Original Article

The therapeutic effect of pelvic floor muscle training on stress urinary incontinence following prostatectomy: a systematic review and meta-analysis

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Background: Prostatectomy often causes urinary incontinence, especially stress Urinary incontinence, which has a serious impact on the quality of life of patients. Previous studies have proved that pelvic floor muscle training can help restore pelvic floor function and reduce Urinary incontinence, but the quantitative evaluation and systematic analysis of its effect have not yet been clear. This meta-analysis aimed to systematically evaluate the therapeutic effect of pelvic floor muscle training on managing stress urinary incontinence after prostatectomy.

Methods: The literature on pelvic floor muscle training for patients after prostatectomy was searched in PubMed, Web of Science, EMBASE, CNKI, VIP, Wanfang, and China Biology Medical Literature Database (CBM) from database establishment up to January 30th, 2023. Risk bias assessment was conducted using RoB1, a risk assessment tool recommended by Cochrane for evaluating RCTs literature. Publication bias was evaluated through funnel plots. Meta-analysis of effect size was performed using R 4.2.2.

Results: Eleven randomized controlled studies were included. The risk of bias assessment showed that three studies had a moderate risk of bias and eight had a low risk. The meta-analysis results showed that the patient-reported incontinence was improved after one month [odds ratio (OR): 2.71, 95% 95% confidence interval (CI): 1.86–3.94, P<0.01]; improved after three months (OR: 3.42, 95% CI: 1.96–5.98, P<0.01); improved after six months (OR: 3.77, 95% CI: 1.51–9.41, P<0.01); improved after 12 months (OR: 1.21, 95% CI: 1.11–1.31, P<0.01); and the International Consultation on Incontinence Questionnaire-Simple Form (ICIQ-SF) score decreased [mean difference (MD): −2.74, 95% CI: −4.96 to −0.52, P=0.02]. Subgroup analysis showed that the ICIQ-SF score decreased after one month (MD: −0.61, 95% CI: −0.81 to −0.40) and three months (MD: −3.43, 95% CI: −6.85 to −0.02).

Conclusions: Pelvic floor muscle training significantly improves stress urinary incontinence after prostatectomy, which can be improved by 2.77 times at most. However, due to the limited number of studies included, further validation is needed.

Keywords: Pelvic floor muscle training (PFMT); prostatectomy; stress urinary incontinence; meta-analysis

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Introduction

Prostate cancer is one of the most common cancers among males worldwide, with its incidence positively correlated with age. In males aged 65 and above, the incidence rate of prostate cancer is close to 60% (1). Radical prostatectomy (RP), is the gold standard for localized prostate cancer treatment and is associated with a 5-year survival rate greater than 95% (2,3). Despite excellent disease-specific survival, RP often causes debilitating consequences to continence and erectile function. Urinary incontinence is common after RP, occurring in 2% to 87% of patients (4,5). While continence improves in most men over time, this recovery time is variable with some patients requiring up to 12 months (6,7). In addition, a large proportion of men fail to achieve complete continence at any point and suffer from long-term leakage and impact on quality of life.

Pelvic floor muscle training (PFMT) is a well-described treatment for urinary incontinence after RP (8,9). Accordingly, it is recommended by the European Association of Urology (EAU) and the American Urology Association (AUA) as a first-line treatment for Urinary incontinence after prostatectomy (8,9).

Despite significant reported studies demonstrating that PFMT can improve post-operative urinary incontinence, there remains controversy as to its efficacy given conflicting results reported in other studies (10-13). For example, a 2004 study did not recommend it as a first-line rehabilitation after prostatectomy, as incontinence symptoms did not significantly improve over time (14). Systematic review is limited and also complicated by the wide variety of PFMT regimens that are reported across the literature. Thus, further systematic evaluations are needed to provide evidence-based medical evidence for the application and standardization of PFMT. We present this article in accordance with the PRISMA reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-23-337/rc).

Highlight box

Key findings

- This study systematically evaluated the therapeutic effect of pelvic floor muscle training (PFMT) on stress Urinary incontinence after prostatectomy.

What is known and what is new?

- PFMT is one of the treatment methods for male Urinary incontinence after radical prostatectomy.
- However, there are still some disputes about whether PFMT can improve Urinary incontinence, so more high-level systematic evaluation is still needed to provide Evidence-based medicine evidence for the application and standardization of PFMT.

What are the implications, and what should change now?

- PFMT can significantly improve stress Urinary incontinence after prostatectomy. In the future, more high-quality research needs to be included for further exploration.

Methods

Literature retrieval

Two trained researchers conducted a literature search following the established inclusion and exclusion criteria. The databases searched included PubMed, Web of Science, EMBASE, CNKI, VIP, Wanfang, and the China Biology and Medicine Literature Database (CBM). The search focused on literature regarding PFMT in patients after prostatectomy. The English search terms included pelvic floor muscle, prostatectomy, urinary incontinence, RP, physiotherapy, and prostatic tumor. The search was conducted from database establishment to January 30th, 2023, and included both Chinese and English language literature. The protocol of this systematic review has been registered in the International prospective register of systematic reviews (PROSPERO, No. CRD42023442960).

