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Long-term follow-up of urethral reconstruction for blunt urethral injury at a young age: urinary and sexual quality of life outcomes

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Summary

Introduction

Little is known about long-term patient-reported outcomes following surgical repair for pediatric blunt urethral trauma.

Objective

The purpose was to evaluate long-term urinary outcomes, sexual function, and quality of life (QOL) of patients who undergo urethroplasty for blunt urethral trauma in childhood.

Study Design

After IRB approval, we retrospectively reviewed the records of patients who sustained blunt urethral injury at ≤ 18 years and underwent urethroplasty at our institution between 1978 and 2013. We then used a web-based survey to assess urinary/sexual/ejaculatory function and overall QOL using validated questionnaires.

Results

Of 68 eligible patients, 15 were able to be contacted (table). Median age of injury, age at urethroplasty, and age

at follow-up were 17 (4–18), 17 (5–20), and 19 (13.5–21.5) years, respectively. The stricture was membranoprostatic in eight and bulbar in seven patients, with median length of 2 (1.6–2.6) cm. Excision/primary anastomosis was performed in all but three patients who required a buccal graft. Overall, 80% were ‘very satisfied’ and 20% were ‘satisfied’ with surgery. One patient reported a subsequent urethral intervention. On urethral stricture surgery patient-reported outcome measurement, the median bother (0 least, 24 worst) was 10 (8–12.5). The force of urine stream (1 strongest, 4 weakest) was 2 (1.5–2), with no report of urinary incontinence. The median Sexual Health Inventory for Men score (0 worst, 25 perfect) was 24 (22.5–24). The median ejaculatory function score (0 worst, 15 normal) was 14 (13–14.75). Six patients had fathered children and none reported infertility. Three patients reported $<30^\circ$ penile curvature not interfering with sex. Median QOL (0 worse, 10 best) was 8 (7.5–8).

Conclusions

Urethroplasty after blunt urethral injury in young adult population is associated with a high long-term success rate with a low rate of long-term urinary and sexual consequences in adulthood.

Pt #	Age at injury (years)	Age at urethroplasty (years)	Stx location/length	Trauma mechanism	Prior intervention	Ancillary maneuvers	Urethroplasty technique	Follow-up (years)
1	4	5	PM – 2	PFUD – MVC	SPT	Partial pubectomy	EPA	16
2	7	16	Bulbar – 1.5	Straddle			EPA	8
3	13	16	Bulbar – 2.5	Straddle			VBMG – 4.5 cm	12
4	13	14	Bulbar – 2.6	Straddle			VBMG – 4 cm	14
5	16	16	PM – 2	PFUD – MVC	SPT	Partial pubectomy	EPA	23
6	16	17	Bulbar – 1.9	Straddle			EPA	13
7	17	17	Bulbar – 3	Straddle	Dilation		EPA	23
8	17	18	PM – 2.5	PFUD – Fall	DVIU, dilation		EPA	19
9	17	17	PM – 5	PFUD – MVC	SPT		EPA	20
10	18	18	PM	PFUD	SPT		EPA	19
11	18	19	PM – 1.2	PFUD – Fall	SPT		EPA	13
12	18	18	PM – 2	PFUD – MVC	Realignment, dilation		EPA	21
13	18	20	Bulbar – 1	Straddle	DVIU, dilation		EPA	20
14	18	19	PM – 1	PFUD – MVC	SPT		EPA	28
15	18	18	Bulbar – 5.5	Straddle	Dilation		VBMG – 7 cm	22

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Introduction

Blunt urethral injury in pediatric and young adult population is rare. Injury to the bulbomembranous urethra occurs in 0.5%–4.2% of pelvic fractures, but the rarity of pelvic fracture in children makes posterior urethral injury extremely infrequent in this age group [1–3]. Anterior urethral injury is commonly associated with straddle injury or fracture of pubic rami from sport activities or cycling events. The incidence of bulbar urethra injuries secondary to straddle injuries in adults has been reported as 0.6–10% [1,4].

