

NEW SUGGESTIONS FOR CORRECTION OF THE SEVERE HYPOSPADIAS COMPLICATIONS

ÇİDDİ HIPOSPADİAS KOMPLİKASYONLARININ DÜZELTİLMESİ İÇİN YENİ ÖNERİLER

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ÖZET

Background: Severe hypospadias complications are defined as large urethral fistulae, chordee recurrence, and severe scar or skin defect limiting urethral reconstruction from the penis skin, and complications persisting in spite of multiple operations. In this study, new flap techniques applied on six patients with severe hypospadias complications have been introduced.

Methods: The 6 patients with hypospadias surgery complications and a mean age of 15.5 years, had undergone hypospadias repair operations an average of 4.5 times. Four cases had undergone repair using the Kutlay technique, one was repaired by island-formed penile skin flap, and the remaining case was repaired using a groin flap prefabricated by skin graft.

Results: In one of the patients, meatal stenosis was found in the first postoperative month. It was treated by continuous and intermittent urethral catheterization. In another patient, purulent drainage was observed secondary to postoperative soft tissue infection. A 0.2 cm urethra-cutaneous fistula was observed on the subcoronal region in the postoperative sixth month in this patient. Other patients had no chordee recurrence, fistula, urethral stenosis or other complications.

Conclusions: In patients with severe hypospadias complications, case-specific and reliable treatment options that may repair each component of the deformity should be used. As the severity of the deformity increases, more complicated and multiple-session techniques may be preferred for treatment.

Keywords: Severe hypospadias complications, hypospadias, Kutlay's technique, chordee

ABSTRACT

Giriş: Ciddi hypospadias komplikasyonları çok sayıda operasyon geçirmesine rağmen hâlâ geniş üretral fistüller, kordinüksü, penisten üretra rekonstrüksiyonunu sınırlandıracak ciddi skarlarıyada penis cildinde defekti bulunan hastalar olarak tanımlanabilir. Bu yazıda ciddi hipospadiaskomplikasyonu bulunan 6 hastaya uygulanan yeni flep teknikleri anlatılmaktadır.

Yöntem: Ortalama yaşları 15,5 olan hipospadias cerrahisi komplikasyonu bulunan 6 hasta daha önce ortalama 4,5 defa hipospadiasla ilgili operasyon geçirmişlerdi. Hastaların 4'üne Kutlay tekniği ile onarım yapılırken, bir hastaya random-paternli ada şeklinde penil skin flebiile ve diğer hastaya ise deri greftiile prefabrike edilmiş groinflebi ile onarım yapıldı.

Sonuçlar: Hastaların birinde ameliyat sonrası 1. ayda meatal darlık tespit edildi. Devamlı ve aralıklı üretralkateterizasyonlameatal darlığın tedavisi yapıldı. Bir başka hastada ise ameliyat sonrası gelişen yumuşak doku enfeksiyonu nedeniyle yara kenarlarından pürülan akıntı gelmeye başlandı. Bu hastada ameliyat sonrası 6. ay da subkoronal bölgede 0,3cm liküretrokütanöz fistül gözlemlendi. Diğer hastalarda kordinüksü, fistül, üretral darlık yada başka bir komplikasyon gözlenmedi.

Çıkarımlar: Ciddi hipospadias komplikasyonu bulunan hastalarda deformitenin her bir komponentini düzeltebilecek, olguya özgü ve güvenilir tedavi seçenekleri kullanılmalıdır. Deformitenin şiddeti arttıkça tedavide daha komplike ve çok seanslı teknikler tercih edilebilir.

Anahtar sözcükler: Ciddi hipospadias komplikasyonları, hipospadias, Kutlay tekniği, kordi.

INTRODUCTION

New techniques and modifications are still being reported for hypospadias repair.^{1,2} While fewer complication rates have been reported for hypospadias repair, new developments related to hypospadias complications have been rarely seen. The most frequent hypospadias complications are urethro-cutaneous fistula, chordee recurrence and meatal stenosis.³⁻³⁰ Patients with severe hypospadias complications are described

as having persistent chordee or fistula despite multiple operations, serious scars particularly on and around the urethra, urethral fistulae larger than the urethral meatus or those with penile skin defects, as well as the urethra. In patients with such severe hypospadias complications, the aim should be to reconstruct the urethra and correct the chordee, if present, to decrease the risk of recurrence. Furthermore, if a penile skin defect accompanies the deformity, the defect should be covered by

healthy skin tissue. To date, various surgical maneuvers have been defined for chordee or urethral repair in the management of hypospadias complications and many tissues have been used as the graft or flap.³⁻³⁰ To correct the deformities specific to each case, different new and safe treatment options that overcome the deficiencies are still needed. This study presents three different techniques applied on six patients presenting to our clinic with severe hypospadias complications. The Kutlay technique, which was first defined by Kutlay et al. in 2010 for hypospadias repair, was used in four patients, and it depends on the principle of using two meatal-based horizontal flaps in order to form the neourethra.¹ The flaps applied on the other patients presented here were randomly patterned island-form penile skin flaps and groin flaps prefabricated using skin grafts.

