# Gasserian ganglion: appearance on contrast-enhanced MR.

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# Gasserian Ganglion: Appearance on Contrast-Enhanced MR

David M. Downs, Thomas R. Damiano, and David Rubinstein

**PURPOSE:** To characterize the appearance of the gasserian ganglion on contrast-enhanced MR images. **METHODS:** We retrospectively reviewed the MR images from 57 patients with suspected pituitary disease. These patients had undergone unenhanced and contrast-enhanced MR imaging of the sella, including evaluation of Meckel's cave. None of the patients had clinical signs or symptoms referable to the fifth cranial nerve or ganglion. Correlation was made with a previous study that compared gross anatomy with high-resolution CT scans of cadaveric specimens. **RESULTS:** A discrete semilunar enhancing structure within the inferolateral aspect of Meckel's cave was identified in 100 of the 114 caves examined; the other 14 caves had a thickened area of enhancement that blended with the dura inferolaterally. A small semilunar structure within the inferolateral aspect of Meckel's cave was also identified on CT scans of the cadaveric specimens. **CONCLUSION:** The gasserian ganglion enhances on MR images and should not be confused with a pathologic process.

**Index terms:** Magnetic resonance, contrast enhancement; Nerves, trigeminal (V); Sella turcica, magnetic resonance

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The anatomic and radiologic characteristics of the gasserian ganglion within Meckel's cave have been described by using anatomic dissection, computed tomography (CT), and unenhanced high-resolution magnetic resonance (MR) imaging (1–6). The purpose of this article is to evaluate the enhancement characteristics of the gasserian ganglion on conventional MR imaging.

## Materials and Methods

We retrospectively reviewed the records of 57 patients referred to the neuroradiology section for suspected pituitary disease. These patients had undergone conventional MR imaging of the sella, including unenhanced and contrast-enhanced T1-weighted coronal sequences through Meckel's cave. Patients with cavernous sinus invasion by tumor were excluded, but intrapituitary disease was not a criterion for exclusion. No patients had symptoms or signs referable to the fifth cranial nerve or ganglion. The examinations were performed with a 1.5-T unit (Signa; GE Medical Systems, Milwaukee, Wis). The sella imaging protocol included coronal T1-weighted sequences (200–700/15/4 [repetition time/echo time/excitations]) with a 3-mm section thickness and a 0- or 0.5-mm intersection gap, an 18-cm field of view, and a 256 × 256 matrix. The repetition time used depended on the number of sections needed to image the sella. This protocol was performed before and after intravenous administration of 10 mL gadopentetate dimeglumine (469.01 mg/mL). Meckel's caves were assessed and the enhancement pattern was characterized by consensus.

Twenty formalin-fixed cadaveric specimens that contained the temporal bone and cavernous sinus were evaluated by high-resolution CT as previously reported (1). The specimens were scanned in 1-mm contiguous coronal sections with a CT scanner (Hispeed Advantage; GE Medical Systems) at 120 kV and 200 or 400 mA. The images were reconstructed with a 9.6-cm field of view and bone algorithm. Seven of these specimens were dissected and directly correlated with their CT scans. The anatomy as

