
Long-Term Followup of Visual Internal Urethrotomy for Management of Short (Less Than 1 Cm) Penile Urethral Strictures Following Hypospadias Repair

D. A. Husmann* and S. R. Rathbun

From the Department of Urology, Mayo Clinic, Rochester, Minnesota

Purpose: We reviewed the results of direct vision urethrotomy for short (less than 1 cm) penile urethral strictures following hypospadias surgery.

Materials and Methods: Patients with less than 1 cm anterior penile urethral strictures located proximal to the meatus underwent direct vision urethrotomy. Based on the type of initial urethroplasty patients were randomly divided into treatment with direct vision urethrotomy vs direct vision urethrotomy plus clean intermittent catheterization for 3 months. Success was defined as absent obstructive voiding symptoms and a normal urine flow 2 years following the last patient instrumentation.

Results: Of patients with urethral strictures following hypospadias repair 44% (32) had previously undergone tubularized graft urethroplasty and 56% (40) had previously undergone flap urethroplasty, including a tubularized island flap in 18, an onlay flap in 11 and urethral plate urethroplasty in 11. Direct vision urethrotomy alone was performed in 51% of patients (37), and direct vision urethrotomy and clean intermittent catheterization were performed in 49% (35). Success with the 2 methods was similar, that is 24% (9 of 37 patients) vs 22% (8 of 35). Following direct vision urethrotomy all patients with tubularized graft urethroplasty showed failure (0 of 32). Success was noted in 11% of patients (2 of 18) with tubularized island flap urethroplasty compared to 72% (8 of 11) with onlay urethroplasty and 63% (7 of 11) with urethral plate urethroplasty (each $p < 0.05$).

Conclusions: The addition of clean intermittent catheterization to direct vision urethrotomy does not improve the likelihood of success. Direct vision urethrotomy for short (less than 1 cm) urethral stricture usually fails following any type of tubularized graft or flap urethroplasty but it had moderate success following onlay flap and urethral plate urethroplasties.

Key Words: urethra, abnormalities, urethral stricture, hypospadias

The likelihood of urethral stricture following hypospadias repair is directly related to the length of urethroplasty, the type of urethroplasty and whether the graft or flap was tubularized or used as an onlay or patch.¹⁻⁴ The current literature on VIU for post-hypospadias urethral stricture disease is plagued with problems in interpretation. Frequently the success of VIU is not separated out based on stricture location, the exact stricture length is not noted and followup is not standardized or it is unavailable. Furthermore, the type of hypospadias repair originally performed is frequently not mentioned or it is not correlated with the results of VIU.^{1,5-7} In addition, to our knowledge no prior attempt to randomize CIC as an adjunct to VIU has been performed for post-hypospadias urethral stricture disease.

In an effort to improve our ability to understand when to perform VIU for post-hypospadias strictures we elected to limit VIU to anterior penile urethral strictures less than 1 cm with the location of the urethral stricture proximal to the urethral meatus but distal to the bulbar urethra. Based on the type of initial urethroplasty patients were randomly placed into treatment with VIU alone or VIU plus postoper-

ative CIC for 3 months. This study was performed with 2 major goals in mind. 1) Does postoperative CIC influence the long-term results of VIU? 2) Does the initial type of hypospadias repair impact the success of VIU?

MATERIALS AND METHODS

Patients with short (less than 1 cm) urethral strictures of the pendulous penile urethra following hypospadias repair were chosen for this study. No patients with meatal or bulbar strictures were accepted for this investigation. Patients were initially considered for study based on a stricture length of less than 1 cm found on RGUG. However, they were only included in the study if stricture length was confirmed to be less than 1 cm at VIU. Patients were accumulated in prospective fashion from 1986 to 2005. A minimum followup of 2 years was necessary to be included in the investigation. Patients were randomized to treatment based on 1 of 4 types of initial hypospadias repair performed, including a tubularized graft, a tubularized flap, an onlay flap or a urethral plate type of urethroplasty.

After separation into 1 of the 4 categories patients were arbitrarily assigned to treatment with VIU or VIU followed by 3 months of daily CIC. VIU was performed after cystoscopic confirmation of the stricture and placement of a guidewire into the bladder. Incisions were made under di-

* Correspondence and requests for reprints: Department of Urology, Gonda Building 7S, Mayo Clinic, Rochester Minnesota 55906 (telephone: 507-284-2949; FAX: 507-284-4987; e-mail: dhusmann@mayo.edu).

rect vision at the 12 o'clock position and a catheter was placed following the procedure for 3 to 7 days. Following catheter removal patients in the VIU plus CIC treatment protocol were immediately started on daily self-catheterization for 3 months.

