

A Study on Functional Outcome of Comminuted Supracondylar Fracture Femur Treated by Plating with Fibular Bone Grafting

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Abstract

Introduction: Distal femur fractures are difficult, complex injuries that can result in devastating outcomes. The intra-articular injury can vary from a simple split to extensive comminution. Articular involvement can lead to posttraumatic arthritis. These fractures constitute 4% to 7% of all femur fractures. There is a bimodal distribution defined by the mechanism of injury. The goal of any treatment is to maintain or restore the congruity of the articular surface and restore the length and alignment of the femur and subsequently the limb.

Materials and methods: A prospective study carried out from February 2015 to February 2016 in government medical college Thiruvananthapuram, involving 24 patients with comminuted supracondylar fracture femur (OTA/AO type A2, A3, C2 and C3) treated by distal femoral LCP with fibular bone grafting. The period of follow up was 12 months and the outcome was assessed using Neer's score.

Results: 24 patients which included 16 males and 8 females with mean age of 45.7 showing a bimodal pattern in age distribution were studied. Mechanism of injury included both road traffic accident and fall in which 14 patients (58.3%) sustained the fracture due to RTA and 10 patients (41.7%) sustained injury due to fall affecting both sides equally. In the study according to AO/OTA classification there were 7 A2, 2 A3, 6 C2 and 9 C3 fractures. The average duration of hospital stay was 10 days with time delay to surgery of average 5 days and average duration of surgery 104 min. 14 patients (58.3%) had more than 100° of knee flexion and 10 patients (41.7%) had less than 100 degree. The minimum flexion obtained was 70° and maximum being 120°. There were 2 patients with varus angulation of 10 and 15° and shortening of 1 and 2 cm each. Complication included 1 case of non-union and 1 case of superficial wound infection which subsided with antibiotics. 3 cases with extensor lag with an average of 6°. Outcome assessment using Neer's score showed 14 patients with excellent, 5 patients with good, 3 patients with fair and 2 patients with poor outcome.

Conclusion: Distal femoral LCP with fibular strut graft appears to be a good treatment option for comminuted supracondylar fracture of femur.

Keywords: Supracondylar; Femur; Distal femoral LCP; Fibular bone graft; Neer's score

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Introduction

Supracondylar area constitutes the distal 9-15 cm of distal femur. Fractures in this region are difficult, complex injuries that can result in devastating outcomes. These fractures are the result of severe axial load with virus, valgus or rotational force [1]. These fractures of distal femur are very difficult to treat. It account for less than 7% of all femur fractures [1].

Supracondylar fractures of femur have a bimodal age distribution, with a high incidence in young adults from high energy trauma, such as motor vehicle accidents and a second peak in elderly with

minor fall [2,3]. They are often unstable and comminuted and tend to occur in elderly or multiply injured patients following road traffic accidents [3]. They may be associated with fractures of femoral neck, shaft, acetabulum, patella, tibia condyle and shaft. Associated ligament injury of knee has been reported in 20% cases [4]. Because of these reasons it is difficult to regain full knee motion and function. Poly trauma associated with the high velocity injuries makes the management extremely challenging. The incidence of malunion, non-union and infection are relatively high in many reported series [3]. It is one of the major challenges to an orthopaedic surgeon to treat this fracture with aim of achieving union and good range of motion at the knee.

Before development of techniques and implant to provide stable fixation, most distal femoral fractures were treated with skeletal traction. Studies done in 1960's by Watson-Jones, Charley, and Neer et al. documented better outcome for patients treated non-operatively than for those treated operatively [5,6]. However, complications of non-operative treatment included angular deformity, joint incongruity, knee stiffness and delayed patient mobilization [7].

In 1970s, the AO (Arbeitsgemeinschaft für Osteosynthesefragen) principles and the use of the angled blade plate revolutionized the treatment of these injuries [8-10]. Over the past years, the implants and techniques have improved. It is now recognized by most orthopaedic surgeons the distal femoral fractures are best treated by open reduction and internal fixation [11-24]. The goals in the treatment are the restoration of bone length, anatomic articular surface alignment and rotation, early mobilization of the associated joints rapid fracture union and minimal complications [25-28]. Although historically the results of operative techniques using internal fixation methods have presented with satisfactory results, the number of cases of non-union, loss of reduction and implant failure have been high [29-32].

Distal femoral LCP was developed by AO/ASIF in the late 1990s [33,34]. It is an implant system which can be used in the management of complex distal femoral fractures, primarily AO 33 A1-C3 fracture types [35]. It is a pre-contoured plate which approximates the anatomy of the lateral distal femur 33 and can be inserted through a minimally invasive lateral incision from distal to proximal into the endoperiosteal space after indirect, closed fracture reduction [36]. The plate is then stabilized to the lateral aspect of the distal femur and proximally with locking screws through stab incisions [36]. The benefits of the distal femoral LCP over condylar buttress plates or dynamic condylar screws as reduced blood loss, lower infection rates and an ability to bridge the supracondylar fracture region as an internal fixator, without extensive dissection of bone fragment and associated periosteal stripping required for conventional plate fixation [37-44].

Bone grafting rates in the treatment of supracondylar femur fractures have been reported to range between 23% and 87% [45]. The use of a fibula to bridge the defects in long bones, especially in the management of bone tumours, has achieved variable success [46] to avoid common problems such as varus collapse and loss of fixation. The use of a fibular strut and corticocancellous graft helped to bridge the fragments with severe comminution, maintain limb length and counteract the relatively unstable distal femoral block from varus/valgus collapse. Immediate replantation and adequate fixation of the fibular graft to the proximal and distal ends of the bone to be grafted, along with placement of a cuff of cancellous bone at the host-graft junction and around the fibular strut, fostered early union of the graft to the host bone. The main disadvantage of this procedure may be the sequestration of the non-vascularised, autogenously fibular graft. Soft tissue preservation could also be important in achieving mechanical stability [47,48].