There are few reports of urethroplasty outcomes in pediatric literature, and they have mostly focused on surgical techniques and short-term stricture outcomes [5–7]. Pediatric urethral trauma is a treatment challenge compared to adults mostly due to a lack of a stabilized posterior urethra, given the small size of the prostate, laxity of the pubourethral ligaments, small perineal space, and small pelvis. Despite technical challenges to achieving a tension-free anastomosis that often requires ancillary maneuvers such as pubectomy or corporal splitting, little is known about the functional urinary and sexual outcomes in this population after they reach adulthood. One recent report from Belgium has reported a poor urinary symptom score and relatively high rate of erectile dysfunction (ED) in a small group of patients with urethral trauma with a median follow-up of 57 months [8]. In a previous report from our institution, we reported short-term outcomes of anterior and posterior urethroplasty after blunt urethral injury in 26 boys with mean 3 years of follow-up (range 2 months–6 years). Only one of the eight patients in the anterior cohort required one additional direct vision internal urethrotomy (DVIU) 14 months after urethroplasty. Two of 18 in the posterior cohort required additional procedures: one patient failed 9 months after urethroplasty and required two subsequent DVIUs. He was followed for an additional 1.5 years without stricture recurrence. Another patient had one DVIU at 4.5 months after urethroplasty. Overall success rate was 87.5% and 88.9% in the anterior and posterior cohort, respectively [9].

The aim of the present study was to investigate long-term functional outcomes and quality of life (QOL) of adults who previously underwent urethroplasty for blunt urethral injury at a young age.

Methods

Data source

After IRB approval, we retrospectively reviewed a departmental database to identify patients who sustained blunt urethral injury at ≤ 18 years and subsequently underwent urethral reconstruction by a single surgeon (J.W.M.) between 1978 and 2013. Patients were contacted, and after informed consent was obtained, they filled out a web-based validated questionnaire via RedCap[®] to assess their current urinary, sexual, and QOL status and to obtain current demographic information. The exclusion criteria were age < 18 years at the time of survey collection, lack of capacity

to participate, confirmed incarceration, non-English speaking only, lack of contact information, or deceased. We used phone numbers on record, email, official departmental letters, hand-written letters, and White Page search to contact potential participants. Patients' records were retrospectively reviewed for demographic and clinical characteristics including, age, trauma mechanism, type of urethroplasty, and any additional interventions before or after definitive repair.

Instruments to assess function and QOL

We used the urethral stricture surgery patient-reported outcome measurement (USS-PROM) for urinary function outcomes. This instrument, developed in 2011, is the first questionnaire specifically designed for patients with urethral stricture disease [10]. It comprises a lower urinary tract symptoms (LUTS) domain and a health-related QOL domain. The urinary symptoms domain is composed of a six-item bother questions that generates a total score that varies from 0 (asymptomatic) to 24 (most symptomatic), followed by a separate urinary symptom-specific QOL question (score of 0–10), and finally, Peeling's voiding picture, an illustration of a man voiding scored between 1 (best) and 4 (worst).

For assessing sexual health, we used the Sexual Health Inventory for Men (SHIM) for erectile function and Male Sexual Health Questionnaire-Ejaculatory Dysfunction (MSHQ-EJD) Short Form to specifically assess ejaculatory function. The SHIM is a five-item questionnaire that respondents rate different aspects of their erections from 1 to 5 and the score varies between 5 (worst function) to 25 (perfect erections); a score of 21 or lower is considered ED in the literature [11]. The MSHQ-EJD short form contains four questions and scores from 0 to 5. Three questions relate to the properties of ejaculation: frequency (from total absence to always present), strength of ejaculation (from total absence to normal strength), and the volume of ejaculation (from total absence to normal amount). The fourth question regards the patients' concern about their ejaculatory condition (ranging from the condition without any problems to deep concerns).

