



# Total Hip Replacement in a Patient with Bilateral Infrapatellar Amputation: Case Report, Literature Review, Tips and Tricks

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Accepted: 13 December 2021 / Published online: 10 January 2022  
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## Abstract

Patients with lower limb amputation (LLA) are prone to greater physical demands. Retrospective studies reported 5 to 61% of ipsilateral or contralateral hip osteoarthritis after LLA. Total hip arthroplasty (THA) has proven effective in improving the quality of life of patients with hip osteoarthritis. Its incidence after ipsilateral LLA is reported to be 0.067%. There is little information on the technical aspects and results of this procedure in such patients. The objective of this study is to report a patient with bilateral LLA and ipsilateral hip arthritis treated with THA, highlighting the challenges of the surgical technique and the postoperative protocol. After Internal Review Board approval (IRB00010193), we present a 64-year-old male patient with bilateral infrapatellar amputation who underwent left THA where the surgical challenge lies in being able to perform an adequate osteotomy of the femoral neck, obtaining an adequate exposure of the femoral canal, and achieving a correct implant placement. Wide release of the psoas and gluteus maximus tendons was necessary to ease femoral preparation and intraoperative maneuverability of the lower extremity. Although THA is a common procedure, when performed in an unusual patient and in the absence of therapeutic guidelines or consensus when dealing with this association, an appropriate preoperative plan should be followed. This case provides a perioperative approach focused on the search for possible intraoperative scenarios that may occur in patients who will undergo a THA after LLA.

**Keywords** Total hip arthroplasty · Lower limb amputation · Below-knee amputee · Tips and tricks · Surgical technique · Literature review

## Introduction

Patients with lower limb amputation (LLA) are prone to increased physical demands. The level at which the LLA is executed is directly proportional to physiological oxygen consumption required to perform activities of daily living. [1, 2] Below-knee amputation (BKA) overloads the contralateral knee to such an extent that it may lead to articular degeneration [3], while it “unloads” the ipsilateral one; however, it is not clear whether BKA provides such joint “protection” for the ipsilateral or contralateral hip. [4, 5] Retrospective studies have reported a high prevalence of both ipsilateral and contralateral hip osteoarthritis after

LLA, ranging from 5 to 61% without any superiority of either. [4, 6].

Increased ipsilateral hip degeneration could arise by overcompensation of the hip joint flexors, extensors, and external rotators due to the lack of ankle function while walking. [5] Total hip arthroplasty (THA) is a safe procedure and has been shown to be effective in improving quality of life of patients with hip osteoarthritis, and its incidence after ipsilateral LLA is 0.067% [7]. However, there is little information on the technical aspects and results of this procedure in such patients.

We report a case of a patient with LLA and ipsilateral hip arthritis treated with THA, highlighting the challenges of the surgical technique and the postoperative protocol. Secondly, we aimed to review the literature on the outcomes of THA in LLA patients.

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## Case Report

A 64-year-old male patient, with a history of hypertension and body mass index of 30 kg/m<sup>2</sup>, underwent bilateral BKA at the age of 9, due to bilateral agenesis of the fibula. He required multiple additional soft tissue procedures for injuries secondary to the use of its transtibial lace exoprosthesis and patellar tendon support. At the age of 39, he suffered a road accident where he presented a displaced left femoral neck fracture, treated by open reduction and internal fixation with 3 cannulated screws.

The patient was referred to our center in January 2020 with pain in the left hip of 3 years, associated with decreased range of motion of the hip and inability to perform activities of daily living. X-rays showed severe left hip osteoarthritis and the presence of osteosynthesis. A panoramic radiograph of both lower limbs showed bilateral infrapatellar amputation and agenesis of both fibulas, severe left hip osteoarthritis, and the presence of osteosynthesis material.

