International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2019; 5(1): 481-486

www.orthopaper.com
Received: 09-11-2018
Accepted: 13-12-2018

Dr. PR Dhanasekaran
Assistant Professor, Institute of Orthopaedics and Traumatology, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Dr. D Suresh Anandan
Assistant Professor, Institute of Orthopaedics and Traumatology, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Dr. M Sathish
Junior Resident in MS Ortho, Institute of Orthopaedics and Traumatology, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Correspondence
Dr. D Suresh Anandan
Assistant Professor, Institute of Orthopaedics and Traumatology, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Outcome analysis of management of tibial pilon fracture by medial locking compression plating

Dr. PR Dhanasekaran, Dr. D Suresh Anandan and Dr. M Sathish

DOI: https://doi.org/10.22271/ortho.2019.v5.i1i.84

Abstract
Introduction: Fractures of the distal tibia can be challenging to treat because of limited soft tissue, the subcutaneous location and poor vascularity. Fractures of distal tibia remain a controversial subject despite advances in both nonoperative and operative care. The goal in expect care is to realign the fracture, realign limb length and early functional recovery. The aim of our study is to analyze the functional outcome of distal tibial fractures treated by Medial Distal Tibial Locking Compression Plate (LCP).
Materials and Methods: This prospective study conducted over a period of 4 yrs from May 2015 to November 2018 after ethical committee approval. Patients in age group of 18-65 yrs presenting with closed distal tibial fractures of Ruedi and Allgower type – I, II, III were included in this study. Compound fractures and Age <18 & >65 were excluded. Patients with associated calcaneal and talar fractures were also excluded. Functional results were analysed with Iowa ankle evaluation score and radiological reduction is analysed with Teeny & Wiss scoring criteria.
Results: The total number of patients included in this study was 30 with age range between 20-64 with a mean age of 32.8yrs. M:F 12:18. RTA being the most common mode of injury among them. Based of Ruedi Allgower types 8 belonged to Type A while 10, 7, 5 belongs to Types C1,C2,C3 respectively. 16 of them had fibular fracture at same level while 8 had fibular fracture at different level while 6 had intact fibula. We had a minimum follow up of 1 yr and maximum follow up of 4 yrs with mean follow up of 2.8 yrs. Union was achieved in all cases between 12-16 weeks. The mean duration from hospital admission to definitive surgery was around 10-14days. The mean functional ankle scores were 80.5with a maximum of 94 and minimum of 74. Anatomic reduction was achieved in about 22 cases with good alignment.
Conclusion: Medial Tibial locking compression plating can be considered as a reliable modality of management of distal tibial fractures and it has to be done either within 24 hrs of the injury before the edema sets in or a delay of 8 to 12 days for the edema to settle down and the wrinkle sign appears. Respect the soft tissues, do not operate too early or through compromised skin, instead wait till the soft tissues is amenable for surgery. Restoration of the articular surface and reestablishing its relationship to the tibial shaft is the primary goal of treatment. Good functional result depends on reasonable anatomic reduction of the articular surface either by direct or indirect methods.

Keywords: medial distal tibia plating, LCP, iowa ankle evaluation score, teeny & wiss scoring

Introduction
Fractures of the distal tibia can be challenging to treat because of limited soft tissue, the subcutaneous location and poor vascularity. Fractures of distal tibia remain a controversial subject despite advances in both non-operative and operative care. The goal in expert care is to realign the fracture, realign limb length and early functional recovery. Fractures of distal tibia remains one of the most challenging for treatment because of high complication rates both from initial injury and also from treatment. All these fractures are severe injuries. They are increased in frequency because of higher incidences of Road Traffic Accidents. Accounts to 1% of all lower extremity fractures, 10% of tibial fractures and bilateral in 0-8% and compartment syndrome in 0-5%.
The mechanism of injury is axial loading due to talus hitting hard the lower end of the tibia. The axial loading on the distal tibia determines the articular surface injury, metaphyseal comminution, joint impaction and severe associated soft tissue injuries. Although the mechanism of injury may be complex, the predominant force is vertical compression. The location of the articular portion of the fracture is determined by the position of the foot at the moment of impact.