Quality of life was evaluated using EQ-5D-3L, a five-item validated questionnaire that assesses individual's global health on five different domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Respondents select the level of bother from most bothersome to the least on a three-level scale: no problems, some problems, and extreme problems. We dichotomized the responses to 'no problem' and 'any problem' for final analysis. The questionnaire also includes a visual analog scale for the respondents to rate their self-rated health on a 0–10 scale labeled as 'best imaginable health state' (10) and 'worst imaginable health state' (0).

Statistical analysis

Given the small sample size, all continuous variables are reported as median (interquartile range [IQR]), and descriptive analysis was used to summarize the cohort.

Results

After IRB approval, of 1186 patients who had urethral reconstruction at our institutional database, 68 pediatric patients with blunt urethral trauma were identified and attempted to be contacted by phone and mail. Fifteen patients ultimately were able to be contacted, and all agreed to participate in and completed the study survey. Clinical and demographic characteristics of the patient population are summarized in Table 1. Urethral injury was sustained at a median age of 17 (range 4–18) years, and urethral reconstruction was performed at the median age of 17 (range 5–20). Median age at follow-up was 19 (8–28) years. Of the eight posterior strictures, one had an endoscopic realignment at an outside institute and presented with a severe but not obliterated stricture. Another patient had two attempts at endoscopic management prior to referral, and the details of his injury are not available for review. The remainder of the six patients who were treated primarily at our institution had complete obliteration of the lumen managed with a suprapubic tube. Partial pubectomy was performed in two patients, no corporal splitting was required in any case, and one patient needed an abdominoperineal approach to achieve a tension-free anastomosis. Neurovascular bundle mobilization or reconstruction was not performed in any of the cases. All buccal mucosal grafts for anterior urethroplasty were performed as ventral onlays in a single stage. All posterior repairs were performed in a delayed fashion with a median interval of 4 (3–14) months, and none had a history of injury to the bladder neck. The median interval between the time of injury and urethroplasty in anterior strictures was 6 (4–108) months.

All patients recalled their experience with urethroplasty except for one who had his surgery at the age of 5 years. Regarding current general demographics, 12 (80%) patients were white, seven (47%) were married, 14 were employed or students, and two-thirds of patients reported an average household income of >\$50,000. When asked 'are you currently satisfied with the outcome of your operation?' 12 of 15 (80%) patients were 'very satisfied' and the remaining 3 of 15 (20%) were 'satisfied'. One patient reported one additional urethral procedure since initial urethroplasty but could not remember the nature of the procedure for an intervention-free survival rate of 93%. All patients reported voiding per urethra and without assistance of catheters or medications (including alpha-blockers or anticholinergics). Three patients had seen a urologist in the past year, two for an issue that was reportedly unrelated to urethral stricture and one for urinary frequency.

Regarding voiding function on the USS-PROM, the median LUTS bother domain (0 least, 24 worst) was 10 (range 7–16). Twelve of 15 (80%) patients reported that urinary symptoms do not interfere with daily life, two of 15 reported that symptoms interfere 'a little,' and one reported that symptoms interfere 'a lot.' The patient with the most bother reported urinary frequency, despite strong urine stream and lack of incontinence on other domains. Median force of stream assessed by Peeling's voiding strength picture (1 strongest stream, 4 weakest stream) was reported as 2 (IQR: 1.5–2). In particular, four patients reported stream strength of 1, eight reported 2, three reported 3, and no patients reported strength of 4. None reported urinary incontinence or any history of any anti-incontinence procedures. Comparison of voiding and sexual function

Table 1 Cohort of patients with blunt urethral injury who underwent urethroplasty.

