NMC Case Report Journal 9, 213-216, 2022

Detection of the Moment of Nerve Decompression Using Continuous Monitoring of Evoked Facial Nerve Electromyograms in a Patient with Facial Nerve Schwannoma: Case Report

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Abstract

Facial nerve function improvement is a challenging goal in facial nerve schwannoma (FNS) surgery. Intraoperative continuous monitoring of evoked facial nerve electromyograms (CFN-EMGs) is performed in acoustic neuroma surgery to preserve facial nerve function. CFN-EMGs were applied in decompression surgery for FNS with severe facial paresis. A 39-year-old woman presented with a sudden onset of vertigo, left hearing disturbance, and severe left facial palsy with House-Brackmann (HB) grade 5. FNS was strongly suspected based on the patient's clinical course and magnetic resonance imaging findings, and the patient underwent surgical decompression of the internal auditory canal (IAC) to improve facial nerve function 9 weeks after onset. CFN-EMG responses suddenly improved after removing the posterior wall of the IAC and incising its dura matter. Since the patient's facial nerve paresis improved to HB grade 2 after surgery, CFN-EMGs could detect the moment of facial nerve decompression. This would be the first report to show that CFN-EMGs applied in decompression surgery for FNS could detect the effects of decompression during surgery in real-time. Thus, CFN-EMGs may be an effective monitoring method in decompression surgery for FNS.

Keywords: facial nerve schwannoma, monitoring, decompression surgery

Introduction

Facial nerve schwannomas (FNS) are rare tumors and sometimes develop in the internal auditory canal (IAC) and cerebellopontine angle segments. Patients with FNS occasionally suffer from facial paresis even if the tumor size is small. The therapeutic goals of FNSs are controversial. Multiple therapeutic options are available, including observation, surgery, and stereotactic radiosurgery. Surgical operations include total gloss resection with nerve grafting, partial resection, and decompression without tumor resection. Surgical interventions with or without nerve grafting were previously common, but treatment results were unfavorable in terms of facial nerve functions.[1-3] Treatment strategies for FNSs have been more currently focused on the long-term preservation of facial nerve function.[4] The current study presents the case of a patient with sudden facial paresis due to a tumor in the IAC. To preserve facial nerve function, bony and dura decompressions were applied with continuous monitoring of evoked facial nerve electromyograms (CFN-EMGs) without tumor resection. CFN-EMGs could detect the moment of nerve decompression in real-time. Additionally, facial nerve function had been gradually improved after surgery. The potential of CFN-EMGs as a monitoring method in decompression surgery for FNS was discussed.

Case Report

Preoperative course and examinations

A 39-year-old woman presented with a sudden onset of vertigo, left hearing disturbance, and left facial paresis. The patient was diagnosed with Ramsay Hunt syndrome and treated with oral corticosteroids and an antiviral drug in

