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Original Article: Clinical Investigation

Preoperative pelvic floor physiotherapy improves continence after radical retropubic prostatectomy

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Abbreviations & Acronyms
HR = hazard ratio
IDC = indwelling catheter
IQR = interquartile range
NVB = neurovascular bundle
PFME = pelvic floor muscle exercises
PFMT = pelvic floor muscle training
PG-PFMT = physiotherapist-guided pelvic floor training
PPUI = post-prostatectomy urinary incontinence
PSA = prostate-specific antigen
RRP = radical retropubic prostatectomy
SHIM = Sexual Health Inventory for Men

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Objectives: Urinary incontinence is a predictable sequela of radical retropubic prostatectomy, and is most severe in the early postoperative phase. The present study aimed to evaluate the effect of a physiotherapist-guided pelvic floor muscle training program, commenced preoperatively, on the severity and duration of urinary continence after radical retropubic prostatectomy.

Methods: A retrospective analysis of men undergoing radical retropubic prostatectomy by one high-volume surgeon ($n = 284$) was carried out. The intervention group received physiotherapist-guided pelvic floor muscle training from 4 weeks preoperatively ($n = 152$), whereas the control group was provided with verbal instruction on pelvic floor muscle exercise by the surgeon alone ($n = 132$). Postoperatively, all patients received physiotherapist-guided pelvic floor muscle training. The primary outcome measure was 24-h pad weight at 6 weeks and 3 months postoperatively. Secondary outcome measures were the percentage of patients experiencing severe urinary incontinence, and patient-reported time to one and zero pad usage daily.

Results: At 6 weeks postoperatively, the 24-h pad weight was significantly lower (9 g *vs* 17 g, $P < 0.001$) for the intervention group, which also showed less severe urinary incontinence (24-h pad weight >50 g; 8/152 patients *vs* 33/132 patients, $P < 0.01$). There was no significant difference between groups in the 24-h pad weight at 3 months ($P = 0.18$). Patient-reported time to one and zero pad usage was significantly less for the intervention group ($P < 0.05$). Multivariate Cox regression showed that preoperative physiotherapist-guided pelvic floor muscle training reduced time to continence (1 pad usage daily) by 28% ($P < 0.05$).

Conclusions: A physiotherapist-guided pelvic floor muscle training program, commenced 4 weeks preoperatively, significantly reduces the duration and severity of early urinary incontinence after radical retropubic prostatectomy.

Key words: incontinence, pelvic floor, physiotherapy, preoperative, radical prostatectomy.

Introduction

Urinary incontinence is a common and predictable sequela of RRP. Reported rates of PPUI, however, vary widely according to both the criteria used to define continence and the postoperative time of assessment. The prevalence and severity of PPUI does appear to decrease with postoperative time; 8–87% of patients have urinary incontinence at 6 months postoperatively, and 5–44% at 12 months postoperatively.[1–3] PPUI has a significant deleterious impact on postoperative health-related quality of life.[4,5] As such, conservative treatments with the potential to reduce early (<12 weeks postoperatively) PPUI are of significant clinical interest.

The etiology of PPUI is not completely understood, but is thought to result primarily from sphincteric injury and/or detrusor overactivity.[1–3,6] Prognostic factors for PPUI include advanced age, bladder neck resection, nerve-sparing status, anastomotic stricture, preoperative urodynamic abnormalities, and the experience and skill of the surgeon.[7–11] It has been proposed that after RRP, the detrimental effect of sphincteric injury on urinary

continence might be partially or completely compensated for by increased activity of the external sphincteric mechanism, including the rhabdosphincter and levator ani (pelvic floor muscle) complex.[12] PFMT aims to improve both the strength and coordination (timing) of the voluntarily-activated, striated muscles of the pelvic floor, thus allowing for contraction during periods where there is an increase in intra-abdominal pressure.

The evidence for formal PFMT in the treatment of PPUI is conflicting.[1,13–22] A Cochrane review of conservative management strategies for PPUI found that their effectiveness, particularly in the long term, remains inconclusive.[12] Furthermore, a recently published multicenter randomized controlled trial of PG-PFMT, commenced 6 weeks postoperatively, showed no benefit of treatment.[23] Notably, however, several studies have shown a positive role of PG-PFMT, when commenced preoperatively and/or early postoperatively (<6 weeks postoperatively).[15,24] The authors propose that by commencing PG-PFMT before RRP, patients are well prepared and are able to understand pelvic floor muscle activation in the absence of PPUI and pain. The PFMT is then able to be recommenced immediately after catheter removal.

