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A modified technique to extract fractured femoral stem in revision total hip arthroplasty: A report of two cases

Hawar Akrawi *, Merzesh Magra, Ajit Shetty, Aaron Ng

Department of Trauma and Orthopaedics, Mid Yorkshire Hospitals NHS Trust, Pinderfields General Hospital, Wakefield, West Yorkshire WF1 4DG, United Kingdom

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ABSTRACT

INTRODUCTION: The removal of well-fixed broken femoral component and cement mantle can be extremely demanding, time consuming and potentially damaging to the host bone. Different methods have been described to extract broken femoral stem yet this remains one of the most challenging prospect to the revision hip surgeon.

PRESENTATION OF CASE: The authors present two cases underwent a modified sliding cortical window technique utilising a tungsten carbide drill, Charnley pin retractor and an orthopaedic mallet to aid extraction of a fractured cemented femoral stem in revision total hip arthroplasty.

DISCUSSION: The modified technique offers a simple and controlled method in extracting a well fixed fractured cemented femoral stem. It has the advantage of retaining the cement mantle with subsequent good seal of the femoral cortical window secured with cable ready system. Furthermore, tungsten carbide drill bit and Charnley pin retractor are relatively readily available to aid the extraction of the broken stem. Finally, it yields the option of implanting a standard femoral stem and obviates the need for bypassing the cortical window with long revision femoral component.

CONCLUSION: Fractured femoral stem is a rare yet a complex and very demanding prospect to both patients and hip surgeons. The sliding cortical window technique utilising tungsten carbide drill and Charnley pin retractor is technically easy and most importantly; preserves host bone stock with cement-in-cement revision hip arthroplasty. We believe this technique can be added to the armamentarium of revision hip surgeon when faced with the challenge of extracting a fractured cemented femoral stem.

1. Introduction

Mechanical failure of femoral stem after total hip arthroplasty is well reported in the literature.[1,2] Albeit being rare, with the prevalence of 0.23–11%, the consequences can be devastating to the patients.[1,2] Nowadays components fracture is exceedingly uncommon due metallurgic advancement and improvement in stem design.[3] Three-dimensional analysis dictates highest stress concentrations are around the lateral aspect of the middle third of the femoral stem. Hence, a fracture of the stem usually originates from its anterolateral aspect.[4] Femoral stem failure can be broadly categorised to patient-specific factors,[5] technical issues[6,7] or implant related factors.[7,8]

In revision hip arthroplasty, the safe extraction of retained fractured components remains a challenging prospect as it can be extremely demanding and potentially detrimental to the remaining host bone. Therefore, many approaches have been described to address this complex issue before hip reconstruction. Among those, the technique of drilling a hole in the exposed proximal part of retained fractured femoral stem and attaching a threaded extraction device,[9] or sophisticated surface undercutting and an extraction device wedged in to facilitate extraction.[10] Removal of cemented well fixed broken stem can be also achieved by a femoral trephine technique,[11] femoral cortical window technique,[12] extended femoral osteotomy (ETO) procedure[13] and retrograde nail impaction via the knee joint.[14]

We describe a modified technique for extraction of well-fixed cemented fractured femoral stem.

2. Presentation of cases

2.1. Case 1

A 52-year-old female had bilateral sequential total hip replacement for idiopathic avascular necrosis of femoral heads. The right hip was cemented Charnley Elite (De Puy International, Leeds, UK) and the left side was uncemented JRI HA coated (Joint Replacement Institution, Sheffield, UK) total hip arthroplasty. Both hip

* Corresponding author. Tel.: +44 1924 542402; fax: +44 1924 542648.
E-mail address: hakrawi@yahoo.com (H. Akrawi).

