Targeted muscle reinnervation for a recurrent traumatic neuroma of the sural nerve: illustrative case

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BACKGROUND Traumatic neuromata often recur after resection. Recently, targeted muscle reinnervation (TMR) has been shown to be a promising alternative for the treatment of traumatic neuroma, also in nonamputees. This case shows that TMR can also be applied for this indication in recurrent traumatic neuroma.

OBSERVATIONS A 55-year-old patient with a history of cerebral palsy presented with a painful swelling in his right knee, 40 years after multiple Achilles tendon surgeries for contractures. On imaging, the lesion was suspect for a traumatic neuroma of the posterior sural nerve. After two failed resections, TMR was performed by connecting the proximal end of the sural nerve to the motor branch of the lateral gastrocnemius muscle. During outpatient visits at 3, 6, and 12 months, the patient reported significantly less pain compared to before the TMR. He had no weakness of plantar flexion. Postoperative imaging, however, showed atrophy of the lateral gastrocnemius muscle.

LESSONS This case shows that TMR can be a successful strategy to treat recurrent traumatic neuroma after previous failed transection of single neuromata in nonamputee cases. In the authors’ patient, TMR did not result in motor deficit, but more research is needed to investigate this consequence of TMR for this indication.

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KEYWORDS gastrocnemius muscle; neuropathic pain; injury; recurrence; nonamputees
Initial Resection

During the first surgery, the neuroma was resected and the proximal stump was covered with a steel-vascularized fat tissue flap. Pathological analysis showed a traumatic neuroma (Fig. 2A and B). Two months after the first surgery, the patient again developed pain symptoms with a positive Tinel sign. Sonographic analysis showed a thickened proximal nerve end suspect for a recurrent traumatic neuroma (Fig. 3A and B).

Reresection

During the second surgery, performed 6 months after the first surgery, there was again a clearly thickened distal end of the proximal stump of the sural nerve. Reresection of the traumatic neuroma was performed, including an extra segment of nerve, until the proximal end again had a normal caliber. Subsequently, this proximal end was sutured into a blind-ending nerve tube (NEUROCAP) (Fig. 4A). The patient initially recovered well from this surgery, but after 3 months he again experienced the same pain symptoms that he had before the first and second surgeries. This time, a second recurrence was suspected based on thickening of the nerve just proximal to the NEUROCAP (Fig. 3C and D). Because of the severity of the pain symptoms, explorative surgery was eventually performed 7 months after the second surgery.

TMR

The possibility of TMR was discussed preoperatively with the patient as well as the risk of postoperative weakness of plantar flexion function, and the patient consented to receive this surgical technique. Intraoperatively, the distal end of the sural nerve was dissected, and together with the NEUROCAP, a segment was sent for pathologic analysis (Fig. 2C and D). The sural nerve was released in a proximal direction to obtain sufficient length for TMR. Subsequently, with the use of intraoperative nerve stimulation, the branch toward the lateral belly of the gastrocnemius muscle was identified. After transection of this branch, it was connected to the proximal end of the sural nerve (Fig. 4B and C).

Outcome and Follow-up

The patient showed good recovery directly after the operation. During outpatient visits at 3, 6, and 12 months, he reported significantly less pain. He now experiences only occasional pain, with a maximum score of 4 out of 10 on the Numeric Rating Scale (i.e., mild to moderate pain) compared to a score of 9 before the TMR procedure. After 1 year of follow-up, the patient was discharged from further follow-up. On neurological examination, he had no weakness of plantar flexion (Medical Research Counsel grade 5). MRI performed 12 months after the surgery, however, showed clear signs of denervation in the lateral belly of the gastrocnemius muscle (Fig. 5).

Discussion

In this case, we successfully treated a patient with a recurrent neuroma of the sural nerve that had developed 40 years after transection injury. Although we believed that the chance for successful pain relief would be small because of the long interval between injury and onset of symptoms together with two previous failed attempts to surgically treat the neuroma, the patient experienced complete pain relief, which was monitored up to 1 year after the TMR procedure.

Observations

This case report shows that TMR can be applied for surgical treatment of recurrent traumatic neuroma. We used the same technique and distal nerve motor branch to the lateral gastrocnemius muscle as in the first case reported by Fracol et al. More recently, results were reported in a retrospective cohort study for two patients with a traumatic neuroma of the sural nerve, one of whom received prior excision. Results for these three cases were successful for pain relief, and motor function was preserved. Nonetheless, the transection of the motor branch is not without risk for motor deficit. In our patient, we believed that the clinical consequence of motor weakness would be limited because of spasticity of the affected limb. Although subjectively and clinically muscle deficit was not detected postoperatively, the presence of atrophy on the postoperative MRI suggested that potential deficit should be discussed with the patient and weighed against other options to treat...
recurrence of the neuroma. It is feasible to connect the proximal stump to a smaller, more distal branch by careful dissection of the motor branch into the distal target muscle until it arborizes, as pointed out by Chang et al. A potential downside of this technique, however, is that it results in a significant size mismatch between the donor nerve and the affected nerve, which may lead to a substantial escape of axons at the coaptation site and the formation of a traumatic neuroma. Although Chang et al. mentioned that all motor target nerves in their cases were redundant, their article did not clarify how this redundancy was determined.

Lessons

The present case is thus unique given that our patient suffered from two previously failed surgeries before TMR was performed and the fact that TMR was performed with an interval of more than 40 years between the initial trauma and our procedure. There are several explanations for failure of the first two resections. As for recurrence of symptoms after the first resection, coverage with a vascularized fat flap has been shown to increase the risk of recurrence by hiding, rather than healing, the transected nerve end. Second, it is known that capped nerve ends may still form neuromas; consequently, the NEUROCAP is not necessarily the ultimate solution. These neuromas may still be painful, as shown in our case, which may be caused by traction on the neuroma or proximal nerve end (so-called mechanosensitivity). Potential disadvantages of TMR, which include size mismatch and the sacrifice of another nerve, should be kept in mind. However, it can be an option to consider in patients with previously failed neuroma surgeries, which is supported by a retrospective cohort study in this population. This case report shows successful TMR in a patient with a recurrent traumatic neuroma of the sural nerve after resection and capping of the distal nerve end. As postoperative MRI in our patient shows, however, TMR may not be without clinical consequence. More research is needed to further investigate this technique in nonamputee cases before wide application of the technique at various locations in the body using different target motor branches.

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References

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