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REVIEW

Catheter strategy and functional recovery after robotic prostatectomy: a systematic review of suprapubic versus urethral drainage

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Abstract

To evaluate whether catheter strategy (suprapubic versus urethral) influences functional and peri-operative recovery outcomes following Robotic Assisted Laparoscopic Prostatectomy (RALP). A PRISMA-2020 compliant systematic review was conducted. PubMed, Embase, Scopus, Web of Science, and Cochrane Library were searched to December 2025 using predefined MeSH terms. All comparative studies of SPC vs. UC following RALP were included irrespective of design. Primary outcomes were early (≤6 weeks) and late post-operative incontinence (≥3 months). Secondary outcomes were early post-operative pain (≤3 days) and late pain (>3 days), unscheduled emergency department (ED) visits and urinary tract infections (UTIs). Risk of bias was assessed using ROB-2 for RCTs and ROBINS-I V2 for non-randomised studies. Thirteen studies met the inclusion criteria. Early incontinence favoured SPC, showing pooled risk ratio of 0.70 (95% CI 0.53–0.92, $p=0.02$, $I^2=36\%$), however this was sensitive to inclusion of Retzius-sparing data. Late incontinence was similar between groups [pooled RR 0.74 (95% CI 0.42–1.30, $p=0.19$)]. Early and late pain outcomes were modestly lower with SPC but did not reach statistical significance. ED visits and UTIs were comparable. Urethral strictures and bladder-neck contractures were rare with no group difference. The certainty of evidence was "very low" for early incontinence and "low" for late incontinence. Available evidence suggests that SPC may be associated with modest reduction in early post-operative incontinence following RALP. However, this effect is sensitive to surgical technique and does not sustain beyond the immediate post-operative period. Catheter route alone is unlikely to independently influence functional recovery in RALP and routine use of SPC over UC cannot be recommended.

Keywords Robotic prostatectomy · Suprapubic catheter · Transurethral catheter · Continence

Introduction

Robotic assisted laparoscopic prostatectomy (RALP) is considered a standard treatment for localised prostate cancer (PC) owing to improved perioperative outcomes [1, 2]. Whilst improved techniques have hastened patient recovery and reduced post-operative pain, "transurethral catheterisation" remains the standard of care which continues to cause discomfort to the patients [3]. A urethral catheter (UC) is used for draining the bladder as well as to protect the urethrovesical anastomosis and promote healing, however it often results in pain/ discomfort, bladder spasms etc. In addition, UCs can be a source of catheter associated urinary tract infections (CAUTIs), possible delayed return to continence and increased urethral stricture formation [4, 5].

Suprapubic catheterisation (SPC) is considered the standard of care in many other urological and non-urological procedures to minimise post-operative discomfort [6].

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Initially, Tewari et al adopted a "catheter-less" approach to RALP with use of a custom made SPC [7]. Since then, several studies have compared the effects of SPC vs. UC with varying results. Despite a few studies showing potential benefits of SPC in terms of reduced bladder spasms and improved overall satisfaction, it has failed to be the standard of care owing to concerns regarding its overall risk versus benefit ratio in terms of possible technical challenges and urine leakage etc [8].

In contemporary times, with refinement of techniques in RALP, the focus has shifted towards earlier functional recovery. Early recovery of urinary incontinence is considered as a key benchmark in surgical performance, particularly in the context of metrics such as "pentafacta". Within this framework, post-operative catheter strategy remains a potential modifiable factor in robotic prostatectomy to improve quality of life outcomes for patients [9].

There have been a few systematic reviews comparing the use of SPC vs. UC post RALP in the last decade. However, since then multiple studies have been published which have reported the use of SPC in Pelvic fascia/ Retzius sparing prostatectomy in addition to conventional RALP. Consequently, the focus has shifted from pain to functional recovery outcomes. We aim to synthesise comparative evidence on SPC vs. UC after RALP, focussing on continence outcomes, post-operative pain/ discomfort as defined by studies, urinary tract infections (UTIs) and unscheduled emergency department (ED) visits due to catheter related issues.

Methodology

1. *Evidence acquisition*

The study protocol was registered on PROSPERO (CRD420251136211) prior to undertaking systematic research of the literature using electronic databases viz., MEDLINE/ PubMed, Embase, Web of Science, SCOPUS, ClinicalTrials.gov and WHO ICTRP and COCHRANE Library databases till 12th December 2025. Additionally, studies of potential interest cited in other reference list of papers were hand searched.

The following MeSH terms were used for the queries: (prostatectomy) (radical prostatectomy) (robotic prostatectomy) (laparoscopic prostatectomy) (suprapubic catheter) (suprapubic tube) (SPC) (indwelling catheter) (transurethral catheter) (urethral catheter). No limits were applied.

All results have been reported in accordance with Preferred Reporting Items for Systematic reviews and Meta-analysis (PRISMA) guidelines.

2. *Study selection*

We adopted a population, intervention, comparator, outcome, study design (PICOS) model to define study eligibility. Two authors (DSS and JS) independently performed the initial screening of all manuscripts. All conflicts were resolved with consensus or by consultation with third author (CFS). We adopted following criteria for study inclusion:

Population (P) Patients undergoing RALP.

Intervention (I) Suprapubic catheter insertion (with or without concomitant Urethral catheterization, which was removed post-operatively).

Comparator (C) Transurethral catheterization.

Outcomes (O): Studies reporting one or more outcomes of following: incontinence (early and/or late), post-operative pain or discomfort (study specific description), UTIs and unplanned emergency department (ED) visits post-operatively.

Study designs (S) We include both Randomized control trials (RCTs) and non-randomized studies (NRS).

We excluded studies which reported outcomes for open prostatectomy and non-comparative surgical series, conference abstracts, case reports, editorials, letter to editors and systematic and non-systematic reviews.

3. *Data extraction*

Data was extracted into an electronic excel sheet by two authors (DSS and JS) independently. Study characteristics including author, year, country, patient demographics, primary and secondary outcomes were collected. Post-operative outcomes including pain/ discomfort (using validated scoring tools), incontinence, UTIs, strictures, unscheduled emergency department visits were extracted.

