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Original Article

Comparative analysis of effects of tip and modified onlay island flap for treatment of hypospadias in children

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Abstract: Objective: The present study aimed to compare the effects of TIP and modified onlay island flap (MOIF) for treatment of hypospadias in children. Methods: A total of 92 children with hypospadias were selected and divided by different operative methods into Group A (GA), including 49 treated with TIP, and Group B (GB), including 43 treated with onlay island flap (OIF). The two groups were compared regarding therapeutic effects, operation related indexes, and complication incidence. Results: (1) There were no obvious differences in overall response rates (ORR) between GA (ORR=87.76%) and GB (ORR=90.70%) (X^2=0.205, P=0.651); (2) Operative duration (OD) times of GA were much shorter than those of GB (P<0.05). There were no obvious differences in intraoperative blood loss (IBL), maximum flow rate (MFR), length of stay (LOS), and hospitalization expenses (HE) between GA and GB (P>0.05); and (3) Bladder spasm (BS) duration, frequencies of BS, and frequencies of urine extravasation (UE) in GA decreased gradually with increases in time (P<0.05). Levels in GB were significantly decreased at 3 days and 9 days after the operation, compared with those at 1 day after operation (P<0.05). However, decreases were not significant between 3 days and 9 days after the operation (P>0.05). Frequencies of BS and UE in GB decreased gradually with increases in time (P<0.05). BS duration, frequencies of BS, and frequencies of UE in GA were much lower than those in GB 3 days and 9 days after the operation (P<0.05). Conclusion: Both TIP and MOIF showed good therapeutic effects for treatment of hypospadias in children. However, TIP, with shorter OD times, improved postoperative BS more obviously.

Keywords: TIP, modified onlay island flap, hypospadias in children

Introduction

Hypospadias is a common deformity of the urinary system in children. Its pathogenesis is chromosomal dominant genetic defects, clinically manifesting as the location of the urethral orifice between the perineum and glans penis, along with complications of the chordee. According to data information, incidence of hypospadias in children is approximately as high as 0.4%-8.2% [1, 2]. Incidence rates have increased continuously with the continuous aggravation of environmental pollution, especially for critical patients. This brings great financial and medical burdens to families and to society, causing adverse effects on the normal growth of children.

Operations are the most common clinical method for hypospadias in children. However, due to the variety of operative methods, there may be BS and pain after the operation. These will reduce the treatment compliance of children patients, adversely affecting therapeutic effects [3]. Hence, appropriate operations are particularly important in the treatment of hypospadias in children. Hypospadias has been treated by stages in previous operations, mainly including Byars and Thiersch. The penis is straightened, the shaft of the penis is corrected, and the local flap is redesigned and distributed in Stage I. This prepares for the repair of the artificial urethra in Stage II. These operations, however, are difficult and there are many operative indications.

Doctors prefer the operation of preserving the urethral plate, with continuous improvement of operative methods. TIP and MOIF are representative procedures [4, 5]. In the current stu-

Table 1. Comparison of therapeutic effects between the two groups [n (%)]

Group	Number of cases	Cured	Markedly effective	Effective	Ineffective	ORR
GA	49	8 (16.33)	19 (38.78)	16 (32.65)	6 (12.24)	43 (87.76)
GB	43	8 (18.60)	20 (46.51)	11 (25.59)	4 (9.30)	39 (90.70)
χ^2 value		0.083	0.561	0.552	0.205	0.205
P value		0.774	0.454	0.457	0.651	0.651

Table 2. Comparison of operation related indexes between the two groups ($\bar{x} \pm s$)

Group	Number of cases	OD (min)	MFR (ml/s)	IBL (ml)	LOS (d)	HE (yuan)
GA	49	84.67±7.98	8.27±1.58	24.63±7.71	11.31±2.07	1.42±0.57
GB	43	118.85±10.87	8.35±1.55	27.60±8.38	11.76±2.54	1.51±0.53
t value		17.329	0.244	1.77	0.936	0.781
P value		<0.001	0.807	0.08	0.352	0.437

dy, TIP and MOIF were used for the treatment of hypospadias in children, aiming to discover suitable methods for hypospadias in children, enhancing the therapeutic effects and relieving BS.

