Review

Perineal resectional procedures for the treatment of complete rectal prolapse: A systematic review of the literature

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HIGHLIGHTS

- 39 studies including 2647 patients were included.
- Recurrence occurred in 16.6% of patients.
- Median rate of recurrence was 11.4% for Altemier versus 14.4% for Delorme.
- FI improved in 61.4% of patients after Altemeir versus 69% after Delorme.
- Complications were recorded in 13.2% of patients.

ARTICLE INFO

ABSTRACT

Background and aim: Several procedures for the treatment of complete rectal prolapse (CRP) exist. These procedures are performed via the abdominal or perineal approach. Perineal procedures for rectal prolapse involve either resection or suspension and fixation of the rectum. The present review aimed to assess the outcomes of the perineal resectional procedures including Altemeier procedure (AP), Delorme procedure (DP), and perineal stapled prolapse resection (PSR) in the treatment of CRP.
Patients and methods: A systematic search of the current literature for the outcomes of perineal resectional procedures for CRP was conducted. Databases queried included PubMed/MEDLINE, SCOPUS, and Cochrane library. The main outcomes of the review were the rates of recurrence of CRP, improvement in bowel function, and complications.
Results: Thirty-nine studies involving 2647 (2390 females) patients were included in the review. The mean age of patients was 69.1 years. Recurrence of CRP occurred in 16.6% of patients. The median incidences of recurrence were 11.4% for AP, 14.4% for DP, and 13.9% for PSR. Improvement in fecal incontinence occurred in 61.4% of patients after AP, 69% after DP, and 23.5% after PSR. Complications occurred in 13.2% of patients. The median complication rates after AP, DP and PSR were 11.1%, 8.7%, and 11.7%, respectively.
Conclusion: Perineal resectional procedures were followed by a relatively high incidence of recurrence, yet an acceptably low complication rate. Definitive conclusions on the superiority of any procedure cannot be reached due to the significant heterogeneity of the studies.

1. Introduction

Complete full-thickness rectal prolapse is a term that describes the protrusion of the full-thickness of the rectal wall through the anus [1]. Although the true incidence of complete rectal prolapse cannot be precisely estimated; it commonly affects the elderly

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population and 80–90% of patients are female [2].

The pathogenesis of rectal prolapse remains controversial. Full-thickness prolapse can be recognized either by being a sliding hernia through a defect in the pelvic fascia or an internal rectal intussusception that progresses to a full-thickness prolapse with straining. Mucosal prolapse maybe attributed to stretching and weakness of the connective tissue attachments of the rectal mucosa [3].

Although the treatment of rectal prolapse is surgical, no consensus on the optimal surgical procedure exists and over 100 various procedures were described [4]. Surgical management of full-thickness rectal prolapse can be broadly classified into abdominal and perineal procedures. The abdominal procedures involve either resection of the sigmoid colon or fixation of the rectum to the sacrum by sutures or by the use of a foreign material such as mesh or sponge. Perineal procedures also entail either resection as Altemeier, Delorme, and stapled resection procedures, or suspension of the rectum as the external pelvic rectal suspension (EXPRESS) procedure [5]. Perineal rectosigmoidectomy was first described by Mikulicz in 1889, then devised by Miles, and ultimately popularized by Altemeier and Culbertson in the late 1960s [6].

Abdominal procedures with lower recurrence rates were traditionally favored for the younger, healthier patients owing to their high morbidity rates. Conversely, older, debilitated patients were treated more often with a perineal approach being deemed safer, although with a much higher incidence of recurrence [7].

However, with the introduction of laparoscopy the abdominal approach re-emerged as a viable option for the treatment of rectal prolapse in the elderly patients with significant co-morbidities. Laparoscopic ventral mesh rectopexy (LVMR) [8] achieved highly satisfactory outcomes attaining a weighted mean recurrence rate of 3.4% according to a systematic review [9]. Furthermore, Gultekin et al. [10] concluded that LVMR can be safely conducted in select elderly patients.

Despite that many studies [11,12] have documented the excellent results of LVMR regarding the low recurrence and complication rates and improvement in bowel function, LVMR is not universally employed. Therefore, perineal procedures still have a role in the management of rectal prolapse.

The present review aimed to assess the outcomes of the perineal resectional procedures including Altemeier, Delorme, and perineal stapled prolapse resection (PSR) operations in the treatment of external full-thickness rectal prolapse. The objective was to determine the recurrence and complication rates and functional outcomes.

2. Methods

2.1. Search strategy

The protocol of this review has been registered in the International prospective register of systematic reviews (PROSPERO).

An organized search of the current literature was made by three of the authors to evaluate the outcomes of the perineal resectional procedures (Altemeier, Delorme, and PSR) in patients with complete full-thickness rectal prolapse in adherence to the screening guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Fig. 1) [13]. Electronic databases including PubMed/Medline, SCOPUS, and Cochrane Library were searched for published and ahead-of-publication studies from January 2000 to July 2016. PubMed function "related articles" was used to search further articles. The reference section of each publication was searched manually for relevant articles.