Fractures involving the distal third of tibia involve the metaphyseal flare which poses the difficulty of decreased implant contact leading to less stability and increased malalignment. Even minor malalignment in this region causes gross mechanical alternation of the ankle thereby leading to increased pain and functional disability. Surgical fixation of distal tibial fractures can be difficult, and require careful preoperative planning. Fracture pattern, soft tissue injury, and bone quality critically influence the selection of fixation technique. Several techniques have emerged – conservative, hybrid external fixation, external fixation with limited internal fixation, percutaneous plate osteosynthesis and intramedullary nailing.

Several minimally invasive plate osteosynthesis techniques have been developed, with union rates ranging between 80% and 100%. These techniques aim to reduce surgical trauma and to maintain a more biological favourable environment for fracture healing. Nevertheless, complications such as angular deformities greater than 7°, hardware failure and non-unions have been reported. A new advance in this field is represented by the "locked internal external fixators". These devices consist of plate and screw systems where the screws are locked in the plate at a fixed angle. Screw locking minimizes the compressive forces exerted by the plate on the bone because the plate does not need to be tightly pressed against the bone to stabilize the fracture.

The system works as flexible elastic fixation that putatively stimulates callus formation. The anatomical shape prevents primary displacement of the fracture caused by inexact contouring of a normal plate, and allows a better distribution of the angular and axial loading around the plate. As the plate is not compressed against the bone the periosteal supply is not disturbed which favours bone healing.

Despite with advances in identification, understanding and treatment of soft tissue injury and with the liberal use of Computed Tomography scanning, advances in implant design which includes locking plate technology, still the management of these challenging fractures remains elusive. Hence aim of this study is to analyse the functional and radiological results of management of distal tibial fractures with medial tibial locking compression plates (LCP).

Materials & Methods

This prospective study conducted over a period of 4 yrs from May 2015 to November 2018 after ethical committee approval. Patients in age group of 18-65 yrs presenting with closed distal tibial fractures of Ruedi and Allgower type – I, II, III were included in this study. Compound fractures and Age <18 & >65 were excluded. Patients with associated calcaneal and talar fractures were also excluded. Functional results were analysed with Iowa ankle evaluation score and radiological reduction is analysed with Teeny & Wiss scoring criteria.

Surgical procedure

Under regional anaesthesia in supine position on a radiolucent table, a small soft supportive bump or towel roll is placed beneath the ipsilateral buttock, flank and shoulder region to minimize the tendency to externally rotate.

Fibula

Fibular was exposed by posterolateral approach as shown in Figure 1. Reduction and fixation is performed using the lateral approach to the fibula, with 1/3 rd tubular plate and 3.5 mm cortical screws.

Tibia

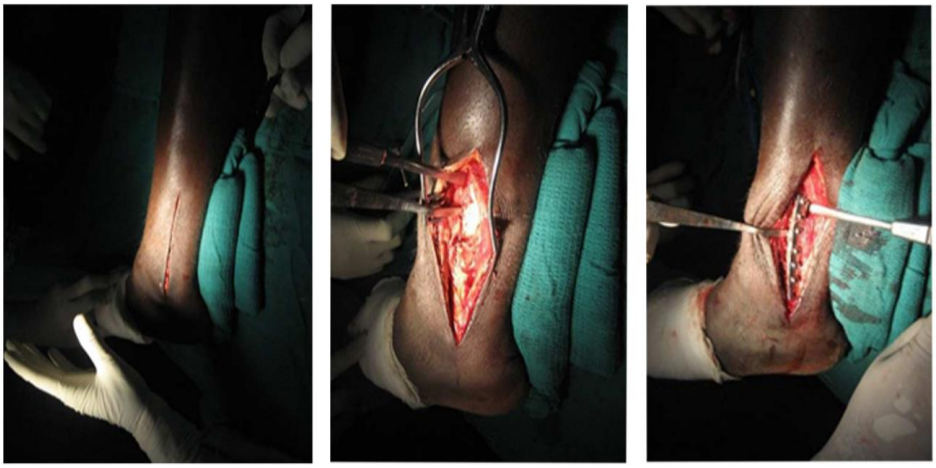
We used Modified Anteromedial approach as shown in Figure 1. Skin incision is approximately 1 cm lateral to tibial crest and follows the course of tibialis anterior tendon. At the level of ankle joint, the skin incision continues distally and medially, ending at the distal tip of medial malleolus. The plane of dissection is medial to anterior tibial tendon. Fracture fragments identified, reduced and fixed with temporary k – wires and then definitive fixation with 3.5 mm medial distal LCP with locking screws 20.

