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Appraisal of Clinical and Radiological Outcome of Management of Distal Tibia Fractures With Distal Tibia Locking Plate (DTLP)

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***Abstract** : Distal tibial fracture is one of the commonest fracture following accidents in over 15% of total fracture cases.The triumph key in managing these niggling fractures is to proficiently preserve, reconstruct the soft tissues, acceptable reduction & early mobilization.AO/OTA classification system is used now a days to classify these fractures.The concept of "biological osteosynthesis", a terminology introduced to designate a new & novel type of osteosynthesis leading to a sufficiently stable fixation of bone fragments allowing early mobilization, and that too without major disturbance of the vascular supply.The advantages of distal tibiallocking plates (DTLP) apply most directly to highly comminuted fractures, unstable metadiaphyseal segments, and osteoporotic fractures.*

***Key Words:**DTLP, biological osteosynthesis, distal tibial fractures.*

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I. Introduction

Fracture of distal tibia is one of the commonest fracture following accidents in over 15% of totalfracture cases. As for the tibia, its subcutaneous nature and be short of adequate musculature medially makes it more vulnerable to fracture and consequentialbone trouncing. The triumphkey in managing these niggling fractures is to proficiently preserve, reconstruct the soft tissues, acceptable reduction& early mobilization.

These fractures are making happeneither by direct vehemenceor indirect trauma.

Sir John charnleyin 1961 stated: "we have still a long way to go before the best method of treatment of a fracture of the shaft of tibia can be stated with finality". Sluggishrate of union is usually as a result of severity of fracture, meagre blood supply to one fragment and sometime distraction of bone fragments; sporadic limitation of joint movement in knee, ankle and foot,usually caused by allied joint soft tissue and vascular injury.

Ruedi and Allgower's classification was the first in widespread useaccetability. This classified axial loading fractures of distal tibia into three types, based on the degree of comminution of the articular surface.[1]

Of late this has largely been supplemented by AO/OTA classification system.[2]

II. AO/OTA CLASSIFICATION

It groups distal tibia fractures as 43.

TypeA fractures are extraarticular distal tibial fractures, subdivided into A1, A2, and A3 groups, based on the amount of metaphysealcomminution.

Type B fractures are partial articular fractures & a portion of the articular surface remains in permanence with the shaft; these are subdivided into B1, B2, and B3, dependingupon the amount of articular impaction and comminution.

Type C fractures are complete metaphyseal fractures with articular involvement; these are subdivided into C1, C2, and C3, based on the extent of metaphyseal and articular comminution.
In present study, AO classification had been followed.
A choice ofmanagement options include: close reduction & pop cast application, external fixation, intra-medullary nailing, open reduction and internal fixation
Conservative managementnowadays is by and large reserved for low-energyclosed, stable, isolated, minimally displaced fractures.

Operative treatment is indicated for mosthigh-energy,displaced comminutedtibial fractures as these areunstable, and associated with varying degrees of soft-tissue trauma. It allows early movement, provides soft-tissue access, and avoids complications associated with immobilization with pop cast.

The complications with other methods has innovated the concept of "biological osteosynthesis", aterminology introduced to designate a new& novel type of osteosynthesis leading to a sufficiently stable fixation of bone fragments allowing early mobilization, and that too without major disturbance of the vascular supply. Locking minimizes the compressive forces exerted by the implant on the bone. Precise anatomical contouring of a implant is no longer a pre requisite. This prevents the loss of primary reduction of fracture fragments caused by inadequate contouring of a plate.[3,4,5,6]
The advantages of locking plates apply most directly to*highly comminuted fractures, unstable metadiaphyseal segments, and osteoporotic fractures*. Theseplates act as "internal fixators". Hybrid techniques that combine the benefits of compression plate fixation with the biological and biomechanical advantages of locking plates are the most likely end result of current locking plate applications.
The main foundations of use of a locking plate embrace four classic principles as documented below:

1 The compression principle,
2 The neutralization principle,
3 The bridging principle
4 The combination principle,

The bridging principle, is classically represented by the concept of minimally invasive percutaneous plate fixation (MIPPO technique), whereby the angular- stable plate is used as an internal splint that bridges the comminuted fracture. *The combination principle* refers to a biomechanical mixture of compression and bridging with only one implant, indicated for fixation of fractures with a simple pattern (e.g. an intra-articular split) at one level and comminution (e.g., metaphyseal-diaphysealcomminution) at a different level.
Proponents of medial plating cite the technical ease of the approach, the ability to perform a minimally invasive procedure, and decreased local soft tissue disruption at the fracture site as the primary advantages.[7,8,9,10]

III. Aim and Objectives

To appraiseclinical and radiological outcome of management of distal tibial fractures using distal tibial locking plate (DTLP).

