An investigation into quality of life improvement in patients undergoing microvascular decompression for hemifacial spasm

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OBJECTIVE Hemifacial spasm (HFS) is a movement disorder characterized by involuntary spasms of the facial muscles, and it can negatively impact quality of life (QOL). This retrospective study and systematic review with meta-analysis was conducted to investigate the QOL in patients with HFS following intervention with microvascular decompression (MVD) and botulinum toxin (BT).

METHODS In the retrospective analysis, a QOL questionnaire was administered to all patients undergoing MVD performed by a single surgeon. The QOL questionnaire included unique questions developed based on the authors’ experience with HFS patients in addition to the health-related QOL HFS-8 questionnaire. The authors also report on a systematic review of the English literature providing outcomes and complications in patients with HFS undergoing treatment with either MVD or BT.

RESULTS Regarding the retrospective analysis, 242 of 331 patients completed the questionnaire. The mean score of the 10 QOL questions improved from 22.78 (SD 9.83) to 2.17 (SD 5.75) following MVD (p < 0.001). There was significant improvement across all subscales of the questionnaire between pre- and postoperative responses (p < 0.001). Regarding the systematic review, it is reported that approximately 90% of patients undergoing MVD for HFS experience a complete recovery from symptoms, whereas the mean peak improvement of symptoms following treatment with BT is 77%. Furthermore, patients undergoing MVD reported a greater improvement in the mean supplemental index of QOL as compared with patients receiving BT therapy.

CONCLUSIONS Microvascular decompression offers a significant improvement in QOL in well-selected patients suffering from HFS, and may offer an increased benefit for QOL over BT injections.

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KEY WORDS hemifacial spasm; microvascular decompression; botulinum toxin; quality of life; functional neurosurgery

Hemifacial spasm (HFS) is a movement disorder characterized by involuntary spasms of the facial muscles. Spasms typically begin in the orbicularis oculi, with eventual spread to other ipsilateral muscles innervated by the facial nerve. This is a debilitating condition leading to decreased quality of life (QOL).²⁴,²⁶,³⁴

Although the pathogenesis of HFS is not known with certainty, vascular compression of the facial nerve at its origin near the brainstem, with resultant demyelination and ephaptic transmission, has been postulated.³⁸,⁵³ Neurovascular compression of the facial nerve in HFS is most commonly attributed to the anterior inferior cerebellar artery, posterior inferior cerebellar artery, or the vertebral artery.

Treatment of HFS with oral medications has proven to be unsuccessful for the majority of patients.⁸³ Two accepted treatment options exist: botulinum toxin (BT) injections and microvascular decompression (MVD). The first reports on the use of BT for facial movement disorders occurred as early as 1984 and 1985.⁵⁶,⁶² Botulinum toxin prevents the transmission of nerve impulses across the synaptic cleft by inhibiting release of acetylcholine, thus temporarily preventing involuntary muscle contraction.

Microvascular decompression is a surgical procedure that attempts to address the etiopathogenesis of the disease by relieving vascular compression of the facial nerve at the level of the brainstem.⁶³ Vascular decompression for HFS was first proposed by Gardner and colleagues⁹⁻¹⁰ and later substantially refined by Jannetta and colleagues.³⁵

Although BT injections and MVD have proven to be varying success for symptom relief, both offer differ-
ent risks as well as benefits. This study was performed to describe the experience at a single institution for the treatment of HFS as well as to report on the results of a disease-specific questionnaire measuring QOL in this patient population. Furthermore, this study presents a meta-analysis of previously published data in an attempt to quantify and compare the risks and benefits of both treatment options.

Methods

This study is a retrospective analysis of patients undergoing MVD for HFS by a single surgeon (R.F.S.) between 2007 and 2013. The study was approved by the University of Pittsburgh Institutional Review Board, with obtaining of a waiver of consent from all participating patients. All patients were diagnosed with HFS by history and physical examination. All patients underwent electromyography studies of the involved facial musculature and MRI with and without gadolinium. More recent patients in the study also underwent thin-section steady-state free precession MRI as previously described to identify vascular compression of the centrally myelinated portion of the facial nerve. All patients meeting diagnostic criteria for vascular HFS were offered MVD surgery. Age and prior use of BT injections were not considered contraindications for a recommendation of the MVD operation. Patients were excluded from this analysis if HFS symptoms were secondary to tumor, demyelinating disease, vascular malformation, or Chiari malformation.

