Ventral mesh rectopexy : does a descending perineum impact functional results and quality of life?

VENTRAL MESH RECTOPEXY. DOES A DESCENDING PERINEUM IMPACT FUNCTIONAL RESULTS AND QUALITY OF LIFE?

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Abstract

PURPOSE
The impact of perineal descent (PD) on functional outcome and quality of life after ventral mesh rectopexy (VMR) is unknown. The purpose of this study was to analyze the effect of PD on the functional outcome and quality of life (QOL) after VMR.

METHODS
A retrospective analysis was performed on fifty-five patients who underwent robotic VMR between 2018 and 2021. Pre and postoperative data along with radiological studies were gathered from a prospectively maintained database. The Cleveland Clinic Constipation score (CCCS), the Rome IV criteria and the 36-Item Short-Form Health Survey (SF-36), were used to measure functional results and QOL.

RESULTS
All 55 patients (mean age 57.8 years) were female. Most patients had radiological findings of severe PD (n=31) as opposed to mild/moderate PD (n=24). CCCS significantly improved at 3 months and 1 year post-VMR (mean difference = -4.4 and -5.4 respectively, $p<0.001$) with no significant difference between the two groups. The percentage of functional constipation Rome IV criteria only showed an improved outcome at 3 months for severe PD and at 1 year for mild/moderate PD (difference = -58.1% and -54.2% respectively, $p<0.05$). Only the SF-36 subscale bodily pain significantly improved in the mild/moderate PD group (mean difference = 16.7, $p=0.002$) 3 months post-VMR which subsided after one year (mean difference = 5.5, $p=0.068$).

CONCLUSION
Severe PD may impact the functional outcome of constipation without an evident effect on QOL after VMR. The results, however, remain inconclusive and further research is warranted.

Keywords: Perineal descent, Robotic ventral mesh rectopexy, Cleveland Clinic Constipation score, Rome IV criteria, Quality of Life

Introduction

Ventral mesh rectopexy (VMR) is a surgical technique that has gained popularity in recent years as a safe and effective treatment option for posterior compartment prolapse.[1-3] In 2004 D'Hoore et al. modified the ventral mesh rectopexy laparoscopically (LVMR) as we know it today.[4] With the uprising of robotically assisted surgery, several studies have been published, comparing laparoscopic with Robot-assisted VMR (RVMR). Functional outcome and quality of life (QOL) were comparable between the two groups.[5, 6]

Perineal descent (PD) and descending perineum syndrome (DPS) were first described in 1966 by Parks et al. and were defined as a relaxation of the pelvic floor.[7] It is characterized by the descent of the perineum below the ischial tuberosities during defecation. DPS is often associated with other pelvic floor disorders such as rectal prolapse and rectocele, and obstructed defecation syndrome (ODS) with symptoms of fragmented stools, need for straining and digitation as well as a sense of incomplete evacuation, and pelvic heaviness.[8-10] Shawkat et al. found a significantly larger PD in patients with ODS compared to healthy volunteers on MR defecography.[11]

It has been suggested that patients with significant perineal descent (PD) do not respond to LVMR and are predestined for higher recurrence rates and less satisfactory results after surgical repair. D'Hoore points out that this is probably due to the impossibility of LVMR to correct the pelvic floor descent, thereby allowing the dissipation of the force vector to void the rectum to persist.[12] Despite these assumptions, there is evidence that VMR significantly improves PD, both laparoscopically and robotically assisted.[13] The impact of PD on the functional outcome after VMR, however, is poorly investigated and no clear comparative studies are available. The aim of this study is to evaluate if PD has an impact on functional results concerning constipation and QOL after rectopexy.

Methods

This is a nonrandomized, retrospective, monocentric study based on a prospectively maintained database between 2018 and 2021. During the examined study period, ninety-four patients underwent a primary robotic ventral mesh rectopexy for external/internal rectal prolapse (ERP/IRP), rectocele, or other structural obstruction defecation syndromes in this period. Exclusion criteria were non-primary rectopexy and the absence of MRI or X-ray defecography. Records of eight patients lacked sufficient preoperative data and another two had a revision of a previous rectopexy. As a result, 83 patients were invited to join the study and complete validated questionnaires. Eventually, 55 agreed to participate and completed all required questionnaires (figure 1). The 28 non-responders were patients who did not want to participate with the study or who did not fill out either the preoperative or the two postoperative questionnaires over time and therefore could not be analyzed for change over time.

Informed consent was obtained, and data was collected from validated questionnaires as well as medical records and defecography.

RVMR was performed by two surgeons, who specialized in robotic colorectal surgery.

The study was given approval by the institutional review board of the university hospital of Antwerp.

After obtaining informed consent, validated questionnaires regarding the QOL as well as the functional outcome were filled out preoperatively and twice postoperatively (after 3 months and 1 year). The Cleveland Clinic constipation scoring system (CCCS), the Rome IV criteria and the Short Form-36 (SF-36) were used.

PD was measured at maximal straining on defecography by a dedicated radiologist, a surgeon, and a last-year surgical resident. The M-line can be used as an indirect measure of perineal descent. This line is a perpendicular line drawn from the pubococcygeal line (PCL) to the posterior tip of the H-line at the anorectal junction.[14] A pelvic floor descent (M-Line) of 6 centimeters was used to differentiate between normal/mild/moderate and severe perineal descent.[15] 0-2 cm is considered as no PD, 2-4 cm as mild perineal descent and 4-6 cm as moderate perineal descent.
Since the measurements were taken by experts from different fields, we took a sample of twenty-three patients (our first inclusions) and measured the M-line on defecography. The three observers stated above were masked from each other and took the measurements individually. Interobserver variability between the measured M-lines was calculated.

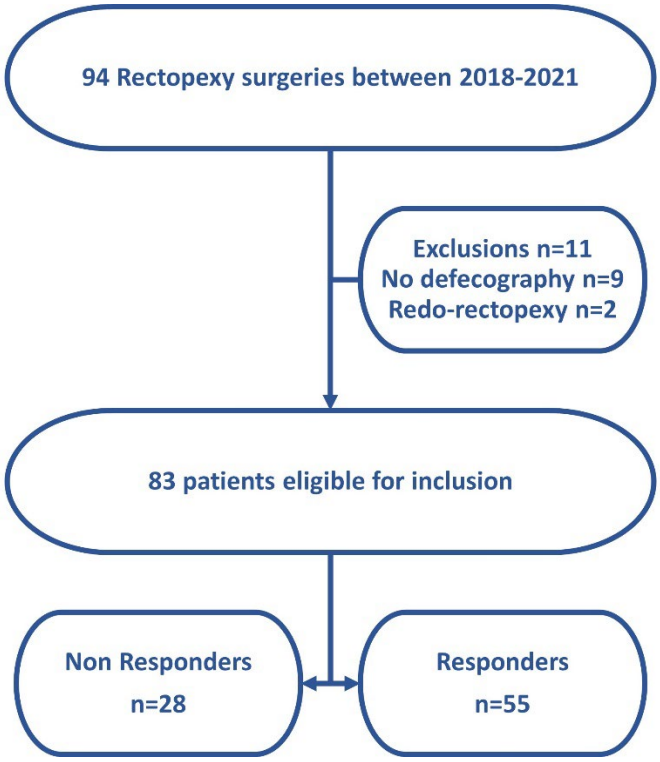

Figure 1. Selection of patients

Preoperative evaluation
All patients included were referred by the GP, by other specialties, or through self-referral. Intake during preoperative clinical appointments was conducted by the surgeon performing the surgery. After clinical and physical evaluation radiological imaging and, if necessary, a urological assessment was obtained. Patients eligible for VMR were discussed in a multidisciplinary setting prior to surgical planning.

