

# Functional outcomes after disc excision in deep endometriosis of the rectum using transanal staplers: a series of 111 consecutive patients

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**Objective:** To assess the postoperative outcomes of patients with rectal endometriosis managed by disc excision using transanal staplers.

**Design:** Prospective study using data recorded in the CIRENDO database (NCT02294825).

**Setting:** University tertiary referral center.

**Patient(s):** A total of 111 consecutive patients managed between June 2009 and June 2016.

**Intervention(s):** We performed rectal disc excision using two different transanal staplers: [1] the Contour Transtar stapler (the Rouen technique); and [2] the end to end anastomosis circular transanal stapler.

**Main Outcomes Measure(s):** Pre- and postoperative digestive function was assessed using standardized gastrointestinal questionnaires: the Gastrointestinal Quality of Life Index and the Knowles-Eccersley-Scott Symptom Questionnaire.

**Result(s):** The two staplers were used in 42 (37.8%) and 69 patients (62.2%), respectively. The largest diameter of specimens achieved was significantly higher using the Rouen technique (mean  $\pm$  SD,  $59 \pm 11$  mm vs.  $36 \pm 7$  mm), which was used to remove nodules located lower in the rectum ( $5.5 \pm 1.3$  cm vs.  $9.7 \pm 2.5$  cm) infiltrating more frequently the adjacent posterior vaginal wall (83.3% vs. 49.3%). Associated nodules involving sigmoid colon were managed by distinct procedures, either disc excision (2.7%) or segmental resection of sigmoid colon (9.9%). Postoperative values for the Gastrointestinal Quality of Life Index increased 1 and 3 years after the surgery, but improvement in constipation was not significant. The probability of pregnancy at 1 year after the arrest of medical treatment was 73.3% (95% confidence interval 54.9%–88.9%), with a majority of spontaneous conceptions.

**Conclusion(s):** Disc excision using transanal staplers is a valuable alternative to colorectal resection in selected patients presenting with rectal endometriosis, allowing for good preservation of rectal function. (Fertil Steril® 2017; ■:■–■. ©2017 by American Society for Reproductive Medicine.)

**Key Words:** Colorectal endometriosis, colorectal resection, deep endometriosis, disc excision, full-thickness excision, transanal stapler

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To treat the deep endometriosis infiltrating the rectum, many surgeons perform colorectal resection, strongly believing that this

approach greatly reduces risk of recurrence and allows for best functional outcomes (1–7). Conversely, others perform selective excision of rectal

nodules so as to allow conservation of the rectum (8–11), therefore reducing the risk of early postoperative complications and functional digestive complaints related to rectal removal, such as distal constipation, increase in frequency of bowel movements, or anal incontinence (12–14). Disc excision was introduced more than 20 years ago by surgeons who reported deep colorectal nodule removal followed by the suture of bowel (15). Then, other surgeons preferred using the transanal end to

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end anastomosis (EEA) stapler (Ethicon Endo-Surgery) to perform tight sutures of the rectal wall (11,16–18), and the procedure has progressively spread worldwide. However, it is when the low rectum is infiltrated by huge endometriotic nodules that rectal shaving and laparoscopic or open disc excision can be awkward to perform. In response to these challenges, we introduced a new technique (the Rouen technique) using the Contour Transtar stapler (Ethicon Endo-Surgery) in combined laparoscopic and transanal full-thickness disc excision of large endometriotic nodules infiltrating the low and mid-rectum (18, 19). However, in a recent survey enrolling 1,135 patients managed for colorectal endometriosis in France in 2015, disc excision was used in only 7.3% of cases (20). This low use of disc excision may be due to the relative poverty of data in the literature on disc excision when compared with colorectal resection and shaving.

The aims of this present study conducted in our gynecology and obstetrics department at Rouen University Hospital were, first, to report the early postoperative complications and functional outcomes of patients with deep infiltrating nodules of the rectum who benefited from full-thickness disc excision; and second, to compare the performance of two different transanal excision procedures using transanal staplers.

## MATERIALS AND METHODS

### Surgical Procedure

The technique for full-thickness rectal nodule excision involves combined transanal and laparoscopic approaches. The first step is performed laparoscopically, and the goal is to achieve rectal shaving (17, 19). The nodule is dissected away from the rectal wall and removed, when required, by resection of the vaginal fornix, the uterine torus, and the utero-sacral ligaments. In nodules infiltrating the vagina over more than 3 cm in diameter, a combined vaginal-laparoscopic approach may be useful (21, 22).

When the shaved area of the anterior rectal wall is still infiltrated by implants of deep endometriosis, it appears hollow, rigid, and thickened under palpation with a laparoscopic probe. In these circumstances, a more complete treatment is achieved by full-thickness disc excision of the shaved area, using transanal staplers. Hence, the colorectal surgeon uses the Contour Transtar stapler when the shaved area is located up to 8–10 cm from the anus, and the EEA circular stapler when it is located in the upper rectum. The thinner and softer the shaved rectal wall, the larger the diameter of the rectal patch that can be removed using the transanal stapler.

**The Rouen technique: disc excision using the Contour Transtar stapler.** The circular anal dilator of the Contour Transtar-STR5G (Ethicon EndoSurgery) stapling kit is then gently introduced into the anus and fixed to the perianal skin with four cardinal sutures. Using both transanal and laparoscopic views, an initial traction suture is placed at the center of the shaved rectal area. The surgeon ensures that this suture does not trap any other viscera in the vicinity of

the rectal wall and confirms the correct positioning of the suture on the shaved area within the rectal wall. Similar sutures are placed above and below, as well as to the left and right side of the shaved area to gain good traction on the captured tissue. Care is taken to ensure against inadvertent trapping of tissue from the opposite wall of the rectum, which may lead to complete or partial closing of the rectum.

The lubricated head of the Contour Transtar, with opening jaws in the 3 o'clock position, is introduced into the rectum. The instrument is then rotated counterclockwise and the shaved rectal area gently pulled inside the jaws until normal tissue can be seen seated within the proximal jaw of the device (Supplemental Fig. 1, available online). The parachute sutures are pulled downward in the direction of the shaft of the stapler, thereby drawing the shaved area along with a margin of normal tissue into the jaws of the stapler; the stapler-retaining pin is then applied and the stapler closed around the tissue. This closure is maintained for a period of 15 seconds to maximize tissue compression and subsequent hemostasis. The stapler is engaged and then removed. The stapler cartridge is then replaced and the device reintroduced into the rectum. The procedure is repeated until full-thickness resection of the shaved area and the surrounding normal tissue is performed. The final staple line is inspected for bleeding and secured with interrupted resorbable stitches as required. Reinforcement sutures along the staple line are placed as deemed necessary.

