Systematic review

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Treatment options to improve anorectal function following rectal resection: a systematic review

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Abstract

Aim Common problems after rectal resection are loose stools, faecal incontinence, increased frequency and evacuation difficulties, for which there are various therapeutic options. A systematic review was conducted to assess the outcome of treatment options aimed to improve anorectal function after rectal surgery.

Method Publications including a therapeutic approach to improve anorectal function after rectal surgery were searched using the following databases: MEDLINE, PubMed, EMBASE, Pedro, CINAHL, Web of Science, PsychInfo and the Cochrane Library. The focus was on outcome parameters of symptomatic improvement of faecal incontinence, evaluation of defaecation and quality of life.

Results The degree of agreement on eligibility and methodological quality between reviewers calculated with kappa was 0.85. Fifteen studies were included. Treatment options included pelvic floor re-education ($n = 7$), colonic irrigation ($n = 2$) and sacral nerve stimulation (SNS) ($n = 6$). Nine studies reported reduced incontinence scores and a decreased number of incontinent episodes. In 10 studies an improvement in resting and squeeze pressure was observed after treatment with pelvic floor re-education or SNS. Three studies reported improved quality of life after pelvic floor re-education. Significant improvement of the Fecal Incontinence Quality of Life Scale was found in three studies after SNS.

Conclusion Conservative therapies such as pelvic floor re-education and colonic irrigation can improve anorectal function. SNS might be an effective solution in selected patients. However, methodologically qualitative studies are limited and randomized controlled trials are needed to draw evidence-based conclusions.

Keywords Rectal surgery, faecal incontinence, anorectal dysfunction, rehabilitation, pelvic floor exercises, biofeedback, sacral nerve stimulation

What is new in this paper?

There are various therapeutic options to improve faecal incontinence, evacuation difficulties and increased frequency after rectal resection. The present study is, to our knowledge, the first systematic review to assess the symptomatic improvement of faecal incontinence, evaluation of defaecation and quality of life of the therapy options aimed at improving anorectal function after rectal surgery.

Introduction

Anterior resection and restorative proctectomy are well-established procedures for the treatment of rectal cancer [1]. They are, however, associated with an altered bowel pattern and anorectal complications [2]. Minor to major faecal incontinence and evacuation difficulties are common after rectal resection [3,4]. Increased diurnal and nocturnal defaecation frequency and urgency can also occur. Although these may improve over the first 6–12 months [5], a substantial proportion of patients consider anorectal function and health-related quality of life (QoL) to be unsatisfactory [6,7]. Many patients use a protective pad, antidiarrhoeal medication and food and liquid restriction [8]. Despite these disadvantages, most patients prefer some impairment of anorectal function to a permanent stoma [9]. Treatment consists of conservative therapy such as drugs, dietary adjustment, pelvic floor re-education (PFR) and colonic irrigation [10,11]. In selected patients sacral nerve stimulation (SNS) and postanal repair have been used [11–14]. All

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options have been extensively investigated for the treatment of faecal incontinence and constipation of different aetiology. However, the efficacy of these approaches for anorectal dysfunction following rectal resection is unclear. A systematic search of the available literature was carried out.

Method

Data sources

Seven electronic databases (MEDLINE, PubMed, EMBASE, Pedro, CINAHL, Web of Science, PsychInfo and the Cochrane Library) were searched in February 2011 and followed up to January 2012. The following keywords and/or MeSH headings were used in different combinations: restorative proctocolectomy, colorectal surgery, (low) anterior resection (LAR), mesorectal excision, sphincter preservation, sphincter saving surgery, sphincter-preserving surgery (SPS), physical therapy modalities, electric stimulation therapy, rehabilitation, physiotherapy, physical therapy, electrotherapy, biofeedback, colonic irrigation, nerve stimulation, neuromodulation, exercise, training and therapy. Additional relevant papers were identified by examining the reference lists of selected articles.

Study selection

Trials were included when a therapeutic treatment to improve anorectal function after rectal resection was reported. Studies including patients with a mixed aetiology of faecal incontinence were only included if data on anorectal function after rectal surgery were reported separately. Articles written before 1990 and in a language other than English were excluded.

