Pediatr Gastroenterol Hepatol Nutr. 2022 May;25(3):211-217
https://doi.org/10.5223/pghn.2022.25.3.211
pISSN 2234-8646·eISSN 2234-8840

Pediatric Gastroenterology, Hepatology & Nutrition
pghn

Original Article

Check for updates

To Button or Not to Button? Primary Gastrostomy Tubes Offer No Significant Advantage Over Buttons

Hector Osei,[2] **Armando Salim Munoz-Abraham**,[2] **Alice Martino**,[1] **Kaveer Chatoorgoon**,[1,2] **Jose Greenspon**,[1,2] **Colleen Fitzpatrick**,[1,2] **and Gustavo A. Villalona**[1,2]

[1]Department of Surgery, Saint Louis University School of Medicine, St. Louis, MO, USA
[2]Department of Pediatric Surgery, SSM Health Cardinal Glennon Children's Hospital, St. Louis, MO, USA

OPEN ACCESS

Received: Jan 12, 2022
Revised: Mar 25, 2022
Accepted: Apr 2, 2022
Published online: May 9, 2022

Correspondence to
Gustavo A. Villalona
Department of Surgery, Saint Louis University School of Medicine and Division of Pediatric Surgery, Department of Surgery, SSM Health Cardinal Glennon Children's Hospital, 1465 S. Grand Blvd., St. Louis, MO 63104-6454, USA.
Email: gustavo.villalona@nemours.org

ORCID iDs
Hector Osei
https://orcid.org/0000-0003-0175-2696
Armando Salim Munoz-Abraham
https://orcid.org/0000-0002-1168-6867
Alice Martino
https://orcid.org/0000-0002-2760-8070
Kaveer Chatoorgoon
https://orcid.org/0000-0002-1101-1448
Jose Greenspon
https://orcid.org/0000-0003-4809-9057
Colleen Fitzpatrick
https://orcid.org/0000-0001-7460-4980
Gustavo A. Villalona
https://orcid.org/0000-0002-9338-5258

ABSTRACT

Purpose: Outcomes between primary gastrostomy tubes and buttons (G-tube and G-button) have not been established in pediatric patients. We hypothesized that primary G-tube have decreased complications when compared to G-button.
Methods: A retrospective review of surgically placed gastrostomy devices from 2010 to 2017 was performed. Data collected included demographics, outcomes and 90-day complications. We divided the patients into primary G-tube and primary G-button.
Results: Of 265 patients, 142 (53.6%) were male. Median age and weight at the time of surgery were 7 months (interquartile range [IQR], 2–44 months) and 6.70 kg (IQR, 3.98–14.15 kg), respectively. Among the groups, G-tube had 80 patients (30.2%) while G-button 185 patients (69.8%). There were 153 patients with at least one overall complication within 90 days postoperative. There was no significant difference in overall complications between groups (G-tube 63.8% vs. G-button 55.7%, p=0.192). More importantly, there were no significant differences in major complications among the groups, G-tube vs. G-button (5% vs. 4%; p=0.455).
Conclusion: Primary G-tube offers no significant advantage in overall, minor or major complications when compared to primary G-button.

Keywords: Gastrostomy; Tubes; Buttons; Nutrition; Pediatric

INTRODUCTION

Gastrostomy device placement has become the standard for long term nutritional support in infants and children. The device placement can be performed by either surgical (open or laparoscopic), endoscopic or radiological (under fluoroscopy) means. Percutaneous endoscopic gastrostomy (PEG) and laparoscopic gastrostomy have supplanted the open Stamm technique, and they are the techniques of choice for most patients [1]. In infants and children, however, laparoscopic gastrostomy has been shown to be safer than PEG [2-8]. The two devices placed by most pediatric surgeons are gastrostomy tubes (G-tube) and gastrostomy buttons (G-button). G-tube is the traditional gastrostomy device with tube projecting out above skin level, and G-button is a skin-level low profile device. Both can have either a mushroom or balloon tip as an internal bolster. Gastrostomy devices are both well-tolerated and provide improved quality of life for caregivers and children [9,10].

Conflict of Interest
The authors have no financial conflicts of interest.