**Transanal excision using the EEA circular stapler.** This procedure uses an EEA circular stapler of 28 and 31 mm diameter. The stapler is gently and progressively pushed inside the rectum, under laparoscopic view control, up to the shaved rectal area. Then the stapler is opened, so as to place the shaved area between the anvil and the shoulder of the stapler. In nodules responsible for rectal stenosis, the feasibility of the procedure requires deep shaving able to completely remove the narrowness of the rectum (17). A suture using a 3/0 resorbable stitch is placed laparoscopically in the center of the shaved area, and the threads are cut 5–10 cm from the knot. The gynecologist holds the threads and pushes them downward, to completely imbricate the shaved area between the anvil and the shoulder of the stapler. Concomitantly the colorectal surgeon gently pushes the tip of the EEA stapler upward, to avoid catching the posterior wall of the rectum in the stapler. The stapler is progressively closed under laparoscopic control to ensure that the whole shaved area is caught in the stapler. Then the stapler is fired and the closure maintained for up to 15 seconds to improve hemostasis. The stapler is removed, and the excised rectal wall area is examined, the diameter of which can be as large as 40 mm.

At the end of both procedures we performed an air test by flooding the pelvic cavity with warm saline solution and insufflating the rectum with air to ensure integrity of the staple line. When the bubble test failed, supplementary stitches were added laparoscopically to reinforce the stapled line. The rectal suture was routinely covered by an omentum flap, which was fixed to the pelvic wall by sutures. Finally, a pelvic drain was positioned in the pelvis and a diverting stoma performed in patients requiring large resection of adjacent vagina.

In [Supplemental Video 1](#), we used the PlasmaJet (Plasma Surgical) to shave the rectum in the same way as surgeons have used the CO<sub>2</sub> laser for more than 25 years (23). Our preference for PlasmaJet was originally related to the lack of availability of the CO<sub>2</sub> laser device in our department. When compared with the CO<sub>2</sub> laser the PlasmaJet provides some advantages, such as the kinetic energy, which enhances the dissection of subperitoneal spaces, and the shortness of the jet, which helps to avoid overshoot injuries of the pelvic organs.

## Patients

We included all patients having undergone disc excision between June 2009 and June 2016. All women were preoperatively examined by an experienced gynecologist (H.R.). A detailed preoperative questionnaire was filled out to complete patient symptom history. Since 2010, standardized gastrointestinal questionnaires are routinely used to assess pre- and postoperative digestive function: the Gastrointestinal Quality of Life Index (GIQLI) (24), the Knowles-Eccersley-Scott Symptom Questionnaire (KESS) (25), and the WEXNER scale (26). Preoperative magnetic resonance imaging, endorectal ultrasound, and computed tomography-based virtual colonoscopy were performed by radiologists with considerable experience in deep endometriosis. Where rectal involvement was revealed, the operative strategy was first discussed with both the patient and digestive surgeon before a decision was made concerning which surgical procedure was to be used. Prospective recording of data concerning antecedents, clinical symptoms, findings of clinical and imaging examinations, surgical procedures, and postoperative outcomes was performed through the CIRENDO database (NCT02294825). This latter is the North-West Inter Regional Female Cohort for Patients with Endometriosis, which is a prospective cohort, financed by the G4 Group (The University Hospitals of Rouen, Lille, Amiens, and Caen) and coordinated by one of the authors (H.R.). Information was obtained using self-questionnaires, including the above-mentioned gastrointestinal scores, and surgical and histologic records, whereas data recording, contact, and follow-up were carried out by a clinical research technician. Prospective recording of data was approved by the French authority CCTIRS (Advisory Committee on Information Processing in Healthcare Research).

Patients had an 8–12-week postoperative visit. When stoma was performed, the closure was planned 3 months after surgery, only if rectal enema ruled out rectovaginal fistula. In patients with rectovaginal fistula, second surgical management was planned by either vaginal-transanal or open approach. One year after surgery, patients had a second postoperative visit and filled out the 1-year follow-up questionnaire. Then 3-, 5-, and 7-year follow-up questionnaires were sent to patients by the clinical researcher, who recorded data into the CIRENDO database.

In patients without pregnancy intention, continuous contraceptive pill was strictly recommended to prevent recurrences. In patients with pregnancy intention, the contraceptive pill was stopped and complete fertility assessment

usually performed 2 months thereafter. The surgeon advised patients on their capacity to conceive and recommended either attempting spontaneous conception or planning assisted reproductive technology (ART). In vitro fertilization or intracytoplasmic sperm injection was planned either immediately postoperatively or after up to 9 months of unsuccessful spontaneous conception. In outline, the factors taken into account to counsel expectative or immediate ART were fallopian tube status at the end of surgery, ovarian reserve before surgery correlated with procedures carried out on ovaries, and spermatoc parameters. Depending on their domiciliation or preference, patients underwent IVF or intracytoplasmic sperm injection and benefited from obstetric care in our tertiary care center or elsewhere.

Statistical analysis was performed using Stata 9.0 software (StatCorp). To emphasize the differences between patients benefiting from disc excision using either the semi-circular or circular stapler, we compared their characteristics using either the Kruskal-Wallis test (continuous variables) or the Fischer exact test (qualitative variables). Kaplan-Meier curves were built to estimate the probability of not being pregnant according to postoperative time, and log-rank test to compare this probability depending on various variables. A *P* value of <.05 was considered statistically significant. The present case series study was approved by the Institutional Ethics Committee for Non-Interventional Research of the Rouen University Hospital.

## RESULTS

From June 2009 to June 2016, we successfully performed disc excision using transanal staplers in 111 women with symptomatic deep endometriosis infiltrating the rectum (Tables 1 and 2). They represented 23.2% of 479 women recorded in the CIRENDO database and managed during this same period for rectal nodules by various procedures, including rectal shaving and colorectal resection, which were performed in 183 (38.2%) and 185 women (38.6%), respectively.

To date, none of the 111 patients with disc excision has been lost to follow-up. The proportion of patients has significantly increased since 2014, because only 53 of them have a follow-up of more than 1 year. Among the overall 111 patients, 47 have already completed their 1-year follow-up questionnaire (88.7%). Twenty-two patients have a follow-up of more than 3 years; to date, 20 (80%) of them have completed the 3-year follow-up questionnaire.

