ORIGINAL ARTICLE

A comparative study of the use of a transverse preputial island flap (the Duckett technique) to treat primary and secondary hypospadias in older Chinese patients with severe chordee

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Abstract

Objective To investigate the outcome between the primary and secondary hypospadias with severe chordee in older patients by the transverse preputial island flap (TPIF).

Materials and methods We retrospectively analyzed 53 hypospadias patients who were performed with TPIF for urethroplasty, including 25 primary hypospadias (Group 1) and 28 secondary hypospadias (Group 2). The mean age in Group 1 was 12.12 ± 10.709 and 18.64 ± 8.727 in Group 2 ($P = 0.0181$). The mean follow-up time was 38.7 months (22–60 months).

Results All of the foreskin flaps survived after the operation without necrosis. The overall complication rate was 24 % in Group 1 and 53.57 % in Group 2 ($P = 0.0280$). All the patients were also divided into two cohorts according to their ages in surgery. In the 0–10-yr cohort, there was a significant difference in the overall complication rate between the primary and secondary groups ($P = 0.0173$). But in the cases who were over 11 year old, there was no significant difference in the overall complications between two groups ($P = 0.1603$). Also no significant difference was found in the mean length of the urethral defect between two groups ($P = 0.8312$).

Conclusion The Duckett technique is an optional choice for some older Chinese patients undergoing primary operations, but it has a higher complication rate in those who have undergone previous failed urethroplasties. The unsatisfactory results found in the reoperative group were supposed to be linked to the older age, the lack of subcutaneous flap coverage and local scar tissue, but not to the length of the urethral defect.

Keywords Complication · Hypospadias · Primary · Secondary · Transverse preputial island flap

Da-chao Zheng and Hao Wang contributed equally to this study and share the first authorship.

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Introduction

Hypospadias is one of the most common congenital malformations affecting newborn males around the world [1]. Various surgical techniques have been used to repair hypospadias, and it is generally thought that the urethral plate should be preserved as much as possible and that a one-stage urethroplasty is preferred. The tubularized incised plate (TIP) and the onlay island flap (OIF) urethroplasty techniques are common in the treatment of both primary and secondary hypospadias. However, in patients with severe chordee or scarring, the urethral plate cannot be used and must be transected. In these cases, we employed another suitable one-stage technique that does not use urethral plates, the transverse preputial island flap (TPIF) or the Duckett technique [2]. The Duckett and related modified techniques can be applied to anterior, middle and proximal penile hypospadias with or without chordee [3–5]. Soutis and his

colleagues suggest that the technique can also be performed following multiple failed urethroplasties with an acceptable complication rate and satisfactory results [6]. In the past 10 years, our department has performed over 600 urethroplasty operations, including 53 cases have been used the Duckett technique to correct both primary and secondary hypospadias. The proportion of patients who are past puberty when they come to our clinic to receive a repair is much higher than in other reports. In this study, we report our experience using the Duckett technique to repair hypospadias in older Chinese patients; we examine the different complication rates in primary and secondary cases and analyze the possible reasons for these differences.

Materials and methods

Patients

Between March 2006 and February 2010, 53 patients with hypospadias underwent the TPIF. All of the patients presented with hypospadias accompanied by severe chordee as demonstrated by an artificial erectile test during the operation. According to the previous literature [7], the severe chordee in our study is defined as the chordee cannot be corrected by the simple degloving procedure and the resection of fibrous tissue around urethra. All of the procedures were performed by a single surgeon in our department. In total, 25 patients (47.17 %) had primary hypospadias and had not received previous treatment (Group 1) and 28 patients (52.83 %) had undergone at least one failed urethroplasty in the past (Group 2). The age of patients in Group 1 ranged from 2 to 35 years (mean 12.12 ± 10.709); 16 of the patients were prepubescent and 9 were postpubescent. The age of patients in Group 2 ranged from 5 to 39 years (mean 18.64 ± 8.727); 7 of the patients were prepubescent and 21 were postpubescent. The number of previous unsuccessful urethroplasties performed on each patient in Group 2 varied from 1 to 4. The length of the urethral defect of all patients ranged from 2 to 8 cm.