For AO type A fractures we used the technique of MIPPO. Here the incision was just proximal to the medial malleolus either transverse or longitudinal. The fracture was reduced indirectly and the plate was inserted through the incision. Through stab incision screws were inserted in the proximal fragment. For AO type C fracture we did open reduction of the fracture fragments and then fixed with LCP.

Post Op protocol

- Drain removal after 48 hrs.
- Suture removal on 12 post op day.
- Radiological examination once in every 6 weeks
- After removal of sutures ankle mobilization was started with non-weight bearing walking with walker.
- Once radiological union started partial to full weight bearing was allowed.

All cases were assessed using the IOWA ankle score and Teeny Wiss radiological scoring.



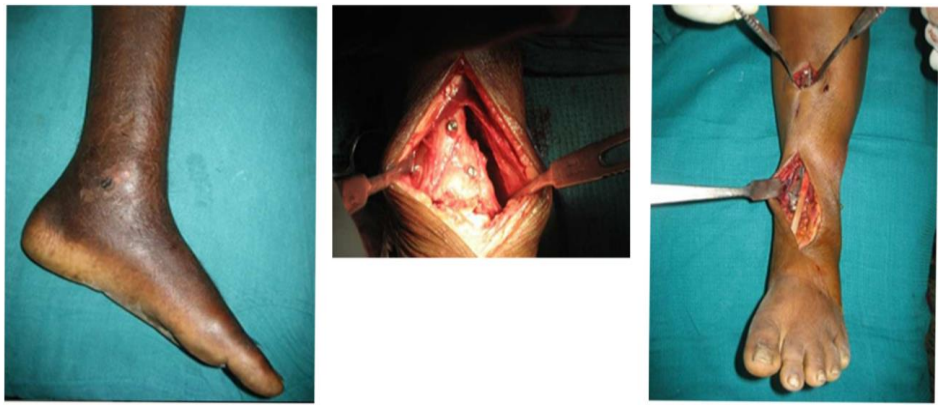


Fig 1: Showing the incision, exposure and plating of fibula in first row and positioning and reduction by lag screw fixation and medial MIPPO plating for distal tibial fracture in distal row.

Results

The total number of patients included in this study was 30 with age range between 20-64 with a mean age of 32.8yrs. M:F 12:18. RTA being the most common mode of injury among them. Based on Ruedi Allgower types 8 belonged to Type A while 10, 7, 5 belongs to Types C1, C2, C3 respectively. 16 of them had fibular fracture at same level while 8 had fibular fracture at different level while 6 had intact fibula. We had a minimum follow up of 1 yr and maximum follow up of 4 yrs with mean follow up of 2.8 yrs. Union was achieved in all cases between 12-16 weeks as shown in Figure 2. The mean duration from hospital admission to definitive surgery was around 10-14days.

Functional Score

A variety of rating systems were proposed for subjective and objective components. We have used modified Teeny and Wiss Score for radiological evaluation of ankle and IOWA scoring for functional analysis. The mean functional ankle scores were 80.5with a maximum of 94 and minimum of 74. Anatomic reduction was achieved in about 22 cases with good alignment.

Table 1: Showing the scoring, excellent and good fair

Scoring	Excellent	Good	Fair
Type A	9	1	0
Type C1	5	2	1
Type C2	3	1	1
Type C3	5	1	1

Teeny wiss radiological scoring

In our study we were able to achieve anatomic reduction in 72% (22cases) of the patients. Good in 5, Fair in 2 and Poor in 1 case respectively.

