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European Association of Urology Guidelines on Urethral Strictures: Summary of the 2026 Guidelines. Update in Recommendations for Endoluminal Management of Male Anterior Urethral Strictures

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Article info

Article history:
Accepted April 18, 2026

Editor-in-Chief:
Alberto Briganti

Keywords:
Direct vision internal urethrotomy
Endoluminal treatments
Urethral strictures

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Abstract

Background and objective: Endoluminal treatments are frequently used for male anterior urethral strictures (USs). We aim to summarize the current evidence assessing the clinical implications for each treatment. Details on epidemiology, diagnosis, open surgical management, and follow-up of US are beyond the scope of this paper, and we refer the reader to the full text Guidelines (Lumen et al., 2026) [1].
Methods: New evidence was identified using a priori criteria. Selected literature was summarized, and recommendations were developed to prioritize clinically important decisions.
Key findings and limitations: Direct vision internal urethrotomy (DVIU) is safe, with success rates improving for shorter, untreated bulbar US. Short recurrences after urethroplasty could be managed using DVIU. Single dilatation offers outcomes similar to those of DVIU, with reduced complications if visually controlled. Self-dilatation, urethral stents, and local corticosteroids could prolong treatment intervals but risk US worsening. Drug-coated balloon dilatation is a promising second-line endoluminal option for bulbar US.
Conclusions and clinical implications: Endoluminal treatments for male anterior USs are safe, offering good long-term patency rates in selected situations. They are an alternative for patients aiming for a less invasive management but with low long-term success.

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https://doi.org/10.1016/j.eururo.2026.04.021
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Discussion of individual options and tailoring male anterior US treatment—including referring for urethroplasty when indicated—should be granted.
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1. Introduction

Anterior urethral strictures (USs) are frequently treated by endoluminal treatments [2]. In an effort to improve the outcomes of endoluminal techniques, several drugs were tested and delivered by different means, including ointments in catheters and injected during incision procedures [3]. Recently, a drug-coated balloon was developed to release paclitaxel at the time of the urethral dilatation (UD), showing promising outcomes [4]. Certainly, the ability to treat the majority of strictures by less invasive and time-consuming means offers certain benefits for patients and physicians. Of particular relevance are contexts where specialist surgical services are not available or for patients who prefer a more pragmatic and immediately available solution. Conversely, it has been proven that minimally invasive therapies for US have limitations, particularly regarding long-term outcomes [5]. Furthermore, their ability to "cure" the patient needs to be discussed during the preoperative stage, balancing the risk of worsening the urethral disease [6]. The Urethral Strictures Guidelines Panel acknowledges this clinical context as relevant for the urological community and therefore summarized the current evidence on this topic.

2. Methods

For the Urethral Strictures Guidelines 2026 update, new evidence was identified through a structured assessment of the literature. A comprehensive literature search, covering all sections of the guidelines was performed. Databases searched included Medline, EMBASE, and the Cochrane Libraries, covering a time frame between April 2022 and April 2025. For the endoluminal treatment sections, the *a priori* inclusion criteria considered were: systematic reviews (SRs), retrospective series $\geq$20 patients, comparative series with $\geq$20 patients per group, minimum follow-up $\geq$12 mo, studies restricted to humans, and studies published in English language only. Excluded from consideration were: case reports, papers where no surgical or functional outcomes were available, letters to the editor or editorial comments, and narrative reviews.

The detailed search strategy can be accessed online (https://uroweb.org/guideline/urethral-strictures/). New evidence was summarized and discussed among panel members. Recommendations were developed to prioritize clinically important care decisions. The strength of each recommendation is determined by the balance between desirable and undesirable consequences of alternative management strategies, the quality of the evidence (including certainty of estimates), and the nature and variability of patient values and preferences [7,8].

3. Guidelines

3.1. Direct vision internal urethrotomy using "cold knife"

Currently, we consider two indications for "cold knife" direct vision internal urethrotomy (DVIU). The first is as primary treatment for a recently diagnosed US. In the only high-level evidence study, 210 patients with non-obliterative strictures at all urethral locations were randomized to either filiform dilatation or DVIU under local anesthesia (LA) [9]. They collected objective data with retrograde urethrograms at seven follow-up visits for up to 48 months. This unique study showed that UD was equally effective as DVIU, but both procedures become less effective with increasing stricture length. A retrospective cohort series on primary treatment of iatrogenic US reported significant poorer patency rates for DVIU than urethroplasties (32.1 vs 82.4–83.5%) [10]. Furthermore, in a non-randomized prospective study comparing DVIU with non-transecting urethroplasty, patient-reported outcome measures related to lower urinary tract symptoms (LUTS) and sexual function demonstrated a clear advantage for the urethroplasty group. At 12 months, urethroplasty maintained significantly better patency than DVIU, with mean Qmax of 26.7 ± 4.1 versus 15.3 ± 5.2 ml/s, respectively [11]. Patency rates vary considerably between 8% and 77% after DVIU in retrospective cohort studies with minimum follow-up of one year. Median time to recurrence was <12 months [12,13].

