

Evaluation of Complications and Weight Outcomes in Pediatric Cerebral Palsy Patients With Gastrostomy Tubes

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Abstract

Background: Feeding difficulties are common in children with cerebral palsy (CP). The goal of this study was to examine pediatric CP patients undergoing gastrostomy tube (G tube) placement and assess the association between patient characteristics and weight after 3 months, 6 months, and 1 year.

Methods: This was a retrospective study of all pediatric patients with CP who received a G tube placement between April 2014 and December 2017 at a single institution. Bivariate analysis was used to examine association between patient characteristics and the primary outcome of improvement in weight Z score at 3, 6, and 12 months.

Results: Of 63 patients who received a G tube, 81% had an increase in Z score at 3 months, 44% at 6 months, and 64% at 12 months. By 12 months, factors associated with a positive Z score change included moderate and severe malnutrition, lack of prior G tube, and fewer comorbidities. The majority (69.8%) of patients experienced complications. Seven (11%) patients died, with only 1 death related to G tube placement.

Discussion: The use of G tubes in CP patients resulted in an increase in an improvement in nutritional status for the majority of patients over the course of a year. Although most complications were minor, patients had a high complication rate and frequently visited the emergency department, highlighting the need for standardized education and follow-up among this patient population.

Keywords

gastrostomy tube, cerebral palsy, weight gain, complications

Key Take-Aways

1. The use of gastrostomy tubes in children with cerebral palsy leads to increased weight gain over 1 year, with patients who are moderately to severely malnourished, who have not had prior gastrostomy tubes, and who have few comorbid conditions benefitting from the most substantial weight gain.
2. Although most complications are minor, the high complication rate makes education and follow-up very important in this population.

Introduction

Cerebral palsy (CP) represents a group of disorders with deficits primarily in motor function with an incidence of 2 per 1000 live births.¹⁻⁴ Children with CP are at increased risk of developing malnutrition secondary to oral motor

and oropharyngeal dysfunction, hypotonia, motility disorders, as well as poor posture due to unstable trunks, leading to feeding difficulties.⁵⁻⁷

Malnutrition, defined as a severe lack of nutrients resulting in decreased body function, affects multiple organ systems and can lead to significant morbidity, mortality, and failure to thrive in this population.⁸⁻¹³

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Studies looking at the use of gastrostomy tubes (G tubes) in children with CP have shown that they lead to increased weight gain.^{6,14-16} However, studies have also shown that there are complications associated with G tubes, with reported complication rates ranging from 4 to 26%.¹⁷⁻¹⁹ Some of these complications are minor, such as dislodgement, leakage, and cellulitis, while others can be more serious, such as bleeding, abscesses, peritonitis, organ injury, and even death.^{10,20,21}

Currently, there are no studies evaluating CP patient characteristics that are associated with successful weight gain in G tubes. Likewise, there are no studies assessing which patient characteristics are associated with complications in G tubes. Ideally, determining these factors would help optimize weight gain and identify patients that are at high risk for complications in order to mitigate that risk. The goal of this study was to examine pediatric CP patients undergoing G tube placement and assess the association between patient characteristics and weight after 3 months, 6 months, and 1 year. Additionally, the study evaluated characteristics associated with complications and mortality in G tube placement.

Methods

This study was approved by the University of North Carolina-Chapel Hill Institutional Review Board. This was a retrospective chart review of all pediatric patients (<18 years) with CP who underwent G tube placement between April 2014 and December 2017 at a single tertiary care institution, with at least 1-year follow-up post-placement. Baseline demographic was collected, as were any use of nasogastric (NG) tube for nutritional support (excluding decompression), length of time of NG tube use in days, and prior G tube placement. Prior G tube placement was defined as a one being placed and removed at any point prior to the study time. Malnutrition status was determined using weight-for-age Z scores. Patients were categorized as mild if Z score was < -1, moderate if Z score was -2 to -3, and severe if Z score was < -3.²² If weight-for-age Z scores were not available on patient charts, they were determined using the Center for Disease Control weight-for-age percentiles calculator, which is the calculator used by our electronic medical record. Comorbidities were classified into categories including cognitive/developmental delay, seizures/epilepsy, cancer, kidney disease, liver disease, heart disease, lung disease, pre-existing reflux, and other digestive disease based on chart documentation. We did not have data on height, skin-fold measurements, mid-upper arm circumference, or Gross Motor Function Classification System.