Patients were followed at 3-month intervals with a verbal assessment for recurrent obstructive voiding symptoms and flow rate with ultrasound post-void residual urine for 2 years after the last instrumentation. For example, a patient in the VIU alone category was seen for 2 years and in the VIU plus CIC category a patient was seen for 2 years 3 months. Patients were discharged from our clinic if they remained free of symptoms at the 2-year (VIU) or 2-year 3-month (VIU plus CIC) followup visit. Patients with obstructive voiding symptoms and abnormal urine flow underwent RGUG, followed by cystoscopic confirmation of stricture disease. Patients who were asymptomatic but had abnormal urine flow underwent repeat uroflowmetry. If 2 abnormal uroflow studies were found, RGUG was performed. If RGUG confirmed recurrent stricture, we maintained patient followup but did not subject the patient to repeat cystoscopy/surgery unless clinical symptoms recurred. Cases were considered VIU failures only when symptomatic complaints and objective findings were present simultaneously. If recurrent urethral stricture was confirmed to be less than 1 cm long, repeat VIU with or without CIC was performed according to the patient prior treatment protocol and followup studies recommenced.

Uroflow studies were considered normal at a peak urine flow of greater than 12 cc per second (average greater than 7 for greater than 100 cc voided).⁸ Statistics were performed with the chi-square test with $p < 0.05$ considered significant.

RESULTS

A total of 72 patients successfully completed our study protocol during the 20-year period of 1986 to 2005. The site of initial hypospadias was penoscrotal or more proximal in 70% of patients (50), proximal penile in 26% (19) and mid penile in 4% (3). The hypospadias repair used was a tubularized graft in 44% of patients (32), including bladder in 20, a buccal graft in 6 and preputial skin in 6. Flap urethroplasty was used in 56% of cases (40). Specifically a tubularized island flap was used in 26% of patients (18), an onlay flap was used in 15% (11) and urethral plate closure was done in 15% (11).

VIU alone was performed in 51% of patients (37), and VIU and CIC were done in 49% (35). The success of the 2 methods 2 years following the last instrumentation was similar at 24% (9 of 37 patients) and 22% (8 of 35), respectively. Due to identical long-term results patients undergoing DVIU or DVIU plus CIC were subsequently combined as 1 study group. All patients with tubularized graft urethroplasty undergoing DVIU with or without CIC showed failure (0 of 32). Success was noted in 11% of patients (2 of 18) with tubularized island flap urethroplasty compared to 72% (8 of 11) with onlay urethroplasty and 63% (7 of 11) with urethral plate urethroplasty (each $p < 0.05$).

Recurrence of a more than 1 cm urethral stricture after initial DVIU occurred in 63% of patients (20 of 32) with a tubularized graft urethral stricture. Subsequently only 37% of those patients (12 of 32) underwent repeat DVIU with or without CIC. All second DVIUs with or without CIC also

failed. Indeed, followup revealed that the second DVIU inevitably resulted in lengthening the urethral stricture, that is extending it from less than 1 cm to a median of 5 cm (range 4 to 12). At definitive open urethral reconstruction for recurrent urethral stricture the median stricture length in patients in whom 1 or 2 DVIUs with or without CIC had failed who had a history of a tubularized graft was 5 cm (range 3 to 12).

Recurrent urethral stricture in patients with tubularized flap urethroplasty was noted to be more than 1 cm in 50% (8 of 16). Subsequently only 50% of those patients (8 of 16) underwent repeat DVIU with or without CIC. Repeat DVIU was successful in 12% of those patients (1 of 8). At definitive open urethral reconstruction for recurrent urethral stricture median stricture length was 5 cm (range 3 to 10) in patients in whom 1 or 2 DVIUs with or without CIC had failed who had a history of tubularized flap urethroplasty.

Of patients with onlay or tubularized plate urethroplasty only a limited number (7) had recurrent strictures following DVIU with or without CIC. Therefore, 7 patients were assessed for possible repeat DVIU. Recurrent urethral stricture was noted to be more than 1 cm in 29% of patients (2 of 7). Subsequently only 71% of patients (5 of 7) underwent repeat DVIU. Repeat DVIU with or without CIC was successful in 20% of patients (1 of 5). In all circumstances the recurrent urethral stricture requiring definitive repair was noted to be longer than the original stricture (median 4 cm, range 2 to 6).

