

Research article

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## The result of bulbar urethroplasty using double layer end-to-end anastomosis at Binh Dan hospital

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### Abstract

**Background:** This study presents the surgical method of bulbar urethroplasty utilizing a two-layer end-to-end anastomosis technique because of its high success rate and widespread global use.

**Subjects and Methods:** We conducted a retrospective analysis of 39 cases involving bulbar urethroplasty utilizing the two-layer end-to-end anastomosis technique at Binh Dan Hospital from April 2022 – November 2023. Success was defined as a satisfactory cystoscopy at 4 months postoperatively and a Qmax index at 1 year after surgery.

**Results:** Among the 39 cases studied, the primary clinical symptom observed was dysuria. Thirty eight cases were successful, yielding a success rate of 97.4%. There was notable improvement in urinary function and postoperative satisfaction, with an average International Prostate Symptom Score (IPSS) of 6.9 points and an average Quality of Life (QoL) score of 1.14 points. No complications occurred, including rectal damage, perineal abscess, or urethral bleeding. The complications were assessed using the Clavien-Dindo classification, which revealed a complication-free rate of 79.4%; Grade I complications accounted for 15.4% (1 case superficial Incisional Infection, 5 case postoperative Urinary extravasation), and Grade II complications for 5.2% (1 case epididymitis, 1 case Surgical site infection).

**Conclusion:** The end-to-end 2-layer anastomosis in the study with a success rate of 97.4% (38/39) is a very suitable and good option for bulbar urethral strictures  $\leq 2$  cm. The procedure was safe, with no serious complications recorded. Postoperative care, avoiding surgical site infection, and using a silicone urethral catheter are important factors contributing to the success of the 2-layer end-to-end urethral anastomosis surgery.

**Keywords:** Bulbar urethral stricture, bulbar urethroplasty, double-layer end-to-end anastomosis technique.

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### 1. INTRODUCTION

Urethral stricture is a pathological condition caused by chronic fibrosis that leads to narrowing of the urethral lumen. This condition often results from trauma,

chronic urethral infections, or iatrogenic injury due to medical procedures or surgeries involving the urethra.[1,2]

In Vietnam—a developing country with a high incidence of road traffic accidents,

particularly involving motorcycles, as well as common domestic accidents such as falls from monkey bridges, staircases, or boats—urethral trauma is relatively common.[3] Among genitourinary injuries, anterior urethral trauma accounts for approximately 15%, with the bulbar urethra being the most frequently affected segment due to its anatomical proximity to the perineum, a region highly susceptible to injury. [3]

As a result, the prevalence of bulbar urethral stricture is not insignificant. Common symptoms include difficulty urinating, urinary retention, and recurrent urinary tract infections, which can lead to complications such as urethral fistula and perineal abscess.[1] These complications have a profound impact on the patient's health, daily activities, and quality of life.

Therefore, effective management of bulbar urethral stricture has become an urgent concern for urologists. Timely and appropriate treatment can restore normal urinary function, help patients return to their daily lives, and contribute meaningfully to reducing the socioeconomic burden of the disease.

Globally, two-layer end-to-end anastomotic urethroplasty is widely used for the treatment of short-segment bulbar urethral strictures due to its high success rate, ranging from 87.9% to 98.8%.[4,5,6] Moreover, studies have shown that this technique yields excellent early anastomotic healing outcomes, with no evidence of contrast extravasation observed on postoperative imaging.[7]

Further research has also suggested that this surgical approach holds great potential for reducing hospitalization time and allowing for earlier catheter removal.[8]

In Vietnam, bulbar urethral reconstruction using end-to-end anastomosis has likely been performed at multiple institutions. However, there is still a lack of comprehensive studies and detailed reports specifically evaluating the two-layer end-to-end technique.

At Binh Dan Hospital, a significant number of patients have undergone urethroplasty, including the two-layer end-to-end anastomosis technique for bulbar urethral strictures. Given the aforementioned benefits of this procedure, we aim to conduct a study to provide an initial scientific basis for evaluating the effectiveness of this technique in treating bulbar urethral stricture.