The primary outcome was weight gain at 3 months, 6 months, and 12 months post-G tube placement. Weight

Table 1. Baseline Characteristics of Patients with Cerebral Palsy Undergoing Gastrostomy.

Variable	Total (n=63) n (%) ^a
Sex	
Female	30 (47.6)
Male	33 (52.4)
Missing	0
Age (years)	
Median (IQR)	2 (0-8)
Range	0-17
Missing	0
Malnutrition	
Mild (between -1 and -2)	6 (11.8)
Moderate (between -2 and -3)	15 (29.4)
Severe (less than -3)	30 (58.8)
Missing	12
Comorbidities (≥1)	
Yes	61 (96.8)
No	2 (3.2)
Missing	0
Complications (≥1)	
Yes	44 (69.8)
None	19 (30.2)
Missing	0
Prior G tube	
Yes	4 (6.4)
No	59 (93.7)
Missing	0
NG tube	
Yes	41 (65.1)
No	22 (34.9)
Missing	0
G tube type	
Percutaneous	0
Laparoscopic	59 (95.2)
Open	3 (4.8)
Missing	1
Mortality	
Overall mortality	7 (11.1)
Mortality related to G tube ^b	1 (1.6)
Mortality related to NG tube ^c	0
Deceased from other causes	6 (9.5)
Missing	0
Postop length of stay (days)	
Mean (SD)	33.3 (54.6)
Range	1-247
Missing	0

Abbreviations: G tube, gastrostomy tube; IQR, interquartile range; NG tube, nasogastric tube; postop, postoperative; SD, standard deviation.

^an%, unless otherwise specified as median (IQR) or mean (SD).

^bSecondary to bowel perforation from G tube conversion to GJ tube.

^cNo events related to aspiration linked to NG tube feeds, NG tube placed into lung, or esophageal perforation.

gain was measured by change in Z score from baseline to 3 months, 3 months to 6 months, and 6 months to 12 months and recorded as a decreased/stable or increased change. Secondary outcomes included mortality and complications. Cause of death and whether or not the death was related to G tube placement were recorded. Complications were broken down into functional bowel problems, aspiration/pneumonia, functional tube problems, nutritional abnormalities, infection, major complications, gastrocutaneous fistula, and bleeding. Functional tube problems included dislodgement, clogging, pressure wounds, leakage, and issues with locking in place. As functional tube problems are generally minor problems but are common, chart review determined whether these issues required a telephone call, clinic visit, emergency department (ED) visit, or admission.

Functional bowel problems included diarrhea, constipation, and gastroesophageal reflux (GERD). As these are common issues in CP patients, in order for the complication to be attributed to the G tube, the causality had to be specifically mentioned in patient notes and 2 reviewers evaluated each complication. Nutritional abnormalities mentioned in the notes included hyperglycemia and electrolyte imbalances related to feeds. Infection was defined as cellulitis or abscess around the G tube site that required medical treatment with a procedure or antibiotics. Major complications included reoperation, specifically, necrotizing soft tissue infections, peritonitis, and organ injury related to G tube placement. Bleeding was defined as any bleeding around the site requiring direct medical attention via clinic visit, ED visit, or admission.

Statistical analysis was conducted using Stata/MP (version 12) (Stata Corp, College Station, TX). Patient demographics, stratified by weight gain, complication, and mortality were compared using chi-squared and Fisher's exact tests, where appropriate. A *P*-value <.05 was considered significant.

Results

Sixty-three CP patients underwent G tube placement from April 2014 to December 2017. The median age was 2 years (IQR 0-8 years), ranging from 2 weeks to 17 years, and 52.4% (*n* = 33) of the patients were male. More than half of the patients (58.8%, 30/51) were severely malnourished at the time of G tube placement (Table 1). Ninety-six percent (*n* = 61) of the admitted patients who underwent G tube placement suffered from 1 or more comorbidities at the time of placement. Ninety-five percent of patients (*n* = 60) had cognitive and developmental delay, 77.7% (*n* = 49) of patients had epilepsy, 76.1% (*n* = 48) had GERD, 31.7% (*n* = 20) had other digestive diseases, 31.7% (*n* = 20) had pulmonary disease, 17.5% (*n* = 11) had heart disease, and 17.5% (*n* = 11) had renal disease.

