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RESEARCH ARTICLE

SURGICAL AND FUNCTIONAL OUTCOMES OF DISTAL THIRD TIBIA FRACTURE FIXATION

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ABSTRACT

Background: Distal tibial fractures are common in the light of increasing incidences of road traffic accidents. The existing treatment option of open reduction and internal fixation results in a delay in wound healing, thereby increasing the need for alternative treatment options. The posterolateral approach with locking compression screw insertion is a technique with potential scope, which was explored.

Methods: This study was done as a non randomized interventional trial among 15 patients with open type 1 and type 2 tibia fractures. The surgical technique was followed up by measuring the duration of union and the outcome of the surgery was assessed using Baird and Jackson scoring system.

Results: The mean age of the study participants was 45 years and majority of them were males. In 46.7%, the fracture was classified as A1 type, and in 20% of the participants, the outcome of the surgery was excellent.

Conclusion: Locking plate compression using posterolateral approach is a positive and a satisfactory alternative in the treatment of tibia fractures.

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INTRODUCTION

Distal tibial fracture constitutes 7% of all tibial fractures and approximately 1% to 10% of lower limb fractures (Martin, 1997). The most of these fractures are due to road traffic accident or falling from a height which are high energy trauma. Another mechanism of this injury is low-energy trauma, as seen in skiing, which produces rotational forces resulting in less comminuted spiral fractures (Michael Sirkin, 2001). Managing distal tibial fracture has been a challenge for orthopedic surgeons. Many treatment options have been described, but the results have not been impressive' (John Charnley, 1999 and Collinge, 2000). Current treatment of displaced Distal tibial fractures is frequently performed with immediate Open Reduction and Internal Fixation (ORIF) of the distal fibular fracture and delayed ORIF of the tibial plafond by various approaches, (Patterson, 1999; Sirkin, 1999; Blauth, 2001; Borrelli, 1999 and Assal, 2007) which require temporary spanning external fixation of the medial side of the ankle. Delay of ORIF of the tibia is based on the concern of the risk of significant wound healing problems with early incisions over the tibia whether anteromedial or anterolateral (Blauth, 2001; Borrelli, 1999), The anteromedial approach provides good exposure of the articular surface centrally and medially and allows for placement of a medial buttress plate to support the comminuted metaphyseal portion of the fracture. It is however less advantageous for exposure of the lateral column of the distal tibia and the syndesmosis. This is especially important in cases where the lateral tibial plafond is dissociated from the fibula and indirect reduction of this lateral fragment cannot be obtained by reducing the fibula fracture. The anteromedial approach has been associated with concerning wound complications. When wound complications do occur with the anteromedial approach they can leave the distal tibia and hardware exposed. Even when healing is uneventful, the subcutaneous location of an anteromedial plate can lead to patient discomfort (Blauth, 2001; Mast, 1988; McFerran, 1992 and Shantharam, 2000). The minimally invasive percutaneous plating through a medial approach has been recommended by some (Collinge, 2007; Krackhardt, 2005), but often the skin over the medial malleolus, which is the location of the incision for inserting the plate, is particularly thin and commonly traumatized with displaced fractures. For these reasons, delayed treatment has been recommended to minimize the risk of wound

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complications (Assal, 2007). An anterolateral approach to distal tibial pilon fractures has been described (Grose, 2007; Manninen, 2007). This approach uses a skin incision placed between the distal tibia and fibula, overlying the anterior border of the fibula. This approach avoids the fragile medial soft tissues and allows for a single incision for plating of both the tibia and fibula fractures. This approach also has the advantages of utilizing a single incision for open reduction and internal fixation of both the distal tibia and fibula, and provides excellent exposure of the articular surface and lateral plafond, and lateral column of the distal tibia (Grose, 2007). However, the superficial peroneal nerve is at risk as it traverses this incision and must be directly identified and retracted. Also, the anterior perforating peroneal artery originates from the deep posterior compartment and passes anteriorly through the hiatus that lies between the proximal aspect of the syndesmosis and the interosseous membrane. While this is often traumatized by the injury, and is frequently not of significant size, it can be the sole dorsal artery of the foot in 3% of cases. A wound dehiscence however will occur directly over the hardware for both the tibia and fibula.

