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Total Hip Arthroplasty in the Severely Narrowed Femoral Canal by a Fibular Strut Using Knee Arthroscopic Tools: A Case Report and Technical Note

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A 58-year-old-male patient presented with worsening pain and restricted movements of his right hip after undergoing multiple procedures for treatment of an inter-trochanteric fracture. Secondary arthrosis and an incorporated intramedullary fibular cortical bone graft which caused severe narrowing of the medullary canal were observed by imaging. Total hip arthroplasty (THA) using knee arthroscopic tools was performed for preparation of the severely narrowed femoral canal. A satisfactory clinical outcome was achieved and stable components were observed on radiographs at the 11-year follow-up. The technique described here may be considered when attempting to perform a conversion THA for preparation of a severely narrowed femoral canal using a fibular strut in order to minimize morbidity and prevent structural destabilization.

Key Words: Inter-trochanteric fracture, Fibular cortical bone graft, Total hip arthroplasty, Knee arthroscopic tools

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INTRODUCTION

Preparation of the femoral canal in the presence of dense sclerotic bone with medullary involvement during performance of a conversion total hip arthroplasty (THA) presents many operative challenges due to altered bone architecture. Such challenges are frequently encountered in management of Paget's disease and Sickle cell disease[1,2]. Several techniques having both pros and cons have been published in an effort to determine the optimum strategy[1,2]. An intramedullary fibular strut causes inevitable distortion of the anatomical framework of the proximal femur, adding an extra dimension of complexity to a conversion THA. The severely narrowed medullary canal and/or bone block impedes preparation of the femoral canal and implantation of the prosthesis. This may lead to inadequate lateralization, an insufficient cement column, and creation of a false tract that results in microfractures, limb-length discrepancies, and implant failure. Given the paucity of published literature addressing conversion THA after healing of an intramedullary fibula in the femoral canal, there are no specific guidelines with regard to surgical technique. Herein, we report on a novel technique and discuss surgical pearls that have not been previously reported for preparation of a severely narrowed femoral canal by a segment of fibula. The patient was informed that information regarding the case history would be submitted for publication, and he provided informed consent.

TECHNIQUE AND CASE PRESENTATION

A 58-year-old-male patient first visited the hospital in early 2009 for treatment of a progressive painful right hip joint that had started two years ago. The patient demonstrated an "antalgic gait" and he was unable to walk without a support. Following an Inter trochanteric fracture in 1992, he underwent multiple surgical procedures; the final procedure was performed in order to achieve union and stabilization with use of an intra-medullary fibula as biological nailing without other supplemental fixation. Union of the fracture was observed one year postoperatively and he had returned to all his routine activities without pain. Except for obesity, his medical history was insignificant. A painful stiff right hip and global restriction of joint movements were observed upon clinical examination. The patient's Harris hip score was 32 points. Minor leg length discrepancy was observed. All operative scars had healed with primary intention. The examination of the spine showed normal findings. The hematological markers were within normal range. The joint showed gross reduction in joint space, coxa vara and features of secondary arthrosis on an anteroposterior radiograph of the right hip. A well incorporated intramedullary fibular segment in the femoral canal with areas of criss-crossing trabeculae was also observed (Fig. 1A, B). Both the fracture and fibular union to the inner femoral cortices was observed at multiple locations on computed tomography (CT) (Fig. 1C). Considering the severity of pain and significant functional disability, the patient received counseling and THA was recommended. Preparation of the femoral canal in the presence of an osseous integrated intramedullary fibula, and insertion of the femoral stem was the main technical