In the current study, we aimed to determine the effects of a PG-PFMT program, commenced preoperatively, in a large cohort of patients operated on by one high-volume surgeon. Specifically, we sought to determine whether PG-PFMT reduced the severity and duration of PPUI.

Methods

Between 1 January 2005 and 1 January 2009, all consecutive men who were continent and undergoing RRP by a single surgeon (MIP) for clinically localized cancer of the prostate were included in the present study. Preoperative continence was defined as no usage of pads.[25] From the 384 men identified in this cohort, 284 men had follow up of greater than 3 months; and full preoperative, intraoperative and postoperative continence data were available. These 284 men were the cohort of the present study. The majority of the 100 men who were excluded from this analysis were missing postoperative data essential for the analysis. The preoperative evaluation included a thorough medical history and physical examination. Routine baseline urodynamic testing was not part of the preoperative work-up.

The cohort was divided into two groups. The control group comprised men who had RRP between 1 January 2005 and 3 October 2007 ($n = 132$). All were given verbal instructions on PFME by the surgeon during the preoperative consultation, and were requested to carry out PFME until the day of surgery.

The intervention group comprised men who had their surgery between 3 October 2007 and 1 January 2009 ($n = 152$). These men started a PG-PFMT program 4 weeks or more before RRP, and were also requested to carry out PFME until the date of surgery.

Postoperatively, men in both the control and intervention groups received PG-PFMT while in hospital, and recommenced their PFME after IDC removal on day 7 postoperatively and continued until continence returned. The size of the Foley catheter the surgeon used was 18-Fr. Cystograms were only carried out where a clinical leak was suspected.

PG-PFMT consisted of a standardized and structured patient education and PFME program, carried out by one of four physiotherapists employed within a physiotherapy practice with a special interest in the management of PPUI.

Those patients receiving preoperative PG-PFMT attended between one and four treatment sessions before RRP, each session of approximately 1 h duration. At the first preoperative session, a detailed history and assessment of comorbidity was undertaken. The structure and function of the bladder, urethra and the pelvic floor muscles were explained with the aid of anatomical models and diagrams, and patients were taught how to activate the pelvic floor muscles in different functional positions; for example, supine, standing and lying. Transabdominal ultrasound imaging was used to provide visual feedback to the patient.[26] Approximately 1-cm upward displacement of the bladder base indicated successful activation of the pelvic floor muscles. Verbal and tactile cues were also used to reduce activation of the superficial abdominal muscles, and to ensure patients did not hold their breath during pelvic floor activation.

At the first and any subsequent preoperative session, patients were supervised in carrying out repeated activations (10 contractions of 10 s) of the pelvic floor muscles; that is, PFME, in each of sitting, standing and lying positions. Patients were instructed to carry out the PFME daily at home, and also to practise activating the pelvic floor muscles while carrying out common activities of daily living; for example, lifting objects, squatting and coughing. Patients were provided with supplemental written material and diagrams detailing all aspects of the PG-PFMT program.

All men in both groups received a standard open RRP as described by Eastham *et al*.[27] A bladder neck-sparing approach[28] was not carried out. The decision to carry out neurovascular bundle sparing was determined by intraoperative palpation and results of a nomogram for extracapsular extension.[29] The primary outcome measure was 24-h pad weight at 6 weeks and 3 months postoperatively as measured by standard protocols.[30] The secondary outcome measure was patient reported time to one pad and zero pad usage. Further surgical intervention, such as periurethral collagen injections, suburethral sling or artificial sphincter insertion, did not affect the 24-h pad weight results as no surgical intervention occurred until after 9 months postoperatively.

