Original Article

Retrospective Comparative Study between Duplay and Koff Methods in Repair of Distal Hypospadias

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Abstract

Background: Hypospadias repair is a complicated surgery even in the best of hands. To date, there is a lack of consensus on which surgical technique offers more favourable post-operative outcomes. The present work was undertaken to evaluate and compare the outcomes and complications rates of two single-stage techniques widely used to repair primary anterior hypospadias, namely Thiersch-Duplay Tubularized Plate Urethroplasty and Koff Urethral Mobilisation and Advancement. **Materials and Methods:** Data from the medical records of 120 patients operated on for primary anterior hypospadias were retrospectively analysed and compared. The patients were divided into two groups: 60 patients underwent Thiersch-Duplay procedure (Group A) and 60 patients underwent Koff procedure (Group B). They were compared using the Chi-squared or Fisher's exact test to assess the relationship between the adopted surgical technique and the complications' development with a $P < 0.05$. **Results:** Neither intraoperative complications nor acute post-operative complications occurred, whereas 28.3% ($n = 34/120$) cases have exhibited at least one late post-operative surgical complication, including 38.3% ($n = 23/60$) in Group A and 18.3% ($n = 11/60$) in Group B, revealing a better outcome of the Koff procedure despite the statistical insignificance ($P = 0.102$). We did not objectify any other complication besides meatal stenosis (MS), urethro-cutaneous fistula (UCF) and wound dehiscence. **Conclusion:** Overall, our study could not demonstrate the superiority of one technique above another. At the same time, it established the versatility, satisfactory cosmetic and functional results, low MS and UCF rates of Koff urethral mobilization and advancement technique in primary anterior hypospadias repair.

Keywords: Complications, distal hypospadias, Duplay–Koff

Introduction

Hypospadias is the most common congenital malformation of the penis. It is a penile developmental disorder in which the urethral meatus is in an abnormal position: at the penial ventral surface, mostly distally and mostly on the glans in 70%–80% of cases, as it may be on the scrotum, or even on the perineum, with or without the presence of ventral penile curvature (VPC), or a hoody prepuce.[1] Unfortunately, its surgical management remains controversial with over 200 reported surgical methods for urethral reconstruction, some being merely modifications of modifications of original techniques, justified with hopes of minimising complications and improving functional and cosmetic results. From a practical surgical perspective, experienced surgeons and after correcting the VPC, they classify the position of the ectopic urethral meatus and establish the most appropriate surgical technique.[2] However, of the many surgical techniques that have been developed to correct distal hypospadias, two main methods have particularly attracted our attention: the Thiersch-Duplay procedure and the Koff procedure. Inopportunely, the question about which of the two techniques is more safe and effective remains controversial and unanswered.

This study aims to compare the efficacy of the two surgical procedures in terms of success and related complications commonly encountered, in order to recommend the best surgical treatment to repair primary distal hypospadias.

Materials and Methods

Study design and period

We assessed the two surgical techniques in a hospital-based

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retrospective comparative study conducted from January 2016 to December 2021.

Study area

The study area was at Pediatric Surgery Department, Hassan II University Hospital, Fes-MOROCCO. It is a reputable centre that recruits patients from all over the Fes-Meknes region.

Study population

Inclusion criteria

All boys admitted for anterior hypospadias (glanular/coronal, sub-coronal and distal penile) who underwent primary hypospadias repair. We chose to review exclusively primary cases because it allows the better assessment of the surgical technique and better evaluation of results since all patients had the quite same penile tissue condition.

Exclusion criteria

- Distal hypospadias with a history of previous repair (secondary hypospadias)
- Other types of hypospadias, namely mid-shaft or proximal/posterior
- Cases operated on with other techniques, namely Mathieu, MAGPI.

Sample size

We reviewed a total of 120 children that we divided into two groups based on the procedure they received:

- Group A: Comprises 60 patients who underwent Thiersch-Duplay urethroplasty [Figure 1]
- Group B: Comprises 60 patients who underwent Koff urethral mobilization and advancement repair [Figure 2].

It was the 1 first 60 consecutive cases reported in the chosen period that were taken for each method.

Surgical techniques

Thiersch-Duplay urethroplasty

The principle consisted in tubulizing the plate urethral on itself from the ectopic orifice to the top of the glans that means creating a new urethral tube (neourethra) by rolling up the tissue around a transurethral urinary catheter and sutured in the form of a tube. This tubulization assumes that the urethral plate is wide enough or which is facilitated by incising it on the midline (SNODGRASS). Some procedures were possibly associated with it: spongioplasty; covering the tube with a subcutaneous flap; incision of the plate according to SNODGRASS; reconstruction of the foreskin.

