

Review Article

Retrosigmoid Versus Other Surgical Approaches for Vestibular Schwannoma: A Systematic Review of Facial Nerve Functional Outcomes

Achmad Rivaldi^{1)*}, I Wayan Aryanta Putra²⁾, Arie Ibrahim²⁾

¹⁾Medical Faculty, Universitas Mulawarman, Kalimantan Timur

²⁾Neurosurgery Division, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta

Corresponding Author:

Achmad Rivaldi

Medical Faculty, Universitas Mulawarman, Kalimantan Timur

achmadrivaldi53@yahoo.com

ARTICLE INFO**Keywords:**

Acoustic Neuroma, Facial Nerve, Surgical Procedures, Treatment Outcome, Intraoperative Neurophysiological Monitoring

How to cite:

Rivaldi A., Putra I. W. A., Ibrahim A. (2026). Retrosigmoid approach for vestibular schwannoma surgery: A systematic review of facial nerve functional outcomes). Nusantara Medical Science Journal. <https://doi.org/10.20956/csznd236>

ABSTRACT

Background: Preservation of facial nerve (FN) function is a major objective of vestibular schwannoma (VS) surgery. Although the retrosigmoid (RS) approach is widely used, reported postoperative FN outcomes vary according to tumor characteristics, surgical technique, and follow-up duration. This systematic review compared FN functional outcomes following RS surgery with those of other surgical approaches. **Methods:** A systematic literature search was conducted in PubMed, Embase, Scopus, and Web of Science from inception through September 2025, in accordance with PRISMA 2020 guidelines. Studies evaluating patients undergoing VS resection through the RS approach and reporting postoperative FN function using the House–Brackmann scale or an equivalent measure were eligible. Two reviewers independently screened studies, extracted data, and assessed risk of bias using validated tools for nonrandomized studies. **Results:** Seventeen studies published between 2003 and 2025 were included. Across studies, 60–85% of patients achieved good postoperative FN function (House–Brackmann grades I–II) following RS surgery. Favorable outcomes were more frequently

DOI:

<https://doi.org/10.20956/csznd236>

reported in patients with small-to-medium tumors and when intraoperative FN monitoring was employed. Comparative studies indicated broadly comparable FN outcomes between RS, translabyrinthine, and middle fossa approaches, although RS surgery may additionally facilitate hearing preservation in selected patients. Larger tumor size, cystic morphology, and more extensive resection were associated with poorer FN outcomes. Cerebrospinal fluid leakage, headache, and synkinesis were among the reported complications. Overall risk of bias was moderate. **Conclusion:** The RS approach provides generally favorable FN functional outcomes that are broadly comparable with alternative surgical approaches. Outcomes appear to be influenced substantially by tumor size and surgical complexity. However, substantial methodological and reporting heterogeneity limits definitive comparisons and supports the need for standardized prospective studies

Copyright © 2026 NMSJ. All rights reserved.

1. INTRODUCTION

Vestibular schwannoma (VS), also known as acoustic neuroma, is a benign tumor arising from Schwann cells of the vestibular nerve.^{1,2} It accounts for approximately 6–8% of all intracranial tumors and up to 90% of tumors in the cerebellopontine angle.³ Advances in neuroimaging have increased the detection of VS, leading to earlier diagnosis and a wider spectrum of management options, including observation, stereotactic radiosurgery, and microsurgical resection.⁴ Despite these developments, surgery remains the definitive treatment for large, growing, or symptomatic tumors.⁵

Facial nerve (FN) preservation is a principal surgical goal, as FN injury can result in facial paralysis, cosmetic disfigurement, impaired speech and swallowing, ocular complications, and significant psychosocial consequences.⁶ The House–Brackmann (HB) grading system is the most widely used measure of FN function and provides a standardized framework for evaluating surgical outcomes.⁷ Achieving good FN outcomes is particularly challenging in larger tumors or when resection involves the internal auditory canal, where the FN is at risk of stretching, compression, or transection.⁸

Among the various microsurgical approaches, the retrosigmoid (RS) approach is one of the most commonly employed worldwide.^{9,10} It provides wide exposure of the cerebellopontine angle, accommodates tumors of nearly all sizes, and offers the potential for hearing preservation in selected patients.¹¹ Nevertheless, RS surgery is associated with risks, including postoperative headache, cerebellar retraction injury, and cerebrospinal fluid leak.^{12,13} Importantly, reported FN outcomes after RS resection vary considerably, reflecting heterogeneity in tumor size, surgical technique, use of intraoperative monitoring, and surgeon experience.¹⁴

Previous systematic reviews have compared different approaches, often combining RS, translabyrinthine, and middle fossa techniques. However, few have

specifically focused on FN outcomes following the RS approach alone. Given the central importance of FN preservation to patient quality of life, a comparative analysis is needed to clarify how outcomes differ between the RS approach and other surgical techniques, which factors influence prognosis across approaches, and where gaps in the evidence persist.

