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Conventional laparoscopic segmental bowel resection with mini-laparotomy specimen extraction compared with Natural Orifice Specimen Extraction (NOSE) procedures in patients with colorectal endometriosis

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ABSTRACT

Background: In patients with colorectal endometriosis the optimal surgical approach for excising disease remains unknown.

Objectives: To compare the safety and efficacy of classic colorectal resection with mini-laparotomy and extracorporeal specimen removal and anastomosis formation (CLS) and colorectal resection with natural orifice specimen (bowel segment) extraction (NOSE), which is performed entirely in the abdominal cavity.

Methods: This is a single centre, retrospective observational study of 161 cases of colorectal endometriosis. Women underwent laparoscopic excision of deep endometriosis with segmental bowel resection between 2015 and 2023.

Main Outcome Measures: Hospital stay, complication rate, infectious issues, pain measured on a 10 cm visual analogue scale (VAS) and quality of life [derived from Knowles-Eccersley-Scott-Symptom (KESS)] questionnaire were the outcomes of interest.

Results: No differences in post-operative pain or bowel quality of life at 3 months were observed between CLS and NOSE surgical treatment of colorectal endometriosis (mean VAS score 2 vs. 1, (P=0.62) and mean KESS score 12.3 vs. 10.7 (P=0.28). No clinically significant differences between techniques for intra-abdominal sepsis were seen as judged by C-reactive protein elevation and bacterial contamination from peri-operative cultures.

Conclusions: NOSE and CLS procedures appear comparable in safety and efficacy for removing colorectal endometriosis. Randomised trials are needed to compare these techniques.

What is New? The NOSE technique for removing colorectal endometriosis is not associated with poorer safety, inflammatory, infective or efficacy outcomes compared to the classical CLS approach. Randomised controlled trials are needed to compare these techniques.

Keywords: Anastomosis, colorectal, endometriosis, laparoscopic, surgery, quality of life

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Introduction

Endometriosis is a chronic disease with a prevalence 10-15% in reproductive- age women.[1-3]

Deep colorectal endometriosis (DE) is the most aggressive type of endometriosis which occurs in 5-12% of women with endometriosis.[3-10] In such patients, characteristic intestinal symptoms may appear during the perimenstrual period—diarrhea, dyschezia, flatulence, tenesmus, ribbon—like stools, difficulty defecating, and the presence of blood in the stool, which significantly affects daily life.[11-38]

Despite its relevance, the question of choosing the optimal treatment method for colorectal endometriosis remains a significant problem.[39-41] Conservative medication (non-steroidal anti-inflammatory drugs, combined oral contraceptives, progestins, gonadotropin-releasing hormone agonists) is a first line treatment, especially for asymptomatic patients. It can reduce symptoms, still, it does not provide long-term control after medication is stopped and cannot halt the progression of endometriosis.[12-15] Therefore, surgical treatment is often required to remove affected tissues to alleviate the symptoms of endometriosis.[16] Endometriosis with involvement of a large bowel is challenging.

Surgical treatment of colorectal endometriosis includes shaving technique (superficial removal of infiltrates without opening its lumen), discoid resection of the intestine (excision of an endometriotic infiltrate on anterior wall, opening its lumen and subsequent suturing), and segmental bowel resection with consequent formation of anastomosis.[17,18]

Currently, colorectal resection is performed with minimally invasive approaches, either laparoscopically or robot-assisted. One of them, that proved its safety and efficacy, is conventional laparoscopic segmental bowel resection with mini-laparotomy specimen extraction (CLS). However, there is still a need to search for alternative techniques to reduce surgical trauma and its complications. Thus, a new direction emerged—transluminal surgical interventions. Natural Orifice Specimen Extraction (NOSE) refer to surgical procedures performed through natural anatomical openings—the vagina or rectum.[16,17,19]

The NOSE technique has become particularly widespread among gynaecological surgeons who operate on colorectal endometriosis, utilising intracorporeal end-to-end anastomosis.[20-22]

A 2021 study by Dobó et al.[24] demonstrated that NOSE is an acceptable surgical treatment method for patients with rectal endometriosis. However long-term data on gastrointestinal well-being after segmental bowel resection for DE in a large cohort of patients are sparse which limits robust conclusions. [23-25]

Therefore, the development of an algorithm for selecting the optimal surgical treatment method for colorectal endometriosis remains an ongoing issue. This retrospective single centre study compares CLS and NOSE bowel resection techniques and its outcomes in patients with colorectal DE in a long-term follow-up.

