Tech Coloproctol (2012) 16:37–53
DOI 10.1007/s10151-011-0798-x

ORIGINAL ARTICLE

Focus on abdominal rectopexy for full-thickness rectal prolapse: meta-analysis of literature

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Received: 4 September 2011 / Accepted: 23 November 2011 / Published online: 15 December 2011

Abstract
Background Laparoscopic rectopexy to treat full-thickness rectal prolapse has proven short-term benefits, but there are few long-term follow-up and functional outcome data available. Using meta-analysis techniques, this study was designed to evaluate long-term results of open and laparoscopic abdominal procedures to treat full-thickness rectal prolapse in adults.
Methods A literature review was performed using the National Library of Medicine's PubMed database. All articles on abdominal rectopexy patients with a follow-up longer than 16 months were considered. The primary end point was recurrence of rectal prolapse, and the secondary end points were improvement in incontinence and constipation. A random effect model was used to aggregate the studies reporting these outcomes, and heterogeneity was assessed.
Results Eight comparative studies, consisting of a total of 467 patients (275 open and 192 laparoscopic), were included. Analysis of the data suggested that there is no significant difference in recurrence, incontinence and constipation improvement between laparoscopic abdominal rectopexy and open abdominal rectopexy. Considering non-comparative trials, the event rate for recurrence was similar in open and laparoscopic suture rectopexy studies and in open and laparoscopic mesh rectopexy trials. Improvement in constipation after the intervention was not statistically significant except for open mesh repair; postoperative improvement in incontinence was statistically significant after laparoscopic procedures and open mesh rectopexy.
Conclusions Laparoscopic abdominal rectopexy is a safe and feasible procedure, which may compare equally with the open technique with regard to recurrence, incontinence and constipation. However, large-scale randomized trials, with comparative, strong methodology, are still needed to identify outcome measures accurately.

Keywords Rectal prolapse · Rectopexy · Laparoscopy · Resection · Meta-analysis

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Introduction

Rectal prolapse, or procidentia, is defined as a protrusion of the rectum beyond the anus [1–3]. Predisposing factors include lax muscles of the pelvic floor and anal canal [4, 5], abnormally deep pouch of Douglas [3–6], weakness of both internal and external sphincters [5, 6], lack of normal mesorectum and weakness of lateral ligaments [4].

The pathogenesis of complete rectal prolapse is therefore complex, with no clear treatment of choice. Regardless of the therapy chosen, physical examination, defecatory history, endoscopy, manometry and colonic transit studies are essential for the correct management of the patients [5–7].

The aim of surgical therapy is to correct the prolapse, restore the continence and prevent constipation or impaired evacuation with acceptable mortality and recurrence rates. There are many procedures described for the treatment for rectal prolapse, and these can be divided into abdominal and perineal approaches. The perineal approaches have been reserved for frail and elderly patients, given that general anaesthesia and laparotomy can be avoided; in contrast, the abdominal approaches are thought to provide a more effective repair with lower recurrence rates [5].

More recently, laparoscopic surgery has emerged as an effective tool for the treatment for rectal prolapse because no specimen is removed and no anastomosis is required. Previous trials have suggested that laparoscopic surgery has many short-term advantages over open surgery, including less pain and scarring, shorter hospital stay and faster recovery [8, 9]. Nevertheless, there are limited data comparing long-term functional outcomes after open and laparoscopic fixation or resection rectopexy.

The main goal of this study is to perform a meta-analysis of the literature on abdominal procedures to treat rectal prolapse with a focus on long-term and functional outcomes of abdominal repair techniques in terms of recurrence, faecal continence and constipation. A meta-analysis of the long-term outcomes from the randomized and non-randomized trials of laparoscopic versus open surgery was performed. Furthermore, in contrast to other previous reviews and meta-analyses, our study included a meta-analysis of non-comparative trials of abdominal procedures, either open or laparoscopic, to evaluate postoperative recurrence of prolapse and improvement in incontinence and constipation after the operation.

Materials and methods

Study selection

A literature review was performed using the National Library of Medicine's PubMed database. All articles published between 1972 and 2010, reporting on abdominal rectopexy, were considered, including non-comparative studies of suture and mesh rectopexy, with or without resection, either open or laparoscopic, and trials comparing open and laparoscopic abdominal approaches for full-thickness rectal prolapse. The following search terms were used: "rectal prolapse", "abdominal rectopexy", "abdominal surgery and rectal prolapse", "rectopexy and comparative study", "rectal prolapse and comparative study", "rectopexy and laparoscopy", "rectal prolapse and laparoscopy", "laparoscopy versus open rectopexy".

Both non-comparative and comparative studies with long-term data for laparoscopic and open abdominal rectopexy (suture and mesh rectopexy with or without resection) were reviewed and discussed. Analysis was performed only on patients undergoing abdominal rectopexy for the treatment of rectal prolapse.

Data extraction

Two independent reviewers (FC and ED) performed the search, reviewed the literature and extracted the following data: first author, year of publication, study demographics, study design, surgical technique, number of patients operated on, primary and secondary end points of the study, long-term results (recurrence, incontinence, constipation) and length of follow-up. The above-mentioned data were tabulated, and a meta-analysis was performed.

Outcomes of interest

The meta-analysis was focused on long-term functional outcomes of abdominal rectopexy both open and laparoscopic. Thus, the primary outcome evaluated was the recurrence of rectal prolapse anytime during the follow-up period, and the secondary outcomes were the improvement in incontinence or constipation after operation. In most of the studies analysed, faecal incontinence was assessed using validated questionnaires (Parks score, Cleveland Clinic incontinence score and Fecal Incontinence Severity Index (FISI) score). Concerning improvement in constipation, some authors used validated score systems, mainly the Cleveland Clinic constipation score, while other authors presented patient reported outcomes. It was possible to perform a meta-analysis of these outcomes considering the numbers and the methodology of data reported in the studies.

Statistical analysis

Statistical analysis was performed using the Comprehensive Meta-analysis software version 2.0 (Biostat, Englewood, USA).

In the meta-analysis of trials comparing open and laparoscopic abdominal rectopexy, the effect measures estimated were odds ratio (OR) for dichotomous data and weighted mean difference for continuous data, both with 95% confidence intervals (CI). Combined overall effect measures were calculated considering random effect model assumptions.

In a "fixed effect" model, it is assumed that there is no heterogeneity in treatment effect between studies, whereas in a "random effect" model, it is assumed that there is variation between studies and the calculated OR has a more conservative value. Although meta-analysis of randomized, controlled trials is preferable, random effect models can be used both to aggregate results of studies with different methodology, focusing not only on the calculation of the overall effect but also on the explanation of heterogeneity, and to perform a sensitivity analysis. In surgical research, meta-analysis using the random effect model is preferable particularly because patients who are operated on in different centres have varying risk profiles and the selection criteria for each surgical technique vary.

Statistical heterogeneity was assessed using the chi-square Q statistic. Furthermore, visual evaluation of possible

Table 1 Results of open versus laparoscopic approach

Trial	Year	Study type	Type Pts	*N* Pts	Continence improvement *N*	Constipation improvement *N*	Recurrence *N* (%)	Follow-up (months)
Johnson et al. [10]	2007	Prosp NR	OPEN	5	GD	GD	1/5	17*
			LPS	15	GD	GD	0	
Kariv et al. [11]	2006	Prosp NR	OPEN	86	19/56	30/56	11/86	59**
			LPS	86	17/56	20/56	15/86	
Demirbas et al. [12]	2005	Prosp NR	OPEN	17	3/11	411	0	36
			LPS	23	2/13	7/13	0	16
Raftopoulos et al. [13]	2005	Retrospec	OPEN	105	NS	NS	9/105	49
			LPS	11	NS	NS	1/11	
Solomon et al. [14]	2002	Prosp RB	OPEN	19			1/19	23**
			LPS	20			0	
Boccasanta et al. [15]	1999	Prosp NR	OPEN	13	NS	5/13	2/13	37*
			LPS	10		1/10	1/10	26
Baker et al. [16]	1997	Retrospec	OPEN	10	NS	NS	NS	27
			LPS	8				
Salkeld et al. [17]	2004	Retrospec	OPEN	20	NS	NS	NS	NS
		Cohort	LPS	19				

NS not stated, *Retrospec* retrospective, *Prosp* prospective, *NR* not randomized, *LPS* laparoscopic, *GD* grouped data, *RB* randomized blinded
* Mean values; ** median values

publication bias was performed by the use of funnel plots. Results were considered statistically significant at $P < 0.05$.

