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A study of outcome in comminuted supracondylar femur fracture with bone loss treated with locking compression plating and fibular bone grafting

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ABSTRACT

Background: Comminuted fractures of supra-condylar femur are rare, difficult to manage and challenging injuries usually associated with extensive soft tissue damage and bone loss. Due to large number of challenges presented, results are usually variable. *Materials and methods*: 33 patients of comminuted supra-condylar femur fracture coming to emergency department of Acharya Vinba Bhave Rural Hospital Sawangi (Meghe) Wardha who met the inclusion criteria and operated with open reduction internal fixation with plating and autologous fibula strut grafting between duration of January 2018 to June 2019 were included in the study. The study was a prospective interventional study. *Observations and results*: The mean age of all the patients in the study was 43.745 years. Out of 33 patients in our study 27 were males and 6 were females. In our study, out of 33 patients, in 25 patients fracture was as a result of road traffic accident while in 8 patients it was due to fall from height. All the patients in our study had associated injuries. Out of 33 fractures, 7 were Type 33A2, 12 were A3, 9 C2 and 5 C3. Out of 33, 14 fractures had intra-articular extention. Also out of 33, 13 fractures were open fractures. Out of 13 fractures, 3 fractures were Type II, 4 IIIa and 6 IIIb according to Gustillo Anderson Classification. In our study, the average duration between injury and 1st intervention was 4.5 days with maximum patients (75%) getting operated within 2 days of arrival to the hospital. Out of 13 fractures, 10 were treated in 2 staged procedures, temporary stabilization followed by permanent stabilization. Average duration between 2 procedures was 2.5 months. All the 33 patients were operated under Spinal or epiural anaesthesia. Average time required for surgery was 104 minutes. The mean duration of union was 4.8 months. All fractures united. At final follow up, functional assessment with Neer's score was done which showed 17 had excellent results, 9 good, 6 fair and 1 patient had poor result. *Conclusion*: In conclusion, severely comminuted supracondylar fracture of the femur with significant bone loss can be effectively managed with distal femur locking compression plate and autologous fibula strut graft and cortico-cancellous bone graft from iliac crest. Harvesting and usage of fibula strut graft and iliac crest graft as mentioned in our study is relatively easy and cost effective and doesn't require micro-vascular expertise.

Keywords: Comminuted supracondylar femur fracture, fibular grafting, bone gap

1. INTRODUCTION

Supra-condylar region of the femur is comprised of the area of the femur which extends approximately 9 to 14 cm proximal to the distal articulating surface of the femur. Fractures in this region are generally very difficult to treat, complex due to associated extensive soft tissue injuries , extension into the inter-condylar region, associated other bone fractures like pelvis, tibia, neck of femur etc. and bone loss (encountered in open/compound fractures) and usually the outcomes of such injuries are not very desirable. The fractures in this region are usually a result of severe axial loading or rotational force which is applied to the femur most commonly due to high velocity road traffic accidents (Schatzker et al., 1974). Supra-condylar femur fractures account for approximately 7% of all the femur fractures. But due to increase in the usage of motor vehicles for transport, the incidence of supra-condylar fractures as a result of high velocity road traffic accident is on a rise. Also the incidence of the complications associated with the injuries is on a rise (Reddy and Dhaniwala, 2019). There are 2 peaks in the distribution of age of supra-condylar fractures, one peak is noted in young adults (associated with high velocity road traffic accidents) while other peak is seen in elderly (associated with domestic trivial trauma) (Walling et al., 1982). Supra-condylar femur fractures associated with high velocity road traffic accidents are usually associated with fractures of neck of femur, shaft of femur, acetabulum or pelvic fractures, fractures of patella, tibial condyles and shaft of tibia. Also these fractures are associated with extensive soft tissue injuries like injuries to ligaments of the knee, injuries to the surrounding muscles etc. (Neer et al., 1967). Compound supra-condylar fractures in particular, present with some additional challenges like extensive bone loss, loss of soft tissue coating and these fractures produce very unfavorable conditions for fracture union. As the long list of challenges a surgeon has to face while treating such injuries, the functional outcomes are usually not satisfactory. Main goals of treatment are directed towards achieving proper union, obtaining adequate function of the knee and avoiding infection is cases of open fractures. These fractures are associated with high rates of malunion, nonunion and infection. Management of these fractures is extremely challenging (Stewart et al., 1966).

During early period, these fractures were treated by immobilization with skeletal traction only. But there were large number of complications associate with this modality of treatment like mal-union, incomplete reduction of articular surface, knee stiffness and delayed union thus delayed mobilization of the patient post-operatively thus owing to complications such as bed sore, chest infections associated with bed ridden patients. But with advancements in the technology, over the past few years the instruments and implants have improved tremendously and now open reduction and internal fixation with plating is considered best treatment for comminuted supra-condylar femur fractures (Chiron et al., 1974). The treatment aims at maintenance of bone length, anatomical reduction of articular surface and metaphyseal area, early mobilization of hip and knee, minimizing complications rate. All these goals are achievable by open reduction internal fixation with plating. Although studies have shown favourable results with open reduction internal fixation with plating, there are high rates of non-union, breakage of hardware and loss of reduction post-procedure especially varus collapse (Olerud, 1972). Bone grafting has been widely used in the treatment of comminuted supra-condylar fractures of femur. Most commonly used bone graft is autologous fibular strut graft. Fibula acts as bridge over the bone defects caused by severe comminution or bone loss in cases of open fractures and thus prevents problems like varus collapse and loss of reduction. The use of a fibular strut and cancellous combination graft helps to bridge the fragments with severe comminution, maintain limb length and counteract the relatively unstable distal femoral block from varus collapse (Yadav, 1990).