One author (A.M.) screened titles and abstracts to identify possible studies. Two independent reviewers (A.D'H., Sanne Verweijen, Department of Rehabilitation Sciences) evaluated the abstracts and full texts of all unique articles for eligibility. Subsequently, two independent reviewers (A.M., A.M.D.) assigned a methodological quality score to all included studies. Reviewers were not blinded for authors and study outcome. Disagreement was resolved during a consensus meeting.

Quality

Methodological quality was based on the Consolidated Standards of Reporting Trials (CONSORT) statement for randomized trials [15] and the Methodological Index for Non-randomized Studies (MINORS) scale [16]. The CONSORT statement rates the quality of a study on a scale of 0–25 points [15]. The MINORS scale allocates 16 points for noncomparative studies and 24 for comparative studies on study aim, inclusion criteria, data collection, endpoints, unbiased assessment, follow-up period, drop-out description, study size calculation and, if applicable, adequate control group, contemporary control group, baseline equivalence and adequate statistics [16].

Outcome parameters included symptomatic improvement of incontinence score, episodes of incontinence, urgency, need for medication, use of pads, difficulty of defaecation and general and condition-specific QoL).

Statistical analysis

Agreement between reviewers on the eligibility of studies was evaluated with the kappa statistic and agreement on methodological quality with the intraclass correlation coefficient (ICC), using SAS 9.2 software (SAS Institute Inc., Chicago, IL, USA). Descriptive analysis was conducted to determine the mean methodological quality score and standard deviation.

Results

Included studies

In the initial literature search, 2166 articles were retrieved, of which 1796 were unique. The degree of agreement between the two reviewers on eligibility of the selected articles was almost perfect ($K = 0.85$). After a consensus meeting, 41 articles were considered relevant based on their title or abstract. After evaluation of the full text, 15 studies were finally included. A flow chart of the article selection process is given in Fig. 1.

Two retrospective studies [17,18], one case report [19], 11 nonrandomized, prospective case series [20–30] and one randomized controlled trial [31] were included (Table 1). Study quality according to the MINORS scale for nonrandomized (comparative) trials ranged from 9 to 17 with a mean score of 12.5. The total quality score on the CONSORT statement for the single randomized trial was 15.8 (Table 1). Preconsensus agreement on methodological quality between reviewers was high ($ICC_{(2,1)} = 0.90$).

Three out of seven studies that used PFR as biofeedback and/or exercise training, included 70, 88 and 95 patients [18,22,29] (Table 2). However, most studies were small. Two groups who underwent colonic irrigation contained up to 29 patients [17,23]. In the six studies on SNS, sample size ranged from 1 to 15 patients but not all patients had permanent electrode implantation [19,25–28,31].

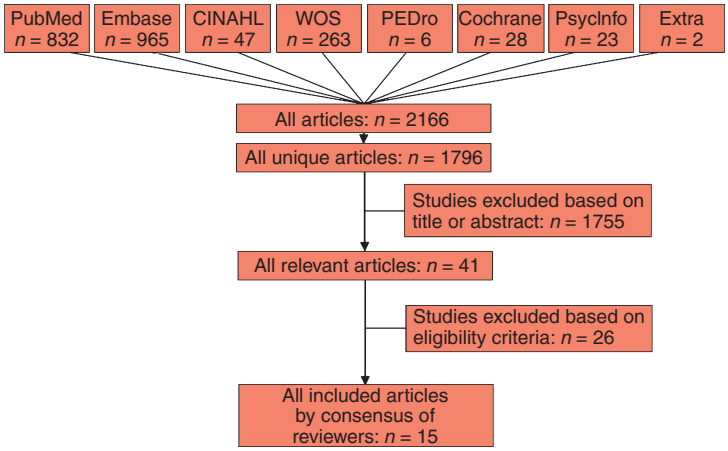

Figure 1 Flow diagram of the selection of articles.

Table 1 Methodological quality of the included studies.

