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CASE STUDY

PEDIATRIC ANAPLASTIC ASTROCYTOMA

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PEDIATRIC ANAPLASTIC ASTROCYTOMA

DEMOGRAPHICS

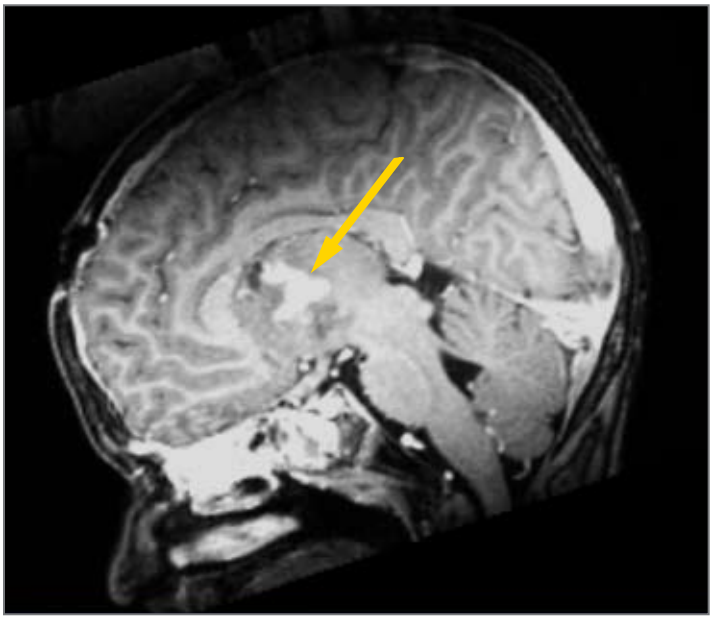
Sex	Male	**Histology**	Anaplastic Astrocytoma
Age	8 years	**Referred by**	Pediatrician

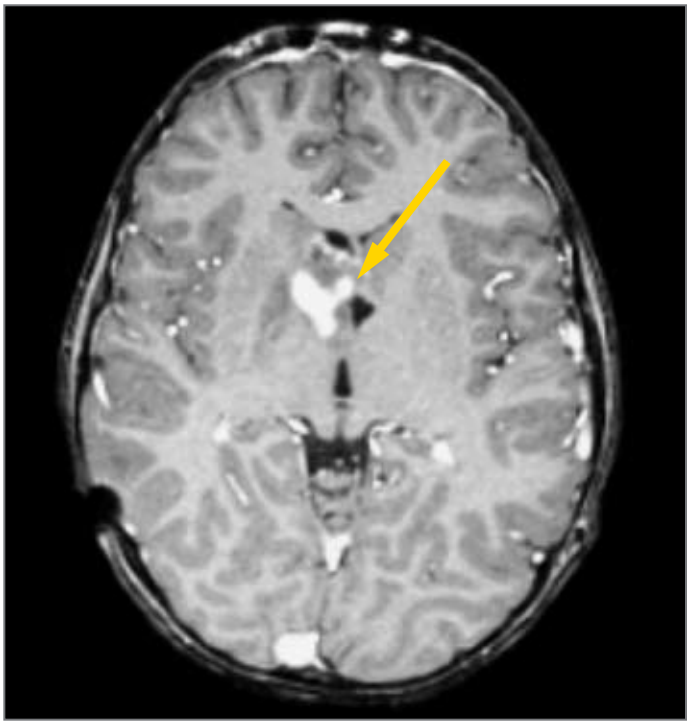
Case History

This 8-year-old boy presented with intractable headaches. A CT scan demonstrated a basal ganglia mass with obstructive hydrocephalus. An open biopsy via a right frontal craniotomy was performed to partially resect the right thalamic mass and place an intraventricular drain. The biopsy specimen was analyzed to reveal an anaplastic astrocytoma. Post-operatively the patient received conventional external beam radiotherapy (EBRT) with a total dose of 4500 cGy delivered in 25 fractions over 6 weeks.

