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Review

Pelvic floor muscle training for the prevention and management of low anterior resection syndrome in patients with rectal cancer: An evidence-based summary

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ABSTRACT

Objective: This study aims to summarize the best available evidence on the effectiveness of pelvic floor muscle training (PFMT) in preventing and managing low anterior resection syndrome (LARS) among patients with rectal cancer, with the goal of enhancing quality of care.
Methods: A systematic search was conducted across databases, including BMJ Best Practice, UpToDate, WHO, GIN, UK NICE, NGC, SIGN, RNAO, NCCN, JBI Library, Cochrane Library, CINAHL, Web of Science, Embase, OVID, PubMed, Chinese Wanfang, CNKI, SinoMed, and VIP, covering publications from inception through June 30, 2024. We targeted clinical decisions, guidelines, evidence summaries, expert consensus statements, systematic reviews, and randomized controlled trials related to PFMT for LARS in patients with rectal cancer. Two independent reviewers assessed the quality of the literature and extracted key findings.
Results: A total of 15 articles were included, yielding 21 pieces of evidence across six core areas: multidisciplinary management, bowel function risk screening and assessment, the purpose and target population for PFMT, pre-exercise instructions, exercise regimens, and exercise feedback.
Conclusions: The summarized 21 recommendations provide guidance for integrating PFMT into care plans for patients with rectal cancer and LARS. However, given that evidence originates from diverse clinical settings, considerations such as the local health care environment should be evaluated before implementation. Future research should focus on optimizing PFMT regimens to improve bowel function outcomes in patients with rectal cancer, refining exercise protocols, and gathering further data to enhance clinical application.
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Introduction

Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer-related deaths worldwide.[1] Owing to the development of stapling devices and neoadjuvant chemoradiotherapy, the application of total mesorectal excision (TME) has improved the quality of life of patients with low rectal cancer by enhancing anal preservation while removing the tumor and avoiding a permanent stoma.[2–5] However, a significant proportion of patients who undergo sphincter-preserving surgery subsequently experience low anterior resection syndrome (LARS),[6] which is characterized by impaired anorectal functions, including increased stool frequency, urgency, soiling, and incontinence.[7] The high prevalence of LARS (60% to 90%) and the severity of symptoms significantly jeopardize patients' quality of life and increase the risk of anxiety and depression.[8,9]

A previous systematic review suggested that pelvic floor rehabilitation (PFR) is an effective method for improving bowel function after anterior resection surgery for CRC.[10] PFR consists of biofeedback, electrostimulation, pelvic floor muscle training (PFMT), and rectal balloon training,[11] of which PFMT is the most commonly used and recommended approach.[12–14] PFMT is also called "Kegel exercises".[14] In a typical PFMT, patients are instructed to contract the pelvic floor muscle for 10 seconds, followed by an interval of 20 seconds for rest, while breathing normally with relaxed abdominal muscles.[14] PFMT is noninvasive[12] and can reduce

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the incidence of fecal incontinence by strengthening the external anal sphincter and increasing the contractile capacity of the pelvic floor muscles, particularly the levator ani. When PFMT is used appropriately, it has a 41%–66% success rate in terms of treating fecal incontinence.[14] The use of PFMT after colorectal cancer surgery has been associated with improvements in bowel function and health-related quality of life.[10] The International Continence Society (ICS)[12] and colorectal specialists[13,15] recommended that every patient who underwent anterior resection surgery should subsequently incorporate PFMT into their daily activities. Recently, the China Colorectal Cancer Surgery expert consensus has recommended that CRC patients undergo PFMT in the initial stages after surgery.[16] Although many guidelines exist for PFMT management, most of them are general and target a wide range of patients, such as postpartum women with urinary incontinence and men who have undergone prostate cancer treatment.[17,18] In addition, most current PFMT interventions for postoperative bowel dysfunction in patients with rectal cancer are symptom-based and empirically based integrative therapies, and there is a lack of clear criteria for the exercise regimen. Therefore, this study aimed to summarize the best evidence regarding the clinical practice of utilizing PFMT to prevent and manage LARS in patients with rectal cancer.

Methods

Question identification

Evidence-based questions were selected based on the PIPOST model.[19] The initial questions were as follows: P (Population): patients with rectal cancer who were ≥ 18 years old; I (Intervention): measures related to pelvic floor muscle training to prevent and treat bowel dysfunction after surgery; P (Professional): health care workers; O (Outcome): the incidence of bowel dysfunction, anxiety, depression, and quality of life among patients with rectal cancer; S (Setting): specialist wards, rehabilitation centers, and home; and T (Type of evidence): clinical decision-making, guidelines, evidence summaries, best practices, expert consensus, systematic reviews and meta-analyses, and randomized controlled trials.

