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Operative Techniques

New surgical technique for creation of a continent appendicostomy: Invaginated appendicostomy

Maria Zornoza [a,*], Alejandro Ruiz-Montañez [a], Guillermo Victoria-Morales [b], Luis De la Torre-Mondragón [c]

[a] Centro Colorrectal para Niños de México, Hospital Ángeles Puebla, Avenida Kepler 2143-530, Puebla, Mexico, 72190
[b] Hospital para el Niño Poblano, Boulevard del Niño Poblano 5307, Puebla, Mexico 72190
[c] Colorectal Center for Children of Children's Hospital Pittsburgh of UPMC, Children's Hospital of Pittsburgh of UPMC, One Children's Hospital Drive 4401 Penn Avenue, Pittsburgh, PA 15224, USA

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ABSTRACT

Introduction: The main complications of appendicostomy are stenosis and stomal fecal leakage. Although many authors report that the appendix is naturally continent, it is recommended to perform a plication of the cecum with the appendix to prevent stomal fecal leakage. We present here the creation of a different continent mechanism. Our technique is advantageous when the anatomy, vascularity, or the length of the appendix does not allow for a standard plication procedure.

Description of operative technique: During 2014–2016 we performed four appendicostomies in patients with anorectal malformations with fecal incontinence that requested an "Antegrade Continent Enema" procedure after a successful bowel management program in the Colorectal Center for Children of Mexico. The average age at surgery was 13 years. All patients had anorectal malformations with a poor prognosis for proper control of defecation, with a sacral ratio lower than 0.4. In these patients, we invaginated a 1 cm length of the appendix at its base, placing eight circumferential stitches with 5-0 silk. None of the patients experienced leakage when a saline solution was introduced with a catheter into the cecum during the surgical procedure. After an average of 15 months of follow-up, none of the patients were experiencing stomal leakage.

Conclusions: The "Invaginated Appendicostomy" is a reproducible and effective continent mechanism to prevent stomal fecal leakage. It appears to be an excellent alternative to cecal plication around the appendix.

In 1990 Malone described the anterograde continent enema (ACE) [1]. Since then, this procedure has allowed most patients to be independent, thus improving their quality of life. Many patients with fecal incontinence, and some with complicated constipation, require daily enemas in order to be socially continent [2]. The two main problems described after the ACE procedure are stenosis of the appendicostomy, and leakage of fluid from the stoma [2,3].

Regarding leakage, some surgeons do not create a cecal plication as a valve because they use the natural valve mechanism of the appendix [2], but most variations of the ACE procedure add some type of continence mechanism. Malone, in his original method, divided the appendix at its base, rotated it 180 degrees, and reimplanted it into the cecum through a submucosal tunnel [1]. Years later, Levitt et al. published a modification [3]. They did not divide and separate the appendix, but instead performed a cecal plication around the base of the appendix in order to create a continent valve mechanism. With this procedure, the rate of stomal leakage was significantly reduced [2].

We now present a different technique for creating a continence mechanism that is simple and appears to be effective in preventing leakage through the appendicostomy. This new technique is particularly applicable when the vascularity or the length of the appendix does not allow for the appendiceal reversal of Malone or the cecal plication of Levitt.

1. Description of operative technique

We present four patients with anorectal malformations and fecal incontinence. After establishing a successful bowel management program, we performed an appendicostomy in the Colorectal Center for Children in Puebla, Mexico between 2014 and 2016, using our new continent valve procedure. The age of the patients at the time of the procedure was between 9 and 14 years (Table 1). The primary indication for surgery was having a successful bowel management program and the desire of the patient to avoid transanal enemas. All the patients had anorectal malformations with a bad prognosis for fecal continence. One of the patients had an associated myelomeningocele. The other three had a normal spine without myelomeningocele or tethered cord. All had a sacral ratio lower than 0.4 (range 0.17 to 0.4).

