UC Irvine
UC Irvine Previously Published Works

Title

Surgical treatments for rectal prolapse: how does a perineal approach compare in the laparoscopic era?

Permalink

https://escholarship.org/uc/item/7823r73p

Journal

Surgical endoscopy, 29(3)

Authors

Young, MT
Jafari, MD
Phelan, MJ
et al.

Publication Date

2015-03-01

DOI

10.1007/s00464-014-3707-3

Peer reviewed

Surgical treatments for rectal prolapse: how does a perineal approach compare in the laparoscopic era?

Monica T. Young • Mehraneh D. Jafari • Michael J. Phelan • Michael J. Stamos •
Steven Mills • Alessio Pigazzi • Joseph C. Carmichael

Abstract

Background Patients with rectal prolapse often have significant comorbidities that lead
surgeons to select a perineal resection for treatment despite a reported higher recurrence
rate over abdominal approaches. There is a lack of data to support this practice in the
laparoscopic era. The objective of this study was to evaluate if risk-adjusted morbidity of
perineal surgery for rectal prolapse is actually lower than laparoscopic surgery.

Design A retrospective review of the American College of Surgeons National Surgical
Quality Improvement Program (NSQIP) database as performed for patients undergoing
surgical treatment of rectal prolapse between 2005 and 2011. Outcomes were analyzed
according to procedure-type: laparoscopic rectopexy (LR), laparoscopic
resection/rectopexy (LRR), open rectopexy (OR), open resection/rectopexy (ORR), and
perineal resection (PR). A multivariate logistic regression was used to compare
riskadjusted morbidity and mortality between each procedure. Main outcome measures
were 30-day morbidity and mortality.

Results Among 3,254 cases sampled, a laparoscopic approach was used in 22 %, an open
abdominal approach in 30 %, and PR in 48 %. Patients undergoing PR were older (76)
and had a higher ASA (3) compared to laparoscopic (58, 2) and open abdominal
procedures (58, 2). Risk-adjusted mortality could not be assessed due to a low overall
incidence of mortality (0.01 %). Overall morbidity was 9.3 %. ORR was associated with
a higher risk-adjusted morbidity compared to PR (OR: 1.89 CI (1.19–2.99), p = 0.03).
There were no significant differences in risk adjusted morbidity found between LR and
LRR compared to PR (OR 0.44 CI (0.19–1.03), p = 0.18; OR 1.55 CI (0.86–2.77), p =
0.18). Laparoscopic cases averaged 27 min longer than open cases (p\0.001).

Conclusion Laparoscopic rectal prolapse surgery has comparable morbidity and mortality
to perineal surgery. A randomized trial is indicated to validate these findings and to
assess recurrence rates and functional outcomes.

The Delorme procedure for the surgical treatment of rectal prolapse was first described
by the French surgeon Edmond Delorme in 1900 [1, 2]. Since that time, over 100
different surgical procedures have been proposed for the management of this condition
[3, 4]. Although the majority of these procedures are now of only historical interest,
many different techniques are still being used today. Procedures to address rectal
prolapse can broadly be split into two main approaches—abdominal and perineal. The
primary goals of the operation are to correct the prolapse, alleviate preoperative
discomfort, and to prevent or improve fecal incontinence or constipation [5].
Traditionally, a perineal approach has been considered the operation of choice in any
elderly or high-risk patient, because it was associated with lower perioperative morbidity,

decreased pain, and a shorter length of hospital stay [6]. However, advances in minimally invasive techniques have called into question the optimal procedure for rectal prolapse, especially when considering long-term outcomes such as recurrence or anorectal function [7].

Although there is currently no established consensus as to the best surgical treatment, a laparoscopic approach to rectal prolapse repair has become increasingly popular ever since its description in 1992 [8]. Several studies have shown the benefits of laparoscopy when compared to open rectopexy (OR) [9, 10]. It has been associated with reduced postoperative pain, earlier recovery, and shorter length of hospital stay, along with the advantage of low recurrence rates found with abdominal rectal prolapse repair [9, 11–13]. However, there is limited data comparing outcomes of laparoscopic repair with perineal resection. In this study, we present a review of the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database to compare postoperative outcomes of laparoscopic abdominal and open abdominal approaches with the traditional perineal resection for rectal prolapse. In this era of laparoscopic surgery, it may be reasonable to consider a minimally invasive approach, even for the high-risk patient.