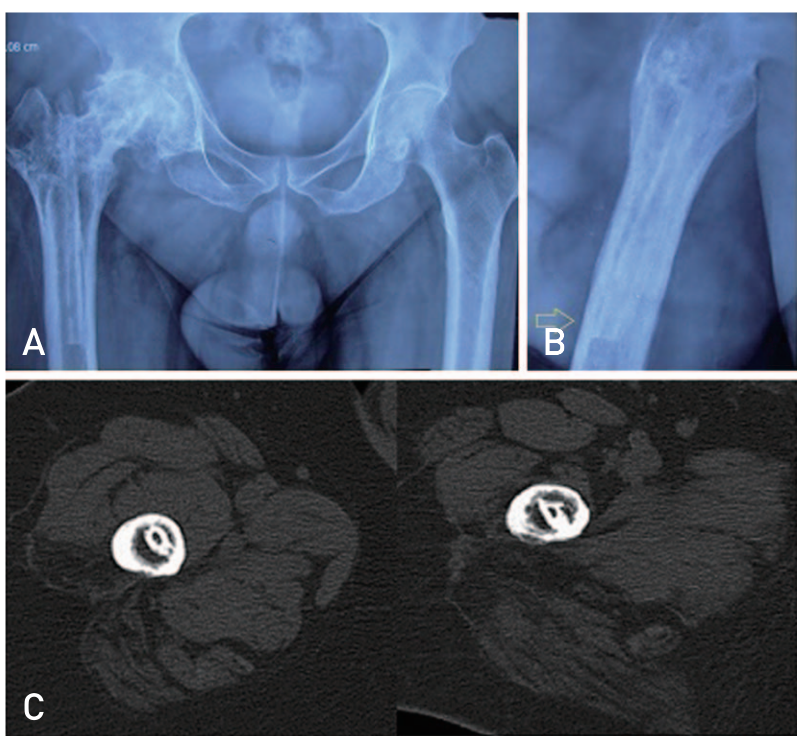

Fig. 1. (A) Anteroposterior view of the pelvis with both hips showing secondary arthritis of the right hip with a long segment of the intramedullary fibula. (B) Lateral radiograph confirms additional information suggesting a distally united fibula to the anterior femoral cortex (arrow). (C) Computed tomography scan coronal section shows the fibular canal, patchy union to the inner cortex of the femur.

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challenge. Preoperative templating was performed according to the established department protocol. Surgery was performed under spinal anesthesia in lateral decubitus position using the posterior approach. The tendon of the gluteus maximums was recessed and the external rotators with the capsule were released as a single layer. Comfortable dislocation of the hip was performed. After adequate neck resection the tip of the proximal segment of the fibula was identified in the trochanteric fossa. Protecting the abductors, the fibula was clearly visualized upon clearing the bone around it. The medullary canal of the fibula could be clearly seen and identified, as confirmed on the CT scan. Because the medullary canal of the fibula was narrow (3.0-4.5 mm), the plan was to use an anterior cruciate ligament (ACL) arthroscopic guide-wire (2.4 mm) with its reamers to ream the fibula. Insertion of these thin guide wires into the narrow canal can be easily performed. It appeared that the corresponding cannulated reamers available from size 4.5 mm with incremental sizes would be the most appropriate and useful for reaming and thinning the fibular cortex from the medullary side. The ACL guide-wire (2.4 mm) was passed into the fibular canal, which was confirmed using an image intensifier in various views (Fig. 2A). The ACL reamers were used in an incremental fashion, starting with a 5 mm ACL reamer, followed by 6 mm, 7, mm, 8 mm, and 9 mm, with gradual thinning of the fibular cortex (Fig. 2B). Most of the fibula was cleared (after using 9 mm reamers), except for the distal 1.5 to 2 cm which remained incorporated into the anterior cortex of the femur. The potential risk of perforation of the anterior cortex on continued reaming using the ACL reamers was identified on an image, so that further reaming with these reamers was avoided (Fig. 2C). The tip of the reamer, which was accidentally broken, could not be retrieved (Fig. 2C). The ACL guide-wire was then removed. A standard 3 mm femoral guide wire was finally introduced, skirting the residual distal fibula (Fig. 2D). Reaming in order to clean out this residual portion was then performed using standard intramedullary reamers (Fig. 2E). Performance of standard reaming started with a 10 mm reamer. The last reamer used was 12 mm, which allowed us to use summit