Operative technique
Surgery is performed under general anesthesia and with one-time preoperative antibiotics. The operation is carried out robotically assisted using a da Vinci Xi robot (Intuitive Surgical Inc, Sunnyvale, CA).
Pneumoperitoneum is gained by a Veress needle through Palmer's point. Four robotic trocars are placed in one line, at around 20 centimeters distance from the Douglas cavity. 1 trocar is placed in the right abdomen to introduce the mesh as well as access for the surgical assistant. First, the peritoneum is incised around the mesosigmoid on the medial side and then followed,

on the right pararectal side all the way into Douglas' pouch, after which we traverse anteriorly to the left side.
Then the recto-vaginal septum is opened and dissected until the pelvic floor. The promontory is visualized until the periosteum.
We use a Bard™ Soft Mesh (large pore monofilament polypropylene) and cut this in the shape of a club, with the broad side (around 4x4 cm) fixed on the rectum and the narrow side (around 2 cm) fixed on the promontory. Fixation is achieved by absorbable Vicryl 3/0 single sutures on the rectum, as well as Ifabond glue. Promontory fixation is done with Capsure tackers and Ifabond glue.
The peritoneal incision is then closed with a V-Loc 3/0.

Questionnaires and scoring

Constipation was quantified by the Cleveland clinic constipation scoring system as described by Agachan et al.[16] The scoring system has a scale of 0-30 points, with higher scoring suggesting worse constipation. A score of 15 or higher indicates the presence of constipation.
The Rome IV criteria were updated in 2016 and are internationally recognized for the diagnosis of functional gastrointestinal disorders.[17] Functional constipation is one of these functional defecation disorders and is mainly defined by symptoms. The criteria are dichotomous in nature, defining the presence or absence of functional constipation.
Short Form-36 is a widely used QOL measurement.[18] It consists of 36 questions with 8 different subscales. Physical functioning (PF), role limitations due to physical health problems (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE), and general mental health (MH). Scores range from 0-100 on the individual subscales. Higher scoring indicates better QOL.
All data were pseudonymized.

Statistical analysis

Normality tests were carried out by the Shapiro-Wilk test of normality and by overviewing the plotted histograms for a Gaussian distribution.
QOL data were analyzed through the related-Samples Wilcoxon Signed Rank Test.
Analyzing the repeated measures for CCCS and comparing the two PD groups was done with a two-way mixed analysis of covariance (ANOVA).
Since the Rome IV criteria are nominal in its nature, we analyzed the data through Mcnemar analysis.
The rate of interobserver agreement on the measurement of the M-line was obtained through the calculation of the intraclass correlation coefficient. Values between 0.75 and 0.9 were graded as good reliability. Values above 0.9 were graded as excellent reliability.[19]
A p-value of <0.05 was set as statistically significant through all analyses.
All statistical analysis was done using IBM SPSS statistics version 28.0.1.1 (14)

Results

Study inclusion

Out of the 83 eligible patients for inclusion, only 55 corresponded with all inclusion and exclusion criteria. The main reason why patients were excluded was refusal to participate, incomplete questionnaires or no response to the request to participate.

Patient characteristics

Fifty-five patients were included in this study. The baseline demography, radiographic findings, and subjective complaints are listed in table 1.

All our 55 patients were female with a mean age of 57.8 years (range 34-79). There were no patients with a M-line below 2 cm and thus all patients had PD.
Surgical indications consisted of ODS due to structural abnormalities (n=47, 85.5%) and external rectal prolapse (n=8, 14.5%).
Thirty patients (54.5%) had previous pelvic surgery, mainly a hysterectomy (19 patients).
Chi-square test of homogeneity showed no statistically significant difference regarding radiographic findings, subjective complaints and pelvic history between the two PD groups ($p>0.05$). Difference in mean age was calculated determined by a student's T-test, which also did not show a statistically significant difference between the two PD groups ($p>0.05$).

Characteristics	**Mild/moderate PD (n=24)**	**Severe PD (n=31)**	**Total (n=55)**
Mean age in years (range)	55.6 (36 - 79)	57.9 (34 - 72)	57.8 (34 - 79)
Female sex, n (%)	24 (100)	31 (100)	55 (100)
Radiographic modality			
MRI, n (%)	20 (83.3)	23 (74.2)	43 (78.2)
X-Ray, n (%)	4 (16)	8 (25.8)	12 (21.8)
Radiographic findings			
Rectocele, n (%)	18 (75)	27 (87.1)	45 (81.8)
IRP, n (%)	10 (41.7)	13 (41.9)	23 (41.8)
Sigmoidocele/enterocele, n (%)	4 (16.7)	11 (35.5)	15 (27.3)
ERP, n (%)	3 (12.5)	5 (16.1)	8 (14.5)
Mild/moderate PD, n (%)	24 (100)	-	24 (43.6)
Severe PD, n (%)	-	31 (100)	31 (56.4)
Subjective complaints			
Obstructive defecation symptoms	21 (87.5)	26 (83.9)	47 (85.5)
Fecal incontinence, n (%)	13 (54.2)	13 (41.9)	26 (47.3)
Feeling of urgency, n (%)	6 (25)	10 (32.3)	16 (29.1)
Pelvic heaviness, n (%)	7 (29.2)	12 (38.7)	19 (34.6)
Splinting, n (%)	7 (29.2)	7 (22.6)	14 (25.5)
Digitation, n (%)	6 (25)	6 (19.4)	12 (21.8)
Pelvic history			
Previous pelvic surgery, n (%)	11 (45.8)	19 (61.3)	30 (54.5)

Table 1. Patient characteristics. Both groups follow the same distribution.

