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Comparative study in distal hypospadias repair: a meatal-based flaps technic vs. tubularized incised plate urethroplasty

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Abstract

Objectives Hypospadias is the most common anomaly of the male genital system after undescended testis. More than 200 surgical repair techniques have been described for the treatment of hypospadias due to many different meatus localisations and other accompanying anomalies. Kutlay defined a new technique in 2010 with 10 patients with distal hypospadias patients. We compared this new technique with tubularized incised plate urethroplasty (TIP) which is one of the most frequently performed methods.

Methods 148 patients with hypospadias who underwent surgery at the Urology and Pediatric Surgery Clinic during the period of January 2010 to December 2022 in the first and 2nd clinic, were retrospectively analyzed. The study focused on the remaining 83 patients with distal hypospadias for the purpose of comparison.

Results The mean age of group one was 10.0 (± 6.9 , range 2–27), while for group two it was 10.8 (± 5.9 , range 3–23). There was no statistically significant difference between the two groups in terms of anatomical position of the meatus, stricture and fistula complications ($p > 0.5$).

Conclusion The Kutlay technique has been described as an easy-to-learn and feasible method with reliable results. No significant difference in complications was observed in this study compared with TIP, which is known as the standard technique worldwide. We would like to suggest that the method be considered for further evaluation with larger patient groups and different techniques.

Keywords Hypospadias, Kutlay technique, Meatal-based flap, Snodgrass, Fistula

Introduction

Hypospadias is abnormal urethral meatus position which is proximal to its normal glanular position anywhere along the penile shaft, scrotum, or perineum. It's not only abnormal position of urethral meatus but also a defect complex, including ventral curvature of the penis (chordee), incomplete prepuce, and an undeveloped corpus spongiosum [1]. The prevalence of hypospadias is 1 in 300 male births. Due to the different anatomical position of the urethral meatus and different presentation of this anomaly complex, there are over than 200 hypospadias repair techniques described in the literature [2, 3].

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There are three main goals for hypospadias surgery: The most important is to move the urethral meatus to the glans tip, the second is to provide straightness of the penis or to correct the existing chordee and finally to provide a cosmetic appearance. Various approaches encompass meatus-based flaps, preputial island flaps [4, 5], techniques involving adjacent tissues for urethral reconstruction [6], as well as the elongation of the urethra [7] through skin and mucosal grafts [8].

Complications of these surgery are fistula formation, urethral stricture, infection and diverticula formation. Among these complications most important problem is fistula formation. The prevalence of fistula formation in all technique is 5–23% [9]. Fistula development can arise from various factors, primarily including infection, utilization of tissues with inadequate blood circulation, incorporation of fibrous or fragile skin, narrowing towards the end, and overlapping the skin stitching with that of the urethral sutures. As the fistula formation could be as high as one of four patient new techniques need to be found.

Kutlay defined a new technique in 2010 with 10 patients with 1/3 distal hypospadias patients. With mean follow up 13.4 months no fistula formation has seen [10]. With this study we compare Kutlay technique with tubularized incised plate (TIP/Snoodgrass) technique.

In this study, our primary aim is to provide a comprehensive and detailed comparison between Kutlay's technique, a novel approach introduced in 2010 for distal hypospadias repair, and the commonly used tubularized incised plate (TIP/Snodgrass) technique all around the world. By undertaking this comparative analysis, we aim to shed light on the effectiveness and outcomes of Kutlay's technique, considering its recent introduction and the need for further exploration and understanding. Specifically, we aim to assess the incidence of complications, particularly fistula formation, which is a significant concern in hypospadias surgeries.

Materials and methods

Study design

Between January 2010 and December 2022, a retrospective analysis was conducted on 148 patients with hypospadias who underwent surgery at the Urology and Pediatric Surgery Clinic, encompassing both the first and second clinics.

Approval for the study protocol was received by Istanbul Medipol University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (Approval Date: 12/07/2023, Reference Number: E-10840098-772.02-3633). The current research was conducted in accordance with the ethical guidelines stated in the Declaration of Helsinki. Consent for publication was obtained from all patients and their families of those under 18 years of age.