CyberKnife® Treatment Rationale

Although the patient completed the full course of EBRT treatment, more dose was needed to ensure ablation of the tumor. The total dose to the optic chiasm after the patient's EBRT course was 4341 cGy, precluding the delivery of further treatment to the tumor by conventional EBRT. It was recommended that the remainder of the radiotherapy course be delivered with the CyberKnife® Robotic Radiosurgery System to minimize further radiation exposure to the optic chiasm, brainstem and pituitary gland. This was accomplished with a two-stage CyberKnife treatment plan. The first stage was intended to treat a large volume (32.5 cm^3) that included the tumor and the surrounding edema. The second stage was intended to increase the dose to the tumor itself (4.8 cm^3).



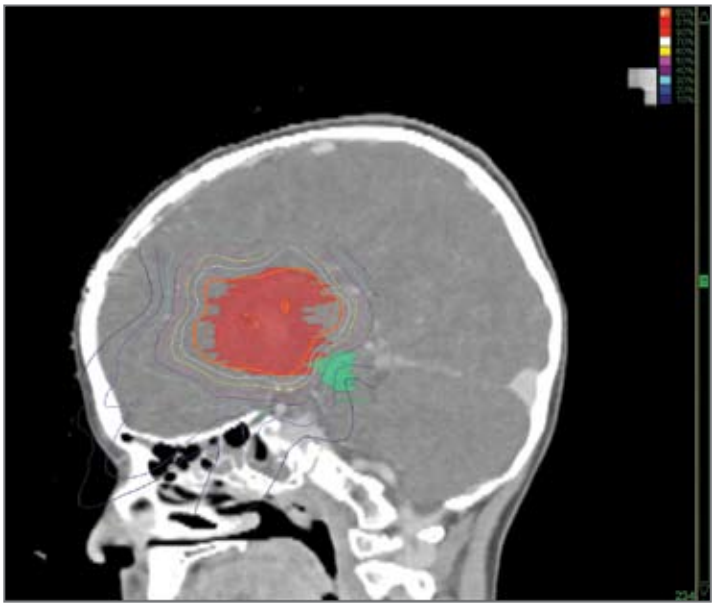


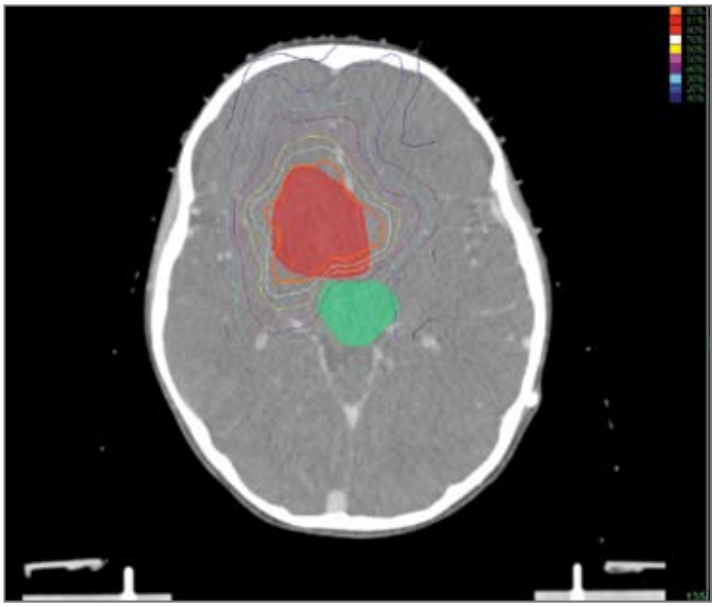
Pre-treatment MRI sagittal and axial images showing the location and extent of the right basal ganglia/right posterior caudate lesion as highlighted by the arrows. Note the proximity of critical structures such as the brainstem and the optic chiasm.

TREATMENT PARAMETERS	FIRST TREATMENT PLAN	SECOND TREATMENT PLAN
PTV	32.50 cm^3	4.8 cm^3
Rx Dose & Isodose	9 Gy to 75%	8 Gy to 80%
Conformality Index	1.45	1.63
Tumor Coverage	93.7%	95.7%
Dose and Fractions	1.8 Gy x 5	2 Gy x 4
Collimator(s)	20 mm	12.5 mm
Number of Beams	152	70

