

Efficacy of Stereotactic Radiosurgery for Vestibular Schwannoma across Age Cohorts

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Introduction

- Vestibular Schwannomas (VS) are benign tumors of the inner ear arising from Schwann cells of the eighth cranial nerve
- Management options include observation, stereotactic radiosurgery (SRS), and microsurgical removal¹
- Treatment choice for VS depends on a range of modulating factors, including age
- Prior literature examining age in SRS patients has found it to be an effective therapy in older patients^{2,3}
- There is limited literature analyzing SRS success across finer age stratifications

Methods

- Single-institutional retrospective chart review of VS patients treated with SRS from 2001 to 2023
- Data on demographics, hearing outcomes, radiation modality (single-dose vs fractionated), and serial MRI sizes were collected
- Patient exclusions:
 - Neurofibromatosis 2
 - Follow-up <12 months
 - No documented imaging prior to radiation
- Patients were stratified into cohorts based on age at time of treatment, separated by decade (<40, 40-49, 50-59, 60-69, 70+)
- Radiation outcomes
 - Tumor control (<2 mm growth in greatest linear dimension)
 - Tumor size change
 - Post-treatment growth rate
 - Change in pure-tone average (PTA)
 - Incidence of non-serviceable hearing (PTA ≥50 dB and WRS ≤50%)
- Survival analyses and linear mixed-effects modeling tests were conducted

Results

- 186 patients met inclusion criteria, distributed in cohorts
 - <40 (n=23), 40-49 (n=21), 50-59 (n=53), 60-69 (n=57), and 70+ (n=32)
- There were no difference in sex, race, or VS laterality across cohorts
- Tumor control was observed across all cohorts, with no significant difference (p = 0.26, **Table 1**)
- Tumor size change was similar across age cohorts (p = 0.63)
- Post treatment growth rate was similarly low across cohorts (p = 0.28)
- Follow up time was significantly different (p = 0.013) across cohorts, with younger SRS patients having greater follow up times than older
 - Inter-MRI interval was not significantly different (p = 0.23)
- At 5-year follow-up, rate of serviceable hearing (**Figure 1**) was
 - <40: 100%
 - 40-49: 75%
 - 50-59: 95.7%
 - 60-69: 80.5%
 - 70+: 53%
- Comparing PTA decline in fractionated vs single-dose SRS patients
 - <40: 7.9 dB/year, fractionated vs 13.9 dB/year, single-dose
 - 40-49: 3.6 dB/year, fractionated vs 4.8 dB/year, single-dose
 - 50-59: 2.6 dB/year, fractionated vs 4.6 dB/year, single-dose (p = 0.017)
 - 60-69: 2.8 dB/year, fractionated vs 5.6 dB/year, single-dose
 - 70+: 3.5 dB/year, fractionated vs 9.5 dB/year, single-dose

Discussion

- Similarity in post-SRS tumor control, size change, and growth rate indicate efficacy of therapy across age groups
- Significant difference in follow up time, but not inter-MRI interval in age cohorts suggest similar adherence to early monitoring guidelines across ages
- While hearing loss is observed post SRS across all age cohorts, older patients receiving treatment may be at higher risk of loss of serviceable treatment
 - Baseline cochlear health may play a key role in this observed difference
- Single-dose therapy produced accelerated hearing loss across all age cohorts, suggesting value in fractionated therapy for long-term hearing preservation

Conclusions

Limitations

- Single-institution and retrospective nature of the study limits external validity
- Radiation dose was not considered in hearing loss analysis

Future Directions

- Integrate patient age, post-SRS tumor control, and hearing outcomes into shared decision-making tools for patients with vestibular schwannomas
- Further explore the biologic mechanism of age on cochlear susceptibility and health in the context of SRS outcomes in VS patients

Kaplan-Meier Survival Analysis - Hearing Serviceability

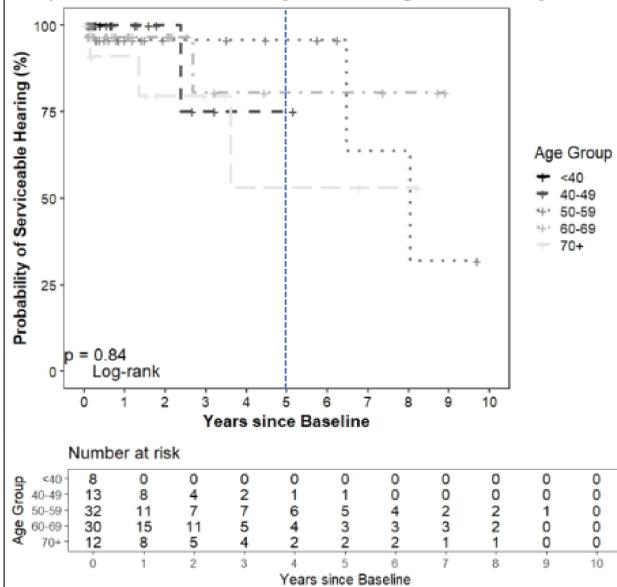


Figure 1. Kaplan-Meier analyses of probability of serviceable hearing by age group. Censored observations (serviceable) are indicated by tick marks. Blue dashed line represents rate of serviceable hearing at 5 years.

Table 1. Measures of post radiation treatment success across age of treatment

	<40 (n = 23)	40-49 (n = 21)	50-59 (n = 53)	60-69 (n = 57)	70+ (n = 32)
Tumor Size Change (mm)	-0.19 ± 0.64	-0.33 ± 0.63	-0.31 ± 0.75	-0.30 ± 0.59	-0.13 ± 0.48
Tumor Control Percentage	95.65%	95.24%	96.23%	100%	100%
Post-treatment growth rate (mm/month)	-0.0079 ± 0.0176	0.0028 ± 0.0198	-0.0070 ± 0.016	-0.0051 ± 0.0208	-0.00164 ± 0.0403
Follow up (months)	73.28 ± 44.38	54.84 ± 35.55	62.4 ± 31.47	62.5 ± 39.25	41.05 ± 29.12
Inter-MRI Interval (months)	18.93	21.82	21.1	16.91	13.92

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