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Research Article

Significant association between urethral length measured by magnetic resonance imaging and urinary continence recovery after robot-assisted radical prostatectomy

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ABSTRACT

Introduction: To determine the clinical predictive factors affecting the recovery from postoperative urinary incontinence after robot-assisted radical prostatectomy (RARP).

Materials and methods: We consecutively analyzed 320 patients who underwent RARP between January 2012 and March 2015. The restoration of urinary continence was defined as follows: the use of no pads/no leakage of urine or the use of a safety pad. Preoperative covariates were statistically assessed by multivariate logistic regression analysis to investigate their predict factor to recovery of urinary incontinence. Therefore, in this study, we sought to identify predictors of early urinary continence status in a single-center retrospective study of consecutive patients who underwent RARP.

Results: Continence rates at 1, 3, 6, and 12 months after the catheter was removed were 44%, 71%, 83%, and 93%, respectively. Age, body mass index, and prostate volume had no significant association with urinary continence recovery. In contrast to this, longer preoperative membranous urethral length (MUL) was significantly associated with earlier postoperative continence recovery. Multivariate analysis demonstrated that longer preoperative MUL is significantly associated with continence recovery at 1 month ($P = 0.0235$).

Conclusion: Approximately 70% of patients achieved urinary continence within 3 months after RARP. Multivariate analysis showed that age, body mass index, and prostate volume had no significant association with urinary continence recovery. Preoperative MUL assessed by magnetic resonance imaging was an independent predictor of early recovery from urinary incontinence after RARP.

1. Introduction

Prostate cancer is a major disease affecting men worldwide, and robot-assisted laparoscopic radical prostatectomy (RARP) is the definitive treatment for localized prostate cancer. As postoperative urinary incontinence has a negative effect on the satisfaction and health-related quality of life (QOL) of patients who undergo radical prostatectomy (RP),[1,2] early recovery from postoperative urinary incontinence (UI) is one of the most important functional outcomes.[3] A younger age at operation and longer membranous urethral length (MUL) as measured on preoperative magnetic resonance imaging (MRI) have been consistently demonstrated to be predictors of early continence recovery after radical prostatectomy.[4,5] Ficarra et al reported UI recovery in some difficult cases or based on different surgeon experiences.[2] Prostate volume, body mass index (BMI) > 30, and surgeon experiences could affect the probability of a patient recovering from UI after RARP.[4,6–8] Furthermore, Paparel et al reported the importance of preserving MUL through accurate dissection of the prostatic apex during operation to the recovery of urinary continence after radical prostatectomy.[5] Recently, Mungovan et al reported the first systematic review and meta-analysis which have investigated preoperative MUL as a prognostic risk factor for overall continence recovery.[9] Meanwhile, the issue on whether the preservation of the neurovascular bundle (NVB) contributes to postoperative urinary continence after RARP has been controversial.[10–12]

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We initiated RARP in 2012 and introduced the technique of dividing the dorsal venous complex using a vascular stapler. With these surgical techniques in RARP, we evaluated the clinical predictive factors to affect recovery from postoperative UI.

2. Materials and methods

2.1. Patients

In this retrospective study, we consecutively analyzed 320 patients with clinically localized prostate cancer who underwent MRI and RARP at our institution between January 2012 and March 2015. All patients were followed up for >12 months postoperatively. Patients who had neurogenic bladder, incontinence, or urinary retention before prostatectomy were excluded. RARP was performed via a transperitoneal approach. We stapled and divided the dorsal venous complex using a 45-mm Endo-GIA stapler (Ethicon, Somerville, NJ) after dividing the puboprostatic ligaments.[13] This technique enables not only a more defined apical dissection and a statistically significant reduction in positive margins but also a clearer and consistent visualization of the apex of the prostate and urethra .[13] We also developed the technique of approaching the bladder neck directly to expose internal urethra and making a small caliber of the internal orifice. Transection of the prostate began from the anterior surface of the bladder neck. Urethrovesical anastomosis was performed using a running suture with 3–0 V-Loc® with minimum Rocco stitches.[14] The criteria for nerve-sparing surgery were cT1–2a and Gleason score ≤ 7. In the case of unilateral nerve sparing, the sparing side was determined from the imaging findings of T2W and diffusion-weighted image (DWI) and the positive site of prostate biopsy. Bilateral nerve sparing was performed when cT1 and Gleason score $\leq 3 + 4 = 7$ cases. To exercise nerve sparing, endopelvic fascia was maintained to keep the structure intact.

