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Case Report

Total Hip Arthroplasty, via Direct Anterior Approach, With Contralateral Proximal Femur Amputation

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ABSTRACT

Lower limb amputation has been well characterized in the literature to cause resultant osteoarthritis in the hip of the contralateral limb. This further amplifies the already significant physical disability and morbidity that come with lower limb amputation. The use of total hip arthroplasty (THA) in patients with lower limb amputations is rare, with available literature subsequently also limited. In this case report, we describe a 52-year-old female with a right proximal femur (subtrochanteric) amputation who underwent left THA due to osteoarthritis. To our knowledge, this is the first published report describing THA, via direct anterior approach, in a patient with contralateral proximal femur (subtrochanteric) amputation. We discuss the complex surgical considerations for this patient population, selection of approach, prosthesis, and postoperative outcomes.

Introduction

Total hip arthroplasty (THA) is an effective operative treatment for severe hip arthritis [1,2]. In Australia, the incidence of primary THA has grown with a 125.2% increase since 2003 [2]. THA has been shown to be a durable option to improve symptoms, with a revision rate of 8.4% at 20 years [2]. Lower limb amputation still plays a vital role in severe trauma, peripheral vascular disease, infection, congenital abnormalities, and malignancy. The patient described in the case report had a right proximal femur (subtrochanteric) amputation due to femoral osteosarcoma. Osteosarcoma is a relatively rare primary bone malignancy with an average incidence of 4.3 per million people per year for males and 3.4 per million people per year for females [3]. Originally, it was managed with amputation; however, the development of chemotherapy and its optimization in the past 40 years has shifted treatment toward limb salvage, with increased survival [4].

Lower limb amputation has been well characterized in the literature to cause osteoarthritis in the knee and/or hip of the contralateral limb [5-7]. There is a 2-fold higher incidence of osteoarthritis in the contralateral hip compared to the nonamputee population, but the onset of osteoarthritis can take place 5-10 times sooner. This is thought to be attributed to altered gait patterns and joint load. Together, this rapid onset of osteoarthritis would further amplify the significant physical disability and morbidity that comes with limb amputation. The literature is sparse regarding the impact of THAs in patients with contralateral lower limb amputation, with lateral and posterior approaches previously described along with their challenges [8-13]. This case report provides further evidence to the management of this unique population with an operative approach not previously described.

Case history

The patient is a 52-year-old female independent with activities of daily living, mobilizing with 2 axillary crutches, a nonsmoker with a body mass index of 18.8 kg/m^2. She underwent a right proximal femur (subtrochanteric) amputation at 8 years old in the setting of osteogenic sarcoma. No further treatment was required

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with no recurrence. The patient utilized a prosthesis initially but ceased 10 years ago due to fatigue, pregnancy, and stump neuropathic pain. She uses 2 axillary crutches and remains very active. Other past medical history includes right hip neuroma excision for phantom limb-associated neuropathic pain, hypertension, fibromyalgia, chronic fatigue syndrome, depression, anxiety, and migraines. She presented with years of progressively worsening left lateral hip and groin pain radiating to the knee. This was associated with nocturnal symptoms, decreasing mobility, and falls. Trials of activity modification and simple analgesia provided no relief. Given the significant lateral pain in addition to groin pain, a diagnostic injection was utilized. Trochanteric bursa corticosteroid injection resulted in transient and partial relief of symptoms. Diagnostic intraarticular local anesthetic injection confirmed a complete but transient relief of pain.

The left hip demonstrated full flexion, 30 degrees of abduction, 10 degrees of adduction, 60 degrees of external rotation, and 20 degrees of internal rotation limited by pain. Examination of the back and left knee was unremarkable. Assessment of the right hip demonstrated a very short stump that was flexed and abducted, with a well-healed scar. X-rays confirmed the diagnosis of moderate-severe left hip osteoarthritis (Fig. 1). Computed tomography demonstrated bone-on-bone osteoarthritis with lateral hip subluxation. The patient was agreeable to proceed with direct anterior approach (DAA) THA with informed consent obtained. Surgery was performed by the senior author (T.G.), who is fellowship trained in DAA hip arthroplasty.

