

Original Article

Evaluation of The Treatment of Open Intercondylar Fracture Distal Femur by Transosseous Osteosynthesis Technique with Ilizarov External Fixator.

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Abstract:

Objectives: Treatment of Distal femoral fractures cannot be done following simple set of rules and when it is an open fracture the treatment is more difficult. Several methods were studied by different authors both at home and abroad, but none were conclusive.

Methods: This prospective study was done between January 2011 to December 2012, 15 patients of the open intercondylar fractures of Distal femur were treated by transosseous osteosynthesis technique by Ilizarov External Fixator in NITOR (National Institute of Traumatology and Orthopaedic rehabilitation), Dhaka. 2 of the patients were not available for final follow up after removal of the fixator frame. So ultimately the final result based on the results of 13 Cases. Minimum 6 months follow up was done from the date of injury. No patient below age 16, no type IIIB or IIIC fractures and no patients having less than 6 months follow up were included in the study. Patients with severe injuries (Head injury, Abdomen and chest injury) were excluded from the study. Patients with medical illness such as Diabetes Mellitus, Peripheral Vascular diseases were not included in the study.

Results: 12 male and 01 female patient between 16 and 56 years were studied. Most common age group in this series were 16-30 year age group (53.85%) and average age of the patients was 31.15 years. Most of the patients were male and road traffic accident was the leading cause of injury (92.31%). Right side involved in (69.23%) most of the cases. All patients were C3 type of fractures and G-II and G-IIIa types were same (38.46%). Most of the patients (53.85%) were operated within 1-2 weeks of admission. Average duration of hospital stay was 22 days ranging from 10 day to 45 days. Most of the patient had soft tissue healing by granulation tissue formation. Others were treated by primary closure, Delayed primary closure or secondary closure.

Various complications were observed among them pintract infection, wire breakage, wire loosening, stiffness of joints, angulations and rotations, deep infection of the tissue, leg length discrepancy was observed in this study. According to the criteria of Neer et al, 1967 final results of the treatment were analyzed. Acceptable result was found in 61.54% of cases (Excellent 7.69% and good 53.85%). Results of the rest of 38.46% cases were not acceptable (Fair 23.08% and poor 15.38%). The result is similar with others done for open fractures of distal femur by Ilizarov External Fixator or other methods of fixation.

Conclusion: So it can be concluded that transosseous osteosynthesis technique is a satisfactory method for treating open intercondylar fracture of distal femur as a primary and definite mode of treatment.

Key words: Ilizarov External Fixator, intercondylar fractures

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Introduction:

Supracondylar and intercondylar fracture of the distal femur historically have been difficult to treat.

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A wide variety of treatment modalities have been used for distal femoral fracture, yet there is disagreement on the optimal choice of treatment. These fractures often are unstable and comminuted and tend to occur in elderly or multiply-injured patient. Because of the proximity of these fractures to the knee joint, regaining full knee motion and function may be difficult. Limited knee motion is secondary to fibrosis of capsular and periarticular soft tissues

and is caused by the initial injury, surgical dissection or prolonged immobilization. The incidence of malunion, nonunion and infection are high in many reported series. Fractures of the distal femur are important for two reasons. The first is that they are common, the second is that they are controversial - and anything that is both common and controversial must be important¹. Fractures of the distal femur cannot be treated by following simple sets of rules.

As any other open fractures, open fracture distal femur is an orthopaedic emergency. An open fracture of the distal femur has been one of the most challenging problem of all long bone injuries. A severe open fracture is the result of high energy injury. It is assumed to be contaminated and may threaten the survival of injured limb and occasionally life. Treatment of open fracture of distal femur is difficult and associated with high risk of infection, non-union and malunion. Surgical reconstruction of distal femoral fractures are technically demanding. The key elements of surgical reconstructions are (1) anatomical reduction (2) stable fixation (3) bone grafting and (4) early range of motion. Achieving these goals requires extensive preoperative planning by surgeon. This planning outlines the fracture pattern, the selection of appropriate implant, the sequential steps in achieving reduction and the steps taken in applying the implant.