Instead of the plication of the cecum around the appendix, we conducted an invagination of 1 cm of the appendix at its base into the

* Corresponding author at: Pediatric Colorectal Surgery, Centro Colorrectal para Niños de México, Hospital Ángeles Puebla, Avenida Kepler 2143-530, Puebla, Mexico, 72190.
E-mail addresses: mariazornoza@gmail.com (M. Zornoza), cirugiapediatrica@msn.com (A. Ruiz-Montañez), guivic@me.com (G. Victoria-Morales), luis.delatorre@chp.edu (L.D. la Torre-Mondragón).

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Table 1
Characteristics of patients with invaginated appendicostomy.

	Patient 1	Patient 2	Patient 3	Patient 4
Age at surgery	14 y	10 y	13 y	9 y
Type of ARM	Bladder neck	Bladder neck	Bladder neck + MMC	Recto prostatic
BMP		Successful		
Sacral ratio	0.31	0.17	0.26	0.4
				
Leakage	No	No	No	No
Follow-up	2 y 6 m	1 y	9 m	8 m

ARM: anorectal malformation; MMC: myelomeningocele; BMP: bowel management program; Y: years; M: months.

cecum, based on the principle of a conical invaginated valve, previously studied in dogs [4,5], and subsequently used in children with biliary atresia [6]. We placed 8 or 9 seromuscular 5-0 silk stitches, each taking two bites, 2 cm apart [7], but avoiding the mesoappendix (Fig. 1). We checked the effectiveness of the continence mechanism and the absence of reflux intraoperatively per the method described by Levitt et al. [3]. In all of our patients, we performed a cecopexia to the abdominal wall, and then anastomosis of the appendicostomy to the umbilicus using a V-shaped incision [2,3]. We then followed the patients postoperatively to evaluate for the presence or absence of leakage, as well as other possible complications.

In the first patient, the anatomy of his appendix led to a kinking of the catheter at the point where the appendix was plicated with the cecum. We therefore turned to this new alternative continence procedure. We used this invaginated valve approach because it has been useful in some previous intestinal procedures where a valve mechanism is required such as the continent gastrostomy [8]. In the second patient, the anatomy of the appendiceal vasculature prevented plication of the cecum and foreshortening of the appendix so that the tip of the appendix would not reach the umbilicus. In the other two patients, we performed this new technique because of the ease and effectiveness that we found in the first two patients.

None of the four patients had leakage during the intraoperative testing, and none of them have experienced leakage or other complications after a follow-up of between 8 and 30 months.

2. Discussion

The decision to perform any “antegrade continent procedure” in a patient with fecal incontinence requires that the patient be in a successful bowel management program that entails enemas, and that patient understands the procedure and its ramifications [2,9].

The two most significant postoperative complications of an appendicostomy are stenosis and leakage [2,3]. Different continence procedures have been published to prevent leakage. Malone creates a submucosal tunnel [1] similar to a Mitrofanoff procedure [10]. 25%