Inclusion and exclusion criteria of literature

Inclusion criteria

(I) Study type: randomized controlled trials, no limitation on blinding;

(II) Study population: prostate cancer patients aged ≥18 years old undergoing prostatectomy;

(III) Intervention: PFMT in the experimental group. The control group patients received routine exercise as a placebo;

(IV) Outcome measures: patient-reported incontinence (1-hour urine pad test or 24-hour urine pad test was used to determine whether there was Urinary incontinence, that is, the incidence of self-control urination) and International Consultation on Incontinence Questionnaire-Simple Form (ICIQ-SF) score at 1-, 3-, 6-, and 12-month post-surgery, which was evaluated from both follow-up data and patients based on validated questionnaires.

Exclusion criteria

(I) Studies that are not randomized controlled trials;
(II) Conference papers, reports, reviews, meta-analyses, and other types of literature;
(III) Studies that included within the review examine PFMT in combination with other interventions and might not be considered eligible;
(IV) Studies where the full text is unavailable or where important data are missing.

Literature screening and data extraction

Two researchers independently performed literature screening and data extraction based on the inclusion and exclusion criteria and then cross-checked their data. In case of any disagreements, a third researcher made the final decision. The extracted data included general information (author, publication year, sample size, patient age, follow-up time, etc.) and outcome indicators.

Risk of bias assessment

The quality assessment of the literature was conducted using the Cochrane collaboration's tool for assessing the risk of bias in randomized trials (RoB1) (15), as recommended by the Cochrane Handbook, which included seven items: random allocation, group blindness, participant and researcher blindness, result measurement blindness, data completeness, selective reporting, and other biases. The items were evaluated as "unclear", "no", or "yes".

Statistical analysis

A meta-analysis was performed using R 4.2.2. For binary data, the combined effect size was analyzed using odds ratio (OR) and 95% confidence interval (CI). For continuous variables, the combined effect size was analyzed using the mean difference (MD) and 95% CI. If $P \geq 0.1$ and $I^2 \leq 50\%$, there was homogeneity among the included literature, and fixed-effect model analysis was performed. If $P<0.1$ and $I^2>50\%$, heterogeneity existed among the included studies. A random-effects model was employed for the analysis, and if necessary, the data were grouped into subgroups. A funnel plot was used to assess publication bias of the included literature. Differences were considered statistically significant at $P<0.05$.

Results

Literature search results

After the literature search, a total of 1,586 articles were obtained. After removing duplicate articles, a total of 1,464 articles were obtained. After reading the titles and abstracts, 1,266 articles that clearly did not meet the requirements were excluded, leaving 198 articles. Among these, the full text of 188 articles was accessible. A total of 113 articles were removed after secondary screening. After excluding 3 articles with duplicate content, 8 articles with significant missing data, and 53 articles that combined other interventions, a total of 11 articles were finally included. All of them were randomized controlled studies. as shown in *Figure 1*. The general information of the articles is shown in *Table 1*.

Risk of bias assessment of included literature

The risk of bias assessment results of 11 studies showed that 3 studies had a moderate risk of bias, and 8 studies had a low risk of bias (see *Figures 2*,*3*).

Meta results

Patient-reported incontinence

One month after the operation

The results of nine studies reporting the patient-reported incontinence one month after surgery were analyzed. Homogeneity existed among the studies ($P=0.54$, $I^2=0\%$), and the fixed effect model was employed. The meta-analysis showed that compared to the control group, patients undergoing PFMT had a significantly improved patient-reported incontinence one month after surgery (OR: 2.71, 95% CI: 1.86–3.94, $P<0.01$). This was visualized in *Figure 4*. A funnel plot was used to assess publication bias, and it was observed that all studies were within the funnel and showed symmetry, as shown in *Figure 5*. Egger's test also supports that the risk of publication bias of included studies is low ($P>0.05$).

