# Posterior musculofascial reconstruction after radical prostatectomy: an updated systematic review and a meta-analysis

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To evaluate the influence of posterior musculofascial plate reconstruction (PR) on early return of continence after radical prostatectomy (RP); an updated systematic review of the literature. A systematic review of the literature was performed in June 2015, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and searching Medline, Embase, Scopus and Web of Science databases. We searched the terms posterior reconstruction prostatectomy, double layer anastomosis prostatectomy across the 'Title' and 'Abstract' fields of the records, with the following limits: humans, gender (male), and language (English). The authors reviewed the records to identify studies comparing cohorts of patients who underwent RP with or without restoration of the posterior aspect of the rhabdosphincter. A meta-analysis of the risk ratios estimated using data from the selected studies was performed. In all, 21 studies were identified, including three randomised controlled trials. The overall analysis of comparative studies showed that PR improved early continence recovery at 3-7, 30, and 90

days after catheter removal, while the continence rate at 180 days was statistically but not clinically affected. Statistically significantly lower anastomotic leakage rates were described after PR. There were no significant differences for positive surgical margins rates or for complications such as acute urinary retention and bladder neck stricture. The analysis confirms the benefits at 30 days after catheter removal already discussed in the review published in 2012, but also shows a significant advantage in terms of urinary continence recovery in the first 90 days. A multicentre prospective randomised controlled trial is currently being conducted in several institutions around the world to better assess the effectiveness of PR in facilitating an earlier recovery of postoperative urinary continence.

## **Keywords**

radical prostatectomy, posterior musculofascial reconstruction, posterior rhabdosphincter reconstruction, urinary incontinence, urinary continence, early continence

## Introduction

Urinary incontinence and erectile dysfunction are the two major disadvantages of radical prostatectomy (RP). According to the European Association of Urology 2015 guidelines on prostate cancer [1], mean continence rates at 12 months range from 89 to 100% for patients treated with robotassisted RP (RARP) to 80–97% for patients treated with retropubic RP. The mean potency recovery rates at 12 months range from 55 to 81% for patients treated with RARP to 26–63% for patients treated with retropubic RP.

In an effort to attain better functional results after RP, in 2001, Rocco et al. [2] described a technique for reconstruction of the posterior aspect of the rhabdosphincter, based on studies of the rhabdosphincter itself [3]. In 2006, it was reported that posterior reconstruction (PR) shortens incontinence time after RP [4]. In 2007, the application of the restoration of the posterior aspect to transperitoneal laparoscopic RP (LRP) was described [5]. In 2011, Coelho et al. [6] described a modified PR of the rhabdosphincter applied to RARP.

Since the original description, the rhabdosphincter reconstruction technique has spread worldwide, with mixed results. In 2012, Rocco et al. [7] published a systematic review of the literature on posterior musculofascial reconstruction after RP, suggesting that PR can improve early return of continence within the first 30 days after RP (P = 0.004) and reduce the incidence of leakage on cystogram (P = 0.050).

The strength of the recommendations derived from this meta-analysis was limited by the high heterogeneity between studies: different continence definitions in each analysed study, several modifications to the original surgical technique, and different surgical approaches [open RP (ORP), LRP, RARP]. Moreover, the small sample size of many of the selected studies was another important limitation of the published review.

Since then, several other trials have been published, mainly studying the effect of PR in RARP and LRP. Consequently, based on the recommendation of the Cochrane Collaboration to update systematic reviews at least every 2 years [8], we elected to update our previous meta-analysis of the literature in the field of PR of the rhabdomyosphincter.

## **Materials and Methods**

## Literature Search and Study Selection

The present study is a systematic review of the literature conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [9]. A systematic and critical analysis of Medline, Embase, Scopus and Web of Science databases was carried out in June 2015, by three authors (A.A.C.G, F.A.M, G.C.) separately, applying the following key terms: posterior reconstruction prostatectomy, double layer anastomosis prostatectomy. The search was conducted across the 'Title' and 'Abstrac't fields of the records, with the following limits: humans, gender (male), and language (English). Only full-text articles were considered, while abstracts were not included. We decided

Fig. 1 Literature analysis and data acquisition.



not to include data from congress abstract proceedings, as they usually lack the completeness of data required.

Of articles found, the ones selected were those in which cohorts of patients who underwent RP (regardless if performed as ORP, LRP or RARP) were compared according to the execution or not of PR of the rhabdomyosphincter, and in which the continence outcomes at defined intervals (3–7, 30, 90 and 180 days after the catheter removal) were reported.

In the present meta-analysis, we assessed the following key aspects of each study: the patients' population, the study design, the definition used to assess the continence recovery, the data collection, if a variant of the PR defined as a 'Rocco Stitch' was performed, the rate of continence recovery (at 3–7, 30, 90 and 180 days after the catheter removal), the rate of urinary anastomotic leakage diagnosed at the postoperative cystogram, the rate of positive surgical margins (PSM), and the rate of postoperative complications potentially related to the PR of the rhabdomyosphincter (i.e. bladder neck stenosis or urinary retention). In case of studies reporting data not adequate for meta-analysis more information was directly requested from the authors.

All the data were collected in a single database and the quality control of the collection was performed on a random sample representative of the 20% of the totality of the studies included in the meta-analysis.

We assessed the methodological quality of studies using the Newcastle–Ottawa quality assessment scale for cohort

Table 1 Newcastle-Ottawa	scale for	risk of	bias	and	quality	assessment	of
the included observational	studies.						

Reference	Selection	Comparability	Outcome	Total score
Rocco et al. [4]	***	*	**	6
Rocco et al. [3]	***	*	**	6
Rocco et al. [5]	****	**	**	8
Tewari et al. [10]	****	*	**	7
Nguyen et al. [12]	***	*	**	6
Krane et al. [13]	***	**	**	8
Kim et al. [14]	****	**	**	8
Joshi et al. [15]	****	**	**	8
Coelho et al. [6]	***	**	**	8
Brien et al. [17]	***	**	**	8
Atug et al. [18]	***	**	**	8
Sano et al. [20]	***	**	**	8
Simone et al. [21]	****	**	**	8
Gondo et al. [22]	****	**	**	8
You et al. [23]	***	**	**	8
Anceschi et al. [24]	***	*	**	6
Ito et al. [25]	***	*	**	6
Daouacher and Waldén [26]	***	**	**	8