Continence was evaluated using the Expanded Prostate Cancer Index Composite (EPIC) survey question: "How many pads or adult diapers per day did you usually use to control leakage during the last 4 weeks?". [15,16] The question was modified to measure continence at the time of catheter removal and 1 week after removal. The patient was defined as continent if they answered "zero pad" or "one safety pad" per day at postoperative visits of 1, 3, 6, and 12 months.

2.2. MRI procedures

All examinations were performed using a 1.5 Tesla MRI system (Signa LX Horizon Echospeed; General Electric Medical Systems Inc., USA). T2W images of the prostate and seminal vesicle included the following parameters: the repetition time (TR), 3300–4000 ms; the echo time (TE), 80–100 ms; slice thickness, 3.0 mm; gap, 0.3 mm; and matrix, 260 × 256. Images were retrospectively interpreted with a urologist specializing in prostate MRI. MRI variables evaluated were preoperative and postoperative MUL. Postoperative MRI was taken after 3 months or longer after surgery. MUL was measured in the midline sagittal plane on T2-weighted MRI. On preoperative MRI, MUL was considered to be the distance from the prostatic apex to the level of the urethra at the penile bulb (Fig. 1A). On postoperative MRI, MUL was considered to be the distance from the bladder neck to the level of the urethra at the penile bulb (Fig. 1B).

Table 1
Patients' characteristics.

Patients' characteristics	Value
Age (years), median (IQR)	66 (62–70)
Baseline prostate-specific antigen (ng/mL), median (IQR)	7.1 (5.1–10.2)
Body mass index (kg/m^2), median (IQR)	24.0 (22.4–25.7)
Prostate volume (g), median (IQR)	25.0 (19.0–35.0)
Preoperative MUL (mm), median (IQR)	10.5 (9.3–11.5)
Clinical T stage	
T1c	122 (38.1%)
T2a	86 (26.9%)
T2b	45 (14.1%)
T2c	45 (14.1%)
T3a	12 (3.8%)
T3b	3 (0.9%)
Unknown	7 (2.1%)

IQR, interquartile ranges; MUL, membranous urethral length.

2.3. Statistical analyses

Frequencies and proportions were generated for categorical variables; means as well as medians and interquartile ranges (IQRs) were generated for continuously coded variables. The *t* test, Mann–Whitney U test, and Pearson's Chi-square test were used to compare categorical variables. Logistic regression analyses were used for univariate and multivariate analyses. Using JMP (version 11.0, SAS Institute Inc., Cary, NC, USA), all P values calculated correspond to two-sided tests, with a P value of 0.05 considered to represent a significant difference.

3. Results

Patient characteristics are summarized in Table 1. The median age of patients was 66 years (IQR, 62–70), median preoperative concentration of prostate-specific antigen was 7.1 ng/mL (IQR, 5.1–10.2), BMI was 24.0 kg/m^2 (IQR, 22.4–25.7), median prostate

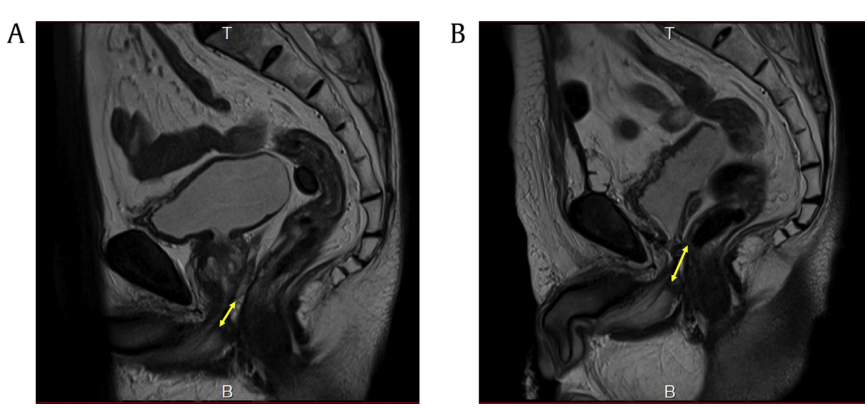

Fig. 1. The anatomical urethral length was measured in the sagittal planes by MRI. (A) Preoperative MUL was measured from the prostate apex to the entry of the penile bulb. (B) Postoperative MUL was measured from the bladder neck to the entry of the penile bulb. MUL, membranous urethral length; MRI, magnetic resonance imaging.