PATIENTS AND METHODS

Six patients with an age range of between 3 and 19 years (mean 15.5) who presented to our clinic between 2005 and 2011 with severe hypospadias complications underwent revisions utilizing new flap techniques. These patients had undergone previous hypospadias operations three to nine times (mean: 4.5). Two patients had glanular dehiscence, two patients had meatal stenosis, three patients had chordee, three patients had penile skin defects, five patients had urethra-cutaneous fistulae, and one patient had a urethral defect secondary to urethral necrosis. Five patients had undergone circumcision during the previous operations (Table I).

SURGICAL TECHNIQUE

Four patients (three had subcoronal fistula, and one had penoscrotal fistula) had undergone urethral repair by the Kutlay technique,¹ and one patient had undergone a two-staged urethral repair using randomly patterned island-form penile skin flap. The remaining patient had undergone urethral reconstruction using a groin flap prefabricated by skin graft. All of the patients were operated on under general anesthesia. The patients had undergone urethral catheterization according to their age and urethral size. Suprapubic urinary diversion was not applied on any patients. The patients received physiological serum (0.9% NaCl) injection into the corpus cavernosum by tourniquet application for intraoperative chordee examination, and artificial erection was achieved.

The Kutlay technique in patients with subcoronal fistula: In these patients, dissection was performed through a horizontal incision over the ectopic meatus towards the tunica albuginea, and those with chordee underwent chordee repair by excising the fibrotic bands over the tunica albuginea. Having measured the distance between the ectopic meatus and the most distal point on the glans penis, the length of the horizontal meatal-based flaps was planned accordingly. Both penile skin flaps were raised over the tunica albuginea. To protect the flap vascularity, sufficient subcutaneous

Table I. Characteristics of the patients with severe hypospadias complications

Nr	Name initials	Age	Circumcision	Number of previous operations	Glanular dehiscence	Meatal stenosis	Chordee	Fistula	Skin defect and management	Management of complications	Postoperative follow-up	Results
1	AK	3	Yes	3	No	No	Yes > 30°	Penoscrotal fistula (1 x 0.5 cm)	Yes / scrotal flap	Kutlay technique	3 months	no complications
2	MS	18	No	3	No	No	Yes > 30°	Subcoronal fistula (0.5 cm in diameter)	No	Kutlay technique	12 months	postoperative infection and subcoronal fistula (0.2 cm in diameter)
3	SD	17	Yes	5	No	Yes	No	Yes	No	Kutlay technique	12 months	no complications
4	FK	18	Yes	9	No	No	No	Subcoronal fistula (1.5 x 0.5 cm)	Yes / skin graft	Randomly patterned penile island flap (two staged)	15 months	no complications
5	EMR	18	Yes	3	Yes	No	Yes < 30°	Total urethral and skin defect from mid-penile region towards the distal end	Yes / groin flap	Prefabricated groin flap (three- staged)	12 months	no complications
6	CA	19	Yes	4	Yes	Yes	No	Subcoronal fistula (1 x 0.4 cm)	No	Kutlay technique	12 months	stent use for meatal stenosis

tissue was left on the lateral side of the meatus. A subcutaneous tunnel was created by a number 15 scalpel and was used in the transfer of the neourethra towards the glans. Then, the urinary catheter was removed, and it was placed into the urethra after having been passed through the tunnel in the glans. The meatal-based flaps were sutured, beginning from the fistula opening towards the distal using 6/0 or 7/0 monofilament polyglyconate synthetic sutures (Maxon®, Covodien Co, UK) around the catheter in the midline using the subcuticular continuous suturing technique. The distal end of the flaps that had been used to create a tube were passed through the tunnel in the glans penis and fastened to the anatomical external meatus. The ventral penile skin remaining under the fistula opening before the operation was sutured onto the glans penis skin, and the neourethra was completely covered by penile skin. In cases with chordee, the ventral penile skin was not sutured onto the glans penis and the incisions on both sides of the penis were sutured together to form a vertical scar at the midline (Figure 1). After the operation, mildly pressed dressings were performed (Coban®,

Operational Medicine 2001, US). On the second postoperative day, the pressed dressings were removed and daily standard dressings were performed. On the postoperative seventh day, the urinary catheters were removed, the patients were allowed to urinate, and they were then discharged.