Materials and methods

The ACS NSQIP database is the first national validated, risk-adjusted, outcomes-based program, created for the purpose of improving surgical quality of care. Approximately 500 hospitals are currently enrolled, collecting and receiving hospital-level data on preoperative risk factors, intraoperative variables, and 30-day morbidity and mortality for patients undergoing inpatient and outpatient surgical procedures. A trained Surgical Clinical Reviewer is used at each participating hospital to capture data and ensure reliability. Additional details on the NSQIP sampling strategy, data abstraction, parameters, and program specifics are available on the ACS NSQIP website [14]. Approval for the use of patient level data analyzed in this study was obtained from the institutional review board of the University of California Irvine and the ACS NSQIP. Exempt institutional review board approval was granted, as patient data were de-identified.

Selection of participants

The NSQIP Database was retrospectively reviewed for all patients who underwent surgery for rectal prolapse between January 2005 and December 2011. Appropriate diagnosis and procedural codes were selected using the International Classification of Disease, 9th Edition (ICD-9) diagnosis codes and Current Procedural Terminology (CPT) codes. The principle diagnosis code utilized was rectal prolapse (569.1). Patients were then divided based on methodology of surgical repair: laparoscopic rectopexy (LR) (CPT code 45400), LR and resection (CPT code 45402), open abdominal rectopexy (CPT code 45540), open abdominal rectopexy and resection (CPT code 45550), and perineal resection (CPT code 45130). Patients who underwent emergent procedures were excluded from analysis.

Study variables and end points

The variables used were provided by the NSQIP database and included patient demographics (age and gender), body mass index (BMI), functional status (independent, partially dependent, totally dependent), comorbid conditions, and American Society of Anesthesiologists (ASA) class. Comorbidity counts were calculated for each cohort and defined as the mean number of comorbidities per patient. Missing demographic data were excluded from analysis. Operative variables included mean number of intraoperative red blood cell units transfused, operative time, and anesthesia time. Primary outcome measures were 30-day morbidity and mortality. Other parameters analyzed in the study were length of hospital stay and postoperative outcomes, including incisional surgical site infection, abdominal abscess, pneumonia, pulmonary embolism, renal insufficiency, acute renal failure, urinary tract infection, cerebrovascular accidents, myocardial infarction, bleeding requiring transfusion, deep venous thrombosis, sepsis, septic shock, and return to the operating room within 30 days of the index operation and 30-day readmission. Progressive renal insufficiency was defined in the ACS NSQIP as an increase in creatinine of greater than 2 mg/dL from preoperative value. Acute renal failure was defined as patients with new requirement of dialysis postoperatively. Readmission rate was available only for 2011 data and was defined as readmission to a surgical service within 30 days of index operation.

Patient data were organized by surgical approach. The laparoscopic abdominal group included LR and laparoscopy resection and rectopexy (LRR). The open abdominal group included OR and open resection and rectopexy (ORR). The perineal group included perineal resection (PR). Patient characteristics, intraoperative and postoperative outcomes were compared between all three groups, with the perineal group used as the control. Multivariate analysis was used to compare risk-adjusted outcomes for all four abdominal procedures (LR, LRR, OR, and ORR) to PR. Risk-adjusted outcomes were also compared between laparoscopic and open approaches. A subset analysis was performed for intraoperative and perioperative outcomes of patients undergoing LRR compared to patients undergoing PR.

