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Case Report

Distal femur arthroplasty for non-union distal femur fracture with failed osteosynthesis in osteoporotic octogenarian: a case report with literature review

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ABSTRACT

Distal femur fractures (DFF) in the elderly have high morbidity and management challenges. The low energy trauma commonly presents significant fracture comminution, osteoporosis, pre-existing knee arthritis, co-morbid medical conditions affecting the union, weight-bearing potential and rehabilitation with profound functional disability. An octogenarian presented with a failed osteosynthesis resulting in non-union of a distal femur fracture compounded by osteoporosis and knee arthritis. He had been non-ambulatory with a painful, deformed knee. Management with a single-stage removal of the distal femur locked plate constructs and the defect reconstruction with the distal femur arthroplasty (DFA). The outcome was a pain-free weight-bearing mobilization with a functional range of knee motion. The surgical management in the elderly for the displaced intra-articular distal femur fractures is to restore the limb length and articular congruence for a functional knee. Fixation with either a distal femur locking plate or an intramedullary nail has a propensity for non-union, malunion, knee stiffness, and failed fixation. Salvage procedure gives good functional outcomes in failed osteosynthesis with DFA. The arthroplasty allows an immediate pain-less weight-bearing potential with improved ambulatory status and quality of life. The single-stage procedure in the elderly can regain a stable, functional knee joint.

Keywords: Distal femur fracture, Total knee replacement, Locking plate, Non-union, Comminuted fracture

INTRODUCTION

The DFF in the elderly presents an inherent challenge in management.[1] The increased aging population presents an increased incidence of DFF.[2] Though they are associated with low energy trauma, the presentation has significant fracture comminution with associated osteoporosis, knee arthritis, and poor ambulatory status.[3,4] There has been high morbidity and mortality associated with DFF in the geriatric age group, similar to a proximal femur and hip fracture.[4-6] A distal femur locking plate (DFLP) is considered a standard fixation technique for the majority of DFF's.[2,4] Advancements with minimally invasive submuscular or less invasive fixation techniques, supplemented by bridge plates for metaphyseal comminution and use of poly-axial locking plate construct have allowed for a more reliable biological fixation construct.[4,5] However, there are still high non-union and fixation failures with DFLP's.[4,7,8] The risk factors for non-union and fixation failures in the elderly include metaphyseal fracture comminution, very distally located fractures, missed Hoffa or condylar fractures, open fractures, osteoporosis, rigid fixation with a limited working length of plate constructs, poor soft tissue handling, poor pre-injury weight-bearing ambulatory status and decreased cognitive function.[2,4,6-8]

A non-union of DFF in an osteoporotic elderly with failed osteosynthesis presents complex scenario.[2,5,9] Management options available are re-osteosynthesis, arthrodesis and DFA. It requires consideration of physiological age, available bone stock, functional knee

demands and socio-economic status to determine line of management.[8] It poses a clinician's dilemma.

We reported a single-stage removal of failed osteosynthesis following DFLP and reconstruction with a DFA, which allowed an excellent functional knee recovery, early weight-bearing potential and a painless knee in the elderly to manage the problematic clinical scenario. By this treatment, the risk of non-union was eliminated.[7] We also reviewed the literature and suggested an optimal DFA that maximized the outcome.

CASE REPORT

An 89-year-old male presented to us with pain and swelling along with the right knee and could not bear weight on the right lower limb in April 2019. He had a history of trauma due to a fall at home around one year ago. He had undergone surgical fixation for right knee DFF by DFLP fixation elsewhere. He could not bear weight and ambulate with toe-touch walker-support walking following his surgery (Figure 1A). He presented a painful varus angulated knee with 20 degrees of flexion deformity (Figure 1 B and C). Any attempted movements at the knee joint were resisted. There were, however, no signs of local induration, the skin condition was healthy, and the local temperature was maintained. The acute phase reactants, including C-reactive protein, serum pro-calcitonin, erythrocyte sedimentation rate was reported within the normal range. Antero-posterior and lateral view radiographs of the right knee showed knee in flexion with a severe degree of varus angulation along with a distal femur laterally placed locking plate, a cancellous screw along posteromedial condyle femur with non-union of femoral condyles, implant loosening, arthritic changes, and decreased bone density (Figure 2). The knee society function score was zero at the time of presentation. He was graded as grade III American society of anaesthesiologist grade on evaluation. A reconstruction was planned with the resection of the distal femur and the removal of the loose implant and DFA with a cemented distal femur modular mega-prosthesis system. Prophylactic antibiotics and thrombo-prophylaxis medications were used.