The Comprehensive Meta-analysis software can be used to estimate means, proportions or rates in one group at one point in time. In a second meta-analysis, we considered all non-comparative studies regarding abdominal rectopexy and estimated recurrence, incontinence improvement and constipation improvement after the operation in patients previously submitted to (1) open suture rectopexy, (2) laparoscopic suture rectopexy, (3) open mesh rectopexy, (4) laparoscopic mesh rectopexy, (5) open resection rectopexy and (6) laparoscopic resection rectopexy. Combined overall effect measures were calculated for random effect model assumptions and presented at 95% confidence interval. Results were considered statistically significant at $P < 0.05$.

Results

Laparoscopic surgery versus open surgery

In the meta-analysis, both randomized and non-randomized trials comparing open and laparoscopic rectopexy with a follow-up longer than 16 months were included. Any technique for abdominal repair of rectal prolapse was considered, i.e. resection and rectopexy with either suture or mesh.

Seventeen trials on open and laparoscopic rectopexy, including more than 1,000 patients, were obtained from the database. Eight comparative studies, published between 1997 and 2007, matched the inclusion criteria, comparing laparoscopic and open rectopexy, with a follow-up longer than 16 months.

The quality of the included studies was assessed in terms of study design, allocation concealment and blinding of participants, both investigators and observers, for randomized trials, mean outcome measures, statistical examination and length of follow-up. These trials included three retrospective, four prospective non-randomized and one prospective randomized blinded study.

A total of 467 patients, 275 of whom (58.8%) underwent open rectopexy and 192 (41.2%) laparoscopic rectopexy, were included in the final analysis. The largest study was based on 172 patients, the smallest on 18 patients. The year the study was published, the number of patients and the study design are shown in Table 1.

The following information about long-term results is summarized in Table 1 [10–17]: incidence of recurrence, improvement in incontinence and constipation improvement after the intervention, and length of follow-up.

Figure 1a demonstrates the outcome of meta-analysis for recurrence. All the studies except for Baker et al. [16] and Salkeld et al. [17] reported the incidence of recurrence, and there was significant heterogeneity among trials ($Q = 4.99$, $P < 0.05$).

The median follow-up time of the studies ranged from 16 to 49 months. Meta-analysis showed no significant difference in the recurrence rate between open rectopexy and

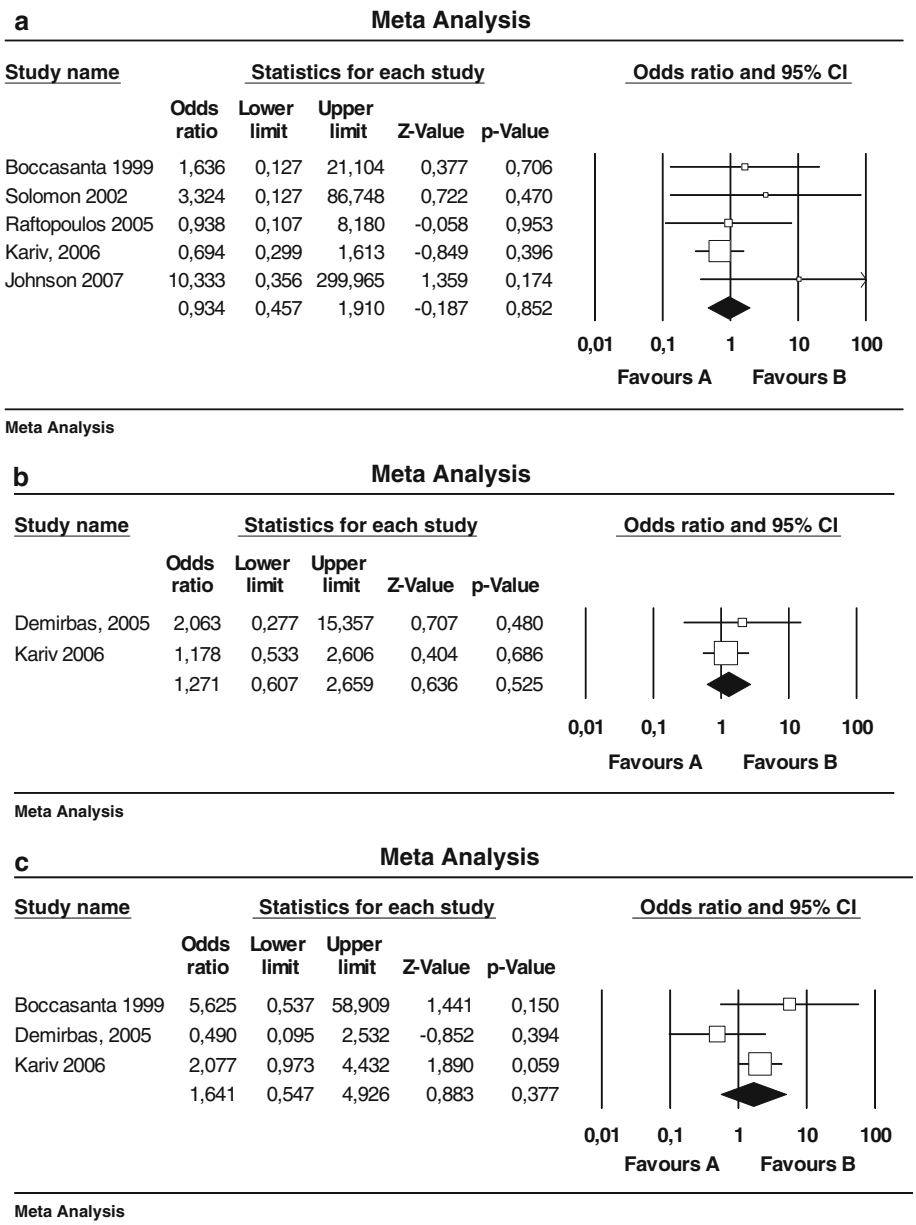


Fig. 1 **a** Meta-analysis of studies comparing open and laparoscopic approach. Forest plot of recurrence. Random model. Salkeld et al. [17] and Baker et al. [16] have been excluded because of lack of data. **b** Meta-analysis of studies comparing open and laparoscopic approach. Forest plot of incontinence Random model. Salkeld et al. [17], Bakeret al. [16] and Boccasanta et al. [15] have been excluded because of lack of data. Johnson et al. [10] and Solomon et al. [14] reported data in a way not suitable for meta-analysis. **c** Meta-analysis of studies comparing open and laparoscopic approach. Forest plot of constipation. Random model. Salkeld et al. [17], Baker et al. [6] and Raftopoulos et al. [13] have been excluded because of lack of data. Johnson et al. [10] and Solomon et al. [14] reported data in a way not suitable for meta-analysis

laparoscopic rectopexy (OR, 0.934; 95% CI, 0.457–1.910; Z value $= -0.187$; $P = 0.852$) using random effect model.

Figure 1b demonstrates the outcome of meta-analysis for incontinence. Baker et al. [16], Boccasanta et al. [15] and Salkeld et al. [17] did not report the incidence of patients with improved continence after the intervention. Jonhson [10] and Solomon [14] reported grouped data not suitable for meta-analysis. The two remaining studies were compared [11, 12]. There was no significant heterogeneity among these studies ($Q < 1$, $P > 0.05$). The median follow-up of the studies was 59 and 24 months. Meta-analysis showed no statistical significant difference regarding incontinence between open rectopexy and laparoscopic rectopexy (OR, 1.271; 95% CI, 0.607–2.659; Z value $= 0.636$; $P = 0.525$) using random effect modelling.

Figure 1c demonstrates the outcome of meta-analysis for constipation. Baker et al. [16] and Salkeld et al. [17] did not report the incidence of patients with improved constipation after the intervention. Jonhson [10] and Solomon [14] reported grouped data not suitable for meta-analysis. The three remaining studies were compared [11, 12, 15]. There was significant heterogeneity among trials ($Q = 4.32$, $P < 0.05$). The median follow-up for the studies ranged from 24 to 59 months. Meta-analysis showed no statistical difference regarding constipation between open and laparoscopic rectopexy (OR, 1.641; 95% CI, 0.547–4.926; Z value $= 0.833$; $P = 0.377$) using random effect modelling.

Finally, although multiple studies have a small sample size, graphic exploration of the results with funnel plots of

the primary and secondary outcomes did not demonstrate any evidence of publication bias.