Literature retrieval strategy

The "6S" pyramid model was used for the evidence retrieval process.[20] The following evidence decision systems and databases were searched: BMJ Best Practice, UpToDate, and Joanna Briggs Institute (JBI) library, World Health Organization (WHO), Guidelines International Network (GIN), National Institute for Health and Care Excellence (NICE), National Guideline Clearinghouse (NGC), Scottish Intercollegiate Guidelines Network (SIGN), Registered Nurses Association of Ontario (RNAO), National Comprehensive Cancer Network (NCCN), American College of Sports Medicine (ACSM), Australian Association for Exercise and Sport Science, American Society of Colorectal Surgeons, PubMed, Embase, OVID, CINAHL, Web of Science, CNKI, Chinese Wanfang, SinoMed, and VIP. We also manually searched the reference lists of relevant studies. The search was conducted with the following subject words + free words: "Pelvic floor muscle training/Pelvic floor muscle exercise/Pelvic floor muscle strengthening/Kegel exercise/Physical exercise/Conservation management/Nonsurgical treatment/PFMT/PFME/PFE" and "Colorectal neoplasms/Colorectal cancer/Colorectal tumor/Colorectal carcinoma/Fecal incontinence/Anterior resection syndrome/Sphincter preservation/Bowel dysfunction". The evidence decision systems and databases were searched from inception to June 30, 2024. An example of an English database search using PubMed with the corresponding search strategy is shown in Fig. 1.

Literature inclusion and exclusion criteria

The inclusion criteria were as follows: (1) the study subjects were patients with rectal cancer who were ≥ 18 years old; (2) the literature involved pelvic floor muscle training to prevent and manage bowel dysfunction; (3) the literature types included clinical guidelines, expert consensus, evidence summaries, systematic reviews, clinical decisions, best practices, and randomized controlled trials (RCTs); and (4) the literature was published in Chinese or English.

The exclusion criteria were as follows: (1) the literature type was a plan, draft, or updated literature; (2) the literature had incomplete information or unavailable full text; and (3) the quality of the research was inadequate.

Literature quality evaluation standard

The quality of the literature was evaluated according to the type of literature as follows: (1) Clinical decisions and evidence summaries are considered types of thematic evidence summaries in the "6S" pyramid model of evidence-based resources. Since the evidence development process for these summaries was similar, their quality was assessed via the "Critical Appraisal for Summaries of Evidence (CASE) checklist".[21] (2) Guidelines were evaluated with the Appraisal of Guidelines for Research and Evaluation II (AGREE II).[22] (3) Systematic reviews were evaluated with the 2017 AMSTAR-2.[23] (4) Expert consensuses and RCTs were evaluated with the corresponding evaluation criteria of the JBI Evidence-based Health Care Centers in Australia (2024 Edition).[24]

#1 Colorectal cancer OR Colorectal tumor OR Colorectal carcinoma OR "anterior resection syndrome" OR "Fecal Incontinence" OR "Sphincter Preservation" OR "Bowel Dysfunction" OR Colorectal neoplasms[MeSH Terms]
#2 Colorectal cancer OR Colorectal tumor OR Colorectal carcinoma OR "anterior resection syndrome" OR "Fecal incontinence" OR "Sphincter preservation" OR "Bowel dysfunction" OR Colorectal neoplasms[Title/Abstract]
#3 #1 OR #2
#4 "Pelvic Floor Muscle Training" OR "Pelvic Floor Muscle Exercise" OR "Pelvic Floor Muscle Strengthening" OR "Kegel Exercise" OR "Physical Exercise" OR "Conservation Management" OR "Nonsurgical Treatment" OR PFMT OR PFME OR PFE[Title/Abstract]

#5 #3 AND #4

Fig. 1. PubMed search strategy.

The literature quality evaluation process

Two graduate oncology nursing students who had been trained in evidence-based nursing studies independently evaluated the quality of the literature. To ensure independent evaluations, the two researchers thoroughly discussed the evaluation criteria at the beginning of the process to establish a shared understanding. Disagreements between their evaluations were resolved through a consensus meeting with a third researcher after the independent assessments were completed. In the case of conflicts among the conclusions drawn by different evidence sources, this study followed the principles of high-quality evidence priority and the latest published authoritative literature priority.

Evidence extraction and recommendation level

The 2014 version of the JBI Evidence Pre-grading System was used for the evidence-level classification, and the 2014 version of the JBI Evidence Rank System was used for the recommended-level classification.[25] The FAME grading principle was used to assess the feasibility, appropriateness, clinical significance, and effectiveness of the evidence and to provide recommendations. In addition, group meetings were held to demonstrate the recommended strength of the evidence. The team members included two graduate students majoring in cancer nursing, a professor in the field of oncology nursing, and three evidence-based experts. The consensus was achieved through structured discussions, wherein each expert presented their evaluation, followed by a group deliberation to align the assessments. In cases of disagreements, these were addressed through further discussions until a consensus was reached. When consensus could not be achieved immediately, a vote or a moderator-assisted resolution was used to finalize the grading. Finally, by their strength, recommendations were divided into strong recommendations (Grade A) and weak recommendations (Grade B) on the basis of the JBI recommendation grading.

