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ORIGINAL ARTICLE

Evaluation of pelvic floor muscle strength before and after robotic-assisted radical prostatectomy and early outcomes on urinary continence

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Abstract The aim of the study was to evaluate the effect of pelvic floor muscle (PFM) assessment and training before and after robot-assisted laparoscopic radical prostatectomy (RARP) in improving PFM strength and urinary continence. We performed an analysis of a database of patients who underwent robot-assisted laparoscopic radical prostatectomy (RARP) performed by two urologists from 2011 to 2013. Pelvic floor muscle (PFM) activation and strength were graded by a trained pelvic floor physiotherapist. Patients were given an exercise program, grouped according to the strength of their pelvic floor as graded by assessment, to complete before and after surgery. PFM strength was recorded preoperatively, 4 days post-catheter removal and 4 weeks post-catheter removal. Continence was recorded at 4 weeks postop and was defined as the requirement of no continence aids. A total of 98 patients had RARP and a preoperative physiotherapy assessment plus postoperative appointments at around 1 and 4 weeks post-RARP. The majority of men improved their PFM strength regardless of preoperative strength with no significant predictors of postoperative strength found. Age was the only significant predictor of postoperative incontinence. In this pilot study, a majority of patients increased their pelvic floor strength with time. Pelvic floor physiotherapy is an important modifiable patient factor, which does have an impact in improving patients' urinary continence by strengthening the pelvic floor muscles. Patient age influences response to pelvic floor physiotherapy.

Keywords Pelvic floor · Prostatectomy · Prostatic neoplasms · Urinary incontinence

Introduction

Prostate cancer remains a common cancer worldwide in men with radical prostatectomy offering an excellent curative option. However, undesirable side effects of any radical procedure (surgery or radiation) including urinary incontinence, along with a rise in the uptake of active surveillance have led to their judicious use. Arguments for and against open and laparoscopic versus robotic-assisted radical prostatectomy (RARP) abound but some data suggest RARP may result in better early continence outcomes for men when compared with other approaches [1–3].

While urinary incontinence is not a problem limited to men who have undergone radical prostatectomy, the procedure is the largest contributor to stress incontinence in adult males [4]. Similarly, stress urinary incontinence (SUI) is not the only urological sequela of radical prostatectomy, with overactive bladder as a consequence of detrusor overactivity seen in up to 77 % of patients and impaired bladder compliance in up to 50 % [5].

Standard treatment for men undergoing RARP involves pre- and postoperative pelvic floor assessment and strength training provided by a qualified pelvic floor and continence physiotherapist. Postoperative urinary incontinence is a

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problem dealt with frequently by urologists as part of the routine postoperative care of these patients with fortunately only a very small percentage requiring further surgical intervention for their postoperative incontinence [6, 7].

We aimed to evaluate changes in PFM strength after RARP and to evaluate factors contributing to strength recovery and incontinence postoperatively.

Patients and methods

Patient population

115 Consecutive patients who underwent RARP by two urologists and had a preoperative physiotherapy assessment were identified between 2011 and 2013. Amongst this cohort of 115 men with preop PFM assessment, seven men did not have an assessment at 4 days post-catheter removal and another ten did not have an assessment at 4 weeks post-catheter removal. Thus, 98 men had a complete physiotherapy course and constitute the cohort for this study. This study represents an audit and patients were de-identified, thus it fulfilled surgical college ethical requirements.

Surgical procedure

The surgical procedure of RARP was done in a standardized fashion using the same robot and having the same technique of anastomosing being: maximizing urethral length, no suspensory or "Rocco" suture and using two continuous monocryl 3-0 sutures commencing at the base and joining anteriorly with placement of a drain. The Foley catheter was 20Fr and placed for as close to 10 days as possible (range 9–11).

Due to our concern regarding the observed correlation between nerve damage and incontinence, an identical nerve-sparing technique was performed in all patients regardless of age [8].

Physiotherapist assessment and training

A single, qualified pelvic floor and continence physiotherapist assessed PFM strength preoperatively and at 4 days and 4 weeks post-catheter removal. Three separate assessments were completed preoperatively to evaluate for correct activation, squeeze pressure, reflex activation and endurance. These included: perineal pelvic floor muscle assessment anteriorly, digital rectal exam (DRE) to evaluate the external anal sphincter (EAS) and puborectalis and finally real-time trans-abdominal ultrasound assessment, graded according to guidelines suggested by the International Continence Society. PFM strength was rated as absent, weak, moderate or strong in accordance with the ICS scale [9]. Assessments were repeated postoperatively with the exception of DRE due to possible pain and discomfort postoperatively.

