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ORIGINAL INVESTIGATION **Facial Nerve**

Selective Neurectomy Outcomes in Synkinesis Patients: The First 56 Consecutive Primary Cases with Minimum 1-Year Follow-up

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Abstract

Introduction: Evaluation of 1-year follow-up outcomes after selective neurectomy (SN) is essential to confirm sustained improvements in patient-reported, clinician-graded, and objective results.

Objective: To assess outcomes of SN in synkinesis, using patient-reported outcomes (VAS), clinician-graded assessments (eFACE), and objective evaluations.

Methods: Synkinesis patients who underwent SN were included in the study. Patients with less than 12 months of follow-up were excluded. Visual analog scale (VAS) was assessed as patient-reported outcomes. The Electronic Clinician-Graded Facial Function Scale (eFACE) was also assessed. Objective evaluations were carried out via Emotrics Software.

Results: Fifty-six primary cases were included, with a mean patient age at surgery of 33.8 ± 11.0 years. Of these, 45 patients (80.3%) were female. The average duration between paralysis and surgery was 124.3 ± 103.3 months. The mean duration between surgery and evaluation was 19.7 ± 7.5 months (mean/SD). Preoperative and postoperative mean aggregate VAS scores were 35.5 ± 19.8 and 67.7 ± 16.5, respectively ($p < 0.001$). However, two patients (3.7%) reported worsening in moving food around in the mouth, and four patients (7.5%) reported worsening in drooling. All postoperative eFACE subscores except periocular demonstrated significant improvement ($p < 0.001$). Emotrics analysis demonstrated improvement in all postoperative symmetry parameters, except in the periocular region.

Conclusions: SN improves patient-reported outcomes, clinician-graded assessments, and objective measurements. However, periocular outcomes remain suboptimal, and functional deficits should be carefully considered.

Introduction

Management of synkinesis involves both nonsurgical and surgical treatment options.[1–6] Chemodenervation and neuromuscular retraining constitute the cornerstone of nonsurgical approaches. Traditional surgical interventions, such as muscle and nerve transfers, primarily aim to enhance the strength of smiling muscles, whereas myectomy procedures target the resection of antagonistic,

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KEY POINTS

Question: Can selective neurectomy surgery improve facial symmetry and patient satisfaction in people with facial synkinesis?

Findings: SN improves patient-reported outcomes, clinician-graded assessments, and objective measurements. However, periocular outcomes remain suboptimal, and functional deficits should be carefully considered.

Meaning: While SN provides measurable benefits in lower-face synkinesis, the periocular domain remains the most challenging, underscoring the need for continued technical refinement and accumulation of experience.

co-contracting muscles. However, none of these methods—unlike selective neurectomy (SN)—directly address the root cause: aberrant neural reinnervation, which disrupts the coordinated harmony of facial mimetic function. In contrast to temporary modalities like chemodenervation, which require repeated clinical interventions, SN offers a permanent solution by targeting the underlying pathology. Furthermore, SN preserves muscular integrity, unlike myectomies that create anatomical absence of targeted muscles.

Although SN for synkinesis was first introduced by Terzis in 2012, Azizzadeh reintroduced and popularized modified SN in 2018.[7–10] It was first described for the treatment of smile dysfunction, and this case-series publication was followed by two other complementary publications by the same author that introduce the idea of synkinetic unilateral lower lip palsy and synkinetic brow dysfunction treatment associated with synkinesis.[11,12] SN as we currently know is a relatively new surgery with very scant data in the literature. In total, six case series have been published in the literature to the best of our knowledge.[10,13–17] Most published studies have focused on short- and medium-term postoperative outcomes, whereas evidence regarding long-term results and the durability of improvements remains limited.

The assessment of 1-year follow-up outcomes following SN is of paramount importance, as it enables surgeons to set realistic expectations for patients and optimize intraoperative decision-making by incorporating the experience of others.

