

# Standardized MRI Targeting of the Sphenopalatine Ganglion for Stereotactic Radiosurgery

Anthony Yulin Chen BA<sup>1</sup>, Alexis Nichaporuck MD<sup>2</sup>, Kiran S. Talekar MD<sup>2</sup>, Rui Feng MD MS<sup>3</sup>, James J. Evans MD<sup>3</sup>, Wenyin Shi MD PhD<sup>4</sup>

<sup>1</sup>Sidney Kimmel Medical College, Thomas Jefferson University, <sup>2</sup>Department of Radiology, Thomas Jefferson University, <sup>3</sup>Department of Neurological Surgery, Thomas Jefferson University, <sup>4</sup>Department of Radiation Oncology, Thomas Jefferson University

## INTRODUCTION

- The sphenopalatine ganglion (SPG) is a key parasympathetic relay within the pterygopalatine fossa (PPF) and an emerging target for stereotactic radiosurgery (SRS) in refractory headaches and facial pain<sup>1</sup>.
- The small dimensions of the SPG ( $3.58 \pm 0.6$  mm) necessitate the use of small collimators for SPG SRS, making accurate localization essential; **however, no reproducible protocol exists**<sup>2</sup>.
- Previous studies used the vidian canal opening (VCo) as a key landmark, but anatomic and methodological variability reduced reproducibility. These studies also excluded many patients with atypical anatomy that complicated identification<sup>2,3</sup>.
- Objective:** To develop a reproducible CISS (Constructive Interference in Steady State) or an equivalent sequence MRI-based measurement protocol for SPG localization using a newly defined landmark, the vidian–palatovaginal apex (VPVA).

## METHODS

### 1. Identify the Vidian Canal

- Select the axial CISS slice where the vidian canal (VC) walls are maximally parallel, corresponding to the canal's horizontal mid-portion.

### 2. Define the VPVA

- Trace medial wall of VC to its junction with the lateral wall of the palatovaginal canal (PVC), forming the imaginary apex that creates an inverted Y configuration of the medial PPF. This apex is the VPVA (Fig 1B&C).

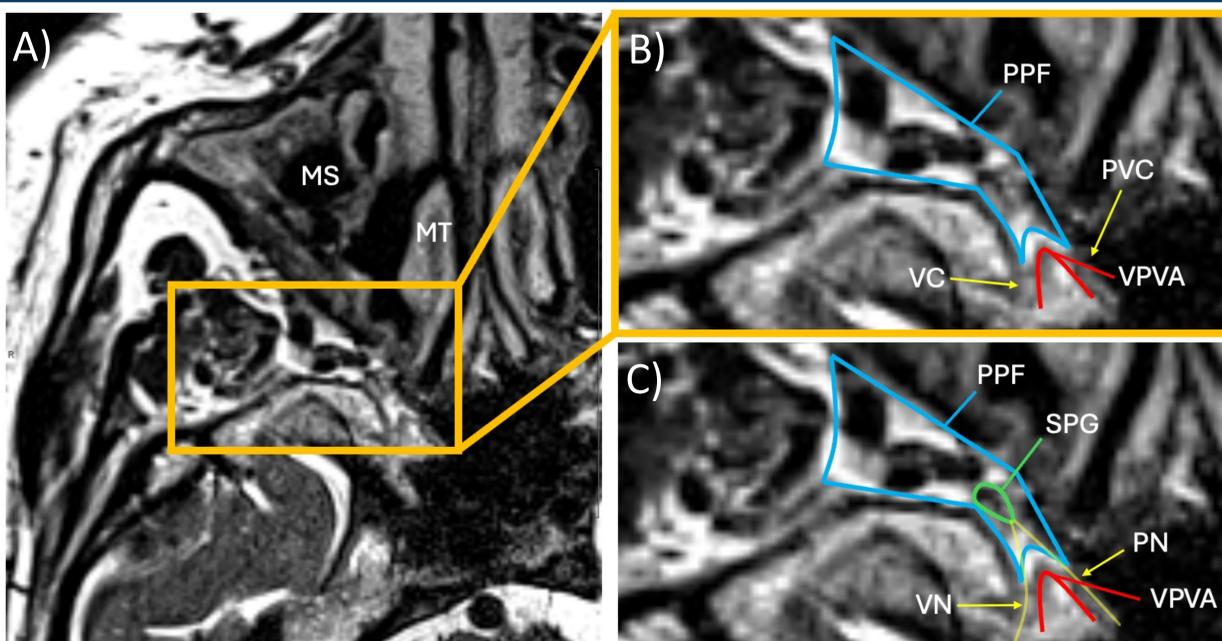
### 3. Identify the SPG & Isocenter

- Trace the lateral wall of the VC beyond the VCo as it transitions into the posterior wall of the PPF.
- Identify the SPG, typically 1–3 mm anterior to the posterior wall and within the medial third of the PPF, surrounded by a T2-hypointense contiguous rim (Fig 1C).
- Select the axial slice where the T2-hypointense rim is the most contiguous and where the SPG has the largest cross-sectional area.
- Define the isocenter as the geometric center of the SPG on the selected slice (SPGi).