The second indication for DVIU would be a recurrent stricture after a failed treatment. The OPEN trial, considered at least one previously failed DVIU, UD, or urethroplasty [5]. Despite poor recruitment, randomized patients to urethroplasty (108) or DVIU (112) in a 24-months study protocol. Both groups obtained similar improvements in LUTS scores. However, urethroplasty patients had 2.6 higher odds of experiencing Qmax improvement >10 ml/s than DVIU. Need for reintervention was observed in 13.8% versus 25.9% of cases allocated to urethroplasty and DVIU (hazard ratio [HR] = 0.52; 95% confidence interval [CI] = 0.31–0.89) [5]. Of note, self-dilatation was not considered as reintervention. Despite more reinterventions in the DVIU group, both treatments obtained similar improvements in quality of life (QoL) but with higher costs for urethroplasty, with limitation of only two years follow-up [14]. Brown et al used DVIU for stricture recurrence (mean length: 4 cm; range: 1.5–7 cm) after excision and primary anastomosis, buccal mucosa grafts (BMG) urethroplasty, and penile skin graft urethroplasty [15]. Patency was obtained in 13/37 cases (35%) after a single DVIU. Rosenbaum et al used DVIU in 43 patients with a short (<1 cm), veil-like stricture or "diaphragm," at distal or proximal end of the graft after BMG

urethroplasty. After a mean follow-up of 12 months, patency rate was 51% [16].

Several groups tried to identify prognostic factors to predict failure after initial treatment with "cold knife" DVIU (Table 1). A recent SR highlighted the stricture length as the primary factor for recurrence, with additional risk factors including prior interventions and baseline Qmax <5 ml/sec [17].

An overall complication rate after "cold knife" DVIU of 6.5% was reported in a SR [18] (Table 2). Notably, erectile dysfunction (ED) was reported in 5.3% [18]. Previously, Graversen et al reported ED in 11/104 (10.6%) of patients [19]. This risk is higher in penile US, which, in addition to poor patency rates, discourage using DVIU in penile urethra. A Cochrane review found no significant differences for overall intraoperative complications between single UD (14%) and DVIU (11%) (RR = 0.75; 95% CI = 0.36–1.55) [20].The low rate of false passage for DVIU (0.96%) and UD (0.94%) might be explained by the systematic use of a filiform leader in both groups, inserted endoscopically in UD, followed by coaxial dilatators [20]. Conversely, a small retrospective study comparing balloon dilatation (n = 31) with DVIU (n = 25) showed significantly less urethral bleeding (6.5 vs 32%) and urinary tract infection (UTI) (3.2 vs 24%) with balloon dilatation [21]. Repeat urethral manipulations can increase stricture complexity and delay time to urethroplasty [22]. The OPEN-trial reported adverse events of any type after urethroplasty (all types) in 61% and DVIU in 26.1% [5]. Conversely, serious adverse events were equally reported after urethroplasty (8.5%) and DVIU (8.7%) [5].

3.2. DVIU using "hot-knife"

Lasers available for urological applications, including neodymium-doped yttrium aluminum Garnet, argon, holmium:YAG, potassium titanyl phosphate, and thulium: YAG, have been used for US treatment. Two SRs were available [18,28], and the European Association of Urology Guideline Panel scope search identified 5 additional randomized controlled trials (RCTs) [29–33]. Outcomes are summarized in Table 3. Complication rate was 11.8% (39/330) after "hot knife" DVIU [18]. See Table 2 for details.

Plasmakinetic (bipolar) urethrotomy was also proposed. Cecen et al conducted an RCT comparing plasmakinetic with "cold knife" DVIU (n = 136) [34]. Patency rates at nine months were respectively 86% and 70% and were 63% and 67% after 18 months, respectively [34]. A prospective cohort study on primary strictures <2 cm reported patency rates at 12 months in 23/30 (77%) for plasmakinetic versus 19/30 (63%) with "cold knife" DVIU [35]. A retrospective case series (n = 27) reported 74% patency rate for short US (1–2.5 cm) after mean follow-up of 14 months [36]. They reported negligible blood loss during procedure and no postoperative urinary incontinence (UI).

