available at www.sciencedirect.com
journal homepage: www.europeanurology.com

European Association of Urology

Surgery in Motion

Anatomic Bladder Neck Preservation During Robotic-Assisted Laparoscopic Radical Prostatectomy: Description of Technique and Outcomes

Marcos P. Freire [a], *Aaron C. Weinberg* [a], *Yin Lei* [a], *Jane R. Soukup* [b], *Stuart R. Lipsitz* [b], *Sandip M. Prasad* [a], *Fernando Korkes* [d], *Tiffany Lin* [a], *Jim C. Hu* [a,b,c,*]

[a] *Division of Urologic Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA*
[b] *Center for Surgery and Public Health, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA*
[c] *Lank Center for Genitourinary Oncology, Dana-Farber Cancer Institute, Boston, MA, USA*
[d] *Faculdade de Medicina do ABC, São Paulo, Brazil*

Article info

Article history:
Accepted September 1, 2009
Published online ahead of print on September 12, 2009

Keywords:
Radical prostatectomy
Continence
Outcomes
Robotic surgical technique

Please visit www.europeanurology.com and www.urosource.com to view the accompanying video.

Abstract

Background: Robotic-assisted laparoscopic radical prostatectomy (RALP) has been rapidly adopted despite a daunting learning curve with bladder neck dissection as a challenging step for newcomers.
Objective: To describe an anatomic, reproducible technique of bladder neck preservation (BNP) and associated perioperative and long-term outcomes.
Design, settings, and participants: From September 2005 to May 2009, data from 619 consecutive RALP were prospectively collected and compared on the basis of bladder neck dissection technique with 348 BNP and 271 standard technique (ST).
Surgical procedure: RALP with BNP.
Measurements: Tumor characteristics, perioperative complications, and postoperative urinary control were evaluated at 4, 12 and 24 months using (1) the Expanded Prostate Cancer Index (EPIC) urinary function scale scored from 0–100; and (2) continence defined as zero pads per day.
Results and limitations: Mean age for BNP versus ST was 57.1 ± 6.6 yr versus 58.9 ± 6.7 yr ($p = 0.033$), while complication rates did not vary significantly by technique. Estimated blood loss was 183.7 ± 95.8 ml versus 224.6 ± 108 ml ($p = 0.938$) in men who underwent BNP versus ST. The overall positive margin rate was 12.8%, which did not differ at the prostate base for BNP versus ST (1.4% vs. 2.2%, $p = 0.547$). Mean urinary function scores for BNP versus ST at 4, 12, and 24 mo were 64.6 versus 57.2 ($p = 0.037$), 80.6 versus 79.0 ($p = 0.495$), and 94.1 versus 86.8 ($p < 0.001$). Similarly, BNP versus ST continence rates at 4, 12, and 24 mo were 65.6% versus 26.5% ($p < 0.001$), 86.4% versus 81.4% ($p = 0.303$), and 100% versus 96.1% ($p = 0.308$).
Conclusions: BNP versus ST is associated with quicker recovery of urinary function and similar cancer control.

* Corresponding author. Brigham and Women's Hospital, 45 Francis Street, ASBII-3, Boston, MA 02115. Tel. +1 617 732 6907.
E-mail address: jhu2@partners.org (J.C. Hu).

0302-2838/$ – see back matter © 2009 European Association of Urology. Published by Elsevier B.V. All rights reserved. doi:10.1016/j.eururo.2009.09.017

Please cite this article in press as: Freire MP, et al., Anatomic Bladder Neck Preservation During Robotic-Assisted Laparoscopic Radical Prostatectomy: Description of Technique and Outcomes, Eur Urol (2009), doi:10.1016/j.eururo.2009.09.017

1. Introduction

Robotic-assisted laparoscopic radical prostatectomy (RALP) has been rapidly adopted in recent years [1], and challenging learning curves have been described [2]. Although robotic-assistance provides advantages such as greater dexterity of instrumentation and magnified three-dimensional vision, it does not provide a novice with instant laparoscopic capabilities and proficiency in terms of tissue plane recognition [3].

Advocates of open radical prostatectomy cite the ability to feel the prostate and urethral catheter balloon during bladder neck dissection as an important advantage. Conversely, the widely noted absence of palpation during RALP may contribute to this being one of the most challenging steps for those early in their learning curve [4,5]. Suboptimal bladder neck dissection yields either residual prostate tissue when dissection is performed too distally into prostate versus a gaping bladder neck that may imperil the ureters and require reconstruction when dissection is too proximal.

The purpose of our study and accompanying video is to describe technique and anatomic landmarks for consistent bladder neck preservation (BNP) during RALP with limited use of monopolar energy, and to evaluate outcomes compared to a standard technique (ST) without bladder neck sparing.

2. Methods and patients

2.1. Enrollment

From September 2005 to May 2009, 619 patients with clinically localized prostate cancer underwent RALP, with 271 men undergoing ST bladder neck dissection and 348 undergoing BNP. The surgeon (JCH) logged 76 open radical prostatectomies during residency training and 397 transperitoneal RALP during fellowship training prior to enrollment of men to this consecutive, single-surgeon series.

