

# Is an Antireflux Procedure Necessary for a Successful Appendicostomy? The Simplified Malone Antegrade Continence Enema Procedure

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## INTRODUCTION

The Malone antegrade continence enema (MACE) procedure revolutionized the management of children with fecal incontinence. In children/adults with neuropathic bowel (myelodysplasia), where behavioral therapy is rarely successful and a daily enema becomes essential, the MACE stoma renders social independence and has a positive impact on their quality of life.<sup>[1]</sup> In children with anorectal malformations (ARMs) and chronic functional constipation too, the MACE is the optimum solution when conservative methods fail.<sup>[2,3]</sup>

In children with neuropathic bowel and bladder, the MACE stoma is usually created along with reconstructive urological procedures. Hence, a quick, effective way of creating a MACE stoma is preferable. Several modifications of the MACE stoma using different techniques of creating an antireflux mechanism have been described with varying results. However, the creation of these mechanisms makes the

### ABSTRACT

**Aim:** The aim of this study was to present the long-term institutional experience and outcomes of our Malone antegrade continence enema (MACE) procedure using the proximal appendix without any antireflux procedure.

**Materials and Methods:** A single-center prospective study of 29 children undergoing a simplified Malone antegrade continence enema (SMACE) procedure from 2006 to 2017 was conducted using the appendix, whole or split. The mean follow-up period was 11.5 years (ranging from 5 to 16 years).

**Results:** In 25 children, the proximal appendix was used, and in 4 cases, the whole appendix was used as a conduit. On follow-up, the MACE channel has been working well in 29/29 patients. Among the complications, seven patients had stomal stenosis, which was managed by home dilatation. There was no reflux of stools seen in any of the patients.

**Conclusion:** The SMACE procedure, without incorporating an antireflux mechanism, is technically simpler and saves operative time. Most importantly, the results are satisfactory and comparable with procedures using antireflux techniques.

**KEYWORDS:** Antireflux, enema, Malone antegrade continence enema, simplified Malone antegrade continence enema

MACE a relatively complicated operation. We describe our experience with a simplified Malone antegrade continence enema technique (SMACE) without the creation of any antireflux mechanism and its operative technique, results, and our follow-up.

## MATERIALS AND METHODS

This was a prospective study conducted in the division of pediatric surgery, from December 2006 to July 2017. Children ranging from 3 to 18 years of age (mean age: 10.8 years) were included in the study. The cohort included cases of spina bifida with incontinence (26/29), sacral agenesis with incontinence (2/29), and anorectal malformation (ARM) with chronic constipation (1/29). Children with neurogenic bowel with incontinence who

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had been on an enema regimen for at least 6 months were considered for the SMACE procedure.

### Simplified Malone antegrade continence enema-operative technique

In children undergoing a concomitant urological procedure, such as bladder augmentation, Mitrofanoff, and bladder neck repair using anterior rectal fascial sling, a Pfannenstiel incision was taken, and in patients undergoing an isolated MACE procedure, a McBurney's incision was preferred. In children undergoing concomitant reconstructive urological procedures, the appendix was split based on its vascular pedicle, with the distal end (3/4<sup>th</sup> to 4/5<sup>th</sup>) being used for a Mitrofanoff channel and the proximal end (1/4<sup>th</sup> to 1/5<sup>th</sup>) for the MACE channel [Figure 1]. This decision in dividing the appendix into MACE as well as Mitrofanoff conduits was taken based on the thickness of the abdominal wall of the individual patient, the length of the individual appendix, and how easy the appendix was getting implanted in the native bladder with augmentation. Thus, there is no fixed ratio to stick on, but we would say usually, an approximate proximal (1/4<sup>th</sup> to 1/5<sup>th</sup>) can be used for MACE conduit and the rest of the distal appendix (3/4<sup>th</sup> to 4/5<sup>th</sup>) can be used to make Mitrofanoff conduit. As the appendix was of sufficient length, there was no difficulty in dividing the appendix into Mitrofanoff and MACE conduits. In isolated MACE procedures, the whole appendix was used.

