



## SHORT COMMUNICATION

# Efficacy of botulinum toxin treatment in older adults with hemifacial spasm: A retrospective pilot study using the Hemifacial Spasm Severity Score

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## Abstract

**Background:** Hemifacial spasm (HFS) is a chronic and disabling movement disorder commonly affecting older adults. Although botulinum toxin (BoNT) is an established treatment, standardized and multidimensional assessments of severity remain limited. **Aim:** This study evaluates the therapeutic efficacy of the HFS Severity Score (HFSS), a newly developed scale incorporating five symptom domains, and compares its responsiveness with that of the Jankovic Rating Scale (JRS). **Methods:** This retrospective study included 18 patients aged 65 years or older who were treated with 10 units of BoNT. HFSS and JRS were assessed at baseline and 4 weeks post-injection by two blinded neurosurgeons. Inter-rater reliability (intraclass correlation coefficient [ICC]) and internal consistency (Cronbach's  $\alpha$ ) were calculated. Pre-post differences were evaluated using the Wilcoxon signed-rank test. Convergent validity was examined using Spearman correlation between baseline HFSS and JRS. Responsiveness was assessed using change-score correlations and standardized response means (SRMs). Scatter plots were generated to visualize relationships between the scales. **Results:** Mean HFSS improved significantly from 9.39 to 3.72 ( $p < 0.001$ ), with all subdomains showing improvement. Baseline HFSS and JRS demonstrated a strong correlation ( $\rho = 0.82$ ,  $p < 0.001$ ), while  $\Delta$ HFSS and  $\Delta$ JRS showed a weaker association ( $\rho = 0.32$ ), reflecting a floor effect in post-treatment JRS scores. SRM scores indicated high responsiveness for HFSS (1.73) and JRS (1.54), while the ICC (0.91) and Cronbach's  $\alpha$  (0.85) confirmed excellent reliability. No adverse events were observed. **Conclusion:** BoNT treatment is effective and well-tolerated in older adults with HFS. HFSS is a reliable, multidimensional, and highly responsive tool that complements existing scales and enhances clinical assessment. **Relevance for Patients:** Older adults with HFS may achieve symptom relief with BoNT. HFSS provides a comprehensive metric that can enhance personalized care and reduce reliance on medication.

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**Keywords:** Hemifacial spasm; Botulinum toxin; Older adults; Severity scale; Psychosocial impact; Quality of life

## 1. Introduction

Hemifacial spasm (HFS) is a neurological disorder characterized by involuntary, intermittent contractions of the muscles innervated by the facial nerve.<sup>1,2</sup> These spasms are often distressing, especially in older adults, as they interfere with daily life and cause social embarrassment.<sup>3</sup> The estimated prevalence of HFS is approximately 11/100,000 individuals, with a higher incidence in females and a mean age of onset over 50 years.<sup>2,4</sup>

Botulinum toxin (BoNT) injection is widely recognized as a safe and effective treatment for HFS, supported by level A evidence.<sup>5,6</sup> Recent systematic reviews and expert consensus continue to confirm its strong safety and efficacy profile.<sup>7</sup> It acts by blocking the release of acetylcholine at the neuromuscular junction, thereby reducing muscle overactivity.<sup>6</sup> Numerous studies have demonstrated the high efficacy, safety, and patient satisfaction for the BoNT treatment, including among elderly populations.<sup>8–11</sup> Despite its effectiveness, clinicians often lack a standardized, easy-to-use scale to objectively quantify the severity of HFS symptoms and the effects of treatment. Existing evaluation tools, such as the Jankovic Rating Scale (JRS), are limited in scope, focusing primarily on motor symptoms while overlooking functional and psychosocial dimensions.<sup>12</sup> Recent evidence further underscores the importance of incorporating psychosocial and quality-of-life domains into HFS assessment. Lee *et al.*<sup>13</sup> demonstrated that patients with HFS frequently experience depression, anxiety, social avoidance, and reduced quality of life, and these psychological and social burdens correlate with clinical severity. These findings highlight that HFS imposes a multidimensional burden that extends beyond motor dysfunction, reinforcing the need for assessment tools that capture the psychosocial impact in addition to motor symptoms.

To address this gap, we developed the HFS Severity Score (HFSS), a five-item tool encompassing frequency, distribution, visibility, functional impairment, and psychosocial burden. This structure reflects the multifaceted burden of HFS, particularly in elderly patients, in whom the impact extends beyond motor dysfunction to quality-of-life issues.<sup>3,14</sup> This study applies HFSS in a real-world clinical cohort of older adults receiving BoNT, aiming to evaluate treatment effectiveness and assess the utility and reliability of HFSS.

