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Case Report

Tendon Transfers for Knee Extension Following Femoral Nerve Injury After Hip Arthroplasty

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ABSTRACT

Femoral nerve injury is a rare but devastating complication of direct anterior approach total hip arthroplasty that occurs in about 1% of the cases and could potentially lead to debilitating loss of knee extension. In this case report, we present a case of femoral nerve injury following direct anterior approach hip arthroplasty with an inability to extend the affected knee, gait instability, and multiple falls. For this patient, an innovative functional adductor magnus muscle transfer was performed to restore knee extension. At 6 months after surgery, the patient's knee extension was partly restored, and ambulation was significantly improved.

Introduction

Femoral nerve injury is a rare but serious complication of primary total hip arthroplasty (THA), with an occurrence rate of less than 1%. [1] While nerve injuries can occur in all approaches, the anterior approach is mostly associated with femoral nerve palsy, whereas the posterior is associated with sciatic nerve palsy. [2] Femoral nerve palsy can occur during an anterior approach when the rectus femoris muscle is retracted laterally rather than medially. The risk of injury is increased in female patients and those with short stature. [3] Femoral nerve injury can impact hip flexion and knee extension, impairing gait, knee stability, and the ability to perform activities of daily living. [4] While traumatic and malignant cases of femoral neuropathy are also possible, most cases have an iatrogenic etiology. [1,4]

When femoral nerve injury after THA is diagnosed early, nerve grafting or nerve transfers from the obturator to femoral nerve may be effective. [5–7] However, if a patient presents in a delayed manner, nerve-based functional reconstruction is not an option. [5] While performing a free functional flap may be considered, this is associated with greater complexity and donor site morbidity. [8] In this report, we present a rare case of iatrogenic femoral nerve injury following hip arthroplasty treated with medial thigh tendon transfers.

Case history

The patient is a 73-year-old female who presented at our institution following primary left hip arthroplasty by the direct anterior approach at an outside institution 21 months prior. She complained of pain and numbness of the anterior thigh, gait instability, and multiple falls. One fall resulted in rib fractures. The strength exam was notable for 0/5 left knee extension indicating suspicion for femoral nerve palsy. She elicited Tinel sign by tapping on the lateral margin of the left femoral triangle. Electromyography (EMG) confirmed a femoral nerve injury. Magnetic resonance imaging showed femoral nerve neuroma and anterior thigh compartment muscle atrophy.

The patient's goals were gait stability to minimize fall risk and pain improvement. After discussing the different treatment options, she elected to proceed with left femoral neuroma excision, nerve grafting, and medial thigh tendon transfers.

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First, the femoral nerve was addressed to treat her pain. An incision was made overlying the left femoral nerve medial to the patient's previous hip arthroplasty scar, and dissection was carried down until the femoral nerve was identified lateral to the femoral artery. The proximal and distal nerve endings were identified with a discontinuous intervening segment of extensive scarring and neuroma. The neuroma was excised back to normal-appearing fascicles, resulting in a 6-cm nerve gap. This was repaired with a nerve allograft (Fig. 1).

For the tendon transfers, an incision was made along the medial thigh, extending distally and medially to the quadriceps tendon and patella. The gracilis, sartorius, and adductor magnus muscles were circumferentially dissected to their distal tendinous insertions, and normal nerve function was confirmed on stimulation. The 3 myotendinous units (gracilis, sartorius, and adductor magnus) were mobilized proximally and distally to allow for anterior transposition. Each distal tendon was secured to the distal quadriceps tendon with the Pulvertaft weave technique and 0 Ethibond suture (Ethicon, Raritan, NJ) within the knee at 20 degrees of flexion (Fig. 2). Twenty degrees of flexion were chosen to prevent restricted flexion in the future. In hindsight, she may have benefited from securing tendon at neutral position to prevent extension lag.

The patient was immobilized in this position for 8 weeks with a long-leg cast. We employed the physical therapy protocol described by Hill et al. [8], which includes nonweight-bearing knee immobilization in extension until 6 weeks postoperatively, transition to full weight-bearing after 6 weeks, antigravity exercises at 8 weeks, short-distance ambulation without braces at 10 weeks, weight-bearing and lower extremity strengthening exercises at 12 weeks, and continuing therapy up until a year after surgery. Postoperatively she developed proximal thigh wound dehiscence that was treated with negative pressure wound vac therapy. At 6-month follow-up, pain was resolved, and she achieved knee extension strength of 3/5 (Video). No objective measures were taken to assess the progress of her anterior thigh numbness. However, the patient was ambulating without an assist device or brace and had no falls.

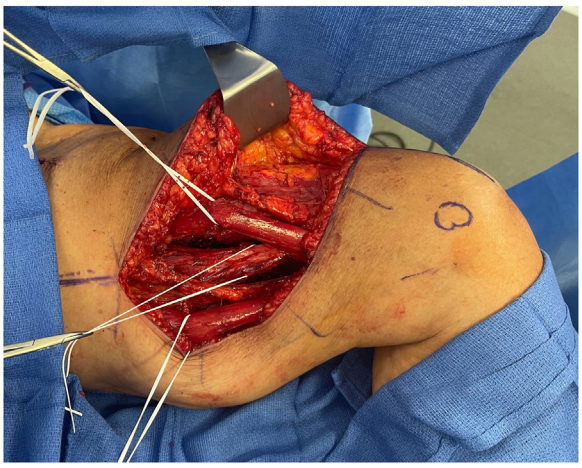

Figure 2. Muscle repair. From top to bottom: sartorius muscle, adductor magnus, gracilis.

