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Case report

Acetabular “up-and-in” defect treated with in-situ femoral head autograft technique during total hip arthroplasty

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ABSTRACT

A 56-year-old male laborer with severe superior and medial acetabular protusio was treated with a cementless left total hip arthroplasty (THA) using an inexpensive technique that preserved the incarcerated femoral head in situ. The head was never dislocated, so the ligamentum was not disrupted. Wires stabilized the femoral head while reaming to prevent it from spinning, and multiple screws united the cup, autograft, and pelvis. At 2-year follow-up, the patient has pain-free hip function, radiographic union, and no component loosening or graft resorption.

Introduction

In certain disease states, the femoral head can erode through acetabular bone, creating a large bone void structural defect. The resected femoral head can be useful as a bony autograft in managing these acetabular bone defects. Techniques have been described in several ways, and here, we describe one additional technique.

Using femoral heads as autograft was initially described for superolateral bony defects when using cemented acetabular components by Harris et al. [1]. The femoral head can be shaped to provide supportive bone stock in these cases of dysplasia or severe degeneration. Long-term outcomes have been acceptable. Abdel et al. [2] reported 20-year outcomes of this technique using cementless components, demonstrating good long-term fixation and restored bone stock in dysplastic hips.

There are a few ways to use the femoral head to reconstruct large medial and superior defects seen with severe acetabular protrusio [3]. Unlike acetabular dysplasia, the acetabular rim is often adequate for component stability, and the central and medial bone void is contained. Most commonly, the resected femoral head is morselized or reamed and then packed into the medial acetabular defect [4,5]. Other techniques describe female reaming the femoral head and then docking it back in the defect [4,6]. To reduce time, but at an expense, metal augments may be used to fill the floor of the defect [7], which is similar to revision settings [8,9]. Allograft can also be used to supplement these techniques but is not without complication [10].

As described, void-filling techniques using the femoral head require time-consuming preparation of the femoral head, including female reaming of the head to denude cartilage, shaping into an augment, or morselizing [4,6]. Here, we present a case in whom an efficient and inexpensive technique for femoral head autograft in a specific pattern of acetabular bone defect was performed, where the femur is not dislocated, cut in situ, and secured during reaming. Although the technique may have been used by others, this is the first description in the literature. The patient was informed that his case would be submitted for publication, and he provided informed consent.

Case history

A 56-year-old male taxi driver with a past medical history of hypertension and type 2 diabetes mellitus presented with worsening left hip pain. He had an unknown injury to his left hip as a

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child when he was living abroad, possibly fracture or infection, but did not receive surgery. He was admitted to the local hospital in his home country for 1 month with high fever and whole-body arthralgias and was treated using a hip spica cast for an extended period. Subsequent to that, over the next 3 decades, his pain progressed, and he began to lose his functional independence. His leg shortened and he required a cane. On physical examination, his left lower extremity was 3 cm shorter than the right. While supine, his left hip passive range of motion was flexion to 70 degrees, external rotation to 20 degrees, and internal rotation to 10 degrees, with associated pain. There was no auto-arthrodesis. The patient had a positive Stinchfield's test (pain with resisted hip flexion while supine) [11]. Plain radiographs of the pelvis and left hip demonstrated left hip arthritis with acetabular bone loss in an “up-and-in” pattern (Fig. 1a-c). No additional imaging studies were obtained. Laboratory studies revealed normal C-reactive protein and erythrocyte sedimentation rate.