Reference	Study design	LoE	Surgical approach	PR	, n	Continence definition	Method used to evaluate		2.7 days
				Yes	No		continence recovery	PR	No PR
Rocco et al. [4]	Retro.	4	ORP	161	50	0–1 pad/day	ICIQ – Short Form – telephone	72.0 <i>P</i> < 0.001	14.0
Rocco et al. [3]	Retro.	4	ORP	250	50	0–1 pad/day	Medical Examination, Pad test, ICIQ – Short	62.4 <i>P</i> < 0.001	14.0
Rocco et al. [5]	Pro.	2b	LRP	31	31	0–1 pad/day	External	74.2 P < 0.001	25
Tewari et al. [10]	Retro.	4	RARP	182	214	0–1 pad/day	External	38.4 P < 0.001	13.5
Menon et al. [11]	Pro. – random.	1b	RARP	59	57	0−1 pad/day, leakage ≤30 g/day	incinever	1 day - 34 2 days - 46 7 days - 54 P > 0.1	1 day – 26 2 days – 49 7 days – 51
Nguyen et al. [12]	Retro.	4	LRP and RARP	32	30	0–1 pad/day	Telephone interview/ questionnaire about the no. of pad used	34.0 P = 0.007	3.0
Krane et al. [13]	Retro.	4	RARP	34	37	0–1 pad/day	Medical	-	-
Kim et al. [14]	Retro.	4	RARP	25	25	0 pad/day	EPIC	24.0 P = 0.540	36.0
Joshi et al. [15]	Pro.	2b	RARP	53	54	0 pad/day, no leakage	EORTC questionnaire, QLQ-C30, Prostate Cancer Module	-	
Coelho et al. [6]	Pro.	2b	RARP	473	330	0 pad/day	EPIC	28.7 P = 0.045	22.7
Sutherland et al. [16]	Pro. – random.	1b	RARP	47	47	0–1 pad/day	EPIC: pad weight in 24 h	_	-
Brien et al. [17]	Retro.	3b	RARP	31	58	Pre- and postoperative RAND-UCLA score	RAND-UCLA QoL and AUA symptom scores	-	-
Atug et al. [18]	Retro.	4	RARP	125	120	0 pad/day		71.2	23.3
Hurtes et al. [19]	Pro. – random.	1b	RARP	39	33	0 pad/day, no leakage	UCLA-PCI scoring system	-	-
Sano et al. [20]	Pro.	2b	LRP	25	23	0–1 pad/day		-	-
Simone et al. [21]	Retro.	4	LRP	155	125	0–1 pad/day	EPIC	-	-
Gondo et al. [22]	Retro.	4	RARP	160	39	0–1 pad/day	Medical examination	_	-
You et al. [23]	Retro.	4	RARP	28	31	0–1 pad/day	ICIQ	-	-
Anceschi et al. [24]	Retro.	4	LRP	52	54	0 pad/day, no	ICIQ and SF36	19.0	22
Ito et al. [25]	Retro.	4	LRP	19	13	leakage 0 pad/day	questionnaire UCLA-PCI scoring	P = 0.657	-
Daouacher and Waldén [26]	Pro.	2b	LRP	99	99	0–1 pad/day	system IPSS	-	-

Table 2 Urinary continence in patients undergoing RP, with or without PR of the rhabdosphincter, at 3–7, 30, 45–75, 90, 180 days and 1 year after removal of the urinary catheter.

EORTC, European Organisation for Research and Treatment of Cancer; EPIC, Expanded Prostate Cancer Index Composite questionnaire; ICIQ, International Consultation on Incontinence questionnaire; LoE, level of evidence; PCI, Prostate Cancer Index; Pro., prospective; QLQ-C30, Quality of Life Core 30; QoL, quality of life; Random., randomised; Retro., retrospective; SF36, Short Form (36) 36-item Health Survey; UCLA, University of California, Los Angeles.

	% Conti	nence recovery	after catheter rem	noval at					
	30 days	45–1	75 days	90	) days	18	0 days	1 year	
PR	No PR	PR	No PR	PR	No PR	PR	No PR	PR	No PR
78.8 P < 0.001	30.0%	-	-	86.3% P < 0.001	46.0	-	-	96.0% 90.0 P = 0.132	9%
74.0 <i>P</i> < 0.001	30.0	-	-	85.2 <i>P</i> < 0.001	46.0	-	-	94.0 90.0 $P = 0.301$	
83.8 P < 0.001 82.6 P < 0.001 80.0	32.3 35.2 74.0	-	-	92.3 P = 0.25 91.3 P < 0.001 -	76.7 50.2 -	- 97.1 P < 0.001 -	 62.0 		
P > 0.1 56.0 P = 0.006	17.0	-	-	-	-	-	-		
 72.0 <i>P</i> = 1.000	- 68.0	85.0% P = 1 -	86.0%  	$ \begin{array}{l} - \\ 84.0 \\ P = 0.730 \\ 75.0 \\ P = 0.391 \end{array} $	 76.0 69.0	$ \begin{array}{l} - \\ 96.0 \\ P = 1.00 \\ 51.0 \\ P = 0.686 \end{array} $	 96.0 43.0		
51.6 P = 0.016 -	42.7  	-	-	91.1 P = 0.908 63 P = 0.07 64.0 P = 0.05	91.8 81 50.0	97.0 P = 0.741 - 69.0 P = 0.27	96.3 - 62.0		
72.8 P < 0.001 26.5 P = 0.047 44.0	49.1 7.1 0.0	-	-	80.8 P = 0.518 45.2 P = 0.016 60	76.6 15.4 30.4	84.8 P = 0.509 65.4 P = 0.609 72	80.8 57.9 52.2	91.2 88.3 P = 0.596  88.0 56.5	5
P < 0.001 80.0 P = 0.037 75.6 -	68.8 20.5	- - -	-	P = 0.049 93.6 P = 0.026 -	82.4	P = 0.230 98.8 P = 0.026	93.6	P = 0.022	
57.2 P < 0.001 69 P = 0.028 21.1 P = 0.625	35.5 37 7.7	 31.6 P = 0.195	- - 7.7	89.2  P = 0.092  86.0  P = 0.006  68.4  P = 0.005	71.0 54.0 15.4	92.8 P = 0.104 67.0 P > 0.25 84.2 P = 0.001	87.5 70.0 23.1	94.5 $92.1$ $P = 0.142$ $73.0$ $73.0$ $72.0$ $P > 0.82$ $84.2$ $84.2$ $69.2$ $P = 0.401$ $69.2$	2
33 P = 0.007	16	-	-	66.0 P = 0.002	44.0	81.0 P = 0.034	67.0	92.0 $P = 0.024$ 80.0	)

studies, as recommended by the Cochrane collaboration. The instrument uses a star system to evaluate observational studies based on three criteria: participant selection, comparability of study groups, and assessment of outcome or exposure. A maximum of four, two, and three stars can be awarded, respectively, for each category. Studies awarded >6 stars were considered to be of high quality.

#### **Statistical Analysis**

Risk ratio (RR) was used in reporting the six dichotomous outcomes analysed in the study: urinary continence, PSM, urinary leakage on cystogram, acute urinary retention (AUR), and stenosis of the new bladder neck.

Heterogeneity between studies was assessed using the  $I^2$  statistics. Pooled estimates were calculated with fixed-effect model (Mantel–Haenszel method) when there was no significant evidence of heterogeneity; otherwise, the random effect model (DerSimonian–Laird method) was used. The significance of the overall treatment effect was tested by the *z*-test. Meta-analysis results were graphically represented using forest plots.

Data were evaluated on an intention-to-treat basis as far as possible. The presence of publication bias was evaluated using funnel plots and the arcsine test was used to test funnel plot asymmetry.

All analyses were undertaken using R 3.2.3 (R Core Team 2015; R Foundation for Statistical Computing, Vienna, Austria) with the meta package.