Discussion

Femoral nerve injury is an exceedingly rare complication following hip arthroplasty. However, when a patient loses active knee extension postoperatively after THA, suspicion for femoral nerve injury should be high. If femoral nerve injury is suspected based on history and physical examination, an early referral should be made to a peripheral nerve surgeon. We recommend EMG/Nerve Conduction Study (NCS) to establish baseline metrics. Imaging with a magnetic resonance imaging or ultrasound, if a reliable musculoskeletal ultrasound sonographer is available, can help define and localize nerve injury. Repeat EMG/NCS can be performed about 6-8 weeks later if symptoms do not improve and imaging is equivocal. Improvement on repeat EMG/NCS may indicate neuropraxia that will continue to resolve without surgery. However, nerve

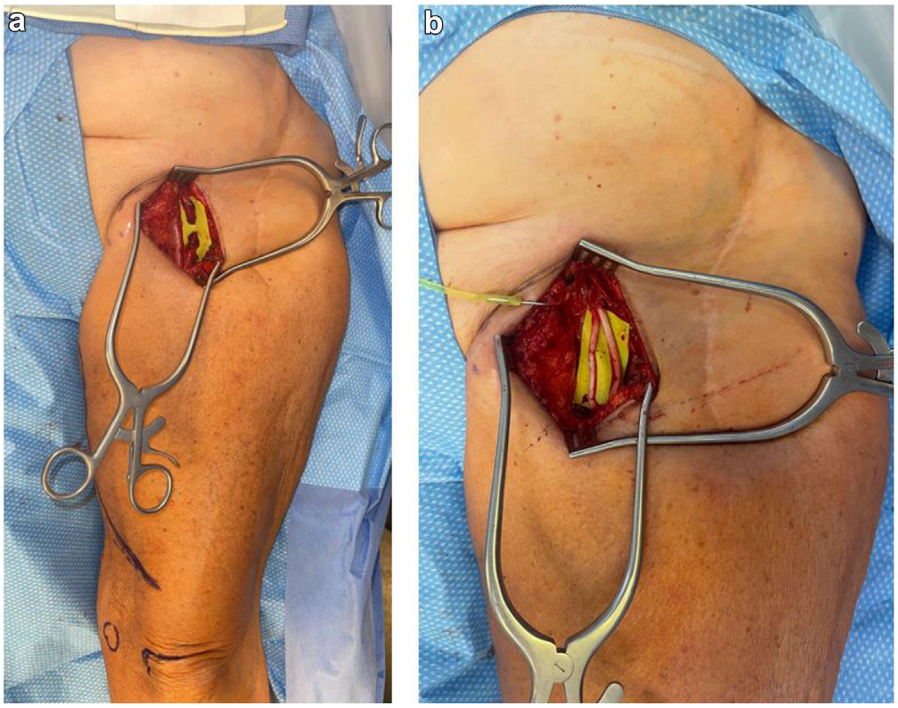

Figure 1. (a) Nerve defect and (b) nerve repair.

transection identified on imaging or a lack of EMG/NCS improvement should lead to early operative intervention.

Early diagnosis can optimize care by avoiding prolonged therapy and minimizing fall risk. If diagnosed early (<12 months), patients may be candidates for neuroma excision and reconstruction with nerve graft or nerve transfers. In situations of late presentation (>12 months) or unsuccessful nerve repair, tendon transfer remains a viable option.

The existing literature regarding tendon transfer to restore quadricep function and knee extension remains scarce. In this report, we present a successful and rare case of knee extension restoration using the adductor magnus, gracilis, and sartorius tendon transfer following femoral nerve injury. In 2021, Hill et al. detailed a case series of 3 patients, [8] 2 of whom had iatrogenic femoral nerve injury and one malignant tumor with loss of knee extension. Following the transfer, 2 of the 3 patients were able to ambulate without the need for support, while the third had no improvement. Our patient achieved a 3/5 knee extension. In our opinion, this was likely related to the loosening of the transfer. Compared to the upper extremity, the demand and force on these transfers are greater, leading to an increased risk of weakness. This patient was previously ambulatory with a knee brace and assistive device (rollator) when knee extension was 0/5; despite the incomplete improvement, she was able to abandon both the brace and the rollator, which were her main concerns. We considered retensioning the transfers, but the patient declined, citing satisfaction with the procedure. In a younger or higher demand patient, retensioning or free functional muscle transfer may be appropriate salvage options.

We believe that careful patient selection for this tendon transfer is critical. The donor muscles must be healthy and functional, as determined by a preoperative assessment with EMG and a physical examination. Both the adductor magnus and gracilis muscle transfers require intact obturator nerve function. A radiculopathy or injury involving L2-L4 nerve roots may jeopardize the transfer, as both the femoral and obturator nerves arise from these roots. Additionally, proper muscle transfer tension and length are crucial, as the risk of loosening or stretching of the transfer is greater in the lower extremity due to greater weight demands. Lastly, for this approach to be effective in restoring knee extension, postoperative rehabilitation is critical. The patient must be educated and committed to intensive motor relearning and long-term strengthening.

Despite the late presentation, we decided to explore the femoral nerve, where a neuroma and obvious femoral nerve division were encountered. Decision to explore and repair the nerve was made solely to improve her pain, with no expectation of functional recovery. Her pain resolved rapidly.

Summary

We propose that pedicled tendon transfer of the medial thigh tendons, either alone or in combination with other muscles for additional support, can provide an effective alternative to restoring knee extension for patients with femoral nerve palsy who are not appropriate candidates for nerve-based or microvascular reconstruction.

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.2024.101427.

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

Charalampos Siotos: Writing – review & editing, Writing – original draft, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nikki Rezania:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Data curation. **Vasili Karas:** Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization. **Ricardo B. Fontes:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Data curation, Conceptualization. **David E. Kurlander:** Writing – review & editing, Visualization, Validation, Supervision, Methodology, Formal analysis, Conceptualization.

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