Regarding complications of "cold knife" versus "hot knife" DVIU, in an SR of RCTs comparing both, only 1/4 series reported complications [28]. In laser urethrotomy (LU), 8.9% complication rate was found due to contrast extravasation to the perineum and US recurrence. For "cold knife" DVIU, 15.5% complication rate was related to bleeding [28]. In a SR of retrospective case series, no significant differences between LU and "cold knife" DVIU were found in incidence rates of UI, urinary extravasation, and UTI. However, urinary retention and hematuria were more frequent with LU than "cold knife" DVIU [18]. See Table 2 for more details.

3.3. Single dilatation

UD can be done in the office, under LA, and without complex resources [20]. Although no direct comparative studies of blind versus visually controlled UD are available, several studies have reported a low complication rate with visually controlled modifications. The recurrence rate largely varies between 23.5% and 64.5% [37]. A SR identified only one prospective RCT comparing UD with DVIU [9] and failed to detect any differences [20]. A small retrospective cohort study described similar 3-year estimated stricture recurrence-free survival for balloon dilatation (35.5%) and DVIU (28%) [21].

3.4. Post-dilatation/DVIU strategies

Several strategies have been developed to prevent wound contraction, improving the stricture-free rate and time to stricture recurrence after UD or DVIU:

3.4.1. Intermittent self-dilatation

An SR identified 6 (quasi)randomized trials comparing intermittent self-dilatation (ISD) with no ISD with a follow-up between eight and 24 months [38]. Stricture recurrence was significantly reduced while performing ISD (85/197, 43%) versus no ISD (128/207, 62%) (RR = 0.7; 95% CI = 0.48–1.00). There was significant heterogeneity, and quality of studies was very low, leading the authors to conclude that there is uncertainty about the estimate [38]. This review found no significant difference in adverse events between ISD and no ISD [38]. One trial (n = 48) found no significant difference in six- versus 12-months duration of ISD, and another trial (n = 59) found no significant difference from using low-friction hydrophylic versus polyvinyl chloride catheters [38]. Chhabra et al reported that patients complying with ISD after UD had non-significant lower need for reintervention (12.3%) than patients who did not (20.5%) [39]. Greenwell et al found similar need for subsequent intervention in men performing ISD (42%) versus those who did not (49%) after a mean follow-up of 25 months. Number of reoperations was lower in ISD group than in those who did not (2.6 vs 3.4). No major complications were reported in both groups [40]. A multicentric prospective study (n = 85) reported moderate (35%) to severe (26%) difficulties in catheterization, and patients suffered moderate (32%) to severe (17%) pain while performing ISD. Catheterization had a serious impact on QoL: 32% rated it as moderate, and 55% rated it as poor [41]. Younger age was identified as predictor for poor QoL, being more impaired in proximal US locations (posterior and bulbar) [41]. The majority of these patients performed ISD at least on a daily basis. Conversely, Scheipner et al reported an improvement in QoL—with weekly ISD after DVIU—with a 3.3% complication rate per six months ISD

Table 1 – Predictors for urethral patency after DVIU

Author	Location	Length	Caliber	Multiplicity	Prior DVIU
Steenkamp et al. [9]/ Heyns et al. [23]	RR for recurrence penile vs bulbar: 1.85 (95% CI: 0.94 to 3.67, $p = 0.077$)	<2 cm: 60% (@12 mo)	NR	NR	None: 50–60% (@48 mo)
	–	2–4 cm: 50% (@12m)	–	–	1: 0–40% (@48 mo)
	–	>4 cm: 20% (@12 mo)	–	–	2: 0% (@24 mo)
Al Taweel *et al.* [24]	Bulbar: 11%	<1 cm: 27%	NR	NR	0: 12.1%
	Penile: 0%	1–2 cm: 0%	–	–	1: 7.9%
	Penobulbar: 0%	>2 cm: 0%	–	–	> 1: 0%
Barbagli et al. [13]	NA	1–2 cm: 71% (@60 mo)	pQmax <5 ml/s: 31%	NA	0: 62%
	–	2–3 cm: 51% (@60 mo)	pQmax 5–8 ml/s: 53%	–	1:37%
	–	3–4cm: 39% (@60 mo)	pQmax> 8 ml/s: 83%	–	–
Kluth et al. [12]	Location no predictor	NR	pQmax no predictor	NR	0: 60%
	–	–	–	–	>1: 39%
Pal et al. [25]	NA	<1 cm: 45%	NR	Single: 35%	0: 30%
	–	1–1.5 cm: 0%	–	Multiple: 0%	1: 23%
	–	>1.5 cm: 0%	–	–	2: 13%
Launonen et al. [26]	Bulbar: 76%[a]	<2 cm: 83%[a]	NR	NR	0: 26%
	Penile: 71%[a]	>2 cm: 0%[a]	–	–	1: 33%
	–	–	–	–	2: 26%
	–	–	–	–	3: 11%
	–	–	–	–	4: 0%
Redon-Galvez *et al.* [27]	NR	<1 cm: 71%	NR	NR	NR
	–	>1 cm: 25%	–	–	–
Güler [10]	Bulbar: 30%	<1.85 cm: OR: 0.86 (95% CI: 0.74–0.99; $p = 0.042$)	NR	NR	NR
	Penile: 34%				
	Membranous: 33%				