The Kutlay technique in a patient with penoscrotal fistula: In the case with penoscrotal fistula, the Kutlay technique was performed by horizontal flaps harvested from both sides. Following the chordee correction, these flaps were formed as a tube, and in cases with subcoronal fistula, anastomosis was performed on the urethral opening, instead of transferring onto the tip of the glans (Figure 2).

Randomly-patterned island-form penile skin flap: The 18-year-old patient who had been operated on nine times previously on the penile area, had a wide subcoronal fistula that was 1.5x0.5 cm in diameter. The tissues around the fistula appeared extremely scarred due to the numerous previous operations. Urethral reconstruction using a randomly patterned penile skin flap

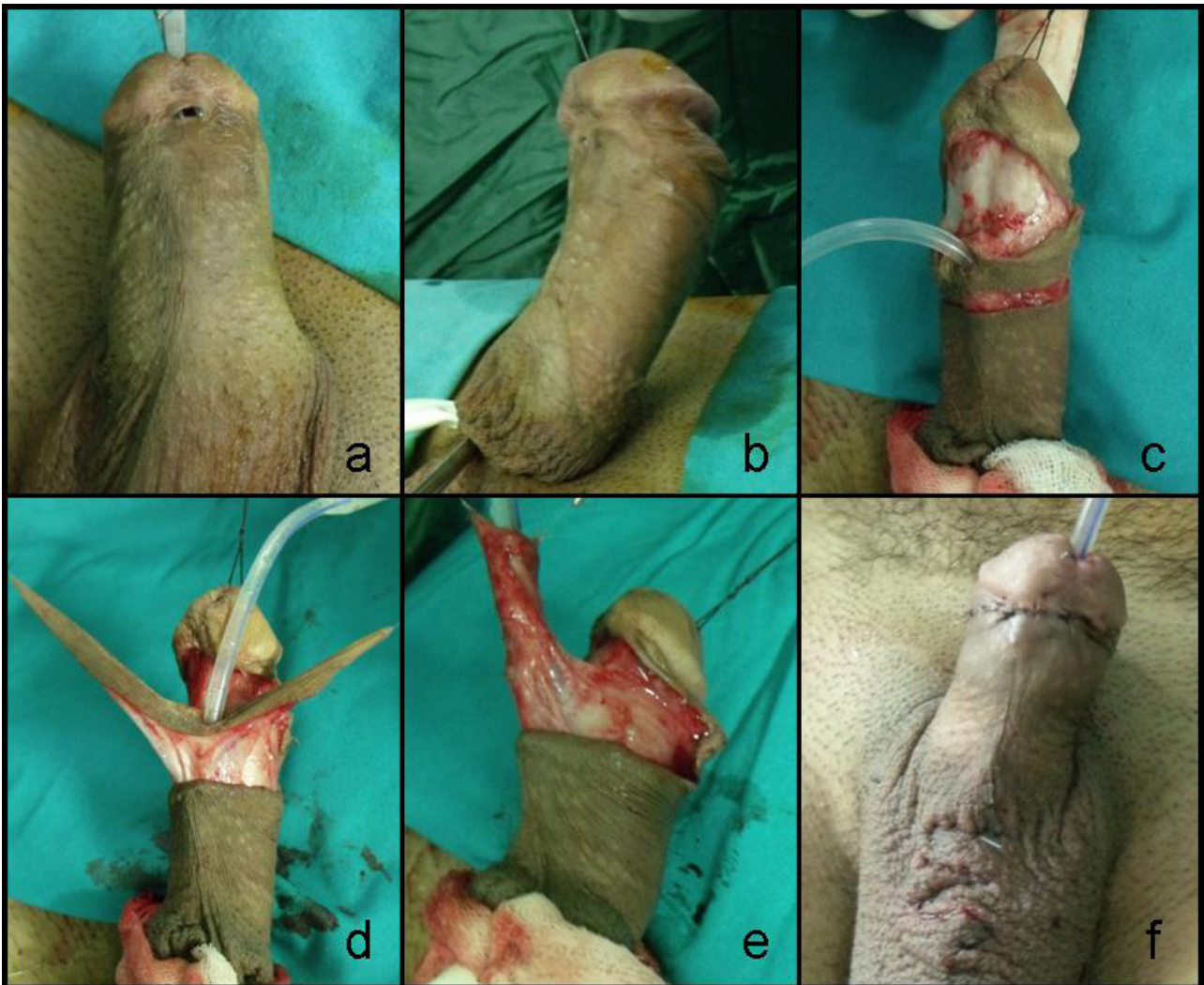


Figure 1. (a) Preoperative appearance of the patient, (b) Identification of chordee by artificial erection, (c) Incision of the horizontal flaps and chordee release, (d) Appearance of harvested horizontal flaps, (e) Tubularized horizontal flaps, and (f) Postoperative appearance of the penis following tunnelization of the horizontal flaps through the glans.