The Rouen technique was carried out in 42 patients (37.8%) and the procedure using the EEA circular stapler in 69 patients (62.2%). The patients presented with nodules infiltrating either the muscular or submucosal layer, except one patient managed by the Rouen technique, who had mucosal layer involvement. Patients presenting with rectal lumen stenosis under 50%–60% were often managed by deep shaving using plasma energy followed by disc excision using the Rouen technique when located on the mid- and lower rectum, whereas those with rectal nodules responsible for stenosis exceeding more than two-thirds of the bowel of the lumen were generally managed by segmental resection and

TABLE 1

Patient characteristics.	Whole sample (n = 111)	Disc excision using the Rouen technique (n = 42)	Disc excision using the EEA stapler (n = 69)	P value
Age (y), mean ± SD	29.7 ± 4.4	29.8 ± 4.2	29.6 ± 4.5	.85
BMI (kg/m <sup>2</sup> ), mean ± SD	24.2 ± 5.1	24 ± 4.7	24.4 ± 5.3	.69
History of endometriosis in patient's family	17 (15.3)	6 (14.3)	11 (15.9)	1
History of gynecologic surgery	52 (46.9)	16 (38.1)	36 (52.2)	.33
Laparotomies	10 (9)	4 (9.5)	6 (8.7)	.64
No. of previous laparoscopies				.33
1	32 (28.8)	9 (21.4)	23 (33.3)	
≥2	12 (10.8)	4 (9.5)	8 (11.6)	
Justification for previous surgeries				
Pelvic pain	35 (31.5)	12 (28.6)	23 (33.3)	.77
Infertility	7 (6.3)	2 (4.8)	5 (7.3)	.89
Presumption of endometriosis	27 (24.3)	11 (26.2)	16 (23.2)	.77
Cystectomy				
Right ovary	14 (12.6)	5 (11.9)	9 (13)	.85
Left ovary	16 (14.4)	5 (11.9)	11 (15.9)	.67
Oophorectomy	2 (1.8)	1 (2.4)	1 (1.5)	1
Unilateral salpingectomy	4 (3.6)	1 (2.4)	3 (4.4)	1
Psychological care (anxiety, depression)	38 (34.2)	13 (30.9)	25 (36.2)	.89
Obstetric history				
Nulligesta	77 (69.4)	30 (71.4)	47 (68.1)	.94
Nullipara	91 (82)	34 (81)	57 (82.6)	.81
Miscarriage	7 (6.3)	2 (4.8)	5 (7.3)	.64
Ectopic pregnancies	4 (3.6)	0	4 (5.8)	.28
Documented infertility	53 (51)	18 (47.4)	35 (53)	.68

Note: Values are number (percentage) unless otherwise noted.

Roman. Disc excision of large rectal nodules. *Fertil Steril* 2017.

not enrolled in this series. Women managed by the Rouen technique presented with lower and larger nodules of the rectum (Table 3) and more frequent and larger infiltration of the adjacent vagina, requiring more frequent use of a vaginal-laparoscopic-transanal approach. However, baseline symptoms were comparable (Table 2), excepting more frequent bowel movements in the first group and more frequent blood in stools and more frequent lack of ability to defer defecation for more than 15 minutes in the second group. The discs removed using the Rouen technique were significantly larger; rectal sutures were lower, thus temporary stoma was more frequently used, and overall operative time was significantly longer. The air test revealed bubble loss through the stapled line in four patients managed using circular staplers (5.8%) and three requiring the Rouen technique (7.1%). In addition, supplementary stitches were placed to reinforce the stapled line along with diverting stoma for 3 months.

Multiple localizations of deep endometriosis were managed by specific procedures, as presented in Table 3. Fourteen patients (11%) had associated deep endometriosis nodules on sigmoid colon, which were managed separately by disc excision or segmental resection to conserve healthy bowel located between two consecutive nodules (27). Associated lesions of adnexa were less frequent in patients with nodules managed by the Rouen technique.

No statistically significant differences were recorded in terms of postoperative complications; however, the rates of rectovaginal fistulae and transitory bladder dysfunction must be emphasized (Table 3). All

rectovaginal fistulae occurred in patients with associated resection of vaginal wall, the diameter of which exceeded 3 cm in five of them.

Postoperative assessment of digestive function showed statistically significant improvement in terms of gastrointestinal quality of life (Table 4). Improvement in constipation assessed using KESS score values was statistically significant only for patients managed by the Rouen technique. The rate of patients with an overall Wexner score value of >2 decreased from 26% before surgery to 15.6% and 0%, respectively, 1 year and 3 years after surgery. Since surgery, none of the 111 patients enrolled in the series has presented postoperative anal incontinence requiring specific care.

Two recurrences were recorded in the two groups, which occurred, respectively, 48 and 24 months postoperatively. In each patient, postoperative amenorrhea was interrupted for 12 months. Both recurrences were represented by 2-cm-long nodules infiltrating the muscular layer of rectal wall, around the stapled line. The first patient is currently managed by continuous medical treatment, whereas the second underwent a new disc excision using the EEA circular stapler, with uneventful outcomes.

Thirty-two patients have stopped medical treatment during follow-up to get pregnant, and 21 of them have achieved pregnancy (65.6%). Most pregnancies were spontaneous, and more than 85% of them were followed by deliveries. The probability of pregnancy 12 months after the arrest of medical treatment in the overall population, in women managed by the Rouen technique, and in women managed using the EEA stapler was, respectively, 73.3% (95% confidence