Materials and Methods

Functional outcome of comminuted supracondylar fracture femur treated by distal femoral LCP plating with fibular grafting

Study setting: Department of orthopaedics, Govt. Medical College, Thiruvananthapuram.

Study period: One year (February 2015-February 2016).

Study population: Patients with comminuted supracondylar fracture of femur admitted in Dr.Suresh Babu, Department of orthopaedics, Govt Medical College, Thiruvananthapuram

Period of follow-up: One year.

Statistical analysis: SPSS.

Data collection: Data collection is by clinical examination and interview method.

The study was a prospective study involving 24 patients with comminuted supracondylar fracture of femur from February 2015 to February 2016 treated by distal femoral LCP with fibular bone grafting.

All the cases were treated initially with emergency care as per ATLS principle in emergency room itself and then once the patient is stabilized, investigated pre-operatively. A case documentation form was used for data including age, gender, mechanism of injury, type of injury, side of injury and associated injuries.

All the study regarding my thesis was done at this institution only. All cases were operated at this institution only and being conducted by teachers and assisted by me. All data were collected by me and being showed and checked by my guide.

Inclusion criteria: Patients with age more than 18 sustaining comminuted supracondylar fracture femur.

Exclusion criteria:

- Pathological fracture
- Periprosthetic fracture
- Existing deformity of same limb
- Open fracture
- Polytrauma patients

Sample size:

Formula for calculating sample size $N = \frac{Z_1^2 \cdot \frac{\alpha}{2} \cdot \rho(1-\rho)}{\delta^2}$

Where, p: Expected proportion; δ : Relative precision; $\frac{\alpha}{2}$: Desired Confidence level=(95%).

According to similar study "Treatment of Supracondylar Fracture of Distal Femur with Condylar Locking Compression Plating, Tapi Nalo 1, Amit Agrahari 2, Snehasish Datta 3, Vinil Paul 4, S. Nongthon Singh 5, Roel Langshong 6" Excellent functional outcome was 83.3%. Expected proportionial dd=83.3%. Here, p=83.3%; δ : Relative precision (20% of p); 1-a/2: Desired Confidence level=(95%); N=19. In our study, we got the follow up of 24 patients.

Management of patient: On arrival of the patient in the emergency room, initial emergency management is carried out by maintaining airway, breathing and circulation. Thorough assessment of the patient is then done to rule out head, chest, spinal or pelvic injury. Musculoskeletal examination is done to look for associated fractures. Stabilization of the patient with intravenous fluids, oxygen and blood transfusion as required. The distal neurovascular status is carefully assessed. Then the fractured extremity is immobilised in a Thomas splint and sent for radiological examination. For open fractures thorough irrigation and lavage, debridement, intravenous antibiotics and delayed wound closure is done. Lower tibia skeletal traction is applied using a Steinmann pin or Denham pin under local anaesthesia followed by continuous traction is given using Bohler Braun splint in ward.

Pre-operative assessment: On admission relevant investigations for surgical workup are done in all patients which include hemogram, blood sugar level, renal function test, liver function test, blood grouping, Rh typing, bleeding time, clotting time, retroviral screening, hepatitis B antigen assay, hepatitis C antigen assay. Medical disorders are optimized before surgery (**Figure 1**).

Fracture is classified according to the AO classification with the help of radiographs. Preoperative planning is done to assess the size of plate and screws to be used.

The limb to be operated is prepared. Third generation cephalosporin given early morning on the day of surgery.

Surgical procedure: Anaesthesia-spinal, epidural or general anaesthesia.

Patient positioned supine on the operating table with a pillow below the knee to flex the knee. A pneumatic tourniquet is applied in the upper thigh. Tibial pin is then removed, the limb is scrubbed with povidone iodine. Ipsilateral iliac crest and contralateral leg is also prepared.

Lateral standard approach is mostly used. A lateral incision parallel to the shaft of femur, extending across the midpoint of lateral femoral condyle, anterior to fibular collateral ligament, across the knee and gently curved anteriorly to end distal and lateral to tibial tubercle. The Vastus lateralis is elevated from the lateral intermuscular septum and retracted anteriorly and medially exposing the distal femur (**Figure 2**).

The condyles are reduced and stabilised temporarily by k wires and fixed with cancellous screws. Fibular strut graft is harvested from the ipsilateral side and inserted in the medullary cavity of the proximal femur and into the distal femur maintaining axial and coronal alignment. Supracondylar part is reduced and distal femoral LCP placed. Cancellous bone graft from the iliac crest is placed to fill the gap. Wound is closed in layers after attaining haemostasis over suction drain.

Postoperative period: Vitals of the patients are monitored. Blood transfusion was given if postoperative haemoglobin is below 9 g/dl. Intravenous antibiotics are continued in the postoperative period for 5 days and oral antibiotics till suture removal. Analgesics

are given as per patient's compliance. Sutures removal done on the 14th postoperative day (**Figures 3 and 4**).

Discharge: Patients are discharged once the surgical wound is healed and the general condition is stable.

Follow up: All patients are followed up at 2 weeks, 6 weeks, 2 months, 3 months, 6 months and 1 year. At every visit patient is assessed both clinically and using radiographs (**Table 1**).



Figure 1 Radiographs preoperative radiographs.