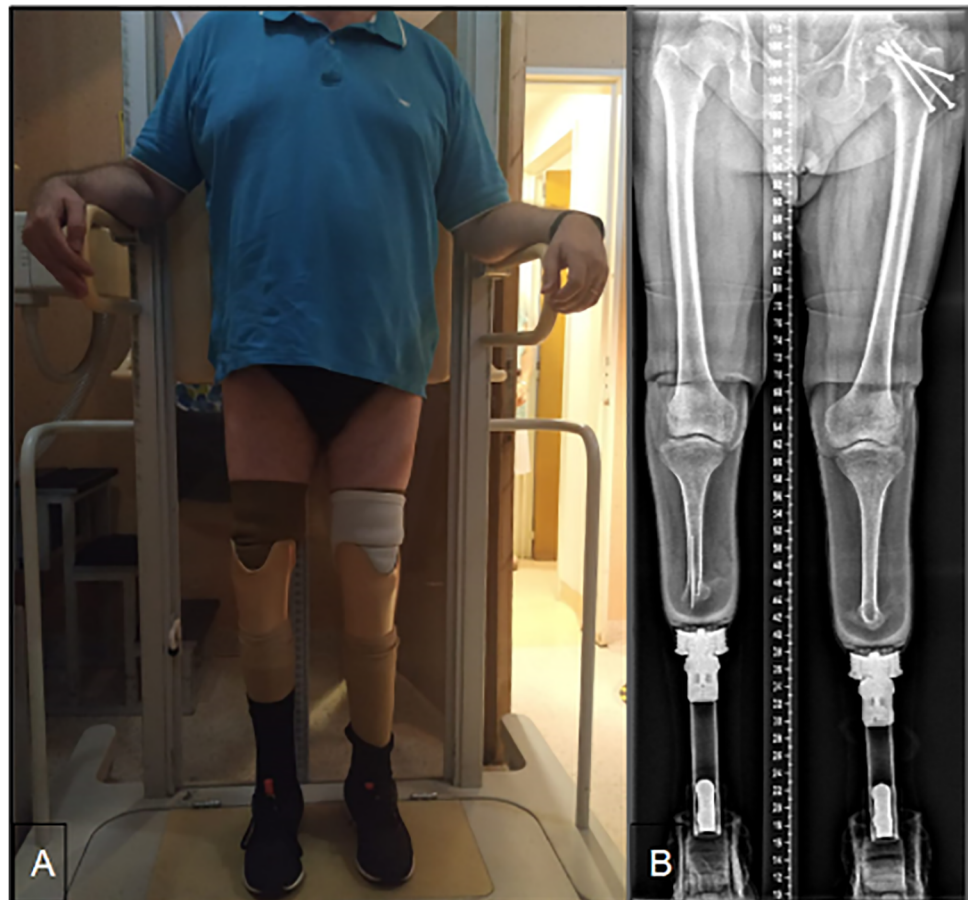
The patient was operated under spinal anesthesia using a posterolateral approach. He was placed on the surgical table in right lateral decubitus, secured with a sacral post

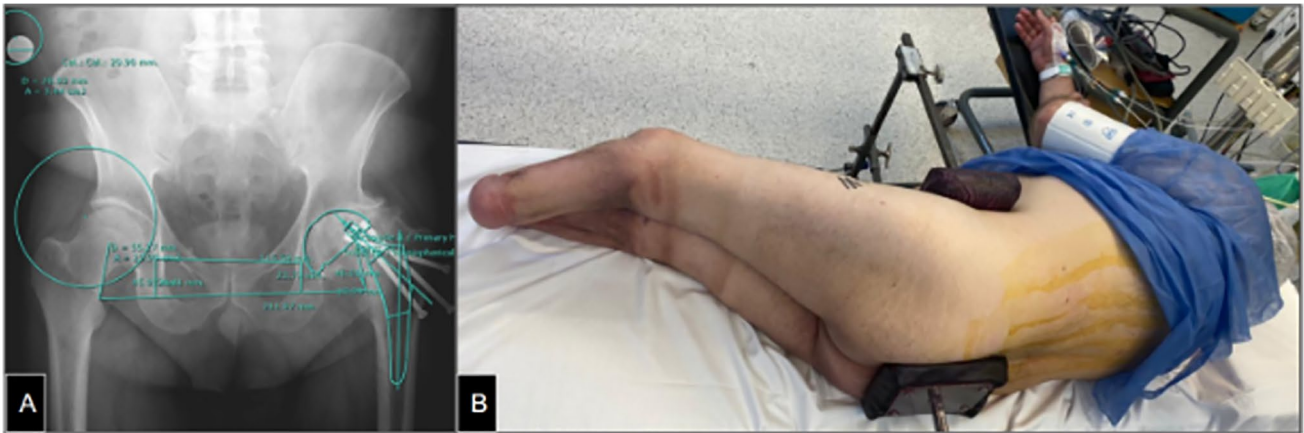
and two anterior posts at the level of the anterior–superior iliac spine to prevent rolling during lower limb stump manipulation (Fig. 2B). A protective silicone patch was placed over the grafted skin area of the stump.