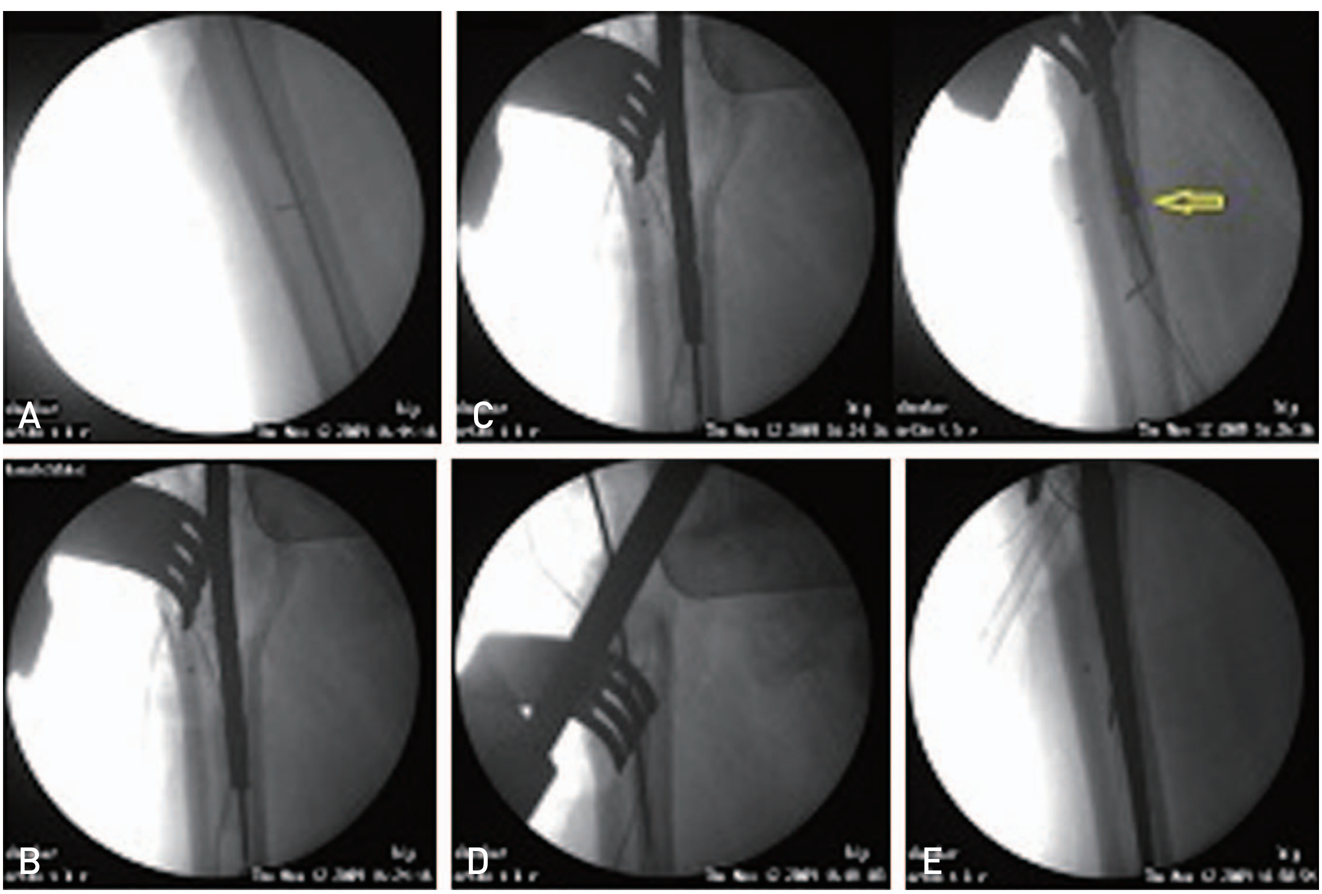

Fig. 2. (A) Arthroscopic guide wire confirmed on image. (B) Progressive reaming confirmed on image. (C) Potential risk of perforation of the anterior cortex [arrow]; accidentally broken tip of the reamer is visualized. (D) Femoral standard guide wire avoiding retaining the fibula confirmed on image. (E) Femoral rasp confirmed on image.

