



## **A Case of Infected Post-Traumatic Bone Loss of 14cm of Femur Treated with Titanium Mesh and Bone Grafts: A Case Report**

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### ***Abstract***

*Treating a significant bone loss is a major challenge for orthopaedic surgeons, let alone treating an infected major bone loss. Bone tumour resections are the most common cause of bone defects requiring complex reconstruction, whereas in trauma bone defects are often associated with very high energy injuries like fire arm injuries or blast injuries.*

*A 35-year-old man brought with severe injury to right thigh following a blast incident. He sustained compound comminuted fracture shaft of right femur with significant bone loss which was infected. Patient was initially treated with external fixator, serial wound debridement, antibiotic cement spacers, HBOT and antibiotics to control infection. Once infection was controlled, bone loss was managed by filling the gap with titanium mesh impregnated with bone graft and bone marrow (RIA). Bone started to show initial signs of healing after couple of months of the definitive procedure.*

### **Introduction**

While blast and firearm injuries are less common than typical orthopaedic trauma, they frequently result in extensive bone and soft tissue loss, as well as significant contamination. Managing these injuries effectively involves immediate debridement, thorough wound irrigation, and stabilisation of fractures(1). Non-viable bone fragments are usually excised, often leaving substantial bone gaps that need to be addressed through methods such as vascularised grafts, bone transport, or allografts—sometimes combined with graft substitutes. If bone loss is accompanied by active infection, a methodical, staged treatment plan is crucial to control the infection while promoting both bone and soft tissue recovery(2).

Here we report staged multidisciplinary approach to control the infection, stabilize the fracture, reconstruct the defect, achieve wound healing, and finally, ensure bone healing and functional rehabilitation.

