Asian Journal of Urology 11 (2024) 341—347

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/ajur

Review

Summarizing the evidence for robotic-assisted bladder neck reconstruction: Systematic review of patency and incontinence outcomes

Tenny R. Zhang [a], Ashley Alford [b], Lee C. Zhao [b,*]

[a] *Department of Urology, NewYork-Presbyterian Hospital/Weill Cornell Medicine, New York, NY, USA*
[b] *Department of Urology, NYU Langone Medical Center, New York, NY, USA*

Received 7 June 2023; accepted 24 August 2023
Available online 9 November 2023

KEYWORDS
Bladder neck;
Continence;
Incontinence;
Patency;
Posterior urethra;
Reconstructive surgery;
Robotic surgery;
Stenosis;
Stricture;
Surgical outcome

Abstract *Objective:* Bladder neck contracture and vesicourethral anastomotic stenosis are difficult to manage endoscopically, and open repair is associated with high rates of incontinence. In recent years, there have been increasing reports of robotic-assisted bladder neck reconstruction in the literature. However, existing studies are small, heterogeneous case series. The objective of this study was to perform a systematic review of robotic-assisted bladder neck reconstruction to better evaluate patency and incontinence outcomes.
Methods: We performed a systematic review of PubMed from first available date to May 2023 for all studies evaluating robotic-assisted reconstructive surgery of the bladder neck in adult men. Articles in non-English, author replies, editorials, pediatric-based studies, and reviews were excluded. Outcomes of interest were patency and incontinence rates, which were pooled when appropriate.
Results: After identifying 158 articles on initial search, we included only ten studies that fit all aforementioned criteria for robotic-assisted bladder neck reconstruction. All were case series published from March 2018 to March 2022 ranging from six to 32 men, with the median follow-up of 5—23 months. A total of 119 patients were included in our analysis. A variety of etiologies and surgical techniques were described. Patency rates ranged from 50% to 100%, and pooled patency was 80% (95/119). *De novo* incontinence rates ranged from 0% to 33%, and pooled incontinence was 17% (8/47). Our findings were limited by small sample sizes, relatively short follow-ups, and heterogeneity between studies.
Conclusion: Despite limitations, current available evidence suggests comparable patency outcomes and improved incontinence outcomes for robotic bladder neck reconstruction compared

* Corresponding author.
E-mail address: lee.zhao@nyulangone.org (L.C. Zhao).
Peer review under responsibility of Tongji University.

https://doi.org/10.1016/j.ajur.2023.08.007

to open repair. Additional prospective studies with longer-term follow-ups are needed to confirm these findings.

1. Introduction

Robotic-assisted surgical approaches have been widely adopted across multiple domains of urologic surgery. Advantages include improved visualization, dexterity, and ergonomics for the surgeon, and superior cosmesis and shorter length of stay for the patient [1,2]. While urologic oncology has traditionally dominated the field via prostatectomy, cystectomy, and nephrectomy, reconstructive urologists have increasingly incorporated robotic surgery into their armamentarium given the complex anatomy encountered and reconstructive techniques required [1,3].

Within the realm of lower urinary tract reconstruction, one particularly challenging area is the management of bladder neck contracture (BNC) and vesicourethral anastomotic stenosis (VUAS). Up to 10% of patients develop BNC after outlet procedures for benign prostatic hyperplasia (BPH) [4]; about 3% will develop VUAS after radical prostatectomy (RP) [5]; and 0%–32% of men receiving pelvic radiation of various modalities may develop prostatic urethral stenosis [6]. Although the etiologies of these defects vary, the common location of the bladder neck and posterior urethra deep within the narrow male pelvis makes surgical access difficult, and their close proximity to the external urinary sphincter, cavernous nerves, and rectum puts patients at high risk for complications, especially the development of *de novo* stress urinary incontinence [2,7].

