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[Review Article]

CURRENT TECHNIQUES TO IMPROVE OUTCOMES FOR EARLY RETURN OF URINARY CONTINENCE FOLLOWING ROBOT-ASSISTED RADICAL PROSTATECTOMY

TOMOHIKO YANAGIDA, TOMOYUKI KOGUCHI, JUNYA HATA, MICHIHIRO YABE, YUICHI SATO, HIDENORI AKAIHATA, YOHEI KAWASHIMA, MASAO KATAOKA, SOICHIRO OGAWA, SHIN KUMAGAI, KEN KUMAGAI, NOBUHIRO HAGA, NOBUHIRO KUSHIDA, KEI ISHIBASHI, KEN AIKAWA and YOSHIYUKI KOJIMA

Department of Urology, Fukushima Medical University School of Medicine, Fukushima, Japan

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Abstract : Although open retropubic radical prostatectomy has been the most commonly used surgical technique for patients with localized prostate cancer for decades, robot-assisted radical prostatectomy (RARP) has recently become an alternative option and widely used in Japan as well as around the world. RARP has been shown to have higher postoperative continent rates than retropubic and laparoscopic radical prostatectomy ; however, urinary incontinence has remained one of the most significant causes for concern among patients who seek surgical treatment for prostate cancer, even after the introduction of RARP. The literature has shown that certain technical modifications to improve urinary continence are advocated as potential aids to reduce the risk of urinary incontinence after RARP. These modifications might be divided into 3 categories to realize the improvement of early return of urinary continence after RARP : 1) preservation, 2) reconstruction, and 3) reinforcement of the anatomic structures in the pelvis, which will make a new supporting system after radical prostatectomy. In this review, we discuss the intraoperative techniques to improve outcomes for early return of urinary continence following RARP, and provide a critical summary of current knowledge on its outcome in the literature.

Key words : robotic surgery, prostatectomy, prostate cancer, urinary continence

INTRODUCTION

Recent concern about radical prostatectomy for the patients with prostate cancer has been focused on not only cancer control but also the need to improve the postoperative quality of life (QOL) of the patients. Robot-assisted radical prostatectomy (RARP) has recently become widely used in Japan as well as around the world. Systematic reviews and meta-analysis of studies have demonstrated that RARP was superior in terms of continence and potency outcomes as well as transfusion rate to retropubic (RRP) or laparoscopic radical prostatectomy (LRP), but not in terms of positive surgical margin[1-4]. Reported continence rates at 12 months in a contemporary RARP series range from 82.1% to 97%[5,6]. However, postoperative early urinary incontinence has remained one of the most bothersome postoperative complications. The advantage of RARP is that it is associated with unlimited potential to develop further modifications to improve urinary continence outcome because of its greater simplification and precision of exposure and suturing compared with RRP and LRP.

The basic concept of the intraoperative technique to improve postoperative urinary continence is to maintain as normal anatomical and functional structure in the pelvis as possible[7]. It may be necessary to conduct three steps to realize improvement of the early return of urinary continence after

Corresponding author : Yoshiyuki Kojima, MD E-mail : ykojima@fmu.ac.jp
https://www.jstage.jst.go.jp/browse/fms http://www.fmu.ac.jp/home/lib/F-igaku/

RARP : preservation (bladder neck, neurovascular bundle, puboprostatic ligament, pubovesical complex, and/or urethral length, etc.), reconstruction (posterior and/or anterior reconstruction, and/or etc.) and reinforcement (bladder neck plication and/or sling suspension, etc.). On the basis of these steps, further modifications during RARP should be developed to improve urinary continence and quality of life (QOL) after RARP[7]. In this review, we discuss the intraoperative techniques to improve outcomes for early return of urinary continence following RARP, and provide a critical summary of current knowledge on its outcome in the literature.

1. PRESERVATION

As described above, preservation of normal anatomical and functional structure in the pelvis as possible is the most important to improve postoperative urinary continence. Some reports showed that the preservation of bladder neck, neurovascular bundle, puboprostatic ligament, pubovesical complex, and/or urethral length, etc. could provide early return of urinary continence.

1) Bladder neck preservation (Fig. 1)

Careful dissection of the prostatovesical junction can maintain most of the circular muscle fibers of the bladder neck, accelerating the return of urinary continence. There are several procedures in the dissection between prostate and bladder, including anterior, lateral and anterolateral approaches. To achieve bladder neck preservation, the bladder neck should be sharply dissected off the base of the prostate to preserve the bladder neck circular fibers, regardless of the approach used.

Some noted an earlier return of urinary continence with preservation of the bladder neck during RRP, while others disputed this view[8,9]. You *et al.* reported that bladder neck preservation and posterior urethral reconstruction during RARP showed a favorable impact on the early postoperative recovery of continence while not affecting positive surgical margins[10]. Freire *et al.* described an anatomic, reproducible technique of bladder neck preservation during RARP in detail[11]. Anterocephalad tension on the bladder is created using the fourth arm to retract the anterior dome of the bladder. This motion