2.2. Surgical technique

After entering the retropubic space of Retzius through either a transperitoneal or extraperitoneal approach, we performed the bladder

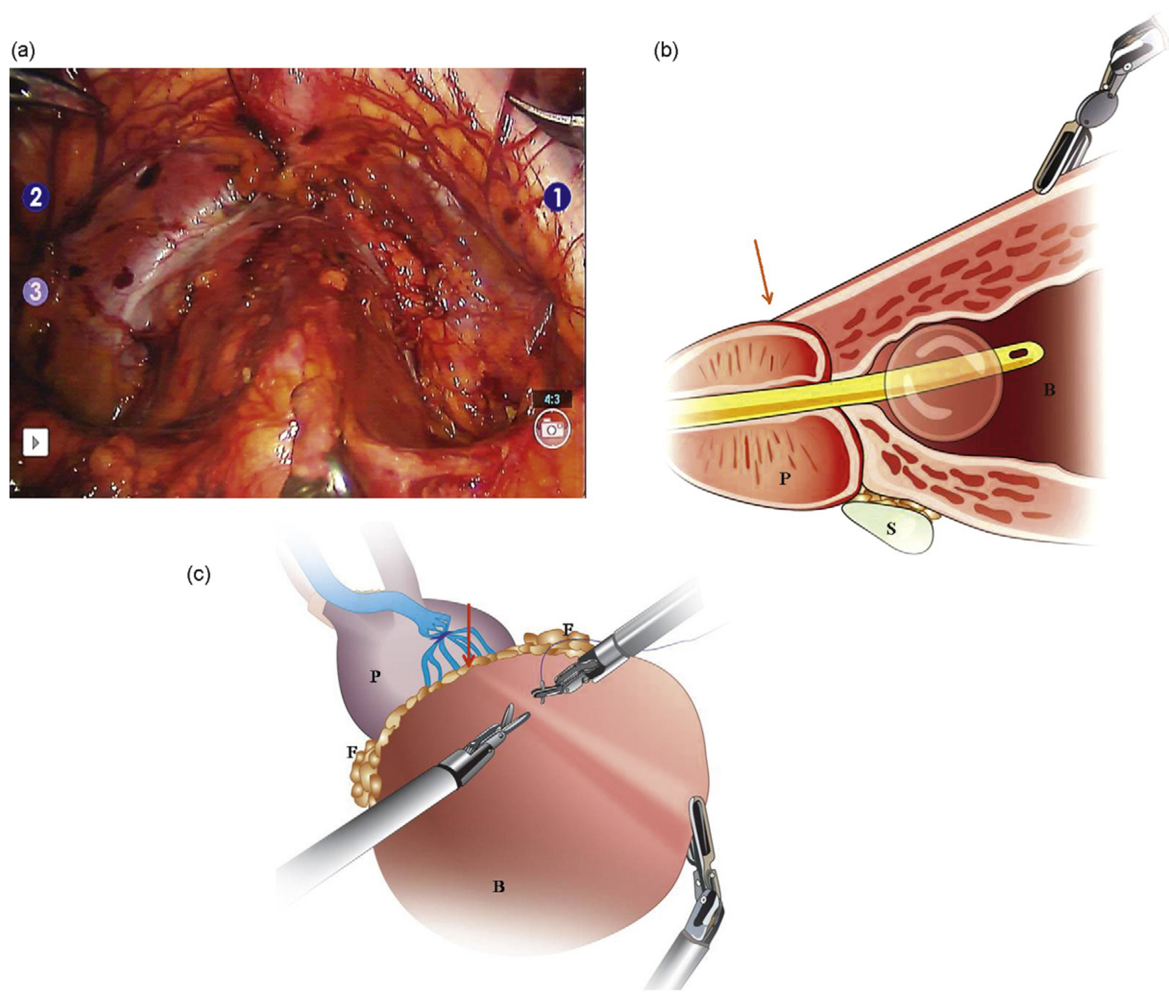


Fig. 1 – (a) Anterior aspect of the vesicoprostatic junction with application of anterocephalad fourth arm Prograsp tension; (b) diagram of the vesicoprostatic junction; (c) three-dimensional view of the vesicoprostatic junction. Red arrow represents the point at which the tented bladder fold ends and incision is made to begin bladder neck preservation technique anteriorly.
P = prostate; B = bladder; S = seminal vesicle; F = fat pad of Whitmore.

Please cite this article in press as: Freire MP, et al., Anatomic Bladder Neck Preservation During Robotic-Assisted Laparoscopic Radical Prostatectomy: Description of Technique and Outcomes, Eur Urol (2009), doi:10.1016/j.eururo.2009.09.017

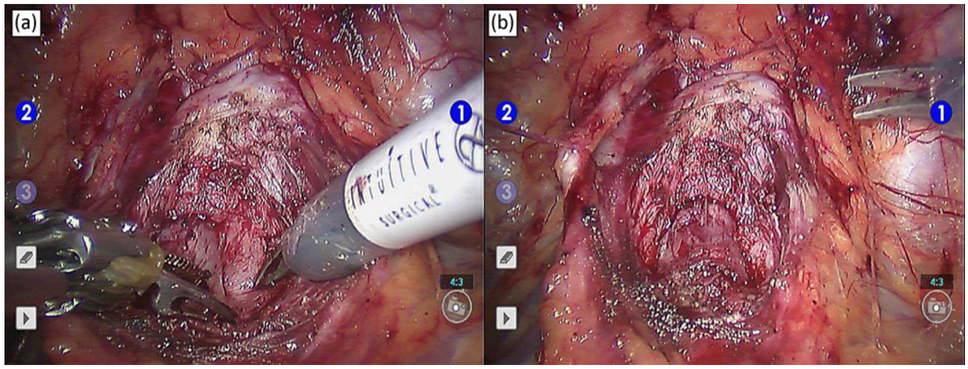


Fig. 2 – Anterior 270° circumferential dissection of funneled bladder neck.

neck dissection as the first step of a completely antegrade RALP. A Prograsp grasper, Maryland bipolar dissector, and curved monopolar scissors were inserted into the fourth arm (on the patient's left), the left, and right robotic arms, respectively. Energy settings were 25 W for both monopolar and bipolar currents.