As such, urologists have historically approached repair with an escalating strategy [8]. The American Urological Association urethral stricture guidelines have recommended starting with endoscopic management and reserving definitive reconstructive surgery for recalcitrant cases [9]. Unfortunately, many patients will recur with conservative management and are left to face a cycle of repeated catheterizations and instrumentation or undergo potentially highly morbid open surgery [8,10,11]. Urologists may, in turn, be discouraged from attempting open reconstructive repair [7].

During the last 5 years, robotic-assisted approaches to BNC and VUAS repair have emerged as a potential alternative with improved visualization and surgical precision and good short-term and mid-term outcomes [7,8,12,13]. First reported in the literature as a case series in 2018 [14], multiple subsequent series have since described varying robotic-assisted techniques, while several narrative reviews have summarized existing data of outcomes [7,8,13]. Given the recent rise of robotic surgery in this area, we aimed to perform the first systematic review of the current literature. Our objective was to compare and compile patency and continence outcomes across existing robotic-assisted bladder neck repair studies. We hypothesized that there would be a relatively wide range of patency and continence rates, but taken collectively, they would be comparable or superior to open reconstructive surgical outcomes.

2. Materials and methods

2.1. Evidence acquisition

We performed a literature search of the National Center for Biotechnology Information PubMed database in May 2023 for all studies evaluating robotic-assisted reconstructive surgery of the bladder neck in adult male patients older than 18 years. All available publication dates were included up to May 28, 2023. The following terms were used in the search strategy: (robot OR robot-assisted OR robotic OR robotic-assisted) AND (bladder neck OR posterior urethra) AND (repair OR reconstruction). Reference lists of relevant manuscripts were also reviewed for eligible articles. Of note, we were solely interested in studies describing patients undergoing reconstructive surgery for a pre-defined bladder neck defect, not studies reporting bladder neck or vesicourethral anastomosis reconstructive techniques at the time of RP or radical cystoprostatectomy.

All articles were screened for eligibility via titles and abstracts. Articles in non-English, author replies, editorials, pediatric-based studies, and reviews were excluded. The remaining studies were reviewed in their entirety and excluded if deemed to be irrelevant to the topic of interest or if they were reviews. Study characteristics assessed included year of publication, number of patients, etiology of bladder neck defect, method of repair, length of follow-up, and quality of evidence. Outcomes evaluated were patency and incontinence rates. We followed the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) guidelines [15].

2.2. Evidence synthesis

The initial search identified 158 articles, of which seven non-English studies and 19 pediatric-based studies were excluded. On screening, 110 irrelevant studies were excluded. On further review of the remaining 22 studies, nine narrative review articles and three case reports were excluded leaving a total of ten relevant studies meeting inclusion criteria. Fig. 1 illustrates the study flow diagram. Because all available studies were retrospective case series, only descriptive statistics could be performed for the outcomes of interest. We combined patients from studies that reported patency and *de novo* incontinence rates to obtain pooled means for each. Due to the nature of these small case series, limited reported granular data, and heterogeneity between studies, we were not able to

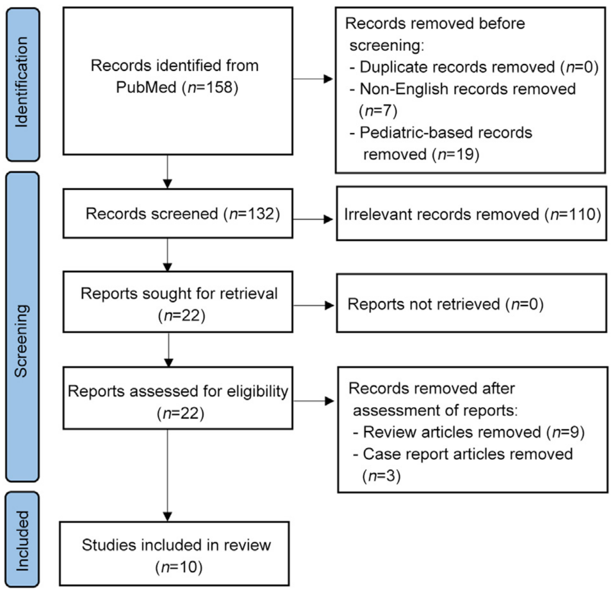

Figure 1 Study flow diagram.

perform subgroup analysis or multivariable regression in a pooled manner.