Koff urethral mobilisation and advancement repair

The principle of Koff urethral translation is to make the use of the elasticity of the urethra to bring it, by "translation" forward, in the right position (apex of glans). It follows these different stages:

- An incision along each edge of the urethral gutter until you find the healthy urethra surrounded by the corpus spongiosum, upstream of the division of the body which is the essential benchmark for defining the degree of severity of a hypospadias
- Release of the urethra from the ventral surface of the corpora cavernosa from the glans to the base of the penis
- Translation of the urethra to the top of the glans
- Meatoplasty, glanuloplasty and skin coverage.

Methods of data analysis

The obtained raw data were edited and coded in a database table on Microsoft Excel. Then, with the team's valuable collaboration from the epidemiology department of our medical school, we used the software program 'Statistical Package for the Social Sciences version 26' (SPSS). The variables were selected, and their statistic values were obtained.

Since all of our variables are categorical/qualitative, they were expressed in numbers/frequencies and percentages. They were compared using the Chi-squared or Fisher's exact test to assess the relationship between the adopted surgical technique and the complications' development.

With a $P < 0.05$

- $*P < 0.05$ indicated that differences were statistically significant
- $*P < 0.001$ was considered as highly significant
- $*P > 0.05$ was considered insignificant.

A graph analysis was performed using Microsoft Excel.

Results

In our series, age at surgery was collected and analysed as a trisected (<2 years, 2–5 years, >5 years) [Table 1]. The surgery on boys presented around the age of 2–5 years for both groups (68.3%; $n = 82/120$), followed by boys aged more than 5 years (18.3%; $n = 22/120$), then those >2 years (13.3%; $n = 16/120$). The difference between the two groups was not

Table 1: Series comparison concerning the age at repair

Age range (years)	Group A, *n* (%)	Group B, *n* (%)	*P*
<2	6 (10)	10 (17)	0.646
2–5	43 (72)	39 (65)	
>5	11 (18)	11 (18)	
Total	60 (100)	60 (100)	

n: Number of cases

Table 2: Series comparison according to the ectopic meatal location and prepuce condition

	Group A, *n* (%)	Group B, *n* (%)	*P*
Ectopic meatal location			
Glanular	15 (25)	18 (30)	0.748
Sub-coronal	8 (13)	6 (10)	
Distal penile	37 (62)	36 (60)	
Total	60 (100)	60 (100)	
Prepuce condition			
Complete	5 (8)	3 (5)	0.689
Incomplete	55 (92)	57 (95)	
Total	60 (100)	60 (100)	

n: Number of cases

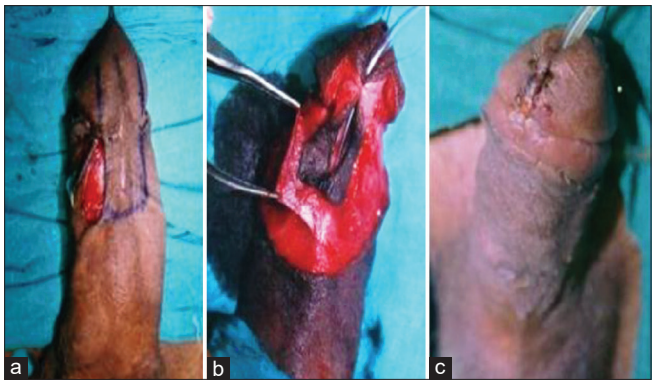


Figure 1: Duplay-SNODGRASS technique performed in our paediatric surgery department. (a) Operative photos showing the U-shaped incision to below the hypospadiac meatus. (b) Operative photo showing the urethral plate tubularisation. (c) Operative photo showing final aspect after glanuloplasty + skin closure

