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# A surgical management of AO type 33c distal femur fractures using VA-LCP

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**Abstract**
**Back Ground:** Fractures of Distal Femur are common due to increased Road traffic accidents and fall from height because of increased construction activities. These fractures are quite disabling. So these fractures necessitate early stabilization. Internal fixation with VA-LCP has shown to give one of the best results in terms of fixation, recovery, fracture union and clinical outcome.
**Materials and Methods:** 23 cases of Distal femur fractures treated with VA-LCP from August 2016 to August 2018 were selected for this study. They were admitted and examined according to protocol clinically and radiologically. All patients were followed up for a minimum of 6 months and outcome assessed with Neer's score.
**Results:** All fractures healed with an average duration of 23 weeks which is comparable with other studies. We had excellent outcome in 6 (26%) patient, satisfactory outcome in 13 (57%) patient and 4 had an unsatisfactory (17%) result. Average Neer's Knee score was 81 which is comparable with other studies.
**Conclusion:** The VA-LCP is the treatment of choice in the management of comminuted distal femoral fractures especially Type C fractures, where type $C_1$ we have found higher Neer's scores. VA-LCP also prevents compression of periosteal vessels. VA- LCP is the implant of choice especially in type $C_3$ fractures as we can get purchase of multiple fracture fragments avoiding intra articular screw penetration because of screw insertion angle upto $15^0$ compared to fixed orthogonal screw placement. Although in our series poor result were found in type $C_3$ fractures we attribute this to long learning curve in treatment of type $C_3$ fractures.

**Keywords:** Variable angle locking Compression plate (VA-LCP), Locked internal fixators, Femoral Fractures, Implants

## Introduction
Fractures affecting the distal femur are very complex injuries that pose a challenge to every orthopaedic surgeon. It commonly occurs during high velocity trauma in younger group of patients and frequently are associated with other skeletal injuries and concomitant other system injuries. In contrast to this, elderly patients especially women with severe osteopenia might sustain isolated distal femur fractures from trivial trauma such as a simple slip and fall [8]. Studies [1] have proved this bimodal distribution of supra condylar fractures of femur. Fractures of distal femur are complex injuries producing long term excluded. Nearly 50% of distal femur intra articular fractures are open fractures. There are multiple options for the treatment of these fractures with their associated merits and demerits [2]. Anatomical restoration of the knee joint congruity proper alignment and secure fixation of both proximal and distal fragments are the key to achieve good functional outcome in these fractures to prevent early secondary osteoarthritis [3, 4]. Locking Compression Plate has the advantage of combination of Compression Plating, Locked Plating and Bridge Plating [5, 6]. This reduces soft tissue damage and periosteal vessels are preserved. Therefore, it acts like a closed external fixator. But regular Distal Femur-Locking Compression Plate is unable to hold on to every fragment because of its prefixed screw trajectory [9]. The treatment of comminuted and unstable fractures of distal femur using double plating i.e. medial and lateral condylar Buttress plate were used, however, the postoperative knee range of movement was unsatisfactory [7]. Variable Angle-Locking Compression Plate (VA-LCP) has overcome this angular deficit of prefixed trajectory of screws.

## Material and Methods

In our study 23 patients with distal femur fracture were studied. All the cases were treated at between Aug 2016 to Aug 2016 at our institution. The method used for fracture fixation was open reduction and internal fixation with Variable angle locking compression plate. The duration of follow up ranged from a minimum 6 months to maximum 18 months.

All the fractures in our series were post-traumatic. Pathological fracture, distal femur fractures in children and fractures treated conservatively or fixed with other fixation systems like AO blade plate and condylar buttress plate were excluded in our study [10, 11]. There were 14 men and 9 women with mean age of 45 years (range 21–70). Fractures were categorized according to AO/OTA classification.

**Inclusion Criteria:** (1) All skeletal mature patients (>18years) (2) Open distal femur fractures up to type I and II. (3) AO muller type $3.3_{C.}$

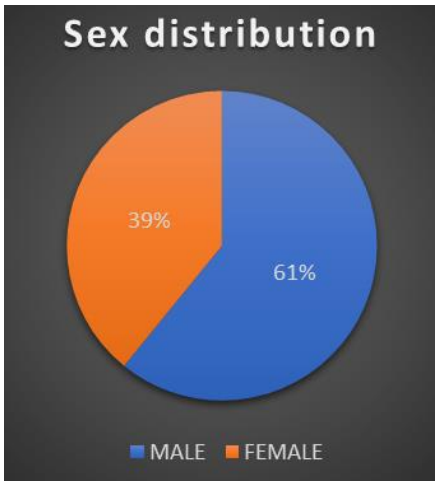
**Exclusion Criteria:** (1) Patients with open distal femoral fractures Type III. (2) Patient with pathological fracture. (3) Patients lost in follow – up were excluded from the study.