3. Results

We identified ten studies meeting our criteria for robotic-assisted bladder neck reconstruction ranging in publication date from March 2018 to March 2022. All were case series with number of patients ranging from six to 32 men, and median follow-up ranging from 5 months to 23 months. We were not able to calculate a pooled median follow-up time as data were incomplete and some studies reported means without the ability to deduce median. The overall total number of patients was 119 men included in this review; nine of 10 men and one of nine men, respectively, were excluded from two studies that also included more distal urethral defects [16,17]. Etiologies of bladder neck and posterior urethral defects varied, as did surgical technique and methods of assessing outcomes. Table 1 summarizes key patient characteristics, operative approaches, and outcomes.

Etiologies ranged from BNC following transurethral outlet procedures for BPH, VUAS after open or robotic-assisted RP, posterior urethral stenosis secondary to pelvic radiation for prostate cancer, and less commonly, trauma, and idiopathic causes. It is important to note that although different authors used varying terminology, for purposes of standardization we will from here on refer to relevant urethral defects based in part on the nomenclature for urethral strictures and stenoses recommended by the International Consultation on Urological Diseases [18]: (1) we use stenosis instead of stricture throughout because stricture describes narrowing of a segment of the urethra surrounded by the corpus spongiosum, which the bladder neck and prostatic urethra lack; (2) we use BNC to describe stenosis of the bladder neck resulting from benign outlet procedures for BPH, after which the prostate remains *in situ*; (3) we use VUAS to describe narrowing of the anastomosis after complete removal of the prostate via RP; (4) and we use radiation stenosis to describe narrowing of the remnant posterior urethra after radiation, only if the patient did not also undergo RP.

Methods of robotic-assisted repair were also heterogeneous and used the Si, Xi, and SP models of the *da Vinci* robotic surgical system (Intuitive Surgical, Sunnyvale, CA, USA). Some studies reported on a single technique, whereas others had multiple approaches. Some surgeries were performed only robotically, whereas other required a simultaneous perineal counter-incision for more distal defects. Some used near-infrared fluorescence to facilitate visualization of healthy versus devascularized tissue. Several authors described Y—V plasty for non-obliterative BNC or VUAS with a preserved posterior urethral plate, which entails making an inverted Y-shaped incision through the anterior bladder neck, thereby creating a V-shaped flap of well-vascularized anterior bladder wall which is advanced to create a widened bladder neck [14,19,20].

Others have described techniques for scar tissue excision with primary or "redo" bladder neck anastomosis or bladder reconstructive techniques for obliterative defects [20—25]. Redo anastomosis is generally approached in a similar fashion across the studies, whereas the other bladder reconstructive techniques somewhat vary. Shakir et al. [24] described an anterior bladder flap technique whereby the anterior bladder and scar tissue are excised, and a full-thickness flap of anterior bladder wall is advanced into the distal bladder neck. Multiple authors also described a technique for creating a neo-bladder neck anastomosis in cases where fibrotic tissue is severe and circumferential; in this technique, the native bladder neck is closed; the bladder is rotated downwards; and a cystotomy is made at the anterior bladder and anastomosed to the urethral stump (this approach termed variously as anterior bladder flap urethroplasty, modified Tanagho flap, and downward rotational bladder advancement) [21,24,25]. Overall, the choice of surgical reconstruction technique depends on both degree and length of stenosis. For partially obliterated stenoses, authors have generally described using a Y—V plasty approach (or a similar T-plasty technique, whereby the proximal incision is straight across and perpendicular rather than in a "Y" shape). For obliterated stenoses, primary reanastomosis and the aforementioned anterior bladder flap technique is preferred.

