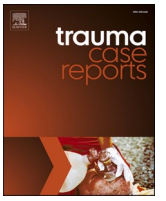
Trauma Case Reports 42 (2022) 100712

Contents lists available at ScienceDirect

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr



Fibular strut graft placement for an open distal femur fracture with a critical bone defect: A case report

Juan Reátiga [a,*], Laura Arzuza [b], Julio Guzmán [c], Juan Molina [c], Ximena Ríos [a]

[a] Orthopedics and Traumatology, Grupo Campbell, Barranquilla, Colombia
[b] Epidemiology, Grupo Campbell, Barranquilla, Colombia
[c] Physician, Fundación Clínica Campbell, Barranquilla, Colombia

ARTICLE INFO

Keywords:
Open fracture
Distal femoral fracture
Grafting
Fibular graft

ABSTRACT

Case: We herein present a case involving a 23-year-old man with an open fracture of the distal portion of the left femoral diaphysis, substantial bone loss, and soft tissue injuries. He was initially treated with antibiotics, limb stabilization, and surgical debridement. On the sixth day, he underwent internal fixation and fibular strut graft placement for bone defect restoration. After 4 years, osteosynthesis, perfect graft integration and consolidation, excellent knee functionality, and painless gait were evident.

Conclusion: Preservation of bone and soft tissue vitality, complete debridement, antibiotic therapy, and early limb stabilization are all crucial factors for restoring knee functionality.

Introduction

Distal femoral fractures are high-energy injuries that account for 5 % to 10 % of all open fractures. Patients with these fractures frequently exhibit critical bone defects caused by high-energy trauma in the supracondylar areas.

Critical bone defects have been characterized in the literature as defects with a length of >1 to 2 cm and circumferential loss of >50% [1]. Current treatment methods include bone transplantation, distraction osteogenesis, and the induced membrane technique (Masquelet technique) [2].

We herein present a case involving a patient who underwent treatment of an acute bone defect with a fibular prop graft and was followed up for 4 years. Informed consent was obtained prior to treatment, and the case was registered.

The purpose of this paper is to present a treatment option for patients with this type of severe femoral injury.

Case report

Description and clinical diagnosis

A 23-year-old man who had been involved in a motorcycle accident (Figs. 1, 2) was diagnosed with a Gustilo III-A [3], Orthopedic Trauma Association 33C2.3 [4] multifragmentary metaphyseal fracture, extensive bone loss, soft tissue injury, and excessive bleeding. However, no neurovascular damage was noted after clinical examination and left thigh and knee imaging via plain radiography and

* Corresponding author.
E-mail address: juan.reatiga@clinicacampbell.com.co (J. Reátiga).

https://doi.org/10.1016/j.tcr.2022.100712
Accepted 2 October 2022

Fig. 1. Knee X-ray, anteroposterior view.

Fig. 2. Soft tissue wound of the knee.

computed tomography. The patient was thus suspected to have an open fracture of the left supracondylar femur and distal diaphysis.

Treatment

Initial treatment included the administration of cephalosporin, aminoglycoside, and crystalline penicillin as well as surgical lavage and debridement, application of an external fixator encompassing the knee for damage control, and implantation of gentamicin-

Fig. 3. Fibular strut graft.

impregnated polymethylmethacrylate beads. After the surgery, the patient was hospitalized in the intensive care unit for 3 days to establish hemodynamic stabilization. After 3 days, a second debridement was performed, and after 6 days, the patient underwent open reduction and internal fixation of the distal femur as well as fibular strut graft implantation (Figs. 3, 4). Following open reduction and internal fixation, the patient received antibiotic therapy for 72 h before the initiation of physiotherapy to enhance the range of motion of the knee.

Follow-up

Clinical and radiological follow-up at 4 years postoperatively revealed a painless gait, a visual analog scale score of 0/10, no requirement of external supports, a stable left knee without laxity or signs of posterior flaccidity, range of motion from 0° to 50°, healed wounds, and no signs of infection. The patient's knee functionality score on the Oxford knee functionality assessment scale was 44 points, which is considered excellent. Furthermore, the patient exhibited intact osteosynthesis, fracture consolidation with adequate bone formation, and fibular strut graft integration with preserved and symmetrical joint spaces (Fig. 5).

Discussion

Open fractures caused by high-energy trauma represent a therapeutic challenge when associated with critical bone defects [5].

In our case, we consider that the thorough two-stage management regimen that was implemented from the time of patient admission (first stage: antimicrobial prophylaxis, debridement and surgical lavage, and external fixation; second stage: open reduction procedure with internal fixation followed by autologous fibular strut graft placement) facilitated satisfactory incorporation of the fibular tissue into the femoral bone in a cost-effective manner. The advantages of this management technique over the incorporation of a bone graft are provided by different mechanisms, such as the role of vascular endothelial growth factor and transforming growth factor beta 1 in Masquelet's membrane and the influence of a polymethylmethacrylate spacer [6]. Additionally, Yadav [7] highlighted the relevance of the autologous fibular strut graft for bringing osteogenesis to the area of nonunion and discussed the association between an increased probability of early union and strengthening of the osteopenic host bone as well as the length of the endosteal surface.

The treatment and outcome described in our case report are comparable with those described by Masquelet et al. [8] in their case series involving 35 patients who underwent reconstruction and by Gopal et al. in their review of 84 patients. In both of the aforementioned studies [9], interventions were performed in two stages: the first stage involved treatment with radical debridement, soft tissue repair with flaps, and acrylic cement spacer and external fixator placement, and the second stage involved cement extraction after 6 to 8 weeks as well as keeping the membrane covered with the spacer and then filling it with a fragmented spongy autograft. Satisfactory outcomes, a low infection rate, and adequate patient performance were achieved.