Questionnaire Administration

All patients involved in this study were contacted by telephone by a disinterested observer (A.M.F.) for administration of the questionnaire. The QOL questionnaire reported in this study includes both the health-related QOL (HRQOL) HFS-7 questionnaire validated by Tan et al., and the extended version including an item regarding sleep disturbance (HFS-8). The extended version of HFS-7 (i.e., HFS-8) has been previously used in measuring QOL among patients with HFS undergoing MVD. From our own experience of factors affecting QOL in patients with HFS, 3 additional items were included regarding difficulties performing job duties, feelings of social isolation, and difficulty of obtaining a referral for MVD. Items in the questionnaire can be found in Table 1. Each item was scored on a 5-point scale ranging from 0 (no trouble at all) to 4 (extremely debilitating or virtually impossible). The cumulative scores of HFS-7, HFS-8, and the total sum of all items in the questionnaire are reported separately. Of note, the QOL question regarding difficulty in obtaining surgery was not included in the total score because there was no corresponding preoperative question.

In addition, patients were asked to subjectively identify their current level of facial spasms and to estimate the percent reduction of spasm severity and frequency since the operation. Degree of spasm relief was also annually assessed by a disinterested observer. Spasm relief was categorized using the following criteria: Grade I, patients reporting no spasm; Grade II, patients reporting > 75% improvement; Grade III, patients reporting > 50% improvement; and Grade IV, patients reporting < 50% improvement in symptoms. Finally, information was obtained regarding the referral patterns to our practice and the types of treatment other than MVD that were offered to each patient.

Meta-Analysis

Literature searches were developed and conducted by a research librarian (P.M.W.) using 2 sources: the National Library of Medicine’s PubMed search engine, and the Cochrane Central Register of Controlled Trials using the Wiley Online Library search engine. Searches included the concepts of hemifacial spasm, surgical therapy, drug therapy, clinical outcomes, quality of life outcomes, and quality of life assessment. Both natural language terms and terms from the Medical Subject Headings (MeSH) controlled vocabulary associated with PubMed’s MEDLINE database were used to search these concepts. Finally, the bibliographies of relevant papers were also searched for additional references.

The breakdown of study selection is depicted in Table 2. References were reviewed and selected by a single reviewer (J.D.L.) and subsequently confirmed by a second reviewer (R.F.S.). Only references published in the English language were considered. Valid reasons for exclusion were populations not including patients with HFS, interventions other than BT or MVD, and inadequate reporting of outcomes. Additionally, review articles, commentaries, and case reports comprising fewer than 10 patients were excluded. Publications reporting on overlapping patient populations were identified, and only the study with the larger patient population was included.

Estimated effects were pooled using a weighted random-effect meta-analysis model. Heterogeneity among the studies was assessed by chi-square test, and the amount of variation attributable to the heterogeneity was quantified by the I² index. The analyses were performed using SAS 9.4 and STATA 9.

Statistical Analysis

Statistical analysis for the retrospective QOL analysis
was performed using IBM SPS Statistics 22 software. Group means for QOL scores were compared using a paired t-test. Analyses of categorical data were performed using the chi-square and Fisher exact tests. For comparison of QOL measurements, the QOL scores were converted to a supplemental index (SI). The SI was calculated by the following formula: reported QOL score/total possible score × 100. Significance was considered to be p < 0.05.

**Results**

**Retrospective Analysis of HFS**

**Outcomes**

Of the 331 patients who underwent MVD, 242 were successfully contacted. Of these, 172 (71%) were female, with an average age of 54 years at the time of the operation. One hundred forty-one had left-sided HFS, with 1 patient suffering bilateral HFS. One hundred seventy-six patients had previously received BT injections prior to surgery. The average number of injections received was 10.75.

The mean time to last follow-up was 41 months (range 2–86 months). A distribution of time to last follow-up can be found in Fig. 1.

All patients were contacted yearly following the MVD operation. Fewer than 2% of patients experienced a recurrence of spasms each year following MVD. At last follow-up, 204 (84.3%) were Grade I, 10 (4.1%) were Grade II, 11 (4.5%) were Grade III, and 17 (7.0%) were Grade IV in terms of spasm relief grades, respectively. Thirty-three of these patients underwent redo operations. Table 3 shows the categorized subgroups of patients undergoing first-time and redo operations. No significant difference of outcomes was detected between these 2 groups.