Table 2
Perioperative parameters

Intraoperative parameters	Value
Operative time, (min), median (IQR)	159 (129–198)
Blood loss (mL), median (IQR)	100 (20–242)
Postoperative catheterization period (day), median (IQR)	8 (7–8)
Postoperative MUL (mm), median (IQR)	10.6 (9.3–12.4)
Nerve sparing	
Bilateral	99 (31%)
Unilateral	116 (36%)
Nonsparing	105 (33%)

IQR, interquartile ranges; MUL, membranous urethral length.

Table 3
Histopathological data

Histopathological data	Number (%)
Positive margins	72 (22)
Apex positive margins	56 (18)
pT2 positive margins	42 (13)
Stage	
pT2	254 (79)
pT3	58 (18)

volume was 25.0 g (IQR, 19.0–35.0), and the median preoperative MUL was 10.5 mm (IQR, 9.3–11.5). Perioperative findings are summarized in Table 2, the median operative time was 159 minutes, and the median blood loss was 100 mL. The median time of postoperative catheterization hospital stay was 8 days. In terms of nerve sparing, 99 patients (31%) had bilateral nerve sparing, 116 patients (36%) had unilateral nerve sparing, and the remaining 105 patients (33%) had non–nerve-sparing operation. Histopathological data are reported in Table 3. The overall positive surgical margin rate was 22.5%, and in 17.5% of the cases, the positive margin was located at the apex. The positive margin rate decreased to 13.1% in the pT2 patient cohort.

Urinary continence was defined as the use of no pads or the use of a safety pad. Based on these criteria, continence rates achieved at 1, 3, 6, and 12 months after catheter removal were 44%, 68%, 85%, and 93%, respectively.

We examined whether covariates affect the recovery from postoperative UI. Age, BMI, and prostate volume had no significant association with the postoperative incontinence periods. In contrast to this, longer preoperative MUL was significantly associated with earlier postoperative continence recovery ($P < 0.001$) (Fig. 2). Multivariate analysis demonstrated that longer preoperative MUL was significantly associated with continence recovery at 1 month ($P = 0.0235$) and 3 months ($P = 0.0002$) in preoperative factors (Table 4). However, MUL was not significantly associated with continence recovery at 6 months ($P = 0.9837$) and 12 months ($P = 0.9933$). The median preoperative MUL was 10.5 mm (IQR, 9.3–11.5). When patients were dichotomized by this cutoff point, the group with preoperative MUL longer than 10.5 mm showed significantly earlier recovery ($P < 0.001$) (Fig. 3).

We examined the relationship between nerve-sparing technique and urethral length. Based on the degree of nerve sparing, the bilateral nerve-sparing group had significantly earlier recovery ($P = 0.0117$). There was no significant difference between the nonsparing group and unilateral group ($P = 0.8398$), but the bilateral nerve-sparing group had significantly earlier continence recovery than the unilateral group ($P = 0.0222$) (Fig. 4). The preoperative median MUL was 10.7 mm (IQR, 9.6–11.9) in the bilateral nerve-spared group, 10.3 mm (IQR, 9.3–11.4) in the unilateral sparing group, and 10.3 mm (IQR, 9.2–11.4) in the nonsparing group, with no significant difference between the groups ($P = 0.2107$). Postoperative MUL was affected by the status of nerve sparing; median postoperative MUL was 11.8 mm (IQR, 9.7–13.2) in the bilateral nerve-spared group, 10.8 mm (IQR, 9.1–12.1) in the unilateral sparing group, and 10.3 mm (IQR, 8.9–11.5) in the nonsparing group. The bilateral nerve-sparing group had significantly longer postoperative MUL than other groups ($P = 0.0020$) (Fig. 5). The median MUL was similar before and after RP (10.5 mm vs. 10.6 mm, respectively).

