# Craniopharyngioma

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## Contents



## 4.1 General Principles of Simulation and Target Delineation

- Immobilization via individually molded thermoplastic mask or stereotactic frame.
- Define gross target volume (GTV) with thin-slice T1 pre- and post-gadolinium MRI and T2-weighted MRI, supplemented by treatment planning CT. The target volume should include tumor cyst. Solid portions are T1 hypointense or isointense, T2 hyperintense, and heterogeneously contrasting enhancing. Cysts are T1 and T2 hyperintense with a contrast-enhancing cyst wall [1]. Summary target description is in Table 4.1 and example in Fig. 4.1.

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**Table 4.1** Suggested target volumes

| Target volumes | Definition and description [3] |
|---|---|
| Gross target volume (GTV) | Postsurgical tumor bed and/or residual tumor, both solid and cystic components (including cyst wall) on postoperative T2/FLAIR MRI and T1 post-contrast images, **and any surfaces to which the tumor was previously attached to preoperatively** |
| Clinical target volume (CTV) | GTV + 2–5 mm. Cover additional at-risk regions that may harbor microscopic tumor extension |
| Planning target volume (PTV) | CTV + 1–5 mm. Account for setup error and/or patient movement during treatment. Depends upon immobilization device and image guidance used |

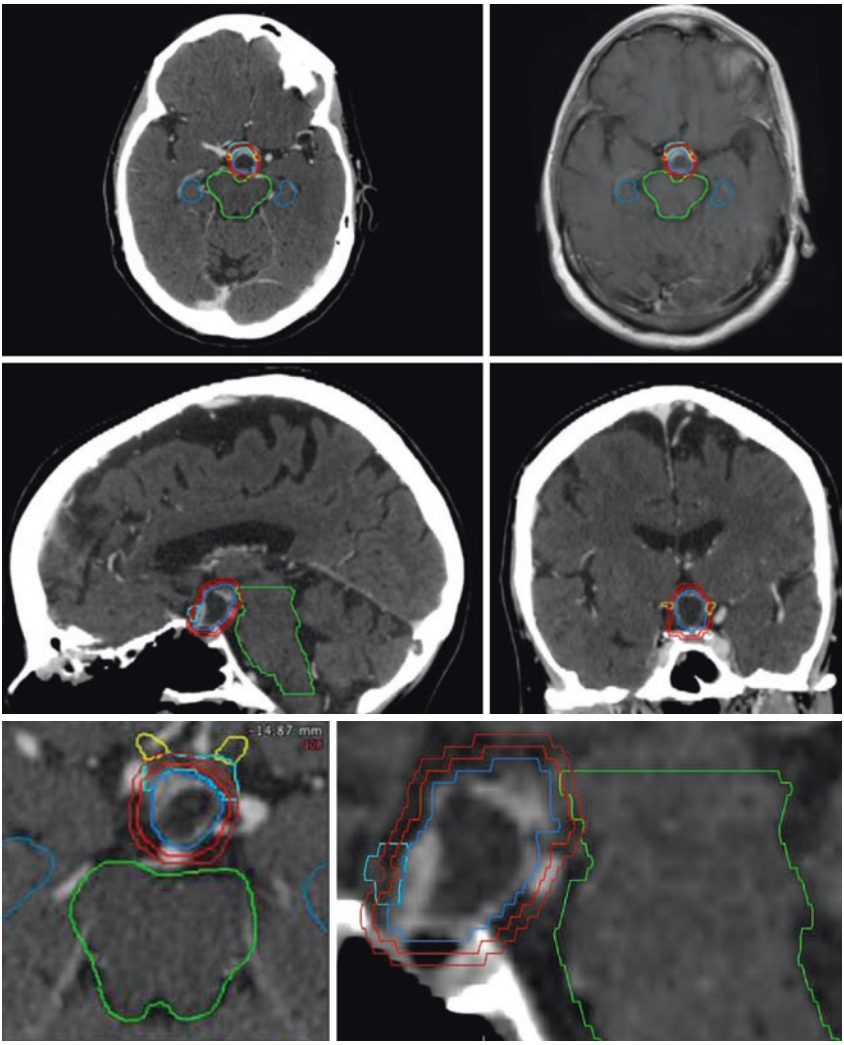


**Fig. 4.1** Contours for an adult patient with an adamantinomatous-type suprasellar craniopharyngioma following subtotal transsphenoidal resection. GTV is blue, CTV is red, PTV is maroon, the brain stem is green, optic nerves and tracts are yellow, and optic chiasm is cyan

- In tumors with prominent cystic components, consider reimaging during treatment to assess for changes in cyst dimensions and need for cyst drainage or replanning [2].
- Stereotactic radiosurgery (SRS), fractionated stereotactic radiosurgery (FSRT), 3D conformal radiation therapy (3D-CRT), intensity-modulated radiotherapy (IMRT), volumetric modulated arc therapy (VMAT), or proton beam therapy (PBT) can be considered.

