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Open Access Case Report

Incision-Site Scalp Metastasis After Gross Total Resection of a Frontal Gliosarcoma: A Case Report of Probable Surgical Seeding

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Review began 10/31/2026
Review ended 11/05/2026
Published 11/07/2026

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DOI: 10.7759/cureus.119280

Abstract

Gliosarcoma is a rare histological subtype of glioblastoma, IDH-wildtype, composed of malignant glial and sarcomatous components, with a higher propensity for extracranial dissemination than conventional glioblastoma. Metastasis to the scalp along the craniotomy incision is exceedingly rare. We report the case of a 43-year-old man who presented with a first generalized seizure and was found to have a right frontal necrotic, ring-enhancing mass. He underwent gross total resection, and histopathology showed a gliosarcoma with glial fibrillary acidic protein (GFAP)-positive glial and vimentin-positive mesenchymal components. He then received radiotherapy with concomitant and adjuvant temozolomide, and MRI at five months showed no recurrence. Nine months after surgery, a progressively enlarging subcutaneous nodule appeared along the previous incision. MRI showed an extracranial scalp mass overlying an intact bone flap, without intracranial continuity or intracranial recurrence. The lesion was excised, and histopathology showed a high-grade sarcomatoid tumor with diffuse expression of GFAP, vimentin, and p53, consistent with metastatic gliosarcoma. The patient's general condition subsequently deteriorated, and he died of intracranial progression six months after the diagnosis of the scalp metastasis. The location of the lesion strictly along the incision, the absence of intracranial recurrence, the identical histology, and the delayed onset all support iatrogenic seeding of tumor cells along the surgical tract. This report highlights the importance of meticulous tumor handling and wound protection during surgery, as well as careful examination of the scar during follow-up.

Categories: Radiation Oncology, Neurosurgery
Keywords: extracranial metastasis, glioblastoma, gliosarcoma, scalp metastasis, surgical seeding

Introduction

Gliosarcoma is a rare and aggressive primary brain tumor characterized by a biphasic pattern of malignant glial and sarcomatous (mesenchymal) tissue. In the 2021 World Health Organization (WHO) classification of central nervous system (CNS) tumors, it is classified as a histological subtype of glioblastoma, IDH-wildtype, CNS WHO grade 4 [1]. It accounts for a small proportion of glioblastomas. In a Danish cohort of 680 patients, primary and secondary gliosarcomas represented 4.8% of cases [2]. Extracranial metastases of glioblastoma are rare, with a reported incidence of 0.4% to 2% [3,4]. Gliosarcoma appears to be over-represented among these cases, an observation that has been attributed to its mesenchymal component [3]. Cutaneous or subcutaneous metastases located along the craniotomy scar are exceedingly rare and suggest direct implantation of tumor cells during surgery [5-7]. We report a case of scalp metastasis along the surgical incision nine months after gross total resection of a right frontal gliosarcoma, without intracranial recurrence at the time of diagnosis.

Case Presentation

A 43-year-old man with no relevant medical history presented in October 2024 with a first generalized seizure. Neurological examination was normal. Brain MRI showed a right frontal intra-axial mass with irregular peripheral enhancement, a necrotic core, and extensive perilesional vasogenic edema with mass effect (Figure *1*).

How to cite this article
Laaguili J, Mandour C, Essaoudi M, et al. (November 07, 2026) Incision-Site Scalp Metastasis After Gross Total Resection of a Frontal Gliosarcoma: A Case Report of Probable Surgical Seeding. Cureus 18(11): e119280. DOI 10.7759/cureus.119280