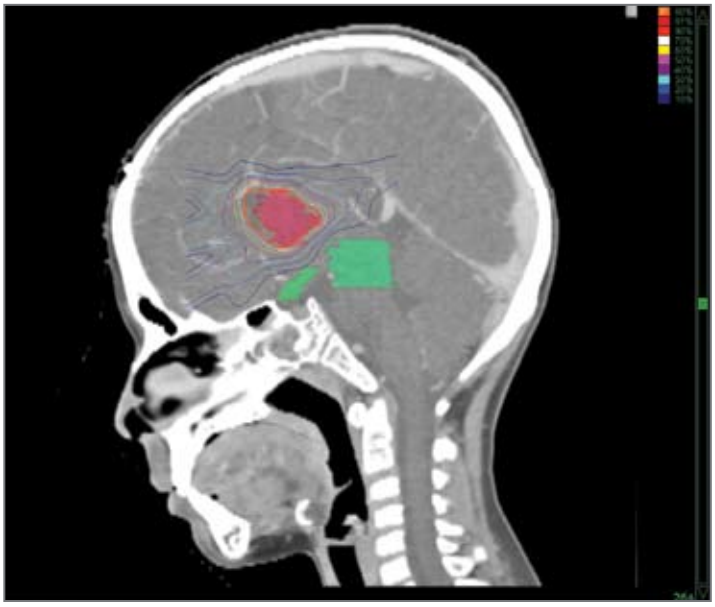
Treatment Delivery

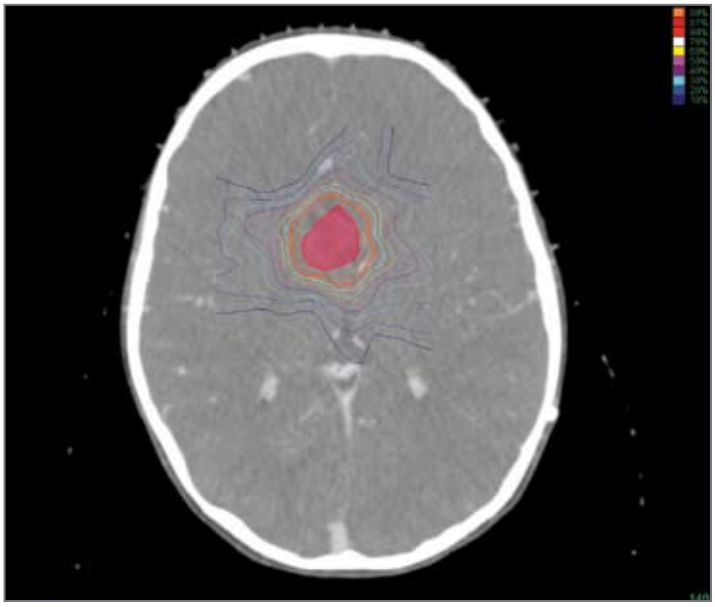
Two CyberKnife treatment plans were used. The first plan delivered 900 cGy in 5 fractions to the 75% isodose line, encompassing both the tumor and a margin of surrounding tissue. The treatment started 1 week post-EBRT and lasted an average of 30 minutes per fraction. The second treatment plan, which followed immediately, delivered 800 cGy in 4 fractions to the 80% isodose line to the tumor without a margin. The average treatment time per fraction of the second plan was 13 minutes. The CyberKnife treatment resulted in an additional 676 cGy to the optic chiasm.





The first treatment plan covered the tumor and a margin of surrounding tissue. The prescription dose is indicated by the orange line; the brainstem and optic chiasm are outlined in green.