Methods

In this single-centre, retrospective study we investigated two surgical scenarios of deep colorectal endometriosis. It is a comparative analysis of data from 161 patients who underwent surgical treatment for DE in the gynaecological department of Krasnopolski Moscow Regional Research Center of Obstetrics and Gynecology from 2015 to 2023. All patients provided informed consent to participate in the study. This study was approved by the Local Ethics Committee of the Moscow Regional Research Institute of Obstetrics and Gynaecology (IRB number: 060004245) on 8th September 2016 and approval number: 715.

In all cases, patients underwent colorectal resection due to the symptomatic form of bowel endometriosis with the following nodule characteristics: length—3 cm or more, depth of invasion—7 mm or more, and the involvement of 40% or more of the bowel circumference, as well as the narrowing of the bowel lumen up to 50% according to colonoscopy in asymptomatic patients with diagnosed colorectal endometriosis. In the classic technique (CLS), after ureterolysis and opening of the pararectal space, the surgeon mobilizes the affected bowel segment. The unaffected distal part of the colon is separated from the mesorectum over a length of 10-20 mm and is cut-off using a linear stapler. Next, the affected proximal section of the intestine is removed through a suprapubic mini-laparotomy incision in the abdominal wall (up to 4 cm long), where it is resected proximally to the infiltrate with a distance of 5-10 mm. Extracorporeally, the anvil of the circular stapler is fixed to the intestinal tube with a purse-string suture and immersed back into the abdominal cavity, the anterior abdominal wall is sutured in layers. The intestinal anastomosis is performed using a transanal circular stapling device (end-to-end or side-to-end).

After the anastomosis is performed, a Michelin gas test is performed to determine the integrity of the suture. The CLS was routinely used from 2015-2020 in our centre.

A second method to compare was NOSE. Krasnopolski Moscow Regional Research Center of Obstetrics and Gynecology developed an algorithm optimising surgical treatment of patients with colorectal endometriosis using transluminal technology, particularly NOSE. The advantage of this method is that it can be performed using a single access port –laparoscopic or robotic. The NOSE technique was introduced as an alternative technique to CLS in our centre from 2020.

Technical Features of the Operation

After restoring the physiological anatomy of the pelvis, the intestine is mobilized. The affected bowel (sigmoid colon, rectosigmoid junction) is mobilized from the promontory level under visual control of the ureters and hypogastric nerves in an avascular space. Dissection continues towards the uterosacral ligaments and rectovaginal fascia as close as possible to the mesentery of the bowel, opening the presacral space. This step is carried out in the embryonic layers, which are limited by presacral and mesocolon fascias.

This stage of the operation helps to approach intact areas of the bowel below the nodule. The uterus is then brought to a position of maximum anteflexion using a manipulator, thus opening the posterior pelvis. Adhesions between the posterior uterine wall and the colon are separated. Simultaneously, the assistant pushes the posterior fornix using the rectal probe placed into the vagina, and the bowel with the nodule is separated from the cervix, uterosacral ligaments, and the posterior fornix of the vagina. The rectal probe is then inserted into the rectum. Along the lower margin of the nodule within healthy areas, the bowel is cleared of visceral fatty tissue under the probe control using the "shaving" method. The primary goal that is being pursued here is to increase the distance between the anus and the lower border of the nodule, thereby allowing for cutting off the affected part of the colon as high as possible from the anus. The rectal probe is then removed.

The colon wall is then cleared of visceral fatty tissue in the cranial direction over 1.5-2.0 cm from the upper margin of the nodule. The affected area of the colon is crossed within the intended boundaries. Using ovarian forceps, the fragment is removed through the anus (Figures 1, 2).

