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Posterior, Anterior, and Periurethral Surgical Reconstruction of Urinary Continence Mechanisms in Robot-assisted Radical Prostatectomy: A Description and Video Compilation of Commonly Performed Surgical Techniques

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

Abstract

Background: Robot-assisted radical prostatectomy (RARP) is hampered by side effects that may have a serious impact on quality of life, particularly stress urinary incontinence. Continence rates may be improved by surgical reconstruction of the pelvic floor.
Objective: Video illustrations of different surgical techniques may be particularly worthwhile for practicing urologists in understanding the pelvic-floor anatomy and in the training of residents and fellows in urology.
Design, setting, and participants: We describe and video-illustrate commonly performed pelvic reconstructive techniques in RARP, as performed by experts in the field.
Surgical procedure: Surgical techniques have been described, such as posterior musculofascial reconstruction, anterior reconstruction and periurethral suspension, preservation of membranous urethral lengthening, bladder-neck reconstruction, and combinations.
Measurements: An overview of continence rates of the different techniques is given.
Results and limitations: All reconstructive surgical techniques result in similar short-term continence rates and good-to-excellent outcomes 1 yr after surgery. There are only a few randomized clinical trials comparing a reconstructive technique with "no reconstruction" or a different reconstructive technique, and outcomes are conflicting.
Conclusions: Although many of the procedures report a benefit with respect to early continence, benefits seem to diminish with longer follow-up. Whether any of the reconstructive techniques is superior to another is a matter of study.
Patient summary: Early continence rates might be improved by surgical reconstruction of the pelvic floor.

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1. Introduction

Robot-assisted radical prostatectomy (RARP) is the main curative surgical approach in localized prostate cancer. The surgical procedure is, however, known to be hampered by side effects that may have a serious impact on quality of life, particularly stress urinary incontinence (SUI). The incidence of bothersome SUI has been reported in 4–31% of patients 1 yr after RARP [1].

RARP may result in severe infravesical changes. It shortens the urethral length, reduces bladder-outlet resistance, may hamper bladder-neck sphincteric function, and changes the structure and function of the urinary sphincteric complex. This urinary sphincteric complex contains periurethral smooth muscles, an omega-shaped loop of striated muscles around the membranous urethra (ie, the rhabdosphincter), and further supporting connective tissues [2]. This combined anatomical functionality is aimed to withstand increased abdominal pressure, thereby facilitating urinary continence. Multiple efforts have been made to improve continence rates by surgical reconstruction of the pelvic floor. A wide range of techniques has been described, such as posterior musculofascial reconstruction, anterior reconstruction and periurethral suspension, anatomical (total) pelvic reconstruction, preservation of membranous urethral lengthening (MUL), bladder-neck reconstruction, and combinations. The efficacy of these surgical techniques has been reported in different cohort, nonrandomized and randomized studies and a meta-analysis of posterior musculofascial reconstruction [3].

We describe and video-illustrate commonly performed pelvic reconstruction techniques in RARP, as performed by experts in the field. We also outline and compare the early and late continence rates as reported. The video illustrations may be particularly worthwhile for practicing urologists in understanding the pelvic-floor anatomy and in the training of residents and fellows in urology.

2. Patients and methods

2.1. *Selection of surgical reconstructive procedures*

The underlined pelvic-floor reconstruction techniques in RARP are selected for efficacy and demonstrated in detailed video presentations. The selection is based on the presence of a detailed anatomical description of the surgical technique in the peer-reviewed literature and/or the availability of scrutinized video illustrations (www.europeanurology.com, www.surgeryinmotion-school.org, and www.urosource.com). Special attention is given to the robot-assisted approach, as this approach is used in the majority of hospitals today and because a robotic-training program is endorsed by the European Robotic Urological Society and the European Urology Scholarship Programme.

2.2. *Description of surgical techniques*

2.2.1. *Posterior reconstruction ("Rocco" stitch)*

This procedure was first described by Rocco et al. [4] in an open approach, and was further investigated in detail in conventional laparoscopic series and in a review of literature on RARP [5,6]. The technique entails realignment of the supportive structures that lie dorsal to the bladder, prostate, and urethra. In anatomical literature, there is no consensus on the nomenclature, resulting in several terms such as Denonvilliers' fascia, the fascia of the vesicoprostatic muscle, the rhabdosphincter, or the median dorsal fibrous raphe. This technique consists of a two-layer reconstruction, the first being the realignment of the sphincteric muscle to Denonvilliers' fascia, followed by a second suture fixing the posterior bladder wall 1–2 cm dorsal and cranial to the median dorsal raphe, thereby stabilizing the sphincteric complex and preserving the urethra in its anatomic and functional position in the pelvic floor. For this procedure, it is important that the urethra itself is not involved in the reconstructive sutures. Moreover, the reconstructive suture should not run too laterally since it may damage the neurovascular bundles running lateral to the urethra. The vesicourethral anastomosis might be easier to perform after posterior reconstruction and hemostasis is improved.

