

## Extraperitoneal end Tunnel Colostomy Before the Posterior Sheath of the Abdominal Poster Rectus Muscles: A Novel Surgical Technique to Reduce the Incidence Of Hernia

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Colostomy; Parastomal hernia; Abdominal rectus muscle; Posterior sheath of abdominal rectus muscle

## 1. Abstract

Parastomal hernia is one of the most common complications after colostomy. Preventive strategies are considerable. For less defect and better mechanical work in abdominal wall, extraperitoneal colostomy is preferred for preventing parastomal hernia. In this work, we demonstrated a new surgery technique through anatomy structures and mechanical principles.

## 2. Introduction

Parastomal hernia (PH) is a common complication after end colostomy, with a high incidence rate of more than 30% in 12 months follow-up period, which raising in a longer period [1]. The main reason for PH is the weakness of abdominal caused by a poor mechanical response [2], especially after end colostomy, due to the permanent defect of abdominal wall of patient. Considering the high incidence rate of PH, in the case of obstruction or strangulation, repair is difficult and plagued [3]. It is urgent to find a viable strategy to prevent the hernia occurrence [4]. With the increase in the incidence rate of colorectal cancer, the number of end colostomy also increased [5,6]. Although the living period of patients who underwent the abdominoperineal excision (APE) with an end colostomy is prolonged, occurrence of PH increased correspondingly [7,8]. There is no consensus on the prevention of PH. Preventive use of mesh is recommended by the European Hernia Society in the “guidelines on prevention and treatment of parastomal hernias” [4], however, due to the small unblinded trials were taken into account in the guideline and lack of persuasion, Odensten et

al considered that this recommendation is short of bigger trail to prove it [9]. During the use of mesh, side effects such as affection, intestinal adhesion and perforation were found, and due to the high cost and uncertain effectiveness, the indication of the use of the mesh became stricter [10]. Therefore, surgical techniques are required to be improved to prevent PH. As expected, extraperitoneal colostomy technique was reported in 1958 [11]. With years of improvement, this technique is widely used in clinical treatment [11-14], by which the incidence rate of PH is reduced to a certain extent [15-17]. It should be noted that due to the natural anatomical structure of abdominal wall, defects still exist in this technique. For this reason, we improved the surgical technique, named “Extraperitoneal end tunnel colostomy before the posterior sheath of the abdominal rectus muscles”. In this paper, we introduced the surgical procedures and the principles in detail.

## 3. Surgical Procedures

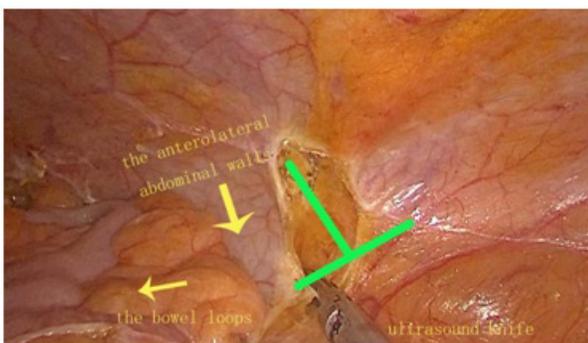
**3.1. Step1:** In the case of colostomy, preoperative stoma site is marked approximately 2-3cm to the left side of umbilicus, and the distance from the center of the stoma to the white line is about 4-5cm where there is no skin fold. The aim of this step is to facilitate operation management and postoperative nursing. The consequent preparations are the same as that in colorectal cancer operations. Perform the abdominoperineal excision(APE) and make sure stoma opening at abdominal rectus muscle and let the terminal bowel go through the tunnel in a proper tense.

**3.2. Step2:** Establishing the tunnel. Combining skin mark and

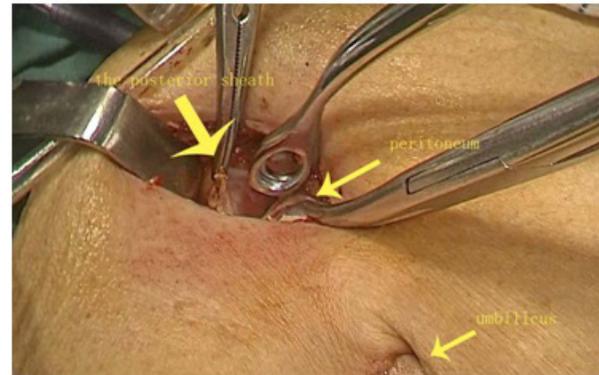
laparoscope's monitoring, locate left of anterolateral abdominal walls, with laparoscopic monitoring, open the abdominal and transversalis fascia in a shape of inverted "T" as the tunnel's entrance, one line of the "T" is point to the stoma and extended to the anterior axillary line (Figure 1). Then, releasing the gas pressure to zero, open the marked skin in a circle, the size is about 2.5cm, that may slightly adjust with the diameter of bowel but it is no more than 3cm. As to the anatomy, cut skin, adipose tissue, and open anterior rectus sheath in shape of cross. Then, pull over some abdominal rectus muscles to the left side, to make sure the posterior sheath to be completely exposed. When separating to the lateral edge of posterior sheath, longitudinally cut in 6cm (adjusted with patients' bowel situations---to make sure best blood supplying and successfully passing) (Figure 2). Next, establishing pneumoperitoneum again, the posterior sheath and abdominal rectus muscle was mobilized with ring forceps or hemostatic forceps by blunt dissection, toward the entrance. This step should combine laparoscope with direct view to confirm the posterior sheath completed and the tunnel unobstructed. All the tunnel's length is about 10-13cm (Figure 3).