Regarding patient responses to the timing of symptom relief (i.e., those patients with chart-documented time to symptom relief), 156 of 208 (75%) reported immediate symptom relief following surgery, 31 (15%) patients reported symptom relief at 0–6 months, 16 (7.7%) at 7–12 months, and 3 (1.4%) at >12 months following surgery. Two (0.9%) patients reported recurrence of symptoms at 9 and 12 months.

**Quality of Life**

Of the 242 patients responding to the QOL question-
ed complications were transient. The most commonly reported complications included ptosis, diplopia, and facial weakness.

### Treatment of HFS With MVD

Studies included for review had publishing dates ranging from 1987 to 2015. A total of 21,246 patients were reviewed. The time to follow-up for assessment ranged from discharge to 156 months. Efficacy of the operation was evaluated for patients reporting complete recovery and patients reporting > 75% improvement in symptoms. Ninety percent (95% CI 88–91, F 0.91) of patients achieved a complete recovery and 92% (95% CI 90–93, F 0.87) of patients achieved > 75% reduction in symptoms following MVD. A comparison of short-term (< 24 months) and long-term (> 24 months) mean follow-up was assessed to determine longevity of the operation, and it revealed similar efficacies between these 2 groups (Table 5). The recurrence rate for patients in all studies was 4% (95% CI 3–6, F 0.89; p < 0.001 for all 3 comparisons).

Complications involving adjacent cranial nerve damage occurring during the procedure were recorded. The following rates of permanent cranial nerve deficits are reported: facial weakness 1% (95% CI 0.0–1.0, F 0.70), 6, 8, 9, 24, 30–32, 34, 37–40, 42, 45, 49, 51, 54, 56, 59–61, 63, 68, 71, 79, 85, 86, 88–91 delayed facial weakness 1% (95% CI 0.0–2.0, F 0.88) hearing loss 3% (95% CI 2.0–4.0, F 0.88), 1, 3, 5, 6, 8, 9, 11, 24, 26, 30–34, 37–40, 42, 43, 45, 49, 51, 54, 56, 59, 60, 63, 66, 67, 71, 81, 85, 86, 88–91 hoarseness 0% (95% CI 0.0–1.0, F 0.60; p < 0.001 for all 4 comparisons), 1, 3, 5, 23, 24, 26, 30, 32, 37, 39, 44, 51, 54, 56, 59, 71, 79, 86, 88, 89.

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### Comparative QOL

An assessment of the quality of full texts reporting on QOL can be seen in Table 7. Figure 2 shows the comparison of pre- and postintervention mean SI scores for each study. The ranges of pre- and postintervention SI QOL scores for patients receiving BT injections were 27.8%–75.5% and 18.2%–26.4%, respectively, 21, 41, 58, 65, 70. The ranges of pre- and postintervention SI scores for patients undergoing MVD were 28.9%–58.4% and 0%–7.9%, respectively, 26, 56, 60.

### Discussion

Hemifacial spasm is a debilitating disease marked by spontaneous spasms of the facial muscles and is believed to be caused by vascular compression of the facial nerve in

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**TABLE 4.** Comparison of pre- and postoperative QOL questionnaire responses

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Preop (SD)</th>
<th>Postop (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty driving</td>
<td>1.59 (1.48)</td>
<td>0.14 (0.53)</td>
</tr>
<tr>
<td>Difficulty reading</td>
<td>2.18 (1.46)</td>
<td>0.20 (0.64)</td>
</tr>
<tr>
<td>Difficulty watching TV/movies</td>
<td>1.52 (1.36)</td>
<td>0.13 (0.50)</td>
</tr>
<tr>
<td>Difficulty w/jobs</td>
<td>2.31 (1.56)</td>
<td>0.21 (0.76)</td>
</tr>
<tr>
<td>Felt depressed</td>
<td>2.41 (1.52)</td>
<td>0.28 (0.75)</td>
</tr>
<tr>
<td>Felt isolated</td>
<td>2.19 (1.55)</td>
<td>0.19 (0.64)</td>
</tr>
<tr>
<td>Avoided eye contact</td>
<td>2.87 (1.42)</td>
<td>0.25 (0.76)</td>
</tr>
<tr>
<td>Embarrassed about having the condition</td>
<td>3.11 (1.28)</td>
<td>0.31 (0.90)</td>
</tr>
<tr>
<td>Felt worried about others’ reaction to you</td>
<td>2.67 (1.58)</td>
<td>0.23 (0.74)</td>
</tr>
<tr>
<td>Difficulty sleeping</td>
<td>1.92 (1.58)</td>
<td>0.24 (0.69)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22.78 (9.8)</td>
<td>2.17 (5.75)</td>
</tr>
<tr>
<td><strong>HFS-7</strong></td>
<td>16.36 (6.87)</td>
<td>1.54 (4.12)</td>
</tr>
</tbody>
</table>

