

## **Epidemiology of Venous Thromboembolism After Pediatric Orthopaedic Surgery: A National Multicenter Study Investigating Trauma versus Infection or Elective Surgery**

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**Purpose:** A lack of consensus exists regarding which children undergoing pediatric orthopaedic surgery are predisposed to venous thromboembolism (VTE) and would benefit from prophylaxis. Our objective was to explore the incidence and epidemiology of VTE within pediatric orthopaedics in a multicenter fashion, particularly the relative influence of trauma versus other categories of pediatric orthopaedic surgery.

**Methods:** A retrospective database was created involving 17 pediatric centers nationwide. From 2014 to 2017, VTE incidence rates with 95% confidence intervals (CIs) were determined overall compared to within orthopaedics by including children undergoing treatment for orthopaedic trauma, infection, and elective procedures. Demographics, risk factors, presence of prophylaxis, treatment, and outcomes for orthopaedic-related VTE were analyzed using descriptive statistics.

**Results:** Of 9,981,771 patients overall, VTE incidence was 2.2 per 10,000 patients (CI 2.10-2.28) from 2014 to 2017. Of the 150,443 orthopaedic patients, VTE incidence was 8.1 per 10,000 patients (CI 6.76-9.72). The weighted mean age for orthopaedic VTE was higher compared to non-orthopaedic VTE (12.1 vs 8.0 years,  $P < 0.001$ ). 116 pediatric orthopaedic VTE patients from 17 participating hospitals were included (median age 13.1 years, 55% male). The majority (90/116, 78%) experienced a deep vein thrombosis (DVT), primarily in the lower extremity (76%). Elective orthopaedic procedures (47%), bloodstream infections (43%), central venous catheters (35%), and orthopaedic trauma procedures (28%) were the most common risk factors associated with VTE development (Table 1). Most orthopaedic VTE events developed during the initial hospitalization (66%). Only 30% (35/116) received prophylaxis, the majority of which were chemical (28/35, 80%) administered postoperatively. 97% of orthopaedic VTE patients were treated with anticoagulation, most frequently low-molecular-weight heparin (82%). While 73% of cases did not experience complications, 2 patients died from their orthopaedic-related VTE (2%).

**Conclusion:** While pediatric orthopaedic-related VTE remains relatively rare, the true incidence may be greater than previously appreciated, with child mortality occurring in a minority of cases. In those affected—less than one-third of whom received VTE prevention—a discrete list of risk factors is elucidated from this cohort of almost 10 million patients. Orthopaedic trauma emerges as one of the top 4 variables and affects over one-fourth of pediatric patients with VTE. Identification of at-risk children undergoing orthopaedic surgery, and ongoing efforts to establish best practice safety protocols for VTE prevention, is critical to preventing associated morbidity and mortality.

**Table 1. Summary of patient risk factors (N=116).**

<b>Characteristic</b>	<b>Freq.</b>	<b>(%)</b>
Number of risk factors per patient		
0	1	(1%)
1	40	(34%)
2	49	(42%)
3	14	(12%)
4	10	(9%)
5	1	(1%)
6	1	(1%)
Type of risk factor		
Elective orthopedic procedure	54	(47%)
Blood stream infection	50	(43%)
Central venous catheter	41	(35%)
Orthopedic trauma procedure	32	(28%)
Obesity	22	(19%)
Medications	11	(9%)
Oncologic diagnosis	6	(5%)
Inflammatory disease	4	(3%)
Thrombophilia	4	(3%)
Hyperosmolar state	3	(3%)
History of venous thrombosis	2	(2%)
Nephrotic syndrome	2	(2%)
None	1	(1%)