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RESEARCH ARTICLE

Long-term Outcomes of Microvascular Decompression Surgery for Hemifacial Spasm: A Clinical Series

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ABSTRACT

Objective: Hemifacial spasm (HFS) is a challenging neurological disorder frequently managed with microvascular decompression (MVD) surgery. This retrospective investigation evaluates the efficacy and outcomes of MVD procedures on patients with HFS at our institution between 2015 and 2023.

Materials and Methods: Forty-six patients diagnosed with HFS based on clinical evaluations, physical examinations, electromyography (EMG), and imaging studies were included. Patients were selected for surgery based on their ability to handle surgical risk and evidence of likely vascular compression. Postoperatively, patients were assessed at regular intervals to evaluate the long-term outcomes of MVD surgery.

Results: MVD surgery resulted in an 84.8% rate of "Excellent" and "Good" outcomes. Arterial compression was commonly observed during surgery, with anterior inferior cerebellar artery (AICA) compression being most frequent. The outcomes were less successful in cases with petrosal venous compression. A low complication rate was noted, with no permanent neurological deficits or mortality. However, reoperation was required in 8.6% of patients due to symptom recurrence.

Conclusion: This study reinforces the efficacy and safety of MVD as a primary surgical treatment for HFS. With a high success rate and a low incidence of complications, MVD provides substantial and lasting symptom relief for most patients. Our findings highlight the importance of identifying vascular compression patterns to optimize surgical outcomes. Future large-scale, multicenter studies will further refine patient selection and surgical strategies to enhance long-term success rates.

Keywords: Arterial compression, complications, hemifacial spasm, long-term follow-up, microvascular decompression, recurrence, surgical outcome, vascular compression, venous compression

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INTRODUCTION

Hemifacial spasm (HFS) is characterized by involuntary, intermittent contractions in the facial muscles, typically affecting one side of the face.[1] Irregular discharges from the facial nerve (CN VII) cause the disease. The contractions usually begin in the orbicularis oculi muscle and can spread to other areas innervated by CN VII, such as the orbicularis oris and platysma. The prevalence of HFS is approximately 9.8 per 100,000 individuals, with a higher incidence in females. The age of diagnosis is usually after the fourth decade of life.[2]

HFS is generally classified into two types: primary and secondary. Primary HFS is defined by vascular compression at the facial nerve root entry zone.[3] The prominent vascular structures involved in primary HFS are the anterior inferior cerebellar artery (AICA), posterior inferior cerebellar artery (PICA), vertebral artery (VA), superior cerebellar artery

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(SCA), their branches, and petrosal veins. Compression of multiple vessels can be detected in approximately 38% of patients.[4] Secondary HFS results from damage along the course of the facial nerve, extending from its internal canal entry to the stylomastoid foramen.[5] This damage can occur due to cerebellopontine angle tumors, vascular malformations, trauma, and other causes.

The diagnosis of HFS is primarily clinical. Unilateral, progressive, involuntary, irregular, recurrent clonic or tonic spasms, along with the “eyebrow lift sign,” are typical of HFS. computed tomography (CT), magnetic resonance imaging (MRI), and Electromyography (EMG) are used as diagnostic aids. Volumetric, high-resolution T2-weighted MRI, T2-weighted MR constructive interference in steady state (CISS), and magnetic resonance angiography (MRA)–time of flight (TOF) are effective methods for investigating vascular compression and secondary HFS etiology.

MVD is the surgical treatment for HFS, aiming to alleviate vascular compression at the root entry zone. Reported series have shown the disappearance of symptoms in 91.1% of patients after MVD surgery.[6] Intraoperative monitoring improves the success and reduces complications of MVD surgery, as shown in previous studies. HFS patients exhibit an abnormal lateral spread response (LSR) upon EMG stimulation of facial muscles.[7] During intraoperative neuromonitoring, the disappearance of LSR signifies adequate decompression.[8]

This study investigates long-term outcomes, factors influencing the outcome, and complications in HFS patients undergoing MVD. Additionally, this study investigates whether the presence or absence of arterial or venous compression impacts the treatment outcome.