Through this study, we seek to answer the following questions: What are the success and complication rates of this technique when applied in the Vietnamese context? What factors may influence the outcomes of this procedure in our local healthcare setting?

To address these questions, we conducted the study titled: "The result of bulbar urethroplasty using double layer end-to-end anastomosis at Binh Dan Hospital."

## **RESEARCH OBJECTIVES**

Specific Objectives:

1. To evaluate the urological outcomes of bulbar urethral stricture repair using the two-layer end-to-end anastomosis technique at Binh Dan Hospital.
2. To assess the complications of bulbar urethral stricture repair using the two-layer end-to-end anastomosis technique at Binh Dan Hospital.
3. To investigate the factors affecting the urological outcomes of bulbar urethral

stricture repair using the two-layer end-to-end anastomosis technique at Binh Dan Hospital.

## **2. STUDY SUBJECTS AND METHODOLOGY**

### **2.1 Study Subjects**

#### **2.1.1 Sample Population**

We selected all patients diagnosed with urethral stricture who were indicated for urethroplasty at the Urethral Unit - Department of Urology C, Binh Dan Hospital, from January 2022 to November 2023.

#### **2.1.2 Inclusion Criteria**

We included all medical records of patients diagnosed with bulbar urethral stricture who underwent two-layer end-to-end anastomotic urethroplasty and had a 12-month postoperative follow-up at the Urethral Unit – Department of Urology C, Binh Dan Hospital, from January 2022 to November 2023.

#### **2.1.3 Exclusion Criteria**

Patients with urethral strictures at multiple sites.

Patients whose medical records were missing, could not be contacted, or had incomplete data for the study.

## **2.2 Research Methodology**

### **2.2.1 Study Design**

A retrospective descriptive case series study.

### **2.2.2 Sample Size**

All cases meeting the inclusion criteria were collected from January 2022 to November 2023 at Binh Dan Hospital.

## **2.3 The Two-Layer End-to-End Anastomotic Urethroplasty of the Bulbar Urethra in This Study**

- At the Urethral Unit of Binh Dan Hospital, several instruments are used to assist the surgery, including a flexible

cysto-urethroscope, a Jordan–Simpson self-retaining retractor set, and a set of gradually sized bougies.

- **Patient position:** Lithotomy (gynecological) position.

- **Skin incision:** A lambda-shaped incision in the perineal region, with the apex of the "U" at the junction between the perineum and the scrotum, or a midline perineal incision.

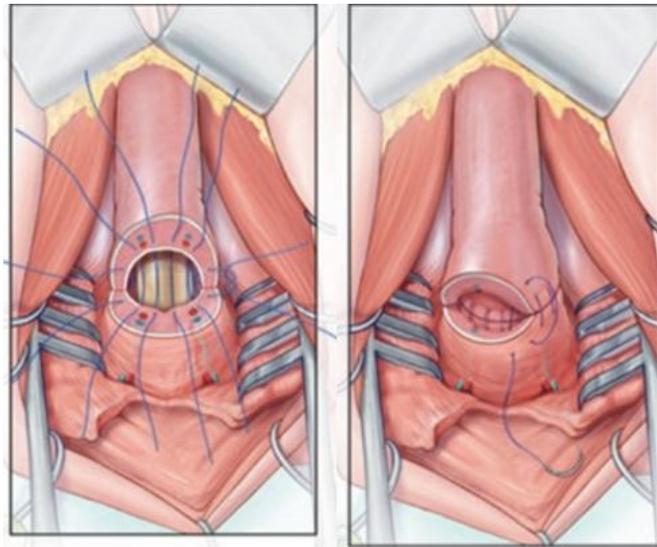
Dissection of the bulbospongiosus muscle to fully expose the bulbar urethra.

Identification and excision of the stricture segment. Both ends of the urethra are trimmed obliquely. All scarred fibrotic tissue is removed. Both ends of the urethra are probed with bougies until the normal urethral caliber of 28Fr–30Fr is achieved.