The patient was indicated for standard posterior total hip arthroplasty with possible use of allograft or autograft bone. The incision was shifted posteriorly from our standard position to aid exposure for a safe in-situ neck cut. No acetabular or trochanteric bone was osteotomized for exposure. The undisturbed femoral head was secured in situ with 2 nonparallel 2.4-mm Kirschner wires (k-wires) inserted through the superolateral acetabulum

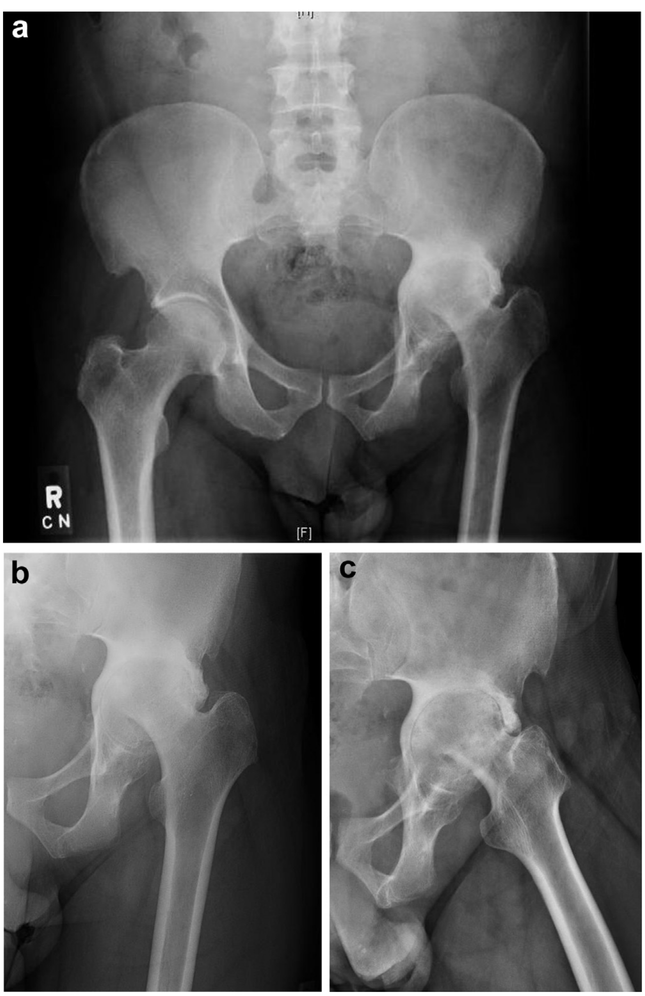

Figure 1. Anteroposterior (AP) pelvis (a), left hip anteroposterior (b), and lateral (c) radiographs demonstrating severe left hip posttraumatic arthritis with significant acetabular protrusio.

from lateral to medial side through superior most part of the reduced femoral head (Fig. 2a). This allowed reaming of the head without it spinning. Thus, it was shaped slowly beginning with a size 44 reamer and sequentially advancing to a size 54 reamer, at which point there appeared adequate contact with the rim. Intraoperative guidance was not used during the procedure. Instead, reaming was performed visually when the apparent medial acetabulum had been reached and when the reamer was enveloped by the native rim, which provided solid perimeter press-fit. Unexpectedly, there was a small section of visible punctate bleeding from the reamed in-situ femoral head, as shown in Figure 2b. A press-fit 54-mm acetabular cup (Tritanium; Stryker, Mahwah, NJ) was impacted securely, and screws were placed to traverse the femoral head and anchor in the pelvis. The k-wires were then removed, and the remainder of the surgery proceeded in a standard fashion. Immediate postoperative radiographs are presented in Figure 3a and b and show increased lateralization of the acetabulum but otherwise acceptable reconstruction. He was allowed to weight-bear as tolerated and initially used a walker, followed by a cane at 2 weeks. He recovered well with no complications.

At 2-year follow-up, he ambulates well with no complaints. His leg lengths are grossly equal. In the supine position, flexion reaches 90 degrees with internal rotation to 25 degrees, external rotation to 35 degrees, 45 degrees of abduction, and 25 degrees of adduction. He reaches 15 degrees of extension while in the lateral position. Radiographs demonstrate persistent femoral head bone stock, obliteration of the articular boundary between the femoral head and acetabulum, and no change in position of the implants (Fig. 4a-f). There appears to be retroacetabular osteopenia on the radiograph, perhaps due to resorption or stress shielding. His Veterans RAND 12 Item Health Survey score was 53.8 for the physical component and 49.4 for the mental component [12]. His Hip Disability and Osteoarthritis Outcomes score was 100 for stiffness, 97.1 for function, and 100 for pain [13].