was planned. The fistula opening was dissected from the skin by an incision where it was connected to the skin. Then, a skin flap of the same size with randomly patterned fistula from the mid-penile region was planned, and the island-form flap was dissected by an incision from the surrounding skin. Without dissection from the dartos fascia in the flap base, it was sutured onto the fistula opening like a cover. The donor skin, which was separated from the flap by incision, was sutured

onto the skin on the edge of the fistula. The raised flap was left in situ for one month to vascularize from the recipient area. Then, a second operation was performed to remove the skin on the flap donor area where it had been sutured on the first session. The urethral defect on the fistula area covered by the penile island flap was closed by full thickness skin graft harvested from the incision line on the edge of the flap donor area. The skin defect on the flap donor area was repaired by primary

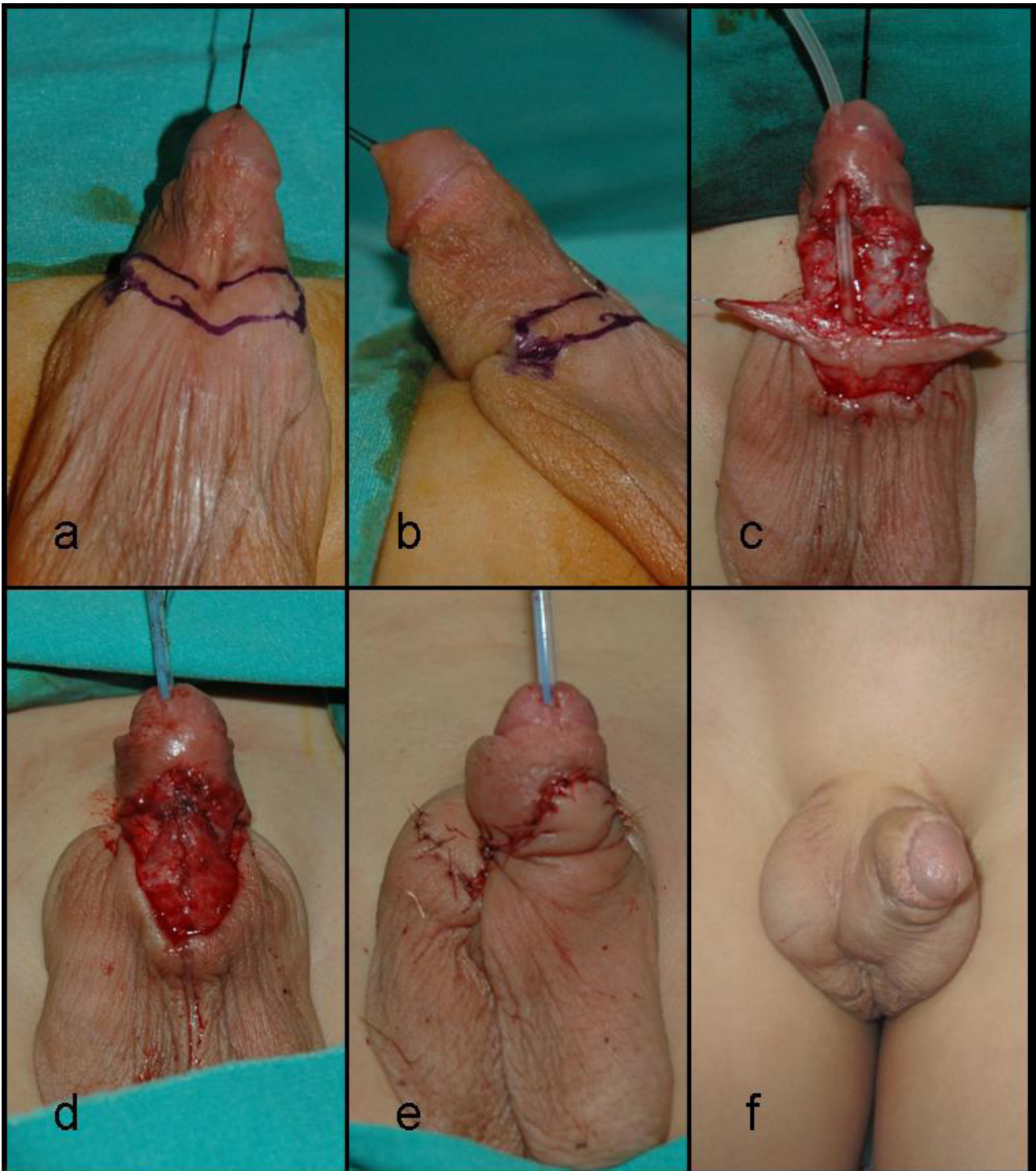


Figure 2. (a) Preoperative appearance of the penis with hypospadias complication and planning of the horizontal flaps in the Kutlay technique, (b) Side view of the penis and chordee preoperatively, (c) Appearance of the existing urethral defect after chordee repair and harvested horizontal flaps, (d) Appearance of the neourethra tubularized and anastomosed to the distal urethra and the skin defect on the ventral side of the penis, (e) Skin defect repair with the scrotal flap, and (f) Appearance on the postoperative third month.

saturation (Figure 3). At the fifteen month follow up, no complication was observed.

Groin flap prefabricated by skin graft

An 18-year-old patient was operated on three times for hypospadias and complications. After the last operation, tissue loss occurred due to necrosis of the penile skin and distal urethra. To repair both the penile skin and the urethral mucosa defect, the three-staged groin flap prefabricated with skin graft was used. During the first session, the full thickness skin graft raised from the right inguinal area was shaped as a tube around the urethral catheter and embedded inside the

subcutaneous tissue under the groin flap skin island in the left inguinal area. Ten days after the first session, the groin flap was harvested and tunnelized subcutaneously in the inguinal region and was transferred to the penis. The skin graft located in the flap on the first session was moved between the proximal urethra and the glans for urethral reconstruction. Three weeks after the second session, the groin flap was divided through its pedicle on the third session (Figure 4). The urinary catheter was removed on the seventh postoperative day, and the patient was allowed to urinate.

