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American Urological Association (AUA) Guideline

MALE URETHRAL STRICTURE: AUA GUIDELINE

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PURPOSE

The purpose of this guideline is to provide a clinical framework for the diagnosis and treatment of urethral stricture.

METHODS

A systematic review of the literature using the Pubmed, Embase, and Cochrane databases (search dates 1/1/1990 to 12/1/2015) was conducted to identify peer-reviewed publications relevant to the diagnosis and treatment of urethral stricture. The review yielded an evidence base of 250 articles after application of inclusion/exclusion criteria. These publications were used to create the guideline statements. If sufficient evidence existed, then the body of evidence for a particular treatment was assigned a strength rating of A (high quality evidence; high certainty), B (moderate quality evidence; moderate certainty), or C (low quality evidence; low certainty) and evidence-based statements of Strong, Moderate, or Conditional Recommendation based on risks and benefits were developed. Additional information is provided as Clinical Principles and Expert Opinions when insufficient evidence existed.

GUIDELINE STATEMENTS

Diagnosis/Initial Management

1. Clinicians should include urethral stricture in the differential diagnosis of men who present with decreased urinary stream, incomplete emptying, dysuria, urinary tract infection (UTI), and after rising post void residual. (Moderate Recommendation; Evidence Strength Grade C)
2. After performing a history, physical examination, and urinalysis, clinicians may use a combination of patient reported measures, uroflowmetry, and ultrasound post void residual assessment in the initial evaluation of suspected urethral stricture. (Clinical Principle)
3. Clinicians should use urethro-cystoscopy, retrograde urethrography, voiding cystourethrography, or ultrasound urethrography to make a diagnosis of urethral stricture. (Moderate Recommendation; Evidence Strength Grade C)
4. Clinicians planning non-urgent intervention for a known stricture should determine the length and location of the urethral stricture. (Expert Opinion)
5. Surgeons may utilize urethral endoscopic management (e.g. urethral dilation or direct visual internal urethrotomy [DVIU]) or immediate suprapubic

cystostomy for urgent management of urethral stricture, such as discovery of symptomatic urinary retention or need for catheterization prior to another surgical procedure. (Expert Opinion)

6. Surgeons may place a suprapubic (SP) cystostomy prior to definitive urethroplasty in patients dependent on an indwelling urethral catheter or intermittent self-dilation. (Expert Opinion)

Dilation/Internal Urethrotomy/Urethroplasty

7. Surgeons may offer urethral dilation, direct visual internal urethrotomy (DVIU), or urethroplasty for the initial treatment of a short (< 2 cm) bulbar urethral stricture. (Conditional Recommendation; Evidence Strength Grade C)
8. Surgeons may perform either dilation or direct visual internal urethrotomy (DVIU) when performing endoscopic treatment of a urethral stricture. (Conditional Recommendation; Evidence Strength Grade C)
9. Surgeons may safely remove the urethral catheter within 72 hours following uncomplicated dilation or direct visual internal urethrotomy (DVIU). (Conditional Recommendation; Evidence Strength Grade C)
10. In patients who are not candidates for urethroplasty, clinicians may recommend self-catheterization after direct visual internal urethrotomy (DVIU) to maintain urethral patency. (Conditional Recommendation; Evidence Strength Grade C)
11. Surgeons should offer urethroplasty, instead of repeated endoscopic management for recurrent anterior urethral strictures following failed dilation or direct visual internal urethrotomy (DVIU). (Moderate Recommendation; Evidence Strength Grade C)
12. Surgeons who do not perform urethroplasty should offer patients referral to surgeons with expertise. (Expert Opinion)

Anterior Urethral Reconstruction

13. Surgeons may initially treat meatal or fossa navicularis strictures with either dilation or meatotomy. (Clinical Principle)
14. Surgeons should offer urethroplasty to patients with recurrent meatal or fossa navicularis strictures. (Moderate Recommendation; Evidence Strength Grade C)
15. Surgeons should offer urethroplasty to patients with penile urethral strictures, given the expected high recurrence rates with endoscopic treatments. (Moderate Recommendation; Evidence Strength Grade C)
16. Surgeons should offer urethroplasty as the initial treatment for patients with long (≥2cm) bulbar urethral strictures, given the low success rate of direct visual internal urethrotomy (DVIU) or dilation. (Moderate Recommendation; Evidence Strength Grade C)
17. Surgeons may reconstruct long multi-segment strictures with one stage or multi-stage techniques using oral mucosal grafts, penile fasciocutaneous flaps or a combination of these techniques. (Moderate Recommendation; Evidence Strength Grade C)
18. Surgeons may offer perineal urethrostomy as a long-term treatment option to patients as an alternative to urethroplasty. (Conditional Recommendation; Evidence Strength Grade C)
19. Surgeons should use oral mucosa as the first choice when using grafts for urethroplasty. (Expert Opinion)
20. Surgeons should not perform substitution urethroplasty with allograft, xenograft, or synthetic materials except under experimental protocols. (Expert Opinion)
21. Surgeons should not perform a single-stage tubularized graft urethroplasty. (Expert Opinion)

22. Surgeons should not use hair-bearing skin for substitution urethroplasty. (Clinical Principle)

Pelvic Fracture Urethral Injury

23. Clinicians should use retrograde urethrography with voiding cystourethrogram and/or retrograde + antegrade cystoscopy for preoperative planning of delayed urethroplasty after pelvic fracture urethral injury (PFUI). (Moderate Recommendation; Evidence Strength Grade C)
24. Surgeons should perform delayed urethroplasty instead of delayed endoscopic procedures after urethral obstruction/obliteration due to pelvic fracture urethral injury (PFUI). (Expert Opinion)
25. Definitive urethral reconstruction for pelvic fracture urethral injury (PFUI) should be planned only after major injuries stabilize and patients can be safely positioned for urethroplasty. (Expert Opinion)

Bladder Neck Contracture/Vesicourethral Stenosis

26. Surgeons may perform a dilation, bladder neck incision or transurethral resection for bladder neck contracture after endoscopic prostate procedure. (Expert Opinion)
27. Surgeons may perform a dilation, vesicourethral incision, or transurethral resection for post-prostatectomy vesicourethral anastomotic stenosis. (Conditional Recommendation; Evidence Strength Grade C)
28. Surgeons may perform open reconstruction for recalcitrant stenosis of the bladder neck or post-prostatectomy vesicourethral anastomotic stenosis. (Conditional Recommendation; Evidence Strength Grade C)

Special Circumstances

29. In men who require chronic self-catheterization (e.g. neurogenic bladder), surgeons may offer urethroplasty as a treatment option for urethral stricture causing difficulty with intermittent self-catheterization. (Expert Opinion)
30. Clinicians may perform biopsy for suspected lichen sclerosus (LS), and must perform biopsy if urethral cancer is suspected. (Clinical Principle)
31. In lichen sclerosus (LS) proven urethral stricture, surgeons should not use genital skin for reconstruction. (Strong Recommendation; Evidence Strength Grade B)

Post-operative Follow-up

32. Clinicians should monitor urethral stricture patients to identify symptomatic recurrence following dilation, direct visual internal urethrotomy (DVIU) or urethroplasty. (Expert Opinion)

INTRODUCTION

Purpose

Urethral stricture is chronic fibrosis and narrowing of the urethral lumen caused by acute injury, inflammatory conditions, and iatrogenic interventions including urethral instrumentation or surgery and prostate cancer treatment. The symptoms of urethral stricture are non-specific and may overlap with other common conditions including lower urinary tract symptoms (LUTS) and urinary tract infections (UTI) to confound timely diagnosis. Urologists play a key role in the initial evaluation of urethral stricture and currently provide all accepted treatments. Thus, urologists must be familiar with the evaluation and diagnostic tests for urethral stricture as well as endoscopic and open surgical treatments. This guideline provides evidence guidance to clinicians and patients regarding how to recognize symptoms and signs of a urethral stricture/ stenosis, carry out appropriate testing to determine the location and severity of the stricture, and recommend the best options for treatment. The most effective approach for a particular patient is best determined by the individual clinician and patient in the context of that patient's history, values, and goals for treatment. As the science relevant to urethral stricture evolves and improves, the strategies presented here will be amended to remain consistent with the highest standards of clinical care.