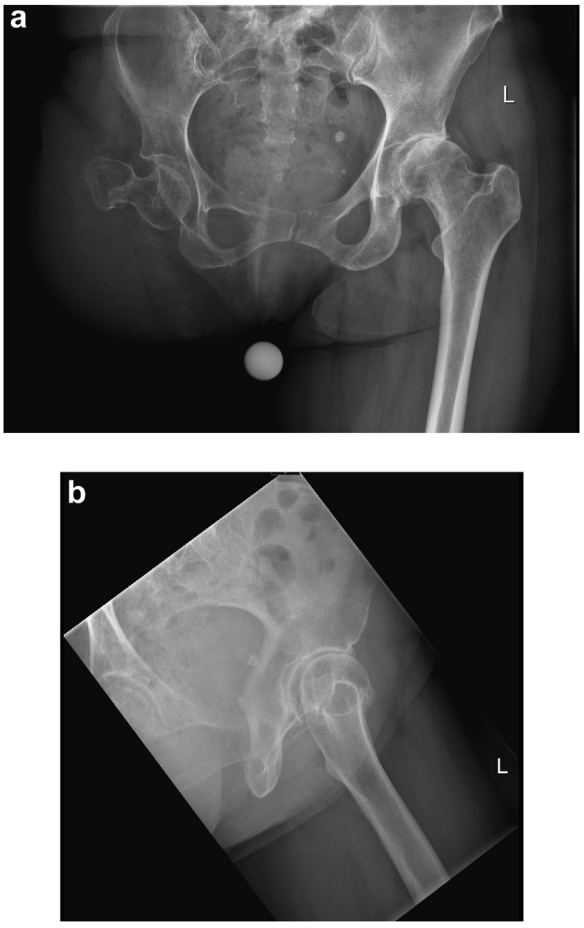

Figure 1. Initial hip X-ray imaging demonstrating moderate-severe left hip osteoarthritis and remaining right femoral stump, (a) anterior-posterior view, (b) lateral view.

Surgical technique

Preoperative templating was undertaken using X-ray with a planned reduction in preoperative offset and mild lengthening of 5-7 mm. The patient was positioned supine on a traction (Purist, Innovative Orthopedic Technology, Baar Switzerland) with the operative leg in the foot holder. Without a contralateral foot to put in the other foot holder, the pelvis was indirectly stabilized by placing a bolster against the ipsilateral chest wall to prevent excessive lateral movement of the trunk or pelvic tilt when manipulating the operative leg (Fig. 2). Level pelvis positioning was carefully confirmed with fluoroscopy (Fig. 3). The operative-side arm was placed in a sling across the body. A DAA was used and a V-shaped capsulotomy performed. Fluoroscopy with navigation software (VELYS, DePuy, Warsaw, Indiana) was used to confirm acetabular positioning, limb length, and offset. Anterior stability was assessed with extension to 45 degrees and external rotation to 90 degrees in the leg holder, and posterior stability was assessed with the leg free with internal rotation and flexion. Definitive components (DePuy, Warsaw, Indiana) were inserted: 50 mm Pinnacle Gripton cup with no screws, a 32 mm neutral polyethylene liner, a collared Corail cementless femoral stem 125 degrees standard offset size 11, and a 32 mm ceramic head. The capsule was closed, followed by a dilute betadine/saline washout and tissue closure in layers.

Low-dose aspirin was used for venous thromboembolism prophylaxis. Prophylactic antibiotics (cefazolin 2 g 8-hourly) were used for 24 hours. The postoperative period was largely unremarkable with mobilization commenced day 1 postoperatively. The patient was cleared for discharge on day 4 postoperatively by physiotherapy and was independent with crutches. Mild paresthesia was noted postoperatively in the distribution of the lateral cutaneous nerve of the thigh. Follow-up included clinical review at both 2 and 6 weeks postoperatively. At the 2-week postoperative review, there were no wound complications, postoperative pain was resolving, and power was intact for all movements at the hip and Trendelenburg negative. The patient was able to stand unaided on her operative leg with a level pelvis (Fig. 4). At the 6-week postoperative review, the patient described resolution of the groin pain with occasional lateral hip and knee pain. Her wound had healed. Repeat X-rays were stable (Fig. 5). At last review (10 months postsurgery), she had no groin pain, and the lateral hip pain was much improved. She had some stump symptoms on the contralateral limb and was being investigated for a recurrent neuroma. Imaging showed a stable prosthesis with no complication.