Our initial ST bladder neck dissection was similar to that described by Menon et al [6], with greater emphasis on cold scissor dissection and selective use of bipolar energy. After completion of the anastomosis [7], an anterior tennis racket repair was performed to taper the larger bladder neck. The impetus toward BNP was to avoid a large bladder neck that was more susceptible to urine leak and prolonged catheterization. As BNP was performed with greater consistency, we did not exclude men with median lobe hypertrophy or those with high-risk features or high-volume disease from this bladder neck dissection technique.

First, mid prostatic and anterior vesical hemostatic sutures are placed (Fig. 1) with a 2-0 vicryl on a CT-1 needle (Ethicon/Johnson & Johnson, Somerville, New Jersey, USA). Next, anterocephalad tension on the bladder is created by using the fourth arm Prograsp to retract the anterior dome of the bladder (Fig. 1). This motion yields numerous advantages to the subsequent dissection: (1) tenting the anterior bladder to form a ridge that ends distally at the detrusor apron [8], serving as a landmark for the incision point of the bladder neck dissection; (2) constant tension throughout the bladder neck dissection; and (3) visualization of the contour of the urethral catheter balloon as the empty bladder caves in to form a concave contour bilaterally. The spherical contour of the Foley catheter balloon may be more difficult to appreciate in men with a greater amount of perivesical adipose tissue; however, we do not use the position of the balloon as a reference point to perform the bladder neck dissection.

Second, at the distal termination of the elevated bladder ridge, the bipolar current is used to control bleeding as sharp dissection is performed with the cold scissors. Avoiding the use of monopolar cautery lessens the amount of tissue charring, thus preserving visualization of the native anatomy that allows for identification of bladder muscle fibers, critical for defining the natural tissue plane of the vesicoprostatic junction. Once the linear fibers of the bladder neck transitioning to prostatic urethra are identified in the midline, we find the cleavage plane using a combination of sharp and blunt dissection to tease bladder muscle fibers away from the prostate, anatomically preserving a funneled bladder neck (Fig. 2).

After dissecting 270° anteriorly and circumferentially, the urethral catheter balloon is deflated and the linear anterior fibers of the bladder neck are incised as distally as possible. The assistant then withdraws the tip of the catheter from the interior bladder into view at the opened bladder neck. The assistant controls the catheter proximally and distally by holding the laparoscopic grasper with the thumb, index, and/or third finger to grasp the catheter tip while simultaneously holding the opposite end of the catheter, the catheter outlet, and balloon port, between the fourth and fifth fingers of the same hand extracorporeally (Fig. 3). This one-handed, intra and extracorporeal, assistant-surgeon manipulation of the deflated Foley catheter elevates the prostate to create tension that facilitates the posterior bladder neck dissection. This differs from the one-way traction obtained by placing a hemostat on the catheter at the meatus, which accordions the penis when the tip of the urethral catheter is elevated in the surgical field and reduces the potential elevation of the prostate and subsequent tension needed for dissection.

With traction and countertraction provided by the above-described manipulation of the Foley catheter and anterocephalad tension applied from the robotic fourth arm, the posterior bladder neck is divided starting in the midline until the posterior longitudinal fascia of the detrusor muscle [9] is encountered (Figs. 4 and 5). Dissecting laterally before identifying this landmark may result in inadvertent cystotomy or ureteral injury. Furthermore, there may be a tendency initially to dissect in a directly lateral rather than a posterolateral plane, which may lead to bleeding due to inadvertent dissection into the prostate or lateral pedicle vessels.

The dissection of bladder neck muscles inserting into the prostate base continues until adipose tissue is encountered situated at the cephalad extent of the endopelvic fascia, lateral to the bladder neck. This anatomic landmark, known as the fat pad of Whitmore (J. Montie, oral communication) was originally described during nerve-sparing radical cystectomy as the point to reach during antegrade bladder pedicle

Fig. 3 – Demonstration of the assistant grip on the laparoscopic grasper while intracorporeally holding the catheter tip to attain through and through catheter control and elevation of the prostate to create tension for the posterior bladder neck dissection.

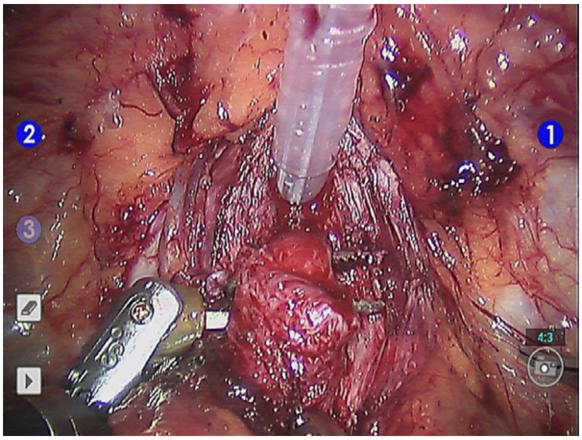
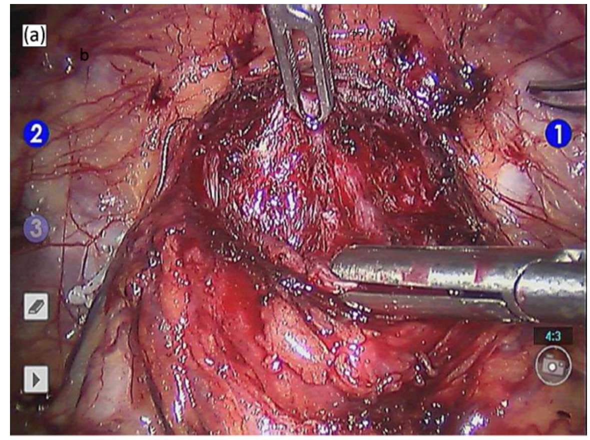