Three months after the operation

Nine studies reported the patient-reported incontinence three months after the surgery. There was heterogeneity among the studies ($P<0.01$, $I^2=68\%$), and a random-effects model was used. The meta-analysis results showed that compared with the control group, patients who underwent

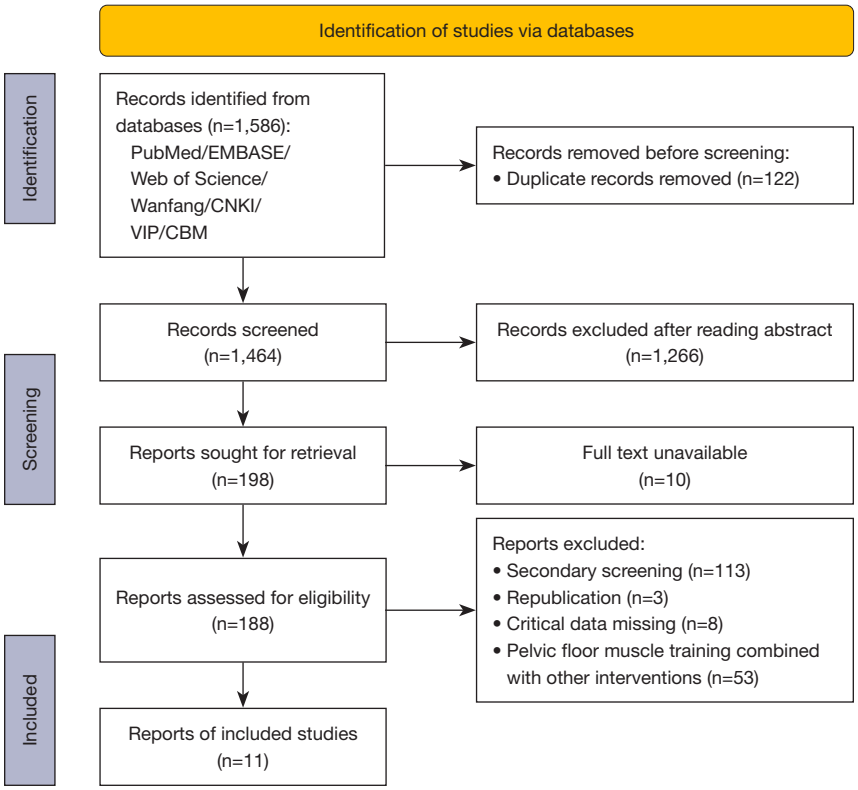

Figure 1 Schematic diagram of the document screening process.

Table 1 Basic information of included literature

Author	Year of publication	Country	Study type	Age, years		Sample size		Operation	Follow-up period, months	Outcome indicators
				Experimental Group	Control Group	Experimental Group	Control Group			
Van Kampen (16)	2000	Germany	RCT	64.38	66.58	50	52	Prostatectomy	12	1, 2, 3, 4
Filocamo (12)	2005	Italy	RCT	65±4.79	68±5.33	150	150	Prostatectomy	12	1, 2, 3, 4
Manassero (9)	2007	Italy	RCT	66.8±6.3	67.9±5.5	54	40	Prostatectomy	12	1, 2, 3, 4
Glazener (17)	2011	UK	RCT	–	–	205	206	Prostatectomy	12	1, 2, 3, 4
Aydın Sayılan (10)	2018	Turkey	RCT	63.00±8.61	59.93±6.98	30	30	Prostatectomy	6	1, 2, 3, 5
de Lira (11)	2019	Brazil	RCT	67.3±5.63	63.53±7.62	16	15	Prostatectomy	3	3, 5
Milios (18)	2019	Australia	RCT	62.2±6.8	63.5±6.8	50	47	Prostatectomy	4	1, 2
Oh (19)	2020	South Korea	RCT	67.5±6.9	65.9±6.8	40	42	Robot-assisted prostatectomy	3	1, 2
Gezginci (13)	2023	Turkey	RCT	67.6± 6.7	69.2± 5.4	30	30	Prostatectomy	3	5
Jian (20)	2020	China	RCT	62.21±4.2	62.48±4.5	40	40	Prostatectomy	3	1, 2, 5
Zhong (21)	2022	China	RCT	54–83	51–82	41	41	Prostatectomy	3	1, 2, 5

Outcome indicators: 1 indicates patient-reported incontinence 1-month post-surgery; 2 indicates patient-reported incontinence 3-month post-surgery; 3 indicates patient-reported incontinence 6-month post-surgery; 4 indicates patient-reported incontinence 12-month post-surgery; 5 indicates ICIQ-SF (International Consultation on Incontinence Questionnaire-Simple Form), a simple form of the questionnaire for international consultation on incontinence. RCT, random clinical trial.