4. *Statistical analysis*

We specified two temporal windows for continence rates and post-operative pain outcomes:

- Incontinence (defined as use of > 1 pads/day): Early (≤6 weeks) vs. Late (≥3 months).
- Post-operative catheter-related/ discomfort: Early (≤3 days) vs. late (> 3 days).

Post-operative pain outcomes were variably defined across included studies and encompassed catheter-related discomfort, penile pain, suprapubic discomfort, or composite pain scores. For the purposes of this review, these outcomes were grouped as catheter-related pain or discomfort as defined by individual studies, recognising heterogeneity.

Meta-analysis was performed using web Cochrane Review Manager (RevMan Web 2025, Version 9.14.0). For continuous outcomes, we calculated the Mean differences (MDs) with 95% confidence intervals (CIs). We used the methods described by Wan et al. to estimate mean and standard deviations, when only medians and interquartile (IQR) ranges were reported [10]. For dichotomous outcomes, we calculated Risk ratios (RRs) with 95% CIs.

To account for clinical and methodological heterogeneity, all analyses were conducted using a random-effects model. The Hartung-Knapp-Sidik-Jonkman (HKSJ) adjustment was applied to provide more conservative variance estimates. Statistical heterogeneity was quantified using the I^2 statistic (25%, 50%, and 75% denoting low, moderate, and high heterogeneity) and τ^2 (between-study variance).

Subgroup analyses were predefined by study design (RCT vs. NRS), conventional vs. Retzius-sparing RALP, posterior reconstruction vs. no reconstruction. Additionally, we also conducted sensitivity analysis to evaluate the robustness of results and leave-one-out analyses to assess the influence of individual studies on overall meta-analyses.

5. ***Risk of bias***

We evaluated the risk of bias using the Cochrane collaboration risk-of-bias assessment tool (Rob-2) for RCTs and ROBINS-I V2 tool for NRS [11–13]. The certainty of evidence was assessed using the GRADEPro software [14].

Results

Study selection and characteristics

The study selection process has been summarized in PRISMA flowchart (Fig. 1). A total of 1581 studies were identified through searching electronic databases. Of these, 31 full-text articles were assessed for eligibility, and 13 studies met our eligibility criteria. This included 4 RCTs, 7 prospective NRS and 2 retrospective NRS. The included studies were published between 2008 and 2025. A total of 1993 RALP cases were used for cumulative analyses of which 936 patients received standard UC and 1057 had SPC placement after RALP.

The baseline characteristics of included studies have been reported in Table 1. Studies varied in their protocol regarding management of catheters, surgical technique and measurement of pain/ discomfort which has been detailed in Table 2.

A. Primary outcomes

Early incontinence (< 6 weeks) [Fig. 2a][Supplementary Fig. 1a]

Six studies reported outcomes for early incontinence (use of >1 pad per day was defined as being incontinent). We defined 6-weeks as the cut-off for this outcome and chose the data from last reported timepoint from a study if multiple endpoints were provided. Krane et al. reported outcomes at 48 h post-operatively, whereas all other studies reported outcomes at 4 or 6 weeks [15]. For multi-arm studies with more than one strategy for SPC (removal on different days), we combined the arms by summing events and totals to enable a single arm against UC and avoid double counting [16].

The pooled analysis suggests that SPC may be associated with lower incontinence rates [RR 0.70 (95% CI 0.53–0.92, $p=0.02$, $I^2=36\%$)]. However, moderate heterogeneity and the 95% prediction interval crossing unity (0.41–1.17) indicates uncertainty in the magnitude and consistency of effect across settings. The included studies were heterogenous with respect to surgical technique and nerve-sparing practices. Most cohorts comprised of mixed nerve-sparing and non-nerve sparing data, no adjustment for this was possible at the study level.

We performed sensitivity analysis excluding the study adopting Retzius-sparing approach [32], the pooled estimate touched unity [RR 0.72 (95% CI 0.52-1.00, $p=0.05$, $I^2=40\%$)], indicating the overall effect is sensitive to inclusion of Retzius-sparing data. Exploratory subgroup analysis by posterior reconstruction showed no evidence of effect modification.

Late incontinence (≥ 3 months) [Fig. 2b][Supplementary Fig. 1b]

Four studies reported incontinence rates at 3 months (use of >1 pads defined as incontinence). Galfano et al. reported Retzius-sparing approach whereas others adopted conventional RALP approach. The pooled estimate showed that SPC is not associated with better incontinence recovery at 3 months [RR 0.74 (95% CI 0.42–1.30, $p=0.19$, $I^2=0\%$)]. On sensitivity analysis by excluding Galfano et al., results remained similar, but confidence interval widened [17].

Martinschek et al. reported that similar number of patients were incontinent (>2 pads) after 12 months [SPC 15.3% vs. UC 13.7%] [18].