Fig. 4 – Isolation of the posterior lip of the bladder neck while Foley catheter tension is applied by the assistant to elevate the prostate.

dissection before transitioning to retrograde prostate dissection. Moreover, this defines the posterolateral bladder neck dissection boundary as the neurovascular bundle is located in close proximity to the lateral pedicle of the prostate [10] (Fig. 6).

We considered BNP to be successful when the diameter of the bladder neck was approximate to the diameter of the urethral stump, thereby not requiring reconstructive tapering prior to the vesicourethral anastomosis (Fig. 7).

Instances requiring reconstructive tapering were classified as ST. Moreover, our urethrovesical anastomotic technique [7] remained constant throughout the study period. Finally, cystography was not routinely performed postoperatively, except in men with difficult anastomosis, increased and prolonged drain output, or urinary retention at catheter removal.



(b)

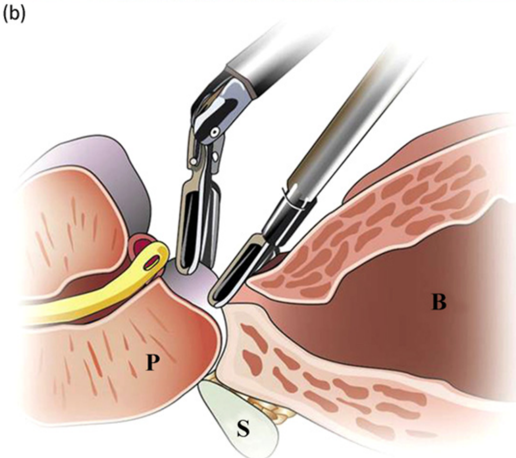


Fig. 5 – (a) The fourth arm provides upward tension on the prostate base while the assistant grasps the posterior lip of the bladder neck to provide countertension; (b) sagittal diagram.
P = prostate; B = bladder; S = seminal vesicle.

2.3. Outcomes

Urinary function was prospectively assessed using the Expanded Prostate Cancer Index (EPIC) short form [11] in 447 men (224 with BNP vs 223 with ST) during postoperative visits at 4, 12, and 24 mo. The EPIC urinary function scale is scored continuously from 0 to 100, with higher scores representing better outcomes. However, continence is commonly assessed in the urologic literature by pad use, and we also compared the EPIC item querying pad use by dichotomizing at no pads versus one pad or more per day. We defined urine leak as (1) high drain output with creatinine greater than serum levels or (2) anastomotic contrast extravasation on cystography.

2.4. Statistical analysis

All clinical data were collected and entered prospectively in an Access database (Microsoft, Redmond, WA, USA). SPSS (SPSS Inc., Chicago, IL, USA) and SAS v.9.1.2 (SAS, Cary, NC, USA) were used for the statistical analysis. The Wilcoxon rank-sum test (for non-normal variables), student *t* test (for approximately normal variables), χ^2 (for categorical variables), and Fisher exact tests (for categorical variables with a small number of events) were used to compare demographic characteristics, pathological results, and preoperative mean urinary function score across groups. An exact trend test was used to compare Gleason grade in both groups. Due to significant overlap of technique that attenuated toward predominantly BNP in later cases, we adjusted for time (learning curve) using a stratified Wilcoxon test for outcomes that may be influenced by increasing surgeon experience, as temporal learning curve

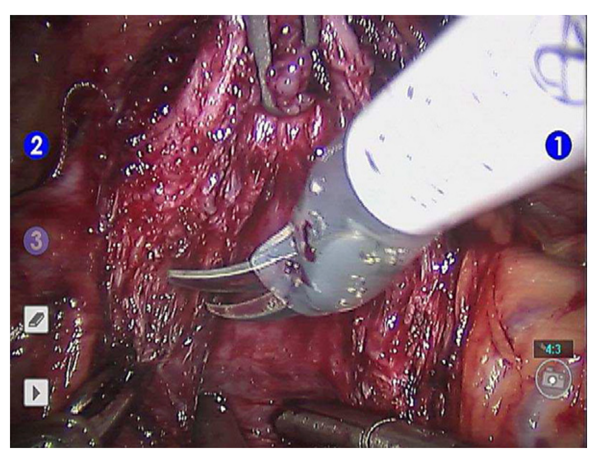


Fig. 6 – Posterolateral bladder neck dissection continues until adipose tissue (fat pad of Whitmore) is encountered.

effects may account for some of the observed differences in length of stay, length of catheterization, estimated blood loss, operative time, and urinary function. Similarly, differences in continence (pad use) by bladder neck dissection technique were adjusted for potential learning curve effects using a Cochran-Mantel-Haenszel test. For more complicated models in which we adjusted for learning curve effects and other

