Tech Coloproctol (2013) 17:425–429
DOI 10.1007/s10151-012-0961-z

ORIGINAL ARTICLE

Use of the gluteus maximus muscle as the neosphincter for restoration of anal function after abdominoperineal resection

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Received: 22 July 2012 / Accepted: 30 November 2012 / Published online: 15 December 2012

Abstract
Background Our aim was to evaluate complications and long-term functional outcome in patients who had sphincter reconstruction using the gluteus maximus muscle as the neosphincter after abdominoperineal resection for rectal cancer treatment.
Methods Seven patients underwent reconstruction from 2000 to 2010. First, the sigmoid colon was brought down to the perineum as a perineal colostomy, with the procedure protected by a loop ileostomy. Reconstruction of the sphincter mechanism using the gluteus maximus took place 3 months later, and after another 8–12 weeks, the loop ileostomy was closed. We studied the functional outcome of these interventions with follow-up interviews of patients and objectively assessed anorectal function using manometry and the Cleveland Clinic Florida (Jorge-Wexner) fecal incontinence score.
Results The mean follow-up was 56 months (median 47; range 10–123 months). One patient had a perianal wound infection and another had fibrotic stricture in the colocutaneous anastomosis that required several digital dilatations. Anorectal manometry at 3-month follow-up showed resting pressures from 10 to 18 mm Hg and voluntary contraction pressures from 68 to 187 mm Hg. Four patients had excellent sphincter function (Jorge-Wexner scores ≤5).
Conclusions Our preliminary results show that sphincter reconstruction by means of gluteus maximus transposition can be effective in restoring gastrointestinal continuity and recovering fecal continence in patients who have undergone APR with permanent colostomy for rectal cancer. Furthermore, the reconstruction procedure can be performed 2–4 years after the APR.

Keywords Abdominoperineal resection · Colostomy · Fecal incontinence · Gluteus maximus transposition

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Introduction

Important progress has been made in the treatment of colorectal cancer in recent decades. Total mesorectal excision [1] has been accepted and is now widely used, even by laparoscopic surgeons [2]. The administration of neoadjuvant therapy [3] has made possible preservative sphincter surgery as the first choice for treatment of tumors of the upper and middle thirds of the rectum. In addition, coloanal anastomosis allows patients with tumors located in the lower third of the rectum to avoid abdominal colostomy and improves their quality of life [4, 5].

A small proportion, 5–30 %, of patients diagnosed with rectal cancer still need abdominoperineal resection (APR) of the rectum [6–8]. This procedure is performed to obtain a tumor-free margin with resection of tumors situated less than 2 cm above the dentate line. Permanent colostomy, as a consequence of APR, causes psychological trauma, diminishes the quality of life, and considerably affects the lifestyle of patients; hence, the restoration of anal function is a major challenge for the colorectal surgical team [9, 10].

Charles Chetwood [11] performed the first transposition of gluteus muscle to reinforce the sphincter muscles and restore function in 1902. Since then, various modifications of gluteus maximus transposition for treatment of fecal incontinence have been described [12–15]. In 1930, Chittenden used gluteal muscle flaps for anal reconstruction after APR [16]. However, most studies using muscle as the neosphincter after colon descent have used the gracilis muscle [17, 18]. The technique has been modified by adding electrostimulation to the graciloplasty [19, 20]. Perineal colostomy has been used [10], and smooth muscle tissue grafts have been implanted as the neosphincter [9]. Artificial sphincters have also been used [21].

There are certain theoretical advantages to using the gluteus maximus as a neosphincter instead of other striated muscles and this is of interest for anal reconstruction after APR. We published our initial experience with bilateral transposition of the gluteus muscles for sphincter reconstruction after APR in 2001 [22]. The aim of the present study was to evaluate complications and long-term functional outcome after descent of the sigmoid colon and gluteus transposition in patients who had been previously treated for rectal cancer with APR and permanent colostomy.

Materials and methods

From July 2000 through March 2010, we performed anal reconstruction in 7 patients who had undergone APR with a permanent colostomy for carcinoma situated in the lower third of the rectum. The reconstruction was performed 2–10 years after the. Of the 7 patients treated, five had radiotherapy.

The patients were highly motivated to undergo the reconstruction procedure and were willing to modify their lifestyle, including dietary habits. All patients were free of local or systemic recurrence, and the residual colon was examined to determine whether its length was sufficient to carry out the anastomosis with the perianal skin. The surgical team clearly explained the procedures and the possible adverse effects to the patients. All patients signed an informed consent form for each surgical procedure.

Surgical technique

Our surgical technique consisted of the following steps: (1) descent of the sigmoid colon to the perineum as a perineal colostomy, with the procedure protected by a loop ileostomy; (2) reconstruction of the sphincter mechanism using the gluteus maximus; and (3) closure of the loop ileostomy.