With the advent of motorized world the incidence of open fracture distal femur is increasing day by day even in a developing country like Bangladesh. So in NITOR we get a good number of cases with open fracture distal femur. A few authors have suggested that the best results can be obtained with initial skeletal traction followed by cast immobilization. Others have advocated the use of a condylar buttress plate, with or without medial plating, retrograde intermedullary fixation device or external fixation. Extra-articular and intercondylar fractures of the distal femur can be satisfactorily treated by open reduction and internal fixation using a 95 degree blade plate, a dynamic condylar screw or a buttress plate. Although reports of good function with these implants have been documented, an extensive exposure is usually required and the condylar comminution

makes secure fixation difficult. Recently, antegrade or retrograde locked intermedullary nailing has become popular. While intermedullary nails have some advantages, such as limited exposure and minimal blood loss, these implants are not suitable for some specific patterns of fractures, especially types C2 and C3 of the AO/ASIF system.

In our perspective it is not always possible to internally fix the open distal femoral fracture within 72 hours. As a result chance of infection increases. So most of the patients are treated with upper tibial skeletal traction on Brawn Bohlar splint or unilateral long external fixators. But as anterior-posterior and torsional stiffness is less in unilateral external fixator and axial compression stiffness is more² most of the patients end up with nonunion, malunion with rotational and angular deformity, joint stiffness and refracture. It also requires late weight bearing, longer hospital stay and nosocomial infection. Most of the patients require a second method- either by plaster immobilization or a second surgery to correct the deformity and nonunion by intramedullary interlocking nail or by Ilizarov Ring fixator. This creates a socioeconomic burden for the patient and the hospital as well. But for open distal femoral fracture if an alternative treatment can be provided as an early and primary option that can stabilize the fracture and also leads to complete union without any second surgery and make the patient ambulant then it can reduce the economic burden for the patient and can be accepted as the choice of treatment.

To solve this problem Transosseous osteosynthesis by Ilizarov ring fixator seems to be a better option. Though the technique was developed by Prof GA Ilizarov in 1950 it has been exposed to western world in recent years by A.S.A.M.I group in Italy. Now in NITOR we are pretty much familiar with this technique as most of our teachers practice this technique. Usually the device is mostly used to treat infected nonunion, bone transport, limb length discrepancy and deformity correction. But there are many indications of Ilizarov technique, among them treating acute fractures is one. With the above facts I am inspired to undertake this study.

Methods:

This prospective interventional study was carried out at the National Institute of Traumatology and Orthopedic Rehabilitation (NITOR) from January 2011 to December 2012. A questionnaire was prepared considering the key variables like age, sex, side, nature of trauma, presenting symptoms, clinical findings, previous treatments, investigations, pre-procedure findings and outcome of procedure which were verified by the guide. Purposive type of non-probability sampling technique was used as according to availability of the patients and strictly considering the inclusion and exclusion criteria. Patients with Open Intercondylar Fracture distal Femur (Gustilo I- IIIA) were the inclusion criteria. 13 patients were included up to final follow up. The written informed consent was taken from each patient. After proper counseling and anesthesia fitness patients were operated. Post-operative follow up was given at 01 week, 02 weeks and 04 weeks, 06 weeks, 08 weeks and 12 weeks. The quantitative data will be expressed as mean and standard deviation and qualitative data as frequency distribution and percentage. Data were processed and analyzed using Computer based SPSS (statistical package for social science) soft-ware for windows, version 21. P value of less than 0.05 will be considered as significant. The final outcome was assessed by

Neer (1967) Criteria –	Maximum score
1. Pain	20
2. Function	20
3. Range of movement	20
4. Working status	10
5. Gross anatomy	15
6. Radiological appearance	15

Excellent:

Required 85 or more points

Good:

70 to 80

Fair:

55 to 70

Poor:

Less than 55

Surgical procedure –

On a fracture table the patient was positioned with supine after spinal anaesthesia.

The alignment was checked by fluroscopy and gentle manipulation was applied. If the position was acceptable, the frame was applied in a closed manner; if not as in three fractures, I used limited open reduction and internal fixation with k-wire.

A 1.8 mm k-wire was passed through the condyles parallel to the axis of the knee.

Two divergent olive wires were passed through the condyles from the anterolateral to posteromedial and anteromedial to posterolateral directions. After positioning the wires a femoral was constructed to incorporate them. Another full femoral ring was placed 4 to 5 cm above the fracture. This two femoral rings were connected by two oblique support with an Italian arch fixed with middle shaft by two shanz screws.