Material and methods

General materials

A total of 92 children with hypospadias were selected and divided by different operative methods into groups, including GA with 49 cases and GB with 43 cases. GA patients were aged 3-10 years old, with an average age of (6.82±2.15). This group included 6 cases of coronary sulcus type, 11 cases of penis and scrotum type, and 32 cases of penis shaft type. GB patients were aged 4-11 years old, with an average age of (6.57±2.02). This group included 8 cases of coronary sulcus type, 12 cases of penis and scrotum type, and 23 cases of penis shaft type. There was comparability, but no obvious differences in age and type of hypospadias between the two groups (*P*>0.05). The present study was approved by the Ethics Committee of the First People's Hospital of Lianyungang. Signed informed consent was obtained from each parent or guardian.

Methods

① GA was treated with TIP. A parallel incision of the urethral plate with a length of 0.6-0.8 cm was made between the urethral orifice and navicula. Distal inflammation was extended to navicula and made in the shape of a U. The proximal end joined the urethral orifice. The foreskin was incised from the position 0.5 cm away from the coronary sulcus to Buck's fascia. Next, fiber cords on ventral and dorsal sides of the penis were incised and the chordee was fully corrected. A longitudinal incision was made in the center of urethral plate and widened to 1.2-1.4 cm. A silicone tube was used as a stent for the penis and the urinary catheter was sutured and constructed along the stent. After transferring the skin on the dorsal side of penis to the ventral side, the urinary catheter was fixed and circumferential compression was performed. Finally, the penis was bandaged; ② GB was treated with MOIF. A parallel incision of the urethral plate with a length of 0.6-0.8 cm was made between the urethral orifice and navicula. Skin degloving and penile straightening were performed using the same methods as GA. A pedicled island flap with a width of 0.8-1.0 cm was incised horizontally, according to the degree of urethral defect. It was then transferred to the ventral side of the penis, with the urethral plate covered under it. A silicone tube was used as a stent of the penis and the urinary catheter was sutured and constructed along the stent. The artificial urinary catheter was covered by tissues of the vascular pedicle. Next, the two wings of the glans penis were sutured. The urethral orifice was set right. Ultimately, the skin on the dorsal side of the penis was transferred to the ventral side, aiming to promote wound repair.

Observation targets

① The two groups were compared regarding therapeutic effects. The problem was consid-

Table 3. Comparison of BS between the two groups ($\bar{x} \pm s$)

Observation targets	Group	1 day after operation	3 days after operation	9 days after operation	F value	*P* value
BS duration (h)	GA (49)	1.16±0.38	0.56±0.17*	0.31±0.09#	154.644	<0.001
	GB (43)	1.23±0.39	1.09±0.34	1.02±0.31	4.054	0.020
Frequencies of BS	GA (49)	6.12±2.01	2.97±0.94*	1.14±0.36#	184.584	<0.001
	GB (43)	5.97±1.94	5.29±1.72	4.64±1.51	6.338	0.002
Frequencies of UE	GA (49)	4.26±1.36	1.35±0.44*	0.31±0.09#	300.409	<0.001
	GB (43)	4.09±1.31	3.66±1.12	2.63±0.85	19.663	<0.001

Notes: *P<0.05 when GA and GB were compared 3 days after the operation; and #P<0.05 when GA and GB were compared 3 days after the operation.