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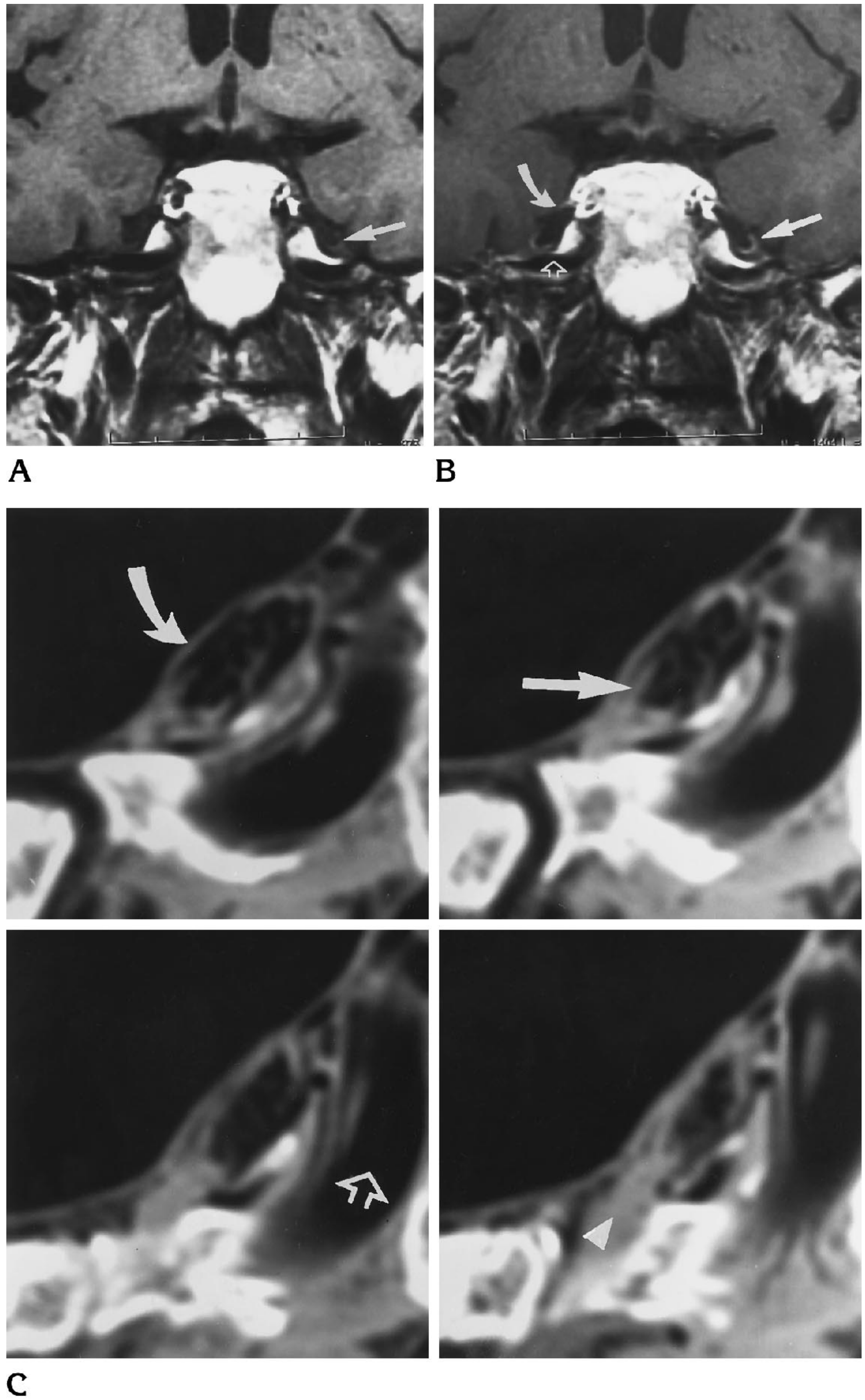
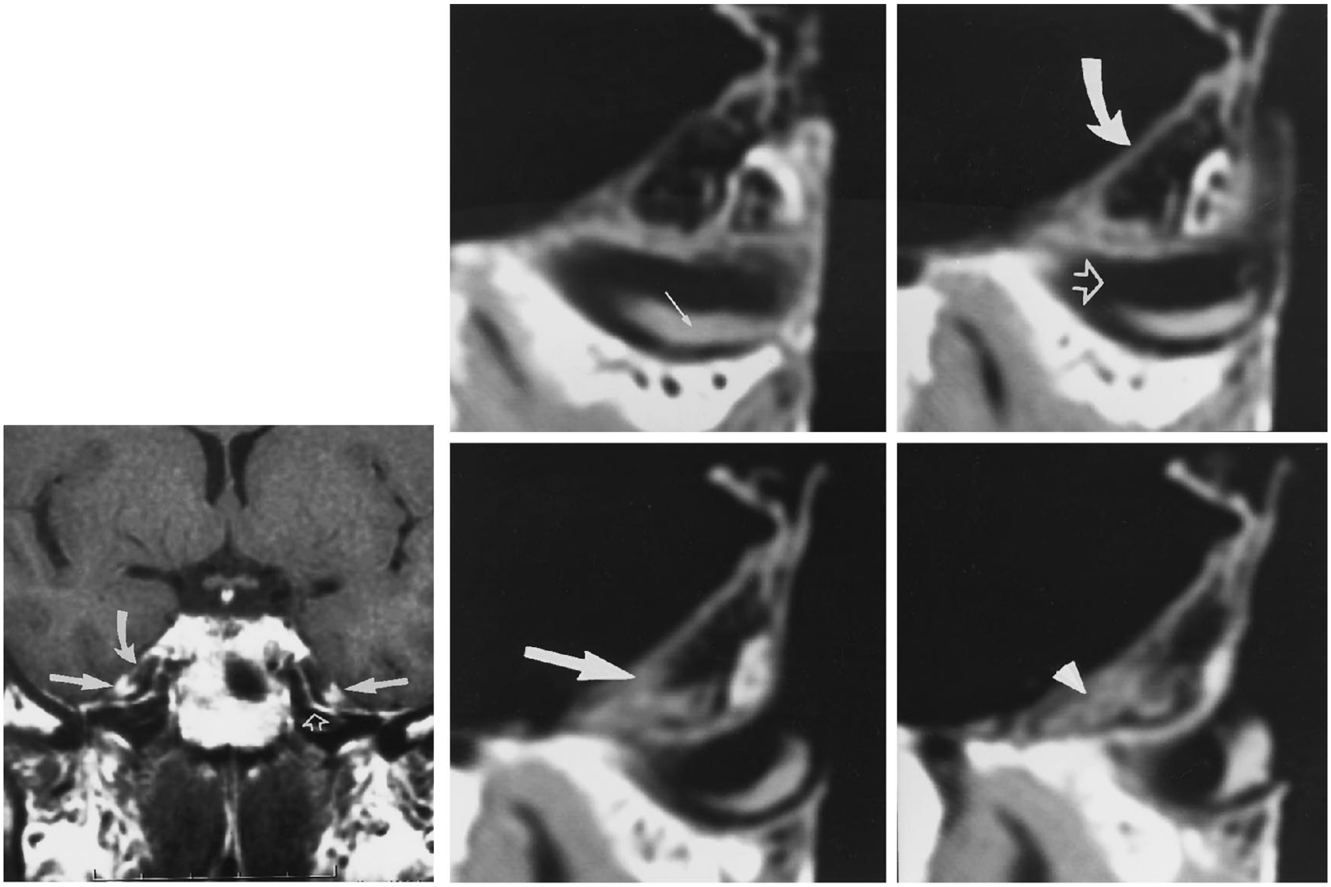