The final reduction was checked by fluroscopy and malalignment corrected by the articulations of the frame. Finally all connections was tightened and tensioned. In order to obtain a secure fixation the frame was extended to the proximal tibia in three patients. The tibial rings were removed six weeks later on as an outpatient procedure.

Results:

Table-I: Age and sex Distribution of the participants (n=13)

Age (yrs)	No. of patients	Percentage (%)
<30	07	53.85
31-40	03	23.08
>40	03	23.08
Sex		
Male	12	92.31
Female	01	07.69
Total	13	100

Mean age: 31.15 years; range: 16 – 56 years. Out of 13 patients, 53.85% was < 30 years, 23.08% 31-40 years and also >40 years old. The mean age of the patients was 31.15 years and the lowest and highest ages were 16 and 56 years respectively. Most of the patients were male 92.31% and the rest was female 7.69%.

Table-II: Distribution of the Patients by occupation (n=13)

Occupation	No. of patients	Percentage (%)
Service	02	15.38
Business	01	07.69
Student	05	38.46
Housewife	01	07.69
Day labourer	04	30.77
Total	13	100

The selected study subjects were predominantly student 38.46% followed by day labourer 30.77% and service-holder 15.38% and business and housewife each 7.69%.

Table-III: Distribution of the limb affected (n=13)

Side	No. of patients	Percentage (%)
Right	09	69.23
Left	04	30.77
Total	13	100

Out of 13 patients, 09 (69.23%) presented with right distal femoral fracture and 04 (30.77%) with left distal femoral fracture.

Table-IV: Distribution of the Patients by Mechanism of injury (n=13)

Mechanism of injury	No. of patients	Percentage (%)
Motor vehicle accident	07	53.85
Motor cycle	05	38.46
Fall from height	01	07.69
Total	13	100

Majority 53.85% of injuries was happened by motor vehicle accident, 05 (38.46%) injury was caused by motor cycle accident and another 01 (07.69%) by fall from height.

Table-V: Distribution of the Patients by types of fracture (n=13)

Type	No. of patients	Percentage (%)
Muller type C1	03	23.08
Muller type C2	06	46.15
Muller type C3	04	30.77
Gustilo type – I	03	23.08
Gustilo type – II	05	38.46
Gustilo type – III A	05	38.46
Total	13	100

Out of 13 patients, in terms of type of fracture, Müller type C1 was 01 (23.08%) patient, Müller type C2 was 06 (46.15%) patients, Müller type C3 was 04 (30.77%) patients. Gustilo type I was 23.08%, Gustilo type II and III-A each were 38.46%.

Table-VI: Incidence of complication in the series

Complication	No. of patients	Percentage (%)
Limb related complications :		
Nonunion	00	00.00%
Muscle wasting	10	76.92%
Leg length discrepancy	11	84.61%
Angulation	11	84.61%
Rotation	08	61.54%
Deep Infection	01	07.69%
Neurovascular injury	00	00.00%
Iizarov External Fixator related complications :		
Pin tract infection	07	53.85%
Wire breakage	04	30.77%
Ring breakage	00	00.00%
Transfixion breakage	03	23.08%

Table-VII: Distribution of the Patients by Neer score on pain (n=13)

Pain	No. of patients	Percentage (%)
No pain	01	07.69
Intermittent or bad weather	06	46.15
With fatigue	04	30.77
Restrict function	01	07.69
Constant or at night	01	07.69
Total	13	100

Objective evaluation of outcome revealed that 01 (7.69%) patient noticed no pain, 06 (46.15%) patients had intermittent pain, 04 (30.77%) pain with fatigue, 01 (7.69%) pain restrict function and 01 (7.69%) constant pain.

Table-VIII: Distribution of the Patients by Neer score on Function (n=13)

Function	No. of patients	Percentage (%)
As before injury	00	00.00
Mild restriction	05	38.46
Restricted; stairs sideways	07	53.85
Cane or severe restriction	01	07.69
Crutches or brace	00	00.00
Total	13	100

38.46% developed mild restriction of function, 53.85% restricted and 7.69% developed severe restriction of function.