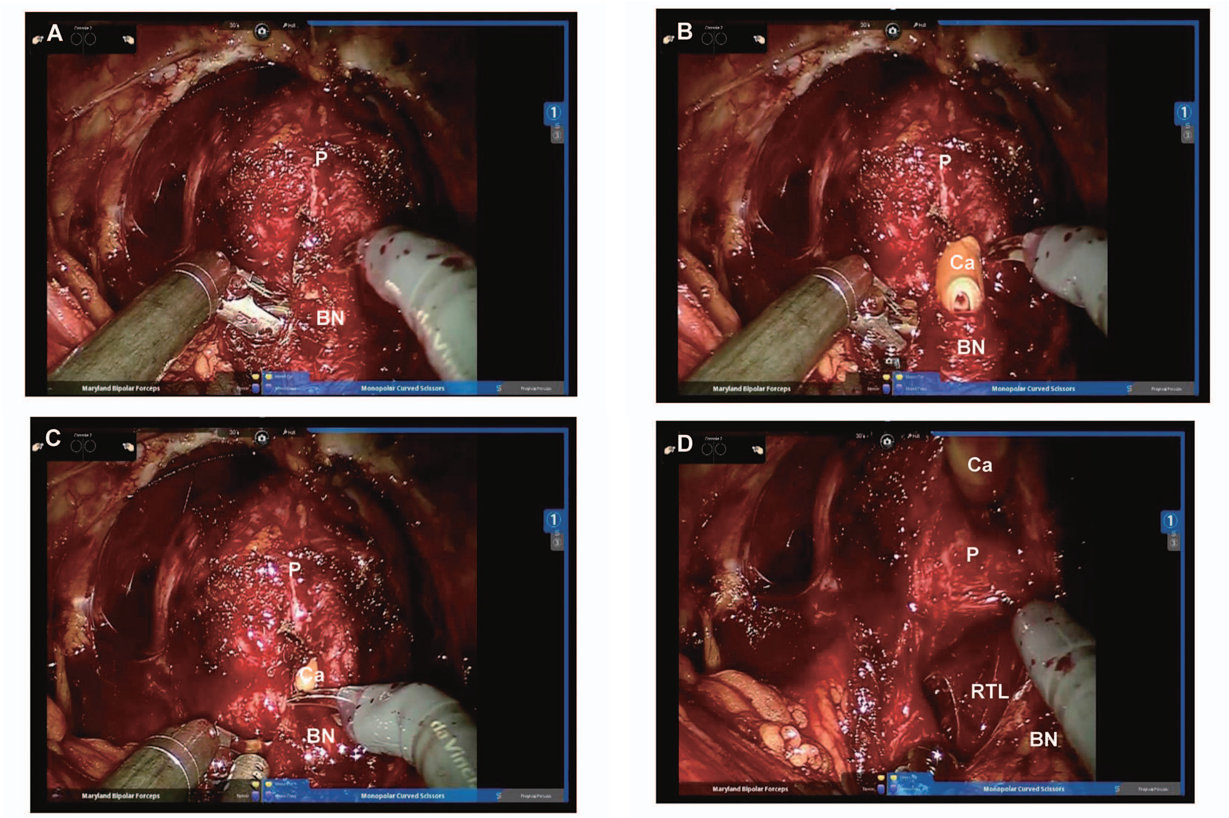

Fig. 1. Bladder neck preservation technique. A : Blunt dissection around bladder neck and exposure of funneled bladder neck. B : Cut of the anterior lip of the bladder neck. C : Cut of the posterior lip of the bladder neck. D : Blunt dissection of retrotrigonal layer. P : prostate. BN : bladder neck. Ca : catheter. RTL : retrotrigonal layer.

facilitates the subsequent dissection because it makes a landmark for the incision point of the bladder neck dissection and constant tension throughout the bladder neck dissection. In addition, cold scissor dissection and selective use of bipolar energy to control bleeding are emphasized during bladder neck dissection. Avoiding the use of monopolar cautery reduces the amount of tissue charring, and, as a result, preserves visualization of the native anatomy, allows for identification of bladder muscle fibers, and enables preservation of a funneled bladder neck[11]. The posterior bladder neck should be incised precisely, maintaining a clean detrusor margin for the subsequent urethrovesical anastomosis[12].

Freire *et al.* demonstrated that bladder neck preservation versus standard technique continence rates at 4, 12 and 24 months were 65.6% versus 26.5% ($p<0.001$), 86.4% versus 81.4% ($p=0.303$), and 100% versus 96.1% ($p=0.308$), respectively[11]. Importantly, the overall positive margin rate did not differ at the prostate base for bladder neck preservation versus standard technique (1.4% vs. 2.2%). They concluded that the bladder neck preservation technique improves urinary continence without compromising cancer control. Choi *et al.* also reported that the bladder neck preservation technique resulted in higher the Expanded Prostate Cancer Index Composite (EPIC) urinary function scores at 4 and 24 months[13]. However, the lack of a randomized study on this issue precludes definitive conclusions being drawn.

Friedlander *et al.* compared the continence and cancer control outcomes of bladder neck sparing vs nonsparing techniques during RARP. They showed that bladder neck sparing is associated with fewer urinary leak complications, shorter hospitalization and better post-prostatectomy continence without compromising cancer control compared to bladder neck nonsparing[14].

Lee *et al.* have recently described the degrees of robot-assisted bladder neck preservation they have encountered, and determined the effect of increasing bladder neck preservation on postoperative continence[15]. All bladder neck dissections were graded between 1 and 4 ; higher grades corresponded to an increasing degree of robot-assisted bladder neck preservation. A higher proportion of patients were continent at 3 months postoperatively who received grade 4 compared with grade 1 ($p=0.043$; $p=0.001$) and grade 2 ($p=0.006$; $p=0.009$) ; and grade 3 compared with grade 1 ($p=0.048$; $p=0.002$) and grade 2 ($p=0.009$; $p=0.030$) bladder neck preservation. There was no difference among the four groups in positive surgical margin rates ($p=0.946$). They concluded that an increasing degree of bladder neck preservation is associated with an earlier return to continence, without compromising oncologic outcomes[15].