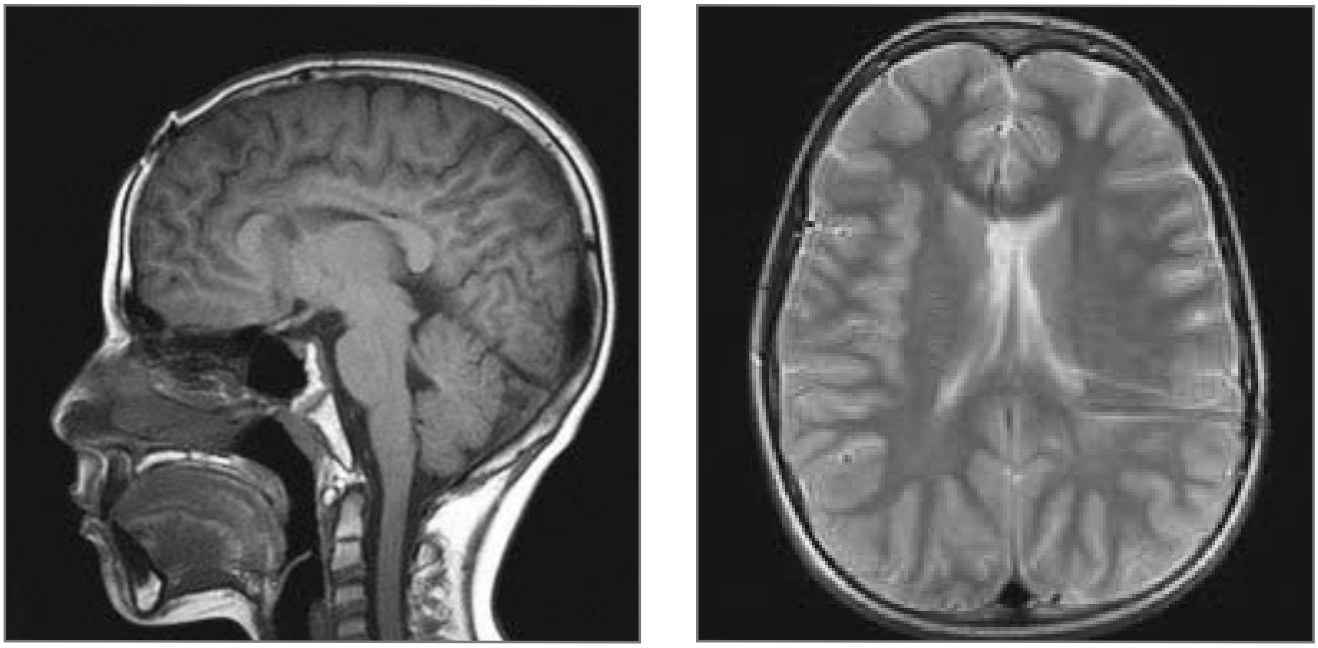
The second treatment plan delivered additional dose to the tumor. The prescription dose is indicated by the orange line; the brainstem and optic chiasm are outlined in green.

Outcome and Follow-Up

- There was no evidence of disease on the patient's follow-up MRI scans 23 months post-treatment
- The patient was evaluated by the Effects Group in the GUH Department of Pediatrics, and was found to have no epilation, no visual or endocrine problems, and no other sequelae
- Thirty-two months after treatment the patient exhibits no evidence of disease; he has not experienced any significant complications throughout the entire follow-up period and is performing reasonably well in school

Conclusion and CyberKnife® Advantages

- The accuracy and conformality of the CyberKnife® Radiosurgery System allowed this patient to receive high-dose radiation treatment for his intracranial tumor, despite prior exposure of his optic chiasm and brainstem to EBRT, decreasing the risk of overdosing these critical structures
- The frameless CyberKnife System allowed this patient to easily and comfortably receive fractionated treatments without the need for hospitalization or use of an invasive head frame



Sagittal and axial MRI images of the patient taken 23 months after the last CyberKnife treatment. There is no abnormal enhancement in the region of the prior right basal ganglia/right posterior caudate lesion, with no evidence of tumor recurrence.

GEORGETOWN UNIVERSITY HOSPITAL (www.georgetownuniversityhospital.org)

Georgetown University Hospital's (GUH) CyberKnife® Robotic Radiosurgery System, installed in 2002, was the first system on the East Coast. The Synchrony® Respiratory Tracking System was added in 2004 and Xsight™ Spine Tracking in 2006. The CyberKnife System allows GUH physicians to provide a targeted, minimally invasive alternative to open surgery and a treatment option for certain tumors that are otherwise untreatable. GUH physicians and the Radiation Oncology Department have created a multi-disciplinary approach to provide their patients with the most comprehensive diagnosis and treatment possible. Over 400 patients were treated in 2006, with a clinical workload of 45% intracranial, 20% spine and 35% extracranial non-CNS. GUH physicians recently treated their 1500th patient with the CyberKnife System.

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