Safety and Usability of Pulse-Controlled Ultrasonic Aspiration (Stryker Sonopet iQ) in Skull Base Surgery: Multi-Surgeon Survey and Video Analysis

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Abstract

Objective:
To evaluate the safety, usability, and effectiveness of the Sonopet iQ Pulse Control system through surgeon-reported outcomes and postoperative video analysis.
Methods:
Two neurosurgeons performed six skull base tumor resections using the Sonopet Pulse Control system. Postoperative surveys assessed seven operative parameters (control, precision, ease of use, visibility, haptic feedback, efficiency, and selectivity) after each case. Independent postoperative video analysis evaluated critical structure preservation and operative efficiency.
Results:
Surgeons rated Sonopet Pulse Control highly across all surveyed operative parameters, with average scores ranging from 7.7 to 9.0 (10-point scale). Video analysis confirmed 100% preservation of critical structures in all cases. Performance was consistent across diverse tumor types and surgical approaches.
Conclusion:
Pulse-controlled ultrasonic aspiration with Sonopet iQ enhances surgical precision, improves tissue selectivity and preserves critical structures during skull base tumor resections. These findings support its safety and usability in complex cranial surgery.
Keywords *Sonopet iQ; Ultrasonic Aspirator; Skull Base; Surgical Safety, Tumor Resection*.