Open rectopexy

To analyse the series of patients who underwent open rectopexy, we used two subgroups: patients who had suture rectopexy and those who had mesh rectopexy (either posterior or ventral mesh repair).

Suture rectopexy

Table 2 [18–23] lists 6 series published between 1983 and 2009. In each series, more than 10 patients underwent suture rectopexy and follow-up was longer than 16 months. The 6 studies contained a total of 276 patients; the largest was based on 70 patients, and the smallest on 24 patients. Follow-up ranged from 48 weeks to 144 months.

Recurrence rate ranged from 0 to 9%. Figure 2a shows the outcome of quantitative analysis for recurrence using random effect modelling: event rate, 0.057; 95% CI, 0.034–0.097; Z value $= -9.753$; $P < 0.001$.

The rate of postoperative improvement in incontinence ranged from 15 to 81%, and the rate of improvement in constipation after the operation ranged between 30 and 83%. Graf et al. [20] reported worsening of continence and constipation in 12 and 27% of patients, respectively. Novell et al. [10] reported worsening of evacuation in 31% of patients.

Figure 2b shows the outcome of quantitative analysis for incontinence using random effect modelling. Most studies reported an improvement in incontinence, but the data were not statistically significant (event rate, 0.556; 95% CI, 0.304–0.781; Z value $= 0.418$; $P = 0.676$).

The effect of rectopexy on constipation was variable; accordingly, on quantitative analysis, the improvement in constipation after the operation was not statistically significant (event rate, 0.322; 95% CI, 0.047–0.821; Z value $= -0.643$; $P = 0.520$) (Fig. 2c).

Mesh rectopexy

Table 3 [7, 19, 24–36] lists 15 studies published between 1972 and 2000. In each series, more than 10 patients underwent mesh rectopexy, with a follow-up longer than 16 months. The 15 studies contained a total of 1155 patients; the largest was based on 150 patients, and the smallest on 18 patients. Follow-up ranged from 24 to 83 months.

After rectal mobilization, a mesh was inserted between the sacrum and the rectum and fixed to the sacral promontory and lateral rectal wall in 9 trials (posterior approach). In 6 studies, the Ripstein technique was used: the mesh was placed anterior to the rectum and fixed to the sacral promontory.

The recurrence rate ranged from 0 to 11%. Specifically, recurrence ranged from 0 to 6.4% in the posterior mesh series and from 0 to 11% in the Ripstein group. Figure 3a shows the outcome of quantitative analysis for recurrence using the random effect model: event rate, 0.045; 95% CI, 0.032–0.064; Z value $= -16.579$; $P < 0.001$.

The rate of postoperative improvement in incontinence ranged from 3 to 78%, and the rate of improvement in constipation after the operation ranged from 0 to 69%. Schultz et al. [34] reported worsening of incontinence and constipation in 10 and 8% of patients, respectively. Novell et al. [19], Holmstrom et al. [28] and Launer et al. [27] reported worsening of constipation in 48, 17 and 10%, respectively, in the absence of improved evacuation in any patient.

Figure 3b shows the outcome of quantitative analysis for incontinence using the random effect model. There was a significant improvement in incontinence after the operation (event rate, 0.356; 95% CI, 0.244–0.488; Z value $= -2.136$; $P = 0.0333$).

Figure 3c shows the outcome of quantitative analysis for constipation using the random effect model with a statistically significant improvement in constipation after

Table 2 Results of suture rectopexy: open approach

Authors	Year	*N* Pts	Procedure	Continence improvement %	Constipation improvement %	Recurrence %	Follow-up
Carter [18]	1983	32	SR	NS	NS	1 (3)	144
Novell et al. [19]	1994	32	SR	15	31 worsening	1 (3)	47
Graf et al. [20]	1996	53	SR	36	30	5 (9)	97
				12 worsening	27 worsening		
Khanna et al. [21]	1996	65	SR	75	83	0	65
Briel et al. [22]	1997	24	SR	67	NS	0	67
Liyanage et al. [23]	2009	81 (70)	SR + resection	81		5 (7)	2–47*

N Pts number of patients, *SR* suture rectopexy, *NS* not stated

* Weeks

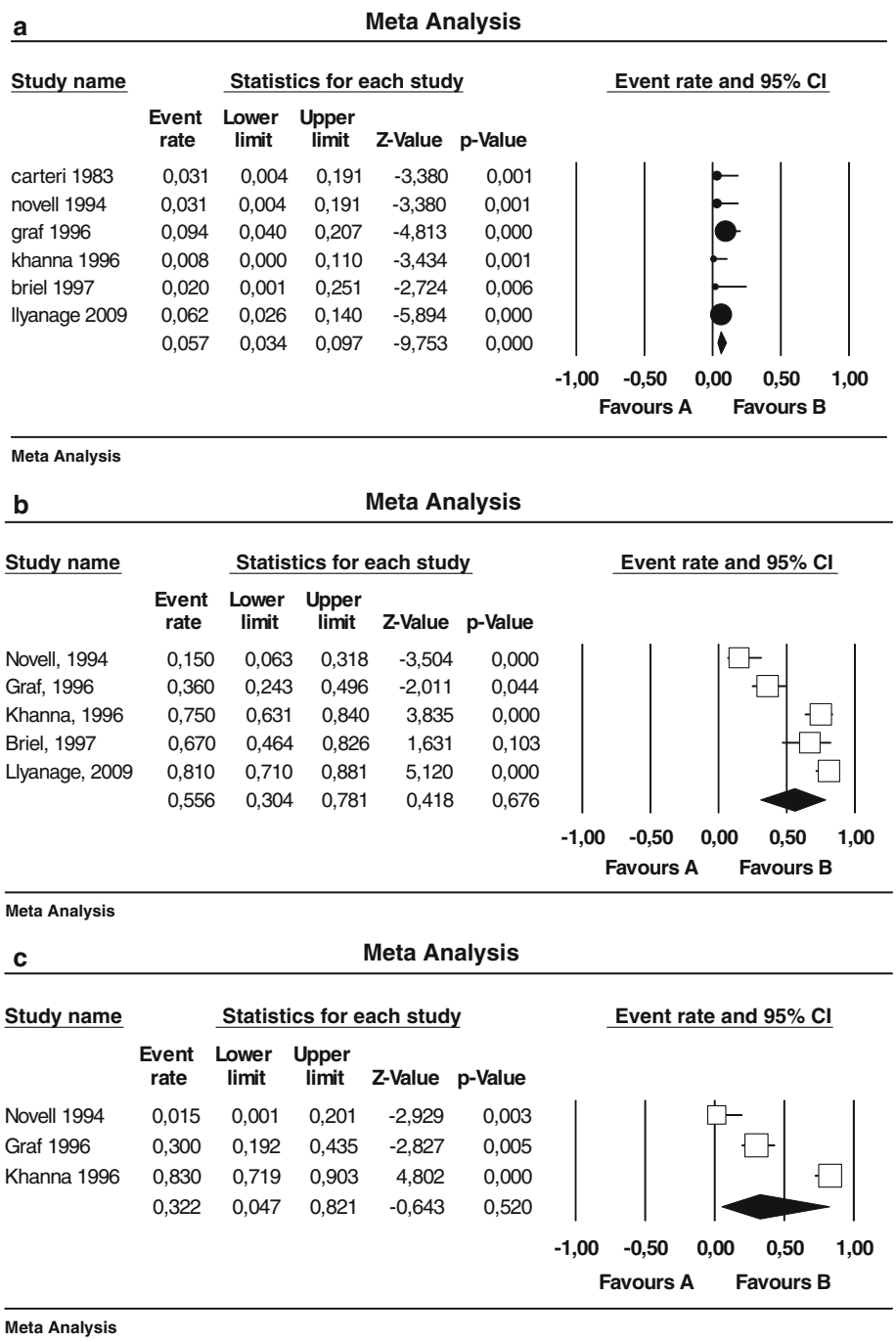


Fig. 2 **a** Forest plot for recurrence after open suture rectopexy. **b** Forest plot of improvement in incontinence after open suture rectopexy. Random model. Carter [18] excluded because of data not suitable for the meta-analysis. **c** Forest plot of improvement in constipation after open suture rectopexy. Random model. Carteri and Llyange excluded from meta-analysis because of data not reported

mesh repair (event rate, 0.133; 95% CI, 0.060–0.269; Z value $= -4.207$; $P < 0.001$).

Laparoscopic rectopexy

Since its introduction, laparoscopic rectopexy gained rapidly in popularity given that it is simple and easy to perform and has several short-term advantages, i.e. reduced postoperative pain, a shorter hospital stay and shorter convalescence period.

