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Abdominal

Replacing gastrostomy tubes with collapsible bumpers in pediatric patients: Is it safe to "cut" the tube and allow the bumper to pass enterally?☆,☆☆

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ABSTRACT

Purpose: The "cut and push" technique for removal of percutaneous endoscopic gastrostomy (PEG) tubes with collapsible bumpers offers an alternative to the standard traction method of removal. This study compared the outcomes of these techniques.
Methods: We completed a research ethics board-approved retrospective cohort study, identifying all patients less than 18 years of age who underwent PEG tube removal at a children's hospital between December 2013 and December 2016. Outcomes included need for sedation and complications.
Results: We identified 127 children who had PEG tubes removed. Significantly fewer children required sedation with the cut and push group (1.1% vs. 60.6%, $p \leq 0.001$). Ten complications occurred, including 9 in the cut and push group (9.6% vs. 3%, $p = 0.23$). Mean age at time of complication was significantly younger in the cut and push group (2.2 vs. 6.3 years $p = 0.004$).
Conclusion: This is the largest reported series comparing the cut and push vs. traction removal methods. The cut and push technique significantly reduced the need for procedural sedation but was associated with increased risk of complications. While these data suggest that the technique is safe in older children, caution should be taken in younger children who appear to be more likely to vomit the residual bumper.
Levels of evidence: Level III—Treatment study, Retrospective comparative study.

Enteral tube feeding is required to ensure adequate nutrition in children with difficulty swallowing or failure to thrive. These devices can be inserted using a variety of approaches, including laparoscopic, radiologic, or endoscopic guidance [1]. Percutaneous endoscopic gastrostomy (PEG) tubes, were first introduced in the 1980s, and are widely accepted as a safe and effective method for long-term enteral feeds [1]. Furthermore, PEG tubes improve the quality of life of patients and their caregivers [1,2]. A gastrostomy tube (G-tube) may be used for months to years prior to being removed. G-tube removal is indicated when there is the resumption of adequate oral feeds or if the tube needs to be replaced. A study looking at the longevity of PEG tubes demonstrated that the median time to removal of silicone PEGs was 301 days, versus 441 days in polyurethane tubes [3].

There are a number of methods for PEG tube removal depending on the type of the tube used. Endoscopic removal has historically been deemed the safest method of removal; however, there are reports of significant complications that have been associated with this approach, including upper airway obstruction, esophagitis and development of retropharyngeal abscess [4,5]. This method also requires sedation.

PEG tubes with a collapsible inner bumper can be removed using external traction. A prospective study of 166 children demonstrated no mortality associated with the traction method of removal [4]. Reported complications associated with traction removal include persistent leakage through a gastrocutaneous fistula [6] and bleeding [7]. In addition, the traction method can cause significant discomfort and pain in a child, which may necessitate conscious sedation or general anesthesia.

A third method, known as the "cut and push" technique, involves cutting the PEG tube at skin level and allowing the bumper to pass via the gastrointestinal tract. This method is commonly used in the adult population, avoiding the risks of anesthesia and endoscopy, with

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decreased trauma to the site, and decreased pain [8,9]. Multiple prospective studies have demonstrated this method's safety and efficacy in adults, with complication rates ranging from 0 to 2.7% [8–11]. Despite this low complication rate, serious adverse events have been reported with cases of intestinal obstruction [12,13], ileus [14], small bowel perforation [13,15–17], and even death [15].

There is a paucity of literature regarding the safety and efficacy of this method of PEG tube removal in children. Case reports of severe complications including gastric outlet obstruction [18], lodging in the esophagus and stricture formation [18,19], esophageal obstruction [20], aspiration secondary to bronchoesophageal fistula [19,21], and small bowel perforation [21] have led to concern regarding the safety of this method in children. To date, only one retrospective review of 11 pediatric patients has been performed, in which 45% (5 patients) developed complications including persistent vomiting and one esophageal perforation resulting in death [22].

Reviews of the literature demonstrate up to 90% of ingested foreign objects pass spontaneously in children [23]. A retrospective review of 249 children reported spontaneous passage of the foreign body located below the esophagus occurred in 77.7% of patients (71.4% for stomach, 85.7% for small bowel, and 96.4% for colon), with no significant differences according to age [24]. Blunt objects in the stomach are often just observed, using inspection of stool or serial x-rays [25], as they will likely transverse the remainder of the gastrointestinal tract spontaneously [23,25].