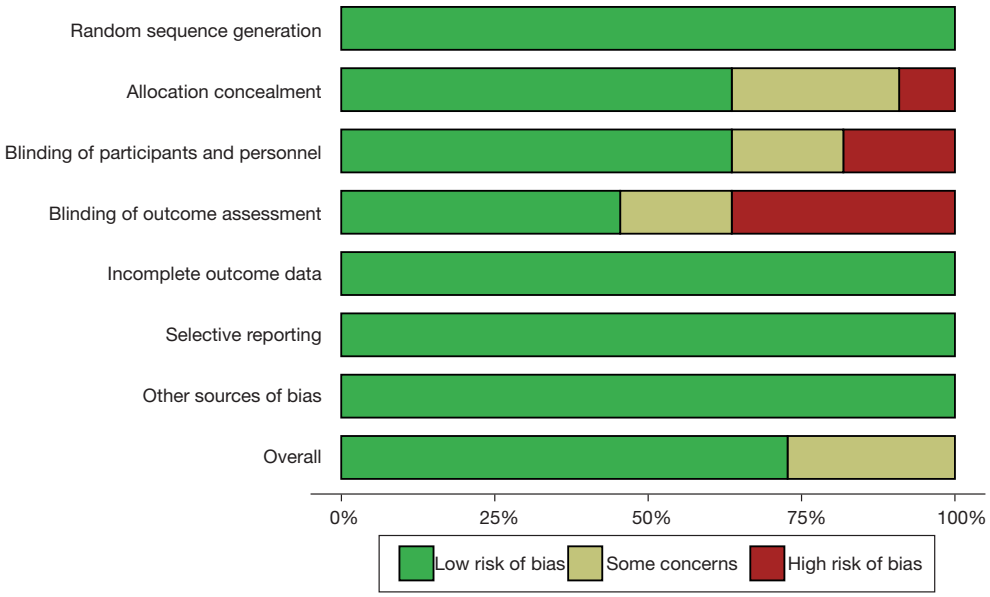

Figure 2 Summary of risk bias assessment included in the study.

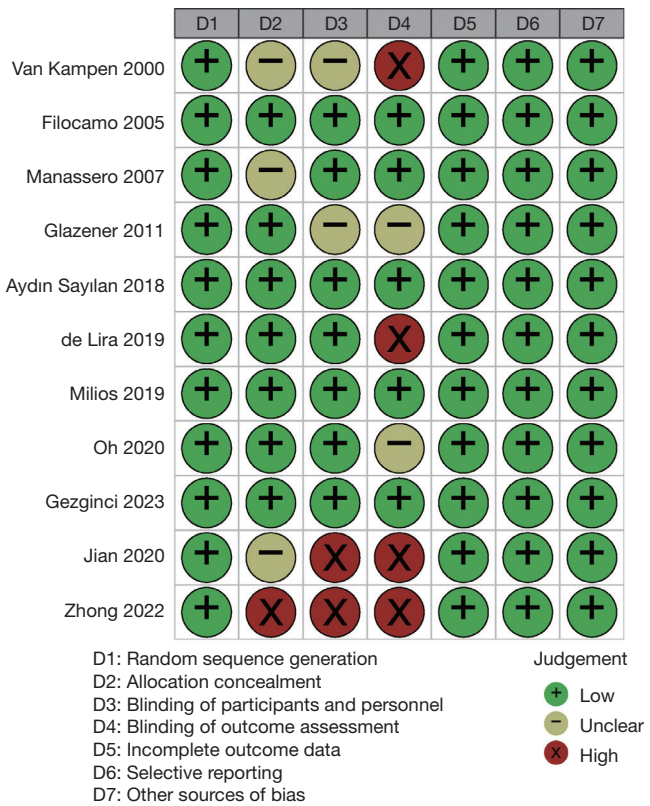

Figure 3 Proportion of risk bias assessment included in the study.

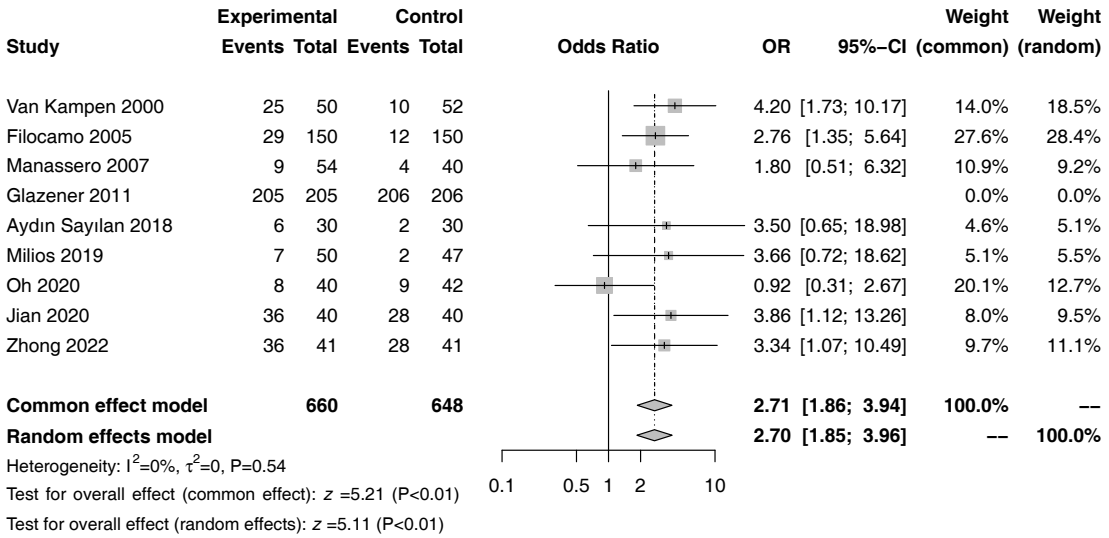

Figure 4 Forest plot of the patient-reported incontinence 1 month after surgery. OR, odds ratio; CI, confidence interval.