Methodology

Systematic review. A systematic review was conducted to identify published articles relevant to the diagnosis and treatment of urethral stricture. Literature searches were performed on English-language publications using the Pubmed, Embase, and Cochrane databases from 1/1/1990 to 12/1/2015. Data from studies published after the literature search cut-off will be incorporated into the next version of this guideline. Preclinical studies (e.g., animal models), commentary, editorials, non-English language publications, and meeting abstracts were excluded. Additional exclusion criteria were as follows: studies of females; studies of stricture prevention; patients with epispadias, congenital strictures, and duplicated urethra; trauma already covered under trauma guidelines including diagnosis and management of acute pelvic fracture urethral injury (PFUI) or disruption (PFUD); urethral cancer not related to stricture; or voiding symptoms not related to stricture. Studies with less than 10 patients were generally excluded from further evaluation and thus data extraction given the unreliability of the statistical estimates and conclusions that could be derived from them. In rare instances, we have included studies with less than 10 patients or studies preceding the literature search date if no other evidence was identified. For certain key questions that had little or no evidence from comparative studies, we included case series with 50 or more patients. Review article references were checked to ensure inclusion of all possible relevant studies. Multiple reports on the same patient group were carefully examined to ensure inclusion of only non-redundant information. The systematic review yielded a total of 250 publications relevant to preparation of the guideline.

Quality of Individual Studies and Determination of Evidence Strength. The quality of individual studies that were either RCTs or CCTs was assessed using the Cochrane Risk of Bias tool.[1] Observational cohort studies with a comparison of interest were evaluated with the Drug Effectiveness Review Project instrument.[2] Conventional diagnostic cohort studies, diagnostic case-control studies, or diagnostic case series that presented data on diagnostic test characteristics were evaluated using the QUADAS 2 tool, which evaluates the quality of diagnostic accuracy studies.[3] Because there is no widely -agreed upon quality assessment tool for single cohort observational intervention studies, the quality of these studies was not assessed.

The categorization of evidence strength is conceptually distinct from the quality of individual studies. Evidence strength refers to the body of evidence available for a particular question and includes not only individual study quality but also consideration of study design, consistency of findings across studies, adequacy of sample sizes, and generalizability of samples, settings, and treatments for the purposes of the guideline. The AUA categorizes the strength of a body of evidence as Grade A (well-conducted and highly-generalizable RCTs or exceptionally strong observational studies with consistent findings); Grade B (RCTs with some weaknesses of procedure or generalizability or moderately strong observational studies with consistent

findings); or Grade C (RCTs with serious deficiencies of procedure, generalizability, or extremely small sample sizes or observational studies that are inconsistent, have small sample sizes, or have other problems that potentially confound interpretation of data). By definition, Grade A evidence is evidence about which the Panel has a high level of certainty, Grade B evidence is evidence about which the Panel has a moderate level of certainty, and Grade C evidence is evidence about which the Panel has a low level of certainty.[4]

AUA Nomenclature: Linking Statement Type to Evidence Strength. The AUA nomenclature system explicitly links statement type to body of evidence strength, level of certainty, magnitude of benefit or risk/burdens, and the Panel's judgment regarding the balance between benefits and risks/burdens (see Table 1). ***Strong Recommendations*** are directive statements that an action should (benefits outweigh risks/burdens) or should not (risks/burdens outweigh benefits) be undertaken because net benefit or net harm is substantial. ***Moderate Recommendations*** are directive statements that an action should (benefits outweigh risks/burdens) or should not (risks/burdens outweigh benefits) be undertaken because net benefit or net harm is moderate. ***Conditional Recommendations*** are non-directive statements used when the evidence indicates that there is no apparent net benefit or harm or when the balance between benefits and risks/burden is unclear. All three statement types may be supported by any body of evidence strength grade. Body of evidence strength Grade A in support of a Strong or Moderate Recommendation indicates that the statement can be applied to most patients in most circumstances and that future research is *unlikely to change confidence*. Body of evidence strength Grade B in support of a Strong or Moderate Recommendation indicates that the statement can be applied to most patients in most circumstances but that better evidence *could change confidence*. Body of evidence strength Grade C in support of a Strong or Moderate Recommendation indicates that the statement can be applied to most patients in most circumstances but that better evidence *is likely to change confidence*. Body of evidence strength Grade C is only rarely used in support of a Strong Recommendation. Conditional Recommendations also can be supported by any body of evidence strength. When body of evidence strength is Grade A, the statement indicates that benefits and risks/burdens appear balanced, the best action depends on patient circumstances, and future research is *unlikely to change confidence*. When body of evidence strength Grade B is used, benefits and risks/burdens appear balanced, the best action also depends on individual patient circumstances and better evidence *could change confidence*. When body of evidence strength Grade C is used, there is uncertainty regarding the balance between benefits and risks/burdens, alternative strategies may be equally reasonable, and better evidence is *likely to change confidence*.

For some clinical issues, particularly diagnosis, there was little or no evidence from which to construct evidence-based statements. Where gaps in the evidence existed, the Panel provides guidance in the form of *Clinical Principles* or *Expert Opinion* with consensus achieved using a modified Delphi technique if differences of opinion emerged.[5] A *Clinical Principle* is a statement about a component of clinical care that is widely agreed upon by urologists or other clinicians for which there may or may not be evidence in the medical literature. *Expert Opinion* refers to a statement, achieved by consensus of the Panel, that is based on members' clinical training, experience, knowledge, and judgment for which there is no evidence.

Process. The Urethral Stricture Panel was created in 2013 by the American Urological Association Education and Research, Inc. (AUA). The Practice Guidelines Committee (PGC) of the AUA selected the Panel Co-Chairs who in turn appointed the additional panel members with specific expertise in this area. The AUA conducted a thorough peer review process. The draft guidelines document was distributed to 90 peer reviewers. The panel reviewed and discussed all submitted comments and revised the draft as needed. Once finalized, the guideline was submitted for approval to the PGC and the AUA Science and Quality Council. Then it was submitted to the AUA Board of Directors for final approval. Funding of the panel was provided by the AUA; panel members received no remuneration for their work.

TABLE 1: AUA Nomenclature Linking Statement Type to Level of Certainty, Magnitude of Benefit or Risk/Burden, and Body of Evidence Strength			
	Evidence Strength A (High Certainty)	**Evidence Strength B (Moderate Certainty)**	**Evidence Strength C (Low Certainty)**
Strong Recommendation (Net benefit or harm substantial)	Benefits > Risks/Burdens (or vice versa) Net benefit (or net harm) is substantial Applies to most patients in most circumstances and future research is unlikely to change confidence	Benefits > Risks/Burdens (or vice versa) Net benefit (or net harm) is substantial Applies to most patients in most circumstances but better evidence could change confidence	Benefits > Risks/Burdens (or vice versa) Net benefit (or net harm) appears substantial Applies to most patients in most circumstances but better evidence is likely to change confidence (rarely used to support a Strong Recommendation)
Moderate Recommendation (Net benefit or harm moderate)	Benefits > Risks/Burdens (or vice versa) Net benefit (or net harm) is moderate Applies to most patients in most circumstances and future research is unlikely to change confidence	Benefits > Risks/Burdens (or vice versa) Net benefit (or net harm) is moderate Applies to most patients in most circumstances but better evidence could change confidence	Benefits > Risks/Burdens (or vice versa) Net benefit (or net harm) appears moderate Applies to most patients in most circumstances but better evidence is likely to change confidence
Conditional Recommendation (No apparent net benefit or harm)	Benefits = Risks/Burdens Best action depends on individual patient circumstances Future research unlikely to change confidence	Benefits = Risks/Burdens Best action appears to depend on individual patient circumstances Better evidence could change confidence	Balance between Benefits & Risks/Burdens unclear Alternative strategies may be equally reasonable Better evidence likely to change confidence
Clinical Principle	A statement about a component of clinical care that is widely agreed upon by urologists or other clinicians for which there may or may not be evidence in the medical literature		
Expert Opinion	A statement, achieved by consensus of the Panel, that is based on members' clinical training, experience, knowledge, and judgment for which there is no evidence		