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**TABLE 5.** Comparison of outcomes from meta-analysis for short- and long-term follow-up

<table>
<thead>
<tr>
<th>Outcome</th>
<th>≤24 Mos to FU</th>
<th>&gt;24 Mos to FU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete recovery</td>
<td>90% (87–91)</td>
<td>89% (88–91)</td>
</tr>
<tr>
<td>Complete recovery or ≥75% reduction in symptoms</td>
<td>92% (90–93)</td>
<td>91% (90–93)</td>
</tr>
</tbody>
</table>

FU = follow-up.
most instances.\textsuperscript{63} Although other treatment options exist, BT injections into the facial musculature and MVD surgery are the 2 most accepted treatments for ameliorating symptoms.

**Quality of Life**

Although HFS is not life-threatening, the condition most often results in a decreased QOL.\textsuperscript{24,56,60,74} In this retrospective analysis, we present the largest study to date of QOL among patients with HFS undergoing MVD.

In 2004, Tan et al. validated an HRQOL scale that used a total of 30 questions across multiple subscales.\textsuperscript{24} They reported that the items most sensitive to detecting change in QOL were mostly found in the subscales involving stigma, emotional well-being, and communication, thus highlighting the debilitating social aspect of the disease. Among our own patients, we found that the most debilitating aspect of HFS was “embarrassed about having the condition.” Studies by Heuser et al. and Ray et al. on patients with HFS undergoing MVD similarly report the same subscale as having the greatest impact on QOL.\textsuperscript{24,56} A third report by Sandel and Eide stated that the subscale with the greatest median preoperative score was “avoided eye contact.”\textsuperscript{60} These results support that social aspects of HFS are the most debilitating part of the condition.

Following MVD in the current study, patients demonstrated a significant improvement in QOL both for total score and for each subscale. Other studies of QOL in patients undergoing MVD for HFS have reported similar improvement.\textsuperscript{24,56,60} A comparison of these studies, as seen in Fig. 2, shows that whereas postintervention QOL scores are similar, the preintervention SI QOL score is higher for our population of patients than is reported for the similar studies. This may be explained by the high proportion of patients in this cohort who traveled from other states and countries, and who therefore may have self-selected for having more debilitating symptoms.

The QOL outcomes may also be compared between treatment groups. As compared with patients receiving BT injections, patients undergoing MVD for HFS had a higher mean preintervention QOL SI score (56.8 vs 48.6) and a lower mean postintervention QOL SI score (5.7 vs 22.7) resulting in a larger mean SI difference between pre- and postintervention scores for patients undergoing MVD. The higher preintervention QOL score seen in patients undergoing MVD may suggest that patients with more debilitating symptoms are motivated to undergo the more invasive treatment option. The greater treatment response and improvement in QOL of patients undergoing MVD may suggest that, among well-selected patients, MVD may be more beneficial to patient QOL. This may be further evidenced in that MVD achieves complete remission in 90% of well-selected patients, whereas BT injections offer a mean peak symptom improvement of 77% with multiple interventions required. This subjective report of better improvement by patients undergoing MVD may as well as the lack of need for regular repeat therapy could contribute to better QOL measurements.

It is important to note that this analysis has certain limitations. First, the QOL studies of patients undergoing MVD are all retrospective analyses and are thus subject to recall bias. Second, whereas all studies reporting QOL...
measures following MVD reported HFS-7 and HFS-8 data, studies following BT injections reported data from HRQOL HFS-30 and HFS-36 questionnaires as well. Given the proposed higher sensitivity of the HFS-7 and HFS-8 questionnaires, it is not unexpected that a difference in pre- and postoperative SI scores might exist. In contrast to this limitation, a direct comparison with the HFS-7 data reported by Tan et al. shows that patients receiving BT had higher (i.e., worse) postintervention QOL scores than did patients undergoing MVD and, again, suggests a greater benefit for patients who receive MVD.