Under tourniquet control, the midline longitudinal incision was used, and medial parapatellar extension was done for knee arthrotomy. The loose implants were removed, and the non-united distal femur was carefully dissected *en bloc* (Figure 3). Care was taken to avoid any injury to the neurovascular bundle. The distal femur was appropriately cut at the diaphyseal level to obtain around ten cm of the distal femoral defect (Figure 4A). We used a cemented XLO modular rotating hinge resection mega-prosthesis system to reconstruct the knee joint and massive bone defect. The tibial arthritic surface was prepared with freehand technique maintaining the neutral posterior tibial slope. The routine femoral and tibial canal preparation was done with adequate canal suction. The trial components were used to check for alignment, limb length, patellar tracking and proper soft tissue envelope coverage. The cementation of the femur and tibia was completed simultaneously with the replacement of trial components with original implants (Figure 4 B and C). The wound closure was done over a negative suction drain, and a compression bandage was given. Knee was immobilized with an extended knee brace. Postoperatively, intensive care monitoring was done for initial 24 hours.

In the immediate postoperative period, one unit of blood was transfused. Thrombo-prophylaxis initiated in the preoperative period was continued in the postoperative period. The suction drain was removed after 48 hours. The immediate postoperative radiograph showed good alignment (Figure 5 A and B). The patient was allowed weight-bearing walking with walker support within 48 hours postoperatively (Figure 5C). He progressed well to get discharged in the next three days of his hospitalization.

Progressive knee mobilization was encouraged and walker support walking with knee brace was continued for the next three weeks. After suture removal, the knee brace support was discontinued and he progressed to independent walking without support within a month. An increased knee society function score of 75 was noted at three months. An uneventful follow-up at 6 and 12 months with good progression was noted. At two-year follow-up, there was no knee laxity clinically, and there were no signs of implant loosening radiologically. He was an independent walker with a functional knee range of movements from 0 to 100 degrees without pain or need for walking support, allowing him all his daily routine activities.

Figure 1 (A-C): Preoperative clinical image shows shortening with walker-assisted walking with preoperative clinical image shows knee varus and flexion deformity (marked with white arrow).

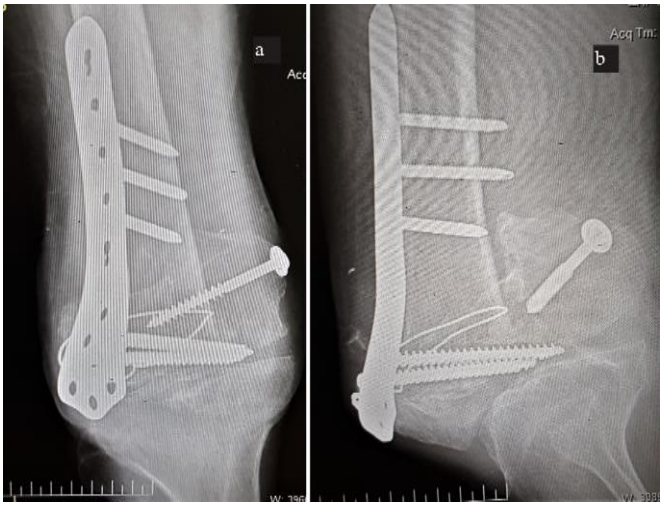

Figure 2 (A and B): Antero-posterior and lateral view radiograph of the right knee with nonunion and implant failure.

Figure 3 (A and B): Resected distal femur per-operative specimen with arthritic joint surface and non-united condylar fragment.

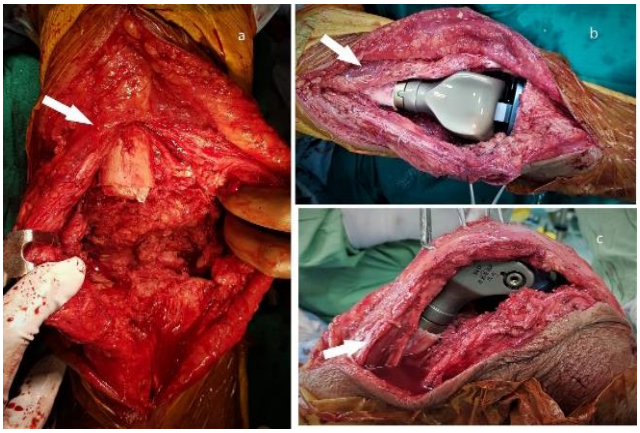

Figure 4 (A-C): Intra-operative image of right knee region after resection of the right distal femur (thigh marked with white arrow) with intra-operative image after cementation and distal femoral prosthesis implantation in anteroposterior and lateral view.

Figure 5 (A-C): Antero-posterior and lateral view radiograph of the right knee with distal femur replacement with postoperative clinical image shows immediate mobilization with walker support.

