DOI: https://doi.org/10.17816/uroved653424 EDN: TWKGQY

Treatment of Urethral Strictures in Women

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ABSTRACT

The limited coverage of female infravesical obstruction has led to the absence of a clear algorithm for the diagnosis and treatment of urethral strictures in women. Currently, various treatment methods are used—from urethral dilation to urethroplasty—with their effectiveness and indications remaining the subject of ongoing discussion. The article discusses the issues of etiology, diagnosis, and treatment of urethral strictures in women and examines the effectiveness of various invasive methods for managing narrowing of the female urethra. The required information was searched in PubMed, Web of Science, CyberLeninka, eLibrary, and Scopus databases for the period 1999–2022 using the following keywords: *стеноз меатуса* (*meatal stenosis*), *стриктура уретры у женщин* (*female urethral stricture*), *стриктурная болезнь уретры* (*urethral stricture disease*), *вентральная уретропластика слизистой половой губы и влагалища* (*ventral urethroplasty using labial and vaginal mucosa*), *дорсальная буккальная уретропластика* (*dorsal buccal urethroplasty*), *пластика уретры лоскутом стенки влагалища* (*urethral reconstruction using vaginal wall flap*), *бужирование* (*urethral dilation*), *обструктивное мочеиспускание у женщин* (*female obstructive voiding*), *and инфравезикальная обструкция у женщин* (*female infravesical obstruction*). It was noted that urethral dilation and internal optical urethrotomy are often used as initial treatments and demonstrate satisfactory results, though they are associated with a relatively high recurrence rate. In patients with partial urethral obliteration and recurrent stricture after previous interventions, subsequent surgical options may include urethral reconstruction using flaps of the anterior or lateral vaginal wall, vestibular flaps, or free grafts (in dorsal or ventral position). The choice of surgical technique may be influenced by several factors—location and length of the stricture, presence of trophic changes in the mucosa, mechanism of development, as well as the surgeon's experience and preferences. Urethrotomy and dilation may be used as initial treatment methods in some cases; however, in the presence of recurrence, marked fibrotic changes, and significant stenosis, urethroplasty is considered more appropriate. Flap-based urethroplasty techniques have demonstrated effectiveness and safety and may therefore represent a preferred treatment method for female urethral strictures.

Keywords: female urethral stricture; urethral stricture disease; urethrotomy; urethroplasty; female infravesical obstruction.

To cite this article
Komyakov BK, Fadeev VA, Tikutskaya EV. Treatment of Urethral Strictures in Women. *Urology reports (St. Petersburg)*. 2025;15(2):183–191. DOI: 10.17816/uroved653424 EDN: TWKGQY

Submitted: 03.02.2025 **Accepted:** 28.04.2025 **Published online:** 30.06.2025

DOI: https://doi.org/10.17816/uroved653424 EDN: TWKGQY

Лечение стриктур уретры у женщин

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АННОТАЦИЯ

Недостаточная освещенность проблемы женской инфравезикальной обструкции является причиной отсутствия четкого алгоритма диагностики и лечения стриктур уретры у женщин. В настоящее время используются различные методы лечения — от дилатации уретры до уретропластики, при этом их эффективность и варианты применения становятся предметом дискуссии. В статье освещены вопросы этиологии, диагностики и лечения стриктур уретры у женщин, рассматривается эффективность различных методов инвазивного лечения сужения женского мочеиспускательного канала. Поиск необходимой информации проведен в базах PubMed, Web of Science, CyberLeninka, eLibrary, Scopus за период 1999–2022 гг. по следующим ключевым словам: «стеноз меатуса», «стриктура уретры у женщин», «стриктурная болезнь уретры», «вентральная уретропластика слизистой половой губы и влагалища», «дорсальная буккальная уретропластика», «пластика уретры лоскутом стенки влагалища», «бужирование», «обструктивное мочеиспускание у женщин», «инфравезикальная обструкция у женщин». Отмечено, что часто первичным методом лечения является дилатация уретры и внутренняя оптическая уретротомия, имеющие удовлетворительные результаты, но отличающиеся достаточно высокой частотой рецидива. У пациенток с частичной облитерацией уретры рецидивом стриктуры после ранее проведенного вмешательства в качестве следующего этапа рассматриваются варианты пластики уретры лоскутом передней или боковой стенки влагалища, преддверия влагалища или пластика свободным трансплантатом (в дорсальном или вентральном исполнении). При этом выбор способа оперативного лечения может быть продиктован различными факторами — локализацией стриктуры, ее протяженностью, наличием трофических изменений слизистой оболочки, механизмами ее развития, опытом и предпочтениями хирурга. В качестве инициального метода лечения стриктуры женской уретры в ряде случаев возможно использовать уретротомию и дилатацию, однако при рецидиве заболевания, выраженных фиброзных изменениях и значимом стенозе целесообразно выполнить уретропластику. Методы лоскутной уретропластики демонстрируют эффективность и безопасность, поэтому могут представлять собой предпочтительный метод лечения стриктур женской уретры.