## 2. Materials and methods

### 2.1. Materials

This retrospective, single-center, observational study was conducted at a tertiary referral hospital in Tokyo,

Japan, and approved by the Institutional Review Board of Juntendo University Faculty of Medicine (Approval No. M19-0042). The study included 18 patients aged 65 years or older who were diagnosed with HFS and received BoNT treatment between 2022 and 2024. Inclusion criteria required patients to have adequate clinical documentation or video recordings for symptom assessment before and 4 weeks after BoNT treatment. Patients were either BoNT-naïve or had not received BoNT treatment in the previous 12 months to ensure a consistent baseline and minimize residual drug effects.

### 2.2. Methods

All patients received an initial dose of 10 units of BoNT, administered to the facial muscles exhibiting spasm, such as the orbicularis oculi or corrugator supercilii. Muscle selection was clinically determined based on the distribution and severity of spasms at the baseline examination. Treatment outcomes were assessed using the HFSS, a multidimensional clinical tool. HFSS encompasses five domains: frequency, anatomical distribution, visibility, functional impairment, and psychosocial impact. Each domain is rated on a scale from 0 to 3 (Table 1), with a total score ranging from 0 to 15 (Table 2). Higher scores indicate more severe symptoms. Two board-certified neurosurgeons independently evaluated HFSS scores based on anonymized clinical records and video footage. Both raters were blinded to each other's assessments. In addition to HFSS, disease severity was also assessed using the JRS,<sup>15</sup> a widely used and validated clinical scale for HFS. JRS comprises two subscales—spasm severity and spasm frequency—each rated from 0 to 4, yielding a total score ranging from 0 to 8. Higher scores indicate more severe clinical manifestations. The scoring criteria for JRS are summarized in Table 3.

To evaluate the convergent validity of HFSS with an established clinical scale, we assessed the association between baseline HFSS and baseline JRS scores using Spearman's rank correlation coefficient. Treatment responsiveness was evaluated using three complementary approaches. First, pre- and post-treatment HFSS and JRS scores were compared using the paired Wilcoxon signed-rank test. Second, standardized response means (SRM) were calculated as the ratio of the mean change to the standard deviation (SD) of the change for each scale, providing an effect-size-based index of responsiveness. Third, scatter plots were created for both the baseline correlation (HFSS vs. JRS) and change scores ( $\Delta$ HFSS vs.  $\Delta$ JRS) to visually assess the relationship between the two instruments. All statistical analyses were performed using standard methods, and a  $p$ -value  $< 0.05$  was considered statistically significant.

**Table 1. Evaluation items of the Hemifacial Spasm Severity Score**

| Item                     | Description                                      | Score (0–3)  |
|--------------------------|--|--|
| 1. Frequency             | How often do spasms occur?                       | 0: None<br>1: Rare (a few times/day)<br>2: Frequent (several times/hour)<br>3: Constant or near-constant                                     |
| 2. Distribution          | Extent of facial area affected by spasms         | 0: Periorbital only<br>1: Upper face (orbicularis oculi+brow)<br>2: Half face<br>3: Extensive (entire face, may include neck)                |
| 3. Visibility            | How noticeable is the spasm to others?           | 0: Not noticeable<br>1: Mild (noticed upon observation)<br>2: Moderate (clearly visible)<br>3: Severe (obvious disfigurement)                |
| 4. Functional impairment | Does the spasm affect speech, eating, or vision? | 0: None<br>1: Mild interference<br>2: Interferes with daily activities<br>3: Severe impairment (e.g., visual obstruction, speech difficulty) |
| 5. Psychosocial impact   | Impact on mental well-being and social life      | 0: No impact<br>1: Noticeable but manageable<br>2: Avoidance of social settings<br>3: Significant distress, withdrawal, or depression        |

Note: The Hemifacial Spasm Severity Score is a clinical scale to evaluate hemifacial spasm severity across five dimensions. Each dimension is scored on a scale of 0–3.

**Table 2. Total score interpretation and clinical implications**

| Total score | Severity level | Clinical implication                            |
|-------------|----------------|---|
| 0–3         | Mild           | Observation or symptomatic treatment only       |
| 4–7         | Moderate       | Consider botulinum toxin and regular monitoring |
| 8–11        | Severe         | Evaluate for botulinum toxin and imaging        |
| 12–15       | Very severe    | Consider microvascular decompression surgery    |

Note: Each item in the Hemifacial Spasm Severity Score is scored 0–3, with a maximum total of 15 points.

