Original Article

Surgical Outcome of Urethroplasty Using Penile Circular Fasciocutaneous Flap for Anterior Urethral Stricture

Kyoung Rok Kim, Jun-Gyo Suh, Jae-Seung Paick, Soo Woong Kim

Department of Urology, Seoul National University Hospital, Seoul, Korea

Purpose: Penile circular fasciocutaneous flap urethroplasty is a useful technique for a long anterior urethral stricture due to the flap's hairless nature and ample length. We investigated the surgical outcomes of urethroplasty for a complex anterior urethral stricture, performed using a penile circular fasciocutaneous flap.

Materials and Methods: Between 2008 and 2013, we performed a retrospective review of 29 patients who underwent urethroplasty using a penile circular fasciocutaneous flap and had at least 6 months of follow-up. A total of 20 cases utilized only a fasciocutaneous flap, while 9 cases combined a fasciocutaneous flap with other surgery. Success was defined as no requirement of additional urethral instrumentation.

Results: The overall success rate was 68.9% (20 out of 29 cases) at a median follow-up of 19 months. Furthermore, fasciocutaneous flap urethroplasty rendered the actual stricture-free rate of 79.3%. The location of recurrence was mostly at the junction of the flap. Among 9 surgical failures, 5 cases were treated successfully by using an additional surgical procedure. Fistula repair was needed in 1 case 4 months later. Further, periodic urethral dilation was performed in the remaining 3 cases. The failure rate was significantly higher in patients with suprapubic cystostomy than in patients without suprapubic cystostomy. The most common complication was post-micturition dribbling.

Conclusions: Penile circular fasciocutaneous flap urethroplasty is a useful method for the reconstruction of a long anterior urethral stricture. A sufficient healthy margin should be acquired for better surgical results due to the fact that most recurrence occurs at the junction of the flap.

Key Words: Penis; Surgical flaps; Urethral stricture

INTRODUCTION

Excision and end-to-end anastomosis remains the optimal technique for urethral reconstruction but is limited to a short bulbar urethral stricture. A long penile urethral stricture needs substitution urethroplasty [1]. The controversy over the best means of reconstructing the penile urethra, using a flap or a graft, is still under debate [2,3]. Dorsal stricturotomy and buccal mucosal graft inlay may be a good surgical option. However, in order to obtain op-

timal results, the urethral caliber is reasonably well preserved and the spongiosum is not too affected by fibrosis [4]. The same is true for the Asopa technique (transventral dorsal stricturotomy and patch from within the lumen) [5], but such mild strictures are not very common [4].

In 1968, a new one-stage urethroplasty technique using pedicled skin grafting was presented by the American urologist Orandi [6]. In 1993, McAninch [7] first described the reconstruction of extensive urethral strictures using a circular fasciocutaneous penile flap. The surgical technique described by McAninch still represents the most important and advanced evolution of Orandi's flap. The use of a circular fasciocutaneous penile flap for anterior urethroplasty, and particularly penile urethroplasty, renders a durable 5- and 10-year estimated stricture-free survival rate of 84% and 79%, respectively, in properly selected patients [8].

Unfortunately, there have been no studies on the surgical outcomes of penile circular fasciocutaneous flap urethroplasty in Korean patients. Therefore, we performed a retrospective evaluation of patients who underwent urethroplasty for anterior urethral strictures using a penile fasciocutaneous flap to report our experience with the surgery and to assess the factors affecting the surgical outcome.

MATERIALS AND METHODS

We reviewed the medical charts of 29 patients who underwent penile circular fasciocutaneous flap urethroplasty for anterior urethral strictures by a single surgeon and who completed at least 6 months of follow-up. About two-thirds of the patients (62%) were identified with a history of circumcision.

The standard surgical technique of penile circular fasciocutaneous flap urethroplasty was applied while the patient was positioned usually in a low lithotomy position [9,10]. The distal line of incision was marked approximately 5 mm proximal to the coronal sulcus, and the second line of incision was marked approximately 15 to 20 mm proximal to the first. Dissection was begun by deepening the more distal incision on the lateral aspect of the penile shaft down to the superficial lamina of Buck's fascia. The proximal circumferential incision was super-

ficial and was deepened only through the thin (subdermal) dartos fascial layer. The corpus spongiosum and urethra were opened ventrally just distal to the stricture, and the entire length of the abnormal urethra was sharply incised in the ventral midline, extending at least 1 cm into the normal urethra. Extensive strictures involving the bulbar urethra required an additional perineal incision.