DVIU = direct vision internal urethrotomy; NA = not applicable; NR = not reported; pQmax = preoperative maximum urinary flow rate; RR = relative risk; OR = odds ratio; CI = confidence interval.
[a] Patency rates are reported after repetitive treatments.

interval [42]. Recently, self-dilatation using a hydraulic urethral catheter (balloon self-dilatation) was proposed for recurrent bulbar US [43]. During follow-up, significantly less UTIs and need for subsequent interventions were described compared with regular nelaton ISD [43].

3.4.2. *ISD combined with intraurethral corticosteroids*

To delay wound contraction at the US site, intraurethral corticosteroids (as a catheter lubricant) have been used to improve the outcomes of ISD. In 2023, this panel performed an SR that identified 5 prospective RCTs comparing ISD and local steroid (triamcinolone) ointment with ISD without local steroids [3]. Maximum duration of ISD allowed for inclusion was six months. The SR reported 124 patients randomized to local steroids and 126 not, with follow-up ranging between six and 36 months. Successful stabilization of US was reported in 77% with and 64% without corticosteroids (OR = 0.67; 95% CI = 0.45–0.99). Three studies reported specifically no extra complications related to addition of steroids to ISD [3]. In a small cohort with US related to lichen sclerosus (LS), an intraurethral steroid regimen was successful in 25 (89%) patients after a mean follow-up of 25 months, considering success as avoiding subsequent escalation of therapy [44]. This regimen consisted of applying clobetasol cream 0.05% as lubricant on a calibration twice a day during a minimum of two months. Eventually, 12 (42.8%) patients could reduce the interval of instillation/dilatation, and 3 (10.7%) of them could stop the treatment [44].

3.4.3. *Intralesional injections*

Adjuvant intralesional injections aim to reduce fibroblast proliferation and excessive urethral scaring. A SR reported seven RCTs (365 patients) comparing local intraurethral steroids (topical or injectable triamcinolone) with no steroids after DVIU for US in males. The authors found improvement in recurrence rates (RR = 0.67; 95% CI = 0.49–0.90) and time to recurrence (HR = 0.58; 95% CI = 0.39–0.85) but not in Qmax. Very serious risk of bias and methodological concerns were reported, and overall certainty of evidence (GRADE) was rated as low [45]. In another SR and meta-analysis (MA), mitomycin C (MMC) provided the lowest recurrence rates (intralesional injection: OR = 0.23, 95% CI = 0.11–0.48; intraluminal injection: OR = 0.11, 95% CI = 0.02–0.61) [46]. Another SR and MA on the efficacy of DVIU combined with MMC revealed significant effect in short (<2 cm), anterior US, in the longer (>12 months) follow-up group [47]. Rezaei et al conducted an RCT comparing DVIU

Table 2 – Complications after "cold knife" DVIU versus laser DVIU

Study/ Complication	"Cold knife" DVIU (%)	Laser DVIU (%)	*p*-value
Jin et al. [18]			
Urinary extravasation	2.9	3.1	0.938
Urinary incontinence	4.1	2.1	0.259
Urinary tract infection	2.1	2.7	0.653
Urinary retention	0.4	9	<0.0001
Hematuria	2	5.2	0.034
Epididymitis	0.5	NR	NA
Fever	2.3	NR	NA
Scrotal abscess	0.3	NR	NA
Erectile dysfunction	5.3	NR	NA
Urinary tract irritation	NR	11.4	NA
Urinary fistula	NR	1.5	NA
Dysuria	NR	5.1	NA
Yenice et al. [30]			
Urinary extravasation	0	2.9	0.6
Hematuria	10	0	
Jiangang Chen et al. [29]			
Urinary extravasation	9.1	4.2	0.5
Urinary incontinence	4.5	4.2	
Ali, et al. [32]			
Urinary retention	15.2	3	0.021
Hematuria	12.1	6.1	0.037
Urethral bleeding	6.1	0	0.014
Akdemir et al [33]			
Urethral bleeding	10	3.3	>0.05
Urinary tract infection	6.7	3.3	>0.05
Erectile dysfunction	6.7	3.3	>0.05

DVIU = direct vision internal urethrotomy; NA = not applicable; NR = not reported.