Our aim was to test this hypothesis. So the study was designed to analyze the outcome of comminuted supra-condylar femur fractures treated with plating and autologous corticocancellous bone grafting.

2. MATERIALS AND METHODS

33 patients of comminuted supra-condylar femur fracture coming to emergency department of Acharya Vinba Bhave Rural Hospital Sawangi (Meghe) Wardha who met the inclusion criteria and operated with open reduction internal fixation with plating and autologous fibula strut grafting between duration of January 2018 to June 2019 were included in the study. The study was a prospective interventional study. Study was performed at Acharya Vinoba Bhave Rural Hospital Sawangi (Meghe) Wardha.

Inclusion Criteria

All the patients with comminuted supra-condylar femur fractures (which fulfilled following criterias) coming to emergency department of Acharya Vinoba Bhave Rural hospital Sawangi (Meghe) Wardha between age group 18 to 70 years, who were willing to participate in the study were included in our study (flow chart 1).

Comminuted supra-condylar femur fractures having According to AO classification (Muller et al., 1991) of distal femur fractures of femur Type 33 A2, A3, C2 and C3 were included in our study.

All comminuted supra-condylar fractures with bone loss due to severe comminution or compound fractures were included in our study.

According to Gustillo Anderson classification (Kim and Leopold, 2012) Grade I, II, IIIa and IIIb fractures.