Results

General characteristics of the included studies

A total of 1368 records were retrieved in this study. After the records were imported into EndNote and duplicates were removed, 882 articles remained. After the exclusion of studies without full texts and unrelated articles, 62 articles remained. After the full texts were read, 47 articles that did not meet the inclusion criteria were excluded. Ultimately, 15 articles were included in the final analysis. These 15 articles comprised two clinical decisions,[26,27] two guidelines,[14,28] three systematic evaluations, two expert consensuses,[16,29] and six RCTs.[30–35] The literature screening process is shown in Fig. 2. The basic characteristics of the included studies are shown in Table 1.

Quality evaluation of the included literature

Quality evaluation of clinical decisions

Two clinical decisions were included in this study,[26,27] both of which were retrieved from UpToDate. These articles followed the evidence development process and standards. Except for Items 4 and 5, which were rated “no”, all the items were rated as "yes", and the overall quality of these records was considered adequate for inclusion.

Quality evaluation of the guidelines

Two guidelines were included in this study,[14,28] and the quality evaluation results are shown in Table 2; one guideline was from Europe,[28] and the other one was from Japan.[14] The ICCs of the two guidelines were 0.903 and 0.871, respectively, indicating high consistency and good reliability among the four raters (Table 2). The average scores for the six dimensions of quality were as follows: scope and purpose, 84.72%; stakeholder involvement, 65.97%; rigor of development, 60.94%; clarity of presentation, 80.56%; applicability, 49.45%; and editorial independence, 79.69%.[22] Thus, these guidelines were considered Grade B recommendations.

Quality evaluation of expert consensus

Two expert consensuses were included.[16,29] All of the items on the quality evaluation were rated as "yes"; thus, two consensuses were considered high quality and ultimately included.

Quality evaluation of systematic reviews

Three systematic reviews were included in this study,[10,11,36] and the results of the quality assessment are shown in Table 3. The three systematic reviews were all of high quality, clearly formulated relevant evidence-based questions, and were scientific and authentic.

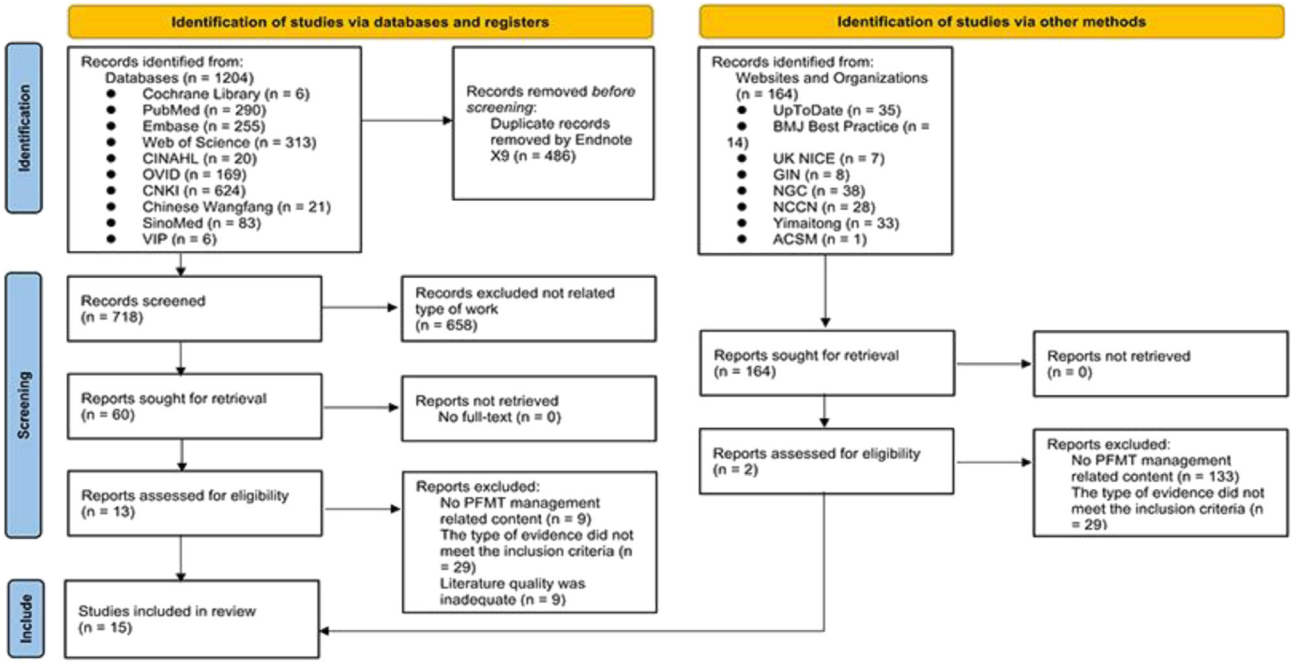

Fig. 2. Flow diagram illustrating the original process of screening and identification of studies.

Table 1
General characteristics of the included studies ($N = 15$).