Although there are popular classifications such as Duckett and Barcat for hypospadias classification, anatomical definitions that define the location of the meatus generally provide more accurate results. We considered cases lower than the midpenile meatus as proximal hypospadias and excluded these cases from the study. Anatomical classification was made according to meatus localization. Only patients with distal hypospadias were included. Those with glanular hypospadias repairs (e.g., GAP, Pyramid, MAGPI) and more proximal hypospadias conditions (midpenile, scrotal, and perineal) were excluded from the study.

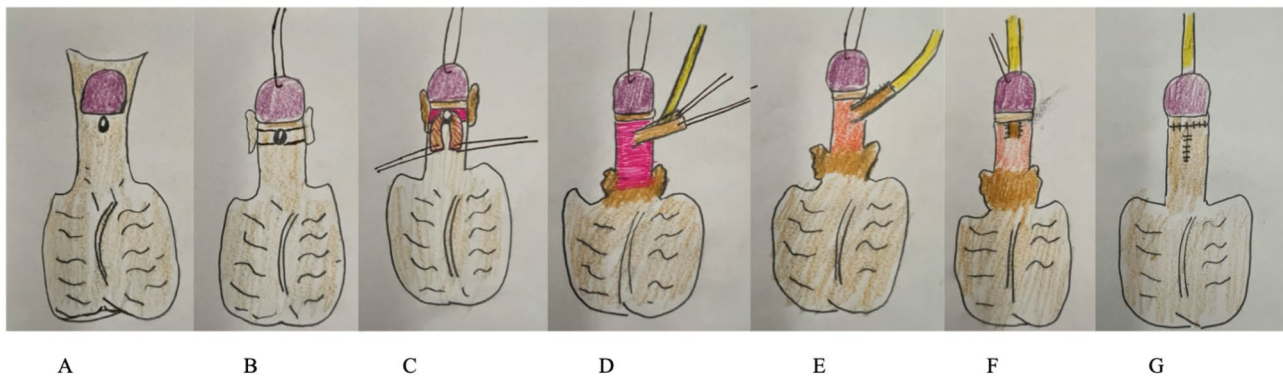
We conducted descriptive statistical analyses employing commercially accessible statistical software (SPSS® version 21.0). Fisher's exact test was preferred for statistical analysis. For significance level, $p < 0.05$ was considered.

Surgical technique

Kutlay procedure

Surgical technique consists of five main parts: (A) Planning meatal-based flaps. (B) Removal of flaps from the tunica albuginea and planning triangular glanular flap. (C) Suturing meatal-based flaps to each other around the tube. (D) Guiding the neourethra through the tunnel in the glans and suturing it to the triangular glanular flap, and (E) Closing the flap donor area by advancing the skin on the penile shaft distally.

After routine preparations, it was planned to create two flaps parallel to the coronal plane on both sides of the meatus. They were marked with a pen. Care was taken to ensure that the flaps were long enough to cover the urethral defect. These flaps were dissected gently from the tunica albuginea. The presence of the cord was confirmed by artificial erection. When the cord was identified, degloving was performed, with additional procedures carried out in cases of severe cords or dominant cords. Triangular glanular wings were lifted at the tip of the glans. Subsequently, a tunnel was created from the tip of the glans to form a neourethra on the glans. A silicone catheter of appropriate diameter was passed through the tunnel and directed towards the bladder. The flaps were then anastomosed around the catheter to form a tube. The flaps were later passed through the glans and meatoplasty was performed. Preputioplasty or circumcision was performed according to the family's preference. If circumcision was desired, the foreskin was left intact. On the 5th postoperative day, the urinary catheter was removed, and the patient's ability to urinate was evaluated. Patients were scheduled for follow-up appointments at one month and again at six months to assess their voiding function. (Figures 1 and 2) [10, 11].



Steps of Kutlay's Technic

- A. Planning meatal-based flaps.
- B. Incising parametral flaps.
- C. Removal of flaps from the tunica albuginea
- D. Planning triangular glanular flap.
- E. Suturing meatal-based flaps to each other around the tube.
- F. Guiding the neourethra through the tunnel in the glans and suturing it to the triangular glanular flap
- G. Closing the flap donor area by advancing the skin on the penile shaft distally.