2. METHODS

2.1. Study design

This study was conducted as a systematic review following the updated guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020).¹⁵ The protocol was developed a priori to ensure transparency, reproducibility, and methodological rigor in synthesizing evidence on FN functional outcomes following the RS approach for VS surgery.

2.2. Literature search strategy

A comprehensive literature search was conducted in **PubMed, Embase, Scopus, and Web of Science** from database inception to September 2025. The search employed both controlled vocabulary (e.g., MeSH and Emtree terms) and free-text keywords, incorporating terms related to VS, RS or suboccipital approaches, FN, and House–Brackmann grading. Boolean operators (AND, OR) and proximity operators (NEAR, NEXT) were applied where appropriate. No restrictions were applied regarding publication year or language. Additionally, the reference lists of included studies and relevant systematic reviews were manually screened to identify further eligible records. The full search strategies for each database are provided in **Table 1**.

Table 1. Search strategies used for online databases		
Database	Search strategies	Records
PubMed	((("Vestibular Schwannoma"[Mesh] OR "Acoustic Neuroma"[tiab] OR "Vestibular Schwannoma"[tiab] OR "Acoustic Neurinoma"[tiab]))	402
	AND	
	((("Retrosigmoid"[tiab] OR "Retrosigmoid Approach"[tiab] OR "Suboccipital"[tiab] OR "Posterior Fossa"[tiab]))	
	AND	
	((("Surgery"[Subheading] OR surgery[tiab] OR surgical[tiab] OR resection[tiab] OR microsurgery[tiab]))	
Web of Science	AND	326
	((("Facial Nerve"[Mesh] OR "Facial Nerve Function"[tiab] OR "Facial Nerve Outcome"[tiab] OR "House Brackmann"[tiab] OR "HB grade"[tiab] OR "Facial function"[tiab]))	
	TS = (("vestibular schwannoma" OR "acoustic neuroma" OR "acoustic neurinoma"))	
	AND TS = (retrosigmoid OR "retrosigmoid approach" OR suboccipital OR "posterior fossa")	
	AND TS = (surgery OR surgical OR resection OR microsurgery)	

	AND TS = ("facial nerve" OR "facial nerve function" OR "house brackmann" OR "hb grade" OR "facial function")	
Medline and EMBASE	('vestibular schwannoma'/exp OR 'acoustic neuroma':ti,ab OR 'vestibular schwannoma':ti,ab OR 'acoustic neurinoma':ti,ab) AND ('retrosigmoid':ti,ab OR 'retrosigmoid approach':ti,ab OR 'suboccipital':ti,ab OR 'posterior fossa':ti,ab) AND ('surgery'/exp OR surgery:ti,ab OR surgical:ti,ab OR resection:ti,ab OR microsurgery:ti,ab) AND ('facial nerve'/exp OR 'facial nerve function':ti,ab OR 'house brackmann':ti,ab OR 'hb grade':ti,ab OR 'facial function':ti,ab)	279
Scopus	TITLE-ABS-KEY ("vestibular schwannoma" OR "acoustic neuroma" OR "acoustic neurinoma") AND TITLE-ABS-KEY (retrosigmoid OR "retrosigmoid approach" OR suboccipital OR "posterior fossa") AND TITLE-ABS-KEY (surgery OR surgical OR resection OR microsurgery) AND TITLE-ABS-KEY ("facial nerve" OR "facial nerve function" OR "house brackmann" OR "hb grade" OR "facial function")	212

2.3. Eligibility criteria

Studies were considered eligible if they reported on patients of any age undergoing microsurgical resection of VS via the RS approach, with postoperative FN outcomes reported using the House–Brackmann (HB) scale or an equivalent grading system. Studies comparing the RS approach with other approaches, such as translabyrinthine or middle fossa, were included if outcomes for the RS group were reported separately. Eligible study designs included randomized controlled trials, prospective or retrospective cohorts, case–control studies, and case series with at least 10 patients. Studies were excluded if they did not specify the surgical approach, focused exclusively on non-RS approaches, were case reports with fewer than 10 patients, narrative reviews, editorials, conference abstracts without full text, or animal or cadaveric studies.

