Combined Dorsal Plus Ventral Double-Graft Urethroplasty in Anterior Urethral Reconstruction

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Abstract This study aims to investigate the effect of combined dorsal plus ventral double-graft urethroplasty in anterior urethral reconstruction. Patients who underwent graft urethroplasty for anterior urethral strictures at West China Hospital from 2005 to 2010 were followed up with clinical evaluation. According to the site of graft fixed, patients were divided into single-onlay group (dorsal or ventral) and double-onlay group (dorsal plus ventral). Success rate and complications were compared between the two groups and were analyzed using *t* test and chi-square. A total of 77 patients completed the follow-up, 51 in single-onlay group and 26 in double group. There was no statistical difference in terms of age, length, site, stricture reason, and the type of graft used between the two groups. The mean follow-up time was 15.6 months (range from 4 to 33 months) in double group and 39.5 months (range from 15 to 59 months) in single group. The total success rate was 72.5 % in single-onlay group and 88.5 % in double-onlay group; no statistical difference existed ($p>0.05$). Subgroup analysis shows the success rate was higher for double-onlay urethroplasty for the stricture of penoscrotal junction (88.9 vs 60.9 %, $p<0.05$). The main postoperative complications including infection and urethrocutaneous fistula

were not significant between the two groups ($p>0.05$). Combined dorsal plus ventral double-graft urethroplasty showed a high success and low complication rate for anterior urethral strictures, especially for the penoscrotal junction.

Keywords Anterior urethral reconstruction · Double onlay · Graft · Urethral stricture · Urethroplasty

Introduction

Urethral stricture remains a common problem worldwide, affecting mainly the male urethra (1/10,000–1/1,000) [1]. Perineal trauma, long-term urethral catheterization, urological instrumentation, chronic inflammatory disorders such as lichen sclerosis et atrophicus, and sexually transmitted disease are typical causes of strictures: most cases, however, are idiopathic, probably arising as a result of remote unrecognized straddle injury during childhood [2]. If the urethral stricture cannot be treated properly, it will have a negative effect on the quality of life and also put heavy economic burden on their family [3].

Surgical treatment of urethral stricture diseases is a continually evolving process, and currently, there is renewed controversy over the best means of reconstructing the urethra [4]. Open urethroplasty is regarded as the gold-standard treatment of resistant urethral stricture disease [5], whereas longer strictures (>2.5 cm), or those in a distal location along the penile shaft, usually require a urethral substitution procedure incorporating a graft or flap to augment the stenotic segment [5]. Over the past decade, buccal mucosa graft (BMG) has become popular for complex urethral reconstruction because it is readily available in all patients, has robust handling characteristics, and has been associated with excellent outcomes [3, 6, 7].

However, there has been controversy as to which surgical technique is the most appropriate for graft application. Patterson and Chapple found that in experienced hands, the

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outcomes of both dorsal onlay grafts and ventral onlay grafts in bulbar urethroplasty are similar [8]. Double-graft bulbar reconstruction (using BMG for both grafts) was popularized by Palminteri et al. with excellent results in moderate length strictures (mean stricture length 3.6 cm, 90 % success rate, and mean follow-up time of 22 months) [9], but with no comparison group to know if this was truly superior to single-graft techniques. Moreover, double-graft reconstruction for penoscrotal and penile urethral stricture is still not fully unknown. In this present study, we try to evaluate the efficacy of augmenting the preserved urethral plate using a combined dorsal onlay plus a ventral onlay double BMG or penile skin graft in patients with penoscrotal and penile urethral stricture.

Patients and Methods

Design

The study was a retrospective cohort analysis, and it was conducted at the Urology Department, West China Hospital, Sichuan University. The charts were reviewed from January 2006 to October 2010.

Participants

Patients who underwent graft urethroplasty for anterior urethral strictures (not bulbar urethral stricture) were eligible. According to the site the graft fixed, patients were divided into single-onlay group (dorsal or ventral) and double-onlay group (dorsal plus ventral).

Surgical Technique

The intraoperative choice of penile skin, scrotal skin (Fig. 1a), or BMG depended on the length of the urethral stricture and local tissue situation. All procedures were performed by a full-time reconstructive urologist (Kunjie Wang).

Regarding the technique, the strictured urethra was opened, guided by a guidewire, and was completely mobilized from the underneath corpora cavernosa. The urethra is then laid open for 0.5 cm both proximally and distally into the healthy urethra. The exposed dorsal urethra is incised in the midline down to the tunica albuginea. The margins of the incised dorsal urethra are dissected from the tunica; an elliptical raw area is created over the tunica albuginea (Fig. 1b); and the incised dorsal free margins of the urethra are anchored by interrupted stitches to the tunica. The first graft is sutured into the recipient elliptical area; the graft is quilted to the underlying tunica and fixed to the urethral mucosal margins (Fig. 1c). Subsequently, second graft is sutured laterally to the left mucosal margin of the urethral plate (Fig. 1d). Indwelling urethral catheter was left for 1 month plus supra-pubic cystocath.