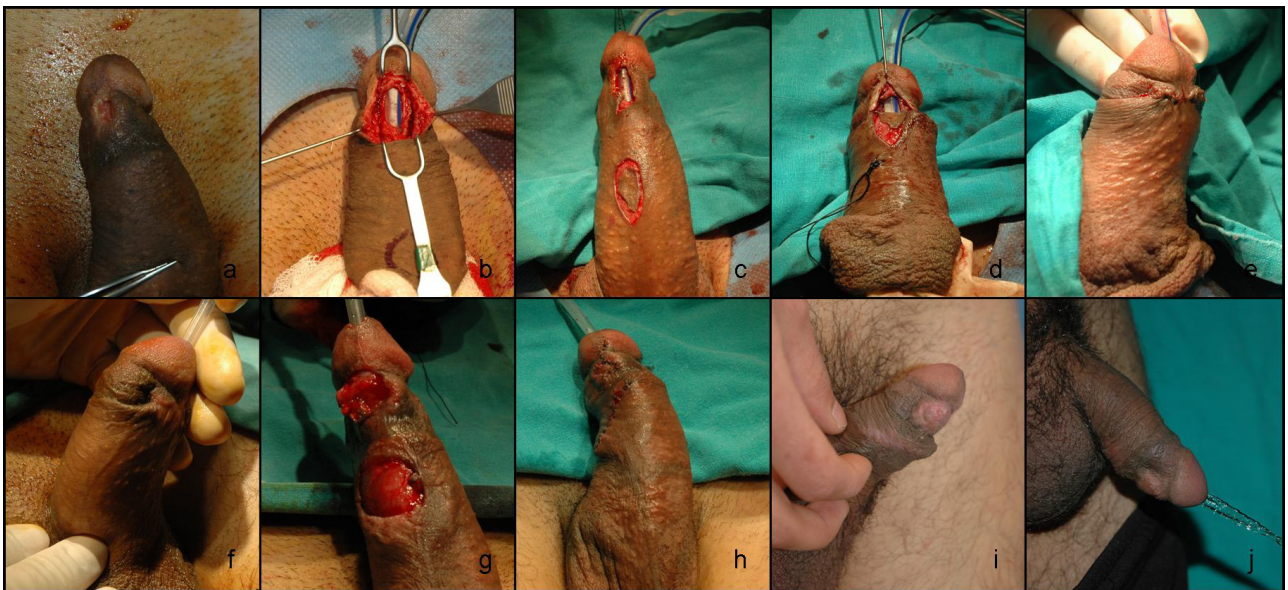


Figure 3. (a) Preoperative appearance of the wide fistula, (b) Dissecting the skin and the urethral mucosa through an incision in the fistula, (c) Mid-penile island flap incision, (d) Suturing of the island flap onto the area of the urethra defect like a cover, (e) Appearance following circular suturing of the flap donor area skin onto the skin around the fistula, (f) The patient's appearance before the second session, (g) Dividing the flap, (h) Primary suturing of the flap donor area and closure of the fistula region by skin graft, and Appearance of the patient on the fourth (i) and the seventh (j) postoperative month during urination.



Figure 4. (a) Appearance of the penis with hypospadias complication on the first session. The arrow shows the sutured skin graft area. The groin flap area and the vascularity were marked before prefabrication on the left inguinal region. (b) Transferring of the prefabricated groin flap by subcutaneous tunnelization to the penis on the second session (appearance of the groin flap sutured to the penile skin following urethral repair) (c) Appearance before the flap division on the third session, (d) Dividing the flap, (e) Suturing of the flap onto the penile skin and the postoperative appearance. Penile view from the side (f), anterior (g) and during urination (h) on the postoperative sixth month.

RESULTS

The mean follow-up period was 10.9 (3-15) months. In one patient who had undergone urethral reconstruction using the Kutlay technique, meatal stenosis was observed on the postoperative first month. Persistent urethral catheterization was applied for two months. Thereafter, the patient was instructed to insert the catheter three times a day for four months. After completion of this catheterization, no other complications were observed at the sixth month follow-up. In another patient undergoing the Kutlay technique, a purulent drainage through the wound began due to wound infection on the third postoperative day. The urinary catheter was changed, and the patient received sulbactam/ampicillin 3x1000 g and gentamicin 1x120 mg by parenteral route for seven days. Wound dressings were changed daily. Following this care, urethral catheterization was ended on the tenth day. At the postoperative sixth month follow-up, a 0.2 cm urethra-cutaneous fistula was observed on the distal penile area. To close the fistula, local fistula repair was planned. There were no chordee recurrences, fistulae, urethral stenoses or any other complications observed in the other patients.

DISCUSSION