2.4. Study selection and data extraction

All retrieved records were imported into a reference management tool, and duplicates were removed. Two reviewers independently screened titles and abstracts, followed by full-text assessment according to the eligibility criteria. Disagreements were resolved through discussion or consultation with a third reviewer. Data were extracted using a standardized form, capturing study characteristics (author, year, country, study design), sample size, patient demographics, tumor size and classification, surgical details (including use of intraoperative monitoring, endoscopy, and extent of resection), FN outcomes (HB grades at early and late follow-up), and complications. The

methodological quality of included studies was appraised using the Joanna Briggs Institute (JBI) critical appraisal checklists, tailored to each study design (case series, cohort, or quasi-experimental). Two reviewers conducted the appraisal independently, with disagreements resolved through consensus. Results of the quality assessment are summarized in Table 2.

Table 2. Quality assessment and risk of bias of included studies for systematic review

ID	Study (Publication year)	Were the criteria for inclusion in the sample clearly defined?	Were the study patients and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Total
1	Ahmad et al. [19]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
2	Aihara et al. [27]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
3	Bi et al. [24]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
4	Boublata et al. [37]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
5	Ceccato et al. [25]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
6	Chovane c et al. [23]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	6
7	Colletti et al. [20]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
8	Colletti et al. [21]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
9	Hillman et al. [28]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
10	Ho et al. [18]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
11	Kim et al. [17]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
12	Samii et al. [16]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
13	Eser Ocak et al. [38]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
14	Khan et al. [39]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	7
15	Lucidi et al. [26]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
16	Mangham et al. [22]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
17	Wilkinson et al. [40]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

2.5. Data synthesis

Due to heterogeneity in study designs, patient populations, surgical indications, operative techniques, and outcome measures, a quantitative meta-analysis was not

feasible. Instead, a qualitative synthesis was performed, summarizing the results of reported postoperative outcomes across the included studies.

3. RESULTS

3.1. Study selection

The initial database search identified **1,220 records** (PubMed, n = 403; Embase, n = 326; Web of Science, n = 279; Scopus, n = 212). **216 duplicates** were removed using EndNote, leaving **1,004 records** for title and abstract screening. Of these, **622 records** were excluded as irrelevant. A total of **383 full-text articles** were assessed for eligibility. **366 reports** were excluded for the following reasons: exposure or intervention of interest not reported (n = 172), outcome of interest not reported (n = 135), conference abstract or review (n = 50), and non-English publication (n = 9). Ultimately, **17 studies published between 2003 and 2025** were included in this systematic review (Figure 1).

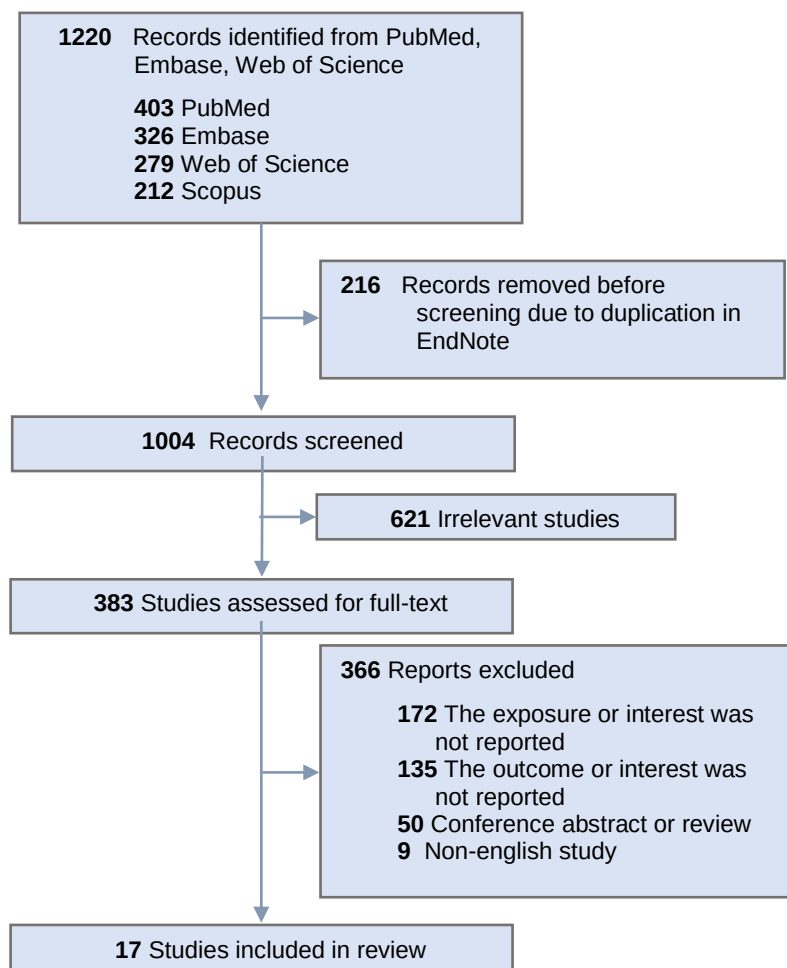


Figure 1. Preferred Reporting Items for Reporting Systematic Reviews and Meta-Analyses (PRISMA)