Discussion

The management of posttraumatic arthritis with acetabular protrusio can be challenging. Autogenous bone graft remains the gold standard in the treatment of medial acetabular bone loss [14,15]. The cut femoral head and neck provides an easy source for autograft. This bone can be collected from bone slices, using a bone mill, female reaming of the head and replacement, or by reaming into the femoral head [6,16]. Paprosky et al. [17] demonstrated good results at an average 5.7 years for acetabular defects treated with allograft and determined that size, orientation, integrity of the allograft itself, and adequate native bone stock for bony ingrowth of the graft were all important for success.

A similar challenge exists for superolateral bone defects or dysplasia, the so-called “up-and-out” pattern. Pioneered by Harris et al. in 1977, the resected femoral head can serve as bulk autograft during THA [2,18-23]. This technique requires shaping the graft into a “figure 7” to reconstruct a dysplastic acetabulum using lateral to medial screws outside the acetabulum.

Currently, a wide range of augment shapes are available from multiple implant companies. Sporer and Paprosky [8] reported good results at 3 years using these augments in patients with Paprosky IIIa defects. While they offer ease, optimal structural integrity, and a favorable bone ingrowth interface, their benefits must be weighed against the additional costs to the health-care system. Although hospital contracts vary widely, the cost savings is estimated to be about $5000 using this technique vs using 2 wedge augments to fill this spherical defect. Trabecular metal augmentation has also been described for acetabular defects, with

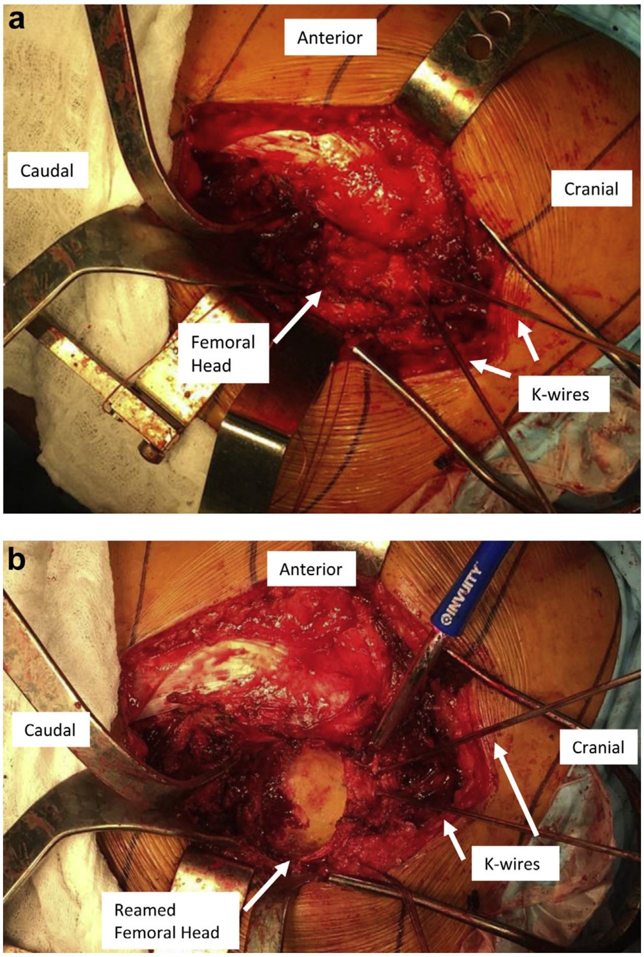

Figure 2. Intraoperative clinical photographs of the femoral head autograft left in situ in the acetabulum and held in place by 2 K-wires before (a) and after (b) reaming.

73%-92% survivorship reported at 8-10 years. However, evidence beyond that point is limited [24,25].

