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Original Article

Intramedullary fixation of pertrochanteric fractures after hip resurfacing arthroplasty – Do we have the answer? Case report and literature review

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ABSTRACT

Objective: To report a case of a peri-prosthetic hip fracture fixed using a previously unreported technique of intramedullary nailing with dual proximal fixation.

Case summary: An 81-year-old nursing home resident suffered a multi-fragmentary peri-prosthetic hip fracture around a Birmingham Hip Resurfacing arthroplasty (BHR), which was fixed using a novel technique.

Discussion: Such fractures pose a significant surgical dilemma with regards to the optimal method of treatment. The increasing popularity of these implants suggests that these fractures will become increasingly common.

Conclusion: We believe that our technique provides a practical and satisfactory solution to these fractures.

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1. Introduction

Post-traumatic pertrochanteric fractures following resurfacing arthroplasty of the hip have rarely been reported in literature. The low risk of wear, dislocation, proximal bone preservation and the long-term survival of the prosthesis together have revived an interest in resurfacing arthroplasty in recent years.^{1,2} This has led to an increased use of these implants in the elderly population.^{3,4}

Subcapital fractures of the neck of femur have been described most often as a complication following resurfacing arthroplasty.⁵ It is correlated with an error in the surgical technique when they occur early in the post-operative period and is often due to avascular necrosis or wear when they

occur late. Surgical errors include notching of the superior aspect of the femoral neck, varus positioning of the femoral stem and inadequate coverage of the reamed femoral head. Treatment options for these peri-prosthetic fractures revolve around retention of the prosthesis with internal fixation of the fracture, or removal of the femoral prosthesis and revision to a stemmed femoral component in the presence of a well-fixed acetabular prosthesis.

The treatment of subcapital fractures following resurfacing arthroplasty is inherently different, if not simpler, from the overall management of pertrochanteric fractures around these implants. The complex nature of the injury associated with the poor proximal femoral bone stock in the elderly provides a significant surgical challenge. The difficulties associated with the fixation of osteoporotic bones irrespective

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of the type of device used (intra or extramedullary) versus the complications associated with a complex revision procedure in the presence of a pertrochanteric fracture, remain the main surgical dilemma when deciding on the treatment of these fractures. To our knowledge, use of a cephalomedullary nail with dual proximal fixation and a trochanteric starting point has not been described in literature for the treatment of osteoporotic, peri-prosthetic hip fractures following resurfacing arthroplasty. We present a case of a multi-fragmentary, pertrochanteric fracture distal to a well fixed hip resurfacing implant, treated with the Holland universal nailing system[®], to highlight the surgical technique and overcome challenges involved in the fixation and the post-operative outcome in the elderly with these injuries.

2. Case report

An 81-year-old male nursing home resident sustained a peri-prosthetic pertrochanteric fracture of his right hip following a mechanical fall whilst trying to get up from a chair. The patient had previously undergone a Birmingham Hip Resurfacing arthroplasty (BHR)[®] through a posterior approach seven years ago for end stage osteoarthritis of his right hip. The preoperative Harris Hip Score was 52 prior to undergoing the resurfacing arthroplasty. The pre-operative neck shaft angle was 125.3°. The acetabular component was implanted uncemented while the femoral stem was cemented in place. Following the procedure, the patient made an uneventful recovery and had pain free range of motion (ROM). The post-operative radiographs showed satisfactory alignment of the femoral and acetabular components with the femoral component implanted at an angle of 125.5° (Fig. 1). The cup inclination angle was 52.1°. The Harris Hip Score at two-year follow-up following the BHR arthroplasty was 88. Two years prior to the mechanical fall, his mobility had decreased to the point that he required a frame and two assistants for transfer

from bed to chair following a diagnosis of Parkinson's disease and associated Lewy body dementia.

The initial radiographs performed in the A&E following the fall revealed an AO Type 31 A3 fracture of the right hip (Fig. 2). The position of the BHR[®] implants was found to be unchanged in comparison to the previous radiographs, with no evidence of loosening or osteolysis. A decision towards operative fixation of the fracture was undertaken and the patient was taken to the operating theatre within 24 h of admission.

