Received: 11 May 2018 | Revised: 14 September 2019 | Accepted: 20 September 2019

DOI: 10.1002/micr.30527

CASE REPORT

MICROSURGERY WILEY

Repair of the femoral nerve by two motor branches of the obturator nerve: A case report

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Abstract

Complete femoral nerve palsies are uncommon but devastating injuries when they are caused by large nerve defects. Direct repair is usually not possible and nerve grafting renders uncertain outcomes. Recent studies proposed different peripheral nerve transfers as treatment strategies for large femoral nerve defects. We report a clinical application of a nerve transfer to reinnervate the quadriceps muscle with two motor branches of the obturator nerve in a 48 years-old man that was diagnosed with a femoral nerve palsy after resection of a retroperitoneal schwannoma. The branches supplying the gracilis and adductor longus muscles were transferred to the motor branch of the femoral nerve to the quadriceps muscle at 6 months postinjury. At 34 months of follow-up, knee extension was quoted M4. The presented nerve transfer may be feasible, technically simple, and renders good functional outcomes.

1 | INTRODUCTION

Iatrogenic femoral nerve lesions are not uncommon and usually occur after abdominal, pelvic, or orthopedic surgery (Al-Ajmi, Rousseff, & Khuraibet, 2010; Kuponiyi, Alleemudder, Latunde-Dada, & Eedarapalli, 2014; Moore & Stringer, 2011; Patton, Runner, Lazarus, & Bradbury, 2018). Femoral nerve palsy causes significant disability due to paralysis of knee extension, weakness of hip flexion, and sensory loss over innervated regions (Moore & Stringer, 2011). Direct repair is mostly impossible, if the femoral nerve injury lies in the pelvis, above the inguinal ligament, where performing a termino-terminal nerve suture without tension is not possible (Campbell, Eckhauser, Belzberg, & Campbell, 2010; Rastrelli et al., 2018). Consequently, these injuries have to be treated by nerve graft or neurotization of the femoral nerve (Inaba et al., 2018; Tung, Chao, & Moore, 2012).

In 2012, Goubier et al. demonstrated in a cadaveric study the feasibility of a femoral nerve neurotization, consisting in a transfer of two united motor branches of the obturator nerve to the motor branch of the femoral nerve, under the inguinal ligament (Goubier, Teboul, & Yeo, 2012) it was also shown that the diameter of the two united branches from the obturator nerve matches the diameter of the receiving quadriceps branch ending. We present the result of this transfer in a clinical case.

2 | CASE REPORT

A 48 years old gentleman with a right renal colic caused by a retroperitoneal schwannomma was referred to a laparoscopic tumoral resection in a specialized surgical department, in another hospital. Postoperative, a total femoral nerve palsy was clinically evident and the anatomopathological result showed that 7 cm of femoral nerve was resected together with the tumor. The patient was then referred to our peripheral nerve surgery institution. Knee extension was paralyzed, at M0 BMRC—British Medical Research Council (Medical Research Council, 1941), hip flexion at M3, and the sensibility was absent over the anteromedial thigh (Figure 1). Hip adduction was clinically present and the electromyography confirmed our clinical examination. We performed a neurotization of the motor part of the femoral nerve for the quadriceps muscle with the branches supplying the adductor longus and gracilis muscles at 6 months after the iatrogenic femoral nerve injury (Figure 2).

Part of this case report was presented at Doctoral thesis of Dr. Elodie Dubois: Nerve Transfers for peripheral nerve injuries except brachial plexus palsy. April 2015, Lille, France. Meeting of the GAM Congress (Groupe pour l'Advancement de la Microchirurgie), May 2016, Paris, France.

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FIGURE 1 Preoperative clinical examination. The march was carried out with widening of the support polygon and mowing

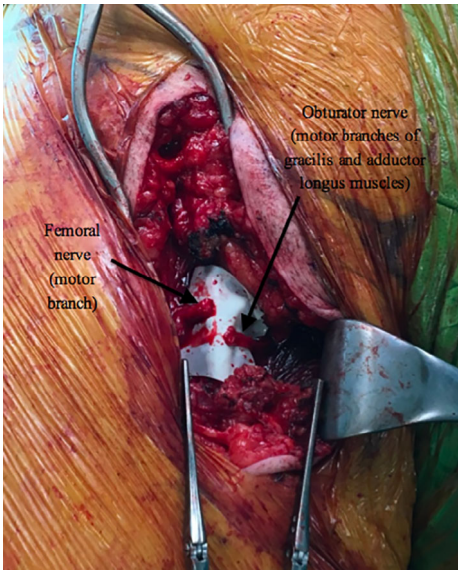

FIGURE 3 The branches supplying the adductor longus and gracilis muscles were glued with fibrin before suture to the motor portion of the femoral nerve. Good matching of the nerves calibers

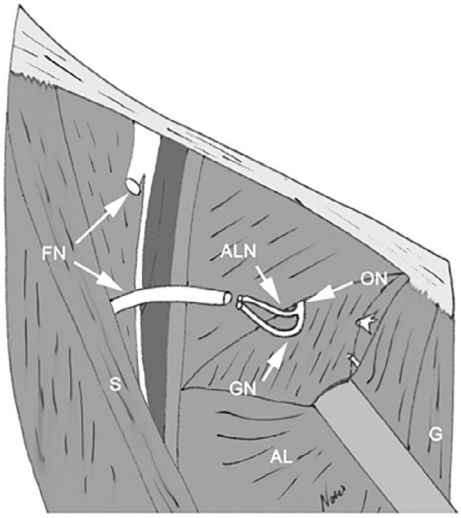

FIGURE 2 Neurotisation principle of the quadriceps branch by the nerve supplying the gracilis and adductor longus muscles. AL, adductor longus muscle; ALN, adductor longus nerve; FN, femoral nerve; G, gracilis muscle; GN, gracilis nerve; ON, obturator nerve; S, sartorius muscle