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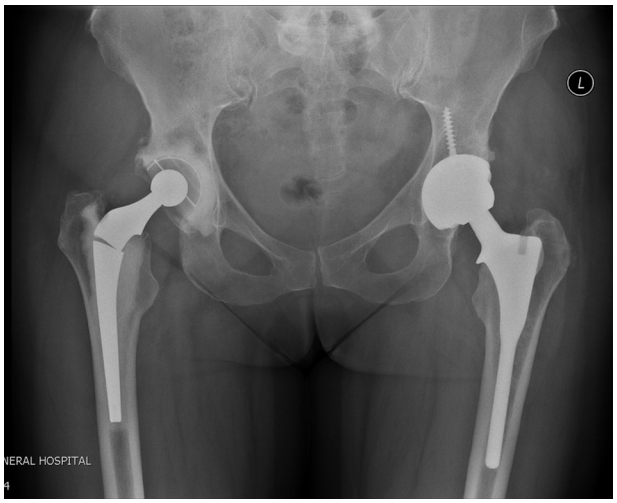

Fig. 1. Case 1. Radiograph shows fracture of right primary Charnley–Elite femoral stem.

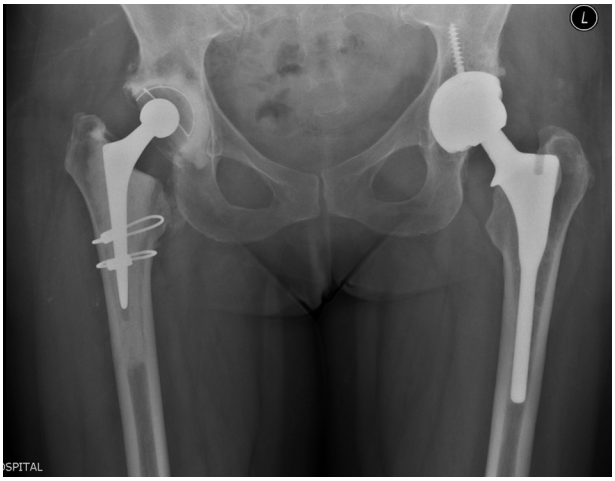

Fig. 3. Case 1. Radiographs 6 months post single stage revision hip arthroplasty.

arthroplasties were uneventful. However, 10 years following right total hip replacement, patient started to experience a gradually worsening pain in proximal right thigh with no history of trauma. This pain progressed and her mobility was significantly curtailed. Examination revealed shortened and externally rotated leg and any hip movement was painful. Radiographs (Fig. 1) showed fractured right femoral stem. The modified technique for extracting the fractured femoral stem was implemented. The lateral decubitus position was used and posterior approach to the hip was utilised. The proximal part of fractured stem was markedly loose and removed with ease. However, the distal part of femoral stem was found to be solidly imbedded. The fractured stem was approached by creating a small, longitudinal, posterior femoral cortical window measures 1 cm × 2 cm just below the level of fracture of femoral stem. Through this window, Tungsten carbide drill bit (Synthes, West Chester, PA, USA) is employed to create a crater on the proximal end of residual stem posteriorly (Fig. 2). Once achieved, a Charnley pin is used to disimpact the residual stem through the crater by controlled retrograde orthopaedic mallet blows till the stem is extracted. Once stem removed, the cortical window is repositioned and two-cable ready system (Zimmer, Warsaw, IN, USA) applied to secure the cortical window. The cement mantle in this technique is preserved and cement-in-cement technique was performed to achieve femoral stem revision. A small Developmental Dysplasia of Hip (DDH) Exeter stem was cemented in utilising the cement- in-cement technique (Fig. 3).

At 12 months follow up, the patient was independently mobile with pain free hip and good range of motion. Oxford hip score was 47 and Harris hip score was 91.