Surgical procedure
All patients underwent a robotic ventral mesh rectopexy. Furthermore, 48 people underwent a simultaneous colpopexy, 8 patients had a simultaneous cystopexy and 4 patients had a supracervical hysterectomy.
The median length of stay was 3 days (range 1-5).

Complications and recurrence
Three patients had a complication intraoperatively which consisted of one bladder perforation during adhesiolysis and two serosal tears. All three were sutured and healed without further need for intervention.
One patient was converted to laparoscopy due to excessive obesity, extensive adhesions and hemorrhage intraoperatively. She also had excessive pain postoperatively, for which a patient-controlled intravenous analgesia pump was installed (Clavien-Dindo 2).

Two patients had recurrent symptoms (n=2, 3.6%). One patient was diagnosed with a recurrence of her rectocele after one year with symptoms of soiling. She was referred to gynecology and underwent a colporrhaphy posterior.
The other patient had recurrent symptoms of obstructive defecation half a year postoperatively. MR defecography was positive for an enterocele. We performed an explorative laparotomy with a redo of the VMR due to loosening of the mesh as well as a caecopexy. Her obstructive symptoms subsided postoperatively.
We saw one new onset of hypertonic pelvic floor with pain complaints, which couldn't be resolved with botulinum toxin injections. We performed a laparoscopic partial removal of the rectopexy mesh after one year, which resolved her complaints.

Constipation
The estimated marginal means of CCCS over time are presented in figure 2.
Mean overall CCCS scoring was 11.7 (95% CI 10.3-13.1) preoperatively and dropped significantly postoperative to 7.3 (<0.001; 95% CI 5.8-8.9) and 6.3 (p<0.001; 95% CI 4.7-7.9) after 3 months and 1 year respectively.
Pairwise comparison showed no significant difference between mild/moderate and severe PD through all the follow-up times (Mean difference 0.427, p=0.732), as well as the individual follow-up times (table 2).

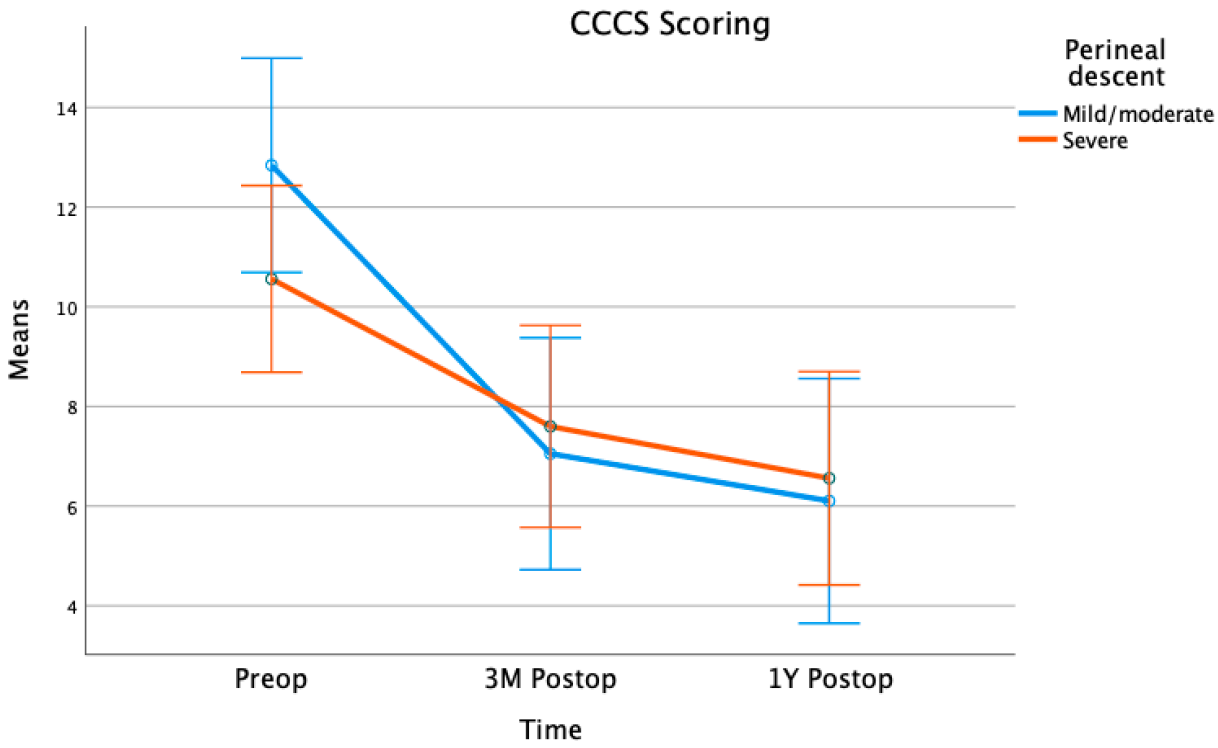

Figure 2. CCCS means after Robotic ventral mesh rectopexy. Interconnected points = means; error bars = 95% Confidence interval; asterisk = P < 0.05 towards preoperative data

PD	Mean preoperative, (P-value, 95% CI) P-value only applicable in last column	Mean 3 months postoperative, (P-value towards preoperative; 95% CI)	Mean 1 year postoperative, (P-value towards preoperative; 95% CI)	Mean difference mild/moderate vs severe PD through all times (P-value; 95% CI)
Overall	11.7 (10.3-13.1)	*7.3 (<0.001; 5.8-8.9)*	*6.3 (<0.001; 4.7-7.9)*	-
Mild/moderate PD	12.8 (10.7-15)	*7.1 (<0.001; 4.7-9.4)*	*6.1 (<0.001; 3.6-8.6)*	0.427 (0.732; -2.1-2.9)
Severe PD	10.6 (8.7-12.4)	*7.6 (<0.05; 5.6-9.6)*	*6.5 (<0.05; 4.4-8.7)*	
Mean difference mild/moderate vs severe PD through specific times	2.3 (0.114; -0.6-5.1)	-0.6 (0.722; -3.6-2.5)	-0.5 (0.780; -3.7-2.8)	-

Table 2. CCCS means after Robotic ventral mesh rectopexy. 95% CI = 95% Confidence interval

The presence of functional constipation according to the ROME IV criteria dropped in all groups following RVMR (see figure 3 and table 3). In the mild/moderate PD group, the percentage of patients with constipation was reduced from 75% to 25% after 3 months and to 20.8% after 1 year. An exact McNemar's test determined that the difference in the proportion of functional constipation pre- and post-intervention after 1 year was statistically significant (p=<0.001).
There was a significant decrease in the proportion of functional obstipation after 3 months in the severe PD group (From 74.2% to 16.1%). However, this significant drop vanished after 1-year postop and a mild rise was seen in the proportion of functional obstipation after 1 year (38.7%, p=0.125 towards preoperatively, p=0.063 towards 3 months postoperatively).