This research assesses patient-reported visual analog scale (VAS), clinician-graded (eFACE), and objective (Emotrics) outcomes in patients with nonflaccid facial paralysis who underwent SN and had at least 12 months of follow-up. We hypothesize that SN leads to significant improvement across patient-reported, clinician-graded, and objective measures of facial function.

Methodology

Local ethical committee approval was obtained from the Haliç University Ethics Committee. (Date: 30.01.2025 Number: 271) Written informed consent for data collection and publication of photographs for scientific purposes was obtained from each patient. Neuromuscular retraining or chemodenervation treatment was not a prerequisite for undergoing surgery. SN indications were determined by the senior author (B.O.). All patients underwent surgery at least 18 months after the onset of facial paralysis and at least 6 months after their last chemodenervation treatment. Patients who failed to attend follow-up visits or received chemodenervation during the study period were excluded. Revision cases were also excluded from the study.

Study design

All primary synkinesis patients who underwent SN operation consecutively between August 2021 and February 2024 by the senior author (B.O.) were included in the study. Data collection was performed between March 1, 2025, and April 30, 2025. Data analysis was performed between May 1 and May 31, 2025. Review of archives and charts included age, sex, facial paralysis side, and etiology. The content of the surgery and adjunct procedures was noted from the surgical charts.

Surgical technique

All SN procedures were performed under general anesthesia without the use of neuromuscular blocking agents or intraoperative lidocaine. All surgeries were conducted by the senior author, ensuring consistency in surgical technique and patient care throughout the series.

Surgical procedures were routinely conducted using ×2.5 or ×3.5 magnification loupes, a shatter-proof mirror, and a transcutaneous electrical nerve stimulation (TENS) device (TENStem Eco Basic 2, Schwa-Medico), as previously described (Supplementary Video S1).[18,19]

Preauricular-posttragal facelift incisions were preferred in female patients, whereas preauricular-pretragal incisions were utilized in male patients. After subcutaneous dissection, the deep plane was accessed to expose facial nerve branches. Depending on the patient's presenting symptoms and deformities, all mimetic muscles from the brow to the platysma were addressed. Nerve branches were classified intraoperatively: branches planned for transection were tagged with blue markers, those preserved were tagged red, and uncertain branches were tagged yellow. Yellow-tagged nerves were traced distally—occasionally as far as the muscle belly—and sub-branches were separately stimulated using the proximal tip of a 7' Gillies skin hook held by the assistant surgeon, allowing repetitive and precise decision-making.[18] Transected nerves were clipped proximally and distally before division. Upon completion of the neurectomies, preserved branches were stimulated once again to verify remaining function. Unlike Azizzadeh's approach, platysmectomy was not routinely performed in this cohort.[9]

Following neurectomy, ipsilateral facelift was routinely performed to prevent postoperative facial droop and laxity, which may result from extended sub-superficial muscular aponeurotic system dissection and ligament transection on the operated side.[20] Intraoperative intravenous tranexamic acid and irrigation of the operative field were routinely applied. A hemostatic net suture was placed over the delaminated subcutaneous plane, and abundant taping with Omnistrip surgical tapes was used to minimize edema and hematoma formation.[21]

Postoperative management included a tapered oral corticosteroid regimen (starting dose 1 mg/kg) to reduce postoperative facial edema, along with antibiotics and analgesics. The hemostatic net suture and Omnistrip tapes were generally removed within 48–72 h postoperatively.

Outcome measures

The preoperative VAS score[22] was obtained prior to surgery, and the postoperative VAS score was obtained after surgery at the final follow-up visit. Participants were instructed to provide a subjective assessment of facial symmetry, specifically focusing on the synkinetic side of their face and comparing it to the healthy side of their face, by comparing the healthy side of the face with the patient's own smiling photographs. The evaluation utilized a VAS ranging from 0 to 100, where 0 represented a complete lack of symmetry and 100 denoted perfect symmetry. This was also assisted by having them view a video recording of their face captured prior to the surgical procedure. The video was presented on a tablet device. Subscores and total scores were statistically analyzed.[23] Preoperative and postoperative video recordings were analyzed in a single-blinded fashion by a clinician using the eFACE (Supplementary Video S2). Fifteen parameters were analyzed, 7 subscores and the total scores were statistically analyzed.[24] Preoperative and postoperative smiling photographs were utilized for quantitative objective analysis using Emotrics Software.[25] Deviation absolutes and deviation percentages were calculated for preoperative and postoperative separately and statistically compared.

