Original Article

Comparison Between the Bulboprostatic Gap and the Index of Elastic Lengthening (Gapometry) in Predicting Surgical Approach and Surgical Outcome in the Repair of Posterior Urethral Defects

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Objective: Urethral stricture longer than 2 cm usually requires urethroplasty. It can be performed by various approaches and different type of procedures. It can be achieved by a simple excision and primary anastomosis in a short bulbo-prostatic gap (usually <2.5 cm) or a more complex perineal or transpubic procedure when a long bulbo-prostatic gap is encountered. Few studies have addressed the pre-operative factor that help predicted the type of procedure performed.

Materials and Methods: The authors retrospectively reviewed the medical records and radiographic imaging of 18 urethral stricture patients who underwent urethroplasty and compare the difference of bulbous urethra length and gap/bulbous urethra index between two groups; a group of patients who-underwent simple excision and primary anastomosis and a group of patients who underwent complex procedure which graft or additional procedure is required.

Results: The mean urethral stricture length was not significantly different between two groups (1.40 cm vs. 1.97 cm; $p = 0.221$). We observed the difference of bulbous urethra length between two groups (6.95 cm vs. 5.50 cm; $p = 0.029$). However, the calculated gap/bulbous urethra index was not significantly different (0.20 ± 0.13 vs. 0.37 ± 0.21; $p = 0.055$).

Conclusion: The surgical approach in bulbous and membranous urethral stricture can be predicted by the length of bulbous urethra. The short urethral gap does not always indicate the simple excision and primary anastomosis approach.

Keywords: Urethral stricture, Urethroplasty

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Urethral stricture disease is one of the most challenging areas of urology due to the difficult anatomical approach and patient's quality of life can be severely affected if not managed properly. Successful outcomes are the result of multiple factors namely; timing of the repair, scar tissue excision, fine-tissue handling, tension-free anastomosis and the appropriate surgical procedure[1]. The appropriate surgical procedure can be determined by thorough information of history, endoscopic findings and radiographic imaging. The combination of retrograde urethrography (RUG) and voiding cystourethrography (VCUG) are the gold standard of radiographic imaging in urethral stricture. Three basic important features to identify are the location, the length of bulbo-prostatic gap and the coexistent urethral pathology[2,3]. From current literature, strictures longer than 2 cm usually require urethroplasty[4,5]. Urethroplasty can be achieved by a simple excision and primary anastomosis in a short bulbo-prostatic gap (usually <2.5 cm). On the other hand, more complex procedures such as perineal or transpubic procedure may require when a long bulbo-prostatic gap is encountered[1,4]. To achieved the tension-free anastomosis, the bulbous urethra need to be mobilized. This raised the question of whether the length of bulbous urethra from pre-operative imaging influences the surgical approach decision intra-operatively.

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Materials and Methods

The present study was conducted in the tertiary care center in Thailand (Ramathibodi Hospital, Mahidol University, Bangkok). A retrospective review of medical records and radiographic imaging in patients whom diagnosed with urethral stricture was done between January 2007 and August 2018. The inclusion criteria consisted of all patients

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above 18 years old, the adequate imaging quality of urethrogram and the patients who underwent urethroplasty at bulbous or membranous urethra for the first time. We excluded the patients who were diagnosed with penile urethral stricture, multiple locations of stricture and the patients who had failed prior urethroplasty.

There are 49 patients eligible to the criteria. After exclusion, a total of 18 patients were enrolled in this study. The enrolled patients were categorized as "The simple group" defined as patients who underwent the simple excision and primary anastomosis (12 patients) and "The complex group" defined as patients who underwent complex procedure which graft or additional procedure is required (6 patients). In the complex group, four patients had underwent the end-to-end urethroplasty with inferior pubectomy; two patients underwent the prepuce flap trans positional urethroplasty. Outcome of surgery was defined at 12 week post-operatively as successful and unsuccessful outcome. Unsuccessful outcome was determined by symptoms of voiding difficulty along with confirmation by radiologic imaging or endoscopic examination of recurrence stricture.

Pre-operative RGU/VCUG from picture archiving and communication system (PACS) was used to measure the length of defect and the length of bulbous urethra. The length of defect was measured between the narrowing points of the urethral caliber or the blind end of the urethra. The length of bulbous urethra was measured from a point where the urethra changes to an S-shape to a point where the urethra form a symmetrical cone at the level of the pelvic floor and focused as the primary variable of the present study[2] (Figure 1). The authors used the malleable strip to measure the bulbous urethra because of its curvature. The length of the urethral gap divided by the length of bulbous urethra was then calculated and called the "index of elastic lengthening" or gap/bulbous urethral index (Gapometry index) and focused as the secondary variable[6-8].