Ключевые слова: стриктура уретры у женщин; стриктурная болезнь уретры; уретротомия; уретропластика; инфравезикальная обструкция у женщин.

Как цитировать

Комяков Б.К., Фадеев В.А., Тикуцкая Е.В. Лечение стриктур уретры у женщин // Урологические ведомости. 2025. Т. 15, № 2. С. 183–191. DOI: 10.17816/uroved653424 EDN: TWKGQY

Рукопись получена: 03.02.2025 **Рукопись одобрена:** 28.04.2025 **Опубликована online:** 30.06.2025

Urethral strictures is a rare cause of anatomical infravesical obstruction (IVO) in women. This is partly why this issue is not adequately addressed in medical journals and is often underestimated. This leads to a lack of clear clinical guidelines or diagnostic and treatment algorithms. Consequently, clinicians who encounter this problem in their daily practice frequently have to rely exclusively on their expert opinion. Overall, among patients with lower urinary tract symptoms (LUTS), the frequency of anatomical urinary outflow obstruction is 3%–8% of cases [1–4]. In turn, narrowing of the urethra is detected in 4%–13% of patients [1, 2, 4, 5]. This condition may cause pronounced symptoms that significantly impair quality of life and lead to complications.

A urethral stricture is one of the intraluminal anatomical causes of IVO in women [3, 4]. In many cases, the etiology may be iatrogenic. For example, fibrosis may develop after urethral dilation, traumatic catheterization, excision of a urethral diverticulum or urethral caruncle, suturing of a urethrovaginal fistula, implantation of a suburethral sling for stress incontinence, as well as after radiation therapy in the pelvic region [1, 3, 6]. Some publications state that possible causes of the urethral stricture in women may include a specific inflammatory process (tuberculosis), lichen sclerosus, urethral carcinoma, fibroepithelial polyp, leiomyoma, as well as complications after transurethral resection of a bladder tumor, removal of a sacrococcygeal teratoma, or consequences of sex reassignment surgery [1, 3].

The diagnosis of IVO and urethral stricture in women is currently not systematized. The reason is frequently attributable to an inaccurate stereotypical approach during the outpatient stage, a consequence of the low incidence of this pathological condition. The complaints reported by patients are nonspecific and may result from IVO complications. These include frequent urination, difficult or interrupted urination, straining during urination, a feeling of incomplete bladder emptying, urgency with urinary incontinence, as well as periodic episodes of urinary tract infections [7]. Consequently, when women with LUTS seek medical care, the presence of IVO, including that caused by urethral strictures, should be excluded. Voiding disorders are detected in 50%–60% of women with recurrent urinary tract infections and are manifested by a decrease in urination rate and/or an increase in residual urine [8]. Some data suggest that up to 42% of patients with symptoms of an overactive bladder have IVO detected by urodynamic testing [9–11].

A bladder ultrasound can provide additional information about structural changes associated with long-standing IVO, such as detrusor hypertrophy and the presence of stones and bladder diverticula. The amount of residual urine is a significant criterion indicating dysfunctional voiding and/or IVO. Another important noninvasive test for urinary dysfunction is uroflowmetry, which involves the assessment of maximum and average urinary flow rates, curve patterns, and interpretations using the Liverpool nomogram. This method has a sensitivity of 50%–100% and a specificity of over 70%.