For patients with defects 2 cm or longer, Liu et al. [17] described a robotic-assisted buccal mucosa graft (BMG) urethroplasty technique via a purely robotic approach or a combined abdomino-perineal dorsal onlay approach if there is stenosis in the bulbar urethra. Tissue transfer may be performed to fill dead space in this case using rectus abdominis, gracilis, or omental flaps. The first report of robotic-assisted BMG urethroplasty in 2019 was not included in this review as it was a case report of a single patient [26].

In terms of patency outcomes, patients were assessed for recurrence in a variety of ways, including via self-reported symptoms and symptoms scores (*e.g.*, the International Prostate Symptom Score), visualization on cystoscopy or passage of a 16 Fr or 17 Fr cystoscope, or uroflowmetry with peak flow greater than 15 mL/s. Individual patency rates ranged from 50% to 100%, though some

Table 1 Summary of studies (in chronological order of publication date).

Study	Patient, *n*	Etiology (*n* of patients)	Type of robotic repair	Follow-up, mo	Patency, *n* (%); method of assessment	*De novo* incontinence, *n*/total without preexisting incontinence (%)
Musch et al. [14] (Mar 2018)	12	- BNC (9); simple prostatectomy (2); high-intensity focused of prostate (1)	- Y—V plasty	23[a]	- 10 (83); International Prostate Symptom Score	Incomplete reporting
Granieri et al. [19] (Jul 2018)	7	- BNC (3); VUAS (1); XRT (3)	- Y—V plasty	8[a]	- 7 (100); cystoscopy	2/7 (29) not included as unclear if *de novo*
Kirshenbaum et al. [20] (Aug 2018)	12	- BNC (7); VUAS (5)	- Varies and includes redo anastomosis, Y—V plasty, partial prostatectomy	14[a]	- 9 (75); passage of 17 Fr cystoscope or uroflowmetry of $>$15 mL/s	2/11 (18)
Unterberg et al. [16] (Mar 2019)	1[b]	- Not specified for 1 included patient	- Not specified for 1 included patient	7[c]	- 1 (100); passage of 16 Fr cystoscope	Not reported
Lavolle et al. [22] (Nov 2019)	6	- VUAS (6), of which 3 also had XRT	- Redo anastomosis$\pm$ bladder flap	19[a]	- 3 (50); freedom from reintervention	3/6 (50) requiring AUS not counted as unclear if *de novo*
Cavallo et al. [23] (Sep 2021)	12	- XRT (10), of which 1 also had salvage prostatectomy; idiopathic (2)	- Redo anastomosis$\pm$adjunctive techniques, prostatectomy, flaps	16[a]	- 10 (83); passage of 16 Fr cystoscope	4/12 (33)
Liu et al. [17] (Jan 2022)	8[d]	- VUAS (7), of which 4 also had XRT; trauma (1)	- BMG urethroplasty	12[a]	- 6 (75); unknown	0/8 (0)
Shakir et al. [24] (Feb 2022)	32	- VUAS (32), of which 16 also had XRT	- Varies and includes primary anastomosis or anterior bladder flap	12[a]	- 24 (75); passage of 17 Fr cystoscope or uroflowmetry of $>$15 mL/s	2/13 (15)
Bearrick et al. [21] (Mar 2022)	20	- BNC (5); VUAS (15), of which 5 also had XRT	- Y—V plasty, redo anastomosis, bladder flap, and urethral pull-through	Varied based on etiology	- 18 (90); "functional" and "anatomic" evaluation	Incomplete reporting
Zhao et al. [25] (Mar 2022)	9	- VUAS (7), of which 4 also had XRT; XRT only (2)	- Bladder flap	5[c]	- 7 (78); unknown	0/3 (0)
Pooled outcome[e]	119				- 95 (80)	8/47 (17)