Table 2: Showing the reduction AP to C3

Reduction	AO Type A	Type C 1	Type C 2	Type C 3
Anatomic	8	6	4	4
Good	2	1	1	1
Fair	0	1	0	1
Poor	0	0	0	1

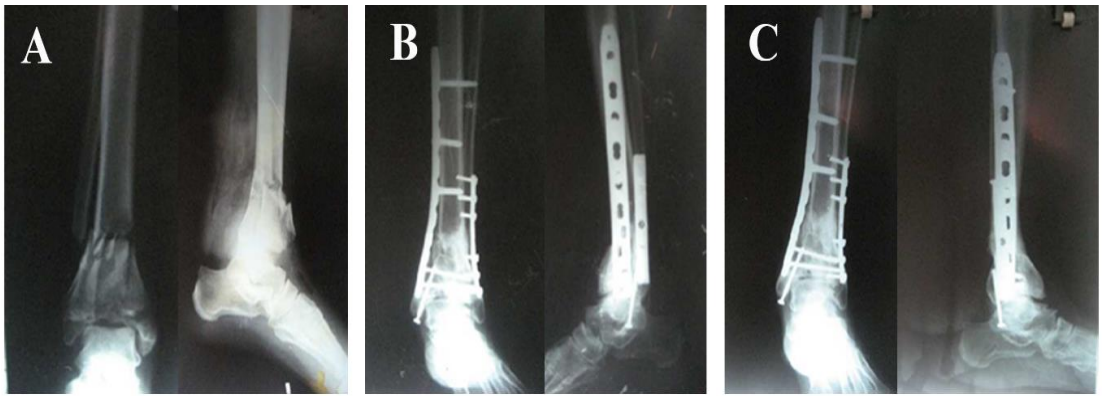


Fig 2: Showing the illustration of medial Tibia LCP for distal both bone fracture of leg A-preoperative X ray B-immediate post-operative X ray C-final follow-up X ray.

Complication

In our study we had superficial infection in 3 cases and one case of deep infection. All superficial infection settled with higher antibiotics and with wound wash. The case of deep infection required implant removal and was treated with hybrid ex-fix.

Discussion

Distal tibial fractures result from a range of low to high energy axial loading and are commonly associated with comminution of both the metaphysis and the distal fibula. This relative rare injury (<10% of lower extremity fractures) occur in adult owing to fall from height or from road traffic vehicle crash. The ideal or optimal treatment for these fractures remains controversial. Fractures of distal tibia most often associated with significant soft tissue injuries. The treatment of distal tibial fractures can be challenging because of its subcutaneous location, poor vascularity and limited soft tissue.

The key point is treatment of this injury is to recognize the importance of these soft tissue compromises. Definitive fixation is only advisable and done only when the soft tissue

allows for surgery or when the wrinkle sign is evident. Minimally invasive plating techniques reduce the iatrogenic soft tissue injury and damage to bone vascularity, and also preserve the osteogenic fracture hematoma.

The key principles in the management of these fractures – Restoration of the length and axis of the tibia and fibula; the reconstruction of the distal end of tibia; the filling of the defect resulting from impaction and the support of the medial side of tibia, by plating to prevent the varus deformity.

In our study we used a single-stage fixation of all distal tibial fractures. We used medial distal tibial locking compression plate for all cases. This plate is a low profile plate of 3.5 mm system. The Medial distal tibial plate is a precontoured plate to that of the distal tibia and thus allows placement of the plate without disruption of fractures fragments. The thread holes in the plate locks to that of the screw head and minimize plate-bone interface and maintain the vascularity at the fracture site.

Among 30 patients, all AO type A (10 cases) fractures were managed with MIPPO technique. AO type C3 fractures were managed with open reduction of the articular surface and fixed with locking compression plate. AO type C1 and C 2 fractures were managed using MIPPO technique and the fractures was transfixed through the plate.

Our study included a total of 30 patients. The peak incidence in our study was among the age group between 40-50 years. In our study we had excellent union and functional outcome in about 27 cases (90%) and 3 cases (10%) of fair outcome based on IOWA scores. As per TEENY WISS SCORE we had good anatomic rating in about 22 cases (72%), good rating in about 5 cases (18%), fair in 2 cases (8%) and one case (2%) of poor rating.

Mast *et al.* recommended primary definitive internal fixation if the patient was presented early within 8 to 12 hours following injury. They advocated a delay in the definitive procedure for about 7 to 10 days for soft tissue to heal, if the patient presented late. In our study the average duration of delay in the definitive treatment was about 10 to 14 days27.

Patterson and Cole *et al.* reported an impressive 0% infection rate following fixation after an average of 24 days, however this study is limited by its relatively small sample size. In our study we had a delay of about 10 to 14 days before going for definitive stabilization.

Barei *et al.* demonstrated that distal tibial fractures with intact fibula, on the whole was considered as less severe injury than those with fractured fibula. An intact fibula was identified as less severely injured than C type fractures.