Table-IX: Distribution of the Patients by Neer score on motion (n=13)

Motion	No. of patients	Percentage (%)
Normal or 135 degrees	00	00.00
100 degrees	02	15.38
80 degrees	09	69.23
60 degrees	02	15.38
40 degrees	00	00.00
20 degrees or less	00	00.00
Total	13	100

Objective evaluation of outcome revealed that 02 (15.38%) patients exhibited 100 degrees of

knee motion, 09 (69.23%) patients 80-100 degrees knee motion and 02 (15.38%) patients exhibited 60-80 degrees knee motion.

Table-X: Distribution of the Patients by Neer score on work (n=13)

Work	No. of patients	Percentage (%)
As before injury	00	00.00
Regular but with handicap	07	53.85
Alter work	04	30.77
Light work	02	15.38
No work	00	00.00
Total	13	100

53.85% of the patients returned to regular work but with handicap, 30.77% patients altered work and 15.38% could able to do light work.

Table-XI: Distribution of the Patients by Neer score on roentgenogram (n=13)

Roentgenogram	No. of patients	Percentage (%)
Near normal	02	15.38
5 degrees angulation or 0.5 centimeter displacement	06	46.15
10 degrees angulation or 1.0 centimeters displacement	05	38.46
15 degrees angulation or 2.0 centimeters displacement	00	00.00
Union but with greater deformity; Spreading of condyles; osteo-arthritis	00	00.00
Non-union or chronic infection	00	00.00
Total	13	100

Roentgenogram showed near normal in 02 (15.38%) patients, 5 degree angulation or .5 cm displacement in 06 (46.15%) patients and 10 degree angulation or 1.0 cm displacement in 05 (38.46%) of the evaluated patients.

Table-XII: Final result of study

Type of Result	No of Patients	Percentage (%)
Excellent	01	7.69
Good	07	53.85
Fair	03	23.8
Poor	02	15.38
Total	13	100

Acceptable results (Excellent and good) = 61.54%

Unacceptable results (Fair and Poor) = 38.46%

Discussion:

The goal of acceptable treatment of open distal intercondylar fractures include maintaining normal length, alignment, rotation of the extremity, minimizing additional damage to the soft tissues and bone, preserving the remaining circulation and providing a mechanical environment that stimulates periosteal and endosteal responses favourable in bone healing and above all control of infection and soft tissue coverage. A simple plan that does not place the patient in significant risk of infection, allows functional use of the extremity while bone healing occurs can be an acceptable option. But as there is much difference and variation in individual cases of open fractures of distal femur, it is very difficult to manage all the cases by a single treatment method.

So, no single treatment regimen, open or closed, operative or non-operative, is suitable for the treatment of all the distal femoral fracture cases. The goal of the study was to examine the application of the Ilizarov method for treatment of severe open distal femoral fractures not to hail the Ilizarov method as a single answer.

Comparing the various methods of stabilization³ it was noted that cast treatment respect the vascularity of the fracture fragments but doesn't achieve greatest stability and early weight bearing cannot be permitted. In open fractures, there is no place of treatment by cast⁴ as wound care is not possible.

Open fractures treated by plate and screws achieve stability but this is not possible in

extensively comminuted fractures e.g. Gustilo IIIA fractures. It does neither respect vascularity nor does it allow weight bearing⁵. On the other hand recent report suggests high failure rates even when plates are used selectively to stabilize open distal femoral fractures⁶.

Recently, antegrade or retrograde locked intramedullary nailing has become popular. While intramedullary nails have some advantages, such as limited exposure and minimal blood loss, these implants are not suitable for some specific patterns of fracture, especially types C2 and C3 of the AO/ASIF system. The treatment of fractures with severe comminution, an open wound or poor skin is still a major problem⁷.

Traditional external fixation respects the vascularity of fracture fragments and allows early joint movement but early weight bearing is not possible. Problems related to the larger pins are frequently encountered and fixation may provide insufficient mechanical stability⁵. But in Ilizarov frame weight bearing is possible from the 1st and 2nd post operative day. Early weight bearing enhance healing by axial loading⁸. Transosseousosteosynthesis technique involves a non invasive operation without the problems of blood loss and transfusion, while providing stability and allowing weight bearing.

