Medical and Research Publications
International Open Access

Research Article **Journal of MAR Orthopedics (Volume 3 Issue 2)**

Distal Femur Fractures in Post-Polio Affected Limb Treated with Distal Femur Anatomical Locking Plate- A Study in A Tertiary Care Hospital in Kolkata, India

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Received Date: March 28, 2022

Published Date: April 01, 2022

Abstract

Objective*: Distal femoral fractures in post-polio patients are difficult to treat because the bone deformed, smaller and osteopenic. This study is a retrospective study where the outcomes of open-reduction internal fixation of distal femur fractures of post polio patients with distal femur anatomical locking plate is evaluated.*

Methods*: The medical records and intra-operative data of 15 post-polio patients (mean age 44 years at time of surgery) were scrutinized and reviewed. Evidence of fracture union were recorded from the post operative radiographs at 6 weeks, 3 months, 6 months and 1 year. Functional outcome was assessed by noting range of motion and Hospital for Special Surgery (HSS) score of the ipsilateral knee joint.*

Results*: All the fractures occurred in the poliomyelitis-affected limb. The mean duration of operation was 90 min and mean blood loss 140 ml. All fractures healed (mean, four months) but union was delayed in three cases. At the final follow-up 1 yrs after surgery, the mean range of knee flexion was 100° (range 80°–120°), and mean HSS score 74 points (range 62–90). There were 2 cases of infection which were treated with culture sensitive antibiotics. There were no cases of nonunion, implant cutout or other complications.*

Conclusions: *Open-reduction internal fixation in post-polio patients with distal femur anatomical locking plate gives stable fixation of distal femoral fractures. Bony union and good functional outcomes can be achieved achieved.*

Key words*- polio, distal femur fracture, distal femur anatomical locking plate*

Introduction

Poliomyelitis is on the verge of eradication. But the survivors of polio are still living with its consequences in different parts of the world. People with post-polio residual paralysis are prone to fractures after mild trauma. The flaccid paralysis, asymmetric involvement, and underdeveloped growth of affected leg may lead to osteoporosis which is the common cause for fracture. Fractures in polio survivors present unique challenges; the bone is often small, deformed, osteoporotic and hypovascularized.

Poliomyelitis is an acute viral infectious disease caused by infection of motor neurons with poliovirus, resulting in denervation of muscle fibers (1,2,3,4). Survivors of polio are still living with its consequences in different parts of the world. A common sequela is asymmetric flaccid paralysis of the lower extremities and halted growth6. As age advances the flaccidity of the limb increases resulting in decreased power and ability to ambulate (7).

There is a high risk of sustaining fractures in polio limbs after fall and trauma due to osteoporosis in the affected limb (2,4,6,8). Common sites of fractures are in the distal femur and proximal humerus (10). Distal femoral fracture in elderly patients with osteopenia is difficult to manage in post-polio patients (11). In addition to the higher incidence of osteopenia in post-polio patients (6,9,10), the bones on the affected side may be small, deformed and hypo-vascular because of the decreased bulk and vascularity of the paralyzed muscles, all these factors can contribute to poor fracture healing (12,13,14). Due to decreased muscle power and limited ambulation post operative rehabilitation is also difficult (10).

Distal femur anatomical locking plate, which provide angular stability by minimizing interference with the fracture site, have been used for treatment of distal femoral fractures in osteopenic bone (15,16).

In the current study, we retrospectively evaluated a series of distal femoral fractures treated with Distal femur anatomical locking plate. The purpose of the study was to evaluate the technique and outcomes of using distal femur anatomical locking plate to treat distal femoral fractures in post-polio patients.

Materials and Methods

From March 2016 to December 2020, (15) consecutive post-polio patients (9 men and 6 women; mean age, 49 years; range, 37–63 years) sustained unilateral distal femoral fracture in polio affected limb were treated with distal femur anatomical locking plate in our hospital. The mode of injury was fall during activities of daily living (13 patients) and road traffic accident (2 patients). The fractures were all closed and classified (Association for Osteosynthesis /Orthopedic Trauma Association classification) as 33-A1 in three, 33-A2 four, 32-A3 four, 33-B1 in one, 33-B2 in one and 33-C1 in two18. 9 surgeries were performed within one week from date of injury and six were delayed according to pre operative fitness status due to associated comorbidities

Surgical technique

The patient was placed in the supine position on a radiolucent operation table. Fluoroscopy machine was positioned from the opposite side. Sterile dressing and draping were done and a bolster was placed underneath the proximal aspect of knee keeping the knee in 300 flexion. A longitudinal parapatellar incision (8–10 cm) was made over the lateral femoral condyle and anatomic reduction of the articular surface was achieved for intra-articular fractures (types 33-B and 33-C).