Included literature	Year	Source	Type of evidence	Topic
Jacopo[26]	2021	UpToDate	Clinical decision	Low anterior resection syndrome (LARS)
Linda[27]	2021	UpToDate	Clinical decision	Patient education: Pelvic floor muscle exercises (Beyond the basics)
Maeda et al.[14]	2021	PubMed	Guideline	Japanese practice guidelines for fecal incontinence part 2-examination and conservative treatment for fecal incontinence- English version
Haas et al.[28]	2022	Embase	Guideline	Management of treatment-related sequelae following colorectal cancer
Christensen et al.[29]	2021	Web of science	Expert consensus	Management guidelines for low anterior resection syndrome - the MANUEL project
Cafsccsa et al.[16]	2021	CNKI	Expert consensus	Chinese expert consensus on the protection of pelvic organ function in the rectal cancer surgery
Chan et al.[10]	2021	Web of science	Systematic review	Efficacy of pelvic floor rehabilitation for bowel dysfunction after anterior resection for colorectal cancer: a Systematic review
Lin et al.[36]	2015	Web of science	Systematic review	Pelvic floor muscle training for bowel dysfunction following colorectal cancer surgery: A systematic review
Visser et al.[11]	2014	Web of science	Systematic review	Pelvic floor rehabilitation to improve functional outcome after a low anterior resection: a Systematic review
Lin et al.[32]	2016	Web of science	RCT	Effects of pelvic floor muscle exercise on fecal incontinence in rectal cancer patients after stoma closure
Hung et al.[31]	2016	Web of science	RCT	Pelvic floor muscle exercise for fecal incontinence quality of life after coloanal anastomosis
Pan et al.[33]	2016	SinoMed	RCT	Exploration of anal function recovery by ileostomy closure of pelvic floor muscle training for anal preservation in low rectal cancer
Cheng et al.[34]	2017	SinoMed	RCT	Effects of Kegel on fecal incontinence in patients with anal endoscopic microsurgery after surgery
Ma et al.[35]	2021	CNKI	RCT	Effect of pelvic floor exercise on anal sphincter after operation of intestinal tumor
Asnong et al.[30]	2022	Cochrane library	RCT	The role of pelvic floor muscle training on low anterior resection syndrome a multicenter randomized controlled trial

Table 2
Quality evaluation results of the included guidelines ($N = 2$).

Study	Percentage of standardization (%)						≥ 60%	≥ 30%	ICC	Quality Evaluation
	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity of presentation	Applicability	Editorial independence				
Maeda et al.[14]	81.94	48.61	56.77	86.11	46.88	87.50	4	6	0.903	B
Haas et al.[28]	87.50	83.33	65.10	75.00	52.01	71.88	5	6	0.871	B

Table 3
Quality evaluation of the included systematic reviews ($N = 3$).

Items	Chan et al.[10]	Lin et al.[36]	Visser et al.[11]
1. Did the research questions and inclusion criteria for the review include the components of PICO?	Yes	Yes	Yes
2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	Yes	Yes	Yes
3. Did the review authors explain their selection of the study designs for inclusion in the review?	No	No	No
4. Did the review authors use a comprehensive literature search strategy?	Yes	Yes	Yes
5. Did the review authors perform study selection in duplicate?	Yes	Yes	Yes
6. Did the review authors perform data extraction in duplicate?	Yes	Yes	Yes
7.Did the review authors provide a list of excluded studies and justify the exclusions?	Partial yes	Partial yes	Partial yes
8. Did the review authors describe the included studies in adequate detail?	Yes	Yes	Yes
9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?	Yes	Yes	Yes
10. Did the review authors report on the sources of funding for the studies included in the review?	No	No	No
11. If a meta-analysis was performed, did the review authors use appropriate methods for a statistical combination of results?	Yes	Yes	Yes
12. If a meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?	Yes	Yes	Yes
13. Did the review authors account for RoB in primary studies when interpreting/discussing the results of the review?	Yes	Yes	Yes
14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	Yes	Yes	Yes
15. If they performed a quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small-study bias) and discuss its likely impact on the results of the review?	Yes	Yes	Yes
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	Yes	No	Yes

Quality evaluation of randomized controlled trials

A total of six RCTs were included in this study. Two of the RCTs were retrieved from Web of Science,[31,32] two were retrieved from SinoMed,[33,34] one was retrieved from CNKI,[35] and one was retrieved from the Cochrane Library.[30] Table 4 presents the quality evaluation results of the RCTs. There was an unclear risk of bias for allocation concealment,[30–35] and the participants were not analyzed in the groups to which they were randomized in all the RCTs.[31,32] Only one RCT[30]

Table 4
Results of the quality evaluation of the included RCTs ($N = 6$).