Statistical analysis

Statistical analysis was performed using SAS version 9.3 (SAS, Cary, NC, USA) and the R statistical environment. Binary outcomes were compared using Chi-square tests with Yates correction. Continuous variables were compared using two-sample t-tests with unequal variance. Multivariate logistic regression analysis was performed for 30-day morbidity between surgical procedures. Independent variable used for risk adjustment included demographics, functional status, ASA, and comorbidities. Multivariate analysis was unable to be performed from 30-day mortality due to the small number of deaths overall. Robust standard errors were used for inference to guard against model misspecification, and Holm's method was used to account for multiple comparisons between adjusted p-values [15, 16]. Comparisons were considered statistically significant if the p-value was\0.05. All reported p-values are two-sided.

Results

A total of 3,254 patients who underwent surgery for rectal prolapse were sampled. Of the total, a laparoscopic approach was used in 22 %, an open abdominal approach in 30 %, and a perineal approach in 48 %. Patients undergoing PR were older (mean age 76 years), and had a higher mean ASA class (2.7) compared to patients undergoing laparoscopic (58 years, 2.2) and open abdominal procedures (58 years, 2.3). Female gender was predominant in all groups, with the highest rate in the patients undergoing PR (92 %). The laparoscopic abdominal group had significantly less female patients compared to the perineal group (89 vs 92 %, $p < 0.05$). There was no difference in BMI between groups. Overall, the majority of patients were categorized as ''independent'' for preoperative functional health. However, 43.9 % of patients were missing this variable overall. Within the perineal group, 7.8 % of patients were characterized as ''partially dependent,'' which was significantly higher than the laparoscopic and open groups (1.37 and 1.97 %, respectively, $p < 0.05$). Patient demographics and characteristics are summarized in Table 1.

Table 1 Demographics of patients undergoing surgery for rectal prolapse at ACS NSQIP hospitals during 2005–2011, divided by surgical approach (laparoscopic, open, and perineal)

Demographic	Laparoscopic ($n = 729$)	Open ($n = 966$)	Perineal ($n = 1,559$)
Age (years)	58 ± 18*	58 ± 17[a]	76 ± 15
Gender (%)			
Male	11.34*	9.83	7.78
Female	88.66*	90.17	92.22
Mean BMI (kg/m^2)	24 ± 5	25 ± 6	25 ± 5
Preoperative functional health (%)			
Independent	47.33*	59.11[a]	47.85
Partially dependent	1.37*	1.97[a]	7.76
Totally dependent	0.41	0.10[a]	0.71
Missing	50.89*	38.82[a]	43.68
ASA class (%)			
I	7.02*	6.02[a]	1.60
II	62.59*	58.46[a]	36.11
III	28.75*	33.54[a]	56.64
IV	1.65*	1.97[a]	5.64
Mean	2.24 ± 0.63*	2.31 ± 0.64[a]	2.66 ± 0.61

* p\0.05, for laparoscopic compared to perineal, with perineal as control
[a] p\0.05, for open compared to perineal, with perineal as control

For preoperative variables and patient comorbidities, the rate of steroid use was significantly higher in patients undergoing PR (7.1 %) compared to laparoscopic and open surgeries (4.1 and 3.5 %, respectively, $p < 0.05$). The overall comorbidity count was also significantly higher for the PR group, with an average of 1.2 comorbidities per patient, compared to 0.72 in the laparoscopic group, and 0.8 in the open group. Patient comorbidity rates are listed in Table 2.

Table 2 Preoperative variables and comorbidities of patients undergoing surgery for rectal prolapse at ACS NSQIP hospitals during 2005–2011, divided by surgical approach (laparoscopic, open, perineal)

Comorbidity (%)	Laparoscopic ($n = 729$)	Open ($n = 966$)	Perineal ($n = 1559$)
Steroid use for chronic condition	4.12*	3.52[a]	7.06
Prior operation (last 30 days)	0.48	0.98	0.94
Diabetes	5.21*	5.59[a]	9.69
Smoking	17.15*	23.91[a]	10.71
ETOH (>2 drinks/ day)	2.74*	1.04	0.58
History of severe COPD	4.12*	4.66[a]	9.75
CHF (last 30 days)	0.69	0.31[a]	1.09
MI (last 6 months)	0.16	0.23	0.29
Previous PCI	3.13*	2.31[a]	6.19
Previous cardiac surgery	2.19	2.42[a]	5.53
Angina (last 1 month)	0.78	0.46	1.18
Hypertension requiring medication	34.02*	36.13[a]	63.05
PVD	0.94	0.23[a]	1.99
Rest pain/gangrene	0.31	0.12	0.15
History of TIA	2.66*	2.31[a]	5.97
CVA/stroke	3.45*	3.81[a]	7.81
Disseminated cancer	0.27	0.10	0.51
Comorbidity count	0.72 ± 0.87*	0.78 ± 0.88[a]	1.15 ± 0.98