The preferred surgical technique for hypospadias repair changes based on the area where the ectopic external meatus is located and the presence of chordee. However, in hypospadias reoperations, more factors are considered when determining the surgical technique. In these patients, the presence of urethra-cutaneous fistula, location of the fistula, the fistula width, the presence of glans dehiscence or chordee, severity of chordee, the presence of urethral stricture or urethral stenosis, wide scar areas due to previous operations in the penis and the presence of penile skin defect all play important roles in determining the surgical technique. Urethro-cutaneous fistula is one of the most common hypospadias complications. In the primary repair of small fistulae, the insertion of an additional barrier between the urethra and the skin is an intervention that decreases the risk of recurrence. As the additional barrier, the fascia lata graft, the dartos flap or the tunica vaginalis flap may be used.³⁻⁷ Urethral reforming techniques are needed in those with larger fistulae that cannot be repaired primarily or that require urethral transection due to chordee correction. In the management of these patients, an appropriate repair technique or urethral reconstruction with skin or mucosal grafts is used.⁸⁻¹⁴ There is no significant difference between the success rates of graft and flap surgery. In urethral techniques that are performed by flaps, the success rate ranges between 14% to 56%,¹⁴⁻¹⁷ while graft use for reconstruction has a success rate ranging between 10% to 57%.^{9,18-23} This variation shows that hypospadias cases with complications following primary repair encounter a higher risk of failure in preceding surgeries than in primary repair.

Another hypospadias complication is chordee recurrence. Chordee seen in hypospadias reoperations may also emerge from wide scar tissue around the urethral fistula, as well as in incomplete correction with primary repair or recurrence.²⁴ The common method used for chordee correction is plication in dorsal tunica albuginea of the penis.²⁴ This method is a reliable, easily applied and successful technique, often used for avoiding urethral transection. However, this method may result in a shortening of penile length in cases with severe chordee. Using wide urethral dissection, the chordee may be corrected without urethral transection.^{25,26} Nevertheless, it is not clear how the urethral vascularity may be preserved in these wide urethral dissections. In correcting the chordee, the dermis, the small intestinal mucosa or the tunica vaginalis may be used as a graft in tunica albuginea repair.²⁷⁻³⁰