A combination of endoscopic and radiological examination methods helps establish a final diagnosis. In some cases, significant stenosis of the urethral lumen can complicate invasive urethral procedures. Urethrocystoscopy may be performed while calibrating the urethra with bougies to determine the diameter of the urethral stenosis. However, vigorous urethral dilation should be avoided prior to cystoscopy. For example, some clinical cases have been described in which symptoms improved in patients with dysfunctional urination after urethral dilation, even though this pathological condition is not strictly an anatomical stricture [1, 3]. However, there is no consensus on whether urethral calibration is effective in diagnosing female IVO. Various threshold values for the bougie diameters used in calibration are indicated, ranging from 12 to 20 Fr. However, most authors consider a diameter of less than 14 Fr to be a stricture criterion [12].

A final diagnosis of IVO in women can be made by conducting a urodynamic pressure-flow analysis. This invasive procedure requires a thorough evaluation, including the patient's symptoms, the results of an objective examination, entries from a urination diary, uroflowmetry indicators, and residual urine volume. A urodynamic picture similar to urethral stricture is often detected in patients with dysfunctional micturition. Under these circumstances, urethroscopy under anesthesia should be performed for a differential diagnosis [13].

A comprehensive search for contemporary surgical treatment methods for female urethral stricture was conducted using major scientific databases, including PubMed, Web of Science, CyberLeninka, eLibrary, and Scopus. The search spanned from 1999 to 2022 and included the following keywords: *стеноз меатуса* (*meatal stenosis*), *стриктура уретры у женщин* (*female urethral stricture*), *стриктурная болезнь уретры* (*urethral stricture disease*), *вентральная уретропластика слизистой половой губы и влагалища* (*ventral urethroplasty using labial and vaginal mucosa*), *дорсальная буккальная уретропластика* (*dorsal buccal urethroplasty*), *уретропластика лоскутом стенки влагалища* (*urethral reconstruction using vaginal wall flap*), *бужирование* (*urethral dilation*), *обструктивное мочеиспускание у женщин* (*female obstructive voiding*), and *ИВО у женщин* (*female infravesical obstruction*). Based on the search results, 30 scientific papers relevant to the subject query were selected.

In cases of female urethral stricture, the diagnosis and treatment may present significant challenges. The most common initial treatments are minimally invasive

Table 1. Results of dilation and urethrotomy in the treatment of female urethral stricture

Author, year	Number of patients (*n*)	Treatment method	Efficacy	Average duration of follow-up, months	Average time to recurrence, months
A.L. Smith et al. (2006) [14]	7	Urethral dilation	57%	21	–
A.N. Romman et al. (2012) [15]	93	Urethral dilation	51%	46	8
J.G. Blaivas et al. (2012) [16]	17	Urethral dilation	6%	52	5
X.B. Jin et al. (2012) [17]	30	Internal optical urethrotomy	83%	60	–
P. Zhang et al. (2014) [18]	84	Internal optical urethrotomy	84.5%	27	–

procedures, such as urethral dilation/calibration and internal optical urethrotomy (Table 1). Smith et al. [14] presented the results of urethral dilation in seven women. The follow-up period averaged 21 months, with positive outcomes observed in 57% of cases [14]. Romman et al. [15] reported positive outcomes in 51% of patients following dilation to 41 Fr. The authors defined a successful outcome as a combination of the ability to urinate independently, a reduction or disappearance of LUTS, and the absence of the need for further urethral dilation or any other intervention. Blaivas et al. [16] presented the outcomes of primary urethral dilation for strictures in 17 patients. Of these, only one patient did not require additional treatment. The urethral calibration is relatively uncomplicated and can be performed under local anesthesia in outpatient settings. One of the main disadvantages of this procedure is the high risk of periurethral fibrosis, which requires repeated dilation procedures. Moreover, its efficacy decreases with each subsequent procedure. Additionally, there are descriptions of cases in which urethroplasty outcomes worsened in patients with a history of multiple dilations. Overall, the frequency of positive outcomes after dilatation may be as high as 58%, though it is typically lower [3, 12].