TABLE 2

## Principal pain symptoms related to pelvic endometriosis.

Symptom	Whole sample (n = 111)	Disc excision using the Rouen technique(n = 42)	Disc excision using the EEA stapler (n = 69)	P value
Dysmenorrhea	106 (95.5)	40 (95.2)	66 (95.7)	1
Primary dysmenorrhea	57 (51.4)	19 (45.2)	38 (55.1)	.63
Biberoglou and Behrman dysmenorrhea score	2.1 ± 0.7	2.2 ± 0.7	2.1 ± 0.7	.58
Intensity of dysmenorrhea (VAS >4)	103 (92.8)	39 (92.9)	64 (92.8)	1
Cyclic symptoms associated with dysmenorrhea				
Defecation pain	84 (75.7)	29 (69.1)	55 (79.7)	.42
Rectorrhage	21 (18.9)	12 (28.6)	9 (13)	.11
Constipation	65 (58.6)	22 (52.4)	43 (62.3)	.56
Diarrhea	62 (55.9)	20 (47.6)	42 (60.9)	.39
Bloating	56 (50.5)	22 (52.4)	34 (49.3)	.94
Urinary pain	29 (26.1)	10 (23.8)	19 (27.5)	.79
Having had sexual intercourse	99 (89.2)	37 (88.1)	62 (89.9)	.89
Deep dyspareunia	86 (77.5)	30 (71.4)	56 (81.2)	.56
Biberoglou and Behrman deep dyspareunia score	1.6 ± 1	1.6 ± 1.1	1.6 ± 1	.69
Intensity of dyspareunia (VAS >4)	67 (67.7)	25 (67.6)	42 (67.7)	1
Evaluation of digestive function				
KESS constipation score (total value)	13.2 ± 6.6	14 ± 7	12.9 ± 6.3	.43
Frequency of bowel movements (KESS item 3)	0.4 ± 0.6	0.6 ± 0.7	0.3 ± 0.5	.04
Abdominal pain (KESS item 6)	2.2 ± 1	2 ± 1	2.4 ± 1	.06
GIQLI score (total value)	86.3 ± 21.8	86.4 ± 19.6	86.3 ± 23	.98
Bowel urgency (GIQLI item 30)	2.5 ± 1.1	2.8 ± 1.1	2.4 ± 1.1	.09
Blood in stools (GIQLI item 34)	3.4 ± 1	3.1 ± 1.3	3.6 ± 0.8	.01
Wexner score (n = 90)	1.5 ± 2.5	1.6 ± 1.8	1.5 ± 2.8	.82
Patients with Wexner score >2	23/90 (25.6)	11/31 (32.3)	13/59 (22)	.32
Lack of ability to defer defecation >15 min (n = 94)	51/94 (54.3)	14/35 (40)	37/59 (62.7)	.01

Note: Values are presented as number (percentage) or mean ± SD. AFSr = revised American Fertility Society score; VAS = visual analog scale.

Roman. Disc excision of large rectal nodules. *Fertil Steril* 2017.

interval [CI] 54.9%–88.9%), 70.4% (95% CI 40%–94.5%), and 72.4% (95% CI 50.6%–90.5%) ( $P=1$ ) (Supplemental Fig. 2).

## DISCUSSION

Our study reports original prospectively recorded data on postoperative digestive function in a large series of consecutive patients managed by disc excision using two different transanal devices. Although the principle of disc excision is similar between the two procedures, their indications vary depending on the size and height of rectal involvement. The Rouen technique using a semicircular transanal stapler allows removal of large nodules of the low and mid-rectum up to 10 cm above the anus. The technique using the EEA circular transanal stapler allows the management of nodules up to 20 cm above the anus but generally of <3 cm in size. Both techniques are used as alternatives to rectal resection, which may be impaired by specific unfavorable functional outcomes, such as low anterior rectal resection syndrome (14, 28) or stenosis of colorectal anastomosis (29). Postoperative assessment of digestive function suggests that functional outcomes after disc excision were good, even though improvement in constipation seemed to be less significant.

Our study presents several weaknesses. We present a series without a control group, which should have included patients managed by colorectal resection, to compare postoperative functional outcomes. Therefore it is difficult

to ascertain whether disc excision is truly a viable alternative to segmental resection in our patient population. A well-selected control group would have strengthened our work, particularly when evaluating unexpectedly high rates of outcomes, such as the rate of rectovaginal fistula formation seen in the Rouen technique. Even though our database includes 185 patients managed by colorectal resection, differences in their baseline characteristics and nodule features would have jeopardized direct comparison between surgical procedures. However, postoperative outcomes, complications, and recurrences following segmental resection have been repeatedly reported by various surgical teams worldwide and have been pooled in large systematic reviews (30, 31). In a review including 49 studies, Meuleman et al. (30) reported that, in women managed by colorectal resection, the rate of rectovaginal fistulae varied at approximately 2.7% and that of anastomosis leakage averaged 1.5%. However, in several retrospective series reported by experienced surgeons who routinely perform bowel resection in endometriosis, the rate of rectovaginal fistulae rose to 8.4% (32) or 10.7% (33), whereas that of anastomotic leakage to 2.1% (34), 4.7% (35), or 6% (22). Concerning recurrence rates after colorectal resection, overall risk of recurrence was estimated at 5.8%, whereas that of proven recurrence in women undergoing secondary surgery was 2.5% (30). Fertility rate after colorectal resection was recently studied in a review of the literature and estimated at 46.9%, whereas that of