Surgical technique

A circumferential incision was made proximal to the corona and reached the depth of Buck's fascia. The dorsal skin was degloved toward the proximal penis, and the scar fiber around the corpus spongiosum was cut to release the chordee. An artificial erection was induced to identify the site and degree of chordee. The urethral plate was transected to correct accompanying chordee completely, and the meatus dropped back to the proximal penis or the penoscrotal junction. The distance between the retracted meatus and the glans tip was measured to confirm the expected length of the neourethra. The rectangular flap was

outlined at the inner aspect of the dorsal prepuce with methylthioninium chloride according to the length of the defect. The outlined foreskin was incised and rolled into a tube over a catheter and sutured with 6-0 absorbed PDS. The size of the catheter depended on the diameter of the patient's urethra and ranged from 10-Fr to 16-Fr. The tubularized neourethra was transposed ventrally and anastomosed with the native urethra with a mucosa to mucosa suture. The glans was incised deeply, the neourethra was placed and the new meatus was sutured on the top of the glans. The subcutaneous tissue was dissected to create secondary flaps to cover the neourethra. All Patients in Group 1 were performed with the second-flap technique, but only 8 patients in Group 2 had enough subcutaneous tissue to perform this approach. Urethral catheters were used to drain the urine for 8 to 10 days. Antibiotics were administered intravenously for at least 5 days.

Results

All of the surgical procedures were performed smoothly. The mean operation time was 95 ± 25 min in Group 1 and 105 ± 22 min in Group 2. The transurethral catheter was withdrawn between 8 and 10 days postoperatively, and the patients were discharged following removal of the catheter. All of the foreskin flaps survived the operation without necrosis. The mean follow-up time of our study was 38.7 months (22–60 months). Patients were required to visit our clinic between 6 and 12 months after the operation for an outpatient follow-up examination. All of them were then followed through a combination of telephone interviews and outpatient follow-up visits, depending on their residence location, education and income levels.

The complications, age, urethra defect and postoperative Qmax observed in both groups are presented in Table 1. All complications were classified as either early or late complications according to the literature [8]. The former included fistulas, dehiscence and infection and the later, observed during the long-term follow-up period, consisted of meatal stenosis, stricture, diverticula and hair growth or uroliths. The urethrocutaneous fistulas all occurred in the anastomotic stoma between the neourethra and meatus. Of the 12 fistula cases, one patient spontaneous healed after 3 months, and the others underwent repairing operations after 6 months and were cured after only 1 procedure. There were 9 and 2 patients developed anastomotic stricture and meatal stenosis, respectively, which required repeated dilations and incision and were classified as unsuccessful treated cases. The long-term success rate was 84 % (21/25) in Group 1 and 75 % (21/28) in Group 2, respectively. There was no meatus recession occurred in our series. All patients were satisfactory with the final

Table 1 The complications, age and urethra defect in the two groups

	Group 1 ($n = 25$)	Group 2 ($n = 28$)	Total ($n = 53$)	P value
No. of patients with complications	6 (24 %)	15 (53.57 %)	21 (39.62 %)	0.0280*
Early complications	5 (20 %)	11 (39.29 %)	16 (30.19 %)	0.0769
Fistula	4	8	12	
Dehiscence and infection	1	3	4	
Late complications	4 (16 %)	7 (25 %)	11 (20.75 %)	0.1965
Stricture	4	5	9	
Meatal stenosis	0	2	2	
Diverticula	0	0	0	
Hair growth or uroliths	0	0	0	
Age at operation				
Mean age	12.12 ± 10.709	18.64 ± 8.727		0.0181*
0–10 yr	3/14 (21.4 %)	4/5 (80.0 %)	7/19 (36.8 %)	0.0173*
11 yr	3/11 (27.3 %)	11/23 (47.8 %)	14/34 (41.2 %)	0.1603
Urethra defect	4.08 ± 0.81 cm	4.02 ± 0.85 cm		0.8312
Postoperative Qmax	12.07 ± 4.13 ml/s	14.80 ± 4.14 ml/s		

cosmetic appearance in our follow-up surveys. The nineteen patients who had sexual activity were satisfied with their erectile function. A χ^2 difference in the overall complication rate was found between these two groups ($P = 0.0280$). However, when the early and late complications were examined separately, no statistically significant differences were observed (early: $P = 0.0769$, late: $P = 0.1965$). All the patients were also divided into two cohorts (0–10, 11 year and over) according to their ages at surgery. In the 0–11-year cohort, there was significant different in the overall complication rate between the primary and secondary groups ($P = 0.0173$). But in the cases who were over 11 year old, there was no significant difference in the overall complications between two groups($P = 0.1603$)(Table 1.). The mean ages of the two groups were significantly different ($P = 0.0181$), but the mean length of the urethral defect did not significantly differ between the two groups ($P = 0.8312$).

