



Suprainguinal Re-Resection of the Lateral Femoral Cutaneous Nerve in Persistence or Recurrence of Meralgia Paresthetica After Previous Transection: Results of a Case Series

Godard C.W. de Ruiter¹, Pieter C. Clahsen², J. Wolter A. Oosterhuis³

■ **OBJECTIVE:** Suprainguinal re-resection of the proximal nerve stump can be performed in case of persistent or recurrent symptoms of meralgia paresthetica after previous transection of the lateral femoral cutaneous nerve (LFCN). Currently, no long-term results for this procedure have been reported in the literature.

■ **METHODS:** In this study, 20 consecutive patients with persistent (13 cases) or recurrent (7 cases) symptoms of meralgia paresthetica were reoperated at a mean interval of 16 months after the first transection of the LFCN. The proximal nerve stump was sent for histopathologic analysis of a potential traumatic neuroma. Outcome was assessed using a 5-point Likert scale, which was obtained at a mean interval of 3.5 years after the suprainguinal re-resection.

■ **RESULTS:** The proximal stump of the LFCN was identified in 90% of the cases. Successful pain relief (Likert 1 or 2) was obtained in 65% of the patients. A neuroma was found in 11 cases (55%), mostly in recurrent cases after a pain-free interval. The indication for recurrence of symptoms more frequently resulted in successful pain relief (71%) compared with results for the indication for persistence of symptoms (62%). There was no correlation between the presence of a neuroma and the chance for pain relief.

■ **CONCLUSIONS:** Suprainguinal re-resection of the LFCN can be a successful procedure, both for persistence and recurrence of symptoms of meralgia paresthetica after previous transection, with long-lasting pain relief. Several

factors, however, should be considered before performing this relatively new technique in patients that are discussed in this article.

INTRODUCTION

Neurectomy or neurexeresis of the lateral femoral cutaneous nerve (LFCN) can be performed to treat symptoms of meralgia paresthetica. Sometimes these procedures are performed if neurolysis has failed, and sometimes they are also performed as primary procedures. Contrary to other compression syndromes, transection of the nerve is a valid option, because the LFCN is purely a sensory nerve and the only consequence is numbness in the anterolateral part of the thigh. Most patients with meralgia paresthetica are not bothered by this numbness, probably because often these patients already experience numbness in this area before transection of the LFCN is performed.¹ Rarely, symptoms of deafferentation pain may develop after transection. In a recent meta-analysis by Lu et al.,² complete pain relief was reported in 85% of the total number of reported cases after neurectomy (vs. 63% after neurolysis). In the same study, the incidence of reoperations was 12% after neurolysis, and no cases of reoperations were reported after neurectomy for the surgical series that were included in this meta-analysis.

In 2015, the first author (G.d.R.) of this article reported a case of recurrence of meralgia paresthetica 5 years after a neurexeresis procedure that was reoperated using the suprainguinal approach.³ Re-resection of the proximal nerve stump resulted in complete pain relief up to 2 years after the surgery in that case. Currently, to the best of our knowledge, there is no series in the literature that

Key words

- Decompression
- Neurectomy
- Neurexeresis
- Neurolysis
- Traumatic neuroma

Abbreviations and Acronyms

ASIS: Anterior superior iliac spine

LFCN: Lateral femoral cutaneous nerve

From the Departments of ¹Neurosurgery, ²Pathology, and ³Surgery, Haaglanden Medical Center, The Hague, the Netherlands

To whom correspondence should be addressed: Godard C. W. de Ruiter, M.D., Ph.D.
[E-mail: g.de.ruiter@haaglandenmc.nl]

Citation: *World Neurosurg.* (2021) 155:e830-e835.
<https://doi.org/10.1016/j.wneu.2021.09.022>

Journal homepage: www.journals.elsevier.com/world-neurosurgery

Available online: www.sciencedirect.com

1878-8750/\$ - see front matter © 2021 Elsevier Inc. All rights reserved.

has looked at the long-term results for a case series. The goal of this study was to investigate long-term pain relief for suprainguinal re-resection of the LFCN in patients with persistence or recurrence of meralgia paresthetica after previous transection of the nerve (neurectomy or neurexeresis). In addition, potential influence of the presence of a traumatic neuroma (determined with pathologic analysis) and indication for surgery (persistence vs. recurrence) on the results were investigated.