2.2.2. *Periurethral suspension stitch ("Patel" stitch)*

The periurethral retropubic suspension stitch has been described by Walsh [7] in an open radical retropubic prostatectomy series, and Patel et al. [8] were the first to describe this suspension technique in RARP. The technique is based on placement of a puboperiurethral suspension stitch after ligation of the dorsal venous complex (DVC). The suture is placed between the urethra and the DVC, passed through the periosteum of the pubic bone, and back through to the DVC in multiple figure-eight loops.

2.2.3. *Anterior suspension combined with posterior reconstruction*

Hurtes et al. [9] combined two previous techniques: first anterior urethral suspension, followed by posterior reconstruction. Anterior reconstruction can also be performed after making the vesicourethral anastomosis, as described by one of the largest monocenter series [10]. After preservation of the anterior supporting structures such as the puboprostatic ligaments and the arcus tendineus, and after performing a posterior reconstruction, the arcus tendineus and the puboprostatic ligaments are reattached to the anterolateral distal bladder. Different surgical reconstructive techniques have been adopted, as shown in the accompanying video.

2.2.4. *Advanced reconstruction of vesicourethral support*

Student et al. [11] investigated the technique of a semicircular support for the urethra and vesicourethral anastomosis on continence rates after RARP. The principle behind the advanced reconstruction of vesicourethral support (ARVUS) consists of creating a semicircle of surrounding musculature around the vesicourethral anastomosis without injuring the neurovascular bundles. The medial aspects of the levator ani muscle are adjusted to Denonvilliers' fascia, and the suture is then continued to fix the median dorsal raphe to the detrusor bladder neck through the retrotrigonal layer. This technique is aimed at creating a strong support for the vesicourethral anastomosis. In ARVUS, it is assumed that multiple reconstructive principles restore or rebuild the presurgical anatomy.

2.2.5. *Total anatomical reconstruction*

Porpiglia et al. [12] described the functional outcomes of total anatomical reconstruction (TAR) during RARP. TAR consists of posterior reconstruction in three layers and anterior reconstruction in two layers. The first posterior layer is the realignment of Denonvilliers' fascia to the median dorsal raphe. The second layer involves the retrotrigonal fascia and median raphe, whereas the third layer involves the bladder neck and the posterior aspect of the rhabdosphincter. After this posterior reconstruction, vesicourethral anastomosis is performed and is followed by anterior reconstruction. The first anterior layer is aimed at restoring the original anatomy by suturing the muscular fibers of the bladder neck to the periurethral tissue located between the DVC and the urethra. The second anterior layer consists of the visceral and parietal layers of the endopelvic fascia in order to recreate the "pubovesical" ligaments.

Table 1 – Short description of the anatomical structures that are sutured, realigned, approximated, or reconstructed in each of the surgical reconstructive procedures after RARP—the reported suture for anatomical reconstruction

Surgical procedure	Description of surgical technique and supposed mechanism by which continence is achieved	Suture as reported[a]
Posterior reconstruction of the rhabdomyosphincter ("Rocco" stitch) [6,24]	Realignment of the tissues dorsal to the bladder and the urethra providing a tension-free vesicourethral anastomosis and recreating posterior support for the urethra and urethrosphincteric complex	Two 3-0 poliglecaprone RB-1 needle or Monocryl 2-0 anchoring suture
Periurethral suspension stitch ("Patel stitch") [8]	Suspension of the tissues ventral to the urethra on the fascia of the pubic bone providing anatomical support and stabilization of the urethra	12-in monofilament Polyglytone suture on a CT-1 needle
Anterior suspension and posterior reconstruction technique [9,10]	Combination of anterior and posterior reconstruction (see above)	Polyglactin absorbable suture or two 3-0 poliglecaprone monofilament sutures on an RB-1 needle
Advanced reconstruction of vesicourethral support [11]	Restoration of anatomical relations between levator muscle, Denonvilliers' fascia, median dorsal raphe, and the rhabdosphincter	Barbed V-lock 2/0 monofilament
Total anatomical reconstruction [12]	Combination of a three-layer posterior reconstruction and a two-layer anterior reconstruction to support the vesicourethral anastomosis and periurethral structures	Barbed 3/0 monofilament
Modified maximal urethral length preservation technique [13]	Increasing the length of the functional sphincteric mechanism by adding intraprostatic urethral length	NR
Bladder-neck preservation [14]	Preserving the bladder neck with its preprostatic "internal" sphincter	NR

NR = not reported; RARP = robot-assisted radical prostatectomy.
[a] As of today, many reconstructive techniques are performed using a barbed wire stitch.

2.2.6. *Modified MUL technique*

One of the principles for achieving continence after radical prostatectomy is to preserve a functional urinary sphincter mechanism by achieving MUL. An increased urethral length, which includes a greater amount of smooth muscles and the rhabdosphincter, increases the length of the urethra pressure profile [2]. Hamada et al. [13] described the MUL-preservation technique. After dissecting the DVC, the prostatic apex and the rhabdosphincter are seen. From the prostatic-rhabdosphincter junction toward the membranous urethra, the striated and smooth muscle fibers are smoothly divided. Together with the release of fibrous connections of the prostate at the apex, an additional length of the intra-abdominal urethra is obtained.