Dorsal end-to-end anastomosis is performed using 4-0 monofilament absorbable sutures with three interrupted stitches involving both the urethral mucosa and a thin layer of surrounding spongiosum tissue. The remaining mucosa is then sutured with 5-0 monofilament absorbable sutures in interrupted stitches, ensuring that the knot lies inside the urethral lumen to avoid creating a gap during the final ventral spongiosum closure.

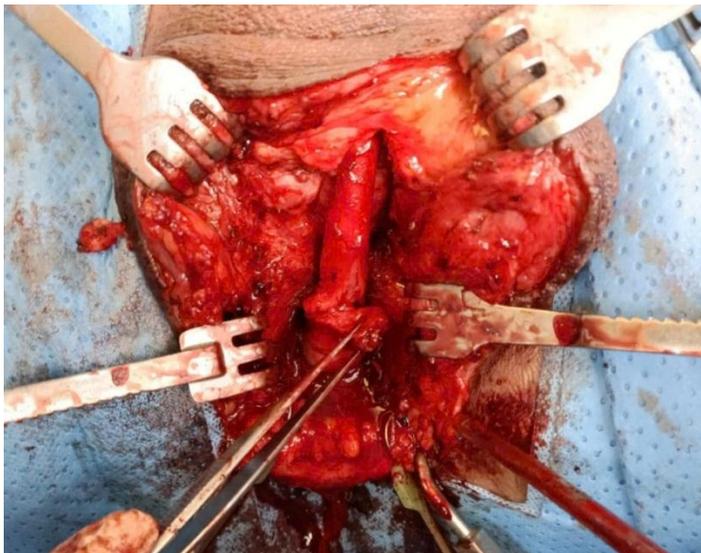
Ventral spongiosum closure is completed using 5-0 monofilament absorbable sutures in a continuous fashion.

A Foley silicon catheter (14Fr or 16Fr) is inserted into the urethra, and a suprapubic cystostomy is performed using a Foley silicon catheter (16Fr or 18Fr). A negative-pressure perineal drain is placed. Subcutaneous tissue and skin are closed in layers.



**Figure 1.** Figure illustrating the two-layer end-to-end anastomotic urethroplasty technique used in this study.

“Source: Martins FE, Textbook of Male Genitourethral Reconstruction, 2020”[9]



**Figure 2.** Intraoperative image of Patient No. 25.

NO	VARIABLE	CLASSIFICATION	DEFINITION	UNIT
<b>OBJECTIVE 1</b>				
1	Retrograde urethroscopy result	Binary	Postoperative evaluation using flexible urethrocystoscopy	Values: 1. Re-stricture 2. No
2	Uroflowmetry result	Quantitative	Maximum urinary flow rate after surgery	$Q_{max}(ml/s)$
3	Voiding condition	Qualitative	Postoperative evaluation of voiding condition using IPSS and QoL scales	Scales: IPSS, QoL

NO	VARIABLE	CLASSIFICATION	DEFINITION	UNIT
<b>OBJECTIVE 2</b>				
4	Surgical complications	Nominal	Surgical complications recorded based on clinical and paraclinical indicators	Values: 1. No complications 2. Fever 3. Surgical site infection 4. Bleeding 5. Urethral fistula 6. Residual abscess Others
<b>OBJECTIVE 3</b>				
5	Age	Quantitative	Year of admission – year of birth	Years
6	Reason for admission	Nominal	Primary reason for patient admission	Values: 1. Urinary retention 2. Difficult urination 3. Others
7	Medical history	Nominal	Patient’s history prior to admission	Values: 1. None 2. Suprapubic cystostomy 3. Urethral dilation 4. Urethroplasty 5. Other surgical intervention
8	Urine culture	Nominal	Result of preoperative urine culture test	Values: 1. Negative 2. Positive + bacteria name
9	Skin incision type	Nominal	Type of skin incision used during surgery	Values: Midline Lambda
10	Surgery duration	Quantitative	Duration of surgery recorded in medical records	Minutes
11	Stricture length	Quantitative	Stricture length measured during surgery	Centimeter
12	Drain removal time	Quantitative	Days to remove surgical drain postoperatively	Days
13	Urethral catheter duration	Quantitative	Duration of urethral catheterization post-surgery	Days
14	Hospital stay duration	Quantitative	Discharge date – admission date + 1	Days

**2.4. Implementation Plan**

**Data collection period:** From December 2023 to November 2024.

The study will be conducted at Binh Dan Hospital.