METHODS

From 2015 to 2020, a total of 20 consecutive patients with persistent (13) or recurrent (7) symptoms of meralgia paresthetica were reoperated (see [Table 1](#) for patient characteristics). Five patients were referred from elsewhere. Fifteen patients had initially been treated in our center by the first author (10 persistent and 5 recurrent cases). Neurectomy had been performed as previous procedure in 18 cases and neurexeresis in 2 cases. Recurrence of symptoms mostly occurred 4–6 months after the initial surgery, except in 1 case, in which it occurred after 8 years. Reoperation in the entire group was performed at a mean interval of 16 months after LFCN transection (range 4 months to 9 years); 24 months for group recurrence and 11 months for group persistence ([Table 1](#)).

Surgical Procedure

The technique for suprainguinal re-resection was the same as previously described.³ The procedures were all performed by 2 surgeons (neurosurgeon G.d.R. and abdominal surgeon W.O.). In short, a 5- to 7-cm incision was made cranial and parallel to the inguinal ligament ([Figure 1A](#) and [Figure 2A](#)). The aponeurosis of the external oblique muscle was opened just medial to the anterior superior iliac spine (ASIS). Subsequently, the lateral attachments of the internal oblique and transverse abdominis muscles were released from the ASIS ([Figure 2B](#)). The proximal stump of the LFCN was identified on top of the iliac muscle or attached to the

inguinal ligament ([Figure 1B](#) and [Figure 2C](#)). The nerve was again transected as proximally as possible and the distal end of the resected nerve segment end was sent for histopathologic analysis.

Follow-up

Patients were first seen in the outpatient clinic 2 months after the surgery. In the case of persistence of symptoms, follow-up (again after 2 months) was scheduled; otherwise, patients were discharged from further follow-up. In February 2021, all patient were contacted again (by telephone or mail) to obtain results measured on the 5-point Likert scale. Successful pain relief was defined for Likert 1 (complete) and Likert 2 (almost complete recovery). Partial pain relief (Likert 3) was not considered a successful result. Likert 4 (no change in pain) and Likert 5 (worsened pain) were defined as failures. The study was approved by the Medical Committee, and informed consent was obtained from all patients.

Histology

After suprainguinal re-resection, the distal end of the proximal stump was sent for histopathologic analysis. The presence of a traumatic neuroma was determined on hematoxylin and eosin-stained slides ([Figure 3](#)). In addition, the presence of other intraneural changes frequently observed after neurectomy, including thickening of the perineurium, depositions of mucoid, and fibrin,⁴ were evaluated. The original slides from the nerve segments obtained after the first neurectomy procedure also were re-evaluated, if available for analysis.

Statistical Analysis

Statistical analysis was performed using SPSS Version 26 (IBM Corp., Armonk, New York, USA). The Student *t* test was used for the comparison of successful results (Likert 1 and 2) for the different groups of indication (persistence vs. recurrence). The Fisher exact test was performed to investigate correlation of success (Likert 1 and 2) and the presence of a neuroma. For the latter, the 2 cases were excluded in which the nerve could not

Table 1. Patient Characteristics for Different Indications of Recurrence or Persistence of Meralgia Paresthetica After Previous Neurectomy of the LFCN

Indication	Recurrence (7)	Persistence (13)
Age, years	58	54
Male/female	4/3	3/10
Left/right	5/2	10/3
BMI	29	31
Mean interval previous neurectomy/neurexeresis, months	24	11
Mean duration pain free interval, months	18	—
Duration surgery, minutes	35	35
Presence of neuroma, <i>n</i> (%)	6 (100%)*	5 (42%)*
Mean follow-up, years	3.3	3.6
Successful pain relief, <i>n</i> (Likert 1–2)	5 (71%)	8 (62%)

BMI, body mass index; LFCN, lateral femoral cutaneous nerve.