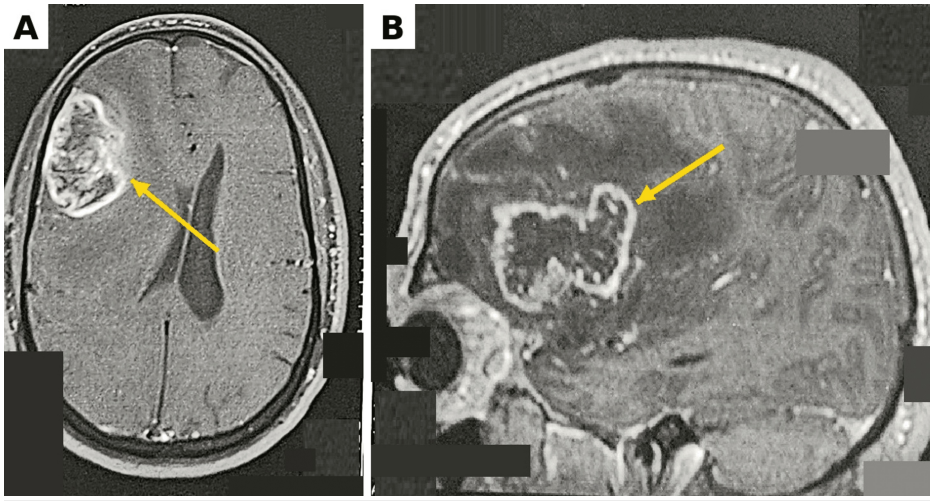


FIGURE 1: Preoperative brain MRI (October 2024)

(A) Axial and (B) sagittal contrast-enhanced T1-weighted images showing a right frontal intra-axial mass (arrows) with irregular peripheral enhancement and central necrosis, with perilesional edema and mass effect on the right lateral ventricle

MRI: magnetic resonance imaging

Gross total resection was performed in November 2024. Histopathological examination showed a biphasic tumor with glial areas positive for glial fibrillary acidic protein (GFAP) and mesenchymal areas positive for vimentin, consistent with gliosarcoma. The tumor was IDH-wildtype; MGMT promoter methylation status was methylated. The postoperative course and wound healing were uneventful. The patient received radiotherapy with concomitant temozolomide, followed by six cycles of adjuvant temozolomide. Follow-up MRI in April 2025 showed the surgical cavity with surrounding gliotic changes and residual T2/FLAIR hyperintensity, without enhancing recurrent tumor (Figure *2*).

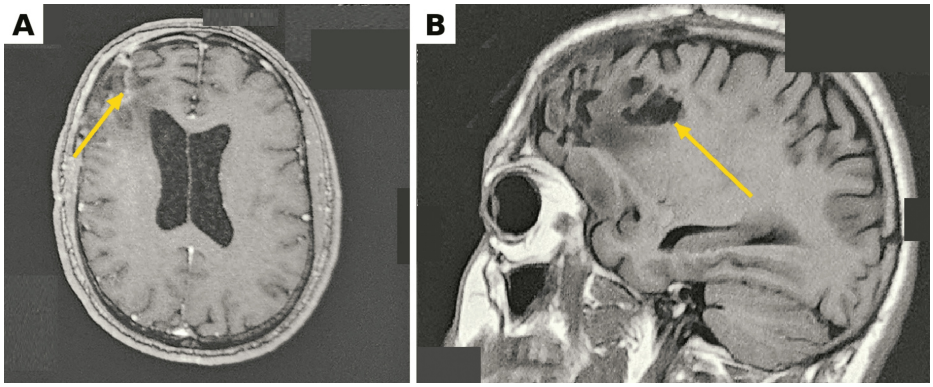


FIGURE 2: Postoperative brain MRI (April 2025)

(A) Axial contrast-enhanced T1-weighted and (B) sagittal T1-weighted images showing the right frontal surgical cavity with surrounding gliotic changes (arrows), without an enhancing recurrent intracranial tumor

MRI: magnetic resonance imaging

In August 2025, nine months after surgery, the patient noticed a progressively enlarging subcutaneous nodule along the previous right frontal incision. Examination showed a firm, well-defined subcutaneous mass at the incision site (Figure *3*).

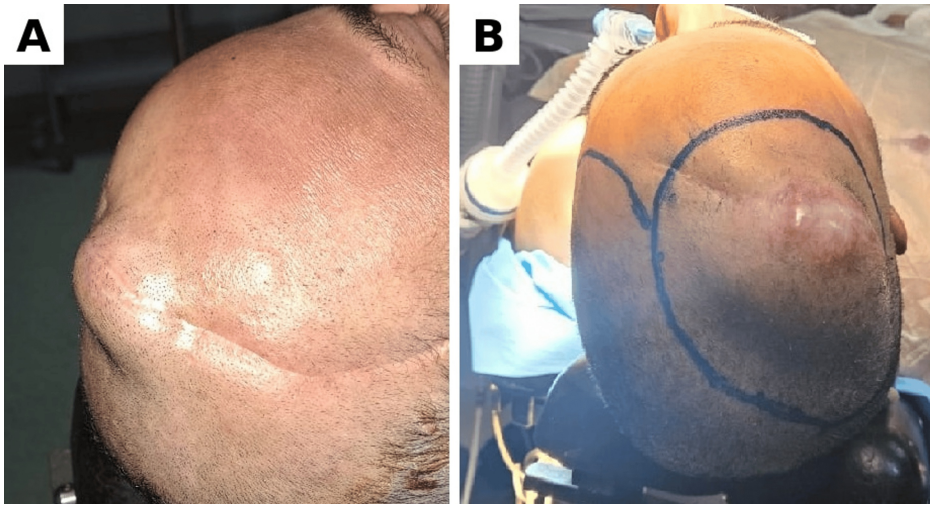


FIGURE 3: Clinical presentation of the scalp metastasis

(A) Preoperative photograph showing a firm, well-defined subcutaneous mass on the previous right frontal incision. (B) Intraoperative photograph showing the scalp mass and the planned excision outlined