The data will be gathered through medical record documentation during the diagnosis, surgery, and postoperative hospitalization phases. Additional postoperative data will be obtained by contacting patients via phone calls.

The data will be processed and analyzed using the Statistical Package for the Social Sciences (SPSS) version 19. The chi-square test and Fisher’s exact test will be used for qualitative variables, and the **t-test** will be used for quantitative variables.

**3. RESULTS**

From January 2022 to December 2023, a total of 39 cases of two-layer end-to-end bulbar urethroplasty were performed at the Urethral Unit, Binh Dan Hospital. The results are as follows:

**3.1 General Characteristics**

- Mean age: 48.3 ± 14.4 years
- The highest proportion of patients was in the middle-aged group (56.4%)
- Youngest patient: 24 years old, oldest: 79 years old

**3.2 Reasons for Hospital Admission**

- 15 cases (38.5%) were admitted due to urinary retention
- 24 cases (61.5%) due to difficulty urinating
- Only two reasons for admission were recorded: difficulty urinating and urinary retention, with difficulty urinating being more prevalent

**3.3 Duration from Symptom Onset to Surgery**

- 56.4% (22 cases) had difficulty urinating for over 12 months before surgery

- Most patients endured symptoms for more than a year

**3.4 Causes of Urethral Stricture**

Based on patient history, the causes were:

**Table 1.** Causes of Urethral Stricture

Cause	Cases (n)	Percentage (%)
Trauma	26	66.7
Prolonged catheterization	3	7.6
TURP	1	2.6
Ureteroscopic stone removal	1	2.6
Idiopathic	8	20.5
Total	39	100

Remarks:

- Urethral trauma was identified as the leading cause in the study sample, accounting for 26 cases (66.7%)
- There were 8 cases (20.5%) in which no identifiable cause was found; these were classified as idiopathic.

**3.5 Preoperative Urine Culture Results**

- All 39 patients (100%) had urine cultures taken preoperatively, there were 28/39 (71.8%) tested positive for bacteria:

**Table 2.** Identified Bacterial Culture Results

Bacteria Identified	Cases (n)	Percentage (%)
<i>Escherichia coli</i>	9	32.2
<i>Klebsiella pneumoniae</i>	6	21.4
<i>Enterococcus cloacae</i>	3	10.7
<i>Citrobacter freundii</i>	1	3.57
<i>Escherichia faecalis</i>	1	3.57
<i>Proteus mirabilis</i>	1	3.57
<i>Pseudomonas aeruginosa</i>	1	3.57
<i>Pseudomonas</i>	1	3.57

<i>ariguania</i>		
<i>Pseudomonas stuartii</i>	1	3.57
<i>Staphylococcus aureus</i>	1	3.57
<i>Serratia marcescens</i>	1	3.57
<i>Streptotrophomonas</i>	1	3.57
<i>Streptococcus aralataiae</i>	1	3.57
Total	28	100

Remarks:

- *E. coli* was the most commonly isolated organism (32.2%), followed by *K. pneumoniae* (21.4%).

- *Klebsiella pneumoniae* ranked second, identified in 6 cases (21.4%)

### 3.6 Stricture Length

- Mean stricture length:  $1.3 \pm 0.5$  cm
- Shortest: 1 cm, longest: 2 cm

### 3.7 Surgical Time

- Mean surgical time:  $127 \pm 36.9$  minutes
- Longest: 240 minutes, shortest: 90 minutes

### 3.8 Intraoperative Complications

No intraoperative complications recorded (0%)

### 3.9 Results After Catheter Removal

- At 3 weeks post-op, all patients returned for follow-up with VCUG imaging:

**Table 3.** VCUG Imaging Results

Approximately 3 Weeks Postoperatively

VCUG Result	Cases (n)	Percentage (%)
1. Good urine flow, no leakage	34	87.2
2. Good flow, but urethral leakage present	5	12.8
3. No urine passage	0	0
Total	39	100

- At 3 weeks post-surgery, the study recorded no cases of recurrent urethral stricture; all patients experienced smooth and unobstructed urination.