*In both groups there was one case in which the proximal stump of the LFCN could not be identified intraoperatively; these cases were excluded for the calculation of the percentage.

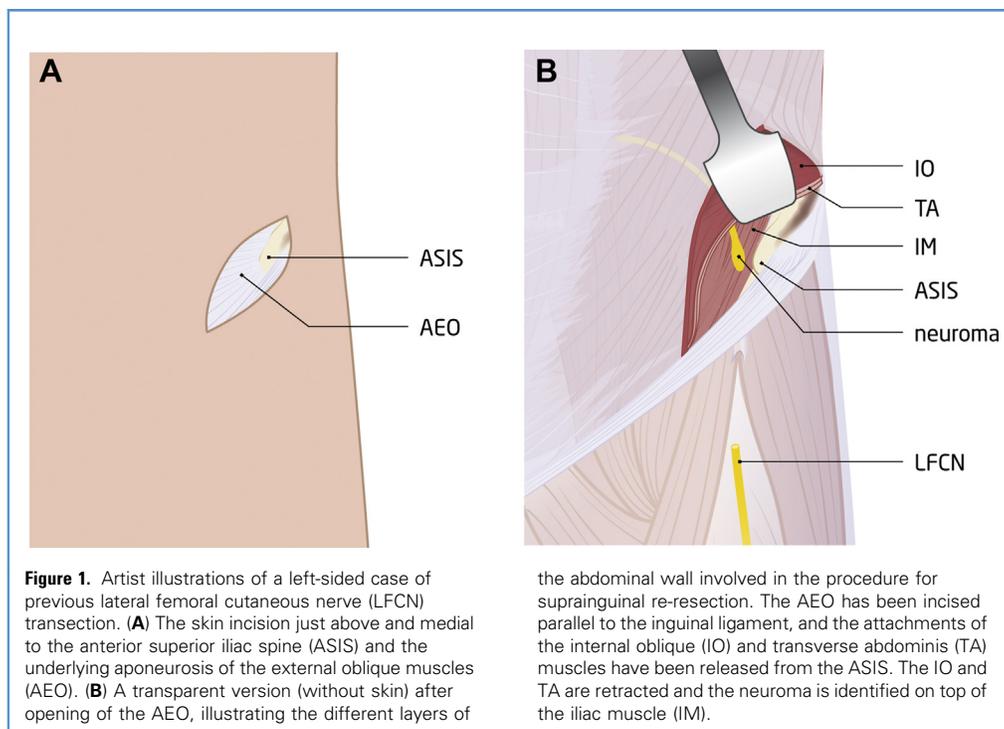


Figure 1. Artist illustrations of a left-sided case of previous lateral femoral cutaneous nerve (LFCN) transection. **(A)** The skin incision just above and medial to the anterior superior iliac spine (ASIS) and the underlying aponeurosis of the external oblique muscles (AEO). **(B)** A transparent version (without skin) after opening of the AEO, illustrating the different layers of

the abdominal wall involved in the procedure for suprainguinal re-resection. The AEO has been incised parallel to the inguinal ligament, and the attachments of the internal oblique (IO) and transverse abdominis (TA) muscles have been released from the ASIS. The IO and TA are retracted and the neuroma is identified on top of the iliac muscle (IM).

be found intraoperatively and therefore there was no pathology. A P value smaller than 0.05 was considered significant.

