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Study on outcomes of fractures of distal femur

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***Abstract*---**Introduction- Open distal femur fractures are rare, complex injuries which occur in polytrauma patients and are complicated by bone loss, contamination, compromised soft tissues and poor host condition. The study intends to evaluate patients treated for open fractures of distal end of the femur using the staged protocol of early external fixation with debridement followed by definitive fixation with an anatomical locking plate and bone grafting at a later stage. Method- The study included a group of 20 patients of open distal femur fractures who were operated with temporary external fixator and later on converted to definitive fixation with condylar locking plate with bone grafting. These patients were operated with our staged protocol and clinical outcome was evaluated using the functional evaluation scoring system by Sander's et al and Knee Society Scoring. Out of these 20 patients, 1 was lost to follow up at 3 months and 2 others were lost to follow up at 6 months. These 3 were excluded from our study. Results- Fracture union was seen in all 17 patients. The average time to union was 22.65±3.3 weeks. Two patients were complicated with infection and delayed union. Ilizarov application was doneto achieve union and gain length once the infection subsided. Conclusion- Staged protocol of temporary external fixator followed by definitive fixation with condylar locking plate and bone grafting is a safe and reliable method for the management of open distal femur fractures.

***Keywords*---**Distal Femur, Open Fractures of Distal Femur, Operative Outcomes of Distal Femur.

Introduction

Distal femur fractures are uncommon, but a significant cause of patient morbidity [1]. Surgical management can be technically challenging, with no clear advantage

of anyone particular surgical implant. Despite increased biomechanical and clinical research alongside the development of modern implants, persistent disability and poor clinical results often result [2]. Some of the poorer outcomes may relate to surgical technique, with a lack of understanding of the management principles of these fractures.

Distal femoral fractures account for 4-6% of all femoral fractures [3] and approximately one third of all femoral shaft fractures. They have a bimodal age distribution, tending to occur in young males from high energy trauma, and in elderly osteoporotic females from low energy trauma [4]. The 85% of low energy fractures occur in the elderly population. In both instances, axial load to the leg is the most common mechanism of injury. Less frequently, rotation forces lead to distal femoral fractures. In low energy trauma, most fractures remain extra-articular [5], whereas, in high energy trauma, over half have an intraarticular extension [4]. Extra-articular and intra-articular comminution is frequent. Open fractures occur in 19-54%, with upto 80% being Gustilo type III. Approximately 1-5% of primary knee arthroplasties [6] are complicated by periprosthetic fracture.

Almost 60% of distal femoral fractures occur in the age group >50. The osteoporosis within this group may pose problems for fixation. Associated meniscal or ligamentous damage following distal femoral fractures has been described, whilst the incidence of neurovascular injury remains rare [7]. Approximately 0.2% of these fractures are associated with the femoral or popliteal artery damage. Nevertheless, because of the low quantity and quality of collaterals, vascular injury threatens the vitality of the whole extremity and therefore has to be carefully ruled out.

Open distal femur fractures are rare, complex injuries which occur in polytrauma patients and are complicated by bone loss, contamination, compromised soft tissues and poor host condition. Distal femur fractures with intra-articular extension are high velocity injuries which different methods have treated.[8]

As improvements have been made in emergency medical services and critical care medicine, polytrauma patients are surviving their life-threatening injuries and require functional orthopaedic reconstruction to promote wellness. Long term functional outcomes of the multi-system trauma patient are often predicated on extremity trauma management.

The timing of the reconstructive effort to achieve limb salvage is the most essentialfactor to consider. The physiology of the severely traumatized host and local musculoskeletal environment deserve special consideration. Although, early skeletal stabilization and open fracture care stop the cycle of injury, removes nidus for infection, and halt ongoing hemorrhage, it may be prudent to delay further reconstructive surgery until the host, and local soft tissue conditions are optimized [9].

