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A prospective study of using a locking compression plate as external fixator for open distal tibial fractures

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Abstract

Many a time, external fixation provides only temporary bony stabilization. Most external frames for the lower leg are bulky and cumbersome, causing significant problems for the patient. To circumvent these issues, they have successfully used an anatomically-contoured supracutaneous metaphyseal locking compression plate as external fixator in a series of five patients for grade I & II compound fracture of the distal tibia.

The locking plate used as a definitive external fixator provided a high rate of union. While the locking plate is not totally rigid, it is clinically stable and may be advisable for stiffness reduction of plating constructs, thus promoting fracture healing by callus formation.

The earlier studies had low number of cases and suggested further research. Hence we decided to do this study of twenty cases treated with one stage external fixation by locking compression plate for open distal tibial fractures Gustilo type I and II, as a definitive procedure to assess the functional, clinical and radiological outcomes. In our study, 10 patients achieved excellent result, 8 patients recorded good result and 2 patients had a fair result as per the Oleur and Molander scoring system.

Keywords: Supracutaneous, locking compression plate, metaphysio-diaphysial, gustilo anderson

Introduction

Fractures of the tibia still pose a challenge to the orthopaedic surgeon due to certain peculiarities like; tibia is a subcutaneous bone so more chances of open type of fracture, greater tendency of displacement of tibial fractures and increased chances of post-op infection. Due to its poor blood supply and less soft tissue coverage there is an increased incidence of delayed union and nonunion. The prevalence of tibial non-unions increases with the severity of open fractures ^[1]. the endosteal and periosteal blood supply is often extensively destroyed when the open fracture occurs in the tibia, which are regarded as the most important to the healing of tibial fractures.

Kloen *et al.* ^[2] were the first to describe the use of a locked compression plate as external fixation.

Locking compression plate as an external fixation device ^[1] has been described in the management of open fractures ^[3], non-union ^[4, 5], septic arthritis ^[4] and even as an adjunct in distraction osteogenesis ^[6]. Using Locking Compression Plate as an external device not only stabilizes the fracture but also preserves the vascularity of tibia and promotes union when it is done as an emergency procedure after thorough wound debridement ^[1]. However, Locking Compression Plate as an external device is superior and advantageous than other conventional fixators.

One-stage external plate fixation decreases both costs and surgical injuries. Fractures are anatomically reduced via a small incision without massive dissection. The medially placed screws and plate have less influence on muscle activity. Because stab incisions were used for screw insertion, and therefore digging and tunneling around the bone was not necessary, the risk of infection could be decreased. With external plating, deep infection is less of a concern due to maintenance of the integrity of the soft tissue envelope. Locking Compression Plate external fixator can be concealed under clothing making it more acceptable to patients. There is much less tendency for the frame to strike the contralateral leg in the swing-through phase of either leg during ambulation ^[1].

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For subcutaneous bones such as tibia, ulna or clavicle, increasing the plate-to-bone distance lifts the LCP into an extra-corporeal location, while preserving its inherent characteristics of flexibility (long-span) and stability (locked-screw) [2, 7]. This concept has been previously elaborated upon by Ramotowski and Granowski [2, 8], who defined the possible depths of plate fixation as paraosseous, subcutaneous and external osteosynthesis for femur, humerus and tibia or ulna respectively.

Low-profile rigid external fixation can be a helpful adjunct in complex posttraumatic cases as part of a staged reconstructive effort. The successful use of plates as low-profile external fixators has been described previously. The locking compression plates have been advocated as internal-external fixators, given their angular stable screw fixation. These properties also make them good candidates for external plate fixation; they called this technique “supercutaneous plating” [2].

In the study [9] ‘One-Stage External Fixation Using a Locking Plate: Experience in 116 Tibial Fractures’, it was concluded that External plate fixation is effective for tibial fractures and especially for metaphyseal fractures. It has the advantages of being easy to perform and less invasive, and the plate is conveniently located for removal.

Materials and Methods

A retrospective study of twenty cases treated with a locking compression plate as external fixator for open distal tibial fractures meeting the inclusion and the exclusion criteria during the study period from Mar 2016 to Dec 2017, admitted to RLJ hospital attached to Sri Devaraj Urs Medical College, was taken up for the study. This study included a minimum followup of six months.