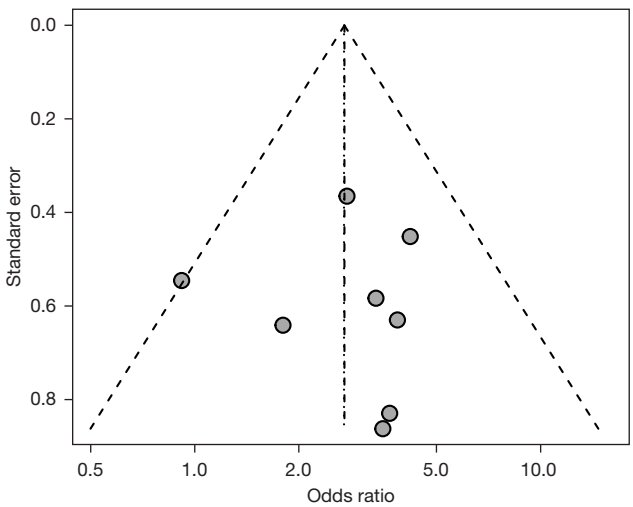

Figure 5 Funnel plot of the patient-reported incontinence 1 month after surgery.

PFMT had an improved patient-reported incontinence three months after the surgery (OR: 3.42, 95% CI: 1.96–5.98, P<0.01). See *Figure 6*. Publication bias was shown using a funnel plot, and although there were three studies outside the funnel, they still showed symmetry, as shown in *Figure 7*. Egger's test also supports that the risk of publication bias of included studies is low (P>0.05).

Six months after the operation

Six studies reported the patient-reported incontinence 6 months after surgery. There was heterogeneity among the studies (P<0.01, I^2=85%), and a random-effects model was used. The meta-results showed that compared to the control group, patients who underwent PFMT had a 2.77-fold increase in urinary patient-reported incontinence 6 months after surgery (OR: 3.77, 95% CI: 1.51–9.41, P<0.01), as shown in *Figure 8*. Publication bias was displayed through a funnel plot, and two studies were outside the funnel and had poor symmetry, as shown in *Figure 9*. Egger's test also supports that the risk of publication bias of included studies is low (P>0.05).

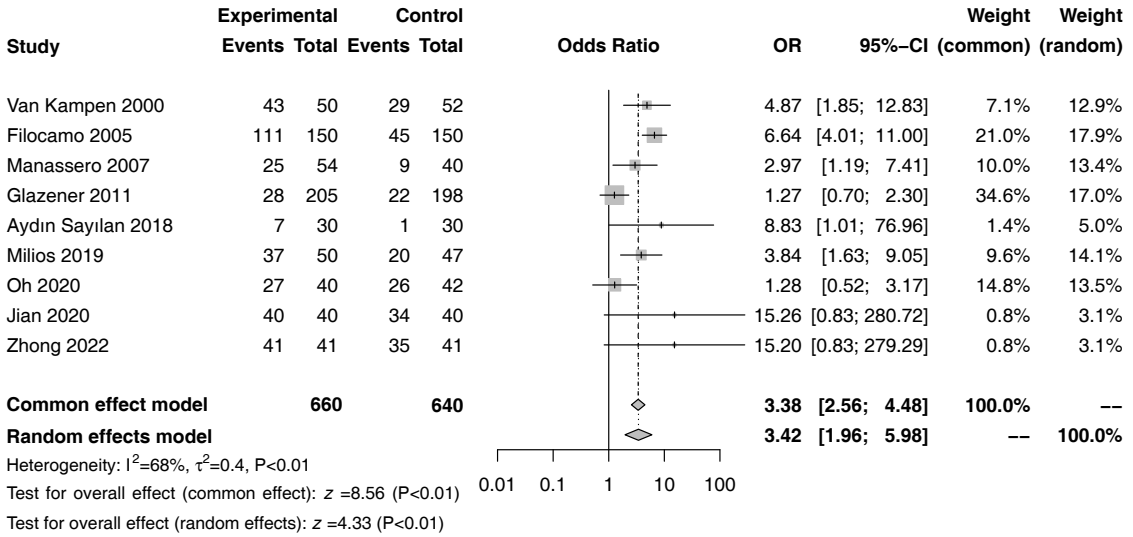

Figure 6 Forest plot of the patient-reported incontinence 3 months after surgery. OR, odds ratio; CI, confidence interval.

