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Review – Prostate Cancer

Pelvic Floor Muscle Training with Preoperative Biofeedback in Patients with Postprostatectomy Incontinence: A Systematic Review and Meta-analysis of Randomised Clinical Trials

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Abstract

Background and objective: The evidence on pelvic floor muscle training (PFMT) with preoperative biofeedback after radical prostatectomy (RP) is inconclusive. The objective was to analyse the efficacy of PFMT with preoperative biofeedback in reducing post-prostatectomy incontinence.

Methods: A systematic review and meta-analysis (CRD42024506285) was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines. The search was performed until July 2024. We selected randomised clinical trials including adults with prostate cancer who were candidates for RP and underwent PFMT with preoperative biofeedback compared with the control group, usual care, or PFMT with postoperative biofeedback, and we assessed urinary incontinence, quality of life, or other surgery-related adverse events. Quality of evidence and risk of bias were assessed. A meta-analysis was performed.

Key findings and limitations: Fourteen studies were included in the systematic review and 13 were included in the meta-analysis. Up to 3 mo following RP, the meta-analysis showed significantly lower rates of postprostatectomy incontinence ($n = 485$; odds ratio [OR] = 0.51; 95% confidence interval [CI] = 0.28, 0.92; $p = 0.02$; $I^2 = 21\%$) in the preoperative biofeedback group than in the control group (ie, no intervention or usual care). Results were maintained at 3–<6 mo ($n = 436$; OR = 0.40; 95% CI = 0.20, 0.79; $p = 0.008$; $I^2 = 49\%$) and at 6–<12 mo ($n = 409$; OR = 0.29; 95% CI = 0.10, 0.85; $p = 0.02$; $I^2 = 65\%$) following RP. No significant changes were observed when compared with the postoperative biofeedback. No publication bias was detected. The level of evidence ranged from very low to low. Further high-quality research is required.

Conclusions and clinical implications: PFMT with preoperative biofeedback reduced post-prostatectomy incontinence significantly at different follow-up periods, supporting its use in clinical practice.

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ADVANCING PRACTICE

What does this study add?

Pelvic floor muscle training (PFMT) is considered the gold standard in postoperative pelvic floor rehabilitation. However, evidence of providing PFMT preoperatively remains inconclusive. To the authors' knowledge, this is the first systematic review and meta-analysis to assess the specific effects of PFMT with preoperative biofeedback. This intervention significantly reduces urinary incontinence (UI) in postprostatectomy patients until 6 mo following radical prostatectomy. Our results suggested that PFMT with preoperative biofeedback is more effective than control interventions, but no significant differences were found between pre- and postoperative biofeedback. Although no significant differences were found for quality of life, it is anticipated that an enhancement in UI will lead to an improvement in quality of life.

Clinical Relevance

This systematic review and meta-analysis shows that pelvic floor muscle training (PFMT) with preoperative biofeedback may reduce urinary incontinence rates up to 6 months after radical prostatectomy. While the findings support its consideration preoperatively, the overall certainty of evidence is low, highlighting the need for further high-quality trials to confirm clinical benefit. Associate Editor: Derya Tilki.

Patient Summary

It is not clear whether pelvic floor muscle training (PFMT) should be used preoperatively. This is the first study to assess the specific effects of PFMT with preoperative biofeedback in reducing urinary incontinence (UI) after prostate surgery. This intervention can reduce UI until 6 mo after prostate surgery.

1. Introduction

The most prevalent adverse event following radical prostatectomy (RP) is urinary incontinence (UI) [1]. The prevalence of postprostatectomy incontinence ranges from 2.5% to 90%, depending on the definition of continence and the assessment method [2,3]. According to the International Continence Society (ICS), the 24-h pad test is the most accurate test to quantify UI [4]. Loss of more than 1 g of urine in the pad test was considered incontinence [5]. The aetiology of UI is multifactorial [6] and remains unclear [7]. Its underlying mechanisms are related to preoperative lower urinary tract function, surgical technique, surgeon experience, and altered anatomy [3,8]. Urethral sphincter dysfunction secondary to surgical damage, detrusor overactivity, and lack of strength of the urethral sphincter are considered its main causes [7,9]. UI has a negative impact on quality of life [10] and prolongs the postoperative recovery period [1]. Between 3% and 12% of patients remain incontinent at 1 yr following RP [11]. Choinière et al [12] reported that the benefits of surgery for postprostatectomy incontinence remain uncertain, while suggesting important harms. Thus, research about prevention and conservative treatment is needed.

Robust evidence supports pelvic floor muscle training (PFMT) as the gold standard in postoperative rehabilitation and as a safe treatment [13]. Pelvic floor muscle exercises (PFMEs) consist of repetitive voluntary contractions and relaxations of pelvic floor muscles involved in continence to increase strength and endurance [11,14,15]. Biofeedback is used as an adjunctive treatment to therapeutic exercise [7]. It provides information during PFMEs and facilitates the activation of these muscles, improving the performance of exercises and patients' awareness [7,13–15]. By providing this treatment preoperatively, it may be possible to reduce cost and time [1]. Patients can gain motor skills and correct the execution of PFMEs before surgery to be more prepared to resume exercise immediately after catheter removal [7,16]. PFMT with preoperative biofeedback may enhance postoperative continence recovery [7,13]. However, evidence remains unclear [13].

According to a recent Cochrane review [17], there is a lack of high-certainty evidence regarding the use of conservative interventions for UI following prostate surgery. Furthermore, evidence on the efficacy of PFMT combined with biofeedback is uncertain. Averbeck et al [8] stated that studies on preoperative PFMT should identify factors related to postprostatectomy incontinence and the additional value of biofeedback should be addressed. Yu et al [1] concluded that biofeedback has a better effect in the early and middle postoperative periods, and preoperative PFMT was ranked in the top three interventions with greater efficacy. To the authors' knowledge, this is the first meta-analysis assessing the specific effects of PFMT with preoperative biofeedback.

Therefore, the objective of this systematic review and meta-analysis was to analyse the effects of PFMT with preoperative biofeedback in reducing postprostatectomy incontinence.

2. Methods

2.1. *Design*

This systematic review and meta-analysis was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 guidelines [18]. It was registered in the International Prospective Registry of Systematic Reviews (PROSPERO): CRD42024506285 (available at: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=506285).

2.2. *Search strategy*

The search was performed in four databases (CINAHL, Medline [via PubMed], Scopus, and Web of Science) from their inception to July 2024, without language restrictions. We also reviewed the reference list of related studies and searched for potential on-going trials. The search strategies are shown in the Supplementary material.

2.3. *Study selection*

We selected the studies using the PICOS strategy: participants—adults (≥18 yr old) with prostate cancer who were candidates for RP; interventions—PFMT with preoperative biofeedback; comparisons—control group (no intervention or placebo), usual care (postoperative PFMT), or PFMT with postoperative biofeedback; outcomes—primary (UI) and secondary (quality of life and other surgery-related adverse events) outcomes; and study—randomised clinical trials (RCTs). We included full-text studies in English, Spanish, or French. Details of study selection are shown in the Supplementary material.

Two reviewers selected the studies independently using Zotero (Zotero 6, Center for History and New Media, George Mason University). A third reviewer resolved any disagreements. In the first screening, titles and abstracts were reviewed, and in the second screening, the full text was analysed. We contacted corresponding authors when the full text was not available.

2.4. *Data extraction*

Table 1 describes the characteristics of included studies and participants. Table 2 describes the characteristics of interventions. Two reviewers performed the data extraction independently. We contacted corresponding authors when information was unclear.

2.5. *Methodological quality*

The modified Downs and Black [19] scale was used. This scale contains 27 items divided into five sections. Total scores range from 0 to 28, and higher ones indicate better methodological quality. Studies can be categorised as excellent (26–28), good (20–25), fair (15–19), or poor (≤14).

2.6. *Risk of bias*

The revised Cochrane risk-of-bias tool (RoB-2) was used [20]. This tool covers all types of biases that affect the results of RCTs in five domains. These domains can be categorised as "a low risk of bias", "some concerns", or "a high risk of bias".

Two reviewers evaluated methodological quality and risk of bias independently. Disagreements were resolved with a third reviewer.

2.7. *Certainty of the evidence*

We used the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach [21,22] to judge the overall certainty of evidence based on five domains: risk of bias, imprecision, inconsistency, indirectness, and publication bias. The GRADE approach categorises the certainty of a body of evidence as "high", "moderate", "low", or "very low" according to the outcome [23]. This assessment was performed by two independent reviewers through the GRADEpro GDT (https://gradepro.org; accessed February 6, 2025).