Figure 2 Intraoperative pictures: Approach and fibular graft harvesting.

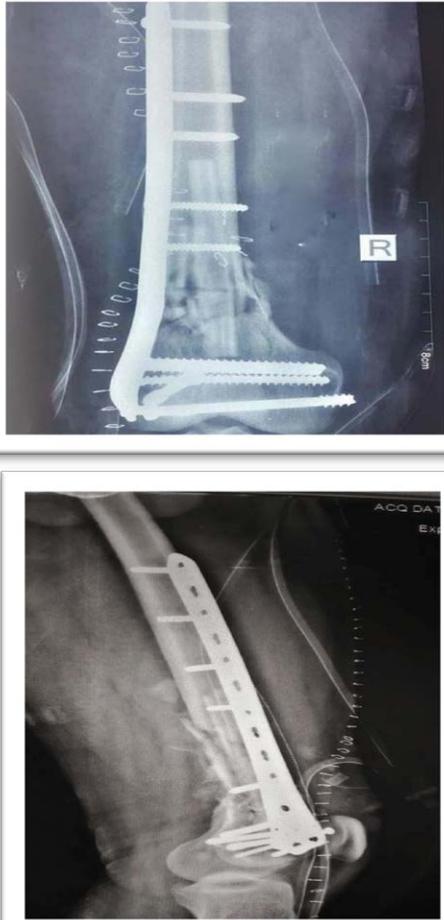


Figure 3 Post-operative radiographs.

In our study among comminuted (Table 6) supracondylar fracture 9(37.5%) were extra-articular fractures and 15 (72.5%) were intra-articular (Chart 5).

The average duration of (Table 7) hospital stay is 10 days (Chart 6).

Table 1: Neer's criteria.

Functional [70 points]	
A) Pain [20 points]	
No pain	20
intermittent	16
with fatigue	12
limits function	8
constant or at exertion	4
B) Walking capacity [20 points]	
Same as before accident	20
Mild restriction	16
Restriction stair sideways	12
Severe/cane	8
Crutches/brace	4
C) Movements-Flexion [20 points]	
Normal or 135	20
Upto 100°	16
Upto 80°	12
Upto 60"	8
Upto 40°	4
Upto 20°	0
D) Work capacity [10 points]	
As before	10
Regular with handicap	8
Alter work	6
Light work	
No work	2



Figure 4 Neers score is used to assess the functional outcome.

Table 2: Age distribution.

Age in years	Frequency	Percent
20-29	8	33.3
30-39	4	16.7
40-49	2	8.3
50-59	4	16.7
More than 60	6	25

Results and Analysis

In our study, incidence of fracture is (Table 2) high in young patients and elderly (Chart 1).

In the study of 24 patients, 16 (66.7%) are (Table 3) males and 8(33.3%) are females (Chart 2).

In the study, both (Table 4) sides affected equally (Chart 3).

In the study, 14(58.3%) patients sustained fracture due (Table 5) to RTA and 10(41.7%) patients by fall. Of this RTA majority were below the age of 30 and among those fall majority were elderly (Chart 4).

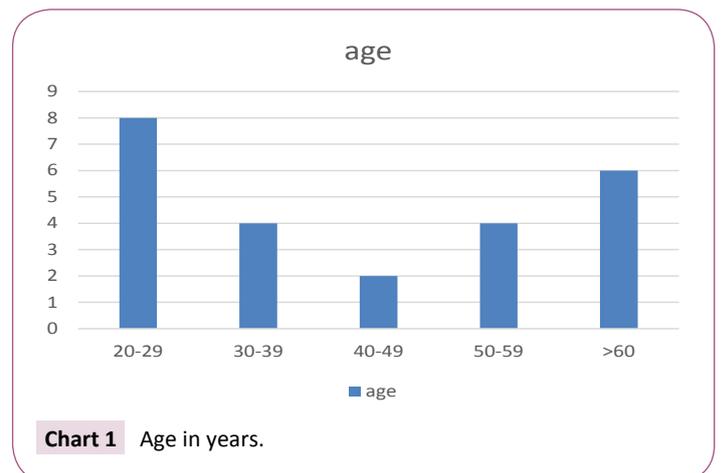


Chart 1 Age in years.

Table 3: Gender distribution.

Sex	Frequency	Percent
Female	8	33.3
Male	16	66.7
Total	24	100.0

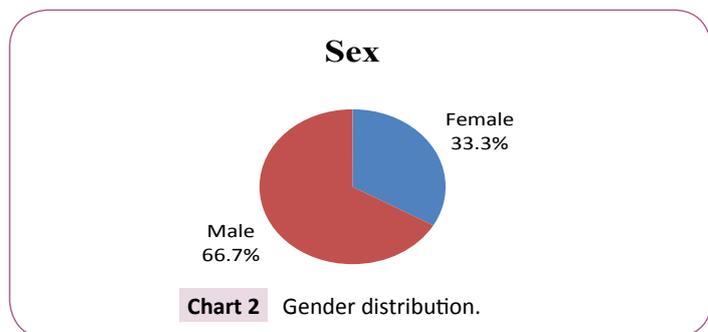


Table 4: Side distribution.

