



# LINAC-Based Stereotactic Body Radiation Therapy for Benign Tumors of the Skull Base

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## Background

### What is LINAC-based SBRT?

- An external-beam radiation therapy (EBRT) that combines high definition multileaf collimators (MLC) based linear accelerators with image guidance to precisely deliver ablative radiation dose to localized tumors while sparing surrounding healthy tissues.

### Two primary techniques

- Intensity modulated radiation therapy (including IMRT and VMAT) - more effective to give a better conformity index, uniformity index, and less dose in untargeted surrounding areas, especially for complex tumor geometries (**head and neck cases**)
- Dynamic Conformal Arc - efficient and effective treatment for less complex tumor geometries, reduced risk of interplay errors induced by motion (**lung cases**)

### What tumors were treated?

- Paragangliomas
  - Neural crest cell-derived tumors that are found in the jugular bulb, near the inner ear, and associated with the autonomic ganglia
- Schwannomas
  - Arise from Schwann cells, the most common glial cells in the peripheral nerve system
  - Vestibular Schwannomas are associated with the vestibulocochlear nerve (CN VIII)
- Myxoid Tumors
  - The most common soft tissue sarcomas and are derived from fibroblasts
- These tumor types are benign or slow-growing and can be found at the base of the skull. The surrounding structures necessitate therapy that limits damage to untargeted areas.

## Methods

### Who?

- Patients enrolled in the prospective skull base registry and treated between 2017 and 2023 were included in the study. All patients were evaluated for surgery and the risk of potential cranial nerve injury was the primary reason for consideration of radiation therapy.

### What?

- This is a retrospective analysis of outcomes of patients presenting with a benign tumor of the skull base treated with LINAC-based SBRT.

### How?

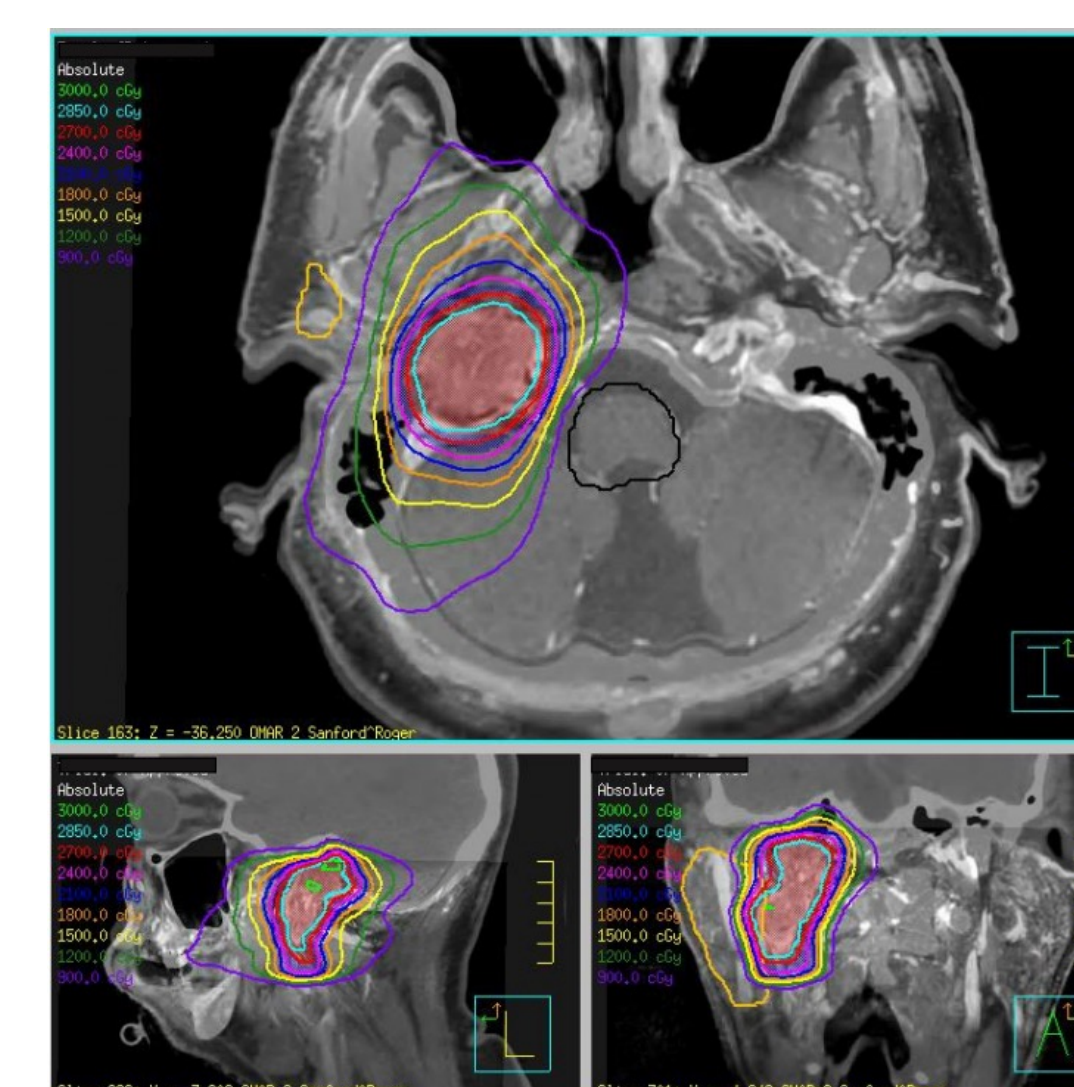
- Variables that were used to measure outcome included local control (LC), overall survival (OS), state of pre-treatment symptoms, and toxicity.
  - LC = radiographic evidence of lack of progression
  - Follow up interval = end of SBRT to last follow up

