SHORT ARTICLE

Minimally Invasive Techniques in Distal Tibial Fractures

Neeraj Mahajan

Abstract

A series of 20 patients of distal tibial fractures treated with minimally invasive techniques have been reviewed after surgery. The technique involves open reduction and internal fixation of the associated fibular fracture when present, followed by minimally plate osteosynthesis of the tibia utilizing precontoured tubular plates and percutaneously placed cortical screws. Out of 20 patients, 14 had excellent results, 4 had good results and 2 patient had a fair result. Two patients had superficial wound infection and one patient had palpable screw.This minimally invasive technique for treatment of distal tibial fractures proves to be a feasible and worthwhile method of stabilization while avoiding the severe complications associated with the more standard methods of internal or external fixation of those fractures

Key words

Minimally Invasive Technique, Distal Fractures

Introduction

Minimally invasive techniques in distal tibial fractures are technically feasible and may be advantageous in that it minimizes soft tissue compromise and devascularization of the fracture fragments (1,2). Indications for minimally invasive plate osteosynthesis of distal fractures include displaced fractures involving the tibial plafond and those unstable fractures too distal for safe stabilization with intramedullary nails(3). This technique involves conventional open reduction and internal fixation of the associated fibular fracture when present, followed by minimally plate osteosynthesis of distal tibia utilizing precontoured plates and percutaneouly placed cortical screws. Post-operatively early active and passive motion is permitted while weight-bearing gradually progesses. Minimally invasive techniques maintains alignment without compression; the operative exposure and soft tissue stripping are minimized with vascular pedicle preserved throughout (3). This present study describes the minimally invasive technique and its usefulness in distal tibial fractures.

Material and Methods

Twenty patients with distal tibial fractures were treated with minimally invasive techniques were analysed in the present study. For minimally invasive plate osteosynthesis of distal tibial fractures, the patient was placed supine on radiolucent table. Initial attention was directed to fracture lines which extend into the tibial plafond. The articular fragments were anatomically reduced by percutaneous method, utilizing fluoroscopy and pointed reduction forceps. Once articular reduction had been achieved, the articular fragments were stabilized with 3.5 mm lag screws. The appropriate length of the semi-tubular plate was determined by placing a plate along the anterior aspect of the leg and adjusting it so that under fluoroscopy the distal end of the plate was at level of the tibial plafond and the proximal end extends at least three screw holes beyond the proximal limit of the tibial shaft fracture. The plate was then flattened along its entire length and the distal end bent to match the contour of the distal tibia (approx. 25 degrees medial angulation and 20 degrees external rotation). A 2-3 cm incision was made along the antero-medial aspect of the tibia, proximal to the fracture and distally at the level of the medial malleolus. Typically, a subcutaneous tunnel was created between the two incisions and along the medial aspect of the tibia by blunt

From the Department of Orthpaedics, Government Medical College, Jammu.

Correspondence to : Dr. Neeraj Mahajan, Ward No. 14, Talab Sailan, Udhampur-182101

dissection using a large Kelly clamp. On occasion this was unnecessary and the plate could be advanced directly beneath the soft tissues without making a tunnel. The position of the plate was adjusted under fluoroscopy in both the coronal and saggital planes so that it lies along the medial aspect of the tibia.

A 4.5 mm cortex screws were placed at each end of the plate through the two incisions and in the mid position via small percutaneous stab incisions. The distal metaphyseal articular fragment could be indirectly reduced to the proximal shaft in this way. Lag screws were then placed across the fracture planes to maintain the reduction, to provide interfragmentary compression, and to increase the stability of the construct.(3-9)

Post-operatively the limb was maintained in the elevated position while the patient was in bed and ambulation begun on first post-operative day in the form of toe-touch weight-bearing with crutches. On second post-operative day, gentle exercises for the ankle were begun. Radiographs, including anteroposterior and lateral views were taken at 2 weeks, 6 weeks and 3 months post-operatively to assess healing and alignment. Partial weight-bearing started depending upon their clinical and radiographic evalution, but in general most patients had advanced to partial weight-bearing by 6 weeks as don by previous authors (3,7,8). Final evaluation was done for distal tibial fractures as per Teeny and Wiss clinical assessment criteria which is based on 100 points system (5).