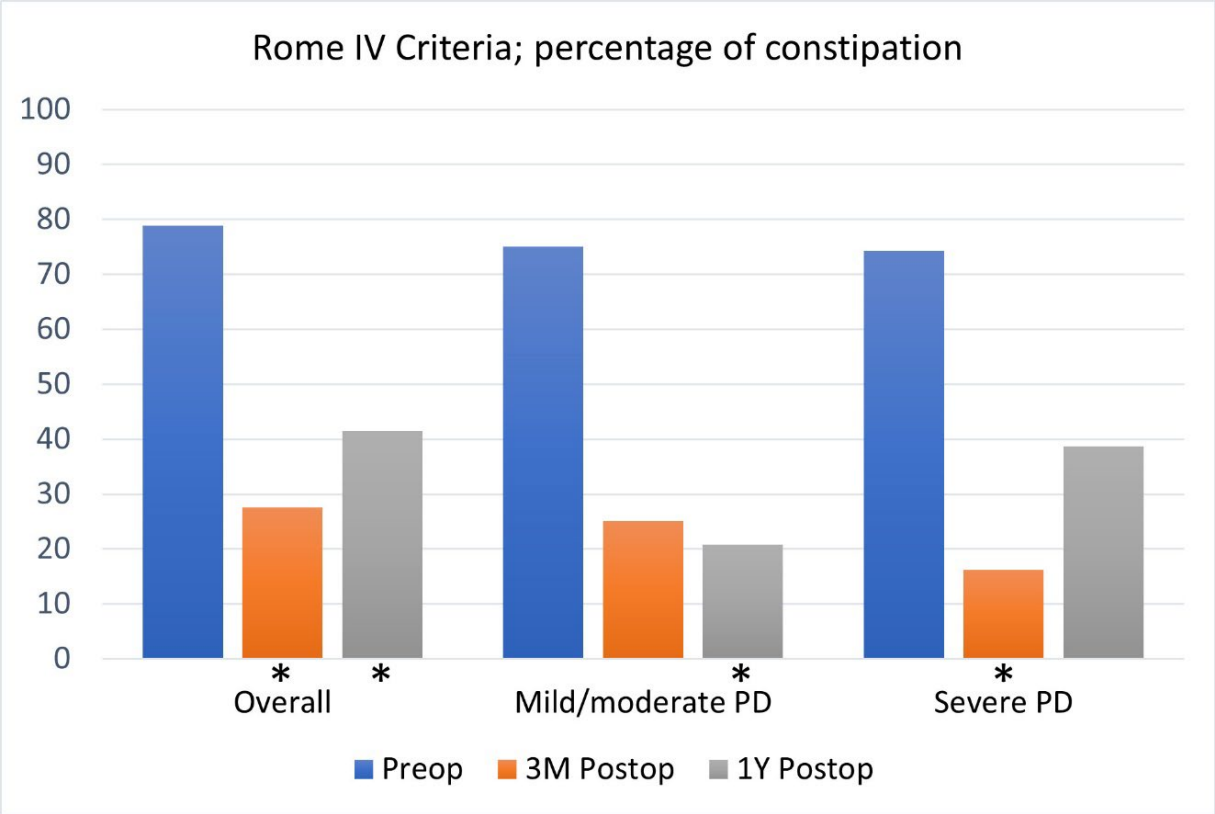

Figure 3. Percentage of functional constipation according to the Rome IV criteria. Asterisk = P < 0.05 towards preoperative data

PD	Percentage functional constipation preoperative	Percentage functional constipation 3 months postoperative, (P-value towards preoperative)	Percentage functional constipation 1 year postoperative, (P-value towards preoperative)
Overall	78.8	*27.5 (p<0.001)*	*41.4 (p<0.001)*
Mild/moderate	75	25 (p=0.109)	*20.8 (p=0.004)*
Severe	74.2	*16.1 (p<0.001)*	38.7 (p=0.125)

Table 3. Percentage of functional constipation according to the Rome IV criteria after robotic ventral mesh rectopexy

Quality of life

The results of the QoL measurements using the SF-36 questionnaire are presented in Table 4. Overall, there was no major improvement of QOL postoperatively. We only saw a significant improvement in subscales “bodily pain” and “vitality” in the whole group 3 months postoperatively (figure 4). This improvement was no longer significant after 1-year postop. Comparing the groups independently of PD grade showed only a significant improvement in subscale “bodily pain” in the presence of mild/moderate PD after 3 months, which, as well, was no longer significant after 1 year postoperatively (figure 5).

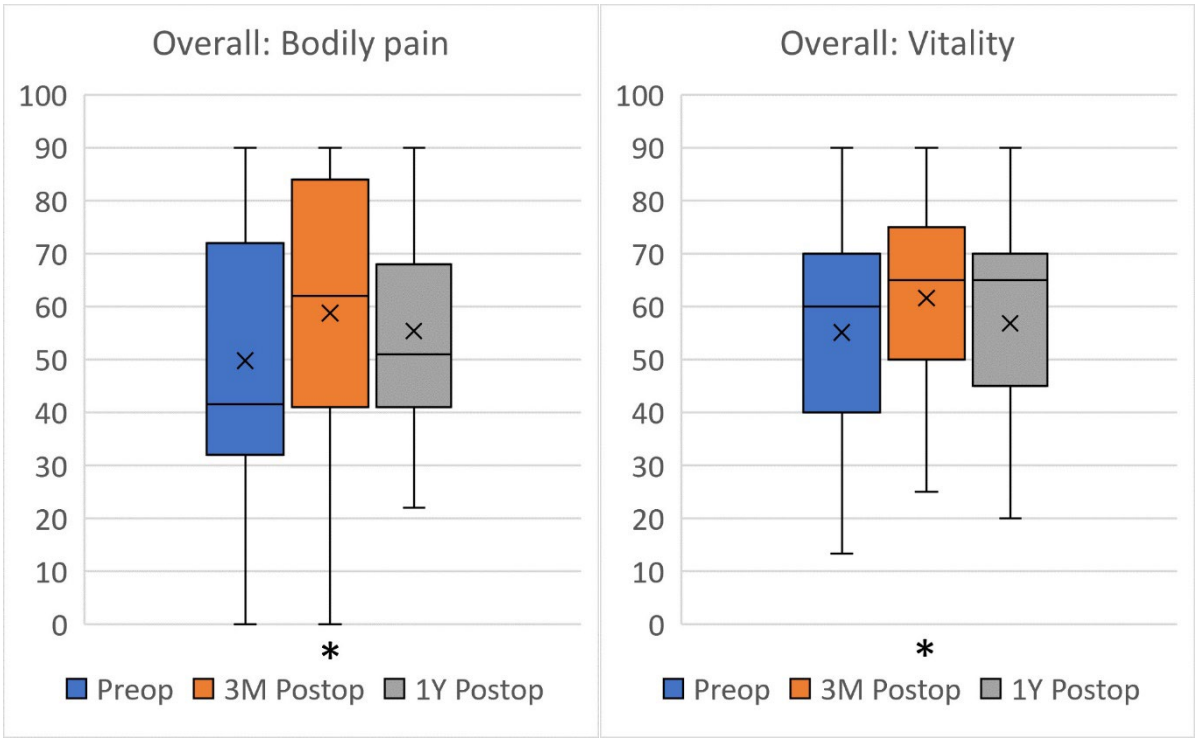

Figure 4. Quality of Life (SF-36) subscales Bodily pain and Vitality in both PD groups. Middle line = median; cross = mean; box = interquartile range; whiskers = minimum and maximum; asterisk = P < 0.05 towards preoperative data

