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Case Report

Total Hip Arthroplasty for Ankylosis Requiring Rotational Rectus Femoris Flap and Skin Graft for Wound Closure

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ABSTRACT

We present a case report of a 51-year-old Ghanaian immigrant who underwent total hip arthroplasty in the setting of spontaneous ankylosis of unknown etiology. The increase in offset of the patient's limb through reconstruction, in combination with severe soft-tissue atrophy of the lower extremity, resulted in a soft-tissue defect that could not be closed primarily. This ultimately required a rectus femoris rotational flap and skin grafting for coverage. We describe the surgical technique used for conversion of an ankylosed hip to total hip arthroplasty, as well as the technique for management of a large proximal thigh soft-tissue defect with rectus femoris muscle flap coverage.

Introduction

Converting an ankylosed hip to total hip arthroplasty (THA) has been described successfully by multiple authors over the last 40 years [1-14]; goals of the procedure are to restore mobility, improve function, and prevent adjacent degeneration of the lumbar spine and knee. To the knowledge of the authors, this is the first report of a fusion takedown with conversion to THA which required rotational muscle flap coverage. The aims of this case report are to provide case history, describe surgical technique, and discuss complications and outcomes of conversion from ankylosis to THA.

Case history

A 51-year-old man, who recently immigrated from Ghana, presented to our institution with a complaint of right hip stiffness and difficulty ambulating secondary to a severe leg length discrepancy, with associated pain in the lumbar spine and contralateral hip. Past medical and family history was unremarkable. The patient recalled a significant leg injury as a child that was treated with a several month history of long leg cast immobilization. He denied any surgical treatment to the hip or a history of joint infection. Physical examination demonstrated no obvious range of motion of the hip with associated severe valgus deformity of the ipsilateral knee. Marked atrophy of the right limb was noted grossly in comparison to the contralateral side. Abductor muscle function was difficult to objectively assess, although distal neurological examination was normal. Plain radiographs demonstrated complete intra-articular ankylosis of the right hip (Fig. 1a). Apparent leg length discrepancy was approximately 8 cm, although the hip length discrepancy was measured at 3.7 cm based on preoperative digital templating (Fig. 1b). Preoperative magnetic resonance imaging demonstrated severe atrophy of the hip musculature as well as a thin subcutaneous tissue envelope (Fig. 2). Magnetic resonance imaging was ordered as opposed to an electromyogram in this case, as it further allowed for evaluation of osteomyelitis (given the insidious nature of this patient's ankylosis), as well as allowed for accurate evaluation of the fusion mass. Given significant functional limitations, the patient was interested in pursuing right THA. Informed consent was obtained, and he electively underwent conversion THA. Intraoperatively, we were unable to attain adequate soft-tissue coverage of the hip given the combination of increased offset from the preoperative ankylosed state and atrophied subcutaneous tissue. Plastic surgery was involved for rotational rectus femoris (RF) muscle flap and skin grafting for wound closure. His wound ultimately healed.

At 1-year follow-up, the patient demonstrated minimal surgical hip pain, with resolution of preoperative back and contralateral hip

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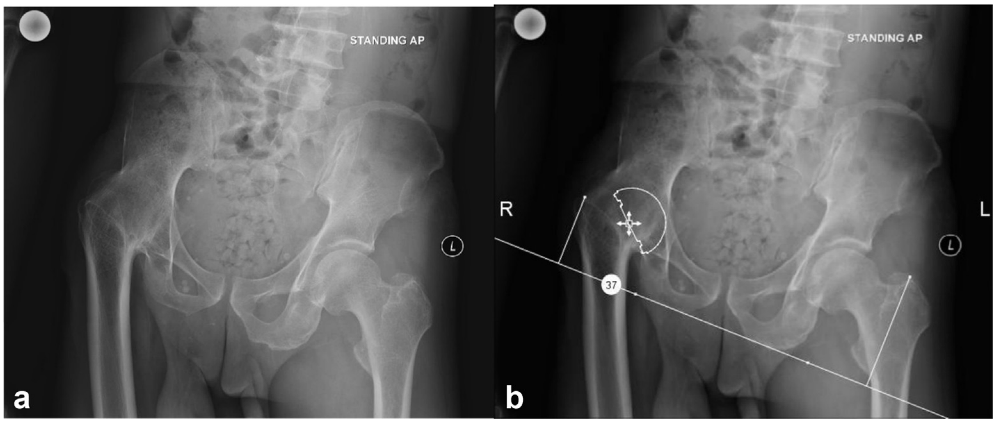

Figure 1. (a) Anteroposterior pelvic radiographs demonstrating complete ankylosis of the right hip. (b) Preoperative templating demonstrating an approximate 37-mm hip leg discrepancy, templated with OrthoView (Materialise Software; Plymouth, MI).

pain. He continued to ambulate with crutches and an ankle-foot orthosis for postoperative sciatic nerve palsy. Despite a prolonged recovery, he reported an improved quality of life and was satisfied with his outcome. Radiographs demonstrated good position and alignment of implants with no evidence of loosening or mechanical failure (Fig. 3a and b).