* $p < 0.05$, for laparoscopic compared to perineal, with perineal as control
[a] $p < 0.05$, for open compared to perineal, with perineal as control

On univariate analysis of intraoperative outcomes, PR had equivalent rates of intraoperative blood transfusion to laparoscopic cases, and a significantly lower rate compared to open cases (0.02 units PR vs 0.06 open, $p < 0.05$). PR had the shortest operative time and anesthesia time (88 and 140 min, respectively) overall. Urinary tract infection, sepsis, and abdominal abscess were the most prevalent complications overall (Table 3).

Table 3 Outcomes of patients undergoing surgery for rectal prolapse at ACS NSQIP hospitals during 2005–2011, divided by surgical approach (laparoscopic, open, and perineal)

Outcome	Laparoscopic ($n = 729$)	Open ($n = 966$)	Perineal ($n = 1559$)
Intraoperative			
Intraoperative RBC units	0.01 ± 0.11	0.06 ± 0.39^a	0.02 ± 0.18
Operation (min)	$164 \pm 74^*$	139 ± 62^a	88 ± 41
Anesthesia (min)	$224 \pm 89^*$	199 ± 69^a	140 ± 53
Postoperative			
Incisional SSI	0.14	1.04^a	0.06
Abscess	1.10	2.48	1.54
Pneumonia	0.69	1.45	1.73
Pulmonary embolism	0.14	0.10	0.13
Renal insufficiency	0.14	0	0.06
Acute renal failure	0.14	0.21	0
Urinary tract infection	3.02	4.04	3.08
Stroke/CVA	0	0.10	0.38
Myocardial infarction	0.14	0.10	0.58
Bleeding transfusion	1.51	1.97	1.15
DVT	0.27	0.21	0.32
Septic shock	0.27	0.41	0.90
Sepsis	1.23	2.69	1.73
30-day reoperation	2.74	2.80	2.57
Readmission (2011 only)	1.28	1.37	1.46
30-day morbidity	9.60	16.67^a	9.81
30-day mortality	0.41^*	0.41^a	1.60
Length of stay (days)	4 ± 3	6 ± 5^a	4 ± 5

[*] $p < 0.05$, for laparoscopic compared to perineal, with perineal as control
[a] $p < 0.05$, for open compared to perineal, with perineal as control

However, there were nostatistically significant differences for these complications among the three groups. Incisional SSI and 30-day morbidity were significantly higher in the open abdominal group compared to the perineal group (1.04 vs 0.06 % and 16.7 vs 9.8 %, respectively). Length of stay was also significantly longer after an open operation (6 vs 4 days). There was no statistically significant difference in morbidity between the laparoscopic and perineal groups. However, 30-day mortality was significantly lower in patients undergoing laparoscopic (0.41 %) and open (0.41 %) approaches compared to the perineal approach (1.6 %). A subset analysis was performed comparing patients undergoing LRR versus PR (Table 4).