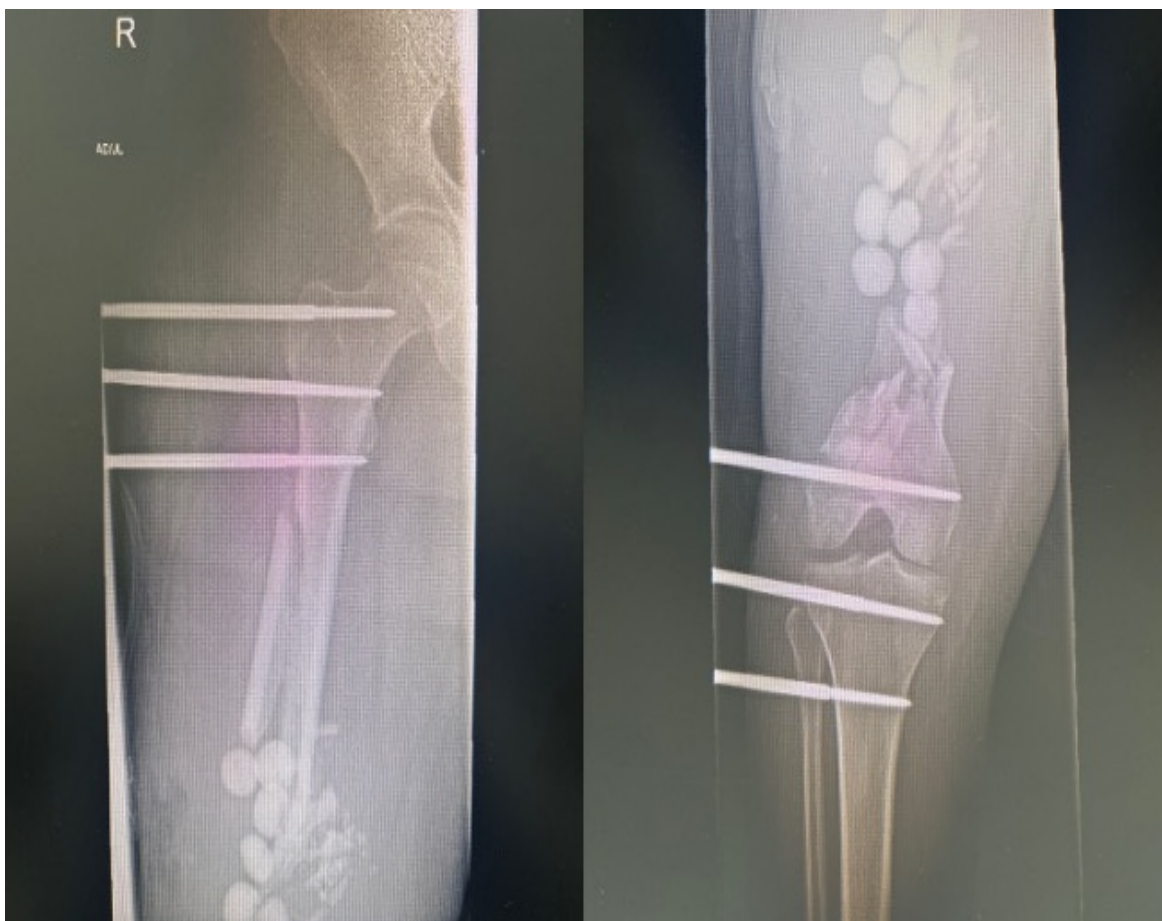
## Case Reports

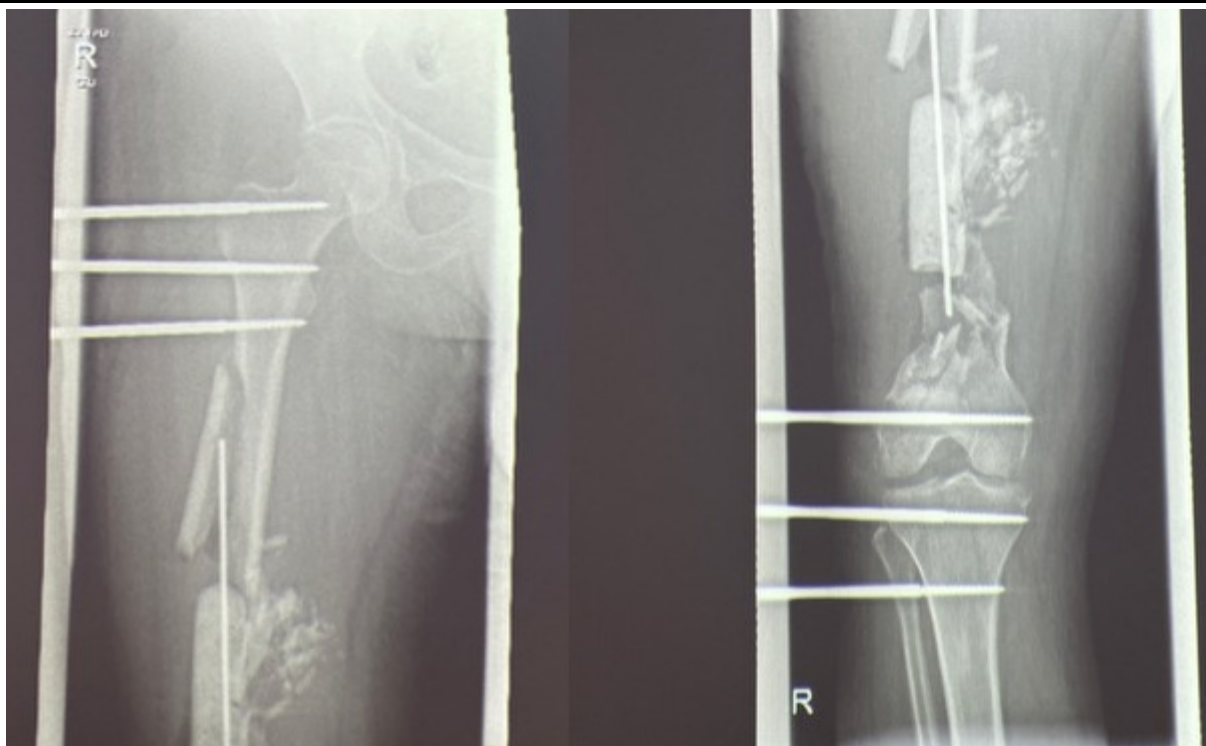
35 year gentleman was admitted into our orthopaedic ward for the treatment of comminuted fracture of femur with significant bone loss. Patient had sustained blast injury resulting in loss of skin, subcutaneous soft tissues and bone in his right thigh 2 months prior to admission to our facility. Patient had underwent primary wound debridement and external fixation for his right thigh from another facility. At the time of admission patient was on exfix with healed wound on the lateral aspect of thigh. His ankle and toe movements were satisfactory with no neurological deficit. XR revealed a bone loss of 14cm (Fig.1).



