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ANALYSIS OF SUPRACONDYLAR FEMUR FRACTURES TREATED WITH RETROGRADE INTRAMEDULLARY NAIL

Orthopedics

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ABSTRACT

Introduction: Supracondylar femur fractures are one of the commonest fractures encountered in high velocity trauma which are associated with high morbidity and mortality. This necessitates early stabilization of fractures. Internal fixation is the treatment of choice for supracondylar fractures (AO type-A). Retrograde supracondylar nail has shown to give one of the best results in terms of recovery, fracture union, return to work and the functional outcome. **Methods:** This study was conducted at Prathima Institute of Medical Sciences, Karimnagar from November 2015 to October 2017. 40 patients with supracondylar femur fracture were studied (AO type-A). Supracondylar femur fractures were treated by closed or open reduction and internal fixation with retrograde supracondylar nail inserted through inter-condylar notch. The patients were evaluated clinically and radiological for outcomes. All patients were followed up for an average of 12 months. Outcome was assessed using NEER'S Score. **Results:** In 38 cases closed reduction was possible while 2 required open reduction. Post-operatively all patients were started on continuous passive mobilization with early toe touch walking and gradually progressive weight bearing with appearance of clinical and radiological signs of union. Evaluation was done according to the Neer's rating system. 75% excellent results were found. All fractures had a sound clinical and radiological union with an average radiological union time of 15.4 weeks and average full weight bearing time was 14.5 weeks. Average knee flexion was 1080 with an extensor lag of 40. In the present study, road traffic accident was observed to be the predominant cause of distal third femoral fractures in young patients. Conclusion: Retrograde intramedullary nailing is a good fixation system for supracondylar, extra- articular femur fractures because of less operative time, less blood loss, less soft tissue dissection. Distal screw related local symptom is a common problem and is related to implant and technique and has a definite learning curve. Non-requirement of bone graft decreases the morbidity.

KEYWORDS

Distal femur fractures, Retrograde supracondylar nail

INTRODUCTION

Rapid industrialization in last few decades has dramatically increased the number of road traffic accidents and crippling many young lives. Supracondylar femoral fractures are often of the difficult fractures to treat due to many complications. In the early 1960s, there was a great reluctance towards operative management of this fracture because of high incidence of infection, non-union, malunion, inadequate fixation and lack of proper instruments, implant as well as antibiotics. Those days displaced supracondylar femur fractures were managed as per the principles of Watson Jones1 & John Charnley2 in the form of skeletal traction, manipulation of fracture and external immobilization in the form of casts and cast bracings. High incidence of deformity, shortening, prolonged bed rest, knee stiffness, angulation, joint incongruity, malunion, quadriceps wasting, knee instability and post-traumatic osteoarthritis was observed with these methods.

Open reduction and internal fixation has become popular with introduction of AO blade plate, dynamic condylar screw, intramedullary supracondylar nails and recently locking compression plate. Supracondylar fractures tend to collapse into varus. During application of AO blade plate or dynamic condylar screw, the shaft of femur is often pulled laterally displacing the line of weight bearing, lateral to the anatomic axis of condyle. This creates rotational movements at the fracture site that causes pulling off the blade plate or condylar screws leading to fatigue fracture of the plates. Also, the presence of osteoporotic bone leads to fixation failures with screws and plates cutting the soft bone.

Advantage of an intramedullary device is that it aligns the femoral shaft with condyles reducing the tendency of varus movement at the fracture site. Other advantages of retrograde intramedullary supracondylar nail include preservation of fracture hematoma, decreased blood loss, minimal soft tissue dissection, less operative time and reduced rate of infection.

Aim of this study is to evaluate the results of supracondylar fractures of femur treated with retrograde intramedullary supracondylar nail in relation to knee flexion, mobilization of patients, early weight bearing, post-operative rehabilitation and compare with the results of similar studies available in literature.

MATERIALS AND METHODS

This study was conducted at Prathima Institute of Medical Sciences, Karimnagar from November 2015 to October 2017. 40 patients with supracondylar fractures of femur without intercondylar extension were included in this study. All patients underwent closed or open reduction and internal fixation with retrograde supracondylar nail under regional anesthesia. Follow up duration ranged from 6 months to 24 months. All the patients were subjected to clinical and radiological examination along with routine pathological investigations. Only patients of age group 18-70 years were included in this study. Supracondylar fractures with intraarticular extension, pathological fractures, fractures with neurovascular injury, patients lost in follow up were excluded from this study. AO-ASIF classification was used to classify fractures. All patients were operated on radiolucent table in supine position with bolster underneath the knee to keep knee in 500 to 600 flexion. Midline patellar tendon splitting approach was used in all cases.