Postoperative time to one and zero pads, and 24-h pad weights were compared between the control group and the intervention group. Statistical analysis was carried out using

Table 1 Preoperative and intraoperative factors

Preoperative factors	Control (n = 132)	PG-PFMT (n = 152)	P-value
Age (median IQR)	62 (44–76)	60 (41–76)	0.182
Preoperative PSA, ng/mL (median IQR)	5.8 (4.2–7.8)	6.2 (4.7–9.2)	0.107
Clinical T stage			0.652
cT1b	1 (1%)	1 (1%)	
cT1c	43 (32%)	60 (39%)	
cT2a	59 (45%)	64 (42%)	
cT2b	16 (12%)	18 (12%)	
cT2c	13 (10%)	9 (6%)	
Gleason score			0.382
5–6	59 (45%)	45 (30%)	
7	62 (47%)	98 (64%)	
8–10	11 (8%)	9 (6%)	
Intraoperative factors			
Estimated blood loss (mL)			0.500
Median (IQR)	400 (400–600)	458 (350–500)	
Nerve preservation			0.10
Bilateral nerve sparing	57 (43%)	72 (47%)	
Unilateral nerve sparing	45 (34%)	35 (23%)	
Bilateral nerve resection	30 (23%)	45 (30%)	

PASW Statistics 18.0 (SPSS, Quarry Bay, Hong Kong). Normally distributed data was compared using t-test and ANOVA. Non-parametric statistical tests used were the χ^2-test and Mann–Whitney U-test. Statistical significance was defined by a P-value of <0.05. Survival analysis was carried out by Kaplan–Meier, log–rank test and multivariable Cox regression analysis. The principles of the Helsinki Declaration were followed for the duration of the present study.

Results

In all, 284 patients were evaluated in the present study. Preoperative and intraoperative characteristics are shown in Table 1. There were no significant differences between groups in age (P = 0.182), clinical T stage (P = 0.652), preoperative Gleason score (P = 0.382) and estimated intraoperative blood loss (P = 0.500). Neurovascular bundle preservation was similar between the control and intervention groups, with 43% of men undergoing bilateral nerve sparing and 18–34% undergoing unilateral nerve sparing (P = 0.10).

Figure 1a shows 24-h pad weights at 6 weeks and 3 months for the intervention and control groups. The 24-h pad weight at 6 weeks postoperatively was significantly lower for the intervention group. At 6 weeks, mean 24-h pad weights were 17.0 g and 8.6 g for the control and intervention group, respectively (P < 0.001). At 3 months, however, there was no significant difference between the groups for the 24-h pad weigh (P = 0.18).

The percentage of men who had nil (0–1.9 g), mild (2–9 g), moderate (10–49 g) and severe (50 g+) urinary incontinence measured by 24-h pad weight is shown in Figure 1b. At 6 weeks, significantly fewer men in the intervention group had severe incontinence. In the same time interval, 17% and 25% of men had no incontinence in the control and intervention groups, respectively. The differences were significant (P = 0.003). At 3 months, 1.5% and 0% of men had severe incontinence in the control and intervention groups, respectively. In the same time interval, 62% and 73% of men had no incontinence in the control and intervention groups, respectively. This did not achieve statistical significance (P = 0.073).

Time to achieve continence as defined by patient-reported one pad usage/day was a median of 3 weeks and 2 weeks for control and intervention groups, respectively (P = 0.004). The Kaplan–Meier graph of time to one pad usage/day is shown in Figure 2a. Time to achieve continence as defined by patient-reported zero pad usage/day was a median of 8 weeks and 7 weeks for control and intervention groups, respectively (P = 0.047). The Kaplan–Meier graph of time to zero pad usage/day is shown in Figure 2b.

Multivariable Cox regression analysis of factors that independently affected time to achieve continence without further surgery revealed that preoperative PG-PFMT reduced the time to continence (as defined by the use of 1 pad per day) by 28% when compared with the control (Table 2). The time to zero pad usage/day was not significantly different between groups (P = 0.084). Other factors that significantly affected time to continence were age and bilateral NVB preservation. Blood loss and time to complete surgery were not significant factors on univariate analysis between groups.

