

Original Research Article

Reconstruction of complex distal femur open fracture with distal femoral locking plate and primary autologous free fibular graft

Rajagopal H. P., Madan Mohan M.*, Anoop Pilar, Keith Behram Tamboowalla

Department of Orthopaedics, St. John's Medical College Hospital, Sarjapur Road, Bangalore, Karnataka, India

Received: 13 July 2017

Revised: 08 August 2017

Accepted: 10 August 2017

*Correspondence:

Dr. Madan Mohan M.,

E-mail: madanmmohan@yahoo.co.in

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ABSTRACT

Background: Distal femur fractures are high velocity injuries which accounts for 7-10% of all femoral fractures. These injuries are complex injuries which are difficult to manage. Despite advances in techniques and implants, treatment remains a challenge, in many situations.

Methods: We present a retrospective review of 8 cases, involved in high velocity road traffic accident who presented to emergency department at St. John's Medical College, Bangalore, Karnataka, India between September 2011 to December 2015, with complex open fracture of the distal femur with bone loss. All were managed with initial wound debridement and skeletal traction. Subsequently fractured femur was reconstructed with distal femoral locking plate stabilization, along with autogenous non vascularised fibular graft and cortical-cancellous graft bridging the bone defect. Radiological union, functional outcome measured with Tegner and Lyslom scores, KOOS score and complications were assessed.

Results: At average 5 years follow up, all the fractures have united well, with good functional outcome. X-ray showing united fracture with incorporation of the fibular graft. According to Tegner and Lyslom scoring, 6 patients had good rating, 2 had satisfactory rating. Average KOOS score was 82.15. Shortening of 2 cm and 4 cm in couple of patients was the major complication.

Conclusions: Delayed primary surgery, using autologous non vascularised free fibular graft in conjunction with a locking compression plate, with autogenous cortico-cancellous graft is an effective, less technically demanding and cost effective means of reconstruction option to manage bone defects in complex open fractures of the distal femur. An overall acceptable results in terms of fracture union, fibular incorporation, adequate restoration of knee motion and early rehabilitation can be expected.

Keywords: Complex open fractures, Distal femur, Distal femoral locking plate, Fibular

INTRODUCTION

Distal femur fractures are consequent to high velocity trauma causing direct application of load to a flexed knee. It accounts for 7-10% of all femur fractures.¹ Historically, distal femoral fractures have been orthopaedic challenges, due to its proximity to the knee joint, as regaining full range of movement and function may be difficult and the fractures most often are open, unstable and comminuted.

Various modalities of treatment including fixation options and grafting are described and the lack of consensus may be attributable to the complexity of these fractures.²⁻⁸

Objective of the study

In the present case series, we present our results of staged reconstruction with distal femoral locking plate, primary

autologous fibular graft and cortico-cancellous grafts in management of bone defects in complex open fractures of the distal femur.

METHODS

From September 2011 to December 2015, 8 cases involved in high velocity road traffic accident who presented to emergency department at St. John's Medical College, Bangalore, Karnataka, India with open comminuted distal femoral fractures with bone loss were included in this study.

All patients presented with pain, swelling, and open wounds in the thigh. On examination patients were hemodynamically stable with no significant non-orthopaedic injuries. There was local tenderness, crepitus, and abnormal mobility in the distal part of the thigh. There was no distal neurovascular deficit. All the cases were of type 3A according to modified Gustilo and Anderson classification with extruded bone fragments and comminution at meta-diaphyseal region of femur.⁹

Radiographs and CT scans was done to assess the fracture type and intraarticular extension, and to know the amount of displacement, depression, angulation and aid in surgical planning. The fractures were all AO/OTA (Arbeitsgemeinschaft furosteosynthesfragen/orthopaedic trauma association) type-C2 supracondylar fractures of the femur.^{10,11}

Management of the injuries was done in a staged manner with initial debridement done at the time of admission, with removal of loose pieces of the bone, copious lavage with normal saline. None of the patients had skin loss. Skin margins were freshened and approximated with widely placed sutures. Subsequently patients were put on proximal tibial skeletal traction. One of the patients had a floating knee injury with mid shaft tibia and fibula fractures also. He was put on joint spanning external fixator after debridement.

Broad spectrum intravenous antibiotics were administered and regular antiseptic dressing was done. Wound cultures were done on the second and fifth day after admission.

Both cultures were free from any growth of organisms. While planning for the second stage, we encountered segmental bone loss of about 6-8 cms. After considering various options, we decided for reconstruction with distal femur lock plate fixation with an ipsilateral autogenous free fibular graft, a cortico-cancellous graft, bone substitutes to bridge the bone defect.

After 14 days when the debrided wound healed with negative cultures the fracture was approached laterally and reduced. We harvested an autogenous fibular graft from the ipsilateral leg. The fibular graft was inserted into the medullary canal both proximally and distally bridging the defect and fixed with a distal femoral locking plate bridging fracture and locked distally and proximally with quadricortical fixation at the fibular graft site. Cortico-cancellous graft from the ipsilateral iliac crest and bone substitutes were packed into the fracture site to fill the defect and the wound was closed in layers over a negative suction drain.