MRI showed a well-defined extracranial mass of the right frontal scalp overlying the bone flap, with no destruction of the bone flap and no communication with the intracranial compartment (Figure *4*). There was no intracranial recurrence. Systemic staging (thoraco-abdomino-pelvic CT) showed no other metastatic site.

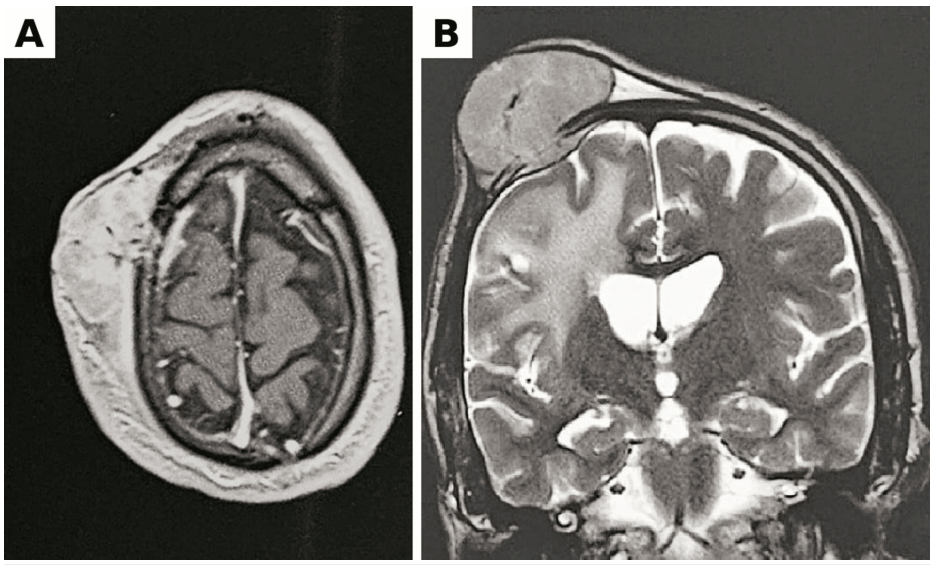


FIGURE 4: MRI of the scalp metastasis (August 2025)

(A) Axial contrast-enhanced T1-weighted and (B) coronal T2-weighted images showing a well-defined right frontal subcutaneous mass along the craniotomy incision, overlying the bone flap, without intracranial extension

MRI: magnetic resonance imaging

The mass was completely excised (Figure *3B*), with clear margins; the bone and dura were not involved. The specimen was an unencapsulated, firm, whitish nodule measuring 3 × 2 × 2 cm. Histopathological examination showed a highly cellular, poorly differentiated tumor composed of intersecting fascicles of spindle cells with focal epithelioid areas, intense mitotic activity with numerous atypical mitoses, foci of tumor necrosis, and a richly vascularized stroma (Figure *5*). On immunohistochemistry, tumor cells showed diffuse and strong positivity for GFAP, vimentin, and p53 (mutant-type pattern); focal and heterogeneous expression of Olig2, cytokeratin AE1/AE3, epithelial membrane antigen (EMA), and smooth muscle actin (SMA); and very focal Melan-A expression. HMB-45, CD31, CD34, and neurofilament were negative (Figure *6*). These findings were consistent with metastatic gliosarcoma, similar to the primary tumor. The patient's general condition subsequently deteriorated, and he died six months after the diagnosis of the scalp

metastasis. Death was attributed to intracranial tumor progression.

