Research Article

Evaluation the results of Ilizarov External Fixator in Management of Distal Tibial Fractures

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Abstract
The management of displaced distal tibial fractures is still controversial. The different internal fixation techniques are often burdened by relatively high complication rates. Minimally invasive techniques with ring fixators have been introduced as an alternative allowing immediate reduction and stabilization, avoiding a staged protocol. The aim of this prospective study was to analyze the clinical and radiographic outcome the Ilizarov technique in patients with distal tibial fractures. Twelve patients with distal tibial fractures treated with the Ilizarov technique, the mean follow up period was 12 months (ranged from 6 to 24 months). Depending on the type of fracture, 3 or 4 rings were used. Unrestricted weight-bearing was allowed in all cases at 6 weeks. Pre- and post operatively conventional radiographs, post-operative pain assessment and complications were evaluated.
Clinical outcomes were evaluated according to the ankle-hindfoot score devised by the American Orthopaedic Foot and Ankle Society (AOFAS). No patient developed compartment syndrome or deep venous thrombosis. Pin infections were frequent, but they were mostly superficial and were treated with antibiotics and local antiseptics. 2 cases of malunion occurred, one of them required ankle fusion, the fixator was removed after a mean of 20 weeks (range 12–28). The clinical outcome according to AOFAS score was excellent in 6 patients, good in 3, fair in 2 and poor in 1.
Key words: Ilizarov, ring fixator, Distal tibia, Pin tract infection.

Introduction
Distal tibial fractures remain one of the most substantial therapeutic challenges that confront the trauma surgeon. Numerous features are responsible for this, but perhaps none are as difficult as the accompanying soft tissue injury that is frequently present [(1)].

Tibial plafond fractures accont for less than 10% of all lower extremity fractures and more common in male than female patients. Pilon fractures in particular constitute only approximately 1% of lower extremity fractures and 7% to 10% of tibial fractures. However, the frequency of these fractures maybe increasing [(2)].

A whole spectrum of treatment options have been advanced over years. Most authors would agree the goal of treatment of any displaced intra-articular fracture should be:

a. Restoration of articular congruity.
b. An anatomic restoration of the joint to the shaft, and early restoration of motion, and hence, functional recovery.
c. Also it has been stated that the status of the soft tissue is one of the most important factors that influence the treatment and prognosis of the patient [(3)].

Regarding treatment the traditional techniques were: Casts, pins in plaster, fibular fixation alone and open reduction and internal fixation (ORIF) which often results in unacceptable function of the ankle and higher rate of wound breakdown, infection, poor anatomical alignment and subsequently post traumatic osteoarthritis [(4)].

Recently, percutaneous lag screws maintain the reduction of the joint, and graft supports the impacted intra-articular fragment. Once the distal tibia is reconstructed at the level of the joint the remaining fracture is treated with external fixation. Both hybrid frames that use tensioned wires (Ilizarov apparatus) and spanning half pin frames have been recommended. The main advantage of this approach is the lower rate of soft tissue problems [(5)].

Patients and Methods

12 patients with fracture distal tibia were incorporated in a prospective study.

Patients demographic data were collected using case notes, there were 5 females and 7 males, their ages ranged from (22 years to 63 years) with an average of 43 years, the mean follow up period was 15 months (6 : 24 months).

Inclusion criteria

All skeletally mature patients with recent distal tibial fractures (within 1 week of injury) were included in our study.

Exclusion criteria This includes:

1. patients with open physis
2. pathological fractures
3. medically unfit patients
4. non-compliant patients.

Side of fractures

Side	No. (patients)	%
RT	7	58.33
LT	5	41.67

Sex of patients

Side	No. (patients)	%
Male	7	58.33
Female	5	41.67

Age distribution

Age	Number of cases	Percentage
20-40 y	8	66.67 %
40-60 y	2	16.67 %
More than 60 y	2	16.67 %

Duration from injury to surgery

Days	Number of cases	Percentage
0-2 d	5	41.67 %
3-5 d	5	41.67 %
More than 5 d	2	16.67 %

Types of fractures

Fracture AO classification	NO. of patients	%
43 A	2	16.67
43 B	7	58.33
43 C	3	25

Surgical Technique

Anesthesia: All patients underwent surgery under spinal anesthesia.