2.2.7. *Anatomic bladder-neck preservation*

Freire et al. [14] described their technique of bladder-neck–sparing surgery in RARP. The anterior bladder is tented by traction of the anterocephalad part of the detrusor muscle to form a ridge that ends distally at the detrusor apron. A funneled bladder neck is created by finding a cleavage plane using a combination of sharp and blunt dissection to tease bladder muscle fibers away from the prostate. One of the key principles is minimal use of monopolar cautery, which chars the tissue and obscures the anatomic plane between the prostate and the bladder. Instead, there is greater reliance on bipolar and sharp dissection. After dissecting anteriorly and circumferentially, the catheter balloon is deflated and the linear anterior fibers of the bladder neck are incised as distally as possible.

3. Results

3.1. *Description of anatomical principles*

Table 1 gives a short description of the anatomical structures that are realigned, approximated, suspended, or reconstructed. Fig. 1 shows the anatomical landmarks within the pelvic floor prior to reconstruction after RARP and after the vesicourethral anastomosis. Figs. 2–7 show the surgical reconstructive techniques graphically.

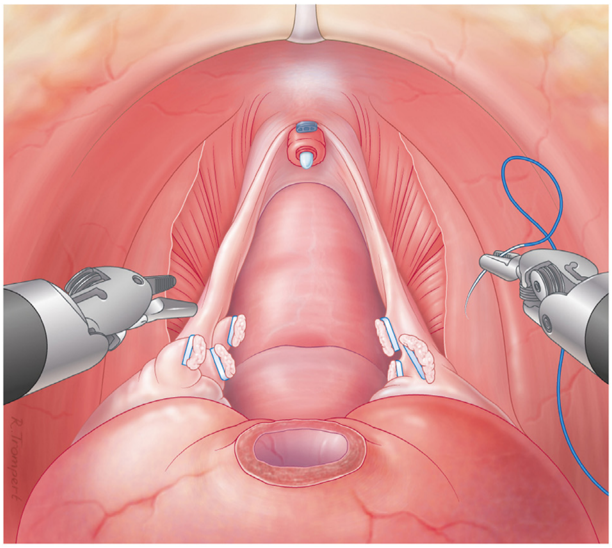
3.2. *Outcome of surgical reconstructive techniques*

Table 2 gives an overview of the continence rates in time after surgery as reported by different study groups of different reconstructive procedures.

3.2.1. *Evaluation of RCTs*

Joshi et al. [6] randomized 109 patients to either posterior reconstruction or no reconstruction, and found no significant differences for either involuntary urine loss or pad use at both 3 and 6 mo postoperatively. Sutherland et al. [15] did not find a difference in early continence at 3 mo in 94 men randomized to posterior reconstruction and standard technique. These outcomes were different from those of Ogawa et al. [16] who randomly compared three-layer posterior reconstruction with standard reconstruction (Table 2).

Menon et al. [17] evaluated 57 patients who underwent a no-reconstruction technique with a technique in which anastomosis was preceded by posterior reconstruction and followed by anterior reconstruction ($n = 59$). Eventually, no improvement in early continence rate was found. No difference in continence outcome was reported on longer follow-up [18]. In an RCT comparing no reconstruction ($n = 33$) with anterior and posterior reconstructions ($n = 39$), Hurtes et al. [9] demonstrated significantly higher continence rates in the reconstruction group at 1 and 3 mo, although without a difference for the very early (15 d) and late (6 mo) time intervals. The group of Aalst, Belgium, performed similar randomization between no reconstruction ($n = 26$) and a combined anterior and posterior reconstructive technique ($n = 24$) [19]. At catheter removal and at 7 wk, more patients in the reconstruction group were continent compared with men in the no-reconstruction group.



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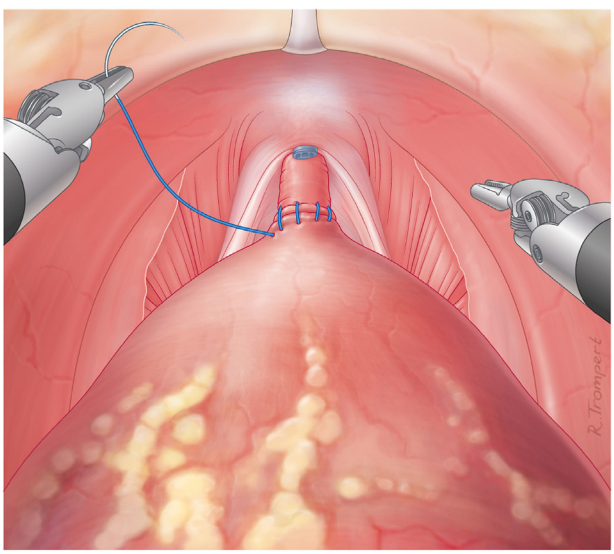

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Fig. 1 – (A) Pelvic-floor anatomy after radical prostatectomy. The supporting structures in the pelvic floor, such as the periurethral smooth muscles, periurethral connective tissues, median dorsal fibrous raphe, Denonvilliers' fascia (or vesicoprostatic muscle), and levator ani muscles, are shown. Supporting structures also include the fascia endopelvica with puboprostatic ligaments and the arcus tendineus. The neurovascular bundle is shown dorsolateral to the resected prostate. (B) Pelvic-floor anatomy after radical prostatectomy and after suturing the vesicourethral anastomosis.