+ platelet rich plasma (PRP) (n = 44) with DVIU + saline (n = 43) in primary, bulbar strictures <1.5 cm [48]. The two-years stricture-free rate after DVIU + PRP was 78% versus 56% without PRP (p = 0.034). Complications were frequent but not significantly different—DVIU + PRP: 70% versus DVIU + saline: 79%—and all classified as Clavien-Dindo grade 1.

3.4.4. *Urethral stents*

Urethral stents are designed to oppose wound contraction after UD or DVIU. Stent insertion is a short procedure (<60 min) easily performed under LA or spinal anesthesia. Only temporary stents (removable after six to 12 months) are currently commercially available. A RCT comparing UD/DVIU with UD/DVIU + temporary stent insertion for bulbar US reported a significantly longer stricture-free survival time in stent group (median 292 vs 84 days) [49]. Only 20.6% of stent patients developed recurrent US within one year versus 82.8% in control group. Wong et al found a median stricture-free survival of two months after DVIU versus 23 months after DVIU + temporary stent in a prospective series in bulbar US [50]. Temporary stenting for >6 months showed a significantly better outcome (79.7% success) than for <6 months (53.3%) at 38.3 months of follow-up [51]. Failure and need for reintervention due to US recurrence, stent encrustation or migration, and urethral hyperplasia are frequent (30–53%). Other complications include recurrent UTI, recurrent hematuria, and genitoperineal pain. Stents in posterior urethra demonstrated high risk (82–100%) of causing UI, most pronounced if previous irradiation and/or stenosis extend into membranous or bulbar urethra [52]. Stents in penile urethra are anecdotal, with Jung et al reporting failure in 4/7 (57%) patients after mean follow-up of eight months. No patient with distal or panpenile strictures was rendered stricture free, with higher stricture recurrences compared with bulbar urethra [53]. Horiguchi et al found that prior urethral stenting was an independent significant predictor of increased stricture complexity (OR = 13.7; 95% CI = 1.7–318.3) and need for more complex urethroplasty (OR = 6.9; 95% CI = 1.1–64.5) [6]. The majority (62%) of patients in this study had permanent stents [6]. If urethroplasty is required, it is possible to preserve the urethral plate and perform a one-stage substitution, but patency rates after different urethroplasty types range between 16.7 and 100% [54,55].

3.4.5. *Drug-coated balloon dilatation*

Drug-coated balloon dilatation (DCBD) aims to reduce scar formation on the basis of paclitaxel antimitotic action. The ROBUST-III RCT prospectively randomized patients with predominantly bulbar strictures (<3 cm) and at least 2 prior failed endoscopic treatments to DCBD (n = 79) or UD/DVIU (n = 48) [56]. Anatomic patency—assessed by cystoscopy—at six months was 75% for DCBD versus 27% after standard UD/DVIU [56]. Estimated retreatment-free survival after two years for DCBD was 77.8%, whereas at one year, it was 23.6% for standard UD/DVIU [57]. The ROBUST-I study—prospective, single arm, including bulbar US <2 cm, 1–4 prior endoluminal interventions—showed 71.7% estimated retreatment-free survival and 58% functional success rate after five years, defined as >50% improvement in the International Prostate Symptom Score (IPSS) values [4]. Functional success rate was significantly higher using 30F balloon caliber (77%) than using 24F (38%), suggesting the use of 30F balloon whenever possible. There were no serious adverse events related to DCBD, but a higher rate of hematuria and dysuria than with standard UD/DVIU (11.4% vs 2.1%) was reported [57]. No negative impact on erectile function was noticed after DCBD [4,57]. Paclitaxel was detected in semen up to six months after treatment, which urges for contraception if the partner has childbearing potential [56].

4. Discussion

A summary of recommendations on endoscopic treatment is showed in Table 4, while a summary of recommendations on surgical management of anterior urethral strictures is detailed in Table 5. DVIU using "cold-knife" or laser energies is safe and could be conducted as outpatient procedures. Large variations in patency rates after DVIU can be in part explained by the heterogeneous nature of the strictures and various definitions of patency used by authors [12,13]. Indication to perform DVIU is dependent on various