Open high energy distal femur fractures with or without bone loss present unique therapeutic challenges when the pathway of limb salvage is prescribed. Although amputation may be the preferred reconstructive strategy for the multiply injured patient in the extremis, limb salvage using a staged approach to care should be

considered. Management factors to consider include the scope of open fracture care, type of skeletal stabilization, soft tissue coverage and bone grafting strategy. Complications such as nonunion, malunion, or infection after lower extremity reconstruction can profoundly negatively impact this unfortunate patient population. It is rare that non-operative treatment is offered. Non-operative management is reserved for the medically unwell or non-ambulatory patients with poor bone stock. Various surgical interventions have been proposed, including external fixator (uniplanar, biplanar or Ilizarov), angular blade plate, angular-stable anatomical locking plate, retrograde supracondylar nail, condylar buttress plate, dynamic condylar screw and arthroplasty. Implant choice can be based on the fracture type. The most common surgical methods employed in modern practice are retrograde nailing or angular-stable anatomical locking plate osteosynthesis. There is a paucity of data in the literature regarding this type of injuries. Very few studies have been conducted on its management with variable results. Arazi et al. [10] and Kumar et al. [11] conducted a study on complex fractures treated with Ilizarov external fixator. Parekh et al. [12] conducted a study where fractures were treated with temporary external fixation and subsequent open reduction and internal fixation. None of the studies hasshown superior results forone procedure over the other.

The study intends to evaluate patients treated for open fractures (Gustilo Grade II, IIIA, IIIB and IIIC) distal end of the femur at our institution using the staged protocol of early external fixation with debridement followed by definitive fixation with anatomical locking plate and bone grafting at a later stage.

Material & Methods

This Descriptive study was carried out Orthopaedics Department, After obtaining approval from the Institutional Ethical Committee and informed consent. From Jan 2020 to september 2021, a total of 20 patients of either sexwith open distal femur fractures (Gustilo Grade II, IIIA, IIIB & IIIC) were treated with an external fixator initially and condylar plate at a later stage wasincluded. However, patientswith open distal femur fractures (Gustilo Grade I), pathological fractures, debilitated medical conditions, closed fractures and young patients with epiphysis still not fused were excluded.

Radiological outcome will be assessed with the help of X-ray appearance of the lower limb on 2nd week, 6th week, 3rd month, 6th month and 1st year. Clinical outcome will be assessed on the basis of range of motion at knee, ankle and foot, limb length disparity, deformity and complication on 2nd week, 6th week, 3rd month,6th month and 1st year. Clinical union will be defined when the fracture site is stable and when of abnormal mobility and are absentpain. Radiographic union will be defined when plain radiographs show bone trabeculae or cortical bone crossing the fracture site. Union will be determined by union in ¾ cortices.

The data for evaluation will be retrieved from previous OPD and hospital records of the patients after obtaining their consent, and only those patients with complete records will be included in the study. The information collected will be noted in proforma and the outcome will be measured using functional evaluation

scoring system described by Sander's et al. [13], Knee society score [14] and Visual analogue scale.

Statistical Analysis

Statistical analysis was performed using MS Excel (R) office 365, GraphPad prism 8.4.2 and SPSS version 25 (SPSS Inc., Chicago, IL, USA). Descriptive statistics will be analysed with SPSS version 17.0 software. Continuous variables will be presented as mean±SD. Categorical variables will be expressed as frequencies and percentages. Association between two or more variables will be done using Chi-Squared or Fisher's exact test. A p value less than 0.05 will be taken to indicate a significant difference.