## Results

- Thirty-one patients formed the cohort.
- Median age was 51 years. Twenty-three cases were paragangliomas, 7 cases were schwannomas, and 1 case was a myxoid tumor.
- Distribution of treated sites
  - 26 jugular foramen/jugulotympanicum
  - 3 carotid space
  - 1 hypoglossal canal
  - 1 petrous apex
- Thirty patients had gross disease at the time of SBRT. One case was treated after resection.
- Six patients were treated prior to SBRT among those with gross disease. Five surgically and one had prior fractionated radiation.
- Indications for treatment were growth and/or symptomatic progression.
- Hearing loss and tinnitus were the most common reported pre-treatment symptoms.

## Results (continued)

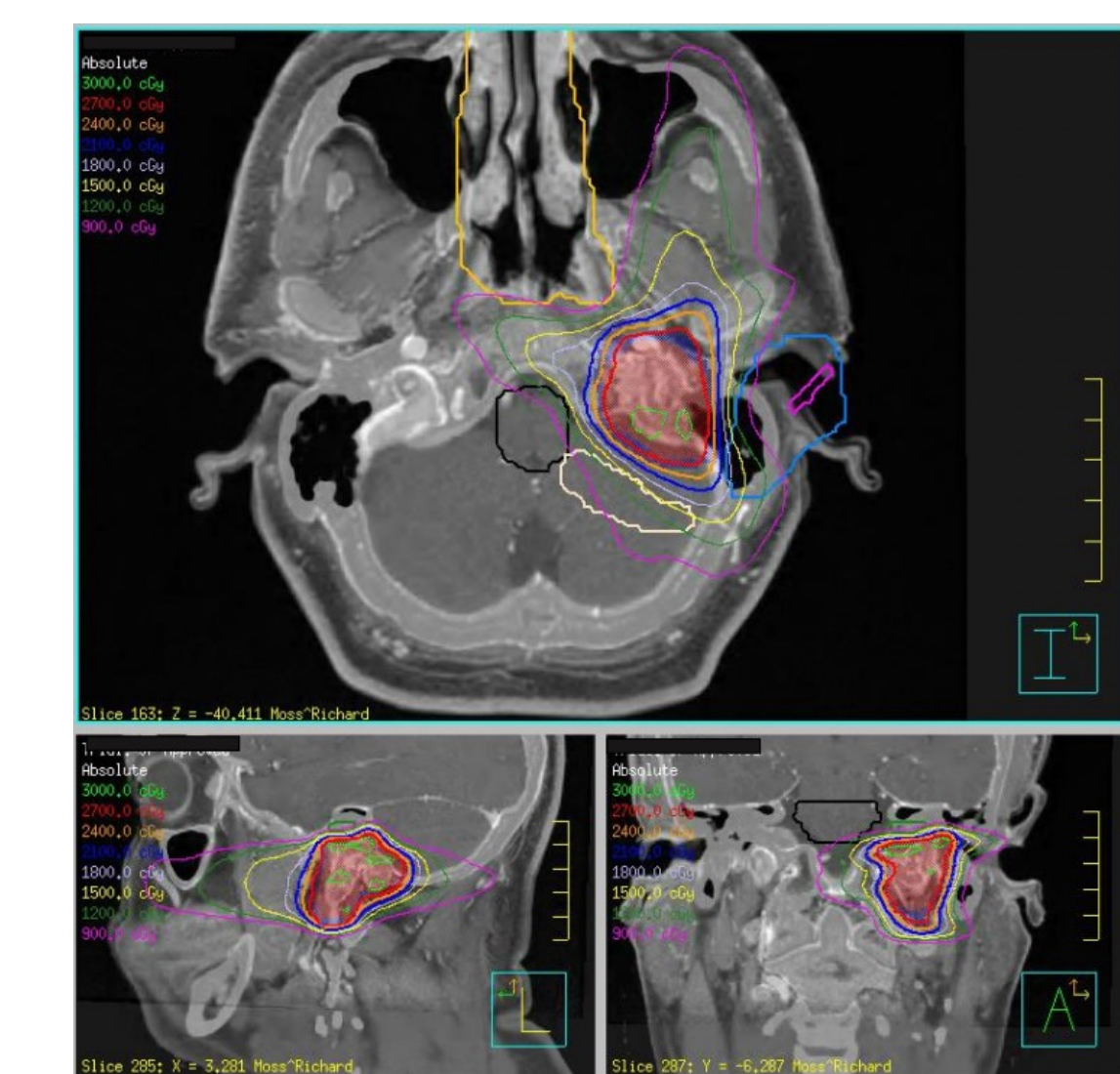
- Seventeen patients (55%) reported an improvement in symptoms and 14 patients (45%) reported no worsening symptoms.
- The treated tumors were radiographically stable in all patients treated for gross disease, and the patient treated adjuvantly remained disease free.
- There was 1 grade 1 tinnitus, 1 grade 2 facial nerve palsy and 1 grade 2 nausea but no grade 3 or higher toxicities.