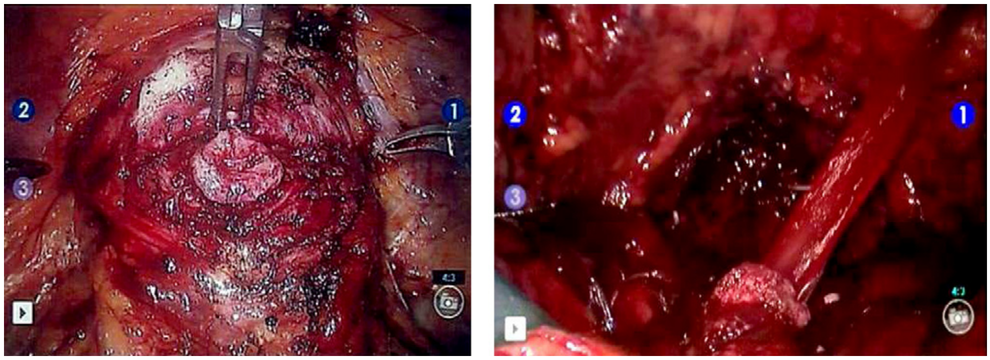


Fig. 7 – Coaptation of preserved bladder neck (left) and compression of bladder demonstrates expulsion of urine stored during robotic-assisted laparoscopic radical prostatectomy by preserved bladder neck.

potential confounders, linear regression (approximately normal outcomes), logistic regression (binary outcomes), and robust linear regression (non-normal outcomes) were used to compare outcomes for BNP versus ST.

3. Results

3.1. *Patient characteristics*

Age differed by technique with means of 57.1 ± 6.6 yr and 58.9 ± 6.7 yr ($p = 0.033$) for BNP and ST, respectively. The majority of the cohort was white (95%), and race did not differ by bladder neck dissection technique (Table 1). An extraperitoneal approach was performed in 50 men with previous abdominal surgery, without significant variation by bladder neck dissection technique. Furthermore, baseline urinary function, prostate-specific antigen, biopsy Gleason grade, nerve-sparing technique, prostate size, and pathologic stage grade were similar by bladder neck dissection technique. In addition, more men with clinical T1c disease underwent BNP versus ST (93.1% vs 86.0%, $p = 0.002$) (Table 1). Successful BNP accounted for 4% in the first 100 men and steadily increased to 99.1% in the last 119 men in the series (Fig. 8). As BNP technique evolved from ST, mean follow-up was shorter for BNP versus ST (387.2 vs 812.5 d; $p < 0.001$).

3.2. *Postoperative outcomes*

Perioperative complications and outcomes did not differ by bladder neck dissection technique; urine leaks, urinary retention, and bladder neck contractures were uncommon events (Table 2). One man undergoing BNP incurred a left ureteral injury due to an unrecognized complete duplication and required ureteral reimplantation. The overall positive margin rate (Table 3) was 12.8%, occurring at 10.5% in men with pT2 disease, 23.1% in pT3a, and 40.9% in pT3b disease ($p = 0.520$). Moreover, prostatic base positive-margin status was similar for men undergoing BNP versus ST (1.4% vs 2.2%; $p = 0.547$).

At 4 mo postoperatively, mean urinary function scores were higher for BNP versus ST (Table 4) at 64.6 versus 57.2 ($p = 0.037$). Similarly, 4-mo continence rates (zero pads per

Table 1 – Patient demographics and tumor characteristics

	Bladder neck preservation $n = 348$	Standard technique $n = 271$	p value
Mean follow-up (d), mean ± SD (range)	387.2 ± 297. 2 (71–1368)	812.5 ± 246.2 (102–1432)	<0.001
Age (yr), mean ± SD	57.1 ± 6.6	58.9 ± 6.7	0.033
Race, no. (%)			
White	336 (96.6)	252 (93.3)	0.083
Black	9 (2.6)	11 (4.1)	–
Other	3 (0.9)	8 (3)	–
Preoperative urinary function, mean ± SD	96.0 ± 11.4	95.2 ± 11.8	0.303
PSA, mean ± SD	5.4 ± 2.8	5.8 ± 3.6	0.295
Clinical stage, no. (%)			
T1c	322 (93.3)	233 (86.0)	0.002
T2	26 (6.7)	38 (14.0)	–
Gleason grade (biopsy), no. (%)			
3 + 2	4 (1.1)	0	0.805
3 + 3	214 (61.4)	175 (64.6)	–
3 + 4	90 (25.8)	54 (20)	–
4 + 3	28 (8)	27 (10)	–
4 + 4	7 (2.0)	14 (5.2)	–
3 + 5	3 (0.8)	0	–
4 + 5	2 (0.6%)	0	–
5 + 4	0	1 (0.4)	–

SD = standard deviation; PSA = prostate-specific antigen.

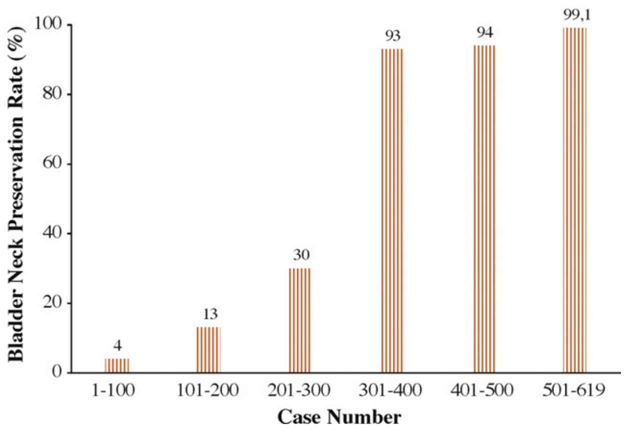


Fig. 8 – Progression of successful bladder neck preservation through the surgical series ($p < 0.001$).

day) were significantly higher for BNP versus ST (65.6% vs. 26.5%, $p < 0.001$). While urinary function and continence rates were similar at 12 mo, mean urinary function scores at 24 mo were significantly higher for BNP versus ST (94.1 vs. 86.8, $p < 0.001$). However, 24-mo continence rates were similar (>96%; $p = 0.308$) for both techniques.