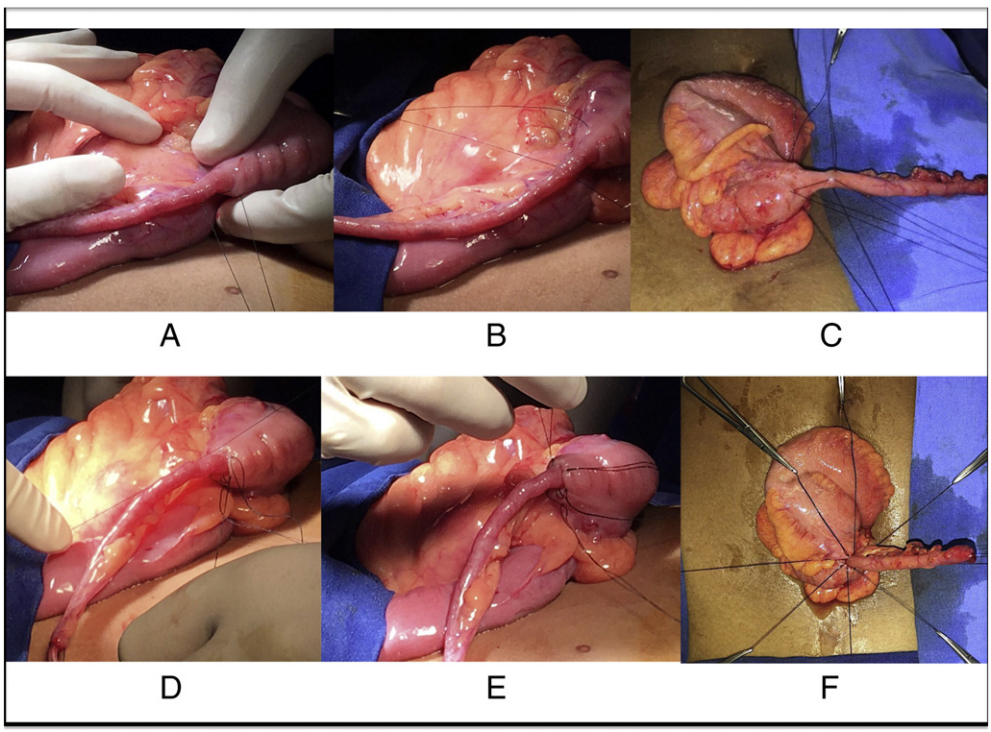

Fig. 1. Surgical steps. A, B and C: Stitches from the base of the cecum to the appendix. D and E: invagination of the appendix on its base. F: Final stage.

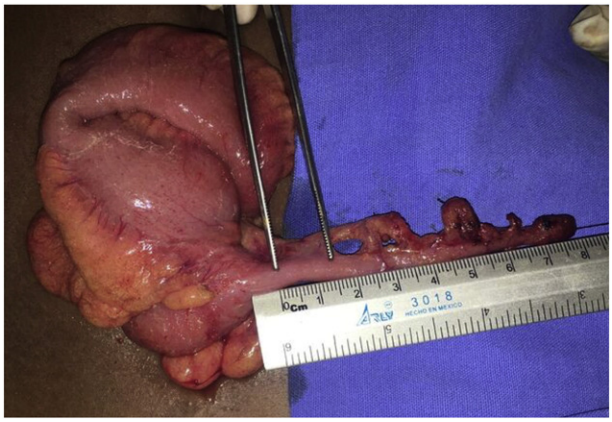

Fig. 2. Length of the stitches.

of appendicostomies performed without a continence procedure need a revision because of fecal leakage [2,3]. Plication of the cecum around the base of the appendix has been demonstrated to be an effective continence procedure that reduces leakage [2,11]. Some studies report that fecal leakage does not always completely disappear despite performing a continence procedure. There appears to be a significant learning curve in the creation of the cecal plication that impacts on the outcomes [11]. The etiology of fecal leakage is multifactorial [2], including the degree of activity of the patient [12] and the characteristics of the stool [3].

A previous study described a continence procedure entailing an invagination of the bowel, and was termed a "conical valve". Initially, the effectiveness of this procedure was evaluated in dogs [4,5]. These conical valves have since been used successfully in adults in the urinary tract [13], in the esophagus [14], and in the stomach for continent gastrostomies [8] and gastroesophageal reflux [15], and for biliary reflux [16]. In children, these valves have been used to prevent biliary reflux after the surgical correction of biliary atresia [6,17]. In subsequent dog studies, it was found that optimal continence is achieved if the valve is short, and the invaginating sutures should be taken such that the two bites are twice as far apart as the desired length of the valve [7]. Thus, the length of the valve in our patients was 1 cm, so the two bites with a suture should be 2 cm apart (Fig. 2).

We originally chose this kind of valve because our group had previously used it for continent gastrostomies in children, using the Spivack procedure [8] where the antireflux mechanism had proven to be effective, without leakage. Although the number of patients now is low, none of the patients had leakage during the intraoperative testing, and none of them experienced leakage after a follow-up between 8 and 30 months.

3. Conclusions

This technique appears promising as a new continence procedure. It prevents the leakage of feces, fluid, and gas from the stoma. It also appears to be an excellent alternative to plication of the cecum in patients with challenging appendiceal anatomy that does not allow plication.

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