Results

There were 17 patients with average age of 36.53 years (±14.569). Maximum number of cases were in the age group 20-30 years, 13 were males and 4 were females. There was clear cut male preponderance in our study. 15 cases had RTA as the mode of injury, and 2 cases were due to fall from height. Road traffic accidents are clearly in excess of any other mode of injury in these fractures. 15 patients had right-sided injury, and only 2 had left-sided injury at the final follow-up. Gustilo type I was excluded from our study from the beginning. There were 4 (23.5%) type II, 6 (35.3%) type IIIA and 7 (41.2%) type IIIB in our study. ; There were 2 (11.8%) type-A1, 2 (11.8%) type-A2, 1 (5.9%) type A3, 2 (11.8%) type-B1, 3 (17.6%) type-C1, 3 (17.6%) type-C2 and 4 (23.5%) type C3 fractures. There was 1 (5.9%) clavicle fracture, 1 (5.9%) head injury, 1 (5.9%) proximal tibia fracture and 2 (11.8%) rib fractures. The average time interval between initial and definitive surgery was 30.76±10.42 days. Extension lag over time following surgery shows a decreasing trend signifying improvement. Degree of flexion over a period of time following surgery, showing an increasing trend signifying improvement. The average extension lag decreased from $15.59±4.96^0$ at 2 weeks to $5±4.33^0$ at 1 year follow-up, showing a significant improvement. The average flexion increased from $83.82±7.18^0$ at 2 weeks to $112.35±10.32^0$ at 1 year follow-up. Pain (Sander's Score) was graded into 4 categories on a scale of 10 and measured at regular follow-ups. 94.1 % of cases had constant pain at 2 weeks, whereas none had constant pain at 1 year follow-up. 70.6% had no pain at 1 year follow-up. [Table-3] Pain (Knee Society Score) is graded on a scale of 50 into 7 categories, and measurement was done at 6 months and 1year follow-up. 5 cases (29.4%) had no pain at 6 months and 12 cases (70.6%) had no pain at 1 year follow-up. Shortening was calculated at initial surgery, followed over a time period, and was found to be constant (p-value-1.00). Walking ability (Sander's Score) was graded on a scale of 6 and measured at regular follow-ups. None of the cases waswheelchair bound/ bedridden at 1 year follow-up(p-value-<0.001). Walking (Knee Society Score) was graded on a scale of 50 and measured at 6 months and 1 year. None of the cases wasunable to walk or housebound at 1 year follow-up (p-value-<0.001). Stair (Sander's Scoring) climbing was graded on a scale of 3 and measured at regular follow-ups. 1(5.9%) case had a score of 0 at 1 year follow-up while 6 (35.3%) had no limitation (p-value-<0.001). Stair (Knee Society Score) climbing was graded on a scale of 50 and measured at 6 months and 1 year. 1(5.9%) case was unable to walk at 1 year follow-up and 2 (11.8%) cases could

climb normal up and down at 1 year (p-value-<0.001). [Table-4]Return to Work (Sander's Score) was graded on a scale of 6, and only 1 (5.9%) was found to be unemployed at 1 year (p-value-<0.001). Functional evaluation was done at regular follow-ups with Sander's Scoring. No poor results were obtained at 1 year, while 1 excellent result was obtained at 1 year (p-value-<0.001). Knee Score and function score were calculated at 6 months and 1 year. Average of both the scores gave us the Knee Society Score. There was 1 (5.9%) poor result and 4 (23.5%) excellent results. Maximum number of the cases had good results i.e. 12 (70.6%) (p-value-<0.001). The average time taken for the radiological union was 22.65±3.3 weeks.

Discussion

Open high energy distal femur fractures with or without bone loss present unique therapeutic challenges when the pathway of limb salvage is prescribed. There is a bimodal age distribution with high-velocity injuries occurring in the younger age group and low/high energy injury in the elderly with osteoporotic bones. The incidence of these fractures is rising due to the abrupt rise in the number of road traffic accidents.

Management of these fractures poses a serious problem. Surgical management of these fractures aims at anatomical restoration of the articular surface with an appropriate reduction of fracture fragments and maintaining the normal alignment of the knee. Early mobilization of the knee is of utmost importance because a good range of motion is necessary for many activities of daily life. Knee stiffness isone of the most common complications of these fractures.

Though many studies have been conducted on distal femur fractures not many studies have been conducted on open fractures of the distal femur. There is no consensus on what should be done, but the timing of the procedure remains an important factor. At our institution, we have been following the staged protocol of temporary bridging fixator and conversion to condylar locking plate at a later stage.