The first principle of management by Ruedi and Allgower was restoration of fibular length which remains vital to obtaining good results. The goal of fibula fixation was restoration of limb length, to prevent varus tilt and rotation and gross mechanical alignment. Of the 30 cases, 14 cases of fracture fibula had gross displacement which required fixation with 1/3rd tubular plate. Plating was done in fracture fibula with comminution. The rest of the cases were not fixed as most of the fractures were undisplaced stable fractures or it was fractured at different levels. All fibula fractures healed within 3 months without any gross complications.

Helfet *et al.* in their study had a superficial infection rate of 3% and deep infection of 6% in their series of 32 fractures treated with locking compression plate. In our study we had 3 cases (10%) of superficial infection 74 and 2 cases (8%) of deep infection, which was comparable to the above study.

Philip *et al.* and Mark Jackson *et al.* in their study of complication of definitive open reduction and internal fixation of distal tibial fractures, they had good functional result in 73.7% cases and 5% of deep infection rate in a follow up of 30.4 months. In our study we had 72% of good functional outcome and 8% of deep infection rate, which was acceptable when compared to the above study.

Pierre Joveniaux *et al.* and Xavier Ohi *et al.* in their study of distal tibia fracture: management and complication, they had a functional score of 76% in their series. Their result had 20 cases of excellent, 15 cases of good, 9 cases of fair and 6 cases of poor in their series of 50 cases. In our study we had nearly 22 cases of excellent outcome, 5 cases of good, 2 cases of fair and one case of poor outcome among the 30 cases35.

Mario Ronga MD *et al.* and Nicola Maffulli MD *et al.* in their study of minimally invasive locked plating of distal tibial fractures, they had the following outcomes of the 21 cases they achieved union in 20 cases and one case went in for non-union. They had 3 cases of angular deformities all less than 7° and no patient had a leg-length discrepancy. Compared to their study, in our study we used MIPPO in about 14 cases, in which all cases went in for union in about 10 to 14 weeks with no case of malunion or nonunion26.

Rakesh Gupta *et al.* and Rajesh Kumar Rohllla *et al.* in their study of locking plate fixation in distal tibial fractures – series of 79 patients, had reported about 88% of healing without malunion, 2.5% of malunion and 3.7% of non-union. They used both MIPPO and ORIF for fixing these fractures. They found good and early union rate in the MIPPO group. In our study also we had good and early union in the MIPPO group and also we had no case of malunion or non-union.

Pugh and colleague evaluated 60 patients, 25 of whom were treated with external fixators. They noted that they had more number of malunion in the external fixator group compared to that of internal fixation. They met most of their complication in the external fixator group. In our study also we had good functional outcome in internal fixation group38. The average follow up period our study was 9.4 months (range from 6 to 20 months). In type III fractures patients may develop late secondary arthrosis,

but it requires a longer follow up. In our series, the results of the patients who had long follow up period of more than 22 months had good clinical scores despite some early mild arthritic changes in type C severe communited fractures.

Anatomic realignment of fibula indirectly redues the talus beneath the anatomic axis of tibia. Restoration of fibular length, alignment and 78 rotation has the substantial impact on the indirect realignment of anterolateral and posterolateral tibial plafond from their attachment to the anterior and posterior tibiofibular syndesmotic ligaments. Hence fibula fixation is advocated wherever possible.

The incidence of head injury or spinal cord injury was less in our series compared to other studies. 15% of our cases had associated other bony injuries like fractures of clavicle and distal radius. Hence the outcome of surgically treated distal tibial fractures depends on the associated injury to and the management of, the soft tissues surrounding the injury and accuracy of the articular reduction. A correlation exists between the severity of the fracture, overall outcome and the development of secondary degenerative arthritis.

Conclusion

Medial Tibial locking compression plating can be considered as a reliable modality of management of distal tibial fractures and it has to be done either within 24 hrs of the injury before the edema sets in or a delay of 8 to 12 days for the edema to settle down and the wrinkle sign appears. Respect the soft

tissues, do not operate too early or through compromised skin, instead wait till the soft tissues is amenable for surgery. Restoration of the articular surface and reestablishing its relationship to the tibial shaft is the primary goal of treatment. Good functional result depends on reasonable anatomic reduction of the articular surface either by direct or indirect methods.