2.8. *Statistical analysis*

The meta-analysis was conducted using Review Manager (RevMan) software 5.4 (The Nordic Cochrane Centre, Copenhagen, Denmark). Results were displayed using forest plots.

For dichotomous outcomes, the number of events and sample size were extracted. Pooled odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using the Mantel-Haenszel method under a random-effect model [24,25]. To clarify the interpretation of the results, we also calculated the number needed to treat (NNT) according to the *Cochrane Handbook* [26].

For continuous outcomes, the mean, standard deviation (SD), and sample size were extracted. We calculated SD when standard errors were reported [27]. We used mean difference (MD) with 95% CI when outcomes were assessed with the same instrument and standardised mean difference (SMD) when the instruments were different. Pooled effect sizes were defined as small (MD <10% of the scale; SMD <0.2), moderate (MD = 10–20% of the scale; 0.2 < SMD < 0.8), or large (MD >20% of the scale; SMD >0.8) [26,28]. We used an inverse variance and random-effect model [24].

A p value of ≤0.05 was considered statistically significant. Heterogeneity was assessed using the I^2 test as low (I^2 = 0–24%), moderate (I^2 = 25–49%), substantial (I^2 = 50–74%), or considerable (I^2 = 75–100%). We planned a subgroup analysis based on the comparisons and type of biofeedback, as well as a sensitivity analysis. To assess the potential publication bias, we used funnel plots and Egger's regression asymmetry test when ten or more studies were available [29]. A p value of <0.05 was considered significantly biased. We used the Statistical Package for the Social Sciences (SPSS) 28.0 (SPSS, Inc., Chicago, IL, USA).

3. Results

3.1. *Search selection*

We identified 1691 relevant records in all databases but did not identify studies via other methods. After determining eligibility, 14 RCTs were included in the systematic review, of which 13 were included in the meta-analysis (Fig. 1). The Supplementary material shows the studies excluded in the last screening. We identified 24 potential on-going RCTs, of which eight were included (Supplementary material).

Table 1 – Characteristics of included studies

Author [ref.]	Sample size (n)	Age, years (mean±SD)	Characteristics of participants	Type of prostatectomy	Continence criteria	Outcome measures	Measuring instrument	Follow-up
Allameh et al. [30]	Total: 57 EG1: 19 EG2: 19 CG: 19	Total: 69.40 ± 6.40 EG1: 69.00 ± 5.70 EG2: 68.40 ± 6.90 CG: 70.60 ± 6.80	Prostate cancer: verified via transrectal biopsy Continence status: comorbidities affect UI	RP Walsh's technique	24 h pad test: ≤1 pad (minimal urine leakage or for security)	Urinary continence* Time to continence*	24 h pad usage (n° of continent patients and %) + mean pad/d d	1 3 6 mo after catheter removal
Aydin-Sayilan et al. [31]	Total: 60 EG: 30 CG: 30	Total: - EG: 63.00 ± 8.61 CG: 59.93 ± 6.98	Prostate cancer: localised stages T1 and T2 Continence status: no UI before surgery	Robot-assisted RP Nerve spare technique	ICIQ-UI SF = 0	Self-reported continence 6 mo* UI*	ICIQ-UI SF (n° of continent patients and %) ICIQ-UI SF scores + n° of pads/wk	10 d, 1 3 6 mo after catheter removal
Bales et al. [32]	Total: 100 EG: 47 CG: 50	Mean Total: - EG: 59.30 CG: 60.90	Prostate cancer: stages T1c and T2c Continence status: NR	Retropubic RP	24 h pad test: ≤1 pad (minimal urine leakage or for security)	Urinary continence	24 h pad usage (n° of continent patients and %)	1 2 3 4 6 mo after surgery
Burgio et al. [33]	Total: 112 EG: 57 CG: 55	Total: 60.90 ± 6.90 EG: 60.70 ± 6.60 CG: 61.10 ± 7.20	Prostate cancer Continence status: no UI before surgery	RP	3 consecutive weekly 1-d or 7-d bladder diary with no leakage.	Time to continence UI* Lifestyle Psychological distress QoL	d 1-d and 7-d bladder diary (n° of incontinent patients and %) + The Incontinence Impact Questionnaire Questionnaire about bladder control and life-style issues The Hopkins Symptom Checklist The Medical Outcomes Study Short Form Health Survey	6 wk, 3 6 mo after surgery
Centemero et al. [16]	Total: 118 EG: 59 CG: 59	Median (IQR) Total: - EG: 60.50 (48–68) CG: 57.50 (46–67)	Prostate cancer: localised stages cT1-cT2a-b Continence status: no UI before surgery	Open RP Nerve spare technique	No urinary leakage reported in bladder diary and a negative stress test.	Self-reported continence 1, 3 mo* UI QoL PFME satisfaction	Bladder diary and stress test (n° of continent patients and %) 24 h pad test (weight >150 g) (n° of incontinent patients and %) ICS male SF PGI-I	1 3 mo after surgery
De Lira et al. [34]	Total: 31 EG: 16 CG:15	Total: - EG: 67.30 ± 5.63 CG: 63.53 ± 7.62	Prostate cancer: adenocarcinoma Continence status: no UI before continence	RP	Incontinence criteria: perception of loss of at least a few drops of urine.	UI Erectile dysfunction Electromyographic recordings of the pelvic floor	ICIQ-UI SF (scores) + n° of incontinent patients and % IIEF Miotool Uro device (Miotec®, Porto Alegre, Brazil)	3 mo after surgery
Dijkstra-Eshuis et al. [35]	Total: 121 EG: 65 CG: 56	Total: 63.70 ± 5.30 - -	Prostate cancer: organ-confined Continence status: no UI before surgery	Laparoscopic RP	24 h pad test: no leakage at all	The rate of continence 1 year postoperatively QoL Examination of the pelvic floor	24 h pad test (n° of continent patients and %) + 24 h bladder diary KHQ and IPSS PeLFIs, anal visual observation, digital palpation and BF registration	6 wk, 3 6 9 12 mo after surgery
Geraerts et al. [36]	Total: 180 EG: 91 CG: 89	Total: - EG: 61.88 ± 5.90 CG: 62.04 ± 6.33	Prostate cancer: localised or locally advanced Continence status: 30.6% incontinent participants	Open or robot-assisted RP	24 h pad test (weight): 3 consecutive d of 0 g of urine loss	Urinary continence QoL* Strength Endurance	24 h pad test (n° of continent patients and %) + 1 h pad test + VAS KHQ and IPSS - -	1 3 6 12 mo after surgery
Khorrami et al. [37]	Total: 80 EG: 40 CG: 40	Median (IQR) Total: - EG: 64.50 (58–73) CG: 63.80 (50–74)	Prostate cancer: localised or locally advanced Continence status: no UI before surgery	Open retropubic RP Nerve spare technique	ICIQ-UI SF = 0	UI* QoL*	ICIQ UI SF (n° of incontinent patients, % + scores) ICIQ MLUTS	1 3 6 mo after catheter removal
Mathewson-Chapman et al. [38]	Total: 51 EG: 27 CG: 24	Ages ranged from 47 to 75 years (mean age 62)	Prostate cancer: localised Continence status: no UI before surgery	RP	NR	UI Urinary continence	3-d bladder diaries and 24 h pad test n° of continent patients and %	2 5 9 wk, 3 mo after surgery
Ocampo-Trujillo	Total: 16 EG: 8	Total: 58.00 ± 11.20 EG: 56.60 ± 5.50	Prostate cancer: T<3 N0M0 PSA<20)	RP	24 h pad test: urine loss on 3 consecutive d	Urinary continence Contraction pressure	24 h pad test (n° of continent patients and %) Myomed 134® (Enraf Nonius, Dresden,	Before surgery 8 wk after surgery

Table 1 (*continued*)

