CT and Angiography of Primary Extradural Juxtasellar Tumors

Tom Moore[1, 2]
S. Ramaiah Ganti[1, 3]
Michel E. Mawad[1, 4]
Sadek K. Hilal[1]

The computed tomographic and angiographic features of 15 histologically proven primary extradural juxtasellar tumors were retrospectively reviewed. Five chordomas were characterized by prominent bone erosion and a significant posterior fossa component. Four trigeminal nerve neuromas each demonstrated bone erosion centered about Meckel's cave and moderate to marked contrast enhancement. Two cavernous sinus meningiomas revealed moderate contrast enhancement, expansion of the cavernous sinus, and moderate angiographic stain. Two cavernous hemangiomas of the cavernous sinus were intensely enhancing and demonstrated angiographic stain. Opacification of the sphenoid sinus with prominent bone destruction and lack of contrast enhancement was characteristic of a sphenoid sinus mucocele. The dural reflection could be directly visualized or indirectly inferred in each case.

While much as been written concerning pituitary adenomas, there is a relative paucity of information in the literature concerning less common extradural juxtasellar tumors. We review our experience with some of the less common tumors of this area with special attention to radiologic differential diagnosis.

Materials and Methods

Fifteen histologically proven primary extradural juxtasellar tumors from the Neurological Institute were retrospectively reviewed. Pituitary adenomas were excluded from the study. Metastatic lesions and tumors that secondarily involved the juxtasellar region were also excluded. Six male and nine female patients comprised the study with ages ranging from 9 to 65 years.

High-resolution axial and direct coronal computed tomography (CT) was performed in each case. The coronal scans were obtained as 3-mm contiguous slices. Axial sections were 6-mm contiguous slices. Contrast material was administered in each case. Angiography was available in 13 cases.

Results

The characterization of a juxtasellar lesion as extradural in origin aids in the differential diagnosis and in surgical planning. Using high-resolution CT with contrast enhancement, we were able to demonstrate the dural reflection or infer its location in each of the 15 cases and, therefore, determine the extradural location of the lesion.

Chordoma

Each of the five chordomas demonstrated prominent erosion of the clivus. Three of the five lesions were confined to the midline. One lesion involved the petroclival junction, and a second lesion extended to the middle cranial fossa. Each of the five chordomas consisted of a significant posterior fossa component. Four of the five

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[1] Department of Radiology, Neurological Institute of New York, Columbia-Presbyterian Medical Center, New York, NY 10032.

[2] Present address: Radiology Associates, 815 Pennsylvania Ave., Fort Worth, TX 76104. Address reprint requests to T. Moore.

[3] Present address: Englewood Hospital, Englewood, NJ 07631.

[4] Present address: Methodist Hospital, Houston, TX 77030.