Kirschner wires were used for temporary fixation of the fracture fragments. In case of extra-articular fractures, indirect reduction was guided by fluoroscopy, manual traction, valgus or varus stress and pointed reduction forceps. For comminuted shaft fractures, only the alignment on coronal and sagittal planes was restored by manual traction; the fracture sites were not exposed.

Distal femur anatomical locking plate were used for internal fixation after satisfactory fracture reduction had been achieved. A plate of length that provided ≥ 4 plate holes proximal to the fracture was selected. Longer plates were preferred in order to increase the span of fixation. A submuscular tunnel along the lateral aspect of femur was created using an osteotome. The plate was inserted through the tunnel and the level of the distal end of the plate checked by fluoroscopy. A locking drill bit was inserted through distal part of plate. An additional incision was made to expose the proximal end of the plate after checking the level in fluoroscopy and a drill bit is passed through the cortical screw hole in order to prevent helicopter effect of the plate. Adequate length locking screws were inserted in the distal part. A conventional cortical screw was usually inserted through the combination hole to compress the fracture and adjust the alignment, then locking fixation screws were inserted with insertion guides. When femoral deformity was present and a precise fit of the distal femur anatomical locking plate on bone was not feasible, the plate was placed on the bone and locking screws were inserted so that the plate could function as an internal fixator. On the second or third postoperative day according to the pain perception of the patient, passive motion of the ankle and knee joints was started. Active exercises (straight leg raising and active knee flexion) were started 5 days after surgery.

Follow up

The patients were followed up 6 weeks, 3 months, 6 months, 1 year after surgery. At each follow-up visit, anteroposterior and lateral radiographs of the distal femur were taken to evaluate fracture union and callus formation. Bony union was established if bridging callus is present for three of four cortices on orthogonal radiographs (18). The functional outcome was assessed by measuring range of motion and the Hospital for Special Surgery (HSS) score of the knee joint (19).

Results

The mean duration of surgery was 90 mins (range, 60–180 mins). Mean intraoperative blood loss was 140 ml (range, 100–200 mL); 2 patients required blood transfusion because postoperative hemoglobin was low. Mean postoperative hospital stay was 7 days (range, 5–10 days). Knee flexion was >60° in 10 (66%) patients before discharge from the hospital. Bridging callus was visible in 8 patients 6 weeks after surgery. Rest patients showed bridging callus from 2 months. Bony union was confirmed three months after surgery in six fractures, four months in six fractures, and remaining three within six months.

At six months, the mean range of knee flexion was 100° (range, 80°–120°) and the mean HSS score 74 points (range, 62–90 points).In 4 patients terminal 100 extension was not possible after 2 months which improved to some extent after physiotherapy but full extension didn't return even at 1 year. There were

2 cases of infection which were treated with culture sensitive antibiotics. There were no cases of nonunion, implant cutout or other complications.

Parameters	Mean	Range
Age	44	35-65
Duration of Surgery	90 mins	60-180 mins
Blood loss (Intra operative)	140 ml	100-200 ml
Knee flexion at 6 months	100^0	80^0 - 120^0
Harris Hip Score at 6 months	74	62-90

Table 1. Showing the different outcome parameters in tabular form

Fig 1. Showing pre-operative X-Ray, immediate post operative X-Ray & 2 months post operative X-Ray

Discussion

In this study we found that distal femur locking plate fixation in distal femur fractures in post-polio paralytic limb provide satisfactory functional outcome.

The incidence of fracture in aging post-polio patients ranges from 28% to 38%; they occur predominantly on the side of polio involvement2,9. The commonest site of fracture in post-polio patients in our center was the distal femur and most fractures occurred in the leg affected by polio like the above-mentioned study.

The high incidence of fracture in post-polio patients may, in part, result from the high incidence of falls during activities of daily living, which may be as high as 64% within 1 year and 79%–82% over 5 years2,9. In our study also 86.6% patients underwent fall and fractured the polio affected limb which is fairly similar to other existing studies.

Only 4% of post-polio patients (mean age, 59 years) have normal bone density and 40% have osteopenia9. Furthermore, the bone mineral density in the limb affected by poliomyelitis (the weaker and shorter limb) is characteristically less than that in the other (stronger and longer limb)6,9, which is the cause of high fracture risk in the limb affected by poliomyelitis.

