MANAGEMENT OF HIGH ENERGY DISTAL TIBIAL FRACTURES WITH CIRCULAR EXTERNAL FIXATOR

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ABSTRACT

Introduction: The high complication rate and poor results associated with open reduction and internal fixations directs many surgeons to investigate another safe method. The new era of external fixators were tried by many who found them to be safer with superior results

Patients and methods: Nineteen cases of high energy distal tibial fractures were treated using circular external fixators with or without limited internal fixation

Results: All cases had united with a mean time of 11.7 weeks, according to the adopted score for evaluation of this series about half of the cases are located in the good zone

Conclusion: Management of high energy distal tibial fractures with ring external fixators provides safe and effective method for management of these risky fractures

Key words: High energy distal tibial fractures, circular external fixators

INTRODUCTION

Management of distal tibial fractures is challenging. There are many problems
associated with these fractures as preservation of soft tissue envelope and coverage of soft tissue loss if present, perfect restoration of intra articular component of the fractures if present and rigid fixation of the fracture to allow early mobilization to prevent later functional disability

The high complication rate and poor results associated with open reduction and internal fixation for high energy distal tibial fractures as skin slough, infection, malunion, non-union, arthritis and even amputations [(1)] has encouraged the use of different types of external fixators for management of theses fractures

The use of circular external fixators alone or combined with limited internal fixation offers solutions for the problems encountered with open reduction and internal fixation. They minimize soft tissue problems and provide rigid fixation that allow early mobilization The high complication rate and poor results associated with open reduction and internal fixation for high energy distal tibial fractures as skin slough, infection, malunion, non-union, arthrodesis and even amputations [(2)] has encouraged the use of different types of external fixators for management of theses fractures.

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PATIENTS AND METHODS

Between October 2008 and December 2010, 19 patients with high energy fractures of distal tibia were treated with circular external fixator with or without limited internal fixation. There were 15 males (79%) and 4 females (21 %%) with average age 42.3 years. The mechanism of injury was fall from a height in 6 cases and road traffic accident in 13 cases

PRE OPERATIVE MANAGEMENT

Included both clinical and radiological evaluation. Clinical evaluation included skin condition, neurovascular state of the limb and systemic review of other skeletal and visceral injuries.

Skin condition: 6 cases were closed while 13 cases were open. Open fractures are classified according to Gustillo and Anderson [(3)], 3 grade I, 5 grade II and 5 grade IIIa. Closed soft tissue injuries were classified according to Tscherene and Gotzen (Table 1) [(4)]. 5 cases were grade 2 while one case was grade 3

The fractures were classified according to Rüedi and Allgöwer [(5)] table 2, 10

fractures were type III while 9 fractures were type II

Neurovascular evaluation: 1case had injury of the anterior tibial artery ligated by a vascular surgeon

Other skeletal injuries: 2 cases had associated wedge fractures of L1 vertebra, one cases had associated ipsilateral tibial plateau fractures, one case 2 associated femoral shaft fractures one ipsilateral and one contralateral

Radiological evaluation: AP, lateral, and mortise plain radiographs were obtained for all cases

Surgical technique

All cases were done within 24 hours from the injury. Under general or spinal anaethesia, patient was supine. Thorough irrigation and adequate debridement were done for all cases with open fractures. In 16 cases fibular fractures were fixed, 14 cases with open reduction and plate fixation and 2 cases fixed with rush nail. The distal articular surface of tibia was anatomically reduced and fixed with canulated screws percutaneously in all cases of intra articular fractures. Limited open reduction through small anterior incision was required in 5 cases to help in reduction of the articular fragment

Application of the frame: 4 ring construct was applied 2 rings proximal to the fracture and 2 rings distally. Fixation of the ankle joint by addition ring fixed to the calcaneus was done in 3 cases where there is high comminution of the fractures as fixation of the fracture by 2 rings only in the distal fragment is not sufficient to provide rigid fixation. The distal tibial ring was connected to the calcanean ring with a uniaxial ring places opposite the axis of the ankle joint aiming for later active mobilization of the ankle joint with progression of union. 3 cases had fracture of the medial malleolus required fixation 2 of them fixed with percutaneous k-wires and the last one needs open reduction and internal fixation with 2 navicular screws. Reduction was checked with image intensifier in all cases

Table1. Grading of closed soft tissue injuries

Grade 0	Minimal or no soft tissue damage
Grade 1	Superficial abrasions or contusions
Grade 2	Deep abrasions, skin or muscle contusion
Grade 3	Extensive skin contusion or crush injury, severe damage to underlying muscle, subcutaneous avulsion or compartment syndrome.

Table2. Rüedi and Allgöwer classification of

Type I	Intra articular fractures without displacement
Type II	Displaced intra articular fractures without comminution
Type III	Fractures with articular and metaphyseal comminution

Post operative care

Postoperative analgesia and anti inflammatory medications were used for a short period. Limb elevation was instructed most of the time for all patients. Active range of motion of the knee, ankle and toes was encouraged from the second postoperative day. Foot support plate is connected to the distal tibial ring during sleep to provide comfort and prevent dropping of the foot. Care of wires and pins to decrease the incidence of pin tract infection was routinely and daily done

RESULTS

All cases are followed monthly for a period ranged from 13 to 16 months, each time evaluation of ankle range of motion , toes range of motion , state of the wound , care of the pins were done . Serial x- rays were done just postoperative, one month, 2 months, 3 months, 6 months and one year postoperative.

The mean time of healing was 11.7 weeks, (Range 8 – 14 weeks). Removal of external fixator was carried out when serial x –rays show adequate callus formation. Below knee cast was applied for one month after removal of the fixator, during this period gradual weight bearing with the aid of crutches is allowed.