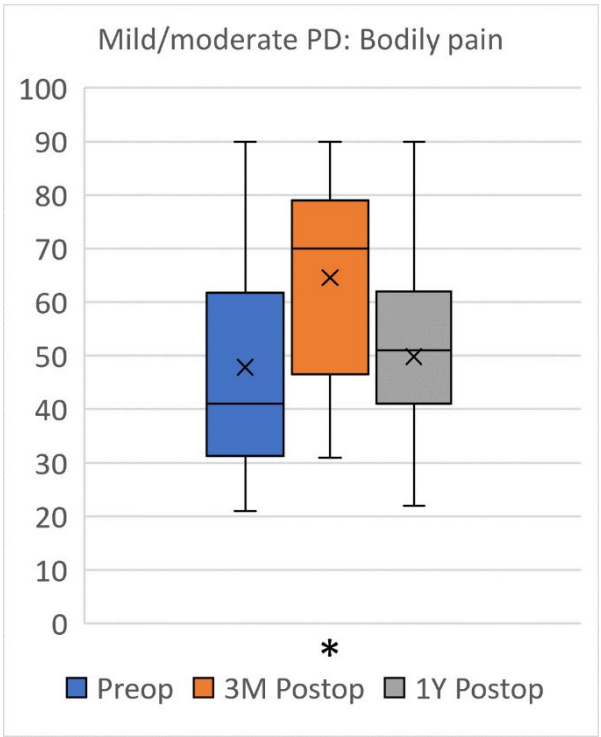

Figure 5. Quality of Life (SF-36) subscale Bodily pain in the mild/moderate PD group. Middle line = median; cross = mean; box = interquartile range; whiskers = minimum and maximum; asterisk = P < 0.05 towards preoperative data

Subscale	PD grade	Mean preoperative score, ± SD	Mean 3 months postoperative, ± SD (P-value towards preoperative)	Mean 1 year postoperative, ± SD (P-value towards preoperative)
Physical functioning	Overall	69.8 ± 23.9	66.8 ± 26.3 (p=0.910)	71 ± 25.1 (p=0.879)
	Mild/moderate	68.6 ± 22	65.6 ± 26.3 (p=0.925)	69.3 ± 25.1 (p=0.752)
	Severe	70.8 ± 25.8	67.6 ± 26.8 (p=0.938)	72.1 ± 25.6 (p=0.970)
Role physical	Overall	54.7 ± 54.4	54.4 ± 40 (p=0.724)	61.1 ± 41.6 (p=0.472)
	Mild/moderate	55.3 ± 45.3	57.4 ± 44 (p=1.000)	57.1 ± 45.4 (p=0.670)
	Severe	54.2 ± 46.4	52.2 ± 37.6 (p=0.594)	63.6 ± 39.9 (p=0.570)
Bodily pain	Overall	49.8 ± 24.7	*58.8 ± 24.7 (p=0.017)*	56.9 ± 20.1 (p=0.168)
	Mild/moderate	47.9 ± 21.8	*64.6 ± 18.8 (p=0.002)*	53.4 ± 19.2 (p=0.068)
	Severe	51.4 ± 27.4	54.5 ± 27.9 (p=0.913)	51.4 ± 20.7 (p=0.390)
General health	Overall	53.9 ± 21.2	56.2 ± 23 (p=0.393)	57 ± 21.2 (p=0.502)
	Mild/moderate	50.9 ± 21.4	49.1 ± 24.5 (p=0.637)	48.4 ± 21 (p=0.937)
	Severe	56.7 ± 21.2	62 ± 20.5 (p=0.654)	62.2 ± 20 (p=0.448)
Vitality	Overall	55.1 ± 19.4	*61.6 ± 16.25 (p=0.038)*	58.4 ± 18.1 (p=0.569)
	Mild/moderate	56.5 ± 23.2	60.6 ± 17.5 (p=0.234)	52.3 ± 22.2 (p=0.167)
	Severe	54 ± 16.2	62.4 ± 15.6 (p=0.091)	62 ± 14.5 (p=0.055)
Social functioning	Overall	67.6 ± 24.3	66.6 ± 28.8 (p=0.911)	69.1 ± 25.8 (p=0.701)
	Mild/moderate	64.4 ± 25.4	60 ± 33.8 (p=0.743)	59.8 ± 29.9 (p=0.823)
	Severe	70.3 ± 23.5	71.7 ± 23.9 (p=0.712)	75 ± 21.5 (p=0.488)
Role emotional	Overall	69.4 ± 43.0	79.2 ± 36.6 (p=0.120)	76.2 ± 38.4 (p=0.433)
	Mild/moderate	61.4 ± 47.5	82.4 ± 39.3 (p=0.074)	61.9 ± 46.9 (p=0.786)
	Severe	75.7 ± 39	76.9 ± 35.1 (p=0.624)	85.7 ± 29 (p=0.292)

Mental health	Overall	69.9 ± 16.3	69.3 ± 18.6 (p=0.424)	69.8 ± 17.4 (p=0.687)
	Mild/moderate	70.6 ± 17.3	67.1 ± 23.2 (p=0.674)	64.1 ± 20.8 (p=0.262)
	Severe	69.4 ± 15.7	71.1 ± 14.4 (p=0.451)	73.2 ± 14.4 (p=0.686)

Table 4. Quality of Life after Robotic ventral mesh rectopexy (SF-36). SD = standard deviation

Interobserver variability

The measurements of the M-line, done by the dedicated radiologist, were set as the gold standard. The selection of images to be interpreted was also set by the radiologist. Both the surgeon and surgical resident had an excellent agreement (0.920 and 0.918 respectively) on the interpretation of the M-line. The results are demonstrated in table 5.