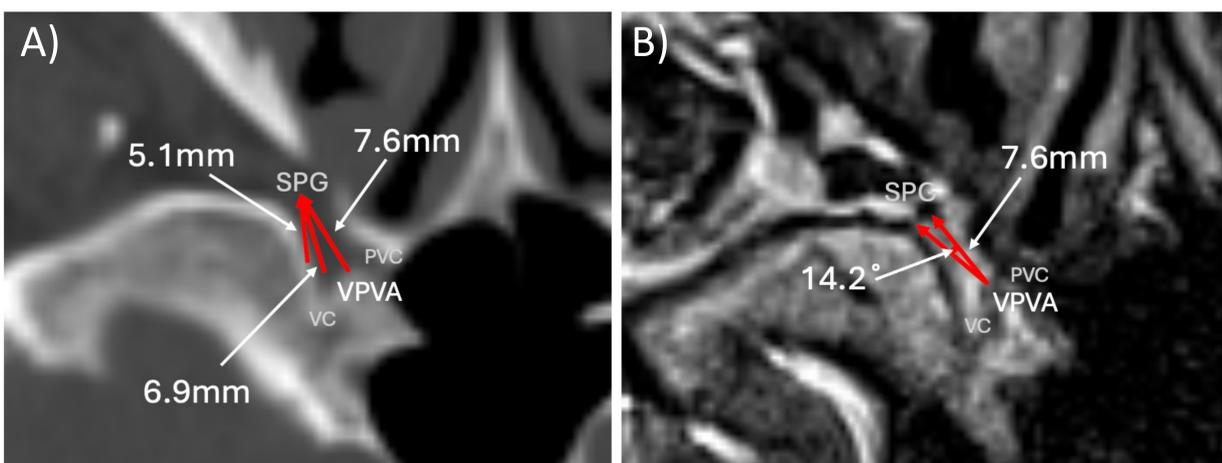
### 4. Measure VPVA → SPG distance & angle

- Measure distance from the VPVA to the SPGi and craniocaudal offset if not in-plane (Fig 2B).
- Find point on posterior wall of PPF nearest to SPG and trace a line from this point to VPVA.
- Record angle between the two lines drawn from previous 2 steps (Fig 2B).

## RESULTS



**Fig 1.** MRI-only workflow for SPG identification, **A)** Axial overview, **B)** VPVA relationship with PPF, VC & PVC, **C)** SPG localization relative to the VPVA and surrounding structures (MS = maxillary sinus, MT = middle turbinate, VN = vidian nerve, PN = pharyngeal nerve)



**Fig 2.** Distance to SPG measurements in one patient, **A)** Axial CT showing measurement from VC opening is inconsistent, **B)** Axial MRI showing VPVA yields stable reference point

Side	VPVA ID	SPG ID	SPG Shape	SPG CC Position vs VC	CC Offset (mm)	In-Plane Distance (mm)	True Distance to SPG (mm)
R	Y	Y	Crescent	Caudal	2.1	7.6	7.9
L	Y	Y	Elongated	In-plane	0	7.0	7.0
R	Y	Y	Ovoid	In-plane	0	5.2	5.2
L	Y	Y	Amorphous	In-plane	0	4.8	4.8
R	Y	Y	Round	Superior	2.6	7.5	7.9
L	Y	Y	Elongated	Superior	0.65	8.9	8.9
R	Y	Y	Crescent	Inferior	7.2	8.0	10.8
L	Y	Y	Crescent	In-plane	0	6.5	6.5
R	Y	Y	Amorphous	Inferior	2.0	8.5	8.7
L	Y	Y	Bipartite	Inferior	2.0	11.5	11.7
R	Y	Y	Crescent	Superior	3.6	4.1	5.5
L	Y	Y	Elongated	Superior	3.2	6.8	7.5

**Table 1.** Sample table of anatomical variation and VPVA-Based SPG measurements in our first 6 patients with no exclusion (ID = identification, CC = craniocaudal)

## DISCUSSION

- We identified a mean VPVA–SPG in-plane distance of 7 mm with a mean craniocaudal offset of 3.6 mm. The VPVA was identifiable in all patients and enabled consistent SPG measurements without MRI–CT fusion, standardizing a previously variable process and supporting radiosurgical planning.
- Limitations include single-center imaging parameters and absence of inter-observer reliability assessment. Broader validation is needed.

## References

- Diener HC, Tassorelli C, Dodick DW. Management of trigeminal autonomic cephalalgias including chronic cluster: A review. *JAMA Neurol.* 2023;80(3):308-319. doi:10.1001/jamaneurol.2022.4804
- Alvernia JE, Spomar DG, Olivero WC. A computed tomography scan and anatomical cadaveric study of the pterygopalatine ganglion for use in Gamma Knife treatment of cluster headache. *J Neurosurg.* 2007;107(4):805-808. doi:10.3171/JNS-07/10/0805
- Bratbak DF, Folvik M, Nordgård S, et al. Depicting the pterygopalatine ganglion on 3 Tesla magnetic resonance images. *Surg Radiol Anat.* 2018;40(6):689-695. doi:10.1007/s00276-017-1960-6