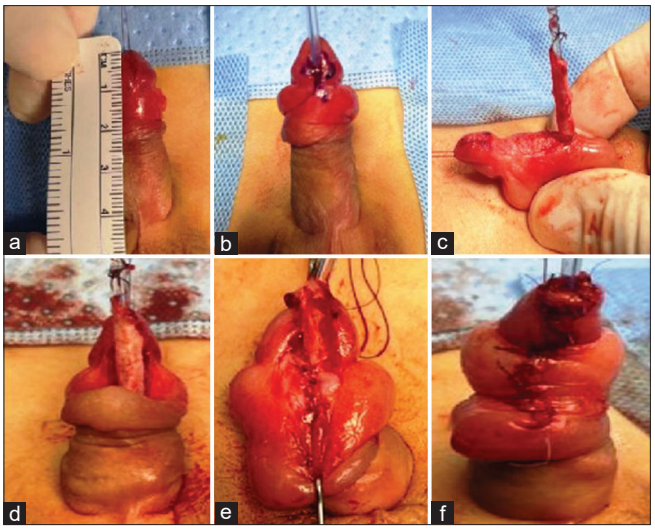


Figure 2: Koff technique performed in our paediatric surgery department. (a) Pre-operative photo showing an ectopic meatus located 1 cm away from the tip of the glans. (b) Operative photo showing the incision around the ectopic meatus. (c) Operative photos showing the complete mobilisation and release of the urethra. (d) Operative photo showing the urethra positioned in the mobilised glans and meatoplasty. (e) Operative photo showing the coverage with the Dartos layer. (f) Operative photos showing final aspect after glanuloplasty + skin closure

statistically significant in terms of age at repair ($P = 0.646$). The penial clinical assessment revealed the distal penile location [Table 2] as the most common hypospadiac location in both groups (61%; n = 73/120), followed by glanular (27.5%; $n = 33/120$) and sub-coronal at the last position (11.6%; n = 14/120). The difference between the two groups was not statistically significant in terms of hypospadias severity ($P = 0.748$). The foreskin's examination highlighted the incomplete prepuce (deficient ventrally and hooded dorsally) as the predominant presentation in both studied groups, marked by 93.3% ($n = 112/120$) cases compared to 6.7% ($n = 8/120$) cases with complete prepuce [Table 2]. The difference between the two groups was not statistically significant in terms of prepuce condition ($P = 0.689$). Before carrying out any surgical repair, none of our 120 patients presented with a Chordee or Penile torsion. None of the 120 patients of our study received any adjunctive hormonal supplementation, replacement or stimulation before the surgery. Regarding the performed anaesthesia techniques, our series disclosed three different methods, which the selection was based on urologist-anaesthesiologist's discretion. General anaesthesia (GA) was the most commonly used in both groups (85.8%; n = 103/120), followed by spinal block (SB) received by 11.6% ($n = 14/120$) cases, while sedation supplemented with caudal block (CB) was utilised occasionally (2.5%; $n = 3/120$) [Table 3]. However, none of the patients had a penile block. All of the 120 patients received prophylactic antibiotics systematically. Pre-operative antibiotics were given intravenously upon anaesthesia induction, in the form of 1 dose of third-generation cephalosporin (ceftriaxone or cefotaxime 50 mg/kg) or first-generation (cefazolin 30 mg/kg). Post-operative oral antibiotics consisted of Amoxicillin Clavulanate 3 times daily starting from day 1 after surgery up to 2 days beyond removing the indwelling urethral catheter. Topical antibiotics were not used. In our study, all 120 bloodless fields were maintained during surgery using a penile tourniquet, without cauterisation or epinephrine injection. In our study, regarding the urethral reconstruction for the patients who underwent Thiersch-Duplay urethroplasty, 5/0–7/0 Polyglactin (VICRYL) and polydioxanone sutures were used. They were sewn over a 6–10 Fr catheter either with running or interrupted patterns mainly dictated by the surgeon preference based on the local prerequisites. Although there remains a certain amount of scepticism and reluctance in offering preputioplasty to all patients, it is still a desirable component of every and each distal hypospadias repair performed in our department, whenever the case is considered suitable. Indeed, in our study, all the Duplay and Koff patients underwent a preputioplasty procedure. We do not circumcise our patients until the repair has definitely healed.

Table 3: Series comparison according to a peri-operative management

	Group A, *n* (%)	Group B, *n* (%)	*P*
Anaesthesia			
GA	52 (86)	51 (85)	0.299
SB	8 (14)	6 (10)	
CB	0	3 (5)	
Total	60 (100)	60 (100)	
DT			
Gauze	17 (28)	27 (45)	0.078
Honey	43 (72)	33 (55)	
No dressing	0	0	
Total	60 (100)	60 (100)	
Length of hospital stay			
<48 h	58 (96)	57 (95)	1.000
48 h–1 week	2 (4)	3 (5)	
>1 week	0	0	
Total	60 (100)	60 (100)	

n: Number of cases, GA: General anaesthesia, SB: Spinal block, CB: Caudal block, DT: Dressing type