RESULTS

Intraoperative Observations

Mean operation time was 35 minutes. In most cases, the proximal nerve stump was identified on top of the iliacus muscle. In 4

cases, the proximal stump was found to be attached distally to the inguinal ligament. It therefore seemed in these cases that the continuity of the nerve was intact, but after careful dissection of the proximal stump in a distal direction, the nerve could be separated from the inguinal ligament. In all cases, the LFCN was retranssected as far proximally as possible to prevent potential reattachment to the iliac muscle. Subsequently, a segment of the distal nerve end was sent for histopathologic analysis. In our

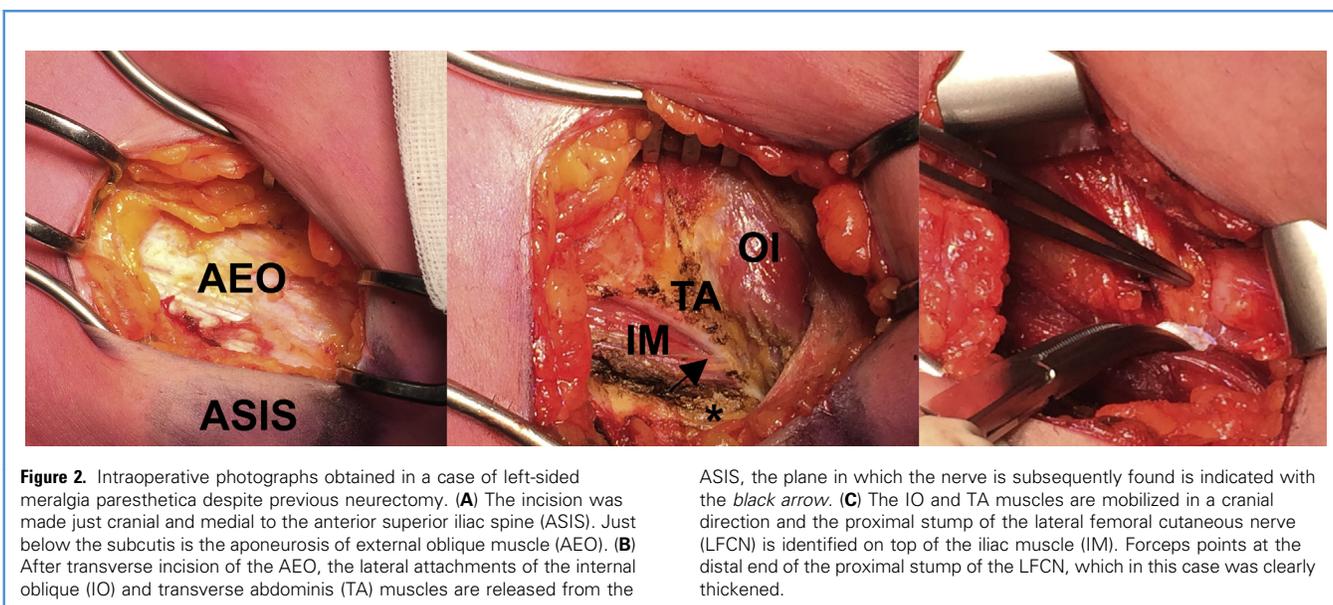
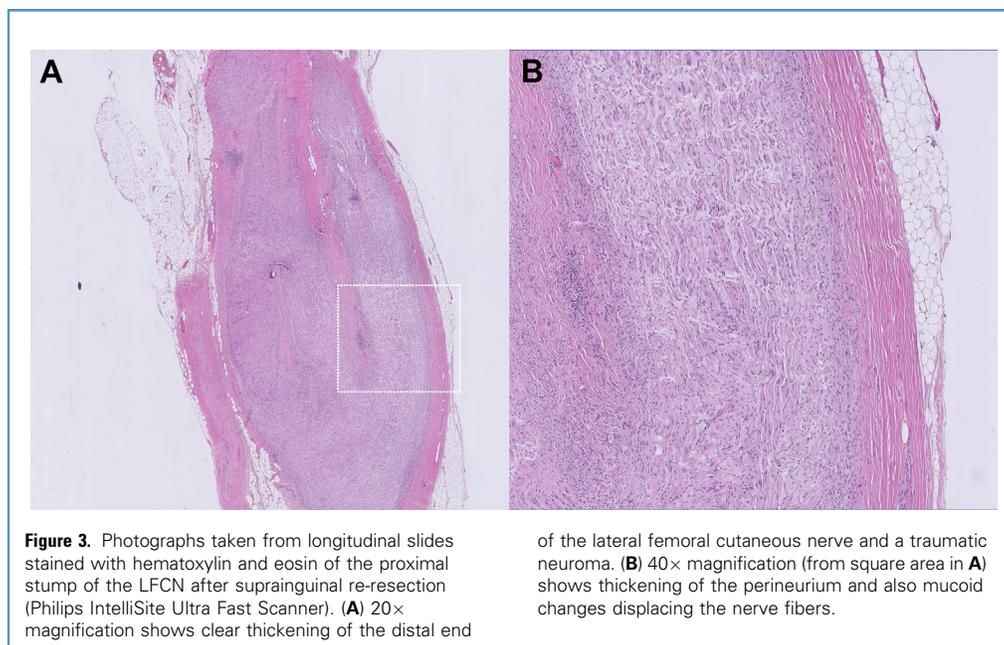


