

Trends in Timing of Hip Surgery in Children with Cerebral Palsy: Is Surgery Being Performed Earlier? A National Observational Study from 2010-2021

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INTRODUCTION: Cerebral palsy (CP) is a group of neuromuscular disorders characterized by impaired motor function, muscle coordination, and balance. Hip instability is a particular concern in pediatric CP patients, occurring due to the combination of abnormal muscle forces, joint laxity, and bony abnormalities. It is estimated that approximately one-third of individuals with CP will develop hip displacement, which can lead to pain, functional limitations, and decreased quality of life. Hip surveillance, consisting of serial physical exams and hip radiographs, plays a critical role in the early detection of hip displacement. It is increasingly thought that due to the progressive nature of hip displacement in CP, earlier surgical interventions may be beneficial. The goals of surgery are to prevent further deterioration, alleviate pain, and improve functional outcomes. Available surgical interventions include soft tissue releases, open reductions, and osteotomies. Despite the agreement of orthopaedic surgeons on the importance of hip surveillance in CP patients, the translation of increased hip surveillance practices to earlier surgical intervention on a national scale is not well described in the literature. The purpose of this study was to determine the trends in the surgical timing of hip interventions in children with cerebral palsy from the years 2010 to 2021.

METHODS: A retrospective observational study was conducted using a large national insurance claims database. Patients with a diagnosis of cerebral palsy during the years of 2010 to 2021 were identified using International Classification of Disease (ICD) Ninth and Tenth Revision codes. Patients 10 years of age and younger were included. Those who underwent surgical hip procedures relevant to the study topic, including open reduction, adductor tenotomy, and pelvic osteotomy were identified using Current Procedural Terminology (CPT) codes. Patients receiving hip surgery were categorized by their age on the date of surgery and year of the procedure. Patients aged 1-4 years and patients aged 5-10 years were analyzed as separate age categories. Ordinary least squares linear regression analysis was conducted and the association of year of surgery with rate of surgery in each age group was reported with a threshold of significance of $p < 0.05$. Finally, the compounded annual growth rate (CAGR) was calculated to quantify the overall annualized changes based on year 2021 compared to the year 2010.

RESULTS: A total of 309,677 patients ages 10 years old or less with a diagnosis of CP were identified in the database. For CP patients aged 1-4 years old, the percentage of patients treated with a surgical hip procedure increased from 10.2% in 2010 to 19.4% in 2021. In the 5-10 year-old age group, the surgery rate peaked at 14.9% in 2016 and steadily declined to 11.5% in 2021. The overall compounded annual growth rate (CAGR) from 2010 to 2021 was +6.03% for the 1-4 year-old group and +0.88% for the 5-10 year-old group. Linear regression demonstrated a significant association between year and CP hip surgery rate for patients ages 1-4 ($R^2 = 0.792$, $p < 0.001$), but not ages 5-10 ($R^2 = 0.019$, $p = 0.704$).

DISCUSSION AND CONCLUSION: Rates of surgical hip procedures in 1-4 year-old CP patients have been increasing since 2010, whereas the rate in 5-10 year-old CP patients has been decreasing since 2016. This suggests that CP patients are undergoing surgical hip interventions at younger ages in recent years. To our knowledge, this is the first study looking at recent trends in the surgical timing of hip interventions in pediatric CP patients, corroborating our assumptions that increased hip surveillance and changing perceptions regarding early intervention may be leading to earlier hip surgeries in CP patients. Further research is needed to determine if a causal relationship exists between frequent hip surveillance and the rise in earlier hip surgeries in CP patients.

Figure 1. Yearly Incidence Rates of Hip Surgery in Cerebral Palsy Patients by Age Group in the United States from 2010-2021

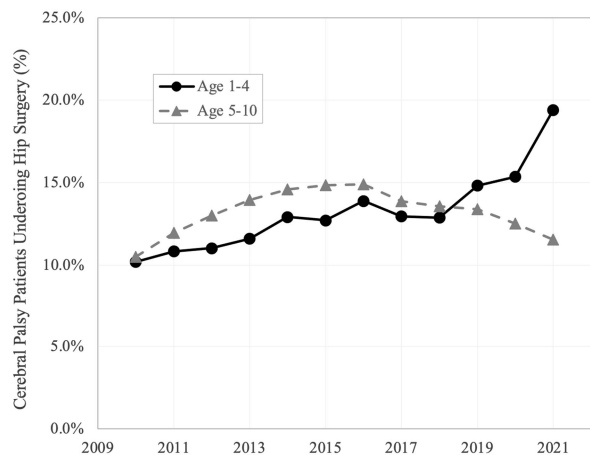


Table 1. Yearly Incidence Rates of Hip Surgery in Cerebral Palsy Patients by Age Group in the United States from 2010-2021

Year	Age 1-4 Years			Age 5-10 Years		
	Total	Hip Surgery	Percent	Total	Hip Surgery	Percent
2010	12,032	1,226	10.2%	19,271	2,022	10.5%
2011	12,668	1,372	10.8%	20,849	2,495	12.0%
2012	12,978	1,431	11.0%	22,071	2,871	13.0%
2013	13,155	1,526	11.6%	24,128	3,366	14.0%
2014	12,751	1,647	12.9%	24,909	3,637	14.6%
2015	12,058	1,533	12.7%	24,647	3,658	14.8%
2016	11,470	1,593	13.9%	24,877	3,705	14.9%
2017	10,735	1,390	12.9%	24,326	3,377	13.9%
2018	9,852	1,269	12.9%	22,671	3,077	13.6%
2019	9,486	1,406	14.8%	22,432	3,003	13.4%
2020	7,725	1,186	15.4%	19,504	2,441	12.5%
2021	6,100	1,183	19.4%	18,053	2,085	11.5%
Mean ± SD			13.2 ± 2.5%			13.2 ± 1.4%
CAGR			+6.03%			+0.88%
R ²			0.792			0.019
p-value*			<0.001			0.704

Bolded values represent significance below threshold of p=0.05

*Linear regression