Pt #	Age at injury (years)	Age at urethroplasty (years)	Stx location/length	Trauma mechanism	Prior intervention	Ancillary maneuvers	Urethroplasty technique	Follow-up (years)
1	4	5	PM – 2	PFUD – MVC	SPT	Partial pubectomy	EPA	16
2	7	16	Bulbar – 1.5	Straddle			EPA	8
3	13	16	Bulbar – 2.5	Straddle			VBMG – 4.5 cm	12
4	13	14	Bulbar – 2.6	Straddle			VBMG – 4 cm	14
5	16	16	PM – 2	PFUD – MVC	SPT	Partial pubectomy	EPA	23
6	16	17	Bulbar – 1.9	Straddle			EPA	13
7	17	17	Bulbar – 3	Straddle	Dilation		EPA	23
8	17	18	PM – 2.5	PFUD – Fall	DVIU, dilation		EPA	19
9	17	17	PM – 5	PFUD – MVC	SPT		EPA	20
10	18	18	PM	PFUD	SPT		EPA	19
11	18	19	PM – 1.2	PFUD – Fall	SPT		EPA	13
12	18	18	PM – 2	PFUD – MVC	Realignment, dilation		EPA	21
13	18	20	Bulbar – 1	Straddle	DVIU, dilation		EPA	20
14	18	19	PM – 1	PFUD – MVC	SPT		EPA	28
15	18	18	Bulbar – 5.5	Straddle	Dilation		VBMG – 7 cm	22

DVIU, direct vision internal urethrotomy; MVC, motor vehicle collision; PFUD, pelvic fracture urethral disruption; PM, prostate membranous; SPT, suprapubic tube; Stx, stricture; VBMG, ventral onlay buccal mucosal graft.

Urethral stricture length is reported in centimeters.

Table 2 Clinical characteristics and voiding/sexual metrics in patients after anterior vs posterior urethroplasty.

Variable, median (IQR)	Anterior (<i>n</i> = 7)	Posterior (<i>n</i> = 8)
Age at surgery (years)	17 (16–17.5)	18 (16.75–18.25)
Age at injury (years)	17 (15–17.5)	17 (16.25–17.75)
SHIM	24 (23–24)	23.5 (21.75–24)
USS-PROM	9 (7.5–11)	10 (8–13.25)
MSHQ-EJD	13 (10.5–14.5)	14 (13.5–14.5)
Overall QOL (0–10)	8 (7–8)	8 (8–9.25)
Follow-up (years)	14 (12.5–21)	19.5 (18.25–21.5)

IQR, interquartile range; MSHQ-EJD, Male Sexual Health Questionnaire-ejaculatory dysfunction; QOL, quality of life; SHIM, Sexual Health Inventory for Men; USS-PROM, urethral stricture surgery patient-reported outcome measure.

metrics between patients with anterior vs posterior urethroplasty is presented in [Table 2](#).

Regarding erectile function, the median SHIM score was 24 (IQR: 22.5–24). There was one patient with a SHIM score of less than 20, who reported not being sexually active, despite perfect erectile function (SHIM score was 10 in this patient). Otherwise, one patient reported a score of 20 and the remainder scored 21 or more. No one reported medical or surgical intervention for ED. On four-item MSHQ-EJD short form, there are three questions for orgasmic function (0 worst function, 15 normal function) and one question assessing bother. The median ejaculatory function score was 14 (IQR: 13–14.75), and 12 of 15 patients (80%) reported ‘no problem at all’ or ‘not at all bothered’ by their ejaculatory function. Six patients reported having fathered a child and none reported infertility. Two patients reported history of pain that they attributed to their urethroplasty (one patient with moderate pain in the scrotum and perineum and one with mild pain in perineum). None reported pain interfering with daily activity or compromising function. Three patients reported penile curvature after urethroplasty which has persisted to date, all of whom reported a severity of <30° curvature and none have required treatments. The results of the self-assessed QOL in five different domains of EQ-5D-3L health questionnaire demonstrated overall median QOL was 8 (IQR: 7.5–8).

Discussion

The results of this study provide a rare glimpse at the urogenital function of children many years after undergoing trauma-related urethral reconstruction. It verifies that a relatively normal and functional life regarding sexual and voiding function can be expected, and patients are overall satisfied with their operation with no major residual morbidity. The patients in our cohort reported a similar QOL score on EQ-5D-3L compared with healthy adults (8 IQR: 7.5–8 vs 9 IQR: 7.5–9.5, respectively), and no patients reported ED (SHIM score > 21) [12].