Surgical technique

The patient underwent THA performed by the senior author (N.F.) through a direct lateral approach in the supine position using a gel hip pad under the pelvis. Supine hip positioning facilitated the use of intraoperative fluoroscopy, which was used judiciously throughout this case. The gluteus medius was split at the anterior one-third of the musculature, with elevation of the tendon off the anterior capsule. A wide anterior capsulectomy was performed to allow for visualization of the fused femoral head, neck, and anterior ilium. Intraoperative fluoroscopy was used to determine the appropriate location of the femoral neck cut, which was initiated with an oscillating saw and completed with a broad osteotome. The femur was partially mobilized away from the retained femoral head with careful exposure of the acetabulum. A small acetabular reamer was used under fluoroscopic guidance to ream through the fused femoral head to gain access to the native acetabulum. The obturator foramen was identified using a hemostat to localize the native hip center. Intraoperative fluoroscopy was used to help guide the acetabular reamer to the true floor of the acetabulum, radiographically congruent with the ilioischial line. Retractors were carefully placed about the anterior and posterior columns to help guide approximate position of the true acetabulum in the sagittal plane. Sequential reaming was performed until a tight anterior/posterior columnar fit was achieved. Removal of the femoral head to gain access to the acetabulum ultimately resulted in approximately 30% of the trial acetabular component being uncovered. An excellent mechanical press-fit was achieved with a multihole trabecular metal implant (Trident Tritanium; Stryker Corporation, Kalamazoo, MI). Multiple screws were placed in the posterior column and ischial spine for multidirectional fixation given the degree of acetabular uncoverage.

Femoral reconstruction was prepared for a proximally porous, coated, tapered stem (Accolade II; Stryker Corporation, Kalamazoo, MI). An excellent press-fit was achieved. An attempt to trial with a reduced femoral head with high offset was unsuccessful because of excessive soft-tissue tension. Sequential soft-tissue releases were performed to achieve an eventual reduction with the shortest femoral head construct given multiple contractures; this included complete release of the gluteus maximus tendon, piriformis, and conjoined tendon; recession of the posterior capsule from the femur; blunt release of the adductor musculature; and eventually a limited subperiosteal elevation of the gluteus medius body off the outer table of the ilium. Intraoperative fluoroscopy was used to confirm approximate restoration of hip length and offset in comparison to the contralateral side. Despite excellent stability in flexion, subtle instability was noted to adduction and external rotation using a 36-5 femoral head; excellent stability was accomplished using a 36 + 0 femoral head and flat 36-mm polyethylene liner (nonlateralized). Despite extensive soft-tissue releases, passive range of motion was limited because of patient stiffness from 0-60 degrees of flexion, with 30 degrees of internal and external rotation. An approximately 4-cm residual clinical leg length discrepancy remained, suggesting that the hip lengthening remained less than 4 cm (given an 8-cm apparent preoperative leg length discrepancy). This was felt to be likely secondary to a fixed pelvis obliquity and severe valgus deformity of the ipsilateral knee.

Upon attempted closure of the gluteus medius tendon, it was noted that mobilization of the tendon to the native footprint required significant traction. A transosseous tendon repair was used to augment fixation. It was subsequently noted that tension

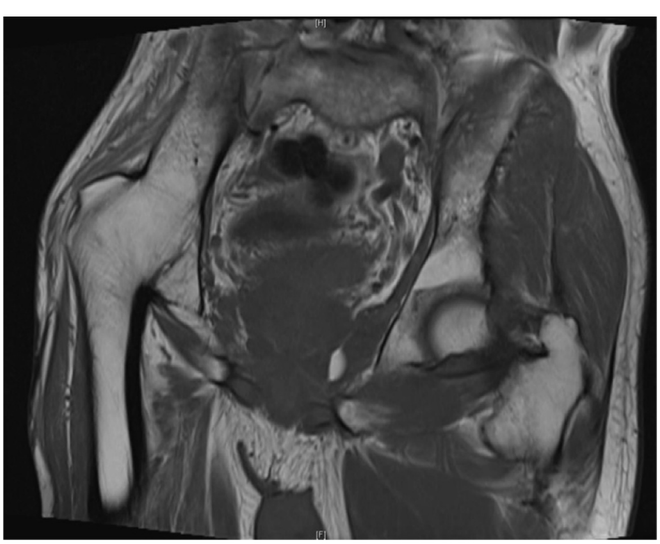

Figure 2. Magnetic resonance imaging demonstrating complete ankylosis as well as atrophy of the gluteus medius and subcutaneous fat.