DISCUSSION

VIU for urethral stricture disease has been plagued by a high failure rate in the adult population with the success of this procedure depending on the etiology of stricture, and its location, diameter and length.⁹⁻¹² With the highest success rate found in bulbar urethral strictures a urethral length of less than 1.5 cm is associated with wide diameter narrowing (greater than 15Fr).⁹⁻¹³

In pediatric urology VIU is commonly performed for pediatric urethral stricture disease following hypospadias repair. Unfortunately followup through adulthood in these patients is hard to find. Short-term followup of 1 year frequently reveals success rates as high as 75% to 80%. However, a followup of more than 5 years reveals that success decreases into the 20% to 35% range with some studies suggesting that long-term success may be doubled by repeating urethrotomy on at least 1 occasion.^{1,5-7}

However, interpretation of published data is fraught with problems. Prior studies of this subject failed to stratify results according to the type of prior hypospadias repair performed, or they included patients treated with urethral dilation or VIU, combined the results of metal, pendulous penile and bulbar urethral strictures or were limited due to lack of a standardized followup.^{1,5-7} As noted, VIU for urethral stricture disease is associated with multiple controversies and we were interested specifically in evaluating 3 of these concerns. 1) Does beginning CIC immediately following VIU result in less wound contracture and subsequently improve the outcome of this procedure?^{12,14-16} 2) Does the type of initial hypospadias repair performed impact the incidence of success with VIU?^{3,4} 3) Will a second VIU lengthen the stricture, making eventual definitive urethral

reconstruction more difficult, or does it double its success?^{7,12,17}

To answer these concerns we evaluated patients with short (less than 1 cm) penile urethral strictures that developed following hypospadias repair. All patients with strictures at bulbar and meatal sites were excluded. Patients were stratified into treatment with VIU or VIU plus CIC for 1 month based on the initial type of hypospadias repair. A mandatory followup of 2 years was necessary for study inclusion with the diagnosis of recurrent urethral stricture disease based on subjective and objective criteria.

This study revealed several clinically relevant findings. 1) The addition of CIC for 3 months following VIU failed to improve the stricture prognosis with stricture recurring in the majority of patients. This finding is in contrast to that reported by Dewan et al¹⁶ but it is similar to that reported by Jordan et al.¹² Our findings have resulted in the recommendation that the addition of CIC after VIU should be abandoned or alternatively continued indefinitely as an alternative to definitive repair of the urethral stricture.

2) Regarding whether the initial type of urethroplasty performed impacts the success of VIU our data suggest that, when hypospadias repair was performed by a tubularized graft or flap, a single VIU resulted in urethral stricture progression in 56% of patients (28 of 50) and it was successful in only 4% (2 of 50). In contrast, VIU performed in patients with a history of onlay or urethral plate urethroplasty resulted in stricture progression in 9% (2 of 22) and it was successful in 68% (15 of 22). There was a significant difference between these 2 groups regarding whether a single VIU resulted in stricture progression or success ($p < 0.01$). Data suggest that the success of initial VIU was greatly impacted by the type of initial hypospadias repair.

3) Regarding the question of whether repetitive VIU enhanced success or advanced stricture disease, a second VIU for recurrent urethral stricture less than 1 cm was performed in 20 patients with a history of a tubularized graft or flap urethroplasty. It resulted in stricture progression in 95% of patients (19) and was successful in only 5% (1 of 20). Of patients undergoing a second VIU with a history of onlay or urethral plate urethroplasty 80% (4 of 5) had urethral stricture progression and 20% (1 of 5) experienced success. No significant difference was noted between the 2 groups. In essence our data suggest that the type of initial hypospadias repair performed does not impact the success of a second VIU. Indeed, in our hands a second VIU for recurrent urethral stricture had minimal success and actually resulted in lengthening the amount of urethra requiring reconstruction irrespective of the type of initial repair. Our findings support prior publications stating that repeating urethrotomy more than once does not appear to enhance success and it may in fact impair the successful results of open urethral reconstruction.^{10,12,17}

We hypothesize that VIU for a urethral stricture following any type of circumferential repair, graft or flap usually fails and results in significant progression of stricture formation due to the absence of a well vascularized dorsal urethral bed. Unlike urethral strictures resulting from inflammatory disease or trauma a urethral stricture following circumferential flap or graft urethroplasty is not associated with spongiofibrosis. Indeed, corporeal spongiosal tissue in this patient population is rudimentary or has been previously excised. The 12 o'clock incision made at VIU in pa-

tients with circumferential repair results in extravasation of fluid, urine and blood into the adjacent periurethral tissue. The extravasated fluid is not confined to a limited space due to absence of the corporeal spongiosum. Subsequently fluid extravasation results in a significant inflammatory response adjacent to the urethra. The inflammatory reaction further impairs the urethral blood supply and results in stricture progression.