We used the following keywords while conducting the

literature search: "Altemeier," "perineal rectosigmoidectomy," "Delorme," "Rectal mucosectomy," "perineal stapled prolapse resection," "stapled prolapse resection," "STARR," "contour transtar," "external rectal prolapse," "complete rectal prolapse," "rectal prolapse," and "fecal incontinence". The medical subject headings (MeSH) terms: (rectal prolapse), (surgery), (surgical stapler), and (perineum) were also searched.

Duplicate reports and conference abstracts with no full-text version were identified and excluded. Articles were systematically screened by title, then by abstract screening as an initial step, and subsequently by full-text screening. The full text versions of the selected articles were reviewed independently by four reviewers to check eligibility.

2.2. Inclusion criteria

The studies that were considered eligible for this review involved patients with complete (external) rectal prolapse who underwent perineal resectional procedures including Altemeier procedure, Delorme procedure, and PSR. Complete rectal prolapse was defined by the studies as full-thickness circumferential protrusion of the rectum throughout the anal canal. Both comparative and cohort studies that evaluated any of the three procedures were included in the review. Only articles in English language were included.

2.3. Exclusion criteria

We excluded irrelevant articles, editorials, comments, case reports, reviews, and meta-analyses. The studies that involved less than ten patients or followed the patients for less than 12 months were excluded. Articles that did not report the recurrence and/or complication rates and articles that reported the outcome of the perineal procedures in a collective manner without stating the individual outcomes of each procedure clearly were also excluded.

2.4. Assessment of methodological quality and bias within the included studies

Two reviewers independently assessed the methodological quality and risk of bias in each study, and any discrepancies in interpretation were resolved by discussion or by consulting a third reviewer. The revised grading system of the Scottish Intercollegiate Guidelines Network (SIGN) [14] was used to assess comparative studies, a score of less than 8 indicated poor quality; a score of 8–14 implied fair quality and a score of more than 14 indicated good quality. The checklist for the quality of case series of the National Institute for Health and Clinical Excellence (NICE) [15] was used for the assessment of cohort studies, a score ≤3 indicated poor quality; a score of 4–6 implied fair quality, and a score of ≥7 indicated good quality. The senior author reviewed the collected results on a regular basis.

2.5. Variables collected

Data of the technical and functional outcomes of the perineal resectional procedures were extracted from the studies included in the review. The primary objective was the clinical recurrence of full-thickness rectal prolapse, and the secondary objectives included postoperative improvement of bowel symptoms as constipation and fecal incontinence (FI), functional bowel scores, complication and mortality rates, operative time, and length of hospital stay (LOS). Data that was not clearly reported in each study was considered missing data and was not expressed as lack of the event.
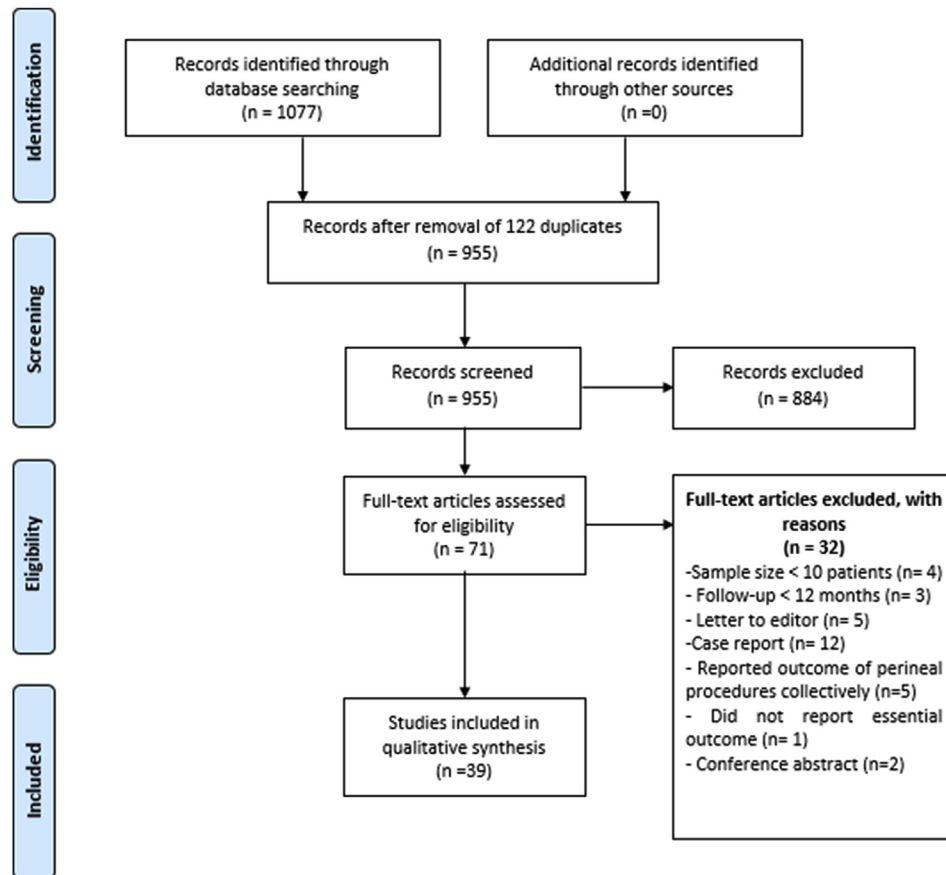
Fig. 1. PRISMA flow diagram for the literature search.

