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A Case Report of Periprosthetic Femur Fracture with Severe Bone Loss Using Impaction Bone Grating Technique

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Abstract

We describe a case of successful revision total hip arthroplasty (THA) for a Vancouver type B3 periprosthetic femoral fracture with extensive bone stock deficiency and osteoporotic diaphyseal bone. The femur was reconstructed with a cemented long stem and mesh using an impaction allograft technique. This procedure facilitated stable stem fixation to the host femur with a bony fusion between the allograft and host bone, as revealed by clinical and radiographic assessments. This technique provides a surgical option for a severe periprosthetic femoral fracture in which the femoral diaphyseal bone is too osteoporotic to support the fixation.

Keywords: revision total hip arthroplasty, vancouver type B3, femoral allograft, allograft-stem composite.

Introduction

The rate of periprosthetic femoral fractures after total hip arthroplasty (THA) is 0.1% – 6%[1-3]. Vancouver type B3 periprosthetic femoral fractures are the most challenging to manage for a surgeon because of bone stock deficiency[4]. Literature review illustrates a few surgical options for this condition including the use of an uncemented extensively porous-coated implant[5]; proximal femoral allograft[6]; modular distally cemented stem[7]; impaction bone grafting[8]; megaprosthesis[9]; or a long uncemented stem[10]. There is a subset of patients with fracture patterns, bone loss, and unfavorable canal geometry surrounding the femoral isthmus that precludes the use of many implants.

However, in the case of an osteoporotic diaphyseal bone, in addition to severe proximal femoral bone defect, an allograft-cemented stem composite would be more rigidly secured to the host femur than an allograft-cementless stem composite[11,12,13,18]. The purpose of this article is to evaluate the role and the outcome of femoral component revision using impaction bone grafting technique in patients with periprosthetic femur fractures after THA.

A Case Report

A 70 year old farmer was referred to our arthroplasty clinic with a history of left THA periprosthetic fracture from a primary center for further management. In detail; primary left THA was performed 13 years prior to presentation at our specialist center secondary to traumatic fracture after a fall from a tree while working in the farm. But within six months the patient developed pain on the operated site and hence a revision surgery

was performed by the primary team. Post revision left THA was uneventful. He was back to his normal farming activities until he presented back to his primary center 13 years post revision THA with a history of painful left hip and inability to move left lower limb after a fall from a tree again while plucking fruits in the farm. Radiographs showed periprosthetic fracture and was referred to a nearby higher center and later to our specialist center.

On examination and investigations preoperative imaging of the left femur showed a Vancouver type B3 periprosthetic fracture with a severe bone stock deficiency and an osteoporotic diaphyseal bone (Fig – 1). Revision THA performed; Intra-operatively loosened implants were removed, granulation and scar tissue excised. Allograft bone graft was prepared using four femoral heads. Cemented acetabulum cup applied after reconstruction with impaction allograft, mesh and stabilized by screws. Femur fracture was reduced, anatomical femoral mesh applied and held with dall-miles cables, morselised allograft was impacted followed by cemented long stem.

Post-operative was uneventful. Patient had regular follow-up. Until the last follow-up at 14 months post-operative, presented with a history of recent motorbike accident and injury to left hip. However clinical and radiological examination revealed the revision left THA was stable (Fig – 2) with a Harris Hip Score of 95.