Discussion

Lower limb amputation has been well characterized to cause premature osteoarthritis in the contralateral hip and/or knee [5-7]. Given the altered pelvic, lower limb, and gait mechanics after lower limb amputation, this would be expected to influence a hip prosthesis differently in the nonamputee population and may affect clinical and radiological outcomes. Literature investigating the effectiveness of THA, surgical approach, and postoperative outcomes is scarce for patients with a contralateral lower limb amputation [14]. This makes counseling patients more challenging. Amanatullah et al. demonstrated that mean Harris hip score (HHS) significantly improved in amputees post-THA [14]. Retrospective cohort studies by Galloway et al. and Cho et al. provided the best evidence for short-, mid-, and long-term outcomes of patients undergoing THA with lower limb amputations [15,16], although they did not encompass our specific patient. Cho et al. utilized a posterolateral surgical approach with cementless prosthesis, whereas Galloway et al. did not discuss the type of THA surgical

Figure 2. Intraoperative positioning of the patient.

approach and had mixed fixation methods. HHS and activities of daily living were significantly worse at the 3-month postoperative mark when compared to nonamputee population, however normalized from 6 months postoperatively and beyond. There were also no radiographic changes to prosthesis at this time.

The literature is mixed regarding patient demographics and type of THA. The side of the arthroplasty relative to the amputation, level of amputation, surgical approach, and implant fixation vary. Although none of these studies captured our patient perfectly, these studies provided insight into managing the unique issues, performing THA on a patient with contralateral lower limb amputation. A case report by Sommerville et al. discussed some of the

Figure 3. Intraoperative fluoroscopy anterior-posterior images of the pelvis being level.

Figure 4. Clinical image of the patient standing at 2 weeks postoperatively.

operative challenges performing a THA has in a patient with contralateral lower limb amputation [9]. Patient positioning and subsequent pelvic position are vital for appropriate cup placement and prosthesis alignment. Lateral positioning is difficult as the absence of the inferior limb can cause the pelvis and therefore the operative acetabulum to adduct toward the missing limb, leading to a relatively abducted cup position if not adjusted for [9]. In the amputee population, there is also a lack of references such as the knee or leg axis to obtain appropriate component version [13]. As a result, there is an increased risk of implant malposition, more so in patients with above-knee amputation [13]. Positioning the patient supine, as for DAA, allows a more reproducible pelvic position, which can be confirmed fluoroscopically.

Surgical approaches such as the DAA, posterior approach (PA), and lateral approach (LA) all have advantages and shortcomings. To our knowledge, there is no published literature for DAA THA in patients with contralateral lower limb amputation; however, there is some evidence for PA and LA. Sommerville et al. proceed with a direct LA rather than a PA [9]. Their patient had a contralateral hindquarter amputation and was thought to be at high dislocation risk postoperatively given they would not be able to adhere to posterior hip precautions. The PA offers a shorter operative time, allows excellent acetabular and femoral shaft exposure, and does not disrupt the abductor muscles decreasing potential for altered postoperative gait [17]. Historically, the PA was found to have