Strength, reflex action, coordination and endurance training exercises were individualized according to assessment findings to complete before and after surgery as described.

The initial physiotherapy consultation was of 2 h duration and focussed on educating the patient and their partner/family/friend about anatomy and guiding patients how to adequately perform exercises. At the conclusion of the consultation, patients were provided with an exercise regimen to practice daily.

Patients were seen again by the physiotherapist at 4 days and 4 weeks postop at which time they have a strength assessment and were provided with ongoing education and exercise programs.

The physiotherapist objectively recorded continence status at the 4-week post-catheter removal visit, specifically assessing whether patients were requiring incontinence pads or pull-ups. Continence was defined as requiring no use of these continence aids at this assessment

Statistical analysis

To assess predictors of PFM strength improvement between day 4 and week 4, we used univariable logistic regression with improvement as the outcome variable. Necessarily, patients with "strong" PFM at day 4 were excluded from this portion of the analysis. Predictors of incontinence were similarly examined with univariable logistic regression. An interaction between baseline PFM strength and age was suspected and assessed with a Chi-square test of homogeneity. The effect of age was then examined by stratifying on PFM strength. The association between age at surgery and the two outcomes above were modelled graphically by locally weighted regressions with tricube weighting. Comparisons in baseline preoperative PFM strength between those in the study sample and those excluded were done with the Fisher's exact test.

All tests were two sided with significance set at the conventional level. Analyses were undertaken with Stata v. 12.0 SE (Statacorp, College Station, TX).

Results

98 Men (median age of 64 years, range 49–77) underwent RARP during our study period and had two documented follow-up physiotherapy appointments. Their pathological characteristics are outlined in Table 1. The cohort had predominately Gleason score 7 and pT2 disease.

Table 1 Tumour characteristics of the cohort

Preoperative PSA (ng/ml) (median, IQR)	5.2 (4.5–7.1)
Gleason score (*N*, %)	
6	9 (9.2 %)
3 + 4	60 (61 %)
4 + 3	19 (19 %)
8+	10 (10 %)
T stage (*N*, %)	Number
pT2	63 (65 %)
pT3a	28 (29 %)
pT3b	6 (6.2 %)
Margin	
Positive	16 (17 %)
Negative	80 (83 %)

1 Unrecorded T stage, 2 unrecorded margin status, 11 unrecorded PSA

PFM strength was assessed preoperatively as strong in 79 % of men (77 patients), with 12 % assessed as moderate (12 patients) and 9 % assessed as weak (nine patients). The 17 men who did not have both postop physiotherapy appointments had a significantly weaker preoperative strength ($p = 0.017$) with four (24 %) assessed as weak and five (29 %) as moderate.

When looking at postoperative PFM strength, it was noted that only a small proportion of men with strong PFM preoperatively were not strong at 4 weeks post-catheter removal (18.2 %). The majority of those with moderate or weak PFM strength preop also improved to strong by 4 weeks post-catheter removal. We observed that there was an improvement in all categories of PFM strength from 4 days to 4 weeks post-catheter removal (Table 2). Of the 21 patients who could increase PFM strength from preoperative levels, 15 (71.4 %) did so by 4 weeks while the balance remained at their baseline level.

Younger age significantly predicted PFM strength improvement from day 4 to week 4 postop (Odds ratio, OR, per one year younger = 1.14, $p = 0.029$) (Fig. 1). No tumour characteristic significantly predicted change in PFM strength over time.

Data for incontinence 4 weeks post-catheter removal were available for 83 patients. 41 men (49.4 %) were continent and 42 (50.6 %) were incontinent. As expected, PFM strength at 4 weeks post-catheter removal correlated with incontinence ($p < 0.01$); however, PFM strength preoperatively was not associated with incontinence at 1 month ($p > 0.4$). Older men were more likely to develop incontinence, although a significant interaction was present between age and PFM strength preoperatively. Increasing age had a stronger effect in predicting incontinence in men with baseline moderate and weak PFM strength (OR = 1.83, $p = 0.07$) than in men with strong preoperative PFM strength (OR = 1.05, $p = 0.3$) (Fig. 2). No tumour factor was significantly associated with incontinence in our cohort.