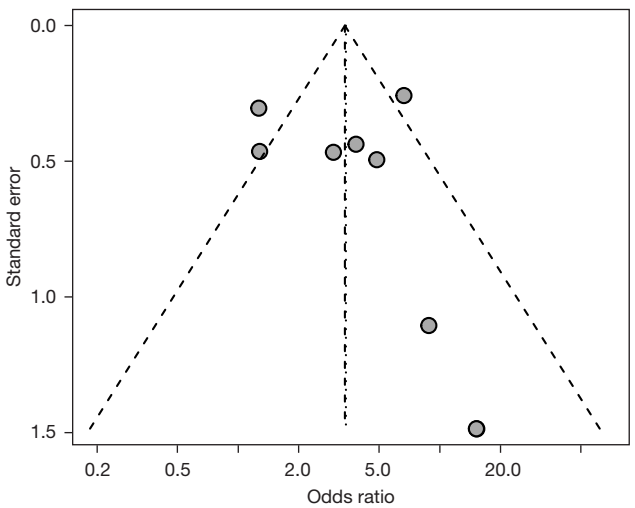

Figure 7 Funnel plot of the patient-reported incontinence 3 months after surgery.

Twelve months after the operation

Four studies reported on the patient-reported incontinence 12 months after surgery. The studies were homogeneous (P=0.12, I^2=49%) using a fixed effect model. The meta-analysis results showed that compared to the control group, patients who underwent PFMT had an increased patient-reported incontinence 12 months after surgery (OR: 1.21, 95% CI: 1.11–1.31, P<0.01), as shown in *Figure 10*. The funnel plot shows a low risk of publication bias, as all included studies were within the funnel and had good symmetry, as shown in *Figure 11*. Egger's test also supports that the risk of publication bias of included studies is low (P>0.05).

ICIQ-SF score

The results of 4 studies reporting postoperative ICIQ-SF scores showed heterogeneity (P<0.01, I^2=96%), and a random effects model was used. The meta-analysis results showed that compared to the control group, patients undergoing PFMT had a reduction in their postoperative ICIQ-SF scores (MD: –2.74, 95% CI: –4.96 to –0.52, P=0.02), as shown in *Figure 12*. Subgroup analysis by

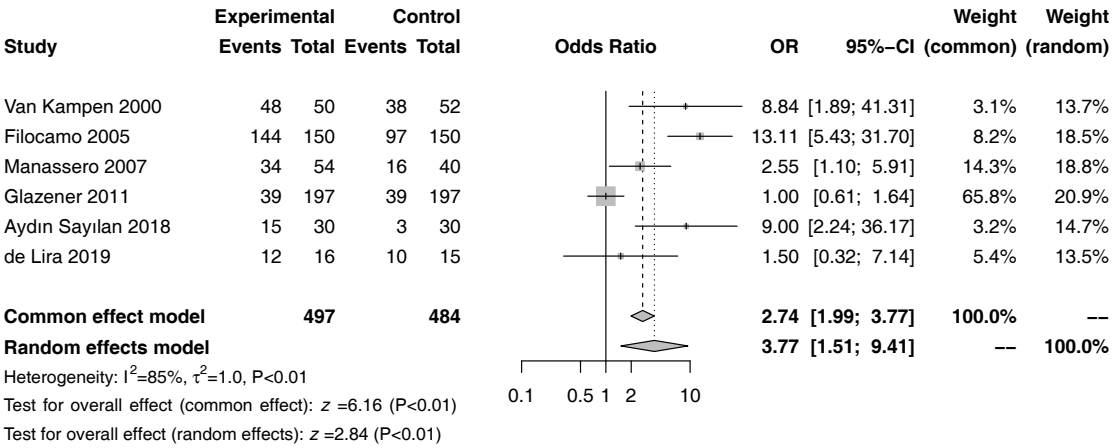

Figure 8 Forest plot of the patient-reported incontinence 6 months after surgery. OR, odds ratio; CI, confidence interval.

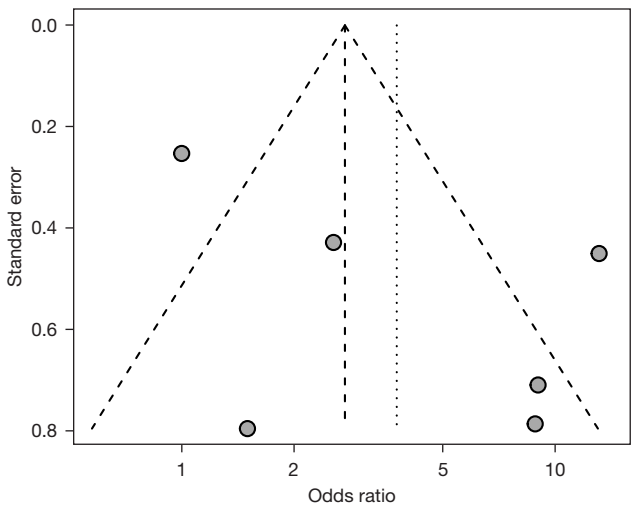

Figure 9 Funnel plot of the patient-reported incontinence 6 months after surgery.

postoperative evaluation time found that the ICIQ-SF scores decreased after 1 month (MD: −0.61, 95% CI: −0.81 to −0.40) and after 3 months (MD: −3.43, 95% CI: −6.85 to −0.02), as shown in *Figure 12*.