Recently, Student et al. [11] randomized 66 patients to either posterior or ARVUS technique. Patients in the ARVUS group achieved better early (2–8 wk) and late (1 yr) continence rates compared with those in the control group.

4. Discussion

One of the major drawbacks of RARP is urinary incontinence. Although most men experience SUI in the early postoperative period, urge urinary incontinence is also common. SUI after radical prostatectomy is generally defined as any involuntary loss of urine or pad use, but definitions and means of recording vary widely between study groups. SUI occurs in 4–31% of cases 1 yr after surgery and has a recognized negative impact on quality of life [1]. A number of modifiable and nonmodifiable factors are known to influence SUI rates, such as age, body mass index,

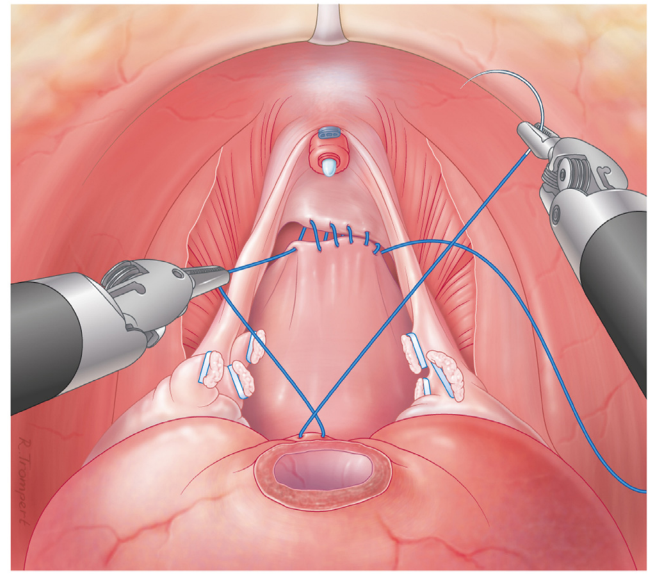

Fig. 2 – Posterior reconstruction ("Rocco" stitch). Realignment of the supportive structures that lie dorsal to the bladder and the urethra, providing a tension-free vesicourethral anastomosis and recreating a posterior support for the urethra and the urethrosphincteric complex.

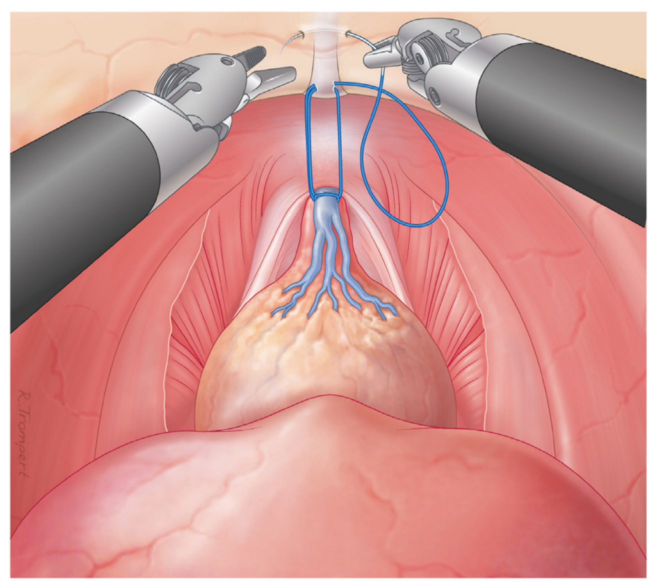

Fig. 3 – Periurethral suspension stitch ("Patel" stitch). The urethra is suspended by anchoring the supportive tissues ventral of the urethra to the periosteum of the pubic bone and back through the dorsal vascular complex for ligation. By this, an anatomical support is created and the urethra stabilized.