Common complications related to primary surgical placement of both devices include, worsening of gastroesophageal reflux (GER), hypergranulation, stoma site infection, gastric content leakage, and tube dislodgement. Historically, G-tubes are primarily placed and subsequently replaced with G-buttons after 4–8 weeks when the tract has matured [11]. This was later replaced by a primary G-button, which allows placement of a low-profile device that can be untethered when patients are not requiring feeds. Although studies have been published on complications of either G-tubes or G-buttons with the different techniques, direct comparison of their safety and outcomes as a primary procedure in children has not been established. We aimed to compare the safety and outcomes between surgically placed primary G-tubes and G-buttons in pediatric patients. We hypothesize that surgically placed primary G-tubes are safer and with fewer complications when compared to primary G-buttons.

MATERIALS AND METHODS

After Institutional Review Board approval was obtained from Saint Louis University (IRB no. 28564), a retrospective review of all surgeon-placed gastrostomy devices in a single pediatric tertiary institution from 2010 to 2017 was performed. We included only patients who had their gastrostomy devices placed either as open or laparoscopic gastrostomy placement using the Seldinger technique. We excluded all patients who underwent standard open Stamm (Seldinger technique was not used) or PEG procedures. All procedures were undertaken by four board-certified pediatric surgeons. All G-tubes and G-buttons placed were of the balloon-tip type. Data collected included pertinent demographics, intraoperative antibiotics administration, type of gastrostomy device, French (Fr) and size placed and clinical outcomes. The primary clinical outcome of interest was complications within the first 90 days after surgery. The complications were further categorized into minor and major. Minor complications included, development of GER, feeding intolerance (fussiness, vomiting, retching, excessive gas, and diarrhea after initiation of tube feeds), conversion to gastrojejunostomy (GJ) tube, wound infections, peristomal bleeding, hypergranulation tissue, and external gastric content leaks. Major complications were defined as complications requiring either nil per os (NPO)/total parenteral nutrition (TPN) and/or surgical intervention. Secondary clinical outcomes of interest were hospital length of stay (HLOS), time to the occurrence of the complications. Patients were categorized into two groups based on the primary device placed - primary G-tube and primary G-button. Device type was based on the surgeon's preference. The two groups were compared using chi-square or Fisher's exact tests for categorical data as appropriate, independent Student *t*-test for parametric continuous data and Mann–Whitney U-test for non-parametric continuous data. Outcomes with $p \leq 0.05$ (two-sided) were used to determine statistical significance. All data were analyzed with SPSS ver. 24 (IBM Corp., Armonk, NY, USA).

RESULTS

There were 296 patients identified to have undergone gastrostomy device placement during the study period. Two hundred and sixty-five (265) patients met inclusion criteria. Of these, 58% were female and 63% were whites. The main indications for gastrostomy device placement were poor oral intake and failure to thrive. There were 80 patients (30%) in the G-tube group and 185 patients (70%) in the G-button group as shown in **Fig. 1**. Demographic characteristics of the two groups are listed in **Table 1**. There was no difference in terms of

https://doi.org/10.5223/pghn.2022.25.3.211

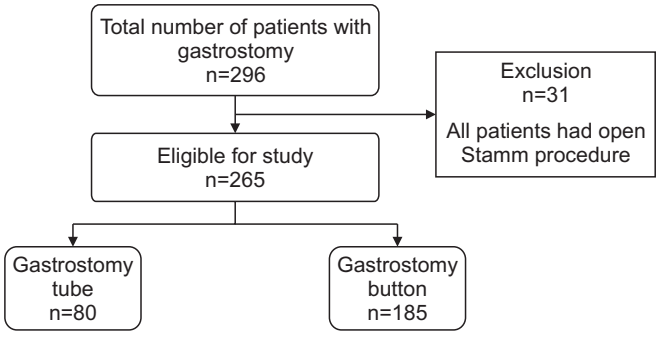

Fig. 1. Study flow chart.

Table 1. Study demographics and baseline characteristics

Characteristic	G-tube (n=80)	G-button (n=185)	*p*-value
Sex, female	32 (40)	91 (49)	0.169
Race			0.127
White	48 (60)	118 (64)	
Black	27 (34)	49 (27)	
Others	5 (8)	18 (10)	
Age distribution (mo)			0.310
0–12	48 (60)	106 (57)	
13–60	12 (15)	42 (23)	
>60	20 (25)	37 (20)	
Weight distribution (kg)			0.987
0–10	52 (65)	120 (65)	
11–15	9 (11)	22 (12)	
>15	19 (24)	43 (23)	
Preoperative albumin (g/dL)	3.46±0.58	3.67±0.53	0.057
Congenital cardiac disease	30 (37)	52 (28)	0.129
Cyanotic cardiac disease	4 (5)	16 (8)	0.077
Non-cyanotic cardiac disease	26 (32)	36 (19)	
Type of surgical approach			0.001
Laparoscopic	65 (81)	178 (96)	
Open	8 (10)	5 (3)	
Lap converted to open	7 (9)	2 (1)	
Operative time (min)	57.8±43.3	58.9±36.4	0.816
Intraoperative antibiotics	74 (92)	169 (91)	0.756
Within 1 hour of the procedure	71 (89)	165 (90)	0.469
Surgeon			0.0001
1	14 (17)	68 (37)	
2	54 (67)	4 (2)	
3	4 (5)	67 (36)	
4	8 (10)	46 (25)	
Tube size (Fr)			
12	52 (65)	11 (6)	0.0001
14	21 (26)	160 (86)	
16	6 (7)	9 (5)	
18	1 (1)	5 (3)	