Some authors began considering internal optical urethrotomy to be the primary treatment option. This type of surgical intervention, which is similar to the one used for men, was employed for short strictures in the middle part of the urethra. The stricture was typically cut at the 3 and 9 o'clock positions. However, some authors added incisures at the 12 o'clock position. In 2012, Jin et al. [17] treated 30 women with urethral strictures using a modified transurethral incision technique. All patients showed significant improvement, with no evidence of recurrence for at least five years following the procedure. In 2014, Zhang et al. published the results of their treatment of patients, achieving positive long-term outcomes in 84% of cases [18]. Overall, optical urethrotomy has demonstrated a satisfactory efficacy of 60%–80% over a three-year follow-up period, with a re-intervention rate of up to 18%. The main disadvantage of this method is the risk of developing stress urinary incontinence [19]. However, the need for repeated urethral dilations and internal optical urethrotomy frequently necessitates multiple visits to the physician. Furthermore, these procedures do not address the underlying problem. Treatment is palliative and may lead to the progressive development of periurethral fibrosis. This may result in stricture recurrence and the need for more extensive interventions. Another controversial practice is urethral dilation or urethrotomy based solely on symptoms of urinary outflow obstruction, rather than confirming the presence of a stricture. Most authors do not recommend this approach because there is a high risk of stress urinary incontinence [20].

The principles of urethral reconstruction differ between men and women. This is due to a significantly shorter length and anatomical features of the urethra in women. Specifically, the striated muscle fibers of the urethral sphincter are positioned outside the smooth muscle layer along nearly the entire length of the urethra [12]. Many authors consider urethroplasty to be the method of choice in cases of partial urethral obliteration and/or stricture recurrence after previous interventions. There are meatolplasty and several types of urethroplasty, including those that use a flap from the anterior vaginal wall (Blandy technique) or lateral vaginal wall (Orandi technique), or vestibular flap (Montorsi technique), as well as urethroplasty with a free graft using either the dorsal or ventral approach. The advantages of using local (vaginal) flaps include their mobility, sufficient vascularization, and the ability to be moved with minimal complications [12].

For short urethral strictures, making a longitudinal ventral incision through the stricture can substantially widen the urethral lumen. According to the Heineke–Mikulicz principle, the incision made after longitudinal dissection of the stricture can be sutured transversely. However, this approach has not been widely adopted in clinical practice. This technique is typically recommended

Table 2. Results of different urethroplasty techniques in the treatment of female urethral stricture

Author, year	Number of patients (*n*)	Treatment method	Efficacy	Average duration of follow-up, months
E.A. Gormley (2010) [20]	12	Anterior vaginal wall flap (Blandy)	91.7%	36
F.F. Önol et al. (2011) [5]	10	Anterior vaginal wall flap (Blandy)	100%	36
J.G. Blaivas et al. (2012) [16]	10	Anterior vaginal wall flap (Blandy)	100%	24
S.P. Petrou et al. (2012) [21]	11	Anterior vaginal wall flap (Blandy)	100%	22,7
F. Montorsi et al. (2002) [22]	17	Vestibular vaginal flap	88%	12
M. Tanello et al. (2002) [23]	2	Lateral vaginal wall flap (Orandi)	100%	24
A. Simonato et al. (2010) [24]	6	Lateral vaginal wall flap (Orandi)	100%	70.8
R. Migliari et al. (2006) [25]	3	Buccal graft (dorsal)	100%	6
A. Tsivian, A.A. Sidi (2006) [26]	3	Buccal graft (dorsal)	100%	27
R.K. Berglund et al. (2006) [27]	2	Buccal graft (ventral)	50%	24
C. Gozzi et al. (2010) [28]	4	Labial graft (ventral)	100%	15
P. Rehder et al. (2010) [29]	8	Labial graft (ventral)	100%	24
Al-Shukri et al. (2022) [30]	1	Buccal graft	100%	12

for short strictures (up to 0.5 cm) of the urethral meatus. When performing this procedure on a longer stricture, a hypospadias-like condition of the meatus may be created. This may lead to urine leakage into the vagina during urination. The probability of a successful outcome is generally high, up to 96% [6, 12].