2) Nerve preservation (Fig. 2)

As described above, the rhabdosphincter receives nerve fibers from the pelvic nerve and dual innervation from an intrapelvic branch and a perineal branch of the pudendal nerve. Preservation of an intrapelvic branch of the pudendal nerve has been shown to improve and maintain rhabdosphincter function after RRP[16]. However, although there is clear evidence that a neurovascular bundle-sparing technique has an advantage for preservation of postoperative potency, there is controversy over whether preservation of nerves around the bladder, prostate and urethra results in improvement of urinary continence after RARP.

Tseng *et al.* conducted a multivariate analysis of an initial cohort of RARP patients and found in their series that nerve-sparing technique was not significantly associated with the time to recovery of continence[17]. Pick *et al.* evaluated associations between nerve-sparing status during RARP and return of continence[18]. No significant difference was found in continence rates at 12 months after RARP among bilateral nerve-sparing, unilateral nerve-sparing and non-nerve-sparing (89.2%, 88.9% and 84.8%, respectively), suggesting that physical preservation of the cavernosal nerves does not predict overall return to continence.

On the other hand, Ko *et al.* identified preoperative or intraoperative factors responsible for the early return of continence after RARP[19]. They indicated that the likelihood of postoperative urinary control was significantly higher in younger patients and when a nerve-sparing procedure was performed. The hazard ratio was 1.61 for partial nerve-sparing and 1.44 for bilateral nerve-sparing compared with the non-nerve-sparing group. Choi *et al.* also reported that both EPIC urinary function score and continence rates were better for bilateral nerve-sparing vs. non-nerve-sparing at 4 months, but only urinary function scores were significantly better at 12 and 24 months post-RARP [13].

Van der Poel *et al.* reported that fascia preservation at the lateral aspect of the prostate was the best predictor of urinary continence after RARP. This suggests that preservation of fascial support lateral rather than dorsolateral to the urethra and prostate may protect neurovascular structures that are im-

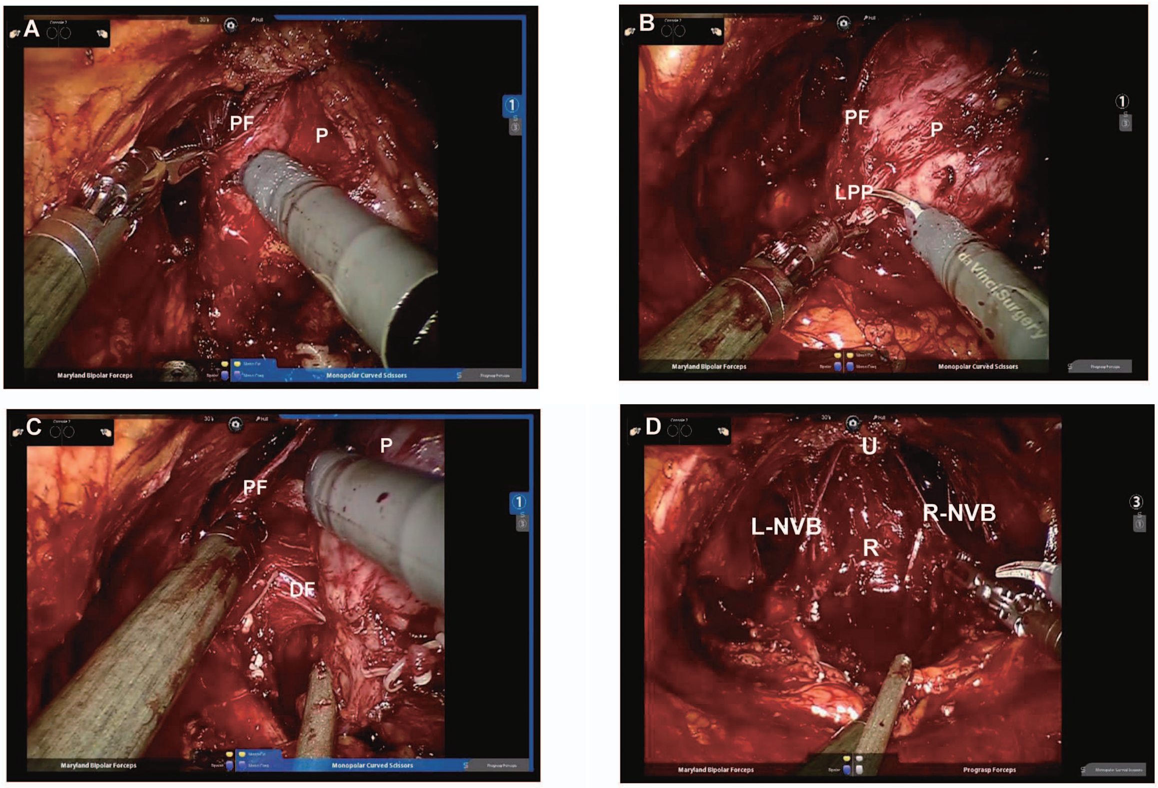

Fig. 2. Nerve-sparing technique (early retrograde release of the neurovascular bundle technique). A : with the prostate rotated laterally, the lateral prostatic facsia is incised and peeled like an onion until the identification of the neurovascular bundle. B : The lateral prostatic pedicle is cut after a hemolock clip placed above the level of the already release bundle. C : At the level of the apex and mid-portion of the prostate, the avascular plane between neurovascular bundle and prostatic fascia is developed with caution. D : bilateral nerve sparing technique. P : prostate. PF : prostatic fascia. LPP : lateral prostatic pedicle. DF : Denonvilliers' fascia. R-NVB : right neurovascular bundle. L-NVB : left neurovascular bundle. R : rectum. U : urethra.

portant for improving postoperative continence[20).