Postoperative radiographs showed good alignment of the fragments. The autogenous free fibular graft was seen inside medullary cavity with surrounding cortico-cancellous graft. Postoperatively, the patients were treated with continuous passive knee movement until more than 60° flexion was achieved. All patients received physiotherapy beginning on postoperative day 1 and were allowed non weight bearing ambulation with walking aid assistance. Follow up was done monthly for initial six months and subsequently yearly for 5-6 years. Parameters analyzed included demographics, time to radiographic fracture union, knee range of motion, and functional outcome measured with Tegner and Lyslom scores, KOOS score. The scoring was performed during the outpatient follow-up review.

RESULTS

The mean age of the population was 34.8 (29-42) years (Table 1). All were male. Radiographic presence of trabeculae across the fracture site with the absence of pain on palpation and weight bearing was defined as union.

Table 1: Patient characteristics and outcome.

Case	Age/Sex	Follow up (years)	Range of movement (degrees)	Tegner & Lyslom	KOOS	Complications
1	30/M	5	0-100	Good	84	Nil
2	38/M	5	0-100	Good	83.33	Nil
3	35/M	5	0-90	Good	82.33	Nil
4	29/M	4	0-90	Good	85	Nil
5	32/M	6	5-100	Satisfactory	80	4 cm shortening
6	42/M	5	0-100	Good	83.33	Nil
7	33/M	5	0-110	Satisfactory	79.33	2 cm shortening
8	40/M	2	0-100	Good	80	Nil

The mean time to union was 18.48 (16-24) weeks (Figures 1 and 2). The mean time to follow-up was 5 (3-6) years. The functional range at final review was good, as all patients achieved a minimum flexion of 90° (90-110; mean, 100.4°). Activity of daily living was restored in all the 8 patients and all returned to work by 6-8 months. None of the patients required any further surgical interventions. Shortening was the major complication encountered which was addressed satisfactorily with shoe rise.



Figure 1: A, B- preoperative radiographs. C- postoperative radiograph following reconstruction. D, E- radiograph 36 months postoperatively showing fracture union and consolidation.



Figure 2: A, B- preoperative radiograph. C- postoperative radiograph following reconstruction. D, E- radiograph 42 months postoperatively showing fracture union and consolidation.

DISCUSSION

Distal femur fractures are high velocity injuries accounting for 7-10% of femur fractures. Comminuted distal femur is an Orthopaedic challenge as they are intraarticular, unstable, and most often open injuries. Reconstruction of these fractures is challenging as it requires anatomical restoration of the congruity of articular surface of knee joint and achieve fracture union, to fix the fracture with adequate stability internally to allow early rehabilitation and mobilization, and to reduce the complications like joint stiffness and shortening.

In our case series we addressed stable internal fixation with distal femoral locking plate, defect by autogenous nonvascularised free fibular graft and graft substitutes.

Ramesh et al in their series demonstrated that surgical repair with fibular strut, cortico-cancellous graft, and Ilizarov ring fixation is a suitable option for treatment of C3 distal femoral fractures.⁴ 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. Expertise in Ilizarov application and patient acceptance are major drawbacks of this method.

Lawal et al in their series on Use of non-vascularized autologous fibula strut graft in the treatment of segmental bone loss addressed stability with external fixator and concluded autologous free, non-vascularized fibula and cancellous graft is a useful addition to the armamentarium of orthopedic surgeon in developing countries attempting to manage segmental bone loss, whether created by trauma or excision of tumors.⁶

Yajima et al treated 20 patients with large bone defects or established nonunion of the femur due to various causes by vascularised fibular grafts (mean length of the fibular grafts was 18.1 cm) achieving successful outcome in 19 of the patients.⁷ They highlighted the need for special microsurgical techniques. More operative time, need for use of external fixator for holding alignment, weakness of the grafted fibula and difficulties with the monitoring flap of skin.

Muramatsu et al reviewed 17 patients for a mean of 25 months after free vascularised fibular transfer to reconstruct massive bone defect or recalcitrant non-union of the femur of varying etiologies and achieved 94% confirmed bone union.⁸ They concluded vascularised fibula grafting is a reliable and safe reconstructive procedure for massive femur defects. Folded or double fibula grafts cannot prevent stress fractures and the key point is to rigidly stabilise the femur in an anatomically aligned position.

Gawri et al in their case report concluded that using autogenous nonvascularised free fibular graft in conjunction with a locking compression plate is a viable/sagacious option to manage bone defects in complex open supracondylar fractures of the femur.⁵ This planned single stage well timed definitive operative intervention helps save the patient from lot of misery and financial burden.

CONCLUSION

Delayed primary surgery with autogenous non vascularized free fibular graft, cortico cancellous graft stabilizing fracture by distal femoral locking plate allowing early rehabilitation is an acceptable, less expensive and widely reproducible option to manage bone defects in complex open distal femoral fractures achieving union, preserving length and motion with no

donor site morbidity, giving patients good functional outcome.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Rajagopal HP, Madan Mohan M, Pilar A, Tamboowalla KB. Reconstruction of complex distal femur open fracture with distal femoral locking plate and primary autologous free fibular graft. *Int J Res Orthop* 2017;3:1066-9.