AUS, artificial urinary sphincter; BMG, buccal mucosa graft; BNC, bladder neck contracture; mo, month; VUAS, vesicourethral anastomotic stenosis; XRT, radiation therapy.
[a] Mean.
[b] Nine patients excluded based on location of defects.
[c] Median.
[d] One patient excluded based on location of defect.
[e] Only patients meeting criteria included.

authors counted towards patency if patients met criteria at last follow-up even after subsequent endoscopic reintervention for recurrence after definitive repair, whereas others appeared to count towards patency only those patients who never developed recurrence during the follow-up period. The pooled patency rate was 80% (95 of 119 men) across all studies. Bearrick et al. [21] performed subgroup analysis based on etiology of defect, and found that 100% (5/5) of patients with BNC, 100% (10/10) of patients with VUAS, and 60% (3/5) of patients with stenosis after both RP and radiation were "functionally" patent (p=0.035), though functional patency was not defined explicitly. Because many studies did not provide granular breakdown of their outcomes by patient, we were not able to perform a combined analysis.

We were only interested in *de novo* incontinence, as many patients in these studies had preexisting incontinence before reconstructive surgery; they were not counted towards incontinence outcomes, regardless of whether authors reported improved or worsened symptoms. Individual *de novo* incontinence rates ranged from 0% to 33% as defined by requiring at least one pad per day. Pooled incontinence across studies who provided granular data was 17% (eight of 47 men). The same study that reported patency outcomes by etiology noted median postoperative pad per day use of 0, 0, and 10.5, among patients with BNC, VUAS, and stenosis after both RP and radiation, respectively (p<0.001) [21]. Some studies also reported or only reported rates of requiring subsequent artificial urinary sphincter (AUS) placement; however, because not all specified whether those patients who received AUS was for preexisting or *de novo* incontinence, we were not able to calculate a standard pooled AUS rate for *de novo* incontinence.

4. Discussion

In this systematic review of robotic-assisted bladder neck reconstruction, we identified ten case series which comprised 119 men with relevant pathology. The most frequent etiologies of urethral defects were benign BNC, VUAS, and post-radiation stenosis, and a variety of reconstructive techniques were employed, including Y–V plasty, redo anastomosis, a rotational anterior bladder flap, and BMG urethroplasty. Several studies employed a combined abdomino-perineal approach when necessary. Patency rates ranged from 50% to 100%, and pooled patency was 80%. *De novo* incontinence rates ranged from 0% to 33%, and pooled incontinence was 17%.

Although all studies were case series contributing only Level 4 evidence, taken together, several salient points can be made despite inter-study heterogeneity. First, patency rates are generally comparable with results from the open reconstructive surgery literature, which ranges from 60% to 100% depending on the stenosis etiology, surgical technique, and length of follow-up [27–32]. Although follow-up times are generally longer for open reconstruction, these comparable patency rates should not be surprising given the degree of comfort and skill of experienced robotic reconstructive surgeons, and the many aforementioned advantages of robotic-assisted surgery, especially in a deep anatomical space such as the male pelvis. In addition to the usual cited benefits of robotic surgery, these studies also demonstrated the added utility of near-infrared fluorescence as well as use of the SP robotic surgical system for facilitating ease of access to the perineum for simultaneous abdomino-perineal surgery, if necessary [17,19]. What will be crucial, however, is prolonged follow-up to demonstrate whether robotic patency rates are durable in the long-term.

