

J Neurosurg Pediatr. 2026 Mar 20:1-10. doi: 10.3171/2025.10.PEDS25394. Online ahead of print.

Extraneural metastases of pediatric brain tumors: a systematic review

Maria Cristina Roccavilla ^{# 1 2}, Eric Vigneul ^{# 1 3}, Edward Fomekong ¹

PMID: 41871436 DOI: [10.3171/2025.10.PEDS25394](https://doi.org/10.3171/2025.10.PEDS25394)

Abstract

Objective: Brain tumors are the most common solid neoplasm in children, accounting for 25% of pediatric cancer cases, with an incidence rate of 6.23 per 100,000. In addition, up to 2% of these patients will develop extraneural metastases associated with a significantly poorer prognosis. The aim of this study was to investigate the incidence, presentation patterns, and neurosurgical considerations associated with extraneural metastases of primary pediatric brain tumors.

Methods: Using PRISMA guidelines, a search was conducted in the PubMed database to identify all full-text articles published in the English language up to May 2024 that described extraneural metastases in the pediatric population. The included studies comprised retrospective case reports and case series detailing the occurrence of extraneural metastasis following diagnosis of a primary brain tumor. Statistical differences between groups were assessed using the Mann-Whitney U-test for continuous variables and the chi-square test for categorical variables.

Results: Of 3811 articles reviewed, 124 articles that included 399 patients (male-to-female ratio of 1.46) with extraneural metastases were identified and analyzed. The mean age at diagnosis of the primary tumor was 8.78 (SD 4.92) years. Latency (the time from diagnosis of the primary tumor to appearance of extraneural metastases) increased with age, with a mean of 19.31 (SD 22.75) months. Medulloblastomas were the most frequent tumors leading to extraneural metastases. Surgical interventions, particularly tumor resection and shunt placement, played a crucial role in the management of the disease, with 79% of children undergoing surgery. Among these patients, placement of a ventriculoperitoneal shunt was associated with a significantly higher occurrence of abdominal metastases ($p < 0.00001$), whereas lymph node and lung metastases were more frequent in patients without shunts.

Conclusions: As nearly all pediatric brain tumors carry a risk of extraneural metastases, these findings provide insights into the metastatic behavior of various tumors and highlight that surgery can influence the pattern of metastatic dissemination. This confirms the need for personalized follow-up and clinical management strategies based on tumor type, age, and surgical approach.

Keywords: brain tumor; extraneural metastasis; medulloblastoma; oncology; pediatric; ventriculoperitoneal shunt.

[PubMed Disclaimer](#)