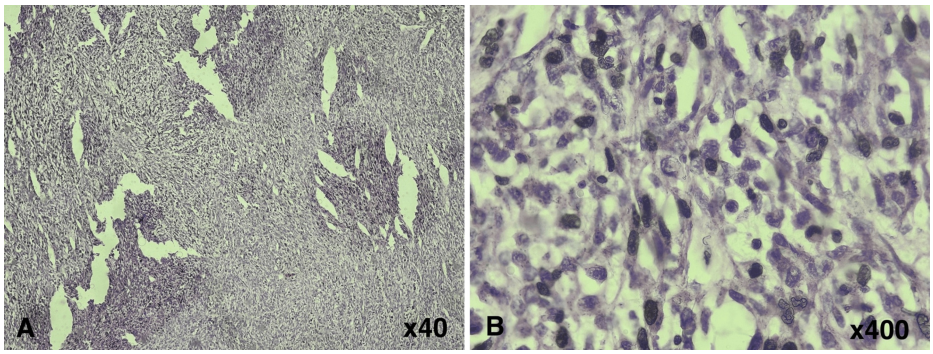


FIGURE 5: Histopathology of the scalp metastasis

(A) Highly cellular tumor arranged in intersecting fascicles of spindle cells with focal epithelioid areas in a richly vascularized stroma. (B) Tumor cells are highly atypical, with increased mitotic activity. Hematoxylin-eosin; original magnification ×40 (A) and ×400 (B)

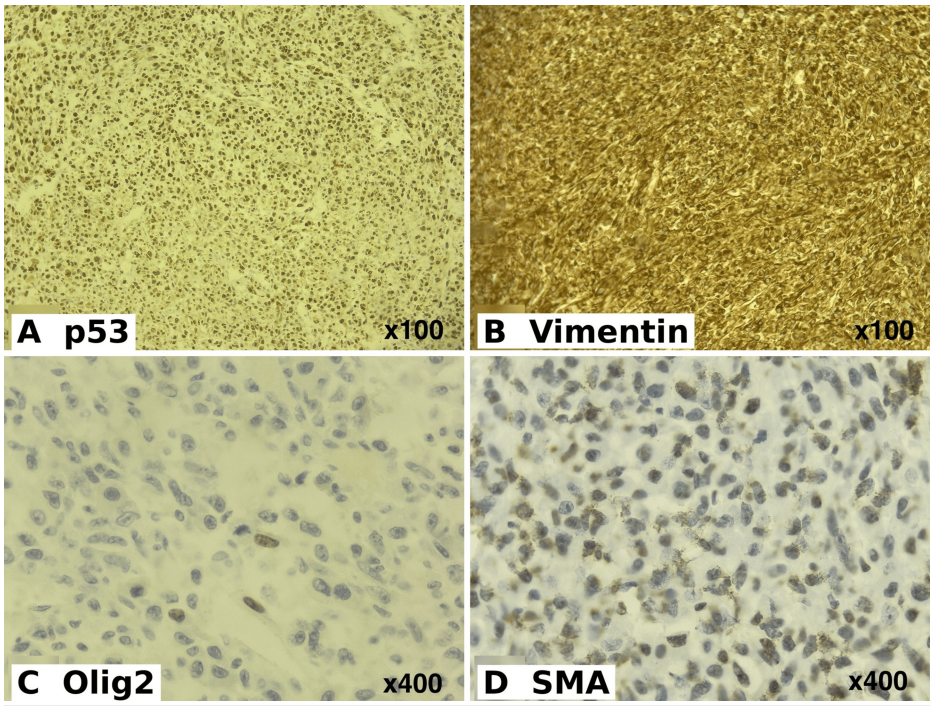


FIGURE 6: Immunohistochemical profile of the scalp metastasis

Tumor cells show diffuse positivity for p53 (A) and vimentin (B), and heterogeneous expression of Olig2 (C) and smooth muscle actin (SMA) (D). Original magnification ×100 (A, B) and ×400 (C, D)

Discussion

Extracranial spread of high-grade gliomas is rare. Proposed explanations include the absence of a conventional lymphatic system in the brain, the barrier formed by the dura and the blood-brain barrier, and the short survival of most patients, which leaves little time for distant metastases to become clinically apparent [3,4]. In an individual patient data meta-analysis of 150 patients with glioblastoma or gliosarcoma metastatic outside the CNS, the most frequent sites were bone, lymph nodes, and the lungs and mediastinum, and the median survival after the diagnosis of extracranial metastasis was six months [3]. Skin and subcutaneous involvement is much less common. Most reported cases occur at or near the craniotomy site, although distant cutaneous metastases have also been described [8,9].

