INTRODUCTION

Ten out of 100,000 people between the ages of 50 and 60 are usually reported to have partial facial spasms (HFS) [1-4]. The symptoms usually progress in frequency and severity, starting with intermittent twitches in the orbicularis oculi muscle, and spreading downward to the ipsilateral facial muscles. The most common cause of HFS is neurovascular compression along the root exit zone of the facial nerve. Microvascular decompression (MVD) works well, with effects that last almost permanently. We analyzed the surgical outcomes and complications from the last 23 years at our institution.

Methods: This study analyzed 244 patients who underwent MVD between June 1998 and July 2021. All patients were followed up for more than 24 months. The preoperative image workups were brain magnetic resonance imaging, magnetic resonance angiography, and constructive interference in steady state (from 2009 onwards). Starting in July 2012, intraoperative monitoring was performed. Surgery was performed through the retrosigmoid approach by a single neurosurgeon.

Results: Out of 244 patients, 160 were female and 84 were male. The average age was 53.8 years (range, 19–78 years). In total, 226 patients (92.6%) completely recovered from HFS, two patients (0.8%) underwent reoperation, and complications occurred in 16 patients (6.6%). In 61 patients with preoperative facial palsy on the affected side, palsy improved in 56 patients (91.8%) and 12 patients (19.7%) had thick arachnoid membranes.

Conclusion: MVD has a durable effect on the improvement of HFS and may also improve HFS and concomitant palsy if preoperative facial palsy is present. Therefore, it is thought to be a treatment method that can be actively recommended to patients.

KEY WORDS: Hemifacial spasm, Microvascular decompression surgery, Facial paralysis, Intraoperative monitoring
Intraoperative monitoring

From the time that patient positioning was completed to dura mater closure, continuous LSR was recorded with paired subdermal needles inserted into the frontalis, orbicularis oculi, orbicularis oris, and mentalis muscles. With another set of paired needles positioned over the zygomatic branches of the facial nerve, response was evoked using a pulse duration of 0.2 millisecond and stimulus intensity between 5 and 30 mA. The signals were amplified, filtered, and displayed using a commercial neurophysiological monitoring workstation (ISIS intraoperative monitoring [IOM] system; Inomed). No neuromuscular blockade agents were used except during intubation. Three checkpoints were established in order to identify LSR disappearance or persistence: 1) during CSF drainage period; 2) during Teflon implantation; and 3) after dura closure (to check for LSR persistence). In addition, brainstem auditory evoked potential monitoring was performed in all patients. IOM was performed after July 2012.

RESULTS

Of the 244 patients, female patients were 160, and male patients were 84. The average age was 53.8 years old (19–78 years old). The average duration of symptoms was 4 years (1 month–20 years). The affected side was left 141 (female:male = 82:59) and right 103 (female:male = 78:25). Offending vasculatures were anterior inferior cerebellar artery (AICA) 150 (61.5%), posterior inferior cerebellar artery (PICA) 37 (15.2%), vertebral artery (VA) 16 (6.6%), basilar artery (BA) two (0.8%), vein eight (3.3%), AICA+VA eight (3.3%), AICA+BA four (1.6%), AICA+vein two (0.8%), PICA+VA 15 (6.1%), PICA+BA one (0.4%) and VA+vein one (0.4%) (Table 1). Two hundred twenty-six patients (92.6%) completely recovered from HFS, two patients (0.8%) got reoperation, and complications occurred in 16 patients (6.6%) (Table 2).

Total symptom free rate was 92.6%. Before the IOM period (1998.06–2012.06), 96.7% of 150 patients were freed from HFS, and after the IOM period (2012.07–2021.07), 86.2% of 94 patients were freed from HFS (Table 2).

In 61 patients with preoperative facial palsy (female:male = 40:21, average age: 55.1 years old, average duration of HFS: 5 years, left:right = 36:25) on the affected side, facial palsy was improved to normal in 56 patients (91.8%) and five patients (8.2%) showed slight improvement from House-Brackman Grade (HBG) 3 to 2.

Surgical procedure

The surgical approach was retrosigmoid approach, and all cases were done by one neurosurgeon (HYC). A small craniotomy behind and close to the sigmoid sinus was performed (2.5 × 2.5 cm square shape just behind sigmoid sinus). The dura was C-shaped opened based on sigmoid sinus. Under binocular microscopy, the cerebellum was depressed spontaneously and progressively helped by CSF aspiration of the cerebellopontine angle and cerebellomedullary cistern. CSF was drained slowly to achieve adequate brain relaxation without the need for a brain retractor. The cranial nerve (CN) IX and X was sharply dissected away from the flocculus cerebelli and the arachnoid dissection around the vessels was performed to cephalad direction until CN VII, VIII complex was seen under arachnoid membrane. Conflict of vascular structure and CN VII exit zone was treated by interposition of Teflon felts and/or liberation vessel or nerve from fibrotic adhesions. Multiple offending vessels were searched in multiple possible affected sites in addition to the REZ of the facial nerve. If lateral spread response (LSR) persisted after decompression, the entire facial REZ was reexplored to confirm that there was no visible evidence of neurovascular conflict. Then the surgeon terminated the decompression despite residual LSR persistence. After that, papaverine and normal saline is filled in cistern, and the dura suture is reinforced with a muscle patch. After reinforcing once more with a hemostat to prevent leakage, the bone defect was reconstructed with hydroxyapatite.