## Results

#### Systematic Literature Search Results

In all, 493 articles dealing with the PR after RP were found: 90 on Medline, 189 on Embase, 101 on Scopus, and 113 on the Web of Science database. Of these, 191 articles were identified after the removal of duplicates, with 161 articles excluded because they were not focused on the PR of the rhabdomyosphincter. Eight studies were excluded because the techniques of PR were different from the original, or for the absence of an adequate assessment of continence recovery. Finally, of the 22 studies defined eligible for the qualitative analysis, one was excluded because of a lack of standardised reporting of the continence recovery outcome (Fig. 1), leaving 21 studies [3–6,10–26].

# Description of Included Studies and Quality Assessment

All the 21 studies included were divided according to the levels of evidence defined by Phillips et al. [27]:

- 1 Three studies were defined as randomised controlled trials (RCT) reaching the level of evidence 1b.
- 2 Five studies were defined as non-randomised controlled trials reaching the level of evidence 2b.
- 3 One study was defined as retrospective with a contemporary cohort of patients reaching the level of evidence 3b.
- 4 12 studies were defined as retrospective with an historical cohort of patients reaching the level of evidence 4.

Table 1 [3-6,10,12-15,17,18,20-26] summarises the quality scores of the studies and the risk of bias assessment.

## Meta-Analysis of Urinary Continence

Table 2 [3–6,10–26] shows the outcomes of urinary continence in the studies included in the meta-analysis, at 3–7, 30,45–75 90, 180 days and 1 year after removal of urinary catheter in patients undergoing RP (ORP, LRP or RARP) with or without PR of the rhabdosphincter. Table 3 [3–6,10–26] summarises the different surgical techniques used in the studies comprised in the meta-analyses.

Of the 21 papers considered in the meta-analysis, five studies did not show any significant advantage in terms of postoperative urinary continence secondary to the PR of the sphincteric complex. However, most publications have shown, although with different levels of evidence, a significant advantage associated with the PR of the sphincter for postoperative urinary continence at different time intervals.

The combined analysis of all studies, regardless of the surgical approach, showed an overall statistically significant advantage in the rate of postoperative urinary continence in favour of the application of the technique of PR at 3–7 days after catheter removal (RR 1.90, 95% CI 1:25–2:90; P = 0.003; Fig. 2), at 30 days after catheter removal (RR 1.77, 95% CI 1.43–2.20; P < 0.001; Fig. 3) and at 90 days after catheter removal (RR 1.32, 95% CI 1.10–1.59; P = 0.003; Fig. 4). A smaller but still significant advantage in terms of urinary continence associated with PR at 180 days after catheter removal emerged (RR 1.13; 95% CI 1.02–1.26; P = 0.025; Fig. 5). Heterogeneity between studies was high for all the time intervals, ranging from an  $I^2$  of 83.8 to 90.5%.

A subgroup analysis by study type (RCT, observational prospective and retrospective) of RR for urinary continence was performed (Figs 2–5). For the RCTs, the pooled RRs at 3-7, 30, 90 and 180 days were 1.07 (95% CI 0.75–1.51), 1.69 (95% CI 0.46–6.27), 1.48 (95% CI 0.41–5.32), 1.13 (95% CI 0.70–1.82), respectively. For the prospective studies the RRs were 1.81 (95% CI 0.81–4.01), 1.95 (95% CI 1.09–3.49), 1.22 (95% CI 0.93–1.58), 1.15 (95% CI 0.91–1.45), respectively. For the retrospective studies the RRs were 2.21 (95% CI 1.27–3.85), 1.86 (95% CI 1.39–2.49), 1.38 (95% CI 1.14–1.68), 1.13

Table 3 Comparison of the different surgical techniques employed.

Reference	Surgical techniques used to improve urinary continence	Inclusion of Denonvilliers' fascia in PR	Suspension of posterior bladder wall to the posterior musculofascial plate
Rocco et al. [4]	PR	Yes	Yes
Rocco et al. [3]	PR	Yes	Yes
Rocco et al. [5]	PR	Yes	Yes
Tewari	PR	Yes	Yes
et al. [10]	Anterior reconstruction with preservation of pubo-prostatic ligaments		
Menon et al. [11]	PR	Yes	No
Nguyen et al. [12]	PR	Yes	No
Krane et al. [13]	PR	No	Yes
Kim et al. [14]	PR	Yes	Yes
Joshi et al. [15]	PR	Yes	No
Coelho et al. [6]	PR	Yes	No
	Periurethral suspension		
Sutherland et al. [16]	PR	Yes	Yes
Brien et al. [17]	PR	Yes	Yes
Atug et al. [18]	PR Urethral suspension	Yes	Yes
Hurtes et al. [19]	PR	Yes	Yes
	Periurethral suspension		
Sano et al. [20]	PR	Yes	Yes
Simone et al. [21]	PR	Yes	No
Gondo	PR	Yes	Yes
et al. [22]	Approximation of the Santorini venous plexus to the anterior bladder wall		
You et al. [23]	PR	Yes	Yes
Anceschi et al. [24]	PR	Yes	Yes
Ito et al. [25]	PR	Yes	No
Daouacher and	PR	No	No
Waldén [26]	Preservation of pubo-prostatic ligaments		

(95% CI 0.97–1.33), respectively. Subgroup differences were not statistically significant at each of the four time intervals. Heterogeneity between studies was high or medium–high in all the study subgroups ( $I^2 > 70\%$ ).

A subgroup analysis of continence by surgical approach (LRP vs RARP; studies considering ORP or both LRP and RARP were excluded) was also performed (Figs 6–9). For LRP the pooled RRs at 3–7, 30, 90 and 180 days were 1.60 (95% CI 0.49–5.21), 1.93 (95% CI 1.20–3.12), 1.58 (95% CI 1.17–2.13), 1.16 (95% CI 0.95–1.43), respectively. For RARP the RRs

were 1.75 (95% CI 1.06–2.87), 1.60 (95% CI 1.20–2.12), 1.21 (95% CI 0.94–1.55), 1.12 (95% CI 0.94–1.34), respectively. Subgroup differences were not statistically significant at each of the four time intervals. Heterogeneity between studies was high in all the study subgroups ( $I^2 > 75\%$ ).

The above analysis shows a statistically significant advantage in terms of urinary continence at 30 and 90 days when LRP is used, and at 3-7 and 30 days when RARP is used.

### Meta-Analysis of PSM

Table 4 [3–6,10,18,19,23–25] shows the percentage of PSM estimated by the studies included in the meta-analysis. The overall meta-analysis of data in the various studies showed a rate of PSM comparable in the group of patients undergoing PR and in the group of patients undergoing standard RP (RR 1.04, 95% CI 0.82–1.31; P = 0.804; Fig. 10). Heterogeneity between studies was very low ( $I^2 = 0\%$ , P = 0.939). Subgroups analysis by type of study did not show significant differences between the pooled estimates (P = 0.664).

#### Meta-Analysis of Urinary Leakage on Cystogram

The meta-analysis of the data reported in the literature showed a statistically significant advantage on the reduction of the risk of peri-anastomotic urinary leakage at postoperative cystogram in the group of patients treated with PR compared with the group of patients not undergoing PR (RR 0.43, 95% CI 0.25–0.75; P = 0.006; Fig. 11). Heterogeneity between studies was very low ( $I^2 = 0\%$ , P = 0.624). Subgroups analysis by type of study did not show significant differences between the pooled estimates (P = 0.930).

