

# Hearing outcomes following stereotactic ablative radiotherapy of head and neck paragangliomas: a single institute experience

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## Introduction

- Background:** Up to 80% of patients with HNPGs present with hearing loss.<sup>1,2</sup> SABR offers high local control of HNPGs with minimal toxicity and shorter treatment duration relative to other treatment modalities.<sup>3-5</sup>
- Gap:** Long-term hearing outcomes after SABR for HNPGs are not yet well characterized.
- Aim:** To assess long term hearing outcomes after SABR for HNPGs.

## Methods and Materials

### Study design and population

- Retrospective cohort study (2009-2020) at a 3° academic center.
- Inclusion criteria:
  - 18+ y/o with diagnosis of HNPG by a neurotologist.
  - Primary treatment with SABR: 25 Gy in 5 fractions.
  - Baseline audiogram with serviceable hearing (AAO-HNS Class A-B) + >1 follow up audiogram post-SABR.
- Exclusion criteria: Bilateral HNPGs.

### Data collected

- Demographics, tumor classification, laterality, CN involvement, prior surgery, baseline and follow up PTA in dB (average of 500, 1000, 2000 Hz) + WRS in % for both ears.

### Primary outcomes

- $\Delta$ PTA: Final PTA – Baseline PTA (average of 500, 1000, 2000 Hz).
- $\Delta$ WRS: Final WRS – Baseline WRS.

### Secondary outcomes

- Association of baseline characteristics with  $\Delta$ PTA and  $\Delta$ WRS.
- Signed-rank analysis of the treated v. contralateral ear.
- Multivariate ANCOVA subgroup analyses.
- Kaplan-Meier survival free of non-serviceable hearing.

## Results

### Sample characteristics

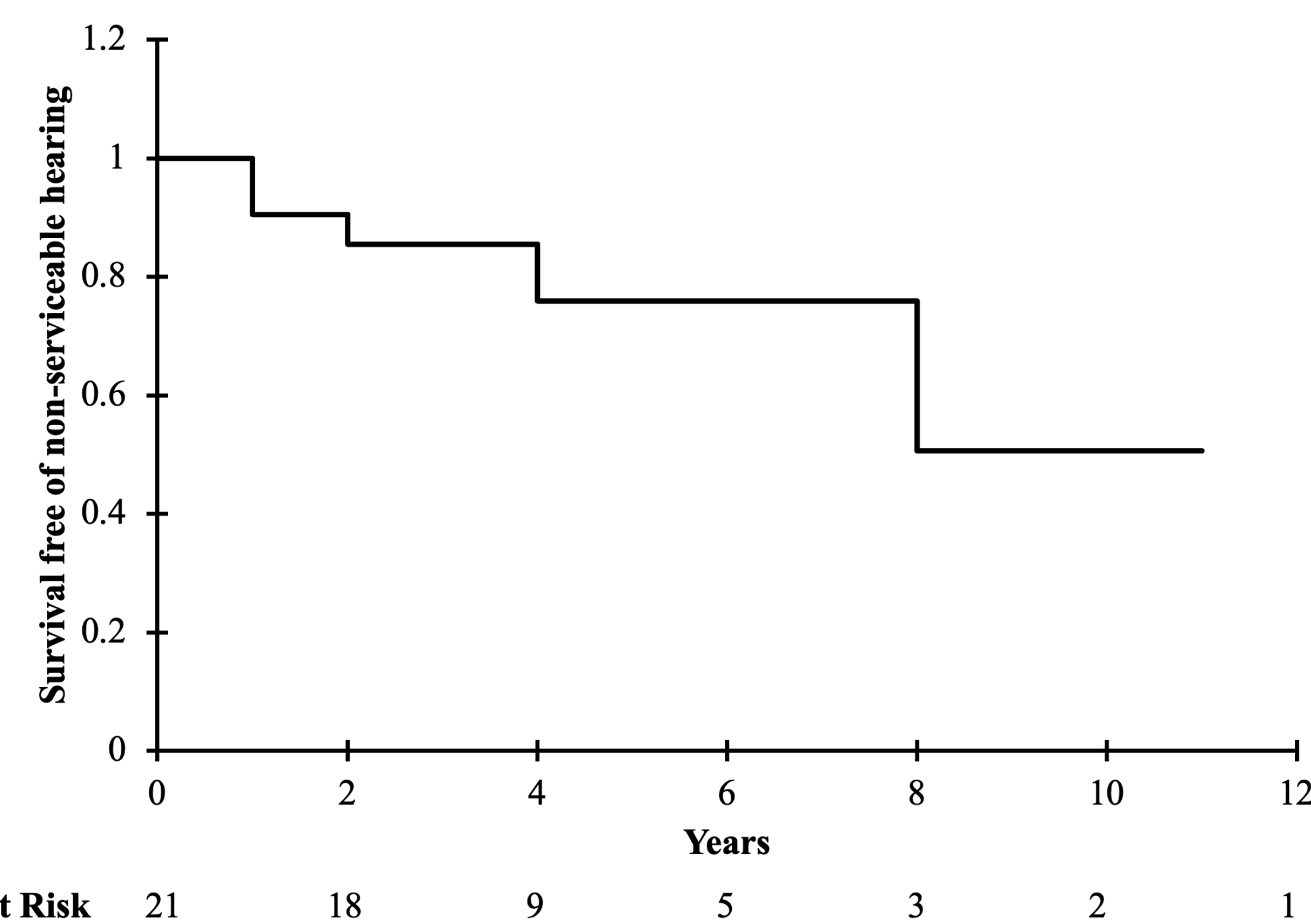
- Seventy-four patients treated with SABR (2009-2020).
- Final cohort: 21 patients.
  - Exclusions: non-serviceable baseline hearing (n=30), missing audiograms (n=21), bilateral tumors (n=2).
- No significant associations between hearing decline and baseline patient/tumor characteristics.