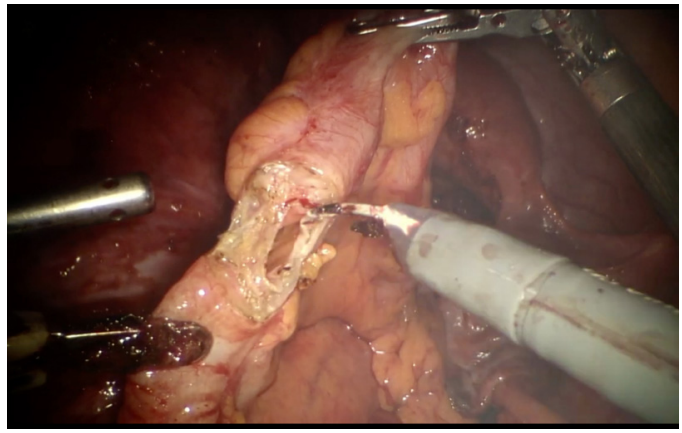


Figure 1. Cutting off the fragment of the colon affected by endometrioid infiltrate within healthy tissue.

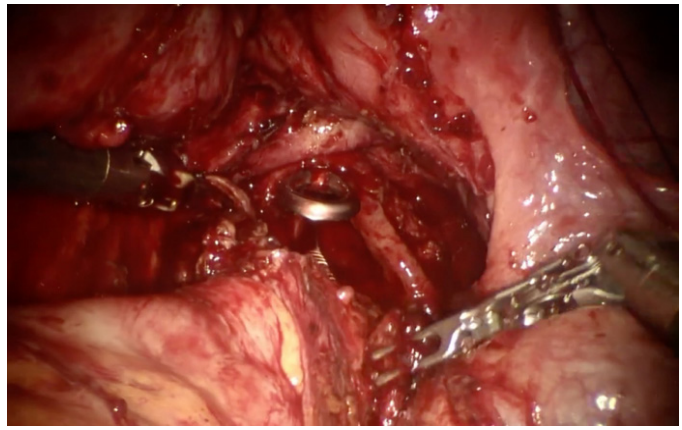


Figure 2. Transanal extraction of histological material.

Purse string sutures are placed through all layers of the colon wall with 2-0 monofilament at the proximal and distal edges of the colon resection. The sutures are not tightened.

The circular stapler with a diameter of 28.5 or 31.5 mm is inserted into the anus, depending on the diameter of the resected section of the bowel (Figure 3). The device is inserted into the abdomen in the "close" state, then its anvil is brought out to the "open" position. The proximal and distal resection margins are immersed in the anvil and proximal part of the circular stapler, and the purse-string sutures are tightened. Next, stapling and suturing of the proximal and distal parts of the rectum are performed to form an end-to-end anastomosis (Figure 4). The final stage involves the rectal air leak (Michelin) test for anastomosis integrity.

As with any new technique, NOSE technology requires some additions to the traditional patient management.

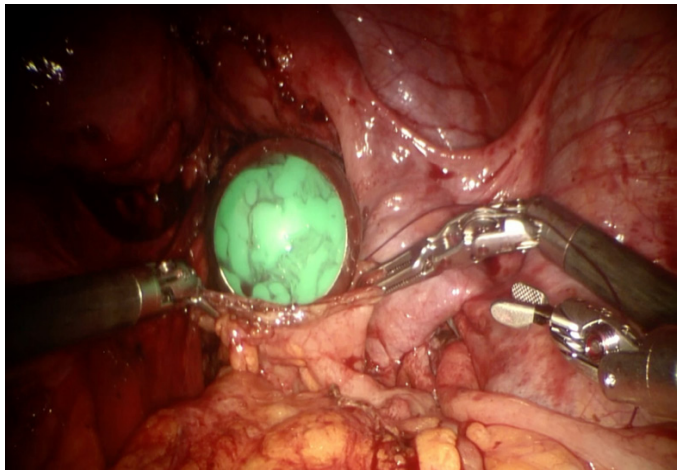
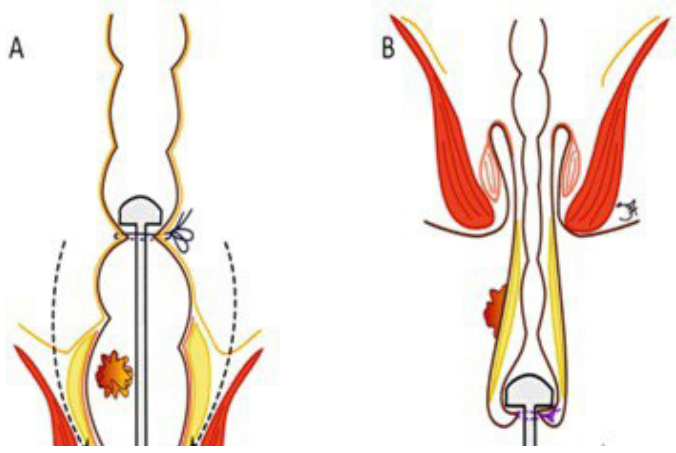