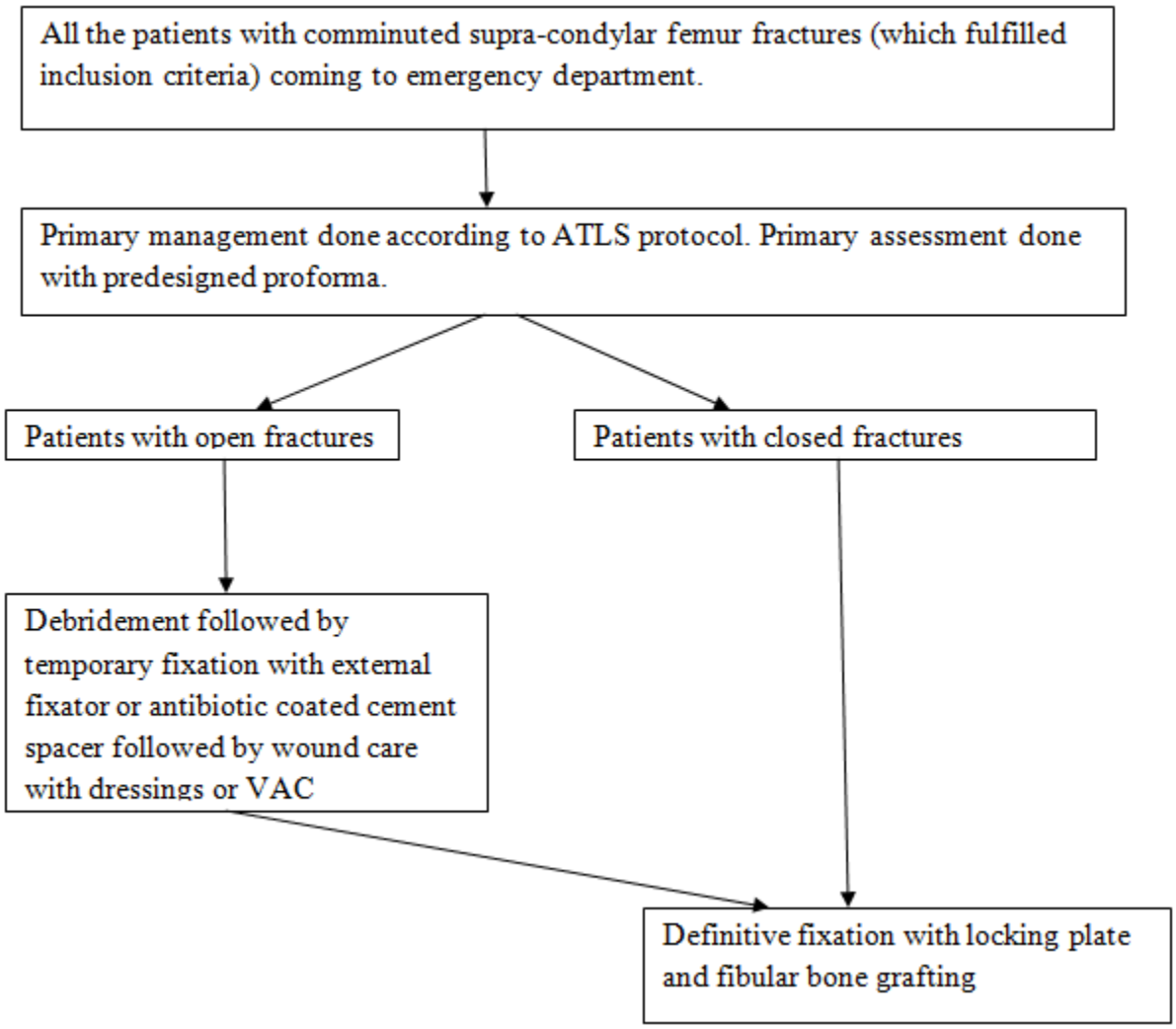
Exclusion criteria

Patients not willing to participate in the study

Factures of midshaft of femur or proximal femur

Fractures older than 2 weeks at time of presentation

Patients with associated vascular injuries



Flow chart 1 Brief outline of the treatment

Emergency care

In the emergency department, all the patients were treated according to Advanced Trauma Life Support (ATLS) principle. In cases of compound fractures, the wounds were irrigated with normal saline and all the contamination was removed. All the wounds were cleaned and dressed in the emergency department itself. All the patients with open wounds were given broad spectrum antibiotics prophylaxis and tetanus prophylaxis. After wound care, immobilization of the affected lower limb was done with Thomas splint. Monitoring of vitals was done in the emergency department and fluids, blood and O2 resuscitation was done accordingly. In cases of closed fractures, management was done according to ATLS principles and affected limb was immobilized with Thomas splint (Girish et al., 2018).

Pre-operative assessment of the patient

Once the patient's condition was stable further evaluation of injury and history taking was done. Details of the identification of the patients were noted with help of preformed questonnaires. Detailed history was taken including mode of injury and mechanism of injury. History of associated illnesses was enquired (Diabetes mellitus type II, Systemic hypertension, immunocompromised states etc.) and noted. Detailed general and systemic examination of the patient was done and noted. Detailed local examination was done to ascertain site of femur fracture, deformity, displacement and other associated injuries. Classification of open fractures was done on basis of Gustillo Anderson classification of open fracture. Plain anteroposterior and lateral radiographs of the thigh, knee and leg were done for all the patients. Plain anteroposteior view of pelvis with both hips was done for all the patients to rule out associated neck of femur fracture or intertrochanteric fracture. Site of femur fractured, fracture pattern, comminution, displacements and associated fractures were noted on basis of X-Ray. The fractures were classified according The AO classification of distal fractures of Femur. Standard pre-operative workup was done which included complete blood count, kidney and liver function tests, blood grouping, random blood sugar levels, Chest X-Ray and electrocardiograph and patients were operated as early as possible when the general condition of the patient permitted.

Preoperative preparation of patients

Patients were kept Nill by Mouth (NBM) for 6 hours prior to surgery. Written consent for surgery, anaesthesia and expected complications associated with both surgery and anaesthesia was obtained from all the patients. Required parts were prepared for surgery i.e. lower limb below knee. Injection Cefriaxone 1000 gm IV was given to all the patients 30 minutes prior to surgery. All the patients were operated preferably under Spinal anaesthesia.

Implant specifications

Distal femur locking compression plates come in either stainless steel or titanium (figure 1). These plates come in 5,7,9,11,13 holes for right and left femurs. These pre-shaped low profile plates. Plates allow locking or cortical screws (Henderson et al., 2011).

Figure 1 showing distal femur locking compression plate

Primary management of open fractures

Debridement was performed in all patients with open fractures, as soon as patient's general condition permitted. Thorough irrigation and debridement was performed. The debridement was aimed at removing all devitalized skin, subcutaneous tissue, fascia, muscle and loose bony fragments followed by irrigation with 3 to 6 Liters of normal saline depending upon the size and extension of the wound. Debridement was performed within 24 hours of presenting to the hospital. The decision to use temporary fixation rather than immediate definitive management was made by the operating surgeon. Factors considered in this decision included the general condition of the patient, associated fractures or internal organ injuries, expected difficulty in achieving anatomical reduction and reconstruction of the articular surface or metaphyseal region, and the condition of surrounding soft tissue

or skin coverage. Patients, in whom decision was made to do temporary stabilization first, were managed either with knee spanning uni or bi-planar external fixator or with antibiotic impregnated bone cement spacer insertion. After performing temporary fixation of the fracture, wound care was done with help of serial debridements, frequent dressings or other modalities like application of Vacuum Assisted Closure (VAC) or skin grafting. Definitive fixation was performed in such patients once the general condition, status of wound, status of other injuries permitted.