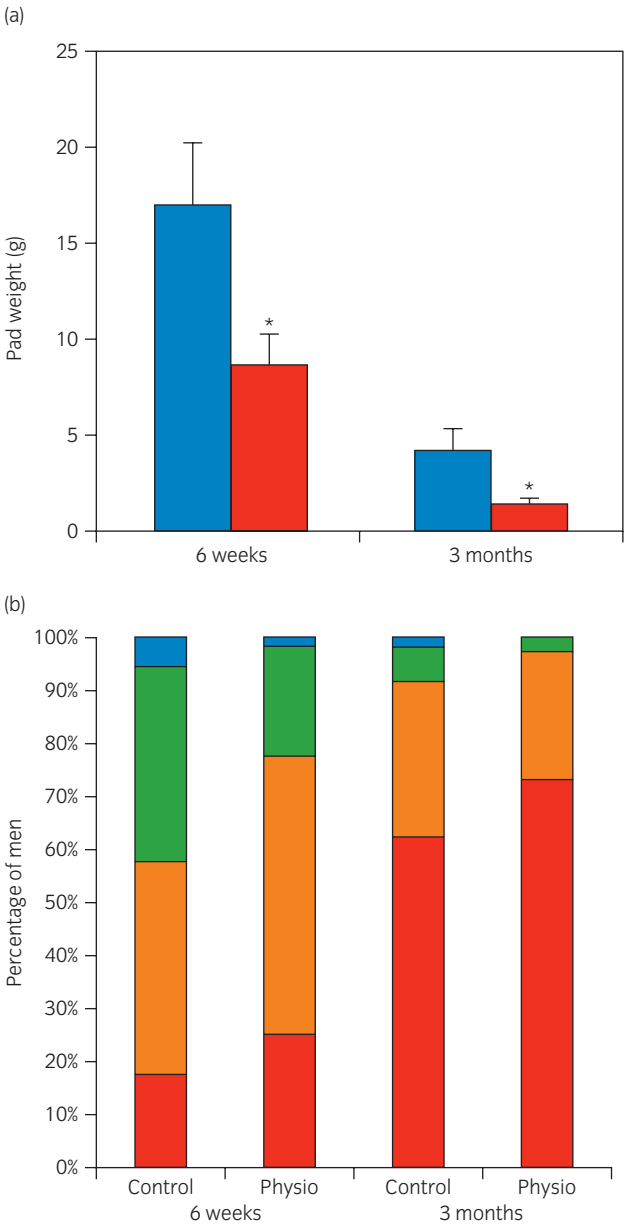

Fig. 1 (a) Mean 24-h pad weights of men undergoing control or PG-PFMT intervention, measured at 6 weeks and 3 months postoperatively (±SEM). (b) Percentage of patients with nil (0–1.9 g/24 h), mild (2-9 g/24 h), moderate (10-49 g/24 h) and severe (>50 g/24 h) incontinence at 6 weeks and 3 months postoperatively. ■, Control; ■, preoperative physiotherapy; ■, 50+; ■, 10–49; ■, 2–9; ■, 0–1.9.