**Implant Used**: Anatomically Precontoured VA-LCP stainless steel. The VA-locking compression plates are available from 3 holed to 11 holed. With 4.5 mm thickness plate for lower end of Femur. Threaded Locking caps to lock the screw to the plate for a secure support. Bone spacers for non-contact bridging. The head of the locking screw is threaded which gets locked to the plate as it is tightened.

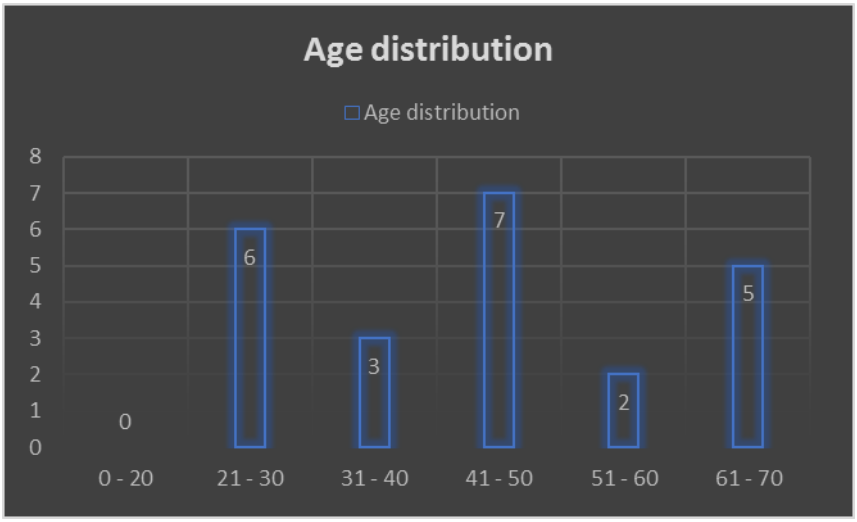
Preoperative AP and lateral radiographs of affected knee with femur were obtained. Computed tomography as and when required. All surgeries were carried out with patient placed supine on the radiolucent table. A bolster was placed posterior to supracondylar region. All the cases operated with a standard lateral approach to the distal femur. Intraarticular fracture reduction was obtained and temporarily fixed with multiple K wires. Indirect reduction of articular surface with femoral diaphysis was done under fluoroscopic guidance. Using anatomic landmarks and C–arm imaging, the plate was mounted on the intact / reconstructed condyle without attempting to reduce the proximal portion of the fracture. Drill holes were placed sequentially in holes of plate and we achieved good purchase of multiple fracture fragments avoiding intra articular screw penetration because of screw insertion angle up to $15^0$ compared to fixed orthogonal screw placement and over that we used locking caps that are threaded into the plate holes. For proximal fixation 3 or 4 bicortical screws were used. Minimum of 5 locking screws were used for distal fixation (Figure 1). Position of the plate was confirmed under image in both AP and lateral views. No screws violated the intercondylar notch area. Suction drain was used in 20 patients and was removed after 24 to 48 hrs. Postoperatively limb elevation was given with knee in about 15 degrees of flexion. Static quadriceps exercises with active hip and knee mobilization were started from 1st postoperative day. Postoperative radiographs were taken. Follow-up radiographs were taken after 6 weeks, 12 weeks, 6 months, 9 months, and 12 months after surgery. Gradual weight bearing was started based on the evidence of bridging callous on follow-up radiographs. The average time until weight bearing was 3 months. Clinical and functional outcomes were assessed using the Neer's scoring system.

## Results

This is a Prospective Study of 23 Patients of Distal femur Fractures treated surgically with Variable angle Locking compression plate. Males were predominantly affected [Graph 1]. Highest number of patients were in their $4^{th}$ decade (30%) [Graph 2].

