

A Study of the Outcome of Anastomotic Urethroplasty as a Delayed Management of Traumatic Posterior Urethral Injury

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ABSTRACT

Background: Pelvic fracture-associated posterior urethral injuries are complex reconstructive problems that require delayed surgical repair. Anastomotic urethroplasty remains the gold standard, although its outcomes are multifactorial. This study was aimed at assessing the surgical outcomes and the predictors of failure after delayed anastomotic urethroplasty for post-traumatic posterior urethral strictures. **Materials & Methods:** This observational study was conducted at Dhaka Medical College Hospital from March 2017 to March 2018, including 50 adult male patients who had complete post-traumatic posterior urethral obliteration and underwent delayed anastomotic urethroplasty. A transperineal approach with spatulated mucosa-to-mucosa anastomosis was done for all cases, with the addition of inferior pubectomy when the urethral gap exceeded 3 cm. Surgical success was defined as asymptomatic voiding with adequate flow and no radiological narrowing. Patients were followed up after 3, 6, and 12 months with uroflowmetry and urethrography. Data were entered and analyzed using SPSS version 26. **Results:** The mean patient age was 32.8±13.9 years, with road traffic accidents accounting for 74% of injuries. Mean stricture length was 2.7±0.9 cm, and mean time to repair was 12.4±3.1 weeks. Surgical success was achieved in 86% of patients, with overall complications occurring in 36%. Stricture length >3 cm (adjusted OR 8.74, p=0.005) and performance of inferior pubectomy (adjusted OR 3.62, p=0.048) were independent predictors of surgical failure. Mean postoperative Qmax was significantly higher in successful repairs compared to failures (20.4±3.9 vs 12.8±2.5 ml/s, p<0.001). **Conclusion:** Delayed anastomotic urethroplasty provides good

results in post-traumatic posterior urethral strictures, with a success rate of 86%. The failure rate is higher in longer strictures and in cases requiring inferior pubectomy. Proper patient selection and planning are essential.

Keywords: Posterior urethral stricture, Anastomotic urethroplasty, Inferior pubectomy.

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INTRODUCTION

Injuries to the posterior urethra are serious complications of pelvic injuries. The estimated incidence is approximately 5-10% of pelvic fractures, or 0.6-1 per 100,000 population annually [1]. PUI predominantly occurs in young males following high-energy trauma, arising commonly from road traffic accidents, falls from height, and industrial crush injuries [2]. The mechanism typically involves disruption at the bulb membranous junction due to shearing forces when the fixed membranous urethra is displaced relative to the mobile bulbar urethra during pelvic ring disruption [3]. The resultant complete urethral distraction defect leads to stricture formation with significant morbidity if left untreated, including urinary retention, recurrent infections, renal impairment, and devastating impact on quality of life [4]. The management of posterior urethral injuries has changed significantly in recent decades. Whereas the approach of immediate primary realignment used to be recommended, contemporary data indicate that the results of delayed repair after a period of initial suprapubic diversion are better in terms of lower incontinence and erectile dysfunction rates [5]. Today,

consensus exists for the initial use of suprapubic cystostomy urinary diversion, usually followed by delayed definitive reconstructive surgery, after resolution of pelvic hematoma and fracture stabilization, typically 3-6 months after injury [6]. This staged approach permits resolution of inflammation, accurate estimation of stricture characteristics, and optimization of conditions for surgical reconstruction [7]. Anastomotic urethroplasty via the perineal approach is considered the gold standard treatment for post-traumatic posterior urethral strictures. Success rates have been reported from 83-97% in specialized centers [8,9]. The surgical principle is the complete excision of fibrotic tissue and the creation of a tension-free, spatulated mucosa-to-mucosa anastomosis over an indwelling catheter [10]. In longer defects, ancillary maneuvers include bulbar urethral mobilization, crural separation, and inferior pubectomy to bridge the urethral gap without tension [11]. Notwithstanding the high overall success rates, factors such as stricture length, prior urethral manipulation, and complexity of reconstruction have been associated with higher failure and complication rates [12]. Given the complexity of the anatomy in posterior

urethral reconstruction and recognized complications that include resticture, erectile dysfunction, urinary incontinence, and urethrocutaneous fistula, comprehensive outcome analysis is required to help devise the best surgical strategies and patient counseling [13]. Stricture length has emerged as a critical determinant, since the management of longer defects mandates extended dissection and ancillary procedures, resulting in increased technical difficulty and risk for complications [14]. The contribution of surgical approach complexity, such as the requirement for inferior pubectomy when bridging longer gaps, toward functional outcomes has not been fully realized, particularly in settings from developing countries where injury patterns and patient demographics may vary from those seen in Western cohorts [15]. This study evaluates the results of delayed anastomotic urethroplasty for completely obliterated post-traumatic posterior urethral strictures, looking into success rates, complication profiles, and identifying independent predictors of surgical failure.