Voiding cystourethrography was done at 1 month after surgery; the urethral catheter was removed after voiding satisfactorily followed by cystocath removal in next 2–3 weeks.

Assessment

Preoperative evaluation included clinical history, physical examination, urine culture, antegrade voiding cystourethrography, retrograde urethrography, and/or urethroscopy.

If the urinary tract infection existed, antibiotics would be offered to patients according to antimicrobial susceptibility testing. Povidone iodine (0.1 %) was to be used to soak the patients' perineum in order to inhibit the growth of bacteria in the skin before operation.

Successful reconstruction was defined as normal voiding without need for any postoperative procedure, including dilation. Failure was defined as recurrent stricture disease requiring urologic intervention; subsequent procedures performed included urethral dilation, suprapubic cystostomy, and repeat urethroplasty.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) 15.0 for Windows (SPSS, Chicago, IL, USA). Continuous variables were presented as mean $\pm$ standard deviation (SD), while categorical data were represented by number and percentage. A descriptive analysis of each study variable was performed, and postoperative change was analyzed using the paired *t* test. Comparison of categorical variables was performed using chi-square test/Fisher's exact test. Statistical significance was considered at $p < 0.05$ in all statistical analyses.

Results

Seventy-seven consecutive men with anterior urethral stricture, who underwent the urethroplasty were enrolled retrospectively in this study. The patients were classified as follows: single-onlay group (51 cases) and double-onlay group (26 cases). Patient characteristics and preoperative data are summarized in Table 1.

Mean age in single-onlay group was 41.2 ± 16.9 years (range from 17 to 71 years), while double group was 48.9 ± 17.7 years (range from 16 to 82). Mean follow-up in double-onlay group (15.6 months, range from 4 to 33 months) was shorter than single-onlay group (39.5 months, range from 15 to 59 months), but both mean follow-up was longer than 4 months. Age, stricture length, etiology of stricture, stricture location, and graft type were balanced between the two groups ($p > 0.05$) (Table 1).

Fig 1 **a** Scrotal skin harvest. **b** An elliptical raw area is created over the tunica albuginea. **c** Dorsal onlay: the first graft is sutured and quilted into the recipient elliptical area. **d** Ventral onlay: the second graft is sutured laterally to the mucosal margin of the urethral plate

The intraoperative choice of penile skin, scrotal skin, or BMG depended on the length of the urethral stricture and local tissue situation. Of the 77 patients, 40.3 % was graft harvested from penile skin, 27.3 % in scrotal skin, and 32.5 % buccal mucosa, but no significant difference was found in these two groups. As shown in Table 2, mean graft length in single-

onlay group was 3.4 ± 1.5 cm (range from 1 to 10 cm), and mean graft length in double-onlay group was 4.4 ± 2.0 cm (range from 1 to 9 cm). The mean graft width in single-onlay group was 1.6 ± 0.6 cm (range from 0.5 to 2.5 cm). In double-onlay group, the ventral graft width was 1.1 ± 0.4 cm (range from 0.5 to 1.6 cm) and dorsal graft width was 0.5 ± 0.2 cm (range from 0.2 to 1.1 cm). Compared to single-onlay group, the graft width in double-onlay group was at least lower than about 0.5 cm.

Table 1 Preoperative characteristics of patients in single-onlay group and double-onlay group

	Single-onlay group (n=51)	Double-onlay group (n=26)	<i>p</i>
Age (years)	41.2±16.9	48.9±17.7	>0.05
Stricture length (cm)	3.0±1.6	3.0±1.9	>0.05
Follow-up (months)	39.5±10.7	15.6±8.1	<0.05
Stricture location			>0.05
Penile urethra	28 (54.9)	8 (30.8)	
Penoscrotal urethra	23 (45.1)	18 (69.2)	
Etiology of stricture			>0.05
Trauma	11 (21.6)	4 (15.4)	
Tansurethral operation	9 (17.6)	9 (34.6)	
Catheterization	15 (29.4)	4 (15.4)	
Urinary tract infection	6 (11.8)	2 (7.7)	
Balanitis xerotica obliterans	2 (3.9)	0 (0)	
Unknown	8 (15.6)	7 (26.9)	
Graft type			>0.05
Penile skin	17 (33.3)	14 (53.8)	
Scrotal skin	13 (25.5)	8 (30.8)	
Buccal mucosa	21 (41.2)	4 (15.4)	

After follow-up, as shown in Table 3, the total success rate in double-onlay group was higher than that of single-onlay group (88.5 % vs 60.9 %), but no significant difference in these two groups. To further analyze the success rate, we compared the success rate in different stricture locations. It was shown that the technique of double onlay had higher success rate than that of single onlay in penoscrotal urethral stricture (88.9 vs 60.9 %, $p < 0.05$). In double-onlay group, three cases (11.5 %) failed. Two failures were successfully treated with urethral dilation direct vision internal urethrotomy. The third failure was treated with repeat urethroplasty. Common complications of this procedure included the following: infection and fistula. One case of local

Table 2 The width and length of graft in single-onlay group and double-onlay group