A lack of the need for repeated intervention is a commonly considered successful outcome after urethroplasty, and only one patient (6%) in this cohort reported a secondary endoscopic intervention. The data within this study are not equipped to conclusively report the success rate of urethroplasty in children, given the that they contain a relatively small proportion of the overall cohort.

Based on a previous publication by one of the study authors on a similar cohort and other reports, the short-term urethroplasty success rate after anterior and posterior urethroplasty appears to be about 90% [13–16]. It should be noted that these studies report on a highly selected group of patients, and a large number of patients were not accessible for evaluation. However, based on the current cohort, it appears that urethroplasty outcomes are durable, and if the patients have not required an intervention in the first few years of follow-up, the chance of them needing an additional intervention is low. This point could have important implications for long-term surveillance protocols.

Erectile dysfunction is a dreaded long-term complication after pelvic fracture, given severe soft tissue and vascular injury that can ensue [17,18]. The reported rate of de novo ED after pelvic fracture is 34% (25%–45%) in the literature, and urethroplasty has been reported to harbor an additional 3% risk in the adult population [19]. Our results, however, show that in long-term follow-up, patients did not report ED. In a recent publication on urethroplasty after urethral trauma from Belgium, Waterloos et al. reported ED in two of five patients who had straddle injury and two of six of the ones after pelvic fracture [8]. In their cohort, erectile function is assessed using a single question from a validated questionnaire on post-urethroplasty questionnaire. This questionnaire specifically excluded pelvic fracture population at the time of validation, and this high ED rate thus needs further verification [20]. Another report on the rate of ED after pediatric urethroplasty is from Trachta et al. [21] from Czech Republic in 2016. They reported 4.5-year follow-up of eight patients who had urethral trauma and underwent anterior (4) and posterior (4) urethroplasty at the mean age of 12.3 years (range 5–17). Using International Index of Erectile Function-5 questionnaire, one patient reported mild ED and two reported moderate ED due to penile shortening. Of note in their series, 75% of patients required a secondary intervention after primary urethroplasty, two of the urethral strictures were >5 cm in length, and significant mobilization and partial pubectomy was performed to achieve a tension-free anastomosis contributing to penile shortening [21]. Our survey did not include a specific question about penile length. However, in the free comment section, one patient reported losing penile length after surgery. He had a straddle injury resulting in 3-cm proximal bulbar stricture that was repaired using excision/primary anastomosis at the age of

17 years. He scored 24 on SHIM score and has fathered children in adulthood and reported no bother from sexual dysfunction. In anterior urethroplasty literature in the adult population, ED has been a matter of debate since Mundy [22] reported de novo permanent ED in 5% of patients after anterior anastomotic urethroplasty and 0.9% after augmented urethroplasty with a graft in 1993. The topic has been controversial, with several contradictory reports afterward, and overall, it is believed that anterior urethroplasty does not have a deleterious effect on erectile function [23]. Our results appear to support this notion in pediatric population as well.

Given the relative novelty of urethroplasty-specific PROMs, except for Waterloo et al. [8], none of the published reports on pediatric urethroplasty have used validated questionnaires to assess voiding function. From a total of 18 patients in their cohort, four had a history of valves and stricture was likely a result of endoscopic valve ablation. Of note, three of these four had a vesicostomy that was closed at the time of urethroplasty at a young age. Interestingly, all those patients had excellent USS-PROM scores. The authors of this study report results of specific questions about postvoid dribbling (25% present) and urinary urgency (50% with any degree of urgency with one patient with incontinence after pelvic fracture). In line with the experience of the current study authors, all the patients were 'satisfied' or 'very satisfied' with surgery and reported that they would undergo surgery again [8]. This study suggests that these complex patients are best served in a tertiary referral center with a urethral surgeon who is familiar with wide range of reconstructive techniques and the authors of this study certainly share this opinion.