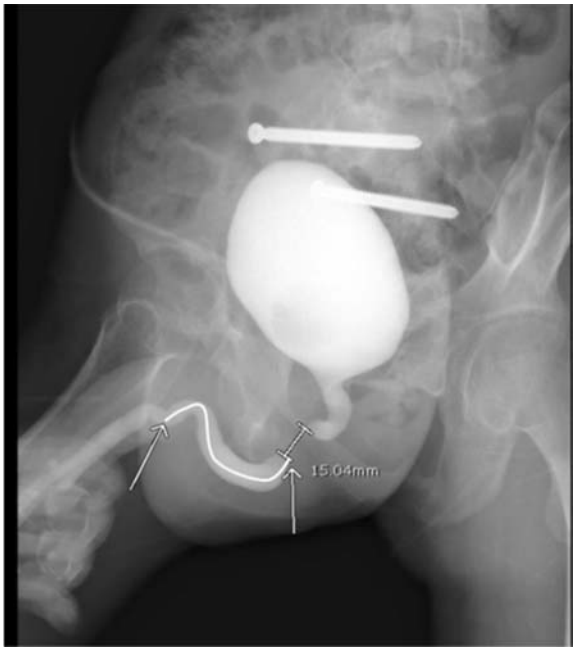

Figure. 1 RGU/VCUG in a 22-year-old male with urethral stricture gap length 15 mm. The length of bulbous urethra was measured between the arrow with malleable strip (Source: PACS, Ramathibodi hospital, Mahidol university).

Statistical analysis was performed Stata program version 14.1 (StataCorp, Texas) with the two-tailed t-test $p<0.05$ was considered statistically significant.

Results

There was a total of 18 patients included in our study. No statistically significant differences appeared at baseline characteristics including age (41.42±17.00 and 35.67±14.43; $p = 0.489$) or location of the stricture part between two groups (percentage of bulbous/membranous urethra) (Table 1).

The mean stricture length based on pre-operative urethrogram was 1.40 cm (range 0.3 to 3.0 cm) in the simple group and 1.97 cm (range 1.0 to 4.0 cm) in the complex group. No statistical significance was found between the two groups ($p = 0.221$). However, the mean bulbous urethra length was different between the two groups which were 6.95 cm (range 5.5 to 9 cm) in the simple group and 5.50 cm (range 4.5 to 6.0 cm) in the complex group ($p = 0.029$). When calculated the gapometry index by using the stricture length divided by the bulbous urethra length, the mean gapometry index in the complex group was higher than the simple group but not statistically significant (simple group = 0.20±0.13, complex group = 0.37±0.21; $p = 0.055$) (Table 2).

The catheter duration between the two groups was not of statistically significant difference (Table 2). Overall, 10 of 18 patients (55.5%) had successful outcomes at 12 weeks postoperatively.

Discussion

From the guideline recommendation, the indication for urethroplasty was based on the stricture length because of the higher success rate of urethroplasty in long stricture compared to direct visual internal urethrotomy (DVIU) or dilatation[5]. When the decision to perform urethroplasty was made, the surgeon had a variety of different approaches and methods. It can be performed by a simple excision and primary anastomosis or a more complex elaborated perineal approach such as using grafts, or urethral rerouting by inferior pubectomy[5,9,10]. No standard cut point or recommendation was chosen between these procedures. It was previously perceived that the final decision is based on the intra-operative findings and cannot be predicted pre-operatively[4,11,12].

However, growing evidence from various studies had been proposed in order to predict the surgical approach. Da Silva et al studied in 25 cadaveric urethra and concluded

Table 1. Patient characteristics

Variables	Simple (n = 12)	Complex (n = 6)	*p*-value
Total number, n (%)	12 (66.67)	6 (33.33)	-
Age (year)	41.42±17.00	35.67±14.43	0.489
Location of Stricture, n (%)			
Bulbous urethra	7 (58.33)	4 (66.67)	0.732
Membranous urethra	5 (41.67)	2 (33.33)	

The *p*-value denote statistical significance ($p<0.05$)
* Comparison of groups by the Independent t-test.