Table 3 – Outcomes of cold knife DVIU versus laser DVIU

Author	Type of Study	Number of patients/ studies	Stricture characteristics	Follow-up time	Reported measures	Outcomes
Torres Castellanos, et al. [28]	SR	4 RCTs	Mixed locations (heterogeneity)	Up to 12 mo (heterogeneity)	Recurrence rate (meta-analysis)	Relative risk -favoring LU- 3 mo: 0.55 (95% CI: 0.18–1.66; $p = 0.29$) 6 mo: 0.39 (95% CI: 0.19–0.81; $p = 0.01$) 12 mo 0.44 (95% CI: 0.26–0.75; $p = 0.003$)
Jin, et al. [18]	SR	44 articles (cases series) "cold knife" DVIU: 25 (495 patients) LU: 19 (2735 patients)	Mixed locations (heterogeneity)	Up to 30 mo (heterogeneity)	Stricture-free rate	Overall: 74.9% "cold knife" DVIU 68.5% LU ($p = 0.004$)
						First urethrotomy: 42.7% "cold knife" DVIU 58.6% LU ($p = 0.09$)
						Second urethrotomy: 39.4% "cold knife" DVIU 50% LU ($p = 0.459$)
						Bulbar urethra: 52.9% "cold knife" DVIU 60% LU ($p = 0.66$)
Yenice, et al. [30]	RCT	"Cold knife" DVIU: 29 Ho:YAG LU: 34	Primary bulbar US	12 mo	Patency rates	79.3% "cold knife" DVIU 67.6% LU NS ($p = 0.299$)
Jiangang *et al.* [29]	RCT	"Cold-knife" DVIU: 22 LU: 24	Anterior and posterior US	5 yr	Patency rates	12 mo: 18.2% "cold knife" DVIU 87.5% LU ($p < 0.05$) 24 mo: 13.7% "cold knife" DVIU 25% LU ($p > 0.05$) 5 yr: 9.1% "cold knife" DVIU 12.5% LU ($p > 0.05$)
Gamal, et al. [31]	RCT	"Cold-knife" DVIU: 40 Ho:YAG LU: 40	US < 1.5 cm Mixed locations	12 mo	Improvement in Q_{max}	"Cold knife" DVIU: 17 ± 4.21 ml/s LU: 19.9 ± 3.7 ml/s ($p = 0.559$)
					Patency rate	32/40 "cold knife" DVIU 36/40 10% LU ($p = 0.044$)
Ali, et al. [32]	RCT	"Cold-knife" DVIU: 35 Ho:YAG LU: 34	Bulbar US <2 cm	12 mo	Recurrence rate	18.2% "cold knife" DVIU 9.1% LU ($p = 0.021$)
					Mean Q_{max}	"Cold knife" DVIU: 14.4 ± 3.1 ml/s LU: 16.1 ± 3.1 ml/s ($p = 0.047$)
Akdemir, et al. [33]	RCT	"Cold knife" DVIU: 176 Ho:YAG LU: 188	US < 3 cm	12 mo	Recurrence rate	29.5% "cold knife" DVIU 10.6% LU ($p < 0.05$)

DVIU = direct vision internal urethrotomy; RCT = randomized control trial; US = urethral stricture; LU = laser urethrotomy

stricture characteristics that are prognostic for a successful outcome, but it is interesting to remember that DVIU should be avoided in isolated strictures in the penile area, owing to the risk of complications. DVIU could be also used as salvage treatment for recurrent US after prior UD/DVIU [5] or urethroplasty [15,16]. In the absence of well-designed, adequately powered multicenter RCTs, it is difficult to answer the question as to which clinical factors are predictive of failure of DVIU [17]. However, on the basis of the predictors evaluated to date, one can summarize that the best candidates are previously untreated patients with a single, short (maximum 2 cm) bulbar stricture. Apart from acute perioperative complications described in Table 2, the stricture length and number of strictures were reported to increase after DVIU [6].

On the basis of the conflicting results comparing "cold knife" DVIU with LU described in Table 3 and considering the heterogeneity of series and absence of long-term follow-up [28,32], the available studies do not support the efficacy of one technique over another. Given the similar complication rates between techniques, no recommendation can be made in favor of one technique over another.

Table 4 – Summary of recommendations on endoscopic management of male anterior urethral strictures

Recommendations	Strength rating
Direct vision internal urethrotomy	
Do not use DVIU for penile strictures.	Strong
Do not use DVIU/dilatation as solitary treatment for long (>2 cm) segment strictures.	Strong
Perform DVIU/dilatation for a primary, single, short (<2 cm), and nonobliterative stricture at the bulbar urethra.	Weak
Perform DVIU/dilatation for a short, veil-like recurrent stricture after prior bulbar urethroplasty.	Weak
Use either "hot" or "cold knife" techniques to perform DVIU depending on operator experience and resources.	Strong
Effectiveness of dilatation compared with direct vision internal urethrotomy	
Use visually controlled dilatation in preference to blind dilatation.	Weak
Do not perform repetitive (>2) direct vision internal urethrotomy/dilatations if urethroplasty is a viable option.	Strong
Intermittent self-dilatation combined with intraurethral corticosteroids	
Perform ISD to stabilize the stricture after dilatation/direct vision internal urethrotomy if urethroplasty is not a viable option.	Weak
Use intraurethral corticosteroids in addition to ISD to stabilize the urethral stricture.	Weak
Intralesional injections	
Use intralesional injections only in the confines of a clinical trial.	Weak
Drug-coated balloon dilation	
Offer drug (paclitaxel)-coated balloon dilatation for a short (<3 cm) bulbar stricture recurring after at least 2 prior endoscopic treatments in patients not fit or unwilling to undergo urethroplasty.	Strong

DVIU = direct vision internal urethrotomy; ISD = intermittent self-dilatation.