IV. Material and Methods

This was a prospective study of 25 cases of fractures of distal tibia, admitted& managed in tertiary care hospital of Punjab.

V. Inclusion Criteria

Fracture distal tibia (closed,open type A and type B) extra & intra articular in adults
Exclusion criteria:-Previous or existing infection, gross comminution of the involved bone, compound grade III fractures.

Fractures were classified according to AO classification and Patients assessed. Preoperative x-rays were done in both planes.Under spinal/epidural anaesthesia, fracture site was exposed by standard medial approach, in metaphyseal fractures without intraarticular extension or comminution, MIPPO technique was followed. In case of intraarticular fractures, accurate reduction was confirmed and provisional fixation was done with K wires or screws before proceeding to final plate fixation.

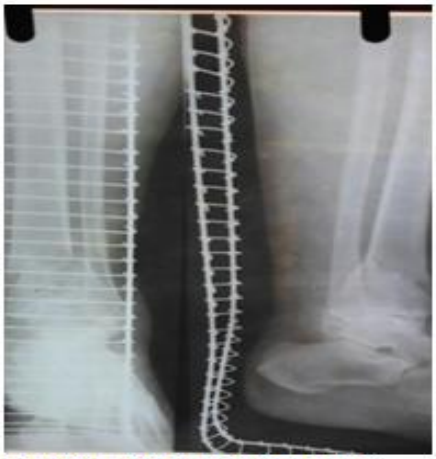
In MIPPO technique, incision was made obliquely at the tip of medial malleolus and extended proximallywith care taken to protect the great saphenous vein. Extraperiosteal tunnel for the platewas created& after plate insertion, the proximal central position of the same on the tibial shaft was checkedfollowed by insertionof non locking cortical screws and locking screws.All the non locking screws were inserted first to achieve reduction and thereafter locking screws were inserted with aminimum of four screws in each fracture fragment. This was followed by irrigation with normal saline and wound closure in layers over closed suction drain.Post operativecheck X-rays were done. Ankle mobilization started as early as possible. Patient followed up and assessed clinically and radiologically till the union occurred.The outcome of distal tibial fractures

management with locking plates was assessed in terms of time to bony union, range of Ankle movement, Malunion, Infection**,** secondary procedures performed (if any).

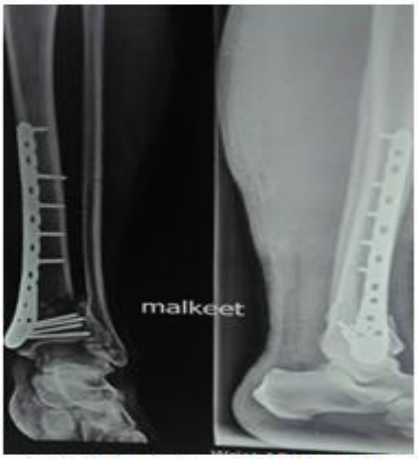
VI. Observations

The present study enrolled 25 patients with fracture of distal end tibia with an average age 38.04 years. It was observed that comminuted fractures of the distal end tibia were more common (60%)in young and middle age groups (20-40 years).

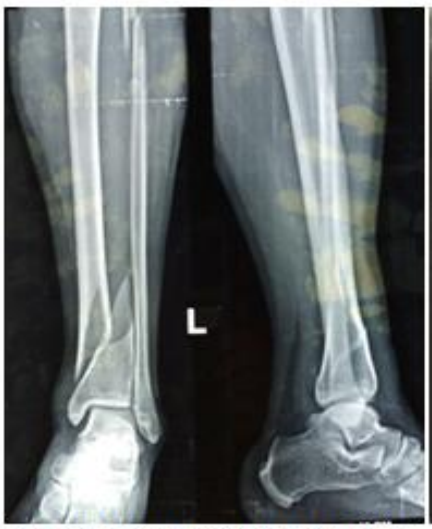
We observed that in our series76%were males and 24% were females (male: female ratio 3.16:1)