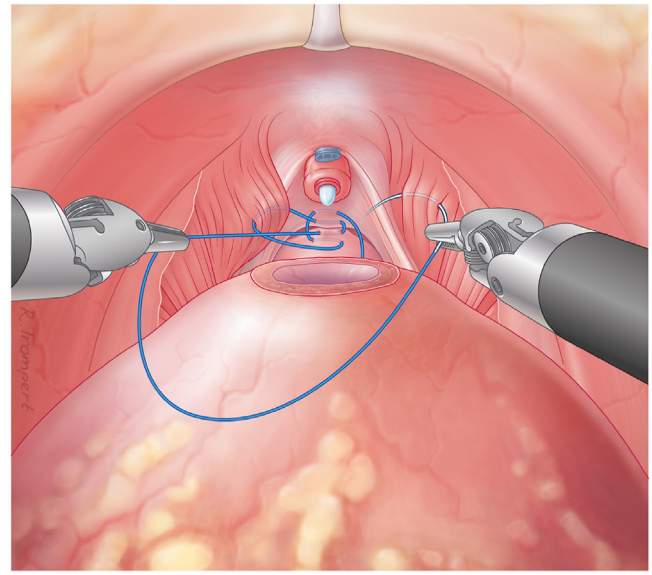

Fig. 5 – Advanced reconstruction of vesicourethral support. A semicircular support of the urethra is recreated by adjusting the medial aspects of the levator muscle to Denonvilliers' fascia and then continued to attach the median dorsal fibrous raphe to the detrusor bladder neck.

preoperative voiding problems, prostate volume, comorbidities, surgical experience, and surgical technique. The effect of pelvic-floor muscle exercise before and after surgery on postoperative SUI rate is limited [20].

As of yet, it is not completely understood which anatomical and functional mechanisms will lead to SUI after RARP. It is postulated that alterations in the muscular and supportive structures of the bladder neck, urethra, and muscular sphincter complex may result in an inability to withstand intra-abdominal pressures. The additive role of the periurethral prostatic tissue, length of the prostatic urethra, and the internal intrinsic sphincter is unclear. If increased intra-abdominal pressures are not guided properly along the structures within the pelvic floor, SUI may occur. Surgical reconstruction of pelvic-floor structures therefore aims to enhance pelvic-floor support, resembling the presurgical state. It is yet unknown whether reconstruction of the peritoneum and/or arcus tendineus on the pubic bone adds any further to the stabilization of pelvic-floor structures. Other hypotheses for SUI after RARP have been put forward. Michl et al. [21] hypothesized that meticulous apical dissection during nerve-sparing surgery additionally spares autonomic nerves that run along the prostatic apex and innervate the rhabdosphincter. Preservation of these pudendal nerve fibers might enhance continence independently of anatomical changes in the supportive structures after RARP. Similar findings were

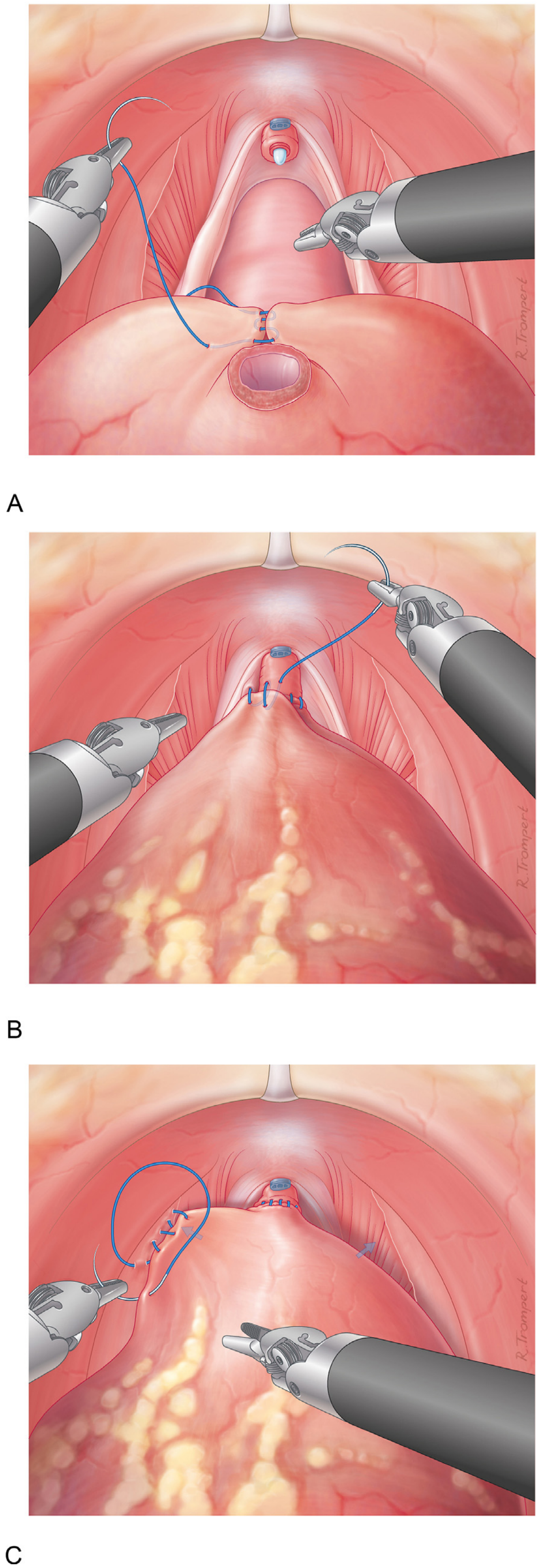

Fig. 4 – Anterior suspension combined with posterior reconstruction. Different surgical techniques may be combined to mimic the anatomical situation before radical prostatectomy. (A) A posterior reconstruction is performed by approximating the tissues dorsal from the bladder neck, (B) followed by anterior reconstruction, suturing the muscular fibers of the bladder neck to the periurethral tissues between the DVC and the anastomosed urethra, and (C) realigning the bladder to the pelvic sidewall to recreate the endopelvic fascia. DVC = dorsal vascular complex.

