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Study of surgical management by internal fixation of distal tibia fractures

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Abstract
The purpose of this study is to evaluate the effectiveness, functional results and complications following surgical internal fixation of comminuted distal tibia fractures with supracutaneous LCP plate. In this study 20 patients of fresh distal tibia fractures treated surgically following internal fixation by LCP plating, studied between January 2017 to March 2018. High energy trauma (RTA) accounts for 70% of cases, and according to AO\OTA classification 43A type of fracture pattern seen in majority of cases in our study. Surgeries were performed within 4-7 days average. All cases treated surgically by supracutaneous LCP plating, all the fractures united with a union rate of 92%. Radiological union was possible in 17.5 weeks, weight bearing started from 12 weeks, early ankle stiffness noted in 1% of cases which was overcome by good physiotherapy and full ankle motion observed in 90% patients. There were one case of superficial infections, one patient with deep infection got treated with antibiotics, and 1 patient with screw loosening had tightened with hexagonal screw driver. Functional results according to criteria by Jing Wei Zhang *et al* and Sven A.F. Tulner *et al* 60% of patients achieved excellent results, 30% patients' shows good results, and fair result obtained in 10% patients.

Keywords: Distal tibia fracture, grade 1&2 compound fractures, internal fixation, supracutaneous plating

Introduction
Motor vehicle accidents are on the rise over the past few years; these are responsible for most of the complex fractures of tibia. The management of distal tibial fractures can be challenging because of the scarcity of soft tissue, their subcutaneous nature, and poor vascularity. Over the past two decades, the AO/OTA classification has been most accepted classification in the literature. It allows not only descriptive, but also treatment guidelines for each defines fracture type.
The three types and nine groups of the AO/OTA classification of distal tibia fractures are illustrated. The three types are extra articular, partial articular, and total articular, and they are divided in to nine groups based on the amount of comminution, as illustrated

Categories: Type 43A- non-articular fractures: A1-Metaphyseal simple
A2-Metaphyseal wedge
A3-metaphyseal complex

Type 43B- partial articular fractures B1-Pure split
B2-Split depression
B3-Multifragmentary depression

Type 43C- Complete articular fractures
C1-Articular simple
C2-Articular simple metaphyseal multifragmentary
C3-Articular multifragmentary
Conventional open reduction and internal plate fixation require extensive soft tissue dissection and periosteal stripping even in expert hands, with high rates of complications, including infection (range, 8.3%–23%), delayed union and non-union (range, 8.3%–35%), Minimally invasive plating techniques reduce iatrogenic soft tissue injury and damage to bone vascularity

and preserve the osteogenic fracture hematoma. Locking compression plates (LCP) have the biomechanical properties of internal and external fixators, with superior holding power because of fixed angular stability through the head of locking screws independent of friction fit. In this review, the rationale for the use of LCPs for distal tibial fracture fixations is presented. Compared with a conventional plate, a locking plate provides a higher degree of stability and provides better protection against primary and secondary losses of reduction and minimization of bone contact.

The soft tissues around the ankle and distal tibia are easily compromised by trauma and subsequent fracture fixation posing a definitive challenge in healing of wounds post-operatively in compound fractures. Most widely used classification for compound fractures is Gustilo Andersons Classification which is as follows:

Gustilo Grade I Open fracture, clean wound, wound <1 cm in length,

Grade II Open fracture, wound >1cm but < 10 cm in length without extensive soft-tissue damage, flaps, avulsions.

Grade III Open fracture with extensive soft-tissue laceration (>10 cm), damage, or loss or an open segmental fracture. This type also includes open fractures caused by farm injuries, fractures requiring vascular repair, or fractures that have been open for 8 hr. prior to treatment

IIIA is Type III fracture with adequate periosteal coverage of the fracture bone despite the extensive soft-tissue laceration or damage.

IIIB is Type III fracture with extensive soft-tissue loss and periosteal stripping and bone damage. Usually associated with massive contamination. Will often need further soft-tissue coverage procedure (i.e. free or rotational flap).

IIIC is Type III fracture associated with an arterial injury requiring repair, irrespective of degree of soft-tissue injury.

Debridement followed by fracture fixation is the usually followed two stage treatment protocol in the management of grade I & II compound fractures of distal tibia. The instability of the fracture after debridement will compromise eradication of infection and wound healing. Hence, temporary bony stabilization by external fixation is advocated. Most of the external fixator frames used in lower tibial fixation are bulky and cumbersome to the patient, causing inconvenience to them in day to day activities and may also cause disturbance in gait while trying to clear from the opposite limb. Locking compression plate as an external fixation device has been described in the management of open fractures, non-union, septic arthritis and even as an adjunct in distraction osteogenesis. The fundamental goal of treatment of distal tibial fractures is the restoration of a normal or a near normal alignment and articular congruity which can be achieved with supracutaneous locking compression plate.