## 2.3. Statistical analysis

Descriptive statistics, including mean, SD, and range, were used to summarize demographic and clinical data. Data normality was assessed using the Shapiro–Wilk test, which showed that the data were not normally distributed. The Wilcoxon signed-rank test was applied to compare HFSS scores before and after BoNT treatment. To evaluate scoring reliability, inter-rater agreement was calculated using the intraclass correlation coefficient (ICC). Internal consistency of HFSS was examined using Cronbach's alpha.

In addition to HFSS, pre- and post-treatment JRS scores were compared using the Wilcoxon signed-rank

**Table 3. Jankovic Rating Scale**

| Score | Severity description                        | Frequency description                    |
|-------|---|--|
| 0     | No spasm                                    | No spasm                                 |
| 1     | Mild spasm, no functional impairment        | Infrequent (<once per hour)              |
| 2     | Moderate spasm, mild functional impairment  | Frequent (several times per hour)        |
| 3     | Marked spasm, obvious functional impairment | Very frequent (several times per minute) |
| 4     | Severe spasm, disabling                     | Continuous or almost continuous          |

Note: The Jankovic Rating Scale is used to assess the severity and frequency of hemifacial spasm and blepharospasm. It consists of two components: severity and frequency. Each component is rated on a scale of 0 to 4, with higher scores indicating more severe symptoms.

test. To assess convergent validity between HFSS and JRS, baseline HFSS and baseline JRS scores were analyzed using Spearman's rank correlation coefficient. The association between treatment-induced changes ( $\Delta$ HFSS vs.  $\Delta$ JRS) was also evaluated using Spearman's correlation.

Responsiveness of each scale was further quantified by calculating the SRM, defined as the mean change divided by the SD of the change. Scatter plots were generated to illustrate (i) the baseline correlation between HFSS and JRS and (ii) the relationship between  $\Delta$ HFSS and  $\Delta$ JRS. All statistical analyses were conducted using Statistical Package for the Social Sciences version 29 (IBM Corp., United States of America), and a  $p$ -value < 0.05 was considered statistically significant.

## 3. Results

### 3.1. Patient characteristics and treatment outcomes

Eighteen patients (16 females and 2 males) were included in the study. The mean age was 75.1 years (range: 60–89 years). Baseline HFSS averaged at 9.39 (SD: 1.29), and decreased to 3.72 (SD: 1.64) at 4 weeks post-BoNT treatment ( $p < 0.001$ ). The mean change was  $-5.67$  points. HFSS scores improved in all participants, and no deterioration was observed. The average disease duration was 6.7 years (range: 2–16 years). Common comorbidities included hypertension ( $n = 7$ ), hyperlipidemia ( $n = 5$ ), and diabetes mellitus ( $n = 1$ ). Two patients had a history of prior BoNT treatment more than 1 year before the index injection. Pre-treatment pharmacological therapy included clonazepam in 14 patients (dose range: 0.5–2.0 mg/day) and diazepam in one patient. Following BoNT administration, 12 patients discontinued medication, while four continued the same regimen.

Baseline JRS averaged at 6.56 (SD: 0.98) and significantly decreased to 1.67 (SD: 0.84) at 4 weeks ( $p < 0.001$ ; Wilcoxon

signed-rank test). The mean JRS improvement was  $-4.89$  points. The SRM was 5.22 for HFSS and 6.45 for JRS, indicating extremely large effect sizes for both instruments.

### 3.2. Subgroup and component analysis

Each HFSS component showed a significant individual improvement. Visibility and psychosocial impact scores declined the most, reflecting both objective and subjective benefit. Inter-rater reliability was excellent ( $ICC = 0.91$ ), and Cronbach's alpha was 0.85, indicating strong internal consistency. No side effects such as facial weakness, ptosis, or speech disturbances were reported. Subgroup analysis was conducted to evaluate the consistency of HFSS-based outcomes. Patients with a prior history of BoNT treatment more than 1 year before the index injection ( $n = 2$ ) demonstrated similar HFSS improvements (median: 5.5 points) compared with treatment-naïve individuals ( $n = 16$ ; median: 5.5 points;  $p=0.94$ , Mann-Whitney U test).

In addition, 12 patients discontinued anxiolytic medications (clonazepam or diazepam) after BoNT treatment. These patients showed a median HFSS improvement of 6.0 points, compared with 5.0 points among those who continued medication ( $p=0.77$ ). Although not statistically significant, these trends suggest a potential role of BoNT in reducing pharmacological dependency in HFS management.