The magnified, well-illuminated robotic-operative field coupled with less blood loss has developed in parallel to a greater understanding of the periprostatic fascial planes, leading to differentiation of intrafascial versus interfascial nerve-sparing approaches[21)]. Xylinas *et al.* reported that 66% of the patients were continent (no pad), 12% presented a minimal SUI (1 pad), and 22% required >1 pad per day 1 month after intrafascial nerve-sparing RP with a robot-assisted extraperitoneal approach, and concluded that an intrafascial approach with robotic assistance provided satisfactory early functional results with respect to postoperative continence as well as potency[22)]. Potdevin *et al.* compared the functional outcomes of intrafascial versus interfascial procedures of nerve-sparing used during RARP, and concluded that the athermal intrafascial procedure greatly shortened the time to return of continence following RARP (continence rates at 1, 3 and 6 months : 27.3%, 68.8% and 93.5% after the interfascial procedure ; and 68.6%, 84.3% and 92.9% after the intrafascial procedure, respectively)[23)].

Srivastava et al have evaluated the effect of a risk-stratified grade of nerve-sparing technique on early return of urinary continence[24)]. Early return of continence was achieved by 55.8% ; of those, 71.8% were in nerve-sparing grade 1, 54.7% were in nerve-sparing grade 2, 45.7% were in nerve-sparing grade 3, and 43.5% were in nerve-sparing grade 4 (p<0.001). On multivariate analysis, better nerve-sparing grade was a significant independent predictor of early return of urinary continence[24)].

3) *Puboprostatic ligament preservation and pubovesical complex sparing*

Some reports have asserted that puboprostatic ligament preservation improved continence results after RRP[25-27)]. This can be combined with minimizing endopelvic fascia incision during the apical dissection. In addition, preservation of the puboperinealis muscle and arcus tendineus may improve the rapidity of return of urinary continence after RARP[28,29)].

Astimakopoulos *et al.* developed a pubovesical complex-sparing technique. They described that a possible explanation of the limitation of puboprostatic ligament preservation could be that, because there was demonstrable anatomic continuity with the bladder, there were no conceivable means of preserving the pubovesical ligaments during RARP, and there must be interruption at some point to expose the pubourethral junction[30)]. In this procedure, the prostate is shelled out from underneath the spared pubovesical complex and urethrovasical anastomosis is performed under the spared complex. 80% of patients were dry (0 pads), and 20% of patients needed one security pad at catheter removal. Absolute preservation of the periprostatic anatomy may enhance early functional outcomes[30)].

4) Preservation of urethral length

Preservation of the functional sphincter mechanism is important to improve postoperative incontinence. The sphincter mechanism is comprised of an inner smooth layer and the striated urogenital sphincter muscle. The striated sphincter is functional from the prostate apex to the bulb, whereas the internal component of the distal sphincter mechanism extends to the verumontanum[31)]. Maximum preservation of not only striated sphincter but also the intraprostatic portion of the membranous urethra leads to a highly significant improvement of full continence and earlier continence[32)]. The most critical point to maintaining maximal urethral length without compromising apical margin status is to identify the junction between the prostatic apex and the proximal urethra precisely.

Preoperative MRI findings on urethral length may be useful to predict postoperative urinary continence. Hakimi *et al.* reported that longer stretched and cut urethral lengths on preoperative MRI appeared to correlate with faster return to a pad-free state, although the intraoperative urethral length did not correlate with International Consultation on Incontinence Questionnaire (ICIQ) score on univariate or multivariate analysis[31]. Nguyen *et al.* reported that shorter urethral sphincter length on preoperative endorectal MRI was associated with an increased risk of postoperative urinary incontinence as well as longer time to achieve continence, but the technical modification of anatomical reconstruction for restoring the continence mechanism could markedly improve continence outcomes in patients with a shorter urethral sphincter[33)].

2. RECONSTRUCTION

The major components of the pelvic supporting system in males are Denonvilliers' fascia, puboprostatic ligament, endopelvic fascia, levator ani muscle and arcus tendineus fascia pelvis. These components may not play a significant role in determining continence in healthy males because the prostate itself can prevent urinary incontinence. However, as the prostate is removed by radical prostatectomy (RP), these components are usually impaired. Therefore, not only preservation but also reconstruction of these systems plays a potential role to improve the recovery of urinary incontinence. Some reports showed that the posterior, anterior and total reconstruction techniques could provide early return of urinary continence.

1) Posterior reconstruction (Fig. 3)

The musculofascial plate, which is formed by the posterior median raphe with the connected rhabdosphincter, the prostate dorsal aspect and Denonvilliers' fascia play a significant role as a dynamic supporting system for the prostatomembranous urethra[34,35)]. This supporting system extends from the peritoneum of the pouch of Douglas to the perineal membrane and the central tendon of the perineum[35,36)]. Prostate removal causes the destruction of this supporting system anatomically and functionally, separates the urethral sphincter complex from the prostatic apex and Denonvilliers' fascia, and thus may result in postoperative incontinence. The reconstruction of this supporting system, which is a reapproximation of the posterior semicircumference of the rhabdosphincter to the cut edge of residual Denonvilliers' fascia, restores the anatomic and functional defect, allows firm support in the posterior aspect of the urethral sphincter complex by fixing it in the natural position, and avoids caudal retraction of the urethrosphincteric complex prior to completion of the vesicourethral anastomosis[35-37)]. It can also reduce the tension on the anastomosis itself and reduce anastomotic leakage by creation of an additional strength layer[38)]. This posterior rhabdosphincter reconstruction was first introduced by Rocco *et al.* as a modification to ameliorate urinary incontinence after RRP[37]. A recent systematic review of the literature showed that posterior reconstruction improves the early return of continence within the first 30 days after RP ($p=0.004$), while continence rates 90 days after surgery are not affected by use of the reconstruction technique. The role of reconstruction of the posterior musculofascial