Figure 3. Introducing of the head of the stapler into the lumen of the proximal resection margin.



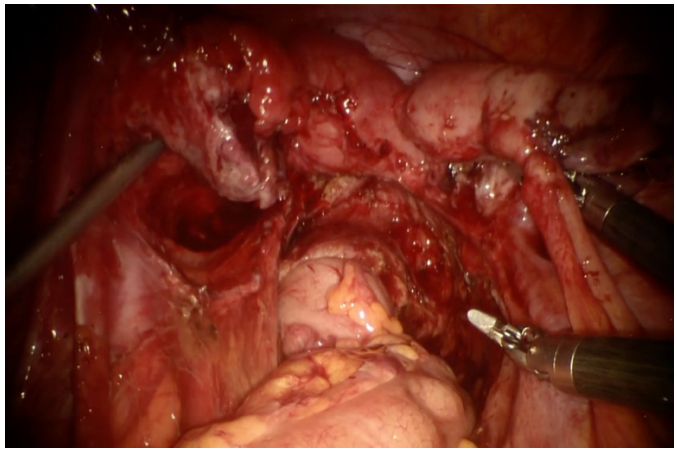


Figure 4. Final view of the end-to-end stapled anastomosis.

In all cases of intracorporeal opening of the intestinal lumen, additional antibiotic prophylaxis was used by irrigating the pelvic cavity with 20.0 hydroxymethylquinoxaline dioxide saline solution. After that, an anastomosis is performed. Finally, a 50 mL syringe is inserted into the rectum and air is injected (the bubble test).

In the current study, a comparative bacterial analysis of two techniques was conducted –classical colorectal resection and resection using NOSE technology. For preoperative preparation, we recommend that the patient's last meal be taken before 2 p.m. on the day before the operation, and fluids were allowed no later than 6 a.m. on the day of the operation. Two to three hours after the last meal, the patients began bowel preparation with a laxative according to the schedule.

In our study, preoperative bowel preparation was performed by following a low residue diet for 72 hours, taking a laxative 24 hours before the operation, and administering antibiotic prophylaxis 30 minutes before the operation commenced. Patients were given a leaflet with dietary recommendations. The preoperational preparation also included IV antibiotic prophylaxis: tinidazole 600 mg and ciprofloxacin 500 mg twice daily for 48 hours, or rifaximin 400 mg twice daily 72 hours before the operation date.

Additionally, patients were divided into two slightly uneven groups. The first group consisted of 56 patients who underwent NOSE surgery, of whom 33 underwent traditional laparoscopic surgery and 23 underwent robot-assisted surgery. The second group included 105 patients who underwent colorectal resection using the classic method (CLS) with mini-laparotomy. Laparoscopic access (laparoscopic surgery) was used in 66 patients, and robotic access in 39 patients. Recognising limitations of retrospective design, we merged robot-assisted procedures with laparoscopic. We found this feasible and reasonable regarding studies suggesting no significant difference between two types of procedures for colon resection.[42,43] Patient reported outcomes were assessed at baseline and 3 days (visual analogue pain scale only) and 3 months after surgery. These measures included pain measured using a 10cm VAS and the Knowles-Eccersley-Scott-Symptom questionnaire (KESS) to assess the frequency and severity of constipation. This is a structured scoring system that evaluates the impact of constipation on quality of life; a higher KESS score is associated with everyday life worsening. Symptoms evaluated include duration of constipation, laxative use, frequency of bowel movement, unsuccessful evacuatory attempts, feeling incomplete evacuation, abdominal pain, bloating, use of enemas/digitation, time taken in minutes in the lavatory per attempt, difficulty evacuating (with painful effort) and stool consistency without laxatives.