In women undergoing urethroplasty, vaginal and labial flaps, as well as buccal and lingual grafts, are quite successful (Table 2). There are dorsal and ventral approaches. For example, Gormley [20] presented the treatment outcomes of 12 patients who underwent urethroplasty using a U-shaped Blandy flap of the anterior vaginal wall (Fig. 1). All patients experienced improved urination and regression of symptoms, with no cases of stress urinary incontinence. The method proved to be effective. Only one patient required surgical treatment for bladder neck stenosis [20]. In 2011, Önol et al. [5] published the treatment outcomes of ten patients who underwent a similar U-shaped urethroplasty with a vaginal flap. Successful outcomes were observed in all cases, with no complications reported [5]. Later publications by Blaivas et al. [16] and Petrou et al. [21] also demonstrated positive outcomes of their patients undergoing surgery, with no clinically significant complications. In 2002, Montorsi et al. published a paper presenting the results of their urethroplasty method using vestibular vaginal flaps in 17 women with distal urethral stricture [22]. An inverted Y-shaped incision was made above the meatus. The distal part of the urethra, measuring approximately 3 cm, was separated from the clitoris and paraurethral tissues between the 9 and 15 o'clock positions. Subsequently, the dorsal wall of the urethra was incised at the 12 o'clock position until the healthy urethra appeared. The tip of the vestibular flap was then sutured to the proximal end of the opened urethra, and the base of the flap was sutured to the vestibular mucous membrane (Fig. 2). The surgery was effective in 88% of cases [22]. Meanwhile, Tanello et al. [23] performed urethroplasty using a lateral vaginal flap (Orandi flap). In this case, the ventral part of the urethra was isolated and dissected until a normal mucous membrane appeared. The flap of the lateral wall corresponded to the length of the dissected urethra. The flap leg was then mobilized so that it may be rotated toward the incised portion of the urethra (Fig. 3). There were only two patients, both of whom experienced successful treatment outcomes without any complications. Later, Simonato et al. [24] reported the successful treatment of six patients using a similar urethroplasty technique.

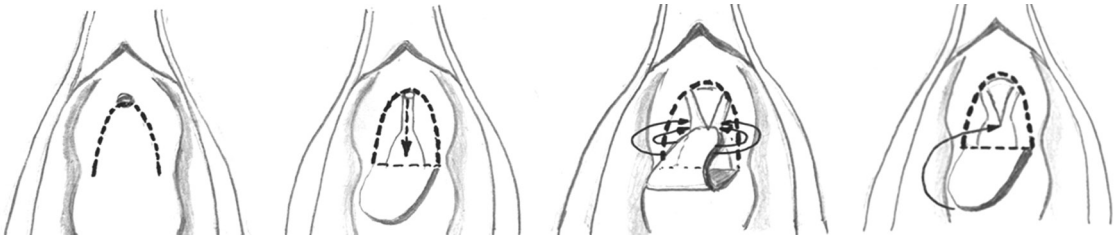

Fig. 1. Urethroplasty using an anterior vaginal wall flap (Blandy technique).

Fig. 2. Urethroplasty using the vaginal vestibule flap (Montorsi technique).