Fig. 1 Drawing of the Stages of the Kutlay Technique **A.** Planning meatal-based flaps. **B.** Incising parametral flaps. **C.** Removal of flaps from the tunica albuginea **D.** Planning triangular glanular flap. **E.** Suturing meatal-based flaps to each other around the tube. **F.** Guiding the neourethra through the tunnel in the glans and suturing it to the triangular glanular flap **G.** Closing the flap donor area by advancing the skin on the penile shaft distally

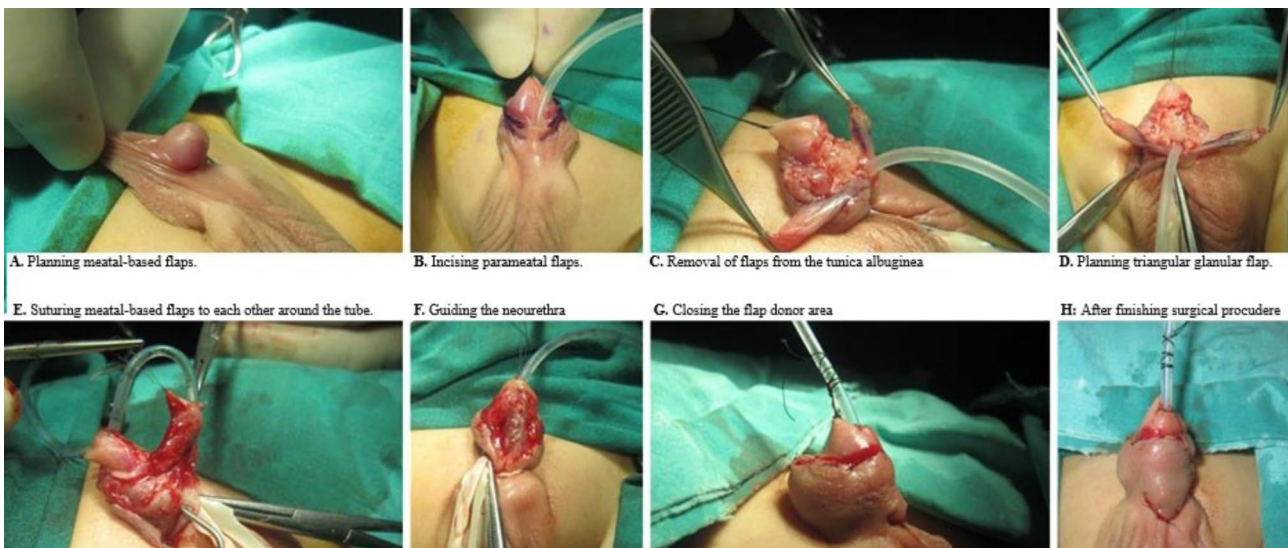


Fig. 2 Photographs of the Stage of the Kutlay Technique **A.** Planning meatal-based flaps. **B.** Incising parametral flaps. **C.** Removal of flaps from the tunica albuginea **D.** Planning triangular glanular flap. **E.** Suturing meatal-based flaps to each other around the tube. **F.** Guiding the neourethra through the tunnel in the glans and suturing it to the triangular glanular flap **G.** Closing the flap donor area by advancing the skin on the penile shaft distally. **H:** After finishing surgical method

TIP/TIPU/snodgrass

This procedure followed Snodgrass' protocol for execution. Beginning with the placement of a traction suture just beyond the ectopic meatus, a precise circumferential incision was made approximately 1–2 mm below the meatus. Subsequently, the penile skin was meticulously dissected until reaching the penoscrotal junction. Cases suspected of chordee underwent an assessment

through induced artificial erection, with dorsal plication performed if necessary. Following this, the urethroplasty phase commenced. The urethral plate underwent lateral dissection via two parallel longitudinal incisions, separating it from the glans wings. Post-placement of a 6 F urethral stent in the meatus, the mobilized urethral plate underwent a midline vertical incision as per Snodgrass' instructions. Closure of the incision involved a

Table 1 The anatomical position of the penile meatus of preoperative patients is in the table below

	Kutlay	TIP	P Value
	38 (100%)	45 (100%)	
Coronal	16 (42%)	9 (20%)	$p=0.1703^*$
Sub-coronal	13 (36%)	24 (53%)	$p=0.3208^*$
Mid-penil	9 (23%)	12 (26%)	$p=1.000^*$

