

Application of laparoscopic total mesorectal excision combined with sphincter-preserving surgery in low or ultralow rectal cancer

Yan Liu, Xiao-Ming Lu*, Yan-Feng Niu, Kai-Xiong Tao
and Guo-Bin Wang

*Department of Gastrointestinal Surgery
Union Hospital Tongji Medical College
Huazhong University of Science and Technology
Wuhan 430022, P. R. China
luxiaoming_6287@163.com

Received 22 February 2016

Accepted 10 May 2016

Published 22 June 2016

This study aimed to investigate the influence of laparoscopic total mesorectal excision combined with sphincter-preserving surgery on the postoperative defecation function, urinary function and sexual function in low or ultralow rectal cancer. A retrospective study was undertaken on 107 patients (65 laparoscopic resection and 42 laparotomic resection) with rectal cancer undergoing laparoscopic or open laparoscopic total mesorectal excision combined with sphincter-preserving surgery from April 2009 to April 2013. The quality of life outcomes of all patients, including defecation, urinary and sexual function, were assessed at 6, 12 and 24 months after operation. Gastrointestinal quality of life index (GQOLI) was used to evaluate the fecal incontinence and bowel dysfunction. Urinary and sexual functions were studied by means of questionnaires on the basis of the international prostatic symptom score (IPSS) and international index of erectile function (IIEF), respectively. In laparoscopic surgery group, there were two cases of anastomotic leakage, three cases of anastomotic stricture, seven cases of local recurrence, ten cases of hepatic metastasis and five cases of lung metastasis. The satisfaction rates of patients about their defecation function reached 60.3% (35/58), 84.5% (49/58) and 91.3% (53/58) at 6, 12, and 24 months follow-up, respectively. The assessment after one year showed that the overall incidence of urinary dysfunction was 10.7% (7/65); Among male patients, 18.4% (7/36) suffered from erectile dysfunction and 27.8% (10/36) suffered from ejaculatory dysfunction; 65.5% (19/29) female patients investigated were satisfied with their postoperative sexual life. In open surgery group, there were two cases of anastomotic leakage, two cases of anastomotic stricture, nine cases of local recurrence, ten cases of hepatic metastasis and seven cases of lung metastasis. The satisfaction rates of patients about their defecation function were 56.4% (22/39), 82.1% (32/39) and 94.8% (37/39) at 6, 12, and 24 months follow-up, respectively. The assessment after one year showed

*Corresponding author.

that the overall incidence of urinary dysfunction was 11.9% (5/42); 25% (4/16) male patients suffered from erectile dysfunction and 31.3% (5/16) suffered from ejaculatory dysfunction; 69.2% (19/26) female patients investigated were satisfied of their postoperative sexual life. There was no statistic difference in the two groups. Laparoscopic total mesorectal excision combined with sphincter-preserving surgery in low or ultralow rectal carcinoma is safe and practicable. It can be helpful for enhancing the probability of anus reservation, and obtains satisfactory defecation, sexual and urinary functions.

Keywords: Rectal cancer; laparoscope; sphincter-preserving surgery; quality of life.

1. Introduction

The radical resection of rectal carcinoma is easy to damage pelvicaudonomic nerve and dysfunctions of defecation, bladder and sexual are recognized complications of rectal carcinoma resection. The incidences of these complications were obviously minimized after total mesorectal excision (TME) was introduced.¹ And then TME has become a standard paradigm for the treatment of rectal cancer. Studies over the past two decades have demonstrated that this procedure of TME for rectal cancer, combined with an awareness of the pelvic autonomic nerve pathways, has resulted in a low frequency of serious bladder and sexual dysfunction.^{2,3} Moreover, accumulating evidences have indicated that laparoscopic TME for middle or low rectal cancer is technically feasible with curative outcomes similar to those for open TME.^{4,5}

Although TME has been adopted due to obvious merits described above, those patients with low or ultralow rectal cancer, who properly conducted this procedure, had to accept a permanent stoma. Therefore, bowel dysfunction and fecal incontinence are also observed,⁶ The urinary and sexual dysfunctions have been reported with some certain rate after operation.⁷

More and more patients with low rectal cancer during the course of treatment not only chase surgical and oncological excellence but also demand better postoperative quality of life. Thus, the strategy for the treatment of very low rectal cancer should focus on advancing the oncological as well as the functional outcomes. In this paper, we applied laparoscopic TME combined with sphincter-preserving surgery in low or ultralow rectal cancer, and study whether the oncologic results after laparoscopic TME with sphincter-preserving surgery are also comparable with the open surgery for ultra-low rectal cancer. The defecation, sexual and urinary functions among patients with rectal cancer who

performed laparoscopic and open TME with sphincter-preserving surgery from April 2009 to April 2013 were assessed.