Second, rates of *de novo* incontinence were much lower than that reported in the open literature, which approaches near 100% [27,28,31,32]. In these robotic series, incontinence rates ranged from as low as 0%–33%, with a pooled rate of 17%. Of course, one must take into account again the relatively shorter follow-up time as well as the specific way that we counted only *de novo* incontinence, and not the rate of AUS placement, given inter-study differences. Indeed, many older open series report incontinence via AUS placement as proxy. However, there may in fact be reasonable explanations for the markedly improved incontinence outcomes with robotic-assisted reconstruction. Whereas open perineal repair often results in disruption of the external sphincter complex, robotic approaches without concomitant perineal dissection can avoid this complication [2,20]. Furthermore, if patients do end up needing AUS placement, a virgin perineum may be more suitable for restoration of incontinence than a previously operated-on perineum [2]. Nonetheless, additional follow-up and standardized ways of assessing incontinence are needed in future studies to confirm the apparently greatly improved incontinence rates seen in robotic reconstruction.

Given these early but encouraging outcomes, some groups have modified their practice to perform only one or two endoscopic interventions before proceeding to robotic reconstruction of the bladder neck or posterior urethra [2,14]. Indeed, the most recent American Urological Association urethral stricture guidelines were updated in April 2023 to reflect the option of robotic reconstruction [33]. Urologists now have at their disposal several viable options for robotic-assisted repair of BNC and VUAS, whether obliterative or non-obliterative, and even longer urethral defects. We believe that patients should be counselled about emerging robotic options and the current patency and incontinence outcomes available in existing studies. Certainly, longer-term follow-up, prospective studies, and comparative studies of robotic versus open are ultimately necessary to generate higher level evidence [34,35], but this review represents a good initial step beyond individual case series.

In addition to the limitations of retrospective case series with relatively small sample size and shorter follow-up time, there may be selection bias in individual studies based on specific inclusion criteria. For example, some studies purposefully excluded patients with a history of radiation or those who required abdomino-perineal dissection to standardize their data [20]. Nonetheless, subsequent studies did include those patients and the pooled and individual results with irradiated patients still compared favorably to open surgery in general. Many of these studies were performed by single surgeons with expertise in robotic surgery, limiting generalizability. However, several are also multi-institutional, including studies from the Trauma and Urologic Reconstructive Network of Surgeons consortium [20,24]. Still, not all facilities have the capabilities or personnel to perform complex robotic reconstructive surgery. In terms of our review, we were limited by heterogeneity between studies in terms of how outcomes were assessed and what granular data were reported. Our pooled patency rate included all metrics of patency, but our incontinence rate only included those studies who specified development of *de novo* incontinence. Given the lack of granular "per patient" data, we were also not able to perform more sophisticated subgroup analysis of outcomes by surgical technique or etiology of disease, which would be helpful information for surgical decision making and patient counselling. Taken together, however, our results suggest that robotic bladder neck reconstruction is a viable option with favorable patency and incontinence outcomes across multiple types of reconstruction and etiology.

5. Conclusion

Robotic-assisted bladder neck reconstruction has been increasingly reported in the literature in the last 5 years, albeit in the form of case series. Current available evidence based on a variety of reconstructive techniques in patients with different etiologies of disease suggests that patency outcomes are comparable to open surgery, and incontinence rates are better than open surgery. Additional prospective studies with longer-term follow-ups are needed to confirm these findings and show durability.

Author contributions

Study concept and design: Tenny R. Zhang, Ashley Alford, Lee C. Zhao.
Data acquisition: Tenny R. Zhang.
Data analysis: Tenny R. Zhang.
Drafting of manuscript: Tenny R. Zhang, Lee C. Zhao.
Critical revision of manuscript: Tenny R. Zhang, Ashley Alford, Lee C. Zhao.

Conflicts of interest

The authors declare no conflict of interest.