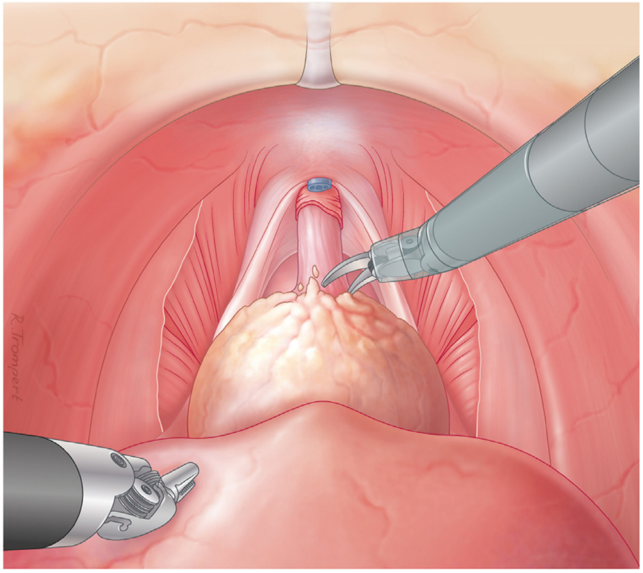

Fig. 6 – Modified maximal urethral length technique. An increased length of the membranous urethra is obtained by releasing the fibrous and muscular connective tissues of the prostate at the apex.

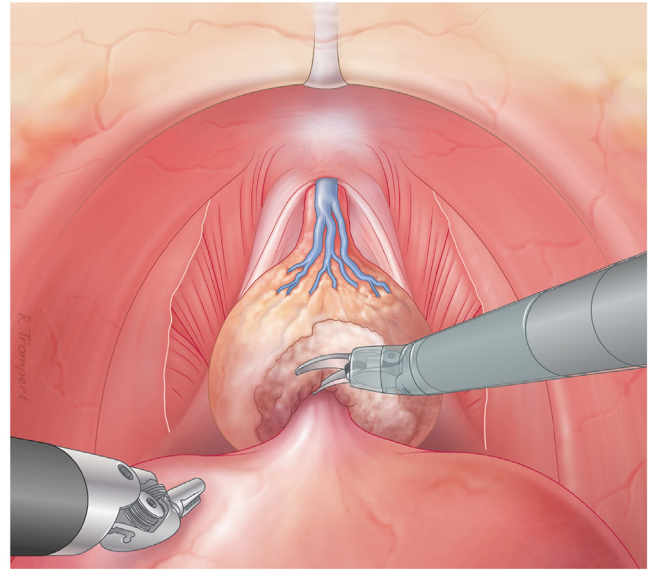

Fig. 7 – Bladder-neck–sparing surgery. Bladder-neck preservation is maintained by a combination of sharp and blunt dissection to tease bladder muscle fibers away from the prostate. The bladder neck is created as distally as possible.

reported by Lei et al. [22] who showed that selective suture ligation of the DVC resulted in more meticulous apical dissection, thereby sparing the rhabdosphincter and autonomic nerve fibers that run into the sphincteric muscle complex.

Pelvic-floor reconstruction was first reported by Rocco et al. [4] as posterior reconstruction during open radical prostatectomy and later in a series of cohort studies of patients undergoing RARP [23–26]. In a meta-analysis, it was shown that posterior musculofascial reconstruction allows for a better approximation of the vesicourethral anastomosis and statistically significant better continence rates 90 d postoperatively compared with the no-reconstruction technique [3]. The result of this meta-analysis is suggestive that these reconstructions improve early continence rates. Nevertheless, the only two true RCTs included in this meta-analysis comparing posterior reconstruction with "no reconstruction" showed no effect on early continence rates [6,15]. The other studies that are responsible for the positive effect were nonrandomized cohort studies [23–26]. From this point of view, there is currently no definitive evidence that posterior reconstructions have a positive impact on early functional outcomes after RARP.

In 2009, Patel et al. [8] showed that the technique of anterior reconstruction through anchoring the urethra and urethral supportive structures to the pubic bone could improve functional outcomes at 3 mo postoperatively in those undergoing RARP compared with a nonrandomized control group. The effect did not last as the continence rates were similar to those in the control group at 6 and 12 mo postoperatively. Different modifications to the original concepts of anterior and posterior reconstructions have been adopted since, with promising continence rates [10,11,27–31]. From small RCTs, it seems that a combined anterior and posterior or total reconstruction has advantage over the standard technique at 1 or 3 mo after RARP [9,11,17–19], whereas long-term outcomes are unknown and have largely not been supported by RCTs [9,17–19,27–31].