Statistical analysis

Preoperative and postoperative VAS, eFACE, and Emotrics scores were compared using Jamovi Software software for statistical analysis. The Shapiro–Wilk test was employed to assess the normality of paired differences. A p value >0.05 was interpreted as consistent with a normal distribution, and the parametric paired t-test was applied. For nonnormally distributed data ($p \leq 0.05$), the nonparametric Wilcoxon signed-rank test was utilized. Statistical significance was set at $p < 0.05$.

Results

Demographics

A total of 56 primary cases were operated. The mean age at the time of surgery was 33.8 ± 11.0 years (range: 10–68 years). The mean interval between the onset of paralysis and surgery was 124.3 ± 103.3 months (range: 18–396 months). The mean follow-up period after surgery was 19.7 ± 7.5 months (range: 12.0–38.3 months). Eleven patients (19.6%) were male, and left-sided surgery was performed in 27 cases (48.2%).

Etiologic assessment revealed Bell's palsy in 36 patients (64.3%), temporal bone trauma in 6 (10.7%), Ramsay Hunt syndrome in 4 (7.1%), iatrogenic injury during tumor removal in 4 (7.1%), recurrent idiopathic facial paralysis in 2 (3.6%), birth trauma in 2 (3.6%), and chronic otitis media with or without cholesteatoma in 2 (3.6%).

Previous facial procedures included depressor anguli oris muscle myectomies in two patients, gold eyelid weight placement in two patients, and orbicularis oculi myectomy with blepharoplasty in one patient. Simultaneous procedures performed during SN surgery included bilateral facial rejuvenation (deep-plane facelift) in four patients, upper blepharoplasty with orbicularis oculi myectomy and contralateral platysmectomy for bilateral facial palsy in one patient, direct ipsilateral brow lift in one patient, and gold weight placement in two patients.

Patient-reported outcome measures

Preoperative and postoperative mean VAS scores, reported by all 56 (100%) patients, were 35.5 ± 19.8 and 67.7 ± 16.5, respectively ($p < 0.001$). VAS scores improved in 54 cases (96.4%) and remained unchanged in 2 cases (3.6%).

Charts were scrutinized retrospectively: two patients (3.7%) reported worsening in moving food around in the mouth, and four patients (7.5%) reported worsening in drooling. Two of these patients who were symptomatic subsequently received lower lip filler injections for lower lip weakness and improved quality of life.[26]

Electronic Clinician-Graded facial function scale scores. In 53 patients (94.6%), statistically significant improvements were observed postoperatively in static, dynamic, synkinetic, lower face and neck, midface, and smile subscores, as well as in the total eFACE score ($p < 0.001$).

All synkinesis scores demonstrated statistically significant improvement (Fig. 1A). All subscores improved significantly, whereas the periocular score did not show significant improvement ($p < 0.05$) (Fig. 1B).

Objective evaluation of smiling photographs using Emotrics Software. Quantitative objective analysis in full denture smiles (Fig. 2) using Emotrics Software in 55 patients (98.2%) demonstrated statistically significant postoperative improvements in deviation percentages