Side	Frequency	Percent
Left	12	50.0
Right	12	50.0
Total	24	100.0

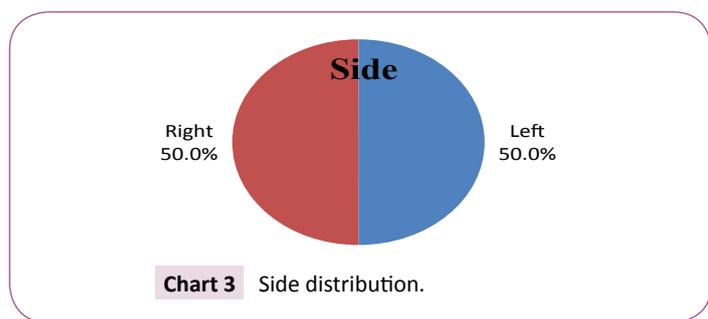
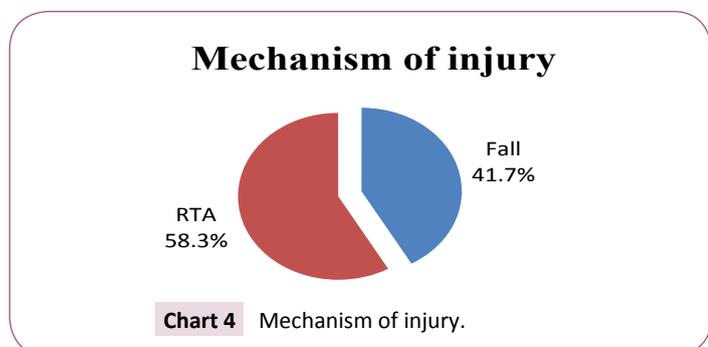


Table 5: Mechanism of injury.

Mechanism of injury	Frequency	Percent
Fall	10	41.7
RTA	14	58.3
Total	24	100.0



The average time delay between (Table 8) admission and surgery is 5 days (Chart 7).

The average duration (Table 9) of surgery is 104 min (Chart 8).

14 patients (58.3%) had more than 100° (Table 10) of knee flexion and 10 patients (41.7%) had less than 100 degree. The minimum

flexion obtained was 70° and maximum being 120° (Chart 9).

There was one case of non-union and one case of superficial (Table 11) wound infection which subsided by intravenous antibiotic treatment (Chart 10).

Table 6: AO classification.

AO classification	Frequency	Percent
A2	7	29.2
A3	2	8.3
C2	6	25.0
C3	9	37.5
Total	24	100.0

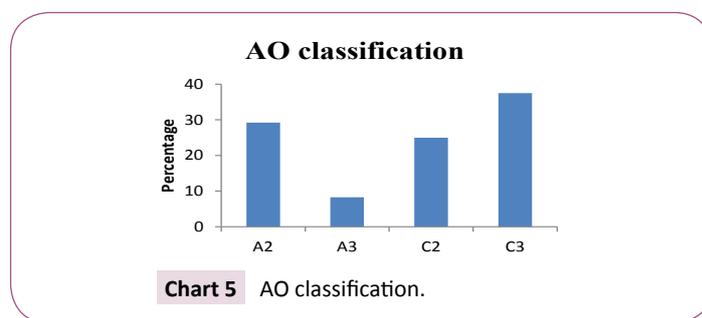


Chart 7: Time delay to surgery.

Hospital stay	Frequency	Percent
<10 days	10	41.7
≥10 days	14	58.3
Total	24	100.0

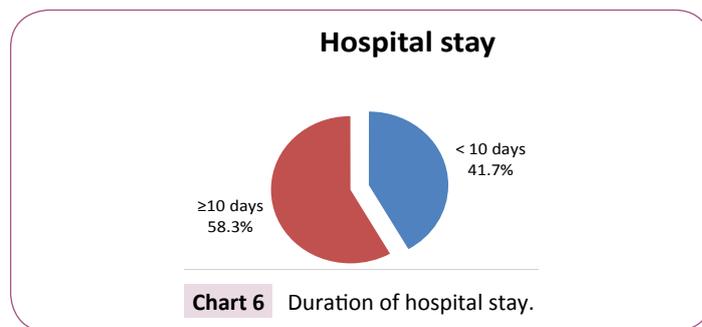


Table 8: Time delay to surgery.

Time delay	Frequency	Percent
<7 days	19	79.2
≥7 days	5	20.8
Total	24	100.0

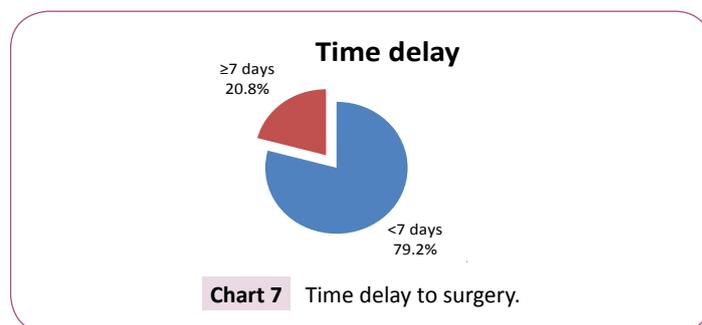
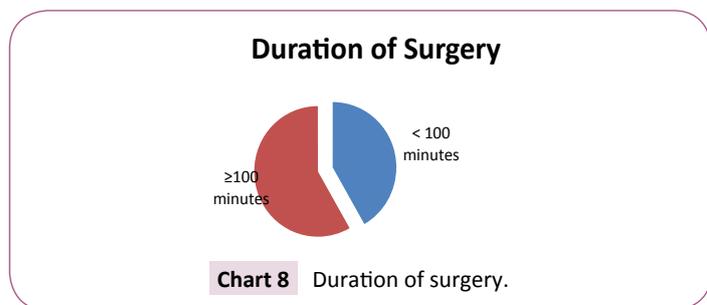


Table 9: Duration of surgery.