2. Patients and Methods

2.1. Patients

The study was approved ethically by the Clinical Research Ethics Committee of Union hospital, Tongji medical college, HuaZhong University of Science and Technology. All patients provided written informed consent.

Selection criteria of patients in this study were described as follows: (1) primary rectal cancer with a diameter <2 cm located at 3–5 cm from the anal verge; (2) well or moderately differentiated adenocarcinoma; (3) TNM stage was T1–3N0M0 or T1–3N1–2M0 or Tis; (4) without internal anal sphincter invasion based on the examination of magnetic resonance imaging (MRI) and endorectal ultrasonography (ERUS); (5) no-obese patient with body mass index (BMI) less than 25. Exclusion criteria of cases were shown as below: (1) patients presenting with intestinal obstruction or perforation or necrosis; (2) patients combining with dementia or cognitive dysfunction; (3) patients having undergone neoadjuvant chemo-radiotherapy preoperative; (4) patients lacking sexual activity; (5) preexisting rectal or urinary incontinence before resection.

According to the criteria as mentioned above, a total of 112 patients with low or ultra-low rectal cancer between April 2009 and April 2013 were enrolled at Union hospital, Tongji medical college, HuaZhong University of Science and Technology, and they were selected for this prospective study. According to patients own intention, they were subjected to laparoscopic TME combined with sphincter-preserving surgery (laparoscopic group, $n = 67$) and open sphincter-preserving TME (open resection

group, $n = 45$). The two groups of patients were comparable in terms of age, sex, tumor staging and so on. This study retrospectively compared defecation, sexual and bladder functions between two groups after operation. Questionnaire analyses were completed between October 2012 and April 2015.

3. Surgical Procedure

This surgical procedure of two groups consisted of an abdominal phase and a perineal phase. Sphincter-preserving TME with protective loop ileostomy was performed by surgeons experienced in both laparoscopic and open rectal surgery. All patients in this study underwent ileostomy closure for seven months after the primary surgery. Patients should receive abdominoperineal resection (APR) if their internal or external anal sphincter has been invaded.

Abdominal phase: TME was completed as described by Heald.¹ Patients in both groups received general anesthesia and took lithotomy position. Artificial pneumoperitoneum of 12–15 mmHg (1 mmHg = 0.133 kPa) was established. In laparoscopic group, five trocars with diameter of 5–10 mm trocars were placed at 2–3 cm interior to both anterior superior spine, above the umbilicus, at the intersection point of umbilical plane and lateral border of right rectus abdominis and at 2–3 cm above pubis, respectively. Laparoscopic TME started with high ligation of the inferior mesenteric artery and vein immediately after the emergence of the left colic artery. Left mesocolon was mobilized via mesofascial separation. After the ligation of the vessels, the parasigmoid and pararectal peritoneal folds were divided and the mesosigmoid was mobilized via mesofascial separation. Mesosigmoid is continuous with left mesocolon above and mesorectum below. The dissection continued at the mesorectal plane, with the separation of the mesorectum from adjacent mesorectal fascia. Although not always necessary, mobilization of the splenic flexure might be required. The dissection of left mesocolon, mesosigmoid and mesorectum via mesofascial separation, allows the removal of the specimen with intact fascial layers whilst simultaneously maximizing lymph node yield.^{8–10} Patients who underwent open surgery had TME according to the same oncologic principles outlined for laparoscopic surgery.

Perineal phase: The patient was also placed in the lithotomy position, a self-retaining retractor was

applied for anal exposure. 1 mg epinephrine diluted in 20 mL of saline solution was injected at several points beneath the anal mucosa, for minimization of bleeding and facilitation of intersphincteric dissection. A circumferential incision in the anal mucosa, at a distance of at least 1 cm from the macroscopic distal edge of the tumor for T1 lesions and 2 cm for T2-3 lesions were made in such a way, and the specimen included the whole rectal wall as well as a part or the whole of the IAS. The anal orifice was then closed transanally with purse string sutures to prevent tumor cell from dissemination during the perineal phase. Under direct vision, the dissection was continued cephalad through the intersphincteric space to be connected with the TME plane developed transabdominally.^{11,12} The specimen was delivered per anus. Coloanal anastomosis was performed by hand-sewn.