Author [ref.]	Sample size (n)	Age, years (mean±SD)	Characteristics of participants	Type of prostatectomy	Continence criteria	Outcome measures	Measuring instrument	Follow-up
et al. [39]						of the levator ani*	Alemania)	
	CG: 8	CG: 66.00 ± 4.30	Continence status: NR			QoL	UCLA-PCI and RAND SF-12	
						Histomorphometric changes*	Tissue samples	
Parekh et al. [40]	Total: 38	Mean Total: -	Prostate cancer: localised Continence status: no UI before surgery	Retropubic RP	24 h pad test: ≤1 pad (minimal urine leakage or for security)	Urinary continence*	24 h pad test (n° of continent patients and %) + postoperative incontinence questionnaire	6 wk, 3 4 5 7 12 mo after surgery
	EG: 19	EG: 61.6						
	CG: 19	CG: 55.5						
Tienforti et al. [41]	Total: 32	Median (IQR) Total: -	Prostate cancer: localised stages cT1a-cT2b	Open retropubic RP	ICIQ-UI SF = 0	Self-reported continence 6 mo*	ICIQ-UI SF (n° of continent patients and %)	1 3 6 mo after catheter removal
	EG: 16	EG: 64 (52–74)	Continence status: no prior diseases with a possible impact on UI	Walsh's technique		UI*	N° of incontinence episodes/wk and n° of pads used/wk	
	CG: 16	CG: 67 (60–74)		Nerve spare technique		OAB symptoms*	ICIQ-OAB	
						QoL*	UCLA-PCI and IPSS	
Veshnavei et al. [42]	Total: 250	Total: -	Prostate cancer: localised or locally advanced and standard metastases	Open retropubic RP	ICIQ-MLUTS = 0	UI*	ICIQ-MLUTS (n° of incontinent patients and %)	24 h, 1 wk, 1 3 6 mo after catheter removal
	EG: 125	EG: 63.25 ± 6.34		Nerve-spare technique		QoL*	ICIQ-MLUTS	
	CG: 125	CG: 62.84 ± 6.20	Continence status: non-severe UI before surgery					

Abbreviations: SD: standard deviation; EG: experimental group; CG: control group; UI: urinary incontinence; RP: radical prostatectomy; d: day(s); mo: month(s); ICIQ-UI SF: International Consultation on Incontinence Questionnaire on Urinary Incontinence Short Form; wk: week(s); NR: not reported; QoL: quality of life; IQR: interquartile range; PFME: pelvic floor muscle exercises; ICS male SF: International Continence Society Male Short Form questionnaire; PGI-I: Patient's Global Impression of Improvement questionnaire; IIEF: the International Index of Erectile Function questionnaire; KHQ: King's Health Questionnaire; IPSS: The International Prostate Symptoms Score; PeLFIs: Pelvic Floor Inventories; BF: biofeedback; VAS: visual analogue scale; ICIQ-MLUTS: International Consultation on Incontinence Questionnaire Male Lower Urinary Tract Symptoms Module; PSA: Prostate Specific Antigen; UCLA-PCI: University of California, Los Angeles - Prostate Cancer Index; RAND SF-12: The 12-Item Short Form Health Survey; OAB; overactive bladder; ICIQ-OAB: International Consultation on Incontinence Questionnaire Overactive Bladder Module. *Outcomes with significant differences ($p < 0.05$) between groups.

3.2. *Characteristics of included studies*

Table 1 summarises the characteristics of included studies and participants. The included RCTs were published between 1997 and 2023 [16,30–42].

3.2.1. *Participants*

The total number of participants was 1246. Sample sizes ranged from 16 to 250 participants. Eight studies [16,31,33–35,37,38,40] had the absence of UI before surgery as an inclusion criterion. Geraerts et al [36] reported that 30.6% of participants were incontinent before surgery. Two studies excluded participants with prior comorbidities or diseases that affect UI [30,31] and one study [42] excluded participants with severe UI. Two studies did not report any inclusion or exclusion criteria related to incontinence [32,39]. Most studies did not report information about the timing of catheter removal. In those that reported the information, the catheter was removed 1–2 wk after surgery.

3.2.2. *Outcomes and measurement instruments*

All included studies assessed UI and established continence criteria, except that of Mathewson-Chapman [38]. Participants were considered continent when a 0 score was obtained in the International Consultation on Incontinence Questionnaire (ICIQ) on Urinary Incontinence Short Form (ICIQ-UI SF) [31,37,41] or in the ICIQ Male Lower Urinary Tract Symptoms Long Form questionnaire (ICIQ-MLUTS) [42]. The continence criterion was based on the 24-h pad test in six studies [30,32,35,36,39,40]. One study [33] used bladder diaries, and another study [16] also used a negative stress test. In their study, de Lira et al [34] considered incontinence when patients reported the perception of loss of at least a few drops of urine. Additionally, studies reported the number of continent [16,30–32,35,36,38–41] or incontinent [16,33,34,37,42] participants according to the continence criteria. UI was assessed across studies using all the instruments mentioned above. A more detailed and specific explanation regarding continence assessment is shown in the Supplementary material.

Another related outcome was quality of life assessed with the International Prostate Symptoms Score [35,36,41]; King's Health Questionnaire (KHQ) [35,36]; University of California, Los Angeles—Prostate Cancer Index [39,41]; ICIQ-MLUTS [37,42]; ICS Male SF questionnaire [16]; and The Medical Outcomes Study SF Health Survey [33].

The most frequent follow-up time points were 1, 3, and 6 mo (after surgery or catheter removal).

3.3. *Characteristics of interventions*

Table 2 summarises the characteristics of interventions.

3.3.1. *Biofeedback interventions*

Interventions started 1–4 wk prior to surgery. In most studies [16,31–38,40–42], before surgery, participants were instructed on how to perform PFMEs using biofeedback and were encouraged to continue PFMEs following a home programme. In six studies, preoperative biofeedback sessions were combined with a pre- and postoperative home programme [31–35,42]. In two studies [16,36], the biofeed-

Table 2 – Characteristics of interventions

Author [ref.]	Type of BF	Start	Interventions	Session duration (minutes)	Frequency (session/ week)	Programme duration (weeks)
Allameh et al. [30]	MyoTrac Infiniti (Thought Technology Ltd., Montreal, Canada)	2 weeks prior to surgery	**EG1: PFMT (pre-BF sessions) + Post non-functional probes** *Prior to surgery*: Patients performed PFMT with BF. *After surgery*: Patients received non-functional probes after the surgery.	30	2	2
			EG2: Pre-non-functional probes + PFMT (post BF sessions) *Prior to surgery*: Patients received non-functional probes. *After surgery*: After removing the catheter, patients underwent PFMT with BF.			
			CG: Non-functional probes before and after surgery	-	-	-
Aydin-Sayilan et al. [31]	-Verbal and tactile pointers -Real-time transabdominal ultrasound imaging (1 cm above urinary bladder)	1 week prior to surgery	**EG: PFMT (pre-BF sessions + home programme)** *BF sessions*: Repeated activations of PFM (20 contractions of 10 s) in various positions (sitting, standing and supine positions) under supervision using BF. Superior displacement of the bladder base exceeding 1 cm was regarded as indicating successful activation of the PFM. *Home programme*: Repeated activations (60 contractions per day) while coughing, sitting down or rising from a chair.	*Pre*: 60 + - *Post*: -	*Pre*: - + 3 times per day *Post*: 3 times per day	*Pre*: 1 to 4 sessions + until surgery *Post*: 24
			CG: Usual care (pre-breathing exercises). Breathing exercises and any questions patients might have about the operation.	-	-	-
Bales et al. [32]	-BF Techniques -Surface electrodes	2 to 4 weeks prior to surgery	**EG: PFMT (pre-BF session + home programme)**. *BF session*: a single PFMT with BF session (surface electrodes were used to assess muscle strength and contractions of 5–10 s, 10–15 times). *Home programme*: Practice PFME 4 times per day until their surgery and after catheter removal.	*Pre*: 45 + - *Post*: -	*Pre*: - + 4 times per day *Post*: 4 times per day	*Pre*: 1 session + until surgery *Post*: -
			CG: Usual care (written and verbal instructions). Written and verbal instructions on how to perform PFME 4 times per day with 10 to 15 repetitions. These instructions asked men to isolate the muscle that starts and stops urine flow. After catheter removal, patients reviewed written instructions with a nurse.	-	4 times per day	*Pre*: until surgery *Post*: -
Burgio et al. [33]	Visual feedback of rectal pressure with a rectal probe with 3 small balloons	1 week prior to surgery	**EG: PFMT (pre-BF session + home programme)** *BF session*: Feedback + verbal instruction and reinforcement was used to teach patients how to contract the sphincter muscles during 2–10 s periods separated by 2–10 s of relaxation, while keeping the abdominal muscles relaxed. *Home programme*: Practice PFME in various positions and integrate them into daily activities (15 exercises). Resume the exercise regimen after catheter removal.	-	*Pre*: - + 3 times per day *Post*: 3 times per day	*Pre*: 1 session + until surgery *Post*: -
			CG: Usual care (post verbal instructions). Post verbal instructions to practice interrupting the urinary stream during voiding + instructions provided by the surgeon as part of usual care.		-	-
Centemero et al. [16]	Visual feedback + verbal instructions	4 weeks prior to surgery	**EG: PFMT (BF sessions + home programme)** PFMT using feedback alternating maximal and submaximal contractions + daily home programme. 48 h after catheter removal, patients attended the course twice per week for 1 month and continued PFME until continence was achieve at home. Correct pelvic floor muscle contraction and muscle strength were assessed by subscrotal digital assessment.	30 + 30	2 + daily	*Pre*: 4 *Post*: 4 + until continence
			CG: PFMT (post BF sessions + post home programme). Postoperatively, CG patients performed the same programme as EG patients.			*Post*: 4 + until continence
De Lira et al. [34]	EMG BF (endoanal probe)	NR	**EG: PFMT (pre-BF sessions + home programme)** *BF sessions*: 2 pre-guided sessions, including exercises and EMG BF. *Home programme*: verbal and written instructions to continue the exercises at progressively higher intensities. Patients resumed exercises immediately after catheter removal.	-	*Pre*: - + 3 times per day *Post*: 3 times per day	*Pre*: 2 sessions + until surgery *Post*: -
			CG: Usual care (post usual care)	-	-	-