Received April 7, 2022; Accepted May 17, 2022

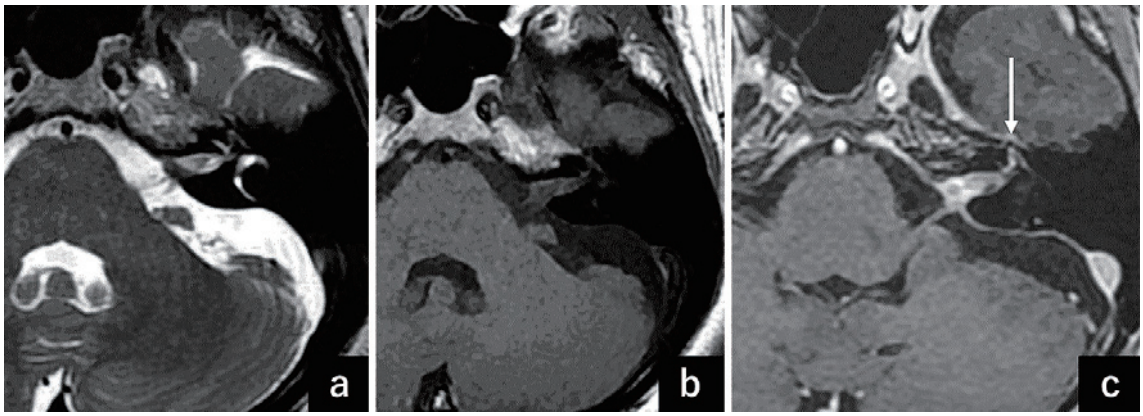

Fig. 1 Preoperative magnetic resonance imaging 4 weeks after the onset of symptoms. a T2-weighted image presenting a lesion with hyperintensity located within the internal auditory canal. b T1-weighted image presenting an isointense mass. c Gadolinium-enhanced T1-weighted image presenting a heterogeneously enhanced mass extending into the geniculate ganglion (*arrow*).

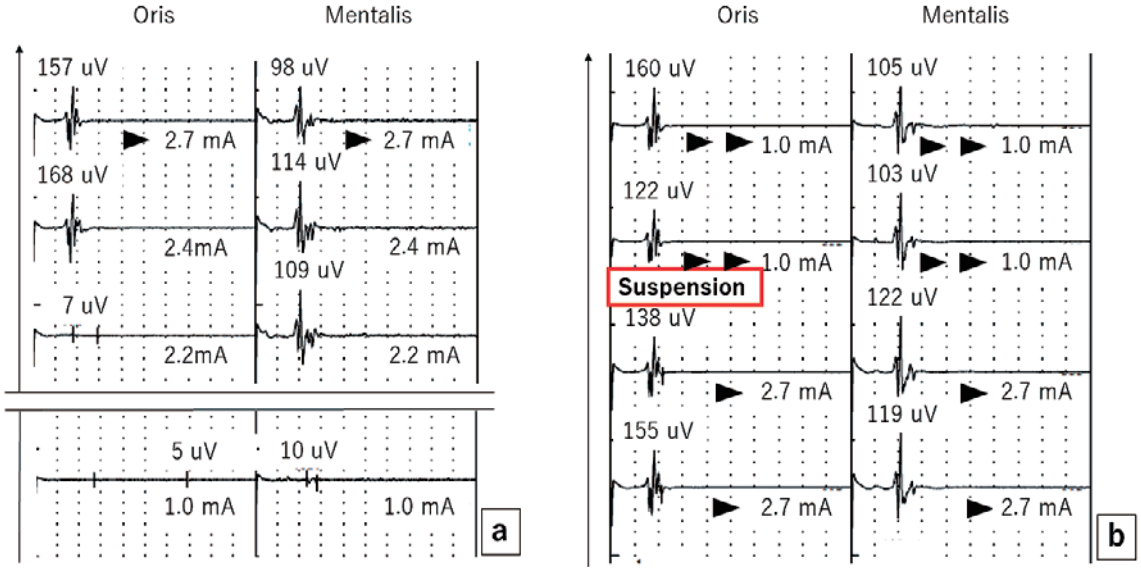

Fig. 2 Intraoperative findings of continuous monitoring of evoked facial nerve electromyograms (CFN-EMGs) for the orbicularis oris (Oris) and mentalis (Mentalis) muscles. a No response was observed after applying 1.0-mA stimulation at 1-Hz frequency, whereas stable CFN-EMGs were obtained when stimulation was increased to 2.7 mA (*single arrowhead*). b After incising the dura of the IAC, the surgical field suddenly vibrated every second with 2.7 mA of stimulations (*single arrowheads*). The vibration stopped when the stimulation was interrupted (suspension). The vibrations were caused by contractions of the facial muscles. Stable CFN-EMGs were observed even at 1.0 mA (*double arrowheads*) after opening the dura mater of the IAC. The threshold was decreased, suggesting that the responsiveness of the facial nerve improved.

another department. Hearing disturbance improved, but facial paresis persisted. The patient was referred to the institution of the current study 6 weeks after onset. Neurological examinations revealed left facial palsy with House-Brackmann (HB) grade 5. Magnetic resonance imaging (MRI) revealed a lesion localized within the patient's left IAC with hyperintensity on T2-weighted image (WI) and isointensity on T1WI (Fig. 1a, b). Gadolinium-enhanced T 1WI revealed a heterogeneously enhanced mass extending into the geniculate ganglion (Fig. 1c). FNS was strongly suspected based on the patient's clinical course and MRI findings, and the patient underwent surgical decompression of the IAC to improve facial nerve function 9 weeks after onset.