Fifty-nine (95.2%) patients underwent laparoscopic G tube placement, while 3 (4.8%) had open placement because of adhesions from prior operations. As summarized in Table 1, 69.8% (*n* = 44) of patients experienced one or more complications. Functional tube problems were the most common complication among 68.3% (*n* = 43) of patients. Among patients with functional G tube complications, 9.3% (4/43) had families that were able to use only a phone call to solve the issue, while 18.6% (8/43) were able to address the problem at home. However, 55.8% (24/43) of patients required a clinic visit specifically to deal with the issue, while 27.9% (12/43) patients required ER visits and 23.3% (10/43) patients required admission specifically for the functional issue (some patients had multiple admissions.)

Twenty-two percent (*n* = 14) of patients experienced functional bowel problems, such as diarrhea, constipation, and GERD. Pulmonary aspiration or PNA were present in 4.76% (*n* = 3) of patients; infections relating to cellulitis, abscess, and necrotizing soft tissue infections were present in 6.3% (*n* = 4); and bleeding in 4.8% (*n* = 3). There was one (1.6%) reported major complication relating to organ injury. There was no significant difference in baseline characteristics or diagnosis among patients who had experienced at least one complication vs those who had no complications.

Overall, 64.5% (*n* = 40) patients went home with self-care post-placement, 32.2% (*n* = 20) patients went to a skilled nursing facility or home with home health, and 3.2% (*n* = 2) patients were discharged to an acute care hospital. Of the 38 patients who had NG tubes to supplement their nutrition, 32 were in the inpatient setting only and 6 were both in the inpatient and outpatient settings. The average length of time a patient underwent NG tube feeds was 54 days (SD ± 52 days, min 6 days, max 226 days.) Seven of the patients were admitted for approximately 1 week specifically to have NG tube feeds to ensure weight gain and toleration of feeds, after which time they underwent G tube placement (Table 2).

Seven of 63 patients (11.11%) died during the study period. Of these patients, one was related to the G tube, resulting from intestinal perforation secondary to G tube conversion to a gastrojejunostomy (GJ) tube; two occurred secondary to cardiac arrest; one was related to respiratory failure; and three were from unknown causes. Five of the deaths were at home with self-care and two were at a skilled nursing facility or at home with home health. (Table 3) Patients who were diagnosed with epilepsy/motor or muscular abnormalities, GI congenital malformations/GERD, or congenital abnormalities had a higher mortality than children who were malnourished, failed to thrive, had feeding difficulties, and low birth weight (*P* = .049).

In terms of weight gain, there was an increase in the mean Z score from their procedure date ($-4.13 \pm .61$) to

Table 2. Patient Characteristics by Complication.

Variable	Total (n = 63) n (%) ^a	At least one complication present (n = 44, 70%) ^a	No complications (n = 19, 30%) ^a	P-value
Sex				.5647
Female	30 (47.6)	22 (50.0)	8 (42.1)	
Male	33 (52.4)	22 (50.0)	10 (55.5)	
Missing	1	0	1	
Age (months)				.7786
Mean (SD)	4.3 (4.9)	4.2 (5.0)	4.6 (4.7)	
Range	0-17	0-17	0-13	
Missing	0	0	0	
Malnutrition				.1785
Mild (between -1 and -2)	6 (12.0)	3 (8.3)	3 (21.4)	
Moderate (between -2 and -3)	15 (30.0)	9 (25.0)	6 (42.8)	
Severe (less than -3)	29 (58.0)	24 (6.7)	5 (35.7)	
Missing	12	8	5	
Comorbidities (≥1)				.0876
Yes	61 (96.8)	44 (100.0)	17 (89.5)	
No	2 (3.2)	0 (.0)	2 (10.5)	
Missing	0	0	0	
Prior G tube				.3060
Yes	4 (6.4)	4 (9.1)	0 (.0)	
No	58 (93.5)	40 (90.9)	18 (100.0)	
Missing	0	0	1	
NG tube				.1732
Yes	40 (64.51)	30 (68.1)	10 (55.55)	
No	22 (35.48)	14 (31.8)	8 (44.4)	
Missing	0	0	1	
G tube type				1.0000
Percutaneous	0	0 (.0)	0 (.0)	
Laparoscopic	58 (95.1)	41 (95.3)	17 (94.4)	
Open	3 (4.9)	2 (4.7)	1 (5.5)	
Missing	1	1	1	
Mortality				.4219
No mortality	55 (88.7)	40 (90.9)	15 (83.3)	
Mortality related to G tube ^b	1 (1.6)	1 (2.3)	0 (.0)	
Mortality related to NG tube ^c	0	0 (.0)	0 (.0)	
Deceased from other causes	6 (9.5)	3 (6.8)	3 (15.8)	
Missing	0	0	0	
Length of stay (days)				.8240
Mean (SD)	33.3 (54.6)	34.4 (51.3)	30.7 (62.8)	
Range	1-247	1-234	2-247	
Missing	0	0	0	