One of the difficulties in comparing different patient series and modification techniques is that different nomenclatures exist for the same reconstructive procedure. As the anatomical structures on the posterior aspect of the bladder wall and on the posterior side of the urethra are sometimes hard to distinguish from one another, it might well be that different modifications are based on a similar reconstructive concept. Otherwise, the same nomenclature is sometimes given for modifications of different reconstructive techniques. For instance, anterior reconstruction might be reserved for techniques that anchor the urethra to the pubic fascia or, alternatively, for fixation of the periurethral tissues to the bladder neck and endopelvic fascia.

MUL on preoperative magnetic resonance imaging (MRI) has been linked to improved continence outcomes at 6 and 12 mo after radical prostatectomy [32]. MUL is measured via T2-weighted MR images and defined as the distance from the prostatic apex to the entry of the urethra into the penile bulb [33]. It is one of the nonmodifiable, patient-related anatomical factors that has been reported to affect continence rates following RARP. In a meta-analysis, Mungovan et al. [34] found that greater preoperative MUL has a significant positive effect on overall time to continence recovery. Therefore, MUL may be of potential value to clinicians and patients in understanding the likely time course for the control of SUI after surgery. Indeed, in different smaller patient series, it was shown that any technique that increases the length of the (residual) functional urethra might lead to a quicker recovery to continence [14,35].

Table 2 – Surgical reconstructive techniques and outcomes of continence at approximately 1, 3, and 12 mo after robot-assisted radical prostatectomy

Surgical reconstructive procedure	Type of study	Definition of continence	No. of patients	Technique	Continence rates at 1 mo, *n* (%)	Continence rates at 3 mo, *n* (%)	Continence rates at 12 mo, *n* (%)
Posterior reconstruction of the rhabdomyosphincter							
Rocco (2007) [4] [a]	n-RCT	No pads or 1 safety pad	31	Posterior reconstruction	26 (83.8)	24 (92.3)	ND
			31	Standard surgery	10 (32.3)	20 (76.9)	ND
Nguyen (2008) [23]	C	0–1 pad	32	Posterior reconstruction	18 (56.0) [b]	ND	ND
			30	No reconstruction	5 (17.0) [b]	ND	ND
Joshi (2010) [6]	RCT	No pads	53	Posterior reconstruction	ND	28 (52.0)	ND
			54	No reconstruction	ND	34 (63.0)	ND
Coelho (2011) [24]	C	No pads	472	Posterior reconstruction	244 (51.6)	431 (91.1)	ND
			330	No reconstruction	141 (42.7)	303 (91.8)	ND
Jeong (2012) [25]	C	No pads	116	Posterior reconstruction	66 (58.4)	91 (82.7)	ND
			126	No reconstruction	53 (45.7)	79 (70.5)	ND
Ogawa (2017) [16]	RCT	1-h pad test <5 g	24	Modified posterior reconstruction	14 (57.0)	18 (74.0)	21 (89.0)
			24	Posterior reconstruction	6 (26.0)	17 (71.0)	22 (91.0)
You (2012) [26]	C	No pads or 1 safety pad (<50 ml)	28	Posterior reconstruction	16 (57.2)	25 (89.2)	ND
			31	No reconstruction	11 (35.5)	22 (71.0)	ND
Sutherland (2011) [15]	RCT	No pads or one security pad	47	Posterior reconstruction	19 (42.0) [b]	29 (63.0)	ND
			47	Standard technique	18 (43.0) [b]	33 (81.0)	ND
Periurethral suspension stitch							
Patel (2009) [8]	n-RCT	No pads, no leakage of urine	237	Suspension stitch	95 (40.0)	220 (92.8)	232 (97.9)
			94	No suspension	31 (33.0)	78 (83.0)	90 (95.7)
Anterior suspension and posterior reconstruction technique							
Hurtes (2012) [9]	RCT	No pads	34	Anterior and posterior reconstruction	9 (26.5)	14 (45.2)	ND
			28	No reconstruction	2 (7.1)	4 (15.4)	ND
Menon (2008) [17]	RCT	0–1 pad (<30 g/d)	59	Anterior and posterior reconstruction	47 (80.0)	ND	ND
			57	No reconstruction	42 (74.0)	ND	ND
Koliakos (2010) [19]	RCT	"Dry"	23	Anterior and posterior reconstruction	ND	15 (23.0) [c]	ND
			24	No reconstruction	ND	8 (34.7)	ND
Tan (2010) [10]	C	No pads or one security pad	1383	Anterior and posterior reconstruction	968 (70.0)	1268 (91.7)	1355 (98.0)
			214	No reconstruction	75 (35.2)	132 (61.9)	176 (82.1)
Sammon (2010) [18]	RCT	No pads	59	Anterior and posterior reconstruction	47 (80.0)	ND	ND
			57	Posterior reconstruction	47 (82.6)	ND	ND
Atug (2012) [27]	n-RCT	No pad or 1 dry pad	125	Anterior and posterior reconstruction	91 (72.8)	101 (80.8)	114 (91.2)
			120	No reconstruction	59 (49.1)	92 (76.6)	106 (88.3)
Kalisvaart (2009) [28]	C	0–1 pad per day	50	Anterior and posterior reconstruction	ND	15 (42.0)	ND
			50	No reconstruction	ND	8 (20.6)	ND
Han (2015) [29]	C	No pads, no leakage	60	Anterior reconstruction	15 (25.0)	36 (60.0)	ND
			70	No reconstruction	16 (23.9)	40 (57.7)	ND
Beattie (2013) [30]	C	No pads, no leakage	81	Anterior and posterior reconstruction	17 (20.5) [b]	36 (44.3)	ND
			51	Posterior reconstruction	4 (8.2) [b]	14 (26.7)	ND
Advanced reconstruction of vesicourethral support (ARVUS)							
Student (2017) [11]	RCT	ICIQ-SF score ≤6 and 0 pads used per day	32	ARVUS	20 (62.5)	22 (68.8) [d]	26 (86.7)
			34	Posterior reconstruction	5 (14.7)	7 (20.6) [d]	19 (61.3)
Dal Moro (2014) [31]	n-RCT	ICIQ-SF ≤6	18	CORPUS technique	15 (83.0)	ND	ND
			18	Posterior reconstruction	11 (61.0)	ND	ND
Total anatomical reconstruction (TAR)							
Porpiglia (2016) [12]	C	No pad or 1 safety pad	252	TAR	225 (89.3)	238 (94.4)	247 (98.0)
			NP	NP	NP	NP	NP
Modified urethral length preservation (MULP)							
Hamada (2014) [13]	n-RCT	No pads	30	MULP	21 (70.0)	29 (96.6)	100 (100.0)
			30	Posterior reconstruction	3 (10.0)	7 (23.3)	16 (53.3)
Bladder-neck preservation							
Freire (2009) [14]	C	No pads	348	Bladder-neck preservation	ND	227 (65.6)	108 (86.4)
			223	Standard technique	ND	59 (26.5)	104 (81.4)
Gu (2015) [35]	C	No pads	233	Bladder-neck preservation	82 (36.0) [b]	152 (69.1)	190 (94.6)
			NP	NP	NP	NP	