Reference	Year	Country	Study design	Methodological quality
Koch *et al.* [17]	2009	Netherlands	Nonrandomized, retrospective	11
Kim *et al.* [18]	2011	Korea	Nonrandomized, retrospective	12
Matzel *et al.* [19]	2002	Germany	Case report	12
Chiang *et al.* [20]	1997	Taiwan	Nonrandomized, prospective	9
Ho *et al.* [21]	1997	Singapore	Nonrandomized, prospective	12
Allgayer *et al.* [22]	2005	Germany	Nonrandomized, prospective	12
Gosselink *et al.* [23]	2005	Netherlands	Nonrandomized, prospective	12
Ho and Tan [24]	1996	Singapore	Nonrandomized, prospective	13
Uludag *et al.* [25]	2004	Netherlands	Nonrandomized, prospective	13
de Miguel *et al.* [26]	2010	Spain	Nonrandomized, prospective	13
Ratto *et al.* [27]	2005	Italy	Nonrandomized, prospective	14
Jarrett *et al.* [28]	2005	UK	Nonrandomized, prospective	14
Pucciani *et al.* [29]	2008	Italy	Nonrandomized, prospective	14
Laforest *et al.* [30]	2011	France	Nonrandomized, prospective	17
Tjandra *et al.* [31]	2008	Australia	RCT	15.8*

Methodological quality is according to the Methodological Index for Nonrandomized Studies (MINORS) scale for noncomparative (0–16) and comparative (0–24) studies after consensus between both reviewers.
*Methodological quality according to the Consolidated Standards of Reporting Trials (CONSORT) statement (0–25).

Demographic data

In 11 of 15 studies, patients had had surgery for rectal cancer [17–19,21,22,24,26–30]. One study had a mixed patient population: rectal cancer (n = 10) and cervical cancer (n = 1) [21]. In four the pathology was not defined though patients had undergone anterior resection (Table 2) [20,23,25,31]. In most studies the patient was evaluated by physical examination, incontinence questionnaires and diagnostic tests, including anorectal manometry, pudendal nerve terminal motor latency, endoanal ultrasound, electromyography, defaecography and endoscopy. The mean duration of anorectal dysfunction following rectal surgery and before starting the intervention ranged from 1 to 50 months (Table 2) [17–22,24,26,28–30]. This interval was not stated in four studies [23,25,27,31].

Type of treatment

Seven studies used PFR to treat postoperative anorectal disorders (Table 2) [18,20–22,24,29,30]. Two of them investigated the effect of biofeedback alone [20,21]. Biofeedback was supplemented with sphincter-strengthening exercises and/or electrostimulation, volumetric rehabilitation and/or breathing exercises in five studies [18,22,24,29,30]. One study compared patients who received 15 sessions of PFR after stoma closure with a case-matched control group who did not [30]. Intractable faecal incontinence was treated by SNS in six studies [19,25–28,31]. In one of these SNS was compared with PFR, bulking agents and dietary manipulation [31]. Patients used irrigation in two studies [17,23] (Table 2).

Nine of 15 studies had a mean or median follow-up period of at least 12 months [19,21–23,26–28,30,31].

Table 2 Study characteristics.

Reference	*n*	Surgical procedure	Mean duration of symptoms before start intervention	Intervention	Mean follow-up
Chiang *et al.* [20]	6	LAR	18.5 months	PFR	3.0 months
Ho and Tan [24]	7	AR	27.9 months	PFR	10.6 months
Ho *et al.* [21]	11	LAR	33.3 months	PFR	12.0 months
Laforest *et al.* [30]	46	AR	1.0 month	PFR	21.0 months*
Kim *et al.* [18]	70	LAR	25.5 months	PFR	2.5 months
Pucciani *et al.* [29]	88	LAR	22.4 months	PFR	4.0 months
Allgayer *et al.* [22]	95	LAR (41 RT/ 54 nRT)	1.5 month*	PFR	12.0 months
Koch *et al.* [17]	26	LAR	3.1 months	Colonic irrigation	1.6 months
Gosselink *et al.* [23]	29	LAR	NA	Colonic irrigation	80 months†
Matzel *et al.* [19]	1	LAR	43.0 months	SNS	18.0 months
Uludag *et al.* [25]	2	LAR	NA	SNS	1.0 month
Jarrett *et al.* [28]	3	AR/LAR	12.0 months	SNS	12.0 months
Ratto *et al.* [27]	4	AR	NA	SNS	19.5 months
Tjandra *et al.* [31]	3	LAR	NA	SNS	12.0 months
de Miguel *et al.* [26]	15	LAR	50.0 months*	SNS	12.0 months*

*Median.

†Total duration of evaluation.

n, number of patients; start intervention, time span following rectal surgery; AR, anterior resection; LAR, low anterior resection; PFR, pelvic floor re-education; SNS, sacral nerve stimulation; NA, not available.