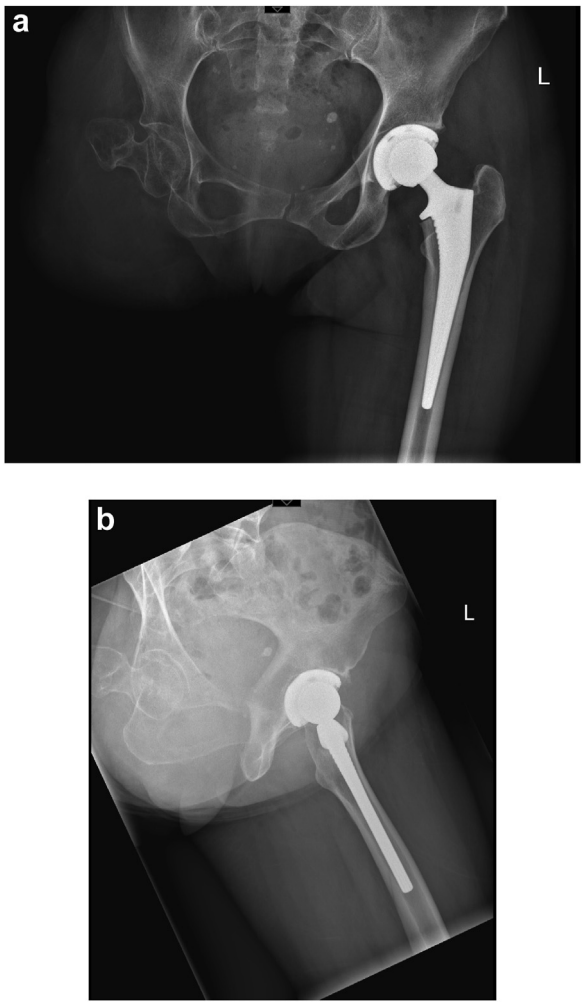

Figure 5. Six-week postoperatively X-ray imaging of left hip prosthesis, (a) anterior-posterior view, (b) lateral view.

increased hip dislocation risk given it requires the short internal rotators to be detached and compromises the posterior capsule resulting in hip instability [18,19], with DAA found to be more stable in comparison [20]. However, more recent literature has found that a PA with capsule repair does not cause increased hip instability [21], although these outcomes are debated in regard to population selection bias [22]. There is also a potential risk of damaging the sciatic nerve [23]. The LA is associated with more gait instability as it often requires tenotomy of the gluteus medius, weakening abductor function [17]. There is also risk of injury to the inferior branch of superior gluteal nerve, potentially weakening hip abduction and causing pelvic instability [23]. Gait instability in our patient with one good lower limb would have been problematic, and any abductor problems would be best avoided. We also looked to reduce the risk of falls, which is increased in patients with lower limb amputation [24]. As such, we opted for DAA.

DAA is muscle sparing and involves an internervous and intermuscular plane approach between superior gluteal nerve and the femoral nerve, along with sartorius and tensor fascia latae [25]. There is limited exposure of the femur for medullary reaming [17] and a risk of damage to the lateral femoral cutaneous nerve, which results in sensory disturbance, but no motor disturbance. This often resolves [26]. A meta-analysis by Ang et al., the first to include only randomized controlled trials, reviewed DAA, PA, and LA for THA in nonamputee population [25]. They found that DAA had a longer operative time but shorter length of stay compared to PA. There was no difference in operative time between DAA and LA. DAA had significantly better HHS than PA at 6 weeks postoperatively and LA at 12 weeks postoperatively. There was no difference in risk of neuropraxia between DAA and LA, and no difference in risk of dislocations, periprosthetic fracture, or VTE between all groups. All approaches showed no significant difference in radiological positioning; however, a single study by Zhao et al. concluded that DAA had more accurate cup positioning [27]. Further to this, although this review did not statistically analyze visual analog scale pain scores, 8 out of 11 studies reported lower visual analog scale scores for DAA. The Australian Orthopaedic Association National Joint Replacement Registry 2022 Annual Report showed DAA was the second most common approach [2]. Major revision rates were higher for DAA compared to other approaches, with the most common reasons being prosthesis loosening and periprosthetic fracture in the first 3 months, with rates normalizing thereafter. DAA had lower rates of revision for hip instability and dislocation. Preoperative and postoperative patient reported outcome measures were better for DAA compared to other approaches, although change in score after surgery showed no difference. Given our patient is a lower limb amputee who utilizes crutches and at higher risk for falls and postoperative pain (both being well associated with poorer recovery [28]), DAA was appealing given the better early functional outcomes, decreased postoperative pain, and lower risk of hip and gait instability. This allowed her to achieve independent mobility on her operative/only hip quickly, allowing our patient to return to her active life.