Several routes have been proposed: hematogenous spread, lymphatic spread through the scalp or dural lymphatics, dissemination through cerebrospinal fluid, and direct implantation of tumor cells during

surgery [4]. Implantation may occur through contaminated instruments, gloves, or irrigation fluid, or by tumor cells reaching the subgaleal space through the dural and bone defects. Senetta et al. observed that skin metastases of glioblastoma were associated with a shift towards a mesenchymal immunophenotype, which suggests that mesenchymal features favor survival in extracranial soft tissue [7]. Gliosarcoma, which carries an intrinsic sarcomatous component, may therefore be particularly prone to this mode of spread. Bekar et al. reported a gliosarcoma growing at a fascia lata graft harvest site, a location that can be explained only by tumor cell contamination during surgery [10].

In our patient, four features support surgical seeding rather than hematogenous or lymphatic spread: the metastasis was strictly confined to the incision, there was no intracranial recurrence, its histology was identical to that of the primary tumor, and it appeared several months after surgery rather than synchronously. The integrity of the bone flap and the absence of continuity with the intracranial compartment on imaging also argue against direct extension from a local recurrence. The immunohistochemical profile further helped exclude the main differential diagnoses of a sarcomatoid scalp tumor: diffuse GFAP expression supported a glial origin, whereas negativity for HMB-45 and for CD31 and CD34 argued against melanoma and a vascular neoplasm, respectively.

Table *1* summarizes comparable reported cases. In these reports, scalp metastases appeared between about 2.5 and 14 months after surgery, and survival after their diagnosis was usually short, ranging from a few weeks to 16 months [5-7,11-13]. Our patient died six months after the diagnosis of the scalp metastasis, a course consistent with the poor prognosis of extracranial dissemination. In the individual patient data meta-analysis by Pietschmann et al., the median survival after the diagnosis of extracranial metastasis was six months [3]. Death resulted from intracranial progression rather than from the scalp lesion itself, as in the case reported by Ciscar-Fabuel et al. [13]. Intracranial progression also followed the scalp metastasis in both cases described by Senetta et al. [7]. This suggests that complete excision of an implantation metastasis provides local control but does not alter the course of the primary disease.

Study	Tumor	Site of metastasis	Interval from surgery	Treatment of metastasis	Outcome
Jain et al., 2005 [5]	Glioblastoma	Scalp nodule at craniotomy site	10 months	Excision	Died 2 months later
Senetta et al., 2009 (case 1) [7]	Glioblastoma	Scalp at craniotomy site	14 months	Excision + RT + CT	Alive 12 months later*
Senetta et al., 2009 (case 2) [7]	Glioblastoma	Scalp at craniotomy site	9 months	RT	Alive 16 months later*
Ginat et al., 2013 [6]	Glioblastoma	Scalp at craniotomy site	10 months	Excision + RT + CT	Died 3.5 months later
Magdaleno-Tapial et al., 2019 [12]	Glioblastoma	Scalp near craniotomy	7 months	Palliative care	Not reported
Lakhdar et al., 2020 [11]	Gliosarcoma	Subcutaneous, temporal and frontoparietal scalp	~2.5 months	Not detailed	Died 7 months after initial diagnosis
Ciscar-Fabuel et al., 2024 [13]	Glioblastoma	Multiple nodules within the surgical scar	~6 months	Excision + flap reconstruction	Died within weeks (intracranial progression)
Present case	Gliosarcoma	Craniotomy incision	9 months	Excision	Died 6 months later

TABLE 1: Reported cases of scalp metastasis of glioblastoma or gliosarcoma at or near the craniotomy site

*Senetta et al. reported intracranial progression four months after scalp metastasis in both cases

Data from references [5-7,11-13]

RT: radiotherapy; CT: chemotherapy

Several intraoperative measures may reduce the risk of implantation: isolating the operative field, minimizing contact between the tumor and the scalp flap, changing gloves and instruments after tumor removal, copious irrigation of the cavity and wound, and watertight dural closure. During follow-up, the scar should be examined clinically at each visit, as early detection allows complete excision. This report has a

limitation: a molecular comparison of the primary tumor and the metastasis was not performed.

Conclusions

Scalp metastasis of gliosarcoma at the incision site is exceptionally rare. The location of the lesion, the absence of intracranial recurrence, and the identical histology strongly suggest implantation of tumor cells along the surgical tract. We recommend meticulous tumor handling, wound protection, and careful scar examination during follow-up. The prognosis remains poor even after complete excision of the metastasis. Reports of further cases will help define the risk factors and optimal management of this complication.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **AI use statement:** The authors have declared that no AI tools were used during the work or in the drafting of this article. The authors take full responsibility for the work. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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