Figure 2. Intraoperative photographs obtained in a case of left-sided meralgia paresthetica despite previous neurectomy. **(A)** The incision was made just cranial and medial to the anterior superior iliac spine (ASIS). Just below the subcutis is the aponeurosis of external oblique muscle (AEO). **(B)** After transverse incision of the AEO, the lateral attachments of the internal oblique (IO) and transverse abdominis (TA) muscles are released from the

ASIS, the plane in which the nerve is subsequently found is indicated with the *black arrow*. **(C)** The IO and TA muscles are mobilized in a cranial direction and the proximal stump of the lateral femoral cutaneous nerve (LFCN) is identified on top of the iliac muscle (IM). Forceps points at the distal end of the proximal stump of the LFCN, which in this case was clearly thickened.



series, there were no cases in which the LFCN had not been transected during the first surgery, except in one case, in which there was a split LFCN, with bifurcation proximal to the ligament, in which only the lateral branch had been transected during the first surgery. In most cases, there was a marked thickening of the distal end of the proximal stump due to neuroma formation. In one case, we suspected a combination of attachment of the proximal stump to the inguinal ligament and thickening of the nerve due to neuroma formation, but after dissection of the nerve in distal direction and hemostasis with bipolar coagulation it turned out that this nerve was the femoral nerve. The proximal end of the LFCN was found more laterally. After this complication in the ninth case, we have started to use intraoperative monitoring during this procedure to be sure that not accidentally the femoral nerve was injured during dissection of the proximal stump from the inguinal ligament. There were 2 cases in which the LFCN could not be identified during the suprainguinal procedure.

Follow-up

The mean follow-up in this series was 3.5 years (standard deviation 1.4, range 1.5 months to 6 years). There was no loss to follow-up. Successful pain relief (almost or complete, respectively, Likert 1 or 2) was obtained in 13 of 20 cases (65%) and partial improvement (Likert 3) in 1 case. There was no improvement in 6 cases: in 2 cases (both Likert 4) the LFCN stump had not been identified during the surgery. Of the other 4 cases, there was 1 patient who reported worsening of symptoms (Likert 5) and 3 no change (Likert 4), of which one patient had initially reported complete relief (Likert 1), but symptoms recurred after several months.

Statistical analysis showed a significantly greater success rate for the indication recurrence versus persistence (respectively, 71%

and 62% Likert 1 or 2). The presence of a traumatic neuroma was not correlated with a better outcome.

Apart from the intraoperative complication mentioned previously, there were no other complications in this surgical series (also no cases with postoperative incisional herniation, hematoma or infection).

Histology

From 16 patients slides from the nerve segment obtained at the first transection of the LFCN were available for analysis. In all of these cases, intraneural changes were present, as sign of chronic compression, which confirmed the diagnosis of meralgia paresthetica.⁴ In the pathologic analysis of the proximal stump after suprainguinal re-resection, traumatic neuroma was observed in 11 of 20 cases (Table 1), mostly after recurrence of symptoms but also in 5 cases after persistence of symptoms. In 1 of the 2 cases of neuroexeresis, a traumatic neuroma also was found. In the cases in which there was no clear neuroma, the same intraneural changes were observed that are frequently present in the LFCN segment obtained from the site of compression after the first neurectomy.