MATERIALS AND METHODS

Two hundred forty-four patients who had got MVD between June 1998 and July 2021 were reviewed retrospectively. All patients followed up for more than 24 months. Preoperative brain magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) were performed in all patients, and constructive interference in steady state (CISS) images were taken after 2009. Institutional Review Board approval and informed consent of the patients were exempted because this study was conducted retrospectively using existing data.
There were no patients with worsening paralysis symptoms. Almost patients showed HBG 3. The spasm-free rate of patients with preoperative facial palsy were similar those without preoperative facial palsy (95% versus 92.8%). A peculiarity of the surgical field compared to patients without facial palsy is that the arachnoid thickened more often in patients with facial palsy (12 cases [19.7%] in 61 patients versus four cases [2.2%] in 183 patients, chi-square test: odds ratio 22.16) (Fig. 1). The HFS duration of patients with facial palsy was slightly longer than that of patients without facial palsy (5 years compared to 4.2 years).

Out of 16 complications, wound dehiscence was in three (1.2%), postoperative facial paralysis in five (2.0%), permanent hearing loss four (1.6%), transient hearing impairment in one (0.4%), tinnitus in one (0.4%), hoarseness plus tinnitus plus hearing impairment in one (0.4%), and one patient (0.4%) died from subarachnoid hemorrhage (SAH) that occurred immediately after surgery. There was no CSF leak. Complications in pre-IOM period were wound dehiscence in one patient, facial palsy in two patients, and death in one patient. In post-IOM period wound infection, hearing impairment, facial palsy, tinnitus, and lower CN deficit (hoarseness+tinnitus+hearing impairment) was two, five, three, one, and one, respectively (Table 2). More complications occurred in the post-IOM period compared to the pre-IOM period (chi-square test: odds ratio 6.39).

**DISCUSSION**

MVD has been established as a first-line surgical treatment for patients with HFS and has been reported to provide relief from spasms in over 90% of cases [5,21,22]. However, although MVD is a reliable treatment method, general anesthesia and the difficulty of handling the area around the brainstem are still reasons for reluctance to perform surgery. We aimed to investigate the results of MVD for HFS, and to evaluate the outcome and morbidity of this treatment. We retrospectively studied 244 patients who underwent retrosigmoid MVD last 23 years.

In our series, the female patients were 160 and male patients were 84. The proportion of female patients was about twice as high, and the average age of the patients was also in their mid-fifties as already known. The left and right incidence rates were the same in the entire patient group, but when the analysis was performed separately for female and male, the left side was more affected in male.

MRI is the gold standard for neurovascular conflicts diagnosis MRI, focusing on the facial nerve trajectory, was performed to diagnose and localize the offenders, and to exclude tumors or other vascular malformations. Improvement in imaging modalities since 1990 would result in overestimation of discordance. Recently, for better information, neurovascular conflicts are documented by

### Table 1. Offending vessels

<table>
<thead>
<tr>
<th>Offending vessel (n)</th>
<th>Thick arachnoid membrane (n)</th>
</tr>
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<tbody>
<tr>
<td><strong>Single</strong></td>
<td></td>
</tr>
<tr>
<td>AICA</td>
<td>150</td>
</tr>
<tr>
<td>PICA</td>
<td>37</td>
</tr>
<tr>
<td>VA</td>
<td>16</td>
</tr>
<tr>
<td>BA</td>
<td>2</td>
</tr>
<tr>
<td>Vein</td>
<td>8</td>
</tr>
<tr>
<td><strong>Complex</strong></td>
<td></td>
</tr>
<tr>
<td>AICA+VA</td>
<td>8</td>
</tr>
<tr>
<td>AICA+BA</td>
<td>4</td>
</tr>
<tr>
<td>AICA+vein</td>
<td>2</td>
</tr>
<tr>
<td>PICA+VA</td>
<td>15</td>
</tr>
<tr>
<td>PICA+BA</td>
<td>1</td>
</tr>
<tr>
<td>VA+vein</td>
<td>1</td>
</tr>
</tbody>
</table>


### Table 2. Surgical outcomes and complications

<table>
<thead>
<tr>
<th></th>
<th>Total (n = 244)</th>
<th>Pre-IOM (n = 150)</th>
<th>Post-IOM (n = 94)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom-free without complications</td>
<td>226 (92.6)</td>
<td>145 (96.7)</td>
<td>81 (86.2)</td>
</tr>
<tr>
<td>Re-operation</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Occurrence of complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wound problem</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Facial nerve paralysis</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Transient cochlear nerve</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Permanent cochlear nerve</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Transient vestibular nerve</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lower cranial nerve dysfunction</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Death</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Values are presented as number (%) or number only. IOM: intraoperative monitoring.
MRI with three-dimensional constructive CISS, alone or together with three-dimensional time-of-flight MRA [23,24].