Abbreviations: G, tube; gastrostomy, tube; IQR, interquartile range; nasogastric, tube; NG, tube; SD, standard deviation
^an%, unless otherwise specified as median (IQR) or mean (SD).

^bSecondary to aspiration linked to feeds, peritonitis from leaking tube feeds, necrotizing soft tissue infection, and organ injury.

^cAspiration event linked to NG tube feeds, NG tube placed into lung, and esophageal perforation.

3 months post-G tube placement ($-2.19 \pm .45$, change in Z score $+1.94$), a slight decrease at 6 months ($-2.71 \pm .57$, change in Z score $-.52$), and increase at 12 months ($-1.80 \pm .40$, change in Z score $+.91$). Eighty-one percent of patients had an increase in Z score at 3 months, 44% had an increase at 6 months, and 64% had an increase at 12 months. A positive change in Z score at 3 months was

associated with age at placement of > 2 years, severe malnutrition, 3 or more comorbid conditions, prior G tube or lack of NG tube, and LOS. (Table 4) At 3 months, the patients who died were more likely to have positive Z score changes; however, this association resolved at 6 and 12 months. Likewise, age at placement became insignificant by 12 months, as did LOS. By 12 months, the

Table 3. Patient Characteristics by Mortality.

Variable	Total (n=63) n (%) ^a	Mortality (n=7, 11%) ^a	No mortality (n=56, 89%) ^a	P-value
Sex				.593
Female	30 (47.6)	4 (57.1)	26 (46.4)	
Male	33 (52.4)	3 (42.8)	30 (53.5)	
Missing	0	0	0	
Age (months)				.7786
Mean (SD)	4.3 (4.9)	4.2 (5.0)	4.6 (4.7)	
Range	0-17	0-17	0-13	
Missing	0	0	0	
Malnutrition				.1785
Mild (between -1 and -2)	6 (12.0)	2 (33.3)	4 (8.8)	
Moderate (between -2 and -3)	15 (30.0)	3 (50.0)	12 (26.6)	
Severe (less than -3)	29 (58.0)	1 (16.6)	29 (64.4)	
Missing	12	8	4	
Comorbidities (≥1)				.0876
Yes	61 (96.8)	7 (100.0)	54 (96.4)	
No	2 (3.2)	0 (.0)	2 (3.5)	
Missing	0	0	0	
Prior G tube				.3060
Yes	4 (6.3)	0	4 (7.1)	
No	59 (93.6)	7 (100.0)	52 (92.8)	
Missing	0	0	0	
Complications (≥1)				.7700
Yes	44 (69.8)	4 (57.1)	40 (71.4)	
None	19 (30.2)	3 (42.8)	16 (28.5)	
NG tube				.1732
Yes	40 (63.4)	5 (71.4)	35 (62.5)	
No	23 (36.5)	2 (28.5)	21 (37.5)	
Missing	0	0	0	
G tube type				
Percutaneous	0 (.0)	0 (.0)	0 (.0)	
Laparoscopic	59 (95.1)	7 (100.0)	52 (94.5)	
Open	3 (4.8)	0 (.0)	3 (5.4)	
Missing	1	1	0	
Length of stay (days)				
Mean (SD)	33.3 (54.6)	34.4 (51.3)	30.7 (62.8)	
Range	1-247	1-234	2-247	
Missing	0	0	0	

^an% unless otherwise specified.

factors associated with a positive Z score change included moderate and severe malnutrition, lack of prior G tube, and fewer comorbidities (Table 4).