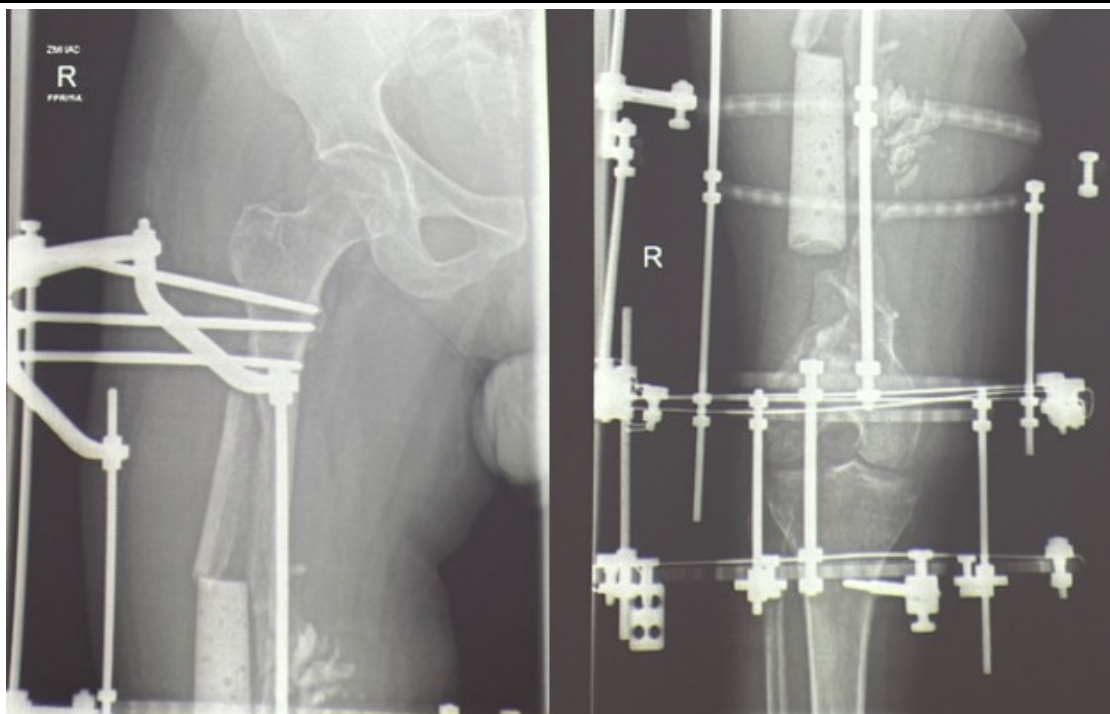
Upon admission, the patient underwent comprehensive evaluation, including radiological imaging and laboratory investigations. CT imaging demonstrated comminuted fracture of the right femoral shaft with significant bone loss, associated with intraarticular lateral condyle fracture. Inflammatory markers (CRP, ESR, TC) were elevated. The patient subsequently underwent surgical exploration and debridement, which

revealed copious amounts of foul smelling pus and sequestrum at the fracture site. Fracture ends were freshened, devitalized bone fragments were excised, wound was irrigated, and gentamicin-impregnated antibiotic cement spacer was placed, followed by closure with vacuum-assisted closure (VAC) dressing (Fig. 2). Wound and bone cultures grew coagulase-negative *Staphylococcus*. Based on wound culture and infectious disease consultation, vancomycin and piperacillin/tazobactam therapy was initiated. A second debridement was performed five days later, during which antibiotic beads were replaced with vancomycin-impregnated cement on the intramedullary nail, and the wound was closed (Fig. 3). Subsequent cultures identified *Klebsiella pneumoniae* sensitive to tigecycline; accordingly, vancomycin and Tazocin were discontinued.