In the present case, we used the native femoral head in an inexpensive manner and with little time spent on preparing the graft. After neck cut and stabilization with wires, the acetabular reconstruction proceeded very similarly to a primary hip replacement. The additional time of autograft preparation, risks to the rim integrity posed by head removal or dislocation, challenging rim-reaming technique, and potential need for augments or additional allograft bone were all obviated by the technique herein described. An additional benefit of this technique is improving bone stock behind the cup by using a bone allograft. The size and shape of bone voids influence the surgical treatment. While retaining the head was expedient in this spherical and contained defect, other defects may be best treated with the aforementioned augmentation techniques.

It was unexpected to encounter bleeding in the in-situ femoral head after reaming. Normally, the anterior branch of the posterior division of the obturator artery travels in the ligamentum teres, but this is an insignificant supply of blood in adulthood. Many consider the ligamentum teres as an embryological vestige with little purpose [26]. In this patient, however, the aberrant anatomical changes after his childhood hip event may explain this persistent, though minimal, blood supply to his femoral head.

Several reports suggest removal of the articular cartilage is not required for successful use of autograft [27-29]. In this case, leaving the articular cartilage was necessary as the femoral head was not dislocated from the acetabulum. The conformity of the head and acetabulum was optimized by leaving the cartilage. Screw fixation from the component, through the femoral head, and into solid pelvic bone, combined with the surgical bleeding and subsequent fibrosis, helped arthrodese the residual femoral head to the pelvis as evidenced by radiographs at 2 years.

Summary

THA for superior and medial acetabular defects requires a void-filling reconstruction. The residual acetabular bone is at risk if trying to dislocate or remove an incarcerated femoral head. We describe a useful and inexpensive technique to utilize an in-situ femoral head autograft without the need for special preparation of the autograft or need for additional implant augmentation. This technique of in-situ femoral head autograft to fill a medial acetabular defect offers a straightforward solution to a complex pelvic bone loss problem in acetabular protrusio, minimizes cost, and has good 2-year clinical and radiographic results in this case. Longer term follow-up will determine the ultimate success of this method.

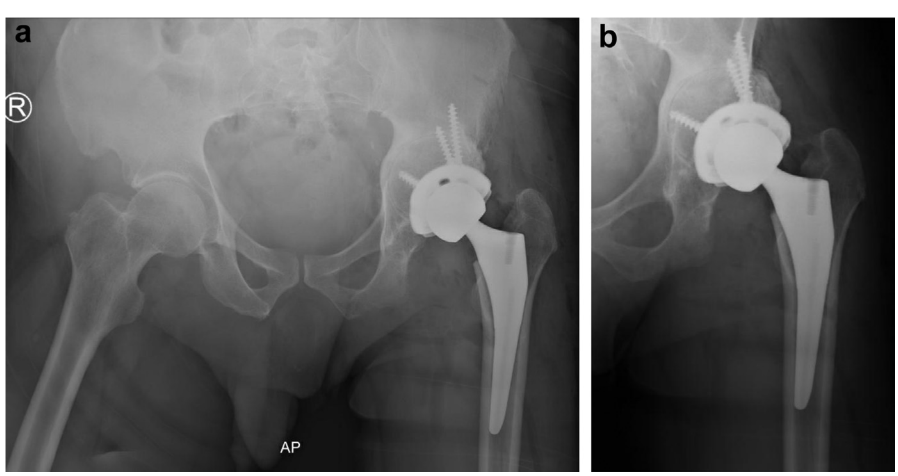

Figure 3. Immediate postoperative AP pelvis (a) and AP hip (b) radiographs. AP, anteroposterior.

Figure 4. AP pelvis (a), left hip lateral (b), pelvic outlet (c), pelvic inlet (d), iliac oblique (e), and obturator oblique (f) radiographs demonstrating good position of THA components and stable autograft without evidence of osteolysis at 2 years postoperatively.

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