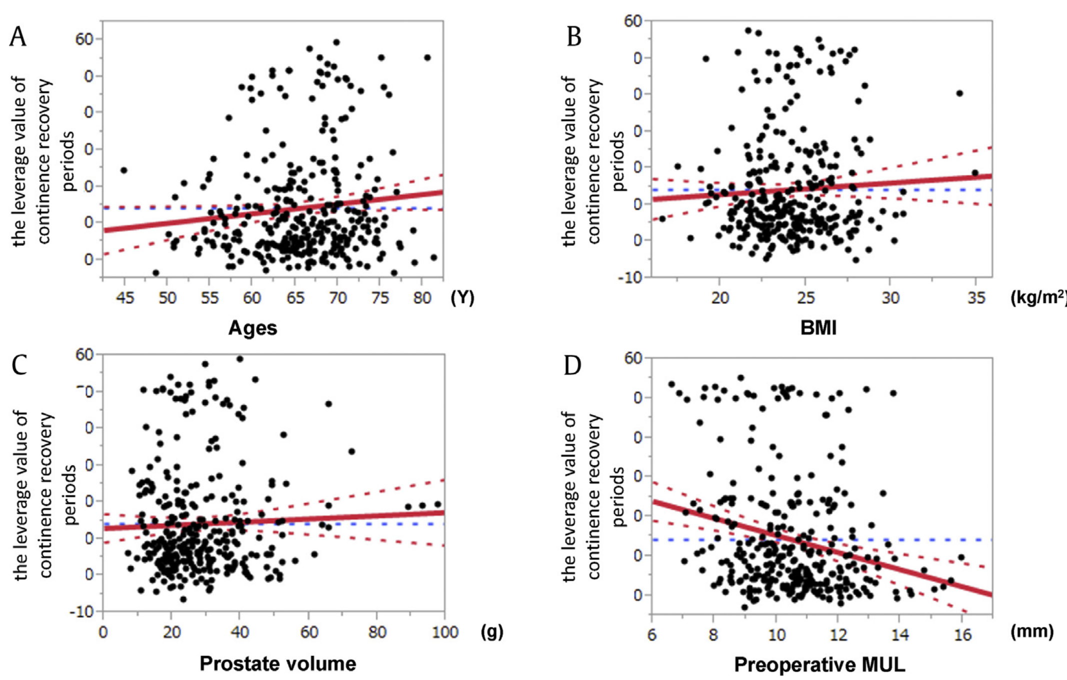

Fig. 2. Age (A) ($P = 0.055$), BMI (B) ($P = 0.337$), and prostate volume (C) ($P = 0.494$) had no significant association with the leverage value of continence recovery periods. In contrast to this, longer preoperative MUL (D) ($P < 0.001$) was significantly associated with earlier postoperative continence recovery. BMI, body mass index; MUL, membranous urethral length.

Table 4
Multivariate logistic regression analysis was performed to identify the risk factors associated with continence at 1 month and 3 months after operation.

Multivariate analysis	Continence at 1 month			Continence at 3 months		
	Odds ratio	95% CI	*P*	Odds ratio	95% CI	*P*
Ages	1.0009	0.9757–1.0542	0.6595	1.0189	0.9789–1.0611	0.3595
BMI	0.9357	0.8408–1.0393	0.2161	1.0466	0.9492–1.1546	0.3572
Prostate volume	1.0024	0.9831–1.0234	0.8041	1.0150	0.9964–1.0327	0.1039
Preoperative MUL	0.8329	0.7071–0.9757	0.0235	0.7460	0.6317–0.8733	0.0002

BMI, body mass index; CI, confidence interval; MUL, membranous urethral length.

