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ORIGINAL STUDY

Long-stem revision prosthesis for salvage of failed fixation of extracapsular proximal femoral fractures

Rory J. SHARVILL, Nicholas A. FERRAN, Huw G. JONES, Stephen A. JONES

From the University Hospital of Wales, Cardiff, United Kingdom and the Lincoln County Hospital, Lincoln, United Kingdom

A retrospective review was made of radiographs and case notes of patients with failed fixation of extracapsular proximal femoral fractures subsequently managed with long-stem revision arthroplasty. Follow-up radiographs, objective scoring, mobility, and complications were assessed. Twenty five hips were managed with long-stem hip arthroplasty in 24 patients with a mean age of 73 years. The mean follow-up was 24 months. Patients received uncemented acetabular components and long-stem uncemented femoral implants. Complications included two intraoperative femoral fractures which were strut-grafted, three wound infections (one required washout), and one recurrent dislocation managed conservatively. Average postoperative Oxford Hip score was 29. We report a low complication rate and no specific implant related problems, with good functional outcome as evidenced by the outcome scores and mobility status following salvage arthroplasty.

Keywords : extracapsular fracture ; salvage ; long stem arthroplasty.

INTRODUCTION

Extracapsular proximal femoral fractures can be stabilised with extramedullary devices such as sliding compression screws or dynamic hip screws (DHS), and intramedullary fixation devices. The DHS is currently the fixation device most commonly used (*14*), and is widely regarded as the optimum treatment for extracapsular proximal femoral fractures (*8*). It allows fracture impaction with stability at the fracture site during weight bearing, offering a biomechanical advantage over other rigid devices (*2*).

Implant failure has been related to type of fracture, particularly its stability, and to inadequate reduction, osteoporosis, and inaccurate placement of the screw within the femoral head (*3*). Of these variables, only reduction of the fracture and screw placement are under surgeon control, therefore, these are of greatest interest when studying reasons for failure of DHS.

The most common cause of failure of fixation of an extracapsular fracture, which is treated by a sliding hip screw, is cutting out of the femoral head screw (*10*). The tip apex distance (TAD) is defined

■ Rory J. Sharvill, BSc, Medical Student.

■ Huw G. Jones, MD, MBBCh, Senior House Officer.

■ Stephen A. Jones, MD, FRCS (Tr & Orth), Consultant Orthopaedic Surgeon.

Department of Trauma and Orthopaedics, University Hospital of Wales, Cardiff, United Kingdom.

■ Nicholas A. Ferran, MD, MBBS, MRCSEd, Specialist Registrar.

Department of Trauma & Orthopaedics, Lincoln County Hospital, Lincoln, United Kingdom.

Correspondence : Mr Nicholas A. Ferran, Orthopaedic Suite, Lincoln County Hospital, Greetwell Road, Lincoln, LN2 5QY, United Kingdom. E-mail : nferran@uku.co.uk

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as the sum of the distance, in millimetres, from the tip of the lag screw to the apex of the femoral head, as measured on an anteroposterior radiograph and that distance as measured on lateral radiograph, after correction has been made for magnification. A TAD less than 25 mm is associated with a lower risk of cut out of the DHS screw (*1*), and Pervez *et al* (*14*) recommend that the tip apex distance should be less than 20 mm.

Fracture reduction and implant positioning are directly related, with adequate reduction of the fracture being the prerequisite to correct implant fixation (*2*) and therefore an important factor in predicting fixation failure.

Several treatment options may be considered for failed internal fixation necessitating reoperation (*5*). In younger patients, with good quality bone stock, a revision internal fixation is usually preferred. Elderly patients often have marked osteoporosis, and as such the purchase of the threads in the femoral head fragment is often less than ideal, and the treads may cut out (*5*). Therefore in the elderly, hip arthroplasty may be considered. Dennis *et al* (*4*) recommended that stress risers from screw holes in the femoral shaft be bypassed by at least two femoral diameters in order to reduce the risk of periprosthetic fracture.

There is little information in the English literature about conversion of failed internal fixation of intertrochanteric fracture to hip arthroplasty (*17*). We present the experience, at our institution, of salvage of DHS fixation of proximal femoral fractures with long-stem total hip arthroplasty.