Surgery (video)

The surgery was performed under general anesthesia without muscle relaxants, except during anesthesia induction. The patient was placed in the lateral position after setting up auditory brainstem response and CFN-EMGs. A

C-shaped postauricular incision and retrosigmoid craniotomy were performed. After the dural incision, the root exit zone (REZ) of the facial nerve was observed. A ball-type monopolar stimulating electrode was placed on the REZ of the facial nerve. The stimulus of the CFN-EMGs was started from 0.3 mA at a frequency of 1 Hz; however, no response was observed when a stimulus of ≤1.0 mA was applied. Stable CFN-EMGs were obtained when the stimulus was increased to 2.7 mA (Fig. 2a). The posterior wall of the IAC was removed by 10 mm using an ultrasonic bone aspirator (SONOPET; Stryker, Kalamazoo, MI, USA) not to damage the semicircular canal. The surgical field suddenly vibrated every second after incising the dura of the IAC. The vibrations stopped when the stimulation of the facial nerve was stopped. Therefore, the vibrations were caused by strong contractions of the facial muscles. Stable CFM-EMGs were subsequently observed even after applying a stimulus of 1.0 mA (Fig. 2b). A normal vestibular nerve without a tumor was confirmed after a dural incision (Fig. 3), which supported the diagnosis of FNS.

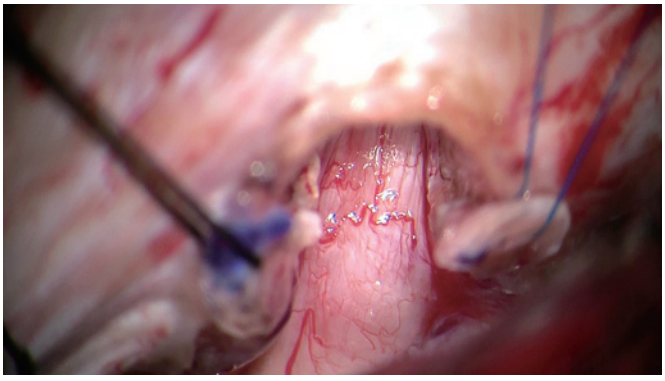

Fig. 3 Intraoperative view after bone removal of the posterior wall of the internal auditory canal and incision of the dura mater. The normal vestibular nerve appeared to be compressed by the tumor from its ventral side.

Postoperative course

The patient realized a slight improvement in mouth movement just after the operation. Postoperative constructive interference in steady-state MRI showed the removal of the posterior wall of the IAC (Fig. 4). The patient's facial paresis improved to HB grades 4, 3, and 2 at 2 weeks, 3 months, and 8 months after surgery, respectively. Additionally, lagophthalmos improved, and eye drops were no longer needed after the operation. No tumor growth was observed, and facial nerve function remained at HB grade 2 at 24 months after surgery.