Items	Lin et al.[32]	Hung et al.[31]	Pan et al.[33]	Cheng et al.[34]	Ma et al.[35]	Asnong et al.[30]
1. Was true randomization used for assignment of participants to treatment groups?	Yes	Yes	Yes	Yes	Yes	Yes
2. Was allocation to treatment groups concealed?	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
3. Were treatment groups similar at the baseline?	Yes	Yes	Yes	Yes	Yes	Yes
4. Were participants blind to treatment assignment?	Unclear	Unclear	Unclear	Unclear	Unclear	Yes
5. Were those delivering treatment blind to treatment assignment?	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
6. Were outcome assessors blind to treatment assignment?	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
7. Were treatment groups treated identically other than the intervention of interest?	Yes	Yes	Yes	Yes	Yes	Yes
8. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Yes	Yes	Yes	Yes	Yes	Yes
9. Were participants analyzed in the groups to which they were randomized?	No	No	Yes	Yes	Yes	Yes
10. Were outcomes measured in the same way for treatment groups?	Yes	Yes	Yes	Yes	Yes	Yes
11. Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes	Yes
12. Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes	Yes
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Yes	Yes	Yes	Yes	Yes	Yes

included blinded participants. Six questions (questions 1 and 10–13) of the JBI critical appraisal tools were rated as satisfactory for all the RCTs.

Summary and description of evidence

Finally, after summarizing the evidence on the management of PFMT in patients with rectal cancer, a total of 21 items of evidence were obtained across six aspects: multidisciplinary management, bowel function risk screening and assessment, purpose and target population of PFMT, PFMT pre-exercise instructions, exercise regimen and exercise feedback (Table 5).

Discussion

In this study, we focused on the use of PFMT for the prevention and management of LARS in patients with rectal cancer. To reduce the incidence and severity of LARS, we evaluated and summarized six aspects of the best evidence for prevention and management of LARS in this study: multidisciplinary management, bowel function risk screening and assessment, purpose and target population of PFMT, PFMT pre-exercise instructions, exercise regimen, and exercise feedback.

Multidisciplinary management

The involvement of multidisciplinary teams serves as the foundation for the effective management of LARS in patients with rectal cancer. Items 1–2 summarize the importance of multidisciplinary team management. The multidisciplinary team care approach is standard for cancer care and is required for cancer center accreditation by the Organization of European Cancer Institutes.[40] However, the multidisciplinary teams currently advocated are focused mostly on improving the accuracy of the diagnosis and the success rate of local resection of rectal cancer,[41] and there is a lack of attention given to the management of postoperative LARS. An expert consensus recommendation is that multidisciplinary team members, including gastroenterologists, radiation oncologists, physical therapists, pelvic floor nurses and patients, and all members of the multidisciplinary team need to be educated about LARS.[27,29] An international education program with a multidisciplinary board to help treat difficult cases can be used as a platform to share experiences and develop new therapies and techniques.[29] The complicated pathophysiology of LARS requires a multidisciplinary team to avoid inappropriate treatments and provide tailored treatments for LARS patients.[29] All survivors with major LARS should be offered treatment, either locally or following referral to a specialized unit. The establishment of multidisciplinary teams facilitates the referral and treatment of patients with LARS,[29] and health care providers should assess each patient's situation and discuss it with multidisciplinary team members before and during treatment. When a patient is in poor physical condition and has difficulty performing PFMT, multidisciplinary team members should develop a new treatment plan on the basis of individual needs.

Bowel function risk screening and assessment

Items 3–8 are related to the early assessment of bowel dysfunction in patients with rectal cancer and include both preoperative and postoperative assessment instruments. The guidelines recommend that health care professionals inform patients and families of the likelihood of organ dysfunction prior to treatment (surgery or radiotherapy) and perform routine preoperative screening for bowel function.[29] Rectal cancer survivors should be offered routine screening for bowel dysfunction, as the prevalence of major LARS among patients with rectal cancer is $> 40\%$.[28] To predict the severity of postoperative LARS in patients with rectal cancer, Battersby et al.[37] developed the preoperative LARS (POLARS) score on the basis of the low anterior resection syndrome scale (LARSS) of 1,401 patients with rectal cancer who had undergone TME. This is the first nomogram and online tool that was developed to predict postoperative LARS in patients with rectal cancer. Colorectal surgeons, gastroenterologists and nurse specialists can derive a predictive LARSS by simply entering the patient's age, sex, surgical procedure, tumor height, presence of a stoma and whether the patient received preoperative radiotherapy, thus helping health care professionals provide additional postoperative support to patients at risk of LARS.[37] However, according to a Swedish study[42] that validated the model via a retrospective cohort study, the sensitivity of the POLARS score for severe LARS was 31%, and its positive predictive value was 68%. Similarly, Pennings et al.[43] used a telephone questionnaire to interview 120 patients. The results of the study demonstrated that the POLARS score was useful in determining the risk of LARS but less reliable in assessing the severity of LARS. However, the study had only a limited sample size, and there were doubts about the reliability and accuracy of the telephone survey. Early screening of patients at high risk for LARS helps surgeons and patients decide on the surgical approach so that patients understand the consequences and risks of deciding whether a low anterior resection or an abdominoperineal excision will provide them with a better long-term functional outcome.[29] The validity and sensitivity of this prediction model need to be further validated.