Discussion

The use of urethroplasty in cases of reoperative hypospadias presents a challenge for urologists. The treatment of secondary hypospadias usually has a high failure rate and results in multiple repairs, a negative functional impact and even a lifelong influence on patients and their families [9]. The best options for repeated hypospadias operations are still debated. Generally, the main strategies for secondary hypospadias include the use of adjacent tissue around the urethral plate, different genital skin flaps and extragenital grafts. The TIP is a typical technique that uses adjacent urethral tissue to repair secondary hypospadias. It is a good choice for secondary hypospadias when the urethral plate

and local tissue are appropriate for neourethral reconstruction. However, when the concomitant chordee is severe and the urethral plate and surrounding fibrous scars must be resected, the TIP is not reasonable choices for reoperative hypospadias. Buccal mucosa [10, 11] or bladder mucosa [12] grafts are primarily used in cases where multiple failures have led to lack of adjacent tissue around the urethral plate or penile and scrotal skin that can be used for urethroplasty. Sometimes the graft technique is the only choice for severe urethral defects in hypospadias patients who have undergone multiple failed operations. However, this technique has several disadvantages, including an unsatisfactory cosmetic result and the time–cost of a two-stage procedure.

Techniques using various penile flaps, including the Duckett technique, offer additional options for reoperative hypospadias. In these cases, residual foreskin skin can be transferred to reconstruct a neourethra as a one-stage procedure. Compared with a two-stage graft, Shukla and his colleagues preferred [13] the modified TPIF since it required less surgical time and resulted in better outcomes when a division of the urethral plate is present. The Duckett technique can be used in midshaft and proximal hypospadias and is also suitable in cases of multiple failed urethroplasties [2, 4, 6]. In our study, the patients in Group 2 had lost the healthy adjacent tissue around the urethral plate in previous urethroplastic operations. Fortunately, the foreskin hoods had been preserved in these patients, and the Duckett technique could be used to repair the secondary hypospadias.

Previous studies have reported different complication rates for the various methods used to correct secondary hypospadias. In most studies, the complication rate of one-stage TIP was below 20 % [14, 15], whereas the

complication rate of buccal mucosa grafts reached 32–38 % [14, 16]. The complication rate of local flap transfer procedure, including the Duckett technique, is between these values [6]. In the present study, the complication rate in Group 2 was much higher than the reported complication rate for other methods used to treat secondary hypospadias. The reasons for a higher complication rate are complex and include older patient age, a lack of subcutaneous tissue coverage and scarring around the meatus caused by previous operations. Various studies have indicated that age is an independent factor that significantly affects wound healing ability in cases of hypospadias. Eassa et al. [17] analyzed ten years of experience with tubularized incised plate (TIP) urethroplasty and found that a patient age of over 4 years is an additional independent risk factor for neourethral complications in reoperations. Dustin and colleagues found that pro-inflammatory cytokines like IL-6, IL-8, TNF-α and TGF-β1 increase with age [18] and may cause the higher level of scarring and stricture formation in older patients of hypospadias. In our study, the higher complication rate in Group 2 was associated with the older age of the patients (mean 18.64 ± 8.727) when compared with Group 1 (mean 12.12 ± 10.709). The mean age of Group 1 was significantly younger than that of Group 2. The majority of patients in Group 1 were just at the onset of puberty, whereas the majority of patients in Group 2 were postpubescent. It is well known that the prepuce skin has a secretory function in puberty and adulthood, and wound healing may be affected by the secretion of prepuce. Morning erections, which gradually develop with age, also induce the neourethra and wound to crack. For these reasons, the American Association of Pediatrics recommended in 1996 that hypospadias reconstruction operations be completed when patients are between the ages of 6 and 12 months [19]. But for various reasons like poor economy condition, lack of specialist medical service and not convenient traffic, the majority of hypospadias patients in our clinic had missed their optimal surgery age. In this clinical study, the hypospadias patients' age varied from child to adult. We choose 11 years old as the onset of puberty to analyze the preadolescent and postpubescent hypospadias, respectively, since Chinese children usually began their puberty development at this age [20]. In the preadolescent patients who were younger than 11 year, the primary group had a significant lower complication rate than the secondary group. In the postpubescent patients, the primary cases still had a lower complication rate than the secondary group, although there was no statistic significant difference between two groups which maybe caused by limited cases.