After removing the osteosynthesis, the external rotators and capsule were simultaneously cut in an L-shaped fashion. After several failed attempts to dislocate the joint, an in situ femoral neck osteotomy was performed (Fig. 3A). Appropriate exposure of the acetabulum was made using a modified Hohmann retractor to move the femur anteriorly, and with two Charnley pins that were placed at the acetabular roof and at the ischium. Acetabular reaming was performed progressively, using a line-to-line technique. An uncemented Trident Stryker® (Stryker, Kalamazoo, MI, USA) cup of 60 mm diameter was implanted and augmented with a 30-mm screw. A highly crosslinked polyethylene liner with 36 mm internal diameter was used.

The most complex technical difficulty in this surgery was femoral canal preparation, in which good exposure by releasing the gluteus maximus tendon insertion was required to obtain proper internal rotation, thus avoiding excessive torque force and preventing intraoperative fractures. Adequate femoral exposure was achieved without use of traction devices, but needing complete release of psoas and gluteus

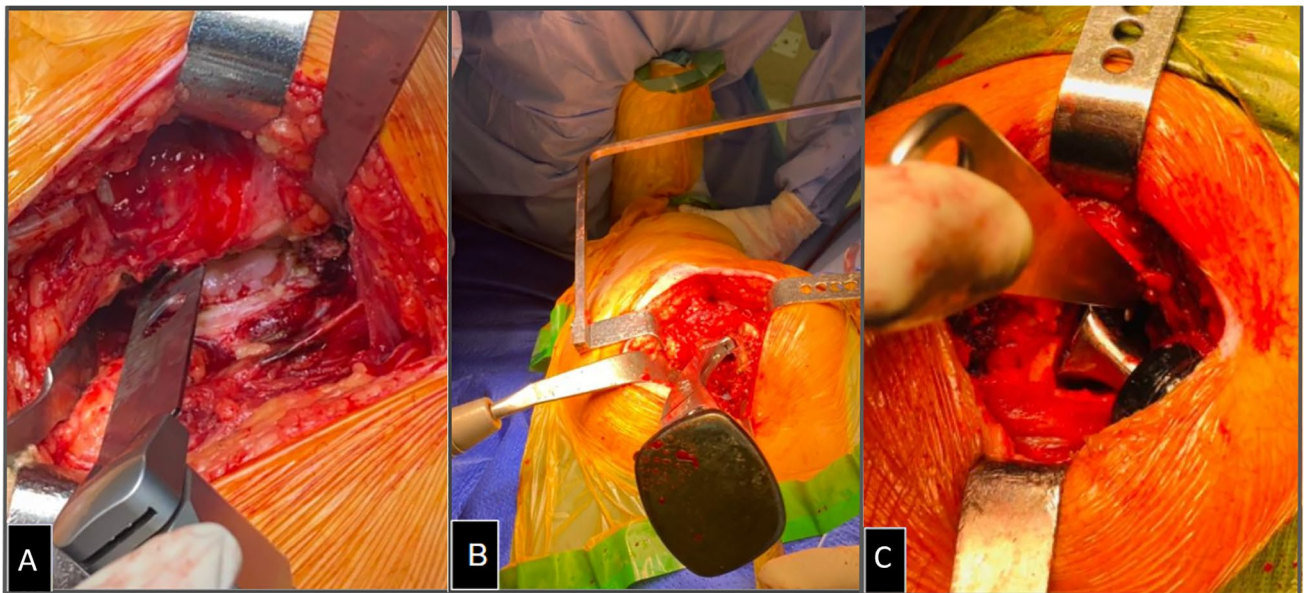
**Fig. 1** **A** Clinical photograph of the patient, standing on his exo-prosthesis with patellar tendon support. **B** Panoramic preoperative antero-posterior radiograph of the lower limbs that shows bilateral infrapatellar amputation and agenesis of both fibulas, severe left hip osteoarthritis, and the presence of osteosynthesis material