Background

The urethra extends from the bladder neck, which is composed of smooth muscle circular fibers, to the meatus, with varying histological features and stromal support based on anatomical location. The components of the posterior urethra are lined with transitional epithelium, whereas the anterior urethra is lined with pseudostratified columnar epithelium that changes to stratified squamous epithelium in the fossa navicularis. The posterior urethra includes both the prostatic and membranous urethra. The prostatic urethra extends from the distal bladder neck to the distal end of the veru montanum. The distal external sphincter mechanism surrounds the membranous urethra and is comprised of both intrinsic smooth muscle and rhabdosphincter. The anterior urethra includes the bulbar urethra, penile urethra and fossa navicularis. This urethra is completely surrounded by the corpus spongiosum, which in the bulbar urethra is surrounded by the bulbocavernosus muscle. The fossa navicularis is located entirely within the glans penis.

Urethral stricture is the preferred term for any abnormal narrowing of the anterior urethra, which runs from the bulbar urethra to the meatus and is surrounded by the corpus spongiosum. Urethral strictures are associated with varying degrees of spongiofibrosis. Narrowing of the posterior urethra, which lacks surrounding spongiosum, is thus referred to as a "stenosis." Pelvic fracture urethral injury typically creates a distraction defect with resulting obstruction or obliteration.[6]

Urethral strictures or stenoses are treated endoscopically or with urethroplasty. Endoscopic management is performed by either urethral dilation or direct vision internal urethrotomy (DVIU). There are a multitude of different urethroplasty techniques that can be generally divided into tissue transfer involved procedures and non -tissue transfer involved procedures. Anastomotic urethroplasty does not involve tissue transfer and can be performed in both a transecting and non-transecting manner. Excision and primary anastomosis (EPA) urethroplasty involves transection and removal of the narrowed segment of urethra and corresponding spongiofibrosis with anastomosis of the two healthy ends of the urethra. Non-transecting anastomotic urethroplasty preserves the corpus spongiosum, thus allowing the strictured urethra to be excised and reanastomosed, or incised longitudinally through the narrowed segment of the urethra and closed in a Heineke-Mikulicz fashion.

Techniques that involve tissue transfer can be categorized into single stage and multi-stage procedures. In single stage procedures, the urethra is augmented in caliber by transferring tissue in the form of a graft or flap. Multi-stage procedures use a graft as a urethral substitute for future tubularization.

Epidemiology

Geographic setting, socioeconomic factors and access to healthcare can affect stricture etiology. In developed countries, the most common etiology of urethral stricture is idiopathic (41%) followed by iatrogenic (35%). Late failure of hypospadias surgery and stricture resultant from endoscopic manipulation (e.g. transurethral resection) are common iatrogenic reasons. In comparison, trauma (36%) is the most common cause in developing countries, reflecting higher rates of road traffic injuries, less developed trauma systems, inadequate roadway systems and conceivably socioeconomic factors leading to a higher prevalence of trauma-related strictures.[7-9]

Strictures in the bulbar urethra predominate over other anatomic locations; however, certain etiologies are closely associated with an anatomic segment of the urethra.[7] For example, strictures related to hypospadias - and lichen sclerosus (LS—previously termed balanitis xerotica obliterans) are generally located in the penile urethra, while traumatic strictures and stenoses tend to be located in the bulbar and posterior urethra.

Preoperative Assessment

Presentation

Patients with urethral stricture most commonly present with decreased urinary stream and incomplete bladder emptying but may also demonstrate UTI, epididymitis, rising post-void residual urine volume or decreased force of ejaculation. Additionally, patients may present with urinary spraying or dysuria.[10]

Patient Reported Outcomes Measures

Patient reported measures (PRMs) help elucidate the

presence and severity of patient symptoms and bother and thus may serve as an important component of urethral stricture diagnosis and management. While the American Urological Association Symptom Index (AUASI) includes items assessing decreased urinary stream and incomplete bladder emptying, it does not identify other symptoms seen in patients with a urethral stricture, such as urinary spraying and dysuria.[10] Therefore, there is a need for development of a standardized urethral stricture PRM that can be used to assess symptoms, degree of bother, and quality of life impact. A more disease specific standardized PRM will also allow for comparison of patient outcomes across research studies.

Diagnosis

All men being evaluated for lower urinary tract symptoms should have a complete history and physical examination and urinalysis at a minimum. Decreased urinary stream, incomplete emptying and other findings such as urinary tract infection should alert clinicians to include urethral stricture in the differential diagnosis. In the initial assessment of patients suspected of having a urethral stricture, a combination of PRMs to assess symptoms, uroflowmetry to determine severity of obstruction, and ultrasound post-void residual volume to identify urinary retention may be used. Patients with symptomatic urethral stricture typically have a reduced peak flow rate.[11,12] Confirmation of a urethral stricture diagnosis is made with urethroscopy, retrograde urethrography, or ultrasound urethrography. Urethroscopy readily identifies a urethral stricture, but does not delineate the location and length of strictures. Retrograde urethrography (RUG) with or without voiding cystourethrography (VCUG) allows for identification of stricture location in the urethra, length of the stricture, and degree of lumen narrowing.[13,14] All of these stricture characteristics are important for subsequent treatment planning. Ultrasound urethrography can be used to identify the location, length and severity of the stricture.[15] While ultrasound urethrography is a promising technique, further studies are needed to validate its value in clinical practice.

Preoperative assessment for definitive reconstruction should elicit details of the etiology, diagnostic information about length and location of the stricture, and prior treatments. In the case of pelvic fracture urethral injury, a detailed history should document all associated injuries and angiographic embolization of any pelvic vessels. The history should assess pre-operative erectile function and urinary continence. Physical examination should include an abdominal and genital exam, digital rectal exam, and assessment of lower extremity mobility for operative positioning.

Patient Selection

Patient selection and proper surgical procedure choice are paramount to maximize the chance of successful outcome in the treatment of urethral stricture. The main factors to consider in decision making include: stricture etiology, location, and severity; prior treatment; comorbidity; and patient preference. As with any operation, surgeons should consider a patient's goals, preferences, comorbidities and fitness for surgery prior to performing urethroplasty.[16]

Operative Considerations

Before proceeding with surgical management of a urethral stricture, the physician should provide an appropriate antibiotic to reduce surgical site infections. Preoperative urine cultures are recommended to guide antibiotic choice, and active urinary tract infections must be treated before urethral stricture intervention. Prophylactic antibiotic choice and duration should follow AUA Best Practice Policy Statement.[17] To avoid bacterial resistance, antibiotics should be discontinued after a single dose or within 24 hours. Antibiotics can be extended in the setting of an active urinary tract infection or if there is an existing indwelling catheter.[17] In the setting of endoscopic urethral stricture management, oral fluoroquinolones are more cost effective than intravenous cephalosporins leading the AUA Antimicrobial Prophylaxis panel to support their use.[17] Antimicrobial prophylaxis is recommended at the time of urethral catheter removal in patients with certain risk factors.[17]

Positioning of the extremities should be careful to avoid pressure on the calf muscles, peroneal nerve and ulnar nerve when using the lithotomy position. Use of sequential compression devices is recommended to reduce deep venous thromboembolism (VTE) and nerve compression injuries. Perioperative parenteral VTE

prophylaxis is a consideration in select circumstances for open reconstruction.