Duration of Surgery	Frequency	Percent
<100 min	5	20.8
≥100 min	19	79.2
Total	24	100.0



In patients with age less than 40 years, 10 patients sustained fracture due to RTA and 2 patients sustained injury due to fall and in patients with age more than 40 years only 5 patients sustained fracture due to RTA and 7 patients sustained fracture due to fall (**Table 19**).

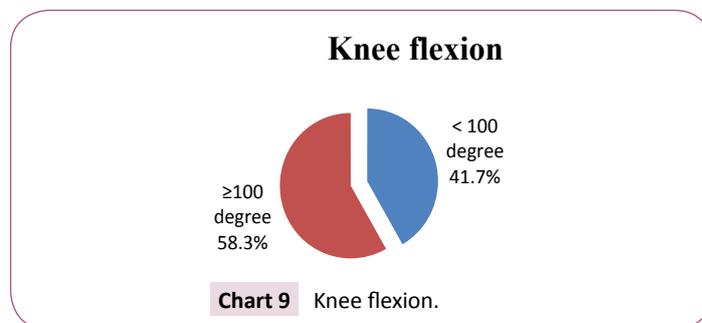


Table 10: Knee flexion.

Knee flexion	Frequency	Percent
<100°	10	41.7
≥100°	14	58.3
Total	24	100.0

In the study 2 patient had varus angulation among them one had 10° of angulation and other had 15° of angulation (**Chart 11**).

In the study 2 patients had shortening among (**Tables 12 and 13**) them one had 1 cm shortening and the other had 2 cm shortening (**Chart 12**).

In the study 14(58.4%) had excellent functional (**Table 14**) outcome, 5(20.8%) had good functional outcome, 3(12.5%) had fair functional outcome and 2 patients (8.35%) had poor outcome (**Chart 13**).

The functional outcome of 11(91.7%) patients out of 12 patients with age less than 40 years is excellent to good and only 1(8.3%) patient had unsatisfactory to poor outcome, similarly out of 12 patients with age more than 40 years 8(66.7%) patients had excellent or good outcome and 4(33.3%) had unsatisfactory or poor outcome (**Table 15**).

Out of 14 patients who sustained fracture due to RTA, 12(85.7%) had excellent or functional outcome and 2(14.3%) had unsatisfactory or poor outcome while out of 10 patients sustained injury due to fall 7(70%) had excellent to good functional outcome and 3(30%) had unsatisfactory to poor outcome (**Table 16**).

Out of 16 males who were treated 14(87.5%) had excellent to good outcome and 2(12.5%) had unsatisfactory to poor outcome and out of 8 females who underwent surgery 5(62.5%) had excellent to good outcome and 3(37.5%) had unsatisfactory to poor outcome (**Table 17**).

Out of 9 extra-articular fractures, 7 (77.8%) had excellent to good outcome and 2 (22.2%) had unsatisfactory to poor outcome and out of 15 intra-articular fractures 12 (80%) had excellent to good outcome and 3 (20%) had unsatisfactory to poor outcome (**Table 18**).

Table 11: Complications.

complication	Frequency	Percent
Infection	1	4.2
Non union	1	4.2
Nil	22	91.7
Total	24	100.0

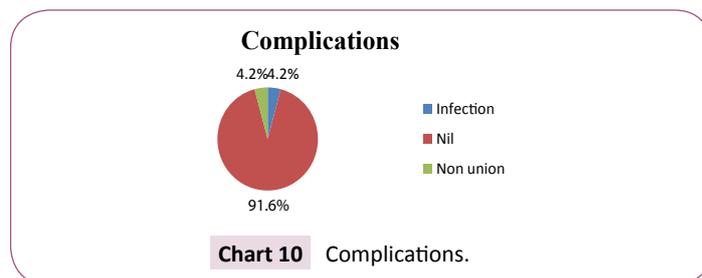


Table 12: Varus angulation.

Varus angulation	Frequency	Percent
10°	1	4.2
15°	1	4.2
Nil	22	91.7
Total	24	100.0

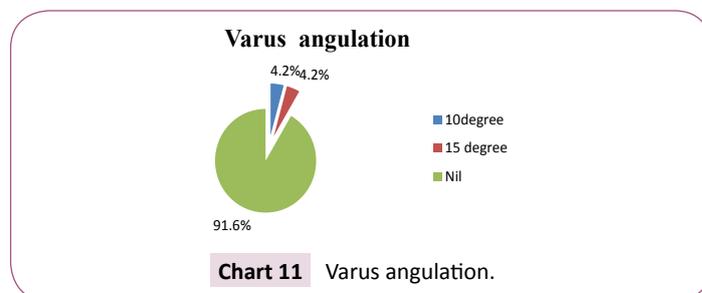


Table 13: Shortening.

Shortening	Frequency	Percent
Nil	22	91.6
1 cm	1	4.2
2 cm	1	4.2
Total	24	100.0

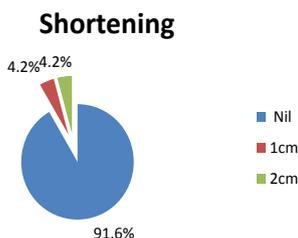


Chart 12 Shortening.

Table 14: Functional outcome as measured by Neers score.

Functional outcome	Frequency	Percent
Excellent	14	58.4
Good	5	20.8
Fair	3	12.5
Poor	2	8.3
Total	24	100.0

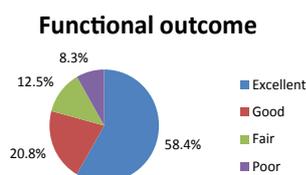


Chart 13 Functional outcome as measured by Neer's score.