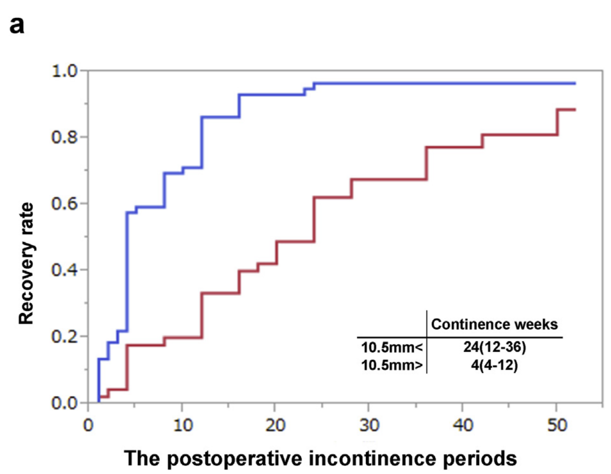

Fig. 3. Kaplan–Meier curve shows the overall urinary continence rate after robot-assisted radical prostatectomy by nerve-sparing criteria. The bilateral nerve-sparing group showed significantly earlier recovery. There was no significant difference between the nonsparing group and the unilateral group, but the bilateral nerve-sparing group had significantly earlier recovery than unilateral groups.

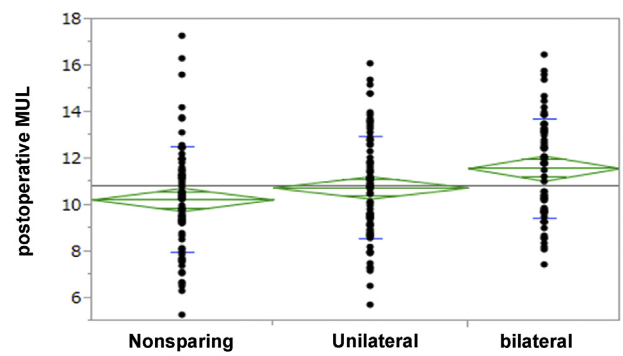

Fig. 5. Comparison of postoperative MUL by nerve-sparing techniques: the bilateral nerve-sparing group had significantly longer postoperative MUL than other groups. MUL, membranous urethral length.

4. Discussion

Postoperative UI is a common complication that significantly impairs the QOL.[17] A recent systematic review and meta-analysis have shown that RARP has higher postoperative continent rates than radical retropubic prostatectomy or laparoscopic radical prostatectomy .[2] Many definitions for continence have been used including pad-free status, leak-free status, and urinary function composite scores.[18] The use of standardized, validated patient-completed questionnaires facilitates the collection of this information and thus standardizes the manner in which the question is asked. The EPIC specifically was developed to better quantify and define the QOL outcome variables after prostatectomy and has become the most widely accepted instrument for this purpose.[15,19] This study defined continence as the use of no pads/no leakage of urine or the use of a safety pad according to the EPIC survey question, "How many pads or adult diapers per day did you usually use to control leakage during the last 4 weeks?".[16,20] In our group, 44% and 68% of patients have achieved urinary continence 1 month and 3 months, respectively, after RARP. Another systematic review showed 1 month urinary continence recovery rates of about 35% to 65% and 3 month rates of about 65% to 85%.[2,18,21]

The etiology of UI after radical prostatectomy is complex and multifactorial. Some reports have shown that increasing age, BMI, prostate volume, and preoperative lower urinary tract symptoms (LUTS) affect continence after RARP.[2,8,18,21,22] And, some studies reported on the role of preoperative and postoperative MUL in the recovery of continence after RP.[5,23,24] In our study, multivariate analysis showed that age, BMI, and prostate volume had no significant association with the recovery of continence but that preoperative MUL assessed by MRI was an independent predictor of early recovery from urinary incontinence after RARP.

Correlation between anatomic variables such as MUL and the recovery of urinary continence is suggested. Functional urethral length is the length of the posterior urethra with a high resting pressure as assessed through urodynamics. This continence zone extends from the bladder neck to the corpus spongiosum and includes the internal and external sphincters.[25,26] Therefore, preoperative pelvic MRI provides an optimal tool to visualize detailed anatomy of the prostate, periprostatic tissue, and MUL to determine if these anatomic structures are associated with the recovery of urinary continence after RARP.[5,23,24,27] Our study suggested that preoperative MUL assessed by MRI is an independent predictor of early recovery from urinary incontinence and that keeping long postoperative MUL is conducive to early recovery from incontinence after RARP. The use of both preoperative and postoperative MRI allowed us to assess the role of changes in urethral length in