## Meta-Analysis of Complications

We tried to evaluate complications that could be related to the specific technique, such as urethral stenosis due to an increased number of sutures in the area, but we found no data in the literature concerning this point.

Of all the trials included in the meta-analysis, six papers also reported information about the rate of AUR episodes in the comparison groups [3,4,6,14,15,24]. From the meta-analysis of these studies there was no statistically significant evidence to suggest any certain increased risk of AUR secondary to the PR of the sphincter (RR 1.36, 95% CI 0.63–2.95; P = 0.937; Fig. 12).

Three studies reported information on the detection of stenosis of the new bladder neck [3,4,15]. The meta-analysis of the RRs of these studies did not show a significant

Fig. 2 Forest plot of RR for urinary continence at 3-7 days after surgery, stratified by type of study: RCT, observational prospective and retrospective.

Study	Experi Events	mental Total	Cc Events	ntrol Total	Risk Ratio	RR	95%-CI	W(random)
otady	Evento	rotur	2.0110	rotur		140	2070 01	(141140111)
Type = RCT					-			
Menon – J Urol 2008	32	2 59	29	57		1.07	[0.75; 1.51]	13.7%
Random effects model		59		57	<b>†</b>	1.07	[0.75; 1.51]	13.7%
Heterogeneity: not appli	cable for a	ı single	study					
Type = Prospective								
Bocco B - Eur Urol 200	7 23	31	8	31		2.88	[1 53: 5 41]	11.3%
Coelho – Eur Urol 2011	136	5 473	75	330		1 27	[0.99:1.62]	14.4%
Random effects model	150	504	75	361		1.27	[0.99, 1.02]	25.6%
Heterogeneity: I_sauare	1=82.3%	tau_sa	uared=0	2774	=0.0175	1.01	[0.01, 1.01]	25.070
nere egenerij i requine	. 021070,							
Type = Retrospective								
Rocco F – Eur Urol 200	7 156	5 250	7	50		4.46	[2.23; 8.92]	10.7%
Tewari – BJUI 2008	70	182	29	214		2.84	[1.93; 4.17]	13.4%
Nguyen – BJUI 2008	11	32	1	30		- 10.31	[1.42; 75.11]	3.5%
Kim – Yonsei Med J 201	.0 6	5 25	9	25		0.67	[0.28; 1.59]	9.2%
Atug – J Endourol 2012	89	125	28	120		3.05	[2.17; 4.30]	13.7%
Anceschi – JSLS 2013	10	) 52	12	54		0.87	[0.41; 1.83]	10.2%
Random effects model		666		493	<b></b>	2.21	[1.27; 3.85]	60.7%
Heterogeneity: I–squared	l=78.4%,	tau–sq	uared=0	.3255, j	p=0.0003			
Pandam affacts model		1220		011		1.00	[1 25, 2 00]	100%
Kandoni enects model		1229		911	<b>T</b>	1.90	[1.23; 2.90]	100%
Heterogeneity: I-squared	=84.9%,	tau-sqı	ıared=0.	3055, p	<0.0001			
Test for overall effect: p=	0.0027							
Test for subgroup differe	nces: p=0	.0688						
					0.1 0.5 1 2 10			

Fig. 3 Forest plot of RR for urinary continence at 30 days after catheter removal, stratified by type of study: RCT, observational prospective and retrospective.

	Experin	nental	Со	ntrol	Risk Ratio			
Study	Events	Total	Events	Total		RR	95%-CI	W(random)
Type = RCT								
Menon – I Urol 2008	47	59	42	57	<b>1</b>	1.08	[0.88; 1.32]	9.2%
Hurtes - BIUI 2012	9	34	2	28	<b>T</b>	3.71	[0.87: 15.77]	1.8%
Random effects model		93		85	-	1.69	[0.46; 6.27]	11.0%
Heterogeneity: I-squared=7	1.3%, tai	ı–squa	ared=0.69	08, p=	=0.062			
Type = Prospective								
Rocco B – Eur Urol 2007	26	31	10	31	<del></del>	2.60	[1.53; 4.43]	6.2%
Coelho – Eur Urol 2011	244	473	141	330		1.21	[1.04; 1.41]	9.6%
Sano – Int J Urol 2012	11	25	0	23	<u> </u>	22.12	[1.30; 376.65]	0.5%
Daouacher–J Endourol 201	4 32	99	16	99		2.00	[1.18; 3.40]	6.2%
Random effects model		628		483	<b>•</b>	1.95	[1.09; 3.49]	22.6%
Heterogeneity: 1–squared=7	8.8%, tai	ı–squi	<i>ired=0.22</i>	65, p=	=0.0027			
Type = Retrospective								
Rocco F – Eur Urol 2007	185	250	15	50		2.47	[1.61: 3.79]	7.2%
Tewari – BIUI 2008	150	182	75	214		2.35	[1.94; 2.86]	9.3%
Nguyen – BIUI 2008	18	32	5	30		3 38	[1 43: 7 95]	3.9%
Kim – Yonsei Med I 2010	18	25	17	25	-	1.06	[0.74; 1.52]	7.8%
Simone-World J Urol 2012	124	155	86	125	-	1.16	[1.01; 1.34]	9.6%
Atug – J Endourol 2012	91	125	59	120	-	1.48	[1.20; 1.83]	9.2%
You – KJU 2012	16	28	11	31		1.61	[0.91; 2.86]	5.9%
Gondo – J Endourol 2012	121	160	7	39		4.21	[2.14; 8.29]	5.0%
Anceschi – JSLS 2013	36	52	20	54		1.87	[1.26; 2.77]	7.5%
Ito – Mol Clin Oncol 2013	4	19	1	13		2.74	[0.34; 21.79]	1.0%
Random effects model		1028		701	•	1.86	[1.39; 2.49]	66.4%
Heterogeneity: I–squared=8	6.2%, tai	ı–squa	<i>wed=0.15</i>	51, p<	<0.0001			
D 1 (7 1 1)							[4 49 9 90]	4000
Random effects model		1749	1	1269		1.77	[1.43; 2.20]	100%
Heterogeneity: 1-squared=8.	3.8%, tau	i-squa	red=0.119	₽6, p<	0.0001			
<i>1est for overall effect: p&lt;0.0</i>	001							
Test for subgroup differences	: p=0.97	66						
					0.01 0.1 1 10 100			

difference between rates of stenosis of the new bladder neck in the two groups (RR 0.67, 95% CI 0.20–2.31; P = 0.526; Fig. 13).

## **Publication Bias**

Funnel plots for urinary continence at the four time intervals are shown in Fig. 14. Although funnel plot asymmetry tests did not detect any significant asymmetry, visual inspection suggests that we cannot exclude the presence of a certain amount of bias.

Publication bias was also investigated for the rate of PSM. The funnel plot (not shown) evidenced a good symmetry, all study outcomes were within the 95% CIs, and the *P* value of the asymmetry test was P = 0.826.

Fig. 4 Forest plot of RR for urinary continence at 90 days after catheter removal, stratified by type of study: RCT, observational prospective and retrospective.