*: P is not significant (Fisher's exact test)

Table 2 The anatomical position of the penile meatus of preoperative patients is in the table below

Complications	Kutlay	TIP	P Value
Fistula	2 (5%)	2 (4%)	$p>0.05^*$
Infection	0	1 (2%)	$p>0.05^*$
Urethral stricture	1(2%)	3 (6%)	$p>0.05^*$
Breakdown/dehiscence	0	0	
Total	3 (7%)	6 (6%)	$p>0.05^*$

*: P is not significant for overall complications (Fisher's exact test)

double-layer continuous 7/0 polydioxanone suture over the stent. In every instance, a protective flap from the penile dartos fascia proximal to the urethral anastomosis was fashioned to safeguard the newly formed urethra. Finally, the mucosal opening created by the preputial skin underwent closure using a rapid-absorbing 5/0 polyglactin suture [6, 7].

Results

The mean age of a total of 148 patients who underwent distal hypospadias repair was 6.1 (± 5.7 and range 0.5 to 27) years. Mean age of group 1 is 10,0 (± 6.9 range 2–27) and group 2 is 10.8 (± 5.9 range 3–23). The number of distal hypospadias included in the study was 83. The total average age was lower than the study groups. Table 1 shows the pre-operative anatomical position of urethral meatus and complications of both groups (Table 1). No statistical differences by anatomical position of two groups as in the Table 1 ($p>0.5$). In group 1 complication rates is statistical different by pre-operative anatomical positions of urethra ($p>0.5$).

Comparing the rates of complications, it was observed that only two patients (5%) in the first group experienced fistula formation, and also in the second group (4%). As anticipated, no notable statistical disparity was observed between the outcomes of these two categories. Fistula is considered the most troublesome complication, and all five fistulas were repaired six months later without any reoccurrence. Infection was observed in only one patient who underwent TIP repair, and it was successfully treated with oral antibiotics and topical antibiotic creams. No other complications related to infection were reported. Urethral stricture occurred in a total of 4 patients. One cases (2%) were from Group 1, while third cases (6%) were from Group 2. Patients with urethral strictures were

managed with urethral dilation program. After at least one and up to four dilations, all patients were able to urinate normally without the need for further surgical intervention. Similarly, no significant difference was found between the two groups in terms of stricture development ($p>0.05$) (Table 2).

All patients who underwent surgical repair were monitored postoperatively with a urethral catheter in the hospital. This period ranged from 5 to 7 days. At the end of one week, all patients were observed to void after the catheter was removed. Patients were followed for wound site infection and voiding calibration at the end of the first and second postoperative weeks. The third follow-up of patients was conducted at the end of the first month. Those with voiding problems were enrolled in a dilatation program. Patients who developed fistulas were kept under observation for fistula repair. Patients without complications were finally evaluated at the 6th month.

Discussion

Hypospadias is an important challenge with numerous techniques of repair but none of them standardized [12]. Most seen type of hypospadias is distal type with %50–70 of all hypospadias cases [13]. Anatomical position of urethral meatus moves more proximally the surgery becomes more complicated and less protected from complications. MAGPI and Snodgrass techniques are reliable and mostly accepted by surgeons as distal hypospadias repair [12].

As a reconstructive surgery hypospadias repair is complicated and fistula formation, urethral stricture and diverticula formation are main complications of this surgery. Fistula formation is most important complication with rates of 5–23% in all techniques [11]. Need of new techniques to solve complication problem is still important behind numerous of techniques defined in the literature.

Kutlay defined new technique with 10 patients; none of them had fistula in 13,4 mean follow up time. They defined most important advantage of this new from flip-flap technique no pedicle pressure, and the risk of fistula decreased because no circulatory problem could occur. Also the other advantages are no suture superimposition because of new urethra is covered by skin and glans and no usage of foreskin that some of parents wish to preserve the foreskin [10]. Chordee is most common pathology seen in hypospadias patients. It is an important problem because the need of sufficient urethral plate is important for correction of hypospadias [11]. Snodgrass dorsally plicate the penis to correct curvature in mild chordee patients [6]. Matheiu's technique is recommended if urethral plate is insufficient for Snodgrass technique [11]. Kutlay technique regardless the urethral plate is sufficient

chordee and penile shaft can be exposed and excised easily [10].