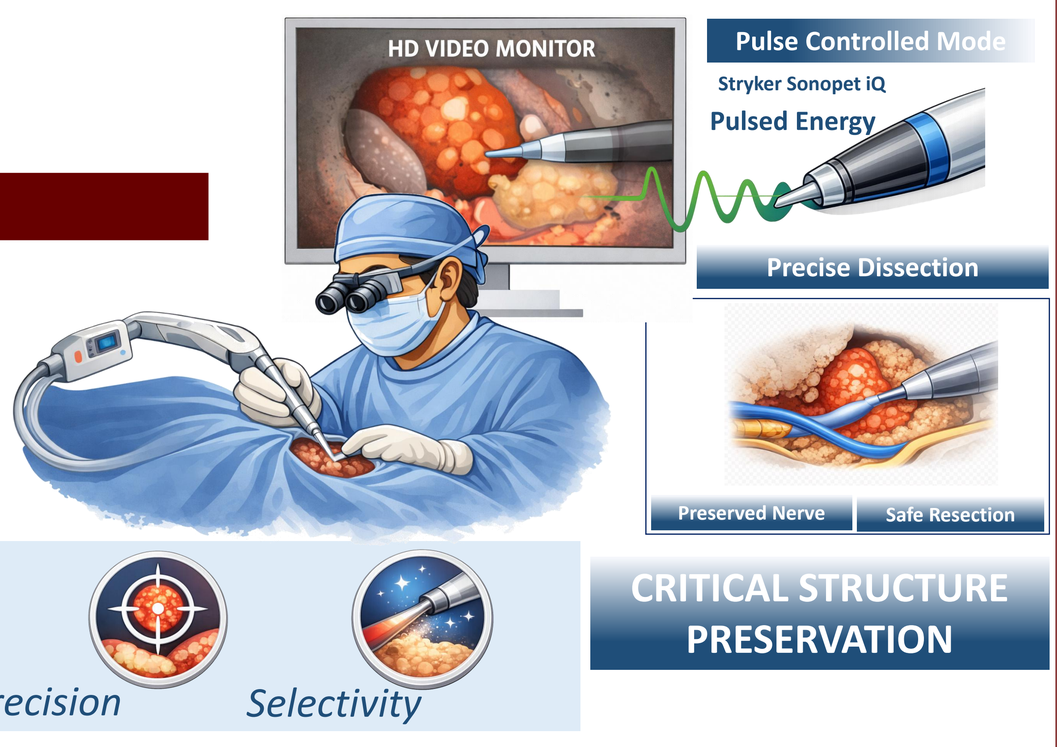
Introduction

Safe resection of skull base and nerve sheath tumors remains one of the most technically demanding challenges in neurosurgery. The proximity of these lesions to cranial nerves, brainstem, and major vessels requires extreme precision, as inadequate selectivity during tumor debulking can result in cranial neuropathies, vascular injuries, or life-altering neurological deficits.
Ultrasonic aspirators facilitate tumor removal in confined spaces by fragmenting and aspirating tissue using high-frequency energy. Continuous Mode Ultrasonic Aspirators, such as the Stryker Sonopet Classic, deliver a continuous, unmodulated stream of ultrasonic energy. Although effective for general tumor debulking, continuous mode devices may lack the finesse required for delicate maneuvers near critical structures, with challenges including excessive tissue disruption, collateral bleeding, and difficulty preserving fine anatomical structures.
To overcome these limitations, the **Stryker Sonopet iQ** Pulse Control system was developed. By introducing adjustable, pulsed energy delivery, this technology allows the surgeon to fine-tune tissue disruption while minimizing collateral damage. Pulse modulation improves haptic feedback, enhances tissue selectivity, reduces tip temperature, and enables safer dissection around vulnerable structures.
In this study we evaluate the safety, usability, and clinical performance of the Sonopet iQ Pulse Control system through prospective surgeon survey and operative video analysis. This study provides early clinical evaluation of pulse-controlled ultrasonic aspiration in skull base surgery.

Methods and Materials

Table 1. Surgeon Profiles and Experience. These surgeon profiles highlight different levels of exposure to ultrasonic aspiration devices.

Surgeon	Specialty Focus	Years in Practice	Skull Base Fellowship	Average Annual Skull Base Cases	Prior Sonopet Classic Experience
1	Skull Base & Neuro-Oncology	25 years	1 year	~40	Extensive
2	Skull Base & Neuro-Oncology	12 years	3 years	~70	Extensive



Study Design
2 board-certified neurosurgeons
6 skull base resections
Tumors: vestibular schwannoma (n=4), meningioma (n=2)
Approaches: translabyrinthine, retrosigmoid, pterional, presigmoid
Device Settings
Power: 50%
Suction: 50%
Irrigation: 25 mL/min
Pulse levels: 1–5
Continuous mode used for bulk debulking
Pulse mode used near critical neurovascular structures
Survey Parameters (10-point scale)
Control
Precision
Ease of use
Visibility
Haptic feedback
Efficiency
Tissue selectivity
Video Analysis
Independent review assessed:
Capsule preservation
Critical structure preservation
Visibility & Efficiency

Postoperative Video Review and Statistical Analysis.
Postoperative videos were independently reviewed by a neurosurgeon blinded to results to assess critical structure preservation, visibility, and operative efficiency, with binary endpoints per case. Quantitative data were summarized using mean and standard deviation and analyzed overall and stratified by surgeon, tumor type, and surgical approach.

Results

Overall Performance
Scores ranged 7.7–9.0
Highest: Visibility & Ease of Use (9.0)
100% critical structure preservation
Tumor Type
Schwannomas: uniformly high scores
Fibrous meningioma: slightly lower control/selectivi
Surgical Approach
Consistent usability across translabyrinthine, retrosigmoid, and pterional approaches. Minor reduction in pterional fibrous case
Inter-Surgeon Consistency
High reproducibility
No major discrepancies between surgeons
Qualitative Feedback
Surgeons described pulse mode as:
"Safer"
"More controlled"
"Improved haptic feedback"
No adverse intraoperative events reported.

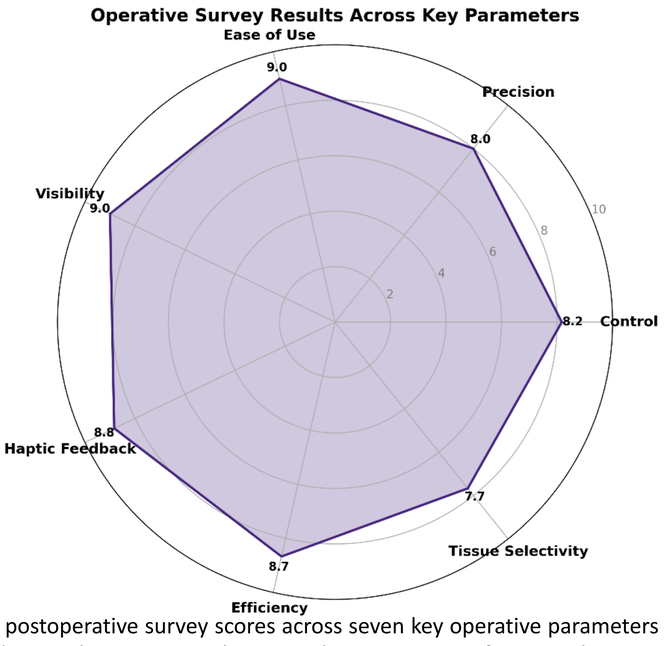


Figure 2. Radar plot displaying average postoperative survey scores across seven key operative parameters for skull base tumor resections performed using the Sonopet Pulse Control system. Scores for control, precision, ease of use, visibility, haptic feedback, efficiency, and tissue selectivity were assessed on a 10-point Likert scale (1 = poor, 10 = excellent). Numeric labels at each data point represent the average score across all cases for each parameter..