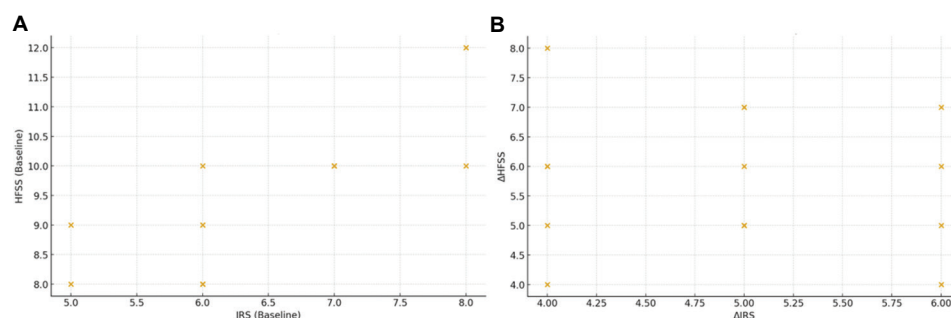
Baseline HFSS and baseline JRS showed a strong positive correlation (Spearman's  $\rho = 0.82$ ,  $p<0.001$ ; Figure 1A). In contrast, the correlation between changes in HFSS and JRS ( $\Delta$ HFSS vs.  $\Delta$ JRS) was weaker ( $\rho = 0.32$ ,  $p=0.19$ ; Figure 1B), likely reflecting a floor effect in post-treatment JRS scores. Scatter plots (Figure 1A and B) were generated to visually illustrate these relationships and to depict the responsiveness of each scale. Although the sample size was limited, subgroup trends were explored as hypothesis-generating observations.

## 4. Discussion

This retrospective pilot study demonstrates the clinical efficacy of BoNT in reducing HFS symptoms among older adults, evaluated using the HFSS, a novel multidimensional tool. Consistent with previous reports,<sup>8,10,16</sup> our results confirmed a statistically and clinically significant reduction in HFS severity following BoNT injection, with a mean HFSS improvement of 5.67 points at 4 weeks post-treatment.

A significant contribution of this study is the introduction and clinical application of the HFSS. Unlike traditional grading systems such as the JRS<sup>12</sup> or binary physician impressions,<sup>17,18</sup> HFSS quantifies five specific dimensions: spasm frequency, anatomical distribution, visibility, functional impairment, and psychosocial impact. This multifaceted structure aligns well with the heterogeneous burden of HFS, particularly in geriatric populations, where visual discomfort, social embarrassment, and limitations in daily activities are frequent complaints.<sup>3,14</sup> Importantly, HFSS demonstrated strong convergent validity, as baseline HFSS scores were highly correlated with those of JRS scores. This finding supports HFSS as an appropriate clinical measure that captures the core motor severity of HFS in a manner consistent with an established reference scale.

However, the correlation between improvement scores ( $\Delta$ HFSS vs.  $\Delta$ JRS) was markedly weaker. This pattern likely reflects a floor effect inherent to the JRS: many patients achieved very low post-treatment JRS scores (often 0–2), leaving minimal room for further differentiation among individuals who responded well to treatment. When a scale compresses toward its lower boundary following effective therapy, its ability to discriminate between degrees of improvement becomes limited, reducing the apparent correlation with another, more responsive measure such as HFSS.



**Figure 1.** Relationship between the Hemifacial Spasm Severity Score (HFSS) and the Jankovic Rating Scale (JRS). Scatter plots illustrate (A) The association between HFSS and JRS at baseline, and (B) The relationship between treatment-induced changes in both scales following botulinum toxin (BoNT) therapy. Abbreviations: HFSS: Hemifacial Spasm Severity Score; JRS: Jankovic Rating Scale.



The SRM analysis further supported the responsiveness of HFSS. Both HFSS and JRS demonstrated extremely large effect sizes (SRM 5.22 and 6.45, respectively), indicating that HFSS is at least comparable to JRS in detecting treatment-induced changes. These findings suggest that the multidimensional nature of HFSS does not detract from sensitivity; rather, it may enhance the instrument's ability to capture broader aspects of clinical improvement.

One of the key observations was the consistency of HFSS-based improvements in both treatment-naïve patients and those who had received BoNT for more than 1 year. This indicates that HFSS is suitable for monitoring both initial and follow-up treatment effects. Although only two patients fell into the latter group, the magnitude of symptom improvement was comparable, consistent with earlier studies reporting sustained responsiveness to BoNT over time.<sup>10,16</sup>

Another relevant finding was that 12 of 15 patients who were receiving clonazepam or diazepam before BoNT treatment discontinued medication post-treatment. Although this reduction in pharmacologic reliance was not statistically significant, it holds clinical importance. Long-term use of benzodiazepines in older adults is associated with sedation, falls, and cognitive decline.<sup>19</sup> The observed medication discontinuation reflects not only symptom improvement but also the potential of BoNT to reduce the need for adjunctive pharmacotherapy.<sup>8,11</sup>

While most patients discontinued anxiolytics after BoNT treatment, some continued their use, potentially indicating more refractory disease or underlying anxiety. These individuals showed slightly lower improvements in HFSS, although the difference was not statistically significant. This subgroup warrants further study to clarify the predictors of continued pharmacotherapy despite the efficacy of BoNT treatment.