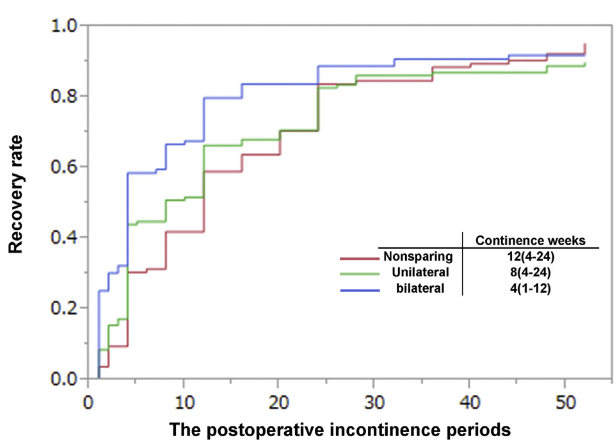

Fig. 4. Kaplan–Meier curve shows overall urinary continence rate after robot-assisted radical prostatectomy according to postoperative MUL (cutoff value for preoperative MUL was 10.5 mm which was the median preoperative MUL). MUL, membranous urethral length.

postoperative urinary continence. The median MUL was similar before and after RP (10.5 mm vs. 10.6 mm, respectively). Some studies reported the importance of urethral preservation for postoperative continence.[5,23,24,27] Bilateral nerve sparing contributed to the early restoration of urinary continence and longer postoperative MUL.

Consistent with other reports, we clearly showed the impact of nerve sparing on early continence recovery after RARP.[11,28,29] The possible effect of nerve sparing is most likely multifactorial. In cases with nerve sparing, the preparation of the surrounding structures might be done more carefully, and anatomic integrity as well as innervation of the sphincter complex might be better preserved.[12,30] The issue of whether the preservation of the NVB contributes to the improvement of continence after RARP remains controversial, and the neuroanatomic role of the NVB in male urinary continence is not clear.[31] Srivastava et al suggested that the impact of autonomic innervation on the urethral sphincter was demonstrated by intraoperative stimulation of the NVB; this resulted in a significant increase in the urethral pressure.[12,31] In the present study, we reconfirmed that early postoperative continence was improved by nerve sparing. Bilateral nerve sparing contributed to the early restoration of urinary continence and longer postoperative MUL. Taken together, keeping the anatomical structure that surrounds the urethra as intact as possible appeared to be conducive to early recovery from incontinence after RARP. This is consistent with the hypothesis that increased distal removal of the prostate damages this voluntary sphincter mechanism or its nerve supply. It would also be consistent with a shorter MUL, as those of patients with more of the urethra removed during distal dissection would be expected to go low enough to affect the distal striated sphincter.[32] As we considered that there was no significant difference in preoperative MUL due to the nerve sparing, it was suggested that bilateral nerve preservation may be a procedure to preserve the periurethral structure.

The present study was limited because there was more than one surgeon. The surgeon's learning curve in RARP has been suggested to affect the recovery of incontinence.[2,33] In this study not comparison by single surgeons but comparison by the number of cases by surgeons has not been implemented. However, among such cases, the incontinence recovery was significantly earlier in patients with preoperative long urethra, and it was suggested that the length of the urethra is a predictor of early incontinence recovery. MRI-assessed preoperative and postoperative urethral lengths seem to be important predictors of who regains continence after RARP. Improved surgical techniques would provide the opportunity to keep a longer stump of the membranous urethra.

In conclusion, our analysis showed that age, BMI, and prostate volume had no significant association with urinary continence recovery. We evaluated the degree of urethral length based on the MRI findings in patients with prostate cancer before RARP and showed the significant impact of preoperative MUL on the delayed recovery of the continence status after RARP in these patients. Keeping the anatomical structure that surrounds the urethra as intact as possible appeared to be conducive to early recovery from incontinence after RARP.

Conflicts of interest

I hereby declare that there is no conflict of interest regarding of this study.

Acknowledgments

None.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.prnil.2018.06.003.

