Combination of the pedicled penile skin flap with the penile advancement flap as a coverage technique for repair of urethrocutaneous fistulas secondary to urethroplasty

chongrui Jin (✉ jinchongrui@126.com)
Shanghai Sixth Peoples Hospital  https://orcid.org/0000-0003-4125-9214

Yinglong Sa
Shanghai Sixth Peoples Hospital

Yuemin Xu
Shanghai Sixth Peoples Hospital

Qiang Fu
Shanghai Sixth Peoples Hospital

Research article

Keywords: Urethrocutaneous, pedicled penile skin flap, penile skin advancement flap, urethroplasty

DOI: https://doi.org/10.21203/rs.3.rs-154779/v1

License: ☑️  This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License
Abstract

Background: The urethrocutaneous stula is a common complication secondary to urethroplasty. The management is complex and not standard yet. We report our experience and technique with combined pedicled skin flap and local skin advancement flap for urethrocutaneous fistulas secondary to urethroplasty.

Methods: We retrospectively analysed data of 36 cases of urethrocutaneous fistulas secondary to different urethroplasties treated from January 2014 to January 2019. All patients underwent treatment with the combination of a pedicled penile skin flap and local skin advancement flap as a coverage technique. The fistula size, fistula location, number of fistulas, and surgical outcomes of fistula repair were recorded. Postoperative evaluation included voiding cystourethrography, uroflowmetry. All patients underwent postoperative follow-up for 6 to 12 months.

Results: Fistula repair was successfully performed in all 36 patients. The overall success rate of urethrocutaneous fistula repair was 30/36 (83.3%). Three patients were cured after a second surgery, one was cured after wound dressing, and two were lost to follow-up after failure of the second surgery. Among all patients, the treatment success rate for urethrocutaneous fistulas in the coronal sulcus, penis, penoscrotal junction, and perineum was 2/2 (100%), 21/26 (80.8%), 5/6 (83.3%), and 2/2 (100%), respectively. The treatment success rate for small- and large-diameter urethrocutaneous fistulas was 23/27 (85.2%) and 7/9 (77.8%), respectively. The treatment success rate for single and double urethrocutaneous fistulas was 28/33 (84.8%) and 2/3 (66.7%), respectively. During the 6- to 12-month follow-up, one patient developed a urethral stricture at the urethral fistula repair site and was cured by urethral dilation.

Conclusions: The repair of urethrocutaneous fistula secondary urethroplasty induces minimal trauma but is quite challenging for surgeons and has a high failure rate. The combined pedicled skin flap and local skin advancement flap for coverage the urethrocutaneous fistulas secondary to urethroplasty can improve the success rate.

Background

Urethrocutaneous fistulas (UCFs) are the most common complications after surgical repair of hypospadias and other urethroplasty, with recurrence rates ranging from 0% to 27% [1]. The rate of fistula formation also remains problematic for other urethral diseases and improperly performed urethral surgeries. A UCF affects the patient’s normal urination can cause recurrent infection of the tissue around the fistula and the genitourinary tract, and can result in complications such as urethral stricture, seriously affecting patients’ physical health, mental health, and quality of life. Various surgical techniques have been used in the treatment of UCF, and no single technique is suitable or effective for all patients [2]. The incidence of fistula formation may decrease with increases in surgeons’ experience, reasonable vascularized flap designs, multilayer coverage, and tension-free suturing with appropriate suture.
materials. We herein report our experience using a combination of the pedicled penile skin ap and the penile skin advancement flap as a coverage technique in repair of UCF secondary to urethroplasty.

**Methods**

**Clinical materials**

We retrospectively analyzed the medical data of 36 male patients with UCF after urethral surgery in our department from January 2014 to January 2019. The collected data included the fistula size, location, and number; the distal urethral obstruction status; the condition of scar softening surrounding the fistula; and the surgical outcome of fistula repair. The clinical characteristics were listed in Table 1. Their mean age was 25.7 years (range, 10-55 years). Among the 36 patients, 24 UCFs developed after hypospadias repair or as a result of failed fistula repair, 2 developed after placement of an indwelling catheter, 2 developed secondary to a urethral calculus, 2 developed secondary to a urethral diverticulum, 2 developed after circumcision, 1 developed secondary to congenital anal atresia, and 3 developed after surgical repair of other urethral injuries. Of all 36 patients, 32 underwent 1 repair procedure and 4 underwent 2 or more repair procedures. We classified each UCF according to the fistula site; 2/36 (5.5%) were located at the coronal sulcus, 26/36 (72.2%) at the middle penis, 6/36 (16.7%) at the penoscrotal junction, and 2/36 (5.5%) in the perineum. A single fistula was observed in 33 patients, and 2 fistulas were seen in 3 patients. The mean fistula diameter was 8 mm (range, 5-15 mm); 27 fistulas had a diameter of <10 mm, and 9 fistulas had a diameter of >10 mm.