We have conducted a descriptive study to evaluate the results of this staged protocol using the functional evaluation and scoring system described by Sander's et al. and Knee Society Scoring. Twenty patients were selected initially and followed for 1 year, but 3 patients were lost to follow up in the interim, so they were excluded from the final study.

In our study group, mean age was 36.53± 14.569 years with 4 (23.5%) females and 13 (76.5%) males. There was male preponderance with the right side being more commonly involved. 2 (11.8%) cases were left-sided and 15 (88.2%) were right-sided.The most common mode of injury in our study was Road Traffic Accident (RTA)- 15 (88.2%) and there were 2 (11.8%) injuries due to falls from height.

Our study comprised of a few associated injuries with 2 (11.8%) rib fractures, 1 (5.9%) clavicle fracture, 1 (5.9%) head injury, 1 (5.9%) proximal tibia fracture and 12 (70.6%) cases with no associated injuries.Out of 17, 4 (23.5%) cases were

Gustilo II, 6 (35.3%) cases were Gustilo IIIA, and 7 (41.2%) cases were Gustilo IIIB as compared to Parekh et al. [12] who conducted a similar study (Gustilo I=8 (22.86%), II=6 (17.16%), IIIA=3 (8.57%), IIIB=13 (37.14%) and IIIC=5 (14.28%) out of 35 open fractures).

We have used AO/ASIF classification which is the most widely used and accepted classification for distal femur fractures. There were 2 (11.8%) type- A1, 2 (11.8%) type-A2, 1 (5.9%) type- A3, 2 (11.8%) type-B1, 3 (17.6%) type-C1, 3 (17.6%) type-C2 and 4 (23.5%) type-C3 fractures as compared to Arazi et al. who conducted a similar study with Ilizarov external fixation. There were 3 (21.43%) type-A3, 2 (14.28%) type-C2 and 9 (64.26%) type-C3 fractures.

The average time interval between initial and definitive surgery was 30.76 ± 10.42 days with a range from 21 to 58 days as compared to a mean of 5 days and a range of 1 to 23 days in a study conducted by Parekh et al. The significant difference betweenthe average time interval can be attributed to the inclusion of closed fractures in their study.

The average time for fracture union was 22.65 ± 3.33 weeks compared to a mean of 16 weeks in a study conducted by Arazi et al. and an average of 39 ± 9 weeks in a study conducted by Kumar et al.[11] The average flexion at 2 weeks was $83.82^0 \pm 7.18^0$, at 6 weeks was $93.53^0 \pm 7.65^0$, at 3 months was $99.41^0 \pm 9.16^0$, at 6 months was $104.71^0 \pm 9.59^0$ and at 1 year was $112.35^0 \pm 10.32^0$. The 1-year average flexion was 112.350+10.320 as compared to 1050 and 1100+100 in type-C2 in the studies of Arazi et al [10] and Kumar et al [11] respectively. So, it was found to be a generalised increasing trend at every follow up.

Similarly, average extension lag at 2 weeks was $15.59^0 \pm 4.96^0$, at 6 weeks was $11.47^0 \pm 4.92^0$, at 3 months was $8.82^0 \pm 5.16^0$, at 6 months was $7.35^0 \pm 5.03^0$ and at 1 year was $5^0 \pm 4.33^0$. So, it was found to be a generalised decreasing trend at every follow up. The final average knee extension lag was $5^0 \pm 4.33^0$ as compared to $12.2^0 \pm 3.5^0$ in the study conducted by Kumar et al. [11].

Sander's score at 6 months was 5 good (29.4%), 10 fair (58.8%), 2 poor (11.8%) and no excellent results. At 1 year, there was no poor result, 2 fair (11.8%), 14 good (82.3%) and 1 excellent (5.9%) result.Knee Society Score at 6 months was 1 excellent (5.9%), 3 good (17.6%), 7 fair (41.2 %) and 6 poor (35.3%) results. At 1 year, there were 4 excellent (23.5%), 12 good (70.6%), 1 poor (5.9%) and no fair results.