We evaluated our cases according to the scoring system of **Olerud and H Molander** (6)

The patients were divided into 4 groups according to their score

Group I: Poor: 0 -30
Group II: Fair: 31 - 60
Group III: Good: 61 - 90
Group IV: Excellent: 91 -100

In our series 3 patients were classified as group I (16%), 5 cases were classified as group II (26%), 9 cases were classified as group III (48%) and 2 cases were classified as group IV (10%).

The complications encountered in our series were not disastrous and dealt with. Post traumatic arthritis occurred in 2 cases (10%) which required later ankle arthrodesis, Chronic osteomyelitis occurred in one case (5%) which required sequestrectomy, Pin tract infection in almost all cases, this complication did not need more than repeated dressing, Delayed union due to presence of metaphyseal comminution required bone graft in 2 cases (10%) which required bone grafting and Lateral ankle instability occurred in 4 cases (20%) which were treated conservatively

DISCUSSION

The high complication rate of traditional methods of treatment of high energy distal tibial fractures forces many surgeons to adopt another policy in management of theses problematic injuries. The new era of external fixators provide reasonable successful solutions that deal with theses risky fractures.

The outcome of theses injuries is determined to great extent by preoperative factors and to less extent to operative and post operative factors.

Preoperative factors controlling final out come are intra articular comminution and

Table (3) Olerud and H Molander: Scoring system After Ankle Fracture

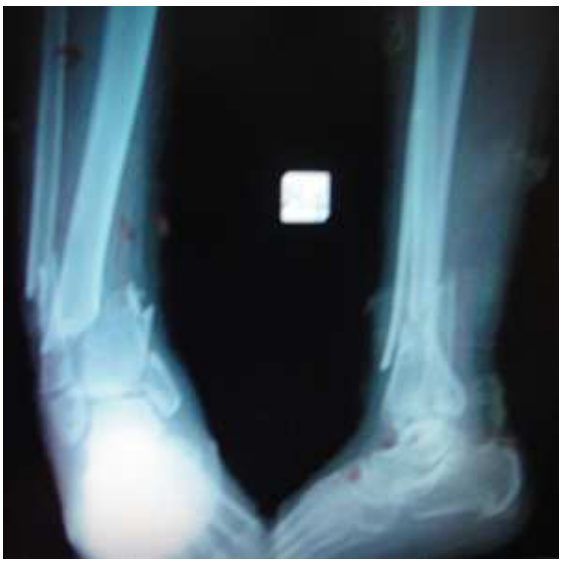
Parameter	Degree	score
Pain	None	25
	While walking on uneven surfaces	20
	While walking on even surfaces	10
	While walking indoors	5
	Constant	0
Stiffness	None	10
	Present	0
Swelling	None	10
	Only evening	5
	Constant	0
Stair climbing	No problems	10
	Impaired	5
	Impossible	0
Running	Possible	5
	Impossible	0
Jumping	Possible	5
	Impossible	0
Squatting	Possible	5
	Impossible	0
Supports	None	10
	Taping	5
	Crutches	0
Working activities of daily life	The same before injury	20
	The same but with some restrictions	15
	Change into simpler job	10
	Severely impaired working capacities	0

the degree of soft tissue damage. The more articular comminution and the more soft tissue damage the worse the final outcome. The most important predictor of the development of post traumatic arthritis is the quality of reduction [7].

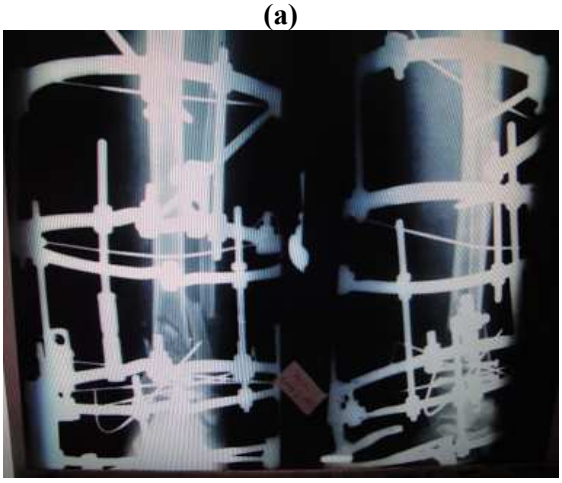
Operative factors include accurate reduction of the articular surface, proper alignment of the distal tibia, and restoration of length of the fibula in cases associated with fibular fractures, rigid stabilization and proper soft tissue coverage.

Post operative factors include keen and strict encouragement of active and passive range of motion of ankle and toes and prevention and control of infections.

External fixation provides adequate stability for these fractures avoids soft tissue stripping, does not prevent the chance of perfect restoration of the articular surface fractures as limited internal fixation and direct reduction techniques through limited small incisions and indirect reduction techniques by ligamentotaxis are easy to be combined with external fixation. The main problems encountered during the management of high energy tibial plateau fractures with ring fixators are pin tract infection and the patient tolerability. These 2 problems are the most common but fortunately with some patient co-operation and medical care both problems cab be faced and solved readily. Anatomical open reduction and fixation of fibular fractures maintain the length of the fibular, support the lateral side of the ankle joint and helps in reduction of the anterolateral fragment of the tibial plafond fractures [8].



(a)



(b)

(c)

Figure (1)

(a) Preoperative x-ray
(b) X-ray after application of the fixator
(c) 9 months after removal of the fixator

CONCLUSION

Based on the results of the current study stabilization of high energy of distal tibial fractures with circular external fixators with or without limited internal fixation provide safe and effective method for management of theses fractures with good final outcome

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