To prepare the colon for the perineal colostomy, polyethylene glycol was used, and metronidazole was administered as a prophylactic antibiotic. A laparotomy was performed by following the APR incision. The peritoneal cavity was exhaustively reviewed to eliminate any tumoral recurrence or metastasis. The left colon, the splenic flexure, and—in a few cases—the transverse colon were freed to be able to bring the colon down to the perineal skin. The previous colostomy was then released, preserving the surrounding skin. The pelvis was always dissected following the median line and very close to the sacrum, until the perineal skin was reached. Great care was taken to avoid injuring the urinary bladder and the ureter. The colon was brought down and an anastomosis was established with the skin preserved from the previous colostomy. The entire procedure was protected with a loop ileostomy (Fig. 1).

Reconstruction of the sphincter mechanism was performed 3 months after the colostomy procedure. Bilateral transposition of the gluteus maximus was carried out by making an incision, bilaterally, extending from the coccyx toward the greater trochanter, freeing it from its insertion at the sacrococcygeal level. The muscle was dissected following the direction of its fibers and conserving its aponeurosis. We were very careful to preserve the vascular and nerve structures situated in the lower half of the muscle, which exit the pelvis through the greater sciatic foramen. Enough muscle must be released to ensure that it reaches the anus without significant tension. Two identical curved and lateral incisions were made 2 cm from the anus to

Fig. 1 Perineal colostomy

Fig. 2 Right gluteus maximus muscle sutured to the left of the anus

avoid laceration of the mucocutaneous fold when closing the incisions. More than 2.5 cm of skin was needed between the 2 incisions to avoid necrosis around that area. These 2 incisions were then joined by a subcutaneous tunnel, which was made from the incision located in the gluteus region to the one situated in the perianal area. The gluteus maximus, previously dissected, was then extracted from this second incision. The end of the exposed gluteus was divided into 2 segments, following the direction of its fibers and leaving enough muscle to poke out from the skin border. One segment passed in front of, and the other behind, the anal canal. The segments were then extracted from the contralateral anal incision and finally sutured on the opposite side. The identical procedure was performed with the other gluteus muscle. After 8–12 weeks, the ileostomy was closed (Fig. 2).

Postoperative care

All patients received instructions to perform contraction and relaxation exercises (Kegel exercises) to train the neosphincter after the surgery. Patients were asked to perform the exercise routine every day for 15 min at a convenient time that did not interfere with their daily activities or work.

Assessments

Anorectal manometry using 8-channel equipment was performed 3 months after surgery on all patients. Follow-up visits and assessments were conducted 2–3 months after the reconstruction surgery, then at 6 months, and then every year. A final evaluation was made in 2011 in all patients except patient number 3, who was evaluated in 2008 and was then lost to follow-up. The Cleveland Clinic Florida fecal incontinence score (CCF-FIS) (Jorge-Wexner score) [13] was used to assess incontinence at the last follow-up visit.

Results

From July 2000 to March 2010, 7 patients underwent anal reconstruction with gluteus muscle transposition. Table 1 summarizes their demographic characteristics, comorbidities, and the year the reconstruction procedure was performed. The mean follow-up was 56 months (median, 47; range, 10–123 months).

Every patient received instructions as to how to carry out the Kegel exercises of the neosphincter. Three patients attended a pelvic floor retraining program; the others reported that the function of their neosphincter was adequate and did not attend the program.

Anorectal manometry in the 7 patients showed resting pressures ranging from 10 to 18 mm Hg and voluntary contraction pressures ranging from 68 to 187 mm Hg. The values of the pressure obtained adequately correlated with the function of the sphincter.

Perianal sepsis occurred in 1 patient and abscess drainage was performed in both ischiorectal fossas. Another patient had fibrotic stricture in the colocutaneous

Table 1 Patient characteristics

Patient	Date	Sex	Age	Comorbidities	Follow-up (months)
1	2001	M	40	Obesity	123
2	2004	M	30	None	84
3	2005	F	38	Chronic diarrhea	47*
4	2006	M	38	None	54
5	2007	F	66	Diabetes	40
6	2007	M	50	Coronary artery disease	39
7	2010	M	43	None	10

* Lost to follow-up

Table 2 Cleveland Clinic Florida fecal incontinence scores at final follow-up

Patient	Incontinence of			Uses diaper	Lifestyle	Total score
	Solids	Liquids	Gases			
1	0	0	0	0	1	1
2	0	0	0	0	0	0
3	0	3	3	2	2	10
4	0	2	3	0	0	5
5	0	3	3	2	2	10
6	0	0	1	0	0	1
7	0	1	2	3	1	7

anastomosis that required several digital dilatations. None of the patients had tumor recurrence.