Sensitivity analysis

The sensitivity analysis using the one-by-one elimination method showed that the elimination of literature one by one has little effect on the results, so it is robust.

Discussion

Continuous urinary incontinence after prostatectomy is a common postoperative complication, with multiple studies suggesting that invasive treatment for urinary incontinence should be delayed for at least one year (17,22). As such, in certain cases, PFMT will be chosen as an alternative option. Some authors still argue that postprostatectomy urinary incontinence is due to an intrinsic deficiency of the pelvic floor muscles caused by excessive activity of the detrusor muscle and pelvic floor muscle damage (23). Excessive activity of the detrusor muscle is a pathological-physiological cause of urinary incontinence that can be corrected by PFMT. Wang *et al.* found that pelvic floor muscle contractions effectively inhibit detrusor muscle hypertrophy, increasing mechanical pressure on the urethra

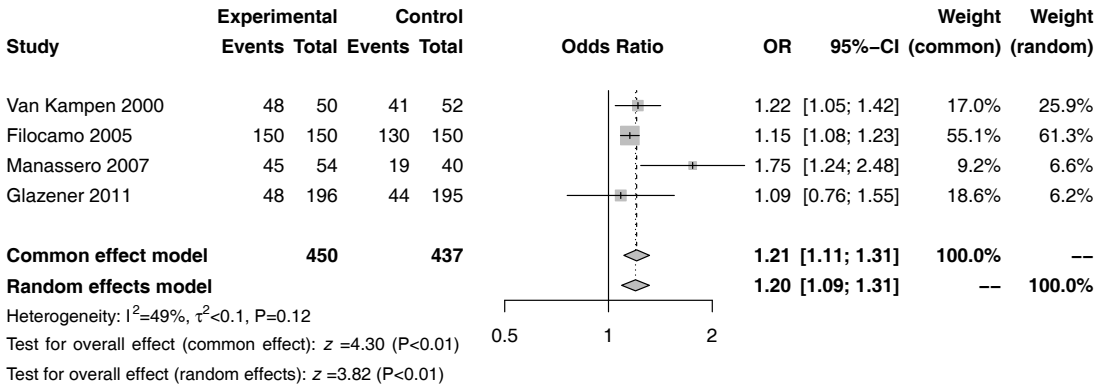

Figure 10 Forest plot of the patient-reported incontinence 12 months after surgery. OR, odds ratio; CI, confidence interval.

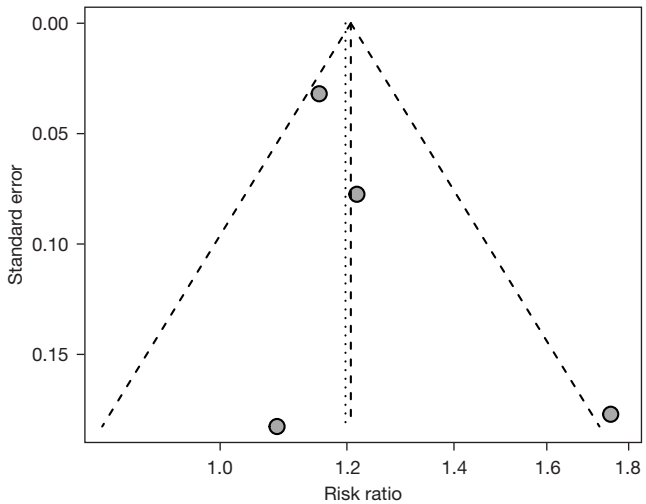

Figure 11 Funnel plot of the patient-reported incontinence 12 months after surgery.

and preventing urinary incontinence (24). However, this does not seem to be widely supported, and the effectiveness of PFMT in treating post-RP urinary incontinence remains a controversial issue. Thus, the present meta-analysis aims to assess the effect of pelvic floor muscles on the patient-reported incontinence after RP.