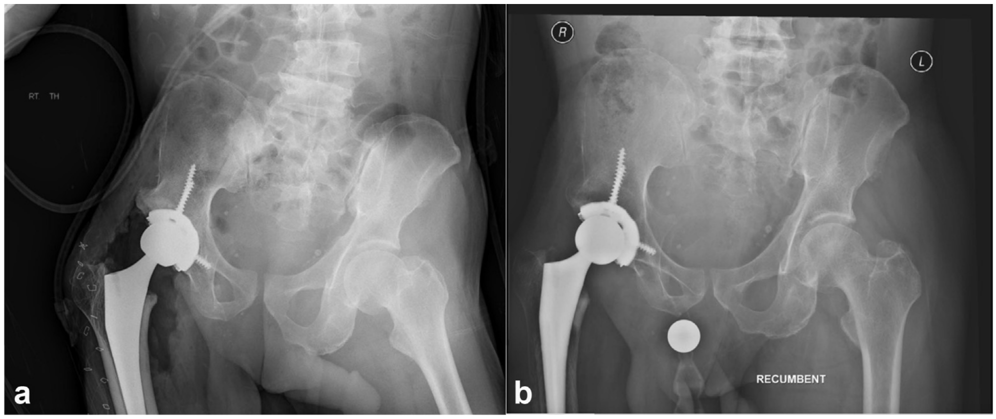

Figure 3. (a) Postoperative radiographs demonstrate acceptable position and alignment of uncemented total hip arthroplasty. (b) One-year postoperative radiographs demonstrate osteointegration without evidence of mechanical loosening.

on the iliotibial band, and surprisingly even the subcutaneous tissue and skin, was overly excessive to allow for approximation (Fig. 4). It was felt that this circumstance was due to a combination of a significant increase in offset from the preoperative ankylosed state and significant emaciation of the limb due to disuse. Although a high-offset stem was used for reconstruction, it was felt that revision of the component to decrease soft-tissue tension would be unwise given the initial difficulty in achieving hip stability. Given the severity of the deficiency, it also seemed unlikely that a change from a high-offset angled stem (127°) to a standard-offset angled stem (132°) would make a significant difference in terms of achieving wound closure. As such, a provisional closure of the skin was formed using a large vessel loop in a Roman Sandal technique. A negative pressure V.A.C. (KCI, San Antonio, TX) dressing was placed over the skin, and the patient was transferred to the post-anesthesia care unit.

Postoperatively, the patient was noted to have signs and symptoms consistent with a right common peroneal palsy. Although hip lengthening was measured to be less than 4 cm, it was discussed with the patient that a traction injury was certainly possible. However, given concerns with achieving stability encountered at the time of reconstruction, it was felt that revision to shorten the femoral length would be potentially unwise. Of note, revision to a larger femoral head, modular dual mobility, or constrained liner are all viable options with this system, which could have potentially allowed for a shorter hip construct while maintaining stability. However, given the extent of soft-tissue releases necessary to mobilize the femur and reduce the hip, it was uncertain whether this was a palsy secondary to leg lengthening vs direct nerve injury. A subtrochanteric shortening osteotomy with femoral revision was also discussed with the patient, but it was felt that would unlikely decrease tension sufficiently to allow for soft-tissue closure given the extent of the defect, as well as unpredictably relieve his sciatic nerve palsy. The patient was counseled of his options, and a shared decision to treat the neuropathy conservatively was made. He was fitted for an ankle-foot orthosis, with neurology consultation organized for outpatient follow-up. Plastic surgery consultation was organized to discuss options available for soft-tissue coverage.