The posterolateral approach to the distal tibia and fibula is performed through a skin incision that is made along the posterior border of the fibula. The deep portion of the dissection used to approach the tibia from the lateral side does not involve any devitalization of the bone or of the soft tissue flap overlying the distal tibia. The incision preserves the angiosomes of the anterior skin over the distal tibia and ankle by keeping the anterior soft tissues envelope completely intact and thus preserving the blood supply from the anterior tibial artery (Salmon). This approach provides excellent exposure of all aspects of both the tibia and fibula fractures, and when closure is performed the intact anterior compartment soft tissues lie over the bone and hardware, which are well away from the skin incision. This paper reports early results of distal tibia fractures using a single posterolateral incision. This surgical approach allows internal fixation of the fibula and the distal tibia fractures.

Aim and Objectives

- To evaluate the functional outcome following use of locking compression plate through postrolateral approach for lower third fractures of tibia.
- To study the advantages and disadvantages of the surgical approach and duration of union in above mentioned fractures.

MATERIALS AND METHODS

Study Setting

This study was carried out as a non randomized interventional trial in our tertiary care hospital in Chennai, between September 2013 and September 2015.

Study Participants

All the adult patients with fractures of distal third tibia who were admitted to our hospital during the study period participated in this study. A total of 15 patients participated.

Inclusion criteria

All adults with simple fractures unfavourable for interlocking nailing or complex fractures of the lower third of tibia and fibula and or patients with type 1 and type 2 open fractures.

Exclusion criteria

Children (<18 years), or patients with type 3 open fractures, not willing or medically unfit for surgery were excluded.

Ethical approval and informed consent

Approval was obtained from the Institutional Ethics Committee prior to the data collection. The participants were explained in detail about the study procedure and informed consent was obtained prior to the commencement of the surgical procedure.

Management of Open Fractures

Patients with open fractures were graded using the Gustilo Anderson classification for open fractures. Antibiotics were started immediately for all patients. After obtaining the necessary radiographs, Type I and II open fractures were treated by primary wound closure was done after initial wound cleaning. The limb was then immobilized in an above knee Plaster of Paris slab till definite fixation was done.

Pre-operative Planning

The participants were taken for surgery after obtaining anaesthetic fitness. A dose of tetanus toxoid and antibiotic was given pre-operatively. Preparation of the part was done before a day of the surgery. Instruments were checked and sterilized.

Surgical Procedure (Koo, 2004)

Patients were placed in the prone position on a radio-lucent operating table, under lumbar sub arachnoid block. A tourniquet was applied to achieve a bloodless field. A longitudinal skin incision was made along the posterolateral aspect of the ankle, 1 cm behind the fibula at the fracture site. The short saphenous vein and sural nerve were identified and protected. The fibular fracture was exposed by medially retracting the peroneal muscle group. The fibular fracture was reduced and fixed with a 3.5-mm small fragment plate placed on the posterior surface of the fibula. Correct fibular length restoration was vital for the subsequent ankle joint reconstruction. After fixation of the fibular fracture, the peroneus longus tendon and peroneus brevis muscle were laterally retracted. The lower third of the flexor hallucis longus was released from the fibula and retracted medially with dissection along the interosseous membrane and then medially to the posterior tibia. Using the same incision, the distal tibia and Volkman's triangle were exposed. The distal tibial articular surface was restored after reduction of the distal tibial fragment. For those patients with bone loss, cancellous bone graft from the posterior iliac crest was used to fill the bone gap and restore the articular surface. Blending instruments were used to contour the locking compression plate to the anatomy. The plate was temporarily held in place with standard plate holding forceps or the Push-Pull Reduction Device. It was inserted near cortex. After power

insertion, it was turned clockwise until it pulled the plate securely to the bone.

Insertion of a cortex or cancellous bone screw

Using the 3.5 mm Universal Drill Guide for dynamic compression, the universal drill guide was placed eccentrically at the edge of the DCU portion of the LCP plate hole, without applying pressure. Tightening of the cortex screws resulted in dynamic compression corresponding to that of the LC-DCP.