## 4.2 Dose Prescriptions

- Fractionated radiation therapy: 50.4–55.8 Gy in 1.8–2.0 Gy fractions [2, 3]
- Stereotactic radiosurgery (SRS): 12–20 Gy for single fraction [4]
- Hypofractionated stereotactic radiotherapy: 13–25 Gy over 2–5 fractions [5]

## 4.3 Treatment Planning Techniques

- Consider 3D-CRT, IMRT, VMAT, PBT, or FSRT to limit dose to the optic chiasm. Example of a photon plan using VMAT is seen in Fig. 4.2a, b. PBT offers improved sparing of normal brain parenchyma and should be considered for all children and for many adults (Fig. 4.3a, b) [3]. Comparative DVHs of photon vs proton plans are shown in Fig. 4.2b.
- For external beam radiation therapy, treatment planning should cover at least 95% of the PTV volume by the prescribed dose while not exceeding OAR constraints [3]. Respecting normal tissue tolerances and delivering as low as reasonably possible radiation dose to indicated organs at risk will further decrease risk of tissue impairment (Table 4.2).
- Consider SRS for very small areas of residual or recurrent tumor located at least 3–5 mm from critical structures [6].

## 4.4 Clinical Considerations

- Craniopharyngiomas are highly curative. Attention to detail should be made to correctly identify regions at risk of harboring residual and often microscopic tumor to encompass in treatment.
- In addition, every effort to minimize collateral irradiation of radiation-sensitive normal tissues is essential to reducing long-term adverse effects of radiation therapy. Patients should be counseled on both potential acute and late side effects (Table 4.3).

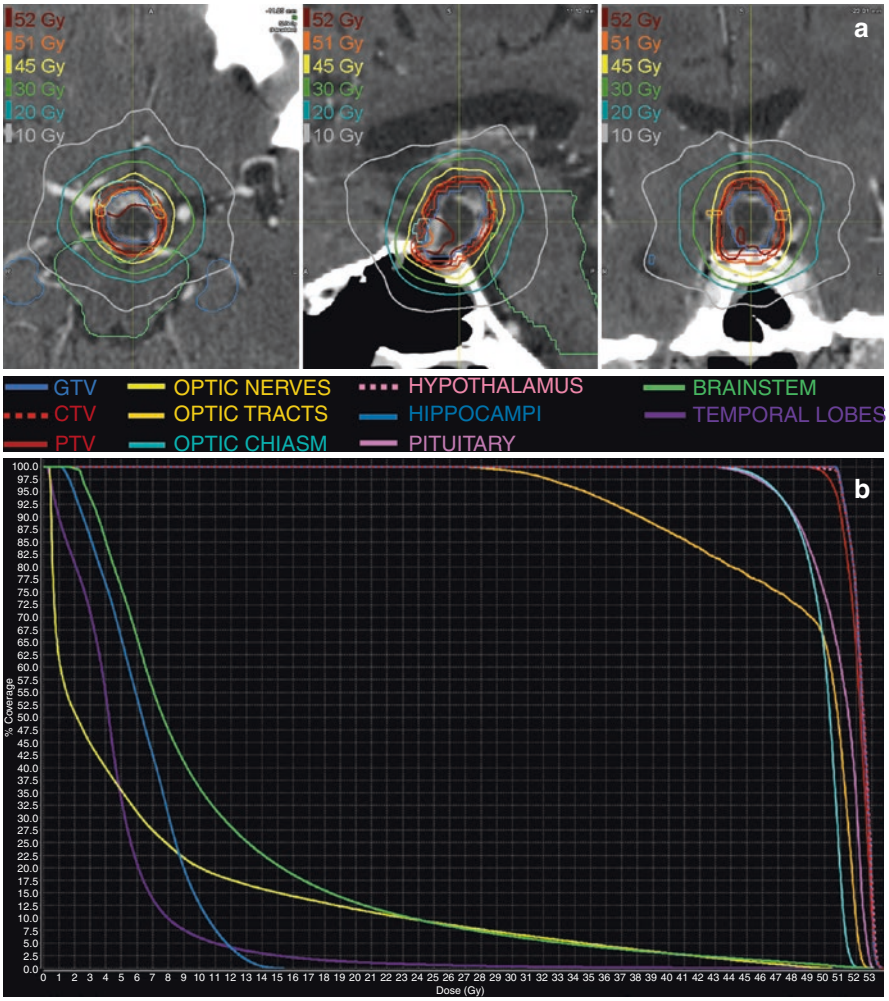


**Fig. 4.2** (**a**) Sample photon plan using six VMAT arcs for the above patient with adamantinomatous-type suprasellar craniopharyngioma. GTV is blue, CTV is red, and PTV is maroon. Prescription dose of 51 Gy in 30 fractions. (**b**) Sample photon dose-volume histogram for above patient with adamantinomatous-type suprasellar craniopharyngioma