Two patients were complicated with deep infection. One of which was managed with implant removal and Ilizarov fixator. Union was achieved, and corticotomy was done to achieve length. Other one was managed with implant removal and temporary fixation with an external fixator. Later on, Ilizarov fixator was used to simultaneously achieve union and prevent infection. Union was achieved in both the patients, but the final results were inferior to the rest of the group.

The strength of our study is that the same surgeon operated the patients and similar implants were used in all the patients unless complicated with deep infection. Our study had the limitation of a smaller number of patients and a

shorter follow-up period due to time constraint. The information from this study can be used for patients and as a reference for further studies.

Conclusion

On the basis of our descriptive study for open fractures of the distal femur, we conclude that the staged protocol of temporary external stabilization and definitive fixation with condylar locking plate at a later date is a safe option with acceptable results. In cases of deep infection, where definitive surgery with plating is delayed, a more stable external fixation, i.e. Ilizaarov may be used. Cancellous bone grafting at the time of definitive surgery enhances fracture healing and decreases the chances of non-union.

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Reference

1. Hoskins W, Sheehy R, Edward ER, Hau RC, Bucknill A, Parsons N, Griffin XL. Nails or plates for fracture of the distal femur? Data from the Victoria Orthopaedic Trauma Outcomes Registry. Bone Joint J. 2016; 98-B:846-850.
2. Hoffmann MF, Jones CB, Sietsema DL, Tornetta P, Koenig SJ. Clinical Outcomes of locked plating of distal femoral fractures in a retrospective cohort. J OrthopSurg Res. 2013; 8:43.
3. Kolmert L, Wulff K. Epidemiology and treatment of distal femoral fractures in adults. ActaOrthop Scand. 1982; 53:957-962.
4. Papadokostakis G, Papakostidis C, Dimitriou R, Giannoudis PV. The role and efficacy of retrograde nailing for the treatment of diaphyseal and distal femoral fracturers: a systematic review of the literature. Injury. 2005; 36:813-822.
5. Martinet O, Cordey J, Harder Y, Maier A, Buhler M, Barraud GE. The epidemiology of fractures of the distal femur. Injury. 2000; 31:62-63.
6. Meek RM, Norwood T, Smith R, Brenkel IJ, Howie CR. The risk of peri-prosthetic fracture after primary and revision total hip and knee replacement. J Bone Joint Surg[Br]. 2011; 93:96-101.
7. Auffarth A, Bogner R, Koller H, Tauber M, Mayer M, Resch H et al. How severe are initially undetected injuries to the knee accompanying a femoral shaft fracture? J. Trauma. 2009; 66:1398-1401.
8. Stewart MJ, Sisk TD, Wallace SL. Fractures of the distal third of the femur. A comparison of methods of treatment. J. Bone Jt. Surg. 1966;48-A:784-807.
9. Dugan TR, Hubert MG, Siska PA, Pape HC, Tarkin IS. Open supracondylar femur fractures with bone loss in the polytraumatized patient – Timing is everything! Injury, Int. J.Care Injured. 2013; 44:1826-1831.
10. Arazi M, Memik R, Ogun TC, Yel M. Ilizarov external fixationfor severely comminuted supracondylar and intercondylar fractures of the distal femur. J Bone Joint Surg[Br].2001;83-B:663-667.
11. Kumar P, Singh GK, Singh M, Bajraacharya S. Treatment of Gustilo grade IIIB supracondylar fractures of the femur with Ilizarov external fixator. ActaOrthop. Belg. 2006; 72: 332-336.

12. Parekh AA, Smith WR, Silva S, Aqudelo JF, Williams AE, Hak D, Morgan SJ. J Trauma. 2008;64(3): 736-739.
13. Sanders R, Swiontkowski M, Rosen H, Helfet D. Double plating of comminuted, unstable fractures of the distal part of the femur. J Bone Joint Surg Am. 1991;73(3):341-346.
14. Rorabeck CH, Taylor JW. Periprosthetic fractures of the femur complicating total knee arthroplasty. OrthopClin North Am. 1999; 30:265-277.