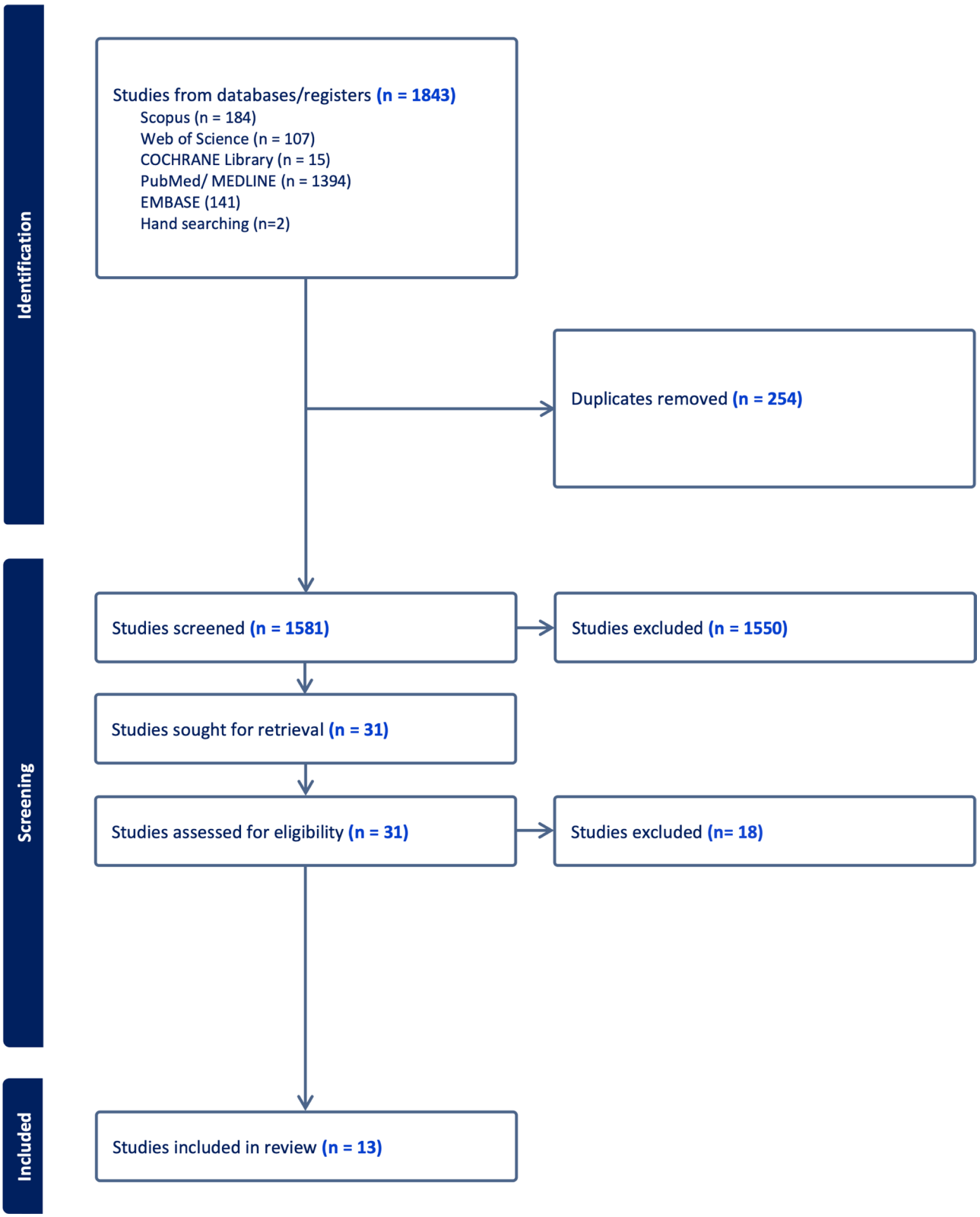


Fig. 1 PRISMA flowchart for study selection process

Table 1 Characteristics of included studies

Study, year (Country)	Group	Sample size	Age (median/mean)	BMI (kg/m^2)	Initial PSA (ng/mL)	Gleason score (≤6/7/≥8)	Pathological stage (T1/T2/T3/T4)	Prostate size (g or mL)
Tewari [7] (USA)	SPC	10	60.8 (52.8-67.3)	26.1 (22.9-33.2)	4.2 (2.0-6.8)	8/2/0	0/9/1/0	35 (20-50)
	UC	20	60.0 (55.8-66.3)	27.3 (23.1-34.2)	5.5 (3.2-12.1)	14/6/0	0/10/0/0	32 (20-60)
Krane [14] (USA)	SPC	202	60 (46-75)	27 (19-38)	5.0 (0.8-22.4)	62/118/22	0/122/80/0	48.1 (17.4)
	UC	50	58 (41-76)	28 (19-41)	5.35 (0.5-19)	13/27/10	0/28/22/0	49.9 (16.6)
Prasad 2014 [29] (USA)	SPC	29	60 (6.4)	28.8 (3.3)	5.3 (3.1)	21/8[1]	0/24/5/0	47.1 (24.1)
	UC	29	57.7 (8.6)	29.0 (4.0)	6.3 (3.2)	12/17[1]	0/20/9	44.8 (16.5)
Yang 2015 [30] (China)	SPC	10	64.6 (49-74)	25.2 (22.1-29.4)	18.4 (7.2-51.8)	NS	NS	NS
	UC	10	68.5 (61-74)	23.8 (19.3-27.9)	16.7 (5.1-60)	NS	NS	NS
Afzal 2015 [31] (USA)	SPC	51	61.9 (6.9)	29.7 (5.0)	6.4 (3.5)	15/28/9	38/11/2/0	48.1 (12.9)
	UC	174	63.7 (7.0)	29.6 (4.0)	6.1 (4.3)	71/88/14	118/48/8/0	48.9 (16.8)
Martinschek [17] (Germany)	SPC	27	64.97	NS	7.51	NS	NS	53.3
	UC	35	62.99	NS	6.0	NS	NS	49.9
Morgan [19] (USA)	SPC	64	62 (56-67)	27 (25-31)	5.4 (4.5-7.3)	10/47/6	0/48/15/0	44 (34-54)
	UC	95	64 (57-69)	28 (26-31)	5.7 (4.5-8.6)	6/69/17	0/53/40/0	50 (37-60)
Harke [18] (Germany)	SPC	59	62.3 (45-74)	25.6 (16.3-36)	7.6 (1.8-51.2)	25/25/9	0/33/26/0	41.5 (21-114)
	UC	78	63.1 (45-76)	26.2 (20.9-38)	7.2 (1.2-49.7)	27/39/12	0/43/34/1	39 (20-134)
Galfano [16] (Italy)	SPC	135	65 (60-69)	NS	7.1 (5.2-10.6)	NS	NS	44 (35-55)
	UC	56	68 (59-72)	NS	7.5 (5-12)	NS	NS	50 (37-60)
Harke [15] (Germany)	SPC5	66	66 (49-79)	26 (20-34)	6.9 (0.9-30.2)	25/61/14	0/39/23/1	35 (17-103)
	SPC2	66	65 (46-77)	26 (21-35)	6.9 (3.2-26.0)	21/71/8	0/40/6/0	43 (16-132)
	UC	66	65 (50-77)	26 (21-34)	6.4 (3.5-4.3)	30/58/12	0/44/8/1	44 (17-95)
Xu 2021 [32] (Germany)	SPC	111	66.20 (7.62)	NS	9.4 (6.4-16.7)	11/75/25	66/37/8[3]	42 (34-56)
	UC	112	66.18 (7.45)	NS	9.3 (6.4-14.1)	9/71/32	59/37/7[3]	40 (30-50)
Engelsgjerd [8] (USA)	SPC	108	64 (6.5)	28.62 (4.6)	7	NS[2]	NS	NS
	UC	104	62 (6.6)	28.25 (4.3)	6.8	NS[2]	NS	NS
Ralston [20] (UK)	SPC	102	63 (6.3)	28	NS	NS	NS	NS
	UC	102	64 (6.8)	29	NS	NS	NS	NS