In order to perform a meta-analysis of the long-term functional results reported from the clinical series, we divided patients who underwent laparoscopic rectopexy into two subgroups: patients who had suture rectopexy and those who had mesh rectopexy.

Suture rectopexy

Table 4 [37–43] lists 7 studies, published between 1999 and 2007, which were conducted on patients who

Table 3 Results of mesh rectopexy: open approach

Authors	Year	*N* Pts	Procedure	Continence improvement %	Constipation improvement %	Recurrence *N* (%)	Follow-up (months)
Penfold and Hawley [24]	1972	101	Post mesh	22	NS	3 (2, 97)	48
Morgan et al. [25]	1972	150	Post mesh	42	58	3 (2)	36
Notaras [26]	1973	19	Post mesh	NS	NS	0	84
Launer et al. [27]	1982	54	Ripstein	41	0 (10 worsening)	6 (11, 1)	64
Holmstrom et al. [28]	1986	108	Ripstein	37	0 (17 worsening)	4 (3, 7)	83
Roberts et al. [29]	1988	135	Ripstein	78	69	13 (9, 6)	41
Novell et al. [19]	1994	31	Post mesh	3	0 (48 worsening)	2 (6, 4)	47
Keighley and Shouler [30]	1984	100	Post mesh	64	NS	0	24
Tjandra et al. [31]	1993	142	Ripstein	18	0	10/142	50
Galili and Rabau [32]	1997	37	Post mesh	NS	NS	1 (2, 7)	44
Yakut et al. [7]	1998	48	Post mesh	NS	0	0	38
Aitola et al. [33]	1999	96	Post mesh	26	24	6 (6, 2)	78
Schultz et al. [34]	2000	69	Ripstein	20 (10 worsening)	37 (8 worsening)	1 (1, 4)	82
Mollen et al. [35]	2000	18	Post mesh	NS	0	0	42
Winde et al. [36]	1993	47	Ripstein-Corman	23	17	0	51

Post posterior, *NS* not stated

underwent laparoscopic suture rectopexy with a follow-up longer than 16 months. The 7 studies contained a total of 180 patients; the largest was based on 72 patients, and the smallest on 4 patients. Follow-up ranged from 24 to 48 months [37–43].

The recurrence rate ranged from 0 to 7%. Benoist et al. [41] and Heah et al. [40] did not report recurrence data. Figure 4a shows the outcome of quantitative analysis for recurrence using the random effect model: event rate, 0.068; 95% CI, 0.030–0.149; Z value $= -5.878$; $P < 0.001$.

The rate of postoperative improvement in incontinence ranged from 50 to 82%. Kessler et al. [37], Wang et al. [42] and Hsu et al. [43] did not report data on recurrence. The rates of improvement in constipation after the operation ranged from 0 to 69%. Kessler et al. [37] and Wang et al. [42] did not report data on constipation. Hsu [43] reported postoperative development of constipation in one case. Benoist et al. [41] reported worsening of constipation in 11% of patients.

Figure 4b shows the outcome of quantitative analysis for incontinence using the random effect model: there was significant improvement in incontinence after the operation (event rate, 0.668; 95% CI, 0.518–0.791; Z value $= 2.182$; $P = 0.029$).

Figure 4c illustrates the outcome of quantitative analysis for constipation using the random effect model with no statistically significant improvement in constipation after suture rectopexy (event rate, 0.309; 95% CI, 0.084–0.687; Z value $= -0.990$; $P = 0.322$).

Mesh rectopexy

The use of meshes in laparoscopic rectopexy has been introduced in recent years. Table 5 [41, 44–55] shows 13 studies published between 1999 and 2008 with more than 10 patients who underwent mesh rectopexy, with a follow-up longer than 16 months. The 13 studies contained a total of 607 patients; the largest was based on 109 patients, and the smallest on 14 patients. Follow-up ranged from 18 to 106 months.

After rectal mobilization, the mesh was inserted between the sacrum and the rectum and fixed to sacral promontory and lateral rectal wall in 3 studies (posterior approach). In 10 studies, ventral mesh rectopexy was performed.

The recurrence rate ranged from 0 to 7.14%. Recurrence was not reported in one posterior mesh study [41], and recurrence rates were 0 and 3.4% [44, 45] in the other two posterior mesh series. Regarding ventral mesh rectopexy, recurrence ranged from 0 to 7.14% [46, 55].

In most studies, particularly those by European authors, ventral mesh rectopexy was performed using the Orr Loygue technique. Surgical procedures that involve extensive mobilization and mesh fixation are likely to correct prolapse and minimize recurrences. Postoperative constipation is the most common side effect after mesh rectopexy and is reported in up to 50% of patients. Several authors found that the preservation of lateral ligaments of the rectum significantly reduced the risk of postoperative constipation. The Orr Loygue technique with preservation

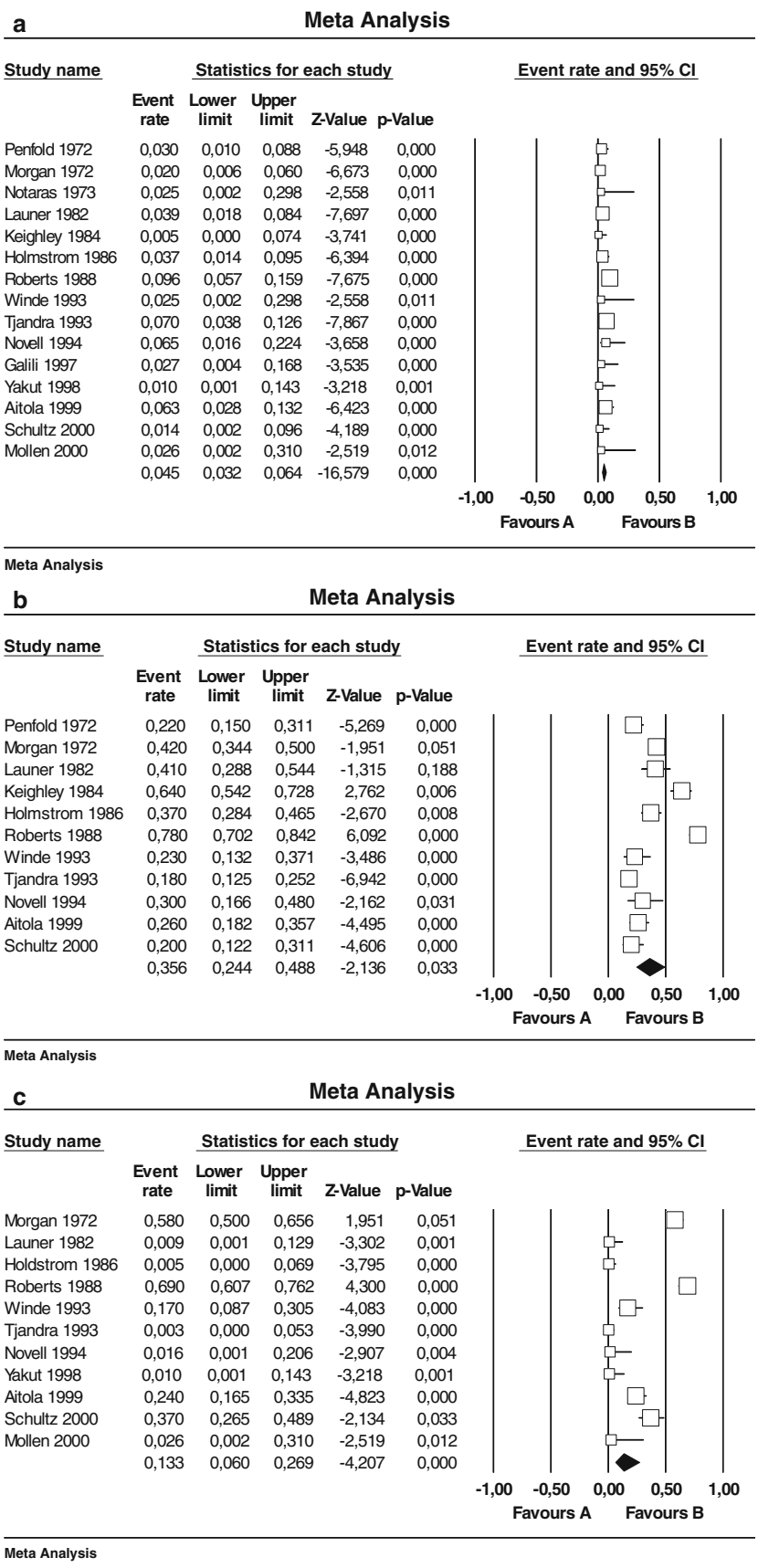


Fig. 3 **a** Forest plot of recurrence after open mesh rectopexy (posterior mesh rectopexy and Ripstein procedure). Random model. **b** Forest plot of improvement in incontinence after open mesh rectopexy (posterior mesh rectopexy and Ripstein procedure). Random model. Notaras [26], Galili and Rabau [32] and Yakut et al. [7] have been excluded because of lack of data. **c** Forest plot of improvement in constipation after open mesh rectopexy (posterior mesh rectopexy and Ripstein procedure). Random model. Penfold and Hawley [24], Notaras [26], Keighley and Shouler [30] and Galili and Rabau [32] have been excluded because of lack of data