References

[1] Osman NI, Mangir N, Mironska E, Chapple CR. Robotic surgery as applied to functional and reconstructive urology. Eur Urol Focus 2019;5:322—8.
[2] Boswell TC, Hebert KJ, Tollefson MK, Viers BR. Robotic urethral reconstruction: redefining the paradigm of posterior urethroplasty. Transl Androl Urol 2020;9:121—31.
[3] Kim S, Buckley JC. Robotic lower urinary tract reconstruction. Urol Clin 2021;48:103—12.
[4] Cindolo L, Marchioni M, Emiliani E, Francesco PDE, Primiceri G, Castellan E, et al. Bladder neck contracture after surgery for benign prostatic obstruction. Minerva Urol Nefrol 2017;69:133—43.
[5] Breyer BN, Davis CB, Cowan JE, Kane CJ, Carroll PR. Incidence of bladder neck contracture after robotic-assisted laparoscopic and open radical prostatectomy. BJU Int 2010;106:1734—8.
[6] Browne BM, Vanni AJ. Management of urethral stricture and bladder neck contracture following primary and salvage treatment of prostate cancer. Curr Urol Rep 2017;18:76. https://doi.org/10.1007/s11934-017-0729-0.
[7] Shakir NA, Zhao LC. Robotic-assisted genitourinary reconstruction: current state and future directions. Ther Adv Urol 2021;13:17562872211037111. https://doi.org/10.1177/17562872211037111.
[8] Bearrick EN, Findlay BL, Boswell TC, Hebert KJ, Viers BR. New perspectives on the surgical treatment of posterior urethral obstruction. Curr Opin Urol 2021;31:521—30.
[9] Wessells H, Angermeier KW, Elliott S, Gonzalez CM, Kodama R, Peterson AC, et al. Male urethral stricture: American Urological Association guideline. J Urol 2017;197:182—90.
[10] Liberman D, Jarosek S, Virnig BA, Chu H, Elliott SP. The patient burden of bladder outlet obstruction after prostate cancer treatment. J Urol 2016;195:1459—63.
[11] Andrews JR, Hebert KJ, Boswell TC, Avant RA, Boonipatt T, Kreutz-Rodrigues L, et al. Pubectomy and urinary reconstruction provides definitive treatment of urosymphyseal fistula following prostate cancer treatment. BJU Int 2021;128:460—7.
[12] Zhao CC, Shakir NA, Zhao LC. The emerging role of robotics in upper and lower urinary tract reconstruction. Curr Opin Urol 2021;31:511—5.
[13] Xu AJ, Mishra K, Lee YS, Zhao LC. Robotic-assisted lower genitourinary tract reconstruction. Urol Clin 2022;49:507—18.
[14] Musch M, Hohenhorst JL, Vogel A, Loewen H, Krege S, Kroepfl D. Robot-assisted laparoscopic Y—V plasty in 12 patients with refractory bladder neck contracture. J Robot Surg 2018;12:139—45.
[15] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. https://doi.org/10.1136/bmj.n71.
[16] Unterberg SH, Patel SH, Fuller TW, Buckley JC. Robot-assisted proximal perineal urethroplasty: improving visualization and ergonomics. Urology 2019;125:230—3.
[17] Liu E, Shakir N, Zhao LC. Single-port robotic posterior urethroplasty using buccal mucosa grafts: technique and outcomes. Urology 2022;159:214—21.
[18] Latini JM, McAninch JW, Brandes SB, Chung JY, Rosenstein D. SIU/ICUD consultation on urethral strictures: epidemiology, etiology, anatomy, and nomenclature of urethral stenoses, strictures, and pelvic fracture urethral disruption injuries. Urology 2014;83:S1—7. https://doi.org/10.1016/j.urology.2013.09.009.
[19] Granieri MA, Weinberg AC, Sun JY, Stifelman MD, Zhao LC. Robotic Y—V plasty for recalcitrant bladder neck contracture. Urology 2018;117:163—5.
[20] Kirshenbaum EJ, Zhao LC, Myers JB, Elliott SP, Vanni AJ, Baradaran N, et al. Patency and incontinence rates after robotic bladder neck reconstruction for vesicourethral anastomotic stenosis and recalcitrant bladder neck contractures: the Trauma and Urologic Reconstructive Network of Surgeons experience. Urology 2018;118:227—33.
[21] Bearrick EN, Findlay BL, Maciejko LA, Hebert KJ, Anderson KT, Viers BR. Robotic urethral reconstruction outcomes in men with posterior urethral stenosis. Urology 2022;161:118—24.
[22] Lavolle A, de la Taille A, Chahwan C, Champy CM, Grinholtz D, Hoznek A, et al. Extraperitoneal robot-assisted vesicourethral reconstruction to manage anastomotic stricture following radical prostatectomy. Urology 2019;133:129—34.
[23] Cavallo JA, Vanni AJ, Dy GW, Stair S, Shakir NA, Canes D, et al. Clinical outcomes of a combined robotic, transabdominal, and open transperineal approach for anastomotic posterior urethroplasty. J Endourol 2021;35:1372—7.
[24] Shakir NA, Alsikafi NF, Buesser JF, Amend G, Breyer BN, Buckley JC, et al. Durable treatment of refractory