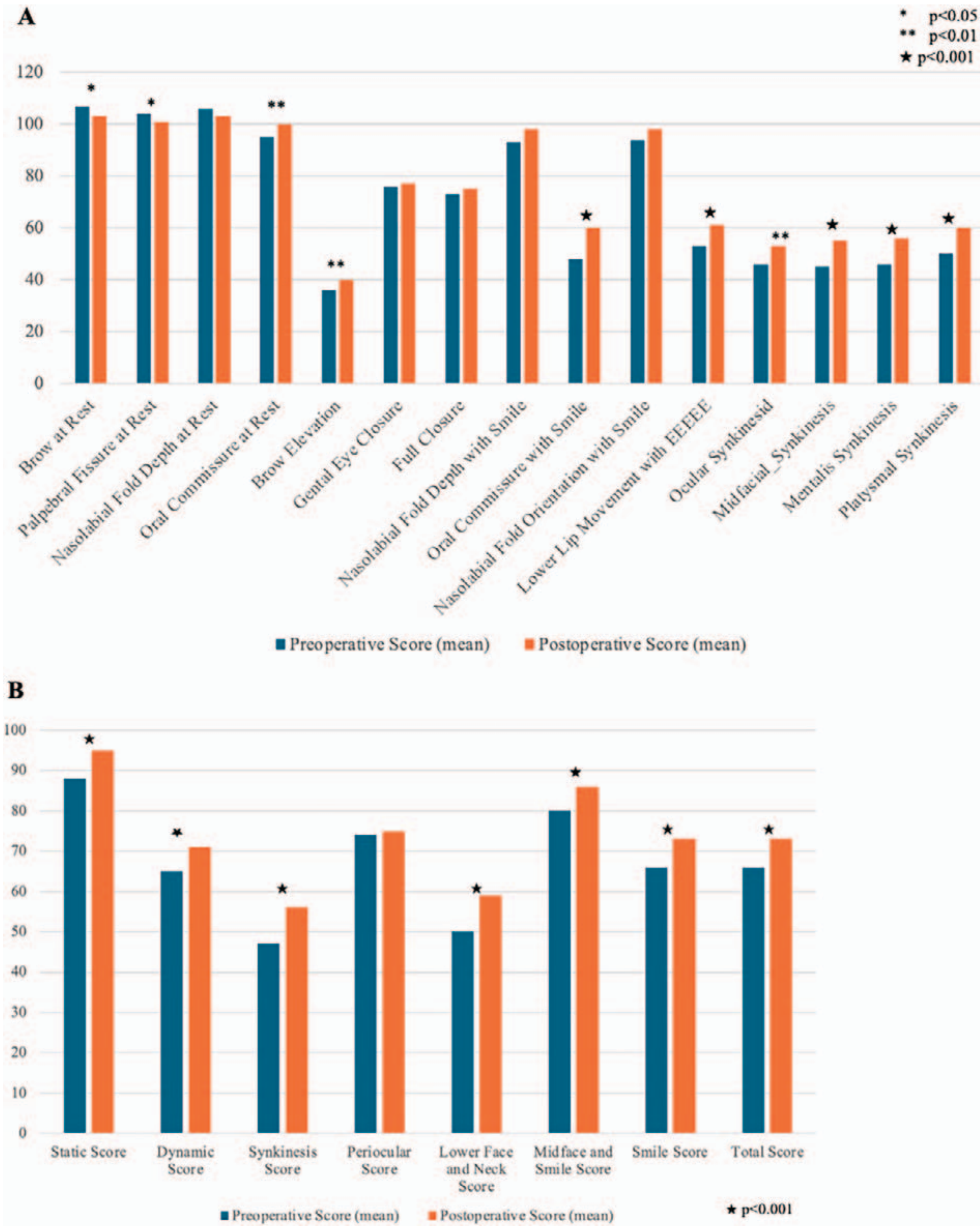

Fig. 1. Electronic Clinician-Graded Facial Function Scale: **(A)** 15 individual parameters, **(B)** 7 calculated subscores, and 1 total eFACE score. The data are presented as Mean ± SD in Supplementary Data S1. eFACE, Electronic Clinician-Graded Facial Function Scale.

Fig. 2. Patient photos before and after selective neurectomy. Patient was 33 years at the time of surgery, left-sided facial aberrant regeneration syndrome was possibly due to birth trauma. **(A)** Preoperative photographs **(B)** Postoperative photograph at 12 months.