Patients were started on static quadriceps on 1st post-operative day and active or active assisted bedside knee mobilization from second postoperative day, discharged on 5th post-operative day. Before discharge, patients were given crutch training and were made ambulatory on bilateral axillary crutches/walking frames without weight bearing. Suture removal was done on 14th postoperative day. Toe touch walking was allowed by the 6th week. Further, weight bearing was allowed depending on the clinical and radiological union progress. The initial fracture geometry, comminution, stability of fixation were the major factors considered while advising progressive weight bearing. At each follow-up patient was assessed as regards clinico-radiological union in the form of pain at fracture site, thickening at fracture site, warmth at fractures site, radiographic alignment, evidence of callus seen, knee range of motion, extensor lag and shortening. Unprotected weight bearing was allowed only after complete union of fracture. Long-term results were evaluated using Neer's rating system15 which assigns points for pain (20 points), working (20 points), walking capacity (10 points), gross anatomy (15 points), radiological appearance (15 points). Results were graded to excellent with score more than 85, good with 70-85 score, fair with 55-69 score and poor with less than 55 score.

RESULTS

Of the 40 cases included in this study, 32(80%) were male and 8(20%) were female. Only two patients were aged less than 20 years, 18 patients between 20-30 yrs, 8 patients between 30-40 yrs, 6 patients

between 40-50 yrs and 6 patients more than 50 yrs. Most of the patients in this study were in younger age group, with average age being 34.9 yrs. 45% of the patients were below 30 years and 75% were below 40 years, while only 15% were above 50 yrs. Considering the male predominance in the outdoor activities in Indian society most of the patients were male. 30(75%) fractures were closed, 6(15%) fractures were grade I open and 4 fractures were grade II open (10%). Considering its preponderance to occur in high energy injuries, most of the fractures were due to road traffic accidents (80%), while two were due to assault (5%). Only four (10%) fractures were low energy injuries in elderly patients. In males, most of the fractures were due to road traffic accidents, whereas in female accidental fall was also important cause of fracture in this study. 26(65%) fractures were right sided and 14(35%) left sided. Only two cases required open reduction and rest 38(95%) fractures were managed with closed reduction. 250mm (25%) and 300mm (75%) nails were used to treat these fractures. 10mm (40%) and 11mm (60%) diameter nails were used. 12mm diameter nails were avoided as it meant putting a shorter nail as most of the patient's isthmus was narrow. Considering the present day high velocity injury and high energy impacts most of the fractures were of A-3 and A-2 group, together constituting 90% of the fractures.

Radiological union was achieved in 14(35%) cases in less than 14 weeks, 24(60%) cases in 14-20 weeks and 2(5%) fractures united after 20 weeks. Average radiological union time was 15.4 weeks. 6(15%) patients had knee flexion less than 900, 6(15%) patients had knee flexion 910-1090 and 28(70%) patients had knee flexion more than 1100. Average knee flexion in our study was 1080, lowest being 500. Knee range of movement exercise was started on 2nd postoperative day. Final knee flexion achieved was mainly depended on the patients' compliance, their education level and their application to physiotherapy.

For most of the cases full weight bearing was started on 14 weeks, considering the patients education level and their compliance. Average full weight bearing was started on 14.5 weeks. Knee extensor lag was present in 22 patients (55%). Average extensor lag was 40. Varus mal-alignment (30%) was more common than valgus (5%). Varus mal-alignment was less than 50 in 8(20%) cases, 60-102 in 2(5%) cases and more than 100 in 2(5%) cases.

Most common complication (45%) was symptoms at distal screw site, while most patients complained pain at distal screw site five patients had palpable snap at distal screw site. Two patients had distal screw site infection, which subsided after debridement and screw removal. One patient had fat embolism syndrome which was treated conservatively. Two (5%) patients had delayed union and 6(15%) patients had shortening. Neer's score was excellent in 30(75%) cases, good in 6(15%) cases, fair in 2(5%) cases and poor in 2(5%) cases.

DISCUSSION

Supracondylar femur fractures are recognized as one of major challenges by the orthopedic surgeons worldwide, not solely for achieving fractures union, but for restoration of optimal function in the shortest possible time with minimal complications. Accordingly, management has drifted towards early mobilization, early rehabilitation and early return to premorbid status. Surgical internal fixation permits early rehabilitation and offers the best chance of functional recovery and hence has become the treatment of choice.