Chordee was observed in three of the six cases reported here. In these cases having undergone several previous repairs, chordee repair was not considered after wide urethral dissection, as the urethral vascularity was suspicious. The Kutlay technique for hypospadias repair does not need urethral dissection or dorsal plication for chordee correction. In cases in which the ectopic urethral meatus is subcoronally located, bilateral meatal-based horizontal flaps are tunnelized under the glans and the tips are transferred after tubularization. Thus, glanular flap reformation and re-suturation of the flap sides are not necessary in cases with glanular dehiscence. Furthermore, because the glans and the penile skin are sutured to one another similar to the horizontal circumcision scar following urethral repair, there are no suture lines superposed between the neourethra and the penile skin. This approach decreases the risk of fistula in the Kutlay technique.

The patient who had been treated for hypospadias complication by randomly patterned penile island flap had undergone nine previous operations for hypospadias. Because of the wide scar areas present around the penis and the wide fistula opening, the vascularity of the meatal-based flaps raised in the Kutlay technique had a high risk. Therefore, the fistula was repaired using an island flap raised from the mid-penile region where there was no scar tissue. This surgical intervention appears to be appropriate for those with wide urethral fistulae and without chordee, despite a history of multiple operations.

In three of the cases presented here, skin defects accompanied the deformity. Skin graft, scrotal flap and groin flap are all used for the treatment of skin defects. We believe that the groin flap prefabricated with skin graft is an appropriate surgical alternative in patients who have urethral defect and severe skin defects. The groin flap is a commonly used flap for skin defects of the penile and scrotal areas.³¹⁻³³ In this case; skin graft was tubularized in the first session and was prefabrica-

ted between the skin and the fascia. The skin graft was used for urethral reconstruction, while the groin flap was used for skin reconstruction.

Complications developed in two of the patients presented here. A complication developed in the case with fistula, due to postoperative soft tissue infection. In the other case, the developing meatal stenosis may have contributed to contraction of the narrow glanular tunnel or the scar on the tip of glans penis due to previous operations.

In conclusion, it is obvious that these patients and their relatives will suffer more emotionally with new surgical interventions that may be unsuccessful. Despite multiple operations, case-specific and reliable treatment options that may correct each component of the deformity should be used rather than the standard techniques in cases with severe hypospadias complications, such as recurrent fistula, chordee formation secondary to recurrence or previous operations, fistulae larger than the urethral meatus, extremely scarred penis and penile skin defects. As the severity of the deformity increases, more complicated and multiple session techniques may be preferred. In addition, cases with chordee recurrence and wide fistula or glanular dehiscence are good candidates for the utilization of the Kutlay technique, if the areas where the flaps are raised are not scarred.