Table 2 (*continued*)

Author [ref.]	Type of BF	Start	Interventions	Session duration (minutes)	Frequency (session/ week)	Programme duration (weeks)
Dijkstra-Eshuis et al. [35]	The Myomed 932® with an EMG anal probe (two rings anal probe 2 mm,V.M.P. Bioparc)	4 weeks prior to surgery	**EG: PFMT (pre-BF sessions + home programme)** *BF sessions*: a standardized protocol of BF-guided exercises comprising MVCs, endurance, relaxation and coordination with abdominal breathing. BF + verbal instruction and reinforcement was used. *Home programme*: PFME (2 sets of 30 contractions during abdominal breathing) in various positions integrating them into daily activities. Resume the exercises postoperatively.	*Pre*: 30 + - *Post*: -	*Pre*: 1 + twice a day *Post*: twice a day	*Pre*: 4 *Post*: -
			CG: Usual care (post written PFMT). Patients received written PFME immediately after catheter removal.	-	-	-
Geraerts et al. [36]	EMG BF	3 weeks prior to surgery	**EG: PFMT (BF sessions + home programme)** *BF sessions*: PFME controlled by the therapist and supplied with EMG BF. *Home programme*: 60 contractions while coughing and sitting down or getting up from a chair. The fourth day after surgery patients restarted PFME. Patients came to the hospital once a week to discuss their bladder diary and to perform an individual exercise session with digital or EMG BF control.	30 + -	1 + daily	*Pre*: 3 *Post*: until continence
			CG: PFMT (post BF sessions + post home programme). Same post programme as EG patients the day of catheter removal.			Until continence
Khorrami et al. [37]	BF techniques	4 weeks prior to surgery	**EG: PFMT (pre-BF sessions + pre-home programme)** *BF session*: Patients were instructed on PFMT with a standardized BF-guided exercise protocol that included MVCs, endurance, relaxation and coordination with abdominal breathing. Surface electrodes were used to evaluate muscle strength and contractions lasting 5–10 s with 10–15 repetitions. *Home programme*: Patients were asked to regularly perform exercises immediately until surgery.	60 + 30	- + twice a day	4
			CG: No intervention. Before the surgery, the CG received no PFMT instructions.	-	-	-
Mathewson-Chapman et al. [38]	The rectal pressure probe and the PRS 8900 Penned Re-education Incare System with BF (Hollister)	NR	**EG: Usual care (pre-education programme) + PFMT (pre-BF session + post home programme)** *Education programme*: Prostate education programme (surgery, anatomy and physiology, self-care activities, restrictions and complications). *BF session*: PFME with BF session included coaching in insertion of the rectal probe and practicing PFME (contractions and relaxation of 10 s, for 3 min.) *Home programme*: Home PFMT protocol from week 3 to week 12 after surgery.	*Pre*: 30 + - *Post*: -	*Pre*: - *Post*: 3	*Pre*: 1 session *Post*: 9
			CG: Usual care (pre-education programme). Patients performed the same education programme as EG but they did not practice PFMT during the pre-session or the 12-week study period.	30	-	-
Ocampo-Trujillo et al. [39]	Myomed 134® (Enraf Nonius, Alemania)	4 weeks prior to surgery	**EG: PFMT (pre-BF sessions)**. Voluntary contractions and relaxations of the elevator ani muscles selectively, accompanied by an auditory and visual signal by BF. Myomed 134® device in lithotomy position with the aid of an anal pressure electrode was used. **CG: Usual care (pre-surgical management)**. Hygienic-dietary measures delivered by the urology department, physiotherapy and treating physician.	-	3 times per day	4
Parekh et al. [40]	-Verbal cues -Visualization with anatomical model -Palpation -Objective PFM contraction -BF with EMG recordings via rectal probe	NR	**EG: PFMT (BF sessions + post home programme)** *BF sessions*: 1st session of PFMT, 4 exercises were performed in the supine, hook-lying position, while coordinating PFM contraction during diaphragmatic breathing exhalation. On 2nd session, 4 exercises were performed with the patient sitting on an inflatable exercise ball. BF was performed to ensure adequate performance. After catheter removal, PFMT was reviewed and patients was seen in physical therapy every 3 weeks for 3 months. *Home programme*: Instructions to continue PFMT at home after surgery.	-	*Pre*: - *Post*: 1 session every 3 weeks + twice a day	*Pre*: 2 sessions *Post*: 12 + up to 24
			CG: No intervention. Patients were not given formal education PFMT.	-	-	-

(continued on next page)

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Table 2 (*continued*)

Author [ref.]	Type of BF	Start	Interventions	Session duration (minutes)	Frequency (session/ week)	Programme duration (weeks)
Tienforti et al. [41]	PelveenCare ® (Coloplast, Bologna, Italy).	NR	**EG: PFMT (BF sessions + post home programme)** *BF sessions*: Patients were placed in the supine position, with hips flexed to ≈ 60°, then the anal probe was inserted, and a reference electrode was placed on the anterior superior iliac spine. After removing the catheter, patients received control visits at monthly intervals, with a new session of BF. *Home programme*: Oral and written instructions and a structured programme of PFME (5 s contractions 5 s relaxations while lying, sitting and standing).	*Pre*: 20 *Post*: - + 10	*Pre*: - *Post*: monthly + 3 times per day	*Pre*: 1 session *Post*: until continence
			CG: Usual care (post oral and written instructions). Patients were not given formal education on PFMT. After catheter removal, they received only oral and written instructions on PFME to be performed at home.	10	3 times per day	Until continence
Veshnavei et al. [42]	BF techniques	4 weeks prior to surgery	**EG: PFMT (pre-BF session + home programme)** *BF session*: PFMT using BF techniques in a training class to learn how to perform exercises at home. Kegel training were similar to Urvaylıoğlu et al. 2021. *Home programme*: Patients followed a home exercise programme immediately after the trainings and continued after surgery.	*Pre*: 60 + 30 *Post*: 30	*Pre*: - + twice a day *Post*: twice a day	*Pre*: 1 session + 4 *Post*: -
			CG: No intervention. Patients received no PFMT instructions.	-	-	-

BF = biofeedback; CG = control group; EG = experimental group; EMG = electromyography; MVC = maximum voluntary contraction; NR = not reported; PFM = pelvic floor muscles; PFME = pelvic floor muscle exercise; PFMT = pelvic floor muscle training; Post = postoperative; Pre = preoperative.

back sessions and the home programme were both pre- and postoperative. In another two studies [40,41], biofeedback sessions were both pre- and postoperative, but the home programme was only postoperative. In one study [38], preoperative biofeedback sessions were combined with a postoperative home programme, and in another one, biofeedback sessions and home programme were only preoperative [37]. In two studies [30,39], the participants performed only preoperative biofeedback sessions. In one of these studies [30], preoperative biofeedback sessions were combined with postoperative nonfunctional probes.

The type of biofeedback differed between studies. Five studies [30,35,38,39,41] used a specific biofeedback device. Three studies [34,36,40] used electromyography biofeedback. Three studies [32,37,42] used biofeedback techniques and two studies [16,33] used visual feedback. One study [31] used real-time ultrasound imaging as biofeedback and verbal and tactile pointers. Additionally, three studies [16,32,33] combined different types of biofeedback.