Statistical Analysis

Statistical analysis of the research results was performed using the IBM SPSS Statistics v26 program. With a normal distribution, the data were described using the mean and range. For distributions other than normal when assessing differences between groups, the nonparametric Mann-Whitney U-test was used; for evaluating dynamic changes, the Wilcoxon test was used. In the analysis, the nominal data were obtained as absolute results, and the percentage (%) was determined using the Pearson χ^2 test with Yates's correction.

Results

Baseline demographic and clinical data can be seen in Table 1. No differences in the severity of bowel symptoms associated with DE were found before or after surgery between CLS and NOSE groups according to mean visual analogue scale (VAS) pain scores and mean KESS scale values (Table 1). Median blood loss as well as mean hospital stay were similar in both groups (Table 2).

As shown by mean C-reactive protein (Table 3) the use of intracorporeal opening of the intestinal lumen is not associated with higher levels of this inflammatory marker. Moreover, as is seen from Table 4 bacterial flora found in pelvic cavity probes remained uniform for both procedures. The rate of operative complications was low (6/161, 4%). A description of complications in both groups is presented in Table 5.

Table 1. Baseline and post-operative pain and constipation quality of life data.

Mean value	**NOSE n=56**	**CLS n=105**	***P* value**
Mean age (years)	36 (30-45)	35 (32-41)	0.07
Mean BMI (kg/m^2)	22.3 (18.5-23.7)	22.7 (22.1-23.3)	0.09
Mean (range) VAS pain score before surgery	7 (5-10)	7 (5-10)	0.87
Mean (range) VAS pain score at day 3 day post-surgery	3 (0-4)	6 (2-5)	0.34
Mean (range) VAS pain score at 3 months post-surgery	1 (0-2)	2 (0-4)	0.62
Mean KESS scale score before surgery	30.3	25.7	0.12
Mean KESS scale score at 3 months post-surgery	10.7	12.3	0.28

P values were calculated using the Mann- Whitney U-test. BMI: Body mass index, KESS: Knowles-Eccersley-Scott symptom, CLS: Conventional laparoscopic surgery, NOSE: Natural orifice specimen extraction, VAS: Visual analogue scale.

Table 2. Perioperative data.

	NOSE (laparoscopic) n=33	**NOSE (robotic) n=23**	**CLS n=105**
Mean (range) blood loss (mL)	100 (75-100)	120 (100-150)	128 (100-150)
Median (range) operation duration (minutes)	90 (80-150)	130 (100-160)	209 (150-270)
Mean (range) length of hospitalisation, days	4 (4-7)	4 (4–6)	4 (4-5)

CLS: Conventional laparoscopic surgery, NOSE: Natural orifice specimen extraction.

Table 3. C-reactive protein mean values during the first four days postoperatively.

C-reactive protein	**Day 1**	**Day 2**	**Day 3**	**Day 4**
NOSE (laparoscopic) n=33	65.7	74.1	67.2	44.7
NOSE (robotic) n=23	69.1	85.6	64.9	33.8
CLS n=105	46.2	60.4	47.1	36.6

C-reactive protein normal range = 0-20 mg/dL.
CLS: Conventional laparoscopic surgery, NOSE: Natural orifice specimen extraction.

Table 4. Abdominal culture data.

Pathogen	Sample taken before anastomosis		Sample taken after anastomosis	
	NOSE n=17	CLS n=10	NOSE n=17	CLS n=10
Staphylococcus epidermidis	2 (11.8%)	0	1 (5.8 %)	1 (10%)
Staphylococcus haemolyticus	1 (5.8%)	0	0	0
Staphylococcus warneri	1 (5.8%)	1 (10%)	0	0
Staphylococcus faecalis	1 (5.8%)	2 (20%)	0	1 (10%)
Enterococcus durans/hirae	0	1 (10%)	2 (11.8%)	0
Pseudomonas aeruginosa	0	0	1 (5.8 %)	1 (10%)

CLS: Conventional laparoscopic surgery, NOSE: Natural orifice specimen extraction.

Table 5. Complications and its description according to Clavien-Dindo scale.