METHODS & MATERIALS

This observational study was carried out in the Department of Urology, Dhaka Medical

College Hospital, from March 14, 2017, to March 13, 2018. 50 consecutively selected adult male patients with post-traumatic, completely obliterated posterior urethral stricture who underwent delayed anastomotic urethroplasty were included in the study. Clinical notes and operative sheets were used to document the following: the mechanism of injury, age, stricture length (in centimeters), time from injury to urethroplasty (in weeks), and operative approach (simple perineal versus perineal urethroplasty with inferior pubectomy). A transperineal approach was used for all procedures: an inverted Y perineal incision was used to mobilize the bulbar urethra, the fibrotic segment was removed, and a tension-free, spatulated mucosa-to-mucosa anastomosis was constructed over a 16 Fr silicone catheter. When the urethral gap was more than about 3 cm, an inferior pubectomy was carried out to achieve a

tension-free repair, and suprapubic diversion was maintained until a satisfactory pericatheter urethrogram was obtained. Surgical success was defined as asymptomatic voiding with adequate urinary flow and no radiological narrowing; complications included wound infection, restricture, erectile dysfunction, urethrocutaneous fistula, and urinary incontinence. Patients were monitored at 3, 6, and 12 months with uroflowmetry, urethrography, and symptom review when necessary. Data were entered and analyzed using SPSS version 26. Descriptive statistics were generated for all variables, chi-square tests were used to evaluate associations between categorical predictors and outcome, independent samples t tests were used for continuous variables like Qmax, and multivariable logistic regression was used to find independent predictors of surgical failure. A p-value < 0.05 was

considered statistically significant.

RESULTS

Table I represents the demographic and clinical baseline characteristics of 50 adult male patients who enrolled in the study. The mean age was 32.8±13.9 years, with over half (52%) of the patients aged between 18 and 30 years. Road traffic accidents were the most common mechanism of injury in 74%, followed by falls from height in 18% and crush injuries in 8%. Mean stricture length was 2.7±0.9 cm, with the majority (44%) having strictures measuring 2-3 cm, while 32% had strictures exceeding 3 cm. The mean interval from initial injury to definitive repair was 12.4±3.1 weeks. A simple perineal approach was used in 76% cases, while 24% needed a perineal approach with inferior pubectomy in order to achieve tension-free anastomosis for longer urethral gaps.

Table I
Baseline and Clinical Characteristics of Study Participants (n = 50).

Variable	Category / Values	(n), (%) / Mean ± SD
Age (years) (Mean ± SD)	-	32.8 ± 13.9
Age group (years)	18-30	26 (52%)
	31-45	14 (28%)
	>45	10 (20%)
Mechanism of injury	Road traffic accident	37 (74%)
	Fall from height	9 (18%)
	Crush injury	4 (8%)
Stricture length (cm) (Mean ± SD)	-	2.7 ± 0.9
	<2 cm	12 (24%)
	2-3 cm	22 (44%)
	>3 cm	16 (32%)
Time from injury to repair (weeks) (Mean ± SD)	-	12.4 ± 3.1
Surgical approach	Simple perineal	38 (76%)
	Perineal + inferior pubectomy	12 (24%)

Table II summarizes the surgical outcomes and complications following delayed anastomotic urethroplasty in the study cohort. A success rate of 86% was observed, with only 14% having surgical failure that required further intervention. The

complication profile revealed the most frequent adverse outcome to be urinary incontinence at 12%, followed by erectile dysfunction at 8%, urethrocutaneous fistula at 8%, wound infection at 6%, and restricture at 6%. The overall complication

rate was 36%, though many complications were minor and managed conservatively. Of note, the mean postoperative Qmax improved substantially to 19.3±4.6 ml/s.

Table II
Postoperative Outcomes Following Delayed Anastomotic Urethroplasty.