Postoperative Care

A urinary catheter should be placed following urethral stricture intervention to divert urine from the site of intervention and prevent urinary extravasation. Either urethral catheter or suprapubic cystostomy is a viable option; a urethral catheter is thought to be optimal as it may serve as a stent around which the site of urethra intervention can heal. The length of urinary catheterization is widely variable, with a shorter recommended time for endoscopic interventions than open urethral reconstruction.[18]

Urethrography or voiding cystography is typically performed two to three weeks following open urethral reconstruction to assess for complete urethral healing. Replacement of the urinary catheter is recommended in the setting of a persistent urethral leak to avoid tissue inflammation, urinoma, abscess, and/or urethrocutaneous fistula. A urethral leak will heal in almost all circumstances with a longer duration of catheter drainage.[19,20]

Complications

Erectile dysfunction, as measured by the International Index of Erectile Function (IIEF) may occur transiently after urethroplasty with resolution of nearly all reported symptoms approximately six months postoperatively.[21-25] Meta-analysis has demonstrated the risk of new onset erectile dysfunction following anterior urethroplasty to be ~1%.[26] Type of urethroplasty, specifically anastomotic urethroplasty, as a causative risk factor for sexual dysfunction remains unclear. Erectile function following urethroplasty for PFUI does not appear to significantly change as a result of surgery. Erectile dysfunction in this cohort may be related to the initial pelvic trauma rather that the subsequent urethral reconstruction.[27]

Ejaculatory dysfunction manifested as pooling of semen, decreased ejaculatory force, ejaculatory discomfort, and decreased semen volume has been reported by up to 21% of men following bulbar urethroplasty.[28] Urethroplasty technique may play a role in the occurrence of ejaculatory dysfunction but the exact etiology remains uncertain.[29-31] Conversely, some patients, as measured by the Men's Sexual Health Questionnaire (MSHQ), will notice an improvement in ejaculatory function following bulbar urethroplasty, particularly those with pre-operative ejaculatory dysfunction related to obstruction caused by the stricture.[28] Data on ejaculatory function in men undergoing penile urethroplasty or urethroplasty for PFUI is limited.

Follow Up

Successful treatment for urethral stricture (endoscopic or surgical) is most commonly defined as no further need for surgical intervention or instrumentation.[32-44] Some studies use the absence of postoperative or post-procedural patient reported obstructive voiding symptoms and/or peak uroflow > 15m/sec as a benchmark for successful treatment.[45-50] Additional measures of success that have been used alone or in combination include urethral patency assessed by urethro-cystoscopy, absence of recurrent stricture on urethrography, post-void residual urine <100mL, "unobstructed" flow curve shape on uroflowmetry, absence of urinary tract infection, ability to pass a urethral catheter, and patient reported improvement in lower urinary tract symptoms.[51-55] Consensus has not been reached on the optimal postoperative surveillance protocol to identify stricture recurrence following urethral stricture treatment.

GUIDELINE STATEMENTS

Diagnosis/Initial Management

1. **Clinicians should include urethral stricture in the differential diagnosis of men who present with decreased urinary stream, incomplete emptying, dysuria, urinary tract infection (UTI), and rising post void residual. (Moderate Recommendation; Evidence Strength Grade C)**

Differences in stricture characteristics (e.g. location, length, luminal diameter), duration of obstruction, and other factors create a heterogeneous combination of subjective complaints related to a symptomatic urethral stricture. Other urologic conditions such as benign prostate enlargement (with or without bladder outlet obstruction), bladder outlet obstruction, and abnormal detrusor function can present with similar subjective findings, making diagnosis challenging. Young men do

not commonly present with voiding urinary symptoms, therefore a urethral stricture should be considered in the differential diagnosis.

Common risk factors for developing a urethral stricture include a history of hypospadias surgery, urethral catheterization or instrumentation, traumatic injury, transurethral surgery, and prostate cancer treatment.[7,9,56] The stricture etiology will be idiopathic in many men. Among iatrogenic strictures, transurethral surgery is the most common etiology.[7,56] While inflammatory disorders are a less common etiology, LS-related urethral strictures are most troublesome among these stricture types. LS-related urethral strictures tend to be longer than other stricture etiologies, more commonly present in the penile urethra, and may have a higher association with urethral cancer.[7,9]

Men with urethral stricture most commonly report a weak urine stream and incomplete bladder emptying, although other symptoms may be urinary, erectile, and/or ejaculatory in nature.[10] Voiding symptoms not captured by the AUASI include urine spraying (13%) and dysuria (10%);[10] the former symptom is more common among patients with penile than bulbar urethral strictures. Recurrent urethral stricture causes the same general constellation of symptoms including weak stream, painful urination, and UTI.[57] Sexual dysfunction is present in a small minority of men with urethral stricture, with erectile dysfunction being more commonly reported than ejaculatory dysfunction.[10] Sexual dysfunction has been reported to be a more common presenting symptom among men with a history of hypospadias failure and LS.[10] A small subset of men with urethral stricture who are being evaluated for a different urological issue will not have urinary or sexual dysfunction complaints.[10]

2. After performing a history, physical examination, and urinalysis, clinicians may use a combination of patient reported measures, uroflowmetry, and ultrasound post void residual assessment in the initial evaluation of suspected urethral stricture. (Clinical Principle)

A number of self-report instruments, including the AUASI, have been used to evaluate men for lower urinary tract symptoms. Individual questions from these instruments may be used to detect symptoms consistent with stricture disease.

If symptoms and signs suggest the presence of a stricture, noninvasive measures such as uroflowmetry may then definitively delineate low flow, which is typically considered to be less than 12 mL per second.[11,12] Similarly, ultrasonographic post void residual measurement may detect poor bladder emptying. The presence of voiding symptoms as described above, in combination with reduced peak flow rate for age, place patients at higher probability for urethral stricture, therefore indicating definitive evaluation such as cystoscopy, retrograde urethrography, or ultrasound urethrography.

3. Clinicians should use urethro-cystoscopy, retrograde urethrography, voiding cystourethrography, or ultrasound urethography to make a diagnosis of urethral stricture. (Moderate Recommendation; Evidence Strength Grade C)

Endoscopy and/or radiological imaging of the urethra is essential for confirmation of the diagnosis, assessment of stricture severity (e.g. staging), and procedure selection. History, physical examination, and adjunctive measures described above in Statements One and Two cannot definitively confirm a urethral stricture. Urethroscopy identifies and localizes urethral stricture and allows evaluation of the distal caliber, but the length of the stricture and the urethra proximal to the urethral stricture cannot be assessed in most cases. When flexible cystoscopy does not allow visual assessment proximal to the urethral stricture, small caliber cystoscopy with a flexible ureteroscope or flexible hysteroscope can be useful adjuncts. MRI can provide important detail in select cases (i.e., PFUI, diverticulum, fistula, cancer).

Retrograde Urethrography

Retrograde urethrography (RUG), with or without voiding cystourethrography, remains the study of choice for delineation of stricture length, location, and severity.[13,14,58] However, the image quality and accuracy of RUG is operator-dependent; surgical planning should be based on high quality images

generated by experienced practitioners or the surgeon him/herself.[59]

The modestly invasive nature of RUG reflects the potential risks, including patient discomfort, urinary tract infection, hematuria, and contrast extravasation. UTI is rare and contrast extravasation is very rare in expert hands. Exposure to the contrast puts the patient at risk for a contrast reaction, should there be an allergy. The risk is very low in the absence of inadvertent extravasation, and may be mitigated by pre-medication with oral corticosteroids and histamine blockers. Complete or near complete occlusion of the urethra may make the assessment of the urethra proximal to the stricture difficult. In this instance, RUG may be combined with antegrade (voiding) cystourethrography or other methods to define the extent of the stricture.