FIGURE 4 Postoperative clinical examination at 10 months. The oscillating and unipodal support phases of the walk performed without lameness

The patient was positioned in dorsal decubitus. A vertical anterior approach was performed over the intersection of the inguinal ligament with the femoral vessels. The femoral vessels were identified and protected; the dissection continued toward the pectineus muscle, which was retracted upward to find the anterior division of the obturator nerve. The branches supplying the gracilis and the adductor longus muscles were identified after retracting the adductor longus muscle. Electrical stimulation, starting with low intensity (0.02 mA), was performed in order to confirm normal innervation. The two motor branches were cut at their entrance in the respective muscles. The femoral nerve, which gives its first divisions shortly underneath the inguinal ligament, was identified on the lateral side of the femoral vessels and its motor branch was cut as proximal as possible, close to the division of the sensory branch. Finally, the motor branches from the obturator nerve were sutured to the motor branch of the femoral nerve under microscopy with 9–0 nylon sutures and fibrin glue (Figure 3). The skin was closed without a drain.

Ambulation with total weight bearing was allowed at day one postoperative, together with physiotherapy for maintaining knee and hip mobility. Ergo- and kinetotherapy for cerebral integration of the neurotization was started after 3 weeks. Although we did not recommended, the patient preferred walking with crutches until 6 month after surgery. At 4 months postoperative, knee extension force was quoted M2, 6 months post-op at M3 and M4 at 10 months.

At the final follow-up time, at 34 months after the nerve transfer, knee extension was at M4 and the free walking time, without crutches, was one hour (Figure 4). Walking up and down the stairs could be done also without any help but running was still not possible. There was no clinical or functional deficit for hip adduction. Patient informed consent was obtained and patient's data protection was assured.

3 | DISCUSSION

Complete femoral nerve palsies are uncommon but devastating injuries, which can occur as an iatrogenic injury following intraabdominal surgery or penetrating trauma (Fleischman, Rothman, & Parvizi, 2018; Kim & Kline, 1995; Kim, Murovic, Tiel, & Kline, 2004; Moore & Stringer, 2011; Patton et al., 2018). When dealing with a large femoral nerve defect, traditional autologous cable grafting is known for its poor prognosis and functional recovery (Daly, Yao, Zeugolis, Windebank, & Pandit, 2012). Nevertheless, Tsuchihara reported good results after nerve grafting, demonstrating knee extension quoted M4 for graft lengths up to 14 cm (Tsuchihara et al., 2008). However, there is no reported case of femoral nerve grafting beyond 3 months after similar injuries.

In contrast to the multiple possible strategies in reconstructive upper limb nerve surgery, there are less known surgical strategies or few publications on lower limb nerve reconstruction. Nerve transfers are an attractive option as it minimizes the time and distance for neuronal regeneration and finally functional recovery. Campell et al. reported two cases of neurotization of the femoral nerve with good functional results, but the nerve sutures were performed in the pelvis (Campbell et al., 2010). The pelvis is hazardous to approach, nerve stumps cannot always be found and the nerve suture in this area involves also sensitive axons, which may lead to an incomplete recovery of the motoric function (Goubier et al., 2012).

An anatomic study was performed by Zhou et al. to evaluate the feasibility of transferring the anterior branch of the obturator nerve on the rectus femoris and to the medial femoral branches (Zhou et al., 2017). However, the donor nerve contains also sensitive axons, thus suturing a mixed nerve on a motor nerve could lead to a less good recovery of the motoric function. Moreover, transferring the anterior branch of the obturator nerve, which innervates four muscles, can potentially develop a more important donor site morbidity than in our technique.

Goubier et al. confirmed in a feasibility study that it is possible to perform a subcutaneous transfer of two obturator motor branches united together with fibrin glue to the femoral nerve in the thigh (Goubier et al., 2012), thus achieving similar motor nerve ending diameters for the final neuroraphy. As revealed in the surgical technique, dissection is easy under the inguinal ligament, there is a good concordance of nerves calibers and there is no sensitive axon involved, thus maximizing the functional outcome.

This neurotization offers the advantage of performing nerve sutures close to the effector muscle in order to decrease the reinnervation time and distance. Concerning the disadvantages of this technique, one may regard the function loss of the gracillis muscle, which we consider having no clinical impact, thus being similar to postoperative situations were the gracillis tendon was used for anterior cruciate ligament reconstructions (Simonian et al., 1997). However, at the final clinical examination, our patient had no clinically relevant hip adduction deficit and recovered sufficient knee extension force to fulfill daily life activities (walking time one hour or stairs up and down), except running.

The presented surgical technique, supported by our reported outcomes, may be considered a valid strategy for treating femoral nerve palsies caused by large intrapelvic nerve defects. It is feasible, technically simple, and renders a good functional recovery.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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How to cite this article: Dubois E, Popescu I-A, Sturbois Nachef N, Teboul F, Goubier J-N. Repair of the femoral nerve by two motor branches of the obturator nerve: A case report. *Microsurgery*. 2019;1–4. https://doi.org/10.1002/micr.30527