TABLE 3

## Intraoperative findings and postoperative outcomes.

Parameter	Whole sample (n = 111)	Disc excision using the Rouen technique (n = 42)	Disc excision using the EEA stapler (n = 69)	P value
Largest diameter of the disc removed (mm)				
Mean ± SD	45 ± 14	59 ± 11	36 ± 7	< .001
Median (range)	40 (20-100)	60 (40-100)	35 (20-60)	
Height of the rectal nodule (mm)				
Mean ± SD	81 ± 30	55 ± 13	97 ± 25	< .001
Median (range)	80 (30-150)	60 (30-80)	100 (40-150)	
Rectal nodule size (cm)				< .001
<1	4 (3.6)	0	4 (5.8)	
1-2.9	34 (31.2)	3 (7.1)	31 (44.9)	
≥3	73 (65.8)	39 (92.7)	34 (49.3)	
Endometriosis foci revealed on specimen edge	47 (42.3)	22 (52.4)	25 (36.2)	.12
Vaginal infiltration	69 (62.2)	35 (83.3)	34 (49.3)	< .001
Vaginal infiltration size (cm)				< .001
<1	5 (4.5)	0	5 (7.3)	
1-2.9	20 (18)	6 (14.3)	14 (20.3)	
≥3	44 (39.6)	29 (69.1)	15 (21.7)	
Operative time (min)	206 ± 80	238 ± 70	187 ± 80	< .001
Operative route				.001
Laparoscopic-transanal	87 (78.4)	27 (64.3)	60 (87)	
Vaginal-laparoscopic-transanal	20 (18)	15 (35.7)	5 (7.2)	
Robotic assisted laparoscopic-transanal	2 (1.8)	0	2 (2.9)	
Laparoscopic followed by open route-transanal	2 (1.8)	0	2 (2.9)	
AFSr score, mean ± SD	56.8 ± 30.5	53.2 ± 28.6	59 ± 31.6	.33
Endometriosis stage				.87
2	16 (14.4)	6 (14.3)	10 (14.5)	
3	16 (14.4)	7 (16.7)	9 (13)	
4	79 (71.2)	29 (69.1)	50 (72.5)	
Douglas pouch complete obliteration	64 (57.7)	26 (61.9)	38 (55.1)	.55
Endometriosis lesions on the diaphragm	14 (12.6)	3 (7.1)	11 (15.9)	.18
Management of ovarian endometriomas				
Drainage of cyst	7 (6.3)	3 (7.1)	4 (5.8)	1
Ablation using plasma energy	49 (44.1)	18 (42.9)	31 (44.9)	.85
Cystectomy	2 (1.8)	0	2 (2.9)	1
Bilateral ovariectomy	1 (0.9)	0	1 (1.5)	1
Adhesiolysis				
Right adnexa	57 (51.3)	15 (35.7)	42 (60.9)	.001
Left adnexa	66 (59.5)	19 (45.2)	47 (68.1)	.09
Deep posterior endometriosis nodule localization				
Left uterosacral ligament (USL)	23 (20.7)	10 (23.8)	13 (18.8)	.63
Right USL	18 (16.2)	10 (23.8)	8 (11.6)	.11
Rectovaginal septum	46 (41.4)	21 (50)	25 (36.2)	.17
Both USL and rectovaginal septum	61 (54.9)	21 (50)	40 (58)	.44
Hysterectomy + colectomy	4 (3.6)	1 (2.4)	3 (4.4)	.56
Surgical procedures on digestive tract				
Sigmoid colon disc excision	3 (2.7)	2 (4.8)	1 (1.5)	.56
Sigmoid colon resection	12 (10.8)	5 (11.9)	6 (10.1)	.79
Length of sigmoid colon specimen (mm), mean ± SD	75 ± 32	84 ± 42	69 ± 23	.44
Height of colorectal anastomosis (mm), mean ± SD	180 ± 54	164 ± 51	190 ± 58	.42
Small bowel+ caecum resection	2 (1.8)	0	2 (2.9)	.53
Cecum resection	1 (0.9)	0	1 (1.5)	1
Appendectomy	5 (4.5)	3 (7.1)	2 (2.9)	.37
Transitory stoma	66 (59.5)	39 (92.9)	27 (39.1)	< .001
Decompression of sciatic nerve roots	2 (1.9)	2 (4.8)	0	1
Surgical procedures on urinary tract	11 (9.9)	4 (9.5)	7 (10.1)	1
Resection of the bladder	4 (3.6)	2 (4.8)	2 (2.9)	.63
Advanced ureterolysis requiring JJ stent	6 (5.4)	2 (4.8)	4 (5.8)	1
Ureteral resection and uretero- cystostomy	1 (0.9)	0	1 (1.5)	1

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TABLE 3

Continued.

Parameter	Whole sample (n = 111)	Disc excision using the Rouen technique (n = 42)	Disc excision using the EEA stapler (n = 69)	P value
Postoperative outcomes				
Follow-up (mo), mean $\pm$ SD	22 $\pm$ 20	24 $\pm$ 22	21 $\pm$ 19	.45
Clavien 3 postoperative complications				
Rectovaginal fistulae	8 (7.2)	5 (11.9)	3 (4.4)	.15
Pelvic abscess requiring second laparoscopy	3 (2.7)	2 (4.8)	1 (1.5)	.56
Pelvic abscess managed only by antibiotics	3 (2.7)	2 (4.8)	1 (1.5)	.56
Rectorrhage requiring endoscopy	3 (2.7)	0	3 (4.4)	.29
Transitory bladder atony requiring 3 wk to 6 mo auto-catheterization	10 (9)	6 (14.3)	4 (5.8)	.29
Stoma related complications	3 (2.7)	0	3 (4.4)	.29
Severe abdominal hemorrhage requiring open surgery in emergency	1 (0.9)	0	1 (1.5)	1
Peritonitis after stoma closure	1 (0.9)	0	1 (1.5)	1
Occlusion due to small bowel strangulation through mesocolon	1 (0.9)	0	1 (1.5)	1
Stenosis of colorectal anastomosis	2 (1.8)	1 (2.4)	1 (1.5)	1
Recurrences located on stapled line		48	24	
Delay from surgery to recurrence diagnosis (months)		12	12	
Length of time free from postoperative medical amenorrhea (mo)				
Fertility outcomes (n = 32)				
Postoperative pregnancy attempt	32 (28.8)	12 (28.6)	20 (29)	1
Pregnant	21 (65.6)	8 (66.7)	13 (65)	1
Pregnancy outcomes				1
Delivery or ongoing pregnancy >25 wk	18 (85.7)	7 (87.5)	11 (84.6)	
Miscarriage	3 (14.3)	1 (12.5)	2 (15.4)	
Ectopic pregnancy	0	0	0	
Conception mode (n = 21)				.90
Spontaneous pregnancy	12 (37.5)	4 (33.3)	8 (40)	
ART	9 (28.1)	4 (33.3)	5 (25)	

Note: Values are number (percentage) unless otherwise noted. AFSr = revised American Fertility Society score; USL = uterosacral ligament.

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spontaneous conception averaged 28.6% (36). Thus, when compared with data in the literature, the postoperative outcomes in our series were satisfactory in terms of complications, recurrences, fertility, and digestive function.

Our study presents several strengths. Recording of data was prospective and was performed by a clinical researcher dedicated to managing follow-up data, which explains the lack of patients lost to follow-up. Assessment of baseline and postoperative digestive function was based on universally accepted and standardized gastrointestinal questionnaires (24–26), which provide accurate evaluation of the effect of disc excision on baseline digestive complaints. Our data are valid because our team is experienced in the management of colorectal endometriosis by disc excision: the technique using the EEA stapler is routinely performed in our department (17), whereas the Rouen technique was created by our team (18).

The major advantage of disc excision over colorectal resection in rectal endometriosis is related to preservation of mesorectum and rectal vessels and nerves, as well as overall length and capacity of rectal ampoula. On the basis of this objective, rectal disc excision was associated with disc excision or segmental resection of the sigmoid colon in

women with multiple colorectal nodules, representing 11% of our sample (27). In our opinion this strategy is feasible when two consecutive nodules are separated by a healthy rectal segment of more than 5 cm in length, ensuring well vascularized rectal wall separating two transversal sutures. In our current practice, we always manage the highest nodule first and then the lowest nodule, to avoid the passage of the circular device through a segment of bowel that has already been stapled.

When compared with rectal shaving, disc excision probably allows for a more complete removal of endometriosis foci. We are aware that endometriotic foci are probably left behind after rectal shaving; however, the question is whether these foci can further develop and be responsible for postoperative recurrence (37). Recent research on baboons suggested that fibrous tissue left behind after shaving might not be a progressive disease (38). However, we recently reported rectal recurrences originating from the site of rectal shaving 5–10 years after the first surgery (37). When recurrences occur into deep subperitoneal spaces previously dissected, second surgery may be more challenging, thus we routinely reserve shaving for older patients with a low risk of recurrence and remove the shaved area using transanal

TABLE 4

Postoperative assessment of digestive function using data from follow-up questionnaires.