Operative procedure

Before inducing the patients, availability of Image Intensifier Television (IITV) and all the required instruments and implants were confirmed. Under spinal anaesthesia patient was kept in supine position on a radiolucent operating table. Entire affected lower limb from thigh to toes was scrubbed, painted and draped. Iliac region was separately prepared for taking cancellous graft from iliac crest. A small bolster was put beneath the knee of the operation site to flex the knee. All the surgeries were performed through standard lateral approach to femur as shown in Figure 2A. Underlying subcutaneous tissue, fascia, iliotibial band were dissected. Vastus lateralis muscle was reflected medially to expose the fracture site. Fracture haematoma drained. Fracture site visualized. All the devitalized bone pieces were removed. Bone pieces from the comminuted fracture were conserved as much as possible. Fracture fragments extending into the articular surface of knee joint were reduced first and fixed temporarily with k wires or with cortical cancellous screws in some cases. Metaphyseal area was reconstructed as much as possible. Fracture was reduced and bony length achieved as much as possible. Fracture was fixed with distal femur locking compression plate. In some cases additional Dynamic compression plating was done by anterior approach as seen in Figure 4B. Thorough irrigation was done with NS. Bony defect was measured with help of a measuring scale as shown in Figure 2B. Fibular strut graft of suitable length was inserted at the site of bone defect as shown in Figure 4A. Also cancellous bone grafting was performed to fill the bony gap. Closure of the incision was done in layers.

2A

2B

Figure 2A showing method of draping and positioning of the patient for plate fixation and location and extent of the incision over lateral aspect of thigh. **Figure 2B** showing method of measurement of bone defect with measuring scale

3A

3B

Figure 3A showing fibula strut graft being harvested by 2 small incisions. **Figure 3B** showing harvested fibular strut graft

4A 4B

Figure 4A showing harvested fibula strut graft being inserted at the site of the bone defect. **Figure 4B** showing final picture after plating and bone grafting

Operative procedure for harvesting fibular strut graft

Fibular strut graft was removed percutaneously. Markings were made over skin overlying the fibula over lateral aspect of the leg as per the required length of the graft needed as seen in figure 3A and B. 2 small vertical incisions were taken over lateral aspect of the fibula each measuring 1-2 cm, proximal incision was taken 5 cm distal to the neck of fibula and distal incision was taken 10 cm proximal to lateral malleolus. Underlying soft tissue, fascia was dissected. Muscular attachments were separated with help of periosteum elevator. Fibular graft was harvested with help of bone saw. Harvested fibular graft was cut in half in sagital plain, turned in side out and was then used for bone grafting. Thorough irrigation of the incision was done and it was closed in layers.

Operative procedure for harvesting graft from iliac crest

Approximately 5 cm incision taken over iliac crest at the junction of anterior 2/3rd and posterior 1/3rd. Underlying subcutaneous tissue and fascia were dissected and muscular attachments were separated with periosteum elevator. Corticocancellous graft was harvested with help of osteotome. Harvested graft was cut into small pieces with help of a nibbler and then used to fill the bony defects. Thorough irrigation of the incised site was done with NS and closure done in layers.

Post-operative protocol

Patients were kept NBM for 6 hours post-operatively. Injection Ceftriaxone plus sulbactum 1500 gm IV BD was given for 3 days to all the patients along with Injection Amikacin 500 mg IV BD for 2 days and Injection Metronidaozole 400 mg IV TDS for 2 days for open fractures followed by Tablet Cefuroxime 500 mg 1 tblet BD for 7 days (Jindal and Swarnkar, 2020). Oral/systemic analgesics were given according to the need. Post-operatively knee was immobilized with help of long knee brace. The operated lower limb was immobilized in a posterior slab in cases of unstable fixation. Check X- rays were taken on 2nd post-operatve day when the pain got reduced. Check dressing of the wound was done on 2rd post-operative day. Check dressing for open fractures was done as and when required. Sutures were removed on 10th or 12th post-operative day depending upon the condition of the wound. Patients were discharged from the hospital after suture removal. Physiotherapy of the affected limb was started from 1st day post-operatively. Gradual increments in the intensity of physiotherapy were done. Static and dynamic Quadriceps and hamstring strengthening exercises along with knee and ankle mobilization as tolerated were started from 2nd day post-operatively. Patient was also encouraged to perform straight leg raising. Non weight bearing mobilization with help of walker/crutches was started from 1st post-operative day. Physiotherapy and minimum weight bearing mobilization was delayed in cases of unstable fixations.

Follow up

All the patients were followed up every monthly i.e. 1st, 2nd and 3rd month post-operatively and then 6th month and 1 year post-operatively. X-Rays were taken on every follow up to know the status of union and implant placement. Functional assessment of knee was done at final follow up with help of Neer's scoring system (Gupta and Dande, 2015). Assessment of the pain were done with Visual Analogue Score (VAS). Also limb length discrepancy, final knee Range of motion examination and assessment of deformity was done at final follow up. Maximum follow up period was 1 year. Fracture was said to be united on basis of clinical and radiological examination, no pain or tenderness at fracture site along with presence of callus along 3out of 4 cortices in both anteroposterior and lateral radiographs was considered to be united.

Data analysis

All the data regarding etiology, mode of injury, classification of fractures, data regarding intra-operative findings, complications, union, final outcome was collected. All the collected data was spread on spread sheet. Data analysed with help of SPSS software and suitable statistical tests were applied wherever required.

3. CASE NUMBER 1

A 35 years male presented with comminuted supracondylar femur fracture with large bone loss. Primary fixation with plating and bone grafting was done. Pre-operative, immediate post-operative and follow up radiographs are shown in the Figures 5A & B, 6A & B and 7A & B.