SPC: suprapubic catheter, UC: Urethral catheter, SPC2: Suprapubic catheter removed on day 2, SPC5: Suprapubic catheter removed on day 5, NS: Not specified, PSA: Prostate specific antigen, BMI: Body mass index

[1]The study divided Gleason score into "6" and "≥7"

[2]The study specified Gleason grade group only (median was 2 for both cohorts)

[3]The study divided into ≤T1c/T2a-T2b/T2c/T3a-T4

B. Secondary outcomes

Early post-operative pain/discomfort (≤ 3 days) [Fig. 3a]

Four studies reported early post-operative pain/ discomfort using VAS scores. The pooled results showed no difference in pain outcomes between SPC and UC [MD -0.64 (95% CI -2.27 to 0.99, $p=0.30$, $I^2=94\%$)].

Harke et al. used NRS questionnaire to quantify pain and reported higher median pain in the patients with UC than SPC (2.4 vs. 1.3, $p=0.012$). Similarly, Morgan et reported lower penile pain scores in SPC group as compared to UC group for minimal-moderate pain (56.9% vs. 79.8%, $p=0.003$). More recently, Ralston et al. reported higher comfort levels in patients with SPC than UC [16, 19–21].

Late post-operative pain/discomfort (> 3 days) [Fig. 3b]

Five studies reported late post-operative pain/ discomfort using VAS scores. For late pain (4–7 days), the value closest to 7 days was selected per study. When only daily data was provided, day 6 scores were chosen as the anchor to maintain comparability across studies reporting 7-day outcomes. Similar results were obtained by excluding Galfano et al. (Retzius-sparing) but the confidence intervals widened. The pooled ratio showed no difference in late post-operative pain/ discomfort scores between SPC and UC [MD -0.86 (95% CI -2.07 to 0.35, $p=0.12$, $I^2=90\%$)]. Harke et reported no significant difference in pain scores on post-operative day 6 using NRS questionnaires [19].

Table 2 Surgical protocol adopted by included studies

Study	Intervention	Comparator	Pain measurement	Posterior reconstruction	Catheter removed (day) SPC/UC	NS% (SPC/ UC)	LND% (SPC/UC)	Follow-up (months) SPC/UC
Tewari [7]	Customised SPC	18Fr UC	Customised protocol	Yes	7	100/200	NA	6
Krane [14]	14Fr SPC + UC removed POD1	UC + SPC removed POD 1	FPS-R	Yes	7	NA	NA	12
Prasad [29]	14Fr SPC + 20Fr UC removed POD1	20Fr UC	VAS, FPS-R	No	7	100/100[1]	86/79	12
Yang [30]	10Fr PCD + 18Fr UC removed POD3	18Fr UC	VAS	Yes	7	NA	NA	6
Afzal [31]	14Fr/16Fr SPC + 12Fr UC removed POD1	12Fr UC	VAS	No	7.3 ± 2.5/ 8 ± 3.8	NA	NA	23.7
Martin-schek [17]	12Fr SPC	18Fr UC	VAS	No	6	NA	NA	12
Morgan [19]	16Fr SPC + 16Fr UC removed POD1	16Fr UC	No/minimal/severe	No	7-10	97/88	71/98	3.6/13.7
Harke [18]	SPC + UC removed POD1	UC	NRS	Yes	5	NA	100/100	24
Galfano [16]	14Fr SPC	18Fr UC	VAS-NAS	Yes	7/7	100/100	NA	12
Harke [15]	14Fr SPC + UC removed POD1	UC	NRS	Yes	POD 2 or 5/ 5	100/100/100	49[2]/54	12
Xu [32]	14Fr SPC + 22Fr UC removed POD1/2	22Fr UC	NA	Yes	4-6	100/100	97	1
Engels-gjerd [8]	14Fr SPC	UC	NA	No	7/7	100/100	NA	14/44
Ralston [20]	SPC	UC	VAS	NS	7	NS	NS	NS

SPC: Suprapubic catheter, UC: Urethral catheter, PCD: percutaneous drainage device, VAS: Visual analogue scale, FPS-R: Face pain scale-revised, NRS: Numerical pain rating scale, POD: Post-operative day, NA: not applicable, NS: not specified, NS: nerve sparing, LND: lymph node dissection

[1]Interfascial (SPC 20/UC 17), Extrafascial (SPC 5/UC 5), Wide (SPC 4/UC 7)

[2]SPC (POD5)- 54.5%, SPC (POD2)- 57%

C. Safety outcomes

Urinary tract infections (UTIs) [Fig. 4a]

UTIs were rare with overall combined incidence being 1.87% (18 events in 927 patients). There was no difference between incidence amongst patients with SPC and UC [RR 0.75 (95% CI 0.20–2.89, $p=0.59$, $I^2=8\%$)].

Unscheduled emergency department (ED) visits [Fig. 4b]

Post-operative catheter related ED visits were infrequent with no difference between two groups [RR 1.44 (95% CI 0.37–5.60, $p=0.46$, $I^2=0\%$)]. Most were related to dislodgement of SPC or blockage/malfunction.