The appendix (whole or split with its proximal end) was kept naturally attached to the cecum and was simply brought out through the abdominal wall after carefully selecting the site of the stoma. Selection of the stoma

site was important so that the lie of the appendix was straight and taut and not loose or kinked. Here, the mobilization of the cecum/the ascending colon was not required in any of our cases in bringing out the proximal end of the appendix to create a tension-free stoma.

The appendix was serially hitched to the parietal peritoneum, the muscle, fascia, and the subcutaneous tissues [Figure 2]. We feel this step is very important in preventing retraction of the conduit. A hidden stoma was created with a "V" shaped skin incision [Figure 3]. The appendix was fixed to the skin with interrupted mucocutaneous sutures. It is to be reemphasized that no antireflux procedure such as tunneling/plication/imbrication/needling was done. Sometimes, cecum was also hitched to the peritoneum to reduce tension. The terminal 0.5 cm of the appendicular length was excised in few cases where the whole appendix was used, to maintain the lie of the appendix straight and taut. The entire SMACE procedure is technically simple and operative time was <1 h in most cases. The time taken for mobilization of the appendix to appendicostomy creation was the operative time considered for MACE component of the surgery, which was <1 hour.

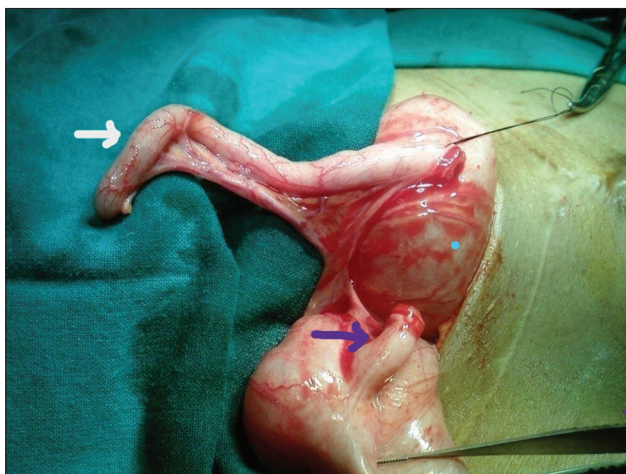
### Postoperative care

Postoperatively, the MACE catheter was changed after 14 days but kept *in situ* for 21 days. The enema regimen was started from the 14<sup>th</sup> day and gradually increased to full volume by the 21<sup>st</sup> day. The enema fluid used was normal saline. All patients were advised to take a daily enema. Some chose to keep the catheter indwelling overnight to prevent stomal stenosis as the choice was left to the patient, not as a part of our postoperative protocol.