Discussion

Similar to previous studies, G tube feeding was associated with increases in weight gain over time in CP patients.^{1,6,14-16,23,25} We noted that patient characteristics associated with improved Z score changes varied over the 3, 6, and 12 months post-gastrostomy placement period. Initially at 3 months, older patients with more comorbidities, prior G tubes, and longer LOS were more likely to

have positive Z score changes. At 12 months, however, factors such as LOS became less important, as 1 might expect further out from hospitalization. At 12 months, fewer comorbid conditions led to greater weight gain. While patients with more comorbid conditions may have benefited early on from G tube placement, their comorbid conditions may have led to issues maintaining that weight gain at 12 months. Unsurprisingly, patients with malnutrition seemed to gain the most benefit in terms of Z score change at 3, 6, and 12 months. Surprisingly, patients who had NG tube supplementation did not appear to have higher growth rates; this may have been secondary to length of supplementation or the fact that all patients received G

Table 4. Change in Z Score by Patient Characteristics at 3, 6, and 12 Months.

Variable	3 months change in Z score			6 months change in Z score			12 months change in Z score		
	Decr	Incr	P- value	Decr	Incr	P- value	Decr	Incr	P- value
	n/N(%)			n/N (%)			n/N(%)		
Sex									
Female	5/26 (19%)	21/26 (81%)	1.00	15/29 (52%)	8/29 (28%)	.64	9/24 (38%)	15/24 (62%)	.46
Male	6/31 (19%)	25/31 (81%)		14/23 (61%)	15/23 (39%)		7/21 (33%)	14/21 (67%)	
Missing	6			11			18		
Age at G tube placement (infant is ref)									
Infant (0 days-2 years)	10/32 (31%)	22/32 (69%)		12/30 (40%)	18/30 (60%)		9/25 (36%)	16/25 (64%)	
Child (2-12 years)	0/18 (0%)	18/18 (100%)	.001	7/15 (47%)	8/15 (53%)	.39	4/14 (29%)	10/14 (71%)	.29
Adolescent (12-18 years)	1/7 (14%)	6/7 (86%)	.03	4/7 (57%)	3/7 (43%)	.017	3/6 (50%)	3/6 (50%)	.06
Missing	6			11			18		
Malnutrition (mild is ref)									
Mild (between -1 and -2)	2/6 (33%)	4/6 (67%)		1/4 (25%)	3/4 (75%)		2/2 (100%)	0/2 (0%)	
Moderate (between -2 and -3)	6/13 (46%)	7/13 (54%)	.08	8/11 (73%)	3/11 (27%)	.001	4/11 (36%)	7/11 (64%)	.001
Severe (less than -3)	1/27 (4%)	26/27 (96%)	.001	9/26 (35%)	17/26 (65%)	.16	7/22 (32%)	15/22 (68%)	.001
Missing	5			10			16		
Comorbidities (≥3)									
Yes	6/47 (13%)	41/47 (87%)	.001	20/45 (44%)	25/45 (56%)	.88	15/40 (38%)	25/40 (62%)	.005
No	5/10 (50%)	5/10 (50%)		3/7 (43%)	4/7 (57%)		1/5 (20%)	4/5 (80%)	
Missing	6			11			18		
Prior G tube									
Yes	0/4 (0%)	4/4 (100%)	.001	2/4 (50%)	2/4 (50%)	.400	2/3 (67%)	1/3 (33%)	.001
No	11/53 (21%)	42/53 (79%)		21/48 (44%)	27/48 (56%)		14/42 (33%)	28/42 (67%)	
Missing	6			11			18		
NG tube									
Yes	9/38 (24%)	29/38 (76%)	.025	14/34 (41%)	20/34 (59%)	.26	9/29 (31%)	20/29 (69%)	.19
No	2/19 (11%)	17/19 (89%)		9/18 (50%)	9/18 (50%)		7/16 (44%)	9/16 (66%)	
Missing	6			11			18		
Mortality									
No mortality	11/50 (22%)	39/50 (78%)	.001	19/47 (40%)	28/47 (60%)	.001	15/42 (36%)	27/42 (64%)	.77
Mortality	0/7 (0%)	7/7 (100%)		4/5 (80%)	1/5 (20%)		1/3 (33%)	2/3 (67%)	
Missing	6			11			18		
Complications									
Any	8/42 (19%)	34/42 (81%)	1.00	15/40 (38%)	25/40 (62%)	.001	13/35 (37%)	22/35 (63%)	.37
None missing	3/15 (20%)	12/15 (80%)		8/12 (67%)	4/12 (33%)		3/10 (30%)	7/10 (70%)	
Missing	5			10			17		
Length of stay (days)									
1 month	6/40 (15%)	34/40 (85%)	.018	17/35 (49%)	18/35 (51%)	.06	10/30 (33%)	20/30 (67%)	.38
Greater than 1 month	5/17 (29%)	12/17 (71%)		6/17 (35%)	11/17 (65%)		6/15 (40%)	9/15 (60%)	
Missing	6			11			18		

Abbreviations: Decr, decreased; G tube, gastrostomy tube; Incr, increased; NG tube, nasogastric tube. Bolded P values are significant P < .05.

tubes and thus were achieving optimal nutrition over the course of the year.