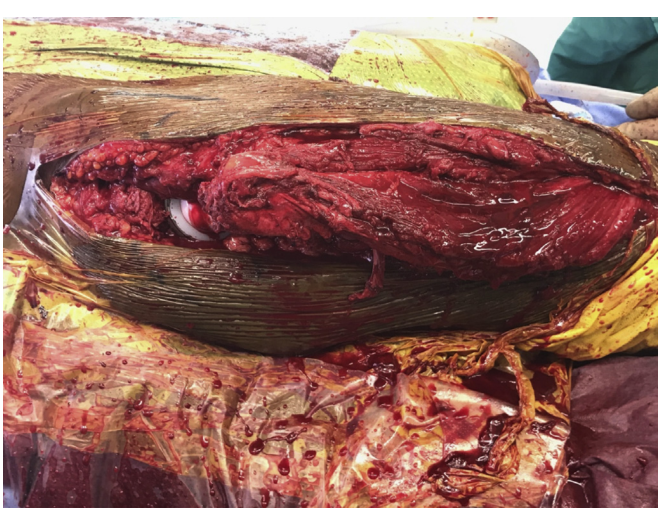

Figure 4. Intraoperative photo demonstrating reduced total hip with excessive soft-tissue tension precluding primary wound closure.

The patient returned to the operating room on postoperative day 7 for reconstruction with a pedicled RF muscle flap. A short longitudinal incision was made over the anterior distal thigh to allow for division of the muscle insertion on the patellar tendon, thus allowing mobilization of the muscle to cover the trochanter. The remainder of the dissection and freeing the RF from its surrounding attachments was performed via the lateral hip incision. The muscle was inset and tucked slightly behind the trochanter, and a split-thickness skin graft was fashioned in place over the muscle (Figs. 5 and 6). A negative pressure V.A.C. (KCI, San Antonio, TX) dressing was applied over the skin graft and removed after 5 days with subsequent transition to daily local wound care to the maturing skin graft. The muscle flap and skin graft went on to heal without any evidence of delayed healing to achieve a sealed wound.

Discussion

Outcomes of converting an ankylosed hip to THA tend to be inferior to primary THA. Postoperative range of motion is less than expected for patients undergoing primary THA for osteoarthritis [1,2]. Published reports indicate that many patients will have a positive postoperative Trendelenburg sign and that 40%-70% of patients will require the use of ambulatory aids postoperatively, as was the case in our patient [1-5]; Kim et al [6] reported that only 31% of patients required walking aids after conversion, but it is worth noting that this group did not perform conversion arthroplasty for patients with absent gluteal contraction preoperatively. Most patients who undergo conversion THA will report an improvement in lower back symptoms [7]. Some studies have suggested that patients aged >50 years at the time of arthrodesis, as

Figure 5. (a) Intraoperative picture demonstrating rotational flap allowing for soft-tissue closure. (b) Healed wound at 1-y follow-up.

well as patients with spontaneous fusion (as opposed to surgical fusion), have been reported to have more favorable outcomes with lower rates of failure [4,8]. Interestingly, other studies have noted no difference in failure rates between patients with spontaneous vs surgical fusions [1,6,9]. The largest published series, performed by Joshi et al, looked at 208 hips converted over a 26-year period with mean 9.2-year follow-up; they reported 96% survival at 10 years and 90% survival at 15 years, with revision for any reason as an endpoint [9]. Overall, the current literature demonstrates that most patients undergoing this procedure tend to be satisfied with the results [1,2,5,7,10].

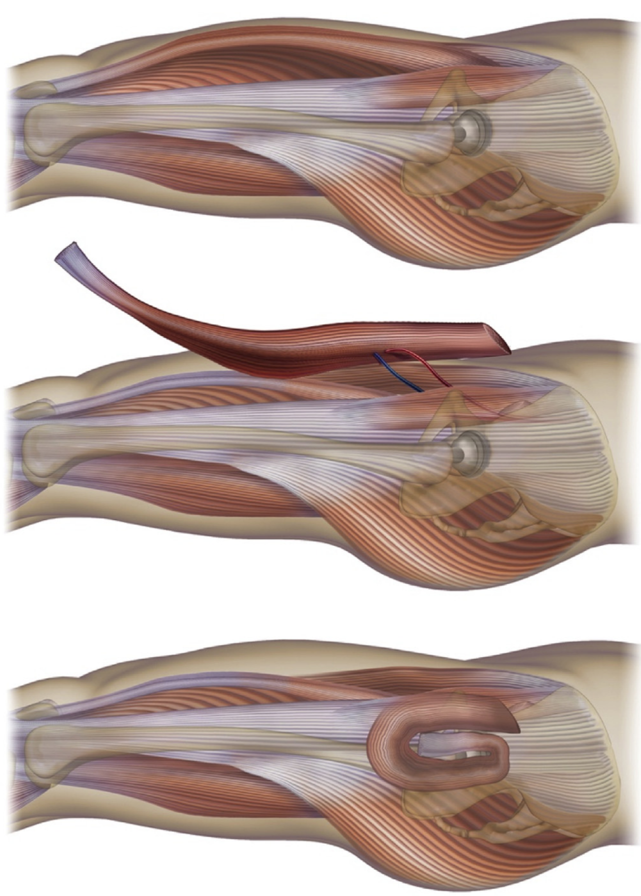

Figure 6. Illustration demonstrating distal release and mobilization of the rectus femoris with rotation and attachment around the trochanter.