Results

Most of the patients were in age group of 20-40 years (70%) with mean age of 36 years. Road traffic accidents were found to be the commonest mode of trauma (65%). Right limb was involved more often (60%) than the left. The time taken for partial weight bearing, mean time for starting partial weight bearing, time taken for full weight bearing, time for starting full weight bearing & time interval for complete union shown in table-3. The mean interval for radiological union was 12 weeks . The range of motion at the ankle & degrees of dorsi & plantar flexion shown in table-3.

Table-2 Clinical results graded as excellent, good, fair or poor

Rating	Results
Excellent	(>92 points)
Good	(87-92 points)
Fair	(65 - 86 points)
Poor	(<65 points)

TABLE -1 Tenny & Wiss Criteria

Symptoms and functional evaluation of Ankle

Parameters	Points
1. **Pain**	
a) No pain, including long walks, running or sports.	50
b) Slight or occasional pain, pain after long walks or sports, or mild pain at end of day.	45
c) Mild pain with walking or running, but no change in activities of daily living. May have some pain going up or down stairs or walking on uneven ground. May require non-narcotic pain medicine several times a week.	40
d) Mild-moderate pain, tolerable, but requires some concessions to pain. May required daily non-narcotic pain medicine. No night pain.	30
e) Moderate pain. Definite change in activities of daily living pain at rest or at night, despite restriction of activities. Occasional weak narcotic needed.	20
f) Continuous pain, regardless or activity, most often not relieved with non-narcotic medication. Dependent on narcotic pain medicine for significant pain relief. Severe limitations of activities.	10
g) Disabled because of pain. Constant pain, no relief with medicines	0
2. Distance	
a) Unlimited	8
b) Limited, but greater than 6 blocks	6
c) 4 - 6 blocks	4
d) 1 - 3 blocks	2
e) Indoors only	1
f) Bed-chair, or unable to walk.	0
3. Supports or Orthosis	
a) None	8
b) Soft wrap needed for long walk	7
c) Cane or orthosis, only for long walks	6
d) Cane, single crutch or orthosis full time	4
e) Two canes or two crutches	2
f) Walker or unable to walk	0
4. Running	
a) Unlimited, as such as desired	5
b) Limited, but able to run	3
c) Unable to run	0
5. Toe raising	
a) Able to raise on toes x 10 repetitions	5
b) Able to raise on toes x 5 repetitions	3
c) Able to raise on toes x 1 repetition	1
d) Unable to raise on toes	0
6. Hills (up or down)	
a) Up and down normally	3
b) Climbs and/or descends with foot externally rotated	2
c) Climbs and/or descends on toes or by side stepping	1
d) Unable to climb and/or descend hills	0
7. Stairs (up or down)	
a) Climbs and descends normally	3
b) Needs banister	2
c) Steps down and/or up with normal foot only	1
8. Limp	
a) None	8
b) Only when fatigued	6
c) Slight, constant	4
d) Moderate, constant	2
e) Marked 0	
9. Swelling	
a) None	3
b) Only in the evening or after walking	2
c) Constant, mild (less than 1 cm difference around calf)	1
d) Marked 0	
10. Plantar range of motion	
a) Greater than 300	2
b) Greater than 100	1
c) Less than 100, or presence of equinus contracture	0
11. Dorsal range of motion	
a) Greater than or equal to 150	5
b) Greater than or equal to 100, less than 150	4
c) Greater than or equal to 00, less than 100	3

Figure 1: X Ray Showing Distal Tibial Fracture & Union After

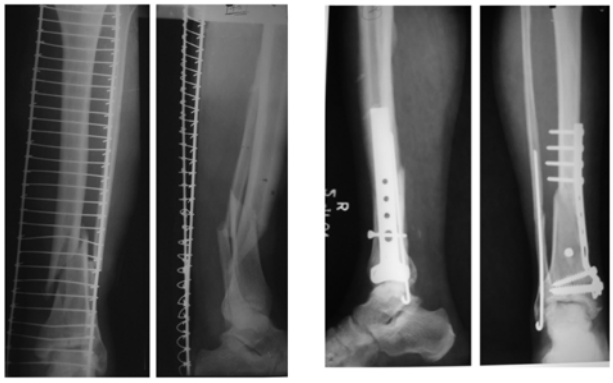

Table-3 Characteristics of Minimally Invasive Technique

S.No.	Characteristics		No.
1.	Age (yrs)	Range(21-57)	Mean age 36
2.	Sex Male/Female		14/6
3.	Mode of trauma		
	Automobile accidents/Fallstairs/height/ Sports		13/5/2
4.	Limb side injured: Right/left		12/8
5.	Time taken for weight bearing (wks) mean		
	Partial		6.1
	Full		11.75
6.	Time for radiological union (wks)	Mean	12.7
7.	Range of motion at ankle (degrees)		
	Dorsiflexion (Average)		15.25
	Plantar flexion (Average)		31.5
8.	Complications		3
9.	Result grading excellent/good/fair		14/4/2