In this study, the age of the patients was between 16-56 years mean average age being 31.15 years. Ramesh LJ et al.⁹ 2004 reported average age was 36 years and Kumar P. et al,¹⁰ 2006 was 37 years.

Total numbers of cases were 13. In the study of Arazi M et al⁷, 2001 total number of cases were 14 and in the study of Ramesh LJ et al⁹, 2004 total number of cases were 13.

Among 13 patients 12 (92.31%) were male and 01 (7.69%) was female. In the study of Ramesh et al⁹, 2004 all 13 patients were male. 69.23% patients were affected on the right side and 30.77% were affected on the left side.

Analysis the mechanism of injury, it was found that all of the patients sustained injury due to

high energy trauma (MVA). Among them 53.46% from motor vehicle accident, 38.46% from motor cycle accident and only 7.69% due to fall from height. Yeap EI et al, 2007¹¹ reported in their study that all of distal femoral fractures were due to high energy trauma – motor vehicle accidents and fall.

In this study, most of the fractures were Muller type C2 (46.15%), followed by type C3 (30.77%) and C1 (23.08%). In the study of Weight & Collinge,¹² 2004 type C were 80% and type A were 20%. In the study of Kregora et al,¹³ 2004 type C fracture were 70% and type A fracture was 30%. In this study Gustilo-I type were 3(23.08%), Gustilo-II and Gustilo-III were 05 (38.46%) each.

In this study, 01 (07.69%) patient had no pain, but intermittent pain in 06 (46.15%) patients, pain with fatigue in 04 (30.77%), restricted function due to pain in 01 (07.69%) patient and constant pain in 01 (07.69%) patient. In the study of Kumar P et al,¹⁰ 2006 50% of the C3 fractures had pain on walking, needed an external support and had pain at rest. They also reported problems with all types of function in all C2 type supracondylar fractures.

In this study, 05 (38.46%) patients developed mild restriction of function, 07 (53.85%) patients restricted function & only 01 (07.69%) developed severe restriction of function. In this study, none of the fractures had malalignment of more than 15° in any plane and none had shortening of more than 3 cm. In the study of Arazim et al⁷, 2001 none of the fracture had malalignment of more than 8° in any plane & none had shortening of more than 2.5 cm.

Regarding range of motion, 02 (15.38%) patients had knee motion 90°, 09 (69.23%) patients had 80°-90° and 02 (15.38%) had 60°-80° of motion, average 75° ± 15°. In the study of Kumar P et al¹⁰, 2006 in C2 type fracture it was 110° ± 10° and 73° ± 36.5° in type C3. Quadricepsplasty was advised to improve knee range of motion, but all patients declined. Radiographic union was achieved by a mean of 19 weeks (range, 16-26 weeks).

Soft tissue healing is one of the most important factors in treatment of open fractures. But with

Ilizarov External Fixator in this study all the wounds healed without any complication. Some tidy wound were closed primarily, in other cases wounds were managed by delayed primary, secondary closure or granulation tissue formation where large area was denuded. Patients who required flap coverage were excluded from the study in the first day as they fall in GIIIB category. The patient with Ilizarov External Fixator was mobilized earlier and encouraged to bear weight. That helped earlier soft tissue healing. Various complications were observed. Muscle wasting 76.92%, angulations 84.61%, rotations 61.54% and deep infection of the tissue 07.69%, leg length discrepancy 84.61%, pin-tract infection 53.85%, wire breakage 30.77% and no neurovascular injury was observed in this study.

After analyzing the final result it was found that 61.54% cases had acceptable results and among them 7.69% was excellent and 53.85% was good and 38.46% had not reached acceptance. Analysis of the results was done on the basis of Neer¹⁴ criteria. This findings were all most similar to the findings of Arazim et al⁷, 2001, which was 64% but that study included closed C3, A3 and only 4 open fractures. In the of Ramesh LJ et al, 2004 it was 76%, but the mean follow-up period was 47 months (range, 26-80 months).

Conclusion: In this study the results of open distal femoral intercondylar fracture treated by transosseousosteosynthesis technique with Ilizarov External Fixator has been found to be satisfactory. Though there were a few minor complications with the fixator the dynamization and compressing ability of this stable frame provided good union without any second surgical procedure or bone grafting and prevented any malunion.

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