METHODS

A retrospective review was carried out of patients undergoing total hip arthroplasty for salvage of failed DHS for proximal femoral fracture between July 2001 and July 2007 at our institution. Hospital notes and plain and digital radiographs were reviewed, where available.

The initial fracture was classified through radiographic review by location in the proximal femur ; intertrochanteric, subtrochanteric, reverse oblique or basicervical fracture, and whether stable or unstable. Fractures were classified as unstable if there was gross displacement, 4-part fracture, medial comminution, reverse obliquity or subtrochanteric fracture.

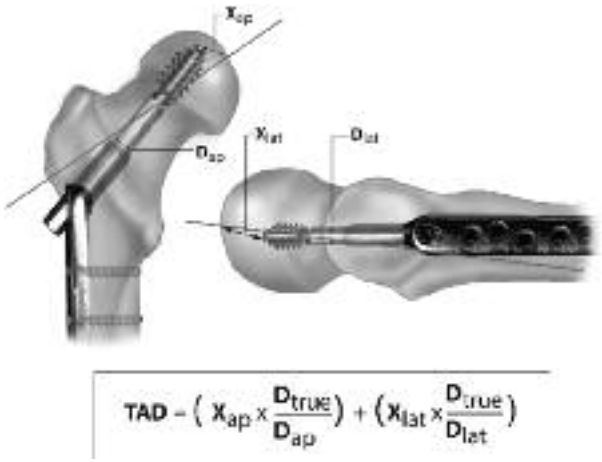

Fig. 1. — Measurement of Tip Apex Distance (TAD)

Post-DHS radiographs were reviewed to determine whether reduction of the fracture had been achieved, and the method of fixation used. The tip apex distance for the dynamic hip screw was measured for all patients where an intraoperative radiograph or a radiograph taken within a week of surgery was available (fig 1).

Patient theatre notes were reviewed to determine implants used. Post-THR radiographs were reviewed to confirm the notes, determine implants in patients where theatre notes were not available, and to determine any postoperative complications. The patients were Oxford scored after assessment at their follow-up appointment. Those patients who were lost to follow-up, or deemed demented, were not scored.

RESULTS

Demographics

There were 24 patients who underwent total hip arthroplasty for salvage of DHS fixation, 16 female and 8 male. One female patient underwent bilateral total hip arthroplasty and is classed as two separate pieces of data ; the total number is thus 25 hips. Complete data was available for 18 patients, and 7 patients had partially complete data. The average time to follow-up was 24 months (range : 4 to 76).

The average patient age at time of fracture was 73 years (range : 48 to 89, n = 25). The location in