3.3.2. *Control interventions*

Eleven studies compared PFMT with preoperative biofeedback versus postoperative PFMT (with or without biofeedback). Preoperative biofeedback was compared with usual care (postoperative PFMT with written and/or verbal instructions) in eight studies [31–35,38,39,41]. In two studies [16,36], the control group performed the same intervention only postoperatively. Allameh et al [30] compared preoperative biofeedback combined with postoperative nonfunctional probes to postoperative biofeedback with preoperative nonfunctional probes, and with only nonfunctional probes. The remaining studies compared preoperative biofeedback with no intervention [37,40,42].

3.3.3. *Dosage*

Biofeedback sessions lasted for 20–60 min. In some studies [30,32–34,37,38,40,42], only one or two sessions were performed, while in others [16,30,35,36], one to three sessions per week were conducted. Some studies [16,30,37,41,42] reported that in-home sessions lasted between 10 and 30 min, but many studies did not report this information. Home programmes were performed one to four times per day. In most studies, programmes lasted until surgery (ie, preoperative interventions) or until recovery of continence (ie, postoperative interventions).

3.3.4. *Supervision and adverse events*

Interventions were supervised in all studies. The most common supervisors were physiotherapists [16,34,35,37,40,42] or researchers [31,38]. Home programmes were not supervised. Only two studies reported that patients experienced no adverse events following the intervention [35,41]. The remaining studies did not provide information on adverse events.

3.4. *Methodological quality*

The Downs and Black [19] scale was used to assess methodological quality. Six studies had good quality (20–25), seven studies showed fair quality (15–19), and one study had poor quality (≤14; Supplementary material).

3.5. *Risk of bias*

We assessed the risk of bias with the RoB-2 tool [20]. Eleven studies were assessed as having a "high risk of bias", one study was assessed as having a "low risk of bias", and two studies showed "some concerns" (Supplementary material).

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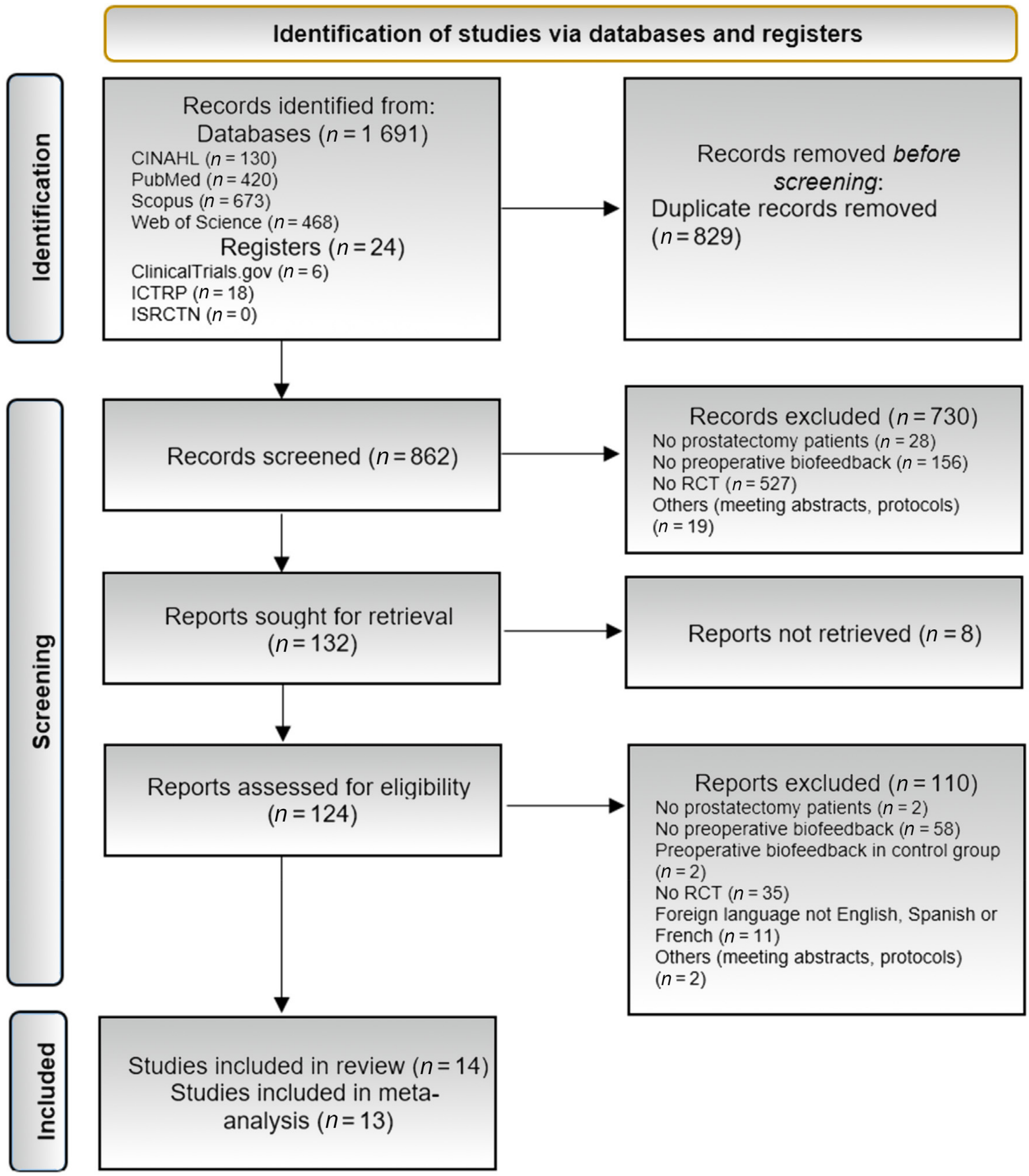


Fig. 1 – PRISMA flow diagram. PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-analyses; RCT = randomised clinical trial.

3.6. *Certainty of the evidence*

The overall certainty of the evidence for each outcome was evaluated using GRADE. The level of evidence ranged from very low to low, mainly because of the risk of bias, inconsistency, and imprecision of results. The GRADE results are available in the Supplementary material.

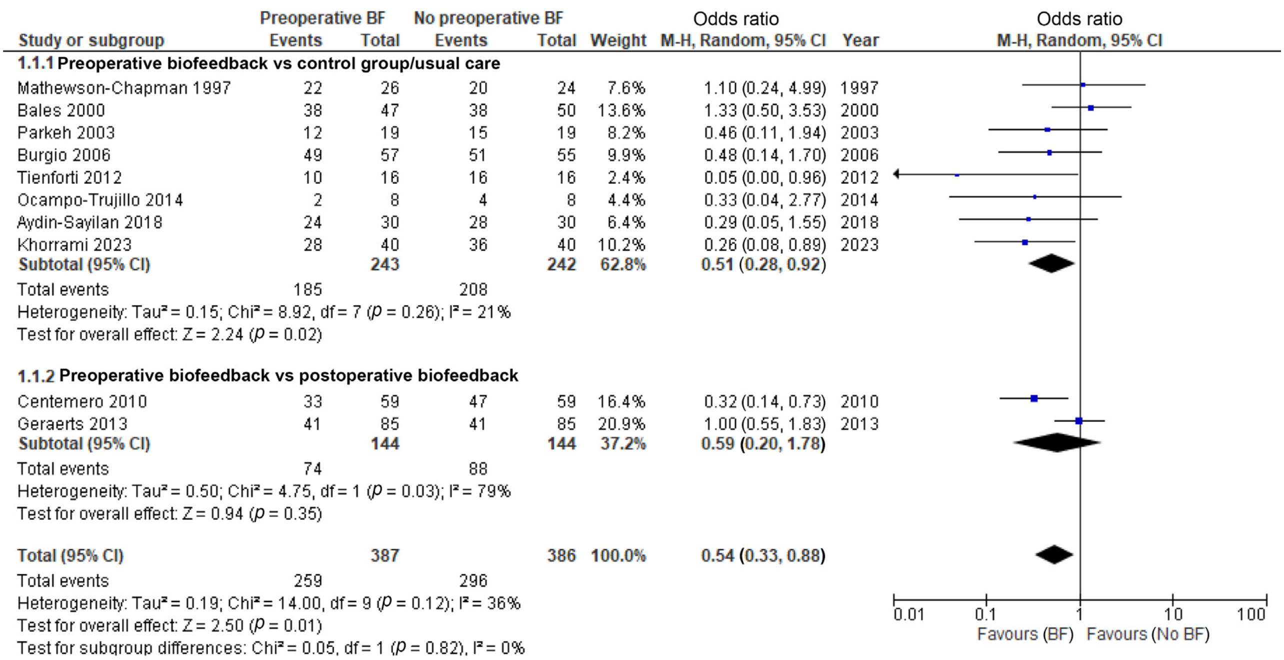
3.7. *Quantitative synthesis*

We analysed the effects of PFMT with preoperative biofeedback versus PFMT with no preoperative biofeedback in patients following RP. We considered outcomes repeated at least in three studies. We analysed UI and quality of life at three follow-up periods: up to 3 mo, at 3–<6 mo, and at 6–<12 mo following RP. When studies included different assessment time points for the same period, the one most similar to that of other studies was selected. The study by Allameh et al [30] was excluded because the interventions were not comparable. A subgroup analysis based on comparisons and type of biofeedback was conducted.