Role	Intraclass correlation (95% CI)
Surgeon	0.920 (0.737–0.969)
Last-year surgical resident	0.918 (0.765-0.967)

Table 5. Intraclass correlation coefficient. 95% CI = 95% Confidence interval

Discussion

The LVMR described by D'Hoore et al [4] is a well-studied procedure for external and internal rectal prolapse, as well as rectocele.

A recent survey carried out among colorectal surgeons and gynecologists in Belgium showed that the majority surgeons did not change surgical strategy when perineal descent was present in symptomatic rectocele.[20]

Mäkelä-Kaikkonen et al. observed a notable enhancement in organ descent within the posterior compartment during strain after VMR.[13] The patients demonstrated a reduction from a mean PD of 6.2 cm (SD: 20.3) to 5.16 cm (SD: 12.1), resulting in a mean difference of -1.04 cm (95% CI: 4.7 to 16.1, $p < 0.001$). No significant differences were seen between the robotic VMR and laparoscopic VMR groups. While indicating an improvement in perineal descent following VMR, it is crucial to recognize that the study was not specifically designed to investigate the impact of PD on the outcomes after VMR.

The main goal of our study was to evaluate the impact of RVMR on quality of life and constipation scoring on the short term of 3 months and 1 year postoperatively and analyze the impact of perineal descent.

To the best of our knowledge, there are no studies investigating the effect of PD grade on outcome after VMR.

We saw a significant improvement in constipation after 3 months and 1 year according to the CCCS, without a significant difference between PD grades. The Rome IV criteria, however, showed a difference between the two PD groups. In the severe PD subgroup, although significantly improved after 3 months, a worsening of the constipation scores was observed. As a result, after one year, no statistically significant improvement was observed. The difference in constipation outcome between the CCCS scoring and Rome IV criteria might be explained by the different questioning and scoring of constipation. The Rome criteria were developed in 1992 to identify functional disorders, mainly focusing on irritable bowel syndrome (IBS).[21] These criteria were revised multiple times, with the Rome IV criteria

being the latest criteria. They provide a dichotomous assessment of functional constipation, whereas the CCCS scoring is quantitative and continuous in nature.
Examining the CCCS graph (figure 2) in further detail reveals a greater decrease of constipation scoring in the mild/moderate PD group compared to the severe PD group. While there may be a trend suggesting a better functional outcome in mild or moderate PD, we were unable to demonstrate a significant difference. It's worth noting the higher CCCS scoring preoperatively in the mild/moderate PD group, which could potentially create a misleading perception of better results.
Multiple studies have shown improvement in constipation after ventral mesh rectopexy in both laparoscopic and robotic surgery.[22-26] However, none of these studies took PD into account.
In the observation of the study conducted by Tsunoda et al. there was an improvement in CCCS scoring, somewhat in line with our findings, with a significant drop from 14 preoperatively to 7 after 3 months ($p<0.001$) and 5.5 a year postoperatively ($p=0.001$).[22]
A similar improvement in constipation was seen by Brunner et al.[23] However, CCCS did not improve significantly in patients with intussusception and full-thickness rectal prolapse, as opposed to patients with perineal descent, rectocele, and enterocele. It is hard to draw conclusions based on a single morphological disorder since there is a large overlap and frequently a simultaneous coexistence of anatomical abnormalities.

Overall, we found no significant improvement in quality of life according to the SF-36 questionnaire after one year for both PD groups. There was a significant improvement in the categories “Bodily pain” and “Vitality” after three months. However, this disappeared after 1-year of follow-up. Further analysis showed only a significant improvement in the absence of severe PD for subsection “bodily pain” after three months in comparison with the presence of severe PD.
The SF-36 questionnaire, however, doesn’t specifically take symptoms into account arising from pelvic floor dysfunction. Several other questionnaires have been developed over the years examining the disease-specific quality of life, such as the Pelvic Floor Distress Inventory (PFDI-20), the Pelvic Floor Impact Questionnaire (PFIQ-7), and Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ-12).[27, 28]
These instruments might be more suitable for examining the impact of perineal descent on quality of life after VMR.
Mäkelä-Kaikkonen et al. compared QOL after laparoscopic and robotic ventral mesh rectopexy with a 24-month follow-up. [1] Health-related QOL was assessed by the 15D instrument. They saw a “much better” change in the robotic group in comparison to the “slightly better” change in the laparoscopic group. These changes declined in both groups after 2 years ($p>0.05$).
Mehmood et al. did compare the robotic to the laparoscopic approach using the SF-36 QOL questionnaire.[29] He found a significantly higher physical component score in the robotic group (49 vs. 44.8 median laparoscopic physical component score, $p=0.015$).
Tsunoda et al. examined the midterm functional outcome after laparoscopic ventral rectopexy for external rectal prolapse.[22] QOL on all subscales did improve after 3 months and 6 months postoperatively. The scores of three domains (physical functioning, vitality, emotional role functioning) did not remain significantly improved at 12 months and thereafter. The scores of the four domains (physical role functioning, general health, social functioning, and mental health) did not remain significantly increased at 2 years and thereafter. Bodily pain domain scores remained significantly increased for 2 years.

Measuring the M-line was done by 3 different observers. Through the calculation of the interobserver variability, we found the measured data to be of high enough agreement to be implemented in this study.
We compared the interobserver variability based on images selected by our dedicated radiologist. However, we didn't analyze the interobserver agreement on the selection of images. Selecting images unsuitable for correct measurement of the M-line or without maximal straining might impact the measurement of the M-line.
It is hard to extrapolate these findings to other studies with radiographic measurements being conducted. Nonetheless, it could be useful when there is no availability of a dedicated radiologist while measuring radiographic images.

The PD cut-offs used in this study is based on the grading of pelvic floor relaxation as proposed by The H line, M line, organ prolapse (HMO) classification system and used as the standard grading system in our center. [15] Even though the coccygeal tip is a reliable and reproducible option to draw the PCL, we followed the current consensus and used the last coccygeal joint. [14, 30]
Literature is somewhat divided over the cut-off of the M-line. Several authors differentiate between an increased dynamic and an increased fixed PD. Landmann and Wexner described PD as a descent >3 cm on straining (measured from the resting position) and a 4 cm descent at rest.[31] They also involved the prolonged latency of a stimulated pudendal nerve to make the diagnosis more definite.
Parks et al. used a cutoff of a descent of 3 cm at rest or a descent of >2.5 cm on straining.[7]

Conventional X-ray defecography and MR defecography were both used in this study. Korula et al. described the conventional barium defecography to be more sensitive compared to MR defecography for detecting pelvic floor descent with an interobserver agreement of 0.460 (kappa, $p < 0.001$).[32] A substantial agreement was reached for the measurement of the M-line with an interobserver agreement of 0.610 (kappa, $p<0.001$). However, there was no description of the objectification of PD, meanwhile, we used the M-line to determine and quantify the grade of PD.