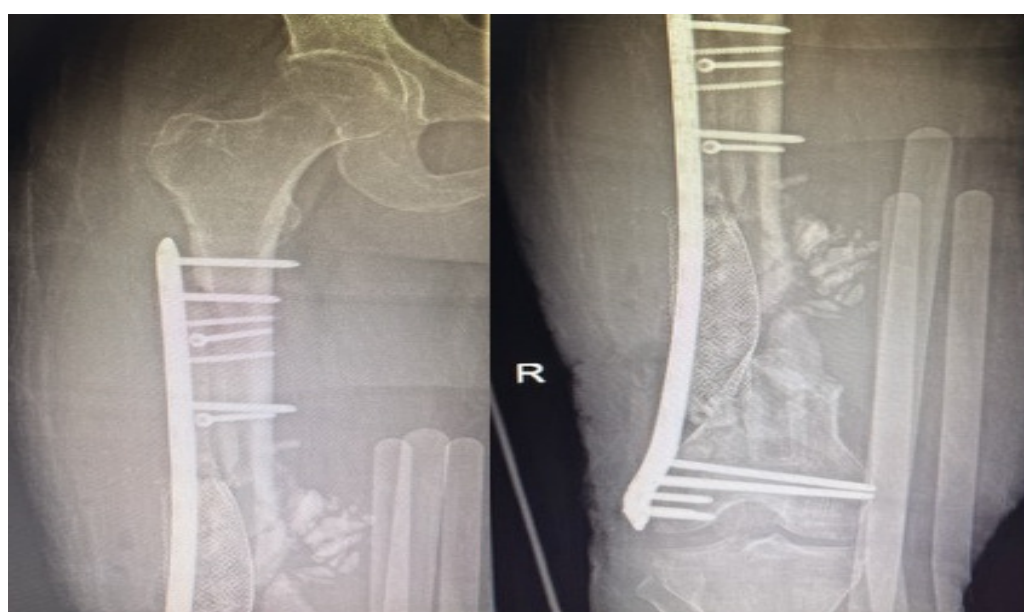




Ten days following the second debridement, the wound started to demonstrate healthy granulation tissue, prompting initiation of hyperbaric oxygen therapy (HBOT). Two weeks post-HBOT, the wound had healed; however, the patient reported increasing right thigh pain. Ultrasound of the thigh identified a significant collection at the fracture site. Wound was explored for the third time, Exfix and cement spacer nail removed, wound debrided, and fracture was stabilized with an Ilizarov external fixator. Gentamicin cement spacer placed and wound closed over a drain (Fig. 4). Serial wound dressings facilitated progressive healing. Suction drain was removed on the 4th postoperative day. During this period, the patient developed drug-induced acute pancreatitis, for which gastroenterology was consulted and antibiotics were adjusted accordingly. By postoperative day fifteen, the thigh wound had fully healed, sutures were removed, and antibiotic therapy was discontinued.



Ten weeks after admission and five weeks following the third debridement, inflammatory markers were normalised and the patient was scheduled for a definitive procedure. With appropriate antibiotic coverage, bone grafts were harvested from both iliac crests, and bone marrow was aspirated from the left femur using the RIA (Reamer Irrigation and Aspiration) technique. The Ilizarov fixator was removed, the fracture site was exposed, and the cement spacer was taken out. The fracture was stabilized with a 14-hole distal femur locking plate. The bone loss gap was filled with harvested bonegraft and bone marrow aspirate enclosed within a titanium mesh (Fig. 5).