Ultrasound urethrography

Ultrasound urethrography may serve to diagnose the presence of urethral stricture as well as describe the location, length, and severity of narrowing of strictures. It has a high sensitivity and specificity in the anterior urethra but shares the drawbacks of RUG, including patient discomfort and dependence on a skilled ultrasonographer.[15] Some advocate the use of urethral sonography (ultrasound urethrography) to define the extent of spongiofibrosis and absolute length of the urethral stricture,[60-73] although this is not strictly required and is not used by a majority of stricture experts.[74]

4. **Clinicians planning non-urgent intervention for a known stricture should determine the length and location of the urethral stricture. (Expert Opinion)**

Determination of urethral stricture length and location allows the patient and urologist to engage in an informed discussion about treatment options, perioperative expectations, and expected outcomes following urethral stricture therapy. In addition, preoperative planning permits operative and anesthetic planning.

5. **Surgeons may utilize urethral endoscopic management (e.g. urethral dilation or direct visual internal urethrotomy [DVIU]) or immediate suprapubic cystostomy for urgent management of urethral stricture, such as discovery of symptomatic urinary retention or need for catheterization prior to another surgical procedure. (Expert Opinion)**

When urethral strictures are identified at the time of catheter placement for another surgical procedure, assessment of the need for catheterization should be made. Urethral catheter placement may not be required for surgical procedures that are short in duration. If catheterization is deemed necessary, the primary consideration should be safe urinary drainage. Urethral strictures may be dilated in this setting to allow catheter insertion, and dilation over a guidewire is recommended to prevent false passage formation or rectal injury. Alternatively, internal urethrotomy may be performed, particularly if the stricture is too dense to be adequately dilated. Suprapubic cystotomy may also be performed to provide urinary drainage at the time of surgery if these initial maneuvers are unsuccessful, or when subsequent definitive treatment for urethral stricture is planned in the near future.

6. **Surgeons may place a suprapubic (SP) cystostomy prior to definitive urethroplasty in patients dependent on an indwelling urethral catheter or intermittent self-dilation. (Expert Opinion)**

Proper evaluation of a urethral stricture may require a period without urethral instrumentation to determine the true severity of the stricture including its degree of narrowing. Men with a urethral stricture who have been managed with either an indwelling urethral catheter or self-dilation should generally undergo suprapubic cystostomy placement prior to imaging. This allows the full length of the stricture to develop, and accurate determination of definitive treatment options. Although no specific studies have evaluated the efficacy of this approach, experts agree that a period of "urethral rest" between 4-12 weeks allows the stricture to mature prior to evaluation and management.[75] This is thought to maximize success by not underestimating the length of stricture and degree of spongiofibrosis. A similar period of observation is recommended before reassessing a stricture after failure or dilation or DVIU.

Dilation/Internal Urethrotomy/Urethroplasty

7. Surgeons may offer urethral dilation, direct visual internal urethrotomy (DVIU), or urethroplasty for the initial treatment of a short (< 2 cm) bulbar urethral stricture. (Conditional Recommendation; Evidence Strength Grade C)

Short bulbar urethral strictures may be treated by dilation, DVIU, or urethroplasty. Urethral dilation and DVIU have similar long-term outcomes in short strictures, with success ranging from 35-70%.[76-78] The success of endoscopic treatment depends on the location and length of the stricture, with the highest success rates found in those with bulbar strictures less than 1 cm.[79-81] Conversely, success rates for dilation or DVIU of strictures longer than 2cm are very low.[78,81]

Urethroplasty has a higher long-term success rate than endoscopic treatment, ranging from 80-95%. Urethroplasty may be offered as the initial treatment for a short bulbar urethral stricture, but the higher success rate of this treatment compared to endoscopic treatment must be weighed against the increased anesthesia requirement, cost, and higher morbidity of urethroplasty.

8. Surgeons may perform either dilation or direct visual internal urethrotomy (DVIU) when performing endoscopic treatment of a urethral stricture. (Conditional Recommendation; Evidence Strength Grade C)

Dilation and DVIU have similar success and complication rates and can be used interchangeably. Few studies exist that compare different methods of performing DVIU, but cold knife and laser incision of the stricture scar appear to have similar success rates and may be used interchangeably.[82,83] Other methods of incision may be used experimentally, such as PlasmaKinetic incision.[54] A small experimental study suggests that holmium: YAG laser urethrotomy may have higher success rates in iatrogenic strictures.[82]

Clinicians may endoscopically inject a urethral stricture at the time of DVIU to reduce risk of stricture recurrence. The few studies available showed a generally consistent lower stricture recurrence rate when steroids were added to DVIU, although the findings did not reach statistical significance and follow up was relatively short.[84,85] Mitomycin C injected at the time of DVIU has also been shown to reduce stricture recurrence rate, although data is limited regarding long term follow up.[86]

9. Surgeons may safely remove the urethral catheter within 72 hours following uncomplicated dilation or direct visual internal urethrotomy (DVIU). (Conditional Recommendation; Evidence Strength Grade C)

The reported length of catheterization after dilation or DVIU is highly variable in the literature, ranging from one to eight days.[78,81,82,87,-91] There is no evidence that leaving the catheter longer than 72 hours improves safety or outcome, and catheters may be removed after 24-72 hours. Catheters may be left in longer for patient convenience or if in the surgeon's judgment early removal will increase the risk of complications.

10. In patients who are not candidates for urethroplasty, clinicians may recommend self-catheterization after direct visual internal urethrotomy (DVIU) to maintain temporary urethral patency. (Conditional Recommendation; Evidence Strength Grade C)

Studies using varying self catheterization schedules after DVIU, ranging from daily to weekly, have demonstrated that stricture recurrence rates were significantly lower among patients performing self-catheterization (risk ratio 0.51, 95% CI 0.32 to 0.81, p = 0.004).[88,92-95] The optimal protocol for DVIU plus self-catheterization remains uncertain. However, data suggests that performing self-catheterization for greater than four months after DVIU reduced recurrence rates compared to performing self catheterization for less than three months.[88,92-97] Even though the risk of UTI does not appear to be increased in patients performing self catheterization after DVIU, the ability to continue with self-catheterization may be limited in some patients by manual dexterity or pain with catheterization.[88,96,98]

11. Surgeons should offer urethroplasty, instead of repeated endoscopic management for recurrent anterior urethral strictures following failed dilation or direct visual

internal urethrotomy (DVIU). (Moderate Recommendation; Evidence Strength Grade C)

Urethral strictures that have been previously treated with dilation or DVIU are unlikely to be successfully treated with another endoscopic procedure,[91] with failure rates of >80%.[99] Repeated endoscopic treatment may cause longer strictures, and may increase the complexity of subsequent urethroplasty.[100] In patients who are unable to undergo, or who prefer to avoid, urethroplasty, repeated endoscopic procedures, or intermittent self-catheterization may be considered as palliative measures.

12. Surgeons who do not perform urethroplasty should offer patients referral to surgeons with expertise. (Expert Opinion)

When evaluating a patient with a recurrent urethral stricture, a physician who does not perform urethroplasty should consider referral to a surgeon with experience in this technique due to the higher rate of successful treatment compared to repeat endoscopic management. The relationship between surgical volume and quality is an area for future investigation. There are cases series that suggest, as with many surgical procedures, that better outcomes following urethroplasty are associated with greater surgeon experience.[101,102]

Anterior Urethral Reconstruction

13. Surgeons may initially treat meatal or fossa navicularis strictures with either dilation or meatotomy. (Clinical Principle)

First time presentation of an uncomplicated urethral stricture confined to the meatus or fossa navicularis can be treated with simple dilation or meatotomy with or without guidewire placement, as long as it is not associated with previous hypospadias repair, prior failed endoscopic manipulation, previous urethroplasty, or LS.[39]

Strictures related to hypospadias and LS require unique treatment strategies.[103] However, in the setting of LS there is some evidence that extended meatotomy in conjunction with high-dose topical steroids may decrease the risk of recurrence as compared to meatotomy alone.[104] Additionally, no evidence exists on the optimal caliber of dilation or the need to implement a post dilation intermittent catheterization regimen to reduce stricture recurrence.

