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Case Report

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Revision Surgery for Atrophic Femoral Shaft Nonunion with Implant Failure Following Multiple Prior Procedures: A Case Report

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ABSTRACT

Background: Femoral shaft nonunion remains one of the most challenging complications in orthopaedic trauma surgery, particularly in patients with multiple previous failed interventions. Atrophic nonunion is associated with poor biological healing potential and may be further complicated by implant failure, making revision surgery technically demanding.

Methods: We present a case of a 50-year-old male with an atrophic femoral shaft nonunion and implant failure following two previous surgical procedures over seven years. A comprehensive revision approach was undertaken, including removal of the failed implant, debridement of sclerotic bone, restoration of the medullary canal by serial intramedullary reaming, and autologous iliac crest bone grafting. Definitive stabilization was achieved using an intramedullary nail augmented with a lateral dynamic compression plate.

Results: Postoperative radiographs demonstrated satisfactory alignment, stable fixation, and appropriate placement of the bone graft. The patient was managed with postoperative immobilization, physiotherapy, and planned gradual progression of weight bearing according to radiographic evidence of healing.

Conclusion: This case highlights the importance of addressing both biological insufficiency and mechanical instability in complex femoral shaft nonunion. Meticulous debridement, restoration of the medullary canal, autologous bone grafting, and dual fixation provide a comprehensive revision strategy for atrophic femoral shaft nonunion associated with implant failure.

Key-words: Atrophic nonunion; Bone grafting; Dual fixation; Femoral shaft nonunion; Implant failure; Revision surgery

INTRODUCTION

Femoral shaft fractures account for approximately 3–5% of all fractures, with nonunion rates ranging from 1–10% depending on the treatment modality and patient factors [1]. Intramedullary nailing remains the gold standard for femoral shaft fractures, with union rates exceeding 95% in uncomplicated cases [2].

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However, when nonunion occurs, management becomes increasingly complex, particularly in patients with multiple prior surgical interventions, biological compromise, and mechanical failure of implants [1,2].

Atrophic nonunion represents a particularly challenging subtype characterized by avascular, sclerotic bone ends with absent or minimal callus formation, indicating a significant biological deficit [3]. The presence of implant failure further complicates management, as it may reflect persistent mechanical instability and inadequate biological healing at the nonunion site [3,4].

Revision procedures for established femoral shaft nonunion generally require removal of failed fixation, thorough preparation of the nonunion site, restoration

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of viable bone surfaces, and appropriate biological augmentation [4,5]. Autologous bone grafting remains an important biological adjunct in the treatment of atrophic nonunion, while restoration of the medullary canal and stable fixation are essential for providing an appropriate mechanical environment for healing [4,6,7].

In complex cases with previous fixation failure, combined fixation using an intramedullary nail and supplementary plate may provide additional mechanical stability, particularly against bending and rotational forces [4,5]. This approach may be useful when conventional single-implant fixation is considered insufficient because of poor bone biology or previous mechanical failure.

We report a case of a 50-year-old male who presented with an atrophic femoral shaft nonunion with failed dynamic compression plate fixation following two prior surgical procedures over a seven-year period. The patient was successfully managed with a comprehensive biological and mechanical augmentation strategy involving removal of failed implants, debridement of sclerotic bone, restoration of the medullary canal, autologous iliac crest bone grafting, and dual fixation using an intramedullary nail supplemented with a lateral dynamic compression plate.

CASE PRESENTATION

Patient History

A 50-year-old male presented to the orthopaedic department with complaints of persistent pain, inability to bear weight, and deformity of the right thigh. Seven years prior, he had sustained a femoral shaft fracture following a road traffic accident and was initially managed with intramedullary nailing at another institution. One year after the index procedure, clinical and radiographic evidence of nonunion was noted. The intramedullary nail was subsequently removed, and open reduction and internal fixation was performed using a fibular strut graft and dynamic compression plate fixation. Despite this intervention, the patient continued to have symptoms, and subsequent follow-up demonstrated persistent nonunion with progressive implant failure. He was therefore referred to our tertiary care centre for definitive management.

Clinical Examination

On presentation, the patient had a well-healed anterior longitudinal surgical scar over the right thigh, tenderness over the mid-shaft of the femur, abnormal mobility and crepitus at the nonunion site, and approximately 2–3 cm shortening of the affected limb. Range of motion of the right hip and knee was restricted because of pain and disuse. There was no neurovascular deficit in the right lower limb and no clinical evidence of active infection, including erythema, warmth, or a draining sinus.

Radiological Evaluation

Preoperative anteroposterior radiographs of the right femur demonstrated an atrophic femoral shaft nonunion with sclerotic and tapered bone ends, absence of bridging callus, a broken dynamic compression plate with multiple screw failures, and surrounding osteopenia secondary to disuse (Fig. 1). Intraoperative fluoroscopy further confirmed the nonunion site, sclerotic margins, and retained failed hardware.

Fig. 1: Preoperative anteroposterior radiograph of the right femur demonstrating atrophic nonunion of the femoral shaft with a broken dynamic compression plate, failed screws in situ, and absence of bridging callus.