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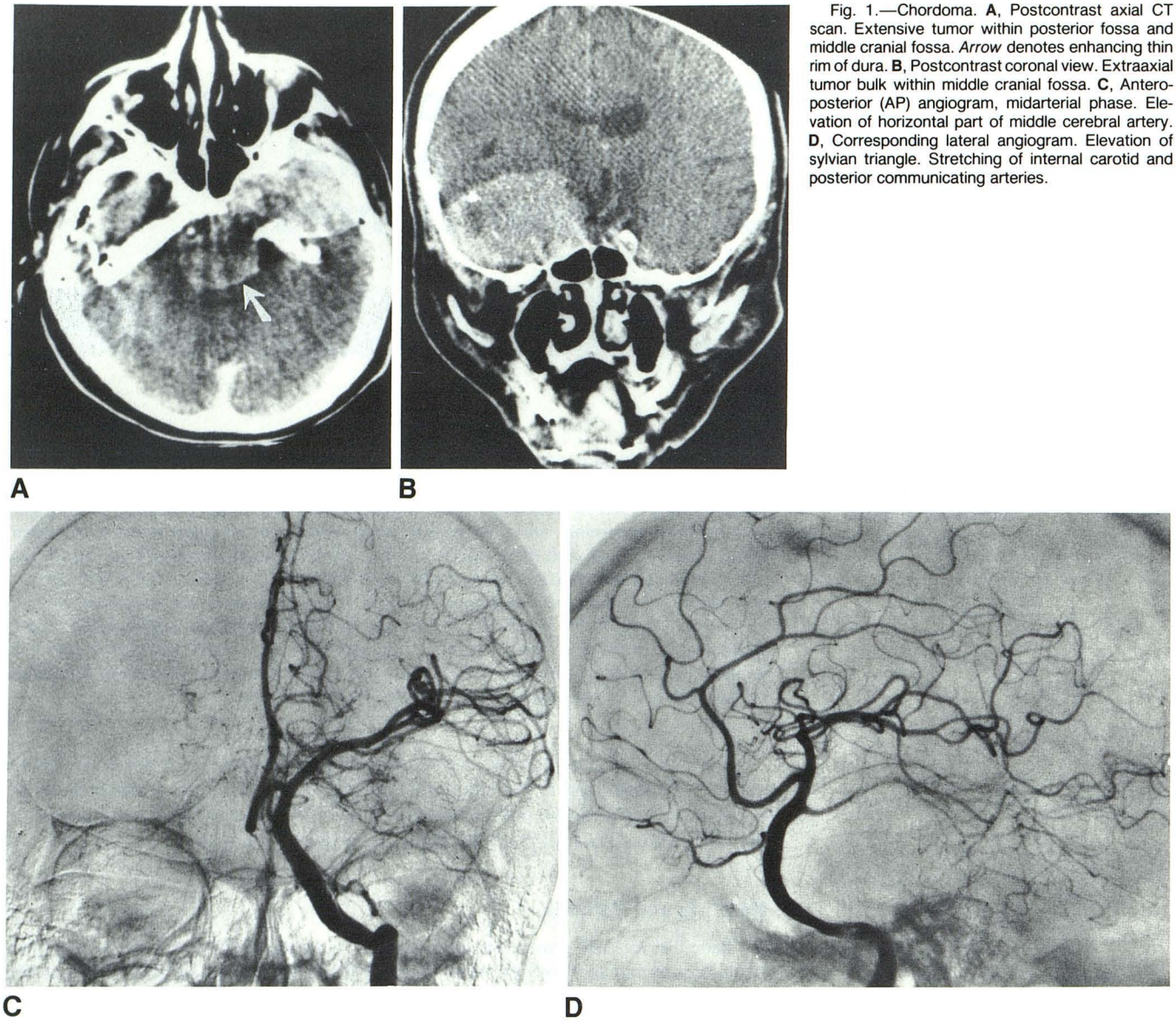


Fig. 1.—Chordoma. **A**, Postcontrast axial CT scan. Extensive tumor within posterior fossa and middle cranial fossa. *Arrow* denotes enhancing thin rim of dura. **B**, Postcontrast coronal view. Extraaxial tumor bulk within middle cranial fossa. **C**, Anteroposterior (AP) angiogram, midarterial phase. Elevation of horizontal part of middle cerebral artery. **D**, Corresponding lateral angiogram. Elevation of sylvian triangle. Stretching of internal carotid and posterior communicating arteries.

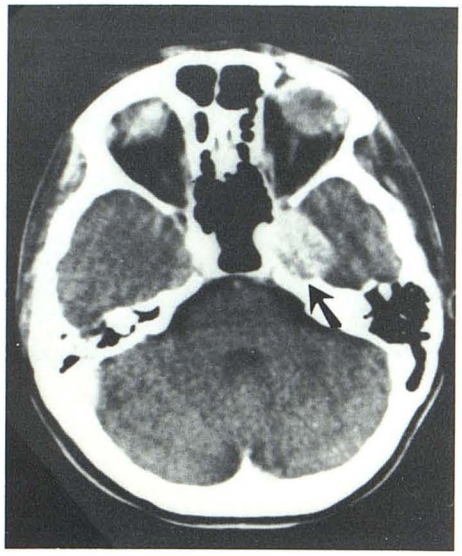
lesions were isodense with brain before contrast administration, and one lesion was hyperdense. Each lesion demonstrated mild contrast enhancement. The dural reflection was evident in each case. Tumor calcification was present in each case, and calcification within the dura mater was evident in four of five cases. An avascular mass effect was present in the four available angiographic studies. One case showed elevation of the horizontal part of the middle cerebral artery indicating middle cranial fossa extension (fig. 1).