Position: All patients were placed in supine position, After positioning of the patient, parenteral antibiotics were administrated.

Frame construction:

Proximal construct made of two rings connected by four rods and distal construct made of either one ring and 5/8 calceneal ring if there is sufficient bone of distal segment to fix with ilizarov k-wires or only 5/8 calceneal ring in cases of highly comminuted articaular surface.

Twin ring construct was used in some cases with low juxta-articular fractures allow for early removal of calcaneal 5/8 ring.

Technique:

- All open fractures were treated with wound debridement and closure prior to application of

a ring fixator. In cases of there is blisters it's treated with a protocol of sterile unroofing with the application of non-adherent dressings.
- Internal fixation was initially required for the lateral malleolus to restore fibular length in 9 cases and achieved by K wire.
- Fragment specific fixation with mini internal fixation for intra-articular fractures using 4.5 mm canulated screws was used in 8 cases.

Post operative protocol:
- Active and passive range-of-motion exercises were begun from day 1 after surgery.
- Partial toe touch weight bearing was permitted at 2-4 weeks according to patient tolerance.
- Full weight bearing was allowed at 6 weeks.
- The assessment of articular fragments reduction was made according to criteria described by Ovadia and beals[6].
- Clinical outcomes were evaluated according to the ankle-hindfoot score devised by the American Orthopaedic Foot and Ankle Society (AOFAS) [7].

Results

This study included 12 patients (7 males and 5 females) suffering from recent distal tibial fractures and were managed by an Ilizarov external fixator, Surgery was performed within 1 week of injury in all cases. the mean age of the population was 36 years (range, 20-63 years), the follow-up interval ranged from 6 to 24 months, the mean operative time was 75 minutes (60 : 90).

All patients experienced tibial pilon fractures as a result of high energy trauma, 7 patients with AO type B fracture, 3 patients with type C and 2 patients with type A. 10 patients had closed fractures and only 2 patients had open fractures (one was GIIIa and the other was GII).

The soft tissue damage in closed fracture was graded according to Tscherne classification as grade 0 in 8 cases, grade I in one case and grade II in one case.
Reduction was judjed good in 4 patients, fair in 6, and poor in 2.

Quality of reduction	Number of cases	Percentage
Good	4	33.33 %
Fair	6	50 %
Poor	2	16.67 %

8 cases of superficial infections of pins all were type 1 and 2 according to Checketts-Otterburn criteria and was treated by antibiotics and local antiseptic.
We had not any case of neurovascular injury due to introduction of the pins, No patients developed compartment syndrome or deep venous thrombosis.

Despite adequate external reduction, 2 malunion occurred. In the coronal plane, the final alignement was neutral +-5° for 10 fractures. One fracture had 20° valgus malalignement; ankle fusion was eventually performed.
Clinical results according to the AOFAS score was excellent in 6 patients, good in 3 patients, fair in 2 and poor in 1.

Clinical outcome according to AOFAS score	Number of cases	Percentage
Excellent	6	50 %
Good	3	25 %
Fair	2	16.67 %
Poor	1	8.33 %

Discussion

Distal tibial fractures are often complex injuries, with regard to both the bony component and the management of the soft tissue problem. They account for less than 10% of all lower extremity fractures and more common in male than female patients. Pilon fractures in particular constitute only approximately 1% of lower extremity fractures. The damage is caused by high-energy trauma mainly in axial load as the usual consequence of road accidents or falls from a considerable height [8].

Ruedi and Allgower (1979)[9] reported a 74% excellent or good functional result when they reviewed 84 pilon fractures treated with open reduction and internal fixation. The four principles that they advocated were: (1) restoration of fibular length; (2) reduction of articular surface; (3) cancellous bone grafting of the metaphyseal defect; and (4) stabilization with a medial buttress plate.

While some authors shared the same good results as Ruedi and Allgower, R.Bourne (1989) [10] and Helfet et al., (1994)[11] reported less favorable results, together with a high rate of complications.

External fixation is a recognized alternative treatment for high-energy pilon fractures, Bone et al., in a study of 20 high energy open pilon fractures managed with ankle spanning external fixators, found that these fractures are better managed by external fixation with or without minimal internal fixation than with plate osteosynthesis. They had no infections [12].

In the present study, 8 patients developed pin site local infection that was treated successfully with antibiotics and local antiseptics.