Table 4. Independent sample t-test results of BS duration at different time points in both groups

Group	(I) Time points	(J) Time points	Mean value difference (I-J)	Standard error	Significance[b]	95% confidence interval for the difference[b]	
						Lower limiting value	Upper limit
GA	1 day after operation	3 days after operation	0.600*	0.058	0	0.485	0.715
		9 days after operation	0.850*	0.058	0	0.735	0.965
	3 days after operation	1 day after operation	-0.600*	0.058	0	-0.715	-0.485
		9 days after operation	0.250*	0.042	0	0.167	0.333
	9 days after operation	1 day after operation	-0.850*	0.058	0	-0.965	-0.735
		3 days after operation	-0.250*	0.042	0	-0.333	-0.167
GB	1 day after operation	3 days after operation	0.140*	0.062	0.026	0.017	0.263
		9 days after operation	0.210*	0.062	0.001	0.087	0.333
	3 days after operation	1 day after operation	-0.140*	0.062	0.026	-0.263	-0.017
		9 days after operation	0.070	0.045	0.120	-0.019	0.159
	9 days after operation	1 day after operation	-0.210*	0.062	0.001	-0.333	-0.087
		3 days after operation	-0.070	0.045	0.120	-0.159	0.019

*The significance level of the mean difference is 0.05. [b]Adjustment multiple comparison: LSD method (equivalent to no adjustment).

Table 5. Multiple comparison of BS duration between the groups by LSD-t test results

Time points	(I) Group	(J) Group	Mean value difference (I-J)	Standard error	Significance[b]	95% confidence interval for the difference[b]	
						Lower limiting value	Upper limit
1 day after operation	GA	GB	-0.07	0.08	0.386	-0.23	0.09
	GB	GA	0.07	0.08	0.386	-0.09	0.23
3 days after operation	GA	GB	-.530*	0.055	0	-0.639	-0.421
	GB	GA	.530*	0.055	0	0.421	0.639
9 days after operation	GA	GB	-.710*	0.046	0	-0.802	-0.618
	GB	GA	.710*	0.046	0	0.618	0.802

Based on the estimated marginal mean. *The significance level of the mean difference is 0.05. [b]Adjustment multiple comparison: LSD method (equivalent to no adjustment).

ered cured if the penis was straightened and the external urethral orifice was in the normal position at the front end of glans penis, without any perineum pain. Treatment was considered markedly effective if penile straightening signs, urination signs in the kneeling-squatting position, and perineum pain were improved obviously, with the symptom of urodynia occasionally. Treatment was considered effective if signs and symptoms were improved to a

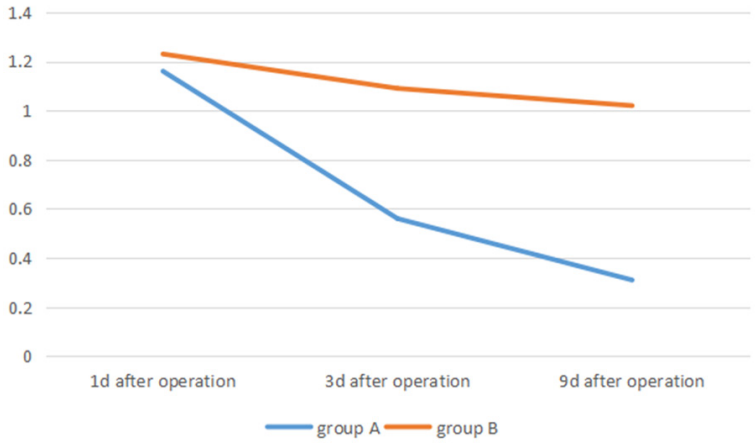

Figure 1. Variation trend of BS duration in the two groups. As shown in **Figure 1**, there was little difference in BS duration between the two groups 1 day after the operation ($P>0.05$). BS duration of GA was much shorter than that of GB at 3 days and 9 days after the operation ($P<0.05$).