Parameter	Baseline characteristics				1-y follow-up assessment			3-y follow-up assessment			P value	
	Whole sample (n = 111)	Disc excision using the Rouen technique (n = 42)	Disc excision using the EEA stapler (n = 69)	Whole population (n = 47)	The Rouen technique (n = 16)	Using EEA circular stapler (n = 31)	Whole population (n = 20)	The Rouen technique (n = 10)	Using EEA circular stapler (n = 10)	Whole population		The Rouen technique
KESS score	13.2 ± 6.6	14 ± 7	12.9 ± 6.3	11.3 ± 6	10.9 ± 6.6	11.4 ± 5.7	12.1 ± 6.7	11.5 ± 8.3	12.7 ± 4.8	.21 <sup>a</sup>	.03 <sup>b</sup>	.35 <sup>c</sup>
GIQLI score	86.3 ± 21.8	86.4 ± 19.6	86.3 ± 23	100.1 ± 22.3	103.8 ± 22.4	97.9 ± 22.3	107.4 ± 22.9	107.4 ± 25.6	107.4 ± 21.4	<.001 <sup>a</sup>	<.001 <sup>b</sup>	<.001 <sup>c</sup>

Note: Values are mean ± SD, unless stated otherwise.

<sup>a</sup> P value of comparison of variances of, respectively, baseline, 1-year follow-up, and 3-year follow-up scores in the whole population.<sup>b</sup> P value of comparison of variances of, respectively, baseline, 1-year follow-up, and 3-year follow-up scores only in women managed by the Rouen technique.<sup>c</sup> P value of comparison of variances of, respectively, baseline, 1-year follow-up, and 3-year follow-up scores only in women managed using the EEA circular stapler.

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staplers in young women with pregnancy intention (37). Immediate postoperative complications were found to be higher in patients managed by disc excision, due to rectal suture-related immediate complications (20, 39).

The rate of rectovaginal fistulae in patients managed by the Rouen technique may be surprisingly high. However, it involves a specific group of women with rectal nodules located on average 5.5 cm above the anus, with a mean diameter of infiltrated rectum of >3 cm in diameter in 93%, with adjacent vaginal involvement in 83.3% and measuring >3 cm in diameter in 69% of cases. Despite a combined vaginal-laparoscopic approach and the systematic use of omentoplasty separating vaginal and rectal sutures, the risk of rectovaginal fistula in such patients is expectedly high. To our knowledge no similar series of patients has yet been reported in the literature to allow comparison with our outcomes. In addition, 6 of 8 patients presenting with fistula had stoma already performed during the first procedure, thus their fistulae were asymptomatic and revealed by barium enema 2 months after surgery. In the remaining two patients rectovaginal fistulae were diagnosed early on the basis of elevated C-reactive protein level and were not responsible for pelvic infection complications.

Digestive functional outcomes were overall favorable, as demonstrated by significant improvement in overall values of the GIQLI score. However, the effect on constipation seemed less relevant, because overall values of the KESS score did not decrease significantly after surgery. In our opinion constipation is a complex symptom, which originally may be due to endometriosis but then develops on its own. Women with deep rectal endometriosis present with numerous factors favoring constipation: narrowness of digestive tract lumen, rigidity of infiltrating rectal muscular wall, and angulation of colorectal loops in multiple nodules (12). To these mechanical factors must be added the dysfunction of inferior hypogastric plexus leading to increased sympathetic activity with anal sphincter hypertonia (40), dyssynergic defecation, and slow transit through the left colon (41), sigma, and rectum. Because autonomic nerve function may or may not be completely restored by removal of deep nodules, further improvement in constipation may be more or less relevant. As a matter of fact, persistent or de novo postoperative constipation has already been reported in patients managed by rectal shaving (37, 42) or colorectal resection (43–46).

The fertility rates recorded in our series are encouraging: two-thirds of women with pregnancy intention achieved conception, and most of them conceived spontaneously. One may object that many patients did not intend getting pregnant before surgery and preoperative infertility was not documented in their cases. However, 85% of women were managed for stage 3 and 4 endometriosis, in which spontaneous conception is dramatically improbable and primary IVF is frequently recommended. Indeed, there is a general tendency to refer young patients with deep colorectal endometriosis and pregnancy intention directly to ART, owing to the risk of complications related to surgery and the lack of data supporting a benefit of the surgery on IVF results. This policy concerns patients with or without



documented previous infertility, who could ultimately achieve an average pregnancy rate of 70% after up to three IVF procedures (36). In our series, at the time of surgery some patients had a past history of infertility and others had only been trying to get pregnant for a few months, whereas others intended to conceive only after the surgery. However, when referred to centers applying the above-mentioned policy, primary IVF would automatically have been offered to these patients. For these reasons, reporting postoperative pregnancy rate in a series of patients managed for colorectal endometriosis, with special mention of spontaneous conception rate, achieves overall meaning, even though patients' characteristics are somewhat heterogeneous. Besides the benefit in terms of postoperative improvement in painful complaints, offering patients the opportunity to spontaneously conceive is a major concern regarding health expenses and patient comfort.

Achieving complete removal of endometriosis implants using disc excision may be disputed, because 42% of rectal discs presented endometriosis implants on at least one of their edges. This rate is similar to that previously reported by Remorgida et al. (47). However, it may also be difficult to achieve complete removal by segmental colorectal resection, because bowel occult microscopic endometriosis implants may be found at a distance of 2 or 3 cm from the macroscopic nodule in, respectively, 31% and 19% of patients (48). Indeed, achieving complete microscopic resection using histologic data as well as the philosophy of performing radical surgery based on systematic colorectal resection may also be called into question. A fundamental question is whether complete excision of microscopic rectal endometriosis implants is realistic. If it is not, focusing on improvement in pelvic pain and digestive complaints while preventing recurrences is a reasonable alternative objective. It is our belief that the techniques of disc excision may both improve digestive complaints and prevent unfavorable outcomes, such as low anterior rectal resection syndrome.

