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Original Research Article

To Study the Functional Outcome of Locking Compression Plate in Metaphyseal Fractures

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ABSTRACT

Introduction- LCP has revolutionized the treatment of metaphyseal fractures by overcoming the few drawbacks of conventional plating system. It offers the possibility of inserting conventional and locking head screws into the specially designed combination holes. We aimed to study the nature of fracture union in fractures treated with the LCP and to analyze any complications arising out of this system. **Materials and Methods-** 60 closed metaphyseal fractures of Tibia, Humerus, Distal femur and Distal radius were included in the study. Compound and pathological fractures were excluded. **Results:** The mean age of the patient was 49.4 years. All the fractures were classified as per the AO classification system. Majority of the cases were proximal humerus fractures. The average duration of surgery was 90±15.5mins. The average time for fracture union was 16±4.8 weeks in majority of the patients. There was 2 (3.33%) cases of superficial infection which responded well with oral antibiotics. There was 1 (1.66%) case of non-union of proximal tibia which had to be re-operated. **Conclusion-** Locking compression plate is a viable option for metaphyseal fractures with good functional outcome and promising results.

Keywords- Locking compression plate, Closed fractures, Metaphysis.

INTRODUCTION

The object of the technique of operative treatment of fractures with compression internal fixation was stable internal fixation with the purpose of giving the bone primary strength to allow early functional mobility. [1] The basic principles of an internal fixation procedure using a conventional plate and screw system (compression method) are direct, anatomical reduction and stable internal fixation of the fracture. Wide exposure of the bone is a necessity and also requires pre-contouring of the plate to match the anatomy of the bone. [2] The dynamic compression plate (DCP) was developed to realize this objective of internal fixation, and it allowed axial compression of the fracture zone by way of eccentric drilling for compression screws. [1] A conventional plate pressed against the bone surface interferes with the cortical blood flow and induces structural changes underneath the plate on the cortex. [3]

Over time a technique for bridging plate osteosynthesis has been developed for fractures that, thanks to a reduction of vascular damage to the bone, permits healing with callus formation, as seen after locked nailing. Since the damage to the soft tissues and the blood supply is less extensive, more rapid fracture healing can be achieved.

The development of the Locking Compression Plate (LCP) has only been possible based on the experience gained with the PC-Fix and LISS. The LCP with combination holes can be used as a compression plate, a locked internal fixator, or as an internal fixation system combining both techniques. It can also be used in either a conventional technique (compression principle), bridging technique (internal fixator principle), or a combination technique (compression and bridging principles). A combination of both screw types offers the possibility to achieve a synergy of both internal fixation, methods and the operative technique is much the same as conventional technique, in which existing instruments and screws can be used. The internal fixator method can be applied through an open but less invasive or an MIPO approach. [4]

This new system has been regarded as technically mature. It offers numerous fixation possibilities and has proven its worth in complex fracture situations and in revision operations after the failure of other implants. [5]

The aim of the present study was to evaluate the functional outcome in patients with metaphyseal fractures treated by Locking compression plate.

MATERIALS AND METHODS

A total of 60 fractures, involving the metaphyseal regions of proximal tibia, proximal humerus, distal femur and distal radius fractures were treated with the various locking compression plates from February 2014 to January 2015. The study design did not affect the surgeon's choice of treatment or implant.

The demographic data was recorded through history and clinical examination. Soft tissue injuries, even in the closed fractures, were assessed, followed by radiological assessment of the fractured limb. Further investigations were done depending on the general condition of the patient and the routine pre-operative protocol as per the hospital guidelines were followed. Before the surgery, the method of reduction, fracture fixation and the type of implant to be used was provisionally decided. The inclusion criteria were skeletally matured patients with closed metaphyseal fracture of long bone. Patients with compound fractures and pathological fractures were excluded from the study. Well written informed consent was obtained from all the patients. Prior Ethical committee approval was taken before commencing the surgery.

Surgical Technique-

All the patients with lower limb fractures were given regional anaesthesia and general anaesthesia along with regional block was preferred for the upper limb fractures. All the patients were given three doses of second-generation cephalosporin (one within 30 min before the procedure and two doses at 12-hour interval post-operatively). Standard surgical steps were followed in all the cases. 3.5mm Locking compression plate (Syntes®, USA) was used in all the cases. MIPPO Technique in cases with comminution and osteoporotic fractures. Meticulous closure was done in all the cases. No closed suction drains were used in any of the cases. Similar post-operative pain control protocol was followed in all the cases. Mobilization was started from the first post-operative day. Non weight bearing till 4-6weeks and then partial weight bearing till fracture union. For patients of proximal tibia, distal femur and distal radius plating, external support was given in the form of knee brace or slab for initial few days, which was removed intermittently for range of motion (ROM) exercises of neighboring joints. Partial weight was initiated after confirming the beginning of healing process.Regular follow-up of the patients was done at 3,6 and 12 months respectively.