Objectives

This study has been undertaken to evaluate the outcome of fresh displaced, comminuted distal tibia fractures treated surgically by internal fixation, problems and difficulties encountered intra operatively, its results, post-operative complications following such treatment have been analysed. And to study the role of supracutaneous locking compression plate in grade1 & 2 compound distal tibia fractures.

Material and Methodology

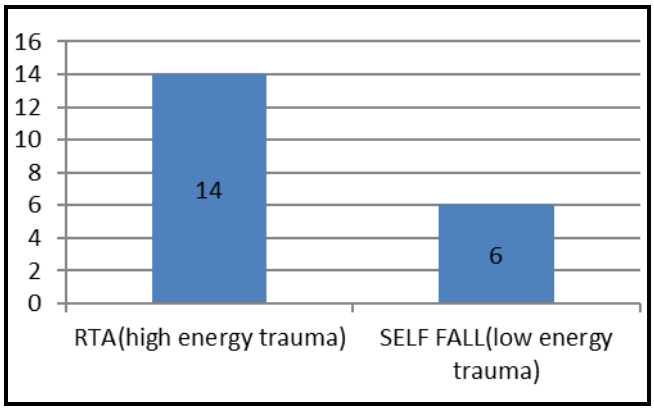
This is the prospective study of effectiveness, results and complications of Fresh Distal tibia fractures following surgical internal fixation by supracutaneous LCP, 20 patients with Fresh Distal tibia fractures admitted from January 2017 to march 2018 were selected for the study, all the fractures in the series were post traumatic, and no pathological fractures included in the study, patients with grade 1 & 2 compound according to Gustilo Anderson classification and fracture patterns 43A and 43B according to AO/OTA classification were included in this series. The method used for fracture fixation was supracutaneous LCP, Distal tibia fractures treated conservatively, old fractures more than 3 weeks, grade 3 compound fractures according to Gustilo Anderson classification, fracture patterns 43C according to AO/OTA classification and fractures with ankle dislocation are excluded in this study. The following protocol was observed for patients with Distal Tibia fractures on arrival.

1. General and systemic examination as well as local examination of the patients
2. Thorough assessment of patient to rule out head/chest/abdominal/spinal or pelvic injuries
3. Preoperatively all patients were immobilized in above knee slab.

Observation and Results: A total of 20 patients with fresh distal tibia fractures were studied from January 2017 to march 2018. All these patients were available for follow up at the time of study. Pre operatively following factors were observed and tabulated as follows:

Table 1: Showing Mode of Injury

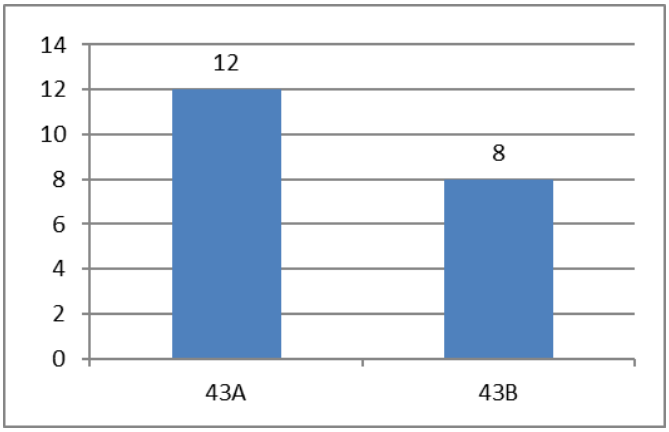
Mode of Injury	Number of Patients	Percentage
RTA (high energy)	14	70%
Self-Fall (low energy)	06	30%
Total	20	100%



Graphs 1: In present study 14 patients (70%) sustained injury due to road traffic accidents and 06 patients (30%) due to self fall. this is comparable with other series like Jing-Wei Zhang *Et al* shows 80% high energy trauma and 20% low energy Trauma and Sven A.F. Tulner *et al* shows 100% of distal tibia fractures due to high energy trauma.