Table 15: Comparison of age and functional outcome.

Age	Functional outcome		Total
	Excellent- good	Unsatisfactory-poor	
Less than 40 years	11	1	12
more than or equal to 40 years	8	4	12
Total	19	5	24

Odds ratio-5.5 and p value-0.317

Table 16: Comparison of mechanism of injury and functional outcome.

Mechanism of injury	functional outcome		Total
	Excellent- good	Unsatisfactory- poor	
RTA	12	2	14
Fall	7	3	10
Total	19	5	24

Odds ratio-2.5 and p value-0.615

Table 17: Comparison of sex and functional outcome.

Sex	Functional outcome		Total
	Excellent- good	Unsatisfactory-poor	
Male	14	2	16
Female	5	3	8
Total	19	5	24

Odds ratio-4.2 p value-0.289

Among (Table 20) males 12 patients sustained injury due to RTA and 4 patients sustained injury due to fall, among females 2 patients sustained injury due to RTA and 6 patients sustained injury due to fall.

Extension lag: In our study there were 3 cases with extensor lag the average being 6°.

Fracture union: Fracture union is defined as the ability of the patient to fully weight-bear without discomfort in the presence of radiological bridging callus on three cortices, assessed on standard AP and lateral radiographs. The time taken for union in our study ranges from 14 weeks to 19 weeks with a mean of 13.5 weeks.

Discussion

Comminuted supracondylar fractures of femur historically have been difficult to treat. Problems such as varus collapse, malunion and nonunion frequently resulted before fixed angle plates and indirect reduction techniques were popularized. In our study an attempt is made to assess the functional outcome of comminuted supracondylar fracture of femur treated by distal femoral locking plate with fibular bone grafting. The study was conducted on 24 patients with comminuted supracondylar fracture admitted in department of Orthopaedics, Govt Medical College, Thiruvananthapuram

Age distribution

In our study age distribution show a bimodal pattern, 8 patients (33.3%) with age less than 30 years and 6 patients (25%) with age more than 60 sustained the fracture and 10 patients (41.7%) sustained fracture in the intermediate group.

In the study by Schatzker et al. [2] also showed a bimodal distribution with 25% of patients in the second and third decade and more than 60% of patients above 60 years.

Average age group in other studies

1. Tapi nalo et al. 59–The maximum age of the patient in the present study was 70 years and minimum being 18 years, with mean age of 27.50 years.

Table 18: Comparison of type of fracture and functional outcome.

Type of fractures	Functional outcome		Total
	Excellent- good	Unsatisfactory-poor	
Extra-articular fractures	7	2	9
Intra-articular fractures	12	3	15
Total	19	5	24

p value-0.897

Table 19: Comparison of age and mechanism of injury.

Age	Mechanism of injury		Total
	RTA	Fall	
Less than 40	10	2	14
More than 40	5	7	12
Total	15	9	24

Table 20: Comparison of sex and mechanism of injury.

Sex	Mechanism of injury		Total
	RTA	fall	
Men	12	4	16
Female	2	6	8
Total	14	10	24

- EJ Yeap et al. 60–The patient's ages ranged from 15 to 85 with a mean of 44.
- Srinath et al. 61–The median age was 47 years ranging from 28-70 years.
- Wong et al. 62–The mean age was 75 years with a range from 62 -101 years.
- Schütz et al. 63–The mean age is 52 years.

Bimodal distribution is due to high incidence of this fracture in young adults due to high energy injury and secondary peak in elderly osteoporotic people.

Gender distribution

In the study of 24 patients, 16 (66.7%) are males and 8(33.3%) are females. In comparison with other studies:

- Tapi nalo et al. 59–out of 30 patients, 23 were males and 7 were females
- Srinath et al. 61–out of 20 patients, 13 patients were females and 7 patients were females
- Wong et al. 62–among 16 patients, there was only 1 male and 15 were females.

Side distribution

In the study, both sides affected equally. Other studies:

- EJ Yeap et al. 60–Seven fractures involved the right side and four involved the left.
- Srinath et al. 61–12 patients were with fracture on right side and 8 on left side.

Mechanism of injury

In the study, 14 (58.3%) patients sustained fracture due to RTA and 10 (41.7%) patients by fall. Of this RTA majority were below the age of 30 and among those fall majority were elderly.

As compared to other studies

- EJ Yeap et al. 60–The causes of fractures was motor vehicle accident in seven patients and a fall in four patients. There were no sports or industrial accidents. One patient sustained multiple fractures including lung injury which required ventilation.
- Srinath et al. 61–15 of the fractures was caused by road traffic accidents and 3 were due to fall, 2 were due to assault.
- Wong et al. 62–majority of patients had low-energy trauma with 15 patients having falls on level ground. One patient was knocked down by a vehicle in a road traffic accident and 13 patients had isolated injuries while three had multiple fractures.
- Weight et al. 64–26 patients with 27 high-energy fractures of the distal femur. Mechanism of injury included 12 motor vehicle collisions, 4 high falls, 5 motorcycle crashes, and 1 bicyclist struck by a car.

Preoperative radiological classification

In our study among comminuted supracondylar fracture 9(37.5%) were extra-articular fractures and 15(72.5%) were intra-articular: AO/OTA types.

Extra articular fractures

A2-7 cases and A3-2 cases.

Intra articular fractures

C2-6 cases and C3-9 cases.