Neuromas of the Trigeminal Nerve

Each of the four trigeminal neuromas was isodense with normal brain before contrast administration and demonstrated moderate to marked enhancement. In addition, the enhancement in three of the four tumors was inhomogeneous. No lesions were calcified, but mild bone erosion was evident in each case characteristically involving Meckel's cave at the petrous apex. One of the tumors had a small posterior fossa component. The dural reflection was demonstrated in each case (figs. 2 and 3).

Cavernous Hemangiomas

Each of the two cavernous hemangiomas arose within the cavernous sinus. Each was isodense with normal brain before contrast administration and demonstrated intense contrast enhancement. Prominent bone erosion in the parasellar region was present in each case. Neither lesion was calcified. The dural reflection was demonstrated in both patients. Angiographic findings consisted of a mild stain in one case and a



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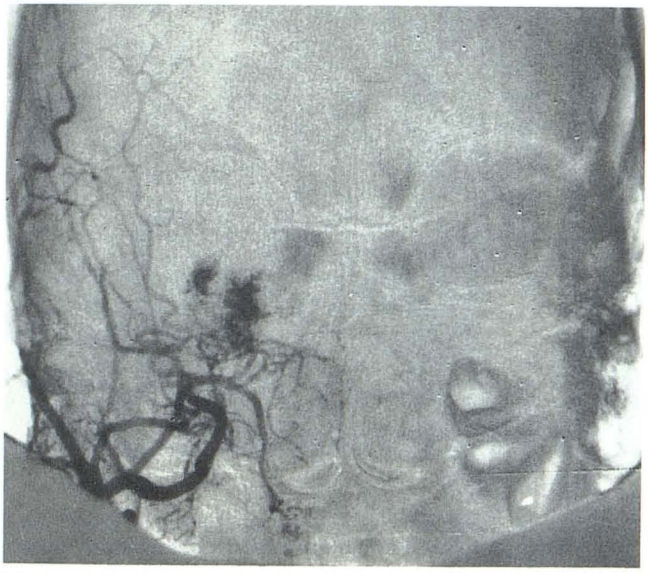

B

C

Fig. 2.—Trigeminal neuroma. **A**, Postcontrast axial CT scan. Enhancing tumor mass with involvement of Meckel's cave (*arrow*). **B**, AP angiogram, external carotid artery injection. Parasellar vascular stain arises from dural branches of middle meningeal artery. **C**, Lateral angiogram, internal carotid artery injection. Vascular stain arises from cavernous branches of internal carotid artery.

prominent stain with pooling of contrast material in the second case (fig. 4).

Meningiomas

The three meningiomas were located within the cavernous sinus. Each was isodense with normal brain before contrast administration and exhibited moderate contrast enhancement. One tumor demonstrated mild bone erosion of the lateral aspect of the sella turcica. The wall of the cavernous sinus was displaced laterally in each case. Hyperostosis of the adjacent sphenoid bone and clinoid process was evident in two of the meningiomas. Angiography demonstrated a mild to moderate stain in each case. The intracavernous carotid artery was encased by one tumor, pushed laterally by a second, and deviated medially by a third tumor (fig. 5).

Mucocele

Our single case of sphinoid sinus mucocele was hypodense relative to normal brain and demonstrated no significant enhancement. Prominent opacification of the sphenoid sinus was present. The bony margin of the posterior and lateral aspect of the sphenoid sinus was eroded and expanded. The overlying dura was displaced posteriorly and laterally. Angiography revealed an avascular mass effect, with both posterior and lateral displacement of the cavernous carotid arteries (fig. 6).