5A 5B 6A 6B

Figure 5A and 5B showing anteroposterior and lateral views of right distal femur with knee showing severely comminuted supra-condylar femur fracture. Radiograph taken are presenting to the hospital. **Figure 6A and 6B** showing antero-posterior and lateral views of right distal femur and knee showing comminuted distal femur fracture fixed with locking compression plate and fibula strut graft

7A 7B

Figure 7A and 7B showing anteroposterior and lateral views of distal femur and knee showing status of fracture 3 months post-operatively. Callus can be appreciated in lateral view bridging posterior cortex.

Case number 2

A 45 years male, came with comminuted supracondylar femur fracture was managed with plating and bone grafting. Pre-operative, post-operative and follow up radiographs are shown in Figure 8A & B, 9A & B and 10A & B.

8A 8B 9A 9B

Figure 8A and 8B showing severely comminuted supra-condylar fracture on presenting to the hospital. **Figure 9A and 9B** showing anteroposterior and lateral views of left distal femur with knee immediately post-operatively, locking compression plate and fibula strut graft in place.

10A 10B

Figure 10A and 10B showing anteroposterior and lateral views of left distal femur with knee. Status of the fracture was 3 months post-operatively. Some callus can be appreciated in both anteroposterior and lateral views.

Case number 3

A 35 years old male came with compound comminuted supracondylar femur fracture. 2 staged procedures were done with debridement and external fixator application followed by plating and bone grafting. Radiographs are shown in Figures 11A & B, 12A & B and 13A & B.

11A 11B 12A 12B

Figure 11A and 11B showing antero-posterior and lateral radiographs of right distal femur and knee showing severely comminuted supra-condylar femur fracture on presenting to the hospital. **Figure 12A and 12B** showing antero-posterior and lateral radiographs of right distal femur and knee showing status of fracture immediately after temporary stabilization.

13A 13B

Figure 13A and 13B showing antero-posterior and lateral radiographs of right distal femur with knee showing status of fracture immediately after definitive fixation.

4. RESULTS AND OBSERVATIONS

The mean age of all the patients in the study was 43.745 years with range from 18 to 66 years shown in Table 1. Most of the patients were from the age group 21 to 40 years i.e. 22 patients (66.565%). Out of 33 patients in our study 27 (81.81%) were males and 6 (18.181%) were females (Table 2). In our study, out of 33 patients, in 25 patients (75.75%) fracture was as a result of road traffic accident while in 8 patients (24.24%) it was due to fall from height shown in Table 3. All the patients in our study had associated injuries. The distributions of the associated injuries are in shown in the Table 4.

Table 1 showing distribution of the patients in our study

Age distribution of the patients	Number	Percentage
<20	5	15.1515152
21 to 30	9	27.2727273
31 to 40	13	39.3939394
41 to 50	2	6.06060606
51 to 60	1	3.03030303

>60	3	9.09090909
Total	33	100

Table 2 showing distribution of the gender of the patients

Gender distribution of the patients	Number	Percentage
Males	27	81.81818
Female	6	18.18182
Total	33	100

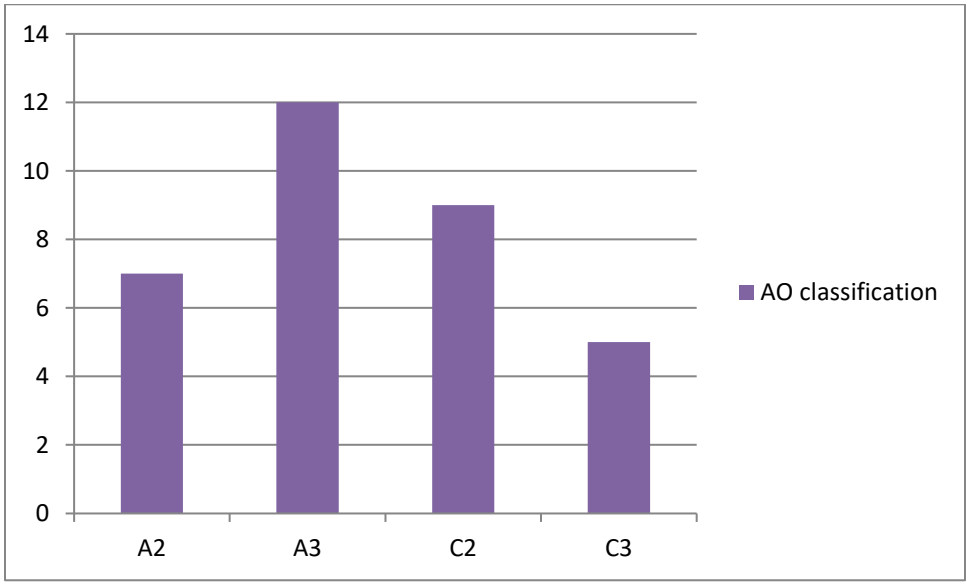
Table 3 showing distribution of mode of injury

Distribution of mode of injury	Number	Percentage
High velocity RTA	25	75.7575758
Fall from height	8	24.2424242
Total	33	100