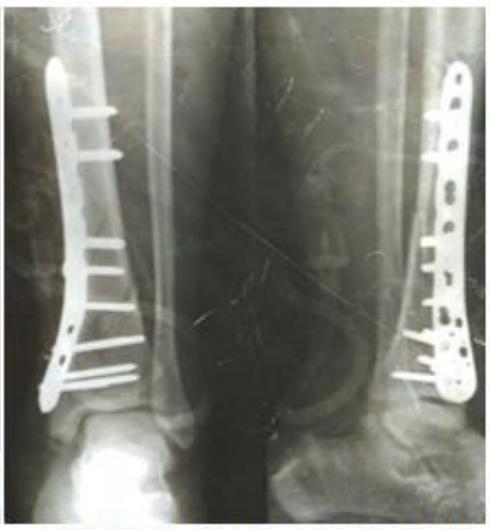
CASEI: PREOPERATIVE



CASE I: POST OPERATIVE



CASE II: PREOPERATIVE



CASE II: POST OPERATIVE

Road traffic accident was most common cause (64%) of injury.

TABLE I
DISTRIBUTION OF SUBJECTS ACCORDING TO MODE OF INJURY

Mode of Injury	No. of Patients	Percentage
RTA	16	64%
Fall	9	36%

64% patients had isolated distal tibial fracture, however 36% patients had associated injuries, out of these 28% patients had trivial fall,12% cases were with head injury, 08% cases with chest injury, 08% with fracture patella and08% with fracture radius.

TABLE 4
DISTRIBUTION OF SUBJECTS ACCORDING TO ASSOCIATED INJURYS

Associated Injury	No. of Patients	Percentage

Head injury	03	12%
Chest injury	02	08%
Patella fracture	02	08%
Fracture radius	02	08%
No associated injury	16	64%

Fractures were graded in accordance to AO/OTA Classification(80% were grade A, 12% were grade B, and the remaining 08% were grade C).

TABLE 5
DISTRIBUTION OF SUBJECTS ACCORDING TO TYPE OF FRACTURE- AO CLASSIFICATION

Type of Fracture	No.of Patients	Percentage
Extra Articular (Type A)	20	80%
Partial Articular (Type B)	03	12%
Complete Articular (Type C)	02	08%

- 84% patients had closed fractures, while 16%had open fractures.

TABLE 6
DISTRIBUTION OF SUBJECTS ACCORDING TO TYPE OF FRACTURE (OPEN/CLOSED)

Type of Fracture	No. of Patients	Percentage
Open :-	04	16%
Type 1	03	
Type 2	01	
Closed	21	84%

Immediate early and late postoperative complications:

Early complications(within first two weeks) were in form of fever in 3, superficial infections in 4, superficial skin necrosis in 3 cases.

In late complications(after two weeks postoperatively to till unionoccurred), 12%patients had persistent pain, 4% had mal-union,08%had deep infection and subsequent implant removal.

TABLE 7
DISTRIBUTION OF PATIENTS ACCORDING TO POST OPERATIVE COMPLICATIONS

Complications	No. of patients	Percentage
Early postoperative complications:		
Fever	03	12.00%
Skin Necrosis	04	16.00%
Superficial Infection	03	12.00%
Total	10	40.00%
Late postoperative complications:		
Persistent pain	3	12.00%
Malunion/ shortening	1	04.00%
Deep infection/implant removal	2	08.00%

92% cases united primarily after fixation; of these 32% fractures united by 16 week, 48% by 20 weeks &12% by 24 weeks.

Average time of union was 19.13 weeks.

We observed fracture non union in 04% patients at 6 month follow up.

TABLE 8
DISTRIBUTION OF SUBJECTS ACCORDING TO TIME TO BONY UNION (RADIOLOGICAL)

Time	No. of Patients	Percentage
By 16 weeks	8	32%
By 20 weeks	13	52%
By 24 weeks	3	12%

VII. Discussion

Treatment of distal tibial fractures has always posed a confront because of associated soft tissue injury and comminution. The main aim of managing these fractures is to achieve bony union in proper alignment and good functional outcome.

The study included 25 patients with age ranging from 19 to 70 years with a mean age of 38.04 years with a preponderance of comminuted fractures of distal end tibia in young and middle age groups (20-40years). In our series,76% were males and 24% were females(male: female: 3.2:1).

In a prospective study **Hazarika S et al** reported their experience in treatment of distal tibia fractures in 20 patients with a mean age of 44.7 years (range 19-69 years), managed with locking plates. There were 80% males and 20% females (male: female: 4:1)[11]

In a prospective study **Mushtaq A. et al**reviewed 21 patients with distal tibia fracture treated with LCP internal fixation. 66.6% were malesand 33.3% female patients (male:female : 2:1) with a mean age of 51 years were included.[12]

A prospective study on 62 patients by **Leung FKet al**who were treated for distal tibia fractures who were treated with locking compression plates from august 2002 to august 2007 and observed that patient's age ranged from 21-87 years with a mean age of 44 years old.[13]

Hence,present study is in accordance with the earlier studies as stated above, as this is the age group indulging in more outdoor activities, thus more prone to injury.