vesicourethral anastomotic stenosis via robotic-assisted reconstruction: a Trauma and Urologic Reconstructive Network of Surgeons study. Eur Urol 2022;81:176—83.
[25] Zhao CC, Shakir NA, Zhao LC. Robotic bladder flap posterior urethroplasty for recalcitrant bladder neck contracture and vesicourethral anastomotic stenosis. Urol Video J 2022;13: 100133. https://doi.org/10.1016/j.urolvj.2022.100133.
[26] Avallone MA, Quach A, Warncke J, Nikolavsky D, Flynn BJ. Robotic-assisted laparoscopic subtrigonal inlay of buccal mucosal graft for treatment of refractory bladder neck contracture. Urology 2019;130:209. https://doi.org/10.1016/j.urology.2019.02.048.
[27] Wessells H, Morey AF, McAninch JW. Obliterative vesicourethral strictures following radical prostatectomy for prostate cancer: reconstructive armamentarium. J Urol 1998;160: 1373—5.
[28] Simonato A, Gregori A, Lissiani A, Carmignani G. Two-stage transperineal management of posterior urethral strictures or bladder neck contractures associated with urinary incontinence after prostate surgery and endoscopic treatment failures. Eur Urol 2007;52:1499—504.
[29] Pfalzgraf D, Beuke M, Isbarn H, Reiss CP, Meyer-Moldenhauer WH, Dahlem R, et al. Open retropubic reanastomosis for highly recurrent and complex bladder neck stenosis. J Urol 2011;186:1944—7.
[30] Nikolavsky D, Blakely SA, Hadley DA, Knoll P, Windsperger AP, Terlecki RP, et al. Open reconstruction of recurrent vesicourethral anastomotic stricture after radical prostatectomy. Int Urol Nephrol 2014;46:2147—52.
[31] Schuettfort VM, Dahlem R, Kluth L, Pfalzgraf D, Rosenbaum C, Ludwig T, et al. Transperineal reanastomosis for treatment of highly recurrent anastomotic strictures after radical retropubic prostatectomy: extended follow-up. World J Urol 2017; 35:1885—90.
[32] Simonato A, Gregori A, Lissiani A, Varca V, Carmignani G. Use of Solovov—Badenoch principle in treating severe and recurrent vesico-urethral anastomosis stricture after radical retropubic prostatectomy: technique and long-term results. BJU Int 2012;110:E456—60. https://doi.org/10.1111/j.1464-410X.2012.11132.x.
[33] Wessells H, Morey A, Souter L, Vanni Alex, Rahimi L, Vanni A. Urethral stricture disease guideline amendment (2023). J Urol 2023;210:64—71.
[34] Obiora D, Yang H, Gor RA. Robotic assisted reconstruction for complications following urologic oncologic procedures. Transl Androl Urol 2021;10:2272—9.
[35] Branche B, Crocerossa F, Carbonara U, Klausner AP, Roseman JT, Hampton LJ, et al. Management of bladder neck contracture in the age of robotic prostatectomy: an evidence-based guide. Eur Urol Focus 2022;8:297—301.