3.7.1. *Effects of PFMT with preoperative biofeedback on UI*

Eleven studies [16,31–34,36–41] contained sufficient quantitative data on the number of incontinent patients at different follow-up periods.

Up to 3 mo following RP (Fig. 2A), results showed significantly lower rates of postprostatectomy incontinence ($n = 773$; OR = 0.54; 95% CI = 0.33, 0.88; $p = 0.01$) in the pre-



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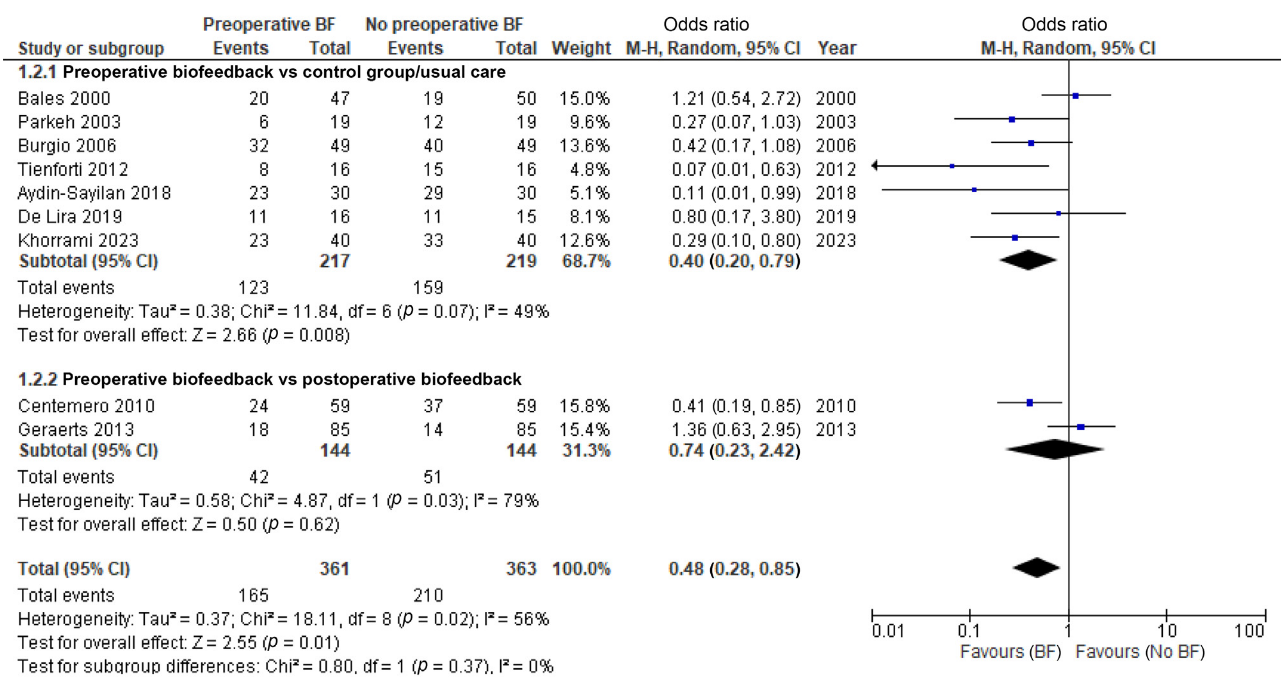

B

Fig. 2 – Forest plots summarising OR and 95% CI for the effects of preoperative biofeedback versus no preoperative biofeedback in prostatectomy patients (A) up to 3 mo, (B) at 3–<6 mo, and (C) at 6–<12 mo following radical prostatectomy for urinary incontinence based on comparisons. (D) A forest plot summarising MD and 95% CI for the effects of preoperative biofeedback versus control group in prostatectomy patients for urinary incontinence (ICIQ-SF) based on the follow-up period. BF = biofeedback; CG = control group; CI = confidence interval; ICIQ-UI SF = International Consultation on Incontinence Questionnaire on Urinary Incontinence Short Form; MD = mean difference; M-H = Mantel-Haenszel; OR = odds ratio.

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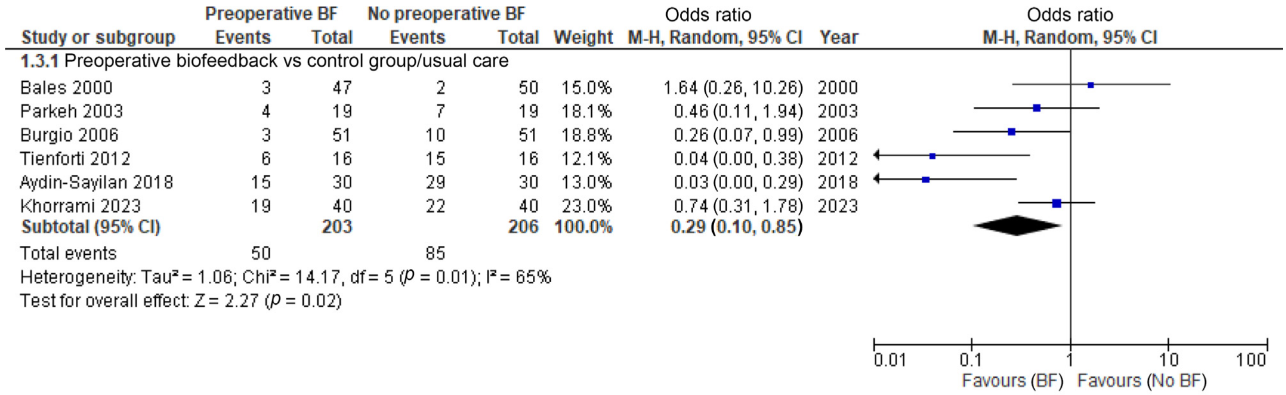

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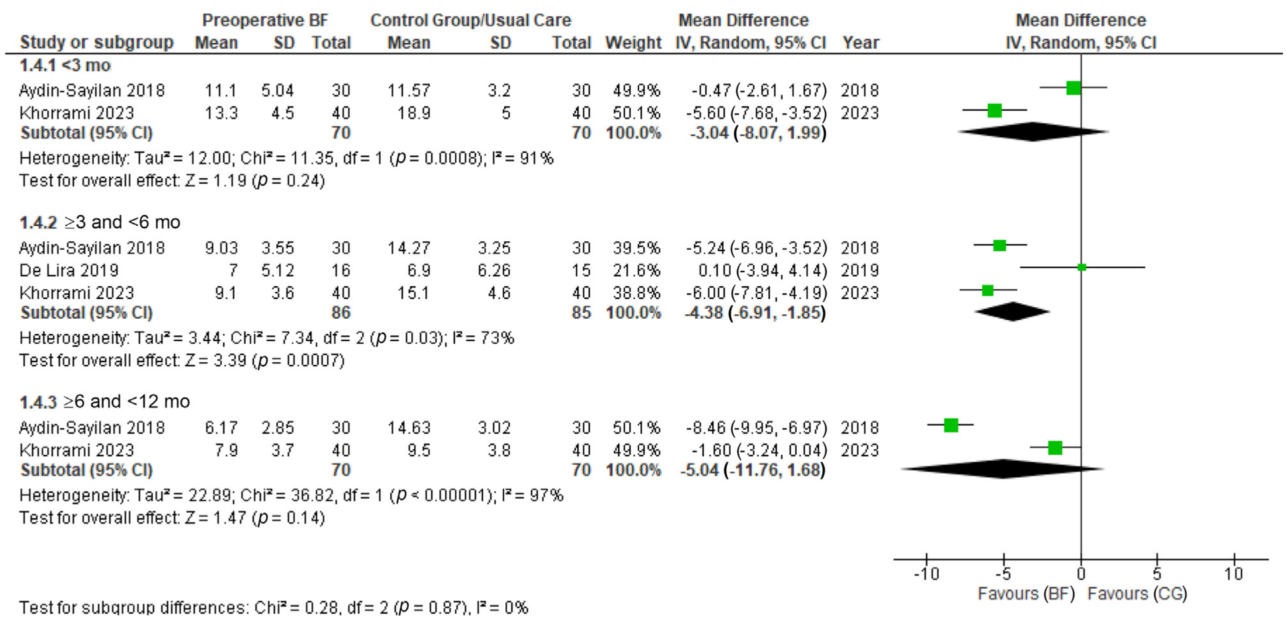

D

Fig. 2 (continued)

operative biofeedback group than in the no preoperative biofeedback group. Heterogeneity was moderate ($I^2 = 36\%$; $p = 0.12$).