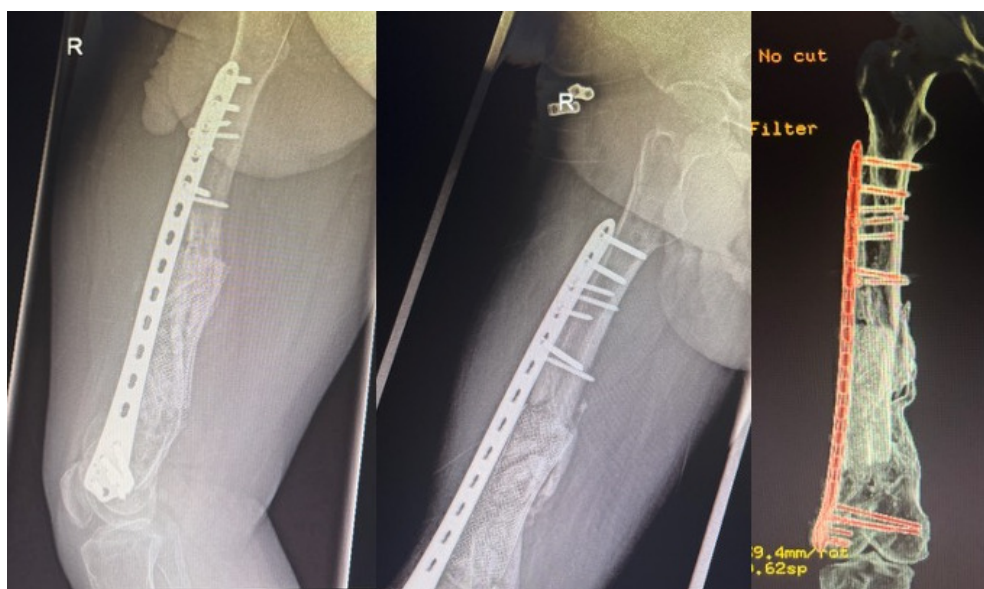


The patient was started on ceftazidime and aztreonam according to intraoperative swab culture results. Two weeks postoperatively, wound breakdown was observed at the distal wound. The wound was irrigated under anesthesia and VAC dressing was applied. Wound cultures grew *Enterococcus* and *Candida* species, and fluconazole therapy was initiated.

Plastic surgery was consulted for wound management and patient was managed by regular wound wash and VAC dressing every week for the next 6 weeks until healthy granulation tissue started to fill up the wound and finally wound was closed (Fig. 6).



The patient began physiotherapy focused on knee mobilisation and toe touch weight bearing. Two weeks after secondary wound closure, sutures were removed, and the patient was discharged home with instructions to continue physiotherapy. The most recent follow-up X-ray (9 months post definitive procedure) demonstrates callus formation and signs of fracture healing (Fig. 7).



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## Discussion

Injuries caused by blasts and firearms present considerable challenges in orthopedic trauma management, primarily due to extensive soft tissue damage, bone loss, and an increased risk of infection(3). These types of trauma often lead to complex injury patterns, including bone fragmentation, comminution, and avulsion. Effectively managing fractures and soft tissue complications resulting from such high-energy trauma requires advanced multidisciplinary care(2). Restoring skeletal integrity in the face of extensive bone loss requires careful consideration of both functional outcomes and complication prevention. Surgical approaches have evolved over time, with early stabilization of the fracture being key to minimizing soft tissue injury and facilitating bone healing. Techniques such as external fixation (e.g., Ilizarov method), intramedullary nailing, and modular prostheses can be utilized based on the extent and location of bone loss(4). In this case we took the advantages of both uniplanar and ilizarov external fixation techniques to stabilise the fracture site while waiting for the infection to subside. Additionally, bone transport techniques, like the Ilizarov method, can not only manage bone loss but also facilitate bone consolidation even in the presence of infection(5).

Infection is a primary concern after blast injuries, as the immense energy released during such trauma leads to substantial soft tissue damage, creating an environment conducive to contamination by various infectious agents. These wounds are more prone to infection and can be particularly devastating when they involve critical areas like the joints, bones, or neurovascular structures. Such injuries carry a heightened risk of osteomyelitis, especially when there is substantial soft tissue and bone loss, making the restoration of bone and eradication of infection an extraordinarily challenging task(6). Management of infected bone defects requires a multi-step approach, which involves both antibiotic therapy and surgical intervention. Early and aggressive debridement to remove necrotic tissue, foreign bodies, and contaminated bone is paramount. Local antibiotic delivery systems, such as antibiotic-impregnated beads or antibiotic-loaded cement spacers, can provide concentrated treatment at the site of infection, particularly where systemic antibiotics alone may be insufficient. In this case we used both Gentamicin and vancomycin impregnated cement as spacer to maintain the gap and also as local antibiotic delivery. A critical aspect of managing infection is ensuring adequate vascularization to promote healing. Negative pressure wound therapy (NPWT) is a popular adjunct in wound management, as it restricts bacterial growth in open fractures and fastens the wound healing(7). Hyperbaric oxygen therapy(HBOT) which is defined as subjecting the whole body of the patient to pure oxygen to atleast 1.4 times the atmosphere absolute pressure has recently proven to be effective in wound healing. HBOT helps to reduce infection and inflammation, simultaneously increases perfusion and enables early wound healing. It aids wound healing by improving the efficiency of WBCs in phagocytosis, reducing