Discussion

Surgical strategy for facial nerve schwannoma with severe facial paralysis

Observation is a considerable option for cases with mild facial paresis to preserve facial nerve function for a long time. However, Carlson et al. have reported 31 observation FNS cases, and none of them spontaneously improved.[5] In gross total removal and nerve grafting, facial nerve function could recover up to HB grade 3.[3,6] Wilkinson et al. have reported that bony decompression could recover facial nerve function.[7] The patient in this case report presented with severe facial paresis corresponding to HB grade 5 but recover up to HB grade 2. Facial nerve paralysis may have improved in the natural course. However, the decompression surgery may have highly contributed to the improvement of facial nerve paralysis because strong vibrations synchronized with stimulus every second were observed and the threshold of stimulation to the facial nerve improved just after the opening of the internal auditory

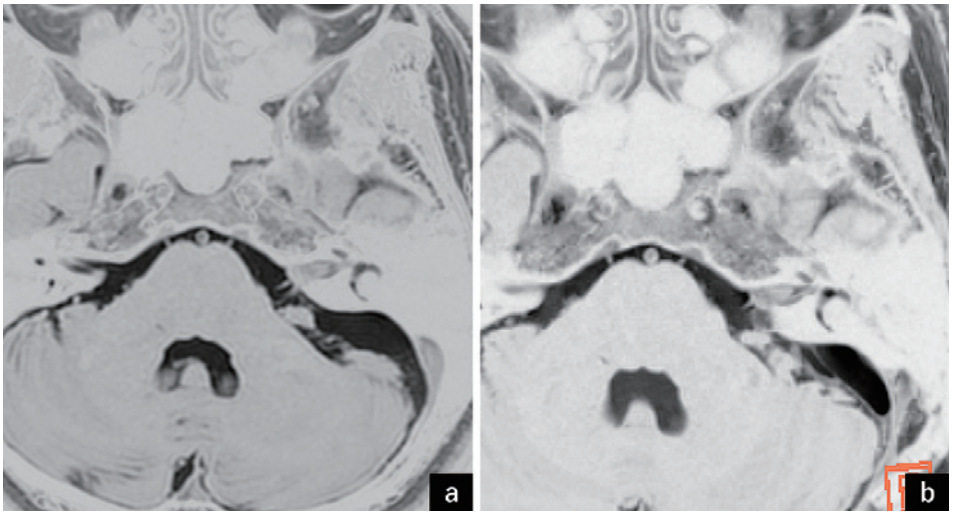

Fig. 4 Comparison of preoperative and postoperative constructive interference in steady-state MRI. a Preoperative image at the level of the left IAC. b Postoperative image presenting the removal of the posterior wall of the IAC.

meatus and its dura. Thus, decompression surgery may be appropriate for cases of noncomplete facial paralysis.

CFN-EMGs

CFN-EMGs have been an effective tool for preserving facial nerve function in acoustic neuroma surgery.[8,9] One of their advantages is that facial nerve conditions during tumor resection can be monitored in real-time. CFN-EMGs were applied for decompression surgery of FNS. The minimum stimulation threshold was improved immediately after the incision of the dura of the IAC (video). Improvement in electrophysiological response may be a hint for determining the range of decompression.

Stimulation thresholds and facial function outcome

The minimum threshold of facial nerve stimulation after removal of acoustic neuroma was associated with the functional prognosis of the facial nerve.[10-12] Facial nerve functions were predominantly maintained in the group in which the stimulation threshold for the facial nerve after removal of the tumors was <2 mA compared with the group in which the minimum stimulation threshold was ≥ 2 mA.[10] In the patient in this case report, a stable reaction was initially obtained using a strong current of 2.4-2.7 mA and a stable reaction was obtained at 1.0 mA after removing the posterior wall and incising the dura mater of the IAC.

Conclusion

This would be the first report to show that CFN-EMGs applied in decompression surgery for FNS could detect the effects of decompression during surgery in real-time. Although case accumulation is necessary, CFN-EMGs could be a promising monitoring method in assessing intraoperative facial nerve decompression in the future.

Supplementary Material

https://doi.org/10.2176/jns-nmc.2022-0117

Abbreviations

FNS facial nerve schwannoma, *CFN-EMGs* continuous monitoring of evoked facial nerve electromyograms, *HB* House-Brackmann, *IAC* internal auditory canal, *MRI* magnetic resonance imaging, *WI* weighted image

Informed Consent

The patient has consented to the submission of the case report in a scientific journal.

Conflicts of Interest Disclosure

The authors declare no conflict of interest.

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