Singla et al. [5] reported their experience with 28 pediatric patients (mean age 12 years) who underwent posterior urethroplasty after pelvic fracture with mean 36 months of follow-up. They reported two patients who had radiographic evidence of bladder neck incompetence on preoperative imaging. No attempts at bladder neck reconstruction were made at the time of urethroplasty, and one of them developed stress urinary incontinence that resolved with time. Trachta et al. used a non-validated questionnaire to assess voiding function in eight boys with posterior or bulbar strictures at 12 years (6 month–23 years) through telephonic follow-up. They reported three patients with transient stress urinary incontinence that resolved with no intervention. None of the patients reported ongoing LUTS, although they remembered such symptoms early after surgery [21]. Interestingly, the youngest patient of our cohort, who was run over by a truck at the age of 4 years, had several years of frequency and urinary incontinence during school years. He underwent a complex abdominoperineal repair at 5 years of age with partial pubectomy but no corporal splitting. Fortunately, at the age of 22 years he has completely recovered with a strong urine stream, USS-PROM bother score of 7, no urinary incontinence, and SHIM score of 23. The overall median bother score on the USS-PROM in our cohort was 10. Herein, Jackson et al. [24], in the original article using the USS-PROM in adults, reported a bother score of 4 after urethroplasty compared with a score of 12 before urethroplasty. Lucas et al. [25] more recently reported improved USS-PROM score of 13.21 to 3.36 in 35 prospectively enrolled adults with 8-month follow-up in

Brazil. Preoperative PROM data is unfortunately not available for comparison, and the long interval between survey response and the injury might affect the participants' scores.

The strengths of this study include using validated questionnaires to assess health metrics related to urethral reconstruction and QOL. This is also the longest follow-up reported in the literature on outcomes of urethroplasty after trauma-related urethral injury. This study does have limitations, particularly given the small number of patients included in our final analysis. We identified 63 patients since 1978 who met our inclusion criteria, and despite our best efforts, only 15 of them were available and completed our surveys. This was not without significant effort to contact individuals; participants were attempted to be contacted by phone and in writing using their most recent available telephone number and mailing address in our medical records, which was often quite outdated. Participants were additionally searched for using the White Pages and contacted by both phone and mailing with any matches that were found. Although the numbers are low, given the long intervening time frame from surgery to follow-up, the fact that these individuals were children living with their parents at the time of surgery, the rarity of the condition, and the fact that many of these patients were referred from out-of-state, it is understandable that it was difficult to contact these patients. In addition, urethral reconstruction had undergone significant changes during the span of practice and follow-up of these patients (over 35 years). Although the basic surgical principals have remained constant, our follow-up protocol and methods of assessing symptoms have changed. Surveillance cystoscopy was not performed on any of these patients, which is the routine current practice in adults within the first year after repair, and therefore, these patients might have anatomic recurrence of stricture; even if this was the case, however, none of them were symptomatic enough to require an intervention. The authors' current practice is also now to administer disease-specific PROMs to every patient after urethroplasty. In addition, only four of our patients were prepubertal, and one might argue that our sample represent an adult cohort. This is a valid point from surgical technique standpoint; however, most young adult patients have not undergone the sexual maturity of a true adult patient with urethral stricture. These results are comforting that, despite their injuries, they are not dramatically impacted in the long run with urethroplasty and can aid in counseling.

Ultimately, this is the first study to report such long-term follow-up of this patient population and highlights the need for prospective data collection and tracking of pediatric patients undergoing reconstructive procedures that may impact future function in adulthood. It also highlights the need for close collaboration between pediatric urologist and adult reconstructive urologist for a successful transition and long-term follow-up.

Conclusion

Urethroplasty after blunt anterior and posterior urethral injury in children is associated with high surgical success rates, similar to adult population. Fortunately, despite

possible transient voiding dysfunction at early post-operative years, these children seem to be left with minimal voiding and sexual function morbidity in adulthood. These results highlight the importance of prospective tracking of pediatric patients after urologic reconstruction to further elucidate the true long-term functional outcome.

Author statements

Ethical approval

The research protocol was approved by the University of California, San Francisco, IRB board, and informed consent was obtained from all participants in compliance with policies in place.

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Competing interests

None to report.

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