femoral reamers and perform broaching. After achieving complete removal of the fibula and a free canal, reaming and broaching of the femoral canal was performed without difficulty .Imaging confirmed the final broach (Fig. 2E). The final position was in an acceptable valgus position (On an image the femoral tip towards the medial femoral cortex indicates that valgus placement is accepted). Standard acetabular preparation was performed and an uncemented 52-mm Duraloc cup (DePuy/Synthes, Warsaw, IN, USA) was press-fit into the socket. Stability and alignment were confirmed. A 10° lipped liner was used. Femoral fixation was completed using a size-2 Summit stem (DePuy/Synthes), and the procedure was completed using a standard neck and a 28 mm cobalt-chrome head. Routine vertical, horizontal-offset measurement and Ranawat limb length measurement were performed for assessment and confirmation of the limb lengths. Suturing of the external rotators and posterior capsule was performed using the pull through technique into the fossa. Post-operative two-month follow-up x-rays appeared satisfactory and recovery was uneventful (Fig. 3A). Assisted partial weight-bearing continued for six weeks with support from a walker, followed by full weight-bearing. An excellent recovery was achieved with regular follow ups at 1, 5, and 11 years. The patient's Harris hip score improved from baseline 32 to 91 points and a radiograph showed that both components were stable with no appreciable wear and no evidence of osteolysis or heterotopic ossification at the last follow-up (Fig. 3B).

DISCUSSION

This case report describes and discusses a novel alternative, which was not previously reported, for management of a healed intramedullary fibula, impeding safe femoral preparation. A clear medullary canal is required for fixation of the femoral stem, whether cemented or uncemented. Obstruction of any kind should be addressed for proper preparation and positioning of the component. Use of a fibula strut as a