Inclusion Criteria

1. Patients diagnosed with open Gustilo type I, II Distal tibial Metaphysio-Diaphyseal fractures
2. Adults (18-70 yrs)

Exclusion Criteria

1. Pathological fractures
2. Ipsilateral associated femur fractures
3. Patients with neurological and vascular deficit

The data was collected from the Outpatient and Inpatient records, PACS etc. we collected the data of history, clinical examination, base line investigation, basic Radiological Examination, intraoperative notes like time needed for surgery, blood loss etc. And also from the post-operative notes after 24 hours-Wound Inspection, check X-rays to assess reduction, follow up notes including those at 4 weeks, 8weeks, 12 weeks, 18 weeks and 6 months was collected.

Whenever necessary patient was followed up on the telephone or called to the hospital for data collection of clinical and

radiological findings. Both Oleaur and Molander scoring system & Johner-Wruth’ Criteria for Evaluation of Final results.

Oleaur and Molander scoring system for Evaluation

1. Please indicate when you experience the pain
 - never [25]
 - only while walking on an uneven surface [20]
 - only while walking on an even surface outdoors [10]
 - only while walking indoors [5]
 - constant and severe [0]
2. Please indicate the degree of stiffness you are experiencing
 - none [10]
 - stiffness [0]
3. Please indicate the degree of swelling you are experiencing
 - none [10]
 - only evenings [5]
 - constant [0]
4. Please indicate the degree of difficulty you are having with stair climbing:
 - no problems [10]
 - impaired [5]
 - impossible [0]
5. Please indicate the degree of difficulty you are having with running:
 - possible [10]
 - impossible [5]
6. Please indicate the degree of difficulty you are having with jumping:
 - possible [10]
 - impossible [5]
7. Please indicate the degree of difficulty you are having with squatting:
 - no problem [10]
 - impossible [5]
8. Please indicate the type of supports you are currently using:
 - none [10]
 - taping, wrapping [5]
 - stick or crutch [0]
9. How is the injury affecting your work and activities of daily life:
 - same as before injury [20]
 - loss of tempo [15]
 - change to a simpler job [15]
 - severely impaired work capacity [0]

Table : Johner-Wruhs’ Criteria for Evaluation of Final Results

	Excellent (left to right)	Good	Fair	Poor
Non-union, osteomyelitis, amputation	None	None	None	Yes
Neurovascular disturbances	None	Minimal	Moderate	Severe
Deformity				
Varus/valgus, °	None	2-5	6-10	> 10
Anteversio/recurvation, °	0-5	6-10	1-20	> 20
Rotation, °	0-5	6-10	1-20	> 20
Shortening, mm	0-5	6-10	11-20	> 20
Mobility, %				
Knee Normal	normal	> 80	> 75	< 75

Ankle Normal	normal	> 75	> 50	< 50
Subtalar joint	normal	> 75	> 50	< 50
Pain	None	Occasional	Moderate	severe
Gait	Normal	Normal	Insignificant limp	Significant limp
Strenuous activities	Possible	Limited	Severed limited	Impossible

A score of 90 to 100 was considered Excellent; 70 to 89-Good; 50 to 69 points-Fair and less than 50 was considered Poor.

Statistics: Statistical analysis was undertaken using SPSS

version 22 (SPSS, Chicago, Illinois). The Students t and Chi-Square Tests was used to analyse the variables. P value of <0.05 was considered statistically significant.

Case No 1



Fig 1A (A): A. p view, B. lateral view, C. post-opa. P view, D. post-op lateral view



Fig 1B: Clinical pictures

Case 2



Fig 2A: A. compound fracture, B. ex-fix lcp, C. primary skin graft



Fig 2: A. pre-op a. p view, B. lat view, post-op a. p view, lat view



Fig 2: After 3 months Flap cover

Results

There were 12 males and 8 females. The average age was 35 years (range 20 to 65 years). The most common mechanism of injury was Road traffic accident. 11 cases were of Gustilo type I type and the 9 cases were type II. All the patients

underwent debridement and supracutaneous locking compression plate as external fixator. One patient had a delayed union, at five months we removed the plate and performed interlocking nailing. Fig 3 A, B, C