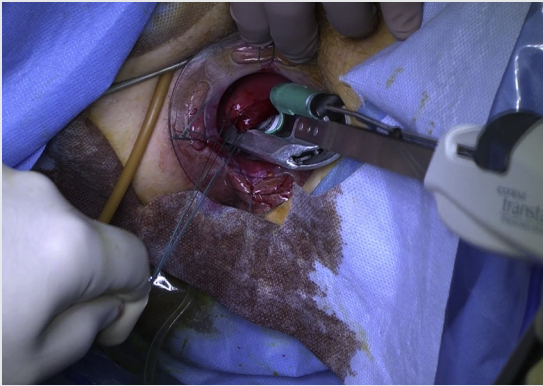
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## REFERENCES

- Thiels CA, Shenoy CC, Ubl DS, Habermann EB, Kelley SR, Mathis KL. Rates, trends, and short-term outcomes of colorectal resections for endometriosis: an ACS-NSQIP review. *Int J Surg* 2016;31:5–9.
- Minelli L, Fanfani F, Fagotti A, Ruffo G, Ceccaroni M, Mereu L, et al. Laparoscopic colorectal resection for bowel endometriosis: feasibility, complications, and clinical outcome. *Arch Surg* 2009;144:234–9.
- Darai E, Dubernard G, Coutant C, Frey C, Rouzier R, Ballester M. Randomized trial of laparoscopically assisted versus open colorectal resection for endometriosis: morbidity, symptoms, quality of life, and fertility. *Ann Surg* 2010;251:1018–23.
- Abrao MS, Petraglia F, Falcone T, Keckstein J, Osuga Y, Chapron C. Deep endometriosis infiltrating the recto-sigmoid: critical factors to consider before management. *Hum Reprod Update* 2015;21:329–39.
- Meuleman C, Tomassetti C, Wolthuis A, Van Cleynenbreugel B, Laenen A, Penninx F, et al. Clinical outcome after radical excision of moderate-severe endometriosis with or without bowel resection and reanastomosis. A prospective cohort study. *Ann Surg* 2014;259:522–31.
- Nezhat F, Nezhat C, Pennington E. Laparoscopic proctectomy for infiltrating endometriosis of the rectum. *Fertil Steril* 1992;57:1129–32.
- Nezhat C, Pennington E, Nezhat F, Silfen SL. Laparoscopically assisted anterior rectal wall resection and reanastomosis for deeply infiltrating endometriosis. *Surg Laparosc Endosc* 1991;1:106–8.
- Roman H, Vassilief M, Gourcerol G, Savoye G, Leroi AM, Marpeau L, et al. Surgical management of deep infiltrating endometriosis of the rectum: pleading for a symptom-guided approach. *Hum Reprod* 2011;26:274–81.
- Donnez J, Squifflet J. Complications, pregnancy and recurrence in a prospective series of 500 patients operated on by the shaving technique for deep rectovaginal endometriotic nodules. *Hum Reprod* 2010;25:1949–58.
- Nezhat C, Nezhat F, Ambroze W, Pennington E. Laparoscopic repair of small bowel and colon. A report of 26 cases. *Surg Endosc* 1993;7:88–9.
- Gordon SJ, Maher PJ, Woods R. Use of the CEEA stapler to avoid ultra-low segmental resection of a full-thickness rectal endometriotic nodule. *J Am Assoc Gynecol Laparosc* 2001;8:312–6.
- Roman H, Bridoux V, Tuech JJ, Marpeau L, da Costa C, Savoye G, et al. Bowel dysfunction before and after surgery for endometriosis. *Am J Obstet Gynecol* 2013;209:524–30.
- Gervaz P, Rotholz N, Wexner SD, You SY, Saigusa N, Kaplan E, et al. Colonic J-pouch function in rectal cancer patients: impact of adjuvant chemoradiotherapy. *Dis Colon Rectum* 2001;44:1667–75.
- Emmertens KJ, Laurberg S. Low anterior resection syndrome score. Development and validation of a symptom-based scoring system for bowel dysfunction after low anterior resection for rectal cancer. *Ann Surg* 2012;255:922–8.
- Nezhat C, Nezhat F, Pennington E, Nezhat CH, Ambroze W. Laparoscopic disk excision and primary repair of the anterior rectal wall for the treatment of full-thickness bowel endometriosis. *Surg Endosc* 1994;8:682–5.
- Landi S, Pontrelli G, Surico D, Ruffo G, Benini M, Soriano D, et al. Laparoscopic disk resection for bowel endometriosis using a circular stapler and a new endoscopic method to control postoperative bleeding from the stapler line. *J Am Coll Surg* 2008;207:205–9.
- Roman H, Abo C, Huet E, Bridoux V, Auber M, Oden S, et al. Full thickness disc excision in deep endometriotic nodules of the rectum. A prospective cohort. *Dis Colon Rectum* 2015;58:957–66.
- Bridoux V, Roman H, Kianifard B, Vassilief M, Marpeau L, Michot F, et al. Combined transanal and laparoscopic approach for the treatment of deep endometriosis infiltrating the rectum. *Hum Reprod* 2012;27:418–26.
- Roman H, Abo C, Huet E, Tuech JJ. Deep shaving and transanal disc excision in large endometriosis of mid and lower rectum: the Rouen technique. *Surg Endosc* 2016;30:2626–7.
- Roman H. A national snapshot of the surgical management of deep infiltrating endometriosis of the rectum and colon in France in 2015: a multicenter series of 1,135 cases. *J Gynecol Obstet Reprod Biol* 2017, In Press.
- Roman H, Darwish B, Schmied R, Remorgida V, Tuech JJ. Combined vaginal-laparoscopic-transanal approach for reducing bladder dysfunction after conservative surgery in large deep rectovaginal endometriosis. *J Gynecol Obstet Biol Reprod (Paris)* 2016;45:546–8.
- Possover M, Diebold H, Plaul K, Schneider A. Laparoscopically assisted vaginal resection of rectovaginal endometriosis. *Obstet Gynecol* 2000;96:304–7.
- Nezhat C, Nezhat F, Pennington E. Laparoscopic treatment of infiltrative rectosigmoid colon and rectovaginal septum endometriosis by the technique of videolaparoscopy and the CO2 laser. *Br J Obstet Gynaecol* 1992;99:664–7.
- Nieveen van Dijkum EJ, Terwee CB, Oosterveld P, van der Meulen JH, Gouma DJ, de Haes JC. Validation of the gastrointestinal quality of life index for patients with potentially operable periampullary carcinoma. *Br J Surg* 2000;87:110–5.
- Knowles CH, Scott SM, Legg PE, Allison ME, Lunniss PJ. Level of classification performance of KESS (symptom scoring system for constipation) validated in a prospective series of 105 patients. *Dis Colon Rectum* 2002;45:842–3.
- Jorge JM, Wexner SD. Etiology and management of fecal incontinence. *Dis Colon Rectum* 1993;36:77–97.

