



A Multi-institutional Evaluation of the Management and Outcomes of Long-segment Urethral Strictures

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OBJECTIVE	To evaluate the treatment options and surgical outcomes of long-segment urethral strictures—a review of the largest, international, multi-institutional series.
METHODS	A retrospective review was performed of patients treated with strictures ≥ 8 cm at 8 international centers. Endpoints analyzed included surgical complications and recurrence.
RESULTS	Four hundred sixty-six patients were identified. Treatment intervals ranged from December 27, 1984 to November 9, 2013. Dorsal onlay buccal mucosal graft (BMG) was the most common procedure (223, 47.9%); others included first- and second-stage Johanson urethroplasty (162 [34.8%] and 56 [12%], respectively), fasciocutaneous (FC) flaps (8, 1.7%), and a combination flap and graft (17, 3.6%). Overall success was achieved in 361 patients (77.5%) with a mean follow-up of 20 months. Second-stage Johanson urethroplasty was found to have a higher recurrence rate compared with that of 1-stage BMG urethroplasty (35.7% vs 17.5%, respectively; $P < .01$). This was also true in cases of lichen sclerosus (14.0% vs 47.8%, respectively; $P < .01$). Otherwise, success rates were similar. Urethroplasties performed with FC flaps had a higher complication rate compared with those without (32% vs 14%, respectively; $P = .02$). Prior dilation or urethrotomy, higher number of prior dilations or urethrotomies, abnormal voiding cystourethrogram, and skin grafts all portend a higher recurrence rate. On logistic regression analysis, only second-stage Johanson had an increased odds ratio of recurrence compared with that of BMG (2.82 [1.41-5.86]).
CONCLUSION	Long-segment strictures can be treated with high success rates in experienced hands. BMG was more successful than second-stage Johanson urethroplasty. FC flaps, although successful, had high complication rates. UROLOGY 85: 1483–1488, 2015. Published by Elsevier Inc.

Management of long-segment urethral stricture is one of the more challenging surgical problems for the reconstructive urologist. Options for treatment are determined by etiology, availability of native urethral plate, availability of local skin, and surgeon preference. Surgical options include a 1- or 2-stage

repair (with or without grafts), skin or buccal mucosal grafts (BMGs), fasciocutaneous (FC) flaps, or a combination of flaps and grafts. The literature comparing outcomes of surgical treatment of long-segment urethral strictures is sparse. This study presents the results of an international multi-institutional collaborative review of the largest available series of nonobliterated long-segment urethral stricture repairs. The authors seek to better understand the management of long urethral strictures and the complications and success rates of various treatment options by examining results of common procedures and features predictive of surgical success.

Long-segment urethral stricture is a poorly defined term. Some authors use a cutoff of 9 cm,¹ or a stricture involving >1 location.² A cutoff of 8 cm was selected for this study for 2 reasons: first, the average bulbar urethral length is reported at 7.5 ± 1.4 cm,³ and second, strictures >7.5 cm are unlikely to be fixed with a single mucosal graft.⁴ The inclusion criteria are meant to evaluate

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strictures that are more complex and span over 2 regions of the urethra such that simple graft only or anastomotic urethroplasty would not be feasible.

METHODS

After obtaining institutional review board approval, a retrospective, international, multi-institutional review was performed of patients who were treated with at least 1 urethroplasty for a nonobliterated stricture ≥ 8 cm with at least 1 year of follow-up and with known recurrence status. Exclusion criteria included obliterative strictures, a stricture treated with an anastomotic urethroplasty (in an augmented fashion), scrotal skin, smooth intestine submucosa augmentation, or a history of radiation. In total, the combined experience of 8 surgeons was evaluated.

Patient data evaluated included age, prior dilations or urethrotomies, prior urethroplasties, and stricture length at surgery. Stricture cause was classified as unknown, lichen sclerosus (LS), trauma, hypospadias, iatrogenic, or infectious. Surgery type was characterized as 1 of 5 categories: FC flap, 1-stage BMG, 2-stage Johanson urethroplasty, definitive first-stage Johanson urethroplasty (including perineal urethrostomy), and a combination of grafts and flaps. First-stage Johanson urethroplasty is defined as opening the urethra through the strictured portion and securing the cut edge of the urethra to the penile skin, or perineal skin in the case of perineal urethrostomy. Second-stage Johanson urethroplasty is defined as the closure of the previously opened urethra with or without the use of grafts to augment the diameter of the urethral lumen. We use the term 2-stage Johanson urethroplasty to represent patients who underwent both a first- and a second-stage Johanson urethroplasty. Graft location (ventral, dorsal, or both) and graft type (skin or buccal mucosa) were also evaluated. Time to catheter removal was evaluated. Early and late complications were assessed. Voiding cystourethrogram findings were evaluated if available. Finally, patients were evaluated based on recurrence, which was defined as any intervention for recurrent strictures including dilation, urethrotomy, or repeat urethroplasty. Date of last follow-up was determined to be the last day the patient was evaluated by the surgeon.