RESULTS

The mean age of the patient was 49.4 years. There were 38 (63.33%) males and 22 (36.7%) females in the present study. 43 (71.6%) cases had involvement of right side showing right sided preponderance. All the fractures were classified as per the AO Classification system (Table 1).

Fig 1
Pre-operative X ray Humerus

Fig. 2
Immediate Post-operative X ray

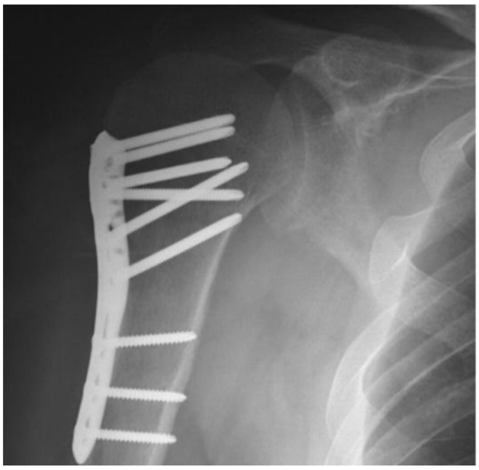

Fig. 3
Follow-up after 12 months

Fig. 4
Follow-up after 12 months

TABLE – 1: Metaphyseal Fractures of the Bone

Bone	No. of patients	Percentage
Proximal Tibia	13	21.7
Proximal Humerus	34	56.7
Distal Femur	6	10.0
Distal Radius	7	11.6
Total	60	100.0

Majority of the cases were proximal humerus fractures. Of the total 34 proximal humerus fractures, the maximum cases were 3 part fractures which accounted for 53%. There were 6 distal femur fractures, AO Type A3 and Type C2 accounting for 33.3 % of cases and AO Type C1 and Type C3 accounting for 16.7% of cases. In proximal tibia fractures, the maximum cases were of Schatzker type IV, 5 i.e. 38.4%, of total 13 cases. Among 7 cases of distal radius fractures there were 1 case each of AO Type A3, Type B2, Type B3, Type C2 Type C3 and 2 cases were of AO Type C1.

We used MIPO technique for 10 patients out of which 8 were proximal tibial fractures and 2 were distal femur fractures. For the remaining 50 patients open reduction and internal fixation was done either with or without bone grafting according to the need of the fracture.Out of total 13 case of proximal tibia fractures bone grafting was done in 4 cases which accounted for 30.8%. Out of total 34 case of proximal humerus fractures bone grafting was done in 2 cases which accounted for 5.9%.

The average duration of surgery was 90±15.5mins. The average time for fracture union was 16±4.8 weeks in majority of the patients. There was 2 (3.33%) cases of superficial infection which responded well with oral antibiotics. There was 1 (1.66%) case of non-union of proximal tibia which had to be re-operated with open reduction and internal fixation and bone grafting. There were no implant related complications like screw loosening, screw breakage, plate failure.

DISCUSSION

The fractures treated with MIPPO technique show healing by secondary fracture union and in the present study, an early solid bony union in these fractures was noted, which corresponds well with the results in biological fixation.

Kumar et al [6] in their study, observed that increasing consideration is being given to biological factors in fracture care by internal fixation. Preservation of periosteal blood supply, avoidance of extensive dissection and stripping of fracture fragments and more rapid fracture healing in biological fixation are currently accepted in routine orthopedic practice. Delayed collapse is common in juxta-articular fractures and technique of ligamentotaxis and external fixators are in vogue, to prevent this delayed malunion. External devices usually need removal at 6-8 weeks. More prolonged maintenance of position without pin related complications is more desirable and a new concept of internal fixator (LCP) utilizing locking screws has been devised. It does not rely on interfragmentary compression, and healing with callus formation is expected to be quicker and more effective than primary healing. [7,8] Nonetheless, its superiority has not been documented. LCPs can, in addition, be used as a compression plate, a bridging fixator, or a combination of both techniques, depending on the portion of screw hole and the type of screw used, as they are provided with combination holes. [9] A single device with multiple options favors reduced inventory.