**Figure 1.** Planning image showing dose distribution encompassing the tumor. This patient was treated for paraganglioma to 27Gy in 3 fractions.

## Conclusions

- In this largest series to date, SBRT for benign skull base tumors resulted in excellent local control, minimal toxicity and overall improvement in presenting symptoms.
- SBRT is a favorable treatment option for those who would otherwise have potentially significant cranial nerve injury following surgical resection.



**Figure 2.** Planning image showing dose distribution encompassing the tumor. This patient was treated for paraganglioma to 27Gy in 3 fractions.

Table 1. Characteristics of 31 patients undergoing SBRT for benign tumors at MD Anderson Cancer Center					
	Incidence	Median (range)			
Age (years)		51 (23-83)			
Follow up (months)		20 (1-65)			
Sex	N (%)				
Male	17 (55)				
Female	14 (45)				
Benign Tumor Type					
Paraganglioma	23 (74)				
Schwannoma	7 (23)				
Myxoid tumor	1 (3)				
Laterality					
Right	16 (52)				
Left	14 (45)				
Bilateral	1 (3)				
Treated sites					
Jugular foramen/Jugulotympanicum	26 (84)				
Carotid space	3 (10)				
Hypoglossal canal	1 (3)				
Petrous apex	1 (3)				
Disease status					
Gross disease	30 (97)				
Postoperative	1 (3)				
Prior treatment among those with gross disease					
Surgery	5 (16)				
Radiation	1 (3)				
Pre-treatment symptoms			Stable/No Change	Improved	Worsened
Tongue deviation	9 (29)	6		3	0
Shoulder weakness	2 (6)	2		0	0
Dysphagia	7 (23)	3		4	0
Palpitations/Flushing	4 (13)	4		0	0
Tinnitus	18 (58)	7		9	1
Hearing loss	25 (81)	16		1	7
Dizziness	9 (29)	2		7	0
Otalgia	6 (19)	3		3	0
Headache	3 (10)	0		2	1
Hoarseness	8 (26)	4		4	0
Response to treatment					
Improvement in symptoms	17 (55)				
No worsening symptoms	14 (45)				
Radiographically stable	31 (100)				
Toxicity following SBRT					
Grade 1	1 (3)				
Grade 2	2 (6)				

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