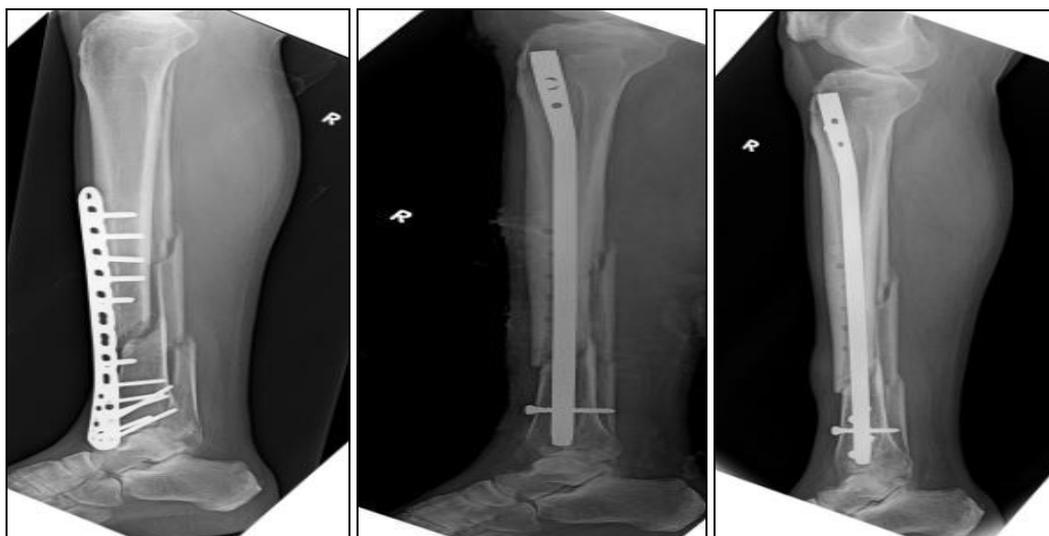


Fig 3: A. shows delayed union B. Interlocking nailing C. At 3 months after nailing

One patient required a flap which was done by our plastic surgeon. Fig 4.



Fig 4: shows flap beneath the supracutaneous locking compression plate

Two patients required bone marrow injection at 6 weeks since we suspected delayed union. All our patients achieved union

by an average of 16 weeks. (Range 12 to 24 weeks) with a p value of 0.06. Fig.3, 4.