Discussion

Post-prostatectomy incontinence occurs due to a complex interaction between patient and surgical factors including surgical approach, making it a difficult concept to unravel [1]. Importantly, a major issue with the literature on continence is the varied definitions and time points at which continence is recorded, leading to wide ranges.

There appear to be no studies assessing the utility of PFM strength training by recording changes in pelvic floor strength. While the value of strength training is understudied, what we have demonstrated is evidence that when done by a trained physiotherapist, PFM training is generally effective at improving men's pelvic floor strength after RARP. Similarly, there are scant data regarding the relationship between pelvic floor strength in men and its effect on urinary continence. Keeping this in mind, we felt that using an assessment of PFM strength as our primary endpoint would control somewhat for the difficulty of adequately assessing and defining continence and shed some light on the relationship between these two factors.

Table 2 Changes in PFM strength at 1 week and 4 weeks post-catheter removal

Preop PFM	4 Days post-catheter removal		4 Weeks post-catheter removal	
Strong $n = 77$	Strong	59 (76.6 %)	Strong	63 (81.8 %)
	Moderate	15 (19.5 %)	Moderate	12 (15.6 %)
	Weak	3 (3.9 %)	Weak	2 (2.6 %)
Moderate $n = 12$	Strong	4 (33.3 %)	Strong	7 (58.3 %)
	Moderate	8 (66.7 %)	Moderate	5 (41.7 %)
	Weak	0	Weak	0
Weak $n = 9$	Strong	3 (33.3 %)	Strong	5 (55.6 %)
	Moderate	2 (22.2 %)	Moderate	3 (33.3 %)
	Weak	4 (44.4 %)	Weak	1 (11.1 %)

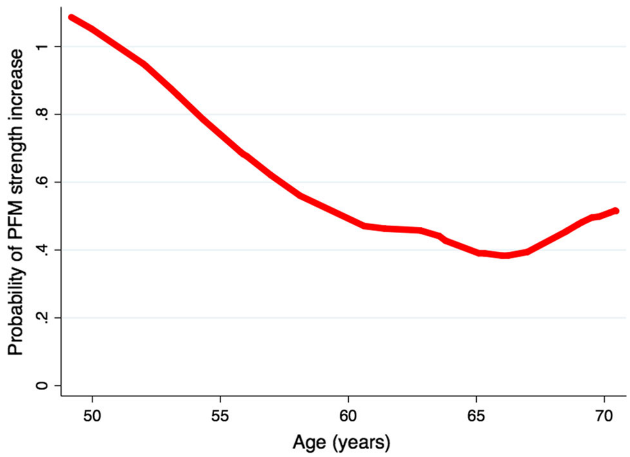

Fig. 1 The probability of an increase in graded PFM strength from day 4 to week 4 as a function of age at surgery

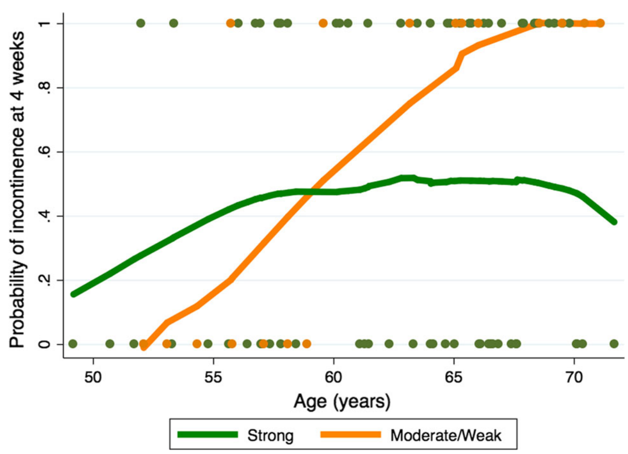

Fig. 2 Probability of incontinence at 4 weeks as a function of age at surgery, split by PFM strength preoperatively. *Dots* individual patients

Continence in our cohort was around 50 % early in recovery at 4 weeks. Given the strict definition (requirement of no continence aids) this is comparable to contemporary series and would be expected to improve with time even out to 12 months [10]. Concerning the effectiveness of PFM training in improving continence rates post-RARP, a recent systematic review suggests a modest overall benefit when compared to control in reduction of incontinence, albeit it with some methodological flaws [11]. The overall value of this finding must be interpreted with caution due to poor–moderate quality studies and wide confidence intervals. Likewise, there is conflicting evidence regarding the benefits of preoperative PFM strength training when compared with postoperative training only [12, 13]. What is clear is that more evidence is required to conclusively answer this question, but there increasing evidence to support training preoperatively to reduce severity and duration of post-prostatectomy urinary incontinence [12, 14, 15]. Our data seem to support this assertion.