2.5.1. Statistical analysis

Data were extracted from the original articles into fields of Excel (Microsoft Windows). Variables were expressed using mean ± standard deviation (SD), or median and normal range, and percentage of patients reported in each variable. Student t-test was used to compare quantitative variables. P value less than 0.05 was considered significant.

3. Results

3.1. Studies included

After reviewing the full text of 71 articles, 39 of them [16–54] met the eligibility criteria of the review. Eighteen studies [16–29,31,32,35,36] evaluated the outcome of Altemeier proced-ure, 12 [37–48] evaluated Delorme procedure, three [30,33,34] assessed both Altemeier and Delorme operations, and six [49–54] studies reported the outcomes of PSR. Overall, the studies included were 24 retrospective, 11 prospective observational, and four randomized controlled trials (RCTs) [19,30,46,48].

The geographic distribution (Fig. 2) of where the studies were undertaken was as follows: for the Altemeier procedure nine studies were undertaken in European countries, eight in the United States, three in Brazil, and one in Japan; for the Delorme procedure five studies were undertaken in European countries, four in Egypt, three in the United States, one in Japan, one in South Korea and one multicenter study conducted in Egypt and Saudi Arabia; and for the PSR four studies were undertaken in European countries, one in Israel, and one in India.

Quality assessment of the studies showed that ten (25.6%) studies were of good quality whereas the remaining 29 were of fair quality. A summary of the characteristics of each study is shown in Table 1.

3.2. Patients

A total of 2647 patients were included in the review. 1748, 712, and 187 patients underwent Altemeier procedure, Delorme pro-cedure, and PSR, respectively. Patients included 2390 (90.3%) fe-males and 257 (9.7%) males of a mean age of 69.1 ± 11.6 (range, 32–81.5) years. The mean age of patients was above 50 years in all the studies except three studies [46–48] which were conducted in Egypt (Table 2). There were 235 patients with recurrent rectal prolapse after previous operations.

3.3. Technical details

The procedures were conducted under general anesthesia in five studies [25,28,32,44,45] spinal/epidural anesthesia in eight studies [19,26,27,41,43,48,51,52], whereas 16 studies used either general, regional, or local anesthesia. Ten studies did not report the type of anesthesia used.

The Altemeier procedure was performed using hand-sewn anastomosis in 1389 (93.3%) patients and stapled anastomosis in 100 (6.7%) patients. Simultaneous levatorplasty with Altemeier procedure was performed in 649 (43.5%) patients. Simultaneous levatorplasty with Delorme procedure was performed in 64 (9%) patients. As for PSR, the median number of cartridges used per procedure was 6.5 (range, 6–7) cartridges.

Altemeier and Delorme procedures had comparable mean operation time and median length of the resected specimen, whereas PSR had much shorter operation time (41 Vs 96 min) and
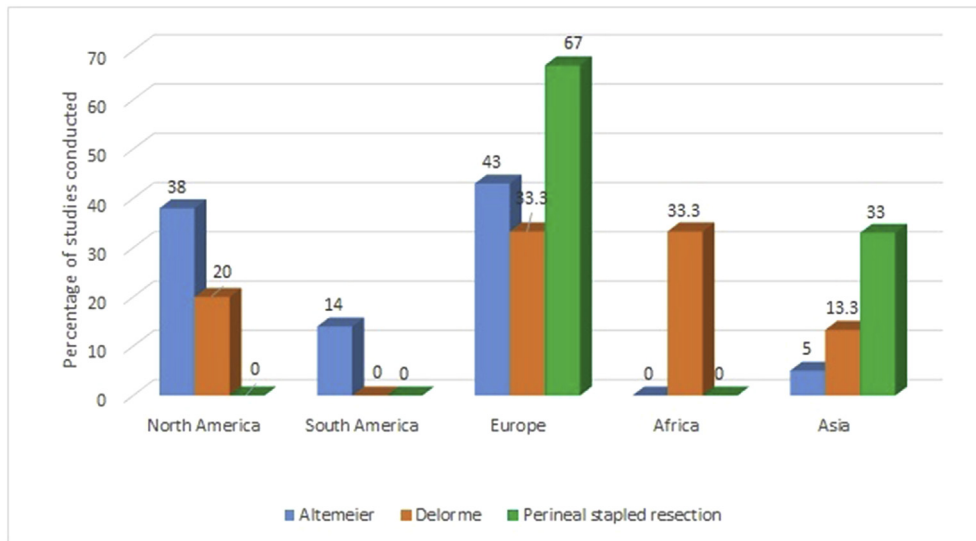
Fig. 2. Geographic distribution of the studies included.

lower median length of the resected specimen. Altemeier and PSR had a median hospital stay time of 4.9 and 5 days, compared to 3.5 days for the Delorme procedure (Table 2).