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the effects of inflammation, and promoting fibroblast proliferation and neoangiogenesis. In addition HBOT is also noted to be effective in stem cell recruitment (8).

In cases of bone loss, autologous bone grafting remains the cornerstone of reconstruction. However, their application in large bone defects is constrained by issues of availability and donor site morbidity. As a result, we have to resort to other osteoconductive or osteoinductive agents such as allografts or bone substitutes, such as biodegradable scaffolds or bone morphogenetic proteins (BMPs) (9). RIA (reamer irrigator aspirator system) which was initially developed as technique to reduce fat embolism during femoral nailing has recently gained property as technique to harvest significant amount of morselised bone grafts and mesenchymal stem cells (MSC)(10). Osteogenic potential of RIA graft is comparable, if not superior than autologous iliac crest graft(11). In this case we took advantage of both autologous iliac crest graft and the RIA bone marrow aspirate to facilitate bone union.

Modular prostheses and mega-prostheses offer viable alternatives for joint-sparing reconstruction, especially in cases of large defects in the femur or tibia. These implants allow for the restoration of limb length and function while reducing the need for extensive bone grafting. Major downside of these devices are aseptic loosening, higher failure rate, and infection(12). Recently, titanium mesh has emerged as a effective technique in guided bone regeneration (GBR), especially in the management of complex bone defects. Titanium mesh act as a nonresorbable barrier membrane which help to maintain the gap at the fracture site and simultaenously protect and promote callus formation by inhibiting soft tissue ingrowth. Relative rigidity and malleability of the mesh helps to shape it according to the bone defect. Main advantage of this technique is attributed to the mesh's rigidity and malleability, which allows it to be shaped according to the defect site. The porosity of the structure facilitates nutrient exchange and promotes vascularization(13). Research shows that macroporous meshes (>100 µm) enhance bone growth more effectively than microporous membranes. Although this technique provides multiple benefits, it also presents certain drawbacks(14). Soft tissue breakdown and mesh exposure is reported in upto 50% of cases. Proper wound care and soft tissue coverage is the cornestone in graft or implant integration(15). In our case we incorporated iliac crest graft with RIA aspirate enclosed in titanium mesh to fill the bone gap. We faced challenges with wound healing which was tackled with the help of plastic surgery and Infectious disease team. Finally wound healed and latest followup XR of the patient showed significant bone healing. Post operative period patient was followed up with rehabilitation team for muscle strengthening and joint mobilisation.

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## Conclusion

Given the complexity of blast injuries, a multidisciplinary approach is essential. The involvement of orthopedic surgeons, plastic surgeons, vascular surgeons, and infectious disease specialists is crucial to optimize outcomes. In addition, active involvement of the rehabilitation team is mandatory to prevent long-term complications such as joint stiffness, muscle atrophy, and regain as much function as possible, especially in cases with extensive bone loss or infection. A comprehensive rehabilitation program, including physical therapy and psychosocial support, is essential to address the long-term impact of such injuries(16). In conclusion, when paired with proper surgical technique and soft tissue management, titanium mesh represents a gold standard in the regenerative treatment of challenging bone defects.

Future advancements in regenerative medicine, such as the use of stem cell therapy and tissue engineering, may offer new solutions for the repair of bone defects. Additionally, innovations in biomaterials for bone grafting, including 3D-printed scaffolds and growth factors, hold promise for enhancing bone healing and reducing infection rates(17). Genetic research on osteoimmunology and antibiotic resistance may also play a role in personalizing treatment for blast-injured patients and improving their long-term outcomes(18).



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