The amount of residual deformity that can be accepted is still controversial. It is difficult to correlate the postoperative radiological findings to the clinical result and to use this as a prognostic factor [13].

In our study 2 malunion occurred, One fracture had 20° valgus malalignement; the patient developed ankle arthritis and ankle fusion was eventually performed.

Another case of 5° valgus deformity also occurred after Ilizarov frame removal that was treated with short cast leg and the final clinical result was judged good. quality of reduction was judjed good in 4 patients, fair in 6, and poor in 2 according to criteria described by ovadia and beals [6].

A retrospective study of 21 patients with high energy tibial pilon fractures treated with Ilizarov technique, Vidyadhara et al., (2006)[14] found encouraging results with good functional outcome in 76% patients. There were no-long-term problems with fracture union, and no patient required an ankle arthrodesis.
In our group study, all fractures united. We attribute the 100% union rate to meticulous respect of soft tissue envelope made possible by the strategy of treatment. Despite the quality of reduction achieved and lack of complications observed, the clinical outcomes in our series have been less favorable than others; there were excellent and good functional results in 75%.

It is believed that approximately 10° of dorsiflexion of the ankle is required for an adequate functional gait [15].

We achieved a relatively higher functional ankle range of motion with 5° to 40° of plantar flexion and 0° to 20° of dorsiflexion. However, pin site infection was observed frequently in our study group. Antibiotic therapy was administered to these patients with a good recovery.

References

1. Mandi DM, Nickles WA, Mandracchia VJ, Halligan JB, Toney PA. Ankle fractures. Clinics in podiatric medicine and surgery. 2006; 23(2):375-422.
2. Mauffrey C, Vasario G, Battiston B, Lewis C, Beazley J, Seligson D. Tibial pilon fractures: A review of incidence, diagnosis, treatment, and complications. Acta Orthopaedica Belgica. 2011;77(4):432.
3. Luk PC, Charlton TP, Lee J, Thordarson DB. Ipsilateral intact fibula as a predictor of tibial plafond fracture pattern and severity. Foot & ankle international. 2013; 34(10):1421-6.
4. Daghino W, Massè A, Marcolli D. Tibial Pilon Fractures. Foot and Ankle Trauma Injuries: Springer; 2018. p. 1-19.
5. Franzone JM, Vosseller JT. Posterolateral approach for open reduction and internal fixation of a posterior malleolus fracture—hinging on an intact PITFL to disimpact the tibial plafond: a technical note. Foot & ankle international. 2013;34(8):1177-81.
6. Ovadia D, Beals R. Fractures of the tibial plafond. The Journal of bone and joint surgery American volume. 1986; 68(4): 543-51.
7. Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M.

Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. Foot & ankle international. 1994;15(7): 349-53.

8. Galante VN, Vicenti G, Corina G, Mori C, Abate A, Picca G, et al.,. Hybrid external fixation in the treatment of tibial pilon fractures: a retrospective analysis of 162 fractures. Injury. 2016;47:S131-S7.
9. RÜedi TP, AllgÖwer M. The operative treatment of intra-articular fractures of the lower end of the tibia. Clinical Orthopaedics and Related Research®. 1979(138): 105-10.
10. Bourne R. Pylon fractures of the distal tibia. Clinical orthopaedics and related research. 1989(240):42-6.
11. Helfet DL, Koval K, Pappas J, Sanders RW, DiPasquale T. Intraarticular" pilon" fracture of the tibia. Clinical orthopaedics and related research. 1994(298):221-8.
12. Bone L, Stegemann P, Mcnamara K, Seibel R. External fixation of severely comminuted and open tibial pilon fractures. Clinical orthopaedics and related research. 1993(292):101-7.
13. Marsh JL, Buckwalter J, Gelberman R, Dirschl D, Olson S, Brown T, et al.,. Articular fractures: does an anatomic reduction really change the result? JBJS. 2002;84(7):1259-71.
14. Vidyadhara S, Rao SK. Ilizarov treatment of complex tibial pilon fractures. International orthopaedics. 2006;30(2): 113-7.
15. Kapoor S, Kataria H, Patra S, Boruah T. Capsuloligamentotaxis and definitive fixation by an ankle-spanning Ilizarov fixator in high-energy pilon fractures. The Journal of bone and joint surgery British volume. 2010;92(8):1100-6.