Mean follow-up after PFR ranged from 3 to 12 months (Table 2). In one trial on retrograde colonic irrigation, patients were followed up to 80 months [23]. In five studies the mean follow-up period was < 4 months [18,20,25,26,29].

Outcome

Faecal incontinence

Faecal incontinence was evaluated by a bowel habit diary, anal manometry and incontinence questionnaires including the Cleveland Clinic Florida (CCF) Incontinence Scoring (IS) system or Wexner Incontinence Score (WIS) [32], Modified Cleveland Clinic Incontinence Score (MCIS) [33], Memorial Sloan Kettering Cancer Center (MSKCC) Bowel Function instrument [34], (modified) Williams classification [35], Pescatori scoring system [33] and self-developed unvalidated questionnaires. Most of these instruments consisted of questions on faecal incontinence, stool frequency, urgency, discrimination, soiling and use of perineal pads and antidiarrhoeal medication. (Table 3).

Pelvic floor re-education

The mean incontinence score decreased significantly in four studies (Table 3) [18,22,29,30]. However, there was no significant difference in continence between groups having and not having rehabilitation in one study. [30]. Kim *et al.* [18] reported a significantly greater improvement in the faecal incontinence score in patients ($n = 35$) who started PFR 18 months or more after surgery compared with patients who started earlier. In the study of Pucciani *et al.* [29] 21 (23.9%) of 88 patients became symptom-free after multimodal rehabilitation. The incontinence score decreased significantly in patients having low anterior resection (LAR) ($P < 0.05$ and LAR with coloanal anastomosis (CAA) ($P < 0.02$). This finding was observed in both men ($n = 34$) ($P < 0.03$) and women ($n = 54$) ($P < 0.02$) [29]. Allgayer *et al.* [22] reported a highly significant effect of short- and long-term training on the MCIS score. Both irradiated ($n = 41$) and nonirradiated ($n = 54$) patients improved equally despite a significantly higher degree of faecal incontinence ($P < 0.001$), stool frequency and loperamide intake in the irradiated group at baseline. Improvement of urgency was one of the most prominent short-term effects in both groups [22]. A significant decrease ($P < 0.05$) in frequency of incontinence episodes was found after PFR, with a more than 50% reduction in incontinence episodes in two studies [21,24]. Furthermore, Ho *et al.* [21] showed a reduced need for antidiarrhoeal drugs ($P < 0.05$) and protective pads after biofeedback in all patients with faecal incontinence.

Table 3 Evaluation of faecal incontinence before (Pre) and after (Post) surgery through incontinence questionnaire and diary.

Reference	Questionnaire/ group	*n*	Incontinence score			Incontinent episodes		
			Pre mean (SD)	Post mean (± SD)	*P*	Pre mean (± SD)	Post mean (± SD)	*P*
Pelvic floor re-education								
Chiang *et al.* [20]	NA	6	–	–		4.4 (2.8)/week	< 1.0/week	(*n* = 3)
							0.0/week	(*n* = 3)
Ho and Tan [24]	NA	7	–	–		2.7 (2.4)/day	0.4 (0.5)/day	*
Ho *et al.* [21]	NA	6	–	–		14.8 (10.0)/week	1.8 (2.0)/week	*
Laforest *et al.* [30]	WIS							
	Rehab group	22	8.3 (3.9)	2.6 (1.3)		–	–	
	Control group	24	9.9	4.0 (2.3)		–	–	
Kim *et al.* [18]	WIS	70	13.0 (5.2)	8.4 (6.0)	***	–	–	
	< 18 months	35	14.2 (4.2)	10.1 (5.0)	***	–	–	
	> 18 months	35	12.0 (5.8)	6.7 (6.4)	***	–	–	
Pucciani *et al.* [29]	WIS	88	12.3 (5.3)	4.9 (3.9)	*	–	–	
	LAR patients	69	11.8 (5.1)	6.4 (3.7)	*			
	CAA patients	19	12.5 (4.5)	5.8 (3.6)	*			
	MSKCC	22						
	LAR patients		32.8 (5.4)	16.6 (6.3)				
	CAA patients		26.6 (4.1)	14.6 (3.1)				

Table 3 (Continued).