- The study noted 5 cases (12.3%) of postoperative urethral fistula, for which the urethral catheter was maintained for an additional week.

- In all 5 cases, a follow-up VCUG (Voiding Cystourethrogram) performed after the extended catheterization period showed complete resolution of the urethral fistula.

### 3.10 Results of Retrograde Urethro-Cystoscopy

- All 39 cases (100%) underwent retrograde urethro-cystoscopy at 4 months postoperatively.

- The study recorded 1 case (2.6%) in which a 16Fr flexible endoscope could not pass through the urethra. This case was classified as a failed urethral reconstruction due to recurrent stricture.

- The surgical success rate was 97.4%.

### 3.11 Results of Qmax on Postoperative Uroflowmetry

- All 39 patients (100%) in the study underwent postoperative uroflowmetry.

- The mean Qmax was  $25.2 \pm 5.3$  ml/s.

- The highest Qmax recorded was 36.5 ml/s.

- The lowest Qmax was observed in one case of recurrent urethral stricture, with a Qmax of 9 ml/s.

### 3.12 Postoperative IPSS and QoL Outcomes.

- Postoperative IPSS and QoL Outcomes

- The highest IPSS recorded was 30 points, while the lowest was 2 points.

- The mean Quality of Life (QoL) score was 1.14.

**3.13 Duration of Urethral Catheterization**

- The mean duration of urethral catheterization was  $19.8 \pm 1.5$  days (range: 19–28 days).

- The patient was catheterized with a 14 Fr silicon urethral catheter. After hospital discharge, the patient continued to carry both the urethral catheter and the suprapubic cystostomy catheter for 3 weeks postoperatively. At the follow-up visit, the urethral catheter was removed and a VCUg (Voiding Cystourethrogram) was performed. In cases where urethral patency was confirmed, the suprapubic catheter was also removed.

- In cases with suspected urethral fistula, the management approach was adjusted accordingly.

- There were 5 cases (12.8%) of postoperative urethral fistula. These patients were managed with an additional week of urethral catheterization. On the second VCUg, all 5 cases showed good urethral patency without any evidence of fistula, and the urethral catheter was removed prior to discharge.

**3.14 Length of Hospital Stay**

- The average hospital stay was  $10.3 \pm 3.8$  days, ranging from 6 to 21 days.

- The postoperative duration averaged  $5.4 \pm 1.2$  days, with the shortest being 4 days and the longest 9 days.

- The study recorded only one case with a postoperative duration of 9 days due to wound site fluid leakage after surgery.

**3.15 Postoperative complications**

- Postoperative patients were monitored for vital signs, surgical wounds, drainage tubes, urethral catheters, and suprapubic catheters. Any complications were recorded and graded according to the Clavien–Dindo classification.

**Table 4.** Postoperative Complications and Grading

Complication	Cases (n)	Rate (%)	Clavien–Dindo Grade
Surgical site infection	1	2.6	II
Wound exudation	1	2.6	I
Epididymitis	1	2.6	II
Urethral fistula	5	12.8	I
Bleeding	0	0	II

- The most common complication was urethral fistula, observed in 5 cases (12.8%).

- Surgical site infection, wound exudation, and epididymitis were each reported in 1 case (2.6%).

**3.16 Duration of Postoperative Antibiotic Use**

- All 39 cases (100%) received perioperative antibiotic therapy.

- The average duration of postoperative antibiotic use was  $10.4 \pm 3.6$  days, ranging from a minimum of 5 days to a maximum of 22 days.