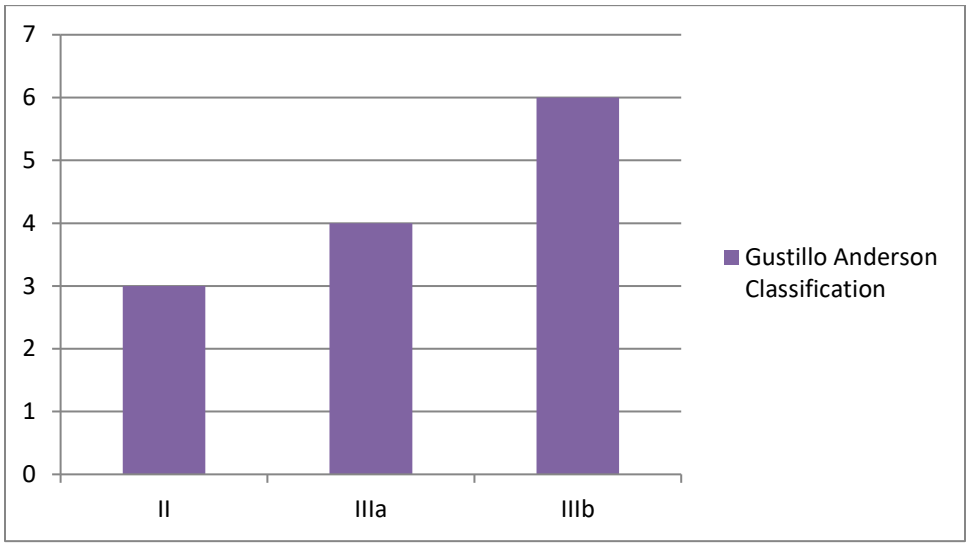
Table 4 showing region wise distribution of associated injuries

Distribution of associated injuries	Number	Percentage
Upper limb	5	15.1515152
Lower limb	12	36.3636364
Thorax and abdomen	8	24.2424242
Head, neck and face	8	24.2424242
Total	33	100

Classification of the fractures was done on basis of AO classification of fractures of distal femur. Distribution of the fractures according to AO classification is shown in the table. Out of 33 fractures, 7 (21.212%) were Type 33A2, 12(36.363%) A3, 9 (27.272%) C2 and 5 (15.151%) C3. Out of 33, 14 (42.423%) fractures had intra-articular extention shown in Graph 1. Also out of 33, 13 (39.393%) fractures were open fractures. These fractures were also classified according to the Gustillo Anderson classification. Out of 13 fractures, 3 fractures (23.067%) were Type II, 4 (30.76%) IIIa and 6 (46.163%) IIIb according to Gustillo Anderson Classification shown in Graph 2.

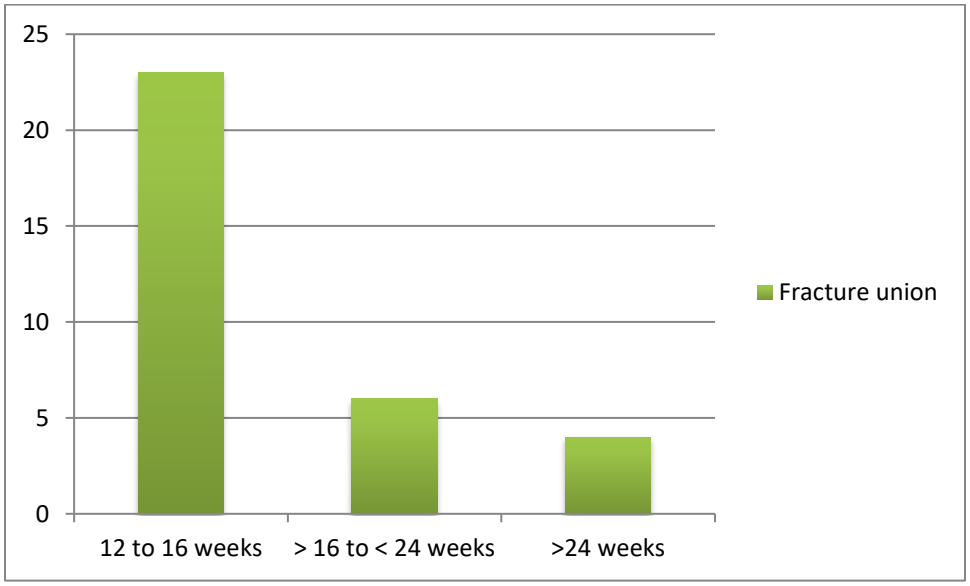


Graph 1 showing distribution of the patients on basis of type of fracture according to AO classification.