Regarding the subgroup analysis, significantly lower rates of postprostatectomy incontinence ($n = 485$; OR = 0.51; 95% CI = 0.28, 0.92; $p = 0.02$) were observed in the preoperative biofeedback group than in the control group. Heterogeneity was low ($I^2 = 21\%$; $p = 0.26$). No significant differences ($n = 288$; OR = 0.59; 95% CI = 0.20, 1.78; $p = 0.35$) were observed between pre- and postoperative biofeedback. Heterogeneity was considerable ($I^2 = 79\%$; $p = 0.03$).

Results were very similar at 3–<6 mo following RP (Fig. 2B). Significantly lower rates of postprostatectomy incontinence ($n = 724$; OR = 0.48; 95% CI = 0.28, 0.85; $p = 0.01$) were observed in the preoperative biofeedback group than in the no preoperative biofeedback group. Heterogeneity was substantial ($I^2 = 56\%$; $p = 0.02$).

Regarding the subgroup analysis, significantly lower rates of postprostatectomy incontinence ($n = 436$; OR = 0.40; 95% CI = 0.20, 0.79; $p = 0.008$) were observed in the preoperative biofeedback group than in the control group. Heterogeneity was moderate ($I^2 = 49\%$; $p = 0.07$). No significant differences ($n = 288$; OR = 0.74; 95% CI = 0.23, 2.42; $p = 0.62$) were observed between pre- and postoperative biofeedback. Heterogeneity was considerable ($I^2 = 79\%$; $p = 0.03$).

At 6–<12 mo following RP, we analysed the effects of preoperative biofeedback versus the control group (Fig. 2C). The meta-analysis results showed significantly

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lower rates of postprostatectomy incontinence (n = 409; OR = 0.29; 95% CI = 0.10, 0.85; p = 0.02) in the preoperative biofeedback group than in the control group. Heterogeneity was substantial (I^2 = 65%; p = 0.01).

The overall quality of the evidence for UI at different follow-up periods was considered low, downgraded for the risk of bias (see the Supplementary material).

Regarding the subgroup analysis based on the type of biofeedback (Supplementary material), visual feedback was the only subgroup that showed statistically significant differences favouring PFMT with preoperative biofeedback. However, the results of this subgroup analysis should be interpreted with caution, given the limited evidence available.

We calculated NNT of 10 (95% CI = 5; 34) for postprostatectomy incontinence at up to 3 mo, 8 (95% CI = 6; 7) at 3–<6 mo, and 6 (95% CI = 4; 7) at 6–<12 mo following RP. Three studies [31,34,37] assessed the effects of preoperative biofeedback versus the control group for UI using the ICIQ-SF. In Fig. 2D, significant differences were observed only at 3–<6 mo following RP, with a large effect size (n = 171; MD = –4.38; 95% CI = –6.91, –1.85; p = 0.0007). Heterogeneity was substantial (I^2 = 73%; p = 0.03). Up to 3 mo following RP, nonsignificant differences with moderate effect sizes were observed (n = 140; MD = –3.04; 95% CI = –8.07, 1.99; p = 0.24). Heterogeneity was considerable (I^2 = 91%; p = 0.0008). At 6–<12 mo following RP, nonsignificant differences with large effect sizes were observed (n = 140; MD = –5.04; 95% CI = –11.76, 1.68; p = 0.14). Heterogeneity was considerable (I^2 = 97%; p < 0.00001).

The overall quality of the evidence for UI at different follow-up periods was considered very low, downgraded for the risk of bias, inconsistency, and imprecision (see the Supplementary material).

3.7.2. *Effects of PFMT with preoperative biofeedback on quality of life*

The effects of PFMT with preoperative biofeedback versus control group for quality of life were analysed in three studies that used KHQ [35] and ICIQ-MLUTS [37,42]. In Fig. 3, nonsignificant differences with small effect sizes were observed between groups (n = 432; SMD = –0.02; 95% CI = –1.01, 0.98; p = 0.97) up to 3 mo following RP. Heterogeneity was considerable (I^2 = 96%; p < 0.00001). Additionally, nonsignificant differences with moderate effect sizes were observed between groups at 3–<6 mo (n = 432; SMD = –0.39; 95% CI = –0.90, 0.13; p = 0.14) and at 6–<12 mo following RP (n = 432; SMD = –0.32; 95% CI = –0.83, 0.18; p = 0.21). Heterogeneity was considerable (I^2 = 84%; p = 0.002 and I^2 = 83%; p = 0.003, respectively).

The overall quality of the evidence for quality of life at different follow-up periods was considered very low, downgraded for risk of bias, inconsistency, and imprecision (see the Supplementary material).

3.7.3. *Sensitivity analysis and publication bias*

A sensitivity analysis was conducted by sequentially removing the three most highly weighted studies [43]. However, it was not performed when contrasting three or fewer trials [44]. The sensitivity analysis suggested that any excluded study significantly affected the results of the meta-analysis at 3–<6 mo of follow-up. Results were not completely robust in the meta-analysis at up to 3 mo and at 6–<12 mo of follow-up (Supplementary material).

Based on a visual inspection of the funnel plot (Supplementary material) and Egger's test, we found no publication bias for postprostatectomy incontinence up to 3 mo following RP (intercept = 0.338; t = 0.584; p = 0.575).

4. Discussion

This meta-analysis analysed the effects of PFMT with preoperative biofeedback in reducing postprostatectomy incontinence. Results showed significantly lower rates of postprostatectomy incontinence in the preoperative biofeedback group than in the control group. No significant differences were observed compared with postoperative biofeedback. Regarding quality of life, no significant differences were observed between groups.

4.1. *Urinary continence recovery*

4.1.1. *Preoperative PFMT*

Mungovan et al [45] proposed that preoperative PFMT may reduce the time to achieve continence. Furthermore, the efficacy of PFMT was enhanced when biofeedback was used as an adjunct and instructions were directed towards the striated urethral sphincter. Nevertheless, no meta-analysis was conducted. These results are not in line with those of Geng et al [11], who concluded that preoperative PFMT led to no significant improvement and is not necessary. However, their meta-analysis presented some limitations, which, in our view, preclude such a conclusion. The low number of included studies limits the meta-analysis, and not all were RCTs. In a review by Zeng et al [46], pre- and postoperative PFMT increased the recovery rate of UI significantly at 1, 3, and 6 mo after RP, supporting our results in PFMT with preoperative biofeedback.

4.1.2. *Biofeedback*

PFMT with preoperative biofeedback significantly reduced postprostatectomy incontinence up to 3 mo and at 3–<6 mo following RP. These results contrast with those of Benedetto et al [14], who investigated the additional benefits of pelvic floor devices for postoperative PFMT. Their findings suggested that the efficacy of pelvic floor devices as an adjunctive treatment for improving postprostatectomy incontinence remains inconclusive. Although they included six studies involving PFMT with biofeedback devices, they did not provide specific information about these devices and interventions were performed postoperatively. Moreover, biofeedback can be delivered through other methods [17]. Our findings partially agree with those of Hsu et al [15], who found significant differences in favour of biofeedback at intermediate follow-up, similar to us. Yet, they did not find significant differences between groups at immediate follow-up. This discrepancy can be attributed to several factors. Our review included a larger number of studies, and we only included studies with preoperative biofeedback, suggesting that its use to learn how to perform PFMT preoperatively [45] may have a significant impact on early continence recovery. However, in our subgroup analysis, preoperative biofeedback was not superior to postoperative biofeedback, but we included only two studies [16,36].