Studies assessing preoperative predictors of incontinence after RARP have demonstrated some predictive factors, specifically: prostate volume, patient BMI, surgeon experience, age, medical comorbidities, salvage prostatectomy and preoperative erectile function [1, 16]. Factors proposed not to influence outcome include: the preoperative symptom score, voiding symptoms, prostate-specific antigen, clinical stage and Gleason score [17]. Our findings would seem to support this, with age the only significant predictor of incontinence while interestingly not predicting weaker PFM strength. This would seem to suggest that while PFM strength is an important contributor to urinary incontinence, there are other patient and surgical factors that contribute to the problem.

Of note, there has been an observed correlation between nerve-sparing technique and early return to continence [8]. Given this variable, our study attempted to control for this using an identical nerve-sparing technique regardless of patient age or preoperative erectile function.

There have been many methods to improve postoperative continence trialled experimentally: lifestyle interventions, pelvic floor muscle training (PFMT) with or without biofeedback, and bladder training. In addition, anti-muscarinic agents are sometimes used in the case of overactive bladder symptoms [18]. Regrettably, there is little good quality evidence for any of these treatment modalities in managing or preventing incontinence. Likewise, there is no literature evaluating the effectiveness of any method of testing PFM strength in men and thus studies are needed to validate technique and to compare this with other methods that exist. While biofeedback has not been shown to be effective in terms of postoperative continence [18], its utility in assessing pelvic floor strength may prove to be of some use.

A significant limitation in the available literature to date is a lack of consensus in the assessment of the actions of the pelvic floor itself. What is agreed is that the PFM, specifically the rhabdosphincter–levator ani complex function to contract, elevate and move anteriorly toward the pubic symphysis triggering the reflex action to close around the external urethral sphincter. It is proposed that this action has the potential to compensate for sphincter incompetence and dysfunction post-prostatectomy in times of urinary 'stress' [19]. Few studies exist to evaluate this action, which is particularly important in assessing the pelvic floor relationship to incontinence. Similarly, available research has typically only utilized DRE to assess the external anal sphincter, but has not qualitatively assessed the preoperative integrity of the pelvic floor. It is clear from the literature that this is a major limitation in evaluation of incontinence and postoperative outcomes and further research is needed.

There are some methodological shortages in this study. First, it is simple and cost effective to qualify PFM strength using digital assessment of the perineal and puborectalis;

however, this method is subjective and varies according to physiotherapist experience and interpretation, as do instructions given to the patient, exercise techniques and other patient factors. Our study attempted to limit this using only one physiotherapist to conduct the assessments. Likewise, continence rates may reflect variability in surgeon practice and experience. We hoped to control for this using two experienced surgeons, providing a series of patients with similar operative technique.

Other limitations in this study include some loss to follow-up and missing continence data. Of note, those patients missing postoperative physiotherapy appointments had a weaker pelvic floor prior to surgery. It is probable that our cohort is biased somewhat in favour of men with inherently strong pelvic floor muscles and those who are amenable and agreeable to physiotherapy treatment. Nevertheless, our results indicate a definitive and positive effect for physiotherapy interventions in the men who attended both post-operative visits. Increased numbers of participants would potentially demonstrate more predictive factors for postoperative incontinence or pelvic floor weakness. In addition to this, it would be useful to follow the strength and continence rates of these patients for at least 12 months [10, 20], and further studies in the area may clarify the relationship between PFM training and continence.

Further research would also benefit from including trans-perineal ultrasound assessment to evaluate the pelvic floor in its action to simultaneously contract, elevate and translate anteriorly. This would allow for a tailored exercise program, aimed at individual issues in contracting the pelvic floor.

In conclusion, our data indicate that the majority of men who undergo PFM strength assessment and training prior to RARP will maintain or improve their strength postoperatively and that PFM strength correlated with continence at 4 weeks post-catheter removal. Age was a predictor of postoperative incontinence though the effect was modified according to baseline PFM strength. We suggest that pre-operative PFM strength assessment and training are effective interventions that improve postoperative outcomes for men undergoing RARP, particularly in younger men. Further prospective studies into the role of strength training will further clarify its utility in improving outcomes.

Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest
All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

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