Table 4: Series comparison according to a post-operative complications

	Group A		*P*	Group B		*P*
	Number of cases	*n* (%)		Number of cases	*n* (%)	
Age (years)						
<2	6	1 (16.6)	0.474	10	2 (20)	0.875
2–5	43	17 (39.5)		39	8 (20.5)	
>5	11	5 (45.4)		11	1 (9)	
Total	60	23		60	11	
Ectopic meatal location						
Glanular	15	7 (46.6)	0.464	18	2 (11)	0.753
Sub-coronal	8	2 (25)		6	1 (16.6)	
Distal penile	37	14 (37.8)		36	8 (22.2)	
Total	60	23		60	11	
Surgeon's qualification						
Mentors	27	10 (37)	0.967	28	4 (14.3)	1.000
Junior surgeons	33	13 (39.4)		32	7 (21.8)	
Total	60	23		60	11	
Anaesthesia						
GA	52	19 (36.5)	0.523	51	10 (19.6)	0.659
SB	8	4 (50)		7	1 (14.2)	
CB	0	0		2	0	
Total	60	23		60	11	
Dressing						
Gauze	17	8 (47)	0.458	28	8 (28.5)	0.103
Honey	43	15 (34.8)		32	3 (9.3)	
Total	60	23		60	11	

n: Number of cases, GA: General anaesthesia, SB: Spinal block, CB: Caudal block

Table 5: Distribution of late complications regarding the surgical procedure

Complications	Group A (*n*=60), *n* (%)	Group B (*n*=60), *n* (%)	*P*	Total (*n*=120), *n* (%)
Total patients with successful procedures	41 (68.3)	45 (75)	0.084	86 (71.6)
UCF	12 (20)	1 (1.6)	0.006	13 (10.8)
MS	4 (6.6)	0	0.067	4 (3.3)
WD	12 (20)	10 (16.6)	0.913	22 (18.3)

n: Number of cases, UCF: Urethro-cutaneous fistula, MS: Meatal stenosis, WD: Wound dehiscence

We prefer to keep the prepuce intact to ensure adequate tissue availability to correct any future complication of the primary repair. Catheterless or catheterised approach remains a source of controversy among surgeons performing distal hypospadias repair. Every patient of our series was equipped at the end of surgery with an indwelling transurethral urinary catheter, not only to maintain urinary diversion but also to keep the reconstructed plate pushed back into its bed and avoid the immediate post-operative painful micturition. We used silicone catheters with different sizes between 6 and 10 Fr. None of our boys got a suprapubic diversion. All of the patients in the present series had their bladders drained with a transurethral catheter for approximately 5–7 days, and all patients voided spontaneously after catheter removal. In order to evaluate post-operative care in affecting surgical success rate or wound healing, we compared the two series regarding the dressing type (DT) [Table 3]. The majority of our boys had Honey dressing for both groups (63.3%; *n* = 76/120), while the remaining 44/120 cases (36.7%) were dressed using simple Gauze compresses dressing followed by a bandage. The difference between the two groups was not statistically significant in terms of DT (*P* = 0.078). The penis was kept elevated and the glans visible and checked regularly postoperatively. Although a regimen of no dressing appears to result in increased patient comfort and decreased burden for the caregiver, none of the patients of our series was deprived of dressing. For all our study patients, the dressing was kept with the trans-urethral catheter and the patient was discharged with both. The dressing was not changed until simultaneous removal with the urethral catheter on the 5th–7th post-operative day. In the present study, the appraisal of the length of hospitalisation after surgical repair reported that-in both studied groups-the majority (95.8%; *n* = 115/120) of children were discharged during the first 48 h post-surgery, mostly the next morning, while none of them exceeded 1 week [Table 3]. The average hospital stay did not differ significantly (*P* = 1.000) between the two groups. Ketoconazole was not administered to any of our 120 patients, whereas all of them received anticholinergics. Our current regimen is to administer orally 5 mg of oxybutynin (Ditropan) prior to surgery, then 5 mg every 8 h until catheter removal. Overall, post-operative complications [Table 4] occurred in 34/120 (28.3%) patients and the rates were not significantly different (*P* = 0.605) when assessing for the impact of age at repair. Specifically, in 2–5 years range, >5 years range