16 out of 25 patients majority of patients (64%) suffered such fracture after high velocity road traffic accidents. other causes were fall in 7 cases (28%), and two cases were result of assault. In 4 of the female patients, the fracture sustainedas a result of fall and the fall were trival. Poor bone stock (osteoporotic) in trival fall cases was evident on the preoperative radiographs.

A retrospective study on 79 patients by**Gupta RKet al**, with distal tibia fractures observed that 68 (86.08%) patients were injured after road traffic accidents and 11 (13.92%) patients had a fall.[14]

A prospective study on 62 subjects by**Leung FKetal**from august 2002 to august 2007 observed that nine patients sustained RTA, four patient's sustained injury in fall while rest of the patients sustained injury as a result of twist.[13]

In a randomized,**Vallier HA et al**did a prospective comparison of plate versus intramedullary nail fixation for distal tibia shaft fracture by assessing complications and secondary procedure in 104 patients. They observed that 36 (34.61%) patients sustained injury in RTA, 38 (36.53%) patients sustained it in fall while 17 (16.34%) patients sustained crush injuries.[15]

Hence distal tibia fracture most commonly occurs after high energy trauma especially motor vehicular accidents;while in an osteoporotic bone, these fractures can result even after trivial injury.

In this study, 9 (36%) patients had associated injuries, however 16 (64%) patients had isolated distal tibial fracture(these include 7 patients who had such fracture following a trivial fall).There were 12% cases with head injury, 04% cases with chest injury, 08% with fracture patella, 04% patients had nasal bone fracture.04% cases with avulsion over opposite leg, and 04%patients with ulna fracture. Hence fracture of distal tibia should be thoroughly assessed as such fractures are often associated with multiple injuries due to association with high velocity trauma.

Fractures were graded in accordance to the(AO/OTA Classification). It was observed that 64% out of 25 fractures were grade A, 20% were grade B, and the remaining 16% were grade C. Amongst grade A fractures,Grade A3 was the commonest with 7 (43.8%) fractures,3 (18%) were grade A1, 6 (37.50%) were grade A2 fractures. More than half of the fractures were comminuted type (A3 B3 C3).

In a retrospective study**Leung FK et al** recruited 62 subjects fromAugust 2002 to August 2007 at mean age of 44 years old (range, 21-87 years old). According to AO classification, there were 8 cases of type A1, 15 cases of type A2, 9 cases of type A3, 7 cases of type B3, 11 cases of type C1, and 12 cases of type C2. Of them, 52 patients had closed fractures and 10 had open fractures. Ten open fractures included 6 Grade I fracture and 4 Grade II fracture.[13]

Mushtaq A et alin a prospective study on 21 distal tibia fractures observed that, there were 12 Type A, 5 Type B, and 4 Type C fractures.[12]

Faschingbauer M et al in a prospective study treated twenty-five patients with closed distal tibial fractures with a locked plate osteosynthesis over a period of two years. According to AO classification, there were three A1, eight A2, nine A3, one B2, two C1, and two C3 fractures [16].

Hence higher thevelocity in road traffic accidents, higher the comminution at the fracture site.

Six (24%) patients developed superficial infection with wound healing problems. All of them healed with oral antibiotics. For one (04%) patients with skin necrosis debridement and ASD was done, and later wound closure was done. Late complications in form of persistent pain 4 cases (16%), mal-union 2 cases (08%), non-union 1 case (04%), deep infection 1 case(04%),were also seen. In patient, where deep infection was present, implant removal was done,

Hazarika S et alin a prospective study reported their experiences with minimally invasive locking plate osteosynthesis(MIPPO), For distal tibia fracture,with specific reference to fracture union and complications encountered in 20 patients with open or closed tibial fractures. Three out of 20 patients require metalwork

removal, for delayed wound breakdown in two cases and wound infection in one case. An uneventful recovery was made following this in all three cases.[11]

Bahari S et al ina prospective studyon 42 patients reviewed at a mean of 19.6 months after treatment of distal tibial and observed that two cases of superficial infection noted, with one case of deep infection.[17]

Mushtaqet al in a prospective study reviewed 21 patients with tibial fractures treated with indirect reduction and minimally invasive Percutaneous LCP internal fixation. Two patients developed superficial wound infections but fractures united completely.[12]

Gupta RK et al in a retrospective study reviewed distal tibialmetaphyseal fractures in a series if 79 patients treated with locking plates. There were two cases of delayed wound breakdown.[14].
In our study lower rate of skin breakdown was probably attributed to meticulous skin care and by use of MIPPO technique where ever possible.