MATERIALS and METHODS

Patient Population and Clinical Data

We conducted a retrospective review of all patients who underwent MVD surgery by a single surgical team at our center between 2015 and 2023. Neurologists diagnosed HFS in all patients based on clinical evaluation, physical examination, and EMG, if necessary. We selected patients for surgery who could tolerate the surgical risk and whose imaging studies indicated likely vascular compression. Every patient underwent 1 mm T1, T2 CISS MRI, and MRA–TOF. Patients with suspected vascular compression on MRI underwent surgery. MRI also helped to rule out non-compressive pathologies such as tumors, aneurysms, and Chiari malformation. We also included patients who had previously received BTX treatment in the study. We recorded the age, gender, affected side, duration of the disease, postoperative follow-up period, and the number of BTX injections.

Ethics

Ethical approval for this study was obtained from the Basaksehir Cam and Sakura Ethics Committee with the decision dated June 7, 2023, and numbered 2023-242. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Surgical Procedure

Routine surgical technique involved microvascular decompression using a retrosigmoid approach. The surgery was conducted under general anesthesia using total intravenous anesthesia, with the patient in the lateral decubitus position. Intraoperative neuromonitoring was performed in all patients to monitor somatosensory evoked potentials (SEP), motor evoked potentials (MEP), brainstem auditory evoked potentials (BAEP), and Lateral Spread Response (LSR). An incision was made on the side of the facial spasm in the mastoid region. We applied a 4×4 cm craniectomy to expose the sigmoid and transverse sinus junction slightly. The dura was opened in an envelope-like manner toward the sinuses. Subsequently, a strip-shaped pad with a slick rubber underside was positioned on the cerebellum to gently displace it without causing a disturbance, allowing for the drainage of cerebrospinal fluid (CSF). While draining the CSF, the arachnoid membranes were carefully opened. After visualizing the facial nerve, vascular compression and arachnoid bands were sought from the inferior and superior aspects toward the root entry zone. Once the compression was completely released, a Teflon pledget was placed. If we detected no significant compression, we cleared all arachnoid bands and performed neurolysis on the root entry zone. During this process, the facial nerve was monitored by EMG to ensure no neurological deficits. At the end of the operation, fibrin glue was applied onto the Teflon. After the watertight closure of the dura, cranioplasty was performed using polymethyl methacrylate.

Outcome Assessment

Patients were evaluated on the first day, first week, and at 1, 3, 6, and 12 months post-surgery, followed by annual evaluations by a neurosurgeon and neurologist. This evaluation included an assessment of the current status of HFS and any complications. We used the Shanghai grading system for postoperative HFS classification (Table 1).[9,10] This classification compared patient characteristics, disease duration, affected side, arterial or venous compression, and arterial type. Recurrent cases were also compared based on these characteristics. A decrease in spasms within the first three months, followed by

Table 1. Classification of hemifacial spasm outcomes according to the shanghai grading system

Grade	Shanghai grading system
Excellent	Symptoms of HFS totally disappeared, and patient subjectively very satisfied with no auxiliary drug needed
Good	Symptoms almost disappeared, but occasionally reappearing when the patient is stressed or making certain facial movements. However patient satisfied
Fair	Symptoms partly relieved, but still frequent. Patient not satisfied
Poor	Symptoms remain unchanged or even worse. Patient invalid
NB	The higher two grades correspond to “effective” result

HFS: Hemifacial spasm

a recurrence, was classified as a relapse. If spasms recurred before the 3-month mark, it was considered inadequate decompression. Vascular compression was verified retrospectively using MRA and MRI–T2 CISS. The artery responsible for the compression was also evaluated using MRI.

Statistical Analysis

Statistical analysis was performed using SPSS Statistics for Windows, Version 29.0.1.0 (Armonk, New York: IBM Corp.). This study compared the patients' ages and disease durations with the Shanghai classification using the Kruskal-Wallis test. The Mann-Whitney U test was applied to compare ages and disease durations with recurrence. The chi-square test was used for all other analyses. A p-value of less than 0.05 was considered statistically significant.

Power Analysis

Given the relatively small sample size, a post-hoc power analysis was performed to assess the statistical strength of the study. Using G*Power software (version 3.1.9.7) and based on the observed effect size and sample size (n=46), the calculated power was approximately 78% with an alpha level of 0.05. Although the limited number of cases may restrict generalizability, this level of statistical power indicates that the analyses performed have a reasonable likelihood of detecting clinically relevant effects. The findings therefore remain meaningful within the context of this cohort.