3.2. Study characteristics

The 17 included studies were published between 2003 and 2025 and encompassed a broad range of geographic regions, including Asia (n = 6), Europe (n = 6), and North America (n = 5). The majority were retrospective case series or cohort

studies, with sample sizes ranging from single case reports to over 200 patients. Studies on VS have explored the outcomes of transmastoid, RS, and translabyrinthine approaches, demonstrating how the choice of surgical corridor influences postoperative FN preservation and hearing outcomes.

3.3. Surgical techniques and timing

Surgical timing was less emphasized, but **approach selection** significantly influenced outcomes. RS approaches were associated with better FN and hearing preservation,^{16,17} while translabyrinthine approaches provided wide exposure but often sacrificed hearing.^{18,19} Middle cranial fossa approaches offered favorable hearing outcomes for intracanalicular tumors.^{20,21,22} Endoscope-assisted RS techniques improved visualization of the internal auditory canal and facilitated tumor removal while preserving FN function.^{23,24,25}

3.4. Functional outcomes

Functional outcomes were strongly influenced by surgical approach. RS approaches, particularly when assisted by endoscopy, were associated with higher rates of FN preservation and useful hearing retention.^{16,23,24,25} Middle cranial fossa approaches were beneficial for hearing preservation in small intracanalicular tumors.^{20,21,22} Long-term studies also demonstrated that translabyrinthine and transcanal transpromontorial approaches achieved favorable FN outcomes, particularly in higher Koos grades or large tumors.^{17,26} Younger age, lower Koos grade, and approach selection (TL or TTS) were significant predictors of better FN recovery.²⁶

3.5. Complications and risk of bias

Overall, complications were uncommon. Reported issues included persistent weakness, synkinesis, donor-site morbidity, postoperative headache, and isolated cerebrospinal fluid leaks or wound infections.^{23,27} No surgery-related mortality was reported. The risk of bias was moderate to high due to retrospective study designs, small sample sizes, variability in surgical techniques, and heterogeneous outcome measures and follow-up durations.^{16,26,28} Differences in institutional practices and surgeon experience further contributed to variability in functional outcomes and complication rates.

Table 3. Characteristics of studies that included in systematic review

ID	Author	Year	Subgroup age	Title	Journal
1	Ahmad et al. [19]	2012	All age	Rate of recurrent vestibular schwannoma after total removal via different surgical approaches	Ann Otol Rhinol Laryngol
2	Aihara et al. [27]	2017	All age	Postoperative Headache after Undergoing Acoustic Neuroma Surgery via the Retrosigmoid Approach	Neurol Med Chir
3	Bi et al. [24]	2021	All age	Endoscope-Assisted Retrosigmoid Approach for Vestibular Schwannomas with Intracanalicular Extensions: Facial Nerve Outcome	Front Oncol
4	Boublata et al. [37]	2017	All age	Facial Nerve Function and Quality of Resection in Large and Giant Vestibular Schwannomas Surgery Operated by Retrosigmoid Transmeatal Approach in Semi-sitting Position with Intraoperative Facial Nerve	World Neurosurg