Table 2: Showing Fracture Pattern Type

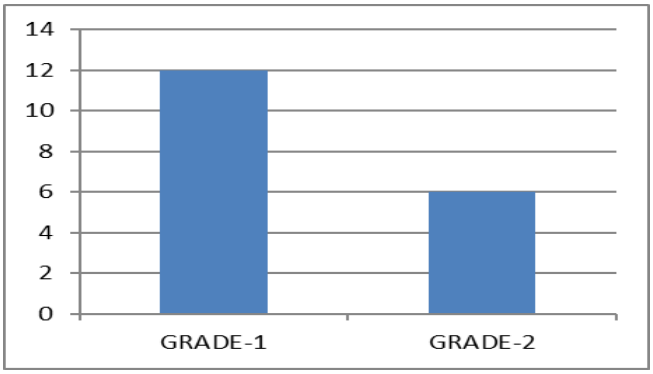
Type	Number Of Patients	Percentage
43A	12	60%
43B	08	40%



Graph 2: In present study the fracture pattern were classified on the basis of Ao/Ota classification. Out of the 20 cases studied, 12(60%) were 43-A type, 8 (40%) were 43-B type. This is compared with other series by Jing-Wei Zhang *et al* shows 100% 43-a type of fractures, and Sven A.F. Tulner *Et al* Had 43% 43-A type fracture and 57% 43-B type fracture pattern

Table 3: Showing Open Injury Type

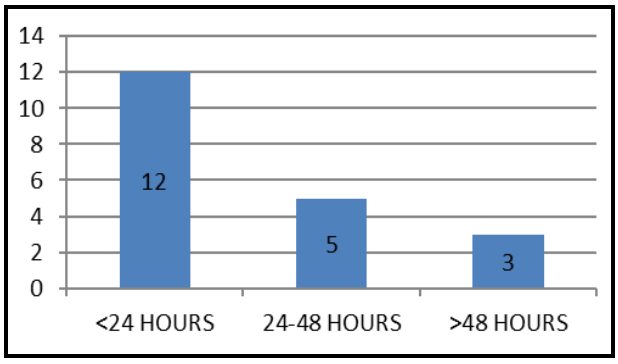
	Number of Patients	Percentage
Grade-1	12	60%
Grade-2	08	40%



Graph 3: The injury is classified on the basis of Gustilo & Anderson classification. Out of 20 cases, 12(60%) were grade-1 and 08(40%) were Grade-2 Type. Which Is compared with other series byjing Wei Zhang *Et al* Shows 8% gustilo type-1 and gustilo type-2 As 11%.

Table 4: Showing Age of Injury At Presentation

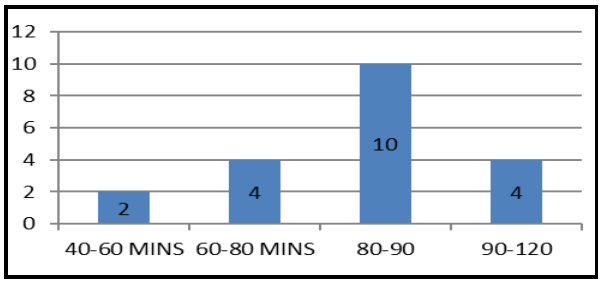
Age At Injury	No. Of Patients
< 24 Hours	12
24-48 Hours	05
>48 Hours	03



Graph 4: In present study the average duration in hours from the time of injury to arrival at the hospital was 10.9 with minimum as early as 3 hours and maximum of 48 hours.

Table 5: Showing Duration of Surgery

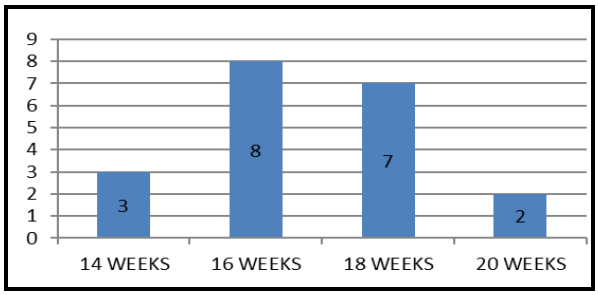
Duration (Mins)	No. Of Patients	Percentage
40-60	02	10%
60-80	04	20%
80-90	10	50%
90-120	04	20%



Graph 5: In present study out of 20 cases studied 2(10%) took 40-60 Mins, 4(20%) Took 60-80 Mins, 10(50%) took 80-90 mins and 4 (20%) took 90-120 mins