3.4. Recurrence

Overall, 441 (16.6%; 95% CI: 15.3—18.1) patients developed recurrence of full-thickness rectal prolapse after the perineal procedures. The numbers of patients who were diagnosed with recurrent prolapse after Altemeier, Delorme, and PSR were 275, 131, and 35, respectively. The median incidences of recurrence were 11.4% for Altemeier, 14.4% for Delorme, and 13.9% for PSR (Fig. 3).

3.5. Improvement in bowel symptoms

The studies that evaluated the improvement of bowel symptoms after each procedure reported improvement in FI in 61.4% of patients after Altemeier procedure, 69% after Delorme procedure, and 23.5% after PSR. The decline in the median Wexner continence score [55] before and after each procedure is shown in Table 2.

Improvement in FI was more notable in the five studies in which levatorplasty was added to Delorme procedure (78 of 107 patients improved; 72.9%) as compared to the six studies in which the authors did not add levatorplasty (118 of 177 patients improved; 66.6%). As for Altemeier procedure, the improvement in FI was reported only in the studies in which Altemeier was combined was levatorplasty whereas the studies in which no levatorplasty was performed did not disclose the functional improvement in the continence state, thus the comparison was not possible.

Improvement in constipation was recorded in 68.1%, 59.8%, and 64.7% of patients after Altemeier, Delorme, and PSR, respectively.

3.6. Physiologic parameters

For the Altemeier procedure, six studies [18,19,22,27,28,33] used anal manometry for evaluation of the anal sphincters before and after the procedure and one study used pudendal nerve terminal motor latency (PNTML) test. Chun et al. [18] reported a slight decrease in the median latency on both sides postoperatively (2.33—2.17 milliseconds on the left side and 2.25 to 2.21 milliseconds on the right side).

Two studies [19,27] employed anal electromyography (EMG) for the assessment of the anal sphincters. Both studies have reported an increased duration, polyphasic motor unit potentials in all cases, indicating a neurogenic damage in the muscle. Also, the tonic, voluntary, and reflex activity was reduced in all patients, whereas fibrillation potentials, positive sharp waves were observed in 70% of patients in the first study and 77.8% in the second study. A paradoxical puborectalis contraction was observed in around half of the patients in both trials. Sacral reflex latency was prolonged in 82.5% and 88.9% of the patients in the two studies with a slight decrease of latency after Altemeier procedure.

Five studies [33,38,45,46,48] utilized anal manometry for the assessment of anal sphincter function before and after the Delorme procedure and two studies [38,46] measured PNTML; Youssef et al. [46] evaluated PNTML during patients' recruitment to exclude patients with pudendal neuropathy from the study whereas Tsunoda et al. [38] used PNTML postoperatively and reported prolonged latency on both sides (2.5 on the left side, 2.7 on the right side).

None of the studies that evaluated PSR used anal manometry, or PNTML for the physiologic assessment of the anal sphincters. The postoperative changes in the mean resting and squeeze anal pressures after Altemeier and Delorme procedures are shown in Table 3.

3.7. Complications

A total of 350 (13.2%; 95% CI: 12—14.5) complications were encountered after perineal resectional procedures. The median rates of complications after Altemeier, Delorme and PSR were 11.1%, 8.7%, and 11.7%, respectively (Table 2).

The majority of complications (n = 252; 72%) were of Grade I-II on the Clavien-Dindo scale of surgical complications [56]. Altemeier procedure had higher rate of major (grade III-IV) complications compared to Delorme and PSR (39.7% Vs 8.7% and 16.3%).

The most common complication after Altemeier procedure was anastomotic leakage (1.88%). Seven studies that used either manual or stapled technique of Altemeier reported AL in 8 (2.4%) of 337 patients, whereas 14 studies that used manual technique only reported AL in 25 (2.2%) of 1152 patients. Suture line and staple line bleeding was the commonest complication after Delorme and PSR

(3.1% and 3.7%).

3.8. Mortality

Seventeen (0.64%) mortalities were recorded; nine after Altemeier and eight after Delorme. Mortality rates ranged from 0 to 3.8% for Altemeier and 0–5.2% for Delorme procedure. There were no recorded mortalities after PSR.

4. Discussion

Surgery for rectal prolapse, whether using the abdominal or perineal approach, usually employs one of two principal strategies: resection or suspension and fixation of the rectum. The perineal procedures employing the suspension/fixation strategy as the EX-PRESS [5] procedure and transperineal mesh rectopexy [57] are less frequently described in the literature compared to the perineal resectional procedures.

The perineal resectional procedures include either full-thickness excision of the rectum and part of the sigmoid colon (Altemeier procedure), mucosal resection with plication of the muscle layer of the rectum (Delorme procedure), or resection of the prolapsed rectum using staplers as PSR and stapled transanal longitudinal posterior proctectomy (STALPP) [58] for external rectal prolapse, and stapled transanal rectal resection (STARR) for internal rectal prolapse.

Due to the interest and popularity of the laparoscopic approach [10–12] for the management of external rectal prolapse, the question about the current role and utility of the perineal approach has been constantly raised [44]. The abdominal approach is thought to have much lower recurrence rates than the perineal approach [7], nonetheless randomized trials [30,48] have not found a definite superiority of the abdominal over the perineal approach. Hence, the present review was conducted aiming to reach one or more conclusions about the overall and the individual efficacy and complication rates of the perineal resectional procedures to answer the question about their contemporary role in the treatment of full-thickness rectal prolapse.

