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ORIGINAL ARTICLE

Operational Andrology

Novel strategy using a spiral embedded flap for meatal stenosis after post-penile cancer amputation surgery: a single-center experience

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This study aimed to investigate the curative effect of spiral embedded flap urethroplasty for the treatment of meatal stenosis after penile carcinoma surgery. From January 2015 to January 2021, we used our technique to treat strictures of the external urethral orifice in seven patients, including four cases of meatal stenosis after partial penile resection and three cases of meatal stenosis after perineal stoma. All patients had previously undergone repeat urethral dilatation. The patients underwent spiral embedded flap urethroplasty to enlarge the outer urethral opening. The patients' mean age at the time of surgery was 60 (range: 42–71) years, the mean operative time was 43 min, and the median follow-up period was 18 months. The patients voided well post-operatively, and urinary peak flow rates ranged from 18.3 ml s⁻¹ to 30.4 ml s⁻¹. All patients were successful with absence of urethral meatus stricture. The present study showed that using spiral embedded flap urethroplasty to treat meatal stenosis after penile carcinoma surgery is an effective surgical technique with good long-term outcomes.

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Keywords: meatal stenosis; spiral embedded flap; urethroplasty

INTRODUCTION

Patients with partial penile resection or perineal stoma owing to penile cancer or other diseases often develop post-operative meatal stenosis.^{1,2} Long-term repeat urethral dilatation rarely achieves complete obstruction relief, while simple urethral external orifice incision increases the difficulty of nursing care and seriously affects the patient's quality of life. From January 2015 to January 2021, seven cases of meatal stenosis after partial penile resection or perineal stoma were treated with spiral embedded skin flap urethroplasty in Shanghai Jiao Tong University Affiliated Sixth People's Hospital (Shanghai, China), with satisfactory therapeutic effects.

PATIENTS AND METHODS

Clinical data

Partial or total penile resection to treat penile carcinoma was performed in seven patients (aged 42–71 years) with stricture of the external urethral orifice. Four cases developed meatal stenosis after partial penile resection, whereas three cases developed meatal stenosis after perineal stoma. The main clinical manifestation was a thin urinary stream with dysuria. All patients had undergone repeat urethral dilatation. The average time interval between previous urethral dilatations was 2.7 weeks. Physical examinations showed the presence of a needle-like stricture of the external urethral orifice that could not be enlarged further. Urethrography and ultrasonography revealed a stricture of the external urethral orifice with a mean length of 0.49

(standard deviation [s.d.]: 0.10) cm. The mean maximum urinary flow rate was 7.06 (s.d.: 0.92) ml s⁻¹.

Surgical technique

All patients were treated under general anesthesia in the lithotomy position after routine disinfection and draping. The following surgical methods and procedures were used to treat meatal stenosis after perineal stoma (**Figure 1a**). We first made a circular skin incision with a radius of approximately 0.3 cm centered around the external urethral orifice. Next, we opened the skin and the subcutaneous tissue and carefully dissected and separated the urethral cavernous body from the surrounding tissues until 0.5 cm of the normal urethral mucosa was exposed at the proximal end. Next, the length of the urethral stricture was measured, and the nonelastic scarred urethral tissue was completely removed and sent for pathological examination. The proximal urethra was explored using a 24-F urethral probe to determine whether there was a stricture in the proximal urethra. Then, the outer perineal skin was incised for approximately 0.5 cm at an angle of 45° at the 2-, 6-, and 10-o'clock positions to obtain spiral perineal skin flaps (**Figure 1b**). Approximately 0.5 cm of the external urethral orifice was also incised in the corresponding positions to achieve a petal-like shape (**Figure 1c**). The tip of each spiral flap was anastomosed with 5-0 absorbable sutures at the bottom angle of the notch in the corresponding urethral orifice incision. The protruding end of the outer urethral orifice mucosa was anastomosed with 5-0 absorbable sutures at the base angle of each

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perineal spiral flap. The lateral edge between the external urethral orifice mucosa and the perineal spiral flap was sutured with interrupted 5-0 absorbable sutures. The external urethral orifice was next widened, and urethroplasty was performed. After the operation, a urethral catheter was placed, and the wound was wrapped with Vaseline gauze (**Figure 1d**). The surgical methods and procedures for meatal stenosis after partial penile resection are presented in **Figure 2**.