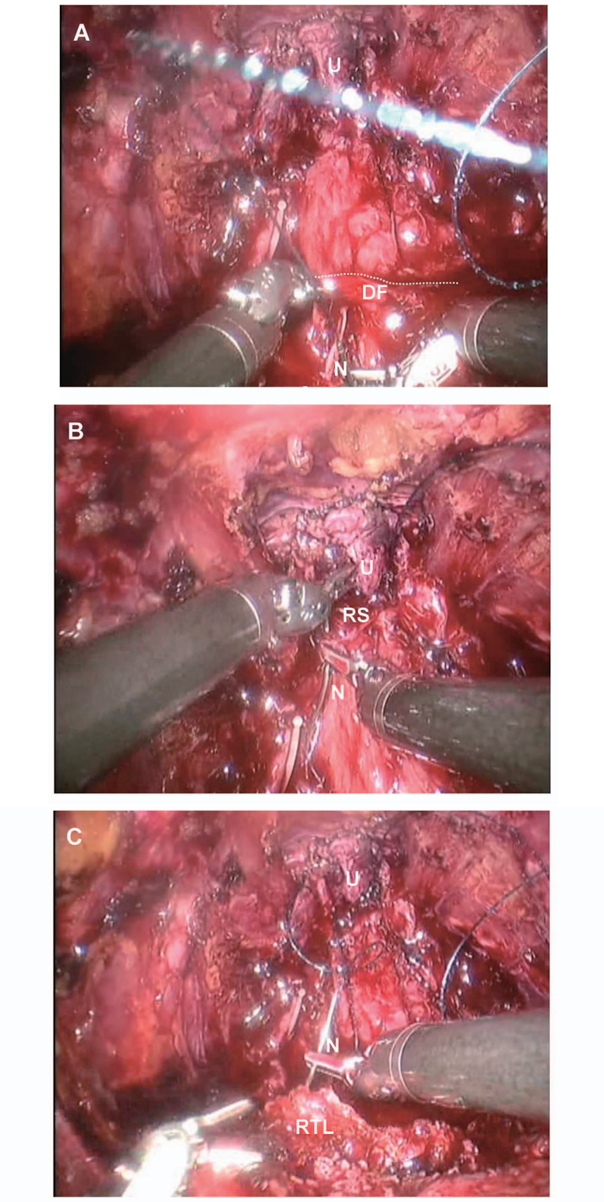

Fig. 3. Posterior reconstruction of the rhabdosphincter. A : Suture on the residual portion of Denonvilliers' fascia on the rectal plane (dotted line). B : Suture on the posterior semicircumference of the rhabdosphincter. **C** : Suture on the retrotrigonal layer. U : urethra. DF : Denonvilliers' fascia. RS : rhabdosphincter. RTL : retrotrigonal layer. N : needle.

plate in terms of earlier continence recovery is encouraging but still controversial[39].

After the introduction of posterior reconstruction, many groups have demonstrated the usefulness of posterior reconstruction during RARP to improve postoperative urinary incontinence. Nguyen *et al.* evaluated the effectiveness of posterior reconstruction in enhancing early continence after LRP and RARP[40]. At 3 days after catheter removal, more patients undergoing posterior reconstruction were continent than with the standard technique (34% versus 3%, $p=0.007$). At 6 weeks, continence was again better in the posterior reconstruction group (56% versus 17%, $p=0.006$). The reconstruction restored the length of the transected membranous urethra. Coelho *et al.* analyzed 803 consecutive patients who underwent RARP : 330 not undergoing posterior reconstruction and 473 with posterior reconstruction[41]. The posterior reconstruction technique (28.7% and 51.6%, respectively) resulted in significantly higher continence rates than the standard technique (22.7% and 42.7%, respectively) at 1 and 4 weeks after catheter removal ($p=0.048$ and 0.016, respectively). The median interval to recovery of continence was also statistically significantly shorter in the posterior reconstruction group (median : 4 weeks) than in the non-posterior reconstruction group (median : 6 weeks, $p=0.037$)[41]. Brien *et al.* reported that, at 3 months after RARP, there was a statistically significant improvement, comparing posterior reconstruction to control groups, in terms of the return to the baseline score for urinary bother (72% vs. 53% ; $p=0.008$) and urinary function (64% vs. 50% ; $p=0.05$), as well as change in absolute International Prostate Symptom Score (IPSS) (+0.2 vs. +3.8 ; $p=0.005$). Differences in urinary bother (+20% ; 95% confidence interval 5%, 34%) and IPSS (−2.8 ; 95% confidence interval, −5.4, −0.2) persisted after multivariate adjustment[42]. Gondo *et al.* have recently reported that posterior reconstruction was significantly associated with early recovery of urinary continence 1 month after catheter removal in univariate analysis[43]. Their multivariate logistic regression analysis also showed that posterior reconstruction and attempted nerve-sparing were the only independent predictive factors of urinary continence recovery 1 month after catheter removal (odds ratio [OR], 15.01, $p=0.0003$; and OR, 2.248, $p=0.0402$, respectively). They concluded that posterior reconstruction and attempted nerve-sparing were significant independent predictive factors of early recovery of urinary continence after RARP.

Fecarra *et al.* has reported that only 12.5% showed urinary incontinence after catheter removal (1-2 pads). At mean follow-up of 9 months, the urinary continence recovery was 95%[44]. They have concluded that this procedure is simple, reproducible, with a very limited increase in operative time, and with only a slight risk of potential harm to the patient. Moreover, it could improve hemostasis and provide greater support for a delicate anastomosis[44].