Thirty-nine studies including more than 2600 patients were included to the review. More than 90% of the patients were female of a mean age of around 70 years in concordance with what has been previously reported in the literature [2]. Interestingly, the

Table 1
Characteristics of the studies included.

Study	Procedure	Type of the study	Country	Period of the study	No	Age	Complications (%)	Recurrence (%)	Quality	Follow-up in month
Kimmins et al. [16]	Altemeier	Retrospective	USA	1993–1999	63	78.6	7 (11.1)	4 (6.3)	7 (good)	20.8
Sobrado et al. [17]	Altemeier	Retrospective	Brazil	1980–2002	12	56.7	1 (8.3)	0	4 (fair)	49
Chun et al. [18]	Altemeier	Retrospective	USA	1989–1999	109	75.7	26 (23.8)	18 (16.5)	6 (fair)	28.8
Boccasanta et al. [19]	Altemeier	RCT*	Italy	1999–2003	40	70.9	2 (5)	5 (12.5)	15 (good)	29.3
Habr-gama et al. [20]	Altemeier	Retrospective	Brazil	1985–2000	44	76	4 (9.1)	3 (6.8)	7 (good)	49
Glasgow et al. [21]	Altemeier	Retrospective	USA	1994–2004	103	75	7 (6.8)	9 (8.7)	6 (good)	21
Altomare et al. [22]	Altemeier	Retrospective	Italy	1998–2006	93	77	21 (22.6)	17 (18.2)	7 (good)	41
Lee et al. [23]	Altemeier	Retrospective	USA	2000–2009	123	80.7	17 (13.8)	14 (11.3)	12 (fair)	12.8
Cirocco [24]	Altemeier	Retrospective	USA	2000–2009	103	68.9	14 (13.6)	0	6 (fair)	43
Kim et al. [25]	Altemeier	Prospective	Germany	2004–2008	38	75	7 (18.4)	1 (2.6)	5 (fair)	24
Ozawa et al. [26]	Altemeier	Retrospective	Japan	2000–2006	13	76	2 (15.3)	1 (7.7)	5 (fair)	29.3
Boccasanta et al. [27]	Altemeier	Prospective	Italy	2007–2008	18	75	0	0	5 (fair)	30
Ris et al. [28]	Altemeier	Prospective	Belgium	1992–2006	60	77	7 (11.6)	8 (13.3)	6 (fair)	48
Ding et al. [29]	Altemeier	Retrospective	USA	2000–2009	136	78	23 (16.9)	29 (21.3)	6 (fair)	42.5
Senapati et al. [30]	Mixed	RCT*	UK	2001–2008	201	73	Altemeier 2 (1.9) Delorme 0	Altemier 24 (23.5) Delorme 31 (31.3)	15 (good)	36
Tiengtianthum et al. [31]	Altemeier	Retrospective	USA	1994–2012	518	77	47 (9)	118 (22.7)	4 (fair)	16.2
Kim et al. [32]	Altemeier	Retrospective	Germany	2004–2012	63	79	12 (19)	8 (12.7)	6 (fair)	53
Mik et al. [33]	Mixed	Retrospective	Poland	2003–2010	68	68	Altemier 2 (4.4) Delorme 2 (8.7)	Altemeier 6 (13.3) Delorme 2 (8.7)	5 (fair)	32
Elagili et al. [34]	Mixed	Retrospective comparative	USA	2005–2013	75	72	Altemier 5 (22.7) Delorme 4 (7.5)	Altemier 2 (9.1) Delorme 9 (16.9)	12 (fair)	13
Akin et al. [35]	Altemeier	Retrospective	Turkey	2010–2013	10	68	0	0	5 (fair)	34
Pinheiro et al. [36]	Altemeier	Retrospective	Brazil	1999–2015	33	67	3 (9.1)	8 (24.2)	5 (fair)	50
Watts and Thompson [37]	Delorme	Prospective	UK	1983–1994	101	73	2 (1.9)	30 (29.7)	5 (fair)	36
Tsunoda et al. [38]	Delorme	Retrospective	japan	1994–2002	31	70	4 (12.9)	4 (12.9)	5 (fair)	39
Watkins et al. [39]	Delorme	Retrospective	USA	1975–2001	52	68	17 (32.7)	5 (9.6)	4 (fair)	61.4
Watkins et al. [40]	Delorme	Retrospective comparative	France	1978–2001	60	67	12 (20)	14 (23.3)	11 (fair)	73
Montero et al. [41]	Delorme	Prospective	Spain	2000–2005	21	59	1 (4.7)	2 (9.5)	5 (FAIR)	34
Liberth et al. [42]	Delorme	Retrospective	USA	1994–2006	76	74	19 (25)	11 (14.4)	6 (fair)	49.2
Elgadaa et al. [43]	Delorme	Prospective	multicenter	1998–2008	20	55	6 (30)	2 (10)	5 (fair)	65
Lee et al. [44]	Delorme	Retrospective	South Korea	1997–2007	19	67.2	0	3 (15.8)	4 (fair)	54
Mahmoud et al. [45]	Delorme	Retrospective	Egypt	NA	37	54	19 (51.3)	6 (16.2)	5 (fair)	27.4
Youssef et al. [46]	Delorme	RCT*	Egypt	2007–2011	82	40	5 (6.1)	7 (8.5)	14 (good)	12
Osman et al. [47]	Delorme	Prospective	Egypt	2010–2013	13	32	10 (7.7)	1 (7.7)	6 (fair)	12
Emile et al. [48]	Delorme	RCT*	Egypt	2012–2014	25	42	3 (12)	4 (16)	15 (good)	18
Mistrangelo et al. [49]	PSR*	Prospective	Italy	2009–2014	27	78	8 (29.6)	4 (14.8)	7 (good)	30.3
Hummel et al. [50]	PSR*	Retrospective	Switzerland	2007–2015	64	74.5	19 (29.6)	19 (29.7)	6 (fair)	72
Ram et al. [51]	PSR*	Prospective	Israel	2010–2011	14	80	0	4 (28.5)	5 (Fair)	32
Bajaj et al. [52]	PSR*	Prospective	India	2010–2012	12	59	1 (8.3)	0	7 (good)	36
Petersen et al. [53]	PSR*	Prospective	Germany	2009–2012	24	81.5	2 (8.3)	2 (8.3)	5 (fair)	13
Sehmer et al. [54]	PSR*	Retrospective	Switzerland	2007–2011	46	78.5	7 (15.2)	6 (13)	5 (fair)	25.5