References

1. Murphy DG, Kerger M, Crowe H, Peters JS, Costello AJ. Operative details and oncological and functional outcome of robotic-assisted laparoscopic radical prostatectomy: 400 cases with a minimum of 12 months follow-up. Eur Urol 2009;55(6):1358–66.
2. Ficarra V, Novara G, Rosen RC, Artibani W, Carroll PR, Costello A, et al. Systematic review and meta-analysis of studies reporting urinary continence recovery after robot-assisted radical prostatectomy. Eur Urol 2012;62(3):405–17.
3. Lughezzani G, Briganti A, Karakiewicz PI, Kattan MW, Montorsi F, Shariat SF, et al. Predictive and prognostic models in radical prostatectomy candidates: a critical analysis of the literature. Eur Urol 2010;58(5):687–700.
4. Nguyen L, Jhaveri J, Tewari A. Surgical technique to overcome anatomical shortcoming: balancing post-prostatectomy continence outcomes of urethral sphincter lengths on preoperative magnetic resonance imaging. J Urol 2008;179(5):1907–11.
5. Paparel P, Akin O, Sandhu JS, Otero JR, Serio AM, Scardino PT, et al. Recovery of urinary continence after radical prostatectomy: association with urethral length and urethral fibrosis measured by preoperative and postoperative endorectal magnetic resonance imaging. Eur Urol 2009;55(3):629–37.
6. Skolarus TA, Hedgepeth RC, Zhang Y, Weizer AZ, Montgomery JS, Miller DC, et al. Does robotic technology mitigate the challenges of large prostate size? Urology 2010;76(5):1117–21.
7. Zorn KC, Orvieto MA, Mikhail AA, Gofrit ON, Lin S, Schaeffer AJ, et al. Effect of prostate weight on operative and postoperative outcomes of robotic-assisted laparoscopic prostatectomy. Urology 2007;69(2):300–5.
8. Link BA, Nelson R, Josephson DY, Yoshida JS, Crocitto LE, Kawachi MH, et al. The impact of prostate gland weight in robot assisted laparoscopic radical prostatectomy. J Urol 2008;180(3):928–32.
9. Mungovan SF, Sandhu JS, Akin O, Smart NA, Graham PL, Patel MI. Preoperative membranous urethral length measurement and continence recovery following radical prostatectomy: a systematic review and meta-analysis. Eur Urol 2017;71(3):368–78.
10. Gandaglia G, Suardi N, Gallina A, Capitanio U, Abdollah F, Salonia A, et al. Preoperative erectile function represents a significant predictor of postoperative urinary continence recovery in patients treated with bilateral nerve sparing radical prostatectomy. J Urol 2012;187(2):569–74.
11. Hinata N, Murakami G, Miyake H, Tanaka K, Abe S, Fujimiya M, et al. Urethral sphincter fatigue after robot-assisted radical prostatectomy: descriptive questionnaire-based study and anatomic basis. Urology 2014;84(1):144–8.
12. Srivastava A, Chopra S, Pham A, Sooriakumaran P, Durand M, Chughtai B, et al. Effect of a risk-stratified grade of nerve-sparing technique on early return of continence after robot-assisted laparoscopic radical prostatectomy. Eur Urol 2013;63(3):438–44.
13. Ahlering TE, Eichel L, Edwards RA, Lee DI, Skarecky DW. Robotic radical prostatectomy: a technique to reduce pT2 positive margins. Urology 2004;64(6):1224–8.
14. Patel VR, Coelho RF, Palmer KJ, Rocco B. Periurethral suspension stitch during robot-assisted laparoscopic radical prostatectomy: description of the technique and continence outcomes. Eur Urol 2009;56(3):472–8.
15. Wei JT, Dunn RL, Litwin MS, Sandler HM, Sanda MG. Development and validation of the expanded prostate cancer index composite (EPIC) for comprehensive assessment of health-related quality of life in men with prostate cancer. Urology 2000;56(6):899–905.
16. Wagner AA, Cheng PJ, Carneiro A, Dovirak O, Khosla A, Taylor KN, et al. Clinical use of EPIC for clinical practice (EPIC-CP) to assess patient-reported prostate cancer quality-of-life following robot-assisted radical prostatectomy. J Urol 2017;197(1):109–14.
17. Chien GW, Slezak JM, Harrison TN, Jung H, Gelfond JS, Zhang C, et al. Health-related quality of life outcomes from a contemporary prostate cancer registry in a large diverse population. BJU Int 2017 Oct;120(4):520–9.
18. Lavigueur-Blouin H, Noriega AC, Valdivieso R, Hueber PA, Bienz M, Alhathal N, et al. Predictors of early continence following robot-assisted radical prostatectomy. Can Urol Assoc J 2015;9(1–2):e93–7.
19. Reynolds WS, Shikanov SA, Katz MH, Zagaja GP, Shalhav AL, Zorn KC. Analysis of continence rates following robot-assisted radical prostatectomy: strict leak-free and pad-free continence. Urology 2010;75(2):431–6.
20. Porpiglia F, Bertolo R, Manfredi M, De Luca S, Checcucci E, Morra I, et al. Total anatomical reconstruction during robot-assisted radical prostatectomy: implications on early recovery of urinary continence. Eur Urol 2016;69(3):485–95.
21. Greco KA, Meeks JJ, Wu S, Nadler RB. Robot-assisted radical prostatectomy in men aged > or = 70 years. BJU Int 2009;104(10):1492–5.
22. Kojima Y, Takahashi N, Haga N, Nomiya M, Yanagida T, Ishibashi K, et al. Urinary incontinence after robot-assisted radical prostatectomy: pathophysiology and intraoperative techniques to improve surgical outcome. Int J Urol 2013;20(11):1052–63.