As a part of the questionnaire, patients were asked to respond to the following question to gauge the difficulty in obtaining an operation: “How would you rate, from 0 to 4, the difficulty of obtaining an operation, taking into account factors such as obtaining a timely referral, making travel arrangements in order to obtain operative treatment, and seeking insurance approval in order to finance the operation?” Fifty-six percent of patients indicated that this adversely affected QOL (i.e., rated the question > 0) and 20% of patients indicated that this very adversely affected QOL (i.e., rated the question 3 or 4). Although many of these factors are beyond the control of the physician, this impact on QOL underlines the need for physicians to supply timely education and referral for MVD.

Comparative Treatments

Injections of BT have proven to be an ameliorating and safe treatment option for patients with HFS. The results reported here are supported by Sorgun et al., reporting on a meta-analysis of BT therapy for HFS. They found that 94.3% of patients experienced an 86.7% improvement in symptoms, adverse events occurred in 2.3%–22.1% of injections, and the average duration of therapy was 15.7 weeks. Although BT injections boast a very high response rate, Hsiung et al. reported primary and secondary resistance rates of 2.9% and 4.3%, respectively. Of note, no other study included in this systematic review reported resistance rates.

Since its introduction, the efficacy and safety of MVD for patients with HFS has improved; MVD offers a definitive treatment option for a majority of patients suffering from vascular HFS. The results of our review are supported by Miller and Miller. Reporting on a systematic review of MVD for HFS, they found that 91.1% of patients had complete resolution of symptoms, with a recurrence rate of 2.4%. In our series, using a more stringent definition of spasm resolution, 84.3% noted absolute resolution of spasms, and our complication profile was more exhaustive but nevertheless compared favorably with Miller and Miller’s meta-analysis.

The risk of complications associated with either treatment option are important to consider. Although BT injections are more likely to cause adverse effects, these complications are transient, allowing patients to return to baseline. In contrast, beyond the typical risks of surgery (bleeding, infection, and so on), MVD is complicated by the risk of damage to adjacent cranial nerves causing both transient and permanent adverse effects. Neurosurgeons have attempted to lower these risks by using techniques such as brainstem auditory evoked potentials to minimize damage. Despite these efforts, a risk of permanent cranial nerve damage remains.

Limitations of the Study

One further limitation of the retrospective QOL analysis not previously mentioned is that patient data were obtained via telephone assessment, introducing possible bias.
and lack of reproducibility of results. Because the majority of patients traveled an extended distance for surgery, in-person follow-up was not practicable for them. All assessments, however, were performed by a single, nonphysician, disinterested observer. In addition, it may be that patients would be more likely to give honest answers to a disinterested observer regarding QOL because there is reduced pressure to not disappoint the physician with a report of poor outcome.

Conclusions

Hemifacial spasm can be a debilitating condition that negatively impacts QOL. This study presents the largest experience to date analyzing the QOL of patients with HFS undergoing MVD. The results suggest that MVD can profoundly improve QOL in patients suffering from vascular HFS. Furthermore, the difficulty in obtaining a referral and subsequent surgical intervention has a negative impact on many patients seeking definitive treatment. It emphasizes the need for timely patient education and appropriate referral. Both BT injections and MVD offer efficacious treatment of HFS. However, MVD may offer additional benefit by way of better improvement in QOL outcomes. A prospective study of QOL improvement for patients with HFS undergoing MVD might add further validity to these results.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Sekula, Lawrence. Acquisition of data: Sekula, Lawrence, Frederickson, Weiss. Analysis and interpretation of data: Sekula, Lawrence, Frederickson. Drafting the article: Sekula, Lawrence, Frederickson. Critically revising the article: Sekula, Lawrence, Frederickson, Weiss, Gerszten. Reviewed submitted version of manuscript: all authors. Statistical analysis: Lawrence, Chang. Study supervision: Sekula.

Supplemental Information

Previous Presentations

Portions of the retrospective analysis have previously been presented at the AANS via abstract submission.

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