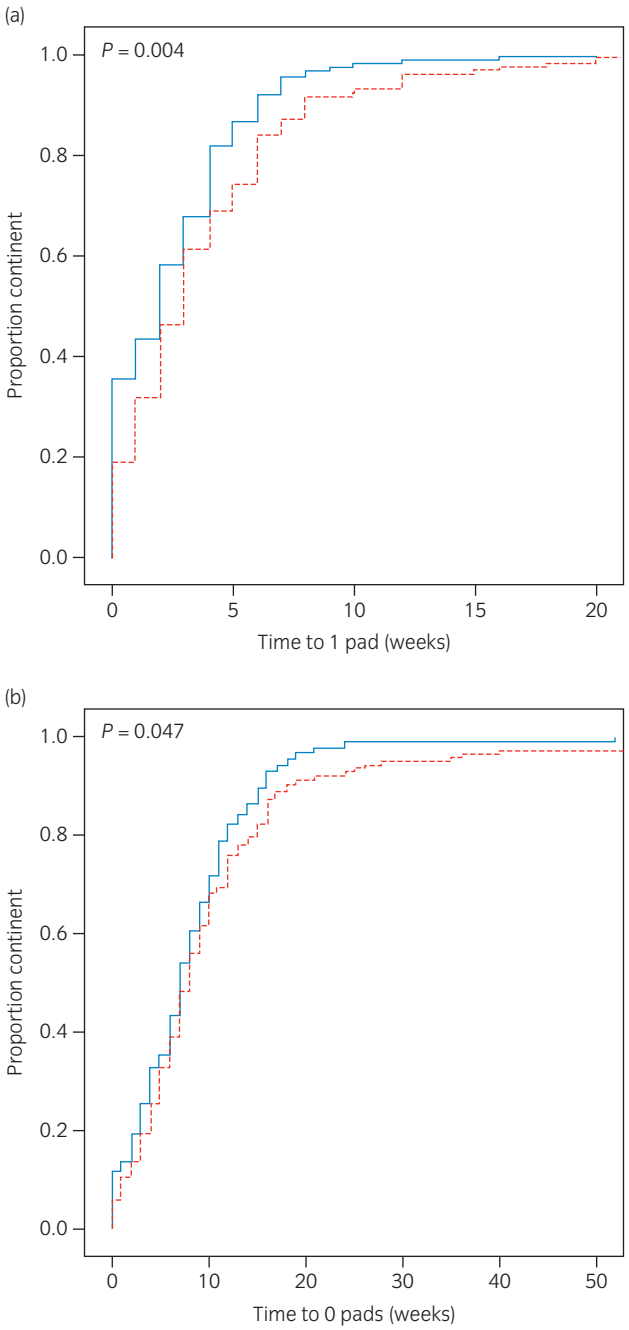

Fig. 2 Kaplan–Meier curve of proportion of patients achieving continence as defined by (a) time to one pad usage and (b) time to zero pad usage. ——, Preoperative physiotherapy; ----, no preoperative physiotherapy.

Discussion

The theoretical basis for PFME in the treatment of PPUI is that the repeated contraction of pelvic floor muscles might strengthen and increase endurance during periods of increased intra-abdominal pressure.[31] Spontaneous improvement in continence might occur up to 1 year after RRP.[9,32] As such, the use of invasive techniques to treat incontinence within this period is not recommended.[9,33,34] Here, the potential advantages of PFME become clear in its non-invasive nature.

The present study has shown that PG-PFMT commenced 4 weeks before RRP has a clear advantage in improving both the severity and duration of PPUI. Outcome measures of 24-h pad weight and pad status were used as they remain inexpensive, relevant and objective methods for the assessment of continence.[25,35] The present study also found that mean 24-h

Table 2 Univariate analysis and multivariate Cox regression analysis of factors significantly improving time to achieve continence

Factors	Univariate		Multivariate			
	Time to 1 pad	Time to 0 pads	Time to 1 pad		Time to 0 pads	
	P-value	*P*-value	HR	*P*-value	HR	*P*-value
PG-PFMT	0.004	0.047	0.72 (0.60–0.84)	0.008	0.80 (0.63–1.02)	0.070
Age	0.001	0.001	1.02 (1.01–1.04)	0.008	0.96 (0.94–0.98)	0.001
Nerve sparing	0.003	0.02	0.65 (0.49–0.82)	0.012	0.73 (0.53–0.87)	0.029
Pre-op SHIM score	0.132	0.06				
Blood loss >400 mL	0.121	0.07				

pad weights and the percentage of patients with severe incontinence improved with time in both the intervention and control groups, but was significantly higher in the control group. At 6 weeks follow up, 24-h pad weight was lower in the intervention group compared with the control group. Furthermore, this advantage was demonstrated, in particular, in the reduction of patients with severe urinary incontinence in the intervention group (Fig. 1b). In addition, the intervention was associated with a shorter duration of incontinence, with a significantly shorter median duration to one and zero pad usage. The present study also shows younger age and bilateral nerve sparing were independently associated with superior urinary continence rates, which has been well established in other studies.[36] Utilizing physiotherapists with a special interest in PFME is the key to the success of the present study, and the authors recommend trialling a number physiotherapists until the ideal one is found.

The effects of postoperatively initiated PFME on incontinence post-RRP are controversial.[12] Systematic reviews of PFME, including one Cochrane review by Hunter *et al*.,[12] have stated that the efficacy of conservative treatment for urinary incontinence after RRP, including PFME, remains uncertain because of the low to moderate quality of evidence of the studies available.[37,38] Furthermore, although some studies show improvement in incontinence rates at 1 year after RRP,[1,13,22,39] others show no such long-term benefit.[16,20] The present study shows the benefit of PFME in the earlier return of continence within the first 6 weeks, but this effect seems to diminish over time. At 3 months follow up, there was a trend toward lower 24-h pad weight in the intervention group, but this difference did not reach statistical significance ($P = 0.18$). It is likely that PG-PFMT, commenced preoperatively, assists in the early return of urinary continence, but might not affect the long-term continence outcome. This result can be explained by the fact that PG-PMFT is unlikely to benefit patients with extensive sphincteric damage or severe bladder dysfunction. Patients with severe urinary incontinence in the long term might warrant further urodynamic evaluation.