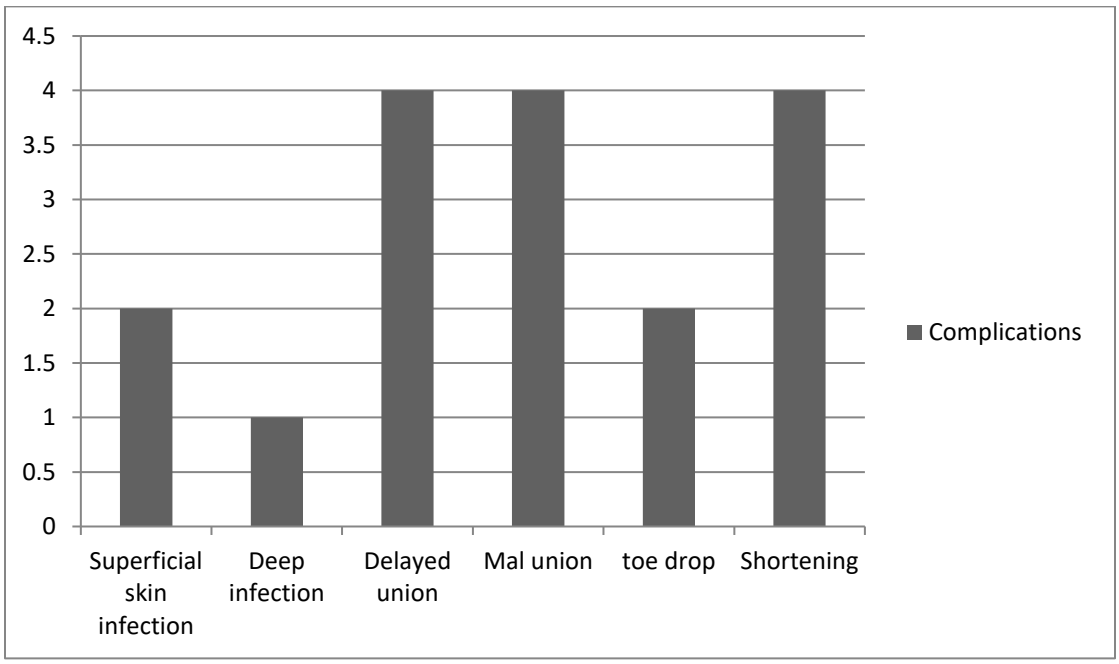
Graph 2 showing distribution of the patients with open fractures according to Gustillo Anderson Classification

In our study, the average duration between injury and 1st intervention was 4.5 days with maximum patients (75%) getting operated within 2 days of arrival to the hospital. Out of 13 fractures, 10 were treated in 2 staged procedures, temporary stabilization followed by permanent stabilization. Average duration between 2 procedures was 2.5 months. All the 33 patients were operated under Spinal or epiural anaesthesia. Average time required for surgery was 104 minutes. The fracture was considered to be united when clinically there was no tenderness, radiologically the fracture line was not visible and full unprotected function of the limb was possible. The mean duration of union was 4.8 months with most of the fractures (68%) uniting by the end of 12 to 16 weeks (Graph 3). Delayed union was seen in 4 (12.121%) patients. All the 4 cases had open fractures. In all these cases fracture were united by the end of 8 months without any further intervention.



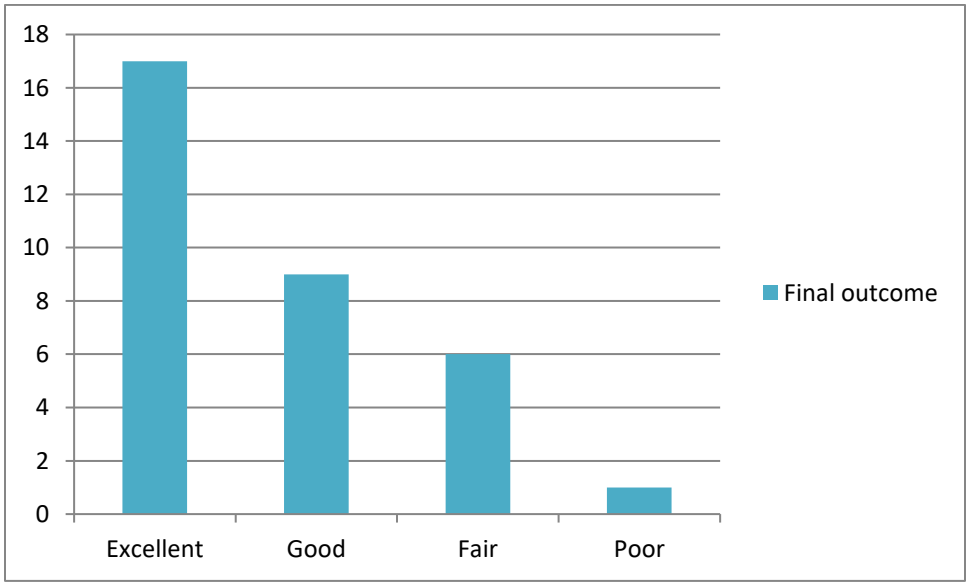
Graph 3 showing the distribution of the patients on basis of duration of fracture union.