Then, the flap was divided ventrally in the midline back to the penoscrotal junction, thereby converting the circular skin island into a longitudinal strip. The flap was rotated to one side in order to begin the onlay reconstruction. A running, watertight, urethral anastomosis was performed along one side, approximating the edge of the skin island to the urethral mucosa margin. A second running suture was begun at the distal apex and run proximally to complete the anastomosis. The flap width could be reduced in certain areas by trimming as needed to produce a smooth contour approximating 26 Fr. complex strictures that exceeded the length of the skin flap could be managed by combining other forms of tissue transfer with the flap. In such cases, the flap should be placed in the pendulous portion of the urethra, and the free graft (buccal mucosa graft) should be placed in the bulbar urethra. At the end of the procedure, a 14-Fr. silastic Foley urethral catheter was placed. In general, a drain was not used.

Patients were usually discharged after 5 to 7 days. Suppressive doses of oral antibiotics were maintained until the catheter was removed, after 2 or 3 weeks depending on the type of operation. The catheter was left in place an additional 1 to 2 weeks when extravasation was present. The patient was seen in the outpatient department at 3, 6, and 12 months after surgery in the first year and annually thereafter. The patients underwent retrograde urethrography or urethroscopy if they developed voiding symptoms, such as slow or splayed stream.

The patients' records were reviewed with respect to the etiology of the stricture, previous treatment, preoperative evaluation, surgical findings, follow-up results, and early and late complications. The preoperative evaluation included history, physical exam, urinalysis, urine culture, uroflowmetry, and retrograde and voiding cystourethrography. Urethroscopy was performed preoperatively to determine the length of the stricture. Stricture length was measured intraoperatively. Success was defined as no re-

quirement of additional urethral instrumentation post-operatively.

The patients' baseline characteristics, preoperative data, and surgery outcomes were compared between the fasciocutaneous flap-only group and the combined surgery group. Comparisons between the two groups were made with the Mann-Whitney U test for continuous variables and the chi-squared test for nominal variables. Binary logistic regression analysis was used to assess the significance of risk factors for surgical failure. Commercially available software (IBM SPSS Statistics version 21.0; IBM Co., Armonk, NY, USA) was applied. All p values were two-sided with significance considered at $p < 0.05$.

RESULTS

The patients' age at surgery ranged from 30 to 87 years (median: 71 years). The most common etiology of the stricture was iatrogenic (n=26, 89.7%), and the other causes of the stricture were trauma, infection, and idiopathic (n=1 for each cause). Seventeen patients (58.6%) underwent urethral dilation or direct vision internal urethrotomy (DVIU) before referral to our center. At presentation, 5 patients had suprapubic cystostomy. In the remaining 24 patients with voiding difficulty, the mean maximal flow rate was 5.1 mL/s (range: 1.2~9.9 mL/s). Thirteen patients (45%) had a penile urethral stricture, and 16 (55%) patients had a combined urethral stricture in the bulbous urethra. The median length of the strictures was 9.5 cm (range: 4~17 cm).

Among 29 patients, 20 patients were treated by fasciocutaneous flap urethroplasty only. The combined surgery group included patients treated with buccal mucosal graft urethroplasty (n=7), end-to-end anastomotic urethroplasty (n=1), or DVIU (n=1). An additional perineal incision was required in 16 of the 29 cases. Of these, 8 cases comprised the fasciocutaneous flap urethroplasty-only group, and the rest comprised the surgery group. The median operation time was 205 minutes (range: 120~300 minutes). The repair of these strictures needed a median flap length of 11 cm (range: 5~15 cm) and a median flap width of 1.9 cm (range: 1.3~2.0 cm). No patient needed a blood transfusion during and/or after the operation. The urethral catheter was removed at a median of 19 days (range: 12~28 days) postoperatively. At a median follow-up of 19 months (range: 6~68 months), 20 (68.9%) of the 29 patients had no evidence of a recurrent stricture.