Table 4 Results of suture rectopexy: laparoscopic approach

Authors	*N* Pts	Procedure	Continence improvement %	Constipation improvement %	Recurrence *N* (%)	Follow-up (months)
Kessler et al. [37]	32	SR	NS	NS	2 (6)	48
Bruch et al. [38]	72	SR	64	76	0	24
Kellokumpu et al. [39]	17	SR	82	70	2 (7)	24
Heah et al. [40]	25	SR	50	11 worsening	NS	NS
Benoist et al. [41]	18	SR	77	NS	0	67
Wang et al. [42]	4	SR	0	0	0	2–36
Hsu et al. [43]	12	–	0	0*	0	32

SR suture rectopexy, *N Pts* number of patients, *NS* not stated

* Obstructive defecation syndrome in 1 patient

of the rectal lateral ligaments for the best possible preservation of rectal and urogenital innervation has been used extensively in France and the rest of Europe.

Figure 5a illustrates the outcome of quantitative analysis for recurrence using the random effect model: event rate, 0.033; 95% CI, 0.021–0.052; Z value $= -14.420$; $P < 0.001$.

The rate of postoperative improvement in incontinence ranged from 27 to 90%, and the rate of improvement in constipation after the operation ranged from 0 to 84%. Lechaux et al. [46] reported worsening of incontinence and constipation in 27 and 4% of patients, respectively. Douard et al. [47] and Marchal et al. [51] reported worsening of constipation in 52 and 58% of patients, respectively, after ventral mesh repair. Himpens et al. [44] and Benoist et al. [41] reported worsening of constipation in 38 and 21% of patients, respectively, after posterior mesh repair [41, 44].

Figure 5b shows the outcome of quantitative analysis for incontinence using the random effect model. There was significant improvement in incontinence after the operation (event rate, 0.765; 95% CI, 0.586–0.882; Z value $= 2{,}779$; $P = 0.005$).

Figure 5c illustrates the outcome of quantitative analysis for constipation using the random effect model with no statistically significant improvement in constipation after mesh repair (event rate, 0.347; 95% CI, 0.185–0.555; Z value $= -1.450$; P 0.147).

Rectopexy plus resection

The addition of sigmoid resection to rectopexy (the Frykman-Goldberg procedure) combines the advantages of rectal mobilization, sigmoid resection and rectal fixation. Most series used resection plus suture rectopexy. Few authors performed resection plus posterior mesh rectopexy. In order to perform a meta-analysis of the long-term functional results reported by the authors, we divided patients into two subgroups: patients who underwent open resection rectopexy and those who underwent laparoscopic resection rectopexy.

Open resection rectopexy

Table 6 [7, 31, 56–60] lists 7 studies published between 1985 and 1999 with 10 patients or more who underwent resection rectopexy with a follow-up longer than 16 months. The 7 studies contained a total of 393 patients; the largest was based on 176 patients, and the smallest on 10 patients. Follow-up ranged from 17 to 98 months.

The recurrence rate ranged from 0 to 8.3%. Figure 6a shows the outcome of quantitative analysis for recurrence using the random effect model (event rate, 0.049; 95% CI, 0.030–0.078; Z value $= -11.720$; $P < 0.001$).

The rate of postoperative improvement in incontinence ranged from 11 to 90%, and the rate of improvement in constipation after the operation ranged from 18 to 56%. No worsening of incontinence or constipation was described after the intervention.

Figure 6b illustrates the outcome of quantitative analysis for incontinence using the random effect model. Most studies reported an improvement in incontinence, but it was not statistically significant (event rate, 0.638; 95% CI, 0.428–0.805; Z value $= 1.297$; $P = 0.195$).

Figure 6c shows the outcome of quantitative analysis for constipation using the random effect model. Although most trials reported an improvement in constipation, it was not statistically significant (event rate, 0.419; 95% CI, 0.275–0.578; Z value $= -1$; $P = 0.317$).

Laparoscopic resection rectopexy

Table 7 [12, 38, 46, 61–63] shows 6 studies published between 1998 and 2005 with 10 patients or more who underwent resection rectopexy, with a follow-up longer than 12 months. The 6 studies contained a total of 244

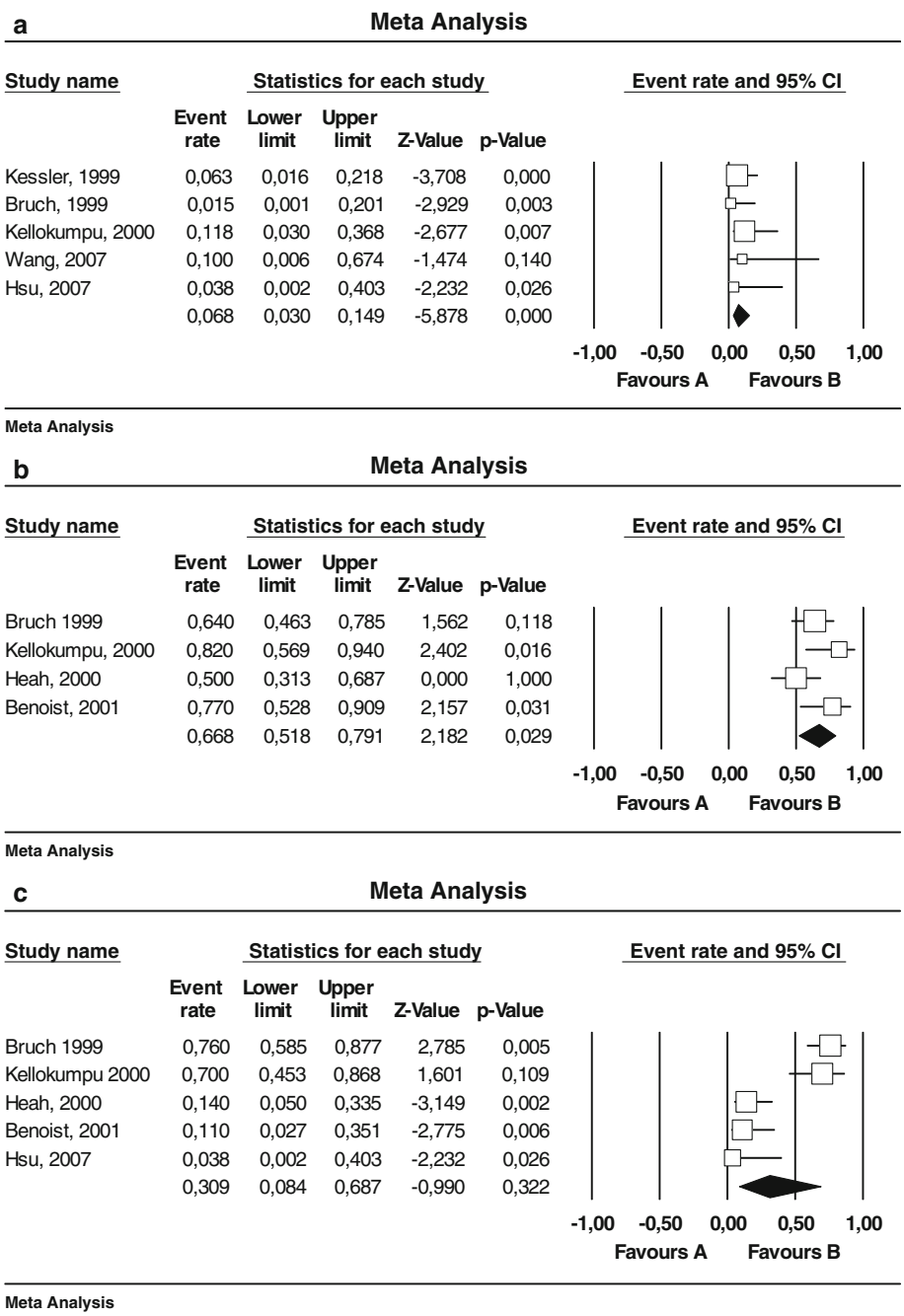


Fig. 4 **a** Forest plot of recurrence after laparoscopic suture rectopexy (random model). Heah et al. [40] and Benoist et al. [41] excluded because data not suitable for meta-analysis. **b** Forest plot of the improvement in incontinence after laparoscopic suture rectopexy. Random model. Wang and Hsu have been excluded because of lack of data, and Kessler has been excluded because of data not suitable for meta-analysis. **c** Forest plot of improvement in constipation after laparoscopic suture rectopexy. Random model. Wang et al. [42], Kessler et al. [37] excluded form the meta-analysis because of not reported data

patients; the largest was based on 124 patients, and the smallest on 10 patients. Follow-up ranged from 12 to 36 months.