4. Discussion

Bladder neck dissection is one of the most difficult steps for those transitioning from open to minimally-invasive approaches to radical prostatectomy [12]. While other steps of RALP diminished in complexity over the first 50 cases, the requisite time for bladder neck dissection increased [13]. The absence of tactile sensation and unfamiliar laparoscopic anatomy may prove challenging for those inexperienced with minimally-invasive approaches to radical prostatectomy as evidenced by the wide variation in techniques to

Table 2 – Perioperative outcomes

	Bladder neck preservation $n = 348$	Standard technique $n = 271$	p value
Estimated blood loss (ml), mean ± SD	183.7 ± 95.8	224.6 ± 108.0	0.938
Operative time (min), mean ± SD	152.8 ± 41.7	189.0 ± 42.1	0.460
Length of stay (d), mean ± SD	1.2 ± 0.76	1.3 ± 1.03	0.792
Length of catheterization (d), mean ± SD	7.7 ± 2.44	8.0 ± 3.97	0.996
Urinary retention*, no. (%)	14 (4)	6 (2.2)	0.256
Bladder neck contracture, no. (%)	4 (1.1)	2 (0.7)	0.701
Urine leak, no. (%)	10 (2.8)	4 (1.5)	0.288
Ureteral injury, no. (%)	1** (0.3)	0	0.436

SD = standard deviation.
* Urinary retention defined as failure of voiding trial necessitating reinsertion of urethral catheter.
** Presence of duplicated system on side of injury.

Table 3 – Nerve-sparing and pathologic features by bladder neck dissection technique

	Bladder neck preservation $n = 348$	Standard technique $n = 271$	p value	Overall
Bilateral NS*	254 (80.2)	215 (76)	0.400	
Unilateral NS*	52 (15.6)	37 (13.8)		
None, no. (%)	28 (8.4)	16 (6)		
Gland size (pathology), mean ± SD	54.4 ± 20.2	56.3 ± 21.9	0.503	–
Pathologic Gleason grade, no. (%)**				
3 + 2	0	2 (0.7)	0.708	2 (0.3)
3 + 3	144 (41.3)	122 (45.0)	–	266 (42.9)
3 + 4	138 (39.6)	90 (33.3)	–	228 (36.8)
3 + 5	2 (0.6)	1 (0.4)	–	3 (0.5)
4 + 3	47 (13.5)	32 (11.8)	–	79 (12.7)
4 + 4	10 (2.9)	11 (4.1)	–	21 (3.4)
4 + 5	5 (1.4)	9 (3.3)	–	14 (2.7)
5 + 3	0	1 (0.4)	–	1 (0.16)
Pathologic stage**				
pT2	296 (85.1)	232 (85.6)	0.161	528 (85.2)
pT3a	38 (10.9)	26 (9.6)	–	64 (10.3)
pT3b	12 (3.4)	10 (3.8)	–	22 (3.5)
Positive margins, no. (%)				
pT2	27 (9.2)	28 (12.1)	0.520	55 (10.5)
pT3a	9 (23.7)	6 (22.2)	–	15 (23.1)
pT3b	6 (50)	3 (30)	–	9 (40.9)
Positive margin at prostate base, no. (%)	5 (1.4)	6 (2.2)	0.547	11 (1.8)
Positive margins (overall), no. (%)	42 (12.1)	37 (13.7)	0.567	79 (12.8)

NS = nerve sparing; SD = standard deviation.
*17 men with missing NS information; **6 men were staged as pT0.

Please cite this article in press as: Freire MP, et al., Anatomic Bladder Neck Preservation During Robotic-Assisted Laparoscopic Radical Prostatectomy: Description of Technique and Outcomes, Eur Urol (2009), doi:10.1016/j.eururo.2009.09.017

Table 4 – Comparison of patient self-reported postoperative recovery of urinary function and continence (zero pads per day)

Postoperative time (mo)	Sample size		Urinary function Mean ± SD			Continence* rate (%) Mean ± SD		
	Bladder neck preservation	Standard technique	Bladder neck preservation	Standard technique	*p* value	Bladder neck preservation	Standard technique	*p* value
4	224	223	64.6 ± 25.9	57.2 ± 24.1	0.037	65.6	26.5	<0.001
12	125	247	80.6 ± 18.7	79.0 ± 19.4	0.495	86.4	81.4	0.303
24	42	128	94.1 ± 10.6	86.8 ± 12.6	<0.001	100	96.1	0.308

SD = standard deviation.
*Continence defined as zero pads per day or pad free.

facilitate this step [4,14]. For instance, Garrett et al use a Lowsley retractor to elevate the bladder neck to define the prostate-vesical junction [15], while others recommended intraoperative ultrasonography [16] or simultaneous use of cystoscopy to help identifying the bladder neck [5]. Once the plane of incision has been identified, exposure may prove difficult. Others employ an additional suprapubic puncture site to snare the catheter tip with a suture that places tension on the catheter, thereby improving exposure and allowing the surgeon and assistant to keep their instruments free to work at the point of bladder neck dissection [17].