23 fractures (92%) united primarily after fixation; of these 8 (32%) fracture united by 16 week, 12 (48%) fracture by 20 weeks, by 24 weeks in three (12%) patients. Average time of union was calculated to be 19.13 weeks.

We observed fracture non-union in one (04%) patients at 6 month follow up, patient was operated for revision plating at some other centre, In one patient implant removal was done before union, due to development of deep infection.

Bahari S et alina prospective studyon 42 patients, reviewed at a mean of 19.6 month after treatment of distal tibial and pilon fracture using AO distal tibial locking plate with a minimally invasive Percutaneous plate osteosynthesis (MIPPO) technique. Mean time to union was 22.4 weeks, all fractures united with acceptable alignment and angulation.[17]

Zha G et al in a prospective study performed on13 patients with tibial fractures treated with indirect reduction and minimally invasive Percutaneous LCP internal fixation. All patients were followed up for 10-18 months (13 month on average)all fractures reached clinical healing, and the healing time was 12-20 weeks (16 weeks on average).[18]

Mushtaq A et al in a prospective study author reviewed 21 patients with distal tibia fracture treated with LCP internal fixation.AO type 43A, 43B and 43C were included, The mean time to union was 5.5 months (range 3-13 months) seventeen fractures healed with good functional outcome. One patient had delayed union. One patient had non union and underwent revision; the fractures ultimately healed with good functional outcome.[12]

Ronga M et al in a prospective study assessed the bone union rate, deformity, leg-length discrepancy; ankle range of motion, return to preinjury activities, infection, and complication rate in 21 selected patients who underwent minimally invasive osteosynthesis of closed distal tibia fractures with locking plates, Union was achieved in all but one patient by the 24th postoperative week.[19]

CollingeCet al in a prospective study evaluated clinical results and outcomes of low metaphyseal distal tibia fractures with minimal or no intra-articular involvement. These were treated using the minimally invasive plate osteosynthesis concept with a 3.5-mm locked medial tibial plafond plate and hybrid (locking and nonlocking) screw construct. Thirty-eight patients were followed on average of 32 months (range, 12-48 months). Mean fracture healing time was 21 weeks (range, 9-60 weeks). One patient (3%) had loss of fixation and two (5%) underwent secondary surgeries to achieve union.[10]

Hence, union rate in our study corroborates with above discussed studies.
Malunion was observed in two (08%) patients. Valgus mal alignment was observed on immediate postoperative radiographs of this patient which healed with no change in alignment.
The other patient had varusmalunion at 6 month follow up.

Protzman R et al in a prospective study on 38 patient observed one case (3%) of Valgus malalignment observed on immediate postoperative radiographs, which healed with no change in alignment. The remaining 37(97%) fractures maintained alignment until healing was achieved.[20]
One case of early scar breakdown, debridement and ASD was done, granulation tissue was formed, and later wound closure was done.
One case of delayed scar breakdown with deep infection resulting in aseptic exposure of plate and required only plate removal as the fracture had united.

Gupta RK et al in a retrospective study reviewed distal metaphysealtibial fractures in a 79 patients treated with locking plates, observed two cases of delayed scar breakdown resulting in aseptic exposure of plate, one required subsequent fasciocutaneous flap. Another patient required only plate removal as the fracture had united.[14]

Hence the result of this study corroborate with the contemporary literature relevant to distal tibia fracture fixation performed with various locking plates. Therefore, locking compression plate is a good device to stabilise the fracture of the distal tibia especially when used with skill along with minimum handling &preservation of the soft tissue. Care must be taken to motivate the patients for their involvement in rehabilitation programme.

VIII. Conclusion

Fractures of the distal end tibia are commonest in young and middle agedpopulation.Majority of patients who suffered a fracture of distal end of tibia were males due to high velocity road traffic accidents.In our study, 36% of patients had associated injuries signifying the severity of trauma. Most common were type A fractures (64%), and amongst them A3 was the commonest subtype; 19 patients had closed fractures (76%),while 6 had open fractures (24%).Infection occurred in 8 patients& was managed accordingly. Mean time to union was 19.13 weeks.Physiotherapy started from 2^{nd} -3^{rd}post operative day according to tolerance of patients and associated injuries. First Partial &then full weight bearing was started after the clinical and radiological healing of fracture.