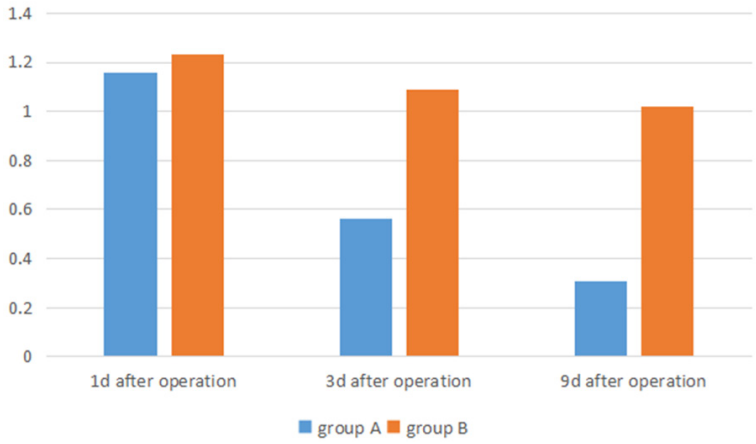

Figure 2. Average BS duration in the two groups. As shown in **Figure 2**, there was little difference in BS duration between two groups 1 day after the operation ($P>0.05$). BS duration of GA was much shorter than that of GB at 3 days and 9 days after the operation ($P<0.05$).

certain extent, but the external urethral orifice was basically located in the normal position at the front end of glans penis. Treatment was considered ineffective if signs and symptoms were not improved obviously and the penis was not straightened, with a symptom of urodynia. ORR = (total number of cases-number of ineffective cases)/total number of cases × 100%; ② The two groups were compared regarding operation related indexes, including OD, MFR, IBL, LOS, and HE; and ③ The two groups were compared regarding BS 1 day, 3 days, and 9 days after the operation, including BS duration, frequencies of BS, and frequencies of UE.

Statistical methods

SPSS22.0 software was used for data analysis. Enumeration data are represented by [n (%)] and were compared using independent sample χ^2 tests. Measurement data, in conformity with normal distribution, are represented by mean ± standard deviation ($\bar{x} \pm s$). Independent sample t-tests were used for comparisons between groups. Indexes at different time points were compared by repeated measures analysis of variance, as well as LSD-t tests. $P<0.05$ indicates statistical significance.

Results

Therapeutic effects

ORR levels in GA and GB were 87.76% and 90.70%, respectively, showing no significant differences in therapeutic effects between the two groups ($P>0.05$), as shown in **Table 1**.

Operation related indexes

The OD was (84.67±7.98) minutes in GA and (118.85±10.87) minutes in GB. Results indicate that the OD of GA was much shorter than that of GB ($P<0.05$). There was little difference in terms of MFR, IBL, LOS, and HE between the two groups ($P>0.05$) (**Table 2**).

BS duration

At 3 days after the operation, BS duration was (0.56±0.17) in GA and (1.09±0.34) in GB. At 9 days after the operation, BS duration was (0.31±0.09) in GA and (1.02±0.31) in GB, respectively (**Table 3**). BS duration in GA decreased gradually with an increase in time ($P<0.05$). BS duration in GB was significantly reduced at 3 days and 9 days after the operation, compared with that at 1 day after the

Table 6. Independent sample t-test results of frequencies of BS at different time points in both groups

Group	(I) Time points	(J) Time points	Mean value difference (I-J)	Standard error	Significance[b]	95% confidence interval for the difference[b]	
						Lower limiting value	Upper limit
GA	1 day after operation	3 days after operation	3.150*	0.298	0	2.557	3.743
		9 days after operation	4.980*	0.307	0	4.37	5.59
	3 days after operation	1 day after operation	-3.150*	0.298	0	-3.743	-2.557
		9 days after operation	1.830*	0.212	0	1.41	2.25
	9 days after operation	1 day after operation	-4.980*	0.307	0	-5.59	-4.37
		3 days after operation	-1.830*	0.212	0	-2.25	-1.41
GB	1 day after operation	3 days after operation	.680*	0.318	0.035	0.047	1.313
		9 days after operation	1.330*	0.328	0	0.679	1.981
	3 days after operation	1 day after operation	-.680*	0.318	0.035	-1.313	-0.047
		9 days after operation	.650*	0.226	0.005	0.201	1.099
	9 days after operation	1 day after operation	-1.330*	0.328	0	-1.981	-0.679
		3 days after operation	-.650*	0.226	0.005	-1.099	-0.201