There have been a number of studies examining the role of PFME, both preoperatively and postoperatively. A randomized controlled trial by Van Kampen *et al*. supports the commencement of therapy as soon as possible after the operation.[1] In that trial, postoperative PFME with biofeedback was compared with placebo electrotherapy, with the intervention commencing at day 1 post-IDC removal. The differences in the percentage of incontinent patients between the two groups were highest in the first 4 months, and decreased from 31% at 1 month to 14% at 1 year.

Moore *et al*., using a randomized controlled design, found no significant difference between postoperative intensive PFME with biofeedback compared with verbal and written instructions and telephone support by a urology nurse.[40] As reported by the authors, the control group participants might have been unduly influenced by their study participation, and adhered to PFME more so compared with "real" patients, as they had regular contact with the urology nurse. Another study,[41] which has shown no benefit of PFME, was underpowered. Notably, participants in both of these studies had commenced PFME relatively late, at 4 weeks postoperatively and 1 week post-catheter removal, respectively. A recent trial reported no benefit of a program commenced 6 weeks after surgery.[23]

Thus, the timing of PFME might well be an important factor contributing to its effectiveness; preoperative PG-PFME might be more effective at maximizing urinary continence rates compared with a postoperative commencement. Possible reasons for this might be that patients are accustomed to activating the relevant pelvic floor muscles before surgery, and would be able to carry out these exercises immediately post-catheter removal. Furthermore, surgery alters pelvic floor sensation in the immediate postoperatively period. This, combined with the additional pain stimulus of surgery, would make learning pelvic floor exercises postoperatively much more challenging than preoperatively. In a recent randomized controlled trial, Centemero *et al*. assessed the effectiveness of preoperative PG-PFME guided by a physiotherapist in a small cohort of patients ($n = 118$).[24] Participants in the intervention group underwent a course of physiotherapy that was similar to PFME in the present study. Specific PFME was commenced 4 weeks before surgery. A clear advantage was shown for preopera-

tive PG-PFMT in reducing duration and severity of incontinence at 1 and 3 months. Similarly, Parekh *et al*., in a small randomized trial, also reported that PFME commenced before surgery resulted in a quicker return of continence.[16] Other studies have also shown the benefits of preoperative PG-PFME on the severity and duration of incontinence after RRP. These studies have also been limited by small sample size.[15–17] The present study confirms the results shown in these randomized studies, but importantly has been demonstrated in prospectively collected data in a much larger cohort, and outside the stringent monitoring and compliance requirements of a clinical trial.

Studies investigating PG-PFMT before and after RRP incorporate the use of various clinical strategies that provide feedback about pelvic floor muscle function. Traditionally, this has included visual and/or auditory feedback about the performance of pelvic floor muscle function. To the best of our knowledge, the present study is the first to report the effects of a preoperative program that also incorporates the use of transabdominal ultrasound for the activation, training and timing of pelvic floor muscle contractions in different functional positions. The application of ultrasound technologies is advantageous because of the non-invasive nature of the intervention, which gives feedback about the correct performance of pelvic floor muscle exercises that result in elevation of the bladder base.

The present study had a number of limitations. The first was that the study population was not randomized; instead the intervention group was compared with a historical control group. The intervention and control groups might have been biased by the surgeon learning curve. However, the surgeon (MIP) had carried out over 300 RRP before commencing the present study. The learning curve of a surgeon is reported to plateau at 200–250 cases.[42–44] It is unlikely that the significant differences in continence outcomes are a result of the surgeon learning curve. A total of 100 men were excluded from the analysis as a result of missing continence data postoperatively. This is a potential source of bias as it has been the surgeon's experience that continent men are the most likely to miss scheduled appointments or fail to do 24-h pad weighs. A quality of life questionnaire was not carried out as part of the present study. It would be useful to analyse whether the significant reduction in time to continence translates to a better quality of life. Finally, the surgeon was not blinded to whether the patient received the intervention, and this might represent a source of bias.

The present study found that preoperative physiotherapist-guided pelvic floor exercise is an effective and non-invasive method of reducing both the duration and severity of early urinary incontinence after RRP.

Conflict of interest

None declared.

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