BNP is one variation of the bladder neck dissection that has been associated with several advantages over the ST, including a lower risk of bladder neck contracture [18] and lower rates of ureteral injury [14]. In addition, a large bladder neck requires time-consuming, reconstructive tapering and may be more susceptible to anastomotic leak due to the longer suture line.

Our paper has several notable findings. First, we present anatomic landmarks and technical modifications that lead to consistent bladder neck sparing with minimization of monopolar cautery. BNP was performed with more consistency over time and plateaued after approximately 300 cases. The premise of our technique is sharp cold-scissor dissection of natural tissue planes rather than use of monopolar energy or ultrasonic shears to create surgical planes. With monopolar electrosurgery, the patient is a part of the electrical circuit, and the path of the current may not correlate with anatomic distances [19]. Conversely, bipolar electrosurgery eliminates the patient from the circuit. The use of thermal energy during bladder neck transection is common, and the cautery tip may come within millimeters of the prostatic vascular pedicle [20]. While the prostate vascular pedicles may serve as a heat sink for energy sources [20], a study of the use of energy in proximity to the periprostatic neurovascular bundle in canines demonstrated diminished erectile function [19]. Furthermore, we use the fat pad of Whitmore as the posterolateral limit of the bladder neck dissection, as it is located in close proximity to the prostatic vascular pedicle and neurovascular bundle components. Finally, while our one-handed assistant technique of creating Foley catheter tension to elevate the prostate may not be superior to other described techniques, it is efficient and does not employ additional surgical steps or instrumentation.

Second, our technique of BNP versus nonpreservation is associated with improved early and late urinary function and better early continence. The discordance between 24-mo urinary function scores parallels the finding of Krupski et al that dichotomizing by pad use may not accurately portray continence, and continuous urinary function scores more accurately reflect health-related quality of life [21]. However, postoperative continence is frequently reported with such definitions as "socially dry" and "security liner" composed of one pad or more, which makes comparison between series more difficult [17,21]. Using a continence definition of no pad use, BNP versus ST was associated with better continence rates at 4 mo, while late continence was similar. Moreover, we identified improved early and late (4 and 24 mo) urinary function scores in men following RALP with BNP using a self-reported, validated quality-of-life instrument. Our results are consistent with the findings of others reporting better early continence with BNP during open radical prostatectomy BNP [22–25]. Additionally, earlier recovery of urinary function enhances quality of life [24].

It has been suggested that preservation of the bladder neck has no effect on continence but may instead compromise cancer control by increasing the likelihood of positive margins at the prostate base [26–28], adversely affecting cancer control [29]. However, we did not observe an increased risk of positive margins at the prostate base with BNP. Similar equivalent findings regarding cancer control have been reported for open radical prostatectomy BNP [18,22,23,30].

Our findings should be interpreted in the context of the study design. First, progression through the learning curve affects outcomes such as operative time and blood loss. While absence of bladder neck reconstruction decreases operative time, we concede that variation in bladder neck dissection technique is not solely responsible for shorter operative times and lower blood loss, and therefore we adjusted for temporal trends and potential learning curve effects that may influence these outcomes. However, the complication and positive margin rates were similar by bladder neck dissection surgical technique. Moreover, the study was performed over a relatively short period of time (3.5 yr) by the same surgeon. Second, we had loss to follow-up, which is inevitable with patient travel to a tertiary referral center. Finally, this was not a randomized study, which is difficult to conduct with single-surgeon series and technique modifications, as a surgeon may develop bias and habits in surgical technique that preclude reversion to a past technique, namely, ST of bladder neck dissection.

Please cite this article in press as: Freire MP, et al., Anatomic Bladder Neck Preservation During Robotic-Assisted Laparoscopic Radical Prostatectomy: Description of Technique and Outcomes, Eur Urol (2009), doi:10.1016/j.eururo.2009.09.017

5. Conclusions

Our technique of anatomic BNP is consistently reproducible and improves urinary function and continence without compromising cancer control.

Author contributions: Marcos P. Freire had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Freire, Hu.
Acquisition of data: Lei, Freire, Weinberg, Hu, Lyn.
Analysis and interpretation of data: Hu, Freire, Lipsitz, Soukup.
Drafting of the manuscript: Freire, Hu, Prasad.
Critical revision of the manuscript for important intellectual content: Hu.
Statistical analysis: Lipsitz, Soukup.
Obtaining funding: None.
Administrative, technical, or material support: None.
Supervision: Hu.
Other (specify): Art: Korkes.

Financial disclosures: I certify that all conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript (eg, employment/affiliation, grants or funding, consultancies, honoraria, stock ownership or options, expert testimony, royalties, or patents filed, received, or pending), are the following: None.

Funding/Support and role of the sponsor: None.

Appendix A. Supplementary data

The Surgery in Motion video accompanying this article can be found in the online version at doi:10.1016/j.eururo.2009.09.017 and via www.europeanurology.com. Subscribers to the printed journal will find the Surgery in Motion DVD enclosed.