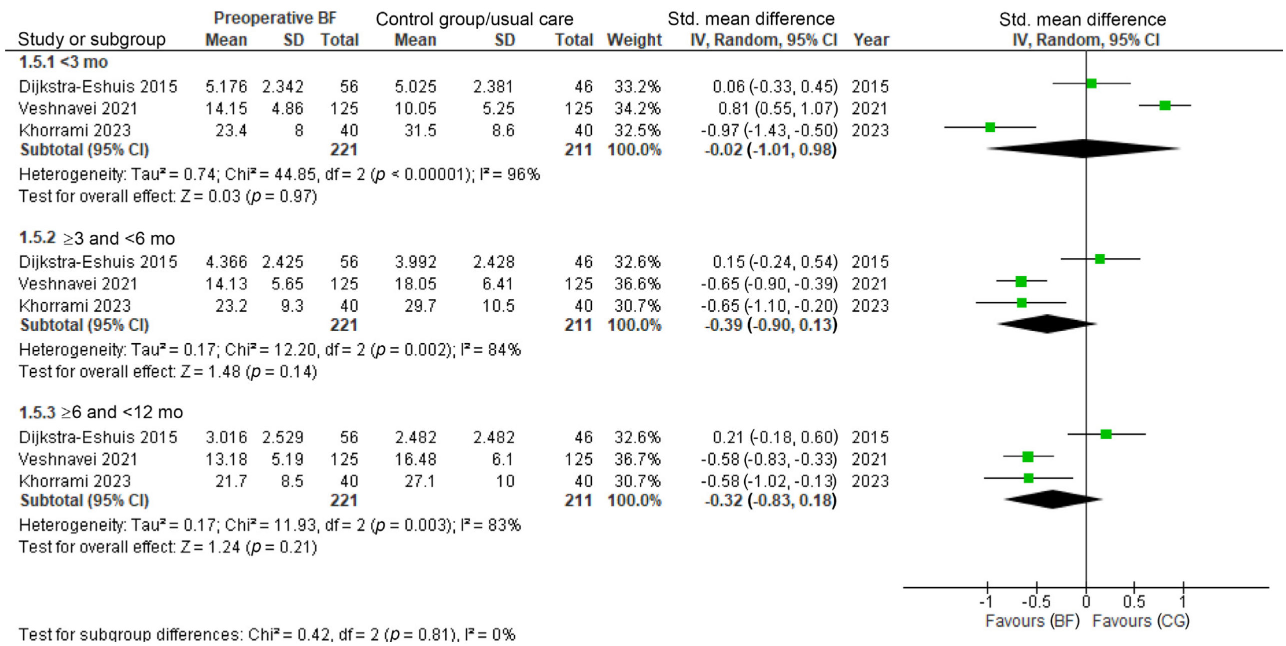

Fig. 3 – Forest plot summarising SMD and 95% CI for the effects of preoperative biofeedback versus control group in prostatectomy patients for quality of life based on the follow-up period. BF = biofeedback; CG = control group; CI = confidence interval; IV = inverse variance; SMD = standardised mean difference; Std. = standardised.

At 6–<12 mo following RP, significant differences were observed in favour of the preoperative biofeedback group compared with the control group. These results are consistent with those of Hsu et al [15]. However, biofeedback interventions were prolonged in the postoperative period, and we cannot attribute all the effects to preoperative biofeedback interventions.

We cannot report quantitative data of the effects of preoperative biofeedback at >12 mo because only three studies [35,36,40] reported that information and were not comparable. However, most patients experience an improvement in UI 1 yr following RP [6], and it may not make sense to analyse the effects of a preoperative intervention after so long. These findings coincide with those of Geng et al [11], who concluded that peri- and postoperative PFMT did not improve UI recovery significantly at 12 mo. Zeng et al [46] supported these results. They reported no obvious improvement in the recovery rate of UI at 12 mo.

Once oncological success has been achieved, quality of life becomes more important [8]. However, our results did not show significant differences between groups for quality of life in any period. Up to 3 mo, follow-up may not yield significant differences, as patients are in a recovery phase following surgery. These results are inconsistent with those of Hsu et al [15]. They reported that biofeedback improved quality of life persisting for at least 6 mo following RP, but this review included pre- and postoperative biofeedback interventions. This could explain the significant effects in the intermediate follow-up compared with our results. Based on our meta-analysis results for UI (ICIQ-UI SF) at 3–<6 mo following RP and the current evidence [47,48], it seems reasonable to expect that an improvement in postprostatectomy incontinence symptoms would lead to better quality of life. Yet, our statistical analysis did not support the results on quality of life.

4.2. *Clinical implications and future research*

PFMT with preoperative biofeedback reduced UI significantly following RP, supporting its implementation in clinical practice. Moreover, the effects persisted for an intermediate period. However, several considerations should be made. The studies used a wide range of continence criteria. The lack of consensus on the definition of postprostatectomy incontinence makes it challenging to determine the efficacy of PFMT [10]. Further research is required to establish a consensus on the appropriate method for measuring UI. Certain factors known preoperatively, such as older age, higher body mass index, or pre-existing lower urinary tract symptoms, have a negative impact on continence after prostatectomy [3]. It is essential to identify these factors to ensure treatment success.

Although good results are shown in an intermediate period, heterogeneity among programme durations makes it difficult to attribute the effects to preoperative biofeedback. Moreover, there is a need to further explore the results obtained from pre- and postoperative biofeedback, due to an absence of available evidence. PFMT has no adverse events [11,49]. However, an anal approach is invasive and can hamper treatment adherence [14]. Biofeedback should focus on anterior pelvic floor muscles rather than the external anal sphincter [7,11,50]. It should be a research priority to determine what type of biofeedback is best to implement in clinical practice. Moreover, characteristics of PFMT should be standardised to draw solid conclusions. Using the GRADE approach, this review found low to very low certainty of evidence. High-quality studies with larger sample sizes are needed urgently.

Postprostatectomy incontinence has significant economic consequences such as costs related to health care services and delays in return to work. [45]. Regarding cost

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effectiveness, a recent systematic review reported that providing PFMT preoperatively may reduce cost and time [1]. Some studies [37,40,42] argued that PFMT with preoperative biofeedback is appropriate and cost effective. The identified benefits included the early return of urine control, an improvement in quality of life, and a decrease in the cost of daily care. However, in addition to the initial expense associated with the purchase of biofeedback equipment, health care professionals must be trained, which increases costs [32]. Our meta-analysis shows good results about the use of PFMT with preoperative biofeedback that may justify the implementation of these devices, but further research is needed.

4.3. Limitations

Using GRADE, the certainty of the evidence was low to very low. This mainly arose from the presence of serious concerns in the risk of bias, inconsistency, and imprecision of the results. A bias due to deviations from intended interventions, measurement of the outcome, and selection of the reported results was very common. The continence criteria, UI measuring instruments, and follow-up periods differed between studies. Additionally, preoperative interventions started 1–4 wk before surgery, and in some studies, interventions continued until the postoperative period. This heterogeneity between the characteristics of studies and interventions may limit the applicability of good results. Finally, some analyses must be interpreted cautiously due to the high risk of bias, heterogeneity, and sensitivity analysis results.

5. Conclusions

PFMT with preoperative biofeedback significantly reduced postprostatectomy incontinence up to 3 mo, at 3–<6 mo, and at 6–<12 mo following RP, compared with the control group. However, no significant differences were found between pre- and postoperative biofeedback. There were no significant changes in quality of life. The overall certainty of the evidence ranged from very low to low, mainly because of the risk of bias, inconsistency, and imprecision of results. Therefore, the results should be interpreted cautiously. Further high-quality research is required.

Author contributions: Irene Torres-Sánchez had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Brea-Gómez, Pazo-Palacios, Pérez-Gisbert, Torres-Sánchez.
Acquisition of data: Brea-Gómez, Pazo-Palacios, Pérez-Gisbert, Torres-Sánchez.
Analysis and interpretation of data: Brea-Gómez, Pazo-Palacios, Pérez-Gisbert, Torres-Sánchez.
Drafting of the manuscript: Brea-Gómez, Pazo-Palacios, Pérez-Gisbert, Torres-Sánchez.
Critical revision of the manuscript for important intellectual content: Brea-Gómez, Pazo-Palacios, Pérez-Gisbert, Valenza, Irene Torres-Sánchez.
Statistical analysis: Brea-Gómez, Pazo-Palacios, Pérez-Gisbert, Torres-Sánchez.
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Other: None.

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Appendix A. Supplementary data

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