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*AJNR Am J Neuroradiol* 1988, 9 (2) 388-389

<http://www.ajnr.org/content/9/2/388.citation>

This information is current as  
of September 16, 2025.

## Calvarial Destruction: An Unusual Manifestation of Glioblastoma Multiforme

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The typical CT characteristics of glioblastoma multiforme (GBM) are well known. Glioblastomas usually enlarge by infiltrating adjacent brain parenchyma, without affecting the overlying bone. We report an unusual case of a temporal lobe GBM that destroyed the bone of the middle fossa and subsequently infiltrated the temporalis muscle. The presence of bone destruction on CT suggested an extraaxial lesion, but MR imaging was useful in confirming the intraaxial location of this neoplasm.

### Case Report

A previously healthy 56-year-old right-handed man presented with a 2-month history of progressive paresthesia involving the left elbow. The patient was otherwise asymptomatic. Complete clinical history and detailed neurologic examination were normal. There was no history of left-sided weakness or seizure activity.

An IV-enhanced CT examination (Figs. 1A–1D) demonstrated a heterogeneous ring-enhancing mass in the right temporal lobe. The mass was 4 cm in greatest dimension and extended anteriorly and superiorly to involve the base of the right frontal lobe. Vasogenic edema and mass effect were present with compression of the ipsilateral lateral ventricle, medial displacement of the uncus, and subfalcine herniation. The enhancing lesion destroyed and extended beyond the greater wing of the sphenoid bone and the squamosal portion of the right temporal bone. The mass was inseparable from the temporalis muscle. The presence of bone destruction and extracranial extension favored an extraaxial site of tumor origin.

MR was performed (Figs. 1E and 1F) using partial-saturation (TR 500, TE 25) and spin-echo (TR 2000, TE 40/80) sequences. In addition to confirming the CT findings, MR more clearly delineated the deep extension of the tumor. The tumor had infiltrated the periventricular white matter of the body and trigone of the ipsilateral lateral ventricle. Identification of this extensive, deep parenchymal infiltration supported the diagnosis of an intraaxial lesion. The deep tumor extension could be separated from the adjacent vasogenic edema, which appeared more intense on the T2-weighted images.

At surgery, there was obvious bone destruction and infiltration of the temporalis muscle. A right temporal parietal craniectomy was performed with biopsy and subsequent subtotal resection of a GBM.

### Discussion

The presence of skull erosion as a result of a primary glioma is relatively uncommon. Superficially located, slow-growing astrocytomas or oligodendrogliomas are the gliomas most frequently responsible for inner table erosion or remodeling [1–4]. Gliomas represent a rare cause of skull erosions. In the series of 333 calvarial translucencies reported by Thomas and Baker [5], only two were secondary to astrocytomas.

The mechanism of skull erosion in these superficial gliomas relates to their chronic mass effect [1]. The mass displaces the CSF, which normally cushions and diffuses brain pulsations over a wide area. Once the CSF space is effaced, the brain may directly transmit these pulsations to the inner table. Over time, this localized elevated pressure may erode the cortical bone of the inner table.

It is exceedingly uncommon for high-grade gliomas to invade and destroy bone. Nager [6] reported two cases of GBM involving the temporal bone. In one of these reported cases, the GBM had invaded the tegmen and extended through the middle ear and tympanic membrane before presenting as a soft-tissue mass in the external auditory canal. In the second case, a pontine GBM had extended into and slightly enlarged the right internal carotid artery. Harwood-Nash and Fitz [7] presented a radiograph demonstrating erosion and lytic changes within the calvarium secondary to a large parietal GBM.

The calvarial destruction and extracranial disease identified on the CT examinations were misleading in this patient as they are far more commonly seen in extraaxial processes such as sarcoma, meningioma, or metastasis to the calvarium. The greater sensitivity of MR over CT in the detection of deep parenchymal tumor infiltration provided better definition of deep tumor extension, and thus established an intracerebral site of tumor origin.

Received March 19, 1986; accepted after revision May 20, 1986.