References

[1] Hu JC, Wang Q, Pashos CL, Lipsitz SR, Keating NL. Utilization and outcomes of minimally invasive radical prostatectomy. J Clin Oncol 2008;10;26:2278–84.
[2] Herrell SD, Smith Jr JA. Robotic-assisted laparoscopic prostatectomy: what is the learning curve? Urology 2005;66(Suppl):105–7.
[3] Chin JL, Luke PP, Pautler SE. Initial experience with robotic-assisted laparoscopic radical prostatectomy in the Canadian health care system. Can Urol Assoc J 2007;1:97–101.
[4] Tewari AK, Rao SR. Anatomical foundations and surgical manoeuvres for precise identification of the prostatovesical junction during robotic radical prostatectomy. BJU Int 2006;98:833–7.
[5] Bird VG, Reese J, Winfield HN. Identification and dissection of bladder neck during laparoscopic radical prostatectomy. Urology 2002;60:680–1.
[6] Menon M, Shrivastava A, Kaul S, et al. Vattikuti Institute prostatectomy: contemporary technique and analysis of results. Eur Urol 2007;51:648–58, discussion 657–8.
[7] Berry AM, Korkes F, Ferreira M, Hu JC. Robotic urethrovesical anastomosis: combining running and interrupted sutures. J Endourol 2008;22:2127–9.
[8] Myers RP. Detrusor apron, associated vascular plexus, and avascular plane: relevance to radical retropubic prostatectomy–anatomic and surgical commentary. Urology 2002;59:472–9.
[9] Gil Vernet S. Morphology and function of vesico-prostato-urethral musculature. Treviso, Italy: Edizioni di Urologia; 1968. p. 334.
[10] Lepor H, Gregerman M, Crosby R, Mostofi FK, Walsh PC. Precise localization of the autonomic nerves from the pelvic plexus to the corpora cavernosa: a detailed anatomical study of the adult male pelvis. J Urol 1985;133:207–12.
[11] 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 200020;56:899–905.
[12] Ahlering TE, Skarecky D, Lee D, Clayman RV. Successful transfer of open surgical skills to a laparoscopic environment using a robotic interface: initial experience with laparoscopic radical prostatectomy. J Urol 2003;170:1738–41.
[13] Thiel DD, Francis P, Heckman MG, Winfield HN. Prospective evaluation of factors affecting operating time in a residency/fellowship training program incorporating robot-assisted laparoscopic prostatectomy. J Endourol 2008;22:1331–8.
[14] Jenkins LC, Nogueira M, Wilding GE, et al. Median lobe in robot-assisted radical prostatectomy: evaluation and management. Urology 2008;71:810–3.
[15] Garrett JE, LaGrange CA, Chenven E, Strup SE. Use of Lowsley tractor during laparoscopic prostatectomy to reduce urethrovesical anastomotic tension. J Endourol 2006;20:220–2.
[16] Ukimura O, Gill IS, Desai MM, et al. Real-time transrectal ultrasonography during laparoscopic radical prostatectomy. J Urol 2004;172:112–8.
[17] 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;55:1358–67.
[18] Licht MR, Klein EA, Tuason L, Levin H. Impact of bladder neck preservation during radical prostatectomy on continence and cancer control. Urology 1994;44:883–7.
[19] Ong AM, Su LM, Varkarakis I, et al. Nerve sparing radical prostatectomy: effects of hemostatic energy sources on the recovery of cavernous nerve function in a canine model. J Urol 2004;172:1318–22.
[20] Khan F, Rodriguez E, Finley DS, Skarecky DW, Ahlering TE. Spread of thermal energy and heat sinks: implications for nerve-sparing robotic prostatectomy. J Endourol 2007;21:1195–8.
[21] Krupski TL, Saigal CS, Litwin MS. Variation in continence and potency by definition. J Urol 2003;170:1291–4.
[22] Gomez CA, Soloway MS, Civantos F, Hachiya T. Bladder neck preservation and its impact on positive surgical margins during radical prostatectomy. Urology 1993;42:689–93, discussion 693–4.
[23] Soloway MS, Neulander E. Bladder-neck preservation during radical retropubic prostatectomy. Semin Urol Oncol 2000;18:51–6.
[24] Selli C, De Antoni P, Moro U, Macchiarella A, Giannarini G, Crisci A. Role of bladder neck preservation in urinary continence following radical retropubic prostatectomy. Scand J Urol Nephrol 2004;38:32–7.
[25] Lowe BA. Comparison of bladder neck preservation to bladder neck resection in maintaining prostatectomy urinary continence. Urology 1996;48:889–93.
[26] Marcovich R, Wojno KJ, Wei JT, Rubin MA, Montie JE, Sanda MG. Bladder neck-sparing modification of radical prostatectomy adversely affects surgical margins in pathologic T3a prostate cancer. Urology 2000;55:904–8.

[27] Katz R, Salomon L, Hoznek A, de la Taille A, Antiphon P, Abbou CC. Positive surgical margins in laparoscopic radical prostatectomy: the impact of apical dissection, bladder neck remodeling and nerve preservation. J Urol 2003;169:2049–52.

[28] Srougi M, Nesrallah LJ, Kauffmann JR, Nesrallah A, Leite KR. Urinary continence and pathological outcome after bladder neck preservation during radical retropubic prostatectomy: a randomized prospective trial. J Urol 2001;165:815–8.

[29] Aydin H, Tsuzuki T, Hernandez D, Walsh PC, Partin AW, Epstein JI. Positive proximal (bladder neck) margin at radical prostatectomy confers greater risk of biochemical progression. Urology 2004;64:551–5.

[30] Bianco FJ, Grignon DJ, Sakr WA, et al. Radical prostatectomy with bladder neck preservation: impact of a positive margin. Eur Urol 2003;43:461–6.

Please cite this article in press as: Freire MP, et al., Anatomic Bladder Neck Preservation During Robotic-Assisted Laparoscopic Radical Prostatectomy: Description of Technique and Outcomes, Eur Urol (2009), doi:10.1016/j.eururo.2009.09.017