When dilators are used to dilate bulbar US, considerable experience is required to avoid accidental perforation of the urethra at the level of the stricture. To reduce the risks (especially false passage, spongiosal perforation, urethral bleeding) of "classic" blind dilatation with rigid sounds, other strategies have been developed and evaluated, predominantly visually controlled dilatation after a guidewire has been inserted [20].

At present, there is lack of evidence to support the claim that UD is superior to DVIU (or vice versa), and therefore, the indications for single dilatation are the same as for DVIU. Repetitive dilatation/DVIU with curative intent should be avoided because no long-term freedom of recurrence can be expected and because of the significant risk of increasing stricture length and complexity, prolonging the time to urethroplasty, which has better patency rates [22].

Several strategies have been proposed to minimize wound contraction after UD/DVIU [38], but they tend to stabilize the US—increasing the time to recurrence—rather than to keep the patient stricture free, and their reported outcomes should be understood in such context.

The potential benefit of ISD in stabilizing the stricture must be balanced against the drawbacks (difficulties in catheterization, pain while performing ISD, and impact on QoL) [41]. As mentioned earlier, repetitive dilatation (including ISD) increases stricture complexity and delays time to urethroplasty [6,22].

In LS-related strictures, using ultrapotent intraurethral steroids as ointment for ISD could be highly successful (89%), but because most of these patients further continued with instillation of steroids on the calibration device, this high "success" rate must be viewed with caution and should be considered as a stabilization of the stricture rather than a cure [44].

Different adjuncts to minimally invasive treatment of US in men were administered injected—MMC, corticosteroids—[45,46]. In the absence of well-conducted and adequately powered RCTs, along with the lack of standardization (dose, technique, volume, etc.) in the current literature, careful clinical review and prospective data collection as part of a clinical trial is advised. Recently, PRP was proposed after DVIU, with promising outcomes, but further validation of this treatment is needed before general clinical implementation.

Temporary stents tend to have fewer and less severe complications than permanent stents, but no direct comparison is available. In cases of stent failure, subsequent urethroplasty (usually with stent removal) is possible, but this urethroplasty is very likely to be more complex than it would have been had it been performed initially [54]. Owing to the fact that the stainless-steel wires of permanent stent are fully embedded into the urethral wall over time—usually within six months are epithelialized—, the urethral spongiosum is severely damaged [6]. Subsequent urethroplasty is usually complex, and owing to these limitations, the use of stents should be avoided if urethroplasty is considered [54]. Urethral stents are not a first-line treatment for US but can be considered in comorbid patients who have a recurrent stricture after UD/DVIU and are unable to have more complex urethroplasty or who refuse urethroplasty [49,52].

The DCDB demonstrated usefulness as a salvage treatment for recurrent US after endoscopic treatment, particularly in ROBUST settings—bulbar stricture, <3 cm, after failed endoluminal intervention. The evidence is too limited to give any meaningful recommendations outside these indications. The panel advises to collect data within a clinical trial or registry study on the use of DCBD for strictures outside the ROBUST indications [58,59].

5. Conclusions

Endoluminal treatments for male anterior US are safe, offering good long-term patency rates in selected situations. They are an option for patients aiming for a less invasive management but with low long-term success. Repetitive endoscopic treatments should be discussed and adapted, because they could risk worsening the stricture. Discussion of individual options and tailoring male anterior US treatment, including using DCDB or referring for a urethroplasty surgery when indicated, should be granted.

Author contributions: Felix Campos-Juanatey had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Table 5 – Summary of recommendations on surgical management of male anterior urethral strictures