Although the majority of complications were minor in nature with only 1 death related to GJ conversion, the overall rate of complications was high, with almost 70% of patients having some issue related to their G tubes. Past studies have also shown a low rate of serious complications from 4 to 26% with minor complications being more frequent.^{17,18,24,26,27} A 2004 systematic review found that the proportion of patients with minor complications can be as high as 95%.⁶ Variation in complication rate may be affected by differences in definitions and diverse study populations, as well as presence or absence of standardization of care. Possibly due to the sample size and the high percentage of complications, we were unable to find any significant associations between patient characteristics and complications.

The most common complications were functional tube problems such as tube clogging, dislodgement, pressure wound, and leakage. While these concerns are minor, very few families were able to deal with the problem over the phone or at home. Over 50% of the patients required an ER visit or admission to address the complication during the span of 1 year. A recent study looking at 30-day ER visits and readmissions after G tube placement in the United States revealed that 8.6% of children visit the ER and 3.9% are readmitted, most commonly secondary to infection, mechanical complications, and dislodgement.²⁸ Another recent study showed that a quarter of the patients are responsible for the majority (82%) of ER visits, with non-Caucasian patients at higher risk, highlighting the need for a larger cohort or prospective database of patients to identify further characteristics of high-risk patients and to begin to mitigate risk and disparities.²⁹

In the face of rising health care costs, the use of resources and financial strain on both the family and the health system should be considered. One study evaluating hospital resource utilization found a decrease in utilization after implementation of a standardized feeding device placement pathway.³⁰ Another study interviewed surgeons and nurses routinely involved in G tube care at high performing institutions demonstrated that common themes among hospitals with favorable outcomes included family education, provider availability, and family empowerment.³¹ Protocols, support systems, and written materials may help to reduce ER visits, and other options such as walk-in clinics and improved 24-hour access to providers could help to alleviate these issues.

Approximately a third of patients had functional bowel issues including diarrhea, constipation, and reflux. The degree to which these problems were related to enteral feeds via G tubes vs the underlying disease process was difficult to delineate. Gastroesophageal reflux is very common among infants, though the majority tend to outgrow it. In CP patients, GERD is found in approximately

15-77% of this population.³²⁻³⁴ Even among 3-month old typical children, GERD can be present 50% of the time, with the percentage of children affected gradually decreasing over time.³⁵ If the complication of functional bowel issues is removed, 68.3% of patients still had a complication, as the majority of patients had more than one complication. Of note, historically concomitant Nissen fundoplication was performed in many children with CP because of the high rates of GERD. Many centers like ours have moved away from performing Nissens, particularly given growing evidence that the Nissens do not decrease readmissions for GERD and have been associated with the need for additional operations.³⁶ This study underscores the success of G tubes in nutritional rehabilitation and supports the avoidance of anti-reflux surgery in this population.

The greatest limitation of this study was the small sample size; thus, we were unable to demonstrate significant associations or perform meaningful modeling. The specificity of the subpopulation studied in addition to the inclusion criteria requiring the patient to receive regular follow-up for at least a year greatly limited the number of patients. Missing weights at follow-up and missing nutritional information limit the study as well. When comparing this sample size to other single institution studies on the topic, it is noted that the sample sizes are similar. This was a single institution study, reducing the generalizability. The investigators had to rely on documentation, which may have errors or missing values.

In conclusion, this retrospective study looking at the use of G tubes in pediatric CP patients demonstrated good weight gain, particularly among patients with moderate to severe malnutrition. The overall ease of use of G tubes and the benefits of weight gain do outweigh the complications faced by these patients, given that major complications were rare. Parents should be aware that patients will require close follow-up and easy access to providers as they grow, as there is a high likelihood of minor complications.

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Declaration of Conflicting Interests

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Ethics Approval

The study complies with ethical standards and was reviewed and granted exemption by the UNC IRB in view of the retrospective

nature of the study and all the procedures performed were part of the routine care. IRB# 17-3075.

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