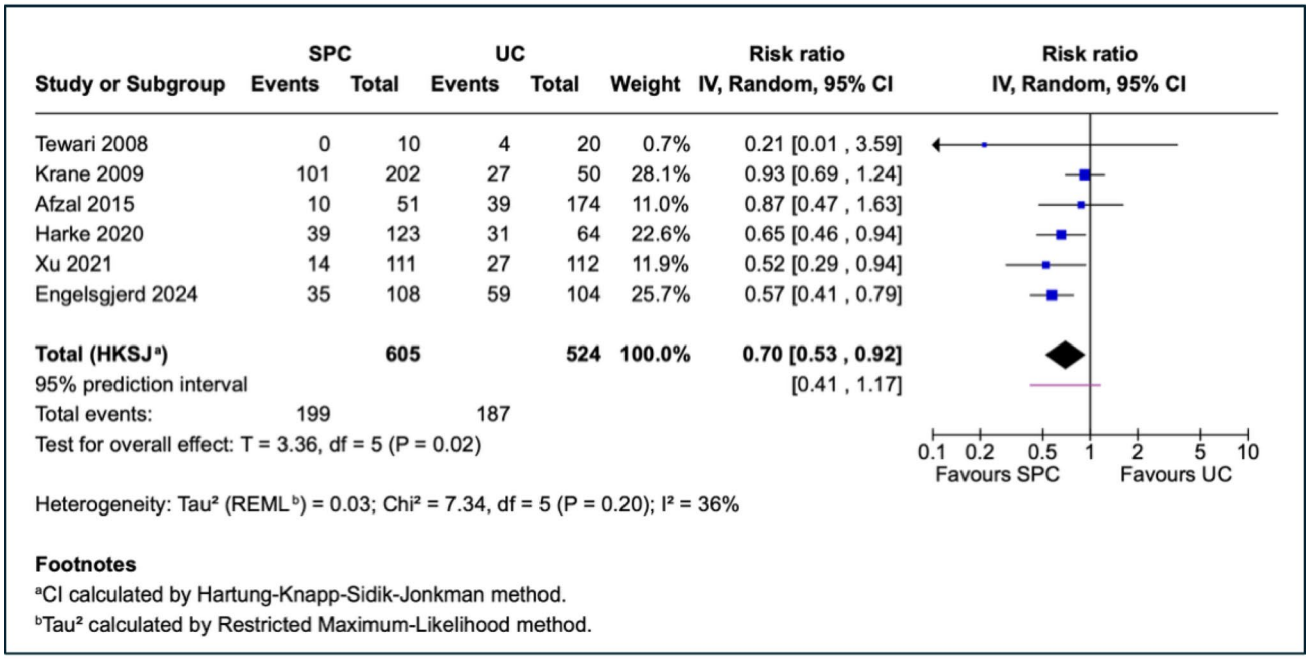
Urethral strictures and bladder neck contractures (BNC)

Urethral strictures and BNCs were rare in either group precluding pooling for a meaningful comparison.

Catheter related complications

Catheter related complications were uncommon and predominantly minor. Reported events included catheter

A



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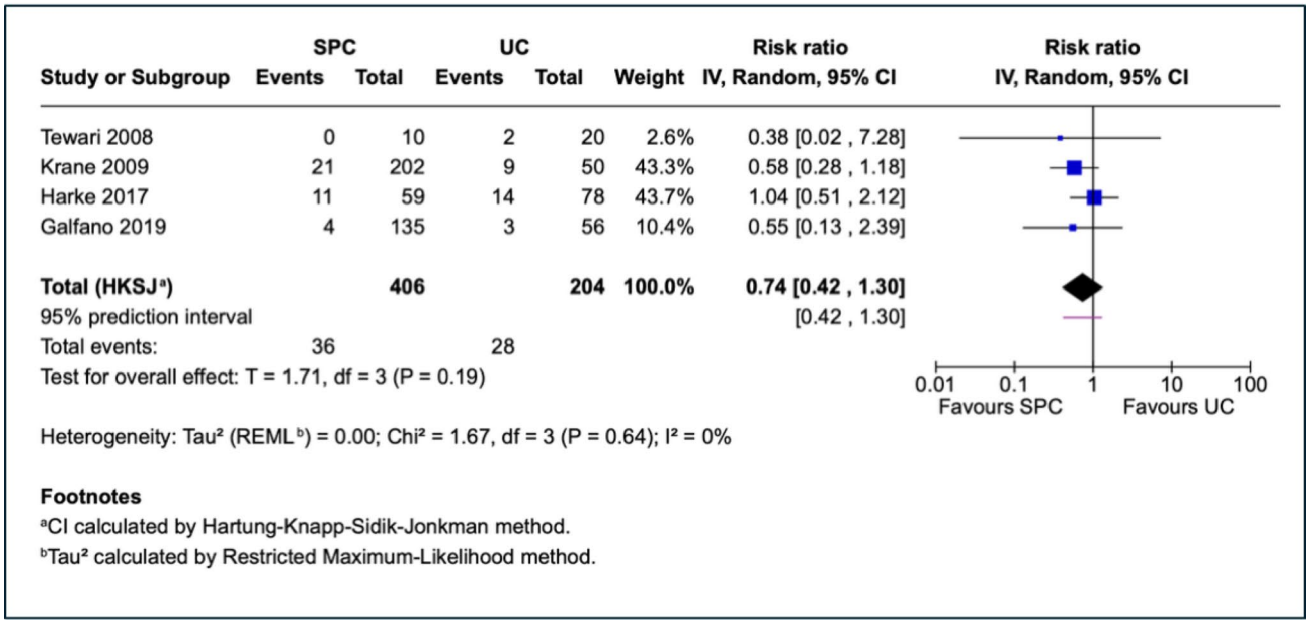

Fig. 2 Forest plot of comparison between SPC vs. UC for: (**A**) early incontinence (≤ 6 weeks). (**B**) Late incontinence (≥ 3 months)