No recurrence was reported by the authors except for Xynos et al. [62] and Rose et al. [63] who did not report information about recurrence. Figure 7a shows the outcome of quantitative analysis for recurrence using the random effect model (event rate, 0.022; 95% CI, 0.004–0.102; Z value $= -4.595$; $P < 0.001$).

The rate of postoperative improvement in incontinence ranged from 38 to 100%, and the rate of improvement in constipation after the operation ranged from 8 to 76%. Lechaux et al. [46] reported worsening of continence and constipation in 8% of patients.

Figure 7b illustrates the outcome of quantitative analysis for incontinence using the random effect model. There was significant improvement in incontinence after the operation (event rate, 0.691; 95% CI, 0.515–0.824; Z value $= 2.124$; $P = 0.034$).

Figure 7c shows the outcome of quantitative analysis for constipation using the random effect model. There was no significant improvement in constipation after the operation (event rate, 0.630; 95% CI, 0.402–0.811; Z value $= 1.122$; $P = 0.262$).

Table 5 Results of mesh rectopexy: laparoscopic approach

Authors	Year	Procedure	*N* Pts	Continence improvement %	Constipation improvement %	Recurrence *N* (%)	Follow-up (months)
Himpens et al. [44]	1999	Post mesh	37	92	0 (38 worsening)	0	26
Zittel et al. [45]	2000	Post mesh	29	76	0	1 (3, 4)	22
Benoist et al. [41]	2001	Post mesh	14	10	0 (21 worsening)	NS	47
Lechaux et al. [46]	2005	Orr-Loygue	35	27 (4 worsening)	19 (27 worsening)	2 (5, 7)	36 (7–77**)
Douard et al. [47]	2003	Orr-Loygue	31	96	26 (54 worsening)	0	28 (13–57**)
D'Hoore et al. [48]	2004	Ventral mesh	42	90	84	2 (4, 7)	61 (29–98**)
Slawik et al. [49]	2007	Ventral mesh	80	91	80	0	54
D'Hoore and Penninckx [50]	2006	Ventral mesh	109	NS	NS	3 (2, 75)	NS
Marchal et al. [51]	2005	Orr-Loygue	49	73	33 (58 worsening)	2 (4, 08)	106 (14–276**)
Portier et al. [52]	2006	Orr-Loygue	73	62, 5†	54†	3 (4, 1)	27, 5 (6–84**)
Vanden Esschert et al. [53]	2008	Ventral mesh	17	*	*	0	38
Cristaldi et al. [54]	2007	Ventral mesh	63	90	78	1 (1, 6)	18 (3–36**)
Marceau et al. [55]	2005	Orr-Loygue	28	*	*	2 (7, 1)	34 (5–82**)

N Pts number of patients, *NS* not stated

* Grouped data; ** range; † patients cured

Discussion

The management of rectal prolapse is still a challenge with no clear predominant treatment of choice. Although short-term results are in favour of laparoscopic surgery, few comparisons have been made of the long-term functional results of laparoscopic and open surgery or different surgical techniques.

In this large study, in contrast to previous meta analyses, a meta-analysis of the long-term functional outcomes of open and laparoscopic procedures for treating rectal prolapse was performed, taking into consideration both comparative and non-comparative trials and only mid- and long-term follow-up (longer than 16 months). Besides, we analysed the functional outcomes of each rectopexy technique whether open or laparoscopic: suture, mesh rectopexy and rectopexy associated with resection.

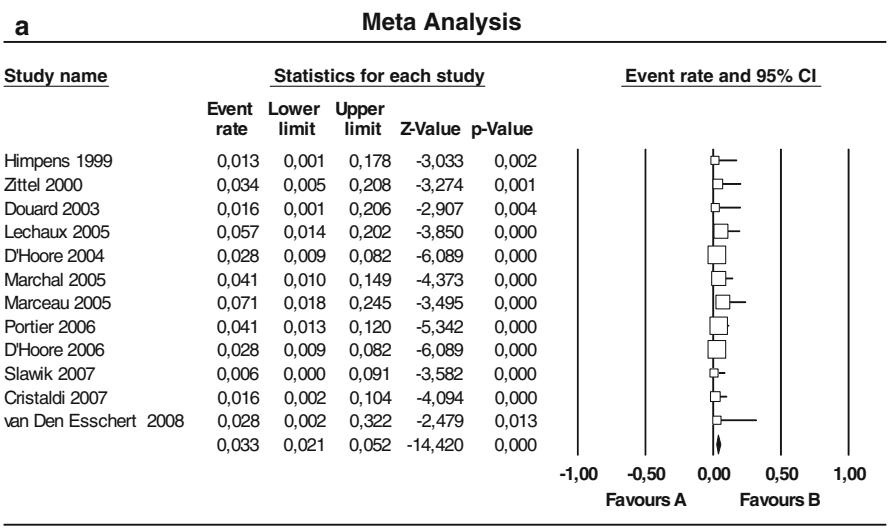
Recurrence after surgery for rectal prolapse is a key measure of successful long-term outcome [11].

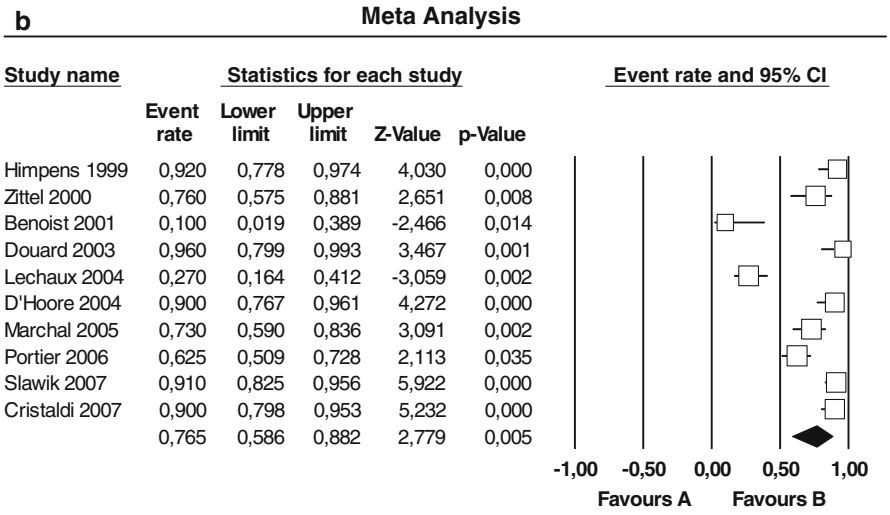
The rate of recurrence varies in the literature according to the type of repair, the length of follow-up and the definition of relapse [64, 65]. Most studies showed that the recurrence rates for rectal prolapse after either laparoscopic or open surgery are lower than 10% [11]. Our meta-analysis of studies comparing open and laparoscopic procedures showed no statistically significant difference in recurrence between the two approaches ($P = 0.852$). Similarly, considering non-comparative trials, the event rate for recurrence after open and laparoscopic suture rectopexies was comparable as was that after open and laparoscopic mesh procedures.

Moreover, the event rate for recurrence after laparoscopic resection rectopexy was slightly lower than that after open resection rectopexy (ER 0.022 vs. 0.049). These data may be subject to bias considering the number of laparoscopic patients (244 laparoscopic vs. 393 open resection rectopexy) as well as the more recent data of laparoscopic studies and thus the better surgical technique of laparoscopic procedure itself in terms of rectal mobilization, type of mesh used and mesh fixation.