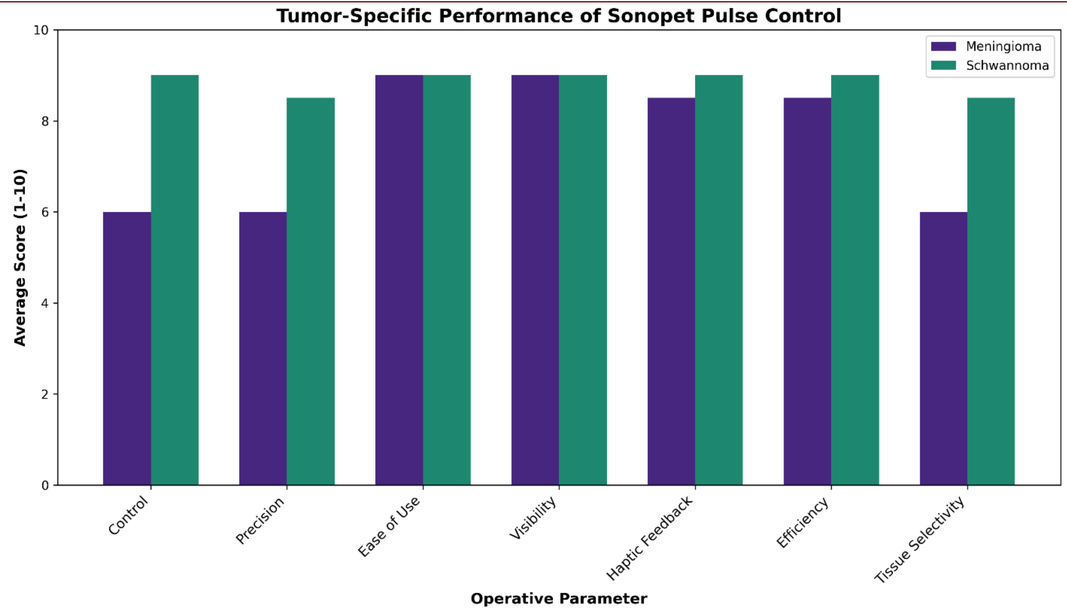


Figure 3. Grouped bar plot comparing average postoperative survey scores between meningioma and schwannoma resections performed using the Sonopet Pulse Control system. Despite differences in tumor consistency, Sonopet Pulse Control achieved consistently high ratings across key operative parameters.

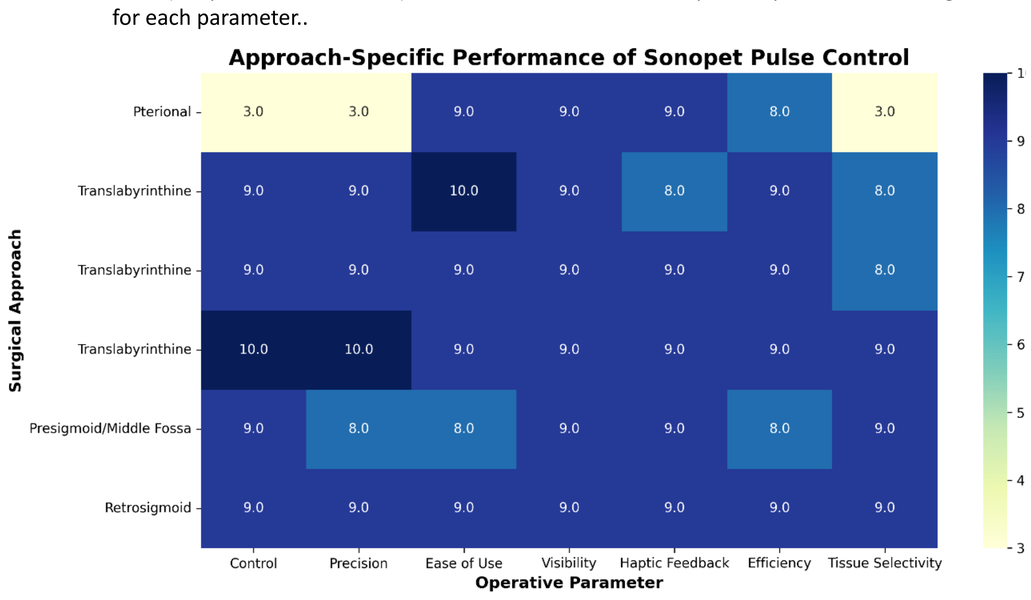


Figure 4. Heatmap depicting postoperative survey scores across different surgical approaches utilizing the Sonopet Pulse Control system. High ratings were maintained across approaches, with translabyrinthine and retrosigmoid cases demonstrating uniformly strong scores