4. Assessment of Defecation Function

Gastrointestinal quality of life index (GQOLI),¹³ was used to assess the defecation function at 6, 12, and 24 months after operation including awareness of defecation, sensation of defecation, defecation frequently. A higher GQOLI score indicates better defecation function. According to the GQOLI evaluation, defecation function of patients was classified into three levels, good, fair and poor, and more information about them was described as follows:

Good: Automatic control of both dry and loose stools; No fecal incontinence during nights; Be able to differentiate flatus and defecation; Awareness of defecation existed and could hold for more than 2 min; Defecate 1–2 times a day.

Fair: Automatic control of dry stools; Loose stools flow out with flatus nonautonomously and the patient suffer from fecal incontinence during nights occasionally; Be able to differentiate flatus and defecation; Awareness of defecation existed but not oblivious and could hold for 1–2 min; Defecate 3–4 times a day.

Poor: Poor control of both dry and loose stools; Unable to differentiate flatus and defecation; No awareness of defecation.

5. Assessment of Urinary Function

The questionnaire consisted of questions relating to difficulty emptying the bladder, feeling of

incomplete bladder emptying, urgency, leakage of urine, dysuria, dribbling, and need for self-catheterization on the basis of the international prostatic symptom score (IPSS).¹⁴ Bladder dysfunction was classified as major for patients with incontinence or self-catheterization and as minor for those with the other symptoms.

Table 1. Clinical and demographic characteristics of patients undergoing laparoscopic or open resection of low/ultralow rectal cancer.

	Laparoscopic resection (n = 67)	Open resection (n = 45)	p
Median age: years (range)	56(30–70)	53(27–75)	0.1785
Sex ratio(M:F)	38/29	19/26	0.1325
TNM stage: (n)			
Tis	6	2	0.3635
T1 ~ 3N0M0	5	1	0.7855
T1N1 ~ 2M0	14	7	0.4778
T2N1 ~ 2M0	19	17	0.2953
T3N1 ~ 2M0	23	18	0.5413
Different types(n)			
Well	35	18	0.2034
Moderately	32	27	

Table 2. Operative procedure and clinical characteristics of postoperative.

	Laparoscopic resection (n = 58)	Open resection (n = 39)	p
Pelvic sepsis	4	3	0.8819
Bleeding	2	3	0.3540
Temporary ileus	3	5	0.1784
Anastomic leakage	3	2	0.9923
Anastomic stricture	8	5	0.8903
Hepatic metastasis	10	7	0.9284
Lung metastasis	7	5	0.9122
Local recurrence	6	5	0.7061

Table 3. Defecation function of patients postoperative.

Follow-up time(month)	Laparoscopic resection (n = 58)			Open resection (n = 39)			p
	Good	Fair	Poor	Good	Fair	Poor	
6*	8	27	23	10	12	17	0.6995
12#	18	31	9	14	18	7	0.7517
24Δ	23	30	5	20	17	2	0.5145

*P: good 0.1411, fair 0.1201; #P: good 0.6175, fair 0.4511; ΔP: good 0.2584, fair 0.4319.

6. Assessment of Sexual Function

Male sexual function was assessed by using the international index of erectile function (IIEF),¹⁵ with an emphasis on the domain for evaluation of erectile function, ejaculatory function, libido, orgasm, and overall sexual satisfaction. Female sexual function was evaluated by evaluation of libido, orgasm, vaginal lubrication, dyspareunia, and sexual satisfaction. All the questions had four possible answers: never, rare, frequent, or always. The first two categories were classified as absence of a specific symptom and the latter two as presence of a specific symptom. The questions comprised preoperative and postoperative urogenital functions to determine subjective functional deterioration.

7. Statistical Analysis

All data were analyzed by using the SPSS 16.0 software. Differences between two groups were analyzed using the Student-*t* test. Rate was assessed using the χ^2 test. $P < 0.05$ was considered statistically significant.

8. Results

The two groups of patients were comparable in terms of age, sex and tumor staging, clinical and demographic characteristics of patients undergoing laparoscopic or open resection of ultralow rectal cancer are shown in Table 1.