Other studies:

- Yeap et al. 60–According to the AO classification system, there were four Type A1, two Type A3, one Type C1, one Type C2 and three Type C3 fractures.
- Srinath et al. 61–Of the 20 fractures two were type A1, two were type A2, three were type C1, nine were type C2 and four were type C3.
- Wong et al. 62–eight patients had type A, three type B and five type C fractures.
- Weight et al. 64–There was 4 A2, 3 A3, 12 C2, and 3 C3 fractures.
- Apostolou 65–One type 41A, two type 41B, six type 41C, four type 33A and four type 33C.

Hospital stay

In our study the average duration of hospital stay is 10 days.

Comparing with other studies:

- Nalo et al. 59–The mean duration of hospitalisation for all patients was 18.77 days (range, 14-29 days).
- Yeap et al. 60–The average length of hospitalisation was 17.2 days with a range of 8 to 34 days.

Time delay

In our study, the average time delay between admission and surgery is 5 days when compared with other studies:

- Nalo et al. 59–The mean time to operation for closed fracture was 8.96 ± 3.2 days (7-14) days and mean time to operation for open fracture was 11.20 ± 3.88 days (7-14) days.
- Yeap et al. 60–The average number of days from injury to surgery was 9.9 days with a range of 4 to 19 days.
- Srinath et al. 61–All the surgeries were done within 3 days after admission.
- Wong et al. 62–All patients were treated surgically within one week of the injury.

Duration of surgery

In our study the average duration of surgery is 104 min, as compared to other studies:

1. EJ Yeap et al. 60—The operative time ranged from 80 to 180 min, with an average of 119.2 min.
2. Srinath et al. 61—Average time duration of surgery was 101 min with shortest duration being 80 min and longest being 130 min. Type C3 fractures accounting for longest surgical time.
3. Schütz et al. 63—The mean duration of surgery was 85 min (range 40-135 min) for 33A fractures and 149 min (range 50-300 min) for 33C fractures.

Knee flexion

In our study, 14 patients (58.3%) had more than 100° of knee flexion and 10 patients (41.7%) had less than 100 degree. The minimum flexion obtained was 70° and maximum being 120°. On comparison:

1. EJ Yeap et al. 60—Mean extension was 1° (range 0° to 5°), with mean flexion 107.7° (range 40° to 140°). Mean range of motion was from 1° to 107.7°.
2. Srinath et al. 61—Average knee flexion was from neutral to 104° with more than 60% patients having knee range of motion from neutral to 110 degree.
3. Wong et al. 62—Concerning the range of motion, six patients had full, nine had slightly limited and one had severely limited range of knee motion.
4. Schütz et al. 63—After fracture healing, maximum flexion of the injured limb was on average 80% of the range of the uninjured limb.
5. Weight et al. 64—The average knee range of motion was 5° to 114°.

Fracture union

The time taken for union in our study ranges from 14 weeks to 19 weeks with a mean of 13.5 weeks.

1. Tapi Nalo et al. 59—Clinical union was seen at a mean time of 14.47 weeks (range, 9-32 weeks). Radiologically, bridging callus was seen at 12-16 post-operative weeks and the mean time to complete radiological union was 26.47 weeks (range, 20-40 weeks).
2. EJ Yeap et al. 60—Average time to union was 18 weeks with a range from 6 weeks to 36 weeks.
3. Srinath, et al. 61—Of 20 patients, 14 Patients (70%) showed radiological union within 18 weeks. Remaining united by 28 weeks. None had implant failure or non-union.
4. Wong et al. 62—Union was defined radio graphically as presence of bony trabecular across the fracture site. All fractures united with an average union time of 30 (16-68) weeks.
5. Weight et al. 64—All fractures healed without secondary surgeries at a mean of 13 weeks (range 7-16 weeks).
6. Apostolou et al. 65—Bony union was achieved on average in 12.5 weeks.

7. Ramesh et al. 66—Union was achieved in all cases by an average time of 19 weeks.

Complications

There was one case of non-union and one case of superficial wound infection in our study which subsided by intravenous antibiotic treatment.

Complications in similar studies

1. Tapi Nalo et al. 59—There were no intra-operative and immediate post-operative complications. Two case of superficial infection was managed by antibiotics and local wound dressing.
2. Yeap et al. 60—Complications included one implant fracture which required revision to another DF-LCP. There was one mal-alignment of the lower limb. One plate was cutting out due to poor fixation. There were no non-unions, deep infections or removal of implants due to ilia-tibial tract pain.
3. Srinath et al. 61—2 patients had signs of early post-operative infection which settled with debridement and intravenous antibiotics.
4. Wong et al. 62—There was no infection. However, there were two cases with failure of fixation, which occurred early in our series. Both were loosening of the proximal fixation of LISS.
5. Weight et al. 64—There were no cases of failed fixation, implant breakage, or infection. 1 mal-union where the fracture was fixed in 8° of valgus and 2 cases of external rotation between 10° and 15°. Painful hardware occurred in 4 patients.
6. Schütz et al. 63—deep infection requiring several debridement's occurred in 2 patients.

Varus angulation and shortening

In the study 2 patient had varus angulation among them one had 10° of angulation and other had 15° of angulation and 2 patients had shortening among them one had 1 cm shortening and the other had 2 cm shortening. In similar studies:

1. Yeap et al. 60—There was varus angulation of 10°, internal rotation of 5°, and limb length discrepancy of 2 centimetres.
2. Srinath et al. 61—Out of 20 patients nine had shortening; 8 patients with shortening of 2 cm and 1 patient with shortening of 3 cm. Patient with 3 cm shortening was managed with heel raise. One patient had 15° varus misalignment, which was in our initial part of study.
3. Schütz et al. 63—Assessment of valgus/varus alignment showed a deviation of 5-10° in 13 cases, and a 10-20° deviation in 1 case.
4. Weight et al. 64—A comparison of postoperative to healed final radiographs for each femur demonstrated no case with greater than a 3° difference in either varus or valgus.