2.2. Case 2

A 74-year-old male patient with bilateral total hip arthroplasties. The left side was implanted 12 years ago and had an uncomplicated course. However, the right hip underwent three revision procedures. The last two were for fractured femoral stems. The last revision was in 2004 years and ran a smooth post operative course. In December 2012, this patient presented acutely with atraumatic crescendo pain in his right hip. The radiographs confirmed fractured long cemented revision femoral stem (Fig. 4). This patient sustained preoperative myocardial infarction and the cardiologist advised strongly against discontinuing clopidogrel to maintain the patency of his cardiac stents. The decision was made to revise only the fractured femoral components as full hip revision arthroplasty could have been detrimental to his health. This is because of his multiple co-morbidities and high American Society of Anaesthesia Score (ASA) of 4. Patient underwent single stage revision surgery where the fractured femoral stem was extracted using this modified extraction technique. The acetabular HMWPE liner was found to have eccentric wear. The acetabular component was retained and supplemented with a posterior lip augmentation device (PLAD) to secure the hip from any potential future dislocation.[15]

At 12 months follow up, patient denies any hip pain and has a stable range of motion. Oxford hip score was 42. Radiographs

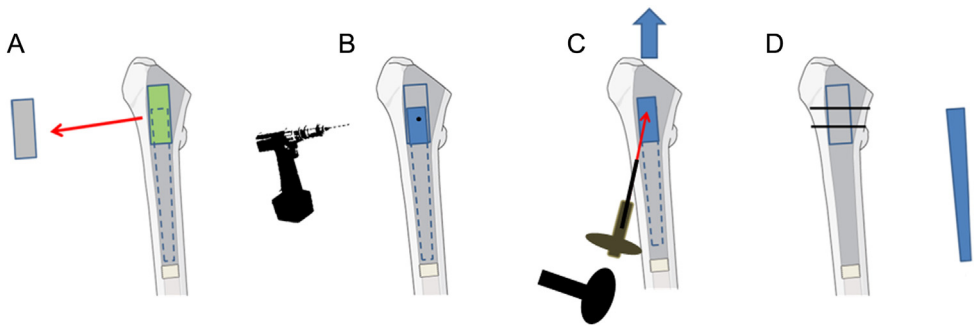

Fig. 2. Diagrams depict sequence of events to extract fractured femoral stem. (A) Small posterior cortical window created. (B) Tungsten carbide drill used to create a crater into the residual femoral stem posteriorly. (C) Fractured stem disimpacted by Charnley pin retractor and mallet through the stem crater. (D) Cortical window is repositioned and secured with two cable ready system.

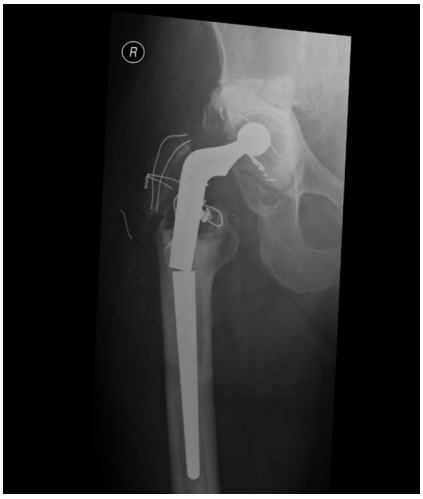

Fig. 4. Case 2. Radiograph illustrates fracture of cemented revision femoral stem.

showed evidence of osseus incorporation of cortical window in both patients (Fig. 5).

3. Discussion

Our proposed method exploits the concept of small cortical window just distal to the proximal part of the broken stem. Although utilising the cortical window is not a novel technique,[12,16] the modification described herein utilising simple instrumentations, using a narrow osteotome, a small rectangular window 1 cm × 2 cm is created along the long axis of the proximal femur posteriorly. The other modification includes, after removal of cortical window, a tungsten drill bit is utilised to drill and create a crater the posterior aspect of the well fixed distal broken stem. A Charnley pin retractor is used to disimpact the femoral stem by careful and controlled retrograde orthopaedic mallet impaction till the successful extraction is achieved.