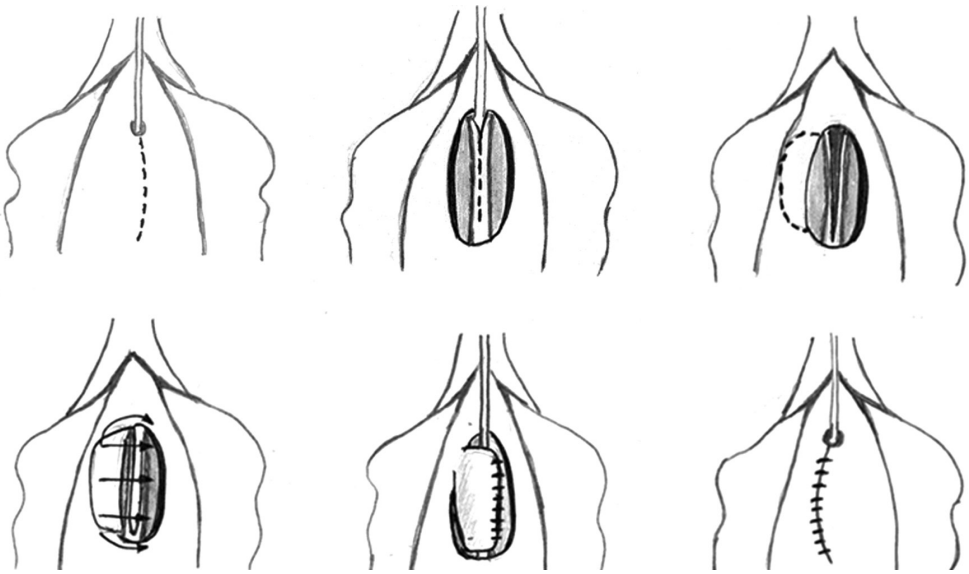

Fig. 3. Urethroplasty using the lateral vaginal wall flap (Orandi technique).

Many studies have demonstrated the advantages of buccal mucosa grafts over skin flaps for urethroplasty in men. However, there are currently no data comparing urethroplasty results using buccal flaps versus vaginal or labial flaps in women [1]. In 2006, Migliari et al. published the results of urethral reconstruction using buccal grafts via the dorsal approach in three patients. First, a semilunar incision was made above the meatus. Then, dissection was performed between the clitoral body and the dorsal part of the urethra. The dorsal part of the urethra was incised until healthy mucosa appeared. Then, the graft was inserted into the urethra with the mucosa facing inward, and its edges were sutured to the incised urethra. The sutures were meticulously placed to secure the paraurethral tissues, ensuring the graft's optimal fixation (Fig. 4). Successful outcomes were reported in all cases [25]. Additionally, Tsivian and Sidi [26] presented the results of successful urethroplasties using buccal grafts in two patients via the dorsal approach. In contrast, Berglund et al. [27] employed a ventral approach to reconstruct the urethra using a buccal graft. According to the proposed method, the graft was taken according to the size of the stricture. Then, the surrounding spongy tissue was brought together to form a vascularized bed (Fig. 5). Successful results were achieved in half of the operated patients.

In 2011, Gozzi et al. published the results of urethroplasty using a labial graft via a ventral approach, with positive outcomes achieved in all cases [28]. Concurrently, Rehder et al. [29] shared their experience using a

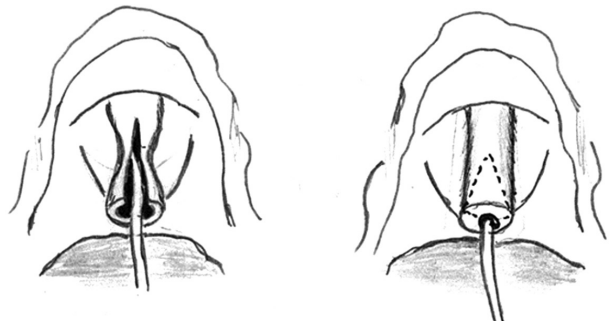

Fig. 4. Dorsal approach for graft urethroplasty.

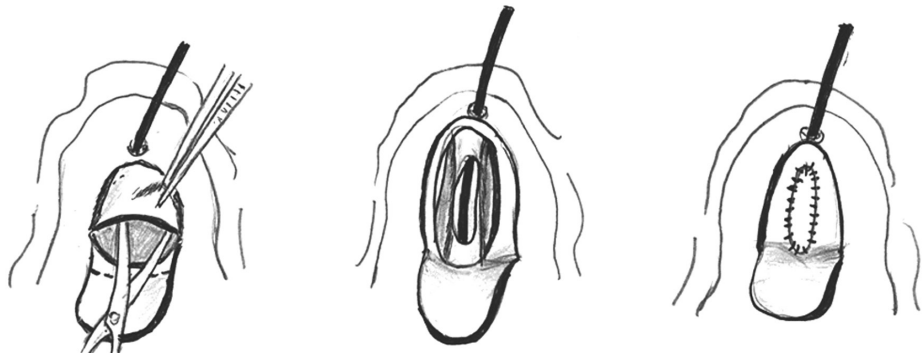

Fig. 5. Ventral approach for graft urethroplasty.