Of the 4 failures, in which the LFCN had been identified during surgery, pathologic analysis of LFCN after initial transection showed the usual intraneural changes confirming the diagnosis (except one case from elsewhere, in which the nerve had not been sent for analysis) and pathologic analysis after suprainguinal re-resection showed a traumatic neuroma.

DISCUSSION

This cases series shows that suprainguinal re-resection of the LFCN can be a successful procedure in both patients with persistent and recurrent symptoms of meralgia paresthetica

despite previous transection. The proximal stump of the LFCN could be identified in 90% (18/20) of the cases. Pain relief in the successful cases was long-lasting with a mean follow-up of 3.5 years. The success rate was slightly greater for the indication of recurrence (71%) versus persistence (62%). Because the explanations for the observed success may vary for the different indications, the results are separately discussed below.

Recurrence of Symptoms After Neurectomy

The success of pain relief in this series confirms the previous success found for the first case report.³ In all cases of recurrence in this study, a traumatic neuroma was found during histopathologic analysis (except for the one case, in which the proximal stump of the LFCN was not identified during surgery). Recurrence after re-resection in this series was only suspected in one case, but of course the incidence might be greater with longer follow-up. Nevertheless, this series shows that suprainguinal re-resection of the proximal stump of the LFCN after a pain-free interval can be quite successful with long-lasting pain relief confirming the results of the first case report from our center.³

The pathophysiologic mechanism for recurrence of symptoms obviously is the formation of the traumatic neuroma after transection. We suspect that this neuroma may become symptomatic due to attachment to the iliac fascia or inguinal ligament, because some patients reported that symptoms during walking or sitting, which might be explained by stretching of the nerve with subsequently traction on the neuroma that is attached to the iliac fascia or inguinal ligament (so-called mechanosensitivity⁵). The cause for this attachment of the neuroma may be explained by the relatively closed compartment around the LFCN caused by a duplicated fascia of the iliac muscle through which the LFCN runs just proximal to the inguinal ligament.⁶ The success after re-resection thus is not caused by prevention of neuroma formation but can be explained by prevention of traction on the neuroma by resecting the LFCN more proximally than is possible through an infrainguinal approach, possibly leading to a more freely moving proximal stump in the retroperitoneal space.

In the past in our center, a neurexeresis procedure was performed instead of a neurectomy, because it was then believed that pulling the LFCN out of the pelvis (after transection of the nerve) results in breakage of fascicles at multiple points, thereby reducing the chance for the formation of a painful neuroma.³ Another explanation could be that the nerve breaks a greater level during neurexeresis than can be achieved through an infrainguinal neurectomy, and therefore makes it less likely for the proximal stump to get attached to the iliac fascia or inguinal ligament.

Despite the pathophysiologic mechanism our series shows that re-resection frequently is sufficient to treat the neuroma and that it is not necessary to for example bury the freshly cut nerve end in adjacent muscle.⁷

Persistence of Symptoms After Neurectomy

Persistence of symptoms after neurectomy is somewhat more difficult to explain than for recurrence of symptoms. Although in some cases a traumatic neuroma also was found, this explanation seems less likely, because patients had experienced no improvement after the first transection. Another explanation could be that

similar to the aforementioned mechanism, attachment of the proximal stump to the iliac muscle, inguinal ligament, or in a duplicated iliac fascia may cause irritation, or, as was found from pathologic analysis, intraneural changes in the remaining proximal stump may lead to persistence of symptoms. The presence of these intraneural changes proximal to the site of compression was also shown in a previous histopathologic study.⁴ It is also the reason why we standardly decompress the LFCN up to the deep circumflex iliac artery during the neurectomy procedure and pull on the proximal end (after first distal transection of the LFCN) to be able to transect the LFCN again as far proximally as possible, but as shown in study, despite this procedure, intraneural changes are sometimes still found in the distal end of the proximal nerve stump after suprainguinal re-resection (Figure 3B). This could also explain the finding in our study that there were substantially more left-sided cases than right-sided, because for a right-handed surgeon it is easier to transect the LFCN proximally if the nerve is located on the right-side of the ASIS (as in a right-sided case) than on the left, because the ASIS may limit the possibility to transect the nerve more proximally in a left-sided case with a type B course of the LFCN (exit from the pelvis just medial to the ASIS⁸).