5	Ceccato et al. [25]	2022	All age	Microsurgical Resection of Intracanalicular Vestibular Schwannoma via Retrosigmoid Approach: 3-Dimensional Operative Video	World Neurosurg
6	Chovanec et al. [23]	2013	All age	Impact of video-endoscopy on the results of retrosigmoid-transmeatal microsurgery of vestibular schwannoma: prospective study	Eur Arch Otorhinolaryngol
7	Colletti et al. [20]	2003	All age	Middle fossa versus retrosigmoid-transmeatal approach in vestibular schwannoma surgery: a prospective study	Otol Neurotol
8	Colletti et al. [21]	2005	All age	Is the middle fossa approach the treatment of choice for intracanalicular vestibular schwannoma?	Otolaryngol Head Neck Surg
9	Hillman et al. [28]	2010	All age	Facial nerve function and hearing preservation acoustic tumor surgery: does the approach matter?	Otolaryngol Head Neck Surg
10	Ho et al. [18]	2003	All age	Comparison of postoperative facial nerve outcomes between translabyrinthine and retrosigmoid approaches in matched-pair patients	Laryngoscope
11	Kim et al. [17]	2021	All age	Comparison between retrosigmoid and translabyrinthine approaches for large vestibular schwannoma: focus on cerebellar injury and morbidities	Neurosurg Rev
12	Samii et al. [16]	2006	All age	Improved preservation of hearing and facial nerve function in vestibular schwannoma surgery via the retrosigmoid approach in a series of 200 patients	J Neurosurg
13	Eser Ocak et al. [38]	2018	All age	Facial nerve outcome and extent of resection in cystic versus solid vestibular schwannomas in radiosurgery era	Neurosurg Focus
14	Khan et al. [39]	2022	All age	Retrosigmoid Approach for Koos Grade 4 Vestibular Schwannoma-Surgical Technique and Nuances for Facial Nerve Preservation: 2-Dimensional Operative Video	Oper Neurosurg
15	Lucidi et al. [26]	2025	All age	Prognostic Factors for Facial Nerve Outcome after Vestibular Schwannoma Surgery: A 12-Year Multicentric Retrospective Study	Otol Neurotol
16	Mangham et al. [22]	2004	All age	Retrosigmoid versus middle fossa surgery for small vestibular schwannomas	Laryngoscope
17	Wilkinson et al. [40]	2016	All age	Hearing Outcomes after Middle Fossa or Retrosigmoid Craniotomy for Vestibular Schwannoma Tumors	J Neurol Surg B Skull Base

4. DISCUSSION

This systematic review synthesized evidence from 17 studies published between 2003 and 2025, examining the role of the retrosigmoid approach and FN preservation during VS surgery. Reported outcomes were generally favorable, But the degree of recovery or preservation varied depending on several factors.

In VS surgery, our review corroborates previous findings that approach selection strongly influences FN preservation and hearing outcomes.²⁹ RS approaches, particularly when assisted with endoscopy, achieved high rates of gross total resection and favorable FN outcomes.³⁰ Translabyrinthine approaches, while providing excellent tumor exposure, often sacrificed hearing but preserved FN anatomy in most cases.³¹ Middle cranial fossa approaches showed advantages for hearing preservation in small intracanalicular tumors, but did not significantly outperform RS approaches in terms of FN outcomes.³² These differences can be explained by the anatomy and trajectory of surgical corridors: RS approaches provide a direct line to the cerebellopontine angle and internal auditory canal without disrupting cochlear structures, whereas translabyrinthine approaches sacrifice cochlear integrity but allow unobstructed tumor removal.³³

Age, tumor size, and Koos grade were significant predictors of FN outcomes across VS studies, in agreement with prior multicenter analyses.³⁴ Older patients and

those with higher Koos grades experienced worse postoperative HB scores, likely due to both reduced neural plasticity and increased intraoperative manipulation of the nerve during resection.³⁵ Endoscopic assistance improved visualization of the intracanalicular portion of tumors, enabling detection and removal of residual tumor not visible under the microscope, which may explain the higher rates of FN preservation reported in studies using this technique.³⁶

Despite the strengths of including studies from diverse geographic and clinical contexts, this review has several limitations. First, heterogeneity in study design, surgical techniques, timing of surgery, and outcome measures limited the ability to conduct quantitative synthesis or meta-analysis. Second, many included studies were retrospective case series with small sample sizes, restricting causal inference and generalizability. Third, variations in reporting of prognostic factors may explain inconsistencies in reported outcomes. Fourth, lack of long-term follow-up in several studies limits understanding of late complications and durability of functional recovery. Finally, publication bias cannot be excluded, as studies reporting successful outcomes may be overrepresented in the literature.

5. CONCLUSIONS

This systematic review demonstrates that FN functional outcomes following the RS approach are generally comparable to those achieved with other surgical techniques, including translabyrinthine and middle fossa approaches. Across the included studies, FN preservation rates (House–Brackmann grade I–II) following RS resection ranged from 60-85%, with outcomes influenced by tumor size, surgical expertise, and the use of adjunctive techniques such as endoscopic assistance. These findings suggest that the RS approach remains a viable and effective option for VS surgery, with outcomes comparable to alternative approaches when appropriately selected.