	Experin	nental	C	ontrol		Risk Ratio			
Study	Events	Total	Events	Total			RR	95%-CI	W(random)
Type = RCT									
Sutherland – I Urol 2011	29	47	33	47			0.88	[0.66:1.18]	6.6%
Hurtes – BIUI 2012	14	31	4	26			- 2.94	$[1 \ 10 \ 7 \ 83]$	2.4%
Random effects model		78	-	73			- 1.48	$[0.41 \cdot 5.32]$	9.1%
Heterogeneity: I-squared=84	2% tau-	-sauar	ed=0 72	72. $p=($	0119		1.10	[0.11, 0.02]	2.170
increase increase in the second		eq		-, r ·					
Type = Prospective									
Rocco B – Eur Urol 2007	29	31	24	31			1.21	[0.98; 1.49]	7.2%
Joshi – Eur Urol 2010	39	53	37	54		<b>#</b>	1.07	[0.84; 1.37]	7.0%
Coelho – Eur Urol 2011	459	473	318	330			1.01	[0.98; 1.03]	8.0%
Sano – Int J Urol 2012	15	25	8	23			1.73	[0.91; 3.29]	4.0%
Daouacher-J Endourol 2014	65	99	44	99			1.48	[1.14; 1.92]	6.9%
Random effects model		681		537		<b>*</b>	1.22	[0.93; 1.58]	33.1%
Heterogeneity: I-squared=88	.2%, tau-	-squar	ed=0.07	)5, p<(	0.0001				
Type = Retrospective									
Rocco F – Eur Urol 2007	213	250	23	50			1.85	[1.37; 2.51]	6.5%
Tewari – BJUI 2008	166	182	107	214			1.82	[1.58; 2.10]	7.6%
Kim – Yonsei Med J 2010	21	25	19	25		-	1.11	[0.84; 1.46]	6.7%
Brien – J Endourol 2011	20	31	29	58		-	1.29	[0.89; 1.86]	6.1%
You – KJU 2012	25	28	22	31		<b>-</b>	1.26	[0.97; 1.63]	6.9%
Simone - World J Urol 2012	145	155	103	125		+	1.14	[1.04; 1.24]	7.9%
Atug – J Endourol 2012	101	125	92	120			1.05	[0.92; 1.20]	7.7%
Anceschi – JSLS 2013	45	52	29	54		-	1.61	[1.23; 2.11]	6.8%
Ito – Mol Clin Oncol 2013	13	19	2	13		+	4.45	[1.20; 16.50]	1.6%
Random effects model		867		690		<b> </b>	1.38	[1.14; 1.68]	57.8%
Heterogeneity: I-squared=87	.2%, tau	-squar	ed=0.06	56, p<0	0.0001				
Random effects model		1626		1300		<b> </b>	1.32	[1.10; 1.59]	100%
Heterogeneity: I-squared=94	.6%, tau	-squar	ed=0.108	8, p<0.	0001				
Test for overall effect: p=0.002	27								
Test for subgroup differences:	p=0.730	5							
					0.1	0.5 1 2	10		

Fig. 5 Forest plot of RR for urinary continence at 180 days after catheter removal, stratified by type of study: RCT, observational prospective and retrospective.

	Experim	nental	Сс	ontrol		Risk Ratio			
Study	Events	Total	Events	Total			RR	95%-CI	W(random)
Type = RCT									
Hurtes – BJUI 2012	17	26	11	19		-	1.13	[0.70; 1.82]	3.6%
Random effects model		26		19			1.13	[0.70; 1.82]	3.6%
Heterogeneity: not applicable	for a sing	gle stu	dy						
True Due on entire									
Iype = Prospective	27	52	22	54			1.20	[0 90, 1 90]	4 504
Coallea Eur Ural 2011	450	472	210	220			1.20	[0.00; 1.00]	4.3%
Coeino – Eur Urol 2011	458	4/3	318	330		The second se	1.00	[0.98; 1.03]	11.9%
Sano – Int J Uroi 2012	18	25	12	25			1.58	[0.87; 2.19]	5.8%
Daouacher-J Endouroi 2014	80	99	66	99			1.21	[1.02; 1.44]	9.3%
Random effects model	10/ 1	650	.1 0 0 20	506	0011	<b>•</b>	1.15	[0.91; 1.45]	29.4%
Heterogeneity: 1–squarea=81	.4%, tau-	-squar	ea=0.038	3, p=0.0	0011				
Type = Retrospective									
Tewari – BIUI 2008	177	182	133	214			1 56	[1 41: 1 74]	10.7%
Kim – Yonsei Med I 2010	24	25	24	25			1.00	[0.89.1.12]	10.6%
Brien – I Endourol 2011	21	31	36	58			1.00	[0.80: 1.50]	5.9%
Atug – I Endourol 2012	106	125	97	120			1.05	$[0.94 \cdot 1.18]$	10.6%
Simone – World I Urol 2012	153	155	117	125			1.05	[1.00, 1.10]	11.7%
You - KILL 2012	26	28	27	31		<b>I</b>	1.05	[0.90:1.26]	9.2%
Anceschi $-$ ISLS 2013	35	52	38	54			0.96	[0.74, 1.20]	7.2%
Ito Mol Clin Oncol 2013	16	10	30	13		T	3.65	[0.74, 1.24]	1.0%
Ro – Mor Chil Officor 2015	10	617	5	640		L .	1 13	[0.07:1.33]	67.0%
Hataroganaity: I squared-90	6% tau	sauar	ad-0.030	M 5<0	0001	Ĩ	1.15	[0.97, 1.55]	07.070
11eterogenetty. 1-squarea-90	.0 <i>7</i> 0, ши-	зчиит	cu=0.039	4, p<0.	0001				
Random effects model		1293		1165		<b></b>	1.13	[1.02; 1.26]	100%
Heterogeneity: I-squared=90	.5%. tau-	-squar	ed=0.025	5, p<0.	0001				
Test for overall effect: p=0.02	52	*							
Test for subgroup differences:	p=0.993	5		E.		1 1 1	1		
	•			01		05 1 2	10		

Fig. 6 Forest plot of RR for urinary continence at 3-7 days after catheter removal, stratified by surgical approach: ORP, LRP, and RARP.

	Experin	nental	Co	ontrol	Risk Ratio		
Study	Events	Total	Events	Total	RR	95%-CI	W(random)
Technique = LPR							
Rocco B – Eur Urol 2007	23	31	8	31	2.88	[1.53; 5.41]	12.5%
Anceschi – JSLS 2013	10	52	12	54		[0.41; 1.83]	11.3%
Random effects model		83		85	1.60	[0.49; 5.21]	23.8%
Heterogeneity: I-squared=	82.8%, t	u–squ	ared=0	599, p=	0.016		
Technique = RARP					_		
Tewari – BJUI 2008	70	182	29	214	2.84	[1.93; 4.17]	15.2%
Menon – J Urol 2008	32	59	29	57	1.07	[0.75; 1.51]	15.5%
Nguyen – BJUI 2008	11	32	1	30	10.31	[1.42; 75.11]	3.6%
Kim - Yonsei Med J 2010	6	25	9	25	0.67	[0.28; 1.59]	10.0%
Coelho – Eur Urol 2011	136	473	75	330	1.27	[0.99; 1.62]	16.4%
Atug – J Endourol 2012	89	125	28	120	3.05	[2.17; 4.30]	15.6%
Random effects model		896		776	• 1.75	[1.06; 2.87]	76.2%
Heterogeneity: I-squared=	87.1%, t	u–squ	ared=0.	2859, p	<0.0001		
Random effects model		979		861	1 72	[1 12: 2 62]	100%
Heterogeneity: I_sauared=	84 2% t	nu-sau	ared=0	2717. n	<0.0001	[1112, 2102]	10070
Test for overall effect: b=0	0128	0444					
Test for subgroup difference	0120 est n=0.8	972					
icsi joi suogioup uijjerene	$c_{3}. p=0.0$	//2					
					0.1 0.5 1 2 10		

Fig. 7 Forest plot of RR for urinary continence at 30 days after catheter removal, stratified by surgical approach: ORP, LRP, and RARP.