In all the trials analysed, synthetic meshes were used (Prolene, Goretex, Marlex, Nylon meshes). To date, we have no data about long-term outcomes and recurrence after procedures using biologic meshes.

Fig. 5 **a** Forest plot of recurrence after laparoscopic mesh rectopexy (posterior mesh rectopexy and ventral mesh rectopexy). Random model. **b** Forest plot of improvement in incontinence after laparoscopic mesh rectopexy (posterior mesh rectopexy and ventral mesh rectopexy). Random model. D'Hoore and Penninckx [50] was excluded because of lack of data. Esschert et al. [53] and Marceau et al. [55] reported data not suitable for meta-analysis. **c** Forest plot of improvement in constipation after laparoscopic mesh rectopexy. Random model. D'Hoore and Penninckx [50] was excluded because of lack of data. van den Esschert reported grouped data not suitable for meta-analysis





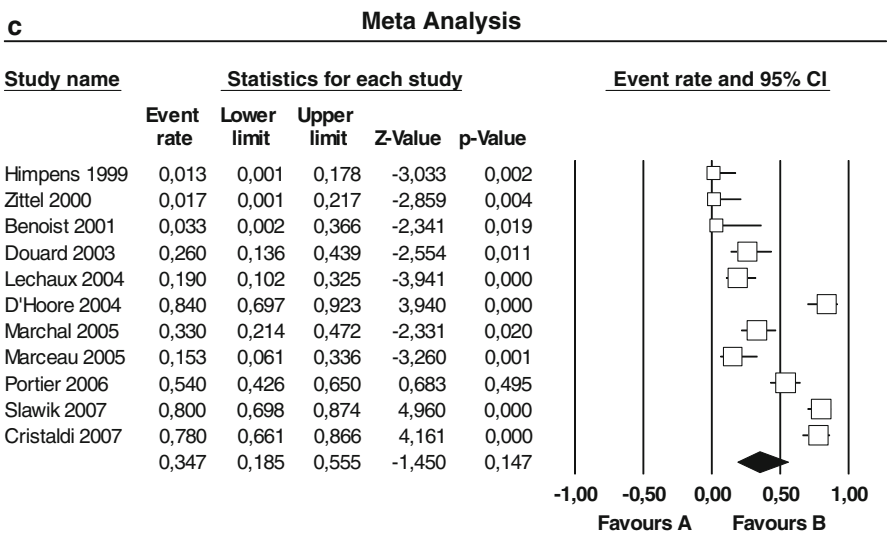


Table 6 Results of rectopexy plus resection: open approach

Authors	Year	*N* Pts	Procedure open	Continence improvement %	Constipation improvement %	Recurrence *N* (%)	Follow-up (months)
Watts et al. [56]	1985	80	SR + Res	78	NS	2 (2, 5)	48
Tjandra et al. [31]	1993	18	SR + Res	11	56	NS	50
Deen et al. [57]	1994	10	SR + Res	90	NS	0	17
Huber et al. [58]	1995	42	SR + Res	44	18	0	54
Yakut et al. [7]	1998	19	SR + Res	NS	NS	0	38
Kim et al. [59]	1999	176	SR + Res	55	42	9	98
Husa et al. [60]	1988	48	SR + Res	90	56	4 (8, 3)	51, 6

SR suture rectopexy, *Res* resection, *N Pts* number of patients, *NS* not stated

Constipation is a major functional problem for patients with rectal prolapse, with conflicting results both for open and for laparoscopic procedures [65]. The only theme that seems clear from the literature is that postoperative constipation after rectopexy is not completely understood, and previous comparisons between laparoscopic and open surgery failed to reveal significant long-term functional differences between the two groups [11, 65–67].

Actually, constipation may be obstructive (bowel intussusception into the rectum, enterocele, puborectalis dissynergia) or secondary to colonic dysmotility [11]. Besides, postoperative constipation may be due to colonic dysmotility [11], denervation, division of the lateral rectal ligaments and sigmoid kinking secondary to rectal mobilization [11, 65]. Accordingly, Nelson and coworkers in a recent Cochrane review on 12 trials and 380 patients reported that division, rather than preservation, of the lateral ligaments was associated with less recurrent prolapse but a higher rate of postoperative constipation [67]. Furthermore, rectal resection was associated with rectopexy according to the theory that the removal of the redundant sigmoid colon could result in less kinking at the rectosigmoid angle and thus improvement in transit into the rectum [11]. Other advantages include avoiding torsion or volvulus of the redundant sigmoid colon and achieving a straighter course and less mobility of the left colon [66].

Nonetheless, in literature, the addition of sigmoid resection is associated with variable results in terms of postoperative constipation [65]. The procedure seems well suited to patients with a long redundant sigmoid and a long history of constipation [66].

In our quantitative analysis, most resection rectopexy studies reported an improvement in constipation after the operation. However, it was not statistically significant either for open ($P = 0.317$) or for laparoscopic procedures ($P = 0.212$).

Furthermore, although the analysis showed a statistically significant improvement in constipation after open mesh repair ($P < 0.001$), several authors reported a noteworthy worsening of evacuation [19, 27, 28, 34]. This heterogeneity can be explained considering the differences in technique that can have a significant effect on function: degree and type of rectal mobilization (lateral dissection and anterior dissection).

Besides this, according to previous meta-analyses [67, 68], our quantitative analysis of studies comparing laparoscopic and open surgery failed to reveal significant differences in constipation between the two groups ($P = 0.377$).

Different mechanisms of faecal incontinence in patients with rectal prolapse have been suggested: pudendal nerve neuropathy, direct sphincter trauma from the rectal intussusception, chronic stimulation of the rectoanal inhibitory reflex and impaired rectal sensation [11]. Continence is restored after surgery in a high percentage of patients with rectal prolapse [66]. In our quantitative analysis, most of the studies reported an improvement in incontinence after the operation that was statistically significant after laparoscopic surgery and open mesh rectopexies. Finally, according to previous results [67, 68], no difference was found in continence in the meta-analysis of trials comparing open and laparoscopic surgery. The exact mechanism of continence restitution has not been firmly established. Suggested mechanisms include restoration of internal anal sphincter function, improved rectal compliance and anorectal sensation and the effect of postoperative constipation that protects patients from incontinence.

The present large meta-analysis includes several limitations. First of all, there was a significant clinical and statistical heterogeneity in the studies, and the heterogeneity of study objectives, study design and outcomes made the analysis difficult. Many review objectives were covered by only one or two studies with small numbers of participants. Clinical variations included surgical skills of the surgeons involved, patients' demographic characteristics, baseline characteristics and differences in bowel preparation. An important limitation of this study is that it does not attempt to evaluate the different laparoscopic surgical