On the other hand, other groups have demonstrated no significant advantage in posterior reconstruction. Joshi *et al.* reported that no significant difference in any of the analyzed outcome measures was observed. Posterior reconstruction of the musculofascial complex does not appear to improve early urinary incontinence after RARP[45]. Sutherland *et al.* conducted a phase II randomized clinical trial intended to detect a 25% difference in 3-month continence outcomes defined by a patient response of 0 or 1 to question 5 of the EPIC urinary domain, comparing the standard technique to posterior rhabdosphincter reconstruction[46]. In their randomized clinical trial, posterior rhabdosphincter reconstruction offered no advantage for the return of early continence after RARP. Menon *et al.* also found no improvement in continence rates with reconstruction of the posterior rhabdosphincter and puboprostatic collar[38].

2) Anterior retropubic suspension (Fig. 4)

Walsh *et al.* described the pubourethral suspension technique in RRP, which can help control venous bleeding and can provide recapitulation of the puboprostatic ligaments, supporting the striated sphincter[47]. The theorized mechanism on continence of anterior suspension technique is that it provides anatomical support for the urethra, improvement of the urethral length during the apex dissection, and stabilizing the urethra and the striated sphincter in an anatomical position[48]. An anterior suspension stitch has been used after dorsal vein complex ligation. A monofilament suture is usually passed from the right to the left between the urethra and the dorsal vein complex, and then through the periosteum on the pubic bone. This can be done as a simple stitch or in a figure-of-eight fashion and then tied.

Patel *et al.* reported that the suspension technique (92.8%) resulted in significantly greater continence rates at 3 months after RARP than a non-suspension technique (83%, p=0.013)[49]. The median/mean interval to recovery of continence was also statistically significantly shorter in the suspension group (median : 6 weeks ; mean : 7.338 weeks) than in the nonsuspension group (median : 7 weeks ; mean : 9.585 weeks, p=0.02), suggesting that the suspension stitch during RARP resulted in a statistically significantly shorter interval to recovery of continence and higher continence rates at 3 months after the procedure[49].

Some researchers attempted anterior suspen-

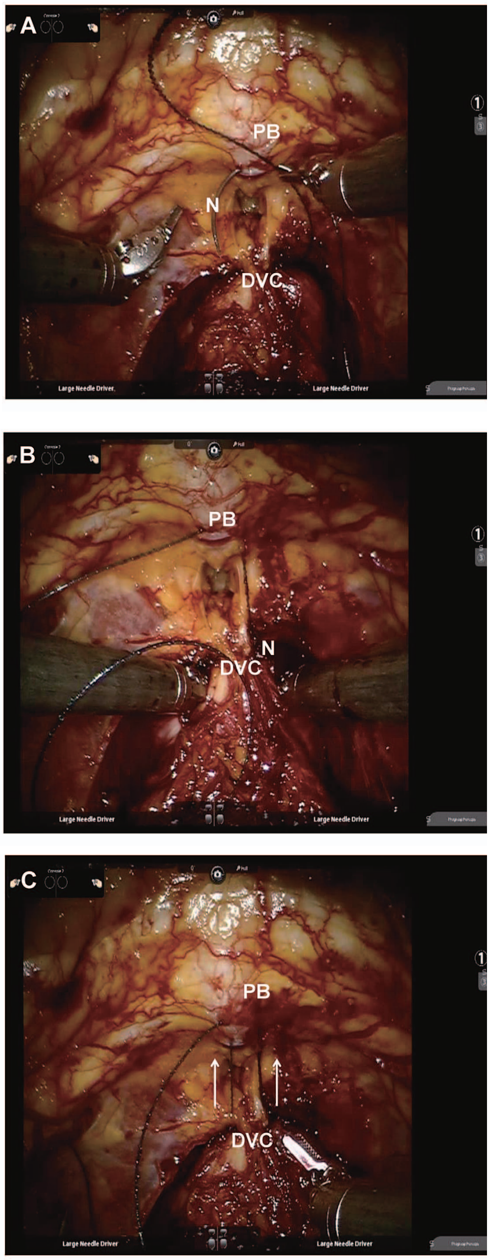

Fig. 4. Anterior retropubic suspension technique. A : A monofilament suture is passed through the periosteum on the pubic bone. B : The suture is passed from the left to the right between the urethra and the dorsal vein complex. C : Final stitch tied and anterior suspension of dorsal vein complex (arrows). PB : pubic bone. DVC : dorsal vein complex. N : needle.

sion combined with posterior reconstruction, and demonstrated that this technique improved the early return of continence[48,50,51]. Hurtes *et al.* have recently reported that the continence rates in anterior suspension combined with posterior reconstruction (26.5% and 45.2%, respectively) at 1 and 3 months after RARP were statistically significantly higher than with the standard technique (7.1% and 15.4% ;

