

Pediatric Giant Cell Tumor of Bone

Joseph Oliver Werenski, Joseph James Connolly, Saurav R Pandey, Marcos R Gonzalez, Mackenzie P Heidkamp, Mark C Gebhardt, Megan E Anderson, Santiago Andres Lozano Calderon

INTRODUCTION: Giant cell tumor (GCT) of bone accounts for nearly 20% of benign tumors and mainly affects young adults, though it can rarely occur in children. In this population, limited data exist on the impact of physeal closure on local recurrence. This study aims to address this gap and characterize clinical features and outcomes in pediatric GCT cases.

METHODS: We retrospectively reviewed patients ages 18 and younger with histologically confirmed GCT of bone surgically treated at three tertiary care academic centers between 1997 and 2022 with minimum one-year follow-up. Data on demographics, clinical and treatment characteristics, and oncologic outcomes was reviewed. Local recurrence-free survival (LRFS) was assessed using Kaplan-Meier analysis and differences between groups with log-rank tests.

RESULTS:

Forty-two patients were included. Median patient age and tumor size was 16 years (IQR: 14–17) and 5 cm (IQR: 3–7), respectively. Most tumors arose in long bones (n=32, 76%) versus flat bones (n=10, 24%). Median follow-up was 63 months (IQR: 27–94). Tumors were located in epiphyseal (n=2), metaphyseal (n=3), or epi-metaphyseal (n=27) regions. Adjacent physes were open in 11 (34%) and closed in 21 (66%) of patients (Table 1). Local recurrence occurred in 19 patients (45%) at a median of 7 months (IQR: 4.8–14), while metastasis was rare, occurring in only two patients (5%) at a median of 16 months (IQR: 3.1–28) (Table 2). LRFS for open physes was 73%, 55%, and 44% at 12, 24, and 60 months, respectively; for closed physes, 81%, 71%, and 60%, with no significant difference at any time point (p=0.62, 0.34, and 0.35, respectively) (Figure 1, Table 3).

DISCUSSION AND CONCLUSION:

In this multicenter cohort of pediatric patients with GCT, most tumors involved both the epiphysis and metaphysis. LRFS did not significantly differ between patients with open versus closed physes at any timepoint. These findings contrast with prior literature, which has reported significantly higher recurrence among patients with open physes and a greater proportion of metaphyseal-only tumors in skeletally immature patients.

Our results suggest that while GCT in children often involves the metaphysis, physeal status alone may not predict recurrence risk. Differences across studies may reflect variability in sample size, follow-up duration, or surgical management. Larger studies are needed to confirm these findings and optimize risk stratification and surgical strategies in the pediatric population.

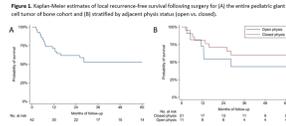


Table 1. Patient demographics, tumor characteristics, and anatomical distribution in pediatric giant cell tumor of bone (n=42).

| Factor | Value |
|--|--------------|
| N | 42 |
| Age (years)^a | 16 (14, 17) |
| Female sex | 28 (67%) |
| Bone involved^b | |
| Long | 32 (76%) |
| Flat | 10 (24%) |
| Tumor site (n=37)^c | 30 (81%) |
| Tumor volume (cm³) | 50 (3.5, 80) |
| Long bone location^d | 63 (27, 94) |
| Proximal | 18 (45%) |
| Distal | 14 (34%) |
| Long bone region^e | |
| Epiphyseal | 2 (5%) |
| Metaphyseal | 3 (7%) |
| Epi-metaphyseal | 27 (64%) |
| Adjacent physis | |
| Open | 11 (26%) |
| Closed | 21 (50%) |
| Metastasis (n=2) | 2 (5%) |
| Metastasis (IQR) | 3.1–28 |
| ^a Median (IQR) | |
| ^b n=42 patients with long bone tumors | |

Table 2. Frequency and timing of oncologic outcomes in pediatric giant cell tumor of bone.

| Factor | Value |
|---|--------------|
| Local recurrence | 19 |
| n | 23 (55%) |
| Time to local recurrence^a | 7 (4.8, 14) |
| Metastasis | 2 |
| n | 4 (10%) |
| Time to metastasis^b | 16 (3.1, 28) |
| Metastasis (IQR) | |

Table 3. Local recurrence-free survival at 12, 24, and 60 months stratified by physis status with log-rank test comparison.

| Timepoint | LRFS | 95% CI | 95% UCI |
|----------------------|------|--------|---------|
| Entire cohort | | | |
| n=42 | 45 | 21.4% | 62.7% |
| n=42 | 24 | 41.7% | 59.2% |
| Open physis | | | |
| n=11 | 8 | 72.7% | 89.1% |
| n=11 | 24 | 54.5% | 78.2% |
| Closed physis | | | |
| n=21 | 11 | 47.6% | 66.7% |
| n=21 | 24 | 71.4% | 85.4% |
| n=21 | 60 | 40.0% | 77.8% |
| Log rank test | | | |
| n=42 | 0.62 | | |
| n=42 | 0.34 | | |
| n=42 | 0.35 | | |

CI: Lower confidence interval; LRFS: Local recurrence-free survival; UCI: Upper confidence interval