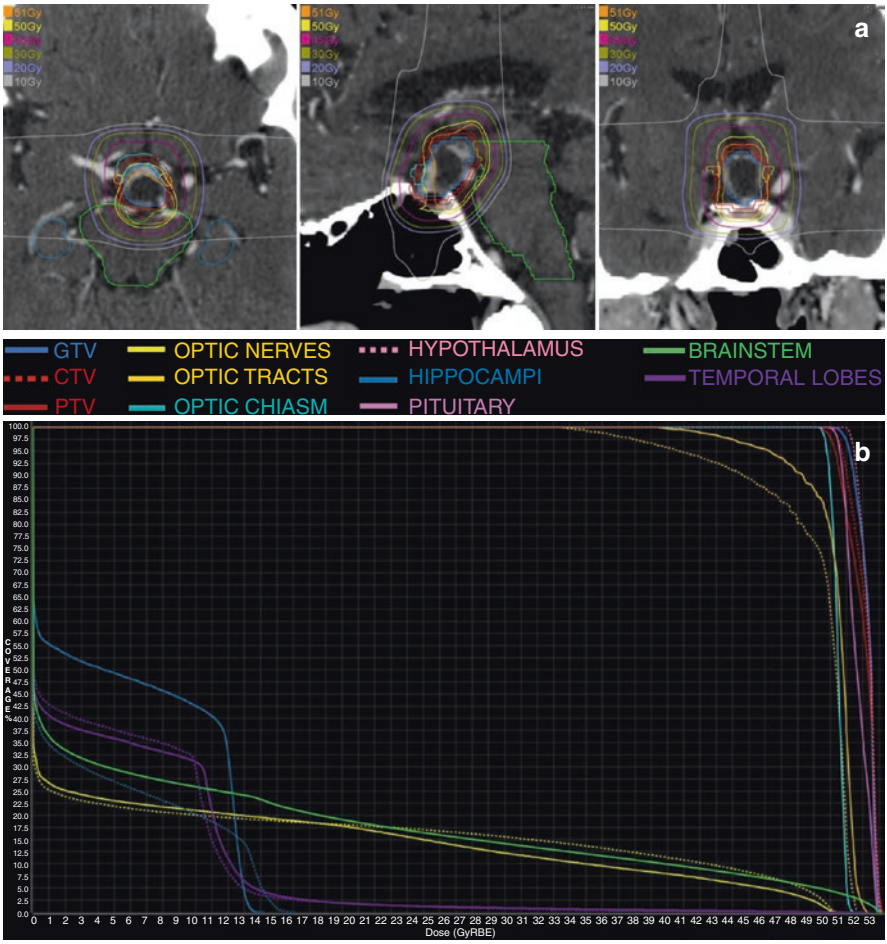


**Fig. 4.3** (**a**) Sample proton plan for the above patient with adamantinomatous-type suprasellar craniopharyngioma. GTV is blue, CTV is red, and PTV is maroon. (**b**) Sample proton dose-volume histogram for above patient with adamantinomatous-type suprasellar craniopharyngioma

**Table 4.2** Recommended normal tissue dose constraints for 50.4–55.8 Gy with 1.8–2.0 Gy/day fractionation schemes

| Organs at risk | Suggested dose constraints [7] |
|---|---|
| Retina | 45 Gy |
| Lens | 10 Gy |
| Optic nerve/ chiasm | 54 Gy |
| Cochlea | 45 Gy, 35 Gy (pediatric) |
| Brain stem | 54 Gy |
| Pituitary | 50–55 Gy, 25 Gy (pediatric).[a] Optimize planning to minimize dose to the pituitary |
| Hippocampus | Optimize planning to minimize dose to hippocampi |

[a]Beyond 20 Gy to the pituitary, screening for hypopituitarism with hormone replacement therapy as needed is strongly recommended

**Table 4.3** Side effects

| | |
|---|---|
| Acute | Dermatitis, alopecia, fatigue, headache, nausea |
| Long-term | Endocrine derangement secondary to hypothalamic-pituitary dysfunction, vasculopathy, visual decline, neurocognitive dysfunction [2, 8] |
| Uncommon or rare risks | Secondary malignancy [9] |

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## *Further Reading*

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