Outcome	(n)	(%)
Success	43	86%
Failure	7	14%
Wound infection	3	6%
Restricture	3	6%
Erectile dysfunction	4	8%
Urethrocutaneous fistula	4	8%
Urinary incontinence	6	12%
Overall complications (any)	18	36%
Postoperative Qmax (ml/s) (Mean ± SD)		19.3 ± 4.6

Table III depicts a very significant relation between stricture length and failure rate of surgery ($\chi^2 = 11.57$; p = 0.003). Patients with a stricture less than 2 cm had all 12 cases

(100%) successful, with no failures. In patients with stricture lengths measuring 2-3 cm, failure was very minimal at 4.5% (1 in 22). However, for those patients with

stricture lengths larger than 3 cm, the rate of failure is markedly increased to 37.5% (6 in 16).

Tables III
Association Between Stricture Length and Surgical Failure (χ^2 Test).

Stricture Length	Success (n = 43)	Failure (n = 7)
<2 cm	12	0
2-3 cm	21	1
>3 cm	10	6
Total	43	7

$\chi^2 = 11.57; p = 0.003$

Table IV demonstrates that there is a statistically significant relationship between the complexity of the surgical approach and the appearance of complications: $\chi^2=5.61$;

$p=0.018$. Among the cases of simple perineal urethroplasty, complications arose among 10 patients, whereas in patients with the more complex perineal approach with

inferior pubectomy, this rate was much higher (8 of 12 patients).

Table IV
Association Between Type of Surgery and Complication Rate.

Surgical Approach	Complications Present	No Complications
Simple perineal	10	28
Perineal + inferior pubectomy	8	4
Total	18	32

$\chi^2 = 5.61; p = 0.018$

Table V denotes a very significant difference in postoperative maximum flow rates when comparing successful versus failed surgical repairs: $t = 5.24; p < 0.001$. Those patients

with successful urethroplasty had a mean Qmax of 20.4 ± 3.9 ml/s, suggesting restoration of near-normal voiding function. Conversely, the mean Qmax for those with

surgical failure was a significantly lower 12.8 ± 2.5 ml/s.

Table V
Comparison of Qmax Between Successful and Failed Repairs.

Outcome	Mean Qmax (ml/s)	SD
Success (n = 43)	20.4	3.9
Failure (n = 7)	12.8	2.5

$t = 5.24; p < 0.001$

Multivariable logistic regression analysis in Table 6 shows independent predictors of failure of surgery after adjustment for potential confounders. Stricture length of more than 3 cm was the strongest independent predictor of failure, with an 8.74-fold increased odds of failure of

surgery compared with strictures of less than 3 cm in length (95% confidence interval 1.92-39.8; $p = 0.005$). The performance of inferior pubectomy further independently predicted an increased risk of failure, with an adjusted odds ratio of 3.62 (95% confidence interval 1.01-12.9; $p =$

0.048). In contrast, advanced age (>45 years) and prolonged time to surgery (>16 weeks) were not independently associated with failure after adjusting for other variables (Table VI).

Table VI
Multivariate Logistic Regression Predicting Surgical Failure.

Predictor	Adjusted OR	95% CI	p-value
Stricture length >3 cm	8.74	1.92-39.8	0.005
Inferior pubectomy performed	3.62	1.01-12.9	0.048
Age >45 years	1.28	0.22-7.34	0.78
Time to surgery (>16 weeks)	1.54	0.39-6.05	0.53

DISCUSSION

This study demonstrates that delayed anastomotic urethroplasty yields favorable outcomes for post-traumatic posterior urethral strictures in our studies, with an 86% success rate comparable to the success rates of 83-97% reported by Koraitim et al. [16]. Our findings are in keeping with contemporary evidence that anastomotic urethroplasty represents the gold standard for complete posterior urethral distraction defects after pelvic trauma [17]. The mean age of 32.8 years reflects a typical

demographic of young, working-age males sustaining high-energy pelvic trauma, consistent with Horiguchi et al. who demonstrated a peak in the third and fourth decades of life [18]. Injuries due to road traffic accidents accounted for 74% of cases, slightly higher than the 50-60% figure common in many developed settings where injury mechanisms are more heterogeneous [19]. This likely reflects the high relative burden of road traffic injury and occupational risk in Bangladesh, emphasizing a need for the implementation