23. von Bodman C, Matsushita K, Savage C, Matikainen MP, Eastham JA, Scardino PT, et al. Recovery of urinary function after radical prostatectomy: predictors of urinary function on preoperative prostate magnetic resonance imaging. J Urol 2012;187(3):945—50.
24. Dubbelman YD, Bosch JL. Urethral sphincter function before and after radical prostatectomy: systematic review of the prognostic value of various assessment techniques. Neurourol Urodyn 2013;32(7):957—63.
25. Myers RP. Male urethral sphincteric anatomy and radical prostatectomy. Urol Clin North Am 1991;18(2):211—27.
26. Coakley FV, Eberhardt S, Kattan MW, Wei DC, Scardino PT, Hricak H. Urinary continence after radical retropubic prostatectomy: relationship with membranous urethral length on preoperative endorectal magnetic resonance imaging. J Urol 2002;168(3):1032—5.
27. Momozono H, Miyake H, Miyazaki A, Fujisawa M. Significance of urethral fibrosis evaluated by preoperative magnetic resonance imaging as a predictor of continence status after robot-assisted radical prostatectomy. Int J Med Robot 2016;12(3):496—501.
28. Palisaar JR, Roghmann F, Brock M, Loppenberg B, Noldus J, von Bodman C. Predictors of short-term recovery of urinary continence after radical prostatectomy. World J Urol 2015;33(6):771—9.
29. Kumar A, Tandon S, Samavedi S, Mouraviev V, Bates AS, Patel VR. Current status of various neurovascular bundle-sparing techniques in robot-assisted radical prostatectomy. J Robot Surg 2016;10(3):187—200.
30. Pick DL, Osann K, Skarecky D, Narula N, Finley DS, Ahlering TE. The impact of cavernosal nerve preservation on continence after robotic radical prostatectomy. BJU Int 2011;108(9):1492—6.
31. Nelson CP, Montie JE, McGuire EJ, Wedemeyer G, Wei JT. Intraoperative nerve stimulation with measurement of urethral sphincter pressure changes during radical retropubic prostatectomy: a feasibility study. J Urol 2003;169(6):2225—8.
32. Cameron AP, Suskind AM, Neer C, Hussain H, Montgomery J, Latini JM, et al. Functional and anatomical differences between continent and incontinent men post radical prostatectomy on urodynamics and 3T MRI: A pilot study. Neurourol Urodyn 2015;34(6):527—32.
33. Finley DS, Osann K, Chang A, Santos R, Skarecky D, Ahlering TE. Hypothermic robotic radical prostatectomy: impact on continence. J Endourol 2009;23(9):1443—50.