In laparoscopic group ($n = 67$), 65 patients received laparoscopic TME combined with sphincter-preserving surgery, two patients were converted to APR. 58 patients were traced for 26–40 months after operation. In open resection group ($n = 45$), 42 patients underwent open TME with sphincter-preserving surgery, three patients were converted to APR. 39 patients were followed for 24–38 months after operation. There was no significant difference

Table 4. Urinary function of patients postoperative.

	Laparoscopic resection (n = 58)	Open resection (n = 39)	p
Difficulty emptying bladder (n)	7	6	0.6384
Feeling incomplete bladder emptying	6	5	0.7061
Urgency	3	4	0.3305
Leaking of urine	5	2	0.5145
Dribbling	4	4	0.5384
Pain, burning discomfort	3	2	0.9928

Table 5. Sexual function of male patients postoperative.

	Laparoscopic resection (n = 30)	Open resection (n = 16)	p
Sexually active	28	13	0.2098
Interested in sex	25	12	0.4974
Can't have an erection	7	4	0.8996
Can't have an ejaculation	10	5	0.8858
Overall sexual dysfunction	17	9	0.9788

Table 6. Sexual function of female patients postoperative.

	Laparoscopic resection (n = 28)	Open resection (n = 23)	p
Sexually active	23	17	0.4771
Interested in sex	15	13	0.8331
Able to achieve orgasm	19	19	0.2290
Diminished vaginal secretion	13	11	0.9207
Dyspareunia	12	12	0.5856
Overall sexual dysfunction	13	12	0.6830

in terms of postoperative complications, local recurrence, distant metastasis between two groups (see Table 2).

The defecation function of both two groups is summarized in Table 3, and no significant difference was observed between them.

Moreover, it was also found that there was no significant difference in urinary function between two groups (Table 4). So did sexual function shown in Tables 5 and 6.

9. Discussion

Low rectal cancer is defined as tumor lying in recta and less than 5 cm from the anal verge.¹⁶ In 1982,

TME was introduced as a standard operation for treatment of rectal cancer, properly conducted TME have been confirmed to decrease the recurrence rate of cancer and increase the overall 5-year survival rate of patient.¹⁷ Although adoption of TME, tolerance of shorter the length of distal resection margin, and availability of circular stapling devices, have decreased the APR rate, these patients with low or ultralow rectal cancer had to accept a permanent stoma. Moreover, bowel dysfunction and fecal incontinence are also not uncommon.⁶ The rates of sexual dysfunction have reportedly ranged from 23% to 69% in male survivors and 19% to 62% in women after operation attributable to inadvertent injury of the pelvic autonomic nerves.⁷ Therefore, attention to patients' oncological and functional outcomes is of paramount importance for colorectal surgeon.

Although laparoscopic TME for rectal cancer in European and American countries was not recommended,¹⁸ the 5-year follow-up result of CLASSIC trial carried out by British Medical Research Council on laparoscopically-assisted versus open surgery for rectal cancer had demonstrated that there was no statistical significance in the overall survival rate, local recurrence and distal metastasis rate between two groups.⁵ Moreover, with the development of laparoscopy surgery, it is both safe and feasible to perform sphincter-preserving and autonomic nerve-preserving radical rectal cancer surgery.^{19,20} We applied laparoscopic TME combined with sphincter-preserving operation in patients with ultralow rectal cancer. The satisfaction rates of patients about their defecation function reached 60.3%, 84.5% and 91.3% at 6, 12, and 24 months follow-up, respectively. The overall incidence of urinary dysfunction was 10.7%; 18.4% male patients suffered from erectile dysfunction and 27.8% suffered from ejaculatory dysfunction; 65.5% female patients were satisfied with their postoperative sexual life. The preliminary result suggested that the changes of postoperative defecation, urinary and sexual functions of patients between the two groups were not significantly different, which was consistent with the results presented in Refs. 12 and 21.