14. Surgeons should offer urethroplasty to patients with recurrent meatal or fossa navicularis strictures. (Moderate Recommendation; Evidence Strength Grade C)

Meatal and fossa navicularis strictures refractory to endoscopic procedures are unlikely to respond to further endoscopic treatments.[77,78,81,90,91,105,106] Furthermore, urethroplasty is the best option for completely obliterated strictures or strictures associated with hypospadias or LS. Some patients may opt for repeat endoscopic treatments or intermittent self-dilation in lieu of more definitive treatment such as urethroplasty. Similar to other types of stricture, exact delineation of length and etiology is important for guiding treatment.

Urologists have a variety of options at their disposal for the surgical treatment of meatal and fossa strictures, including meatoplasty, extended meatotomy, and several variations of urethroplasty. It is important to consider both aesthetic and functional outcomes when reconstructing strictures involving the glanular urethra. Simple reconfiguration of the meatus can be performed using a variety of techniques but is best suited to non-obliterated strictures confined to the meatus.[103] In this setting, there is an approximate 75% chance of success.[103] Meatotomy and extended meatotomy have also been employed with success rates up to 87%. [39,103]

Reconstruction of the fossa navicularis can be achieved using a variety of techniques and tissue sources without possible negative cosmetic and functional consequences of meatotomy. One-stage urethroplasty for recurrent meatal and fossa navicularis strictures has been reported with acceptable outcomes.[39,107-109]The most commonly used tissue sources are penile fasciocutaneous flaps and oral mucosal grafts. In the absence of LS, penile fasciocutaneous flaps have been used most commonly, with reported short-term success rates up to 94%.[39,103,109-111] Strictures related to LS are less likely to be reconstructed successfully using genital skin transfer, because LS is a condition of the genital

skin.[112] In these instances, the success of oral mucosal grafts has been reported between 83%-100%.[107,108,113]

In the setting of failed hypospadias surgery, no single technique can be recommended, although the absence of adjacent skin for transfer increases the likelihood of requiring a staged oral mucosa graft urethroplasty.[114-118]

15. Surgeons should offer urethroplasty to patients with penile urethral strictures, because of the expected high recurrence rates with endoscopic treatments. (Moderate Recommendation; Evidence Strength Grade C)

Strictures involving the penile urethra are more likely to be related to hypospadias, LS, or iatrogenic etiologies when compared to strictures of the bulbar urethra, and are thus unlikely to respond to dilation or urethrotomy, except in select cases of previously untreated, short strictures.[77,78,81,90,91] Given the low likelihood of success with endoscopic treatments, most patients with penile urethral strictures should be offered urethroplasty at the time of diagnosis, avoiding repeated endoscopic treatments. When compared to bulbar strictures, penile urethral strictures are more likely to require tissue transfer and/or a staged approach.[112,119]

When performing single stage urethroplasty, penile fasciocutaneous flaps and oral mucosal grafts have been used in differing configurations.[39,47,110,111,120-124] Success rates in penile urethroplasty for properly selected patients appear similar regardless of tissue and technique used.[122,125,126]

16. Surgeons should offer urethroplasty as the initial treatment for patients with long (≥2cm) bulbar urethral strictures, given the low success rate of direct visual internal urethrotomy (DVIU) or dilation. (Moderate Recommendation; Evidence Strength Grade C)

Longer strictures are less responsive to endoscopic treatment, with success rates of only 20% for strictures longer than 4cm in the bulbar urethra.[76] The success rate for buccal mucosa graft urethroplasty for strictures of this length is greater than 80%.[41,127,128]

Given the low efficacy of endoscopic treatment, urethroplasty should be offered to patients with long urethral strictures. Urethroplasty may be performed using a variety of techniques based on the experience of the surgeon, most often through substitution or augmentation of the narrowed segment of the urethra.

17. Surgeons may reconstruct long multi-segment strictures with one stage or multi-stage techniques using oral mucosal grafts, penile fasciocutaneous flaps or a combination of these techniques. (Moderate Recommendation; Evidence Strength Grade C)

Multi-segment strictures (frequently referred to as panurethral strictures) are most commonly defined as strictures over 10 cm in length spanning long segments of both the penile and bulbar urethra. These strictures are particularly complex to treat surgically.[35] Several treatment options exist including long-term endoscopic management, urethroplasty, or perineal urethrostomy. Clinicians should be aware that panurethral strictures are very unlikely to be treated successfully with endoscopic means, which offer only temporary relief of obstruction.[77,78,81,90,91,105,106] However, urethroplasty in these instances is also more complicated, time-consuming, and have a higher failure rate as compared to urethroplasty for less complicated strictures.[35,129,130] Thus, some patients may choose repeat endoscopic treatments, with or without a self-dilation protocol, or a perineal urethrostomy, in order to avoid complex urethral reconstructive surgery.

Reconstruction of panurethral strictures should be addressed with all of the tools in the reconstructive armamentarium including fasciocutaneous flaps, oral mucosal grafts, or other ancillary tissue sources, and may require a combination of these techniques.[35,121,131] These labor intensive and technically challenging surgeries are best performed at established high volume reconstructive centers. Several tissue sources have been reported including oral mucosal grafts, various skin grafts, and genital fasciocutaneous flaps.[35,121,131] Regardless of technique and combinations, success rates appear similar in all of these small series. Superior efficacy of "double graft" procedures has not yet been demonstrated and these techniques are

typically applied to select instances of urethral obliteration.[19,44,47,52,113,132,133] Staged procedures may offer a conservative approach suited to the most complex strictures such as those related to failed hypospadias surgery.[114-118]

18. Surgeons may offer perineal urethrostomy as a long term treatment option to patients as an alternative to urethroplasty. (Conditional Recommendation; Evidence Strength Grade C)

Perineal urethrostomy can be used as a staged or permanent option for patients with anterior urethral strictures in order to establish unobstructed voiding and improve quality of life. Reasons to perform perineal urethrostomy include recurrent or primary complex anterior stricture, advanced age, medical co-morbidities precluding extended operative time, extensive LS, numerous failed attempts at urethroplasty, and patient choice.[39,134,135] Patients undergoing perineal urethrostomy have reported high quality of life, although surgical revision may be necessary to maintain patency over long term follow up.[134,135] Successful treatment with perineal urethrostomy has been reported in both traumatic and LS strictures.[134,135] There are no data demonstrating that a specific surgical technique is associated with a higher patient quality of life or long term patency rate.

19. Surgeons should use oral mucosa as the first choice when using grafts for urethroplasty. (Expert Opinion)

Oral mucosa is the preferred graft for substitution urethroplasty. Patient satisfaction is higher for oral mucosa due to less post-void dribbling and penile skin problems.[45,136]

Oral mucosa may be harvested from the inner cheeks, which provide the largest graft area, the undersurface of the tongue, or the inner lower lip. Harvest of buccal mucosa from the inner cheek results in fewer complications and better outcomes as compared to a lower lip donor site.[137] A randomized controlled trial comparing buccal and lingual donor sites demonstrated that minor morbidity lasted longer following lingual graft harvest,[46] while other cohort studies have exhibited inconsistent findings.[51,138] None reported any major complications.

When harvesting buccal mucosa from the inner cheek, the donor site may safely be left open to heal by secondary intention or closed primarily.[139] Ultimately the decision to close the donor site primarily or leave it open is at the discretion of the surgeon.

20. Surgeons should not perform substitution urethroplasty with allograft, xenograft, or synthetic materials except under experimental protocols. (Expert Opinion)

Use of non-autologous grafts may be indicated in the patient who has failed a prior urethroplasty and has no tissue available for reoperative substitution urethroplasty. However, experience to date is limited and the long term success rates are unknown.[37,140-143] Such patients should be considered for referral to a center involved in clinical trials using allograft, xenograft, engineered or synthetic materials.