Reference	Questionnaire/ group	*n*	Incontinence score			Incontinent episodes		
			Pre mean (SD)	Post mean (± SD)	*P*	Pre mean (± SD)	Post mean (± SD)	*P*
Allgayer *et al.* [22]	MCIS					–	–	
	RT group	41	7.4 (2.2)	8.1 (3.6)	***			
	nRT group	54	8.6 (2.8)	10.5 (4.4)	***			
Colonic irrigation								
Koch *et al.* [17]	Williams IS	21	4.5 (0.6)	1.7 (0.9)	***	–	0.0	(*n* = 12)
Gosselink *et al.* [23]	NA	NA	–	–		–	–	
Sacral nerve stimulation								
Matzel *et al.* [19]	WIS	1	17.0	2.0		37%/week	0.0	
Uludag *et al.* [25]	NA	0	–	_		–	–	
Jarrett *et al.* [28]	NA	3	–	_		14.0/week	2.0	(*n* = 1)
						5.7/week	0.0	(*n* = 1)
Ratto *et al.* [27]	Pescatori	4	4.5	1.5	*	12.0/week	2.5/week	*
	WIS	4	16.3	4.5	*			
Tjandra *et al.* [31]	NA	3	–	–		–	Decrease:	
							100%/week	(*n* = 1)
							75–99%/week	(*n* = 1)
							50–74%/week	(*n* = 1)
de Miguel *et al.* [26]	CCF-FI	7	19.2 (1.2)	6.2 (1.7)	**	7.0 (0.0)/week	0.2 (0.3)/week	**

NA, not available; *n*, number of patients; LAR, low anterior resection; CAA, coloanal anastomosis; nRT, nonirradiated patients; RT, irradiated patients; Rehab, rehabilitation; (W)IS, (Wexner) Incontinence Score (0–20); MCIS, modified Cleveland Incontinence Score (16-point scale); Williams IS, Williams incontinence score (1–5); MSKCC, Memorial Sloan Kettering Cancer Center Bowel Function Instrument (0–68); Pescatori, Pescatori Incontinence Score (0–6); Cleveland Clinic Florida Fecal Incontinence scoring system.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Patients who underwent LAR or CAA for rectal cancer showed lower anal pressures before and after PFR compared with healthy controls [29]. Furthermore, almost identical values were found after short-term PFR in irradiated patients and in those with surgery alone [22] (Table 4). Pucciani *et al.* [29] and both the studies of Ho *et al.* [21,24] reported a slight increase in manometric values after PFR, whereas Kim *et al.* [18] showed significant improvement of maximum anal resting and squeeze pressures and rectal capacity in 31 of the 70 patients. No change in anal pressures was found by Chiang *et al.* [20]. Since values on the influence of PFR on initial rectal sensation, maximum tolerable volume and rectal compliance varied between studies no conclusions could be drawn. Nevertheless, Kim *et al.* [18] demonstrated a significant increase in maximum tolerable volume.

Colonic irrigation

Twelve (57.5%) of 21 patients were completely continent after daily retrograde colonic irrigation [17]. Gosselink *et al.* [23] found an effectiveness of 79% in patients with defaecation disturbances following LAR or pouch surgery. Studies on colonic irrigation did not report manometric data.

Sacral nerve stimulation

After 12 or more months of SNS, improvement could be demonstrated in most patients. Both the faecal incontinence score and frequency decreased (Table 3) [19,26,27]. In the study of Jarrett *et al.* [28] all three patients had improved continence following SNS. Tjandra *et al.* [31] also found significant better long-term results in the incontinence score of 50–100% in three patients treated by SNS for faecal incontinence after low or ultralow anterior resection [31]. In three studies, patients were able to defer defaecation to a socially desirable moment [27,28,31]. Although Jarrett *et al.* [28] showed an increase in postponement of bowel movement from 0–5 to 5–15 min in two patients, the sensation of urgency seemed to be unaffected after SNS [19]. Three studies reported an improvement in squeeze and resting pressure at follow-up (Table 4) [19,26,27], but the effect of SNS on initial sensation, maximum tolerable volume and rectal compliance was unclear.

Defaecation difficulty

Ho *et al.* [21] showed a significant increase in stool frequency in five patients ($P < 0.05$) (Table 3). Two still needed laxatives to facilitate defaecation. One patient reported continued straining to pass stool. A sensation of incomplete defaecation was no longer reported. All manometric values increased after biofeedback (Table 4).