**Fig. 2** **A** Preoperative planning using an uncemented total hip arthroplasty template. **B** Clinical photograph of the surgical position and patient fixation to the stretcher. Right decubitus lateralis with one

fixation post in the back and two in the front, holding the anterior–superior iliac crests to avoid a rolling movement during manipulation of the stump



**Fig. 3** **A** Intraoperative photograph showing the in situ osteotomy of the femoral neck, protecting the sciatic nerve with a Hohmann retractor. **B** Intraoperative photograph during femoral preparation, shows the rasp positioning, with the optimal anteversion due to proper manipulation of the stump with one hand on the thigh and fulcrum

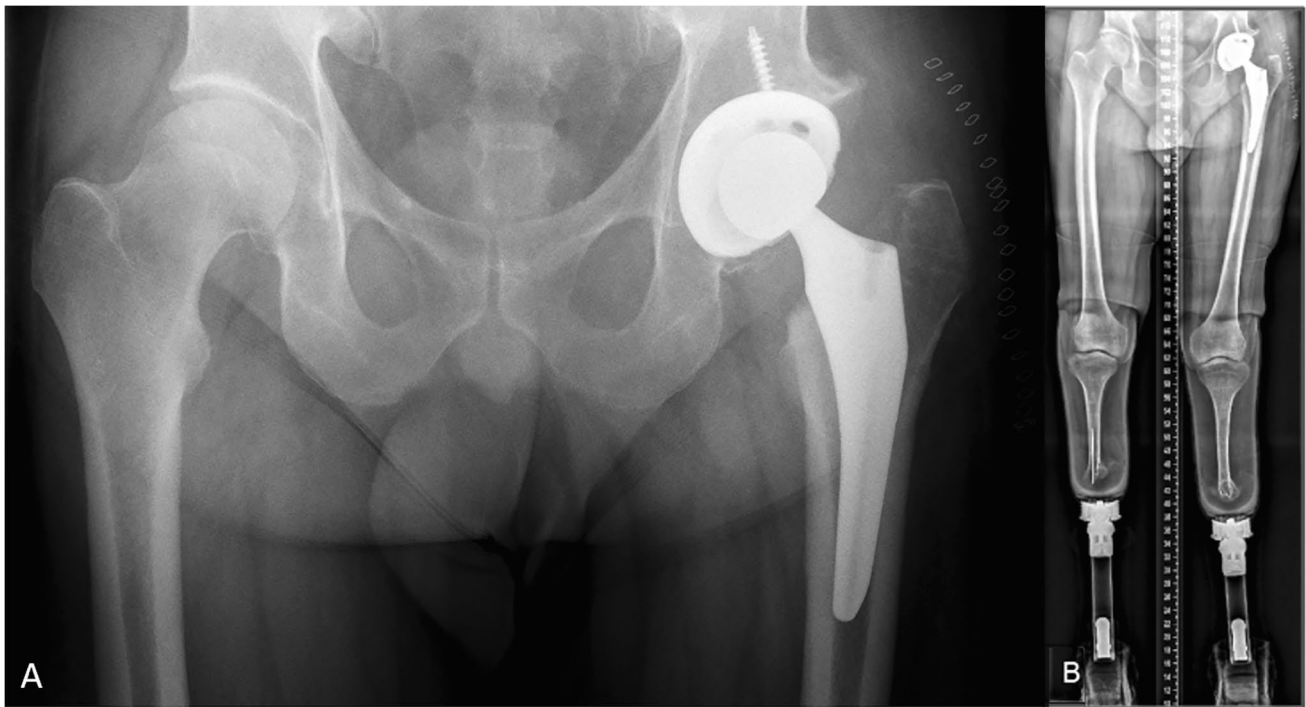
in the body of the assistant obtaining a perpendicular position of the tibia with respect to the floor. **C** Intraoperative photograph during stem reduction, shows a Hohmann retractor placed on the anterior wall of the acetabulum applying a sliding force on the femur