3. Operative technique

The procedure was performed under fluoroscopic guidance. The operative technique as recommended by the manufacturer and from previous studies using the Holland universal nailing system[®] (Biomet-Warsaw, Indiana, USA) was used. Initially, a closed reduction was performed on a traction table to achieve near anatomic alignment of the fracture fragments. The proximal femur was approached through a 4 cm incision to the access the tip of the greater trochanter. A guide wire was introduced from the tip of the greater trochanter keeping a sufficient margin of safety from the tip of the femoral stem to allow easier passage of the Holland nail[®]. After gentle proximal and necessary distal reaming to 13 mm a 12 mm × 400 mm nail was introduced over the guide wire. Two partially threaded 7 mm cannulated screws were used proximally, superior and inferior to the femoral stem of the resurfacing implant (Fig. 3). A single 4 mm partially threaded bolt was used in addition distally to achieve rotational stability (Fig. 4). The aim of the treatment was to achieve a stable construct, which would allow early mobilization and weight bearing with minimal complications. The duration of the operative procedure was 43 min. The immediate post-operative haemoglobin was 9.1 g/dl, which precluded the need for a blood transfusion. The patient received post-operative thromboprophylaxis with Dalteparin and TED[®] stockings.

Fig. 1 – AP radiograph showing the hip resurfacing arthroplasty in situ with no evidence of loosening or osteolysis at 5 years follow-up. The femoral stem is placed in near anatomical alignment.

Fig. 2 – AP Radiograph showing the multifragmentary pertrochanteric peri-prosthetic fracture.

Fig. 3 – Immediate post operative AP radiograph after intramedullary fixation of the peri-prosthetic fracture.

4. Post-operative course

Post-operatively the patient had pain free ROM of his right hip and could stand with the support of a frame and assistance of two physiotherapists from post-operative day (POD) four. He was discharged from orthopaedic care on the 10th post-operative day and was transferred back to the nursing home. He was readmitted 10 weeks post-surgery following an episode of aspiration pneumonia and was treated with antibiotics. At 10 weeks follow-up he was able to full weight bear on the operated limb during the bed to chair transfers without

Fig. 4 – AP radiograph showing the distal locking.

any pain. He had pain free ROM in the right hip with flexion to 120°, extension 10° abduction 30° and adduction 20. However his condition deteriorated during the hospital stay for the aspiration pneumonia and he suffered from respiratory failure and sustained a cardiac arrest and died two weeks later, three months post surgery.

5. Discussion

Peri-prosthetic pertrochanteric fractures are becoming increasingly common due to the popularity of resurfacing arthroplasty of the hip. Extended use of these implants in the elderly population creates a challenge when traumatic hip (peri-prosthetic intertrochanteric and sub trochanteric) fractures occur around these implants, since the elderly tend to have a significantly higher peri- and post-operative mortality rate.⁶ Taking a decision whether to retain the previously well-functioning resurfacing implant with stable internal fixation of the fracture in favour a revision arthroplasty procedure is often the dilemma, which the surgeon encounters when dealing with these injuries.