Table 6: Showing time of fracture union

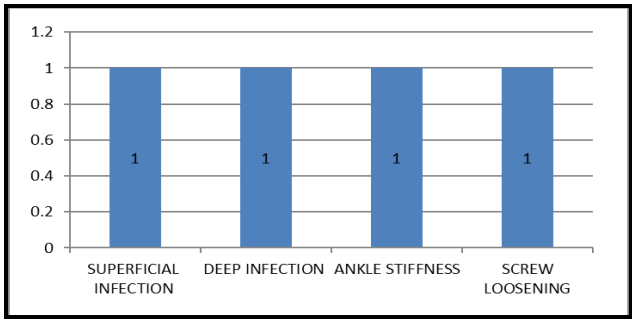
Time (In Weeks)	No. Of Patients	Percentage
14	03	15%
16	08	40%
18	07	35%
20	02	10%
Total	20	100%



Graph 6: In present study the average duration of fracture union was 17.5 weeks. There were 2 cases of delayed union with 20 weeks of radiological callus formation, This is comparable with other series by Jing-Wei Zhang had an average fracture union of 16.7 weeks and Sven A.F. Tulner had an average of 17.5 weeks

Table 7: Showing Complications

Mode of Complications	Number Of Patients
Infection (Superficial Wound Infection)	01
Infection (Deep Infection)	01
Ankle Stiffness	01
Screw Loosening	01



Graph 7: Superficial and deep wound infection was noted in 1 cases each which is readily controlled with proper antibiotics treatement. Ankle stiffness reported in 1 patient because of prolonged immobilization which was overcome by appropriate physiotheraphy

Table 8: Functional results of internally fixed cases (20 cases)

Rating	Number Of Patients	Percentage
Excellent	12	60%
Good	06	30%
Fair	02	10%
Poor	00	0%

Study	Number of Patients	Method	Excellent/Good Outcome
Jing-Wei Zhang *et al*	20	Supracutaneous lcp	100%
Sven A.F. Tulner	07	Supracutaneous lcp	100%
Present Study	20	Supracutaneous lcp	100%

Discussion

In this study, twenty cases with fractures of distal tibia in adults were surgically managed by closed reduction and fixation with supracutaneous LCP between January 2017 to march 2018. All patients were evaluated clinically and radiologically before and following surgery, for an average period of follow up was 1 year. The age of the patient in this study, ranged from 24 years to 75 years average being 54 years. There were 14 male patients as compared to 6 female patients in this study. 12 patients had fracture of left distal tibial fractures and 08 patients had fracture of right distal tibia. 12 fractures were Gustilo type-1 and 8 fractures were type -2 Gustilo Anderson open injury type. 14 cases sustained fracture following road traffic accident (high energy trauma) and 6 cases sustained fractures following self-fall (low energy trauma). The mean duration to surgery from the day of presentation and injury was 4-7 days for soft tissue swelling around the fracture to subside as evidenced by appearance of wrinkles on the skin. The fractures united in 18(92%) patients with 2(8%) case of delayed union which took 20 weeks of time period for the radiological signs of callus formation. The fracture was additionally supported by dyna long leg brace for 4 weeks. Post-operatively, 1 patient developed superficial infection, 1 patient with deep infection got treated with antibiotics and 1 patient with ankle stiffness treated with physiotherapy and able to do normal ankle movements. Good amount range of mobility of ankle joint was present in almost all patients. By the analysis of the data collected in the present study, closed reduction and fixation with supracutaneous Locking compression plate for distal tibia fractures is the choice of treatment for adult fractures, predominantly AO type 43-A and 43-B where intramedullary nails are not the choice when lower third comminution is seen. Our study concludes that in selected patients, supracutaneous locking compression plate fixation had excellent results in terms of bony union and patient compliance with minimal complications.

Conclusions

Distal one third extra-articular and partial articular fractures usually require operative management because they are usually present with rotation as well as varus angulation. Stabilization with cast requires prolonged immobilization. Among the internal fixation methods intramedullary fixation do not control rotation if nail is not locked in two planes. In this study primary closed reduction and external fixation with supracutaneous LCP of fresh distal third tibia fractures provides a more rigid fixation and does not require immobilization for longer periods. All the fractures united with a mean average period of 17.5 weeks. Implant removal was not done until full bony healing both clinically and radiologically was obtained. Routinely, after initial debridement and temporary bony stabilization is provided by external fixation in compound fractures of the distal tibia with significant soft tissue injury. Most external frames for the lower leg are bulky and cumbersome, causing significant problems for the patient. To circumvent these issues, we have successfully used an anatomically contoured supracutaneous metaphyseal locking compression plate as external fixator in a series of twenty patients for grade I & II compound fracture of the distal tibia.

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