RESULTS

Patient Characterization

A total of 46 patients who underwent surgery between 2015 and 2023 were included in the study. Of the patients, 32 were female and 14 were male. The mean age was 49.1 years (range: 21–68). The patient population had 21 cases of right-sided HFS and 25 cases of left-sided HFS. The average duration of the disease from onset was 6.8 years (range: 1–30 years). Age, gender, and disease duration did not significantly correlate with the outcome. The minimum follow-up period was three months, and the maximum follow-up period was 97 months. Among the patients, 33 had previously received BTX treatment but no longer benefited (71.7%) (Table 2).

Table 2. Patient demographics and clinical characteristics

Patient demographics and clinical characteristics	Total (n=46)	Male (n=14)	Female (n=32)
Mean age (range)	49.1 (21–68)	49.8 (21–66)	50.03 (29–68)
HFS side			
Left, n (%)	25 (54.3)	7 (50)	18 (56.2)
Right, n (%)	21 (45.7)	7 (50)	14 (43.8)
Mean disease duration (year)	6.8 (1–30)	6.85 (2–16)	6.69 (1–30)
BTX treatment, n (%)	33 (71.7)	10 (71.4)	23 (71.8)

BTX: Botulinum toxin

Vascular Compression

Patients were selected for surgery based on observed arterial compression on MRA–TOF and T2 MRI CISS; however, intraoperative observations confirmed arterial compression in 86.9% of these patients. The most frequently involved artery was the AICA (56.5%). Dominant petrosal vein compression was observed in 4.3% of patients. All vascular compression findings are presented in Table 3.

Outcome Results

According to the Shanghai classification, 73.9% of patients were “Excellent,” 10.9% “Good,” 4.3% “Fair,” and 10.9% "Poor." A significantly higher proportion of patients in the "Poor" group had dominant venous compression. Among the patients, 8.6% experienced complete remission after the operation but developed recurrence after a certain period. Four patients with recurrence underwent reoperation. The average time to recurrence was 9.5 months (range: 2–27 months). Af-

Table 3. Vascular compression in hemifacial spasm patients

Vascular compression type	Total (n=46)	
	n	%
Arterial compression	40	86.9
AICA	26	56.5
PICA	2	4.3
SCA	7	15.2
Basilar artery	1	2.1
Vertebral artery	4	8.6
Petrosal vein compression	2	4.3
No compression	4	8.6

AICA: Anterior inferior cerebellar artery; PICA: Posterior inferior cerebellar artery; SCA: superior cerebellar artery

Table 4. Outcomes and recurrences

Outcomes and recurrences	Total (n=46)	
	n	%
Shanghai classification		
Excellent	34	73.9
Good	5	10.9
Fair	2	4.3
Poor	5	10.9
Recurrence	4	8.6
Average time to recurrence (months)	9.5 (2–27)	
Reoperation	4	8.6
Post-reoperation outcomes		
Excellent	2	50
Good	0	
Fair	1	25
Poor	1	25

ter reoperation, two patients were “Excellent,” one “Fair,” and one “Poor,” according to the Shanghai classification (Table 4). There was no significant prognostic relationship between age, gender, side, disease duration, presence of arterial compression, arterial type, and recurrence or Shanghai classification.

We observed complications in three patients in our study, which included superficial wound infection, a CSF fistula, and keloid formation at the incision site (6.5%). No patient developed permanent complications (Table 5). The superficial wound infection was resolved with surgical debridement and antibiotic treatment. The CSF fistula resolved after the dural repair operation. The patient with keloid formation chose medical treatment and follow-up due to reluctance to undergo plastic surgery for reconstruction.

Table 5. Postoperative complications in MVD surgery

Complications	Total (n=46)	
	n	%
Superficial wound infection	1	2.2
CSF fistula	1	2.2
Keloid formation	1	2.2

CSF: Cerebrospinal fluid

DISCUSSION

Our research provides insight into the long-term outcomes of MVD surgery in HFS patients. The surgery showed a high success rate with an 84.8% "Excellent" and "Good" outcome in HFS patients. Meta-analyses have reported similar rates ranging from 86.7% to 90.4%.[11] Furthermore, our study showed that HFS cases with arterial compression were more successful than those with petrosal venous compression.