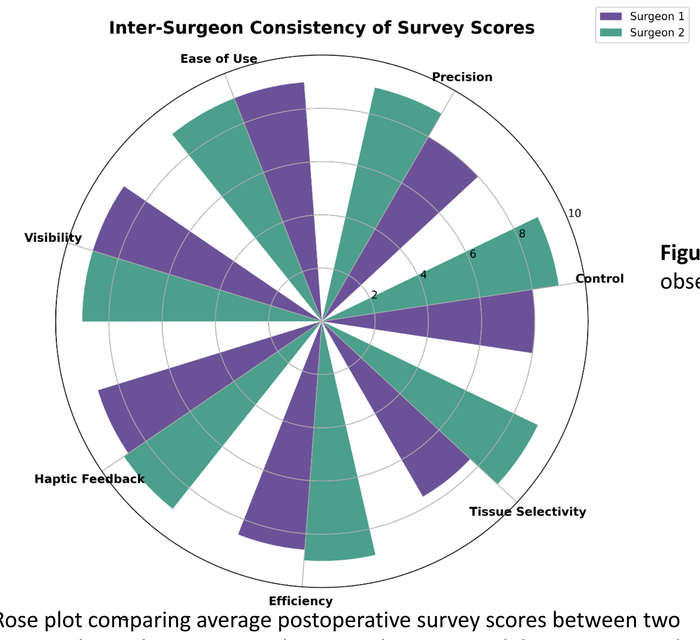


Figure 5. Rose plot comparing average postoperative survey scores between two neurosurgeons utilizing the Sonopet Pulse Control system. Each bar represents the average rating for a specific operative parameter assessed by Surgeon 1 and Surgeon 2

Figure 6 . Word cloud summarizing qualitative free-text observations from neurosurgeons

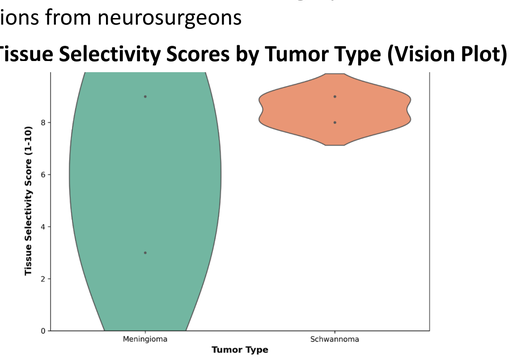


Figure 7. Violin plot comparing tissue selectivity scores between meningioma and schwannoma resections

Discussion

Our findings demonstrate advantages of pulse-controlled ultrasonic aspiration over traditional continuous mode systems in skull base surgery. The Sonopet iQ Pulse Control system enhances precision through modulated energy delivery, particularly near critical neurovascular structures.
The five pulse settings allow improved tissue selectivity compared to continuous mode, especially when differentiating tumor from adjacent cranial nerves. This selectivity is essential for preserving neurological function. Temperature reduction with higher pulse settings (approximately 0.5–2.0°C per increment) further supports safety during prolonged dissection around heat-sensitive structures such as the facial nerve and brainstem.
Key features include intermittent energy delivery for improved control, ergonomic handpiece design, interchangeable tips, and reduced thermal spread with integrated irrigation.
The learning curve appeared modest. Both surgeons adapted within two cases, and pre-study tissue model training facilitated understanding of pulse settings and operative feel.

Limitations and Future Direction

This study represents preliminary experience with a small sample size and limited tumor types and should not be interpreted as definitive validation. Larger prospective studies incorporating quantitative measures such as extent of resection, operative time, blood loss, and postoperative neurological outcomes are needed to further validate these findings and define the clinical benefit of pulse-controlled technology.
Future refinements may include automated tissue recognition with real-time adjustment of pulse and power settings based on intraoperative feedback. Integration with intraoperative navigation and electrophysiological monitoring could further enhance precision and safety during skull base tumor resections.
Positive surgeon-reported outcomes and video-confirmed preservation of critical structures suggest that pulse-controlled ultrasonic aspiration may represent a meaningful advance in skull base surgery. Improved tactile feedback and tissue discrimination may also have implications for surgical training. While performance was consistent across tumor types and approaches, further evaluation in specific pathologies and anatomical locations remains warranted.