In addition to preoperative risk screening, patients with persistent intestinal symptoms are recommended to undergo a formal evaluation for LARS one month after initial surgery without a stoma or after protective stoma closure.[26,36] Two validated tools, i.e. the Memorial Sloan Kettering Cancer Centre Bowel Function Instrument (MSKCC-BFI)[39] and the LARSS,[21] have been introduced as specific patient-reported outcome measures (PROMs) for bowel function after TME. Although both questionnaires were developed with the same purpose, they differ

Table 5
Summary of the best evidence regarding PFMT for the prevention and management of LARS in patients with rectal cancer.

Evidence Aspect	Evidence Content	Evidence Level	Recommendation
Multidisciplinary management	1. A multidisciplinary team can avoid inappropriate treatments and provide tailored treatments for LARS patients.[29]	Level 5	A
	2. Multidisciplinary team members include gastroenterologists, radiation oncologists, physical therapist, pelvic floor nurses and patients. All members of the multidisciplinary team need to be educated about LARS.[27,29]	Level 5	A
Bowel function risk screening and assessment	3. Postoperative organ dysfunction is an important issue affecting patients' quality of life, and attention needs to be given to the protection of organ function in patients with rectal cancer.[16]	Level 5	A
	4. Patients and families should be informed of the likelihood of organ dysfunction prior to treatment (surgery and radiotherapy) so that patients can understand the possible long-term consequences and risks of low anterior resection or endolaparotomy.[16,29]	Level 5	B
	5. Patients with rectal cancer should be screened for bowel dysfunction prior to treatment (including radical rectal cancer surgery, preoperative radiotherapy, ileostomy closure surgery, etc.), especially those at high risk of LARS, such as patients with low-position tumors, preoperative radiotherapy, and patients with protective stomas.[16,28]	Level 2	A
	6. Preoperative assessment tools: Health care professionals can use the LARS preoperative scoring tool (POLARS) to assess the risk of LARS in patients undergoing proctocolectomy for rectal cancer before surgery and to raise awareness of the prevention and treatment of the disease.[37]	Level 4	B
	7. Postoperative assessment tools: Only two scoring systems address LARS specifically: The LARS score[38] and the MSKCC bowel function instrument (MSKCC-BFI).[39] the LARS score is recommended along with the MSKCC-BFI,[29] which can be combined with anorectal manometry if available.[14,26] anorectal manometry may be useful not as a diagnostic tool but to guide biofeedback therapy.[29]	Level 5	A
	8. Assessment time: Formal evaluation of LARS is recommended for patients with persistent intestinal symptoms one month after initial surgery without a stoma or after protective stoma closure.[26]	Level 4	B
Purpose and target population of PFMT	9. Purpose: The contraction of the anorectal muscles can strengthen the anorectal muscles, reduce the incidence of fecal incontinence, and enhance the function of the anus.[14,16,29–35]	Level 1	A
	10. Exercise effect: PFMT alone is beneficial as a simple treatment for fecal incontinence, and PFMT combined with biofeedback training or rectal balloon training is usually more effective than PFMT alone.[11,28,36]	Level 1	A
	11. Target population: Correct and compliant PFMT has a positive effect on improving fecal incontinence, anal function, and quality of life in patients with rectal cancer after colorectal anal anastomosis, TME, ileostomy closure, and transanal endoscopic microsurgery.[14,16,29–35]	Level 1	B
	12. Target population: As all patients with rectal cancer undergoing anal sphincter preservation surgery are at risk of LARS, it is recommended that all patients are instructed by their health care provider at discharge to perform home PFMT to prevent LARS.[26,36]	Level 1	A
PFMT pre-exercise instructions	13. Patients should discuss PFMT with their health care provider to determine a personalized exercise program before starting the exercises. The health care provider can help the patient understand whether PFMT is beneficial in improving the patient's symptoms, instruct the patient on how to do the exercises correctly, and refer the patient to a physiotherapist if necessary.[27]	Level 5	A
	14. Prior to formal exercise, the health care provider should teach the patient how to identify the pelvic floor muscles, and it is recommended that the therapist uses digital rectal examination (DRE) to ensure that the patient is exercising correctly.[14,27]	Level 1	A
	15. Health care professionals can use intermittent voiding for health education but should emphasize to the patient that the bladder should be emptied before exercise and that pelvic floor muscle contractions during voiding are not recommended to avoid increasing the risk of urinary tract infection.[27]	Level 1	A
	16. Health care professionals should inform patients that to achieve the benefits of the exercise, the abdominal, gluteal and thigh muscles should be kept relaxed during the exercise, and patients should be instructed to repeat the exercise to master the correct way of doing it.[14,16,27]	Level 1	A
Exercise regimen	17. Timing of initiation: PFMT should be offered to all patients with bowel symptoms, starting 1 month after surgery/stoma closure.[30]	Level 1	A
	18. Position: PFMT can be performed in any position (standing, sitting or lying down), thus making it easy for the patient to integrate into daily life.[27]	Level 5	A
	19. Intensity: To contract the pelvic floor muscles, the pelvic floor muscles should be contracted for 8–10 seconds, and then, patients should completely relax for an effective contraction. This duration may be difficult to achieve at the beginning of the exercise. Therefore, it is recommended that the patient gradually increase the duration of contraction.[27]	Level 5	B
	20. Duration: The recommended course of PFMT is 8–12 effective contractions per set, and 3–4 sets per day for 15–20 weeks.[14,27]	Level 1	B
Exercise feedback	21. If the patient does not exhibit improved bowel function after several months of proper PFMT, they should contact their health care provider to modify the exercise program or try other treatment options.[27]	Level 5	B