Surgical Management

Considering the biological compromise associated with the atrophic nonunion, mechanical failure of the previous fixation, and history of multiple surgical procedures, a comprehensive revision strategy was planned. The objectives were removal of failed implants, debridement of sclerotic and avascular bone, restoration of medullary canal continuity, biological augmentation with autologous iliac crest bone graft, and mechanical stabilization using dual fixation with an intramedullary nail and lateral plate.

The patient was positioned supine on a radiolucent operating table.

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Under general anaesthesia and fluoroscopic guidance, the previous anterior approach was utilized. Extensive soft-tissue dissection was required because of scarring from the previous surgeries. The broken dynamic compression plate and all screws were carefully removed, and the previously placed fibular graft, which had failed to incorporate, was also excised (Fig. 2).

Fig. 2: Photograph of the removed failed implants, including the broken dynamic compression plate and multiple screws.

The nonunion site was exposed and revealed dense, sclerotic, avascular bone margins (Fig. 3). Aggressive scraping and resection of the sclerotic bone were performed until bleeding, viable bone was encountered at both the proximal and distal fragments. The medullary canal was subsequently opened and serially reamed to accommodate an appropriately sized intramedullary nail (Fig. 4). Autologous cancellous bone graft was harvested from the ipsilateral iliac crest and densely packed at the nonunion site to provide biological augmentation.

Fig. 3: Intraoperative photograph showing exposure of the nonunion site with dense, sclerotic and avascular bone margins during debridement.

Fig. 4: Intraoperative photograph showing opening and serial reaming of the medullary canal.

A distal femoral interlocking intramedullary nail was then inserted in an antegrade manner under fluoroscopic guidance (Fig. 5). Proximal and distal interlocking screws were placed. To augment rotational and bending stability, a lateral dynamic compression plate was applied across the nonunion site and fixed with multiple cortical screws proximally and distally (Fig. 6–8).

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Fig. 5: Intraoperative fluoroscopic image showing serial reaming of the intramedullary canal prior to insertion of the distal femoral intramedullary nail.

Fig. 6: Postoperative anteroposterior radiograph of the right femur showing the distal femoral intramedullary nail augmented with a lateral dynamic compression plate and bone graft at the nonunion site.

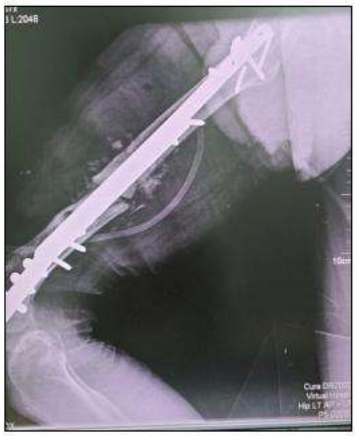

Fig. 7: Postoperative lateral radiograph of the right femur showing satisfactory sagittal alignment with the dual fixation construct.

Fig. 8: Postoperative anteroposterior radiograph of the right femur showing satisfactory alignment with the distal femoral intramedullary nail, augmented lateral dynamic compression plate, and bone graft at the nonunion site.

Postoperative Course

Thorough irrigation was performed, and the wound was closed in layers over a suction drain, followed by application of a sterile dressing. The patient tolerated the procedure well. Postoperative radiographs confirmed satisfactory implant position, good alignment, and adequate bone graft placement. Immediate postoperative management included intravenous antibiotics for 48 hours, thromboprophylaxis, and early mobilization with non-weight bearing on the affected limb, and physiotherapy for range-of-motion exercises of the hip and knee. The patient was discharged on postoperative day 5 with instructions for strict non-weight bearing for 12 weeks, followed by gradual progressive weight bearing based on radiographic evidence of union.

DISCUSSION

This case illustrates several important principles in the management of complex femoral shaft nonunions. The development of nonunion following femoral shaft fracture is multifactorial, with both biological and mechanical factors contributing to failure of fracture healing. In the present case, the atrophic pattern of nonunion, characterized by sclerotic bone ends and minimal callus formation, indicated a significant biological deficit. The subsequent failure of plate fixation further suggested inadequate mechanical stability at the nonunion site. Successful revision therefore required simultaneous correction of the compromised biological environment and restoration of adequate mechanical stability [4,8].

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The management of established femoral shaft nonunion requires careful assessment of fracture biology, fixation stability, bone quality, alignment, and the possibility of infection before selecting the appropriate revision strategy [4,8]. In multiply operated cases, persistent instability may further compromise the biological healing response. Therefore, simply replacing a failed implant without addressing the underlying biological deficiency may not be sufficient to achieve union.

The use of combined intramedullary and extramedullary fixation has been described in complex femoral nonunions, particularly in cases with compromised biology and poor bone quality [5,9]. The intramedullary nail provides load-sharing fixation with axial and bending stability, while the supplementary lateral plate provides additional resistance to rotational and bending forces at the nonunion site. This combined construct can therefore provide enhanced mechanical stability in cases where previous single-implant fixation has failed. Previous evidence has reported favourable outcomes with augmentative plating in femoral shaft nonunion, with some studies suggesting higher union rates compared with exchange nailing in selected cases [9,10]. In the present case, dual fixation was selected to provide robust mechanical stability following removal of the failed dynamic compression plate.