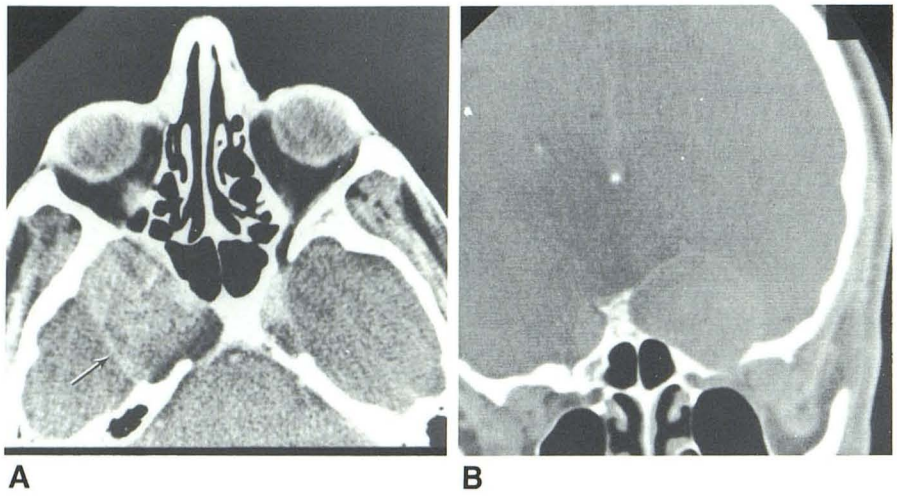

Fig. 3.—Trigeminal neuroma. **A**, Postcontrast axial CT scan. Inhomogeneously enhancing mass with parasellar and petroclival junction bone erosion. *Arrow* denotes enhancing dura. **B**, Postcontrast coronal view. Bone erosion of lateral aspect of sella turcica. Inferior bone erosion in region of Meckel's cave and foramen ovale.