Lucas SE et al28 (1993) reported 39 years as mean age group with 13 male and 11 female. Gellman RE et al48 (1996) reported 50 years as mean age group with 10 male and 12 female. Watanabe Y50 (2002) reported 64 years as mean age group with 4 male and 20 female. In the present series, the mean age was 34.9 years with 32 male and 8 female.

In the present study of 40 patients, 32 had suffered road traffic accident with all being less than 50 years of age. This highlights the predominant cause of trauma in younger population as road traffic accident. 30 of the patients who had RTA were males showing the male dominance in outdoor activities in Indian society.

Lucas SE28 (1993) reported no difference in the range of motion in patients less than 60 years old and more than 60 years old. Watanabe Y50 (2002) concluded that, final knee arc was inversely correlated to age. All patients less than 60 years age had excellent range of motion. In the present series though knee flexion was better in younger individuals compared to their older counterparts but there was no statistical significance of this observation. This was mainly due to one age group of 30-40years, where the knee flexion was low due to other reasons.

Studies conducted by Schatzker et al13 (1974), Yang RS et al24 (1990) and Leung KS et al26 (1991), demonstrated road traffic accidents as the major cause. Lucas SE28 (1993) reported 79% road traffic accident, 17% fall and 4% gunshot wound. In the present series, road traffic accidents accounted for 80% of cases, 15% resulting from fall and 5% resulting from assault. We also agree with the results of Gellmann RE36 (1996) who stated that high energy fractures occurred more in young, male patients and low energy falls caused fracture in older women and men.

High percentage of open injuries was found in the studies by Lucas SE et al28 (1993), Iannacone et al30 (1994). Lucas SE28 (1993) did not report any difference in the final outcome in terms of knee flexion and nature of fracture. In the present study, 25% were open injuries and 75% were closed. Most of the fractures that came to our hospital in the same time were either grade 3 open fractures or had intraarticular extension. Both were out of study group. Among the 40 patients in the study group around 45% fractures belonged to A-2 category, while 45% belonged to A-3 category and only 10% belonged to A-1 category. The final outcome in terms of knee flexion was not affected by nature of fractures. 12 out of 18 each of A-2 and A-3 category had knee flexion of ^{3}110 degree (66.66%). while 4 out of 4 of A-1 fractures had knee flexion ^{3}110 degree (100%). Extensor lag was found to be more in 22 patients and it had no relationship with the type of fracture.

In the present series, 14 patients had associated injuries. Associated injuries did affect the rehabilitation (delayed mobilization and delayed weight bearing) but the effect on final outcome was less significant. Danziger MB32 (1995) performed open reduction in all cases. Gellmann GE36 (1996) reported 9 open reduction and 15 closed reduction where as Gynning JB44 (1999) reported 29 open reduction and 21 closed reduction. In the present series, fracture fixation was done by closed reduction under image intensifier in 38 patients and open reduction done in 2 patients out of 40.

Kumar A48 (2000) in his series used longest available nail in osteoporotic bones for better purchase in intact bone. Sears et al65 (2004) concluded that longer nails provide improved initial fracture stability when compared with short retrograde nail for supracondylar fracture. In the present series 4 patients of 10 in whom 250 mm long nail had < 90 degree flexion (40%). 6 patients out of 10 with 250mm diameter nail had ^{3}110 degree flexion (60%). 22 out of 30 in whom 30mm nail was used had flexion of more than 1100 (73.33%) while 6 out of 30 had flexion in range of 91-109 (20%) and only two had less than 90(6.66%). There was no significant relationship between the length of the nail and the final knee flexion (p value-0.14).

Danziger MB32 (1995) reported average radiological union time 12.4 weeks. Gellmann GE36 (1996) reported average radiological union time of 12 weeks. Kumar A48 (2000) reported average radiological union time of 14 weeks. Average union time in the present study was 15.6 weeks. The fractures which required more time for union were more comminutted.

Lucas SE28 (1993) obtained an average knee flexion of 104 degrees. Gellmanna GE36 (1996) obtained an average knee flexion of 1060. Kumar A48 (2000) obtained an average knee flexion of 1000. Watanabe Y50 (2002) obtained an average knee flexion of 1020. Ingman AM63 (2002) obtained an average knee flexion of 1010. In the present study, the average knee flexion was 1080. As this study included only extra articular fractures knee flexion was better than other studies which included intra articular fractures also. Lucas SE28 (1993) reported, no difference in the range of motion in patient <60 years or >60 years. This finding was contradicted by Watanabe Y50 (2002) who reported inverse correlation of final knee arc and age with excellent range of motion in all patients <60 years. Watanabe Y50 (2002) attributed this discrepancy in Lucas SE28 (1993) study to many severely injured patients in younger population. In the present study, 4 patients with A1-type had ^{3}110 degree knee flexion (100%), 12 of 18 patients with both A1 and A2 type had ^{3}110 degrees flexion (66.66%). Lucas SE28 (1993) noted that, “the patients consistently showed a continued increasing range of motion for 12 months and frequently for 15 months post-operative.