Insertion of 3.5 mm Locking Screws

Star Drive Screwdriver was used to manually insert the appropriate length locking screw. It was then carefully tightened. Since the direction of a locking screw is determined by plate design, final screw position was verified with a K-wire prior to insertion.

Postoperative treatment

Immobilization with above knee casting and non-weight bearing of the patient using standard walking frame was done from the first post operative day under the supervision of a physiotherapist. Intravenous antibiotic regimen was continued for 5-7 days (12-14 days in compound fractures) after the surgery. Suture or staple removal was done at 10th-12thpost operative day. Compound fractures were dressed as per instructions from the plastic surgeon.

Follow up & Data collection

The patients were followed up at intervals of 6, 12, 24 weeks to assess the radiological union. Functional outcome was assessed using Barid and Jackson scoring system.[19] After the 1st follow up of 6 weeks participants were allowed to partial weight bear with patellar tendon bearing cast. This patellar tendon bearing cast was allowed till signs of union were seen and later removed.

Operational definition

The fracture was designated as united, when there was periosteal bridging callus 'at the fracture site at least in three cortices in the antero- posterior and lateral views. Trabeculations extending across the fracture site was also taken into consideration. Partial and full weight bearing were allowed based on the radiological union and consolidation of the fractures. Patellar tendon bearing cast was applied which were removed after radiological union of the fracture.

RESULTS

The study was carried out among 15 adults with with distal third tibial fracture who were admitted in our tertiary care hospital. The majority of participants 5 (33.3%) belonged to the age group of 36-45 years. 4 (26.7%) of the participants belonged to the age group of 46-55 years. 3 (20%) of participants belonged to the age group of 26-35 years and 56-65 years. The average age was 45 years. The majority of participants 11 (73.3%) are males and 4 (26.7%) of the participants are females. The majority of participants 10 (66.7%) are affected on the right side and 5 (33.3%) of the participants are affected on the left side. The background characteristics of the study participants are given below (table-1):

Table 1. Background characteristics of the study participants

S. No	Characteristics	Frequency (N=15)	Percentage (%)
1	Age (in years)		
	26-35	3	20.0
	36-45	5	33.3
	46-55	4	26.7
	56-65	3	20.0
2	Sex		
	Male	11	73.3
	Female	4	26.7
3	Mode of injury		
	Road traffic accident	10	66.7
	Self fall	5	33.3

The particulars regarding the fracture sustained are given below.(Table 2) The majority of participants 12 (80%) got closed fracture and 3 (20%) got open fracture type I. In 90% of the participants, right side was commonly affected and 46.7% had A1 type of fracture.

Table 2. Details of fracture among the study participants

S. No	Characteristics	Frequency (N=15)	Percentage (%)
1	Type of fracture		
	Closed fracture	12	80.0
	Open fracture type I	3	20.0
2	Fracture pattern (AO classification)		
	A1	7	46.7
	A2	5	33.3
	A3	3	20.0
3.	Side affected		
	Right side	10	66.7
	Left side	5	33.3

The particulars regarding the surgery and its outcome are given in table 3. The majority of participants 5 (33.3%) took 100mins, 4(26.7%) took 95mins, 3(20%) took 90mins, 2(13.3%) took 110mins and 1(6.7%) took 80mins for completion of surgery. The average duration of surgery for 15 cases was 96mins. The majority of participants 6 (40%) took 16 weeks, 4(26.7%) took 18 weeks, 3(20%) took 20 weeks and 2(13.3%) took 14 weeks for fracture union. The average duration of fracture union for 15 cases was 17 weeks. The sample shows that 6 (40%) of cases had good and fair outcome and 3(20%) had excellent outcome.