According to systematic reviews, the most commonly identified arterial compression varies between studies, with some reporting posterior inferior cerebellar artery (PICA) and others reporting AICA.[11,12] In our series, AICA compression was the most common, observed in 56.5% of cases. We did not encounter any patients with multiple vascular compressions in our series, whereas the literature reports a rate of 27.4%.[11] Among the patients with arterial compression, 80.4% had "Excellent" and "Good" outcomes (Fig. 1). There was no significant relationship between arterial type and outcome. In our series, the number of patients with HFS due to dolichoectatic compression of the vertebral artery was four (8.6%), whereas the literature reports a range of 3.5–29%.[13] Three of these patients had an “Excellent” or “Good” outcome, while one required reoperation due to a “Poor” outcome. Considering that the Teflon pledget used for decompression may not be sufficient in cases of severe compression due to dolichoectasia, we performed transposition using the recently reported "Sling Technique" by Khan et al.[14]. The outcome of the operation was "Excellent." In cases with severe compression due to dolichoectasia, alternative strategies that provide a wider opening may be successful.[15]

In our series, we encountered two cases (4.3%) with isolated petrosal venous compression, whereas the reported rates in systematic reviews range from 0.1% to 5.5%. The cases with combined arterial and venous compression rates are between 0.7% and 7.9% in the literature.[12,13] The lower outcome results in our study compared to the literature can be explained by

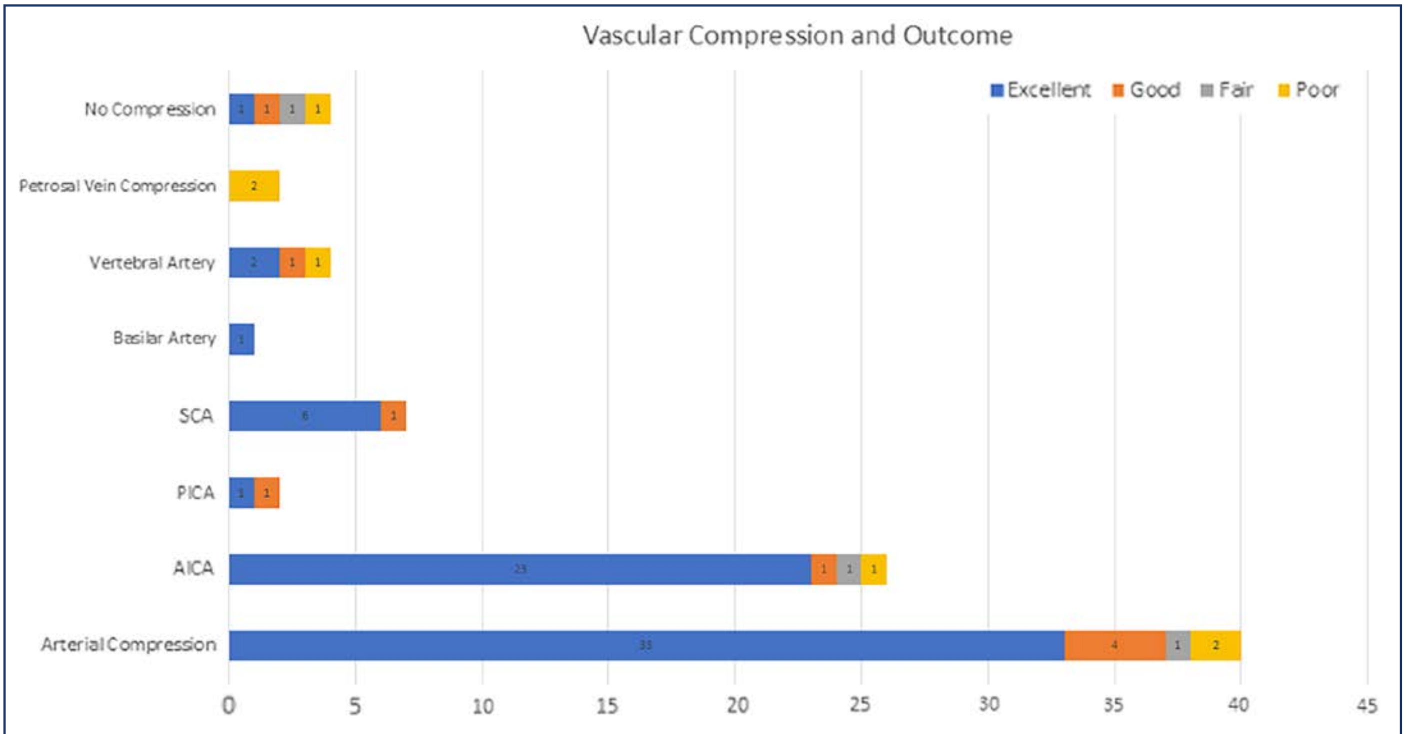

Figure 1. Distribution of vascular compression types and treatment outcomes in MVD surgery for hemifacial spasm