maximus tendons (Fig. 3B). Femoral canal preparation was made with progressive rasps up to size 5 (until intraoperative medial–lateral contact was noticed) with a neck of 132°, achieving good rotational stability. The reduction and stability test (8) were performed with a 36-mm head without the need to use any device to help maneuver the stump, other than a Hohmann retractor placed in the anterior wall of the acetabulum (Fig. 3C). The definitive uncemented Accolade II Stryker® (Stryker, Kalamazoo, MI, USA) No. 5 was

implanted, with a 36-mm metal head. After wound closure, a postoperative antero-posterior pelvic x-ray was performed in the operating room (Fig. 4A).

The surgical procedure had a total duration of 41 min with 100 ml of blood loss, recorded from the aspiration receptacle. On the same day of surgery, the patient was encouraged to walk with the help of his previous exo-prosthesis attached to the stump, using a regular walker weight-bearing as tolerated. The day after surgery he was discharged home. The





**Fig. 4** **A** Postoperative antero-posterior radiograph of both hips, shows a left uncemented THA. **B** Panoramic postoperative antero-posterior radiograph showing a correct lengthening of the affected hip without need of correction of the previous exo-prosthesis

patient was provided with anti-dislocation guidelines such as avoiding adduction, internal rotation, and hip flexion above 90°, sleeping with a cushion between the knees, and sitting on chairs of at least 55 cm height and with support for both arms. Within 2 weeks of rehabilitation, he was encouraged to leave the walker and progressed to canes. After 3 months of follow-up, the patient was able to walk without any assistive device. He was able to return to his city of origin performing activities of daily living without restrictions at 2 years of follow-up (Fig. 4B).

## Discussion

The reconstitution of hip biomechanics is a primary asset to determine the future success of a THA. This is even more challenging in patients with high functional demands and long-life expectancy [9], making implant selection an important part of treatment success [10]. In this sense, surgical exposure, maneuverability of the stump, and implant positioning are potential problems that a surgeon should anticipate in order to successfully perform a prosthetic replacement in the amputee patient.

The first surgical challenge of THA after a LLA is to perform an adequate osteotomy of the femoral neck. Second, obtaining adequate exposure is crucial for femoral preparation and to achieve a correct placement of the final implant.

Third, adequate maneuverability of the limb stump is necessary at several surgical moments, including femoral head dislocation, femoral canal preparation, and reduction of both the trial and the final stem. However, it is not always possible to maneuver the stump using the knee and remnant tibia as a fulcrum, and this may result in insufficient traction.

Although some reports encourage the use of a Steinman pin anchored to the distal femur to obtain traction and ease in rotation [11, 12], the osteopenia present in the femoral condyles due to disuse may generate an area of weakness and predispose to femoral mid-shaft or distal fracture. In the eventuality of severe soft tissue contractures or heterotopic ossifications, a greater trochanteric osteotomy can be performed. In this case, the instruments for the trochanteric fixation should also be ready in the operating table. [13] In our case, an in situ femoral neck was enough to enable femoral canal preparation (Fig. 3A).

On the other hand, manipulation of the femur during femoral time is no less important since inadequate exposure of the canal could preclude periprosthetic fracture or femoral component malalignment. Prickett and Scanlon reported the latter complication in a patient with a BKA, in which case the placement of the patient's exo-prosthesis had to be adjusted in internal rotation to amend the femoral component's malpositioning.[14] In any case, this situation should be avoided, as it would increase the risk of dislocation and alter the kinematics of the gait. [15] One option to