significantly in their clinical applicability and scope. The MSKCC-BFI was developed and validated for patients following rectal resection, and it can be used to collect information on the complex symptomatology of LARS, especially for research purposes. However, the instrument has no weighting for different symptoms and is considered time-consuming for both patients and health care professionals; therefore, it may be less useful in the clinical setting.[39] The MSKCC-BFI and LARSS showed good correlation and similar discriminant validity. As the LARSS is easier to complete, it may be considered the preferred tool to screen for bowel dysfunction.[44] In addition to patient-reported outcome indicators, anorectal manometry is recommended for objective assessment of anal function.[14,26] However, rather than being used as a diagnostic tool, anorectal manometry can be helpful in guiding biofeedback therapy.[29] Health care practitioners should place a high priority on assessing intestinal function because it is crucial for the prevention and treatment of LARS.

Purpose and target population of PFMT

Items 9–12 summarize the purpose and target population of PFMT. The PFMT has great potential for rehabilitative and pre-habilitative improvement of bowel symptoms in patients with LARS.[45] The purpose of PFMT is to strengthen the muscles of the external anal sphincter through voluntary contraction of the levator ani muscle, which in turn reduces the incidence of fecal incontinence and enhances anal function.[14,16,28–35] As physiotherapy, PFMT requires a high degree of compliance for its efficacy, and maintaining compliance was a common implicit concern across all the studies.[45] Correct and compliant PFMT has a positive effects on improving fecal incontinence, anal function, and quality of life in postoperative patients with rectal cancer.[14,16,28–35] To increase patients' intention to perform PFMT, health care providers should educate patients before surgery about the risk of postoperative LARS and the purpose of PFMT.[29] Currently, high-quality evidence is insufficient to demonstrate that PFMT combined with electrostimulation, rectal balloon training, and a physiotherapist's guidance is superior to PFMT alone.[14] As PFMT is a noninvasive, cost-effective and potentially home-based intervention, clinical recommendations highlight the importance of guiding patients in performing PFMT at home after hospital discharge to prevent LARS.[11,26] However, there is also no consensus between studies about absolute and relative contraindications for PFMT. The majority of studies listed a previous history of fecal incontinence and the inability of patients to engage in PFMT as absolute contraindications.[45] Nevertheless, the exclusion criteria were quite diverse and included those with concomitant conditions such as neuromuscular degeneration or compromise as a relative contraindication[45]; also excluded were patients with diabetes on insulin, renal insufficiency, and congestive heart failure, as well as those with an American Society of Anesthesiologists score of 4.[46] Future research should further clarify the population that would benefit from PFMT.

PFMT pre-exercise instructions

Items 13–16 highlight the importance of implementing pre-exercise instructions for patients performing PFMT. Pape's study[47] revealed that over 80% of patients with LARS did not receive adequate advice or guidance on pelvic floor rehabilitation, indicating a significant gap in postoperative care. Effective PFMT implementation requires both clinical expertise and personalized guidance to bridge the gap between initial treatment and long-term postoperative outcomes. Therefore, to maximize the benefits of PFMT, patients are encouraged to consult with their health care providers before starting the program to receive individualized exercise plans, proper guidance, and referrals to physical therapists if needed.[27] A challenge to compliance was the patient's ability to replicate PFMT movements repeatedly in self-directed settings. Therefore, health care professionals play a crucial role in helping patients identify the pelvic floor muscles via techniques such as digital rectal examinations (DREs).[14,32] Health care professionals should inform patients that, to achieve the benefits of the exercise, the abdominal, gluteal and thigh muscles should be kept relaxed during the exercise, and patients should be instructed to repeat the exercise to master the correct way of doing it.[14,16,27] Poor compliance makes it challenging to determine whether the effect of PFMT is ineffective or its effect is less than anticipated as a result of poor implementation of the exercise in home-based settings.[48] For compliance tracking, most research used mobile application reminders,[30] call reminders,[33] and social software.[35] However, these studies did not address how to quantify compliance with PFMT; they merely explained how to monitor it. To improve patients' attention and management of PFMT compliance at home, future research should design more appropriate PFMT compliance assessment tools.