New study from Kocak et al. has found one fistula of thirty-one distal hypospadias patients with mean 9,3 months follow up time [14]. Both studies don't compare Kutlay technique with other hypospadias techniques. In our study we compare Kutlay technique with Snodgrass and no statistical difference found in complication of fistulas rates. In our study, we observed a statistically lower incidence of urethral stricture complications in the Kutlay technique. While the original description of the technique did not report any cases of fistula complications, our study identified two cases of fistula formation in the Kutlay technique. In both groups our fistula rate is nearly one for twenty patients which is lower from the rates defined in literature [15, 16]. The caseload in hypospadias repair is pivotal, and a recent report showed the severe consequences of bad management. A surgical repair that is not performed meticulously and surgical techniques performed without sufficient experience can be a lifelong nightmare for the patient [17]. After Snodgrass popularized the TIP technique, although other surgical techniques are less preferred, alternative methods that young surgeons can prefer in mild variations of hypospadias have also been presented in the literature comparatively with TIP [18].

Although the most distressing complications after hypospadias surgery may appear to be urethral fistula and glans dehiscence, it is actually well known that the most commonly occurring complication is urethral stricture. Bagasi et al. conducted a study involving 408 adult patients who had undergone primary hypospadias repair, where the localization of strictures following surgery was examined. Balanic strictures were manageable with short-term dilation programs, whereas surgical correction may be necessary for bulbar strictures. In our study, we observed urethral stricture more frequently than fistula. Due to the distal nature of the hypospadias surgeries, patients were able to regain normal voiding with a short dilation program [19]. Certainly, dealing with complications such as urethral strictures and fistulas is not always straightforward. Urethral dilation and primary repairs may lead to unsuccessful outcomes in some patients. Recent developments in tissue engineering emphasize the need to consider alternative treatment approaches for individuals with strictures and fistulas. A study that compiles data from six investigations demonstrates that there is promising potential in using tissue engineering, specifically employing epithelial oral or bladder mucosa, to address the complications associated with hypospadias [20].

The most important accepted fact in hypospadias repair is that surgical repair of all patients is not possible with a single method. The method is chosen according to the localization

of the meatus and the presence of additional anomalies. The surgeon should be interested in hypospadias surgery by mastering many techniques. Learning and practicing new techniques broadens the surgeon's vision of repair options. The Kutlay technique seems to be a very suitable method to avoid the fistula complication of hypospadias, but it may be preferred for patients with a well-developed glans, a normal meatus width and adequate penile development.

In conclusion our study is the first study that compares Kutlay technique for hypospadias repair with Snodgrass techniques. The results of our study shows no difference of fistulas complication rates beyond the Kutlay technique group has more complicated cases. In both groups one of twenty patient had fistula formation. As a new technique with well vascularized flap, comparison of Kutlay technique with other hypospadias repair techniques. More randomized prospective studies are needed for Kutlay technique.

The Kutlay technique, a novel approach for distal hypospadias repair, offers potential advantages over the TIP technique, including the creation of a wider urethra due to the use of two flaps for urethral tubularization. This wider urethroplasty is significant as it likely results in fewer complications related to stenosis in both mid-term and long-term follow-ups. Emphasizing these benefits could enhance the consideration of the Kutlay technique as a viable option for young surgeons.

Since the study was conducted in a remote region of Turkey, some hypospadias cases were diagnosed at a later age. Since the correction operation was performed at a later age, the average age was higher than the literature. In order to have more data for our study, patients treated by different clinics and surgeons were included. The small number of patients is a limitation of the study.

Acknowledgements

Not applicable.

Author contributions

SK: Data Collection, Methodology, Writing. MK: Data collection, Formal analysis. İG: Data collection.

Funding

Not applicable.

Data availability

The datasets generated and analysed during the current study are not publicly available due to patients' privacy but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study protocol was approved by Istanbul Medipol University, Faculty of Medicine, Non-Interventional Clinical Research Ethics Committee (Date: July 14, 2023, No: E-10840098-772.02-3633). This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Consent for publication was obtained from the family of the all patient.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 11 March 2024 / Accepted: 24 September 2024

Published online: 11 November 2024

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