RESULTS

The results are summarized in **Table 1**. All operations were completed successfully. The mean operation time was 43 (range: 30–50) min, and the mean post-operative hospital stay was 1.3 (range: 1–2) days. The wounds healed well, and the catheters were removed 3 weeks post-operatively. Follow-up of 6–33 months' duration was performed for all patients. During the follow-up, success after spiral embedded flap urethroplasty was defined as no need for further surgical intervention and a urinary

Table 1: Patient characteristics

Characteristic	Value
Patient (<i>n</i>)	7
Age (year), mean (range)	60 (42–71)
Etiology, <i>n</i> /total (%)	
Partial penile resection	4/7 (57.1)
Perineal stoma	3/7 (42.9)
Previous urethral dilation, <i>n</i> /total (%)	7/7 (100.0)
Stricture length of the external urethral orifice (cm), mean±s.d.	0.49±0.10
Pre-operative maximum flow rate (ml s ⁻¹), range	5.3–8.2
Surgery time (min), mean (range)	43 (30–50)
Length of stay (day), mean (range)	1.3 (1–2)
Time with catheter (week)	3
Post-operative maximum flow rate (ml s ⁻¹), range	18.3–30.4
Follow-up time (month), median (range)	18 (6–33)
Satisfaction, <i>n</i> /total (%)	7/7 (100.0)

s.d.: standard deviation

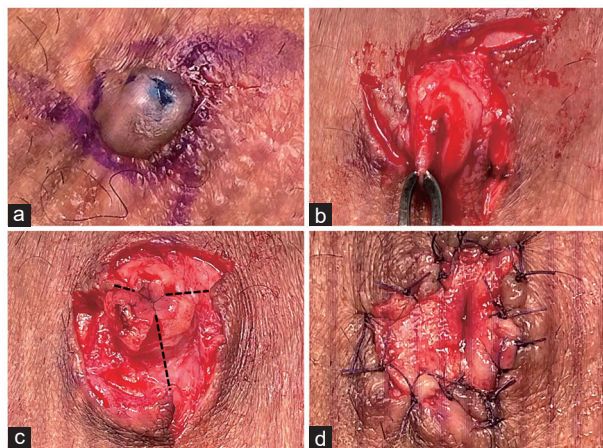


Figure 1: Spiral embedded flap urethroplasty for the treatment of external urethral orifice stricture after perineal stoma. (a) External urethral orifice stricture after perineal stoma. (b) Freeing of the external opening to remove the scarred urethral tissue and incising the perineal skin obliquely into three equal parts to form a spiral flap. (c) The mucosa of the external urethral opening is obliquely divided into three equal parts on the basis of the corresponding skin incision positions and incised into a petal-like shape. The dashed lines show that the tip of each spiral flap is anastomosed with 5-0 absorbable sutures at the bottom angle of the respective notch in the external urethral opening. (d) Reconstruction of the new urethral orifice after the operation.

flow rate >15 ml s⁻¹. The surgical outcome was successful in all patients. A maximum urinary flow rate of 18.3–30.4 ml s⁻¹ was achieved with no urinary stream deviation or bifurcation. During the follow-up, the only post-operative complication was a urinary tract infection in one patient, which was resolved by treatment with antibiotics.

DISCUSSION

Penile cancer is a relatively uncommon malignancy, with an incidence rate of 0.6/100 000 and a lifetime prevalence of approximately 1 in 1000.^{3,4} Surgery is currently the most effective treatment for this disease.⁵ Previous study has reported an incidence of urethral stenosis after penile cancer of approximately 16.7%.⁶ Partial penile resection after severe penile injury, anterior urethral resection or exclusion, urinary perineal stoma diversion for various reasons, and intraoperative urethral stump and surrounding skin suturing directly *in situ* to reconstruct the external urethral orifice are prone to post-operative stricture of the external urethral orifice. Simple urethral dilatation has been extensively used previously,^{7,8} but the procedure often needs to be repeated, causing inconvenience to the patient. In addition, simple urethral dilatation can lead to tearing of the external urethral orifice. The processes of healing and re-adhesion of the scars of a torn external urethral orifice further aggravate urethral stenosis.^{9,10} A torn urethral orifice is susceptible to contamination, leading to cicatricial stenosis and a worsened condition. The use of external orifice urethrotomy dorsally or ventrally changes the direction of the external urethra, resulting in urinary deviation and splashing post-operatively, poor appearance of the external opening, and a substantial negative effect on the patient's quality of life. In addition, the narrow scar tissue of the urethra is not completely removed, and chronic inflammation of this tissue worsens owing to stimulation from the surgical procedures, which may cause reoccurrence of the urethral orifice stricture.