After stem extraction, the cortical window is keyed-in and secured with cable ready system. In Morland's technique, the cortical window has to be grafted due to cortical destruction using a high speed burr.[12] The cortical window in our method is slightly bigger in dimension (1 cm × 2 cm in comparison to 0.4 cm × 1 cm in Morland's method). We believe this is necessary to prevent damage to the rest of femoral bone during drilling and preserving cement mantle during femoral component extraction. This cortical bone window can be readily sealed and secured with cables. In our method, radiological signs of fracture healing observed at 12 weeks postoperatively. We favour this technique as slot osteotomy in femoral component/synthetic bone construct offer significantly superior stiffness when compared to (ETO) constructs.[17]

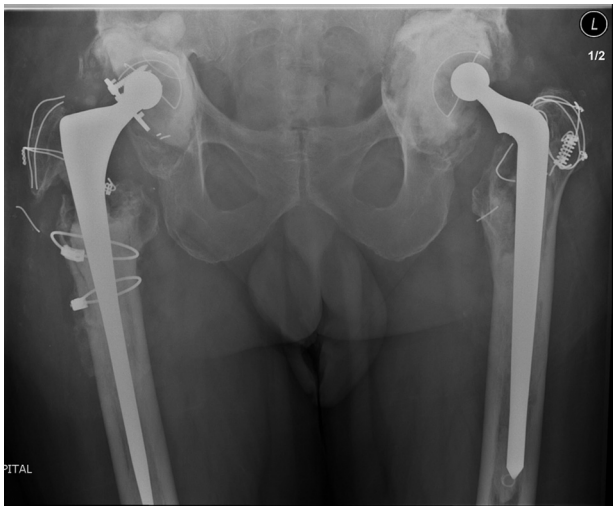

Fig. 5. Case 2. Postoperative anteroposterior view at 8 months showing osseus incorporation of the cortical window.

In our case series, the first patient had her femoral stem revised to small DDH stem with cement in cement technique. By creating a proximal femoral window, a standard length primary stem can span the window without risking weakening of the femur. Femora windowed distal to tip of fractured stem, to aid retrograde tapping, risk stress risers and authors recommend long revision stem to traverse cortical window to prevent periprosthetic fractures.[12,16] Therefore, proximal cortical window was performed because the fracture of femoral stem happened at the proximal one third; this allowed safe bypassing the cortical window without running the risk of the cortical window acting as a stress riser. Therefore, proximal cortical window and the existing cement mantle were sufficient to utilise and offer the patient a primary rather than revision implant. The second patient was a high anaesthetic risk patient who was in significant hip pain and limited mobility due to a fracture of a long revision femoral stem and with evident proximal femoral bone loss (Paprosky III-B). A lengthy single stage revision of both acetabular and femoral components would invariably be associated with high perioperative morbidity and mortality. Such symptomatic patient requires short procedure, albeit the revised long stem may re-fracture with time because of poor proximal femoral bony stock. Therefore, it was mandatory to implant a long revision femoral stem to address the non supportive femoral metaphysis and the limited diaphysial fixation.[18]

In both patients, cement-in-cement femoral stem revision arthroplasty was executed. The preservation of femoral stem cement mantle remains an attractive option as removing bone cement can be detrimental to host bone and can culminate in fractures or perforation. Medium to long term results of cement within cement femoral revision arthroplasty are encouraging.[19,20]

Our modified technique offers a simple and controlled method in extracting a well fixed fractured cemented femoral stem. It has the advantage of retaining the cement mantle with subsequent good seal of the femoral cortical window secured with cable ready system. Furthermore, tungsten carbide drill bit and Charnley pin retractor are relatively readily available to aid the extraction of the broken stem. Finally, it yields the option of implanting a standard femoral stem and obviates the need for bypassing the cortical window with long revision femoral component.

4. Conclusion

The removal of well-fixed fractured femoral component can be extremely demanding and potentially detrimental to the remaining host bone. The sliding cortical window technique utilising tungsten carbide drill and Charnley pin retractor is technically easy and most importantly; preserves host bone stock with cement-in-cement revision hip arthroplasty. We believe this technique can be added to the armamentarium of revision hip surgeon when faced with the challenge of extracting a fracture cemented femoral stem.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request

Author contributions

All authors contributed to the writing and collection of data. The two senior authors supervised, critically revised the article and were the operators in the surgical procedures illustrated.

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