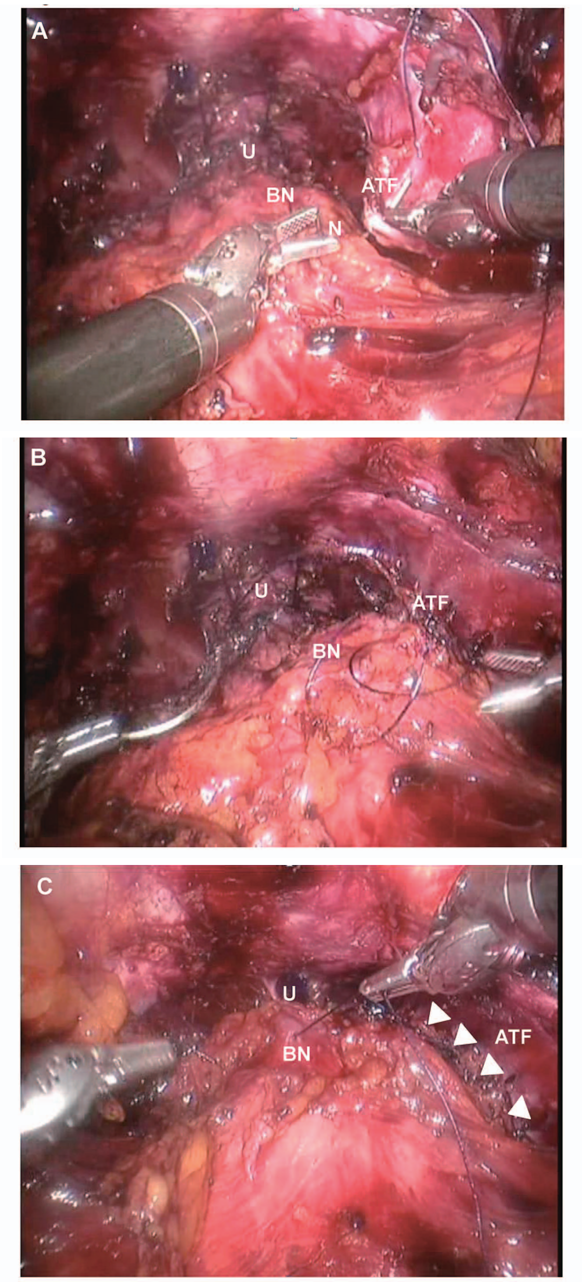

Fig. 5. Reattachment of the arcus tendineus to the bladder neck. A : Anatomic reapproximation between the bladder neck and the arcus tendineus. B : Suture between the bladder neck and the arcus tendineus. C : Reattachment (arrowheads) of the right arcus tendineus to the bladder neck. U : urethra. BN : bladder neck. ATF : arcus tendineus fascia of the pelvis. N : needle.

p=0.047 and p=0.016, respectively)[48]. Atug *et al.* also reported that patients undergoing the combined technique had higher early continence rates than patients undergoing the standard technique[50].

3) Total reconstruction of the vesicourethral junction

Tewari *et al.* described a novel technique of total vesicourethral reconstruction to achieve early urinary continence[51]. This technique has the following components : (a) minimal distal incision of the endopelvic fascia, (b) preservation of the puboperinealis, (c) preservation of puboprostatic ligaments, (d) placement of a puboprostatic ligament-sparing dorsal venous suture, (e) watertight anastomosis, (f) refixation of the puboprostatic ligaments to the anterior aspect of the vesicourethral anastomosis, and (g) reattachment of the arcus tendineus to the lateral aspect of the bladder neck (Fig. 5)[28]. They demonstrated that the continence rates for the total reconstruction technique were 38%, 83%, 91%, and 97% at 1, 6, 12, and 24 weeks, respectively, and this technique provided a statistically significant early return to continence compared with the standard technique or with only the anterior reconstructive technique[52]. They have also reported a modification of total reconstruction with the additions of a circumapical urethral dissection, a dynamic detrusor cuff trigonoplasty, and placement of a suprapubic catheter[53]. Of the initial 23 patients receiving the modified total reconstruction, 60.9% had 0 pad use at 6 weeks. By 2 weeks, 65.4% of the most recent 26 patients operated on achieved continence with 0-1 pad use. They concluded that this technique not only hastens continence, but also that a significant level can be achieved within 2 weeks.

3. REINFORCEMENT

In addition to preservation and reconstruction, reinforcement of the anatomical and functional structures in the pelvis may provide additional support to avoid postoperative urinary incontinence.

1) Bladder neck plication (Fig. 6)

The bladder neck plication technique is a simple and effective technical modification for shortening the period of recovery of urinary continence in RARP patients[54]. In this technique, the anterior bladder plication stitch is positioned 2 cm proximal to the vesicourethral anastomosis at 3 o'clock and 9 o'clock. When tied securely, this creates funneling of the distal bladder neck. The mean time to total continence was significantly shorter than that with no stitch technique (5.10 ± 3.80 vs. 8.49 ± 6.32 weeks, respectively ; p=0.002). The likelihood of total continence improved with the bladder plication stitch : odds ratios of 1.95 ± 0.72 (p<0.001) at 1 month, 1.25 ± 0.56 (p=0.113) at 3 months, and 2.07 ± 0.66 (P=0.005) at 12 months[54]. The bladder neck stitch may decrease the amount of stretch on