Fig 1. *A*, Coronal unenhanced T1-weighted MR image through Meckel's caves shows the thin semilunar gasserian ganglion within the left cave (*arrow*).

*B*, Coronal contrast-enhanced T1-weighted MR image shows enhancement of the ganglion (*straight white arrow*). The internal carotid artery (*open arrow*) and the lateral wall of Meckel's cave (*curved arrow*) are also shown.

*C*, Coronal CT scans through a cadaveric specimen of Meckel's cave from posterior to anterior (*top left to bottom right*) show the thin semilunar ganglion (*straight white arrow*), lateral wall of Meckel's cave (*curved arrow*), mandibular division of the trigeminal nerve exiting the foramen ovale (*white arrowhead*), and internal carotid artery (*open arrow*).



A B

Fig 2. *A*, Coronal contrast-enhanced T1-weighted MR image shows enhancement of the gasserian ganglia (*straight arrows*). Their appearance is thicker and more nodular than the ganglia in Fig 1. Also noted are the internal carotid artery (*open arrow*) and the lateral wall of Meckel's cave (*curved arrow*).

*B*, Coronal CT sections of a cadaveric specimen show a thick, nodular ganglion (*thick straight arrow*) that is continuous inferiorly with the mandibular division of the trigeminal nerve (*arrowhead*). The internal carotid artery (*open arrow*) contains a small amount of clot (*thin arrow*). Also noted is the lateral wall of Meckel's cave (*curved arrow*).

demonstrated by MR imaging, CT, and dissection were then compared.

## Results

All Meckel's caves studied had thin peripheral enhancement along the anterior and superior aspects (which decreased posteriorly) and thin curvilinear enhancement between the medial surface of the cave and the cavernous portion of the internal carotid artery. This enhancement pattern represents the dural layers that define Meckel's caves (4–8).