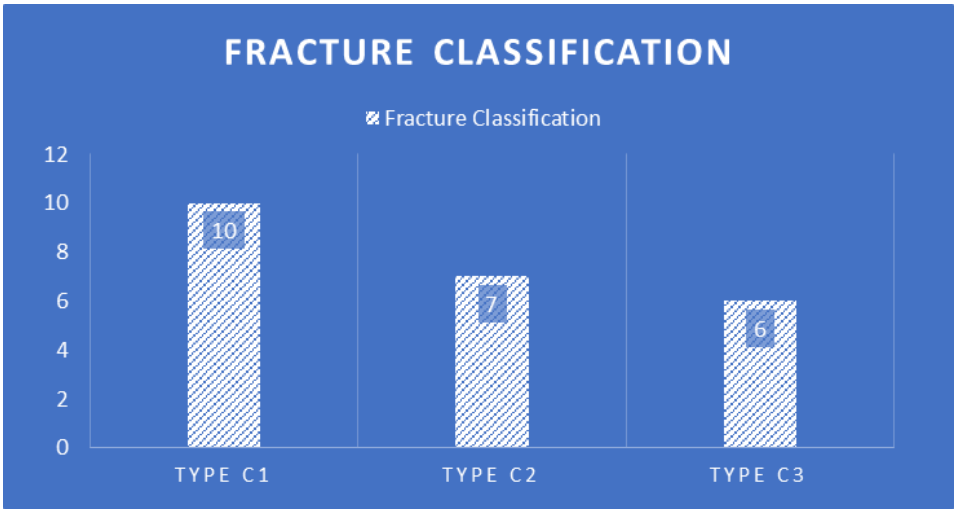



**Graph 1:** Sex distribution

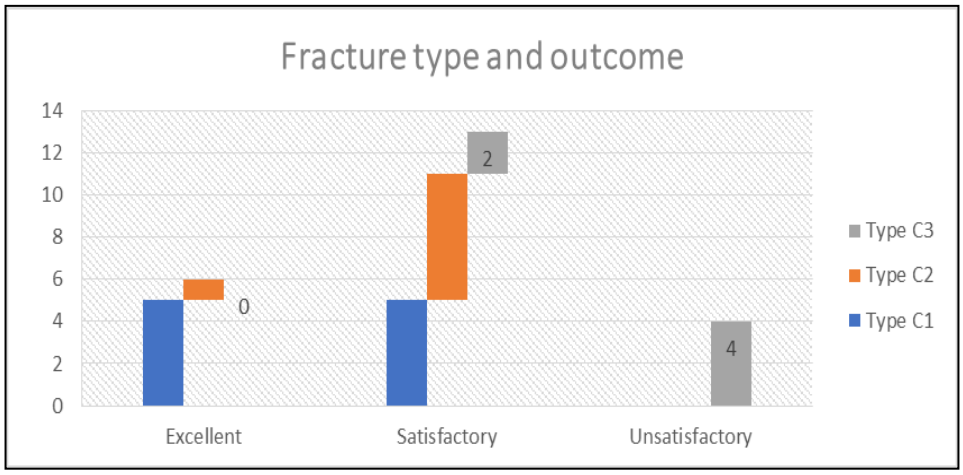



**Graph 2:** Age distribution

Road traffic accident was the most common mode of injury (63%). One patient had associated two patients had ipsilateral proximal tibia fracture, one patient had ipsilateral both bone forearm fracture, one patient had ipsilateral both superior and inferior rami fracture making a total of four patients (23%) with associated fractures. Most of the patients, reported within 24 hours of injury to the hospital. 04 out of 23 patients had open injury. Type $C_1$ muller's fracture was the most common fracture type 10 out of 23 patients (43%) [Graph 3].

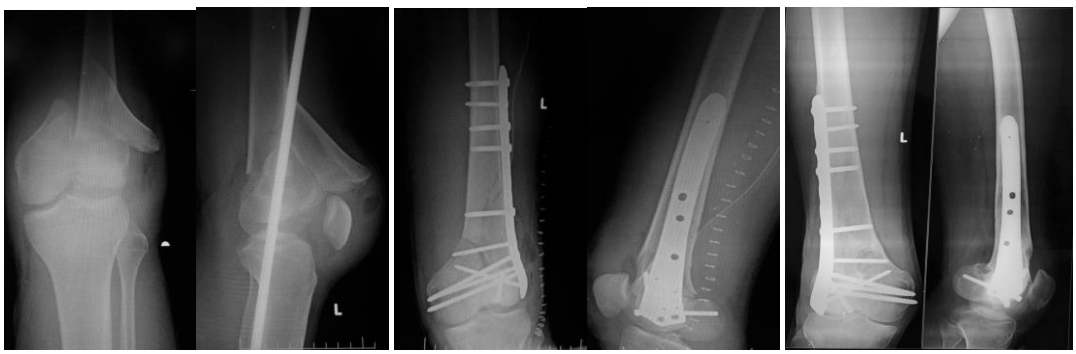



**Graph 3:** Fracture Classification




**Graph 4:** Fracture type and outcome

The minimum follow up period was 6 months and the maximum follow up was 18 months. The mean follow up in our study was 11.7 months. The average range of knee flexion achieved was about 85°. Maximum gain in knee flexion was 110° and minimum gain about 40°. The average knee score 81 points was rated using NEER functional score. (Max 96). Early complications were encountered in three patients and these were superficial wound infection, gross shortening in two patient. Late complications were observed like knee stiffness in two patient and malunion in one patient. The average stay in hospital was about 11 days. Postoperative immobilization with knee brace was advised for severely comminuted fractures, for 3 weeks, although gentle physiotherapy exercises were started earlier. The VA-LCP plate is the treatment of choice in the management of distal Femoral Fractures especially Type $C_1$ and $C_2$. Though Neer's scores are lower in Type $C_3$ Fractures, it remains the implant of choice even in Type C3 fractures [Graph 4].