**Table 1** Literature review of amputated patients with subsequent ipsilateral hip replacements

Author (s)	Cases	Cause for amputation	Level of the amputation	Treatment	Approach	Tips and tricks
Prickett and Scanlon (1976) [14]	1	-	BKA	THA	Posterior	-
Salai et al. (2000) [18]	5	3 trauma/1 DBT/1 dysvascular	BKA	THA	5 anterolateral	-
Nejat et al. (2005) [19]	3	1 infection/2 congenital	2 BKA/1 symes	THA	Posterior	-
Mak et al. (2008) [20]	1	Dysvascular	BKA	THA	Posterior	-
Pekmezci et al. (2010) [11]	1	Burns	Through-knee	THA	Posterolateral	-Peg-board -Transfemoral Steinman traction pin -Peritrochanteric Lane self-retaining bone clamp
Sathappan et al. (2011) [13]	1	Trauma	AKA	THA	Posterolateral	-Trochanteric osteotomy -In situ femoral neck osteotomy
Magagelada (2013) [16]	1	Dysvascular	AKA	THA	Posterolateral	-Dislocation big self-retaining bone clamp
Amanatullah (2015) [7]	18	5 dysvascular/4 DBT/3 infection/2 trauma/2 congenial/1 tumor/1 neuropathy	13 BKA/2 AKA/2 through-knee/1 through-ankle	THA	16 ante-rolateral/2 posterior	-Bone clamp -In situ femoral neck osteotomy -Trochanteric osteotomy
Current case (2021)	1	Agenesis of both fibulae	BKA	THA	Posterolateral	-Two anterior and one back posts in lateral decubitus -In situ femoral neck osteotomy -Wide release of psoas and gluteus maximus -Hohmann retractor at the anterior acetabular rim

avoid such complication would be to place the anteriorly described Steinman or a periarticular clamp in the distal femur to obtain a lever arm for better rotational control. [16].

Additionally, any effort to dislocate the femoral head or rotate the stump during surgery is in vain if the patient is not “fixed” to the stretcher with appropriate supports. When a posterolateral approach is performed, the classic fixation is one post in the back and one in the front at the level of the pubis. This type of fixation has proven to be less effective controlling pelvic pitch and roll. In a prospective study, Gonzalez Della Valle et al. showed that the maximum pelvic roll and pitch detected during surgery averaged 17.62° (SD: 5.08) and 9.3° (SD: 3.39) respectively, using one anterior post and other posterior [17]. Pekmezci et al. presented a case of a patient with a through-knee amputation who underwent a THA, and suggested the use of a peg-board to improve patient positioning [10]. We prefer to use a 3-point fixation system, with one post in the back at the level of the sacrum and 2 in the front at the level of the anterior–superior iliac crests as shown in Fig. 2B.

Rapid rehabilitation plays a key role in LLA patients to avoid contractures and improve functional outcomes. A protocol focused on strengthening hip flexors and knee extensors is needed to avoid hip flexion contracture as much as

possible. During the surgical procedure, tenotomies of the corresponding muscular groups should be added. [18].

There are few reports and case series focusing on clinical improvement in amputated patients with a THA (Table 1). The largest one was published in 2015 by Amanatullah et al. [7], where the authors presented 13 cases with a BKA due to peripheral vascular disease and/or diabetes mellitus, and treated with primary THA through an anterolateral approach in the vast majority. Four reports also suggested tips and tricks during the THA surgical technique when performed in a LLA patient [7, 10, 12, 15], but only one highlighted these tips when the amputation was below the knee [7].

We conclude that the approach of the patient with THA after LLA must be carried out with a meticulous preoperative plan. As it is a common procedure in an unusual patient, in the absence of therapeutic guidelines or consensus, this case provides a perioperative approach focused on the search for possible intraoperative scenarios that may occur in patients who will undergo a THA surgery after LLA.

**Author Contribution** Agustin Garcia-Mansilla: idea, redaction. Martín Buljubasich: redaction, review. Carlos Lucero: redaction. Gerardo Zanotti: review. Fernando Martín Comba: review. Francisco Piccaluga:

idea, review. Pablo Ariel Slullitel: review, translation. Martín Alejandro Buttaró: idea, review, translation.

**Data Availability** Not applicable.

**Code Availability** Not applicable.

## Declarations

**Ethics Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Internal Review Board #IRB00010193.

**Consent to Participate** Written consent was obtained from the patient included in the study.

**Written Consent for Publication** The patient has given written permission for publication.

**Conflict of Interest** The authors declare no competing interests.

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