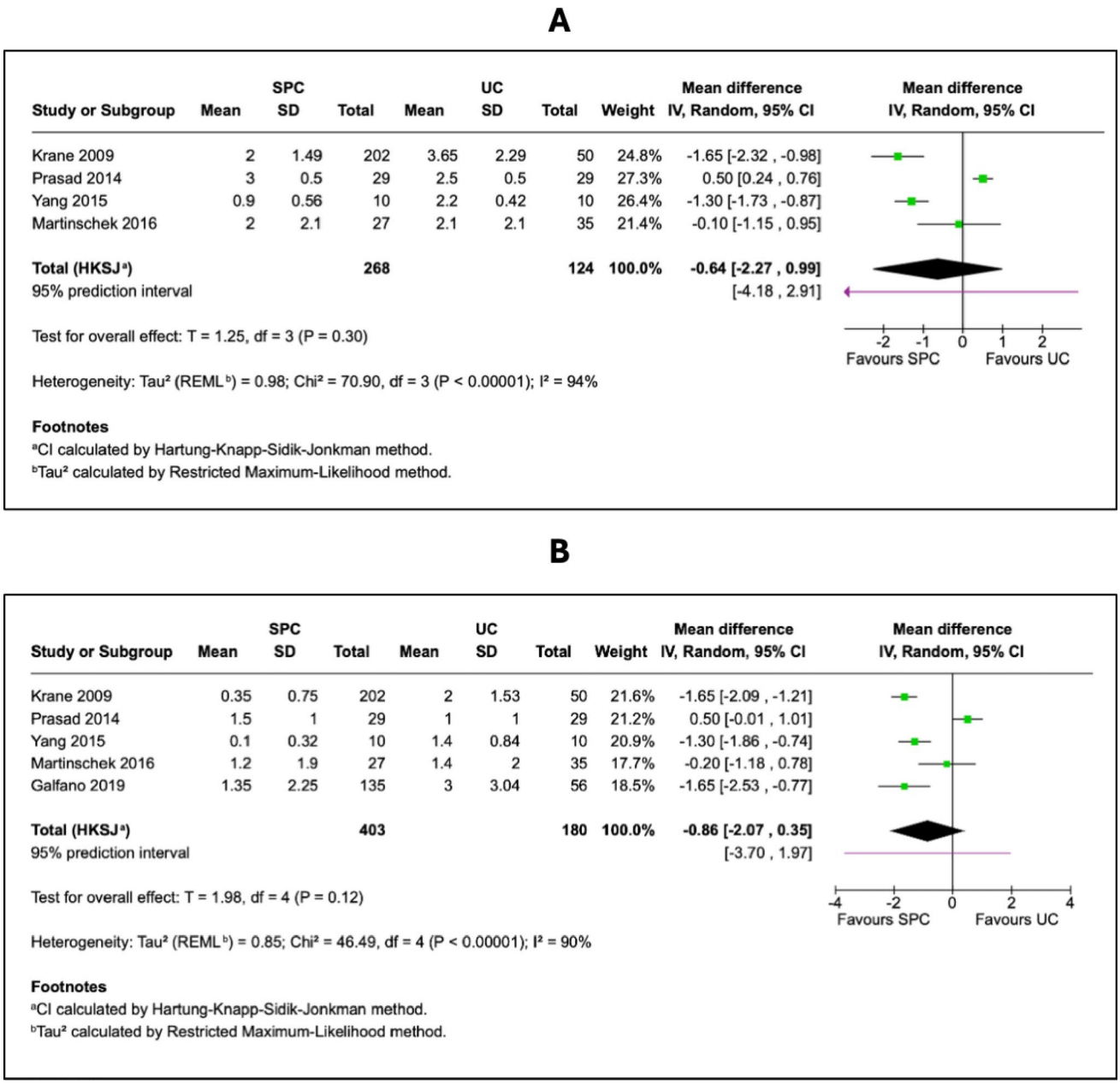

Fig. 3 Forest plot of comparison between SPC vs. UC for: (**A**) Early post-operative pain (≤ 3 days). (**B**) Late post-operative pain (> 3 days)

blockage, dislodgement, bladder spasms etc. Serious complications were rare, and we did not note any consistent difference across groups.

D. Patient choice regarding catheter post-operatively

Three studies assessed recommendation rate / preference of a catheter post-operatively by patients however the data was heterogenous and inconsistently reported. Two studies reported no clear difference whereas Harke et al. suggested a higher preference for SPC and a preference for earlier trial of void.

Risk of bias and certainty assessment

RCTs were assessed using COCHRANE Risk of Bias tool and revealed that three studies were at low risk of bias [16, 18, 29] whereas Harke 2020 was deemed at high risk owing to high dropout rate and deviations from intended outcomes due to intra-operative factors.

Non-randomized studies were assessed using ROBINS-I V2 tool and revealed low risk of bias for 4 studies and