**3.17 Duration of Drainage Tube Placement**

- The duration of drainage tube placement was  $4 \pm 0.7$  days.

- The earliest drain removal occurred at 3 days.

- The longest duration of drain retention was 7 days.

**4. DISCUSSION**

**4.1 Clinical and para-clinical features of the patients**

**4.1.1 Age Characteristics**

The mean age of the 39 patients was  $48.3 \pm 14.4$  years.

The largest age group was 40–60 years, followed by 18–40 years, and finally those over 60 years old.

Referring to the results from other authors regarding patient age, it is noted that the working-age group in these studies falls within the range of 38–50 years.[8] With the mean age reported by Santucci being 38 and by Waterloos being 50, the mean age of 48.3 in this study demonstrates similarity in the age characteristics of the study samples.

Our study focused on cases of short-segment anterior urethral stricture, commonly caused by trauma, with most being first-time diagnoses. Consequently, the patient group undergoing this surgical method tends to be younger and within the working-age population. Due to their relatively young age and mostly first-time diagnosis, we observed that patients are increasingly proactive in seeking health-related information. This leads to timely medical examinations and treatment, facilitating a smoother urethral stricture repair process. This factor is crucial because primary urethroplasty generally has a higher success rate compared to recurrent cases that have undergone multiple prior interventions.

#### ***4.1.2 Clinical Symptoms of Patients in the Study***

According to Barbagli, urethral stricture is a common cause of lower urinary tract disorders, presenting symptoms such as dysuria and urinary retention. If not properly treated, urethral stricture can lead to complications including urinary tract infections, urethral stones, bladder wall thickening and diverticula, as well as abscesses and fistulas in the perineal region.[10]

In this study, 24 cases (61.5%) presented with dysuria and 15 cases

(38.5%) with urinary retention. Patients with dysuria due to anterior urethral stricture often showed poor response to conservative treatment, with symptoms progressively worsening. In cases of short-segment stricture, patients sometimes described a sensation of a “blockage” in the urinary tract, where straining strongly to pass the “blockage” relieved the difficulty in urination. All patients in the study underwent urethroplasty intervention three months after the injury to allow complete stabilization of fibrotic scar tissue, ensuring thorough removal of the scar during surgery. [9] During the waiting period for urethroplasty, patients with urinary retention or urinary tract infections unresponsive to medical treatment underwent suprapubic cystostomy. Unlike injuries associated with pelvic fractures, where patients often experience urinary retention due to significant urethral displacement or rupture, most of these patients required urinary diversion through suprapubic cystostomy.[9]

#### ***4.1.3 Causes of Urethral Stricture***

According to McAnnich, most urethral strictures are caused by trauma and infections. Although gonococcal urethral stricture is less common today than before, infections remain a frequent cause. Injuries can originate internally, caused by catheters or large-caliber endoscopic instruments leading to bleeding. External trauma can cause partial or complete urethral damage, resulting in rapid and complex strictures.

The study sample recorded trauma as the main cause of anterior urethral stricture, accounting for 66.7%.

Cases of urethral stricture with unknown causes also accounted for a high proportion, at 20.5%.

This result is consistent with the findings of Santucci, where trauma and unknown causes constituted the groups with the highest proportions.[4]

In Vietnam, due to complex traffic conditions, many cases of anterior urethral stricture result from traffic accidents causing trauma. Additionally, sexually transmitted infections and other urethral infections remain common causes. However, not all patients seek hospital examination, screening, and treatment, which leads to a high proportion of cases with unknown causes. According to Claassen, up to 81% of patients with urethral stricture in rural areas have a history of treatment for sexually transmitted urethral diseases.[8]

#### **4.1.4 Length of the Stricture Segment**

The average length of the stricture segment in our study was 1.3 cm, similar to other authors worldwide reporting an average length ranging from 1.3 to 1.7 cm. This is because the end-to-end anastomosis technique is indicated for strictures measuring 2 cm or less.[4,11]

Overall, since the 2024 European Association of Urology guidelines recommend this surgical method for anterior urethral strictures with a length of approximately 2 cm or less,[12] the average stricture length in our study aligns with global reports, all being less than 2 cm.