27. Darwish B, Roman H. Surgical treatment of deep infiltrating rectal endometriosis: in favor of less aggressive surgery. *Am J Obstet Gynecol* 2016;215:195–200.
28. Lee WY, Takahashi T, Pappas T, Mantyh CR, Ludwig KA. Surgical autonomic denervation results in altered colonic motility: an explanation for low anterior resection syndrome? *Surgery* 2008;143:778–83.
29. Maytham GD, Dowson HM, Levy B, Kent A, Rockall A. Laparoscopic excision of rectovaginal endometriosis: report of a prospective study and review of the literature. *Colorectal Dis* 2010;12:1105–12.
30. Meuleman C, Tomassetti C, D'Hoore A, Van Cleynenbreugel B, Penninckx F, Vergote I, et al. Surgical treatment of deeply infiltrating endometriosis with colorectal involvement. *Hum Reprod Update* 2011;17:311–26.
31. De Cicco C, Corona R, Schonman R, Mailova K, Ussia A, Koninckx PR. Bowel resection for deep endometriosis: a systematic review. *BJOG* 2011;118:285–91.
32. Daraï E, Ackerman G, Bazot M, Rouzier R, Dubernard G. Laparoscopic segmental colorectal resection for endometriosis: limits and complications. *Surg Endosc* 2007;21:1572–7.
33. Bracale U, Azioni G, Rosati M, Barone M, Pignata G. Deep pelvic endometriosis (Adamyán IV stage): multidisciplinary laparoscopic treatments. *Acta Chir Iugosl* 2009;56:41–6.
34. Ferrero S, Anserini P, Abbamonte LH, Ragni N, Camerini G, Remorgida V. Fertility after bowel resection for endometriosis. *Fertil Steril* 2009;92:41–6.
35. Mereu L, Ruffo G, Landi S, Barbieri F, Zaccoletti R, Fiaccavento A, et al. Laparoscopic treatment of deep endometriosis with segmental colorectal resection: short-term morbidity. *J Minim Invasive Gynecol* 2007;14:463–9.
36. Cohen J, Thomoin A, Mathieu D'Argent E, Lass E, Canlorbe G, Zilberman S, et al. Fertility before and after surgery for deep infiltrating endometriosis with and without bowel involvement: a literature review. *Minerva Ginecol* 2014;66:575–87.
37. Roman H, Moatassim-Drissi S, Marty N, Milles M, Vallée A, Desnyder E, et al. Rectal shaving in deep endometriosis infiltrating the rectum: a 5-year continuous retrospective series. *Fertil Steril* 2016;106:1438–45.e2.
38. Donnez O, Orellana R, Van Kerk O, Dehoux JP, Donnez J, Dolmans MM. Invasion process of induced deep nodular endometriosis in an experimental baboon model: similarities with collective cell migration? *Fertil Steril* 2015;104:491–7.
39. Mohr C, Nezhat FR, Nezhat CH, Seidman DS, Nezhat CR. Fertility considerations in laparoscopic treatment of infiltrative bowel endometriosis. *JSL* 2005;9:16–24.
40. Mabrouk M, Ferrini G, Montanari G, Di Donato N, Raimondo D, Stanghellini V, et al. Does colorectal endometriosis alter intestinal functions? A prospective manometric and questionnaire-based study. *Fertil Steril* 2012;97:652–6.
41. Possover M, Schneider A. Slow-transit constipation after radical hysterectomy type III. *Surg Endosc* 2002;16:847–50.
42. Seracchioli R, Ferrini G, Montanari G, Raimondo D, Spagnolo E, Di Donato N. Does laparoscopic shaving for deep infiltrating endometriosis alter intestinal function? A prospective study. *Aust N Z J Obstet Gynaecol* 2015;55:357–62.
43. Roman H, Milles M, Vassilief M, Resch B, Tuech JJ, Huet E, et al. Long-term functional outcomes following colorectal resection versus shaving for rectal endometriosis. *Am J Obstet Gynecol* 2016;215:762.e1-9.
44. Dubernard G, Piketty M, Rouzier R, Houry S, Bazot M, Daraï E. Quality of life after laparoscopic colorectal resection for endometriosis. *Hum Reprod* 2006;21:1243–7.
45. Landi S, Ceccaroni M, Perutelli A, Allodi C, Barbieri F, Fiaccavento A, et al. Laparoscopic nerve-sparing complete excision of deep endometriosis: is it feasible? *Hum Reprod* 2006;21:774–81.
46. Benbara A, Fortin A, Martin B, Palazzo L, Le Tohic A, Madelenat P, et al. Surgical and functional results of colorectal resection for severe endometriosis. *Gynecol Obstet Fertil* 2008;36:1191–201.
47. Remorgida V, Ragni N, Ferrero S, Anserini P, Torelli P, Fulcheri E. How complete is full thickness disc resection of bowel endometriotic lesions? A prospective surgical and histological study. *Hum Reprod* 2005;20:2317–20.
48. Badescu A, Roman H, Aziz M, Puscasiu L, Molnar C, Huet E, et al. Mapping of endometriosis microimplants surrounding deep endometriosis nodules infiltrating the bowel. *Fertil Steril* 2016;105:430–4.

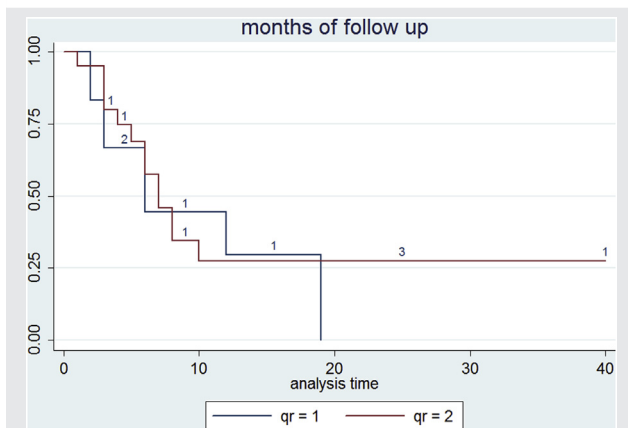
## SUPPLEMENTAL FIGURE 1



Transanal step of the Rouen technique.

*Roman. Disc excision of large rectal nodules. Fertil Steril 2017.*

## SUPPLEMENTAL FIGURE 2



Probability of postoperative pregnancy in patients managed by, respectively, the Rouen technique ( $qr = 1$ ) and the procedure employing the circular stapler ( $qr = 2$ ).

Roman. Disc excision of large rectal nodules. *Fertil Steril* 2017.