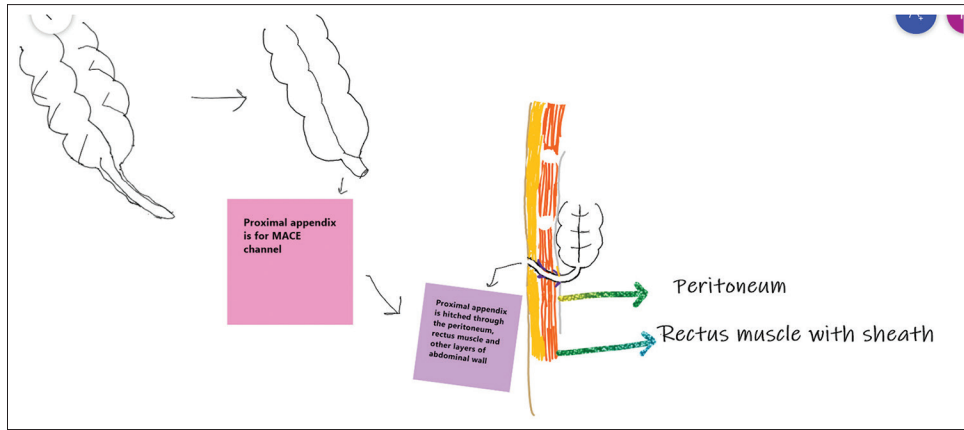
### RESULTS

Of the 29 children, there were 17 boys and 12 girls. All 29 underwent a SMACE procedure. The split appendix was used in 25 (25/29) patients with spina bifida who also required a creation of a Mitrofanoff stoma. The whole appendix was used in 4 (4/29) children, one in an operated case of ARM with chronic constipation and three others in children with spina bifida where a Mitrofanoff stoma was not required.

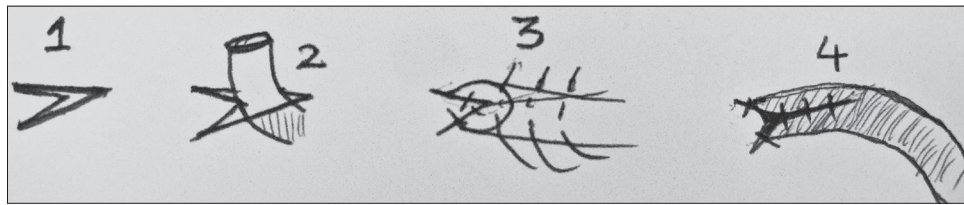
In 25 cases, where the split appendix (proximal end) was used, there was no technical difficulty with the stomal creation as the length of the appendix was adequate enough to divide. Out of four cases, where the whole appendix was used, the terminal appendix (redundant part) of 0.5 cm length was needed to be excised in two patients to align the MACE conduit in a straight course. We have encountered many such cases where the appendix was not enough for creating both MACE and



**Figure 1:** Intraoperative image with split appendix for MACE (the proximal part indicated by purple arrow) and Mitrofanoff (the distal part indicated by white arrow) conduits creation. MACE: Malone antegrade continence enema



**Figure 2:** Line diagram showing the appendix is serially hitched (from inside to outside) to the layers of the abdominal wall (showed in small purple fixation sutures). MACE: Malone antegrade continence enema



**Figure 3:** (1) "V" shaped skin incision and deepening the incision to the peritoneum level as V shaped stoma, (2) Proximal appendix is brought out the V shaped stoma, (3) Fixation of the appendix to the subcutaneous tissue by serosal – subcutaneous interrupted absorbable sutures all around (4) Fixation of the appendix to the skin with interrupted absorbable sutures all around forming the MACE stoma (appendicostomy)

Mitrofanoff conduits, where a spiral Monti technique with ileal conduit was used for creating Mitrofanoff conduit, but those patients have not been included in our study. No specific length of the appendix was measured in our cases and referred to be ideal based on our experience. For instance, in a thin 5-year-old patient, the minimum length required [Figure 1] will be different, and in an obese 16-year-old patient, the minimum length required will be different and much longer. Hence, no such opinion about the ideal length of the appendix was commented in our study or can be recommended. As Figure 1 shows, the appendix stump left for MACE does look smaller, but we did not encounter any technical difficulty in hitching and fixing the same as the concerned patient was young and thin walled.

All children, except a 3-year-old child, were able to use the SMACE stoma independently. In cases, where split appendix (proximal end) was used, seven children had stomal stenosis which resolved by dilatation at home.

It is noteworthy that none of the children had reflux of stools from the stoma or soiling at the stomal site on a mean follow-up of 56 months [Table 1].