**Preoperative evaluations**

The repair procedures were performed with the patient under general anesthesia at least 6 months after the initial operation. Urinary bacteriological examination was performed to exclude urinary tract infection. An appropriately sized metal urethral probe was used to check for a distal urethral obstruction, and diluted iodine solution was then administered under pressure into the urethra through the external meatus to confirm the exact number and locations of the fistulas.

**Surgical technique**

Methylene blue was used to mark the location of a 2-mm incision made at the edge of the fistula. The skin along the marked line at the edge of the fistula was incised by a number 15 scalpel. The surrounding tissue was then separated subcutaneously, and the subcutaneous adhesion surrounding the fistula was loosened to ensure that the skin of the UCF could be sutured without tension. The unhealthy scar tissue at the edge of the urethral fistula was trimmed. A Foley catheter of suitable caliber was inserted into the urethra. An appropriately sized pedicled penile flap was taken from one side of the incision and then inverted to repair and cover the urethral fistula without tension. The surrounding subcutaneous tissue was raised from the other side of the incision and used to cover the fistula suture site, and a penile skin advancement flap was used to close the incision and thus complete the combined coverage. For distal urethral fistula, as coronary sulcus UCF caused by improper electrocoagulation during circumcision,
fresh tissues amenable to coverage were difficult to find after several failed surgical repairs. After closure of the fistula with continuous sutures, we placed a penile skin advancement flap beside the incision to cover the fistula and urethra (Fig. 1). For penile UCF due to improper dressing after circumcision, excessive pressure on the penis caused local skin necrosis. After multiple failed repairs, the local skin condition was poor. We designed a one-sided pedicled skin flap and transferred it to close the fistula and reconstruct the continuity of the urethra, and a lower-side penile skin advancement flap was then used to close the incision and complete the combined coverage (Fig. 2). For perineal and proximal UCF, a patient developed UCF due to surgical treatment of congenital anal atresia. In this case, a one-sided pedicled skin flap was used to repair and cover the urethra, and an opposite-side skin advancement flap was used to cover and reinforce the fistula surface (Fig. 3). Absorbable suture material (6/0 polydioxanone; Ethicon Inc., Somerville, NJ, USA) was used for both the fistula repair and skin incision closure. Any overlapping suture lines were noted during the repair procedure. A diluted iodine solution was injected into the urethra through the external meatus to test the effect of the UCF closure. The criterion for success was the absence of fluid leakage. Drainage from the incision was established to reduce the risk of hematoma and effusion if necessary, and Vaseline gauze with an elastic bandage was applied after skin closure and maintained for 2 days.

**Postoperative management**

Prophylactic antibiotics were continued for 3 to 5 days, and the urethral catheter was left indwelled for 5 to 7 days. Postoperative evaluation included voiding cystourethrography, uroflowmetry. We defined successful repair as normal voiding with a peak flow > 15ml/s and no fistula recurrence. All patients underwent postoperative follow-up for 6 to 12 months.

**Results**

All 36 patients enrolled in the study. A pedicled penile skin flap and a local skin advancement flap were successfully used in the present series of patients who had undergone multiple previous operations. No patients developed serious incisional infections after the operation. The overall success rate of UCF repair was 30/36 (83.3%) (Table 1). Uroflowmetry showed that maximum urine flow rate ranged from 17 ml/s to 24 ml/s (mean value 20 ml/s). Cystourethrography indicated continuity of the urethra and no contrast agent extravasation. Among these patients, the repair success rate for UCFs in the coronal sulcus, penis, penoscrotal junction, and perineum was 2/2 (100%), 21/26 (80.8%), 5/6 (83.3%), and 2/2 (100%), respectively. The repair success rate for single and double UCFs was 28/33 (84.8%) and 2/3 (66.7%), respectively. The repair success rate for UCFs with a diameter of <10 and >10 mm was 23/27 (85.2%) and 7/9 (77.8%), respectively. During the 6- to 12-month follow-up period, three patients developed a recurrent fistula and were cured after a second surgery, and two patients were lost to follow-up after failure of the second surgery. One UCF spontaneously resolved after wound dressing. One patient developed a urethral stricture at the urethral fistula repair site and was cured by urethral dilation.

**Discussion**
UCF formation is a common and frequently discussed complication after surgical repair of hypospadias and other urethroplasties. Possible causes of UCF include a urethral stricture, suture line dehiscence, an inappropriate repair technique with inadequate inversion of the mucosa, the use of inadequate layers for closure, ischemic tissue, or overlapping of the suture lines leading to suture line leakage [3,4]. In the present study, UCFs developed after various urethral diseases and improperly performed urethral surgeries (urethral stricture, urethral stones, urethral diverticulum, circumcision, indwelling catheter, urethroscopy, and other conditions).

Direct closure of a UCF is a commonly performed and technically easy procedure; however, this treatment is associated with a higher recurrence rate [5]. Possible reasons for repair failure are high tension of the direct suture line, leading to suture line dehiscence, and overlapping of the suture lines, leading to suture line leakage [4].