*The significance level of the mean difference is 0.05. [b]Adjustment multiple comparison: LSD method (equivalent to no adjustment).

Table 7. Multiple comparison of frequencies of BS between groups by LSD-t test results

Time points	(I) Group	(J) Group	Mean value difference (I-J)	Standard error	Significance[b]	95% confidence interval for the difference[b]	
						Lower limiting value	Upper limit
1 day after operation	GA	GB	0.15	0.413	0.717	-0.671	0.971
	GB	GA	-0.15	0.413	0.717	-0.971	0.671
3 days after operation	GA	GB	-2.320*	0.284	0	-2.885	-1.755
	GB	GA	2.320*	0.284	0	1.755	2.885
9 days after operation	GA	GB	-3.500*	0.222	0	-3.942	-3.058
	GB	GA	3.500*	0.222	0	3.058	3.942

Based on the estimated marginal mean. *The significance level of the mean difference is 0.05. [b]Adjustment multiple comparison: LSD method (equivalent to no adjustment).

operation (P<0.05). However, the decrease was not significant between 3 days and 9 days after the operation (P>0.05) (**Table 4**). There was little difference in BS duration in GA and GB at 1 day after the operation (P> 0.05). BS duration levels in GA at 3 days and 9 days after the operation were much lower than those in GB (P<0.05) (**Table 5**) (**Figures 1**, **2**).

Frequency of BS

At 3 days after the operation, frequency of BS was (2.97±0.94) in GA and (5.29±1.72) in GB. At 9 days after the operation, frequency of BS was (1.14±0.36) in GA and (4.64±1.51) in GB. Frequencies of BS in GA and GB gradually decreased with increased time (P<0.05) (**Table 6**). There was little difference in frequencies of BS in GA and GB at 1 day after the operation (P>0.05). Frequencies of BS in GA at 3 days and 9 days after the operation were much lower than those in GB (P<0.05) (**Table 7**; **Figures 3**, **4**).

Frequency of UE

At 3 days after the operation, frequency of UE was (1.35±0.44) in GA and (3.66±1.12) in GB. At 9 days after the operation, frequency of UE was (0.31±0.09) in GA and (2.63±0.85) in GB (**Table 3**). Frequency of UE in GA decreased gradually with increased time (P<0.05) (**Table 8**). There was little difference in frequencies of UE in GA and GB at 1 day after the operation (P>0.05). Frequencies of UE in GA at 3 days and 9 days after the operation were much lower than those in GB (P<0.05) (**Table 9**; **Figures 5**, **6**).

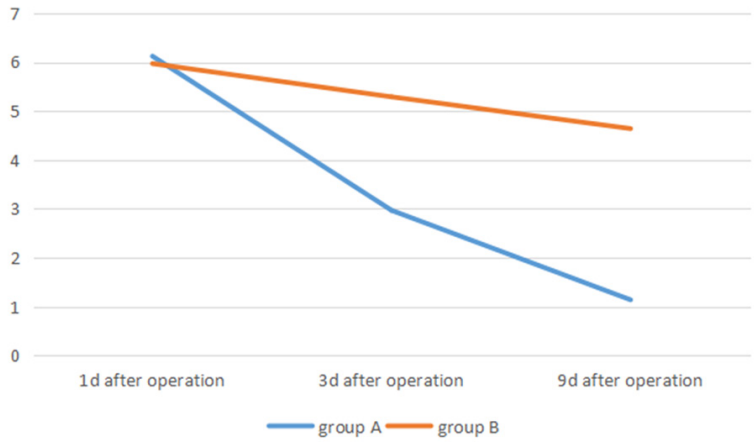

Figure 3. Variation trends of frequencies of BS in the two groups. As shown in **Figure 3**, there was little difference in frequencies of BS between two groups 1 day after the operation ($P>0.05$). Frequencies of BS in GA were much lower than those in GB at 3 days and 9 days after the operation ($P<0.05$).