V For cases with anterior urethral strictures longer than 2 cm, attempting this technique may lead to complications such as penile shortening, ventral penile curvature, and excessive tension at the urethral anastomosis site. Therefore,

precise preoperative assessment of the stricture length using retrograde urethrography combined with voiding cystourethrography and flexible cystourethroscopy allows the surgeon to select the most appropriate treatment method before the incision.

Accurate identification of the stricture location and length is a key factor influencing the success of urethroplasty. Choosing the appropriate surgical technique based on the stricture characteristics improves the success rate and reduces postoperative complications caused by unsuitable treatment choices. For short or long strictures, techniques such as end-to-end anastomosis or the use of autologous grafts can be selected.[13,14] For complex, long, or recurrent strictures, perineal urethrostomy may be considered, allowing patients to void spontaneously without catheterization and return to normal daily activities.

#### **4.2 Effectiveness of Two-Layer End-to-End Anastomotic Surgery for Anterior Urethral Stricture in the Study**

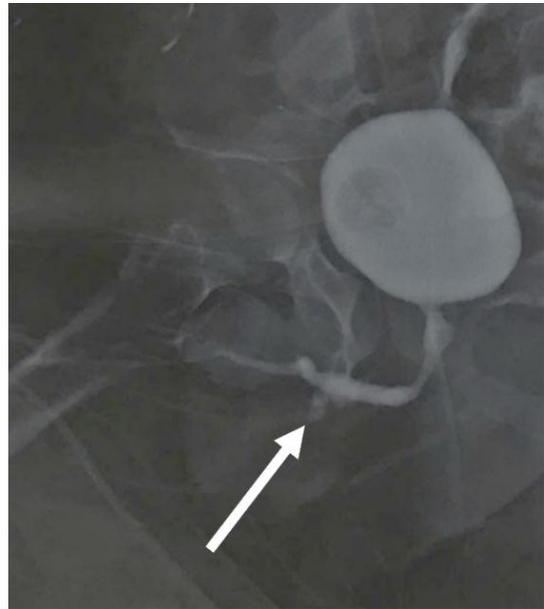
In two-layer end-to-end anastomosis, since the mucosal layer and the corpus spongiosum are mostly sutured separately, the likelihood of successful anastomotic healing is very high. Early postoperative complications commonly include contrast extravasation. In our study, urethral fistula was recorded at the first follow-up around 3 weeks after surgery. Patients were indicated for voiding cystourethrography (VCUG), which revealed 5 cases of contrast leakage. This finding is comparable to Barbagli's study with 8 cases and Waterloos' study with 6 cases,

with no recurrent urethral stricture observed at this time point.[11]

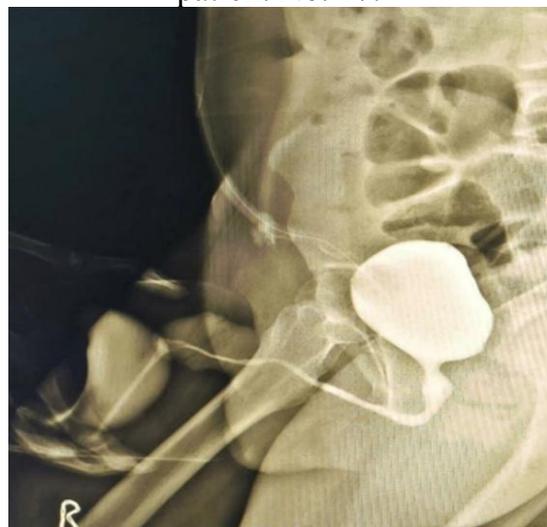
According to Barbagli, when the reconstructive techniques are properly performed and fibrotic scar tissues are thoroughly removed, urethral fistulas typically resolve after maintaining catheterization for an additional 1–2 weeks.[15] In our study, all 5 cases showed no contrast leakage one week after re-catheterization, demonstrating the superiority of the two-layer end-to-end anastomosis technique. Although initial contrast leakage was observed, healing occurred well within just one week. This is attributed to the mucosal layer being mostly sutured independently from the thick ventral corpus spongiosum. In cases of contrast leakage, if fibrotic tissue removal is incomplete or if the ventral spongiosum is not independently sutured in a separate layer, there is a high risk of “rabbit ears” formation, which leads to urine leakage through fistulas and subsequent recurrent urethral stricture due to scar formation. The two-layer end-to-end anastomosis technique effectively minimizes these complications. Thus, all 5 patients with contrast leakage healed well after just one week of silicon catheter replacement. Proper surgical technique combined with the use of a silicon Foley catheter is therefore a crucial factor for optimal anastomotic healing.[4,5,6]