		Length (cm)	Width (cm)
Single-onlay group		3.4 ± 1.5	1.6 ± 0.6
Double-onlay group	Ventral	4.4 ± 2.0	1.1 ± 0.4
	Dorsal	2.4 ± 1.3	0.5 ± 0.2

Table 3 Surgical results and complications in patients with single-onlay and double-onlay urethroplasty

	Single-onlay group (n=51)	Double-onlay group (n=26)	<i>p</i>
Success rate (%)	37/51 (72.5)	23/26 (88.5)	>0.05
Penile stricture (%)	23/28 (82.1)	7/8 (87.5)	>0.05
Penoscrotal stricture (%)	14/23 (60.9)	16/18 (88.9)	<0.05
Complications	5 (9.8)	2 (7.6)	
Wound infection	2 (3.9)	1 (3.8)	>0.05
Fistula	3 (5.9)	1 (3.8)	>0.05

wound infection was found in each group and treated with early catheter removal, and fresh dressing changed frequently. In patient with fistula after operation, two cases cured with supra-pubic cystocath maintain for 3 months and two cases cured with surgical repair.

Discussion

Anterior urethra consists of penile urethra and bulbar urethra. As for bulbar urethra stricture, removal of bulbar urethral stricture scar using narrow segment anastomosis has shown satisfactory results [10]. However, using the above treatments in penile urethra stricture may result in penile shortening, painful erection, etc., and thus, their clinical use is minimal [11]. Meanwhile, the traditional treatments such as urethral dilation and cold knife urethrotomy have higher recurrence rates which also results in limited clinical application. Surgical techniques such as flap or graft replacement therapy have been continuously developed and are becoming the new trend for treatment of urethral strictures, especially because the free graft operation is simple and can often lead to definitive cure in the majority of cases [4]. These commonly include free penile skin graft, scrotal skin, and buccal mucosa, of which both dorsal and ventral sides are applied. In this present study, we try to evaluate the efficacy of augmenting the preserved urethral plate using a combined dorsal onlay plus a ventral onlay double BMG or penile skin graft in patients with penoscrotal and penile urethral stricture.

Although iatrogenic injury is still a major cause of urethral stricture [12], but with extensive transurethral surgery, various medical operations (including indwelling catheter) have significantly increased urethral stricture causation and have become the second largest cause of urethral stricture etiology. In a group of 445 cases of urethral stricture cause analysis, iatrogenic injuries accounted for 35.1 % [13]. This present study found that iatrogenic injury is a major cause of penile urethral stricture, estimated to be 48.1 %.

This study demonstrates that iatrogenic factors are the most common causation of peno-scrotal junction stenosis with

relatively higher incidence, except for nonstandard operations as etiology. Unfortunately, the peno-scrotal junction stenosis treatment has not been given sufficient attention and there is clear lack of efficacy literature for various treatment options. Our follow-up results showed that unilateral free inlay graft surgery success rate was 60.9 %, significantly lower than the therapeutic effect of the penile part (82.1 %), and therefore to explore further treatment options to overcome the current difficulties in managing these patients successfully.

Palminteri et al. [9] in 2008 first reported 48 cases of dorsal plus ventral buccal mucosa urethroplasty for bulbar urethral stricture, with an average follow-up of 22 months; the success rate was 89.6 %. Since 2008, we tried using the combined dorsal plus ventral double-graft urethroplasty in anterior urethral reconstruction, especially penis and scrotum junction stenosis; the success rate was 88.9 %, significantly better than the urethroplasty forming 60.9 % of the treatment effect. Advantages of combined treatment is reflected in the following aspects: when double-onlay urethroplasty was used, the luminal urethra by is covered to a large extent to ensure the continuity of histology, more conducive to the growth of epithelial cells and thus rebuild the integrity of the narrow section histology; the width of graft in double onlay is greater than the single-onlay urethroplasty, which can ensure maximum urethral lumen diameter and reduces the incidence of anastomotic stricture, thus improve the success rate; since the poor blood supply at peno-scrotal junction, consequently, graft survival is not conducive to the area when it is too large. The combined effect of these factors may enhance the therapeutic effect.

This study also shows that although our surgical procedure is slightly more complex than the one-sided, the incidence of major complications did not significantly increase as reported by others [14]. Lower incidence of infection between the two groups and urinary fistula rate had no significant difference, suggesting that surgery may be associated with less postoperative complications itself. Adequate preoperative preparation, strict infection control, and postoperative intensive dressing care may help to reduce postoperative complications.

There were several limitations to our study. These include its retrospective nature in both study groups and the fact that patient numbers and follow-up time were less for the double-onlay group than for the single-onlay group. But both follow-up time in two groups is longer than 4 months. Also, this study was designed to compare single- and double-graft techniques in patients in whom graft urethroplasty was already planned, but which type of graft is decided by surgeon according to the length of the urethral stricture and local tissue situation. Thus, it may cause bias, although no significant difference was found in these two groups. Further study, as always, is indicated.

Conclusion

The combined dorsal plus ventral urethroplasty for anterior urethral stricture has higher success rate with fewer complications and is ideal technique for peno-scrotal urethra strictures.

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