Discussion

The results of operative treatment are dependent on the severity of the initial injury and the quality and stability of the reduction. The mechanism of injury, the status of the soft tissues and the degree of comminution affect the long term clinical result.The mean interval for radiological union was 12 weeks in our study in accordance to previous study (10). However, the most important factor is to achieve stable fixation and to allow early range of motion without unnecessary osseous and soft tissue devascularization (11). Minimally invasive techniques are based on principles of limited exposure, indirect reduction methods and limited contact between bone and implant.As a result of these principles this technique, as seen in present study, avoided major soft tissue complications and shortened the length of the patient's stay in the hospital (3,7,8).

The bone healing was excellent with this type of fixation because the stresses were distributed over a longer segment of bone.This technique can be used in fractures where locked nailing cannot be done like vertical slit and markedly comminuted fractures. There was rapid fracture consolidation due to preserved vascularity. There were fewer incidences of delayed union and non-union. There was decreased need for bone grafting. There was less incidence of infection due to limited exposure. There were less chances of refracture. There was no chance of vascular complication by carefully inserting the plate submuscularly through limited incisions. There was no need of any specialized instrumentation and the method was less time consuming and cost effective in the present study in a similar fasion as reported by previous authors (6,12).With the introduction of Locking Compression Plates (LCP), minimally invasive techniques have become widely used. The plates act as internal fixators in a bridging manner, thus resulting in secondary bone healing (13,14). Thus, MIT for distal tibial fractures will prove to be a feasible and worthwhile method of stabilization while avoiding the severe complications associated with the more standard methods of internal or external fixation.

References

1. Macnab I. The role of periosteal blood supply in healing of fracture of tibia. *Clinical Ortho*1974;105:27
2. Rhinelander WF. The normal microcirculation of diaphyseal cortex and its response to fracture. *JBJS* 1968; 50A:784-800
3. Helfet D, Paul Y S, David L, Joseph B Jr. Minimally invasive plate osteosynthesis of distal fracture of tibia.*Injury* 1998:28:S42- S48
4. Helfet DL, Koval K, Pappar J *et al* : Intra-articular pilon fractures of tibia.*Clin Orthop* 1994:298, 221-28.
5. Tenny SM, Wiss DA. Open reduction and internal fixation of tibial plafond fractures.*Clin Orthop*1993;292:108
6. Borrelli J Jr, Ellis E.Pilon fracture treatment and assessment.*Ortho Clin North Am* 2002; 33:231
7. Redfern DJ,Syed SU, DevisSJM. Fractures of the distal tibia minimally invasive plate osteosynthesis.*Injury* 2004;35: 615-20
8. Nicola Mi, Andrew D , Andrew M, Francesco O. Percutaneous plating of distal tibial fractures.*Int Ortho* 2004;.28:159-62
9. Sirkin M , Sanders R : Treatment of pilon fracture.*Ortho Clin North Am* 2001; 32:91
10. Crutchfield EH, Seligson D, Henry SL *et al*. Tibial plafond fracture,comparative clinical study of management techniques and results.*Orthopaedics* 1995:18,613-17.
11. Sands A, Gurjic L, Byck DC *et al* . Clinical and functional outcome of internal fixation of displaced pilon fracture.*Clin Orthop* 1998:347, 131- 37.
12. Gerber C, Mast JW. Biological internal fixation of fractures. J *Ortho Trauma* 1990;109:295-303
13. Hazarikaa S,Chakravarthy J, Cooper J. Minimally invasive locking plate osteosynthesis for fractures of the distal tibia. *Injury 2006;* 37: 877-87
14. Hasenboehler E, Rikli E, Babst R. Locking Compression Plate with Minimally Invasive Plate Osteosynthesis in diaphyseal and distal tibial fracture: A retrospective study of 32 patients. *Injury 2007;* 38; 365-70

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