21. Surgeons should not perform a single-stage tubularized graft urethroplasty. (Expert Opinion)

Tubularized urethroplasty consists of a technique in which a graft or flap is rolled into a tube over a catheter to completely replace a segment of urethra. This approach, when attempted in a single stage, has a high risk of restenosis and should be avoided. When no alternative exists, a tubularized flap can be performed with results that are inferior to onlay flaps.[144,145] Currently, available alternatives include combined tissue transfer (e.g. a dorsal buccal graft combined with a ventral skin flap in a single stage), combined dorsal and ventral grafts (e.g. a dorsal graft in the technique of Asopa and a ventral onlay graft), or staged urethroplasty with local skin flaps or oral mucosa grafts.

22. Surgeons should not use hair-bearing skin for substitution urethroplasty. (Clinical Principle)

The use of hair-bearing skin for substitution urethroplasty may result in urethral calculi, recurrent urinary tract infection and a restricted urinary stream due to hair obstructing the lumen, and therefore should be avoided except in rare cases where no alternative exists.[146] Intraurethral hair should be suspected in

patients who report these symptoms and have a history of prior tubularized urethroplasty or surgery for proximal hypospadias, in which scrotal skin may have been incorporated into the repair and demonstrate later hair growth.

Pelvic Fracture Urethral Injury

23. Clinicians should use retrograde urethrography with voiding cystourethrogram and/or retrograde + antegrade cystoscopy for preoperative planning of delayed urethroplasty after pelvic fracture urethral injury (PFUI). (Moderate Recommendation; Evidence Strength Grade C)

Pre-operative evaluation of the distraction defect after PFUI should include retrograde urethrography, voiding cystourethrography (VCUG) and/or retrograde urethroscopy. The VCUG may include a static cystogram to determine the competency of the bladder neck mechanism and the level of the bladder neck in relation to the symphysis pubis. Other adjunctive studies may include antegrade cystoscopy (with or without fluoroscopy) and pelvic CT or MRI to assess the proximal extent of the injury, degree of malalignment of the urethra, and length of the defect.

24. Surgeons should perform delayed urethroplasty instead of delayed endoscopic procedures after urethral obstruction/ obliteration due to pelvic fracture urethral injury (PFUI). (Expert Opinion)

The acute treatment of PFUI includes endoscopic primary catheter realignment or insertion of a SP tube. The resulting distraction defect, stenosis or obliteration should be managed with delayed perineal anastomotic urethroplasty. Repeated endoscopic maneuvers including intermittent catheterization should be avoided because they are not successful in the majority of PFUI, increase patient morbidity, and may delay the time to anastomotic reconstruction. Clinicians should avoid blind "cut to the light" procedures in the obliterated PFUI since they are rarely successful in long term follow up.

Anastomotic reconstruction is performed through a perineal approach. Excision of the scar tissue and wide spatulation of the anastomosis is required. Several methods to gain urethral length and reduce tension can be employed when necessary including mobilization of the bulbar urethra, crural separation, inferior pubectomy and supracrural rerouting, but in most cases the latter two maneuvers are not required. In rare cases, trans abdominal or transpubic techniques may be required. In order to potentially decrease the potential for vascular compromise to the urethra, a bulbar artery sparing approach has been described. No comparative study has yet shown any definitive benefit. Clinicians should refer patients to appropriate tertiary care centers for reconstruction when necessary.

25. Definitive urethral reconstruction for pelvic fracture urethral injury (PFUI) should be planned only after major injuries stabilize and patients can be safely positioned for urethroplasty. (Expert Opinion)

The timing of urethral reconstruction in PFUI is highly dependent on patient factors. No optimal time to perform urethral reconstruction has been established, with studies reporting a wide range of times from six weeks to four years. Reconstruction should occur when patient factors allow the surgery to be performed (usually within three to six months after the trauma). Patient positioning in the lithotomy (standard, high, or exaggerated) may be limited until orthopedic and lower extremity soft tissues injuries have resolved.

Bladder Neck Contracture/Vesicourethral Stenosis

26. Surgeons may perform a dilation, bladder neck incision or transurethral resection for bladder neck contracture after endoscopic prostate procedure. (Expert Opinion)

Treatment of bladder neck contractures following endoscopic prostate procedures can be performed with either a bladder neck incision or bladder neck resection depending on surgeon preference, with comparable outcomes expected. Repeat endoscopic treatment may be necessary for successful outcomes. No studies exist that compare the different treatment strategies for bladder neck contractures after endoscopic prostate procedures.

27. Surgeons may perform a dilation,

vesicourethral incision, or transurethral resection for post-prostatectomy vesicourethral anastomotic stenosis. (Conditional Recommendation; Evidence Strength Grade C)

Treatment of first time vesicourethral anastomotic stenosis is successful in about 50-80% of cases, with all techniques having similar success rates.[147-151] Success appears to be lower in cases with prior pelvic radiation; however, prospective cohort studies including radiated and nonradiated patients are lacking. Repeat endoscopic treatment may be necessary for successful treatment. There is conflicting data about the utility of Mitomycin-C for the treatment of recurrent vesicourethral stenosis, with further study necessary to validate its use.[152,153] Patients should be made aware of the risk of incontinence after any of these procedures.

28. **Surgeons may perform open reconstruction for recalcitrant stenosis of the bladder neck or post-prostatectomy vesicourethral anastomotic stenosis. (Conditional Recommendation; Evidence Strength Grade C)**

The treatment of recalcitrant vesicourethral anastomotic stenosis must be tailored to the preferences of the patient, taking into consideration prior radiotherapy and the degree of urinary incontinence. Urethral reconstruction is challenging and may cause significant urinary incontinence requiring subsequent artificial urinary sphincter implantation, but offers success rates of approximately 66-80%.[154,155] Success rates are lower after radiation. For the patient who does not desire urethroplasty, repeat urethral dilation, incision or resection of the stenosis is appropriate. Intermittent self-dilation with a catheter may be used to prolong the time between operative interventions. Suprapubic diversion is an alternative.

Special Circumstances

29. **In men who require chronic self-catheterization (e.g. neurogenic bladder), surgeons may offer urethroplasty as a treatment option for urethral stricture causing difficulty with intermittent self-catheterization. (Expert Opinion)**

In men with neurogenic bladder urethral pathology may include stricture, diverticulum, fistula, and erosion. Bladder function must be considered prior to urethroplasty as significant underlying detrusor dysfunction it may alter the course of treatment. It is unclear if anterior urethroplasty in this setting has higher rates of complications, stricture recurrence or reoperation when compared to men with anterior urethral stricture and intact bladder function.[156,157] There is some evidence to suggest that urethral reconstruction, if offered at an early stage in men with stricture and neurogenic bladder, can achieve outcomes comparable to men without neurogenic bladder.[157] It is not definitively known if resumption of intermittent catheterization following anterior urethroplasty impacts the risk of stricture recurrence.