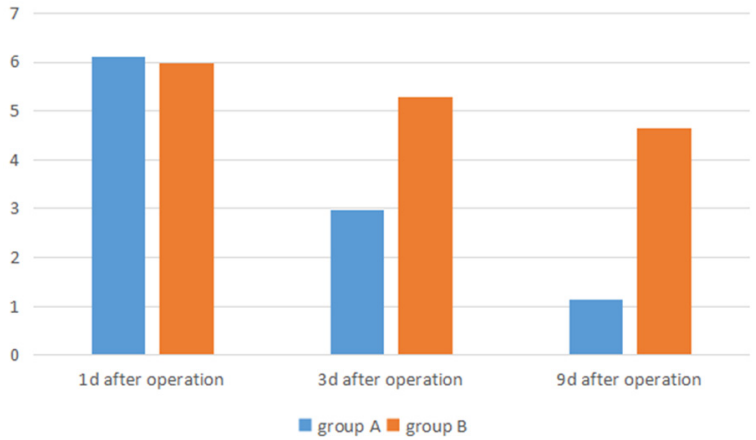

Figure 4. Average frequencies of BS in the two groups. As shown in **Figure 4**, there was little difference in frequencies of BS between two groups 1 day after the operation ($P>0.05$). Frequencies of BS in GA were much lower than those in GB at 3 days and 9 days after the operation ($P<0.05$).

Discussion

Hypospadias may be related to maternal pregnancy, environmental factors, and congenital genetic defects. With increasing incidence rates, it has an adverse impact on urination in childhood and sexual life in adulthood [6]. Treatment of hypospadias is clinically divided into the preservation or incision of the urethral plate. According to previous studies, urethroplasty is more suitable for children with hypospadias because their urethral plate has a lot of nerve vascularis, smooth muscles, and glands. Preservation of the urethral plate can make the formed urethra continuous and complete by using penile skin, reducing incidence of urethrostenosis [7-9]. TIP and MOIF were used for treatment of hypospadias in children in the present study, achieving good clinical therapeutic effects.

A common treatment method for hypospadias in children, TIP was first proposed in 1994. It has been widely applied to hypospadias since then [10, 11]. Taking advantage of abundant blood flow and elastic tissues in the urethral plate, the incision is made in the center of urethral plate in TIP. This is to increase the width of the urethral plate and reduce the influence on blood supply to the urethral plate. These factors are conducive to the formation and survival of the new urethra and to the postoperative recovery of normal urethra function [12-15]. The incision is made in the center of urethral plate in TIP to avoid the circular scar after operation. This helps to reduce incidence of urethrostenosis [16]. As a supplementation of TIP, MOIF can be used for more types of hypospadias. It matches the original urethra with the new urethra in a better way, ensuring the integrity and connectivity of the urethra. Moreover, the corpus cavernosum can support the new urethra and reduce incidence of urethrostenosis and urethra distortion [17]. The pedicled island flap is characterized by abundant blood flow and ample materials. Thus, it is incised and used as preputial skin in MOIF. Furthermore, the tension of anastomosis can be controlled [18].