Now, patients have greater demand on postoperative quality of life as they quest surgical and oncological excellence. New techniques for the treatment of very low rectal cancer aiming to improve the oncological as well as the functional

outcomes, should be emphasized. The aim of sphincter-preserving surgery in low or ultralow rectal cancer is to preserve the sphincter function. Rationally choosing and performing sphincter-preserving and autonomic nerve-preserving surgery has become an important focus in the colorectal surgery.²² Open colon-anal anastomosis was proposed by Parks in 1982, the requirement of anal mucosa excision at 1 cm above the verge and preserving 3 cm of rectum in men with narrow pelvis had been proved very difficult for surgeons.²³ Meanwhile, both apparent complications and dysdefecation also make this procedure controversial. In this research, we underwent laparoscopic TME with sphincter-preserving surgery, facilitating to mobilize the splenic flexure of colon and minimize surgical trauma in abdomen, to perform the dissection as close to the pelvic floor as possible in the ultralow rectal cancer. Pelvic autonomic nerve and sphincter were well protected by performing anatomical, functional and sharp dissection. So, it was technically safe and feasible for laparoscopic sphincter-preserving curative resection in low or ultralow cancer.

Although both oncologic and functional results are important in sphincter-preserving surgery of ultralow rectal cancer, the curative effect must be paramount. Functional preservation should not be considered at the expense of curative operation. For laparoscopic TME with sphincter-preserving, it is also not wise to sacrifice radical effect to minimize invasion. Therefore, the indications for the proposed laparoscopic procedure in this paper must be strictly followed. Based on our experiences, the ideal indications for this procedure were described as follows: (1) well or moderately differentiated adenocarcinoma; (2) mobile tumor with diameter below 3 cm and occupying less than 1/2 circumference of anal bowel according to necessary digital rectal examination; (3) T1-3 tumor located at 3–5 cm from the anal verge; (4) without infiltration of internal anal sphincter based on MRI or endoanal ultrasonography. Absolute contraindications for this procedure: (1) T4 tumor, invasion of external anal sphincter; (2) poorly differentiated tumor; (3) poor defecation; (4) distant metastases and mental patients. The following measures can be used to minimize the complications of patient after operation: (1) protective loop ileostomy could effectively reduce the incidence of anastomotic leakage; (2) length as well as blood supply of colon should be guaranteed enough; (3) Anal dilatation should be

gently performed interoperation. Violent dilatation could cause sphincter injury, muscle scarring or even paralysis, thus lead to poor defecation control; (4) Exact anastomotic suture and drainage should be guaranteed.

References

1. R. J. Heald, "The 'holy Plane': of rectal surgery," *J. R. Soc. Med.* **81**, 503–508 (1988).
2. M. Pocard, F. Zinzindohoue, F. Haab, S. Caplin, R. Parc, E. Tiret, "A prospective study of sexual and urinary function before and after total mesorectal excision with autonomic nerve preservation for rectal cancer," *Surgery* **131**, 368–372 (2002).
3. A. Nesbakken, K. Nygaard, T. Bull-Njaa, E. Carlsen, L. M. Eri, "Bladder and sexual dysfunction after mesorectal excision for rectal cancer," *Br. J. Surg.* **87**, 206–210 (2000).
4. S. B. Kang, J. W. Park, S. Y. Jeong, B. H. Nam, H. S. Choi, D. W. Kim, S. B. Lim, T. G. Lee, D. Y. Kim, J. S. Kim, H. J. Chang, H. S. Lee, S. Y. Kim, K. H. Jung, Y. S. Hong, J. H. Kim, D. K. Sohn, D. H. Kim, J. H. Oh, "Open versus laparoscopic surgery for mid or low rectal cancer after neoadjuvant chemoradiotherapy (COREAN trial): Short-term outcomes of an open-label randomised controlled trial," *Lancet. Oncol.* **11**, 637–645 (2010).
5. D. G. Jayne, H. C. Thorpe, J. Copeland, P. Quirke, J. M. Brown, P. J. Guillou, "Five-year follow-up of the medical research council CLASICC trial of laparoscopically assisted versus open surgery for colorectal cancer," *Br. J. Surg.* **97**, 1638–1645 (2010).
6. M. M. Lange, M. den Dulk, E. R. Bossema, C. P. Maas, K. C. Peeters, H. J. Rutten, E. Klein Kranenbarg, C. A. Marijnen, C. J. van de Velde, "Risk factors for faecal incontinence after rectal cancer treatment," *Br. J. Surg.* **94**, 1278–1284 (2007).
7. P. Ho Vanessa, L. Yoori, S. L. Stein, K. F. Larissa, "Temple. Sexual function after treatment for rectal cancer: A review," *Dis. Colon Rectum* **54**, 113–125 (2011).
8. R. Sehgal, J. C. Coffey, "Historical development of mesenteric anatomy provides a universally applicable anatomic paradigm for complete/total mesocolic excision," *Gastroenterol. Rep. (Oxf)* **2**, 245–250 (2014).
9. L. J. Kuo, C. S. Hung, C. H. Wu, W. Wang, K. W. Tam, H. H. Liang, Y. J. Chang, P. L. Wei, "Oncological and functional outcomes of intersphincteric resection for low rectal cancer," *J. Surg. Res.* **170**, e93–e98 (2011).
10. Y. Liu, X. M. Lu, Y. F. Niu, K. X. Tao, G. B. Wang, "Application of laparoscopic transanal coloanal