Table 6: Series comparison according to the cosmetic appearance

	Group A (*n*=37), *n* (%)	Group B (*n*=49), *n* (%)	*P*
Apical meatus			
Yes	29 (78)	42 (85)	0.552
No	8 (22)	7 (15)	
Total	37 (100)	49 (100)	
No excess ventral or dorsal skin			
Yes	34 (92)	45 (92)	1.000
No	3 (8)	4 (8)	
Total	37 (100)	49 (100)	
US			
Single strong and straight	34 (92)	49 (49)	0.242
Reduced/spray	3 (8)	0	
Total	37 (100)	49 (100)	

n: Number of cases, US: Urinary stream

and <2 years range, the overall complication rates were 40.3% (25/82), 37.5% (6/21) and 25% (3/17) respectively. When adjusting to the surgical technique used for the hypospadias repair, the post-operative surgical complication rates were not significantly correlated with the age at repair (GA: $P = 0.474$/GB: $P = 0.875$), even though we had more complications in >5 years range in Group A versus more complications in <5 years range in Group B. Overall, post-operative complications occurred, including 22/74 (40%) patients with distal penile variant in the 1st position, followed by 9/32 (37.5%) with glanular in the second position and 3/14 (27.3%) with sub-coronal in last position. No statistical significance was achieved ($P = 0.728$). The ectopic meatal location in this study was not significantly correlated to the development of post-operative complications (GA: $P = 0.464$/GB: $P = 0.753$). However, we had more complications with glanular variant than distal penile in GA versus more complications in distal penile variant than glanular in GB. Overall, post-operative complications occurred in 34/120 (28.3%) patients, including 20/65 (30.7%) cases repaired by junior surgeons and 14/55 (25.4%) cases fixed by mentors ($P = 0.949$). The post-operative complication rate was not significantly correlated with the surgeon qualification (GA: $P = 0.967$/GB: $P = 1.000$), even though we had more complications under junior surgeons' hands in both groups. Overall, post-operative complications occurred in 34/120 (28.3%) patients and the rates were almost identical ($P = 0.474$) when assessing for the impact of anaesthetic technique. Specifically, after SB, GA and CB, the overall complication rates were 45.4% ($n = 5/15$), 28.1% ($n = 29/103$) and 0%, respectively. When adjusting to the surgical procedure used for the hypospadias repair, the post-operative surgical complication rate was not significantly correlated with the anaesthetic technique (GA: $P = 0.523$/GB $P = 0.659$), even though we had more complications under SB compared to GA in Group A versus more complications under GA compared to SB in Group B. Overall, post-operative complications occurred in 34/120 (28.3%) patients, including 16/45 (35.5%) cases wrapped with gauze, followed by 18/75 (24%) covered with Honey ($P = 0.153$). In this study, the post-operative complications rates were not significantly correlated with the DT (GA: $P = 0.458$/GB: $P = 0.103$), even though we had more complications with Gauze dressing than honey dressing in both groups. For all of our patients, the procedures were carried out without incidents. In addition, none of the reviewed children has shown any post-operative surgical complication within the first 10 days after repair, such as bleeding, haematoma, oedema and wound infection. Despite the advancement in the surgical field, even the most commonly used hypospadias correction techniques continue to challenge surgeons with post-operative complications most commonly meatal stenosis (MS), urethro-cutaneous fistula (UCF) and wound dehiscence (WD). In our series, 62.2% of patients ($n = 86/120$) had successful surgeries (free of complications); whereas 28.3% ($n = 34/120$) cases have encountered at least one post-operative surgical complication, including 38.3% ($n = 23/60$) in Group A and 18.3% ($n = 11/60$) in Group B, revealing a better outcome of the Koff procedure despite the statistical insignificance [$P = 0.084$, Table 5]. We did not objectify any other complication besides WB, UCF and MS in both groups. Moreover, none of the boys from Koffs group developed a complication before the 6th month postoperatively. The cosmetic appearance was assessed on the following criteria: apical meatus and excess residual skin [Table 6]. Both techniques gave excellent cosmetic results ($P = 0.575$), with better outcome in Koff group. For the most part, the non-apical meatus was the cause of the judged insufficient cosmetic results in both groups. However, there was not a significant difference between the two groups with regard to the meatal location ($P = 0.552$) nor concerning the excess skin ($P = 1.000$). Overall, a total of 83 cases out of 86 patients with successful surgeries (free of complications) (96.5%), had a satisfactory urinary stream (US) in a forward direction, while the remaining 3/86 (3.4%) patients had spray or reduced US.