Exercise regimen

Items 17-20 address key aspects of PFMT regimens, including initial timing, position, intensity, and duration. Currently, there is insufficient evidence to determine the optimal timing for initiating PFMT. Some studies have suggested that patients should begin PFMT at home after discharge,[36] whereas one study[30] indicated that PFMT should start 1 month after surgery or stoma closure for patients with bowel symptoms. We recommend that patients with rectal cancer start PFMT 1 month following surgery or stoma closure for patients with rectal cancer, taking into account the healing period of the anastomosis following surgery. However, we also recommend that the scheduling of health education for patients be shifted forward to the preoperative period since the anal conditions of patients in the early postoperative period are unsuitable for PFMT health education or DREs, which does not help patients acquire exercise techniques for PFMT. Furthermore, there were minor variations in the PFMT intensity used in different studies.[30–35] For a duration of 15–20 weeks, we recommend that the usual regimen could consist of 8–12 contractions per set, 3 to 4 sets per day, for a period of 15–20 weeks.[14,27] Patients may initially find it difficult to fulfill these goals because of a rigorous nature of this regimen. Therefore, depending on the patient's condition and progress, it is advised to progressively increase the time of contractions and relaxation.[27] Ensuring that patients receive the complete information and assistance from medical professionals can greatly improve their compliance with these regimens.[49]

Exercise feedback

Item 21 focuses on the exercise feedback of the PFMT. Before evaluating the exercise feedback, physicians should ensure that there is no underlying "organic" lesion, such as radiation-related mucosal lesions, anastomotic strictures, or local recurrence, that could account for the patient's postoperative symptoms. If bowel function does not improve after several months of performing PFMT correctly, health care providers should promptly reassess the exercise regimen or consider alternative treatments.[27] Commonly alternatives include transanal irrigation and pelvic floor rehabilitation techniques, such as biofeedback, balloon training, and electrostimulation. If conservative treatments remain ineffective after one year, sacral nerve stimulation/percutaneous tibial nerve stimulation can be considered. As a final step, stoma formation may be proposed for patients with severe LARS after two years.[13,28] Therefore, clinical recommendations suggest extending the follow-up to two years, as LARS symptoms typically stabilize by that time.[13,50] The effectiveness of exercise can be assessed using subjective tools, including the LARS score, MSKCC-BFI, Wexner score, Kirwan classification, and the FIQL scale, along with objective measures, such as anorectal manometry, rectoanal sensory testing, pelvic MRI, and anal electromyography.[14,45] However, the patient's own assessment should remain the gold standard, as only patients can truly gauge the impact of these symptoms on their quality of life.[28] Active management of LARS through postoperative follow-ups by colorectal surgeons, gastroenterologists, and nurses is essential for ensuring an acceptable quality of life for patients.[51] Given that the majority of patients will experience LARS symptoms for 12–18 months following sphincter-preserving rectal resection, future studies could explore the development of a structured LARS follow-up system in clinical practice, focusing on the restoration of postoperative bowel function in patients post-TME and providing timely interventions based on the patient feedback.

Limitations

First, only English and Chinese databases were searched in this study. Despite efforts to conduct a comprehensive literature search, there is a possibility of missing relevant evidence in non-English languages. Second, gray literature was not searched, and this exclusion may introduce publication bias, which may limit the comprehensiveness of the findings. Third, the two guidelines included in this study scored low in Domains 2 and 5, and need further improvement in terms of stakeholder involvement and the applicability of the guidelines. In addition, the RCTs included in this study did not describe allocation concealment or blinding, which may have led to measurement bias. Finally, there is currently a paucity of

high-quality clinical evidence on the use of PFMT for the prevention and management of LARS, and the corresponding guidelines and systematic evaluations are limited by the constraints of the original studies.

Conclusions

This article summarized a total of 21 items with the best evidence regarding the application of PFMT for the prevention and treatment of bowel dysfunction in patients with rectal cancer who underwent TME. The covered aspects included multidisciplinary management, bowel function risk screening and assessment, the purpose of and target population for PFMT, PFMT pre-exercise instructions, exercise regimens, and exercise feedback. Limited high-quality evidence currently exists for the use of PFMT in the prevention and management of LARS following rectal cancer. Future research should address this shortcoming by focusing on high-quality, multicenter original studies to better understand the relationships between PFMT exercise regimens and exercise outcomes, identify the populations that may benefit from PFMT; assist patients and health care professionals in creating a customized PFMT exercise programs and follow-up plans, and develop a comprehensive pelvic floor muscle function screening, postoperative rehabilitation, and long-term systems for patients with rectal cancer to increase their quality of life of patients with rectal cancer following PFMT.

CRediT authorship contribution statement

Meirong Hong: Conceptualization, Methodology, Formal analysis, Data Curation, Writing-Original Draft, and Writing-Review & Editing. **Wei Yu**: Methodology, Formal analysis, Data Curation, and Writing-Review & Editing. **Yating Gao**: Methodology, Formal analysis and Writing-Review & Editing. **Bei Pei**: Formal analysis and Writing-Review & Editing. **Ji Chen**: Writing-Review & Editing. **Yan Lou**: Supervision, Writing-Review & Editing, and Funding acquisition. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Ethics statement

Not required.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, Yan Lou, upon reasonable request.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Declaration of competing interest

The authors declare no conflict of interest.

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