- anastomosis in sphincter-preserving surgery for low rectal cancer," *J Chin. Gastrointest. Sur.* **16**(8), 727–729 (2013).
11. L. J. Kuo, C. S. Hung, W. Wang, K. W. Tam, H. C. Lee, H. H. Liang, Y. J. Chang, M. T. Huang, P. L. Wei, "Intersphincteric resection for very low rectal cancer: Clinical outcomes of open versus laparoscopic approach and multidimensional analysis of the learning curve for laparoscopic surgery," *J. Surg. Res.* **183**, 524–530 (2013).
 12. N. Dimitriou, O. Michail, D. Moris, J. Griniatsos, "Low rectal cancer: Sphincter preserving techniques-selection of patients, techniques and outcomes," *World J. Gastrointest. Oncol* **7**(7), 55–70 (2015).
 13. E. Eypasch, J. I. Williams, S. Wood-Dauphinee *et al.*, "Gastrointestinal quality of life index: Development, validation and application of a new instrument," *Br. J. Surg.* **8**(22), 216–222 (1995).
 14. W. Mebust, R. Roizo, F. Schroeder, A. Villers, "Correlation between pathology, clinical symptoms and course of the disease," *Proc. Int. Consultation on Benign Prostatic Hyperplasia*, A. T. Cockett, V. Aso, C. Chatelain *et al* Eds., pp. 51–62, WHO, Geneva (1991).
 15. R. C. Rosen, A. Riley, G. Wagner, I. H. Osterloh, J. Kirkpatrick, A. Mishra, "The International Index of Erectile Function (IIEF): A multidimensional scale for assessment of erectile dysfunction," *Urology* **49**, 822–830 (1997).
 16. Network NCC, Rectal Cancer. Clinical Practice Guidelines in Oncology: National Comprehensive Cancer Network; Version 1 (2015).
 17. R. J. Heald, E. M. Husband, R. D. Ryall, "The mesorectum in rectal cancer surgery—the clue to pelvic recurrence?" *Br. J. Surg.* **69**, 613–616 (1982).
 18. Network NCC, Rectal Cancer. Clinical Practice Guidelines in Oncology: National Comprehensive Cancer Network; Version 4 (2011).
 19. O. Asoglu, T. Matlim, H. Karanlik *et al.*, "Impact of laparoscopic surgery on bladder and sexual function after total mesorectal excision for rectal cancer," *Surg. Endosc.* **23**, 296–303 (2009).
 20. S. S.-M. Ng, W.-W. Leung, C. Y.-N. Wong, S. S.-F. Hon *et al.*, "Quality of life after laparoscopic vs open sphincter-preserving resection for rectal cancer," *J. Gastroenterol.* **19**(29), 4764–4773 (2013).
 21. L. Bordeianou, L. H. Maguire, K. Alavi, R. Sudan, P. E. Wise, A. M. Kaiser, "Sphincter-sparing surgery in patients with low-lying rectal cancer: Techniques, oncologic outcomes, and functional results," *J. Gastrointest. Surg.* **18**, 1358–1372 (2014).
 22. T. Morita, J. Suzuki, T. Yoshizaki *et al.*, "Sphincter-preserving surgery for lower rectal cancer aimed at improving postoperative bowel function," *Nippon Gek-a Gakkai Zasshi* **101**(6), 459–463 (2000).
 23. P. Rouanet, A. Mourregot, C. C. Azar, S. Carrere, M. Gutowski, F. Quenet, B. Saint-Aubert, P. E. Colombo, "Transanal endoscopic proctectomy: An innovative procedure for difficult resection of rectal tumors in men with narrow pelvis," *Dis. Colon Rectum* **56**, 408–415 (2013).