The results of this study suggest that PFMT programs impact the recovery of patient-reported incontinence in men after RP. The meta-analysis showed that compared to the control group, the patient-reported incontinence after PFMT programs improved (1-month post-surgery OR: 2.7, 3-month post-surgery OR: 3.42, 6-month post-surgery OR: 3.77, 1-year post-surgery OR: 1.21). Our findings differ from those of Chang *et al.*, who concluded that PFMT had low ORs at 1-, 3-, and 6-month post-surgery, with only a significant difference at 3 months (25). The study by Rangganata *et al.* found that PFMT significantly reduced the incidence of urinary incontinence at 1-, 3-, and 6-month post-surgery, while there was no difference in the incidence of urinary incontinence at 12 months post-surgery (23), which may be related to the relatively few studies included in their study (only 4 articles). Although there is heterogeneity in the results of patient-reported incontinence at 3- and 6-month post-surgery in our results, these results still need to be treated with caution. Additionally, the ICIQ-UI SF questionnaire scores also showed that the scores of patients in the PFMT group significantly decreased, indicating that the patient's urinary

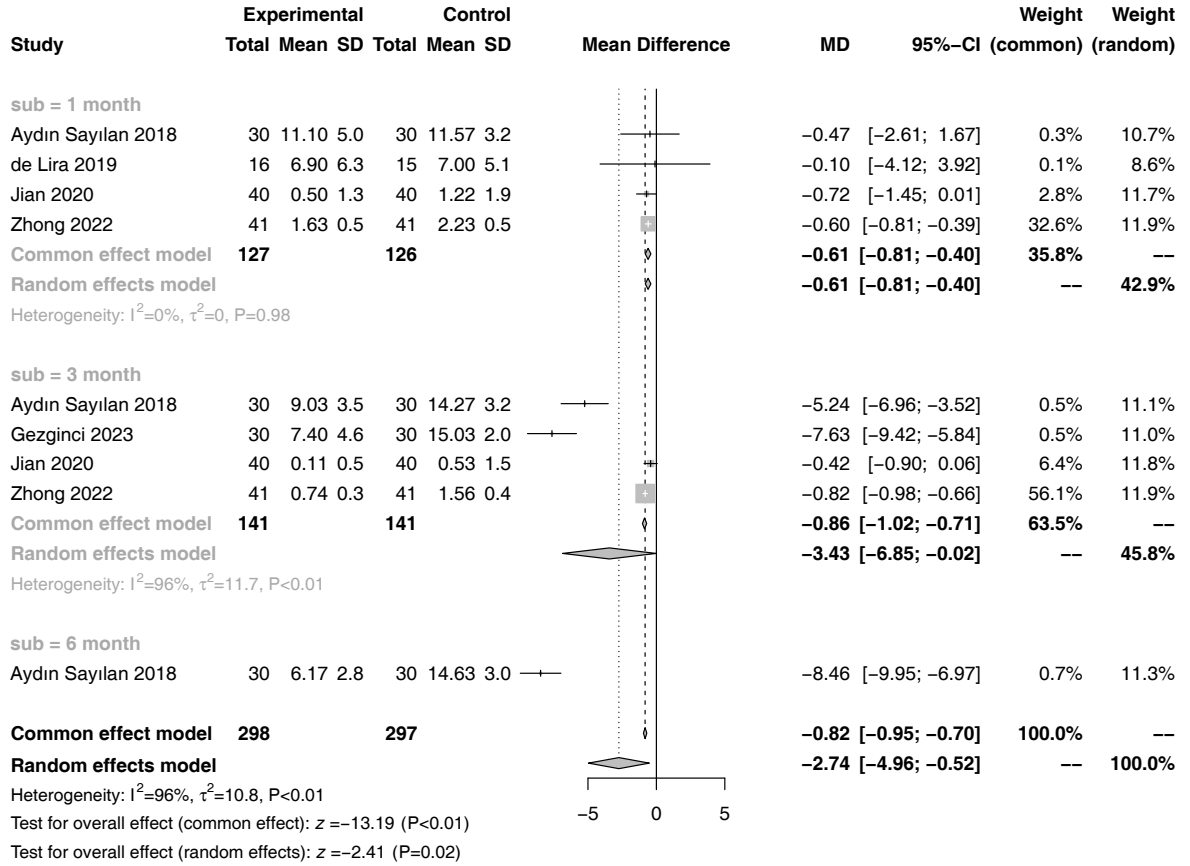

Figure 12 Forest plot of postoperative ICIQ-SF scores. ICIQ-SF, International Consultation on Incontinence Questionnaire-Simple Form; SD, standard deviation; MD, mean difference; CI, confidence interval.

incontinence improved, but there was also a high degree of heterogeneity between studies.

There are some limitations in this study. First, some of the included literature did not mention the blind part, may lead to the low quality of the included literature. Secondly, the heterogeneity of some results may have an impact on the results.

Conclusions

PFMT significantly improved stress urinary incontinence after prostatectomy, which can be improved by 2.77 times at most; however, due to the limited number of studies included and the heterogeneity of some of the results, further validation of the effectiveness of PFMT is still needed. Therefore, more high-quality studies need to be included for further exploration in the future.

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-23-337/rc

Peer Review File: Available at https://tau.amegroups.com/article/view/10.21037/tau-23-337/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-23-337/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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