**a.** **b.** **c.**

**d.** **e.**

**Fig 1:** A 22-year-old male presented with an AO/OTA typeC2 supracondylar femoral fracture (a); the fracture was treated with DF VA-LCP (b) The fracture healed with good alignment (c) with satisfactory knee movements (d) and (e).

## Discussion

| Study series | Year | number of fracture | % open fractures | % nonunion | % delayed union | % needing bone graft or hard ware revision% | % hardware failure | average healing time | average follow up (months) |
|---|---|---|---|---|---|---|---|---|---|
| Schandelmaier *et al.* | 2001 | 54 | 19 | 2 | 6 | 11 | 9 | 13 | 6 |
| Fankhauser *et al.* | 2004 | 30 | 47 | 0 | 3 | 20 | 20 | 12 | 20 |
| Kregor *et al.* | 2004 | 103 | 34 | 2 | | 10 | 5 | | 14 |
| Weight and Collinge | 2004 | 22 | 27 | 0 | 0 | 0 | 0 | 13 | 10 |
| Vallier *et al* | 2006 | 46 | 54 | 9 | 15 | 20 | 13 | | 12 |
| Kayali *et al.* | 2007 | 27 | 26 | 0 | 0 | 4 | 7 | 15 | 26 |
| Henderson *et al.* | 2011 | 70 | 26 | 20 | 0 | 13 | 8 | 12 | 20 |
| Pascarella *et al.* | 2012 | 77 | 25.5 | 9.1 | 0 | 6 | 4 | 16.3 | 19.25 |
| J. B. Erhardt | 2014 | 26 | 38 | 7.8 | 0 | 31 | 0 | 17 | 36.5 |
| Vaibhav *et al.* | 2017 | 20 | 45 | 0 | 0 | 0 | 0 | 17 | 21 |
| Our study | 2018 | 23 | 17 | 0 | 13 | 0 | 0 | 20.17 | 11.7 |

The good outcome seen in our study can be attributed to more of Type $C_1$ fractures, which usually show favorable results. Most of the series above have equal or higher number of Type $C_1$ fractures. We had only 17% of open fractures, which were much higher in other case series. Also the small sample size can be used only as Level III evidence in Evidence based medicine.

We had three cases of varus collapse, was due to gross comminution. Earlier, fixation of these fractures with a lateral plate alone has historically been associated with non-union and /or malunion with varus collapse. Prior to advent of variable angle locking compression plates, these problems were addressed with dual plating methods [1]. Though this prevented varus collapse, extensive soft tissue stripping and medial incision increased the chance of extensor lag. With the introduction of plates with option of locked screws, the results were encouraging, as it increases the rigidity of fixation in osteoporotic bone and in presence of periarticular or juxta-articular comminution.[2] The VA- LCP plates provide multiple points of fixed plate to screws contact, generating greater stability and thereby reducing the tendency of varus collapse.

In our study, radiological union was seen at an average of 20.17 weeks which is comparable to study of LCP by Pascarella *et al*. [13]. in 2012 (16.3) and J. B. Erhardt *et al*. [14]. 2014(17). Overall results were excellent in 6 out of 23 cases and 13 were satisfactory and 4 which were unsatisfactory. The overall average knee score in our study was 81, as apposed to by Schandelmaier *et al*.

The problems in fixing distal femoral fractures with osteoporosis, extensive comminution and revision surgeries following failed implant was addressed effectively using variable locking compression plate [13-15]. We believe that variable angle locking plates represent a valuable advancement in fracture treatment. However, the limitations of this new technology and indications for its use have not been completely elucidated and the long-term results are awaited.

However, the variable angle locking plates can fail when physiological loads are outside plate- design parameters. The locked screws can dis-engage from the plate secondary to failure of the screw to seat into the plate properly, as a result of cross – threading or when insufficient screw torque is used to engage the screw threads into the plate threads.

## Conclusion

The VA-LCP is the treatment of choice in the management of comminuted distal femoral fractures especially Type C fractures, where type $C_1$ we have found higher Neer scores. VA-LCP also prevents compression of periosteal vessels. VA-LCP is the implant of choice especially in type $C_3$ fractures as we can get purchase of multiple fracture fragments avoiding intra articular screw penetration because of screw insertion angle upto $15^0$ compared to fixed orthogonal screw placement. Although in our series poor result were found in

type $C_3$ fractures we attribute this to long learning curve in treatment of type $C_3$ fractures.

**Ethical Approval**

All patients gave the informed consent prior to being included in the study and the study was authorized by the local ethical committee and was performed in accordance International Scholarly Research Notices.

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