(commissure excursion, smile angle, and dental show) and absolute deviations (commissure height, upper lip height deviation, and lower lip height deviation) (Fig. 3). Detailed analysis of periocular parameters revealed no significant changes in average brow height, mid-pupil to upper eyelid margin distance (MRD-1), and mid-pupil to lower eyelid margin distance (MRD-2) deviation percentages.

Complications and revisions

No hematoma formation was observed in this patient cohort. Two cases developed wound edge dehiscence at the postauricular incision sites during the early postoperative period; one healed secondarily, while the other required scar revision. At the time of publication, seven revision SN procedures had been performed in 5 of these 56 patients. The first two patients of the cohort additionally underwent tertiary revision surgeries.

Discussion

The current 1-year follow-up clinician-graded assessments and objective outcome measures also aligned with the patient-reported outcomes (Figs. 1, 3). However, it is noteworthy that during the early phase of this cohort, the surgical focus was primarily directed toward enhancing smile aesthetics and reducing synkinesis and muscular hypertonicity. This emphasis on correcting synkinetic deformities and improving mimetic function may represent a potential pitfall for novice surgeons, who might inadvertently overlook functional deficits. Recent reports by Kaufman and Hadlock have highlighted such postoperative functional impairments, including oral incompetence, speech difficulties, challenges with intraoral manipulation of food and fluids, and drooling.[15]

In our cohort, two patients reported worsening in intraoral food manipulation, while four patients reported increased drooling postoperatively. Temporary weakness was frequently observed across this cohort. This transient weakness was preoperatively discussed with patients as an expected part of the recovery process rather than a complication. Although the duration of weakness was not formally documented, it varied among individuals. Multiple