Data were analyzed with IBM SPSS Statistics for Windows, version 19.0 (IBM SPSS, Chicago, IL). Categorical variables were analyzed using the Pearson chi-square test and the Fisher exact test. Continuous variables were analyzed using the Student independent *t* test and nonparametric Mann-Whitney *U* test for non-normally distributed variables. Logistic regression using a forced entry method was used for multivariate analyses. The Kaplan-Meier survival analysis using the log-rank test was used to compare recurrence rates. All tests were 2 sided, and statistical significance is determined by a $P < .05$.

RESULTS

Four hundred eighty-two patients were evaluated from December 1984 to November 2013. Four hundred sixty-six patients met inclusion criteria for analysis. Of the excluded patients, 3 had small intestine submucosal augments, 8 had an augmented anastomotic urethroplasty, 1 had previous radiation, 1 was treated with scrotal skin, and finally 3 had no available information regarding recurrence status.

Mean age was 51.3 years (range, 16-82 years); average follow-up was 20 months (range, 12-344 months). Mean

Table 1. Surgery type and cause of stricture with recurrence rates

	Number (%)	Recurrence (%)
Type of surgery		
FC flap	8 (1.7)	3 (37.5)
One-stage BMG	223 (47.8)	39 (17.5)
First- and second-stage Johanson urethroplasty	56 (12.0)	20 (35.7)
Perineal urethrostomy or definitive first stage	162 (34.8)	39 (24.1)
Combination FC and graft	17 (3.6)	4 (23.5)
<i>P</i> value		.039
Cause of stricture		
Unknown	104 (22.3)	29 (27.9)
Lichen sclerosis	234 (50.2)	48 (20.5)
Trauma	13 (2.8)	5 (38.5)
Hypospadias	19 (4.1)	4 (21.0)
Iatrogenic	92 (19.7)	19 (20.7)
Infection	4 (0.9)	0
<i>P</i> value		0.36

BMG, buccal mucosal graft; FC, fasciocutaneous.

stricture length was 12.7 cm (range, 8-24 cm). Overall success rate was 77.5% (361 of 466), with recurrence rate of 22.5% (105 of 466). Table 1 demonstrates the recurrence by cause and surgery type. The Pearson chi-square test demonstrated a statistically significant difference in recurrence rates by type of surgery. On chi-square analysis comparing the various procedures, only BMG demonstrated a significant superiority compared with a 2-stage Johanson urethroplasty (17.5% vs 35.7%, respectively; $P < .01$). The Pearson chi-square analysis showed no difference in recurrence by cause.

When examining hypospadias vs LS treated with a 2-stage Johanson urethroplasty, we found that the recurrence rates were similar (3 of 12 [25%] vs 11 of 23 [47.8%], respectively; $P = .28$). However, when evaluating patients with LS treated with a 2-stage Johanson urethroplasty vs a 1-stage BMG, there was a difference in recurrence rates (11 of 23 [47.8%] vs 21 of 151 [14.0%], respectively; $P < .01$).

Table 2 summarizes the complications. Occurrence of a complication conferred no statistical impact on stricture recurrence ($P = .29$). Patients with an FC flap (alone or in combination) were compared with those without a flap. The complication rate was higher in the FC group compared with those without a flap (32% vs 14%, respectively; $P = .02$).

Previous dilation or urethrotomy was found to have a statistically significant negative impact on success (Table 3). Previous urethroplasty did not appear to significantly affect outcome. Using a Mann-Whitney test, the total number of previous procedures was significantly higher in those with recurrence compared with those without (mean, 2.9 vs 2.5, respectively; $P < .01$). One hundred one patients had a perineal urethrostomy (PU) without a prior urethroplasty, whereas 61 patients had a PU after a previous urethroplasty. In the patients with prior urethroplasty, PU was the most common procedure

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