Discussion

Hypospadias surgical repair can be performed at any age. The American Academy of Paediatrics[3] pointed out the age range of 6–18 months to perform surgery of the male genitalia. However, higher age at surgery leads to a higher surgical complication rate.[4] In our study, patients with more complications were obviously older than patients without complications. However, age was not a significant predictor of complications ($P = 0.605$). This is in part because our study included a considerable number of children aged 2–5 years. The degree of hypospadias is the most decisive risk factor for the frequency of complications after surgical repair.[5] In our study, the overall risk of complications after anterior hypospadias repair did not significantly correlate to the hypospadias degree, even after adjusting to the surgical technique (GA: $P = 0.464$/GB: $P = 0.753$).

However, our results were basically in accordance with the outcomes reported in the literature. It became apparent that surgical complications were more often encountered in proximal than in distal repairs. It is suspected that this is justified because

the longer defect length needs better tissue and richer vascular supply to repair and healing is relatively difficult.[6] The effect of suture materials on urethroplasty complications remains controversially debated. Whereas general agreement exists upon the use of absorbable sutures, surgeons are still divided over the use of materials with an early or delayed absorption rate.[7] Whilst the use of absorbable sutures for hypospadias repair has been universally accepted, there is no general agreement on the suturing techniques (interrupted or continuous). The choice is mainly dictated by the surgeon's preference.[8] The election of an appropriate wound dressing is one of the most controversial aspects of hypospadias surgery. In fact, there may be as many different types of dressing as there are types of surgical repair. An 'ideal' penile dressing should maintain the phallus in an upright (zenith) position, be non-adherent to the surgical wound, slightly absorbent, gently compressive but non-ischemic and yet elastic and soft to allow for slight swelling. Natural honey's benefits on open wound healing have been known for centuries, but the scientific foundations have been fully revealed and proven recently.[9] It has been confirmed to be safe and more effective than many expensive synthetic and biological dressings. For late post-operative complications, MS is a relatively common but avoidable unfavourable result that can be quite troublesome, causing harm to the bladder and thus the upper urinary tract. It can also lead to UCF development. In our study, the rate of MS was insignificantly higher with Thiersch-Duplay procedure (6.6%) when compared to Koff procedure (0%) ($P = 0.067$). These findings were consistent with the results reported Grosos *et al*.,[10] who demonstrated a high incidence of MS among the hypospadias repairs with Duplay procedure. The choice of a particular surgical technique is a key factor; a failure to invert all epithelial edges at urethroplasty, devitalisation of tissue and failure to add appropriate second-layer urethroplasty coverage may lead to UCF.[11] The rate of UCF formation seemed higher in the patients treated by the Duplay versus Koff.[12,13] In our study, a statistically significant difference in the UCF incidence was noted between the Koff team, with the less frequent UCF rate (1%), and the Duplay team (20%) ($P = 0.006$). WD is a discouraging complication after hypospadias surgery. All urology surgeons have definitely experienced the child who, despite what appears to be a well-performed operation, ultimately manifests this unexpected complication. In our study, WD occurrence was quite similar between the Koff group and the Duplay group ($P = 0.913$), which refutes the common theory consisting of the Koff technique resulting in the higher rates of WD when compared to Duplay technique.[14] The basic principles of hypospadias surgery are to reconstruct the urethra to the glans' tip, straighten the VPC, achieve acceptable cosmetic penile appearance and allow normal urinary and sexual function. These principles are well established and hundreds of surgical procedures have been described. In the end, the authors advocated that the anterior urethral advancement procedure is a safer and more reliable modality for distal hypospadias management. It has better cosmetic and functional results as well as a shorter operative time than SNODGRASS, which is concordant with our own results.[14]

Conclusion

The surgical management of anterior hypospadias depends on the surgeon's custom and is tailored to the child based upon anatomical variations, including meatal location, glanular size and degree of chordee. The Duplay procedure is suited for patients with a wider urethral plate that can be directly rolled up to complete the urethral formation, whereas the Koff procedure is an alternative to creating a neourethra by mobilisation and elongation of the existing urethra and advancing its meatus distally. Overall, our study demonstrated that both techniques gave comparable results in terms of dehiscence. However, the Koff repair was found to have highly significantly better results regarding UCF and MS rates than Thiersch-Duplay repair. Furthermore, more natural apical meatus and better urinary functional results were predominantly present with the Koff procedure.

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Conflicts of interest

There are no conflicts of interest.

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