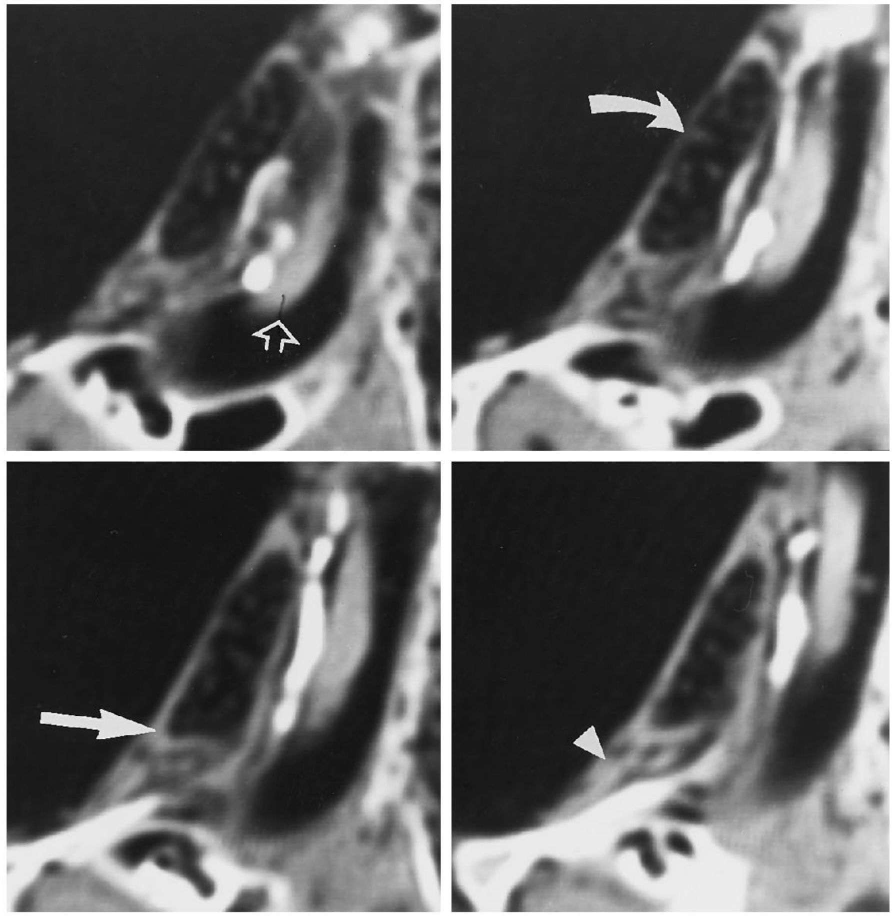
MR imaging showed discrete semilunar enhancing structure within the inferolateral aspect of Meckel's cave in 100 of the 114 caves. This structure's shape varied from thin and regular (Fig 1A and B) to thick and nodular (Fig 2A), with the convex margin always oriented inferolaterally. The remaining contents of Meckel's cave showed isointensity with cerebrospinal fluid. Variations on this enhancement pattern included linear superomedial extensions into the cave from the semilunar structure in 13 of the caves, a separate linear band oriented along the cave's long axis anterolaterally in 1 cave, and a separate round focus of enhancement in 2 caves (Fig 3).

For 14 Meckel's caves, MR imaging did not show a distinct enhancing structure within the cave but rather showed a thickened semilunar area of enhancement inferolaterally that blended with the dura (Fig 4A).

All 20 CT scans showed similar anatomy. The trigeminal nerve consisted of numerous small fibers, surrounded by air, within the posterior and superior aspect of Meckel's cave. A

3

4A



4B

Fig 3. Coronal contrast-enhanced T1-weighted MR image shows an isolated round focus of enhancement (*straight arrow*) within the left Meckel's cave, separate from the ganglion. The enhancing lateral wall of the right Meckel's cave (*curved arrow*) is also noted.

Fig 4. *A*, Coronal contrast-enhanced T1-weighted MR image shows thin enhancing gasserian ganglia inferolaterally (*straight arrow*) that blend with the dura (*curved arrow*).

*B*, Coronal CT scans of a cadaveric specimen also show a very thin ganglion (*straight arrow*) contiguous to the dura (*curved arrow*). Also note the mandibular division of the trigeminal nerve inferior to the ganglion (*arrowhead*) and a small amount of clot within the internal carotid artery (*open arrow*).

small semilunar structure was identified within the anterior and inferolateral aspect of Meckel's cave; its variations were similar to those shown by contrast-enhanced MR imaging (Figs 1C, 2B, and 4B). This semilunar structure was continuous with the mandibular division of the trigeminal nerve inferiorly at the level of the foramen ovale in all cases (Figs 1C and 2B).

## Discussion

The normal anatomy and imaging characteristics of the gasserian ganglion within Meckel's cave, as well as its pathologic appearances, have been well described (1–8). Extensive research has been directed toward the trigeminal nerve, the gasserian ganglion, and the three divisions, primarily in search of better ways to evaluate the clinical entity of trigeminal neuralgia. Contrast-enhanced MR imaging of the normal gasserian ganglion has not been adequately discussed in the literature (6, 8). By correlating the MR anatomy with the anatomy shown on high-resolution CT scans, we have shown that conventional coronal T1-weighted MR imaging (both unenhanced and contrast-enhanced) shows enhancement of the gasserian ganglion in asymptomatic patients.