In contrast, all of our onlay flaps or urethral plate reconstructions initially maintained dorsal plate integrity. VIU at the 12 o'clock position in these patients may have resulted in fluid extravasation into the corpora spongiosum but extravasation was minimal and confined to the well vascularized dorsal plate. Indeed, initial VIU in this circumstance was similar to localized tubular plate incision, as recommended by Snodgrass.¹⁸ However, if initial VIU failed, we hypothesize that recurrent stricture was probably related to the incision eliciting fibrosis of the spongiosal tissue. Further VIUs resolved the fibrotic spongiosal tissue that had developed and served only to advance stricture disease by causing further fibrosis of the corporeal spongiosa.^{10,12}

CONCLUSIONS

We have treatment recommendations for short (less than 1 cm) penile urethral strictures following hypospadias repair. If initial urethroplasty was a tubularized graft or flap, we would strongly consider initial treatment with open urethral reconstruction since VIU in this situation has little long-term success and it carries a significant risk of urethral stricture progression. In patients with a short urethral stricture following onlay or dorsal plate urethroplasty a single VIU is merited and will be met with modestly successful results. If urethral stricture recurs, we would recommend proceeding to open urethral reconstruction, rather than performing repeat VIU. A repeat or second VIU in our hands had only a small incidence of success and it carried a significant risk of urethral stricture progression irrespective of the initial type of urethroplasty. Finally, the addition of CIC following VIU has no benefit for preventing stricture recurrence.

Abbreviations and Acronyms

CIC	=	clean intermittent catheterization
RGUG	=	retrograde urethrogram
VIU	=	direct vision internal urethrotomy

REFERENCES

1. Duel, B., Barthold, J. and Gonzalez, R.: Management of urethral strictures after hypospadias repair. *J Urol*, **160**: 170, 1998
2. Manzoni, G., Bracka, A., Palminteri, E. and Marrocco, G.: Hypospadias surgery: when what by whom? *BJU Int*, **94**: 118, 2004
3. Dubey, D., Kumar, A., Bansal, P., Srivastava, A., Kapoor, R., Mandhani, A. et al: Substitution urethroplasty for anterior urethral strictures: a critical appraisal of various techniques. *BJU Int*, **91**: 215, 2003
4. El-Sherbiny, M., Abol-Enein, H., Dawaba, M. and Ghoneim, M.: Treatment of urethral defects: skin, buccal or bladder

- mucosa, tube or patch? An experimental study in dogs. *J Urol*, **167**: 2225, 2002
5. Scherz, H., Kaplan, G., Packer, M. and Brock, W.: Posthypospadias repair of urethral strictures: a review of 30 cases. *J Urol*, **140**: 1253, 1988
 6. Hsiao, K., Baez-Trinidad, L., Lendvay, T., Smith, E., Broecker, B., Scherz, H. et al: Direct visual internal urethrotomy for the treatment of pediatric urethral strictures: analysis of 50 patients. *J Urol*, **170**: 952, 2003
 7. Hafez, A., El-Assmy, A., Dawaba, M., Sarhan, O. and Bazeed, M.: Long-term outcome of visual internal urethrotomy for the management of pediatric urethral strictures. *J Urol*, **173**: 595, 2005
 8. Blavis, J. and Chancellor, M.: Atlas of Urodynamics. Baltimore: Williams and Wilkins, pp. 56–57, 1996
 9. Albers, P., Fichtner, J., Brühl, P. and Müller, S.: Long-term results of internal urethrotomy. *J Urol*, **156**: 1611, 1996
 10. Pansadoro, V. and Emiliozi, P.: Internal urethrotomy in the management of anterior urethral strictures: long-term followup. *J Urol*, **156**: 73, 1996
 11. Mandhani, A., Chaudhury, H., Kapoor, R., Srivastava, A., Dubey, D. and Kumar, A.: Can outcome of internal urethrotomy for short segment bulbar urethral stricture be predicted? *J Urol*, **173**: 1595, 2005
 12. Jordan, G. and Schlossberg, S.: Surgery of the penis and urethra. In: Campbell's Urology. Edited by A. Retik, E. Vaughan, Jr., A. Wein, L. Kavoussi, A. Novick, A. Partin et al. Philadelphia: W. B. Saunders Co., vol 4, pp. 3915–3920, 2002
 13. Stormont, T., Suman, V. and Oesterling, J.: Newly diagnosed bulbar urethral strictures: etiology and outcome of various treatments. *J Urol*, **150**: 1725, 1993
 14. Smith, P., Dunn, M. and Roberts, J.: Surgical management of urethral stricture in the male. *Urology*, **18**: 582, 1981
 15. Lipsky, H. and Hubner, G.: Direct visual urethrotomy in the management of urethral strictures. *Br J Urol*, **49**: 725, 1977
 16. Dewan, P., Gotov, E. and Chiang, D.: Guide wire assisted urethral dilation for urethral strictures in pediatric urology. *J Pediatr Surg*, **38**: 1790, 2003
 17. Roehrborn, C. and McConnell, J.: Analysis of factors contributing to success or failure of 1-stage urethroplasty for urethral stricture disease. *J Urol*, **151**: 869, 1994
 18. Snodgrass, W. and Lorenzo, A.: Tubularized incised-plate urethroplasty for proximal hypospadias. *BJU Int*, **89**: 90, 2002