Quality of life

The Fecal Incontinence Quality of Life (FIQL) scale [36] was reported to be depressed less frequently with improved self-perception following PFR, compared with controls (3.2 ± 0.6 *vs* 2.6 ± 0.7; $P = 0.005$) [30]. General QoL using the Short Form-36 (SF-36) health status questionnaire [37] improved significantly after rehabilitation for vitality (47.3 ± 9.9 *vs* 39.3 ± 8.2; $P = 0.004$) and mental functioning (48.3 ± 7.1 *vs* 42.7 ± 8.6; $P = 0.02$) subscales [30]. Kim *et al.* [18] observed a mean satisfaction score of 61.9 after PFR, using a subjective visual analogue scale from 0 (extremely dissatisfied) to 100 (extremely satisfied) (Table 5). Patients who had frequency of defaecation were more satisfied after PFR (85%) than those whose main symptom was incontinence (61%) or incomplete evacuation (53%). The mean patient satisfaction score was independent of the starting time of PFR after surgery. Furthermore, patients who were treated with radiation therapy and surgery felt significantly more satisfied after PFR than those who underwent surgery alone ($P = 0.041$) [18]. Ho *et al.* [21] reported that four out of five patients felt satisfied after biofeedback therapy for evacuation difficulties. In all but two studies on SNS, all domains of the disease-specific ASCRS measure, the FIQL scale [36] and most SF-36 scores were notably enhanced after treatment. A significant improvement was found [19,26–28].

Discussion

In patients having sphincter preservation during rectal resection, PFR, colonic irrigation, SNS and postanal repair can successfully be applied to improve postsurgical anorectal function. Conservative treatment to regain strength, tone, coordination and endurance of the pelvic musculature includes physiotherapeutic approaches such as pelvic floor muscle exercise training, biofeedback and electrostimulation. The effectiveness of PFR for postoperative faecal incontinence and evacuation difficulty is unclear due to the limited methodological quality of these studies. Nonetheless conservative therapy can improve anorectal function and should be recommended first before adopting more invasive approaches [18,20–22,24,29,30].

If conservative options fail and faecal incontinence is considered intractable, colonic irrigation and SNS might be an effective solution. Irrigation can result in full continence, especially when a large volume of water is used [17,23]. Despite this, only a form of only pseudo continence is achieved, and in contrast with other therapies, the rate of discontinuation with time is high owing to various side-effects. These include technical difficulty in performing the irrigation, nausea and

Table 4 Manometry in patients with faecal incontinence and evacuation difficulties before (Pre) and after (Post) surgery.

		Ps max (mmHg)		Pr mean (mmHg)		Volume of initial sensation (ml)		Max tolerable volume (ml)		Compliance (ml/mmHg)	
Reference	Group	Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)
Pelvic Floor re-education											
Chiang *et al.* [20]		–	–	–	–	–	–	–	–	–	Decrease**
Ho and Tan [24]		134.7 (52.9)	171.7 (3.6)	53.3 (6.7)	73.3 (32.5)	70.2 (111.4)	37.3 (21.4)	192.0 (142.1)	110.0 (90.5)	7.2 (1.1)	1.2 (1.3)
Ho *et al.* [21]	FI	89.3 (19.1)	108.2 (52.4)	52.3 (23.0)	57.6 (34.8)	65.3 (34.0)	78.4 (30.1)	130.5 (124.2)	123.0 (28.7)	1.6 (1.7)	4.3 (4.7)
	ED	109.8 (52.3)	118.5 (30.4)	50.4 (15.9)	71.3 (9.4)	50.8 (49.0)	98.0 (127.0)	89.5 (78.3)	148.5 (175.3)	2.9 (5.4)	1.4 (1.6)
Laforest *et al.* [30]	Rehab	–	–	–	–	–	–	–	–	–	–
	Control	–	–	–	–	–	–	–	–	–	–
Kim *et al.* [18]	Total	136.4 (45.2)	162.7 (56.1)**	39.1 (11.1)	44.9 (18.1)**	–	–	102.3 (42.3)	120.3 (30.6)**	–	–
	< 18 m	127.7 (45.3)	149.5 (50.0)	39.0 (12.6)	42.3 (19.8)***	–	–	102.9 (45.2)	118.2 (28.9)***	–	–
	> 18 m	150.1 (43.3)	183.4 (60.9)*	39.2 (8.8)	49.1 (15.0)**	–	–	101.3 (39.0)	123.8 (34.2)	–	–
Pucciani *et al.* [29]	LAR	88.3 (49.1)	107.1 (79.8)	20.5 (10.5)	32.2 (10.6)	34.6 (29.6)	32.2 (10.3)	133.8 (51.2)	131.0 (42.8)	–	–
	CAA	86.9 (56.1)	98.8 (37.7)	20.1 (9.6)	30.0 (5.3)	33.3 (11.5)	36.6 (11.0)	124.0 (52.9)	143.1 (34.6)	–	–
Allgayer *et al.* [22]	RT	79.5 (34.0)	–	27.3 (17.2)	–	44.7 (16.9)	–	–	–	–	–
	nRT	79.5 (34.1)	–	33.3 (17.8)	–	43.0 (13.8)	–	–	–	–	–
Colonic irrigation											
Koch *et al.* [17]		–	–	–	–	–	–	–	–	–	–
Gosselink *et al.* [23]		–	–	–	–	–	–	–	–	–	–
Sacral nerve stimulation											
Matzel *et al.* [19]		75.0	115.0	43.0	50.0	50.0	50.0	150.0	200.0	8.7	6.9