Use of this device was done in this study was to gain experience with this new modality, and also to assess union rates. In this series all 25 cases went on to union by 9 months. Delayed union was noticed at 6 months in two cases of diaphyseal fractures of ulna. They went on to union without additional intervention. Both had comminution and this was the probable cause of delay. One grossly comminuted distal radial fracture had loss of reduction with collapse and intra articular screw penetration and malunion. The screw was removed and wrist mobilized. There were no other complications.

In 1975, Anderson et al [10] reported a 98% union rate of radial fractures and a 96% for ulnar fractures, with 86% of the patients having excellent or satisfactory results. Chapman et al [11] reported an excellent or satisfactory functional result in 92% of their patients, with an infection rate of 2.3% which is similar to our results. Fixation using an LCP is an effective treatment method in terms of union rate, pain and functional outcomes. [12,13] In a prospective multi-center study on 144 patients with 169 fractures fixed with LCP was reported by Sommer et al in 2003. [5] 45 were humeral and 19 radial fractures. After 1 year, results were 86% union, 18 revisions for implant failure, nonunion and secondary fractures. Expert analysis commented that problems were due to technical errors. The new LCP system was concluded as a mature fixation system with proven worth in complex fracture situations and revision situations. Fixation of metaphyseal fractures of upper limb with LCPs gives good and stable fixation even in the presence of comminution and osteoporosis. In this series all the patients showed satisfactory union.

The proper attention to technical details is essential. [2]

Correct selection of DCP holes vs. LCP locking holes, use of spacers and use of the torque limiting screw drivers are required for implant system. Preliminary temporary K-wire fixation is advisable to maintain reduction in difficult situations prior to application of LCP. It is additionally observed that LCP is a good method of fixation for osteoporotic displaced metaphyseal/diaphyseal fractures with the additional options for unicortical fixation and bicortical fixation with combi-holes. [6]

In a study by Nayak RM [14] et al, 22 male and 9 female consecutive patients aged 21 to 65 (mean, 42) underwent minimally invasive plate osteosynthesis using a locking compression plate (LCP) for distal femoral fractures. The mean time to union was 3.7 (range, 2.8-4.6) months. No patient had angular or rotational deformity of >10º. No patient developed deep infection, malunion or nonunion. MIPO using a LCP achieves favorable biological fixation for distal femoral fractures with few complications. Bone grafting is not needed even in cases of metaphyseal comminution. Proper patient selection and preoperative planning are essential to prevent complications.

Messmer P et al, [15] concluded that new stabilization techniques such as LISS (Less Invasive Stabilization System) and LCP (Locked Compression Plate) provide angle stability and minimal invasiveness. Therefore stability of fixation is improved and wound-healing problems decrease. Today simple fractures are still fixed with conventional plates and screws, however more complex bicondylar fractures, particularly those with a metaphyseal comminution zone and/or severe soft tissue damage are fixed favorably by the new stabilization techniques.

Egol KA et al [16] concluded that, locked plates and conventional plates rely on completely different mechanical principles to provide fracture fixation and hence provide different biological environments for healing. Locked plates are increasingly being indicated for indirect fracture reduction, diaphyseal/metaphyseal fractures in osteoporotic bone, bridging severely comminuted fractures, and the plating of fractures where anatomical constraints prevent plating on the tension side of the bone. Conventional plates may continue to be the fixation method of choice for periarticular fractures demand perfect anatomical reduction and to certain types of nonunions which require increased stability for union.

Schütz M et al [17] concluded that, the key to these internal fixators is the locking mechanism of the screw in the implant, which provides angular stability. This technical detail ensures that compression forces on the bone surface are not necessary to gain stability of the bone-implant construct, which improves fracture healing and provides an excellent holding force even in osteoporotic bone. The locking mechanism also makes the technique of percutaneous plating easier because, in contrast to conventional plates, the fragments are not pulled toward the implant by the locking screws. The new internal fixator systems [LISS (less invasive stabilization system) and LCP (locking compression plates)] offer new approaches to trauma surgery, especially for metaphyseal fractures.

Lee SK et al, [18] reported the average time to fracture union was 16 weeks. The volar long LCP is useful in the management of comminuted fractures of the distal radius, in which there is proximal extension into the diaphysis and can avoid or minimize the complications of external fixation or dorsal bridging distraction plate.

Limitations-

Smaller sample size and short duration of follow-up are the limitations of the study.

CONCLUSION

Locking compression plate is a viable option for metaphyseal fractures with good functional outcome and promising results.

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