SCA: superior cerebellar artery; PICA: Posterior inferior cerebellar artery; AICA: Anterior inferior cerebellar artery; MVD: Microvascular decompression

the relatively high proportion of patients with petrosal venous compression who did not benefit sufficiently from MVD surgery. Some authors have reported that venous compression is one of the main causes of inadequate decompression.[16,17] While some clinicians suggest petrosal venous sacrifice for MVD, the rate of venous complications ranges from 1.6% to 11.8%. These complications may include cerebellar infarction, hematoma, hydrocephalus, etc.[12] Zhong et al.[18] reported that all patients who died in their series had sacrificed petrosal veins. To avoid sacrificing the petrosal vein, we recommend working between the veins during initial dissection and employing tailored strategies as necessary. If the nerve compression is caused by a venous vessel, it should be carefully dissected away, and a barrier should be created using Teflon.

Our series showed no significant vascular compression during surgery in four patients (8.6%). These patients underwent surgery based on suspected vascular compression on MR T2 CISS and MRI TOF, but no compression was found during the operation. Although advanced imaging systems are used, MRI may not accurately confirm vascular compression. In such cases, all arachnoidal connections of the facial nerve were released. All visible vascular structures were cleared, and finally, neurolysis was performed on the root entry zone of the facial nerve using a bipolar probe under intraoperative neuromonitoring. We observed at least 40% loss of Lateral Spread Response (LSR) in all patients. Among these patients, one had an "Excellent" outcome, one had a "Good" outcome, one had a "Fair" outcome, and one had a "Poor" outcome. In patients with lower outcomes, it is possible that vascular structures were not explored due to the size of the meatus internus tubercle, large flocculus, or flat posterior cranial fossa. In such cases, strategies that provide a wider exposure may be successful (Fig. 2).[15]

Although multiple vascular compression has been described in the literature, no such cases were observed in our series. This may be attributed to several factors, including sample characteristics, the resolution limits of preoperative imaging, and intraoperative differentiation challenges. In cases where arterial and venous components coexist, distinguishing the dominant compressive structure may be difficult without high-resolution visualization tools. This limitation should be taken into consideration when interpreting the outcomes. Further studies with advanced imaging modalities and more refined intraoperative techniques are warranted to better evaluate the true incidence and clinical impact of multiple vascular compression.

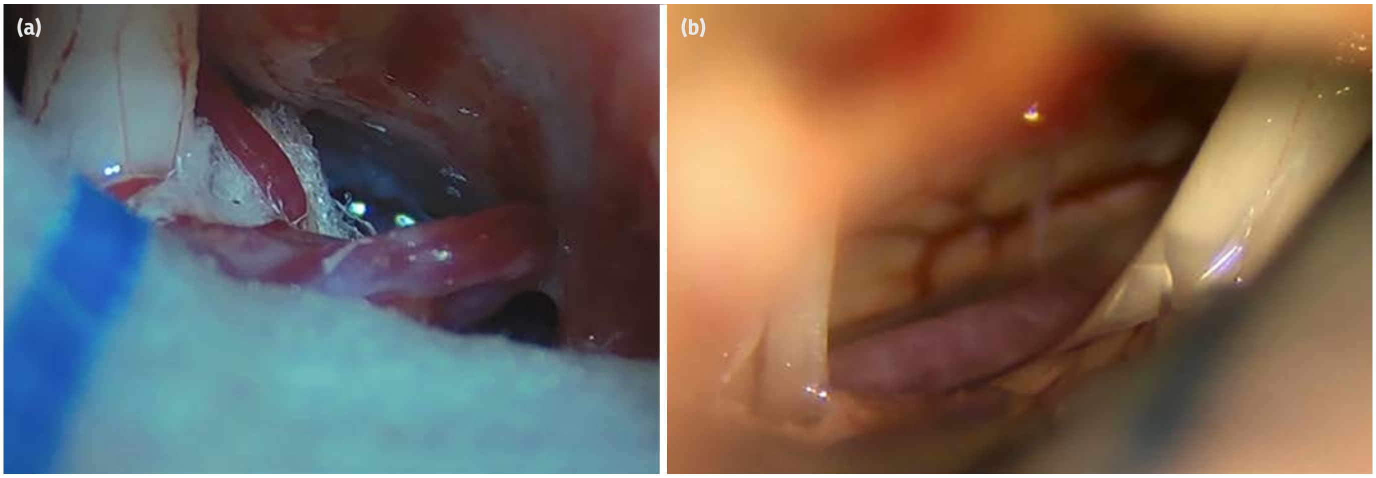

Figure 2. The appearance of arterial and venous compression in microsurgery. **(a)** Arterial compression at the CN VII Root-entry zone. The patient's symptoms have completely disappeared. **(b)** Significant arterial compression and sufficient decompression are consistent with successful outcomes.