In recent years, techniques using a second-layer covering flap like the dartos [21, 22] and tunica vaginalis flap [23] have been increasing adopted for urethroplasties, which lead to a low fistula complication rate. The use of a second flap is associated with a decrease in the development of fistulas no matter what technique is used [21–23]. In our series, the subcutaneous tissues were used as a second-layer flap in Group 1. However, in Group 2, most patients lacked this flap coverage due to the poor quality of the foreskin and a lack of sufficient subcutaneous tissue around the neourethra. We speculate this is another important reason for the difference of complication rate between primary and secondary hypospadias.

The poor quality of the penile skin may be another risk factor in secondary hypospadias. This poor quality is caused by previous operations and can lead to severe scarring, penile curvature, fistula or even meatal stenosis [24]. Some urologists therefore prefer two-stage operations over one-stage procedures in cases of severe secondary hypospadias [25, 26]. The patients in Group 2 had undergone several previous operations that led to severe scarring, poor skin vascularity and a decreased wound healing ability. We attempted to examine the relationship between meatus scarring and complication rates. Generally, patients who had a wide, severe scar were more likely to have a discouraging result. However, no standard international classification system exists to document the extent of scarring. Due to some incomplete descriptions in the medical histories of patients in this study, we failed to identify a statistically significant relationship between scarring and complication rates.

Some studies have shown that the location of the proximal meatus is also associated with a higher postoperative complication rate [17, 27]. Generally, the proximal meatus has a higher complication rate than the distal meatus. However, in our study, the mean length of the urethral defect was not related to the outcome; no significant association was found between groups or within either group. This finding suggests that the length of the urethral defect is not a critical factor affecting complications following the use of the tubularized island flap technique to treat either primary or secondary hypospadias.

The significant feature of our cohort is the hypospadias patients underwent TPIF procedure at an unexpected older age than most of pediatric literatures, whether primary or secondary hypospadias. So we can also classify most of patients as adult hypospadias. Compared the adult hypospadias with pediatric counterpart is difficult, because the adult hypospadias repairing had a much higher complication rates [28, 29]. In the adult hypospadias cases, Hensle et al. reported 37.5 % complication rate in primary hypospadias repairing and 41.67–63.6 % complication rate in secondary hypospadias. But the long-term success rate in this group was 88.1 % [29]. Also in our study, most complications in primary hypospadias group were fistula, which were cured by secondary repair. Compared with the

unsatisfactory cosmetic result and the time–cost of two-stage graft urethroplasty, meanwhile considering the 84 % long-term success rate in our study, we think the Duckett technique even with additional fistula repair is acceptable in primary hypospadias cases. Based on the above data, we conclude that the Duckett technique is an optional choice for patients undergoing primary operations for hypospadias, especially in the older cases with severe chordee and preputial skin was preserved. But considering the high complication rate in reoperative patients, this technique should be used with caution.

Conclusion

The TPIF (the Duckett technique) is an option for the treatment of older Chinese primary hypospadias patients with severe chordee, but it has a higher complication rate for those patients who have undergone previous failed urethroplasties. These unsatisfactory results in reoperative patients may be linked to older patient age, the lack of subcutaneous flap coverage and local tissue scarring caused by previous operations, not related to the length of the urethra defect.