*RCT: randomized controlled trial.
*PSR: perineal stapled prolapse resection.

Table 2
Comparison between the outcomes of the perineal resectional procedure reviewed.

Variable	Altemeier	Delorme	Perineal stapled resection
Number of studies	21 (3 shared with Delorme)	15 (3 shared with Altemeier)	6
Publication date	2001—2016	2000—2016	2013—2016
Total number of patients	1748	712	187
Female patients (%)	1622 (92.7)	596 (83.7)	172 (91.9)
Mean age in years ± SD	73.5 ± 5.5	60.7 ± 13.3	75.2 ± 8.3
Recurrent/Primary cases (%)	169/984 (14.6)	44/353 (12.4)	22 (11.7)
Levatorplasty (%)	649 (43.5)	64 (9)	0
Mean operation time in minutes ± SD	95.1 ± 20.2	96.1 ± 43.9	41 ± 5.6
Median length of resected specimen in cm (range)	11.9 (7.2—23.4)	11.45 (7.8—15)	9.3 (8— 10)
Median hospital stay in days (range)	4.9 (1.5—13)	3.5 (1.3—12)	5 (3—7.9)
Recurrence (%)	275 (15.7%) [14.1—17.5]	131 (18.4)	35 (18.7)
[95% CI*]		[15.7—21.4]	[13.8—24.9]
Median recurrence rate (range)	11.4 (0—24.2)	14.4 (7.7—31.3)	13.9 (0—29.7)
Improvement of FI (%)	256/417 (61.4) [56.6—65.9]	196/284 (69)	31/132 (23.5)
[95% CI*]		[63.4—74.1]	[17—31.4]
Median preoperative Wexner continence score (range)	13.4 (11—15.7)	11.3 (7—16)	12.2 (9.7—16)
Median postoperative Wexner continence score (range)	7.6 (4.5—11.4)	3.8 (2.7—6)	4.2 (1—5)
Improvement of constipation (%) [95% CI*]	113/166 (68.1) [60.6—74.7]	85/142 (59.8)	22/34 (64.7)
		[51.6—67.5]	[47.9—78.5]
Complications (%)	209 (11.9)	104 (14.6)	37 (19.8)
[95% CI*]	[10.5—13.5]	[12.2—17.4]	[14.7—26.1]
Median complication rate (range)	11.1 (0—23.8%)	8.7 (0—51.3)	11.7 (0—29.6)
Clavien-Dindo Grade I-II	126 (60.2%)	95 (91.3%)	31 (83.7)
Clavien-Dindo Grade III-VI	83 (39.7%)	9 (8.7%)	6 (16.3)
Most common complication (n; %)	Leak (33; 1.88)	Bleeding (22; 3.1)	Bleeding (7; 3.7)
Anastomotic dehiscence (%)	33 (1.88)	9 (1.2)	5 (2.6)
Stricture (%)	21 (1.2)	11 (1.5)	0
Bleeding (%)	13 (0.7)	22 (3.1)	7 (3.7)
Mortality (%)	9 (0.5)	8 (1.1)	0
Median follow-up in months (range)	32 (12.8—53)	36 (12—73)	26.1 (13—72)