Extensor deficit

In our study there were 3 cases with extensor lag the average being 6°.

Srinath et al. 61—Average knee extensor lag was 5°.

Schütz et al. 63—An extension deficit of more than 5° was measured in 3 cases.

Functional outcome

In the study 14(58.4%) had excellent functional outcome, 5(20.8%) had good functional outcome, 3(12.5%) had fair functional outcome and 2 patients (8.35%) had poor outcome, as compared to:

1. Tapi Nalo et al. 59—Based on Neer's scoring system the final outcome for all cases was Excellent in 25 (83.33%), good in 3 (13.33%) and fair in 1 (3.33%) patients.
2. Yeap et al. 60—Using the Schatzker scoring system, there were four excellent results, four good, two fair and one failure.
3. Srinath et al. 61—According to NEER'S Score 13 patients (65%) showed excellent result. 3 Patients (15%) showed good outcome, 4 patient (20%) showed fair outcome and none showed poor outcome.

Comparison of age and functional outcome

The functional outcome of 11(91.7%) patients out of 12 patients with age less than 40 years is excellent to good and only 1(8.3%) patient had unsatisfactory to poor outcome, similarly out of 12 patients with age more than 40 years 8(66.7%) patients had excellent or good outcome and 4(33.3%) had unsatisfactory or poor outcome.

Comparison of mechanism of injury and functional outcome

Out of 14 patients who sustained fracture due to RTA, 12(85.7%) had excellent or functional outcome and 2(14.3%) had unsatisfactory or poor outcome while out of 10 patients sustained injury due to fall 7(70%) had excellent to good functional outcome and 3(30%) had unsatisfactory to poor outcome.

Comparison of sex and functional outcome

Out of 16 males who were treated 14(87.5%) had excellent to good outcome and 2(12.5%) had unsatisfactory to poor outcome and out of 8 females who underwent surgery 5(62.5%) had excellent to good outcome and 3(37.5%) had unsatisfactory to poor outcome.

Comparison of type of fracture and functional outcome

Out of 9 extra-articular fractures, 7 (77.8%) had excellent to good outcome and 2 (22.2%) had unsatisfactory to poor outcome and out of 15 intra-articular fractures 12 (80%) had excellent to good outcome and 3 (20%) had unsatisfactory to poor outcome.

Comparison of age and mechanism of injury

In patients with age less than 40 years, 10 patients sustained fracture due to RTA and 2 patients sustained injury due to fall and

in patients with age more than 40 years only 5 patients sustained fracture due to RTA and 7 patients sustained fracture due to fall.

Comparison of sex and mechanism of injury

Among males 12 patients sustained injury due to RTA and 4 patients sustained injury due to fall, among females 2 patients sustained injury due to RTA and 6 patients sustained injury due to fall [49-62].

Conclusion

In our study age distribution show a bimodal pattern, 8 patients (33.3%) with age less than 30 years and 6 patients (25%) with age more than 60 sustained the fracture and 10 patients (41.7%) sustained fracture in the intermediate group.

In our study the mechanism of injury included road traffic accident and fall. 14 patients (58.3%) sustained the fracture due to RTA and 10 patients (41.7%) sustained injury due to fall.

In our study 16 (66.7%) are males and 8(33.3%) are females, Among males 12 patients (75%) sustained injury due to RTA and 4 (25%) patients sustained injury due to fall, among females 2 patients (25%) sustained injury due to RTA and 6 patients (75%) sustained injury due to fall

In our study among comminuted supracondylar fracture 9(37.5%) were extra-articular fractures and 15(72.5%) were intra-articular.

14 patients (58.3%) had more than 100° of knee flexion and 10 patients (41.7%) had less than 100°. The minimum flexion obtained was 70° and maximum being 120°. Average being 100°.

The average duration of hospital stay is 10 days. The average time delay between admission and surgery is 5 days. The average duration of surgery is 104 min.

Excellent to good functional outcome as assessed by Neer's score is obtained in 19 patients (79.1%) and fair to poor outcome was obtained in 5 patients (20.8%).

The functional outcome of 11(91.7%) patients out of 12 patients with age less than 40 years is excellent to good and only 1(8.3%) patient had unsatisfactory to poor outcome, similarly out of 12 patients with age more than 40 years 8(66.7%) patients had excellent or good outcome and 4(33.3%) had unsatisfactory or poor outcome.

Out of 16 males who were treated 14(87.5%) had excellent to good outcome and 2(12.5%) had unsatisfactory to poor outcome and out of 8 females who underwent surgery 5(62.5%) had excellent to good outcome and 3(37.5%) had unsatisfactory to poor outcome.

Out of 9 extra-articular fractures, 7 (77.8%) had excellent to good outcome and 2 (22.2%) had unsatisfactory to poor outcome and out of 15 intra-articular fractures 12 (80%) had excellent to good outcome and 3 (20%) had unsatisfactory to poor outcome.

There was one case of non-union and one case of superficial wound infection which subsided by intravenous antibiotic treatment.

In the study 2 patient had varus angulation among them one had 10° of angulation and other had 15° of angulation.

In the study 2 patients had shortening among them one had 1 cm shortening and the other had 2 cm shortening?

In the study there were 3 cases with extensor lag with average being 6°.

Distal femoral LCP is a good implant in fixation of comminuted supracondylar fracture of femur. When augmented with fibular strut grafting it prevented varus collapse in majority of cases in the study population.

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