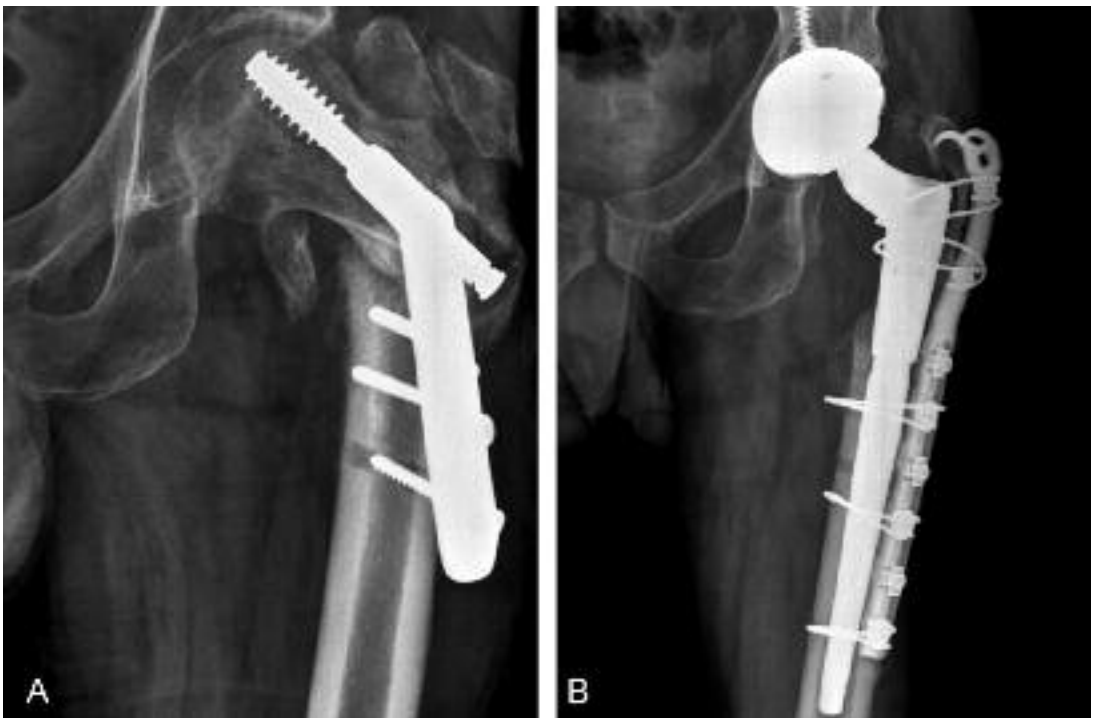

Fig. 2. — Failure of fixation by plate screw cut out in multi part fracture (A). Long-stem distal fixation prosthesis bypassing cortical defects and abductors secured with plate fixation (B).

the proximal femur was as follows : 4 basicervical, 16 intertrochanteric, 1 reverse oblique and 4 subtrochanteric. Thirteen fractures were stable and 12 were unstable, with seven involving the right hip, and 18 involving the left.

The average time to revision to THR from date of DHS was 16 months (range : 1 to 36, n = 25). Twenty-one patients were converted directly to THR after DHS failure. Three patients had an initial DHS revision, and one patient had 2 revisions before conversion to THR.

Eleven fixations were revised due to cut out (3 anterosuperiorly, 8 superiorly), one due to cut out of the plate screws, one due to fracture at the distal end of the plate, one due to infection, 3 due to avascular necrosis of the femoral head, one due to pain without sepsis, one due to fracture non-union, one due to varus collapse, and 3 due to osteoarthritis of the hip. Data was unavailable for 2 patients.

Radiographic

Twenty-two patients received DHS, and 3 received DHS plus antirotation screws. The average TAD was 25.1 mm (range : 12.1 to 41.0, n = 18). Eleven of the fractures were reduced on postop radiograph, 12 were not reduced, 2 data were unavailable.

Implants

All of the patients received uncemented sockets of which 10 were constrained, and uncemented stems of which 19 were distal fixation stems (ZMR Revision system, Zimmer, Inc., Swindon, UK) and 6 were proximal fixation stems (S-ROM, DePuy, Warsaw, Indiana, USA). The friction pairing was metal on polyethylene in 22 hips, metal on metal in two (large-diameter heads) and ceramic on ceramic

in one. Four patients had a head size of 22 mm, 8 patients had a head size of 28 mm, one of 32 mm, 5 of 36 mm, 2 of greater than 40 mm and 5 were unknown.

Post-THR review

Six patients experienced major post-THR complications. Three suffered wound infections, one of which required a washout. Two presented intraoperative femoral fractures which were strut-grafted, and one presented recurrent dislocations.

The average Oxford Hip score was 29 (range : 13 to 45, n = 10). Post operatively, 7 patients had notable improvements in mobility. Five patients had no deterioration in mobility post operatively (3 still required a Zimmer frame and 2 still required the use of a stick). Mobility data was unavailable for 13 patients.

DISCUSSION

Non-union or material failure in internal fixation of intertrochanteric and subtrochanteric fractures requires reoperation in 0.5-2% of cases (*12*). Reduction and revision of internal fixation should be considered for young patients and those with normal bone structure. In the elderly patient a number of factors cause an increase in the risk of DHS failure. Marked osteoporosis can lead to reduced screw purchase and previous internal fixation can result in damage to femoral bone structure (*7*). As such hip arthroplasty, especially in the elderly patient, has been proposed for DHS failure (*5*). This is illustrated by the elderly patient population in this study (mean age : 73 years) where 21 of the 24 patients with DHS fixation underwent hip arthroplasty right away rather than revision DHS.

The recent completion of the procedures in this study, no earlier than 2001, means that the modern hardware, techniques and treatments used were of an excellent standard for attaining the best possible clinical results.