This study is the authentic work of the authors. No financial benefits were received from any commercial party for this study.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article

References

1. Arlettaz Y, Blanc CH *et al.* Fractures of the tibial pilon. Long term retrospective study of 51 fractures treated with open reduction and osteosynthesis. Rev Chair Orthop Reparatrice Appar Mot. 1998; 84(2):180-8.
2. Babis GC, Vayanos ED, Papaioannou N *et al.* Results of surgical treatment of tibial plafond fractures. Clin Orthop. 1997; 341:99-105.
3. Barei DP Bellabarba. Is the absence of ipsilateral fibular fracture predictive of increased radiographic tibial pilon fracture severity? Jorthop Trauma 2006, 6-10.
4. Blauth M, Bastian L, Krettek C, *et al.* Surgical option for the treatment of severe pilon fractures. J Orthop Trauma 1999; 15:153-160.
5. Borrelli J, Catalano L. Open reduction and internal fixation of pilon fractures. J Orthop Trauma 1999; 13:573-582.
6. Bourne RB, Rorabec CH, Macnab J. Intra-articular fractures of the distal tibia: the pilon fracture. J Trauma. 1983; 23:591-595.
7. Bonnevialle P, Lafossse JM *et al.* Distal leg fractures: How critical is the fibular fracture and its fixation? Orthop Traumatol Surg Res. 2010; 96(6):667-73.
8. Boren P, Richmond J *et al.* Minimally invasive treatment of pilon fractures with a low profile plate preliminary report. 2006; 8:230-235.
9. Decoster TA, Willis MC, Marsh JL *et al.* Rank order analysis of tibial plafond fractures: does injury or reduction predict outcome? Foot Ankle Int. 1999; 20:44-49.
10. Egol KA, Kubiak EN, Fulkerson E *et al.* Biomechanics of locked plate and screws. J. Orthop Trauma. 2004; 18(8):483-93.
11. Egol KA, Wolinsky P *et al.* Open reduction and internal fixation of tibial pilon fractures. Foot Ankle Clin. 2000; 5(4):873-85.
12. Etter C. Operative long term result of tibial pilon fractures treated with open reduction and internal fixation Orthop Trauma. 1991; 189:1191- 1197.
13. Frigg R. Development of Locking Compression Plate. Injury 2003; 34(supp.):B6-10.
14. Helfet DL, Suk M *et al.* Minimally invasive percutaneous plate osteosynthesis of distal tibial fractures, Instr Course Lect. 2004; 3:471- 475.
15. Helfet DL, Koval K *et al.* Intraarticular pilon fractures of the tibia. Clin Orthop Relat Res. 1994; (298):221-228.
16. Howard JJ, Barie *et al.* A prospective study of evaluating incision placement and wound healing for tibial plafond fratures. J Orthop trauma. 2008; 5:250-255.
17. Hasenboehler E, Rikli D *et al.* Locking compression plate with minimally invasive plate osteosynthesis in distal tibial fractures: a retrospective study of 32 patients. Injury 2007; 38(3):365-370.
18. John Scolaro, Jaimo Ahn. In Brief: Pilon fractures. Clin Orthop Relat Res 2011; 469(2):621-623.
19. Kellam JF, Waddell JP. Fractures of the distal tibia metaphysis with intra-articular extension: the distal tibial explosion fractures. J Trauma. 1979; 19:593-609
20. Lee YS, Chen SW, Chen SH *et al.* Stabilisation of the fractured fibula plays an important role in the treatment of pilon fractures: a retrospective comparison of fibular fixation methods. Int Orthop. 2009, 695-699.
21. Rakesh K, Gupta, Rajesh Kumar Rohbilla *et al.* Locking plate fixation in distal metaphyseal tibial fractures: series of 79 patients. Int Orthop 2010; 34(8):1285-1290.
22. Mario Ronga, Umile Giuseppe Longo *et al.* Minimally invasive locked plating of distal tibia fractures is safe and effective. Clin Orthop Relat Res. 2010; 468(4):975-982.
23. Mast J. A test of surgical judgement. In; Major Fractures of the pilon, the Talus, and the Calcaneus, ed by Tscherne H, Schatzker J. Berlin, Springer-Verlag, 1993, 7-27.
24. Martin JS, Marsh JL, Bonar SK *et al.* Assessment of the AO/ASIF fracture classification for the distal tibia. J Orthop Trauma. 1997; 11:477-483.
25. Martin J, Marsh J, Nepola JV *et al.* Radiographic fracture assessments: which ones can we reliably make? J Orthop Trauma. 2000; 14:379-385.
26. Mcferran MA, Smith SW, Bouslas HJ *et al.* Complications encountered in the treatment of pilon fractures. J Orthop Trauma. 1992; 6:195-200.
27. Muhr G, Breitfuss H *et al.* Complications after plion fractures. In: Major Fractures of the pilon, the talus and the calcaneus, ed by Tscherne H, Schatzker J. Berlin, Springer-verlag, 1993, 65-68.
28. Mu"ller ME, Allgo" wer M, Schneider R *et al.* Manual of Internal Fixation. Techniques recommended by the AO-ASIF group. Berlin, Springer-verlag, 1991.
29. Ovadia DN, Beals RK. Fractures of the tibial plafond. J Bone Joint Surg (Am). 1986; 68:543-551.
30. Patterson MJ, Cole JE. Two staged delayed open reduction and internal fixation of severe pilon fractures. J Orthop Trauma. 1999; 13:85-91.
31. Pierre Joveniaux, Xavier Oh *et al.* Distal tibia fractures: management and complications of 101 cases.
32. Philip A, McCann Mark Jackson *et al.* Complications of definitive open reduction and internal fixation of pilon fractures of the distal tibia. Int Orthop. 2011; 35(3):413-418.
33. Pollak AN, McCarthy ML, Bess RS *et al.* Outcomes after treatment of high-energy tibial plafond fractures. J Bine Joint Surg Am. 2003; 85:1893-900.
34. Pugh KJ, Wolinsky PR *et al.* Tibial Pilon fractures: a comparision of treatment methods J Trauma. 1999; 47:937-941.
35. Resch H, Philander S *et al.* Long term results of conservative and surgical treatment for distal end of tibia 1986; 16:117-123.
36. Ruedi T. Fractures of the lower end of the tibia into the ankle joint: result 9 years after open reduction and internal fixation. Injury 1973; 5:130-134.
37. Reudi T, Matter P, Allgower M *et al.* Intra-articular fractures of the distal tibial end. Helv Chir Acta. 1968; 35:556-582.
38. Reudi TP, Allgower M *et al.* The operative treatment of intra-articular fractures of the lower end of the tibia. Clin

