft, state of fibula with delayed and nonunion in open #

Bone graft	Subtype*	No. of cases	Fracture configuration			State of fibula		Delayed union		Nonunion	
			Comminuted	Oblique	Transverse	Fracture	Intact	No.	%	No.	%
No	I	3	-	2	1	1	2	-	-	-	-
	II	4	-	3	1	1	3	1	25	-	-
	IIIa	11	9	2	-	9	2	6	54.5	3	27.3
	IIIb	4	4	-	-	4	-	4	100	3	75
	IIIc	-	-	-	-	-	-	-	-	-	-
Yes	I	2	-	1	1	-	2	-	-	-	-
	II	2	-	2	-	1	1	-	-	-	-
	IIIa	9	8	1	-	8	1	3	33.3	-	-
	IIIb	6	6	-	-	6	-	4	66.6	1	25
	IIIc	-	-	-	-	-	-	-	-	-	-

- according to Gustilo classification

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