This study has some weaknesses. Its retrospective nature resulted in a substantial amount of incomplete patient data. The age and health of the patients studied also meant some were lost to follow-up, with a number of the individuals demented, or residing in residential or nursing homes, meaning accurate postoperative review was not always possible. The procedures were carried out by a number of different surgeons. Differing personal techniques along with their personal preference of treatment plans, combined with differing patient criteria, lead to a variation in procedure and implants used.

A number of technical hurdles arise in the conversion of failed DHS to hip arthroplasty. The remnants of the failed internal fixation device and scar tissue present obstacles that must be overcome, leading to increased operation time and potential blood loss (*17*). We recommend dislocating the head with the metalwork *in situ* as otherwise refracture can occur during dislocation. When removing metalwork one must be prepared to remove broken screws as these may obstruct passage of a long-stem prosthesis.

Proximal bone loss, bone deformity, and compromised proximal bone quality limit implant fixation options (*7*). A number of studies have highlighted the difficulty of pressurising cement in the presence of screw holes when using cemented stems (*7,13,17*), and as a result we recommend the use of uncemented implants. We stress the importance of choosing an implant based on the physiological status of the patient and findings at operation. Haidukewych *et al* (*7*) used long-stem implants in 50% of patients to bypass cortical defects caused by screw holes. In our study, 19 implants were fixed distally and 6 proximally. With distal fixation in the presence of previous screw holes, splitting the femoral shaft is a real possibility and prophylactic cabling of the shaft may be necessary. Regardless of whether the implant is proximally or distally fixed, we recommend bypassing the distal screw hole by at least two shaft diameters in order to avoid leaving a stress riser at the distal screw hole (*4*).

On the acetabular side one must consider the risk of dislocation and with this in mind 10 patients in our series were treated with a constrained cup. The final operative challenge in this group is the reattachment of the abductors which may often fall victim to proximal bone loss. Trochanteric plates are regularly used in our practice to address this

challenging problem. As such, conversion of failed DHS to hip arthroplasty provides extra complexities not present in routine arthroplasty, hence it is not routinely carried out for all patients after failed DHS.

In this current study, conversion to THR saw an improvement in average mobility, with a number of patients able to walk unaided, or with the use of a single stick postoperatively, showing good functional outcome. This is in line with a number of other studies showing it to be a successful procedure in this situation (*6,9,11,13*), with the operation allowing most patients to regain function that would otherwise have been lost, a hallmark of an effective procedure (*7*). Mariani and Rand (*12*) reported on twenty patients in whom an intertrochanteric nonunion had been treated between 1961 and 1981. Nine patients underwent subsequent arthroplasty, and eleven underwent repeat internal fixation and bone grafting. At a mean of six years, function was improved for all patients who had had an arthroplasty. Stoffelen *et al* (*15*) reported on seven patients who had an arthroplasty for the treatment of an intertrochanteric nonunion ; five had a good or excellent result after a mean follow-up of thirty-two months (*7*).

The elderly patient group studied is prone to yielding high complication rates (*16*). This study, however, noted a low overall rate of complication, with only 6 patients experiencing complications following conversion to THR. Only one of these was due to dislocation, which is in contrast to other studies which found dislocation to be problematic (*11*). None of the complications were associated with hardware failure.

This study also looked at possible reasons for the initial DHS implant failure. Previous studies have identified fracture type, particularly stability and inadequate reduction, inaccurate placement of the screw within the femoral head, and osteoporosis, as the most significant causes resulting in failure (*3*). In this series of failed DHS implants, less than half the fractures (11/25) were adequately reduced postoperatively.

It has been suggested that a TAD of less than 20 mm is ideal to reduce the cut-out rate of the screw (*14*). In this study, the average TAD was 25.1 mm, with the greatest measuring 41 mm, and combined with a rate of cut-out of 11/25, the findings support that recommendation. Inadequate fracture reduction and imprecise screw positioning within the femoral head were associated with an increased level of cut-out, implant failure, and nonunion of the fracture, ending up in the need for revision to hip arthroplasty.

In such circumstances, especially in the older patient, whilst the procedure is associated with an increased complication rate and is of increased technical complexity, revision to hip arthroplasty represents a viable treatment option that can significantly restore mobility to patients.

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