Values are presented as number (%) or mean±standard deviation.
G-tube: gastrostomy tube, G-button: gastrostomy button, g/dL: grams/deciliters, Lap: laparoscopy, Fr: French.

the sex, race, age, and weight distributions as well as history of congenital cardiac disease and preoperative albumin status at the time of surgery among the groups. There was also no difference in the mean operative time between G-tube and G-button groups (52 vs. 42 minutes, p=0.149). Nonetheless, there was significant difference in the type of surgical approach and tube sizes placed among the two groups. Both groups had more devices placed laparoscopically. Whereas most of the G-tube group had 12-Fr tube, the G-button group had

https://doi.org/10.5223/pghn.2022.25.3.211

14-Fr size placed. More importantly, there was a significant difference in the laparoscopic to open conversion rate between the groups; G-tube vs. G-button (9% vs. 1%, p=0.0001). There was a statistically significant difference on tube type placement by the four different surgeons.

There were 153 (58%) patients with overall complications within 90 days of surgery; of these 142 (93%) were minor while 11 (7%) were major complications. About 10% of patients in both groups developed GER after surgery, 15% developed feeding intolerance, 2% had to be converted to a GJ tube, 4.5% developed wound infections and about 40% of patients developed hypergranulation tissue in both groups. More importantly, patients with primary G-tubes had statistically significant higher rates of peristomal bleeding (5% vs. 1%, p=0.049) and external gastric content leak (18% vs. 9%, p=0.03). See **Table 2**. Furthermore, patients in the G-tube group had more overall complications, however, this was not statistically significant, (64% vs. 56%, p=0.192). There was no difference in major complications between groups. Three patients in each groups required intervention (NPO/TPN or surgery) due to external gastric content leakage. There were no patients in the G-tube group with hypergranulation tissue requiring surgery, although three patients in the G-button group required surgical intervention for hypergranulation. Lastly, only 1 patient in each group required surgical intervention for device dislodgement. The median time to start feeds between the groups was significantly different (G-tube, 2 days vs. G-button 1 day, p=0.003), with no difference in the inpatient or outpatient median HLOS. There were no intraoperative complications and procedure-related mortality.

Predictors of complications

Patients with weight children <10 kg had a significantly higher number of overall complications on univariate and multivariate analysis. On subgroup evaluation of major complications, patients with prior Nissen fundoplication (1% vs. 9%, p=0.04), open procedures (6% vs. 27%, p=0.01), with longer operative time (58 vs. 85 minutes, p=0.04 and failure to receive

Table 2. Postoperative outcomes

Outcomes	G-tube (n=80)	G-button (n=185)	p-value
Length of stay (d)			
Inpatient	23 (5–66)	22 (3–62)	0.4
Outpatient	4 (1–4)	4 (1–3)	0.9
Overall 90-day complications	51 (64)	102 (56)	0.1
Minor complications	47 (59)	95 (51)	0.2
Major complications	4 (5)	7 (4)	0.6
Complications			
GER	8 (10)	10 (5.4)	0.1
Feeding intolerance	12 (15)	28 (15.1)	0.9
Conversion to GJ	3 (3.8)	2 (1.1)	0.1
Peristomal infection	4 (5)	8 (4.3)	0.8
Device dislodgement	9 (11.3)	19 (10.3)	0.8
Peristomal bleeding	4 (5)	2 (1)	0.049
Hypergranulation tissue	33 (41.3)	70 (37.8)	0.6
External gastric content leak	14 (17.5)	16 (8.6)	0.03
Major complications			
External leaks with intervention	3	3	
NPO/TPN	2	1	0.4
Surgery	1	2	1.0
Hypergranulation tissue requiring surgery	0	3	0.2
Device dislodgement requiring surgery	1	1	1.0