The majority of primary THA in Australia is undertaken with cementless implants, although there was no difference found for revision rates in patients <55 years old when compared to cemented implants. Our patient was young, did not have a diagnosis of osteoporosis, and had not had radiotherapy for her sarcoma [29]. Given long-term risks of cement aging and late loosening when used in young or middle-aged patients [30,31] and better survival for cementless THA in younger patients [32], our patient was a good candidate for the cementless implant. The Corail femoral stem and Pinnacle acetabular prosthesis were both in the top 3 most used femoral stem and acetabular prosthesis for primary THA, with Corail the most common femoral stem for uncemented THA [2]. Cumulative revision rates for the Corail-pinnacle prosthesis combination at 10 years were 4.8%.

Summary

This case report describes the rare case of THA in a patient with contralateral proximal femur (subtrochanteric) amputation. Although the literature for THA in the lower limb amputation population is sparse, there is a growing body of evidence to describe its fidelity and the unique surgical considerations that need to be considered. We demonstrate that the DAA is a viable option for young active patients as it allows earlier functional return and does not increase the risk of hip or gait instability. However, these considerations should be made in conjunction with each patient and their specific functional requirements. Although THA in the amputee population appears to be beneficial, further reviews are required to better characterize the unique considerations to enable more informed patient counseling.

Conflicts of interest

The authors declare there are no conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101580.

Informed patient consent

The author(s) confirm that written informed consent has been obtained from the involved patient(s) or if appropriate from the parent, guardian, power of attorney of the involved patient(s); and, they have given approval for this information to be published in this case report (series).

CRediT authorship contribution statement

Joseph Femia: Writing − review & editing, Writing − original draft. **Tom Gieroba:** Writing − review & editing.

References

[1] Bottai V, Dell'Osso G, Celli F, Bugelli G, Cazzella N, Cei E, et al. Total hip replacement in osteoarthritis: the role of bone metabolism and its complications. Clin Cases Miner Bone Metab 2015;12:247−50.

[2] Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR). Hip, knee and shoulder arthroplasty. Annual Report 2022. Adelaide: AOA; 2022. p. 1−171.

[3] Mirabello L, Troisi RJ, Savage SA. International osteosarcoma incidence patterns in children and adolescents, middle ages and elderly persons. Int J Cancer 2009;125:229−34.

[4] Misaghi A, Goldin A, Awad M, Kulidjian AA. Osteosarcoma: a comprehensive review. SICOT J 2018;4:1−8.

[5] Burke MJ, Roman V, Wright V. Bone and joint changes in lower limb amputees. Ann Rheum Dis 1978;37:252−4.

[6] Kulkarni J, Adams J, Thomas E, Silman A. Association between amputation, arthritis and osteopenia in British male war veterans with major lower limb amputations. Clin Rehabil 1998;12:348−53.

[7] Struyf PA, van Heugten CM, Hitters MW, Smeets RJ. The prevalence of osteoarthritis of the intact hip and knee among traumatic leg amputees. Arch Phys Med Rehabil 2009;90:440−6.

[8] Murphy C, Bonnin M, Selmi T. Total hip arthroplasty after contralateral hip disarticulation: a challenging "simple primary". Am J Orthop 2015;44:233−5.

[9] Sommerville S, Patton J, Luscombe J, Grimer R. Contralateral total hip arthroplasty after hindquarter amputation. Sarcoma 2006;2006:1−4.

[10] Nejat EJ, Meyer A, Sánchez PM, Schaefer SH, Westrich GH. Total hip arthroplasty and rehabilitation in ambulatory lower extremity amputees–a case series. Iowa Orthop J 2005;25:38−41.

[11] Boussakri H, Alassaf I, Hamoudi S, Elibrahimi A, Ntarataz P, A EL, et al. Hip arthroplasty in a patient with transfemoral amputation: a new tip. Case Rep Orthop 2015;2015:1−5.

[12] Diamond OJ, Mullan CJ, McAlinden MG, Brown JG. Total hip arthroplasty following an ipsilateral above knee amputation. Hip Int 2013;23:104−7.

[13] Malagelada F, Coll Rivas M, Jiménez Obach A, Auleda J, Guirao L, Pleguezuelos E. Total hip replacement in an ipsilateral above-the-knee amputation: surgical technique, rehabilitation, and review of the literature. Int J Low Extrem Wounds 2013;12:39−43.

[14] Amanatullah DF, Trousdale RT, Sierra RJ. Total hip arthroplasty after lower extremity amputation. Orthopedics 2015;38:e394−400.

