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Analysis of Distal Femur Fractures Treated with Locking Compression Plate

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Abstract: Distal femur fractures are one of complex fractures to treat because they are often communitted, unstable and osteoporotic. Various modalities of treatment are available now with varied results. Introduction of locking compression plates in 2001 has revolutionized the treatment of these fractures. We have studied clinical and radiological outcome of distal femur fractures treated with locking compression plate in comparison to existing studies available in the literature. This study was conducted at Prathima Institute of Medical Sciences, Karimnagar from January 2015 to December 2017. 42 patients with distal femur fractures were included in this study. All patients underwent open reduction and internal fixation with locking compression plate. Neer's scoring system was used to assess the functional outcome of surgery. Out of 30 patients, 24(57%) patients had excellent results, 8 patients (19%) had good result, six (14%) patients had fair and four (10%) had poor result. Average knee flexion in our study was 115^0 with more than 62% patients having knee range of motion more than 110^0. We recommend open reduction and internal fixation of distal femur fractures with locking compression plate. Easier surgical technique, low complication rate, early rehabilitation, rigid fixation are the advantages over other modalities of treatment.
Keywords: Distal femur fractures, locking compression plate.

INTRODUCTION

Distal femur fractures ate one of the most common fractures encountered by orthopedic surgeons in routine practice. Incidence of distal femur fractures is approximately 37 per 1, 00,000[1].

Distal femur fractures occur in two different scenarios- high energy and low energy. High energy injuries are mainly due to road traffic accidents which are often open with committed condyles and metaphysis. Management of higher energy distal femur fractures is a challenging due to associated ligament injuries, commination and cartilage damage. Low energy injuries occur in elderly with osteoporosis due trivial fall. Management of extreme osteoporotic distal femur fractures is difficult due to poor fixation.

Surgical stabilization with internal fixation is the treatment of choice for all displaced distal femur fractures[4]. Various studies had reported good results with internal fixation for last 3 decades. Despite this, number of revisions is high due to nonunion, loss of reduction and implant failure[2]. Various modes of internal fixation include Blade plate, Dynamic condylar screw, Condylar buttress plate, Antegrade intramedullary nailing, retrograde nailing, Sub muscular internal fixation, External fixation[4]. Due to increasing complexity of fracture, these conventional implants are not ideal choice. Dual plate and Locked compression plates can be used for complex communitted fractures. Downside of dual plating is excess soft tissue dissection resulting in reduced blood supply which may cause nonunion and implant failure[2,5,6]. Most common implants used for distal femur fractures fixation are fixed angle devices, usually in the form of Dynamic Condylar Screw (DCS) system, which is a supracondylar plate combined with a lag screw. This two piece device is more forgiving and allows correction in the sagittal plane after the lag screw is inserted [78]. LCP is a single construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's pullout resistance as seen in unlocked plates. Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilization, avoidance of stress shielding and induction of callus formation. MIPO with locked plate helps in prompt healing, low infection rate and less bone resorption[9]. Internal fixation with locking plates creates a toggle free, fixed angle construct[10]. Introduction of plates with the option of locked screws has provided the way to increase the rigidity of fixation in osteoporotic bone or in the presence of periarticular or juxta-articular fractures with a small epiphyseal segment[10]. It offers multiple points of fixed-angle contact between the plate and screws in the distal part of femur, reducing the tendency for varus collapse that is seen with traditional lateral plates[10]. Distal femur LCP is a further development from the LISS which was introduced in the mid to late 1990's. Main difference between the LCP and the LISS is that the LISS utilizes an outrigger device for shaft holes, functioning essentially as a locking guide jig, which is attached to the distal part of the plate and guides the placement of the proximal locking screws. Shaft holes on the LCP are oval allowing for the options of a compression screw or a locking screw. This leads to a more precise placement of the plate, as it can be compressed more closely to the bone[2-4]. Aim of this study is to evaluate the functional outcome of locked compression plating of distal femur fractures based on union rate, time to union, malunion, implant failure and functional recovery.

MATERIALS AND METHODS

This study was conducted at Prathima Institute of Medical Sciences, Karimnagar from January 2015 to December 2017. 42 patients with distal femur fractures were included in this study. All patients were followed up according to post-operative follow up protocol adopted. Mean follow up period was 1 year, and patients were assessed for functional capacity and radiological fracture healing during every follow up. Follow up duration ranged from 12 months to 36 months. Only traumatic distal femur fractures managed with locking compression plate were included in this study. Pathological fractures, distal femur fractures in children, fractures associated with neurovascular injury, patients lost in follow – up were excluded. All routine radiological and pathological investigations were performed for all patients. AO classification was used to classify fractures based on x rays. Surgery was performed on radiolucent table through lateral approach. Size of plate was selected based on the type of fracture. Knee range of motion exercises were started on the 3^{rd} or 4^{th} day postoperatively. Non weight bearing mobilization was started from the first post-operative week till 6-8 weeks depending on the fracture pattern. Partial weight bearing was allowed after callus is visible on x ray and continued till fracture united. Sutures were removed 2 weeks after surgery. First follow up was after 4 weeks from suture removal, there after every 6 weeks.