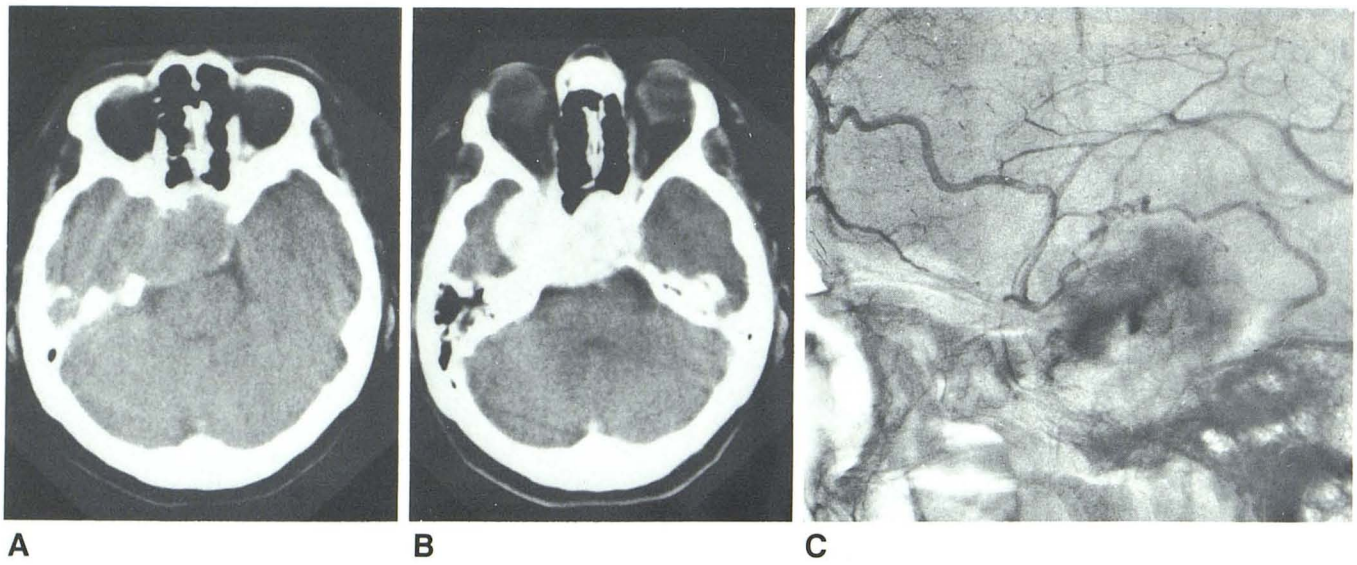

Fig. 4.—Cavernous hemangioma. **A**, Precontrast axial CT scan. Isodense sellar and parasellar mass with smooth margins. **B**, Postcontrast axial CT scan. Densely enhancing, smoothly marginated sellar and parasellar mass. **C**, Lateral angiogram, venous phase, internal carotid artery injection. Dense stain with pooling of contrast material.

Discussion

Our series of extradural tumors had several features in common. First, with high-resolution axial and coronal CT aided by contrast enhancement, the dura could be demonstrated in almost all cases. Occasionally, calcification of the dura, as seen in four of the five chordomas, permitted its identification.

Second, with markedly enhancing tumors, such as cavernous hemangiomas and some trigeminal neuromas, the dura could not be directly visualized due to a lack of differential enhancement between the tumor and the dura. However, the position of the dura could be strongly inferred by the presence of a smoothly marginated tumor mass. In addition, tumor was confined to the extradural space in each case, and no radiographic or surgical evidence of dural breakthrough or violation was encountered. No brain edema was present.

The tumors in our series could be differentiated by the presence or absence of tumor calcification, degree and character of contrast enhancement, degree and location of bone erosion, and to some extent, by angiographic criteria.

The most common tumor in our series was the chordoma (five of 15). Chordomas are rare, forming only 0.1%–0.2% of intracranial tumors [1]. These tumors arise from primitive notochordal remnants, and about 30% are intracranial [2]. While each chordoma in our series demonstrated prominent erosion of the clivus, lateral extension occured with two lesions. These tumors are primarily midline, but previous authors have reported many cases that were predominantly or entirely unilateral [3, 4]. The chordomas could be distinguished from other tumors of our series primarily by the following characteristics: (1) prominent irregular bone destruction of the clivus, (2) significant posterior fossa tumor com-

Fig. 5.—Cavernous sinus meningioma. **A**, Postcontrast axial CT scan. Parasellar bone erosion and expansion of cavernous sinus. **B**, Slightly higher axial view. Hyperostosis of adjacent anterior and posterior clinoid processes. **C**, Postcontrast coronal view. *Arrow* denotes laterally displaced dura. Carotid siphon calcification is present. **D**, Lateral angiogram, internal carotid artery injection, venous phase. Moderate parasellar blush.

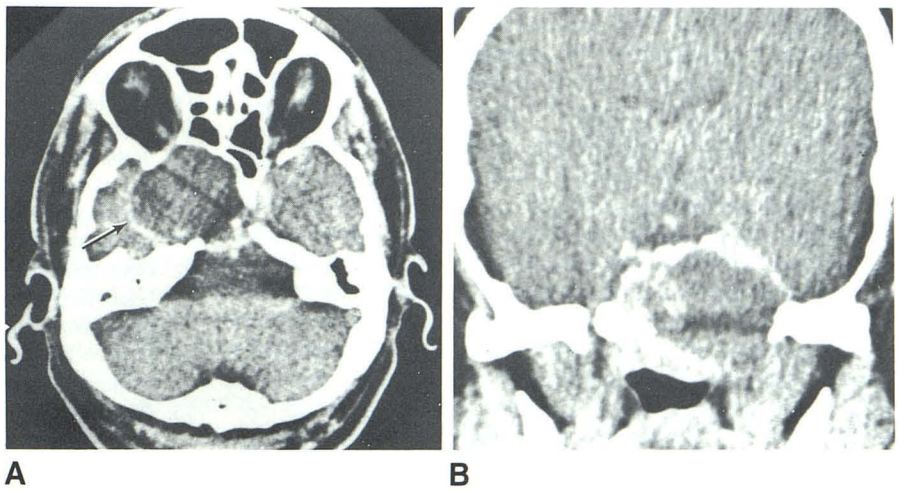

Fig. 6.—Sphenoid mucocele. **A**, Postcontrast axial CT scan. Hypodense mass with lateral and posterior displacement of enhancing dura and, probably, adjacent sinus mucosa (*arrow*). **B**, Postcontrast coronal view. Hypodense mass with elevation of enhancing dura and, probably, adjacent sinus mucosa. Erosion of skull base.

ponent, and (3) tumor calcification. Although chordomas are generally avascular, there are reports of angiographic tumor stain [5–7].