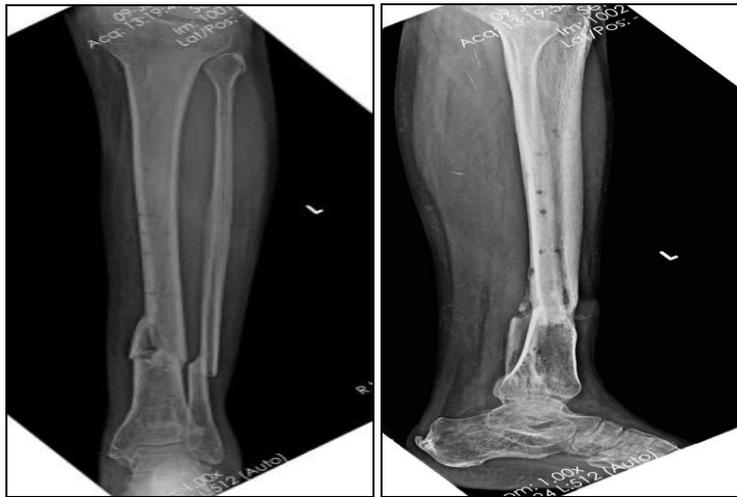


Fig 5: Bone Marrow Injection, Xray at ten months, shows union and consolidation

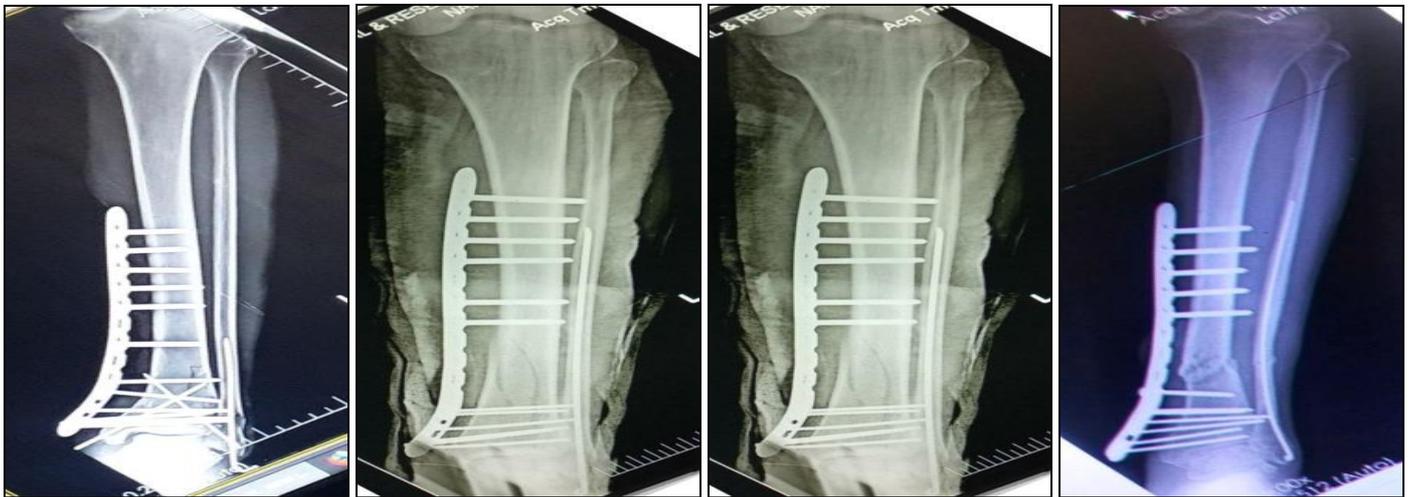


Fig 6: Mal-Union after 3 months

The average time to weight bearing was twelve weeks (range 10 to 16 weeks). One patient developed deep infection, which was managed by conservative management and resolved without any additional surgery. One patient had a malalignment, but he was nonsymptomatic and he too was managed conservatively. Fig 6.

The plate was removed at an average of 18 weeks (range 16 weeks to 24 weeks) after union. Most of our patients were put on Patellar tendon bearing functional cast for 4 to 8 weeks after plate removal. 10 patients achieved excellent result, 8

patients recorded good result and 2 patients had a fair result as per the Oleur and Molander scoring system.

Discussion

Kloen *et al.* were the first to use locking compression plate as external fixator from 2004. They treated 4 patients. In 1 patient it was used as a definitive fixation, while in 3 patients they converted to internal fixation. 3 patients had tibial fractures and 1 had clavicle fracture. Implant removal was done at an average of 4 months (range 2-6 months) in the

outpatient clinic. In the study by Rajasekharan *et al*, 4 patients were treated, with plate in situ for an average of 20 weeks (range 18 to 22 weeks). All the patients achieved union. One patient had screw loosening at 15 weeks. They also opined that locking compression plate as an external fixator, can be removed under local anaesthesia. It imparts a less conspicuous radiographic silhouette compared with conventional fixators allowing ease of assessment of healing of wound and the fractures to treating surgeons ^[1]. Small amounts of axial micro-motion may reduce stress shielding of fracture site. Load sharing during weight bearing may stimulate the developing callus until bony union. Controlled dynamisation by removing screws closest to the fracture site was possible, allowing some measure of control to the load sharing ^[1].

In the study by Venkatesh gupta *et al*, 5 cases were operated with plate in situ for 24 weeks (range 20 to 28 weeks) until union. In our previous study ^[12], union occurred at a median of 6 months (range 5 to 9 months) with 70% patients achieving excellent result and the rest had good result as per the IOWA ankle scoring system. 1 had screw loosening and 1 had superficial infection which settled with conservative management. None required additional surgery.

Thus we can observe that all the studies obtained very good results with a low rate of complications.

Conclusion

Locking compression plate can be used as a definitive external fixator for open distal tibial fractures as it gives good results and low complication rates, with satisfactory stability. It also has the advantage of facilitating wound healing, plastic procedures. It is also cosmetically acceptable and noncumbersome while ambulation as it does not strike the contralateral leg. It allows easy assessment of fracture healing on xrays due to nonoverlapping of the implant.

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