There were no major complications noted in any of the patients in our study. In our study, out of 33 patients 2 patients (6.0606 %) developed superficial skin infection which healed subsequently with dressing only and no further intervention was required, 4 patients (12.121 %) had delayed union which later united without any intervention, 1 patients (3.03 %) developed deep infection at incision site which healed later with serial debridements and antibiotic coverage, 4 patients (12.121 %) developed malunion having varus angulaton of average 12.5 degrees which was asymptomatic so no additional procedure was required, 2 (6.06 %) patients developed toe drop which recovered later with physiotherapy, 4 patients (12.121%) developed shortening (average 1.5 cm) which was treated with shoe raise only. There were no cases of non-union or breakage of hardware noted in our study. Details of various complications are shown in Graph 4.



Graph 4 showing details of the various complications noted during our study

At final follow up, functional assessment with Neer's score was done which showed 17 (51.515%) had excellent results, 9 (277.272%) good, 6 (18.181%) fair and 1 patient had poor result seen in Graph 5. At final follow up average knee ROM ranged from 70 degrees flexion to 120 degrees flexion with average flexion of 105 degrees with 23 patients (70%) having flexion more than 100 degrees while 10 patients (30%) having flexion less than 100 degrees. Average VAS at final follow up was 1.353.



Graph 5 showing distribution of the patients on basis of final outcome

5. DISCUSSION

For discussion purpose, we have compared our study with 3 similar studies namely Barei et al., (2012) in which 36 cases of open supracondylar fractures were treated with lateral plating and secondary bone grafting, Dugan et al., (2013) in which 15 open supracondylar femur fractures were treated with primary temporary stabilization followed by definitive stabilization after some time and Huang et al., (2003) in which 16 patients of supracondylar femur fractures were treated with open reuction and internal fixation with plating.

Age distribution

The mean age of the patients in our study was 43.73 years when compared to 45 years in Barei et al., (2012), 41 years in Dugan et al., (2013) and 42.34 years in Huang et al., (2003).

Gender distribution

Out of all patients, there were 82% males and 18% females in our study. Barei et al., (2012) had 68% males and 32% females, 50% males and 50% females in Dugan et al., (2013).

Distribution of mode of injury

In our study, out of 33 patients, 75% patients developed fractures due to high velocity road traffic accident while 25% due to fall from height. When compared to Barei et al., (2012) 73% injuries due to motor vehicular accidents 17% due to fall from height and 10% due to other mechanisms, in Dugan et al., (2013) 100% injuries occurred due to motor vehicular accidents, in Huang et al., (2003) it was 87% injuries due to motor vehicular accidents and 13% due to fall from height.

Distribution of classification of fractures

Fractures when classified according to the AO classification, in our study there were 21% 33A2, 36% 33A3, 27% 33C2 and 15% 33C3 fractures, Barei et al., (2012) had 47.2% 33C2 and 52.7% 33C3, Dugan et al., (2013) had 46% 33C2 and 54% 33C3 fractures while Huang et al., (2003) had 43% 33A3, 37% 33C2 and 10% 33C3 fractures. Fractures when classified according to Gustillo Anderson Classification, in our study there were 23% type II, 30% type IIIa and 46% type IIIb, Barei et al., (2012) had 94% type IIIa, 2.8% type IIIb and 2.8% type IIIc while Dugan et al., (2013) had 75% IIIa and 25% IIIb.

Duration between presentation and intervention

Average duration between presentation and 1st stabilization in our study was 4.5 days; it was 4 days in Barei et al., (2012), 2 days in Dugan et al., (2013) and 10 days in Huang et al., (2003). Average duration between 1st stabilization and 2nd stabilization in our study was 2.5 months while it was 2.3 months in Barei et al., (2012) and 3.5 months in Dugan et al., (2013).

Duration of fracture union

The average duration of fracture union in our study was 4.8 months, as compared to 4.5 months in Barei et al., (2012), 4 months in Dugan et al., (2013) and 5 months as seen in Huang et al., (2003). This shows that our study is comparable with already established studies. Our method of treating supra-condylar femur fractures with bone loss has shown encouraging results. But there are some limitations to the study, like the procedure being a 2 staged procedure has a longer duration and may present as a burden to the patient. Also the duration of follow up is shorter which will be dealt with in subsequent studies.

6. CONCLUSION

In conclusion, severely comminuted supracondylar fracture of the femur with significant bone loss can be effectively managed with distal femur locking compression plate and autologous fibula strut graft and cortico-cancellous bone graft from iliac crest. Harvesting and usage of fibula strut graft and iliac crest graft as mentioned in our study is relatively easy and cost effective and doesn't require micro-vascular expertise.

Funding Support

This study didn't receive external funding.

Conflict of Interest

The authors declare that they have no conflict of interest.

Informed consent

Written and oral informed consent was obtained from the participants included in the study.

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Ethical approval

The study was approved by the Medical Ethics committee of Datta Meghe Institute of Medical Sciences University Sawangi (Meghe) Wardha, Maharashtra, India (Ethical approval code: 9113)

Author contribution

Dr. Gajanan Pisulkar, was responsible for manuscript preparation and decision making and management of the patients, Dr. Swapnil Date was responsible for data collection and manuscript writting, Dr. Kiran Saoji was responsible for study design, Dr. Kiran Belsare was responsible for management of the patients, Dr. Amit Saoji was responsible for management of the patients, Dr. Kushal Surana was responsible for management of the patients.

Data and materials availability

All data associated with this study are present in the paper.

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