	CD I	CD II	CD IIIb
NOSE	Three patients with microperforations of bowel detected that resolved with conservative treatment	-	One patient with a sigmoid colon injury that led to peritonitis and required anastomosis. Initially made anastomosis was intact
CLS	-	One patient with initial anastomosis stenosis. Bougienage was indicated but anecdotal resolvement of stenosis was found after anaesthesia (probably due to bowel relaxation and functional nature of stenosis)	One patient with a small bowel anastomosis failure. Combined procedure was initially performed. Re-laparotomy was required to fix anastomosis failure

CD: Clavien-Dindo.

Discussion

Main Findings

The NOSE technique for excising colorectal endometriosis appears to be as safe and efficacious as the conventional CLS approach. Moreover, the procedure time is shorter. Inflammatory markers and bacterial cultures did not suggest a higher risk of intra-abdominal septic complications.

Strengths and Limitations

Our study has some limitations including its retrospective and observational design, that introduces the risks of recall and selection bias. Moreover, the NOSE technique was introduced to our centre later than CLS, raising the possibility of proficiency bias. Procedures were dispersed in time which could cause bias due to surgeon's skills evolution and changes in the operating team experience. Generalisability is an issue also as all procedures were performed by a single surgeon in a single centre.

Strengths and Limitations Compared to Other Studies

Our results are consistent with previous studies that show that outcomes of colorectal endometriosis surgical treatment might be associated with technique used. A retrospective cohort study[34] comparing two methods of specimen extraction during colorectal resection for endometriosis: transvaginal removal and suprapubic removal showed that there were no statistically significant differences in the incidence of postoperative complications including rectovaginal fistulas between the groups. Another Russian retrospective single centre study showed no differences between two types of procedures, although there were some better pain outcomes (according to VAS scale) and cosmetic abdominal wall appearance after NOSE procedure.[35] It is consistent with the results of some other studies.[36]

Other authors have previously demonstrated the efficacy and safety of NOSE (transvaginal and transrectal) in DE patients.[37,38] These findings are also confirmed by a more recent study.[39] Our study showed

the same rate of intra- and postoperative complications when using classic mini-laparotomy access and NOSE. Relatively small difference in long-term outcomes was also previously shown[37] as well as in the duration of the procedure and hospital stay. Our study showed the same mean procedure time but slightly prolonged hospital stay in NOSE group. This implies that NOSE, being a novel technique, can attain comparable results with well-established CLS.

Clinical and Policy Implications

The NOSE technique should be considered for excision of colorectal endometriosis. The CLS technique also has disadvantages: histological material (bowel segment) is extracted extracorporeally which in turn increases the risk of infectious complications and, as above-mentioned severe pain in the postoperative period, requiring more frequent use of analgesics and narcotics. Hernia formation should also be considered as it is a well-known complication of compromising the abdominal wall integrity. There are also risks of anastomosis failure due to the T-shaped line in the area of the circular suture. Still, in our work, we did not encounter such complications. However, duration of recovery period and the physical promotion of patients were longer in the CLS group compared to NOSE, and more postoperative analgesia was required for pain relief, especially after mobilisation of patients. The absence of greater skin incision also eliminates some instruments and suturing, along with no need for stapler use. All the above suggests better cost effect provided by NOSE technique, making this potentially useful in less well-resourced centres.

Unanswered Questions and Future Research

The NOSE technique for colorectal endometriosis surgical treatment has two obvious advantages –no need for mini-laparotomy and hence shorter procedure duration. When performed mini laparotomy inevitably takes more operative time in OR and is associated with wound issues, longer recovery and need for suture integrity control. Although we didn't find any significant differences in complication rate and pain dynamics, it only proves comparability of NOSE with well-established conventional laparoscopic surgery.

The technique can be proposed as an efficient method for surgical treatment in patients with colorectal endometriosis. This may be one of the directions of further research and development of surgical techniques in such patients. Larger, randomised, blinded studies are necessary to provide evidence to be more affirmative about the method.

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Informed consent: Retrospective design doesn't suggest informed consent to use patient's data for specific research, although routine consent to process any personal data before surgery was taken.

Data sharing: Data does not compromise any ethical standards or legal requirements and has no restrictions for access but intended to be shared solely with Facts, View and Vision in ObGyn journal.

Transparency: The manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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