Complications associated with conversion THA appear to be higher than those for primary THA. Reported postoperative deep infection rates range from 4.5% to 13% [3,6,8,11,12]. Nerve palsy has been reported to occur in sciatic and femoral distributions and occurs in 2.3%-13.3% of published reports [3,5-7,9,11,13,14], compared to an overall incidence in primary THA of 0.3%-3% in large series. The relationship between leg lengthening and sciatic nerve palsies is well recognized, although controversy remains as to the degree of lengthening that can be safely achieved. Hanssen et al [15] in their series evaluating dysplastic patients at the Mayo Clinic demonstrated a significant increase in nerve palsies if lengthening exceeded 4 cm. Nercessian et al [16] suggested that lengthening of the limb more than 10% of the femoral length was a risk factor for nerve palsy irrespective of absolute distance. Although neither of these measures were thought to be exceeded in this patient, the causes of nerve injuries are often felt to be multifactorial, with 50% of cases found without an obvious etiology [17].

Several studies reported a 0% dislocation rate (n = 41, 44, and 133) [5,7,11]; other reports have dislocation rates reported between 1.3% and 4.6% [8-10,14]. Heterotopic ossification has been reported as another possible complication and occurred in 13% of a series of 208 patients [9].

There are multiple reports that describe successful management of THA wound defects with soft-tissue transfers; previously described donors include RF, vastus lateralis (VL), tensor fascia latae, latissimus dorsi-serratus anterior (LD-SA), and rectus abdominis (RA) flaps [18-22]. Meland et al describe their experience with management of recalcitrant THA wounds, with their preferred donor being RF, followed by VL, then RA; if no local flaps are available, then they recommend free tissue transfers for coverage of the defect [18]. This group was the first to report success of free-tissue transfer (LD-SA) in coverage of THA wounds. They reported complete healing in 28 cases. The authors attribute their preference for RF due to the ease, dependability, and "virtually bloodless" nature of procedure in comparison with dissection of VL pedicle [18]. Arnold and Witzke describe 7 patients treated successfully with RF, VL, or combined RF/VL flaps for failed THA [19]. They report 2 complications: sterile seroma managed non-operatively with aspiration and compression, and 1 patient requiring reoperation for partial flap debridement. All patients had complete healing at final follow-up [19]. Jones et al [20] describe their success with successful healing of chronically infected hip wounds in 9 hips; they performed subcutaneous or transpelvic transposition of RA for small defects, with VL and free LD flaps for progressively larger wounds. All patients had complete primary healing within 3 weeks of surgery without any infection in this case series. In a larger study, Choa et al [21] support the efficacy of pedicled RF and VL muscle flaps for coverage of 24 recalcitrant hip wounds. The authors provide a succinct description of relevant anatomy and technique for RF and VL flaps. They reported 2 flap losses (RF and VL), each reoperated on once for failure of healing, and subsequently healed without reoperation. They experienced 1 case of transient quadriceps spasm postoperatively and otherwise reported no donor site morbidity. Nineteen wounds healed primarily, 3 healed by secondary intention, and 2 wounds had draining sinus at final follow-up. The authors highlight the need for postoperative physiotherapy to address quadriceps weakness after the use of these flaps [21]. Collins et al [22] describe their experience with VL flap in 7 patients with intractable hip infection after resection arthroplasty. They report successful healing in all 7 patients; 1 patient had recurrence of drainage treated successfully with local wound care. The authors provide an excellent description of surgical technique for VL rotational flaps [22]. They highlight that VL remains largely undisturbed in the setting of multiple prior hip surgeries and praise the wide arc of rotation achieved with VL flaps, as well as its capacity to fill deep defects.

The aforementioned muscle flaps have primarily been described in the context of deep hip infections recalcitrant to traditional treatment. This case provides a unique account of requiring muscle flap coverage to obtain primary closure at the index arthroplasty procedure. Similar attempts at flap coverage should be done in conjunction with an experienced soft-tissue reconstructive surgeon.

Summary

Conversion THA is technically demanding and associated with an increased inherent risk compared with primary THA. Outcomes in comparison to primary THA are typically inferior, but most patients are satisfied with the outcome of this procedure. Surgeons should be aware that a significant increase in hip offset with concurrent soft-tissue emaciation may result in the need for muscle flap coverage in the primary setting.

Conflict of interest

The authors declare there are no conflicts of interest.

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