Table 4 Subset analysis of laparoscopic resection and rectopexy compared to perineal resection

Outcome	LRR (n = 351)	Perineal (n = 1,559)	p-value
Intraoperative			
Intraoperative RBC, mean ± SD (units)	0.01 ± 0.15	0.02 ± 0.18	0.55
Operation, mean ± SD (min.)	187 ± 77*	88 ± 41	<0.01
Anesthesia, mean ± SD (min.)	251 ± 96*	140 ± 53	<0.01
Postoperative (%)			
Incisional SSI	0.28	0.06	0.33
Abscess	1.71	1.54	0.81
Pneumonia	0.85	1.73	0.34
Pulmonary embolism	0.28	0.13	0.46
Progressive renal insufficiency	0.00	0.06	0.99
Acute renal failure	0.28	0	0.18
Urinary tract infection	4.56	3.08	0.19
Stroke/CVA	0	0.38	0.60
Myocardial infarction	0	0.58	0.38
Bleeding transfusion	1.71	1.15	0.42
DVT	0.57	0.32	0.62
Septic shock	0.57	0.90	0.75
Sepsis	2.28	1.73	0.51
30-day reoperation	3.70	2.57	0.28
Readmission (2011 only)	8.20	6.57	0.79
30-day morbidity	13.96*	9.81	0.03
30-day mortality	0.57	1.60	0.21
Hospital length of stay, mean ± SD, (days)	5 ± 4*	4 ± 5	<0.01

* $p < 0.05$, for LRR compared to perineal, with perineal as control

Once again, laparoscopy was associated with longer times for operation (187 vs 88 min) and anesthesia (251 vs 140 min). There were no differences between groups for univariate analysis of individual postoperative outcomes, but unadjusted 30-day morbidity was significantly higher in the LRR group (14 % LRR vs 9.8 % PR, p = 0.03). Hospital length of stay and 30-day mortality was similar between groups. For patients undergoing perineal resection, the type of anesthesia use to perform the case was analyzed (Table 5).

Table 5 Anesthesia type utilized for patients undergoing a perineal approach for repair of rectal prolapse

Anesthesia type ($n = 1,559$)	(%)
General	83.6
Epidural/spinal	9.81
Monitored anesthesia care/IV sedation	3.66
Local	2.88

The majority of cases were performed under general anesthesia (83.6 %), with the next most common anesthesia type being spinal or epidural anesthesia (9.8 %). Only a small percentage of cases were performed under local anesthesia (2.88 %).

The results of a multivariate regression analysis comparing the morbidity of each abdominal procedure (LR, LRR, OR, ORR) with PR are listed in Table 6. ORR was associated with significantly higher odds of morbidity compared to PR (1.89, 95 % CI (1.19–2.99) p = 0.03). There were no other significant differences in risk-adjusted morbidity between groups.

Table 6 Multivariate regression analysis evaluating the association of morbidity with each procedure (LR, LRR, OR, and ORR) compared to PR

Procedure	Adjusted OR/MD (95 % CI)	Naïve p-value	Adjusted p-value
Open resection + rectopexy versus Perineal	1.89 (1.19, 2.99)*	<0.01	0.03
Open rectopexy versus perineal	1.50 (0.95, 2.38)	0.08	0.18
Lap resection + rectopexy versus perineal	1.55 (0.86, 2.77)	0.14	0.18
Lap rectopexy versus perineal	0.44 (0.19, 1.03)	0.06	0.18

* p < 0.05, for adjusted OR open resection and rectopexy compared to perineal, with perineal as control

Discussion

The optimal therapy for repair of rectal prolapse continues to be a subject of much debate. Proponents of the traditional perineal approach cite decreased operative time, the potential to avoid general anesthesia and decreased postoperative morbidity with a shorter length of hospital stay [17]. These advantages are reasonable when considering that the majority of studies have been performed comparing open abdominal repair with the perineal approach. When presented with an elderly, high-risk patient with three studies found excellent outcomes with respect to recurrence. A meta-analysis by Purkayastha et al. also showed laparoscopic abdominal rectopexy to have equivalent efficacy to open repair in terms of recurrence rates and morbidity, with decreased length of hospital stay [21]. There are very few studies comparing laparoscopic resection and/or rectopexy with perineal repair [24–26]. Those that have been published are small single-institution studies or retrospective database reviews. Clark et al. utilized the ACS NSQIP to analyze outcomes of rectal prolapse repair in the elderly [24]. In this study, laparoscopic repair was associated with improved short-term outcomes compared to open and PR, with shorter hospital stay (3.77 days) and significantly decreased morbidity (2.22 %) compared to other approaches. They found that open surgery was the only factor associated with an increased complication rate. Additional studies are needed to help elucidate differences in outcomes between these groups. Laparoscopic repair of rectal prolapse can involve rectopexy alone or sigmoid resection with rectopexy.