Thus locking plates are a good device to stabilize the fractures of the distal tibia. Especially when used in conjunction with meticulous intraoperative handling of soft tissue and active participation of patients in rehabilitation programme.

Bibliography

[1] Ruedi T, Allgower M. Fractures of the lower end of the tibia into the ankle joint. Injury 1969; 1: 92-9.
[2] Orthopaedic Trauma Association Committee for Coding and Classification. Fracture and dislocation compendium. J Orthop Trauma 1996; 10(1):1.
[3] Broos PL, Sermon A. From unstable internal fixation to biologicalosteosynthesis. A historical overview of operative fracturetreatment. ActaChirBelg 2004;104(4):396-400.
[4] Smith WR, Ziran BH, Anglen JO, Stahel PH. Locking Plates: TipsandTricks J Bone Joint Surg Am 2007;89:2298-307.
[5] Sommer C, Gautier E, Muller M, Helfet OL, Wagner M. First Clinicalresults of the Locking Compression Plate (LCP). Injury 2003;34(2):B43-54.
[6] Wagner M. General principles for the clinical use of the LCP.lnjury 2003; 34(2):B31-42.
[7] Oh CW, Kyung HS, Park IH, Kim PT, Ihn JC. Distal tibia metaphyseal fractures treated by percutaneous plate osteosynthesis. *ClinOrthopRelat Res.* 2003; 408:286-291.
[8] Collinge C, Sanders R, DiPasquale T. Treatment of complex tibialperiarticular fractures using percutaneous techniques. *ClinOrthopRelat Res.* 2000; 375:69-77.
[9] Borrelli J Jr, Prickett W, Song E, Becker D, Ricci W. Extraosseous blood supply of the tibia and the effects of different plating techniques: a human cadaveric study. *J Orthop Trauma.* 2002; 16(10):691-695.
[10] Collinge C, Protzman R. Outcomes of minimally invasive plate osteosynthesis for metaphyseal distal tibia fractures. *J Orthop Trauma.* 2010; 24(1):24-29.
[11] Hazarika S, Chakravarthy J, Cooper J. Minimally invasive lockingplateosteosynthesis for fractures of the distal tibia--results in20patients. Injury 2006; 37(9):877-87.
[12] Mushtaq A, Shahid R, Asif M. Distal Tibial Fracture Fixationwith Locking Compression Plate (LCP) Using the Minimally Invasive Percutaneous Osteosynthesis (MIPO) Technique.Eur J Trauma EmergSurg 2009;35:159-64.
[13] Leung FK, Law TW.Application of minimally invasive locking.compression plate in treatment of distal tibia fractures. ZhongguoXiuFu Chong JianWaiKeZaZhi2009;23:1323-5.
[14] Gupta RK, Rohilla RK, Sangwan K, Singh V, Walia S.: Locking plate fixation in distal metaphysealtibial fractures: series of 79 patients. IntOrthop 2009; 33:120-3.
[15] Vallier HA, Cureton BA, Patterson BM: Randomized, prospective comparison of plate versusintramedullary nail fixation for distal tibia shaft fractures. J Orthop Trauma 2011; 25(12):736-41.
[16] Faschingbauer M, Kienast B, Schulz AP. Treatment of DistalLower Leg Fractures: Results with Fixed-Angle Plate Osteosynthesis.Eur J Trauma EmergSurg 2009;35:513-9.
[17] Bahari S, Lenehan B, Khan H, McElwain JP. Minimally invasive percutaneous plate fixation of distal tibia fractures.ActaOrthopBelg2007; 73:635-40.
[18] Zha G, Chen Z, Qi X. Minimally invasive percutaneous lockingcompression plate internal fixation in the treatment of tibial fractures. ZhongguoXiu Fu Chong JianWaiKeZaZhi 2008;22:1448-50.
[19] Ronga M, Longo UG, Maffulli N. Minimally Invasive Locked Plating of Distal Tibia Fractures is Safe and Effective. ClinOrthopRelat Res 2009;468:110-4.
[20] Protzman R, Collinge C. Outcomes of Minimally Invasive Plate Osteosynthesis for Metaphyseal Distal Tibia Fractures. J Orthop Trauma 2010;24:24-90

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