Our series included four neuromas of the trigeminal nerve. These tumors were seen to arise within Meckel's cave at the anterior aspect of the petrous bone just lateral to the petroclival junction. Lateral displacement of the dura was seen in each case and was best demonstrated on coronal CT views after injection of contrast material. These tumors generally enhanced more than the remaining lesions of the series, with the exception of cavernous hemangiomas. While bone erosion centering on Meckel's cave was present in each case, this erosion was not as irregular or as destructive in appearance as that demonstrated by the chordomas. In addition, the

tumor bulk in three of the four trigeminal neuromas was confined to the anterior part of the petrous apex. One tumor had a small posterior fossa component. Angiography demonstrated mild to moderate vascular supply from meningeal branches of the internal carotid artery and/or external carotid system [8, 9].

Cavernous hemangiomas arising within the cavernous sinus are rare tumors, with most reports coming from the Japanese literature [10]. These tumors are a difficult surgical problem because of their location and degree of vascularity. Our two cases were isodense with normal brain before contrast administration and were characterized by their extreme and homogeneous enhancement. No other tumors in our series displaced this degree of enhancement. These tumors tend to displace the dura laterally and may encase the cavernous carotid artery. Our two cases demonstrated parasellar bone erosion without evidence of tumor calcification, and these findings have been supported by others [11, 12]. An angiographic stain was exhibited in each case, with one tumor exhibiting pooling of contrast material.

Coronal CT was instrumental in demonstrating three meningiomas arising within the cavernous sinus and displacing the adjacent dura laterally. When present, hyperostosis of the adjacent bony structures is of great help in establishing a diagnosis. Hyperostosis was not present in any other tumor type in this series. Bone erosion of the adjacent lateral wall of the sella turcica is helpful but is a somewhat nonspecific finding. The cavernous carotid artery may be displaced medially or laterally, depending on the exact site of tumor origin within the cavernous sinus. The degree of angiographic blush was similar to that present in the three cases of trigeminal neuroma but generally less than that found in the two cases of cavernous hemangioma. The tumor supply may arise either from cavernous branches of the internal carotid artery or from meningeal branches of the external carotid circulation.

Prominent opacification of the sphenoid sinus with significant expansion and bone erosion of the sinus wall is typical of a sphenoid sinus mucocele. These tumors may extend anteriorly to involve the ethmoid sinuses or nasopharynx. Less commonly, these tumors extend superiorly or posteriorly to involve the sellar and suprasellar region or the clival and prepontine region. While our single case of mucocele was hypodense relative to normal brain, previous authors have described both iso- and hyperdense sphenoid sinus mucoceles [13, 14]. The tumor margin was well demonstrated in our case due to a lack of tumor enhancement coupled with prominent enhancement of probably both the dura and the adjacent sinus mucosa. If substantial intracranial extension of the mucocele is present, an avascular mass effect on the cavernous carotid arteries, basilar artery, or A1 segment of the anterior cerebral artery may be seen.

While the previous discussion has focused on tumors that arise primarily within the juxtasellar space, one must keep in mind that a significant number of tumors may secondarily occupy this area. Direct extension of nasopharyngeal carcinomas into the juxtasellar region is not uncommon. Bloodborne metastases may also occupy the parasellar region and are also usually associated with prominent bone erosion. The most common primary sites are breast, lung, and prostate [15].

In summary, tumors primarily arising within the extradural juxtasellar region are unusual but can be differentiated by a combination of enhancement characteristics, bone changes, and angiographic findings. In addition, the dura can be directly visualized or its position inferred in the vast majority of cases.

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