A discrete semilunar enhancing structure within the inferolateral aspect of Meckel's cave, representing the gasserian ganglion, was identified in 100 (88%) of 114 caves evaluated by conventional MR imaging. The ganglia varied from thin to nodular. For the other 14 Meckel's caves (12%), MR imaging showed a semilunar thickening, which was thought to represent the ganglion. This thickening blended with the dura of the cave. Both these patterns of gasserian ganglion enhancement correlated well with the high-resolution CT findings. The cerebrospinal fluid intensity of the remaining contents of Meckel's cave represents the cisterna trigemini surrounding the small root bundles of the trigeminal nerve as they course anteriorly to join the gasserian ganglion (1, 6). A single round focus of enhancement separate from the ganglion was seen in two caves; this focus might represent an ectopic focus of ganglion, a vascular structure, or a small benign lesion.

The mechanism of gasserian ganglion enhancement is unclear. Gebarski et al (9) reported that this enhancement seen on contrast-enhanced MR images along the normal facial nerve within the facial canal was probably caused by the flux of contrast material in the lush circumneural arteriovenous plexus that invests the nerve in the canal. The arterial supply to the gasserian ganglion arises from branches of the inferolateral trunk, the tentorial artery of the meningohypophysial trunk, or the middle meningeal artery, all of which arise from the intracavernous carotid artery (10). However, we found no description of an arteriovenous plexus within Meckel's cave. Experimental studies using biochemical and fluorescent tracers, as well as gadopentetate dimeglumine, have shown vascular permeability within the ganglionic portions of the facial and trigeminal nerves in animal models (11, 12). Also, normal spinal dorsal root ganglia have fenestrated capillaries with no blood-nerve barrier, and consequently they show enhancement with gadopentetate dimeglumine (13). Therefore, it seems likely that enhancement of the gasserian ganglion with this contrast material is also caused by lack of a blood-nerve barrier at these locations.

In conclusion, enhancement of the gasserian ganglion on conventional contrast-enhanced MR images in asymptomatic patients is a normal finding and should not be confused with schwannoma, neurofibroma, or other pathologic entities.

## References


1. Rubenstien D, Stears RLG, Stears JC. Trigeminal nerve and ganglion in the Meckel cave: appearance at CT and MR imaging. *Radiology* 1994;193:155–159
2. Kapila A, Chakeres DW, Blanco E. The Meckel cave: computed tomographic study, I: normal anatomy, II: pathology. *Radiology* 1984;152:425–433
3. Chui M, Tucker W, Hudson A, Bayer N. High resolution CT of Meckel's cave. *Neuroradiology* 1985;27:403–409
4. Hutchins LG, Harnsberger HR, Hardin CW, Dillon WP, Smoker WRK, Osborn AG. The radiologic assessment of trigeminal neuropathy. *AJNR Am J Neuroradiol* 1989;10:1031–1038
5. Daniels DL, Pech P, Pojunas KW, et al. Trigeminal nerve: anatomic correlation with MR imaging. *Radiology* 1986;159:577–583
6. DeMarco JK, Hesselink JR. Trigeminal neuropathy. *Neuroimaging Clin N Am* 1993;3:105–128
7. Sevick RJ, Dillon WP, Engstrom J, Bergman WG, Harnsberger HR. Trigeminal neuropathy: Gd-DTPA enhanced MR imaging. *J Comput Assist Tomogr* 1991;15:605–611
8. Kilgore DP, Breger RK, Daniels DL, Pojunas KW, Williams AL, Haughton VM. Cranial tissues: normal MR appearance after intravenous injection of Gd-DTPA. *Radiology* 1986;160:757–767
9. Gebarski SS, Telian SA, Niparko JK. Enhancement along the normal facial nerve in the facial canal: MR imaging and anatomic correlation. *Radiology* 1992;183:391–394
10. Krisht A, Barnett DW, Barrow DL, Bonner G. The blood supply of the intracavernous cranial nerves: an anatomical study. *Neurosurgery* 1994;34:275–279
11. Sakihama N. Vascular permeability of fluorescent substance in cranial nerve roots. *Nippon Jibiinkoka Gakkai Kaiho* 1994;97: 684–687
12. Yanagida M. MRI enhancement of the facial nerve with Gd-DTPA, first report: experimental study on the enhancement mechanism used in viewing vascular permeability of the facial nerve. *Nippon Jibiinkoka Gakkai Kaiho* 1993;96:1320–1328
13. Breger RK, Williams AL, Daniels DL, et al. Contrast enhancement in spinal MR imaging. *AJNR Am J Neuroradiol* 1989;10:633–637