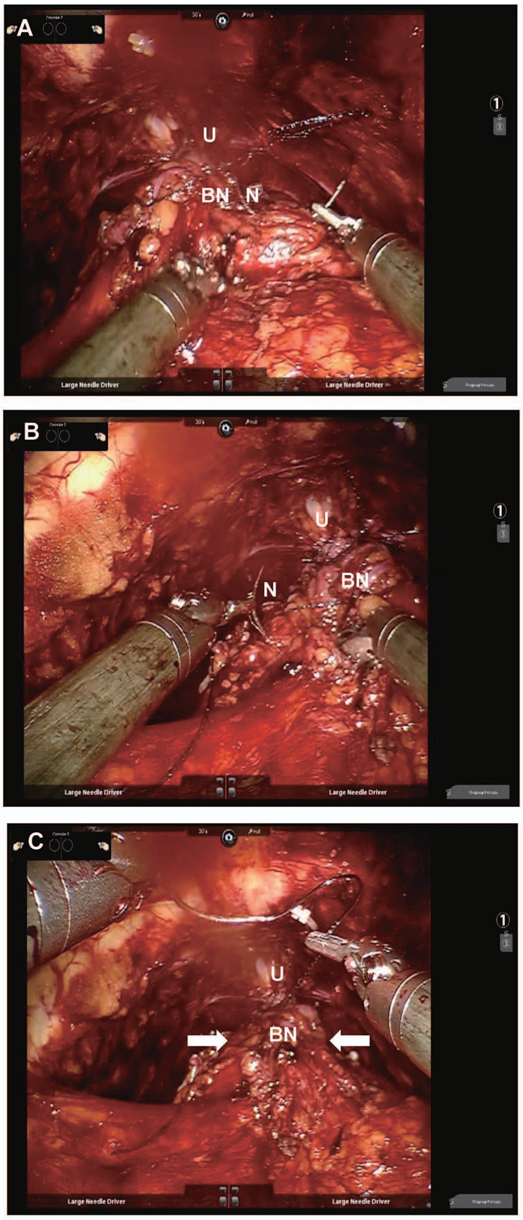

Fig. 6. Bladder neck plication technique. Anterior bladder plication stitch positioned 2 cm proximal to the vesicourethral anastomosis at 3 o'clock (A) and 9 o'clock (B). **C** : When tied securely, this creates funneling of the distal bladder neck (arrows). U : urethra. BN : bladder neck. N : needle.

the bladder neck and sphincter at rest, increase the functional length of the urethra, and improve urinary continence.

2) Bladder neck sling suspension (Fig. 7)

Bladder neck sling suspension procedures, which have been used for the management of female stress urinary incontinence, can support the proximal urethra and bladder neck, and as a result, provides a direct compressive force on the urethra/blad-

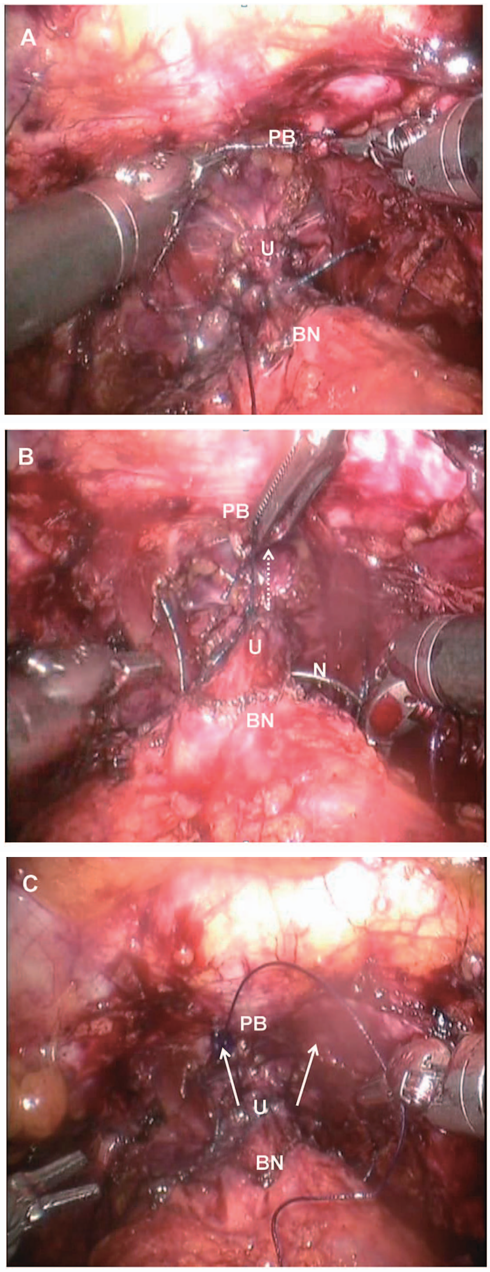

Fig. 7. Bone-anchored bladder neck sling suspension technique. A : A CT-1 needle with 2-0 vicryl is passed and fixed at the posterior part of the pubic bone in the periosteum. B : the 4th arm, using grasping forceps to hold the suture thread, serves as vesicourethral anastomosis, and is locked in position to place the suture thread on anterior traction (dotted arrow). The needle is passed between the bladder neck and reconstructed Denonvilliers' fascia. C : The needle is passed and fixed to the pubic bone again with as much tension as possible, and the bladder neck is elevated toward the pubic bone (arrows). PB : pubic bone. U : urethra. BN : bladder neck. N : needle.

der outlet, increasing the functional length of the urethral sphincteric complex and potentially reestablishing and reinforcing the suburethral tissue used as a backboard for urethral closure. We applied this concept for the prevention of urinary incontinence during RARP[55,56]. The IPSS ($p<0.05$) and ICIQ-SF ($p<0.05$) in the sling group were significantly lower and EPIC urinary incontinence score ($p<0.05$) in the sling group was higher than those in non-sling group 4 weeks after RARP. In addition, mean pad weight gain on 1-hour pad test in the sling group was significantly smaller than that in the non-sling group 4 weeks after RARP ($p<0.05$). Valsalva maneuver during cystography demonstrated that the mean posterior urethrovesical angle in the sling group was smaller than that in the non-sling group ($p<0.001$). Bladder neck sling suspension technique is a simple and feasible procedure in RARP, and can improve the early return of continence after RARP[55,56].

CONCLUSIONS

Robot-assisted laparoscopic surgery has gained enormous popularity in urological field. It has several advantages over conventional laparoscopic surgery, with the main advantage being simplification and precision of exposure and suturing because of allowing movements of the robotic arm in real time with increased degree of freedom and magnified 3-dimentional view. These features render RARP ideal to produce the modifications to improve urinary continence[57,58]. Although subsequent efforts to improve postoperative urinary incontinence have led to many modifications in surgical techniques since the introduction of RARP, clear evidence of improvement of the early return of urinary continence by these modifications has remained controversial. Robotic surgery has provided a revolutionary advance for RP and greatly benefits for patients with prostate cancer. We should make a sustained effort to develop new procedures until complete continence after RARP is achieved in each patient[56].

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