Fig 1: Preoperative antero-posterior and lateral view of left THA

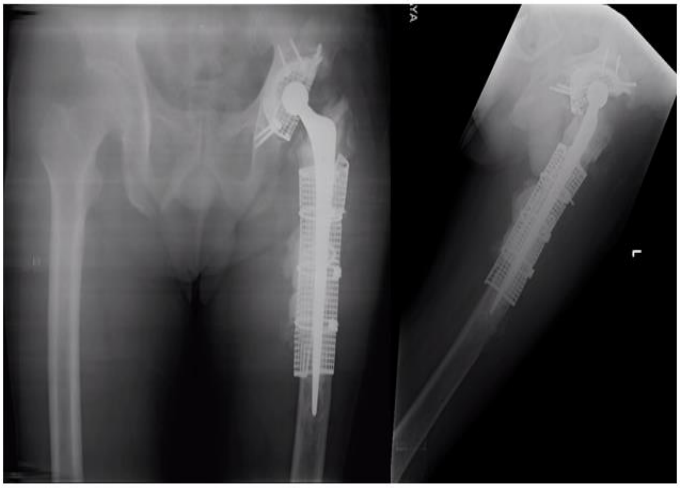

Fig 2: 14 month's postoperative radiographs of revision left THA showing antero-posterior and lateral views

Discussion

The treatment of periprosthetic femur fractures after THA has historically been associated with a high rate of treatment failures, complications and unsatisfactory outcomes. Difficulty arises in comparison of various results in the literature due to differences in length of patient follow-up, patient demographics, types of implants used, the number of revision arthroplasties, the types of operative techniques employed and variable outcome measures utilized.

For extensive proximal femoral bone stock deficiency in particular, the standard treatment has been either proximal femoral arthroplasty using a megaprosthesis or an allograft-cementless stem composite, or the use of a long uncemented bypass femoral stem with distal fixation[6,9]. The challenge is to simultaneously achieve implant and fracture stability. However, the effect of this standard treatment in case of an osteoporotic diaphyseal bone is limited because of inadequate support for stem fixation[14,15]. Studies also reports, a cementless stem has been preferentially used for the composite because cement may interfere with interosseous integration at the allograft-host bone junction and with fracture healing[16].

The Vancouver classification[4] is a guide for the treatment of periprosthetic femoral fractures according to their severity. One cannot, therefore, simply deal with this fracture as a problem; and it is important to coordinate treatments with each individual condition. Vancouver type B3 periprosthetic fracture is the most difficult to manage; hence, an allograft-cemented stem composite would be more rigidly secured to the host femur than an allograft-cementless stem composite[11,12,13,18].

Impaction grafting has been recently introduced as an intra-medullary grafting technique for the reconstruction of the proximal femur in hip revision procedures. It is based on earlier experience of a similar technique employed in acetabular reconstruction[19]. Morsellised fresh frozen cancellous or corticocancellous allograft chips were impacted into the femoral canal to provide a so called neo-endosteum for prosthesis to be inserted with cement[20]. Early results of the impaction grafting revision technique for the femur have been encouraging[13,20]. In our case we noted good fracture healing, stability of implant with no subsidence and functional hip.

However, in an impaction allograft bone grafting there are certain limitations including allograft compatibility with the host and allograft viability following cementation of the stem, and it is technically demanding. In addition, the biological and biomechanical efficacy of the impaction grafting technique has been studied and the ability of the cancellous bone allograft to survive and remodel through re-vascularisation is well understood[18,21-23]. Studies have reported that bone grafts, even when covered with methylmethacrylate bone cement, still retain their viability as well as their osteogenic potential[22,23]. Hence has a higher rate of union[17,18].

The mechanical strength of the bone chips following impaction has also been studied and improvement has been achieved in terms of graft size, compaction forces and cementing technique[21-23]. The biological potential of the allograft and the plasticity of the impacted bone in reconstructing the deficient bone allow the surgeon to use conventional cemented prostheses. In overview the advantages of combining long-stem cemented femoral fixation with impaction bone grafting include intramedullary fixation, presence of osteoconductive substrate at the fracture site, immediate stability associated with the use of cement, and potentially reliable long-term prosthetic fixation and restoration of bone stock.

Conclusion

In periprosthetic fractures around the unstable femoral stem with surrounding bone of poor quality or deficient bone stock, an impaction allograft cemented stem composite would be more rigidly secured to the host femur with a high rate of union.

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