As mentioned previously, during the neurexeresis procedure, the LFCN may break at a more proximal level, which would prevent the issue of remaining intraneural changes in the distal nerve end, which may trigger the pain. Nevertheless, we still prefer the neurectomy procedure, because of the risk of persistence of pain due to the risk of traction injury to the nerve roots L2 and L3 (from which the LFCN originates). More research is needed to investigate the pathophysiologic mechanisms for persistence of pain after previous neurectomy. Centralization, which also can explain phantom pain, may be a mechanism,⁵ but as the present study shows, other mechanisms also play a role, because otherwise the pain symptoms would probably not have resolved after the suprainguinal re-resection in the persistent cases in this study.

Considerations

To the best of our knowledge, this is the first case series that describes the results for suprainguinal re-resection of the LFCN after previous neurectomy or neurexeresis. Although results show that the procedure can be quite successful for both indications (persistence and recurrence), it is important to consider several factors before offering and performing this technique in patients.

First, it is important to realize, before performing any type of surgery for meralgia paresthetica, that it can be difficult to diagnose and distinguish the pain symptoms from other potential causes, as, for example, radicular pain in lumbar stenosis. In our center, the diagnosis of meralgia paresthetica therefore has to be supported by at least one of the following: thickening of the nerve on ultrasonography, side-difference in somatosensory-evoked potentials, and/or a positive nerve block.⁹ Although we don't think that the failures in our study were caused by a differential diagnosis (also because of characteristic intraneural changes in the nerve segments obtained after the first neurectomy), it thus is important to reconsider the diagnosis in case of failure after previous neurectomy.

Second, when performing neurectomy procedures, it is important to realize that symptoms may sometimes worsen in the

first few weeks after the surgery and that these symptoms will often spontaneously resolve in time and therefore need to be treated conservatively with neuropathic pain medication for at least several months before offering another transection through a supra-inguinal approach. In our center, reoperation was discussed with every patient when symptoms had not improved after at least 3 months of conservative treatment. The number of patients surgically treated (10 cases for persistence of symptoms) may seem high, but when considering the total number of neurectomy procedures performed by the first author during the same study period (72), the percentage of successful procedures probably doesn't differ from previous results found in our studies (87.5% and 93.3%).^{1,10}

Third, it is important to realize that the suprainguinal procedure may have several complications, including vascular injury (of the deep circumflex iliac vessels), postoperative incisional herniation (if the fascia of the oblique muscles is not closed sufficiently), and nerve injury (of the femoral, ilioinguinal, genitofemoral, iliohypogastric nerves). As for the latter, it is also important to realize that the anatomical course of the LFCN around the ASIS may vary^{8,9} and that in the most medial variant (type E), the LFCN may join the femoral nerve proximal to the ligament.^{6,11} Because of potential femoral nerve injury, we advise using intraoperative nerve monitoring during this procedure. The aforementioned complications should be discussed with the patient, as well as the chance that the nerve is not found intraoperatively.

Finally, it is important to mention that the suprainguinal procedure in this article was presented as rescue procedure for cases of persistent or recurrent symptoms of meralgia paresthetica despite previous transection. We do not advocate performing the suprainguinal approach as primary surgical procedure in patients with meralgia paresthetica (which was suggested by the authors who first described the suprainguinal exposure of the LFNC¹²), nor

do we advocate in this study that neurectomy should be performed as primary procedure in all patients with meralgia paresthetica. In our center, we preoperatively discuss the different pros and cons of decompression versus neurectomy with the patient,¹ as well as the option to participate in the STOMP (surgical treatment options for meralgia paresthetica) trial, in which patients are randomized between the 2 procedures. Hopefully, in the near future the results of this trial will provide more information on the effectiveness of these techniques.