DISCUSSION

The DFF with failed osteosynthesis had limited management options with either a re-osteosynthesis, DFA, or knee arthrodesis. The DFA presents unique challenges when planning for a failed osteosynthesis in DFF.

The DFA was reserved for the elderly with comminution and osteoporosis.[8] In the systematic review for DFF non-union, only 10 cases underwent DFA out of the 169 reported cases. 61.5% of non-unions were augmented with bone graft and fixation with either a fixed angle blade plate, intramedullary nail, condylar buttress plate construct or an external fixator.

In a retrospective COHORT study, acute comminuted articular DFF in the elderly above 70 years was studied. Thirty-eight patients were included, 10 underwent acute DFA, and 28 were treated by fixation. DFA was ambulatory at one-year follow-up compared with the fixation group, and no one was wheelchairbound.[10] The authors concluded that ambulation was early with DFA.

In a comparative retrospective cohort study designed to confirm the effectiveness of DFLP in 68 cases with periprosthetic and 57 cases with non-periprosthetic fracture management, the authors found similar outcomes with similar union rates in both groups. However, there were increased chances for non-union when comminution was present in both the groups of DFLP.[7]

Another systematic review for treating acute geriatric DFF with either fixation or DFA included 36 studies with 766 DFF's to conclude that similar complication rates are observed in both the treatment options.[11] The study concluded that the decision making remains controversial with guiding factors emphasized on the fracture

configuration, bone quality, pre-injury walking ability, medical comorbidities and surgeon expertise.

DFA had been accepted more as a salvage procedure than a primary DFF management option.[12] The DFA had the advantage of allowing immediate weight-bearing potential with the elimination of the possibility for fixation failures and non-union when used for an acute DFF.[2] However, the extensile exposure and dissection, the possibility of deep infection, aseptic loosening and limited options following a failed DFA have been reported as significant deterrents as a primary management option in the elderly.[3,11,12]

DFA as a salvage procedure in a DFF with failed osteosynthesis or a periprosthetic fracture requires meticulous planning.[4,12,13] The challenges can be minimized with specific technical considerations to reduce the complications during a DFA.[13] The available literature was reviewed for the technical considerations and technical tips were discussed for an effective DFA.

The failed implant has an underlying concern for an indolent infection not visible to the naked eye. The preoperative evaluation needs biochemical and acute phase reactant markers and radiological assessment for radiolucent lines or evidence of loosening.[14] The medical comorbidities and anaesthesia risk assessment should further guide the risk-benefit ratio for the procedure. Any cognitive dysfunction may impair the eventual functional outcomes. Thrombo-prophylaxis and stringent precautions for aseptic measures for a DFA are advisable.

The midline incision with a medial parapatellar extension of arthrotomy is usually preferred.[13] However, the previous approach may require the surgeon to alter his planned or preferred surgical incision.[14] The fibrosis along the operated femoral segment and the proximity of the neurovascular bundle to distal femur resection need careful dissection of posterior structures.[1] The DFLP removal may present difficulties due to damaged screws during implantation surgery, bone ingrowths into screw holes, and the possibility of abnormal shearing forces leading to peri-implant fractures. The distal femur resection should be ascertained by preoperative planning to accommodate the minimum size of the distal femur prosthesis. Any rotational or axial malalignment during implantation should be avoided. The rotation can be guided by the predetermined marking of femoral resection or by aligning and approximating the linea-aspera along the posterior femoral shaft.[1,14,15] Trial implantation and patellar tracking will ensure proper joint line restoration to prevent any subsequent limitation of knee motion.[14,16] The poor bone quality due to disuse osteoporosis following a DFLP may need a longer extension rod to protect from stress shielding.[17] The length of the distal femoral stem tip may erode the femoral cortex while negotiating the femoral curvature and present with the postoperative painful thigh. The appropriate length needs to be ascertained with the preoperative templating. Additional challenges may arise with a proximal femoral fixation or an arthroplasty implant. The limb length discrepancy needs to be compensated for without compromising the implanted knee's stability, patellar tracking, and avoiding any possible neurovascular deficit. The soft tissue envelope may be compromised due to poor nutritional, dietary, or inactivity-related wasting of muscles in the elderly and present with additional challenges in soft tissue coverage of implant with myo-plastic procedures.

A salvage procedure with a rotating hinged DFA will allow an optimal knee function with a low reoperation rate and reliable implant survivorship in an osteoporotic elderly.[13-15]

CONCLUSION

A complex situation of non-union for a DFF with implant failure in an osteoporotic elderly can be managed with a single-stage DFA with an excellent functional knee outcome and immediate weight-bearing potential.

The challenges in managing a resistant non-union of the distal femur in geriatric cases can be managed with a case-based approach with a single-stage DFA.

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