*CI: confidence interval.
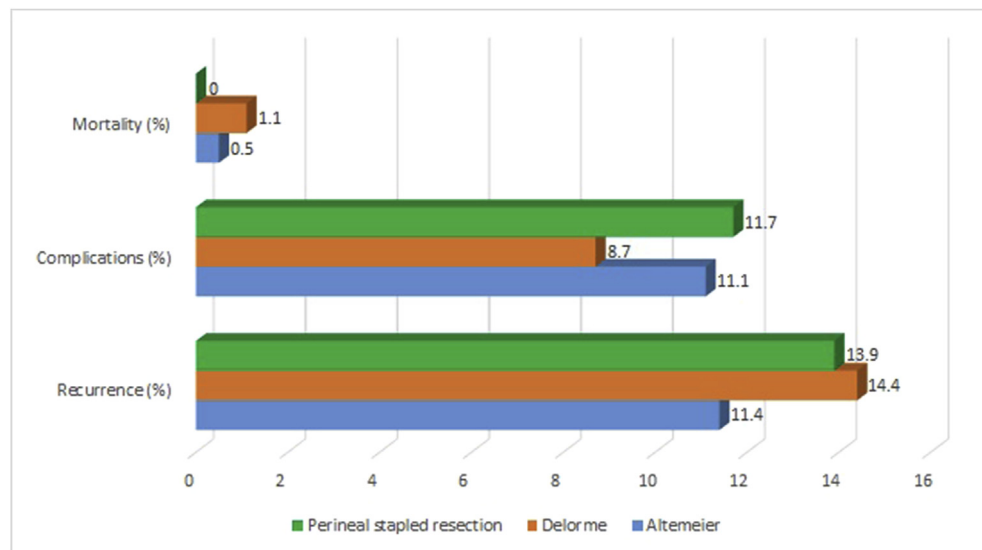
Fig. 3. Comparing the outcomes of the three perineal resectional procedures.

Table 3
Changes in the anal pressures before and after Altemeier and Delorme procedures.

Variable	Altemeier (n = 349)	Delorme (n = 198)	P value
Preoperative resting anal pressure (mean ± SD) in mmHg	30.7 ± 5.7	39.9 ± 10.6	<0.0001
Postoperative resting anal pressure (mean ± SD) in mmHg	35.5 ± 11.3	47.7 ± 14.2	<0.0001
P value	<0.0001	<0.0001	
Preoperative squeeze anal pressure (mean ± SD) in mmHg	47.1 ± 13.7	73.1 ± 23.9	<0.0001
Postoperative squeeze anal pressure (mean ± SD) in mmHg	57.5 ± 8.2	94.3 ± 30.6	<0.0001
P value	<0.0001	<0.0001	

patients in three studies [46—48] were mostly male aging less than 50 years, all of these studies were conducted in Egypt. These peculiar patients' demographics were once attributed to schistosomal pelvic floor myopathy that mainly afflicts young males in Egypt [59]. However, Abou-zeid et al. [60] stated that Schistosoma should not be considered the cause of rectal prolapse in young Egyptian males, but malnutrition and recurrent parasitic infections maybe the actual cause of childhood prolapse that continues through adulthood. Further investigations are needed to reveal other potential etiologies such as underlying ultrastructural alteration of the connective tissues supporting the rectum [61].

The overall recurrence rate of the perineal procedures was around 16%, much higher than the pooled incidence of recurrence of external rectal prolapse (3.4%) [9] ranging from 1.5 to 15.4% [62] and internal rectal prolapse (6.5%) [63] after LVMR. Altemeier procedure had a slightly lower median recurrence rate than Delorme and PSR, however since no direct statistical comparison has been made, the superiority of Altemeier procedure in terms of recurrence cannot be substantiated. It is important to note that the recurrence rates presented in this review reflect the short term follow-up only which may limit the applicability of the results. Recurrence of rectal prolapse after perineal procedures can be substantially higher with longer follow-up.

Unlike Delorme operation, Altemeier procedure entails full-thickness recto-sigmoidectomy which better prevents recurrence than simple mucosal resection, hence the lower incidence of recurrence can be explained. Furthermore, PSR is a relatively new procedure that was devised by Scherer and colleagues [64] in 2008 and high recurrence rates in the early adoption stage of new surgical techniques can be anticipated.

In addition to the recurrence of rectal prolapse, the improvement in bowel function is also an important parameter of the effectiveness of the procedure. The improvement in the continence state was around 60% after Altemeier, 70% after Delorme, and less than 25% after PSR. Given that none of the studies evaluating PSR performed concurrent levatorplasty, unlike the other two procedures, the addition of levatorplasty may have contributed to a further improvement in the continence level. Indeed, a randomized trial [46] has clearly demonstrated that the addition of levatorplasty to Delorme procedure did not only improve FI, but also served to improve preoperative constipation and decrease the incidence of recurrence significantly more than Delorme procedure alone.

Although abdominal procedures have lower documented recurrence rates; the improvement in bowel function may not be equally satisfactory. According to a systematic review [9] of LVMR for rectal prolapse, the weighted mean rate of improvement in FI was 45%, much lower than Altemeier and Delorme procedures. However, another recent review reported higher range of continence improvement (50—93%) after LVMR [62]. Measuring the degree of continence improvement using the Wexner continence score, the median reduction of the score after the perineal resectional procedures ranged between 5.8 and 8 points versus 4.1 points after LVMR and 3.5 points after posterior sutured rectopexy according to a recent randomized trial by Lundby et al. [65].