Table 2 shows the individual CCF-FIS for the 7 patients included in the present study. Four patients had excellent sphincter function, 3 patients used diapers occasionally, and just 1 used a diaper frequently. In 2 patients, bowel function was controlled with enemas every 2 days, thus allowing them to work and have a normal social life. The four patients with excellent sphincter function could defecate without difficulty and at will. None of the patients wanted a colostomy again.

Although the gluteus maximus muscle is important for walking up stairs, none of our patients complained of difficulties in performing this activity.

Discussion

Our goal is to restore anal function and improve the quality of life in patients who have had a permanent colostomy after APR. However, before we propose anal reconstruction, patients need to be highly motivated to achieve this goal. Patients with advanced stage cancer or those who have undergone noncurative resections should not be considered candidates for reconstruction.

Since the first attempts by Chittenden [16], anorectal reconstruction after APR has been a major challenge for colorectal surgical teams, and various methods have been used. The advantages of the gluteus maximus muscle are that it is a powerful voluntary muscle, its vascular and nerve structures can be preserved after liberation from its origin at the level of the sacrum, and it can be dissected following the direction of its fibers with a length sufficient to reach the anal canal. Despite these considerations, the neosphincter produced by transposition of the gluteus has received little attention, and only a few sporadic reports on its use in reconstruction after APR have been published [12, 15, 22]. We did not perform electrostimulation of the gluteoplasty in our patients, although others [23] have used electrostimulation for fecal incontinence treated with gluteoplasty. In contrast, a number of reports on the use of the gracilis muscle have appeared [14]. Simonsen et al. [17] first described the technique with unstimulated gracilis muscle in perineal colostomy for restoration of anal function after APR. Williams et al. [24] and Baeten et al. [25] used low-frequency chronic electrostimulation by an implanted pulse generator to change easily fatigued muscle fibers into resistant muscle by inducing a structural and metabolic transformation of the fiber from type II to type I. Cavina et al. [18, 19] then made great progress in this field: first in a long-term study using a nonstimulated gracilis muscle in 81 patients and in a further study using the low-frequency stimulated muscle in 31 patients. The results of these studies motivated several groups to use the electrostimulated gracilis as the neosphincter for total anorectal reconstruction after APR [26, 27].

The use of an artificial anal sphincter seems promising [28]. Romano et al. [21] reported good results in 8 patients. Devesa et al. [29] described a patient who underwent a perineal colostomy with a coloplasty, internal sphincter reconstruction using smooth muscle, and placement of an artificial sphincter with excellent results for continence and quality of life.

The effectiveness of anorectal reconstruction is difficult to measure because success depends not only on the procedure but also on how much the patient exercises the neosphincter. At the beginning, it is more difficult to control defecation, but with the Kegel exercises and retraining of the pelvic floor, continence begins to improve. Anorectal sensitivity substantially changes but the patients get used to this situation with time. Changes in dietary habits and drug use should be implemented to modify the frequency of defecation and consistency of each stool. The final outcome in regard to continence is obtained only some months after surgery.

Assessment of neosphincter function with the CCF-FIS and anorectal manometry gives us only general idea of sphincter performance. Although anorectal manometry is a tool frequently used to monitor sphincter function, resting pressure correlates only weakly with incontinence [30]. Thus, manometry should only be used as a complementary tool in the analysis of incontinence.

Our previous experience using the gluteus maximus transposition technique in 22 patients with fecal incontinence due to various causes resulted in a success rate of approximately 70 % [15]. The present study group was too small to draw conclusions, but 4 of the 7 patients were judged to have excellent sphincter function, and all stated that they preferred the sphincter reconstruction to the previous colostomy. The success of anorectal reconstruction after APR may be influenced by a myriad of factors that could interfere with the delicate balance among anatomy, sensitivity mechanisms, and muscular groups that is responsible for the function of normal continence [12]. Every part of the reconstruction—descent of the colon, construction of the neosphincter, and closure of the protective ileostomy—presents inherent risks. Perianal sepsis, the most frequent complication of such procedures, occurred in only 1 patient in the present series. Owing to the comprehensive diagnostic studies we performed before the procedure, no local or regional recurrence of cancer was observed in any patient who underwent reconstruction.

Conclusions

Our preliminary results show that sphincter reconstruction by means of gluteus maximus transposition can be effective in restoring gastrointestinal continuity and recovering fecal continence in patients who have undergone APR with permanent colostomy for rectal cancer. Furthermore, the reconstruction procedure can be performed 2–10 years after the APR.

Conflict of interest None.

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