**Table 1.** Patient demographic and clinical data of study and excluded sample.

Characteristics	Study sample, n=21	Excluded sample, n=53	p
Age in years, median, IQR)	65 (54-70)	56.5 (51-68)	0.044
Sex, N (%)			0.122
Female	17 (81.0)	33 (62.3)	
Male	4 (19.0)	20 (37.7)	
Race, N (%)			0.343
White	17 (81.0)	38 (71.7)	
Black	2 (9.5)	12 (22.6)	
Other	2 (9.5)	3 (5.7)	
Laterality, N (%)			0.453
Left	10 (47.6)	30 (56.6)	
Right	11 (52.4)	21 (39.6)	
Tumor site, N (%)			0.859
Jugulare	8 (38.1)	24 (45.3)	
Jugulotympanic	9 (42.9)	19 (35.8)	
Vagale	4 (19.0)	8 (15.1)	
Approach, N (%)			0.834
Primary surgery	15 (71.4)	31 (68.9)	
Primary SABR	6 (28.6)	14 (31.1)	

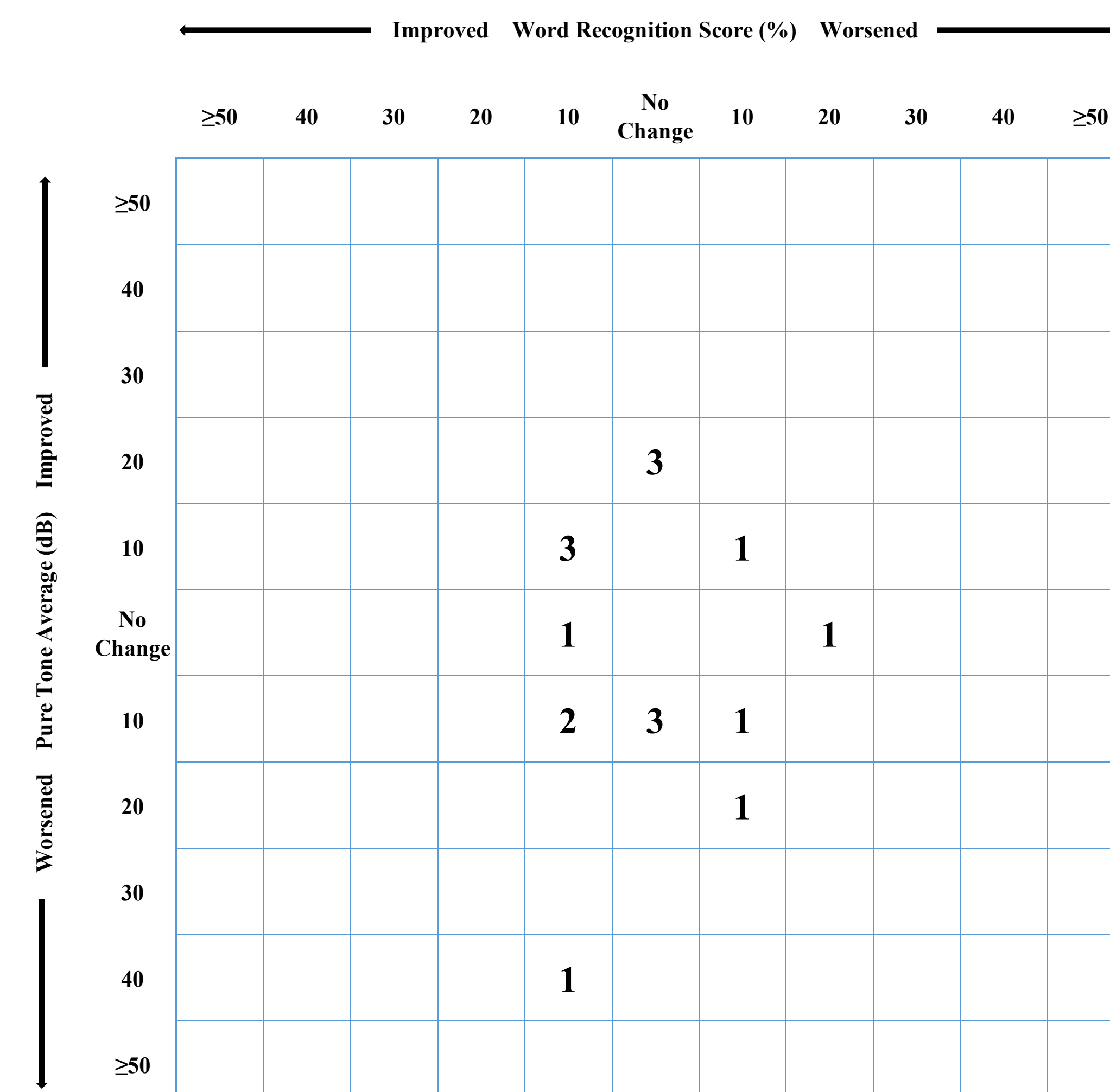
**Table 2.** Hearing outcomes over a median follow-up of 36.6 months (IQR 18.1-80.1).

Characteristics	Treated ear	Contralateral ear	Median difference (95% CI)	p
Baseline PTA, dB	30 (20-33)	16 (8-20)	14 (7.5, 17.0)	0.0001
Baseline WRS, %	96 (92-100)	100 (100-100)	4 (4-8)	0.002
$\Delta$ PTA, dB/yr	1.12 (1.34-3.31)	1.32 (0.93-1.92)	0.20 (-4.91, 2.61)	0.149
$\Delta$ WRS, %/yr	0 (0-0.74)	0 (-8-0)	0 (-0.45, 8.73)	0.063