CN VII: Facial nerve

Within our patient cohort, four individuals (8.6%) required reoperation due to the recurrence of symptoms. We reoperated on these patients when their symptoms recurred. Two patients underwent redecompression due to Teflon displacement and achieved an "Excellent" outcome. In the two patients, we did not observe any noticeable displacement of the Teflon. The results in these patients were "Fair" and "Poor." As mentioned earlier, the literature reports a negative rate of 37% for the second exploration.[19] In these two patients, we also observed that LSR did not disappear. As previously reported, LSR is one of the most reliable parameters for surgical outcomes.[15,20,21]

Our study also demonstrated that MVD surgery is a safe procedure with no mortality or development of permanent neurological deficits. The overall complication rate was 6.5%, and all complications were temporary. The reported temporary complications in systematic analyses include facial palsy (9.5%), hearing loss (3.2%), local infection (1.2%), meningitis (0.9%), vertigo (2.4%), and cerebrospinal fluid fistula (1.4%). The rates of permanent complications include hearing loss (2.3%), other cranial nerve palsies (1.4%), facial palsy (0.9%), stroke (0.05%), and death (0.01%) (6, 11). Table 5 summarizes the complication rates observed throughout this study.

Although the overall complication rate in our series was low, we recognize the importance of assessing the long-term effects of these events. In our study, transient facial paresis was the most frequent complication, all of which resolved within 6 months. No permanent neurological deficits were observed. To prevent such complications, meticulous dissection under high magnification and careful handling of the neurovascular structures were routinely applied. Compared to the literature, our complication rates are within the lower range of reported values, which vary between 5% and 20% depending on surgical technique and patient characteristics. These findings further support the safety of the MVD procedure when performed with appropriate expertise.

In our study, the follow-up period ranged from 3 to 97 months. This variability reflects the retrospective design of the study and differences in patient adherence to postoperative visits. To address this, we grouped the follow-up duration into three subcategories (short-term: <12 months, mid-term: 12–36 months, long-term: >36 months) to allow a more structured analysis. Notably, patients with long-term follow-up (>36 months) generally maintained favorable surgical outcomes with sustained relief of symptoms. Future prospective studies with standardized follow-up protocols may further strengthen the validity of long-term outcome assessments.

While our study provides significant insights into the long-term outcomes of MVD surgery for HFS, there are a few noteworthy limitations. Firstly, this is a retrospective study from a single center with a limited sample size, potentially leading to selection bias and reducing the generalizability of our results. While we carefully recorded and assessed symptoms and surgical outcomes, subjective bias could influence these observations. Additionally, due to the study design constraints, there may be other unmeasured or unrecognized confounding variables that may have influenced the outcomes of our analysis. Despite these limitations, our study contributes significantly to the growing evidence supporting MVD as a successful treatment strategy for HFS. Future prospective, multicenter studies with larger sample sizes could help to validate our findings and explore the aspects we could not cover.

In our series, the success rate in patients with venous compression was notably lower compared to arterial compression cases. This may be attributed to the softer and more pliable nature of venous structures, which can make identification and effective decompression technically more challenging. Additionally, venous compression may not always exert a consistent pulsatile effect on the nerve, leading to delayed or suboptimal postoperative improvement. Future studies with larger patient groups may help to further clarify the underlying mechanisms and guide the development of specific surgical techniques or alternative strategies to improve outcomes in such cases.

CONCLUSION

MVD surgery is a safe and efficient treatment modality for HFSs, with more than 80% of patients seeing substantial symptom improvement, as corroborated by our findings and existing research. Our study demonstrates that isolated venous compression is a potential factor in reducing successful outcomes. However, due to the limited number of patients in this group, we emphasize the necessity of examining all contributing factors in larger series.

Disclosures

Ethics Committee Approval: The study was approved by the Basaksehir Cam and Sakura City Hospital Clinical Research Ethics Committee (No: 2023-242, Date: 07/06/2023).

Informed Consent: Written informed consent was obtained from all patients.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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