In the 20 fasciocutaneous flap-only cases, surgical results were assessed within a median follow-up period of 19.5 months (range: 6~47 months), using a median flap

Table 1. Characteristics of patients who underwent fasciocutaneous flap surgery

	Total (n=29)	FCF only (n=20)	Combined surgery (n=9)	p value
Age (yr)	71 (30~87)	73 (30~87)	70 (40~75)	0.229[a]
Stricture etiology				
Iatrogenic	26 (89.7)	17 (85.0)	9 (100.0)	0.229[b]
Others	3 (10.3)	3 (15.0)	0 (0.0)	
Prior instrumentation	17 (58.6)	11 (55.0)	6 (66.7)	0.555[b]
Suprapubic cystostomy	5 (17.2)	3 (15.0)	2 (22.2)	0.634[b]
Stricture location				
Penile urethra	13 (45.0)	12 (60.0)	1 (11.1)	
Bulbous penile urethra	16 (55.0)	8 (40.0)	8 (88.9)	
Stricture length (cm)	9.5 (4~17)	8.8 (4~12)	14.0 (8~17)	0.002[a]
Combined surgery				
Buccal mucosa graft	7 (24.1)	-	7 (77.8)	
End-to-end anastomosis	1 (0.3)	-	1 (11.1)	
DVIU	1 (0.3)	-	1 (11.1)	
Follow-up (mo)	19 (6~55)	19.5 (6~47)	12 (6~55)	0.266[a]
Success rate	20 (68.9)	15 (75.0)	5 (55.6)	0.295[b]

Values are presented as median (range) or number (%).
FCF: fasciocutaneous flap, DVIU: direct vision internal urethrotomy.
[a]Mann-Whitney U test, [b]chi-squared test.

length of 11.5 cm (range: 5~15 cm). The success rate was 15 out of 20 cases (75.0%). The median length of the reconstruction in the 9 cases of combined surgery was 14.0 cm (range: 8~17 cm). Four surgical failure cases were reported postoperatively, leading to a success rate of 55.6%. There was no significant difference in the success rate between the fasciocutaneous flap-only group and the combined surgery group (Table 1).

In 6 patients, the stricture recurred at the junction of the fasciocutaneous flap: proximal (n=3), distal (n=2), and both (n=1). Fistula occurred at the proximal border in 1 case. In the remaining 2 cases, stricture recurred at the end-to-end anastomosis site and the site of DVIU, whereas stricture was not found at the site of flap urethroplasty.

Several surgical procedures were required for 1 out of the 3 cases of a recurrent stricture at the proximal junction of the flap; first, buccal mucosal ventral onlay graft urethroplasty was performed followed by two consecutive DVIUs and then, additional buccal mucosal graft urethroplasty. The other 2 cases underwent DVIU and urethral dilation, respectively. One out of the 2 cases of a recurrent stricture at the distal junction of the flap was accompanied by diverticulum and underwent urethroplasty using a diverticular tissue. Another needed dorsal onlay graft urethroplasty using the buccal mucosa. The only case of the recurrent stricture at both junctions of the flap underwent urethroplasty using Orandi's flap. The fistula that occurred at the proximal border was successfully managed by primary repair 4 months later. Periodic urethral dilation was performed in the 2 cases of recurrent strictures at the end-to-end anastomosis site and the site of DVIU.

Categorical risk factors for surgical failure were analyzed (Table 2). The failure rate was significantly higher in patients with suprapubic cystostomy preoperatively. There were 4 failures among the 5 patients that underwent suprapubic cystostomy. However, previous urethral instrumentation and combined surgery did not affect the surgical outcome. The effects of diabetes and smoking on the risks of recurrence were analyzed. There were significant differences in the success rate between the diabetic and the nondiabetic patients; however, no difference in the success rate was found between smokers and nonsmokers. There were no significant differences between the failure and success groups in terms of circumcision.

As shown in Table 3, early complications were minimal. Catheter-related infection and epididymitis were controlled by antibiotics in 5 patients. Post-micturition dribbling was the most common late complication, which occurred in 12 cases (41.3%). Three of them showed ejaculatory dysfunction simultaneously. A single patient complained of penile curvature, and corporal rotation is being considered.

Table 3. Early and late complications after fasciocutaneous flap urethroplasty

	Value
Early complications	
Epididymitis	3 (10.3)
Urinary tract infection	2 (6.9)
Late complications	
Post-micturition dribbling	12 (41.3)
Ejaculatory dysfunction	3 (10.3)
Penile curvature	1 (3.5)

Values are presented as number (%).

Table 2. Univariable and multivariable logistic regression analyses of risk factors for surgical failure

	Univariable[a]		Multivariable[a]	
	OR (95% CI)	p value	OR (95% CI)	p value
Suprapubic cystostomy	15.200 (1.375~167.982)	0.026[b]	68.000 (3.460~1,336.268)	0.005[b]
Previous instrumentation	0.431 (0.087~2.142)	0.303	-	-
Combined surgery	2.400 (0.457~12.613)	0.301	-	-
Circumcision	1.333 (0.256~6.940)	0.732	-	-
Smoking	1.619 (0.220~11.891)	0.636	-	-
Diabetes mellitus	7.200 (1.009~51.392)	0.049[b]	34.000 (2.436~474.549)	0.009[b]

OR: odds ratio, CI: confidence interval, -: univariable analysis.
[a]By binary logistic regression analysis; [b]$p < 0.05$.