Kumar et al. [10] reported that the use of external axial fixation and application of a locking plate with a collagen sheet

Fig. 4. Postoperative radiographic findings.

Fig. 5. Radiographic follow-up after 4 years.

impregnated with antibiotics after debridement is an efficacious treatment option for adequate consolidation, excellent radiological and functional results, and infection prevention.

Dugan et al. [11] also demonstrated optimal results in the treatment of grades IIIA and IIB and types C2 and C3 open supracondylar femoral fractures using a two-stage approach: complete initial debridement and definitive early fixation with a lateral plate combined with the placement of antibiotic microspheres, which stopped the course of the soft tissue injury, restored the length and alignment, and prevented wound infection. Similar results were reported by Barei and Beingessner [12], who treated all fractures with open reduction, internal fixation with a lateral locking plate, antibiotic beads (depending on the case), and posterior bone grafting. Despite medial comminution, the lateral blocking plate prevented the occurrence of several collapses without the need for surgical intervention.

Consolidation of the autologous fibular strut graft in our case was observed 12 months postoperatively. Liu et al. [13] reported that the mean time to achieve union when vascularized and nonvascularized fibular grafts were used was 21.3 and 30.5 weeks, respectively ($P = 0.310$), with an average time to bone healing of 26.8 weeks. This differed from the average time of 28 months (range, 3–120 months) described by Wang and Weng [14]. Yadav [7] reported a much shorter time for the repair of nonunion using internal fixation and a strut allograft (mean of 17 weeks to union; range, 8–26 weeks).

In conclusion, preservation of bone and soft tissue vitality as well as complete debridement, antibiotic treatment, and early stiffness stabilization are key factors in completing the injury cycle, eradicating nidus infection, and restoring the function of the damaged limb.

Acknowledgment

We thank Angela Morben, DVM, ELS, from Edanz (www.edanz.com/ac), for editing a draft of this manuscript.

References

[1] E.H. Schemitsch, Size matters: defining critical in bone defect size!, J. Orthop. Trauma 31 (10) (2017) S20–S22.
[2] E. Roddy, M.R. DeBaun, A. Daoud-Gray, Y.P. Yang, M.J. Gardner, Treatment of critical-sized bone defects: clinical and tissue engineering perspectives, Eur. J. Orthop. Surg. Traumatol. 28 (3) (2018) 351–362.
[3] B.B. Ramon Gustilo, J.T. Anderson, The McKee-fan-ar Total hip replacement. Preliminary results and complications of 368 operations performed in five general hospitals, J. Bone Jt. Surg. 140 (1975) 54–257.
[4] E.G. Meinberg, J. Agel, C.S. Roberts, M.D. Karam, J.F. Kellam, Fracture and dislocation classification Compendium-2018, J. Orthop. Trauma 32 (1) (2018) S1–S170.
[5] E. Boero, M.D.A.P. Mogollo, The treatment of femoral bone loss by axial external fixation and susbequent locking plate application: a case report, Injury 46 (2015) S31–S34.
[6] J.C. Vejarano-Solano, C.F. Ruiz-Semba, C.J. Ganoza-Arróspide, J.E. Hurtado-Fernández, Reconstrucción de defectos óseos segmentarios postraumáticos mediante técnica de inducción de membrana, Rev. Med. Hered. 26 (2) (2015) 76.
[7] S.S. Yadav, The use of a free fibular strut as a “Biological intramedullary nail” for the treatment of complex nonunion of long bones, JBJS Open Access. 3 (2) (2018), e0050.
[8] A.C. Masquelet, F. Fitoussi, T. Begue, G.P. Muller, Reconstruction of the long bones by the induced membrane and spongy autograft, Ann. Chir. Plast. Esthet. 45 (3) (2000) 346–353.
[9] S. Gopal, S. Majumder, A.G.B. Batchelor, S.L. Knight, P. De Boer, R.M. Smith, Fix and flap: the radical orthopaedic and plastic treatment of severe open fractures of the tibia, J. Bone Joint Surg. (Br.) 82 (2000).
[10] M.D. Kumar, R. Singh, R. Khiyani, K. Kaur, Svareen, Evaluation of results of open distal femur fractures with primary fixation and antibiotic impregnated collagen, Chin. J. Traumatol. 22 (6) (2019) 328–332.
[11] T.R. Dugan, M.G. Hubert, P.A. Siska, H.C. Pape, I.S. Tarkin, Open supracondylar femur fractures with bone loss in the polytraumatized patient - timing is everything!, Injury 44 (12) (2013) 1826–1831.
[12] D.P. Barei, D.M. Beingessner, Open distal femur fractures treated with lateral locked implants: union, secondary bone grafting, and predictive parameters, Orthopedics 35 (6) (2012) e843–e846.
[13] S. Liu, S. Tao, J. Tan, X. Hu, H. Liu, Z. Li, Long-term follow-up of fibular graft for the reconstruction of bone defects, Medicine (United States) 97 (40) (2018) 1–8.
[14] J.W. Wang, L.H. Weng, Treatment of distal femoral nonunion with internal fixation, cortical allograft struts, and autogenous bone-grafting, J. Bone Jt. Surg. 85 (3) (2003) 436–440.