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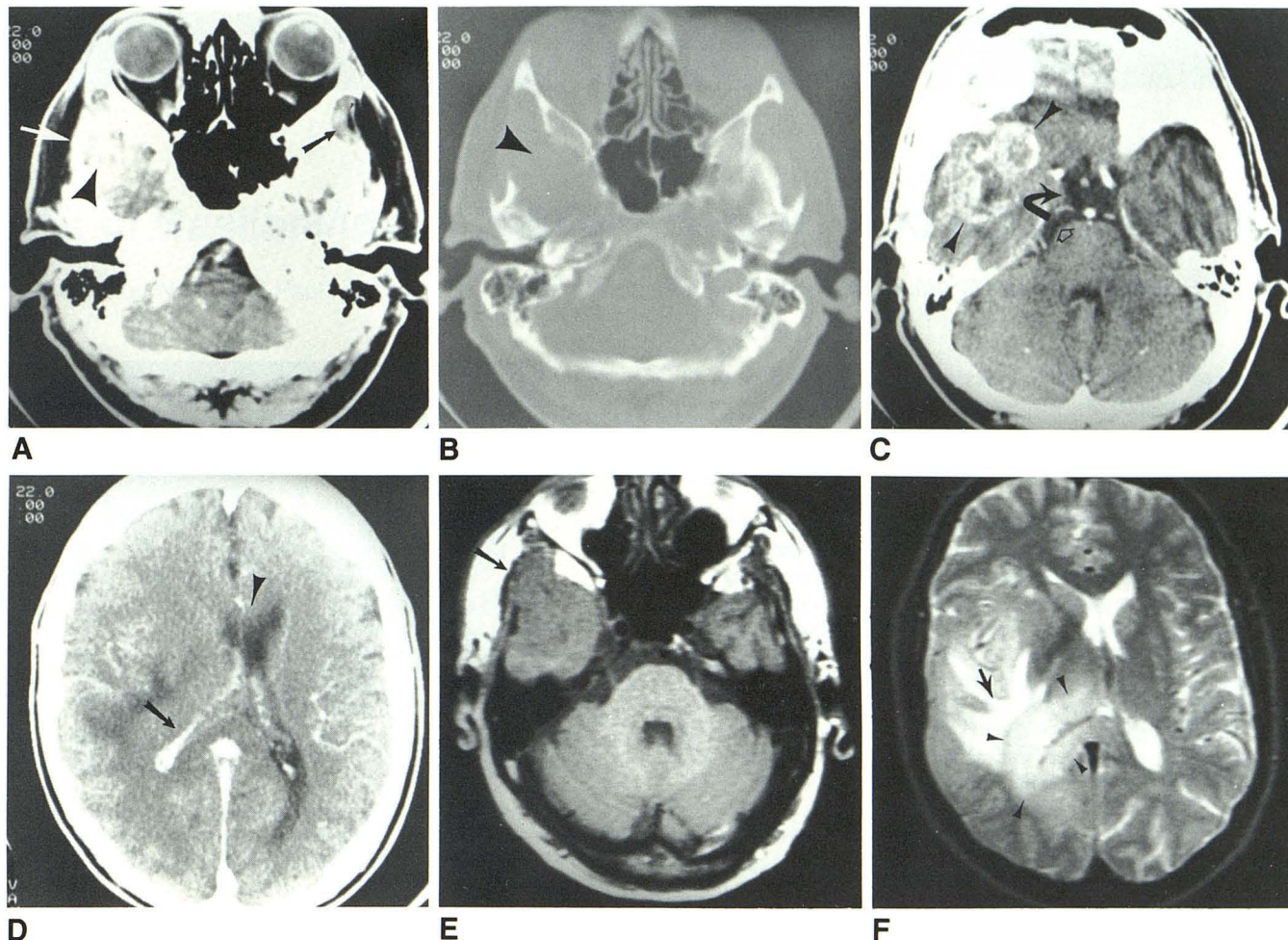


Fig. 1.—Enhanced cranial CT of glioblastoma multiforme.

A, Normal left-sided temporalis muscle (black arrow). A heterogeneously enhancing mass (black arrowhead) extends through right middle fossa, infiltrating temporalis muscle (white arrow), which enhances abnormally.

B, Bone windows demonstrate destruction of portions of greater wing of sphenoid (arrowhead) and squamosal portion of temporal bone on the right.

C, Heterogeneous ring-enhancing mass (arrowheads) extends into inferior-posterior portion of right frontal lobe. Medial displacement of uncus (curved arrow) is present. Asymmetric enlargement of right ambient cistern (open arrow) represents early transtentorial herniation.

D, Compression of right lateral ventricle (arrow) and subfalcine herniation (arrowhead) is present. Vasogenic edema is present in right parietal lobe.

E, T1-weighted (TR 500, TE 25) MR image through floor of middle fossa demonstrates loss of normal gray/white distinction in right temporal lobe. An isointense mass extends through calvarium, inseparable from focally enlarged right temporalis muscle (arrow).

F, T2-weighted (TR 2000, TE 80) MR image also demonstrates differing signal intensity between less-intense peritumoral tumor infiltration (arrowheads) and more-intense adjacent vasogenic edema (arrow).

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