A Cochrane meta-analysis indicates that concomitant sigmoid resection is associated with a lower rate of postoperative constipation [7]. Since our laparoscopic group included both LR and LRR, we decided to perform a subset analysis comparing patients undergoing LRR with PR. The comparison is applicable given that the Altemeier procedure, which is the most common perineal repair utilized in the United States, involves a perineal proctosigmoidectomy with a hand sewn coloanal anastomosis. When comparing these two procedures, which involve resection and primary anastomosis, we found both to be comparable with regard to 30-day mortality and hospital length of stay. As expected, operative and anesthesia time was higher for the LRR group. Although there were no statistically significant differences in individual postoperative outcomes, overall morbidity was higher after LRR (*14 %), compared to PR (9.8 %). This morbidity rate might be slightly inflated due to inclusion of minor complications such as urinary tract infection and wound infection. On multivariate analysis, however, the odds of mortality were not found to be significantly different between groups. It is important to acknowledge certain limitation of the NSQIP database. Information is restricted to 30-day postoperative morbidity and mortality, thus any complications or readmissions occurring after this time period are not captured. Long-term functional outcomes or quality of life data cannot be analyzed or included in the study. There is no information on the nature of reoperation. NSQIP also does not provide information on the level of experience or subspecialty interest of the surgeon involved. This may affect outcomes in the laparoscopic group depending on the skill level of the surgeon. As previously mentioned, selection bias is likely to occur based on whether a patient is deemed high-risk by the operating surgeon. Finally, the study population is generated by hospitals utilizing the NSQIP system and therefore may not be reflective of all hospital across the United States. Despite these limitations, this study offers a large sample of patients undergoing

surgical repair for rectal prolapse and enables an analysis of 30-day perioperative outcomes by procedure type. Patients with rectal prolapse require a tailored surgical approach based on their risk factors and surgical history. While perineal resection has traditionally been used successfully, minimally invasive techniques provide a new approach with similar postoperative advantages. When comparing laparoscopic repair with perineal resection, we found no significant risk-adjusted differences in postoperative morbidity. Further prospective studies are needed to improve the understanding of outcomes after laparoscopic versus perineal repair of rectal prolapse.

References
1. Classic articles in colonic and rectal surgery (1985) Edmond Delorme 1847–1929. On the treatment of total prolapse of the rectum by excision of the rectal mucous membranes or rectocolic. Dis Colon Rectum 28(7):544–553
2. Lee S, Kye BH, Kim HJ, Cho HM, Kim JG (2012) Delorme's procedure for complete rectal prolapse: does it still have it's own role? J Korean Soc Coloproctol 28(1):13–18
3. Mahmoud N. Rectal Prolapse. http://www.fascrs.org/physicians/education/core_subjects/2004/rectal_prolapse/. Accessed 8 Feb 2014
4. Senapati A, Gray RG, Middleton LJ et al (2013) PROSPER: a randomised comparison of surgical treatments for rectal prolapse. Colorectal Dis 15(7):858–868
5. Bordeianou L, Hicks CW, Kaiser AM, Alavi K, Sudan R, Wise PE. Rectal prolapse: an overview of clinical features, diagnosis, and patient-specific management strategies. J Gastrointest Surg. 19 Dec 2013
6. Melton GB, Kwaan MR (2013) Rectal prolapse. Surg clin N Am 93(1):187–198
7. Tou S, Brown SR, Malik AI, Nelson RL (2008) Surgery for complete rectal prolapse in adults. Cochrane Database Syst Rev. (4):CD001758
8. Berman IR (1992) Sutureless laparoscopic rectopexy for procidentia. Technique and implications. Dis Colon Rectum 35(7): 689–693
9. Baker R, Senagore AJ, Luchtefeld MA (1995) Laparoscopicassisted vs. open resection. Rectopexy offers excellent results. Dis Colon Rectum 38(2):199–201
10. Kariv Y, Delaney CP, Casillas S et al (2006) Long-term outcome after laparoscopic and open surgery for rectal prolapse: a casecontrol study. Surg Endosc 20(1):35–42