labial graft with a ventral approach on eight women. All patients achieved successful outcomes, with no clinically significant complications reported. Additionally, Russian sources cite urethroplasty using buccal grafts, as documented by Al-Shukri et al. in 2022. The case of a patient with complete urethral obliteration and an inability to urinate independently was described. Cystostomy drainage exacerbated the patient's poor quality of life. The patient underwent a successful urethraplasty with a buccal flap using the dorsal approach. There were no reported complications, and one year after surgery, the patient was still urinating independently [30].

Importantly, dorsal urethroplasty may be necessary in cases of severe scarring of the ventral wall. This option is preferable for strictures affecting the sphincter area and extending to the bladder neck. In dorsal urethroplasty for women, the graft possesses a well-vascularized bed, which significantly reduces the risk of urethrovaginal fistula formation and meatal hypospadias. When considering the ventral approach, the following are of primary importance: the technique's relative simplicity and the absence of risk to the clitoris and its neurovascular bundles, the sphincter complex, and the pubourethral ligaments. Urethroplasty may also be combined with sling installation to correct incontinence.

Currently, there is no consensus on the most effective method for treating urethral strictures in women. When choosing a treatment strategy for patients, important factors include the anatomical features of the stricture, such as its location and length, how easily it can be accessed, the length of the healthy proximal urethra, the integrity of the bladder neck, and the surgeon's experience and preferences. For women with true urethral stricture, it is recommended that dilation or urethrotomy be used reasonably. It is advisable that urethroplasty should be planned immediately for patients with severe initial stenosis or those who experience disease recurrence after dilation. Notably, the efficacy of most treatment methods is unclear due to the limited clinical data. This allows the surgeon to choose an approach based on individual experience and surgical skills. Flap urethroplasty techniques have been shown to be effective and safe and appear to be the preferred treatment for most women with urethral strictures. However, developing an algorithm to select the optimal treatment method requires extensive clinical data and a detailed analysis.

ADDITIONAL INFO

Author contributions: B.K. Komyakov: conceptualization, methodology, writing—review & editing; V.A. Fadeev: conceptualization, methodology, formal analysis, writing—review & editing; E.V. Tikutskaya: investigation, writing—original draft. All the authors approved the version of the draft to be published and agreed to be accountable for all aspects of the work, ensuring that issues related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding sources: No funding.

Disclosure of interests: The authors have no relationships, activities or interests for the last three years related with for-profit or not-for-profit third parties whose interests may be affected by the content of the article.

Statement of originality: No previously obtained or published material (text, images, or data) was used in this study or article.

Generative AI: Generative AI technologies were not used for this article creation.

Provenance and peer-review: This paper was submitted unsolicited and reviewed following the standard procedure. The peer review process involved a single reviewer (an editorial board member, editorial council member, or an external reviewer); double-blind review was conducted.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Б.К. Комяков — концепция и дизайн исследования, редактирование текста рукописи; В.А. Фадеев — концепция и дизайн исследования, анализ данных литературы, редактирование текста рукописи; Е.В. Тикуцкая — поиск и анализ данных литературы, написание текста рукописи. Авторы одобрили версию для публикации, а также согласились нести ответственность за все аспекты работы, гарантируя надлежащее рассмотрение и решение вопросов, связанных с точностью и добросовестностью любой ее части.

Источники финансирования. Отсутствуют.

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Оригинальность. При создании настоящей работы авторы не использовали ранее опубликованные сведения (текст, иллюстрации, данные).

Генеративный искусственный интеллект. При создании настоящей статьи технологии генеративного искусственного интеллекта не использовали.

Рассмотрение и рецензирование. Настоящая работа подана в журнал в инициативном порядке и рассмотрена по обычной процедуре. В рецензировании участвовали один рецензент (член редакционной коллегии, член редакционного совета или внешний рецензент), рецензирование двойное слепое.

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