Values are presented as median (interquartile range), number (%), or number only.
G-tube: gastrostomy tube, G-button: gastrostomy button, GER: gastroesophageal reflux, GJ: gastrojejunostomy, NPO: nil per os, TPN: total parenteral nutrition.

https://doi.org/10.5223/pghn.2022.25.3.211

Pediatric Gastroenterology, Hepatology & Nutrition pghn

Table 3. Logistic regression analysis for major complications

Patient characteristics	Odds ratio (confidence interval)	*p*-value
Age	0.99 (0.97–1.01)	0.4
Weight	1.03 (0.95–1.12)	0.4
Operative time	1.01 (1.00–1.03)	0.1
Sex	1.29 (0.27–6.14)	0.7
Type of tube	1.54 (0.32–7.47)	0.5
Congenital cardiac disease	0.93 (0.19–4.54)	0.9
Preoperative antibiotics	12.71 (2.34–68.95)	0.003
Open surgical approach	6.68 (1.1–40.67)	0.039

preoperative antibiotics (92% vs. 63%, p=0.004) were more likely to experience a major complication. However, only failure to receive antibiotics and open procedures were significant predictors of major complications in multivariate analysis (**Table 3**).

DISCUSSION

For durable long term enteral access, gastrostomy devices are the procedure of choice both in children and adults. The primary device placement can be performed surgically, endoscopically or radiologically. In infants and children, most devices are commonly placed surgically by pediatric surgeons. The type of device placed is based on surgeon's discretion, patients' comorbidities and device availability [2,8-10]. Based on internal discussions in our practice, we had hypothesized that primary G-tubes were safer and with fewer complications when compared to primary G-buttons. Subsequently, we aimed to compare surgical outcomes of patients undergoing G-tube or G-button placement.

Our study shows that there was no difference in the overall, minor or major complications within 90-days of surgery between primary G-tube and primary G-button. Such comparison has been made between PEG tubes versus PEG buttons [12,13], but to our knowledge, this is the first report comparing complications of surgically placed primary G-tubes and G-buttons. Laparoscopic gastrostomy device placement using Seldinger technique is our preferred approach for pediatric patients. Interestingly, conversions to open were significantly higher in the G-tube group. We hypothesized this could be due to harder to perform the Seldinger technique with this tube, which could lead to difficulty confirming intragastric position. More importantly, we found no differences in outcomes when comparing preoperative characteristics, surgeon, tube size or length. Regarding the minor complications evaluated, we estimate that all of them can be attributed to the procedure with possible the exception of GER and feeding intolerance. However, several patients required conversion to a GJ tube, which indicated worsening of their reflux or feeding intolerance. For the purposes of this study, we defined major complications as hypergranulation tissue, device dislodgement or gastric content external leaks requiring prolonged NPO/TPN, or surgery. Gastric content external leak requiring intervention in G-button patients was one of the main reasons that prompted this study. Surprisingly, our results showed that this complication occurred significantly more commonly in G-tube patients (17% vs. 8%, p=0.03). However, only 3 patients with external leaks in each group required intervention. Furthermore, there were no differences between the groups with regards to hypergranulation tissue around the gastrostomy tract. Nonetheless, hypergranulation requiring surgical intervention was necessary in 3 patients who underwent G-button placement. Overall device dislodgement rate was 10%, with an average time to dislodgement of 40 days for G-tubes and 30 days for

https://doi.org/10.5223/pghn.2022.25.3.211

G-buttons. At that time, a well-formed tract permits easy replacement without requiring an intervention. However, 1 patient in each group required an intervention for device dislodgement at postoperative day (POD) 0 for G-button and POD 2 for G-tube. These were considered to be due to technical errors and our results are similar to other series where device dislodgement requiring surgical intervention is a rare event [3-5,7,8]. Regarding predictors of complications, we identified that only weight at insertion (<10 kg) had a significantly higher number of overall complications on univariate and multivariate analysis. Furthermore, on subgroup analysis, we noted that patients with prior Nissen fundoplication (1% vs. 9%, p=0.04), open procedures (6% vs. 27%, p=0.01), with longer operative time (58 vs. 85 minutes, p=0.04) and failure to receive preoperative antibiotics (92% vs. 63%, p=0.004) were more likely to experience a major complication. However, only failure to receive antibiotics and open procedures were significant predictors of major complications in multivariate analysis.