REFERENCES

1. Gupta, V. K., Thakker, A., & Gupta, K. K. (2020). Vestibular Schwannoma: What We Know and Where We are Heading. *Head Neck Pathol*, 14(4), 1058-1066. doi:10.1007/s12105-020-01155-x
2. Haider, N., Radi, Q., Ahmad, S., & Mohsen, S. (2025). Unmasking vestibular schwannoma: A series of unusual cases. *International Journal of Surgery Case Reports*, 131, 111291. doi:https://doi.org/10.1016/j.ijscr.2025.111291
3. Tuan, H. X., Hung, N. D., Khuong, N. H., Duong, Q. T., Dung, L. D., & Duc, N. M. (2023). Vestibular schwannoma with fluid-fluid levels mimicking aneurysm bone cyst. *Radiology Case Reports*, 18(3), 1079-1083. doi:https://doi.org/10.1016/j.radcr.2022.12.063
4. Leon, J., Lehrer, E. J., Peterson, J., Vallow, L., Ruiz-Garcia, H., Hadley, A., . . . Trifiletti, D. M. (2019). Observation or stereotactic radiosurgery for newly diagnosed vestibular schwannomas: A systematic review and meta-analysis. *J Radiosurg SBRT*, 6(2), 91-100.
5. Jakubeit, T., Sturtz, S., Sow, D., Groß, W., Mosch, C., Patt, M., . . . Markes, M. (2022). Single-fraction stereotactic radiosurgery versus microsurgical resection for the treatment of vestibular schwannoma: a systematic review and meta-analysis. *Systematic Reviews*, 11(1), 265. doi:10.1186/s13643-022-02118-9

6. Saraniti, C., & Verro, B. (2024). Reanimation Techniques of Peripheral Facial Paralysis: A Comprehensive Review Focusing on Surgical and Bioengineering Approaches. *J Clin Med*, 13(20). doi:10.3390/jcm13206124
7. Mengi, E., Orhan Kara, C., Necdet Ardiç, F., Topuz, B., Metin, U., Alptürk, U., . . . Şenol, H. (2024). Comparison of the Reliability of the House- Brackmann, Facial Nerve Grading System 2.0, and Sunnybrook Facial Grading System for the Evaluation of Patients with Peripheral Facial Paralysis. *J Int Adv Otol*, 20(1), 14-18. doi:10.5152/iao.2024.231162
8. Hostettler, I. C., Jayashankar, N., Bikis, C., Wanderer, S., Nevzati, E., Karuppiah, R., . . . Roethlisberger, M. (2021). Clinical Studies and Pre-clinical Animal Models on Facial Nerve Preservation, Reconstruction, and Regeneration Following Cerebellopontine Angle Tumor Surgery-A Systematic Review and Future Perspectives. *Front Bioeng Biotechnol*, 9, 659413. doi:10.3389/fbioe.2021.659413
9. Matsushima, K., Kohno, M., Sakamoto, H., Ichimasu, N., & Nakajima, N. (2022). Intraoperative Continuous Neuromonitoring for Vestibular Schwannoma Surgery: Real-Time, Quantitative, and Functional Evaluation. *World Neurosurg*, 158, 189. doi:10.1016/j.wneu.2021.11.102
10. Matsushima, K., Komune, N., Matsuo, S., & Kohno, M. (2017). Microsurgical and Endoscopic Anatomy for Intradural Temporal Bone Drilling and Applications of the Electromagnetic Navigation System: Various Extensions of the Retrosigmoid Approach. *World Neurosurgery*, 103, 620-630. doi:https://doi.org/10.1016/j.wneu.2017.04.079
11. Papazian, M., Cottrell, J., Pan, L., Kay-Rivest, E., Friedmann, D., Jethanamest, D., . . . McMenomey, S. (2024). Characterizing Hearing Outcomes Following Treatment of Cerebellopontine Angle Meningiomas. *Journal of Neurological Surgery Part B: Skull Base*, 0. doi:10.1055/a-2399-0081
12. Daming, C., Yiwen, S., Bin, Z., Yajun, X., Jia, Y., Rui, S., . . . Meiqing, L. (2014). Large vestibular schwannoma resection through the suboccipital retrosigmoid keyhole approach. *J Craniofac Surg*, 25(2), 463-468. doi:10.1097/scs.0000000000000528
13. Zhao, J., Wang, S., Zhao, X., Cui, H., & Zou, C. (2023). Risk factors of cerebrospinal fluid leakage after neuroendoscopic transsphenoidal pituitary adenoma resection: a systematic review and meta-analysis. *Front Endocrinol (Lausanne)*, 14, 1263308. doi:10.3389/fendo.2023.1263308
14. Milicevic, M., Solari, D., Illic, R., Frio, F., Stanimirovic, A., Savic, D., . . . Grujicic, D. (2020). The Impact of Intraoperative Monitoring on Extent of Resection and Long-Term Neurological Outcomes: A Series of 39 Intramedullary Ependimomas. *Turk Neurosurg*, 30(2), 252-262. doi:10.5137/1019-5149.Jtn.27471-19.2
15. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., . . . Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, 372, n71. doi:10.1136/bmj.n71
16. Samii, M., Gerganov, V., & Samii, A. (2006). Improved preservation of hearing and facial nerve function in vestibular schwannoma surgery via the retrosigmoid approach in a series of 200 patients. *J Neurosurg*, 105(4), 527-535. doi:10.3171/jns.2006.105.4.527
17. Kim, K. H., Cho, Y. S., Seol, H. J., Cho, K. R., Choi, J. W., Kong, D. S., . . . Lee, J. I. (2021). Comparison between retrosigmoid and translabyrinthine approaches for large vestibular schwannoma: focus on cerebellar injury and morbidities. *Neurosurg Rev*, 44(1), 351-361. doi:10.1007/s10143-019-01213-1
18. Ho, S. Y., Hudgens, S., & Wiet, R. J. (2003). Comparison of postoperative facial nerve outcomes between translabyrinthine and retrosigmoid approaches in matched-pair patients. *Laryngoscope*, 113(11), 2014-2020. doi:10.1097/00005537-200311000-00030