Studies have shown that ORR levels of TIP and MOIF were respectively 88.46% and 84.62%, with good therapeutic effects on hypospadias in children [19, 20]. The present study showed little differences in ORR levels between GA

Table 8. Independent sample t-test results of frequencies of UE at different time points in both groups

Group	(I) Time points	(J) Time points	Mean value difference (I-J)	Standard error	Significance[b]	95% confidence interval for the difference[b]	
						Lower limiting value	Upper limit
GA	1 day after operation	3 days after operation	2.910*	0.195	0	2.523	3.297
		9 days after operation	3.950*	0.189	0	3.574	4.326
	3 days after operation	1 day after operation	-2.910*	0.195	0	-3.297	-2.523
		9 days after operation	1.040*	0.125	0	0.792	1.288
	9 days after operation	1 day after operation	-3.950*	0.189	0	-4.326	-3.574
		3 days after operation	-1.040*	0.125	0	-1.288	-0.792
GB	1 day after operation	3 days after operation	.430*	0.208	0.041	0.017	0.843
		9 days after operation	1.460*	0.202	0	1.058	1.862
	3 days after operation	1 day after operation	-.430*	0.208	0.041	-0.843	-0.017
		9 days after operation	1.030*	0.133	0	0.765	1.295
	9 days after operation	1 day after operation	-1.460*	0.202	0	-1.862	-1.058
		3 days after operation	-1.030*	0.133	0	-1.295	-0.765

*The significance level of the mean difference is 0.05. [b]Adjustment multiple comparison: LSD method (equivalent to no adjustment).

Table 9. Multiple comparison of frequencies of UE between groups by LSD-t test results

Time points	(I) Group	(J) Group	Mean value difference (I-J)	Standard error	Significance[b]	95% confidence interval for the difference[b]	
						Lower limiting value	Upper limit
1 day after operation	GA	GB	0.17	0.279	0.544	-0.385	0.725
	GB	GA	-0.17	0.279	0.544	-0.725	0.385
3 days after operation	GA	GB	-2.310*	0.173	0	-2.654	-1.966
	GB	GA	2.310*	0.173	0	1.966	2.654
9 days after operation	GA	GB	-2.320*	0.122	0	-2.563	-2.077
	GB	GA	2.320*	0.122	0	2.077	2.563

Based on the estimated marginal mean. *The significance level of the mean difference is 0.05. [b]Adjustment multiple comparison: LSD method (equivalent to no adjustment).

(ORR=87.76%) and GB (ORR=90.70%). Both operations were shown to achieve good therapeutic effects, in accord with previous relevant studies. Contents analyzed in this study included therapeutic effects of TIP and MOIF, as well as relevant indexes during and after the operation. OD of GA was much shorter than that of GB. There were no obvious differences in IBL, MFR, LOS, and HE between the two groups. Present results are in accord with relevant references for shorter OD in TIP [21, 22]. The reason may be that the pedicled island flap that has been incised is placed on the urethral plate and sutured. Additionally, the blood vessel on the dorsal side of the penis is protected when tissues of the vascular pedicle are separated. Thus, the operation becomes difficult and OD is prolonged [23]. However, TIP is relatively simple and easy, with the urethral plate expanded into urinary catheter merely. As a result, OD is relatively short.

OD and indwelling urinary catheters can stimulate the bladder, causing BS after the operation [23]. BS may lead to a strong micturition desire, complicated with UE and urethrospasm pain. These symptoms occur frequently every day for different time spans [24]. Children patients often feel agitated and in pain, crying and screaming due to urethra-spasms. These increase the incidence of urethrostenosis and incision infections. They may cause an adverse effect on postoperative recovery. In the current study, BS duration, frequencies of BS, and frequencies of UE in GA decreased gradually with increased time. Levels in GB were significantly reduced at 3 days and 9 days after the operation, compared to 1 day after the operation.