Atrophic nonunions fundamentally represent a failure of the biological healing environment. In such cases, mechanical stabilization alone may not be sufficient. Aggressive debridement of the sclerotic and avascular bone was therefore performed until viable bleeding bone was encountered. This was followed by restoration of the medullary canal and placement of autologous iliac crest bone graft at the nonunion site. Autologous bone graft remains an important biological adjunct because of its osteogenic, osteoinductive, and osteoconductive properties [6]. Serial intramedullary reaming may also contribute to biological stimulation through reaming debris and improvement of the endosteal environment [7].

Restoration of the medullary canal is particularly important during revision surgery when previous fixation and chronic nonunion have resulted in sclerosis and narrowing of the canal. In the present case, serial reaming was performed after removal of the failed implant and debridement of the nonunion site, allowing insertion of an appropriately sized intramedullary nail. Reaming may additionally provide local biological stimulation through the generation of bone debris and stimulation of the endosteal blood supply [7].

Each previous surgical intervention can increase the technical difficulty of subsequent revision because of scar formation, altered tissue planes, possible devascularization, compromised bone quality, and increased risk of infection. A strategic approach addressing both biological and mechanical deficiencies is therefore essential [4,8]. In the present case, the failed plate and screws were removed, the nonunion site was thoroughly debrided, and the previously placed fibular graft that had failed to incorporate was excised. Autologous iliac crest bone grafting was then combined with intramedullary nailing and supplementary lateral plating to address both components of the nonunion.

The present case emphasizes that successful treatment of a complex femoral shaft nonunion requires more than replacement of a failed implant. The underlying biological and mechanical causes of nonunion should be systematically addressed. In an atrophic nonunion associated with implant failure, restoration of viable bone, biological augmentation, restoration of the medullary canal, and stable fixation are important components of revision surgery [8–10]. The combined approach used in this patient provided a stable construct while simultaneously improving the biological environment at the nonunion site.

CONCLUSIONS

This case demonstrates that complex femoral shaft nonunions with implant failure following multiple previous procedures require correction of both biological and mechanical deficiencies. Thorough debridement of sclerotic bone, restoration of the medullary canal, autologous iliac crest bone grafting, and stable dual fixation provided a comprehensive revision strategy. The combination of an intramedullary nail and supplementary lateral plate offered additional mechanical stability in this challenging case. Careful preoperative planning and meticulous surgical technique are essential for successful management. Long-term clinical and radiological follow-up remains necessary to confirm fracture union, maintain alignment, and assess functional recovery.

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REFERENCES

[1] Rodriguez-Merchan EC. Nonunion of femoral shaft fractures. Injury, 2022; 53(2): S33-S38.
[2] Ricci WM, Gallagher B, Haidukewych G. Intramedullary nailing of femoral shaft fractures: current concepts. J Am Acad Orthop Surg., 2009; 17(5): 296-305.
[3] Weber BG, Cech O. Pseudoarthrosis: Pathology, Biomechanics, Therapy, Results. Bern: Hans Huber Medical Publisher; 1996.
[4] Hak DJ, Lee SS, Goulet JA. Success of exchange reamed intramedullary nailing for femoral shaft nonunion or delayed union. J Orthop Trauma, 2000; 14(3): 178-82.
[5] Furlong AJ, Giannoudis PV, DeBoer P, Matthews SJ, Macdonald DA, Smith RM. Exchange nailing for femoral shaft aseptic non-union. Injury, 1999; 30(4): 245-49.
[6] Giannoudis PV, Dinopoulos H, Tsiridis E. Bone substitutes: an update. Injury, 2005; 36(6): 623-27. doi: 10.1016/j.injury.2005.07.029.
[7] Luo H, Su Y, Ding L, Xiao H, Wu M, et al. Exchange nailing versus augmentative plating in the treatment of femoral shaft nonunion after intramedullary nailing: a meta-analysis. EFORT Open Rev., 2019; 4(8): 513-18. doi: 10.1302/2058-5241.4.180054.
[8] Rupp M, Biehl C, Budak M, Thormann U, Heiss C, Alt V. Diaphyseal long bone nonunions—types, aetiology, economics, and treatment recommendations. Int Orthop., 2018; 42(2): 247-58. doi: 10.1007/s00264-017-3734-5.
[9] Medlock G, Stevenson IM, Johnstone AJ. Uniting the un-united: should established non-unions of femoral shaft fractures initially treated with IM nails be treated by plate augmentation instead of exchange IM nailing? A systematic review. Eur J Orthop Surg Traumatol., 2018; 28(7): 119-28.
[10] Jin YF, Xu HC, Shen ZH, Pan XK, Xie H. Comparing Augmentative Plating and Exchange Nailing for the Treatment of Nonunion of Femoral Shaft Fracture after Intramedullary Nailing: A Meta-analysis. Orthop Surg., 2020; 12(1): 50-57. doi: 10.1111/os.12580.