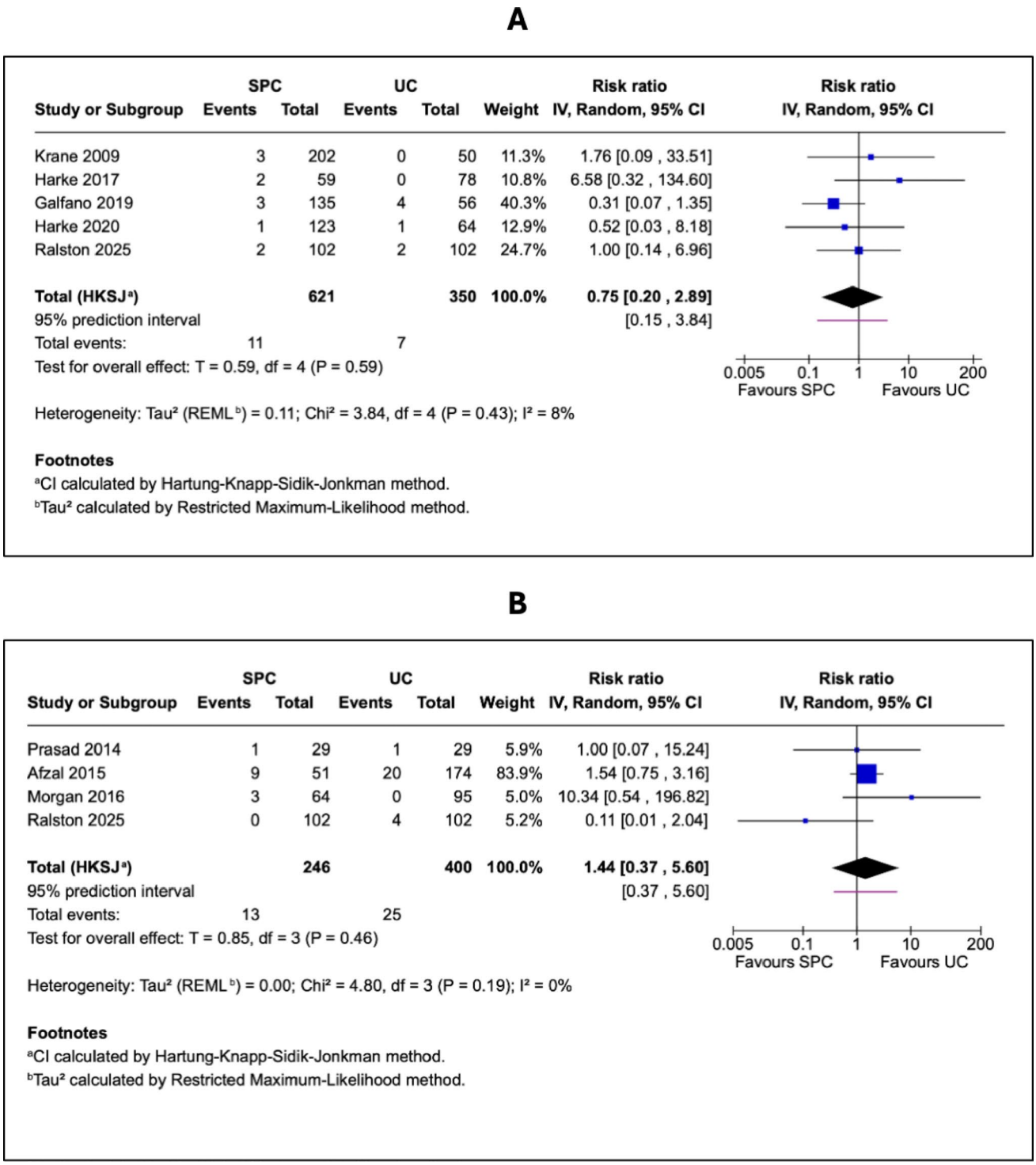

Fig. 4 Forest plot of comparison between SPC vs UC for: (**A**) Urinary tract infection rate (UTI). (**B**) Emergency Department (ED) visits

moderate risk of bias for 3 studies (downgraded for confounding and selection bias). Tewari et al. and Galfano et al. were deemed at serious risk of bias owing to concerns regarding confounding and deviation from the intervention planned owing to contraindications to SPC (Fig. 5).

The overall quality of evidence for primary outcomes was assessed using the GRADE approach. Certainty was downgraded for possible confounding and variable follow-up schedule. The evidence was perceived to be of "very low" certainty for early incontinence and "low" for late incontinence (Table 3).

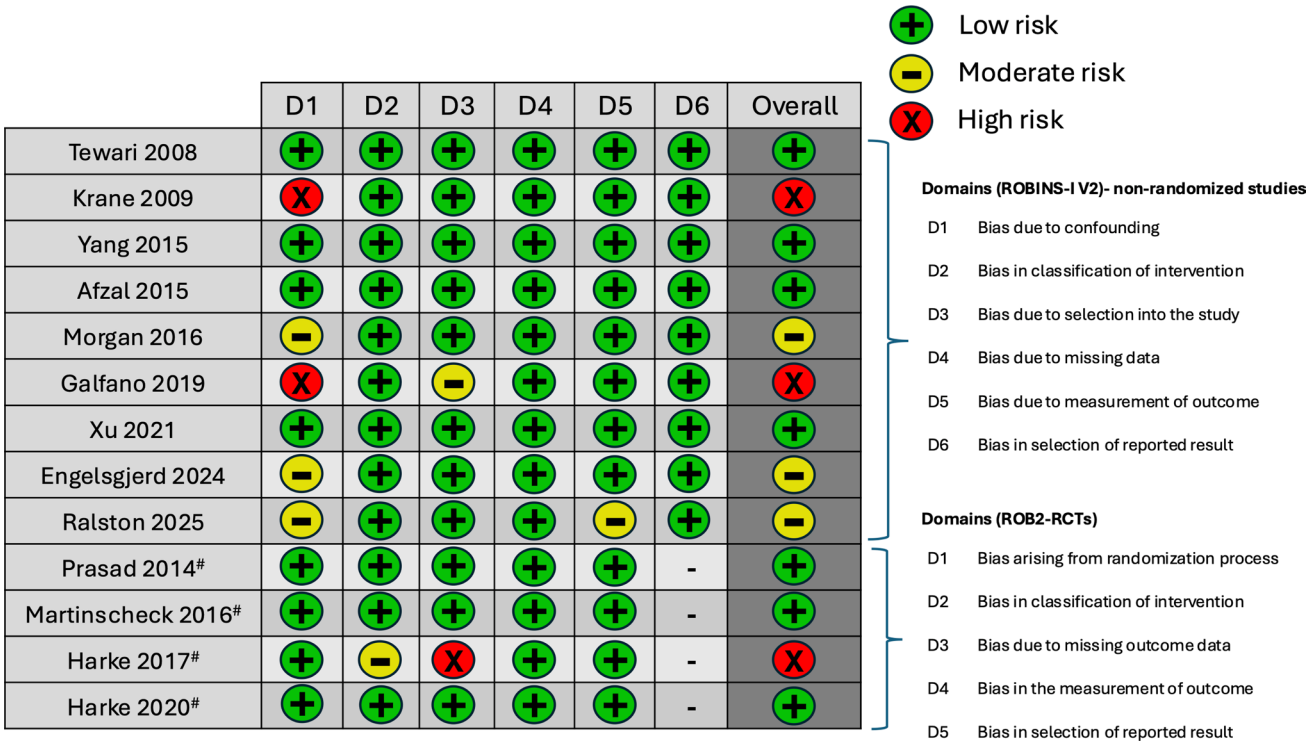

Fig. 5 Risk of bias of included studies (ROBINS-I V2/ Risk of Bias 2.0 was used for non-randomized studies/ RCTs)

Discussion

Summary of main results

In this systematic review and meta-analysis, we evaluated whether SPC offers advantage over UC post-RALP, with emphasis on incontinence recovery, pain and catheter-related safety outcomes. Our results show that SPC may be associated with modest reduction in early incontinence rates following RALP, however this effect is sensitive to inclusion of Retzius-sparing data. We also observed that SPC offers no benefit over UC in long-term continence, post-operative pain/ discomfort or catheter related safety outcomes.