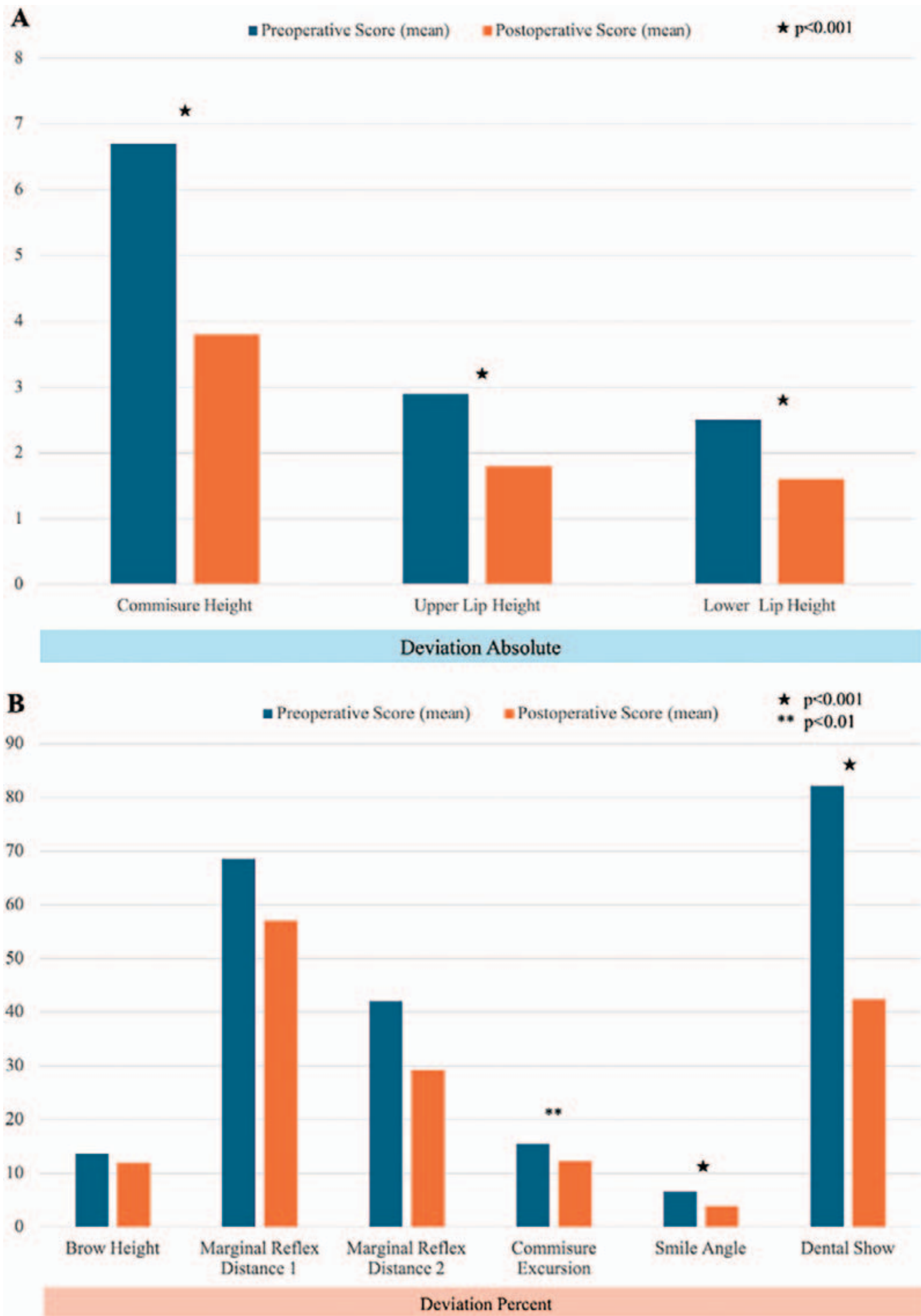

Fig. 3. Objective evaluation of smiling photographs using Emotrics Software. **(A)** Deviation absolutes **(B)** Deviation percents. The data are presented as Mean ± SD in Supplementary Material 2.

intraoperative and postoperative strategies were employed to mitigate these deficits. Patients were routinely instructed to perform mirror-based physical exercises beginning at the first postoperative month, and those with persistent weakness were referred for physical therapy at their 3-month follow-up. Additionally, two patients received lower lip filler injections, which resulted in symptomatic improvement.

Our current intraoperative strategy for preserving lower lip tonus is based on two key principles: First, preservation of the orbicularis oris fibers responsible for

Table 1. Selective neurectomy series in the literature

Year	Authors	n	Mean follow-up duration (months)	Patient reported outcome	Clinician graded outcome	Objective outcome
2019	Azizzadeh et al.[10]	65	15.9	—	House Brackmann, eFACE	—
2021	Miller & Hadlock et al.[13]	19	4	FaCE	eFACE	Emotrics
2021	Shtraks & Azizzadeh et al.[16]	57	21.4	FaCE & SAQ	—	—
2023	Park et al.[14]	122	—	SAQ	—	Photoshop
2024	Kaufman Goldberg & Hadlock et al.[15]	56	19.5	FaCE	eFACE	Emotrics
2024	Varman et al.[16]	14	8.3	FaCE	eFACE	Emotrics & Photoshop
2025	Ozucer et al.[19]	56	19.7	VAS	eFACE	Emotrics

VAS, visual analogue scale; SAQ, Synkinesis Assessment Questionnaire; FaCE, the facial clinimetric evaluation; eFACE, Electronic Clinician-Graded Facial Function Scale.

coordinated purse-string movement of the upper and lower lips. Second, selective preservation of the nerve subbranches innervating the mentalis muscle in isolation, while transecting the remaining mentalis subbranches that contribute to concomitant mimetic movements (i.e., periocular co-contraction).

With regard to periocular outcomes, no significant changes were observed in either clinician-graded eFACE scores or objective measurements. Although ocular branches were selectively transected in the latter half of the cohort, any observed improvements in periocular parameters were transient and failed to demonstrate sustained 1-year follow-up benefit. Despite prior attempts described in the literature to address periocular synkinesis, in our experience, this remains a challenging problem without a consistent or predictable solution.[5,12,15,27–29] Suboptimal periocular outcomes constitute a significant limitation of this surgical approach. Consequently, future efforts should be strategically directed toward refining techniques and developing new interventions to enhance efficacy and predictability in reducing unwanted eye closure during smiling, speaking, and puckering.