In practice, retrograde urethrography performed 3 weeks after surgery mainly detects urethral fistulas rather than recurrent strictures. This is because, in our study, dissecting both urethral ends to a caliber of 28–30 Fr and performing end-to-end anastomosis significantly minimized the risk of anastomotic stricture. Assessment for recurrent

stricture typically takes place around 4 months post-operation, when tissue healing has stabilized. At this time, flexible urethroscopy with a 16 Fr scope easily passes through the anastomosis site, allowing us to evaluate whether the reconstructed segment remains patent. This evaluation serves as a key technical success criterion for our surgical procedure.



**Figure 3.** VCUG showing urethral leakage 3 weeks postoperatively in patient No. 17.



**Figure 4.** VCUG after 3 weeks postoperatively in patient No. 17.

### 4.3 Complications of Urethroplasty in the Study

We used the Clavien–Dindo classification system to evaluate postoperative complications. Our findings were consistent with those of Waterloos and O.G. Nilsen, who also reported no major complications classified as grade IV or V according to Clavien–Dindo.[11] The proportion of patients in our study without any complications was 79.5%, which lies within the range of 77.3% to 89.3% reported by the above authors. This favorable outcome may be attributed to the superficial surgical field, which avoids major vascular structures and thereby reduces the risk of serious complications. Furthermore, all patients in our cohort underwent preoperative urine screening and received prophylactic antibiotics, which likely contributed to the prevention of urinary tract infections and surgical site infections. The contrast extravasation detected during postoperative urethrograms was categorized as a Clavien–Dindo Grade I complication, as it did not represent a severe clinical issue. Previous studies have shown that contrast leakage on follow-up imaging does not predict recurrent stricture or affect surgical success rates after end-to-end urethroplasty.[16] This is consistent with our findings, where no correlation was found between postoperative contrast leakage and stricture recurrence in the studied cohort. In our study, the proportion of patients experiencing Clavien–Dindo Grade II complications was 5.2% (2 cases), which is comparable to the rates reported in previous studies. The three most commonly observed postoperative complications were surgical site infection and scrotal fluid collection, which is consistent with the findings of Waterloos [11]. However, this differs from the study

by O.G. Nilsen, who reported postoperative bleeding as the most frequent complication. This discrepancy can be attributed to the different definitions of hemorrhagic complications: in our study, only cases requiring blood transfusion were classified as bleeding complications, whereas Nilsen included all postoperative bleeding events regardless of clinical significance. Given that no severe complications (Clavien–Dindo grade IV or V) were observed and most complications were mild to moderate, this two-layer end-to-end anastomosis technique appears to be a safe and effective option, suitable for wider implementation by urologic surgeons in various hospitals nationwide.

### 5. CONCLUSION

Based on the findings of our study, the following conclusions can be drawn:

- The two-layer end-to-end anastomosis is an effective and feasible surgical approach for treating bulbar urethral strictures  $\leq 2$  cm in length, with a success rate of 97.4% (38 out of 39 cases).
- The technique demonstrated a high safety profile, as no severe complications (Clavien–Dindo grade IV or V) were observed during the study period.
- Postoperative care plays a vital role in achieving optimal outcomes. In particular, preventing surgical site infections and utilizing silicone urethral catheters are key factors that support the healing of the anastomotic site and contribute to the overall surgical success.

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