Early incontinence recovery and surgical technique

This review incorporates more recently published studies with a greater emphasis on for early incontinence recovery outcomes. The pooled analysis showed that SPC may be associated with lower incontinence rates in the early post-operative period as compared to UC. However, this analysis needs to be interpreted with caution as the prediction interval crossed unity indicating uncertainty regarding reproducibility across clinical settings. Moreover, it was highly sensitive to the inclusion of Xu et al. [32], which reported data for patients who underwent Retzius-sparing RALP, which indicates results being driven by surgical techniques rather than purely the choice of catheter route.

Nerve-sparing and Retzius sparing approaches are associated with better incontinence outcomes compared to conventional approach [22, 23]. Most of the included studies in this review included patients with/ without nerve sparing, however lacked adjustment for this critical confounder. This translates to our inability to perform a formal assessment of effect modification by surgical technique and caution should be exercised while interpreting the pooled ratio.

Substantial urinary incontinence

We noted no difference in the incontinence outcomes at 3 months timepoint post-operatively indicating that the catheter route does not influence long-term recovery. This effect was consistent across studies and minimal heterogeneity was noted. This can be physiologically attributed to the fact that in longer term, continence is primarily regained by tissue healing and sphincter integrity [24].

Our results are in coherence with previous reviews, however they had pooled outcomes for variable timepoints and had not used similar robust methodology [25–28].

Table 3 GRADE summary of findings

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with Urethral catheter	Risk with Suprapubic catheter				
Early incontinence follow-up: mean 6 weeks	357 per 1,000	250 per 1,000 (328 to 189)	RR 0.70 (0.53 to 0.92)	1129 (6 studies)	⨁◯◯◯ Very low[a, b,c]	Suprapubic catheter may reduce/ have little to no effect on early incontinence, but the evidence is very uncertain.
Late incontinence follow-up: mean 3 months	137 per 1,000	102 per 1,000 (178 to 58)	RR 0.74 (0.42 to 1.30)	610 (4 studies)	⨁⨁◯◯ Low[c]	The evidence suggests that suprapubic catheter does not reduce late incontinence.

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI). **CI**: confidence interval; **RR**: risk ratio

GRADE Working Group grades of evidence

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

a. Data sensitive to inclusion of Retzius sparing data

b. Possible confounding due to surgical technique

c. measured at variable time periods

Pain and discomfort

Our analysis showed no significant difference in post-operative pain/ discomfort experienced by the patients depending on catheter route. Our pooled ratio had high heterogeneity which is possible as pain/ discomfort is a patient reported outcome and can be easily influenced by factors such as timing of reporting, interpretation of tool, interpersonal variability and overall perception of pain. Our findings differ from previous reviews who had pooled the outcomes from studies which had used variable pain reporting tools hence concluding superiority of SPC over UC [25–27].

Safety outcomes

Catheter related complications were uncommon. The incidence of UTIs and post-operative catheter related visits to ED did not differ between groups, although confidence intervals were wide owing to low event numbers. The occurrence of urethral strictures and bladder neck contractures were rare in either groups, therefore could not be meaningfully pooled for quantitative synthesis. Overall, these findings suggest that SPC is safe but does not confer a clear advantage over UC.

Strengths and limitations

This review incorporates more recently published studies with a special emphasis on incontinence outcomes. Previous reviews focused primarily on pain/ discomfort outcomes and had pooled studies which had used different scales for pain assessment.

However, our review is limited by the relevant limitations of the current literature as different studies adopted different protocols for patient selection, surgical technique, removal of urethral catheter on varying time points and reporting of incontinence on variable time points. Definitions of continence also varied between early and late post-operative timepoints, which may limit direct comparability of continence outcomes over time. In addition, pain outcomes were heterogeneously defined across studies limiting precise attribution to catheter route or anatomical source. We also acknowledge our inability to quantify safety outcomes in detail owing to smaller event numbers. These factors constrain robust inference and highlight the need for cautious interpretation of our pooled estimates.

Clinical implications

Based on our review, the routine use of SPC post-RALP cannot be recommended solely to improve continence outcomes. At most, SPC may be associated with modest short-term continence advantage, however this is context dependent and is not sustained over time. Moreover, sensitivity of early incontinence findings to inclusion of Retzius-sparing data cohorts reinforces the interpretation that surgical technique, rather than catheter route alone, likely drives functional recovery after RALP.

Decisions regarding catheter type should be based on patient experience, surgeon preference, and practical considerations rather than patient recovery. A shared decision-making with patient and carers should take place regarding catheter route.

Research implications

Well-designed RCTs stratified by surgical approach and nerve-sparing status, with standardized endpoints are required to be determined to establish whether choice of catheter route independently influences functional recovery following robotic prostatectomy.

Conclusions

Available evidence suggests that use of SPC may be associated with modest reduction in early post-operative incontinence following RALP. However, this effect is small and is sensitive to surgical technique adopted and does not sustain beyond the 6-week immediate post-operative period. The available data is limited as it is drawn from studies which are mixed in design, and do not report outcomes in a standardized manner. Hence, the use of SPC over UC after RALP cannot be routinely recommended based on current evidence, as catheter route alone is unlikely to independently influence functional recovery. Further well designed RCTs are needed to investigate the role of SPC as compared to UC to determine if catheter route independently influences functional recovery.

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Declarations

Competing interests The authors declare no competing interests.

Declaration of conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval This study was exempt from ethical approval from Institutional Review Board.

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