There are several limitations to this study. First, the study was nonrandomized and retrospective in its nature. It was also limited to a 1-year follow-up and a small sample size. Longer follow-up and a larger population size as well as a randomized and prospective design might reveal other insights into the impact of PD grade on VMR. Additionally, 28 out of the 83 eligible patients were non-responders. It is important to acknowledge that the lack of information about these patients might introduce bias to our results. For instance, they might not have completed their full questionnaires due to results falling short of their expectations. Second, no analyses were done on different anatomical abnormalities. Since there was a large overlap in anatomical abnormalities, we suspect it will not be clear what the real impact might be on the examined outcome. Third, we compared mild and moderate PD to severe PD. None of our patients had no PD (<2 cm) and we, therefore, are not able to tell if PD, in general, is of significant impact on the QOL or the functional outcome of VMR. And last but not least, we used CCCS and SF-36 scoring for constipation and general QOL. However there are numerous other scoring systems focusing on disease specific QOL. Additionally, it is crucial to note that our study did not include measurements for fecal incontinence. Since the surgical indications were mainly ODS, which is a major cause of functional constipation, we primarily focused on measuring constipation. Measuring fecal incontinence and including an fecal incontinence score could, however, provide a more comprehensive assessment.

Conclusion

This nonrandomized, retrospective single-center study demonstrates that ventral mesh rectopexy significantly improved the one-year general outcomes in PD. However, the severity of PD could affect the functional outcome since the subgroup of patients with severe PD showed no significant improvement in constipation scores. In fact, a recurrence of constipation in 22.6% of the patients with severe PD was seen after 1 year. Nevertheless, the CCCS didn't show a significant difference between the mild/moderate and severe PD groups. The QOL, measured by the SF-36 questionnaire, didn't improve significantly after 1 year in both groups. One caveat is the generic nature of the SF-36 questionnaire.
Further investigations with longer-term follow-up and larger population size are warranted.

Data availability

All data is available upon request.

Declarations

Authors' contribution

Sylvie Van den Broeck and Niels Komen conceived, planned, and supervised the research. Ali Al-Nejar, Sylvie Van den Broeck, Niels Komen, and Quinten Smets established and contributed to the database. Ali Al-Nejar, Sylvie Van den Broeck and Maarten Spinhoven performed the measurements of the radiographic images. Ali Al-Nejar and Sylvie Van den Broeck performed the analysis of the measurements. Ali Al-Nejar, Sylvie Van den Broeck, Niels Komen, Philip Plaeke and Guy Hubens contributed to the analysis and interpretation of the results. Ali Al-Nejar drafted the manuscript and designed the figures and tables. All authors provided critical feedback and helped shape the research, analysis and manuscript.

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No funding was obtained for this study.
The authors have no relevant financial or non-financial interests to disclose.

Ethics approval

Approval was obtained from the ethics committee of University Hospital of Antwerp. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

References

1. Makela-Kaikkonen, J., T. Rautio, A. Ohinmaa, S. Koivurova, P. Ohtonen, H. Sintonen, and J. Makela, *Cost-analysis and quality of life after laparoscopic and robotic ventral mesh rectopexy for posterior compartment prolapse: a randomized trial.* Tech Coloproctol, 2019. **23**(5): p. 461-470 DOI: 10.1007/s10151-019-01991-2.
2. Samaranayake, C.B., C. Luo, A.W. Plank, A.E. Merrie, L.D. Plank, and I.P. Bissett, *Systematic review on ventral rectopexy for rectal prolapse and intussusception.* Colorectal Dis, 2010. **12**(6): p. 504-12 DOI: 10.1111/j.1463-1318.2009.01934.x.
3. Emile, S.H., H.A. Elfeki, M. Youssef, M. Farid, and S.D. Wexner, *Abdominal rectopexy for the treatment of internal rectal prolapse: a systematic review and meta-analysis.* Colorectal Dis, 2017. **19**(1): p. O13-O24 DOI: 10.1111/codi.13574.
4. D'Hoore, A., R. Cadoni, and F. Penninckx, *Long-term outcome of laparoscopic ventral rectopexy for total rectal prolapse.* Br J Surg, 2004. **91**(11): p. 1500-5 DOI: 10.1002/bjs.4779.
5. Mantoo, S., J. Podevin, N. Regenet, J. Rigaud, P.A. Lehur, and G. Meurette, *Is robotic-assisted ventral mesh rectopexy superior to laparoscopic ventral mesh rectopexy in the management of obstructed defaecation?* Colorectal Dis, 2013. **15**(8): p. e469-75 DOI: 10.1111/codi.12251.
6. Laitakari, K.E., J.K. Makela-Kaikkonen, J. Kossi, M. Kairaluoma, S. Koivurova, L. Pollari, P. Ohtonen, and T.T. Rautio, *Mid-term functional and quality of life outcomes of robotic and laparoscopic ventral mesh rectopexy: multicenter comparative matched-pair analyses.* Tech Coloproctol, 2022. **26**(4): p. 253-260 DOI: 10.1007/s10151-021-02563-z.
7. Parks, A.G., N.H. Porter, and J. Hardcastle, *The syndrome of the descending perineum.* Proc R Soc Med, 1966. **59**(6): p. 477-82.
8. Felt-Bersma, R.J., E.S. Tiersma, and M.A. Cuesta, *Rectal prolapse, rectal intussusception, rectocele, solitary rectal ulcer syndrome, and enterocele.* Gastroenterol Clin North Am, 2008. **37**(3): p. 645-68, ix DOI: 10.1016/j.gtc.2008.06.001.
9. Ellis, C.N. and R. Essani, *Treatment of obstructed defecation.* Clin Colon Rectal Surg, 2012. **25**(1): p. 24-33 DOI: 10.1055/s-0032-1301756.
10. Khaikin, M. and S.D. Wexner, *Treatment strategies in obstructed defecation and fecal incontinence.* World J Gastroenterol, 2006. **12**(20): p. 3168-73 DOI: 10.3748/wjg.v12.i20.3168.
11. Schawkat, K., H. Heinrich, H.L. Parker, B.K. Barth, R.P. Mathew, D. Weishaupt, M. Fox, and C.S. Reiner, *How to define pathologic pelvic floor descent in MR defecography during defecation?* Abdom Radiol (NY), 2018. **43**(12): p. 3233-3240 DOI: 10.1007/s00261-018-1652-7.
12. D'Hoore, A., *Fine-tuning indications for laparoscopic ventral mesh rectopexy.* Tech Coloproctol, 2017. **21**(8): p. 593-594 DOI: 10.1007/s10151-017-1678-9.
13. Makela-Kaikkonen, J.K., T.T. Rautio, S. Koivurova, E. Paakko, P. Ohtonen, F. Biancari, and J.T. Makela, *Anatomical and functional changes to the pelvic floor after robotic versus laparoscopic ventral rectopexy: a randomised study.* Int Urogynecol J, 2016. **27**(12): p. 1837-1845 DOI: 10.1007/s00192-016-3048-y.
14. Gurland, B.H., G. Khatri, R. Ram, T.L. Hull, E. Kocjancic, L.H. Quiroz, R.F.E. Sayed, K.R. Jambhekar, V. Chernyak, R.M. Paspulati, V.R. Sheth, A.M. Steiner, A. Kamath, S.A. Shobeiri, M.M. Weinstein, L. Bordeianou, and D. Members of the Expert Workgroup on Magnetic Resonance Imaging of Pelvic Floor, *Consensus Definitions and Interpretation Templates for Magnetic Resonance Imaging of Defecatory Pelvic Floor Disorders: Proceedings of the Consensus Meeting of the*