The surgical treatment of polio affected limb fractures are difficult due to the fact that the bone is profoundly osteopenic, smaller and deformed. So gentle handling is very much essential in order to prevent iatrogenic fractures. Again, due to osteopenia cortical screw hold is weaker therefore locking screws are preferred. Due to deformity in the bone maintaining alignment and rotation and plate fixation is also difficult and time consuming. In case of metaphyseal comminuted fractures length, alignment and rotation is reproduced and plate fixation is done in a minimally invasive way. Therefore, longer operative times and greater intra-operative blood loss than normal is usually expected here15,16.

Different types of implants and treatment methods are available for reduction and fixation of distal femoral fractures. We didn't use angled blade plates in our cases because of the large incisions they involve and their requirement for direct compression of the plate on bone, which causes disruption of the blood supply at the fracture site and during making the slot of blade plate for its insertion sufficient amount of bone needs to be cut which may be deleterious is smaller, deformed and severely osteopenic bone. Intramedullary nails, especially those with multiple distal locking screws, do improve stability of distal femoral fractures and require minimal incisions21. However, these devices are relatively contraindicated for comminuted fractures such as intercondylar fractures (type 33-C) or post-polio patients with deformity and small femoral shafts and medullary cavities12.13.14. Furthermore, flexion contracture of the knee joint can impede entry of nails19,20 and the osteoporosis that is so often present in these patients6,9 may increase susceptibility to implant cutout21.

In recent years, Distal femur anatomical locking plates have been increasingly used for treating metaphyseal comminuted fractures22. In contrast to conventional screw-plate systems that depend on the bone-plate interface for stability23. Distal femur anatomical locking plates have been designed with a fixed-angle construct, enabling placement of the plate without any contact with bone16,24,25,26. With associated insertion guides, these plates can be inserted and fixed by minimally invasive techniques22. These characteristics of distal femur anatomical locking plates facilitate closed reduction of these fractures with preservation of the fracture hematoma. Distal femur anatomical locking plates have improved fixation strength, pull-out strength of locking screws and purchase in osteoporotic

bone16,22,24,25. Due to these advantages, distal femur anatomical locking plates were helpful in our patients with post-polio syndrome.

In a previous study, surgical management of 13 femoral fractures in post-polio patients with distal femur anatomical locking plates resulted in radiographic union in 12 fractures by 12 to 20 weeks after surgery and return to the same level of disability at the end of follow-up as before occurrence of the fracture; only one patient had nonunion with a decreased disability score and daily walking time17. However, some of the patients in that previous study had proximal femoral fractures17, whereas in this present study, we used distal femur anatomical locking plates only for distal femoral fractures. The present results are comparable to those of the previous study and confirmed that distal femur anatomical locking plates result in satisfactory union and functional outcomes in post-polio patients with distal femoral fractures17.

In our case series all the fractures were treated in minimally invasive technique in order to promote indirect healing and callus formation. In cases of intra-articular component only the articular reduction was done by exposing the fracture site but the metaphyseal fracture was dealt in a minimally invasive indirect reduction technique. The theoretical possibility of nonunion with LCPs did not occur. In a systematic review of distal femoral fractures (excluding periprosthetic fractures) treated with LCPs, complications included nonunion (0%–19%), delayed union (0%–15%) and implant failure (0%–20%)27. Bone in polio affected limb is small deformed and hypo-vascular. Due to this hypo-vascularity bone healing may be impeded theoretically. But in our study, we did not encounter any non-union probably because biologic fixation was done in all of our cases preserving the fracture hematoma. Moreover, minimal periosteal stripping was done to preserve the blood supply. Another concern is that poor bone stock quality caused by osteoporosis can result in poor implant anchorage in the distal femur, leading to screw cutout. In our cases, there were no screw malposition's or cutouts or implant failure. The angular fixation of screws with plate in distal femur anatomical locking plates used in these patients may explain the absence of these complications.

Limitations of the present study are the small sample size. So, we can't separately analyze results for intra-articular and extra-articular fractures and we didn't assign any control group also.

However, the study confirms that distal femur fractures in polio affected limb should be treated properly by plating with distal femur anatomical locking plate in-order to rehabilitate the patient properly. In most of the cases biologic and minimally invasive plating should be tried without disturbing the metaphyseal fracture site maintaining proper length, alignment and rotation to promote indirect fracture union and callus formation.

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