In about offending vessels the most common conflict vessels was AICA 150 (62.3%), followed by PICA 37 (15.2%), VA 16 (6.5%), BA two (0.8%), vein eight (3.3%), and AICA+VA eight (3.3%), AICA+BA 4 (1.6%), PICA+VA 15 (6.1%), PICA+BA 1 (0.4%) and VA+vein 1 (0.4%). Most of the vessels colliding with facial REZ were AICA and PICA.

We were interested in the changes in the surgical outcome and postoperative paralysis symptoms of 61 patients with facial paralysis before surgery. Almost patients showed HBD 3. A peculiarity of the surgical field compared to patients without facial palsy is that the arachnoid thickened more often in patients with facial palsy (12 cases [19.7%] in 61 patients versus four cases [2.2%] in 183 patients). We believe that the reason for the thick arachnoid membrane observed in patients with facial paralysis before surgery suggests the possibility of some previously unknown inflammation.

The overall rate of symptom-free without complications after MVD was 92.6%. This result is similar to previous reports. Out of 16 complications, wound dehiscence was in three (1.2%), postoperative facial paralysis in five (2.0%), transient hearing loss four (1.6%), transient hearing impairment in one (0.4%), tinnitus in one (0.4%), hoarseness plus tinnitus plus hearing impairment in one (0.4%), and one patient (0.4%) died from SAH that occurred immediately after surgery. Our results also showed a complication rate similar to that previously known. The risk of permanent CN deficit was 1–2% for facial palsy, 2–3% for non-functional hearing loss, 0.5–1% for lower CN dysfunction. Risk of stroke was at 0.1% and mortality at 0.1%.

We analyzed the surgical results and complications before and after IOM. Before IOM, one serious complication, death, occurred, but the complication rate was 2.7%. After IOM, there were no serious complications, but the complication rate was 12.7%. It is thought that the introduction of the IOM has led to an increase in the incidence of complications even though the operator or surgical method has not changed. It is thought that the cause of the problem is that the vascular and nerve structures are further manipulated until the loss of the LSR is confirmed. It is particularly valuable when LSR induced before craniotomy disappears immediately after the culprit vessel is moved off the facial nerve; this is important clinically to help surgeons to confirm whether adequate decompression has been achieved [25,26]. Since Moller and Janetta [27] documented that spasms are more likely to persist if LSR is still present at the end of the operation, LSR has been studied as an independent prognostic predictor of surgical outcome. Its value, however, it is still a matter of debate [28-34]. In Wei et al.’s report [35] in 2018 patients who underwent MVD with intraoperative LSR monitoring did not exhibit better clinical outcomes than those who underwent MVD without intraoperative LSR monitoring at the 1-week or 1-year follow-up examination. In most of their cases (all but 18), LSR monitoring did not play a guiding role during surgery. A meta-analysis conducted by Sekula et al. [36] indicated that the chance of a cure if the LSR disappeared during Teflon implantation was 4.2 times greater than if the LSR persisted. Hatem et al. [21] demonstrated that an excellent result is still likely to be obtained in patients with LSR persistence after successful decompression, and delayed spasm relief strongly supports the hypothesis that HFS is not only due to the neurovascular compression but also to severe nerve demyelination and/or hyperactivity of the facial nucleus. Although LSR exists in almost all patients with typi-
MVD results for HFS during 23 years

cal HFS, the exact mechanism of this phenomenon has not yet been well elucidated. It was presumed to be related to cross-transmission between axons at the lesion site because LSR disappeared immediately in most cases after the offending vessel was separated from the facial nerve [27,37,38]. However, LSR could also be due to hyperactivity of the facial nucleus [39]. As such, there are various causes of LSR, so manipulating blood vessels and nerves and inserting more Teflon until the LSR disappears in the surgical field can only increase the possibility of complications.

CONCLUSION

MVD has a durable effect on the improvement of HFS and also improves HFS and simultaneous palsy if preoperative facial palsy is present. When using an IOM, it is better to use it at a level that prevents or predicts complications rather than relying solely on LSR loss.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

by fusion magnetic resonance imaging and technical considerations. Acta Neurochir (Wien) 2013;155:855-62