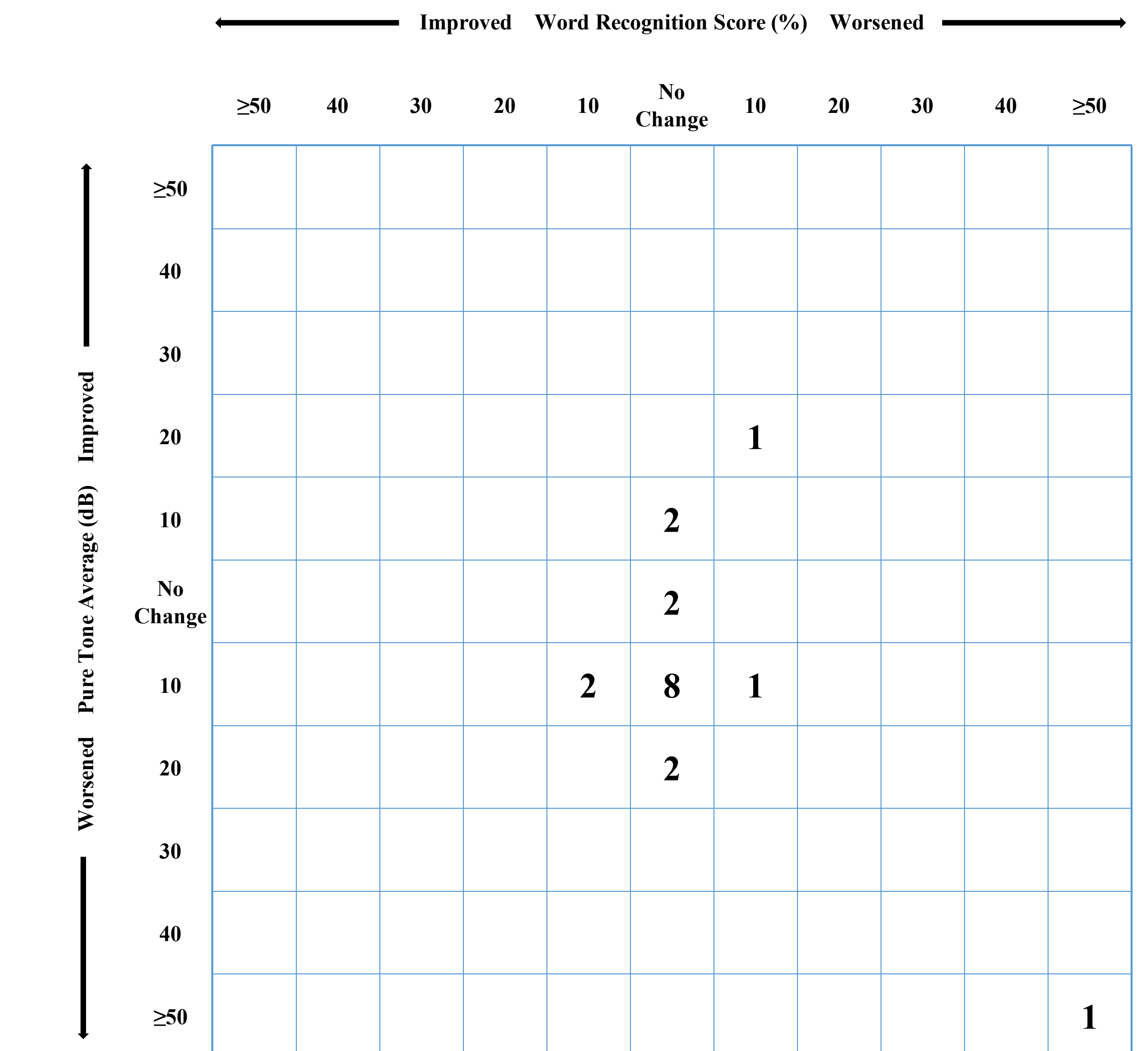
**Figure 1.** Survival free of non-serviceable hearing (Kaplan–Meier method) following SABR, defined as progression to AAO-HNS Hearing Class C-D.

- Estimated median survival free of non-serviceable hearing rates at 1-, 3-, and 5-years post-SABR: 90.5% (95% CI 67.0-97.5), 85.5% (95% CI 61.3-95.1), and 76.0% (95% CI 45.2-90.9), respectively.
- Four patients developed non-serviceable hearing of the treated ear at a median of 23.6 months (IQR 6.16-41.0) post-SABR.



**Figure 2.** Scattergram of posttreatment hearing results of the treated ear over the study duration. Each number represents the number of patients whose audiometric data place them into a certain square.

- One patient experienced a decline in PTA >30 dB of the treated ear, corresponding with progression to non-serviceable hearing.
- Remaining patients cluster near the origin, indicating minimal change in PTA and WRS of the treated ear over the study duration.



**Figure 3.** Scattergram of posttreatment hearing results of the contralateral ear over the study duration. Each number represents the number of patients whose audiometric data place them into a certain square.

- One patient experienced a decline in PTA and WRS >50 dB of the contralateral ear, corresponding with progression to non-serviceable hearing.
- Remaining patients cluster near the origin, indicating minimal change in PTA and WRS of the contralateral ear over the study duration.

## Discussion and Conclusion

- Our findings of minimal HL after SABR are consistent with prior SRS/SABR studies, which similarly demonstrate preserved serviceable hearing.<sup>6-8</sup>
- There was no difference in HL between the treated and contralateral ear, suggesting SABR may not contribute to the observed HL.
- Four patients (19%) developed non-serviceable hearing of the treated ear within at least 5 years. This data within our older cohort aligns with the 21% 5-year-incidence of presbycusis in the general population.<sup>9</sup>
- Strengths:** 10+ year study duration, use of the contralateral ear as an internal control.
- Limitations:** Retrospective design, limited long-term follow up (median 3 years), older study sample limits generalizability to younger populations.

## Conclusion

- The insights generated in this single institution series provide a more complete understanding of long-term hearing expectations following SABR of HNPGs.
- The impact of SABR on any subsequent deterioration in hearing remains minimal and mirrors changes seen in the contralateral ear.
- Risk of progression to non-serviceable hearing over intermediate to long term follow-up is low following SABR of HNPGs.

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