11. Boccasanta P, Rosati R, Venturi M et al (1998) Comparison of laparoscopic rectopexy with open technique in the treatment of complete rectal prolapse: clinical and functional results. Surg Laparosc Endosc 8(6):460–465

12. Boccasanta P, Venturi M, Reitano MC et al (1999) Laparotomic vs. laparoscopic rectopexy in complete rectal prolapse. Dig Surg 16(5):415–419

13. Senagore AJ (2003) Management of rectal prolapse: the role of laparoscopic approaches. Semin Laparosc Surg 10(4):197–202

14. American College of Surgeons National Surgical Quality Improvement Program. http://site.acsnsqip.org. Accessed 8 Feb 2014

15. Huber PJ. The behavior of maximum likelihood estimates under nonstandard conditions. Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. 1967:221–233

16. Holm S (1979) A simple sequentially rejective multiple test procedure. Scand J Stat 6:65–70

17. Mahmoud SA, Omar W, Abdel-Elah K, Farid M (2012) Delorme's procedure for full-thickness rectal prolapse: does it alter anorectal function. Indian J Surg 74(5):381–384

18. Wijffels N, Cunningham C, Dixon A, Greenslade G, Lindsey I (2011) Laparoscopic ventral rectopexy for external rectal prolapse is safe and effective in the elderly. Does this make perineal procedures obsolete? Colorectal Dis 13(5):561–566

19. Bachoo P, Brazzelli M, Grant A(2000) Surgery for complete rectal prolapse in adults. Cochrane Database Syst Rev. (2):CD001758

20. Solomon MJ, Young CJ, Eyers AA, Roberts RA (2002) Randomized clinical trial of laparoscopic versus open abdominal rectopexy for rectal prolapse. Br J Surg 89(1):35–39

21. Purkayastha S, Tekkis P, Athanasiou T et al (2005) A comparison of open vs. laparoscopic abdominal rectopexy for full-thickness rectal prolapse: a meta-analysis. Dis Colon Rectum 48(10): 1930–1940

22. Sajid MS, Siddiqui MR, Baig MK (2010) Open vs laparoscopic repair of full-thickness rectal prolapse: a re-meta-analysis. Colorectal Dis 12(6):515–525

23. Fleming FJ, Kim MJ, Gunzler D, Messing S, Monson JR, Speranza JR (2012) It's the procedure not the patient: the operative approach is independently associated with an increased risk of complications after rectal prolapse repair. Colorectal Dis 14(3):362–368

24. Clark CE 3rd, Jupiter DC, Thomas JS, Papaconstantinou HT (2012) Rectal prolapse in the elderly: trends in surgical management and outcomes from the American College of Surgeons National Surgical Quality Improvement Program database. J Am Coll Surg 215(5):709–714

25. Fang SH, Cromwell JW, Wilkins KB et al (2012) Is the abdominal repair of rectal prolapse safer than perineal repair in the highest risk patients? An NSQIP analysis. Dis Colon Rectum 55(11):1167–1172

26. Lee SH, Lakhtaria P, Canedo J, Lee YS, Wexner SD (2011) Outcome of laparoscopic rectopexy versus perineal rectosigmoidectomy for full-thickness rectal prolapse in elderly patients. Surg Endosc 25(8):2699–2702

M. T. Young (&) * M. D. Jafari * M. J. Stamos * S. Mills * A. Pigazzi * J. C. Carmichael
Department of Surgery, University of California, Irvine School of Medicine, 333 City
Blvd. West Suite 850, Orange, CA 92868, USA
e-mail: mtyoung@uci.edu
J. C. Carmichael e-mail: jcarmich@uci.edu
M. J. Phelan Department of Statistics, University of California, Irvine, Irvine, CA, USA