All of the perineal resectional procedures conferred a significant improvement of constipation in 59—68% of the patients with the highest improvement achieved by the Altemeier procedure. Conversely, the largest randomized trial [30] comparing abdominal and perineal approaches for rectal prolapse did not report significant differences between the two approaches regarding bowel function and life quality.

Few studies employed physiologic assessment of the anorectal functions after perineal procedures. Despite the paucity of useful data in this regard; significant increase in the resting and squeeze anal pressures and a slight decrease in the PNTML were noted after Altemeier and Delorme procedures. This functional improvement can be attributed on one hand to the regain of anal sphincter tone after removal of the prolapsed rectum which has been stretching and attenuating their muscle fibers, and to the release of pudendal nerve compression on the other hand. Levatorplasty and postanal repair contributed also to the better improvement of the anorectal functions.

The perineal resectional procedures were comparable regarding the technical aspects, nevertheless PSR had shorter operation time owing to the relatively simple technique employed whereas Delorme procedure had a shorter hospital stay. Simultaneous levatorplasty was performed in around half of the patients who underwent Altemeier procedure and around 10% of patients who underwent Delorme procedure. The possibility of adding levatorplasty to the perineal procedures to further improve the continence state can be considered a unique advantage of the perineal approach in comparison with the abdominal approach. Another potential advantage is the feasibility to perform perineal procedures using different types of anesthesia according to the general condition of the patient, whereas abdominal procedures are usually performed under general anesthesia.

Approximately 13% of the patients developed complications after perineal resectional procedures and less than 20% of the recorded complications were major complications. Delorme procedure achieved lower median complication rate (less than 9%) than Altemeier procedure and PSR (around 11%). The type and severity of complications varied among the procedures as around 10% of complications after Delorme and PSR were major versus 60% after Altemeier procedure which reflects the technically demanding nature of Altemeier procedure that involves full-thickness excision of the rectum with performing a low colo-anal anastomosis. This explains why the most common complication of Altemeier was anastomotic dehiscence and leak. It is worthy to note that the incidence of AL of hand-sewn and stapled anastomoses was more or less the same in line with previous reports [66] that concluded no significant difference between the two anastomotic techniques with regard the incidence of leakage.

Suture and staple line bleeding was the most common complication after Delorme and PSR which may necessitate longer hospitalization of the patient that reached up to 12 days in one report [44]. Other unique complications were recorded as stapler malfunction and entanglement of the posterior vaginal wall during PSR [50].

In summary, the data of the present review tends to refute the well-established notion that abdominal procedures are associated with much lower recurrence and higher morbidity rates than the perineal procedures. According to a recent retrospective study of 231 patients [67], LVMR had a recurrence rate of 11.7%, close to that of Altemier procedure and slightly lower than the median incidence of recurrence for Delorme and PSR. In addition, a recent meta-analysis [63] found the weighted mean complication rate of abdominal rectopexy to be 15%, comparable to the complication rates of the perineal resectional procedures reviewed.

The present review is limited by the fair quality of the majority of the studies included which may influence the overall outcomes of the review. In addition, meta-analysis of the results could not be conducted owing to the marked heterogeneity of the studies which can be attributed to differences in patient populations and/or variations in the methodology of the studies. The continental variation in the technique of repair with Altemier preferred in North and South America, PSR in Europe and Asia, and Delorme in Africa raises a question whether the difference in the outcomes of these procedures was due to the technique per se, or is attributed to different patient populations or varying preferences of the surgeons. Since

the PSR procedure was recently introduced in the management of rectal prolapse, the number of studies and patients included was much lower than the other two well-established techniques. Hence, the outcome of PSR should not be compared directly with that of Altemier and Delorme procedures since PSR is still in the stage of technical adoption. Finally, the relatively short follow-up that ranged from two to three years may prevent making interim conclusions about the recurrence rates and the improvement in bowel function since they can deteriorate with time.

5. Conclusions

Perineal resectional procedures were followed by a relatively high incidence of recurrence, yet an acceptably low complication rate. They also achieved satisfactory improvement in bowel function which was paralleled by similar improvement in physiologic anorectal functions.

Definitive conclusions on the superiority of one procedure over another regarding recurrence and complication rates and functional outcome cannot be reached due to the significant heterogeneity of the studies and the relatively short follow-up.

Although the number of published trials as shown in Fig. 2 may not correlate to the numbers of procedures performed, the PSR seems much more popular in Europe and in Asia than in the rest of the world.

Ethical approval

No ethical approval was required.

Sources of funding

None.

Author contribution

Sameh Hany Emile and **Steven D Wexner** designed the study. **Sameh Hany Emile, Hossam Elfeki, Mostafa Shalaby, and Ahmad Sakr** participated in data collection and analysis, writing and drafting of the manuscript. **Pierpaolo Sileri** participated in data interpretation, drafting and critical revision of the manuscript. **Steven D Wexner** reviewed the collected results on regular basis and participated in drafting and critical revision of the manuscript.

Conflicts of interest

None.

Trial registry number

Reviewregistry266.

Guarantor

Sameh Emile, M.D.

Informed consent

Not applicable to this type of studies (review article).

Protocol registration

The protocol of this review has been registered in the International prospective register of systematic reviews (PROSPERO) under the registration number CRD42016039590.

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