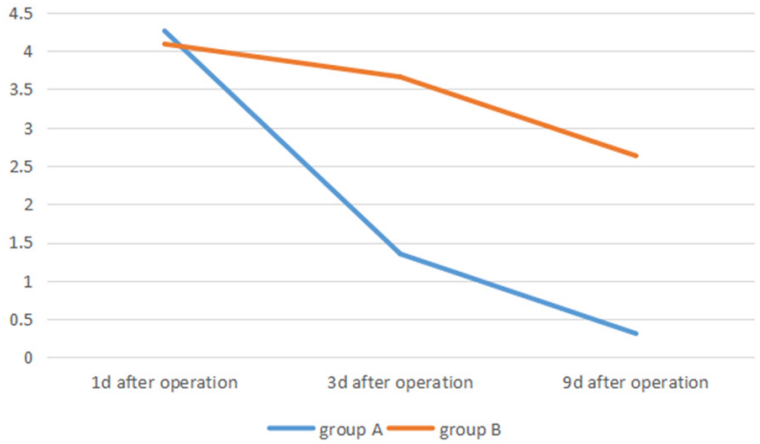

Figure 5. Variation trends of frequencies of UE in the two groups. As shown in **Figure 5**, there was little difference in frequencies of UE between two groups 1 day after the operation ($P>0.05$). Frequencies of UE in GA were much lower than those in GB at 3 days and 9 days after the operation ($P<0.05$).

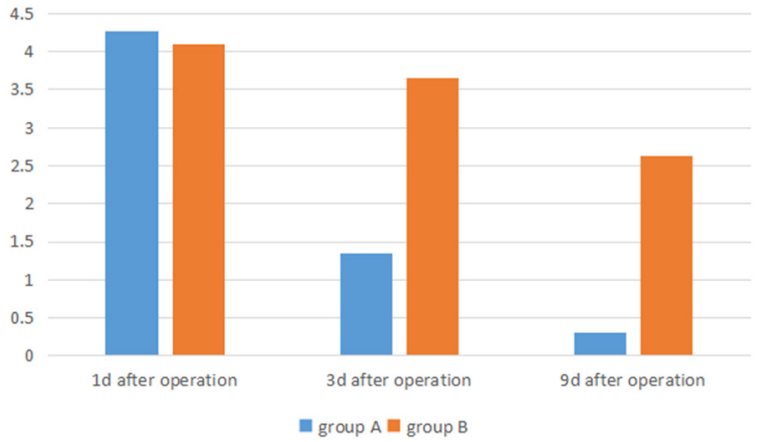

Figure 6. Average frequencies of UE in the two groups. As shown in **Figure 6**, there was little difference in frequencies of UE between two groups 1 day after the operation ($P>0.05$). Frequencies of UE in GA were much lower than those in GB at 3 days and 9 days after the operation ($P<0.05$).

However, no significant differences were found in the decreases between 3 days and 9 days after the operation. Frequencies of BA and frequencies of UE in GB decreased gradually with increased time. Present results suggest that both TIP and MOIF can ameliorate BS duration, frequencies of BS, and frequencies of UE. Previous studies have shown that incidence of BS after MOIF was higher than that after TIP, due to the longer OD of MOIF [25, 26]. As shown in the present study, BS duration, frequencies of BS, and frequencies of UE in GA were much lower than those in GB at 3 days and 9 days after the operation, in accord with previous results.

In conclusion, both TIP and MOIF have demonstrated good therapeutic effects on hypospadias in children. However, OD levels were shorter and the operative risks were lower in TIP. Moreover, the pain of children patients could be relieved as early as possible and the family burden could be eased. Thus, TIP is more suitable for children patients that need a re-operation. MOIF is more suitable for children patients with poor development of the glans penis and severe stenosis of the urethral plate. Additionally, TIP may greatly improve postoperative BS and reduce incidence of incision infections caused by agitation and pain. TIP showed an active effect on postoperative recovery. Therefore, in clinical practice, appropriate operations should be selected according to the actual situation of hypospadias, aiming to improve the therapeutic effects, reducing incidence of postoperative complications, and enhancing patient prognosis.

Disclosure of conflict of interest

None.

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