Decision-making in SN surgery requires a delicate balance between under- and over-transection of neural branches, akin to walking a surgical tightrope. To support safer and more efficient intraoperative judgment, we have incorporated several practical techniques. The use of a mirror and Gillies skin hook allows for rapid, solo assessment and decision-making. In cases of uncertainty, we routinely mark the main branch as "yellow" and proceed distally to subbranches for more precise transection while maximizing neural preservation (Supplementary Video S1).[16]

In many cases, particularly in the perioral region, dissection often extends distally to the terminal fibers, sometimes requiring exposure medial to the facial artery. The facial nerve arborizes extensively, creating a complex grid-like branching pattern, where a relatively proximal branch may correspond to multiple distal subbranches. Consequently, we have intentionally refrained from quantifying the number of transected or preserved branches, as such numerical reporting may yield misleading or oversimplified interpretations. As a guiding principle, maximum preservation must always precede maximum transection.

In line with previous publications, our findings demonstrate similarly promising outcomes (Table 1). While the issue of surgical unpredictability has been raised in the literature, we anticipate that ongoing accumulation of surgical experience will help mitigate this concern over time.[17] Furthermore, the safe intraoperative application of TENS devices may facilitate broader adoption of SN surgery by lowering costs and improving accessibility, particularly in resource-limited settings.[16,17]

By presenting a consecutive series of 56 primary cases, this study offers valuable guidance for the novice surgeon. Perfection remains elusive in this technically demanding procedure. The most prudent strategy for less experienced surgeons is to adopt a conservative approach, favoring undercorrection when in doubt, with readiness to perform revision procedures if necessary. In our practice, the potential need for revision surgery is routinely discussed with patients preoperatively, framed as an inherent component of the staged surgical process rather than a complication. Further staged revisions may be considered based on individual patient expectations and the surgeon's judgment and willingness.

This study includes a consecutive cohort with 1-year follow-up, incorporating patient-reported outcome measures (PROMs), clinician-graded assessments, and objective evaluation data. However, several limitations should be acknowledged. Layperson assessments were not included. Some patients underwent concurrent facial rejuvenation or reanimation procedures; these adjunct procedures were not adequately controlled or stratified in the analysis and may serve as confounding variables. No facial paralysis-specific PROM (i.e., FaCE) was used, which would be another way patients can report difficulty with manipulating food and keeping liquids in their mouth. It is possible that synkinesis can recur more than 1 year out from surgery, and future research should study 2–3 year outcomes. Additionally, this study did not specifically assess the impact of SN surgery on involuntary facial muscle twitching.

Conclusions

In conclusion, SN represents a promising surgical option for addressing non-flaccid facial palsy by targeting the underlying aberrant reinnervation, with favorable 1-year follow-up outcomes demonstrated in this consecutive case series. While surgical precision and patient-specific customization remain critical to minimize functional deficits. Periocular outcomes remain suboptimal, and continued refinement of surgical techniques and accumulation of 1-year follow-up data are essential to enhance predictability, safety, and broader applicability of this evolving procedure. This research demonstrates that improvements in smile symmetry seen after SN persist at 12-month follow-up. Care should be taken to minimize functional deficits by prioritizing nerve preservation over nerve transection.

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Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Authors' Contributions

Conceptualization: B.O. Methodology: B.O. and B.Y. Investigation: B.O. Data Curation: B.O. and B.Y. Formal Analysis: B.O. and B.Y. Visualization: B.Y. Writing—Original Draft: B.O. and B.Y. Writing—Review & Editing: B.O. and B.Y. Supervision: B.O. Project Administration: B.O.

Author Disclosure Statement

No competing financial interests exist.

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Supplementary Materials

Supplementary Table S1
Supplementary Table S2
Supplementary Video S1
Supplementary Video S2

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