of targeted injury prevention strategies. The mean stricture length of 2.7 cm, slightly longer than the 1.6-2.0 cm reported by Mehmood et al., suggests more severe initial trauma or delayed presentation, although still amenable to single-stage perineal reconstruction in most cases [20]. Stricture length >3 cm emerged as the strongest independent predictor of failure (OR 8.74, $p = 0.005$), in keeping with Alberca et al. that longer defects present greater technical and biological challenges [21]. Such cases often require more extensive urethral

mobilization and ancillary maneuvers, including corporeal separation and inferior pubectomy, to achieve a tension-free anastomosis [22]. Success rates in prior series are reported to decline from >95% for defects <2 cm to 75-85% for defects >3 cm [23]. Our analysis demonstrates that inferior pubectomy was independently associated with higher failure risk (OR 3.62, $p = 0.048$) should be interpreted as a marker of reconstructive complexity rather than an inherently deleterious maneuver. Inferior pubectomy is typically reserved for the most challenging defects; multicenter data suggest that when performed with meticulous technique, pubectomy-based approaches can still yield excellent long-term outcomes despite higher early complication rates [24,25]. The overall complication rate in our cohort was 36%, but the overwhelming majority of these were complications manageable with conservative or minimally invasive measures. Urinary incontinence occurred in 12% of patients, within the reported range of 5-21% [26]. The majority of cases appeared to be mild and responded to behavioral and pelvic floor interventions, and none required sphincter prosthesis. Erectile dysfunction was observed in 8% of patients, lower than many series reporting 30-75% [27]. This comparatively favorable rate likely reflects a younger population, less severe associated pelvic injuries, or underreporting due to sociocultural reluctance to disclose sexual issues. The use of validated erectile function instruments would likely provide a more accurate estimate. Functional outcomes were promising, with a mean postoperative Qmax of 19.3 ml/s. The notable difference between the successful (20.4 ml/s) and failed repairs (12.8 ml/s, $p < 0.001$) further argues for uroflowmetry as a functional, objective outcome measure. Previous literature suggests that Qmax > 15 ml/s, with a normal flow curve, strongly predicts anatomical success and that large decrements in flow correlate with stricture [28]. However, flow studies should supplement, not supplant, imaging or endoscopy, as early or focally narrowed strictures may pass undetected by uroflowmetry alone [29]. The lack of significant associations between failure and either age >45 years or increased time to urethroplasty is consistent with Hofer et al. and Davenport et al. that, within reasonable limits, other anatomical variables such as stricture length and degree of pelvic distortion are more important predictors of outcome than age or exact timing of repair [30,31]. The 14% failure rate, though acceptable and comparable to published data, illustrates continued refinement in technique and case selection. Failures often reflect residual scar, anastomotic tension, or progressive fibrosis, all of which emphasize

complete excision of diseased tissue and strict adherence to tension-free principles [32]. Most postoperative strictures after a well-performed anastomotic urethroplasty respond favorably to a single direct vision internal urethrotomy, whereas a minority require redo anastomotic urethroplasty, which still can achieve high success in experienced hands [33,34].

LIMITATIONS

The limitations of this study include its single-center design, with a relatively modest sample size of 50 patients, which may limit the generalizability of the findings to broader populations. A maximum follow-up duration of 12 months may be inadequate for the detection of late stricture recurrence, as some series report continued failures beyond one year post-operatively.

CONCLUSION

Delayed anastomotic urethroplasty is an effective treatment modality for post-traumatic posterior urethral strictures, with an 86% success rate in our study. However, stricture length greater than 3 cm and need for inferior pubectomy independently predict surgical failure, emphasizing meticulous preoperative assessment and surgical planning. While overall results are encouraging, a complication rate of 36% highlights the importance of thorough counseling regarding potential adverse effects, including incontinence, erectile dysfunction, and stricture formation. Continued refinement in surgical technique, patient selection, and postoperative surveillance protocols will further improve results in this challenging patient population.

RECOMMENDATIONS

Future studies will need to be prospective, multicenter trials with larger sample sizes and longer follow-up to fully delineate the long-term durability of repairs and late complication rates. Furthermore, comparative studies examining different surgical techniques, such as vessel-sparing approaches and variations in ancillary maneuver utilization, may highlight strategies to minimize complications yet maintain success rates.

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