Stable internal fixation of these fractures allowing early mobilization may be justified in this population when the medical condition precludes a major revision procedure. A variety of fixation devices have been reported in literature to stabilize these injuries varying from cannulated screws, locking⁷ and non-locking plates and blade plates to intramedullary nails. Definite conclusions favouring one device over another in the fixation of these pertrochanteric fractures are difficult to construe as there is little evidence in the literature. Difficulty associated with the proximal fixation of these fractures is often due to the presence of the centrally located prosthetic stem in the femoral neck which limits the space available for fixation and the poor bone mineral density in the proximal femur which compromises the proximal purchase of any fixation device. Cannulated screws typically require the fracture configuration to be located intracapsularly to provide stable fixation limiting their use in subtrochanteric and intertrochanteric fractures. The blade plate provides stable proximal fixation but being an extramedullary device (load-bearing) is less biomechanically favourable compared to an intramedullary nail (load sharing). Weinrauch et al⁸ in their report of a patient with a peri-prosthetic intertrochanteric fracture stabilised with a blade plate felt that the device could be used in less complex fractures as an alternative method of fixation. Besides, the surgical technique of introduction of the blade portion of the device can become challenging in the presence of a prosthetic stem in the femoral neck. The proximal femoral locking plate although seemingly easier, at least technically, than the blade plate due to its multiple fixation points in the proximal femur, is still biomechanically inferior to the intramedullary nail.⁹ A proximal femoral locking plate with polyaxial locking screws however does provide the luxury of negotiating the femoral stem due to the variability in the direction of the locking screws. Whittingham-Jones¹⁰ reported the use of a non locked broad AO DCP (Synthes, Switzerland) in a 32-year-old lady who sustained a comminuted subtrochanteric femoral fracture following a high velocity motor vehicle accident. It was felt that an intramedullary nail would

cause further comminution and a plate fixation was used instead. However, we did not face any difficulty during insertion of the intramedullary nail nor did the surgical technique cause any further comminution at the fracture site. Annig et al¹¹ reported good results following intramedullary fixation with circumferential wiring in their case report of a patient with a multi fragmentary fracture of the proximal femur around a hip resurfacing implant. They used a piriform fossa entry reconstruction nail with two proximal screws. The cephalomedullary nails like the Holland Universal Nailing System®, with a trochanteric entry point, have the advantage of bypassing the femoral stem due to their slight lateral location compared to the nails with a piriformis fossa entry point, therefore reducing the chance of fracture malreduction.

Peskun et al¹² also reported good outcomes following trochanteric entry point cephalomedullary fixation for peri-prosthetic fractures around hip resurfacing implants in two patients. However these fractures occurred in patients younger than 50 years of age with no evidence of underlying osteoporosis when they sustained moderate to high velocity injuries after accidentally falling from a height. They used an intramedullary nail with a single central screw in the head for proximal fixation in both their patients. The presence of dual proximal fixation in the form of two 7 mm screws superior and inferior to the femoral stem allows adequate proximal fixation in the Holland Universal nailing system® to allow early mobilization in patients with intertrochanteric fractures. This has been previously reported by Krastman et al¹³ and the senior author (NJL).¹⁴ We believe that the use of two parallel, slightly smaller proximal screws (7 mm, Holland® nail, Biomet, Warsaw, IN, USA) instead of a centrally placed single large proximal screw (10.5 mm for a Gamma3 Nail, Stryker, MI, USA) reduces the chance of drilling into the cement mantle around the femoral stem thereby reducing the chance of prosthetic loosening. This also allows slightly easier placement of the evenly spaced screws superior and inferior to the prosthetic femoral stem. It provides greater leeway in the proximal fixation compared to a cephalomedullary device with a single large screw, whose optimal placement can be jeopardized due to the presence of an anatomical or slight valgus placed femoral stem in the neck.

The intramedullary nails have the advantage that a minimally invasive technique can be used for their insertion, which reduces the amount of blood loss and soft tissue compromise. The mismatch in the electrode potentials of the metal in the femoral stem (cobalt chrome) and the implant (stainless steel) increases the chance of galvanic corrosion. Intramedullary nails (like the Holland nails®), which are made of titanium metal, reduce the amount of galvanic corrosion and fretting wear due to its biological inertness.¹⁵ Although our patient did not live long enough to test the true strength of fixation, he was full weight bearing during transfers and had pain free full ROM in the affected hip at short term follow-up.

In conclusion, more evidence will be required in future to ascertain the ideal method of treatment for these peri-prosthetic fractures, especially in the elderly population. It is debatable whether a major revision procedure, taking into consideration the associated co morbidities, is warranted in the elderly to treat these complex injuries. However, we believe that the Holland® type nails with dual proximal fixation and a trochanteric entry do provide some advantage when internal

fixation is chosen as a method of fixation for pertrochanteric peri-prosthetic fractures around hip resurfacing implants.

Conflicts of interest

All authors have none to declare.

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