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REFERENCES

- Kutlay R, Isik D, Ercel C, Anlatıcı R, Isik Y: A new technique for correction of distal penile hypospadias. *Ann Plast Surg.* 2010, 65:66-9.
- Bilici S, Sekmenli T, Gunes M, Gecit I, Bakan V, Isik D: Comparison of dartos flap and dartos flap plus spongioplasty to prevent the formation of fistulae in the snodgrass technique. *Int Urol Nephrol.* 2011, 43:943-8.
- Kargi E, Yesilli C, Akduman B, Babuccu O, Hosnuter M, Mungan A: Fascia lata grafts for closure of secondary urethral fistulas. *Urology* 2003, 62:928-31.
- Ozturk H: Dartos flap coverage of the neourethra following repair for primary hypospadias, reoperative hypospadias and urethrocutaneous fistulas. It is a safe approach. *Acta Cir Bras.* 2010, 25:190-3.
- Routh JC, Wolpert JJ, Reinberg Y: Tunneled tunica vaginalis flap is an effective technique for recurrent urethrocutaneous fistulas following tubularized incised plate urethroplasty. *J Urol.* 2006, 176:1578-80.
- Landau EH, Gofrit ON, Meretyk S, et al.: Outcome analysis of tunica vaginalis flap for the correction of recurrent urethrocutaneous fistula in children. *J Urol.* 2003, 170:1596-9.
- Joseph DB, Perez LM: Tunica vaginalis onlay urethroplasty as a salvage repair. *J Urol.* 1999, 162:1146-7.
- Teague JL, Roth DR, Gonzales ET: Repair of hypospadias complications using the meatal based flap urethroplasty. *J Urol.* 1994, 151:470-2.
- Snodgrass W, Elmore J: Initial experience with staged buccal graft (Bracka) hypospadias reoperations. *J Urol.* 2004, 172:1720-4.
- Amukele SA, Stock JA, Hanna MK: Management and outcome of complex hypospadias repairs. *J Urol.* 2005, 74:1540-2.
- Söylet Y, Gundogdu G, Yesildag E, Emir H: Hypospadias reoperations. *Eur J Pediatr Surg.* 2004, 14:188-92.
- Hensle TW, Tennenbaum SY, Reiley EA, Pollard J: Hypospadias repair in adults: adventures and misadventures. *J Urol.* 2001, 165:77-9.
- Zhao M, Li Y, Tang Y, et al.: Two-stage repair with buccal mucosa for severe and complicated hypospadias in adults. *Int J Urol.* 2011, 18:155-61.
- Borer JG, Bauer SB, Peters CA, et al.: Tubularized incised plate urethroplasty: expanded use in primary and repeat surgery for hypospadias. *J Urol.* 2001, 165:581-5.
- Secret CL, Jordan GH, Winslow BH, et al.: Repair of the complications of hypospadias surgery. *J Urol.* 1993, 150:1415-8.
- Jayanthi VR, McLorie GA, Khoury AE, Churchill BM: Can previously relocated penile skin be successfully used for salvage hypospadias repair? *J Urol.* 1994, 152:740-3.
- Simmons GR, Cain MP, Casale AJ, Keating MA, Adams MC, Rink RC: Repair of hypospadias complications using the previously utilized urethral plate. *Urology* 1999, 54:724-6.
- Yerkes EB, Adams MC, Miller DA, Brock JW 3rd.: Coronal cuff: a problem site for buccal mucosal grafts. *J Urol.* 1999, 162:1442-4.
- Barbagli G, De Angelis M, Lazzeri M: Failed hypospadias repair presenting in adults. *Eur Urol.* 2006, 49:887-94.
- Metro MJ, Wu H, Snyder HM 3rd, Zderic SA, Canning DA: Buccal mucosal grafts: lessons learned from an 8-year experience. *J Urol.* 2001, 166:1459-61.
- Hensle TW, Kearney MC, Bingham JB: Buccal mucosa grafts for hypospadias surgery: long-term results. *J Urol.* 2002, 168:1734-7.
- Fichtner J, Filipas D, Fisch M, Hohenfellner R, Thüroff JW: Long-term followup of buccal mucosa onlay graft for hypospadias repair: analysis of complications. *J Urol.* 2004, 172:1970-2.
- Bracka A: Hypospadias repair: the two-stage alternative. *Br J Urol.* 1995, 76:31-41.
- Yucel S, Sanli A, Kukul E, KARAGUZEL G, Melikoglu M, Guntekin E: Midline dorsal plication to repair recurrent chordee at reoperation for hypospadias surgery complication. *J Urol.* 2006, 175:699-702.
- Snodgrass W, Bush N: Tubularized incised plate proximal hypospadias repair: Continued evolution and extended applications. *J Pediatr Urol.* 2011, 7:2-9.
- Bhat A: Extended urethral mobilization in incised plate urethroplasty for severe hypospadias: a variation in technique to improve chordee correction. *J Urol.* 2007, 178:1031-5.
- Badawy H, Morsi H: Long-term followup of dermal grafts for repair of severe penile curvature. *J Urol.* 2008, 180:1842-5.
- Leslie JA, Cain MP, Kaefer M, Meldrum KK, Misseri R, Rink RC: Corporeal grafting for severe hypospadias: a single institution experience with 3 techniques. *J Urol.* 2008, 180:1749-52.

29. Kajbafzadeh AM, Arshadi H, Payabvash S, Salmasi AH, Najjaran-Tousi V, Sahebpor AR: Proximal hypospadias with severe chordee: single stage repair using corporeal tunica vaginalis free graft. *J Urol.* 2007, 178:1036-42.
30. Caesar RE, Caldamone AA: The use of free grafts for correcting penile chordee. *J Urol.* 2000, 164:1691-3.
31. Atik B, Tan O, Ceylan K, Etlik O, Demir C: Reconstruction of wide scrotal defect using superthin groin flap. *Urology* 2006, 68:419-22.
32. Akoz T, Erdogan B, Gorgu M, Kapucu MR, Kargi E: Penile reconstruction in children using a double vascular pedicle composite groin flap. *Scand J Urol Nephrol.* 1998, 32:225-30.
33. Sun GC, Zhong AG, He W, Du P, Song WM, Ma JG: Reconstruction of the external genitals and repair of skin defects of the perineal region using three types of lateral groin flap. *Ann Plast Surg.* 1990, 24:328-34.