**3.3. Step3:** Taking terminal bowel out. Adjust the bowel and mesentery under the laparoscope's monitoring, let the ring forceps going through the tunnel. Then get the terminal bowel bringing through the tunnel by the ring forceps and out to skin. Check the posterior sheath integrity, mesentery being not twisting and colon being not volvulus and obstruction. If it is necessary, use sutures to close the entrance to reinforce the combination.

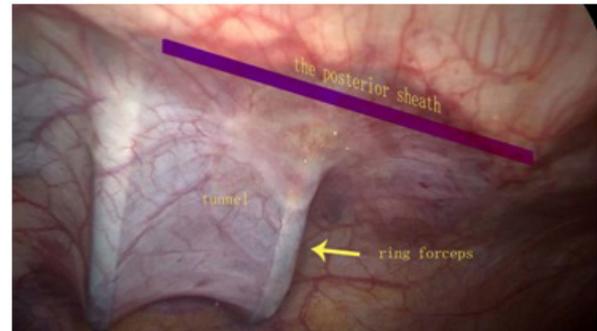
**3.4. Step4:** Constructed stoma. In the end of operation, suture adipose tissue, the anterior rectus sheath and stoma seromuscular layer. Open the stoma, suture whole intestinal structure of stoma with the skin, along the edge of the stoma at 0.3cm intervals.



**Figure 1:** inner entrance of tunnel in shape of "T".



**Figure 2:** cut skin and sheath of muscles, finding the posterior sheath.



**Figure 3:** Tunnel, and the posterior sheath completed.

## 4. Discussion

### 4.1. Principle Analysis

#### 4.1.1. Anatomical structure

**a.** Understanding the composition of the rectus sheath is of great significance for surgeons. The rectus sheath is consist of three tissues, combines tightly with each other, it is the durable, resilient, fibrous compartment. Superior to the arcuate line, the fascia of the external oblique and half of the internal oblique pass anterior to the abdominal rectus muscle and make up the anterior rectus sheath. The other half of the internal oblique fascia, the transversus abdominis fascia, and the transversalis fascia make up the posterior rectus sheath superior to the arcuate line. Which are the mainly functional structures of the abdominal walls [20], and is also the focus point of incision closure after surgery. So, it is important to keep the rectus sheath completely, no matter in theory or practice. Our technique has keep the posterior rectus sheath and the peritoneum as complete as possible, which keep most strong structure than other methods [18,19].

**b.** Considering rectus sheath is disappearing under the arcuate line, open the stoma at the side of umbilicus will make sure there have complete sheath to support the stoma. We choose the opening incision at the lateral edge of posterior sheath and keeping the lateral edge of anterior sheath completely, which keep the blood supply and nerve of abdominal rectus muscles' to make sure the muscle could work as normal [18]. In this way, it also keeps the posterior sheath completely beneath the stoma the most functional and strong structure [19].

c. Stoma is open at side of umbilicus 2-3cm, human abdominal rectus muscle width is usually 6-8cm, which make the stoma open at the abdominal rectus muscle. This structure will reinforce the stoma incase retractions. Because of keep most blood supplying and original functions of abdominal rectus muscle, there are less atrophy of abdominal rectus muscle, that means there will less stoma prolapses.

d. The terminal bowel has made an obtuse angle to the abdominal walls which is different to the traditional colostomy, this way reduce the obstruction and longitudinal tensile.

### 5. Mechanical principle

Normal people have a complete abdominal walls, Podwojewski [2] has found that different abdominal position has different pressure, which means our abdominal walls having different mode of action that keep our inner pressure stable and to manage the changes together. Obviously, traditional colostomy destroy the completeness of abdominal walls, and when separate the tissues, these methods still do not take the physiological structure into considerations, which means our inner pressures can not be managed as normal. Unstable pressures and a defect cause the hernia appearing. But keeping the posterior rectus sheath completely and making the stoma-bowel situation sticking with abdominal is more fitting in the direction of mechanical conduction. Tensile properties of posterior rectus sheath make better mechanical response in abdominal walls than the peritoneum [19]. The tunnel also makes more supporting pressures and reduces axial force of the stoma-bowel, the principle is same as “Sugarbaker”, increasing intra-pressure is exerted onto the posterior rectus sheath and to the bowel [21]. As the recovery, the scar is another factors to reinforce the stoma-bowel. Parastomal hernia is the most common side effect of colostomy. As the living period and diagnosis rate raising, PH incidence rate has raised too. But PH will cause serious complications, such as pain, obstruction, infection and strangulation, which will bring the burden to mentally and physiology. Preventing of PH has become the focus. Using mesh and extraperitoneal colostomy surgery have not solid evidence to proving the effectiveness. But considering the mesh will bring a higher cost and uncertain prognosis. So we put eyes on the surgical techniques, considering anatomical factors and mechanical principles, we choose the Extraperitoneal end tunnel colostomy before the posterior sheath. Unbalanced pressure and mechanical work is the main reason of hernia. The posterior sheath is the tunnel most important tissue, in this technique, firstly, it has cover the defect beneath the stoma directly; secondly, the sheath is a strong structure which will help keep inner abdominal pressure stabilizing. With our projects proceeding, more clinical study will be implemented, and there will have more evidence to support this technique.

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