C = retrospective cohort study; CORPUS = complete reconstruction of posterior urethral support; n-RCT = nonrandomized clinical trial; ND = no data; NP = not present; RCT = randomized clinical trial.

[a] Conventional laparoscopic radical prostatectomy.

[b] At 6 wk postoperatively.

[c] At 7 wk postoperatively.

[d] At 8 wk postoperatively.

It is striking that all described reconstructive techniques show good-to-excellent outcomes 1 yr after surgery, that is, continence rates between 87% and 98% of cases (Table 2). Apparently, all reconstructive surgical techniques result in similar short-term continence rates, without significant differences in long-term continence rates as compared with "no reconstruction." Only few RCTs have compared a particular reconstructive technique with "no reconstruction" or a different reconstructive technique. The RCTs showed conflicting results when functional outcome rates were compared [6,9,11,15–19], and despite the finding that the only meta-analysis on posterior reconstruction in RARP is suggestive in favor of using these techniques, it might be hampered by inherent biases comparing cohorts without randomization [3]. Yet, as restoring anatomy is generally considered a basic principle of reconstructive surgery, one can advocate that this might justify its use as all reconstructive techniques seem feasible and safe.

It might well be that functional outcomes may be dependent on transitory neuropraxia due to (counter) traction on the neurovascular bundle by the suction tip or robotic instruments [36,37]. Stretch neuropathy by lateral displacement of the neurovascular bundle was shown to be related to delayed and diminished sexual function, and might intuitively lead to short-term incontinence as well [37]. To answer this question definitely, we need RCTs that compare different reconstructive techniques or maybe a reconstructive technique with "no reconstruction, no tension on the neurovascular bundles technique".

5. Conclusions

All the aforementioned reconstructions aim at restoring normal anatomical and functional relationships in the pelvic floor to reduce SUI rates and the time to achieve continence. Although many of the procedures report a benefit with respect to early continence, the benefits seem to diminish with longer follow-up. Whether anterior or posterior reconstruction (or combinations) of the pelvic floor, bladder-neck reconstruction, or enhancement of urethral length is superior to one another is a matter of study. Larger randomized studies comparing different techniques are lacking and eagerly awaited.

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Study concept and design: Vis, Nieuwenhuijzen.
Acquisition of data: Vis, Ruiter.
Analysis and interpretation of data: Vis, van der Poel, Nieuwenhuijzen.
Drafting of the manuscript: Vis, Ruiter.
Critical revision of the manuscript for important intellectual content: Vis, van der Poel, Ruiter, Hu, Tewari, Rocco, Patel, Razdan, Nieuwenhuijzen.
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Appendix A. Supplementary data

The Surgery in Motion video accompanying this article can be found in the online version at https://doi.org/10.1016/j.eururo.2018.11.035 and via www.europeanurology.com.

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