Lucas SE28 (1993) documented extensor lag of 40. Gellmann GE36 (1996) documented extensor lag of 20. Kumar A48 (2000) documented extensor lag of 6.90. Watanabe Y50 (2002) documented extensor lag of 50. The average extensor lag in the present series was 40.

In Lucas SE28 (1993) study 1 patient had shortening of >3 cm while Gellmann GE36 (1996) reported 6 out of 24 patients having 2 cm shortening and Kumar A48 (2000) reported as average shortening of 1.4 cm. In the present study, 6 patients had shortening with an average 1.5 cm and could be compensated by giving a shoe raise.

There has been no report of infection by any authors except for Lucas SE28 (1993) who reported one case of septic knee nine months after nail insertion in a patient who had multiple bouts of intra-abdominal sepsis and multiple abdominal surgeries. The infection resolved after removal of nail and irrigation and debridement of knee. In the present series, there was no case of septic knee, but there was one case where distal screw was infected which subsided after debridement and screw removal.

Four cases of non-union were reported by Iannacone WM30 (1994), which were treated with bone grafting and revision fixation. Kumar A48 (2000) reported one case of non-union but attributed it to technical error, rather than implant. Christodoulou A et al67 (2005) reported 2 cases of non-union in their study. All other studies reported good and solid union. In the present study, there was no non-union.

Iannacone WM30 (1994) reported 5 delayed unions which were treated with screw removal and dynamization or revision internal fixation. Danziger MB32 (1995) also reported a case of delayed union. In this study there was one delayed union which united eventually without any intervention.

Gellmann RE36 (1996) reported a case of distal migration of nail, which was due to technical error when the distal interlocking screws missed the nail, allowing it to migrate distally. Gynning JB44 (1999) reported a case in which the distal locking screws broke at 3 months and the nail protruded in knee joint by 2 cm. In our study there was no distal migration or implant breakage.

Lucas SE28 (1993) stated the most common complications was prominent distal locking screws or condylar screws, that required removal for local symptoms. Gynning JB44 (1999) reported no screw breakage but in 5 of his patients, distal screws backed out and were removed under local anesthesia after fracture union. Kumar A48 (2000) reported a case of loosening of distal screw in 1 patient 4 weeks after surgery which was removed without affecting final outcome. Watanabe Y50 (2002) reported 2 cases of distal screw breakage in whom early weight bearing was permitted.

In the present study, there were 18 patients who complained pain at the site of distal screws and 10 patients who had snapping, and which required screw removal after fracture healing. Lucas SE28 (1993) reported 2 cases of stress fractures at the proximal tip of nail, which were successfully treated with cast. Kumar A48 (2000) reported 2 cases of stress fracture at the proximal tip of nail who also had ipsilateral total hip stem. He attributed the fracture to high stress concentration between two intramedullary implants in an osteoporotic bone. In the present series, there was no case of stress fracture. High implant failure rate was reported by Danziger MB32 (1995) and Iannacone30 (1994) in their studies where nails with multiple holes were used along with 6.5 mm locking screws. With the modification of the nail to total 4 to 5 holes placed at both ends with screw size of 5.0mm, no implants failure has been reported in newer studies. In the present study also, there were no cases of implant failure.

Neer et al15 (1967) reported 52% satisfactorily results with operative method. Janzing et al53 (1998) used retrograde nailing to treat 26 distal femoral fractures and 72% had neer score of 85 points or more (excellent). In the present series, 75% had excellent score and 15% had good score.

CONCLUSION

Supracondylar nail provides rigid fixation in a region of femur, where a widening canal, thin cortices and frequently poor bone stock make fixation difficult. Surgical exposure for nail placement requires significantly less periosteal stripping and soft tissue exposure than that of lateral fixation devices. Orthopaedic surgeons experienced with intramedullary nailing will find the supracondylar nail a useful technique but requires attention to prevent complications especially distal screw related symptoms. Supracondylar nail is the optimal tool for extraarticular supracondylar fractures of femur due to less blood loss, less soft tissue dissection, often fracture is reduced closed and it doesn't require primary bone grafting. Hence, we recommend supracondylar nail fixation for extraarticular type of supracondylar femur fractures.

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