Recommendations	Strength rating
Distal urethral strictures (meatal stenosis, fossa navicularis strictures)	
Offer open meatoplasty or distal urethroplasty to patients with meatal stenosis or fossa navicularis/distal urethral strictures.	Weak
Urethroplasty in the management of penile urethral strictures	
Offer men with penile urethral stricture disease augmentation urethroplasty by either a single-stage or staged approach taking into consideration previous interventions and stricture characteristics.	Strong
Offer an interval of at least four to six months before proceeding to the second stage of the procedure provided that outcome of the first stage is satisfactory.	Weak
Do not offer anastomotic urethroplasty to patients with penile strictures >1 cm owing to the risk of penile chordee postoperatively.	Strong
Counsel patients with penile strictures that single-stage procedures might be converted to staged ones in the face of adverse intraoperative findings.	Strong
Specific considerations for failed hypospadias repair-related strictures	
Men with FHR should be considered complex patients and referred to specialist centres for further management.	Weak
Propose psychological and/or psychosexual counselling to men with unsatisfactory cosmesis and sexual or urinary dysfunction related to FHR.	Weak
Do not use penile skin grafts or flaps in patients with failed FHR with LS or scarred skin.	Strong
Specific considerations for LS-related penile urethral strictures	
Do not use genital skin in augmentation penile urethroplasty in men with LS-related strictures.	Strong
Perform single-stage oral mucosa graft urethroplasty in the absence of adverse local conditions in men with LS-related strictures.	Weak
Urethroplasty for bulbar urethral strictures	
Use tEPA for short post-traumatic bulbar strictures with (nearly) complete obliteration of the lumen and full thickness spongiofibrosis.	Strong
Use nontransecting excision and primary anastomosis or free graft urethroplasty instead of tEPA for short bulbar strictures not related to straddle injury.	Weak
Use free graft urethroplasty for bulbar strictures not amendable to EPA.	Strong
Perform augmented non-transecting anastomotic repair during bulbar free graft urethroplasty in short, nearly obliterative segments.	Weak
Use dorsal, dorsal-lateral, or ventral approach according to surgical practice, expertise, and intraoperative findings.	Strong
Offer staged urethroplasty to men with complex anterior urethral stricture disease not suitable for single stage urethroplasty and who are fit for reconstruction.	Weak
Do not perform staged bulbar urethroplasty for lichen sclerosis if single stage urethroplasty is possible.	Weak
Consider staged procedure in patients unsure about PU versus urethral reconstruction.	Weak
Warn men that staged urethroplasty may comprise more than two stages.	Weak
Use oral mucosa free graft urethroplasty for ReDo urethroplasty in case the of a long stricture.	Strong
Urethroplasty for penobulbar or panurethral strictures	
Offer panurethral urethroplasties in specialized centers because different techniques and materials might be needed.	Weak
Combine techniques to treat panurethral strictures if one technique is not able to treat the whole extent of the stricture.	Weak
Perineal urethrostomy	
Offer PU as a management option to men with complex anterior urethral stricture disease.	Strong
Offer PU for men with anterior urethral stricture disease who are not fit or not willing to undergo formal reconstruction.	Weak
Choose type of PU on the basis of personal experience and patient characteristics.	Weak
Consider augmented Gil-Vernet-Blandy PU or "7-flap" PU in men with proximal bulbar or membranous urethral stricture disease.	Weak
Consider "7-flap" PU in males with obesity.	Weak

EPA = excision and primary anastomosis; FHR = failed hypospadias repair; LS = lichen sclerosus; PU = perineal urethrostomy; tEPA = transecting excision and primary anastomosis.

Study concept and design: Lumen, Campos-Juanatey.
Acquisition of data: Lumen, Campos-Juanatey, Dimitropoulos, Greenwell, Martins, Osman, Ploumidis, Riechardt, Waterloos, Barratt, Chan, Esperto, Oszczudlowski, Verla.
Analysis and interpretation of data: Lumen, Campos-Juanatey, Dimitropoulos, Greenwell, Martins, Osman, Ploumidis, Riechardt, Waterloos, Barratt, Chan, Esperto, Oszczudlowski, Verla.
Drafting of the manuscript: Campos-Juanatey.
Critical revision of the manuscript for important intellectual content: Lumen.
Statistical analysis: None
Obtaining funding: None.
Administrative, technical, or material support: Bezuidenhout
Supervision: None.
Other: None.

Financial disclosures: Campos-Juanatey certifies that all conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript (eg, employment/affiliation, grants or funding, consultancies, honoraria, stock ownership or options, expert testimony, royalties, or patents filed, received, or pending), are the following: N. Lumen reported receiving grants or research support from Janssen Pharmaceutica. F. Campos-Juanatey reported receiving travel grants from Casen Recordati and receiving company speaker honoraria or consultant fees from Boston Scientific, Laboratorios Rubió, S.A., and Laborie Medical Measurement Systems B.V. T. J. Greenwell reported receiving company speaker honoraria from Boston Scientific. N. I. Osman reported financial interest from Urotronic. M. Waterloos reported receiving company honoraria or consultant fees from Coloplast and EAU research foundation. M. Oszczudlowski reported receiving company consultation fees from Medtronic Poland Sp. Z O.o. K. Dimitropoulos, F. Martins, A. Ploumidis, S. Riechardt, R. Barratt, G, Chan, W. Verla and F. Esperto have nothing to declare.

***Funding/Support and role of the sponsor*:** None.

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