This is a retrospective study and therefore limited in establishing a causal relationship. Another important limitation was that one surgeon preferentially places primary G-tubes, whereas the other three surgeons mostly place primary G-buttons. However, based on patients' comorbidities the other three surgeons sometimes placed primary G-tubes. The decision to primarily place a G-tube versus a G-button was the surgeon's preference and no clear indications could be found in the chart as to why they chose one device over the other. It is important to mention that preoperative characteristics amongst patients were not significantly different, which helps comparison between groups, surgeons and technique. Also, gastrostomy outcomes definitions can be highly variable and difficult to standardize. However, our results are similar to previous reports where up to 60% of patients will have minor complications and less than 5% of patients will have a major complication [1,5,14]. More importantly, despite these limitations, our study suggest that primary G-tube offer no significant advantage in overall, minor or major complications when compared to primary buttons. Primary G-tube or buttons are safe and effective means to provide enteral nutrition in children of all ages with a low major complication rate.

REFERENCES

1. Akay B, Capizzani TR, Lee AM, Drongowski RA, Geiger JD, Hirschl RB, et al. Gastrostomy tube placement in infants and children: is there a preferred technique? J Pediatr Surg 2010;45:1147-52.
PUBMED | CROSSREF
2. Khattak IU, Kimber C, Kiely EM, Spitz L. Percutaneous endoscopic gastrostomy in paediatric practice: complications and outcome. J Pediatr Surg 1998;33:67-72.
PUBMED | CROSSREF
3. Franken J, Mauritz FA, Suksamanapun N, Hulsker CC, van der Zee DC, van Herwaarden-Lindeboom MY. Efficacy and adverse events of laparoscopic gastrostomy placement in children: results of a large cohort study. Surg Endosc 2015;29:1545-52.
PUBMED | CROSSREF
4. Jones VS, La Hei ER, Shun A. Laparoscopic gastrostomy: the preferred method of gastrostomy in children. Pediatr Surg Int 2007;23:1085-9.
PUBMED | CROSSREF
5. Merli L, De Marco EA, Fedele C, Mason EJ, Taddei A, Paradiso FV, et al. Gastrostomy placement in children: percutaneous endoscopic gastrostomy or laparoscopic gastrostomy? Surg Laparosc Endosc Percutan Tech 2016;26:381-4.
PUBMED | CROSSREF
6. Wragg RC, Salminen H, Pachl M, Singh M, Lander A, Jester I, et al. Gastrostomy insertion in the 21st century: PEG or laparoscopic? Report from a large single-centre series. Pediatr Surg Int 2012;28:443-8.
PUBMED | CROSSREF

7. Petrosyan M, Khalafallah AM, Franklin AL, Doan T, Kane TD. Laparoscopic gastrostomy is superior to percutaneous endoscopic gastrostomy tube placement in children less than 5 years of age. J Laparoendosc Adv Surg Tech A 2016;26:570-3.
PUBMED | CROSSREF
8. Villalona GA, Mckee MA, Diefenbach KA. Modified laparoscopic gastrostomy technique reduces gastrostomy tract dehiscence. J Laparoendosc Adv Surg Tech A 2011;21:355-9.
PUBMED | CROSSREF
9. Sullivan PB, Juszczak E, Bachlet AM, Thomas AG, Lambert B, Vernon-Roberts A, et al. Impact of gastrostomy tube feeding on the quality of life of carers of children with cerebral palsy. Dev Med Child Neurol 2004;46:796-800.
PUBMED | CROSSREF
10. Pemberton J, Frankfurter C, Bailey K, Jones L, Walton JM. Gastrostomy matters--the impact of pediatric surgery on caregiver quality of life. J Pediatr Surg 2013;48:963-70.
PUBMED | CROSSREF
11. Rothenberg SS, Bealer JF, Chang JH. Primary laparoscopic placement of gastrostomy buttons for feeding tubes. A safer and simpler technique. Surg Endosc 1999;13:995-7.
PUBMED | CROSSREF
12. Novotny NM, Vegeler RC, Breckler FD, Rescorla FJ. Percutaneous endoscopic gastrostomy buttons in children: superior to tubes. J Pediatr Surg 2009;44:1193-6.
PUBMED | CROSSREF
13. Evans JS, Thorne M, Taufiq S, George DE. Should single-stage PEG buttons become the procedure of choice for PEG placement in children? Gastrointest Endosc 2006;64:320-4; quiz 389-92.
PUBMED | CROSSREF
14. Antonoff MB, Hess DJ, Saltzman DA, Acton RD. Modified approach to laparoscopic gastrostomy tube placement minimizes complications. Pediatr Surg Int 2009;25:349-53.
PUBMED | CROSSREF