RESULTS

All 42 patients included in the study presented for clinical and radiological examination at regular intervals. 32 patients were male and 10 were female. Age ranged from 18 to 74 years with a mean age of 44 years. 28 fractures were involved on the right side and 14 on the left side. Road traffic accident caused injury in 32 cases and domestic fall in 10 cases. According to Muller's classification of distal femur, 6 were Muller's type A1, 14 were Muller's type C1, 14 were Muller's type C2 and 8 were Muller's type C3. 34 were closed fractures and 8 were open fractures.

14 patients had associated injuries like rib fractures, mandible fracture, radius fracture, humerus fracture, patella fracture, ulna fracture and head injury. All associated injuries were treated accordingly at the same time. Eight patients had primary bone grafting at the time of surgery and two patients who had non-union underwent secondary bone grafting.

Radiological union was defined as presence of bridging callus across three cortices. Of 42 patients, 36 Patients (85%) showed radiological union within 20 weeks. Average time for union was 16 weeks. Two patients operated for supracondylar fracture non-union with implant failure had delayed union at 13 months. Average knee flexion in this study was 115 degree with more than 62% patients having knee range of motion more than 110^{o}.

Four patients had nonunion. Two cases of superficial infection observed, which was controlled with dressings and antibiotics. No deep infection noted. Out of 42 cases, <1cm shortening was observed in 6(14%) patients, 1-2cm shortening in 2(5%) patients, >2cm shortening in 6(14%) patients and no shortening in 28(67%) patients. Varus malunion was observed in 2(5%) patients and valgus malunion in 2(5%) patients. 4(10%) patients had implant failure.

Functional outcome was assessed at the end of one year using Neer's scoring system was Excellent in 24 (57%), Good in 8 (19%), Fair in 6 (14%) and Poor in 4(10%). Four patients who had poor outcome contributed to 10% non-union, 10% implant failure and 5% superficial infection.

DISCUSSION

We have evaluated outcome of distal femur fractures treated with locking compression plate over a period of three years. Outcome was assessed using NEER'S Score. Of 42 cases included in our study, 32 are male and 10 female. Median age was 44 years ranging from 18 to 72years. 32 fractures were caused by road traffic accidents and 10 due to domestic fall. Road traffic accidents were more common in young male patients and domestic falls in elderly females. 28 fractures were on right side and 14 on left side. The epidemiology of group is consistent with previously reviewed literature.

Schutz M, Muller M *et al*. [6] studied 48 cases of distal femur fractures treated with LISS. 4 cases had implant loosening. Revision fixation was required for 2 cases. 7 debridements were performed in this series to control infections. Nonunion rate was 5%. Follow up rate was 93%. This study concluded that primary cancellous bone grafting is not required for distal femur fractures stabilized with LISS.

Weight and Collinge[67] retrospectively evaluated 22 distal femur fractures in 21 patients treated with LISS. All fractures achieved union at a mean of 13 weeks (range, 7 to 16 weeks) without requiring secondary intervention. No implant failures were observed in this series. At mean follow- up of 19 months, knee range of motion was 5 to 114 degrees.

Kregor *et al*. [6, 8] reported a 93% union rate without secondary bone grafting in 103 distal femur fractures treated with LISS. Remaining 7 cases went on to uneventful union following secondary cancellous bone grafting. At a mean follow-up of 14 months, the mean knee range of motion in this study was 1 to 109^0. Proximal screw loosening occurred in 5 cases, requiring revision surgery.

Yeap, E.J., and Deepak, A. S57 retrospectively reviewed 11 cases of type A, C(AO) distal femur fractures fixed with titanium distal femoral locking compression plate. Age of patients ranged from 15 to 85 with a mean of 44. Clinical assessment was done 6 months post-operatively using Schatzker score system. Four patients had excellent results, four good, two fair and one failure.

Zlowodzki *et al*.[58] systematically reviewed 2 comparative studies and 45 case series. Average nonunion, fixation failure, deep infection, and secondary surgery rates were 5.5%, 4.9%, 2.1%, and 16.2% respectively.

Vallier *et al*. [60] study concluded that locking plates should only be used when conventional fixed-angle devices cannot be placed. They noted the significant added cost of locking plates. To decrease the risk of implant failure with locking plates, it was recommended to accurate fracture reduction and fixation along with judicious bone grafting, protected weight bearing, and modifications of the implant design.

In our study, we have evaluated 42 cases of distal femur fractures treated with distal femur locking compression plate with an average age of 44 years. Average union time was 16 weeks. 10 % non-union, 10% implant failure, 5% deep infection, 5% each of varus and valgus malalignment were noted in our study. We had two cases of delayed union. At a mean follow-up of 12 months, mean knee range of motion in our study was 0 to 115^0. Functional outcome at the end of one year was assed using Neer's scoring system. Results were excellent in 24 patients (57%), good in 8 (19%), fair in 6(14%) and poor in 4(10%). Functional outcome and complication rate of our study is similar to other studies reported in literature.

CONCLUSION

Locking compression plate is an optimal fixation device for distal femur fractures. It provides rigid fixation especially in osteoporotic fractures and communitted periarticular fractures. Surgical exposure requires significantly less periosteal stripping compared to nonlocking plates. However careful understanding of its basic principles, identification of appropriate fracture patterns is essential to avoid complications. Based on our results and experience, we recommend locking compression plate for fixation of distal femur fractures.

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