References

1. Baskin LS (2000) Hypospadias and urethral development. J Urol 163:951–956
2. Duckett JW (1980) Transverse preputial island flap technique for repair of severe hypospadias. Urol Clin North Am 7:423–431
3. Elder JS, Duckett JW (1987) Urethral reconstruction following an unsuccessful one-stage hypospadias repair. World J Urol 5:19–60
4. Abu-Arafeh W, Chertin B, Zilberman M, Farkas A (1998) One-stage repair of hypospadias—experience with 856 cases. Eur Urol 34(4):365–367
5. Elbakry A (1999) Complications of the preputial island flap-tube urethroplasty. BJU Int 84:89–94
6. Soutis M, Papandreou E, Mavridis G, Keramidas D (2003) Multiple failed urethroplasties: definitive repair with the Duckett island-flap technique. J Pediatr Surg 38(11):1633–1636
7. Kajbafzadeh AM, Arshadi H, Payabvash S, Salmasi AH, Najja-ran-Tousi V, Sahebpor AR (2007) Proximal hypospadias with severe chordee: single stage repair using corporeal tunica vaginalis free graft. J Urol 178(3 Pt 1):1036–1042
8. Nuhoğlu B, Ayyildiz A, Balci U, Ersoy E, Gürdal M, Germiy-anoglu C, Erol D (2006) Surgical treatment options in proximal hypospadias: retrospective analysis of 171 cases at a single institution. Int Urol Nephrol 38(3–4):593–598
9. Barbagli G, Perovic S, Djinovic R, Sansalone S, Lazzeri M (2010) Retrospective descriptive analysis of 1,176 patients with failed hypospadias repair. J Urol 183(1):207–211
10. Zhao M, Li Y, Tang Y et al (2011) Two-stage repair with buccal mucosa for severe and complicated hypospadias in adults. Int J Urol 18(2):155–161
11. Metro MJ, Wu HY, Snyder HM 3rd, Zderic SA, Canning DA (2002) Buccal mucosal grafts: lessons learned from an 8-year experience. J Urol 166:1459–1461
12. Fu Q, Deng CL (2006) Ten-year experience with composite bladder mucosa-skin grafts in hypospadias repair. Urology 67(6):1274–1277
13. Shukla AR, Patel RP, Canning DA (2004) The 2-stage hypospadias repair. Is it a misnomer? J Urol 172(4 Pt 2):1714–1716
14. Snodgrass WT, Bush N, Cost N (2009) Algorithm for comprehensive approach to hypospadias reoperation using 3 techniques. J Urol 182(6):2885–2891
15. Söylet Y, Gundogdu G, Yesildag E, Emir H (2004) Hypospadias reoperations. Eur J Pediatr Surg 14(3):188–192
16. Hensle TW, Kearney MC, Bingham JB (2002) Buccal mucosa grafts for hypospadias surgery: long-term results. J Urol 168:1734–1736
17. Eassa W, Jednak R, Capolicchio JP, Brzezinski A, El-Sherbiny M (2011) Risk factors for re-operation following tubularized incised plate urethroplasty: a comprehensive analysis. Urology 77(3):716–720
18. Bermudez DM, Canning DA, Liechty KW (2011) Age and pro-inflammatory cytokine production: wound-healing implications for scar-formation and the timing of genital surgery in boys. J Pediatr Urol 7(3):324–331
19. American Academy of Pediatrics (1996) Timing of elective surgery on the genitalia of male children with particular reference to the risks, benefits, and psychological effects of surgery and anesthesia. Pediatrics 97:590–594
20. Ma HM, Chen SK, Chen RM, Zhu C, Xiong F, Li T et al (2011) Pubertal development timing in urban Chinese boys. Int J Androl 34(5 Pt 2):e435–e445
21. Ozturk H (2010) Dartos flap coverage of the neourethra following repair for primary hypospadias, reoperative hypospadias and urethrocutaneous fistulas. It is a safe approach. Acta Cir Bras 25(2):190–193
22. Yiğiter M, Yildiz A, Oral A et al (2010) A comparative study to evaluate the effect of double dartos flaps in primary hypospadias repair: no fistula anymore. Int Urol Nephrol 42(4):985–990
23. Tavakkoli KT, Mohammadi S (2010) Tunica vaginalis flap as a second layer for tubularized incised plate urethroplasty. Urol J 7(4):254–257
24. Van der Werff J, Van der Meulen J (2000) Treatment modalities for hypospadias cripples. Plast Reconstr Surg 105:600–608
25. Nitkunan T, Johal N, O'Malley K, Cuckow P (2006) Secondary hypospadias repair in two stages. J Pediatr Urol 2:559–563
26. Springer A, Krois W, Horcher E (2011) Trends in hypospadias surgery: results of a worldwide survey. Eur Urol 60(6):1184–1189
27. Manzoni G, Marrocco G (2007) Reoperative hypospadias. Curr Opin Urol 17(4):268–271
28. Ching CB, Wood HM, Ross JH, Gao T, Angermeier KW (2011) The Cleveland Clinic experience with adult hypospadias patients undergoing repair: their presentation and a new classification system. BJU Int 107(7):1142–1146
29. Hensle TW, Tennenbaum SY, Reiley EA, Pollard J (2001) Hypospadias repair in adults: adventures and misadventures. J Urol 165(1):77–79