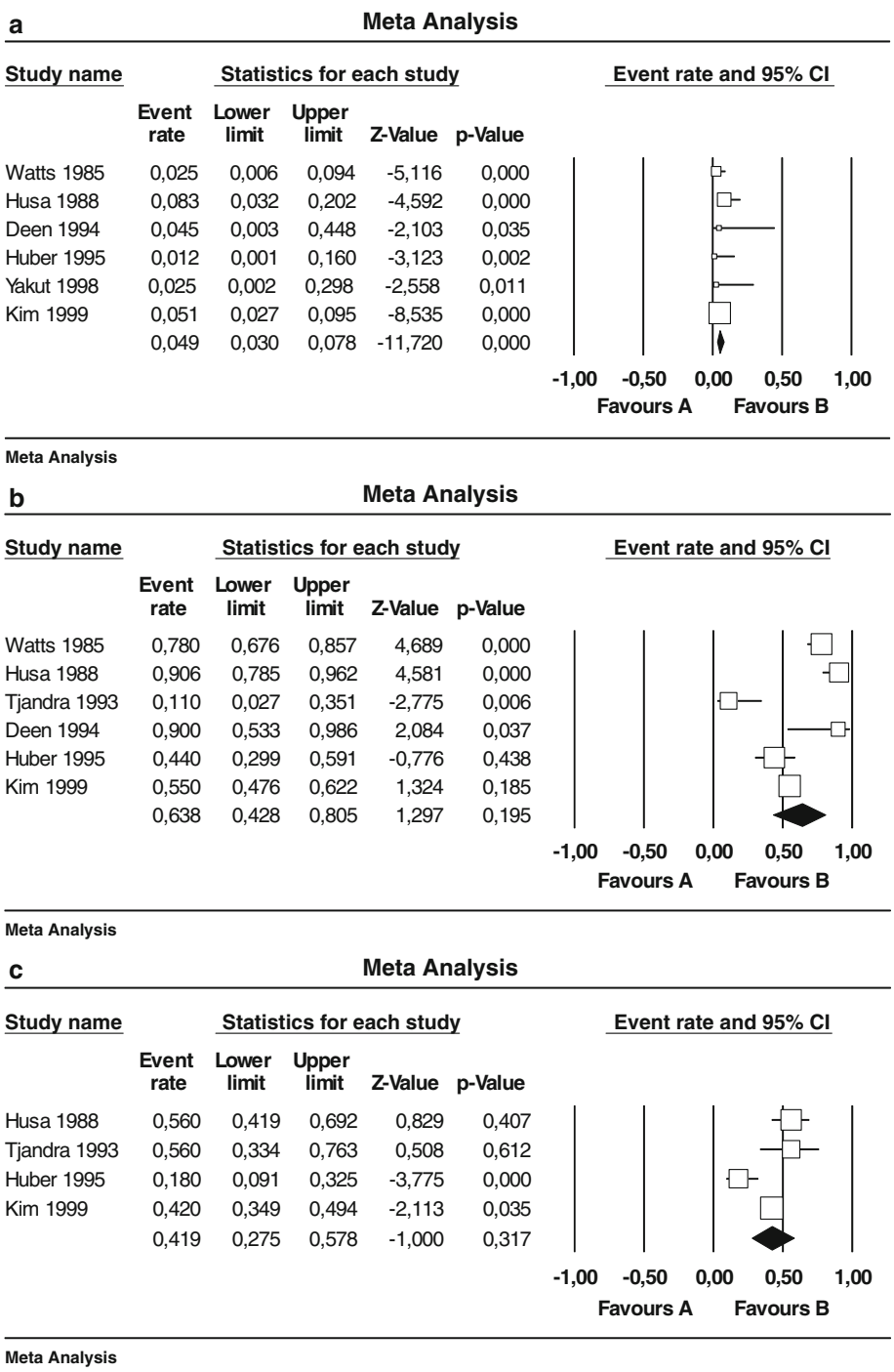


Fig. 6 **a** Forest plot of recurrence after open suture rectopexy plus resection. Random model. Tjandra et al. [31] has been excluded because of lack of data. **b** Forest plot of improvement in incontinence after open suture rectopexy plus resection. Random model. Yakut et al. [7] was excluded because of lack of data. **c** Forest plot of improvement in constipation after suture rectopexy plus resection. Random model. Watts et al. [56], Deen et al. [57] and Yakut et al. [7] were excluded because of lack of data

techniques and methods for reducing the prolapse itself. Furthermore, most comparative trials were non-randomized and therefore have inherent weaknesses. There is also a possibility of observer bias due to the differences in patient management and follow-up measures.

Furthermore, to date, we have no data regarding the use of new tools such as biomeshes instead of synthetic materials in order to improve tissue integration and functional outcomes. In the future, robotic surgery could improve rectal mobilization and make mesh fixation with stitches easier to perform, thus improving functional outcome.

Nevertheless, our results are in line with previous reviews, add weight to the meta-analyses from 2005, 2009 and the Cochrane review [67–69] and indicate that good long-term results can be achieved with laparoscopic

Table 7 Results of rectopexy plus resection: laparoscopic approach

Authors	Year	*N* Pts	Procedure	Continence improvement %	Constipation improvement %	Recurrence *N* (%)	Follow-up
Stevenson et al. [61]	1998	34	SR + Res	70	64	0	18
Xynos et al. [62]	1999	10	SR + Res	100	NS	NS	12
Bruch et al. [38]	1999	40	SR + Res	64	76	0	24
Demirbas et al. [12]	2005	23	SR + Res	85	30	0	36
Lechaux et al. [46]	2005	13	SR + Res	38 (8 worsening)	8 (8 worsening)	0	36
Rose et al. [63]	2002	124	SR + Res	NS	NS	NS	NS

SR suture rectopexy, *Res* resection, *N Pts* number of patients, *NS* not stated

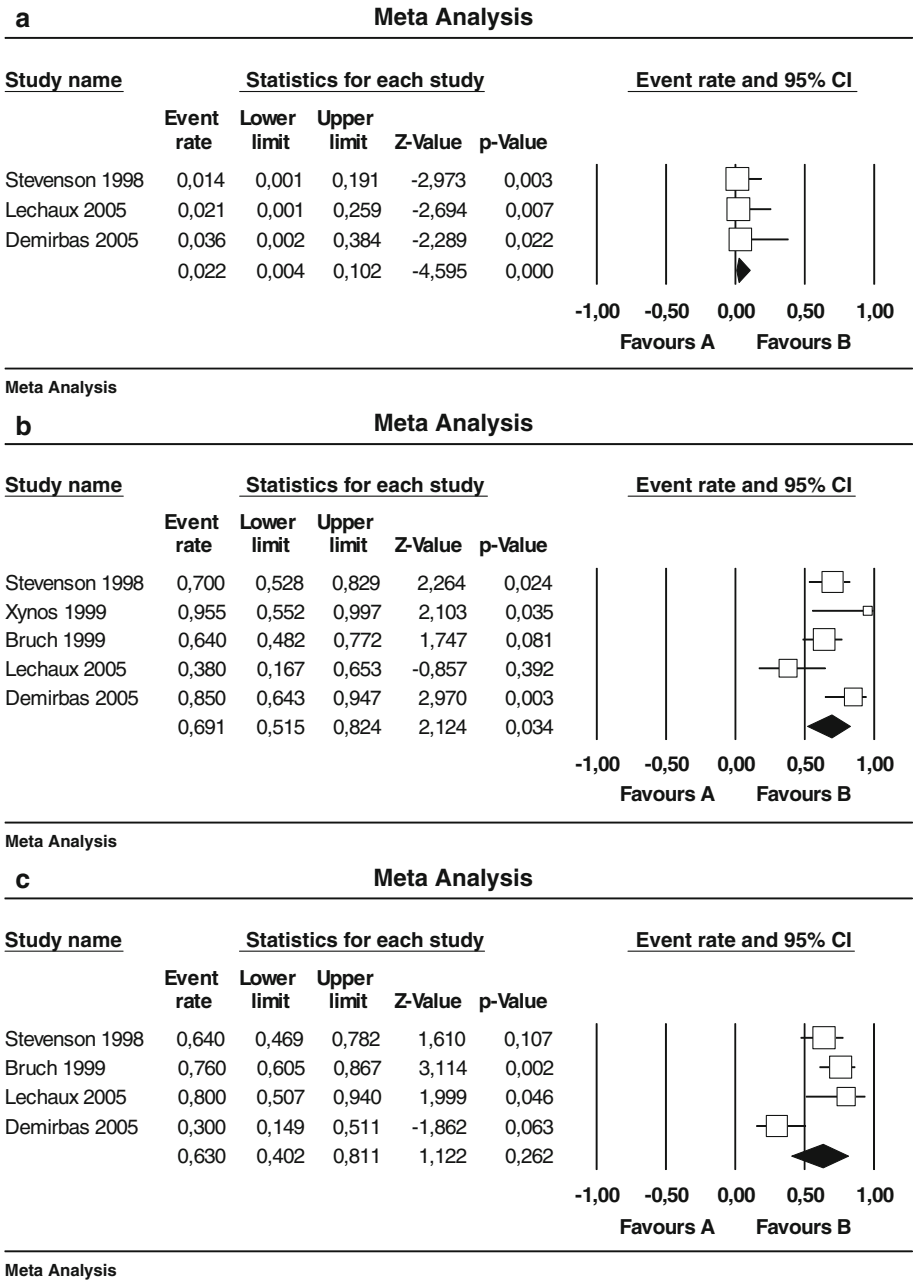


Fig. 7 **a** Forest plot of recurrence after laparoscopic suture rectopexy plus resection. Random model. Xynos et al. [62] and Rose et al. [63] were excluded because of lack of data. **b** Forest plot of improvement in incontinence after laparoscopic suture rectopexy plus resection. Random model. Rose et al. [63] was excluded because of lack of data. **c** Forest plot of improvement in constipation after laparoscopic suture rectopexy plus resection. Random model. Rose et al. [63] and Xynos et al. [62] were excluded because of lack of data

rectopexy and resection rectopexy in an institution with expertise in laparoscopic colorectal surgery. Larger rigorous randomized trials are needed to improve the evidence in order to define the gold standard for treating rectal prolapse; the results of one such trial are awaited.

Conflict of interest The authors declare that no conflict of interest exists.

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