Table 4 (Continued).

Reference	Group	Ps max (mmHg)		Pr mean (mmHg)		Volume of initial sensation (ml)		Max tolerable volume (ml)		Compliance (ml/mmHg)	
		Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)	Pre Mean (SD)	Post Mean (SD)
Uludag *et al.* [25]		–	–	–	–	–	–	–	–	–	–
Jarrett *et al.* [28]		–	–	–	–	–	–	–	–	–	–
Ratto *et al.* [27]		52.8 (25.9)	70.8 (25.5)	47.9 (42.5)	38.5 (13.2)	51.3 (25.9)	35.0 (14.7)	145.0 (80.6)	137.5 (81.0)	–	–
Tjandra *et al.* [31]		–	–	–	–	–	–	–	–	–	–
de Miguel *et al.* [26]		151.1 (54.9)	182.7 (59.3)	33.9 (17.8)	60.6 (19.5)	26.0 (11.4)	18.0 (8.4)	190.0 (89.4)	208.0 (85.6)	–	–

Ps max, maximum squeeze pressure (normal range 80–160 mmHg); Pr mean, mean resting pressure (normal range 40–80 mmHg); normal volume of initial sensation 10–15 ml; normal rectal volume 650–1200 ml; normal rectal compliance 20 mmHg/ml; FI, faecal incontinence; ED, evacuation difficulties; < 18 m, start biofeedback < 18 months postoperative; > 18 m, start biofeedback 18 months postoperative; RT, irradiated patients; nRT, nonirradiated patients.

$^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$.

abdominal cramps. Irrigation is time-consuming and demands self-discipline [23].

There is little information in the literature on SNS as treatment for postoperative incontinence after rectal resection. Its specific mechanism is still unclear [38,39]. In five included studies, a good response was defined as a ≥ 50% [25,26,28,31] or 70% [27] reduction of incontinence episodes and/or incontinence days per week. The single study which reported postanal repair after anterior resection [40] was not included in this review because it included only three patients.

This review has shown a decrease in faecal incontinence or evacuation difficulty after various therapeutic approaches. However, the quality of the studies was often poor. Only one was randomized, but only six patients who underwent anterior resection were included [31]. In most of the included studies the sample size was small and there was no control group. Details of the treatment and its duration and the protocol of follow-up varied, making it difficult to compare them.

Furthermore, post-treatment function depends on the surgical procedure, the use of adjuvant treatment, level of anastomosis, presence of an intestinal reservoir, the need for a temporary stoma and the suture technique [41–43]. For this reason the six studies of restorative proctocolectomy with ileal reservoir were not included in the present study [44–49] and greater attention was given to function during the early period of recovery and in the long-term follow-up [50]. Factors such as adjuvant treatment before and after surgery will also affect function [4,22,29,51,52].

The use of exercises to help postoperative recovery has also been investigated [53], but anorectal function is rarely included. Two articles on postsurgical bowel dysfunction have emphasized the importance of a multidisciplinary approach, including education, dietary and medical advice, emotional support, physical therapy, behavioural strategies and pelvic floor muscle training [54,55]. It would therefore be interesting to devise a standardized postoperative rehabilitation programme, including treatment of anorectal function.