19. Ahmad, R. A., Sivalingam, S., Topsakal, V., Russo, A., Taibah, A., & Sanna, M. (2012). Rate of recurrent vestibular schwannoma after total removal via different surgical approaches. *Ann Otol Rhinol Laryngol*, 121(3), 156-161. doi:10.1177/000348941212100303
20. Colletti, V., & Fiorino, F. (2003). Middle fossa versus retrosigmoid-transmeatal approach in vestibular schwannoma surgery: a prospective study. *Otol Neurotol*, 24(6), 927-934. doi:10.1097/00129492-200311000-00018
21. Colletti, V., & Fiorino, F. (2005). Is the middle fossa approach the treatment of choice for intracanalicular vestibular schwannoma? *Otolaryngol Head Neck Surg*, 132(3), 459-466. doi:10.1016/j.otohns.2004.09.027
22. Mangham, C. A., Jr. (2004). Retrosigmoid versus middle fossa surgery for small vestibular schwannomas. *Laryngoscope*, 114(8), 1455-1461. doi:10.1097/00005537-200408000-00026
23. Chovanec, M., Zvěřina, E., Profant, O., Skřivan, J., Cakrt, O., Lisý, J., & Betka, J. (2013). Impact of video-endoscopy on the results of retrosigmoid-transmeatal microsurgery of vestibular schwannoma: prospective study. *Eur Arch Otorhinolaryngol*, 270(4), 1277-1284. doi:10.1007/s00405-012-2112-6
24. Bi, Y., Ni, Y., Gao, D., Zhu, Q., Zhou, Q., Tang, J., . . . Lou, M. (2021). Endoscope-Assisted Retrosigmoid Approach for Vestibular Schwannomas With Intracanalicular Extensions: Facial Nerve Outcomes. *Front Oncol*, 11, 774462. doi:10.3389/fonc.2021.774462
25. Ceccato GHW, de Oliveira JS, Neto PHS, de Carvalho ND, Coelho VN, Hasegawa HA, Sufianov AA, Borba LAB. Microsurgical Resection of Intracanalicular Vestibular Schwannoma via Retrosigmoid Approach: 3-Dimensional Operative Video. *World Neurosurg*. 2022 Jan;157:1. doi: 10.1016/j.wneu.2021.09.112
26. Lucidi, D., Marchioni, D., Bisi, N., Calvaruso, F., Presutti, L., Alicandri-Ciufelli, M., & Donvito, S. (2025). Prognostic Factors for Facial Nerve Outcome after Vestibular Schwannoma Surgery: A 12-Year Multicentric Retrospective Study. *Otol Neurotol*, 46(8), 978-983. doi:10.1097/mao.0000000000004582
27. Aihara, N., Yamada, H., Takahashi, M., Inagaki, A., Murakami, S., & Mase, M. (2017). Postoperative Headache after Undergoing Acoustic Neuroma Surgery via the Retrosigmoid Approach. *Neurol Med Chir (Tokyo)*, 57(12), 634-640. doi:10.2176/nmc.oa.2017-0108
28. Hillman, T., Chen, D. A., Arriaga, M. A., & Quigley, M. (2010). Facial nerve function and hearing preservation acoustic tumor surgery: does the approach matter? *Otolaryngol Head Neck Surg*, 142(1), 115-119. doi:10.1016/j.otohns.2009.10.015
29. Arts, H. A., Telian, S. A., El-Kashlan, H., & Thompson, B. G. (2006). Hearing preservation and facial nerve outcomes in vestibular schwannoma surgery: results using the middle cranial fossa approach. *Otol Neurotol*, 27(2), 234-241. doi:10.1097/01.mao.0000185153.54457.16
30. Kunigelis, K., Yang, A., & Youssef, A. S. (2018). Endoscopic Assisted Retrosigmoid Approach for Cerebellopontine Angle Epidermoid Tumor. *J Neurol Surg B Skull Base*, 79(Suppl 5), S413-s414. doi:10.1055/s-0038-1669978
31. Nickele, C. M., Akture, E., Gubbels, S. P., & Başkaya, M. K. (2012). A stepwise illustration of the translabyrinthine approach to a large cystic vestibular schwannoma. *Neurosurg Focus*, 33(3), E11. doi:10.3171/2012.7.Focus12208
32. Gibbon, F. L., Lindner, R. J., Vial, A. D. M., da Silva, G. G., Palavani, L. B., Semione, G., . . . Lavinsky, J. (2025). Translabyrinthine versus Retrosigmoid Approach for Vestibular Schwannoma: A Systematic Review and An Updated Meta-Analysis. *Otolaryngol Head Neck Surg*, 172(3), 774-786. doi:10.1002/ohn.1031
33. Hedjrat, A., Schwager, K., Hofmann, E., & Behr, R. (2018). Postoperative Cochlear Obliteration after Retrosigmoid Approach in Patients with Vestibular Schwannoma. *J Neurol Surg B Skull Base*, 79(4), 343-348. doi:10.1055/s-0037-1608649