	Experin	nental	С	ontrol	Risk Ra	tio			
Study	Events	Total	Events	Total			RR	95%-CI	W(random)
Technique = LPR									
Rocco B – Eur Urol 2007	26	31	10	31	4	-	2.60	[1.53; 4.43]	6.9%
Simone-World J Urol 2012	124	155	86	125	+		1.16	[1.01; 1.34]	11.1%
Sano – Int J Urol 2012	11	25	0	23			22.12	[1.30; 376.65]	0.6%
Anceschi – JSLS 2013	36	52	20	54	-		1.87	[1.26; 2.77]	8.4%
Ito - Mol Clin Oncol 2013	4	19	1	13			2.74	[0.34; 21.79]	1.0%
Daouacher-J Endourol 201	4 32	99	16	99	-	-	2.00	[1.18; 3.40]	6.9%
Random effects model		381		345			1.93	[1.20; 3.12]	34.8%
Heterogeneity: I–squared=7	9.5%, tau	-squar	ed=0.21	27. p=	0.0002				
Technique = RARP									
Tewari – BIUI 2008	150	182	75	214			2.35	[1.94; 2.86]	10.6%
Menon – I Urol 2008	47	59	42	57			1.08	[0.88; 1.32]	10.5%
Kim – Yonsei Med I 2010	18	25	17	25			1.06	[0.74; 1.52]	8.8%
Coelho – Eur Urol 2011	244	473	141	330			1.21	[1.04; 1.41]	11.0%
Atug – J Endourol 2012	91	125	59	120	-		1.48	[1.20; 1.83]	10.5%
Hurtes – BJUI 2012	9	34	2	28			3.71	[0.87; 15.77]	1.9%
You – KJU 2012	16	28	11	31		-	1.61	[0.91; 2.86]	6.4%
Gondo – J Endourol 2012	121	160	7	39		-	4.21	[2.14; 8.29]	5.5%
Random effects model		1086		844			1.60	[1.20; 2.12]	65.2%
Heterogeneity: I–squared=8	7.2%, tau	-squar	ed=0.12	26. p<	0.0001				
Random effects model		1467		1189			1.67	[1.34: 2.07]	100%
Heterogeneity: I-sauared=8	3.6%. tau	-sauar	ed=0.10	71. D<	0.0001			[ = = = , = = = , ]	
Test for overall effect: $p < 0.00$	001	1		1					
Test for subgroup differences	: p=0.499	1			т. т. Ц	1	т		
	-				0.01 0.1 1	10	100		

## Discussion

The PR of the rhabdosphincter was proposed nearly 15 years ago, first for ORP, then LRP, and finally RARP [2–4,6], and several studies to date have presented different outcomes and versions of the described technique. We know that >50% of robotic surgeons in Europe are now using this technique when performing RARP [28].

In 2012, Ficarra et al. [29] reported a significant advantage in terms of earlier continence when PR was performed in the robotic setting. In their study, Ficarra et al. [29] included only robotic studies focused on PR, also including other

technical nuances such as anterior suspension suture. Differently from the Ficarra et al. [29] study, we published a meta-analysis in 2012 [7] investigating the role of PR only, but including ORP, LRP and RARP series. We found a significant advantage associated with PR for postoperative urinary continence at 3–7 days (P = 0.030) and 30 days (P = 0.004) after the removal of the catheter. No significant differences in the levels of urinary continence between the two comparison groups were apparent at 90 and 180 days (P = 0.18 at 90 days, P = 0.66 at 180 days).

The results obtained in our present meta-analysis are in agreement and also indicate that PR seems to be associated

Fig. 8 Forest plot of RR for urinary continence at 90 days after catheter removal, stratified by surgical approach: ORP, LRP, and RARP.

	Experim	ental	Co	ntrol		Risk Ratio				
Study	Events	Total	Events	Total				RR	95%-CI	W(random)
Technique = LPR										
Rocco F – Eur Urol 2007	213	250	23	50		} <b>-</b>		1.85	[1.37; 2.51]	7.1%
Simone-World J Urol 2012	145	155	103	125		+		1.14	[1.04; 1.24]	8.4%
Sano – Int J Urol 2012	15	25	8	23				1.73	[0.91; 3.29]	4.4%
Anceschi – JSLS 2013	45	52	29	54				1.61	[1.23; 2.11]	7.3%
Ito - Mol Clin Oncol 2013	13	19	2	13				4.45	[1.20; 16.50]	1.8%
Daouacher-J Endourol 2014	65	99	44	99				1.48	[1.14; 1.92]	7.4%
Random effects model		600		364		-		1.58	[1.17; 2.13]	36.4%
<i>Heterogeneity: I–squared=84</i>	%, tau–so	quared	=0.0976,	p<0.000	01					
Technique = RARP										
Tewari – BJUI 2008	166	182	107	214				1.82	[1.58; 2.10]	8.2%
Kim – Yonsei Med J 2010	21	25	19	25		-		1.11	[0.84; 1.46]	7.3%
Joshi – Eur Urol 2010	39	53	37	54				1.07	[0.84; 1.37]	7.6%
Coelho – Eur Urol 2011	459	473	318	330				1.01	[0.98; 1.03]	8.5%
Sutherland – J Urol 2011	29	47	33	47				0.88	[0.66; 1.18]	7.2%
Brien – J Endourol 2011	20	31	29	58				1.29	[0.89; 1.86]	6.6%
You – KJU 2012	25	28	22	31				1.26	[0.97; 1.63]	7.4%
Atug – J Endourol 2012	101	125	92	120				1.05	[0.92; 1.20]	8.2%
Hurtes – BJUI 2012	14	31	4	26				2.94	[1.10; 7.83]	2.7%
Random effects model		995		905		<b>*</b>		1.21	[0.94; 1.55]	63.6%
Heterogeneity: I–squared=94	.9%, tau-	square	ed=0.118	7,p<0.0	0001					
Random effects model		1595		1269		-		1.33	[1.10; 1.62]	100%
Heterogeneity: I-squared=95	%, tau–so 37	quared	=0.1154,	p<0.000	01					
Test for subgroup differences:	p=0.1822	,			<i></i>	- 1 - T				
is joi subgroup unjerchees.	r -0.1022	-		0	) 1	0512	10			
				0		0.0 1 2	10			

Fig. 9 Forest plot of RR for urinary continence at 180 days after catheter removal, stratified by surgical approach: ORP, LRP, and RARP.