**DISCUSSION**

Fecal incontinence can be not only physically limiting but also has a negative impact on the psychological development and social well-being of a child.<sup>[4,5]</sup> The

**Table 1: Simplified Malone antegrade continence enema complications and their management**

SMACE complications	n (%)	Management
Stenosis	7 (24)	Managed well by simple home dilatation
Stool reflux	0	-

SMACE: Simplified Malone antegrade continence enema

antegrade continence enema procedure, first described by Malone in 1990 for children with spina bifida, has had a great impact on children with fecal incontinence.<sup>[6]</sup> Although several modifications of the primary procedure have been described.<sup>[7-11]</sup> The basic principle remains that of an antegrade enema. This is a much easier and more effective way of large bowel cleansing procedure than a conventional retrograde rectal enema. This avoids embarrassment caused to a growing child and provides social independence and a longer duration of effective dryness. The MACE operation has stood the test of time.

The MACE procedure has been used in children with spina bifida, idiopathic chronic constipation, chronic constipation in operated cases of anorectal malformations, and Hirschsprung’s disease. The most common indication was neuropathic bowel (in spina bifida), as seen in our center.<sup>[12]</sup>

The original procedure described by Malone involved detachment of the appendix from its base, reversal, reimplantation into a submucosal tunnel in the cecum,

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and exteriorization of the free end.<sup>[6]</sup> Some of the modifications of MACE (appendicostomy) described in the literature are cecal flap by Kiely *et al.*<sup>[13]</sup>, ileal tube by Monti *et al.*<sup>[10]</sup>, the needling technique by Yang<sup>[11]</sup>, involve the creation of anti-reflux mechanism.

In our SMACE procedure, we do not perform any such antireflux procedure. Although there could be fear of incontinence of flatus/stool when an antireflux procedure is not performed,<sup>[14]</sup> we have found no incidence of stomal incontinence for feces or flatus in our patients.

Adel-Elah K *et al.* had a stomal leakage in 3 out of 35 patients (8.6%) who did not undergo an antireflux procedure.<sup>[15]</sup> Koivusalo *et al.*, compared laparoscopic and open MACE by antireflux procedure (cecal fixation on the inside of the abdominal wall and cecal wrap around the base of the appendix) with laparoscopic procedure without fixation and wrap, and concluded that antireflux is unnecessary for appendicostomy as he found that performing the antireflux procedure required twice the actual operative time, increased hospital stay and there was no significant decrease in stomal complications.<sup>[16]</sup> Moreover, some authors have found a significant incidence of stomal leak even antireflux procedures were performed. Curry *et al.* have found that out of 17 stomas that leaked, only in three, the antireflux procedure was not performed.<sup>[19]</sup>

As regards stomal stenosis, in our series, in seven patients who had stomal stenosis, there was a lack of compliance of daily catheterization in six patients, and in the other, the patient was an elder and obese child. Stomal revision rates have been reported to be between 33%<sup>[17]</sup> and 67%.<sup>[12]</sup> However, in our series of 29 patients over a mean follow-up of 56 months, none of them required stomal revisions.

We have not tested for the appendix and cecal junction continence intraoperatively before reconstructing as it is naturally evident. No specific literature search was done in this. In all our cases, there was no difficulty in catheterization or enema fluid flow into the ascending colon on follow-up. Hence, no such testing can be recommended.

As the study comprised two groups, one with whole appendix (4 cases) and the other with split appendix (25 cases), where MACE conduit was made without antireflux mechanism in all the cases, we would declare that further larger studies with more patients, especially in group 1, may be recommended to claim that no antireflux technique is required in cases of where the whole appendix is used to create MACE conduit.

## Continence status

On a mean follow-up of 56 months, 29/29 (100%) children were completely dry without soiling (comparable to the published literature where more than 90% are dry<sup>[14]</sup>). There was a significant improvement in the quality of life of all the patients and their families. The majority of patients in our series were children with neurogenic bowel and bladder that are known to have the best response rates to MACE.<sup>[18]</sup>

## CONCLUSION

A SMACE involving an appendicostomy without any antireflux procedure is a simple, quick, and easy procedure. Stomal complications are rare and stomal leakage was not seen in the SMACE.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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