Given that observation of blunt foreign bodies in the stomach is deemed a safe approach to management, we hypothesized that the cut and push method of PEG tube removal would also be safe and effective in the pediatric population. This retrospective study compares the outcomes of two groups of pediatric patients having PEG tubes removed via the cut and push or traction techniques.

1. Methods

1.1. Participants

We retrospectively identified all pediatric patients who underwent PEG tube removal at McMaster's Children's Hospital between December 2013 and December 2016. This period was chosen as this is when the cut and push method was introduced at our hospital. Approval was obtained from the Hamilton Integrated Research Ethics Board (REB#14-888-C) prior to data collection. Inclusion criteria consisted of age less than 18 years with a PEG tube requiring either complete removal or replacement by one of five pediatric surgeons. We used the CORFLO PEG Tube (CORPAK Medsystems, Buffalo Grove, ILL) [26], which is made of polyurethane and traction-removable. Although the company recommends traction removal, we found that this often required sedation with its attendant additional risks in complex children. For this reason, with parental consent, we began selectively using the cut and push method of removal. As this was a retrospective study there were no predefined selection criteria for method of removal. Participants were chosen for the cut and push or traction method based on the surgeon's preference. Factors taken into consideration included patient's age, prior abdominal surgeries, likelihood they would require sedation for removal, and if they had other procedures scheduled that would utilize sedation.

The electronic medical record was used for data collection. To capture all postoperative complications, the patients' first follow-up visit postremoval and their most recent follow-up visit were reviewed. Not all patients had scheduled follow-up in the surgical clinic post PEG removal; however, documented follow-up reviewed included that in the surgical clinic, in another pediatric clinic, or by telephone. Data included patient age, weight, gender, history of prior abdominal surgery, method of removal, sedation required, and procedure specific complications.

The primary outcome of interest was presence of complications resulting in subsequent therapeutic intervention. Major complications were defined as those requiring surgical or procedural intervention, while minor complications were those requiring medical intervention only. The study design was a retrospective, comparative cohort study without case matching or selection.

1.2. Removal of PEG tubes

Tubes were removed either via the traction method, utilizing external traction, or via the cut and push method. In the cut and push method, the tube is pulled taut and cut at the skin surface below the crossbar; the remaining tube and bumper are then gently pushed into the stomach using forceps, or in the case of replacement, using the mic-key measuring device. Procedures not requiring sedation were performed in clinic whenever possible. If the child was undergoing conscious sedation or general anesthesia for another procedure, we would coordinate removal to minimize exposure to additional sedation. Procedures requiring sedation specifically for removal were performed in the sedation suite with conscious sedation, cardiorespiratory monitoring, and supplemental oxygen as needed.

1.3. Statistical analysis

Data analysis was performed using STATA 2015 [27]. Descriptive statistics were used; categorical variables were compared using chi-squared and Fisher's exact tests, and continuous variables with independent t-test. Effect size was reported as unadjusted odds ratios with 95% confidence interval (CI). A p-value of <0.05 was considered statistically significant.

2. Results

2.1. Patient characteristics

127 patients underwent PEG tube removal: 94 underwent the cut and push method and 33 were treated with the traction method. The two groups were comparable in terms of baseline characteristics, including age, weight at removal, duration of PEG tube, and history of prior abdominal surgery (Table 1).

2.2. Sedation

In total, 21 children required sedation at the time of removal. Significantly fewer children in the cut and push group required sedation (1.1% vs. 60.6%, $p < 0.001$). Whenever possible, these procedures were combined with other procedures requiring sedation in order to minimize exposure to sedation and anesthesia. Two children underwent sedation solely for PEG tube removal (9.5%); all of these were in the traction group.

Table 1
Baseline characteristics of children with gastrostomy tubes removed via cut and push or traction method.

Characteristic	Cut and Push	Traction	p-value
Number of participants	94	33	
Males[b], n (%)	48 (51.1%)	20 (60.6%)	0.37
Laparoscopic-assisted insertion[b], n (%)	4 (4.3%)	0 (0%)	0.33
Duration of PEG tube[a], mean months (range)	17.1 (2–72)	16.4 (1–59)	0.81
Age at removal[a], mean months (range)	48.2 (3–205)	49.8 (5–198)	0.88
Weight at removal[a], mean kg (range) (n = 71)	15.4 (6.2–92.5)	16.9 (5–54.5)	0.69
Prior abdominal surgery[c], n (%)	9 (9.6%)	3 (9.1%)	0.61
Need for sedation at time of removal[c], n (%)	1 (1.1%)	20 (60.6%)	<0.001

[a] Independent t-test.
[b] chi-squared test.
[c] Fisher's exact test.