	Experimental		Control			Risk Ratio			
Study	Events	Total	Events	Total			RR	95%-CI	W(random)
Technique = LPR									
Sano – Înt J Urol 2012	18	25	12	23			1.38	[0.87; 2.19]	3.8%
Simone-World J Urol 2012	153	155	117	125			1.05	[1.00; 1.11]	11.7%
Anceschi – JSLS 2013	35	52	38	54		-	0.96	[0.74; 1.24]	7.2%
Ito - Mol Clin Oncol 2013	16	19	3	13				[1.33; 10.03]	1.0%
Daouacher-J Endourol 2014	4 80	99	66	99			1.21	[1.02; 1.44]	9.3%
Random effects model		350		314		<b></b>	1.16	[0.95; 1.43]	32.9%
Heterogeneity: I–squared=76	5%, tau–sq	uared	=0.0324,	p=0.0	022				
Technique = RARP									
Tewari – BJUI 2008	177	182	133	214		1 <b>**</b>	1.56	[1.41; 1.74]	10.7%
Joshi – Eur Urol 2010	27	53	23	54		- <u>+</u>	1.20	[0.80; 1.80]	4.5%
Kim – Yonsei Med J 2010	24	25	24	25			1.00	[0.89; 1.12]	10.6%
Brien – J Endourol 2011	21	31	36	58			1.09	[0.80; 1.50]	5.9%
Coelho – Eur Urol 2011	458	473	318	330			1.00	[0.98; 1.03]	11.9%
Atug – J Endourol 2012	106	125	97	120			1.05	[0.94; 1.18]	10.6%
Hurtes – BJUI 2012	17	26	11	19			1.13	[0.70; 1.82]	3.6%
You – KJU 2012	26	28	27	31		#	1.07	[0.90; 1.26]	9.2%
Random effects model		943		851		-	1.12	[0.94; 1.34]	67.1%
Heterogeneity: I-squared=93	8.5%, tau-	square	d=0.049	9, p<0.	0001				
<i>o</i> , <i>i</i> , <i>i</i> ,		<u> </u>		<u> </u>					
Random effects model		1293		1165		<b>é</b>	1.13	[1.02; 1.26]	100%
Heterogeneity: I-squared=90	).5%, tau–	square	d=0.025	5, p<0.	0001				
Test for overall effect: p=0.02	52								
Test for subgroup differences:	p=0.8069	)		Í					
	-			0.	1	0.5 1 2	10		

with a lower incidence of cystographic leakage, probably as PR allows a greater hold of the vesicourethral anastomosis through a better approximation of the structures involved in the anastomosis.

All the published studies showed no statistical significant increase in the risk of postoperative complications (such as stenosis of the new bladder neck or AUR) in patients treated with PR. For cancer outcomes, the application of the technique of PR does not appear to be associated with an increased risk of PSM at final pathological analysis.

For postoperative urinary continence, the present metaanalysis indicates an advantage of PR regardless of the surgical approach (ORP, LRP and RARP): a significant benefit at 3–7 and 30 days from surgery and, unlike the findings of the previous meta-analysis, even at 90 days after

Reference	No. of pa	tients	Overall PSN	l, n (%)	PSM in pT2 pati	ents, <i>n/N</i> (%)	PSM in pT3 patients, n/N (%)		
	No PR group	PR group	No PR group	PR group	No PR group	PR group	No PR group	PR group	
Rocco et al. [4] Rocco et al. [3] Rocco et al. [5]	50 50 31	161 250 31	8 (16.0) 8 (16.0) 7 (22.5) P = 1	30 (18.6) 43 (17.2) 7 (22.5)	(6.0) 3/21 (14.2) P = 0.34	(7.6) 1/19 (5.3)	(10)	-	
Tewari et al. [10] Coelho et al. [6]	214 330	182 473	8 (3.7) 36 (11.0) P = 0.912	9 (4.9) 54 (11.4)	18/262 (6.8) P = 0.832	28/393 (7.1)	18/63 (28.5) P = 0.672	-	
Atug et al. [18]	120	125	(8.3) P = 0.920	(8.0)					
Hurtes et al. [19]	33	39	4 (12.1) P = 0.460	8 (20.5)					
You et al. [23]	31	28	10 (32.2) P = 0.223	5 (17.8)					
Anceschi et al. [24]	54	52	(33) P = 0.490	(32)	(25) P = 0.714	(26)	(30) P = 0.629	(29)	
Ito et al. [25]	13	19	2 (15.3) P = 0.687	4 (21.0)					

Table 4 Percentage of PSM estimated in the studies included in the meta-analysis.

Fig. 10 Forest plot of RR for rate of PSM, stratified by type of study: RCT, observational prospective and retrospective.

	Experim	ental	Co	ontrol	Risk Ratio			
Study	Events	Total	Events	Total		RR	95%-CI	W(fixed)
Type = Prospective								
Rocco B – Eur Urol 2007	7	31	7	31		1.00	[0.40; 2.51]	6.1%
Coelho – Eur Urol 2011	54	473	36	330		1.05	[0.70; 1.56]	37.1%
Hurtes - BJUI 2012	8	39	4	33		1.69	[0.56; 5.12]	3.8%
Fixed effect model		543		394	-	1.09	[0.77; 1.54]	47.1%
Heterogeneity: I-squared=0	0%, tau−sq	uared=	=0, p=0.7	116				
Type = Retrospective								
Rocco F – Eur Urol 2007	43	250	8	50		1.07	[0.54; 2.15]	11.7%
Tewari – BJUI 2008	9	182	8	214		1.32	[0.52; 3.36]	6.4%
Atug – J Endourol 2012	10	125	10	120		0.96	[0.41; 2.22]	8.9%
You – KJU 2012	5	28	10	31		0.55	[0.22; 1.42]	8.3%
Anceschi – JSLS 2013	17	52	18	54		0.98	[0.57; 1.69]	15.5%
Ito - Mol Clin Oncol 2013	4	19	2	13		1.37	[0.29; 6.41]	2.1%
Fixed effect model		656		482	-	0.99	[0.71; 1.36]	52.9%
Heterogeneity: I–squared=0	0%, tau−sq	uared=	=0, p=0.8	413				
Fixed effect model		1199		873		1.04	[0.82; 1.31]	100%
Heterogeneity: I-squared=0	)%, tau−sq	uared=	=0, p=0.9	388				
Test for overall effect: p=0.8	3044		•		l l			
Test for subgroup difference	rs (random	effects	): p=0.66	36				
					02 05 1 2 5			

catheter removal. In addition, a smaller but still statistically significant advantage in terms of urinary continence was associated with PR at 180 days after catheter removal.

Performing a meta-analysis stratified by surgical approaches, a significant benefit was found for urinary continence at 30, 90 and 180 days when the PR is applied in the course of a LRP; a significant advantage at 3–7, 30 and 90 days when applied in the course of RARP was also found, but at 180 days this advantage was not statistically significant.

There are some limitations of the present study. Firstly, we did not include data from congress abstract proceedings because generally this type of publication does not report a complete set of data, which is required for a meta-analysis. This choice might be considered a limitation of the study. In

the present meta-analysis, there are clues (in some cases quite obvious) of an asymmetry of the funnel plots; therefore the presence of publication bias cannot be excluded. The heterogeneity is quite high and this may have implications for the ability to extend the results to other populations. As already discussed in the previous meta-analysis [7], one of the main limitations is that the different authors who published their experience with this technique found different or even contrasting results for post-RP urinary continence, the main outcome examined. To explain the rate of heterogeneity found among these studies, some factors, which had already been mentioned in the previous study, will be briefly listed here. First, it must be recognised that several different definitions of continence have been given in the literature for post-RP outcomes and several ways of assessing continence Fig. 11 Forest plot of RR for risk of peri-anastomotic urinary leakage at postoperative cystogram, stratified by type of study: RCT, observational prospective and retrospective.