Regarding safety, no adverse events were observed in this cohort. Known complications of BoNT therapy in HFS include facial asymmetry, ptosis, speech difficulty, dry eye, and transient facial weakness.<sup>4,11,20</sup> The absence of such effects may be attributed to the low-dose (10-unit) regimen and cautious injection technique. However, this also raises the question of whether the full therapeutic potential was realized. Future prospective studies could explore dose escalation or optimization strategies to balance efficacy and safety.

Psychosocial improvement was another notable result. The HFSS explicitly incorporates this domain, recognizing the social and emotional distress associated with facial spasms. In our study, this subscore showed one of the most pronounced improvements, echoing earlier findings

that BoNT significantly enhances quality of life.<sup>3,14</sup> This reinforces the idea that symptom control should be measured beyond motor manifestations alone, especially in older adults, who often report embarrassment or reduced social interaction due to involuntary movements.<sup>1,3</sup>

Despite its contributions, this study has limitations. The small sample size ( $n = 18$ ) limits statistical power, particularly for subgroup comparisons. The retrospective design restricts control over data completeness and uniformity. In addition, follow-up was limited to a single time point (4 weeks post-injection), which prevented the assessment of long-term efficacy, relapse patterns, or cumulative dosing effects.<sup>5</sup> Another limitation is the use of JRS as the sole comparator for validation. Although JRS is widely used, its susceptibility to floor effects after effective treatment may lead to underestimated correlations in change scores. Future studies should incorporate additional validated scales or patient-reported outcomes to further assess the responsiveness and construct validity of HFSS.

Nevertheless, the present findings provide early evidence that HFSS is a sensitive, practical, and reliable scale that may improve the consistency of HFS assessment in both clinical and research settings. Its multidimensional nature aligns with the holistic needs of the elderly population, and its high inter-rater reliability and internal consistency are encouraging.<sup>12</sup>

In summary, BoNT treatment in older adults with HFS was found to be effective and well-tolerated. The HFSS appears to be a useful clinical tool for capturing the complexity of disease presentation and treatment response. Future studies should aim to validate this scale in larger and more diverse populations, investigate its long-term responsiveness, and consider integrating patient-reported outcomes.<sup>14,21</sup> With refinement, HFSS may contribute significantly to standardizing HFS evaluation and guiding therapeutic decisions.

## 5. Conclusion

In this retrospective pilot study, BoNT therapy significantly reduced HFS symptoms in older adults, with no adverse events reported. The HFSS, introduced and applied for the first time in this context, proved to be a reliable, consistent, and clinically sensitive instrument for assessing treatment response. By integrating functional and psychosocial dimensions with motor evaluation, HFSS offers a more holistic view of disease burden, which is particularly valuable in geriatric populations where quality-of-life considerations are paramount.

Furthermore, the observed reduction in pharmacological dependence, such as discontinuation of

anxiolytic medications, highlights the broader therapeutic potential of BoNT when evaluated in combination with HFSS. While the small sample size and short follow-up period limit the generalizability of these findings, the uniform improvements observed across participants underscore the utility of the scale.

With further validation in larger, prospective, multi-center cohorts, HFSS may play a crucial role in standardizing HFS evaluation, informing long-term treatment decisions, and facilitating patient-centered care and research.

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## Conflict of interest

The authors declare that they have no competing interests.

## Author contributions

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## Ethics approval and consent to participate

This study was conducted in accordance with the ethical standards of the Institutional Review Board of Juntendo University, which approved the study protocol (Approval No. M19-0042). It was designed as a retrospective analysis using clinical data from patients who received treatment at the Department of Neurosurgery, Juntendo University. Verbal informed consent was obtained from all participants before inclusion in the study.

## Consent for publication

Verbal consent was obtained from all participants to allow the publication of their clinical data in this manuscript. All patient data were anonymized, and identifying information was removed to ensure confidentiality.

## Availability of data

The datasets generated and/or analyzed during the current study are not publicly available due to patient privacy

restrictions, but are available from the corresponding author upon reasonable request.

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