DISCUSSION

Unlike bulbar strictures, length-sparing urethroplasty is essential in the reconstruction of a penile urethral stricture irrespective of the stricture length due to the risk of ventral curvature resulting from the shortened urethral length. Since the publication of the Orandi [6] technique in 1968, urethroplasty using a penile skin flap has been the mainstay treatment. Unlike the Orandi technique, which used a longitudinal penile skin flap, McAninch [7] suggested a circular fasciocutaneous flap for the reconstruction of a penile urethral stricture in 1993. It is a useful technique with excellent cosmetic and functional outcomes because it is a hairless, flexible tissue having a rich vascular supply from the surrounding tissues.

Based on the initial report by McAninch and Morey [11], the overall success rate of a penile circular fasciocutaneous flap was 79% (52 of 66 patients) with a mean follow-up of 41 months (range: 1~7 years). Later on, Whitson et al [8] reported the long-term efficacy of the penile circular fasciocutaneous flap for one-stage reconstruction of complex anterior urethral strictures. Recently, Schwentner et al [12] reported a long-term success rate of 90% in 36 patients who underwent single-stage urethroplasty using the fasciocutaneous flap with a mean follow-up duration of 96.7 months.

In our series of 29 patients who underwent penile circular fasciocutaneous flap urethroplasty, the overall success rate was 68.9% with a median follow-up duration of 19 months. The success rate of the present study was somewhat lower than that of previous studies. However, among the patients who underwent a fasciocutaneous flap only, the success rate was 75% (15 of 20 patients); this corresponded with the success rate of the earlier studies. Furthermore, the stricture recurred in 9 cases, of which in 6, it was located at the fasciocutaneous flap. Therefore, the actual stricture-free success rate of fasciocutaneous flap urethroplasty was 79.3% (23 of 29 patients).

Surgical failure was reported in 31.1% of our patients, wherein focal recurrence occurred mainly at the anastomotic margin, showing results similar to those of previous studies [11-13]. Many recurrences occurred within the bulbar urethral portion; therefore, it is important to incise the urethra into the normal healthy tissue proximally in order to guarantee a complete stricture incision and adequate exposure. In addition, accurate urethra-flap suture placement is essential for the prevention of recurrence.

Wessells et al [14] described a combination of tissue transfer techniques to reconstruct long and complex urethral strictures in one stage. These series show a success rate of 88% in 25 patients with a median follow-up duration of 16 months. Recently, Erickson et al [15] published a success rate of 78.6% in 14 men who underwent single-stage segmental urethral replacement using a combination of a ventral onlay fasciocutaneous flap with dorsal onlay buccal grafting for long segment strictures. Their surgical outcome was similar to that reported for two-stage repairs. In the present study, 7 cases of fasciocutaneous flap urethroplasty combined with ventral onlay buccal mucosal grafting showed a success rate of 71.4% with a median follow-up duration of 12 months. Despite limited cases and short follow-up periods, a combination of tissue transfer techniques for one-stage reconstruction of long complex urethral strictures remains a viable option. Likewise, in one case of fistula occurrence, surgical records showed that insufficient flap length was used during anastomosis, resulting in flap tension and eventually leading to anastomosis failure. We speculate that in such cases, urethral reconstruction using a combination of the fasciocutaneous flap with buccal mucosal grafting could have had better results.

A risk factor analysis revealed that patients with suprapubic cystostomy were more likely to experience surgical failure than patients without. Patients with a severe urethral stricture requiring suprapubic cystostomy might undergo a flap tubularization, which was inferior to onlay reconstruction in terms of the success rate [11]. Breyer et al [16] described their cohort of 495 patients who underwent urethroplasty with a median follow-up duration of 5.8 years. They found smoking and diabetes mellitus to be the risk factors for urethroplasty failure. In the present study, diabetes mellitus was predictive of failure; however, smoking was not. The limited and imbalanced sample size might have contributed to this result. Even in circumcised men, a comparable surgical outcome and good cosmetic results could be attained by using the penile circular fasciocutaneous flap technique [8,11,12]. In our experience, there were no effects of circumcision on the risks of re-

currence and no penile skin complications.