Table 3. Surgery particulars of the study participants

S. No	Particulars	Frequency (N=15)	Percentage (%)
1	Duration of surgery (mins)		
	80	1	6.7
	90	3	20.0
	95	4	26.7
	100	5	33.3
	110	2	13.3
2	Duration of union (in weeks)		
	14	2	13.3
	16	6	40.0
	18	4	26.7
4	Outcome (Baird & Jackson score)		
	Excellent	3	20.0
	Good	6	40.0
	Fair	6	40.0

DISCUSSION

Treatment of distal tibial fractures remains a challenge to orthopaedic surgeons because of the high incidence of soft tissue involvement and variable fracture patterns. Ruedi and Allgower showed their initial results using internal fixation for 84 fractures in 1969 (Ruedi, 1979). In their report, they concluded that the results was good or Excellent in 70%. This report showed clear demonstration of principles of treatment namely, fibula length restoration, the tibial joint surface reconstruction, bone grafting of the defects, and buttress plate fixation. However, other researchers have shown significant complication rates on open reduction and internal fixation for high- energy distal tibial fractures. Of which 6% to 55% had infections and delayed soft tissue healing with slough ranged from 11%to 27%. (Bourne, 1983), Hence, surgeons were opting for newer methods for treating distal tibial fractures with lower complications. The staged or a single procedure with external fixation reduces the rate of infection. Even, this method had problems like loss of fracture reduction, pin tract infection, and stiffness of joint. Kim *et al* in his study used ring and wire fixatoron 21 patients, and reported that he found no deep infection, but wire tract problems were found in 8 patients which required removal (Kim, 1997), Anglen in a study of 34 patients treated using hybrid external fixator with or without minimal internal fixation and 27 patients treated by open reduction and internal fixation (Anglen, 1999), Court-Brown *et al* in a study of 24 patients with a half-ring external fixator (Court Brown, 1999). Authors reported incidence of infection in 4% and 75% of the patients showed good or excellent results. Even, they reported difficultly to get adequate stability of small bone fragments and had reported malunion in 6 patients. Advantage of the posterolateral approach is fixation of the fibula and tibia using a single incision.

Traditional common open reduction and internal fixation is done using 2 incisions — the fibula is fixed using lateral incision and the distal tibia using anterolateral incision. The width of atleast 7cm is needed between the 2 incisions to form a skin bridge; so that, circulation compromise around the wound would be prevented. The single incision technique in the posterolateral approach has adequate skin bridge and circulation is not compromised. Cosmetically, the single incision technique is more appealing than the 2-incision approach. Overall, the flexor hallus longus muscle bulk acts over the implant as a buffer between the skin and the implant to avoid spread of superficial skin infection to deep structures. Wound healing using this approach was found satisfactory with good cosmesis. In this approach stable fixation of fracture can be achieved so use of a joint-spanning external Fixator can be avoided, so stiffness of ankle is decreased. As a result, rehabilitation can be started earlier and the time of hospital stay is decreased. In our study there were 10 men and 5 women with the mean age of 45 (28-64) years as compared to the mean age of 46.5 years in a study conducted by Chen DW *et al* (Chen, 2014), Moreover, 10 patients have sustained injury due to road traffic accident and 5 patients with self fall. Based on OA classification there were 7 A1, 5 A2 and 3 A3 distal tibial fractures. 12 patients had closed fractures and 3 patients had type I open fractures according to Gustilo Anderson's classification. The mean duration of surgery was 97 (80- 110) minutes. The average duration of fracture union was 17 (14-20) weeks as compared to the average duration of 20 (12-47) weeks in a study done by Sheerin DV *et al.* (Sheerin, 2006). There were no complications such as non union, mal union, osteomyelitis after surgery. Wound healing was satisfactory for all patients. Wound cosmesis was also satisfactory with no hypertrophic scars, keloid formation or discomfort when socks or shoes are worn. The ankle Baird Jackson's score was functional outcome was found excellent in three patients, good in six patients and fair in six patients.

Conclusion

The treatment of distal tibia fractures using locking compression plate through posterolateral approach with or without soft tissue injuries can lead to good outcome and consistent bone union with no complications. The posterolateral approach is a safe approach with satisfactory wound healing and cosmesis. Therefore the posterolateral approach provides a viable alternative for the orthopaedic surgeons for the treatment of distal tibial fractures.

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