CONCLUSIONS

In this case series good results were found for suprainguinal re-resection of the LFCN with a 65% chance on successful pain relief. Based on these results we believe that this technique should be considered in case of persistent or recurrent symptoms of meralgia paresthetica despite previous transection of the LFCN. At the same time, it is important to stress that several factors should be considered before starting to perform this relatively new technique in patients.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Godard C.W. de Ruiter: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization, Supervision. **Pieter C. Clahsen:** Investigation, Visualization, Writing – review & editing. **J. Wolter A. Oosterhuis:** Writing – review & editing, Project administration.

ACKNOWLEDGMENTS

The authors thank Ditte Varkevisser for sending out the questionnaires and Maartje Kunen for the medical illustrations in **Figure 1**.

REFERENCES

- de Ruiter GC, Wurzer JA, Kloet A. Decision making in the surgical treatment of meralgia paresthetica: neurolysis versus neurectomy. *Acta Neurochir (Wien)*. 2012;154:1765-1772.
- Lu VM, Burks SS, Heath RN, Wolde T, Spinner RJ, Levi AD. Meralgia paresthetica treated by injection, decompression, and neurectomy: a systematic review and meta-analysis of pain and operative outcomes [e-pub ahead of print]. *J Neurosurg*. <https://doi.org/10.3171/2020.7.JNS.202191>, accessed February 26, 2021.
- de Ruiter GC, Wurzer JA, Kloet A. Recurrence of meralgia paresthetica years after a neurexeresis procedure: a case report. *Br J Neurosurg*. 2015;29:885-887.
- de Ruiter GCW, Lim J, Thomassen BJW, van Duinen SG. Histopathologic changes inside the lateral femoral cutaneous nerve obtained from patients with persistent symptoms of meralgia paresthetica. *Acta Neurochir (Wien)*. 2019;161:263-269.
- Campbell JN. Nerve lesions and the generation of pain. *Muscle Nerve*. 2001;24:1261-1273.
- Hanna A. The lateral femoral cutaneous nerve canal. *J Neurosurg*. 2017;126:972-978.
- Dellon AL, Mackinnon SE. Treatment of the painful neuroma by neuroma resection and muscle implantation. *Plast Reconstr Surg*. 1986;77:427-438.
- Aszmann OC, Dellon ES, Dellon AL. Anatomical course of the lateral femoral cutaneous nerve and its susceptibility to compression and injury. *Plast Reconstr Surg*. 1997;100:600-604.
- de Ruiter GCW, Wesstein M, Vlak MHM. Preoperative ultrasound in patients with meralgia paresthetica to detect anatomical variations in the course of the lateral femoral cutaneous nerve. *World Neurosurg*. 2021;149:e297-e335.
- de Ruiter GC, Kloet A. Comparison of effectiveness of different surgical treatments for meralgia paresthetica: results of a prospective observational study and protocol for a randomized controlled trial. *Clin Neurol Neurosurg*. 2015;134:7-11.
- Kokubo R, Kim K, Morimoto D, et al. Anatomic variation in patient with lateral femoral cutaneous nerve entrapment neuropathy. *World Neurosurg*. 2018;115:274-276.
- Alberti O, Wickboldt J, Becker R. Suprainguinal retroperitoneal approach for the successful surgical treatment of meralgia paresthetica. *J Neurosurg*. 2009;110:768-774.

Conflict of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received 20 August 2021; accepted 6 September 2021

Citation: *World Neurosurg*. (2021) 155:e830-e835. <https://doi.org/10.1016/j.wneu.2021.09.022>

Journal homepage: www.journals.elsevier.com/world-neurosurgery

Available online: www.sciencedirect.com

1878-8750/\$ - see front matter © 2021 Elsevier Inc. All rights reserved.