In conclusion, this review shows that promising treatments exist to improve postsurgical anorectal function. However, the quality of the available studies is limited. More randomized controlled trials are needed to assess the outcome of various treatment options and to draw firm and evidence-based conclusions. Conservative therapy including antidiarrhoeal medication and dietary adjustments should be used first. Depending on the degree of conscious control of the pelvic floor and on the presence or absence of an intestinal reservoir, patients may also benefit from supplementary therapy such as pelvic floor re-education, colonic irrigation or SNS

Table 5 Quality of life after treatment.

Reference	Group	*n*	Questionnaire	Quality of life
Pelvic floor re-education				
Chiang *et al.* [20]		6		NA
Ho and Tan [24]		7		NA
Ho *et al.* [21]	Faecal incontinence	6		NA
Laforest *et al.* [30]	Evacuation difficulties	5	Subjective satisfaction	Satisfied (n = 4)
	Rehabilitation group	22	FIQL	Improved
			SF-36	Improved
	Control group	24	FIQL	Improved
			SF-36	Improved
Kim *et al.* [18]	Total group	70	Satisfaction score	61.9 (27.6)
	Faecal incontinence	58	Satisfaction score	61.0 (27.5)
	Incomplete evacuation	8	Satisfaction score	53.1 (29.8)
	Frequent defaecation	4	Satisfaction score	85.0 (9.1)
	< 18 m start biofeedback	35	Satisfaction score	59.0 (26.8)
	> 18 m start biofeedback	35	Satisfaction score	63.9 (28.4)
	RT patients	49	Satisfaction score	65.8 (23.5)
	nRT patients	21	Satisfaction score	51.2 (33.6)
Pucciani *et al.* [29]		88		NA
Allgayer *et al.* [22]		71		NA
Colonic irrigation				
Koch *et al.* [17]		26		NA
Gosselink *et al.* [23]		29		NA
Sacral nerve stimulation				
Matzel *et al.* [19]		1	FIQL	Improved
Uludag *et al.* [25]		0		NA
Jarrett *et al.* [28]		3	FIQL	Improved
			SF-36	Improved
Ratto *et al.* [27]		4	SF-36	Improved
Tjandra *et al.* [31]		3		NA
de Miguel *et al.* [26]		7	FIQL	Improved (n = 5)

Data are mean ± standard deviation.
n, number of patients; FIQL, Fecal Incontinence Quality of Life Scale; SF-36, Short Form-36; NA, not available.

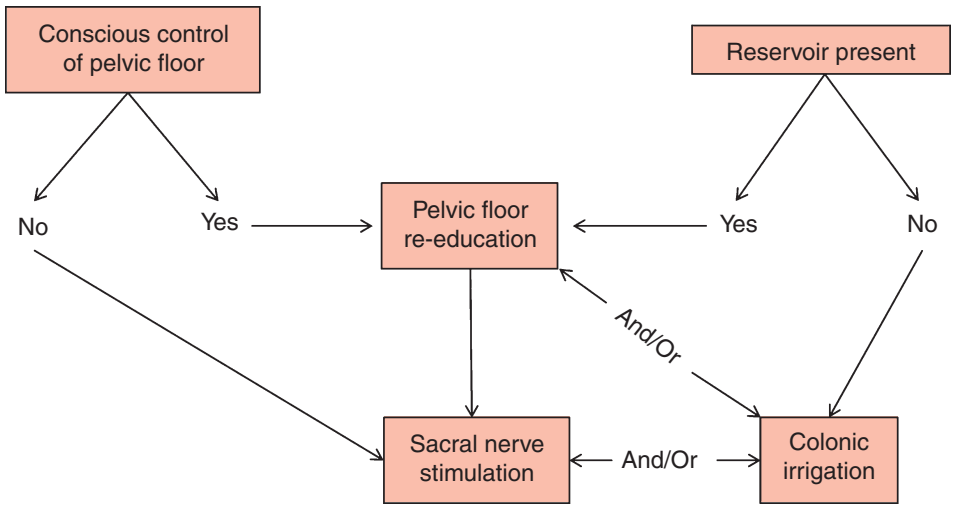

Figure 2 Treatment strategy to improve anorectal function after rectal resection for cancer.

(Fig. 2). Randomized controlled trials with a follow-up period of at least 24 months are needed to assess the outcome of the various treatment options.

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Conflict of interest

None.

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