Pelvic Floor Disorders Consortium of the American Society of Colon and Rectal Surgeons, the Society of Abdominal Radiology, the International Continence Society, the American Urogynecologic Society, the International Urogynecological Association, and the Society of Gynecologic Surgeons. AJR Am J Roentgenol, 2021. **217**(4): p. 800-812 DOI: 10.2214/AJR.21.26488.

15. Boyadzhyan, L., S.S. Raman, and S. Raz, *Role of static and dynamic MR imaging in surgical pelvic floor dysfunction.* Radiographics, 2008. **28**(4): p. 949-67 DOI: 10.1148/rg.284075139.
16. Agachan, F., T. Chen, J. Pfeifer, P. Reissman, and S.D. Wexner, *A constipation scoring system to simplify evaluation and management of constipated patients.* Dis Colon Rectum, 1996. **39**(6): p. 681-5 DOI: 10.1007/BF02056950.
17. Schmulson, M.J. and D.A. Drossman, *What Is New in Rome IV.* J Neurogastroenterol Motil, 2017. **23**(2): p. 151-163 DOI: 10.5056/jnm16214.
18. Ware, J.E., Jr. and C.D. Sherbourne, *The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection.* Med Care, 1992. **30**(6): p. 473-83.
19. Koo, T.K. and M.Y. Li, *A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research.* J Chiropr Med, 2016. **15**(2): p. 155-63 DOI: 10.1016/j.jcm.2016.02.012.
20. Van den Broeck, S., Y. Jacquemyn, G. Hubens, H. De Schepper, A. Vermandel, and N. Komen, *Rectocele: victim of availability bias? Results of a Belgian survey of colorectal and gynecological surgeons.* Int Urogynecol J, 2022. **33**(12): p. 3505-3517 DOI: 10.1007/s00192-022-05118-4.
21. Aziz, I., W.E. Whitehead, O.S. Palsson, H. Tornblom, and M. Simren, *An approach to the diagnosis and management of Rome IV functional disorders of chronic constipation.* Expert Rev Gastroenterol Hepatol, 2020. **14**(1): p. 39-46 DOI: 10.1080/17474124.2020.1708718.
22. Tsunoda, A., T. Takahashi, S. Matsuda, N. Oka, and H. Kusanagi, *Midterm functional outcome after laparoscopic ventral rectopexy for external rectal prolapse.* Asian J Endosc Surg, 2020. **13**(1): p. 25-32 DOI: 10.1111/ases.12701.
23. Brunner, M., H. Roth, K. Gunther, R. Grutzmann, and K.E. Matzel, *Ventral rectopexy with biological mesh: short-term functional results.* Int J Colorectal Dis, 2018. **33**(4): p. 449-457 DOI: 10.1007/s00384-018-2972-3.
24. Abdelnaby, M., M. Fathy, E. Abdallah, M. Balata, M. Arnous, H.M. Mikhail, and S.H. Emile, *Laparoscopic Ventral Mesh Rectopexy Versus Transvaginal Posterior Colporrhaphy in Management of Anterior Rectocele.* J Gastrointest Surg, 2021. **25**(8): p. 2035-2046 DOI: 10.1007/s11605-020-04823-z.
25. Naldini, G., B. Fabiani, A. Sturiale, E. Russo, and T. Simoncini, *Advantages of robotic surgery in the treatment of complex pelvic organs prolapse.* Updates Surg, 2021. **73**(3): p. 1115-1124 DOI: 10.1007/s13304-020-00913-4.
26. Tsunoda, A., T. Takahashi, T. Ohta, and H. Kusanagi, *Quality of life after laparoscopic ventral rectopexy.* Colorectal Dis, 2016. **18**(8): p. O301-10 DOI: 10.1111/codi.13247.
27. Barber, M.D., M.D. Walters, and R.C. Bump, *Short forms of two condition-specific quality-of-life questionnaires for women with pelvic floor disorders (PFDI-20 and PFIQ-7).* Am J Obstet Gynecol, 2005. **193**(1): p. 103-13 DOI: 10.1016/j.ajog.2004.12.025.
28. Rogers, R.G., K.W. Coates, D. Kammerer-Doak, S. Khalsa, and C. Qualls, *A short form of the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ-12).* Int Urogynecol J Pelvic Floor Dysfunct, 2003. **14**(3): p. 164-8; discussion 168 DOI: 10.1007/s00192-003-1063-2.

29. Mehmood, R.K., J. Parker, L. Bhuvimanian, E. Qasem, A.A. Mohammed, M. Zeeshan, K. Grugel, P. Carter, and S. Ahmed, *Short-term outcome of laparoscopic versus robotic ventral mesh rectopexy for full-thickness rectal prolapse. Is robotic superior?* Int J Colorectal Dis, 2014. **29**(9): p. 1113-8 DOI: 10.1007/s00384-014-1937-4.
30. Picchia, S., M. Rengo, D. Bellini, D. Caruso, E. Pironti, R. Floris, and A. Laghi, *Dynamic MR of the pelvic floor: Influence of alternative methods to draw the pubococcygeal line (PCL) on the grading of pelvic floor descent.* Eur J Radiol Open, 2019. **6**: p. 187-191 DOI: 10.1016/j.ejro.2019.05.002.
31. Landmann, R.G. and S.D. Wexner, *Paradoxical puborectalis contraction and increased perineal descent.* Clin Colon Rectal Surg, 2008. **21**(2): p. 138-45 DOI: 10.1055/s-2008-1075863.
32. Korula, D.R., A. Chandramohan, R. John, and A. Eapen, *Barium Defecating Proctography and Dynamic Magnetic Resonance Proctography: Their Role and Patient's Perception.* J Clin Imaging Sci, 2021. **11**: p. 31 DOI: 10.25259/JCIS_56_2021.