34. Fujita, Y., Uozumi, Y., Akutsu, N., Sasayama, T., & Kohmura, E. (2024). Delayed facial palsy after resection of vestibular schwannoma: does it influence long-term facial nerve functional outcomes? *J Neurosurg*, 140(6), 1605-1613. doi:10.3171/2023.10.Jns231581
35. Gharabaghi, A., Samii, A., Koerbel, A., Rosahl, S. K., Tatagiba, M., & Samii, M. (2007). Preservation of function in vestibular schwannoma surgery. *Neurosurgery*, 60(2 Suppl 1), ONS124-127; discussion ONS127-128. doi:10.1227/01.Neu.0000249245.10182.0d
36. De Marco, R., Froelich, S., Albera, A., Garbossa, D., & Zenga, F. (2025). A systematic review on the role of the endoscope in the surgical management of cerebellopontine angle tumors: is it time to draw the conclusion? *Eur Arch Otorhinolaryngol*. doi:10.1007/s00405-025-09427-4
37. Boublata L, Belahreche M, Ouchtati R, Shabhay Z, Boutiah L, Kabache M, Nadji M, Djenna Z, Bounecer H, Ioualalen N. Facial Nerve Function and Quality of Resection in Large and Giant Vestibular Schwannomas Surgery Operated By Retrosigmoid Transmeatal Approach in Semi-sitting Position with Intraoperative Facial Nerve Monitoring. *World Neurosurg*. 2017 Jul;103:231-240. doi: 10.1016/j.wneu.2017.02.053
38. Eser Ocak P, Dogan I, Ocak U, Dinc C, Başkaya MK. Facial nerve outcome and extent of resection in cystic versus solid vestibular schwannomas in radiosurgery era. *Neurosurg Focus*. 2018 Mar;44(3):E3. doi: 10.3171/2017.12.FOCUS17667
39. Khan N, Wu EM, Jamshidi AM, Morcos J. Retrosigmoid Approach for Koos Grade 4 Vestibular Schwannoma-Surgical Technique and Nuances for Facial Nerve Preservation: 2-Dimensional Operative Video. *Oper Neurosurg*. 2022 Sep 1;23(3):e176. doi: 10.1227/ons.0000000000000303
40. Wilkinson EP, Roberts DS, Cassis A, Schwartz MS. Hearing Outcomes after Middle Fossa or Retrosigmoid Craniotomy for Vestibular Schwannoma Tumors. *J Neurol Surg B Skull Base*. 2016 Aug;77(4):333-40. doi: 10.1055/s-0035-1571166

Conflict of Interest Statement:

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2026 NMSJ. All rights reserved.