The surgical application of free mucosa for reconstruction is complicated, and the recurrence of external urethral orifice stenosis is relatively common owing to the poor blood supply to the mucosal tissue. Spiral embedded skin flaps of the penis or perineum have good flexibility and strength.^{11,12} Compared with free mucosal tissue, the spiral embedded skin flap is easy to obtain. Moreover, the vascular pedicle is often preserved, and the possibility of post-operative skin

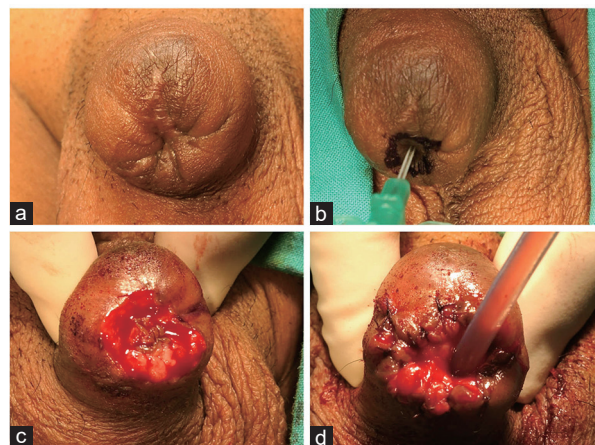


Figure 2: Spiral embedded flap urethroplasty for the treatment of external urethral orifice stricture after partial penile resection. (a) External urethral orifice stricture after partial penile resection. (b) The surgical incision using the external urethral orifice as a center is clearly marked. (c) Freeing of the external opening to remove the scarred urethral tissue. (d) Reconstruction of the new urethral orifice after the operation.

flap necrosis is relatively low.¹³ In our hospital, we performed spiral embedded flap urethroplasty in seven patients who had external urethral orifice stenosis after penile cancer surgery. The success rate was high. This operation is characterized by simple surgical procedures and a high success rate. Major improvements in two aspects were achieved. (1) Three flaps were created and embedded into the mucosal grooves, and thus, the circumference of the external urethral opening was increased, and the external urethral opening was enlarged. (2) Owing to the oblique pulling force of the spiral embedded skin flap, the invaginated urethral mucosa was everted, reducing the impact of post-operative urethral external opening contraction and retaining the original morphology and structure.

Importantly, the following points must be observed during the operation. (1) The length of the stenosis must be accurately measured and analyzed. We used urethral angiography to fully evaluate the condition of each patient before the operation. However, owing to the characteristics of the external urethral orifice and the influence of the operator's technique, it is recommended to also perform urethral ultrasonography and other related examinations before the operation to determine the length of the urethral stenosis and the extent of the scar, to make the best diagnosis.^{14,15} (2) The urethral scar tissue must be thoroughly removed to prevent the urethral scar from pulling on the peripheral spiral flap and causing the external urethral orifice to retract, as well as to avoid recurrence of urethral stenosis owing to urethral scar contracture. (3) After the operation, a urethral catheter must be indwelling for two main reasons. First, the urethral catheter supports the formation of the revised external urethral orifice. Second, short-term urinary diversion prevents irritation to the local wounds, which is conducive to healing.

This operation has good therapeutic effect in patients with urethral stenosis with a length less than 1 cm. For patients with a stenosis length greater than 1 cm, if the external urethral orifice is created using this surgical method, it will cause the external urethral orifice to retract, and the increased tension on the spiral embedded skin flap can lead to painful erection. In such a case, on the basis of the length of the urethral stricture, free mucosal tissue or a pedicle flap can be selected for reconstruction.¹⁶⁻¹⁸

The limited number of patients is the main limitation of this study. Hence, it is necessary to include a larger number of cases in a future clinical trial with a longer follow-up period.

CONCLUSIONS

The spiral embedded flap urethroplasty described in this report has the advantages of reasonable design, innovative conception, high success rate, lack of the need for special surgical instruments, and ease of performance. It should be attractive to patients because it maintains the normal appearance of the affected region. This surgical method is feasible and effective for patients with an external urethral orifice stricture after partial penile resection or perineal stoma.

AUTHOR CONTRIBUTIONS

QF designed the study and revised the manuscript. ML collected the clinical data. YW drafted the manuscript and prepared figures. QF, YW, LJS, RXY, and KLZ participated in the operation. SBJ helped to revise the manuscript. All authors read and approved the final manuscript.

COMPETING INTERESTS

All authors declared no competing interests.

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