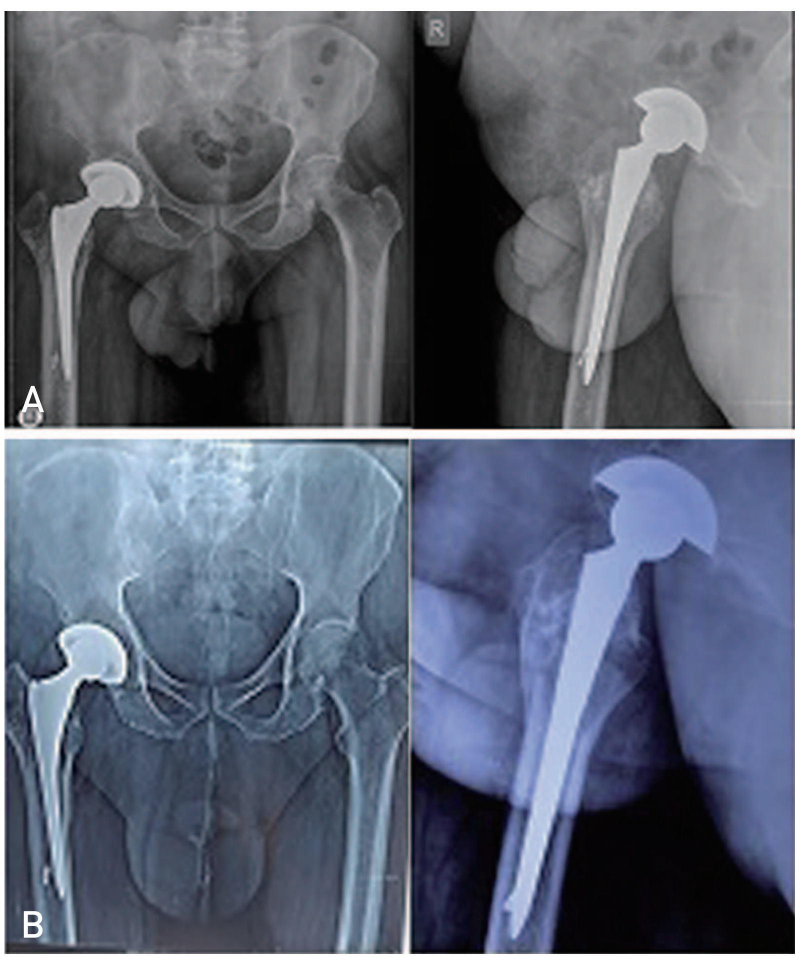

Fig. 3. (A) Follow-up 2-month radiograph anteroposterior (AP) and lateral view, with satisfactory alignment of components. (B) Follow-up 11-year radiograph AP and lateral view, stable components, no evidence of osteolysis or appreciable wear.

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"biological intramedullary nail" has been reported for non-union of long bone fractures, either as standalone fixation or as an adjunct in osteoporotic fractures[3-5]. In addition, use of segments of fibula in osteonecrosis in an attempt to salvage the femoral head is not uncommon. In most of these situations the fibula is transfixed from the lateral cortex to the head and is in horizontal orientation and restricted only to the head neck segment. Use of high speed burrs to clear the fibular cortex and enable free the entry into the canal for preparation in order to address these situations is fairly straightforward[6,7]. In the current case the most unusual feature was the use of the fibula as an intramedullary device, thereby obliterating the medullary cavity. A few of the critical issues requiring consideration during performance of conversion THA include the triangular shape of the fibula, obliteration of the plane between the fibula and native endosteal bone owing to osseous healing, potential possibility of a false tract and cortical perforation. In addition, a residual fibular bone can block appropriate alignment, seating of the stem and sometimes make sizing difficult. Therefore, ensuring that the entire length of the canal is free of fibular cortical bone is imperative. The hollow mills used for extracting well-integrated stems in revision surgeries may not be suitable due to the odd shape (non-tubular) of the fibula and the danger of creating a false tract[8,9]. The extended trochanteric osteotomy is an option[10]. However, it is associated with higher morbidity and necessitates the use of longer-stems. In addition, use of short stems in the current situation is limited by possible stem malalignment, stem subsidence, risk of proximal femoral fracture, and paucity of long term clinical results. Endo-femoral removal of the entire fibula with burrs using a computer-assisted fluoroscopic navigation technique is a technical challenge and time consuming. Furthermore, although navigation and robotics are helpful in improving the accuracy of surgery in THA, unfortunately its routine use has been limited by exorbitant cost, learning curve, specialized armamentarium, and issues regarding latency (intra-operative men-machine communication). To the best of our knowledge there are no reports on a healed intramedullary fibula impeding femoral preparation and no solution to address these situations has been reported. The technique described above addresses many of these issues. The technique is an added application of the commonly used technique with instruments used for preparation of the tunnels in ACL reconstruction surgery and is easily available. Use of a medullary guide pin minimizes the risk of a false track and enables performance of a guided procedure. Gradual expansion and reaming of the fibula enables better control and safety. Ensuring that there is a visible and patent medullary canal in the fibula is imperative. Performance of preoperative CT scans enables an accurate study of both the patency of the canal and the extent of endosteal healing between the femur and the graft.

The current technique is simple, reliable, and efficient, eliminating potential complications and allowing easier conversion to THA. The arthroscopic tools (guide wires with reamers) for preparation of the femoral canal during performance of conversion THA provide a credible alternative to existing armamentarium and should be considered when faced with such an unprecedented situation.

CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest relevant to this article.

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