In our series of 29 patients, the most common complication was post-micturition dribbling, due to the increased distensibility of the skin flap as compared to the normal urethra [9]. Although further advances in surgical technique are required for the prevention of post-micturition dribbling, management by gentle digital compression seems feasible. The evaluation of the ejaculatory dysfunction reported in 3 cases was difficult due to an insufficient analysis of the preoperative ejaculatory function. In contrast, Sharma et al [17] reported an improvement in ejaculation and overall satisfaction, while the increased incidence of erectile dysfunction was not definite. Previous authors reported neurovascular complications of lower extremities due to the prolonged high-lithotomy position, particularly in cases where the operation time exceeded 5 hours [11]. However, we have not encountered the post-operative compartment syndrome, possibly because the median operation time was 205 minutes (range: 120~300 minutes) in this series.

There are several noteworthy limitations of the present study. This is a retrospective study. Only 29 patients were included for the analysis, and the combined surgery group was not excluded. For better results, a large prospective series with long-term follow-up is necessary.

CONCLUSIONS

Penile circular fasciocutaneous flap urethroplasty for a complex anterior urethral stricture showed an acceptable success rate of 68.9% with or without combined surgery. In addition, the actual stricture-free success rate of fasciocutaneous flap urethroplasty was 79.3%. A sufficient, healthy margin should be acquired due to the fact that most of the recurrence occurs at the anastomotic margin of the flap.

REFERENCES

1. Barbagli G, Palminteri E, Lazzeri M, Guazzoni G. Anterior urethral strictures. BJU Int 2003;92:497-505.
2. Barbagli G, Lazzeri M. Penile urethral stricture reconstruction--flap or graft? Graft J Urol 2011;186:375-6.
3. Gonzalez C. Penile urethral stricture reconstruction--flap or graft? Flap. J Urol 2011;186:376-7.
4. Andrich DE, Mundy AR. What is the best technique for urethroplasty? Eur Urol 2008;54:1031-41.
5. Asopa HS, Garg M, Singhal GG, Singh L, Asopa J, Nischal A. Dorsal free graft urethroplasty for urethral stricture by ventral sagittal urethrotomy approach. Urology 2001;58:657-9.
6. Orandi A. One-stage urethroplasty. Br J Urol 1968;40:717-9.
7. McAninch JW. Reconstruction of extensive urethral strictures: circular fasciocutaneous penile flap. J Urol 1993;149:488-91.
8. Whitson JM, McAninch JW, Elliott SP, Alsikafi NF. Long-term efficacy of distal penile circular fasciocutaneous flaps for single stage reconstruction of complex anterior urethral stricture disease. J Urol 2008;179:2259-64.
9. Carney KJ, McAninch JW. Penile circular fasciocutaneous flaps to reconstruct complex anterior urethral strictures. Urol Clin North Am 2002;29:397-409.
10. Buckley J, McAninch J. Distal penile circular fasciocutaneous flap for complex anterior urethral strictures. BJU Int 2007;100:221-31.
11. McAninch JW, Morey AF. Penile circular fasciocutaneous skin flap in 1-stage reconstruction of complex anterior urethral strictures. J Urol 1998;159:1209-13.
12. Schwentner C, Seibold J, Colleselli D, Alloussi SH, Gakis G, Schilling D, et al. Anterior urethral reconstruction using the circular fasciocutaneous flap technique: long-term follow-up. World J Urol 2011;29:115-20.
13. Moradi M, Moradi A. Urethroplasty for long anterior urethral strictures: report of long-term results. Urol J 2006;3:160-4.
14. Wessells H, Morey AF, McAninch JW. Single stage reconstruction of complex anterior urethral strictures: combined tissue transfer techniques. J Urol 1997;157:1271-4.
15. Erickson BA, Breyer BN, McAninch JW. Single-stage segmental urethral replacement using combined ventral onlay fasciocutaneous flap with dorsal onlay buccal grafting for long segment strictures. BJU Int 2012;109:1392-6.
16. Breyer BN, McAninch JW, Whitson JM, Eisenberg ML, Mehdizadeh JF, Myers JB, et al. Multivariate analysis of risk factors for long-term urethroplasty outcome. J Urol 2010;183:613-7.
17. Sharma V, Kumar S, Mandal AK, Singh SK. A study on sexual function of men with anterior urethral stricture before and after treatment. Urol Int 2011;87:341-5.