Orthop Relat Ras. 1979; (138):105-110.
39. Sands A, Byck *et al.* Clinical and functional outcomes of internal fixation of displaced pilon fractures. Clin Orthop. 1998; 347:131-137.
40. Schatzker J, Tile M *et al*. Tibial pilon fracutes. Rationale of Operative Fracture management. 2 ed. Berlin: Springer-Verlag, 1996.
41. SyahBahari, Brian Lenehan, *et al.* Minimally invasive percutaneous plate fixation of distal tibia fractures. Acta Orthop. 2007; 73:635-640.
42. Surgical exposures in Orthopaedics – Stanley Hoppenfield – fourth edition.
43. Teeny S, Wiss D. Open reduction and internal fixation of tibial plafond fractures. Clin Orthop 1993; 292:108-117.
44. Topliss CJ, Jackson M *et al.* Anatomy of pilon fractures of the distal tibia. J Bone and Joint Surg Br. 2005; 87:692-697.
45. Tornetta P, Weiner L, Bergman M *et al.* Pilon fractures: treatment with combined internal and external fixation. J Orthop Trauma. 1993; 7:489-496.
46. Wagner M. General principles for the clinical use of the LCP. Injury 2003; 34(2):B31-42.
47. Watson JT, Moed BR, Cramer KE *et al.* Pilon fractures – Treatment protocol based on severity of soft tissue injury. Clin Orthop Relat Res 2000; (375):78-90.
48. William TM, Nepola JV *et al.* Factors affecting the outcome in tibial plafond fractures. Clin Orthop Relat Res. 2004; (423):93-98.
49. Wyrsch B, Mcferran MA *et al.* Operative treatment of fractures of the tibial plafond. A randomized prosepective study. J Bone Joint Surg Am. 1996; 78:1646-1657.