Table 2. Clinical data

Variables	Simple (n = 12)	Complex (n = 6)	*p*-value
Stricture length (cm)	1.40±0.90	1.97±0.88	0.221
Bulbous urethra length (cm)	6.95±1.37	5.50±0.77	0.029*
Gapometry index (gap/bulbous urethra length)	0.20±0.13	0.37±0.21	0.055
Catheter duration	5.67±1.15	5.67±1.51	>0.999
Outcome**, n (%)			
Successful	6 (50.00)	4 (66.67)	
Unsuccessful	6 (50.00)	2 (33.33)	

The *p*-value denote statistical significance ($p<0.05$)
* Comparison of groups by the Independent t-test.
** Unsuccessful outcome was determined by symptoms of voiding difficulty along with confirmation by radiologic imaging or endoscopic examination of recurrence stricture at 12 weeks post-operatively.

that a maximal gap-to-normal urethra ratio should not exceed the 1: 4[13]. Morey found that a stretched penile length more than 15 cm is a good indicator for anastomosis repair of bulbar strictures[7]. Koraitim proposed the index of elastic lengthening and reported that urethral gaps shorter than one third of the length of bulbous urethra were usually corrected by a simple perineal operation[6]. Because one key point for the good outcome in urethroplasty is the tension-free anastomosis[1], the authors agree that the bulbous urethral length that varies in different patients may have the impact on the type of operation performed apart from considering only the stricture length.

According to its findings, the present study the stricture length and location between the two groups were not different for patients without a history of prior urethroplasty. Nonetheless, the authors observed the differences between the bulbous urethra which was longer in the simple group than the complex group. These help the surgeon in deciding which is the proper operation. The longer the bulbous urethra, the more straightforward simple excision and primary anastomosis can be achieved without the need of grafts or extensive mobilization. Because of the technical challenge to perform the elaborated perineal approach surgery, AUA guideline recommended patient referral to the center of expertise[5]. If these findings help suggest the tendency to perform the complex surgery, the patients should be referred to the center of expertise for a higher rate of successful treatment.

Limitations

Still, the authors cannot determine the cut point of bulbous urethral length to differentiate the two groups due to the limited sample size. The authors also observed the non-statistical different of gapometry index (0.20±0.13 vs. 0.37±0.21; $p = 0.055$ in simple and complex group, respectively). Further studies are needed to determine the cut point of bulbous urethral length or gapometry index or to access other predictive factors for surgical approach.

Conclusion

The surgical approach in bulbous and membranous urethral stricture can be predicted by the length of a bulbous urethra. The short urethral gap does not always indicate the simple excision and primary anastomosis approach.

What is already known in this topic?

Urethral stricture longer than 2 cm usually required urethroplasty. Urethroplasty can be performed by various approaches and different type of procedures. The location, the length and the co-existent urethral pathology are the key factors to consider for the treatment success. However, few studies have addressed the pre-operative factor that influenced the surgeon to choose the type pf the surgery.

What this study adds?

The length of bulbous urethra helps predict the procedural type of urethroplasty. Further studies should

focus on the increasing the sample size and determining the cut point of bulbous urethra.

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Potential conflicts of interest

The authors declare no conflicts of interest.

References

1. Koraitim MM. Optimising the outcome after anastomotic posterior urethroplasty. Arab J Urol 2015;13:27-31.
2. Angermeier KW, Rourke KF, Dubey D, Forsyth RJ, Gonzalez CM. SIU/ICUD Consultation on urethral strictures: Evaluation and follow-up. Urology 2014;83:S8-17.
3. Maciejewski C, Rourke K. Imaging of urethral stricture disease. Transl Androl Urol 2015;4:2-9.
4. Turner-Warwick R. Prevention of complications resulting from pelvic fracture urethral injuries-and from their surgical management. Urol Clin North Am 1989;16:335-58.
5. Wessells H, Angermeier KW, Elliott S, Gonzalez CM, Kodama R, Peterson AC, et al. Male urethral stricture: American Urological Association guideline. J Urol 2017;197:182-90.
6. Koraitim MM. Gapometry and anterior urethrometry in the repair of posterior urethral defects. J Urol 2008;179:1879-81.
7. Koraitim MM. Predictors of surgical approach to repair pelvic fracture urethral distraction defects. J Urol 2009;182:1435-9.
8. Sekhon V, Kudchadkar SJ, Raj A, Ansari MS. Radiographic gapometry score: A simple predictor for surgical approach in pediatric traumatic posterior urethral strictures. J Pediatr Urol 2017;13:624.e1-5.
9. Mundy AR. Urethroplasty for posterior urethral strictures. Br J Urol 1996;78:243-7.
10. Webster GD, Ramon J. Repair of pelvic fracture posterior urethral defects using an elaborated perineal approach: experience with 74 cases. J Urol 1991;145:744-8.
11. Andrich DE, O'Malley KJ, Summerton DJ, Greenwell TJ, Mundy AR. The type of urethroplasty for a pelvic fracture urethral distraction defect cannot be predicted preoperatively. J Urol 2003;170:464-7.
12. Koraitim MM. The lessons of 145 posttraumatic posterior urethral strictures treated in 17 years. J Urol 1995;153:63-6.
13. Da Silva EA, Sampaio FJ. Urethral extensibility applied to reconstructive surgery. J Urol 2002;167:2042-5.