	Experimental		Control		Risk Ratio				
Study	Events	Total	Events	Total		RR	95%-CI	W(fixed)	
Type = RCT									
Menon – J Urol 2008	2	59	6	57		0.32	[0.07; 1.53]	16.3%	
Fixed effect model		59		57		0.32	[0.07; 1.53]	16.3%	
Heterogeneity: not application	ble for a sir	ıgle stu	dy						
Type = Prospective									
Joshi – Eur Urol 2010	6	53	8	54		0.76	[0.28; 2.05]	21.2%	
Coelho – Eur Urol 2011	2	473	7	330		0.20	[0.04; 0.95]	22.0%	
Fixed effect model		526		384	-	0.48	[0.21; 1.06]	43.2%	
Heterogeneity: I– squared=	=51.7%,tau	ı–squar	ed=0.476	67,p=0.	1503				
Type = Retrospective									
You – KJU 2012	0	28	2	31		0.21	[0.01; 4.43]	6.4%	
Anceschi – JSLS 2013	6	52	13	54		0.48	[0.20; 1.17]	34.1%	
Fixed effect model		80		85	-	0.44	[0.19; 1.02]	40.5%	
Heterogeneity: I- squared=	=0%,tau–sa	quared=	=0, p=0.6	6047					
Fixed effect model		665		526		0.43	[0.25; 0.75]	100%	
<i>Heterogeneity: I– squared=</i> <i>Test for overall effect: p=0.</i>	Theterogeneity: I - squared=0%, tau-squared=0, p=0.6241 Test for overall effect: p=0.0063								
Test for subgroup differenc	es (randon	i effects	): p=0.93	03					
			-	0.0	01 0.1 1 10	100			

Fig. 12 Forest plot of RR for risk of AUR secondary to the PR of the sphincter, stratified by type of study: RCT, observational prospective and retrospective.

	Experimental		Control			Risk Ratio						
Study	Events	Total	Events	Total						RR	95%-CI	W(fixed)
Type = Prospective												
Joshi – Eur Urol 2010	0	53	1	54	_		•  :			0.34	[0.01; 8.13]	13.4%
Coelho – Eur Urol 2011	3	473	3	330		-				0.70	[0.14; 3.44]	31.8%
Fixed effect model		526		384		-	-			0.59	[0.14; 2.42]	45.2%
Heterogeneity: I-squared=	0%, tau-	squared	<i>1=0, p=0</i>	.6864								
Type = Retrospective												
Rocco F – Eur Urol 2007	8	250	1	50			-			1.60	[0.20; 12.51]	15.0%
Kim – Yonsei Med J 2010	7	25	0	25			÷			15.00	[0.90; 249.05]	4.5%
Anceschi – JSLS 2013	2	52	4	54		_				0.52	[0.10; 2.71]	35.3%
Fixed effect model		327		129			-	-		2.00	[0.76; 5.30]	54.8%
Heterogeneity: I-squared=	56.3%, ta	u–squa	ared=1.5	03, p=0	0.1014							
							1					
Fixed effect model		853		513			+			1.36	[0.63; 2.95]	100%
Heterogeneity: I-squared=28%, tau-squared			ed=0.441	3, p=0	.2349							
Test for overall effect: $p=0$ .	9365											
Test for subgroup difference	es (rando	n effec	ts): p=0.3	3634		1		1				
					0.01	0.1	1	10	100			

Fig. 13 Forest plot of RR for risk of stenosis of the new bladder neck secondary to the PR of the sphincter.



have been used. In addition, due to the fact that continence is self-reported by the patient, this outcome can be affected by a certain degree of subjectivity. Second, only a subset of the studies considered in the meta-analysis used the PR technique as originally described in 2006; several variations have been developed by different authors. Third, differences in terms of surgical approach (ORP, LRP and RARP) may have a significant role in justifying different results for post-RP urinary continence. In particular, Joshi et al. [15] argued that, using a robotic approach, the better preservation of the structures involved in the continence recovery process might reduce the apparent benefit of the PR; this hypothesis seems



Fig. 14 Funnel plots for urinary continence at 3–7, 30, 90 (3 months) and 180 days (6 months) after catheter removal with P values of the test for funnel plot asymmetry.

 Table 5 Design of the prospective multicentre randomised controlled study 'NCT01809522'.

Title	Does the posterior reconstruction of the rhabdosphincter improve early recovery of continence after robotic-assisted radical prostatectomy? (PRR) A multicenter randomized controlled trial
Study design	A Phase III open-label prospective international multicentre randomised controlled study
Target	Patients with clinically localised prostate cancer undergoing
population	definitive treatment with RARP. Total number: 1 500
	patients; Competitive enrolment, with minimum of 125 and
	maximum of 250 patients per centre
Objectives	
Primary	Evaluation of efficacy of PRR (vs no PRR) on early
	recovery of continence in prostate
Secondary	Evaluation of perioperative parameters of RALP with and without PRE
	Comparison of other functional outcomes
	Evaluation of the quality of life
	1 /

to be supported by the results of our present study, where a reduced advantage of PR in the robotic setting compared with laparoscopy was evidenced. Lastly, some methodological aspects of the studies can affect their ability to detect significant differences; study design and sample size being two of the most relevant. To better assess the effectiveness of the PR in facilitating an earlier recovery of postoperative urinary continence, an international prospective multicentre randomised controlled study is ongoing (ClinicalTrials.gov Identifier: NCT01809522; Table 5).

## Conclusions

The PR of the sphincter is used by many surgeons in several centres around the world to improve one of the main adverse effects of RP, i.e. urinary incontinence. The PR technique is easily reproducible, quickly executed, and it does not appear to be associated with an increased risk of perioperative complications, but it appears to be associated with a reduction of peri-anastomotic urinary leakages.

Our present analysis confirms the benefits already discussed in the review published in 2012 [7], evidencing a significant advantage for urinary continence recovery in the first 90 days after RARP and also subsequently (at 180 days) after LRP. An advantage in terms of lower leakages at cystography is also reported. No significant increase in PSM or complications is reported while using the PR. However, further high-quality, unbiased studies are required to allow firm conclusions to be drawn. To better assess the effectiveness of the PR in facilitating an earlier recovery of postoperative urinary continence, a multicentre randomised controlled trial is ongoing.

## **Conflicts of Interest**

The authors declare no conflicts of interest, including specific financial interests or relationships or affiliations relevant to the subject matter or materials discussed in the manuscript.

The nature of the study and the dissemination worldwide of the surgical technique investigated make the study free from any ideological conflict of interest, although the creators of the surgical technique in question are in the list of the Authors of the current study.

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Abbreviations: AUR, acute urinary retention; PR, posterior reconstruction; PSM, positive surgical margins; RCT, randomised controlled trial; (L)(O)(RA)RP, (laparoscopic) (open) (robot-assisted) radical prostatectomy; RR, risk ratio.