30. **Clinicians may perform biopsy for suspected lichen sclerosus (LS), and must perform biopsy if urethral cancer is suspected. (Clinical Principle)**

The external manifestations of LS in males can range in severity from mild to aggressive. It is most commonly found in the genital region and may be associated with urethral strictures.[158-160] LS may mimic many other skin diseases: therefore, biopsy is the best method for definitive diagnosis. The rate of squamous cell carcinoma in male patients with LS has been reported to be 2-8.6% thus further indicating the need for biopsy in selected cases both to confirm the diagnosis as well as to exclude malignant or premalignant changes.[160-163]

31. **In lichen sclerosus (LS) proven urethral stricture, surgeons should not use genital skin for reconstruction. (Strong Recommendation; Evidence Strength Grade B)**

Goals of management of LS should be to alleviate symptoms, prevent and treat urethral stricture disease and prevent and detect malignant transformation.[159]

Treatment of genital skin LS reduces symptoms, such as skin itching and bleeding, and may serve to prevent meatus stenosis and progression to extensive stricture of the penile urethra. Current therapies rely heavily on topical moderate- to high-potency steroid creams, such

as clobetasol or mometasone creams. Calcineurin inhibitors such as tacrolimus have been shown to cause regression in external skin manifestations.[159]

Reconstruction of anterior urethral strictures associated with LS should proceed according to principles outlined previously, with the caveat that the use of genital skin flaps and grafts should be avoided due to very high long-term failure rates.[112,138,164,165]

Post-operative Follow-up

32. Clinicians should monitor urethral stricture patients to identify symptomatic recurrence following dilation, direct visual internal urethrotomy (DVIU) or urethroplasty. (Expert Opinion)

Urethral stricture recurrence following endoscopic treatment or urethroplasty can occur at any time in the postoperative period, and, because of this, a specific regimen for postoperative follow-up cannot be reliably determined. The surgeon may consider more frequent follow-up intervals in men at an increased risk for stricture recurrence including those with prior failed treatment (multiple endoscopic procedures or previous urethroplasty), tobacco use, diabetes, increasing stricture length, strictures related to LS, hypospadias, or a repair involving a flap or graft. [101,102,122,129,130, 165-173]

Surgeons can use a number of diagnostic tests to detect or screen for stricture recurrence following open or endoscopic treatment (see guideline statements 1 and 2); however the use of, or combination of, urethrocystoscopy, urethral ultrasound, or RUG appears to provide the most definitive confirmation of stricture recurrence.[60-67,174,175] No specific urethral lumen diameter, determined endoscopically or radiographically, has been shown to be diagnostic of a stricture recurrence.

Although stents are not currently recommended for the treatment of urethral stricture. Patients treated with a urethral stent after dilation or internal urethrotomy should be monitored for recurrent stricture and complications. Recurrent strictures have been reported in new urethral regions outside of the stent placement in addition to within the stent treated region.[176-178] Patients with completely obstructed stents may require open urethroplasty and removal of the stent.[178] Other stent complications include stent-induced hematuria, urethral pain, urinary incontinence, and chronic urinary tract infection.[99,176-180] Complications can occur at any time point after stent placement, so long term monitoring with cystoscopy or urethral imaging, is advised. Stents do not need to be prophylactically removed and should be followed conservatively unless associated with significant urethral or voiding symptoms.

RESEARCH NEEDS AND FUTURE DIRECTIONS

Much of the literature on the topic urethral strictures consists of single surgeon or single institution case series with inconsistent definitions of disease process, success of treatment, and follow up. These inconsistencies resulted in difficulty in comparison between studies. These inadequacies in the literature means there is ample opportunities for future research. To improve the quality of research, the Panel recommends the following:

- Research terms should be standardized to allow comparison between centers—the International Consultation on Urological Diseases[6] nomenclature should be used. For example, the term "urethral stricture" should be applied to a narrowing of the anterior urethra that restrict the flow of urine.

- In studies of the treatment of urethral strictures, multiple criteria for success should be reported. When data is available, studies should report success based several criteria: patient reported outcome measures, symptoms, uroflowmetry, radiography, cystoscopy, and need for subsequent procedures. Reporting success based on multiple criteria would facilitate comparison between multiple studies.

- The duration and type of follow up should be reported in all studies of urethral stricture treatment, follow up based on time of last clinic visit, telephone contact, or absence of known treatment for recurrence. Time-to-event analysis (Kaplan-Meier) should be reported.

- Multi-institutional collaboration should be formed to evaluate management of uncommon diagnoses

such as pelvic fracture urethral injury, hypospadias, panurethral strictures, and LS.

- Multi-centered randomized clinical trials, pragmatic trials, or registries should be created for evaluation of techniques, such as injection of antiproliferative agents during DVIU, dorsal versus ventral onlay buccal mucosa graft urethroplasty, and skin flap versus oral mucosa graft urethroplasty.
- Multiple measures have been used to determine and report success after treatment for urethral stricture. Currently there is no universally accepted definition of success following treatment for urethral stricture. Multi-center randomized trials are necessary to standardize follow-up protocols to accurately and efficiently define successful treatment, and enable comparative effectiveness research across centers.

Urethral stricture remains a subject of active investigation. The Panel suggests the following issues in future investigations:

- Both basic science and epidemiological research into the etiology of urethral strictures.
- Prevention of traumatic strictures through educational efforts on proper technique of catheter insertion.
- Studies on the effectiveness of early diagnosis and treatment of LS toward prevention of disease progression and urethral stricture formation.
- Basic science and animal studies using novel graft materials for urethral reconstruction—stem cells, tissue-engineered scaffolds, etc.
- Long term follow up for adults in patients who have been treated as children, such as urethral stricture in adults after hypospadias repair.
- Further evaluation of alternative sources of autologous graft material.
- The efficacy of injection of anti-proliferative or other pharmacological agents at time of endoscopic incision for urethral stricture and bladder neck contracture.
- The relationship between of urethroplasty and erectile dysfunction.
- Role of urethral transection in urethroplasty regarding morbidity and outcomes.
- The optimal timing and duration of perioperative antibiotics given at the time of urethrotomy and urethroplasty.
- Determination of the ideal tissue for substitution urethroplasty.

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LIST OF ABBREVIATIONS

AUSAI	**American Urological Association Symptom Index**
CCT	**Controlled clinical trials**
DVIU	**Direct visual internal urethrotomy**
EPA	**Excision and primary anastomosis**
IIEF	**International Index of Erectile Function**
LS	**Lichen Sclerosis**
LUTS	**Lower urinary tract symptoms**
MSHQ	**Men's Sexual Health Questionnaire**
PFUD	**Pelvic fracture urethral disruption**
PFUI	**Pelvic fracture urethral injury**
PRM	**Patient reported measures**
RCT	**Randomized controlled trial**
RUG	**Retrograde urethrography**
SP	**Suprapubic**
UTI	**Urinary tract infection**
VCUG	**Voiding cystourethrography**
VTE	**Deep venous thromboembolism**

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DISCLAIMER

This document was written by the Male Urethral Stricture Guideline Panel of the American Urological Association Education and Research, Inc., which was created in 2015. The Practice Guidelines Committee (PGC) of the AUA selected the committee chair. Panel members were selected by the chair. Membership of the panel included specialists in urology with specific expertise on this disorder. The mission of the panel was to develop recommendations that are analysis-based or consensus-based, depending on panel processes and available data, for optimal clinical practices in the treatment of male urethral strictures.

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While these guidelines do not necessarily establish the standard of care, AUA seeks to recommend and to encourage compliance by practitioners with current best practices related to the condition being treated. As medical knowledge expands and technology advances, the guidelines will change. Today these evidence-based guidelines statements represent not absolute mandates but provisional proposals for treatment under the specific conditions described in each document. For all these reasons, the guidelines do not pre-empt physician judgment in individual cases.

Treating physicians must take into account variations in resources, and patient tolerances, needs, and preferences. Conformance with any clinical guideline does not guarantee a successful outcome. The guideline text may include information or recommendations about certain drug uses (‘off label‘) that are not approved by the Food and Drug Administration (FDA), or about medications or substances not subject to the FDA approval process. AUA urges strict compliance with all government regulations and protocols for prescription and use of these substances. The physician is encouraged to carefully follow all available prescribing information about indications, contraindications, precautions and warnings. These guidelines and best practice statements are not in-tended to provide legal advice about use and misuse of these substances.

Although guidelines are intended to encourage best practices and potentially encompass available technologies with sufficient data as of close of the literature review, they are necessarily time-limited. Guidelines cannot include evaluation of all data on emerging technologies or management, including those that are FDA-approved, which may immediately come to represent accepted clinical practices.

For this reason, the AUA does not regard technologies or management which are too new to be addressed by this guideline as necessarily experimental or investigational.