[15] Galloway R, Madanipour S, Lemanu D, Jayadev C, McCulloch R. Short- and long-term outcomes in patients with lower extremity amputations undergoing total hip and knee arthroplasty. Arthroplast Today 2023;20:1−6.

[16] Cho HM, Seo JW, Lee HJ, Kang KB, Kim JR, Wee HW. Mid-to long-term results of total hip arthroplasty after contralateral lower extremity amputation. Acta Orthop Traumatol Turc 2018;52:343−7.

[17] Talia AJ, Coetzee C, Tirosh O, Tran P. Comparison of outcome measures and complication rates following three different approaches for primary total hip arthroplasty: a pragmatic randomised controlled trial. Trials 2018;19:1−9.

[18] Masonis JL, Bourne RB. Surgical approach, abductor function, and total hip arthroplasty dislocation. Clin Orthop Relat Res 2002:46−53.

[19] Angerame MR, Fehring TK, Masonis JL, Mason JB, Odum SM, Springer BD. Early failure of primary total hip arthroplasty: is surgical approach a risk factor? J Arthroplasty 2018;33:1780−5.

[20] Sheth D, Cafri G, Inacio MC, Paxton EW, Namba RS. Anterior and anterolateral approaches for THA are associated with lower dislocation risk without higher revision risk. Clin Orthop Relat Res 2015;473:3401−8.

[21] Kwon MS, Kuskowski M, Mulhall KJ, Macaulay W, Brown TE, Saleh KJ. Does surgical approach affect total hip arthroplasty dislocation rates? Clin Orthop Relat Res 2006;447:34−8.

[22] Kunal P, Brenden C, Michael H, Ryan C, William P, Jesua IL. Instability in total hip arthroplasty. In: Alessandro Z, Hechmi T, Eric L, editors. Arthroplasty. Ch. 4. Rijeka: IntechOpen; 2022. p. 1−29.

[23] Cho HM, Seo J-W, Lee H-J, Kim S-D, Kang K-B, Kim J-R, et al. Effect of surgical approach for contralateral side hip arthroplasty in below knee amputees: a retrospective cohort study. BMC Musculoskelet Disord 2019;20:1−11.

[24] Kulkarni J, Wright S, Toole C, Morris J, Hirons R. Falls in patients with lower limb amputations: prevalence and contributing factors. Physiotherapy 1996;82:130−6.

[25] Ang JJM, Onggo JR, Stokes CM, Ambikaipalan A. Comparing direct anterior approach versus posterior approach or lateral approach in total hip arthroplasty: a systematic review and meta-analysis. Eur J Orthop Surg Traumatol 2023;33:2773−92.

[26] Patel NK, Krumme J, Golladay GJ. Incidence, injury mechanisms, and recovery of iatrogenic nerve injuries during hip and knee arthroplasty. J Am Acad Orthop Surg 2021;29:e940−9.

[27] Zhao H-Y, Kang P-D, Xia Y-Y, Shi X-J, Nie Y, Pei F-X. Comparison of early functional recovery after total hip arthroplasty using a direct anterior or posterolateral approach: a randomized controlled trial. J Arthroplasty 2017;32:3421−8.

[28] Gan TJ. Poorly controlled postoperative pain: prevalence, consequences, and prevention. J Pain Res 2017;10:2287−98.

[29] Maggs J, Wilson M. The relative merits of cemented and uncemented Prostheses in total hip arthroplasty. Indian J Orthop 2017;51:377−85.

[30] Masmoudi K, Rbai H, Fradj AB, Saâdena J, Boughattas A. Primary total hip replacement for a femoral Neck fracture in a below-knee amputee. J Orthop Case Rep 2016;6:63−6.

[31] Stea S, Comfort T, Sedrakyan A, Havelin L, Marinelli M, Barber T, et al. Multinational comprehensive evaluation of the fixation method used in hip replacement: interaction with age in context. J Bone Joint Surg Am 2014;96(Suppl 1):42−51.

[32] Zhang C, Yan CH, Zhang W. Cemented or cementless fixation for primary hip arthroplasty—evidence from the International Joint Replacement Registries. Ann J 2017;2:1−10.