The frequency of UCF formation has decreased with increased surgeon experience, improvements in operative techniques, use of appropriate suture materials and instruments, and coverage of the urethra with well-vascularized tissue [6]. Many studies have shown that placement of a covering layer between the urethra and the penile skin is advantageous for fistula repair. Many materials have been suggested as effective covering layer materials, such as a local scrotal dartos flap, external spermatic fascia, a tunica vaginalis flap, and others [7,8,9].

Although coverage techniques are now performed as a routine step by most surgeons, each attempted repair further depletes the local tissue and makes the treatment more difficult. The reported recurrence rate of coronal sulcus fistulas is substantially higher than that of fistulas in other locations. This is probably related to the lack of sufficient soft tissue adjacent to the fistula and the more pronounced traction effect of erection on the repaired fistula as it gets closer to the glans [10]. To avoid this condition, we used a penile skin advancement flap to repair the coronary sulcus or distal UCFs. It is feasible and effective to treat the fistula with the penile skin advancement flap in the study. The advantages of this coverage technique are not only closure of the urethral fistula but also avoidance of direct communication between the fistula and the skin incision. The advancement flap we used can reduce the tissue deficiency and high tension of the incision; bring healthy, well-vascularized tissue over the urethral repair site; and avoid overlapping suture lines.

There is still a high recurrence rate of UCF after multiple operations of hypospadias, the lack of available surrounding materials and poor coverage are the main reasons. We designed the combined coverage technique. In this technique, the vascularity of the pedicled penile flap is maintained because it is harvested from the side opposite of where the skin advancement flap is raised. This procedure may avoid surgical failure caused by a poor blood supply to the skin. The combined coverage ensures stable adhesive formation between the UCF suture site and the penile skin tissue and promotes the healing of the UCF. When the penile skin advancement flap fully covers the skin wound, the principle of longitudinal, tension-free sutures should be followed. According to previous reports, pedicled tissue rotation may compromise the original shape of the penis [11], the advantages of the penile skin advancement flap are
that it reduces the tension of the local penile skin and reduces the penile rotation and abnormal appearance.

The site and size of the fistula and the quality of surrounding tissues may affect the outcome of fistula repair [12,13]. In the present study, the overall success rate of UCF repair was 83.3%, and patients with larger or multiple fistulas were more likely to develop recurrence. Additionally, the success rate of perineal fistula repair was high in our study. We believe that tissues for a pedicled skin flap and perineal skin advancement flap are relatively abundant in that region, are easy to harvest, and have good blood supplies. Although the number of patients in our study was limited, these characteristics can effectively improve the success rate of UCF repair. No serious infection occurred in any patients after the operation in the study. We believe that tissue coverage with a good blood supply provides more resistance to infection than administration of antibiotics.

Several important principles of successful UCF repair should be kept in mind: tension-free closure, multilayer coverage with well-vascularized tissue, avoidance of overlapping suture lines, and correction of distal obstruction [14,15]. Our surgical experience and results have led to certain recommendations for UCF repair. Previous procedures can adversely influence the results of subsequent surgical attempts. Patients whose fistulas fail to heal must undergo urethral fistula repair 6 months after surgery to soften the tissue induration and decrease tissue fragility. The suture material is another important aspect of proper repair [16,17]. We used absorbable 6-0 polydioxanone sutures in our patients; nonabsorbable or thicker delayed absorbable sutures should be avoided because the suture itself can cause fistula tract formation when it remains in place for a prolonged period of time.

Conclusions

UCF repair induces minimal trauma but is quite challenging for surgeons. The combined pedicled skin flap and local skin advancement flap for coverage the urethrocutaneous fistulas secondary to urethroplasty can improve the success rate. Clinical application has shown that this procedure deserves further promotion.

Declarations

Ethics approval and consent to participate

Written and verbal informed consent to participate was obtained from the patients or their relatives and this study was approved by the Ethics committee of Affiliated Sixth People's Hospital, Shanghai Jiao Tong University.

Consent for publication

Written informed consent for publication of their clinical details and clinical images were obtained from the patients.
Availabilty of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

Abbreviation

UCF: urethrocutaneous fistula

Competing interests

The authors declare that they have no competing interests

Funding

None.

Authors' contributions

CRJ., QF. contributed primarily to the Conception, Design; CRJ., YLS., YMX., QF. contributed to the performing of the research; CRJ. contributed to interpreting the data and writing the manuscript. All authors have read and approved the manuscript.

Acknowledgements

We thank Angela Morben, DVM, ELS, from Liwen Bianji, Edanz Editing China (www.liwenbianji.cn/ac), for editing the English text of a draft of this manuscript.

Authors' information

1 Department of Urology, Shanghai Jiao Tong University Affiliated Sixth People’s Hospital, Shanghai, China. 2 Shanghai Eastern Urological Reconstruction and Repair Institute, Shanghai, China.

References

1. Muruganandham K, Ansari MS, Dubey D, Mandhani A, Srivastava A, Kapoor R, Kumar A. Urethrocutaneous fistula after hypospadias repair: outcome of three types of closure techniques. Pediatr Surg Int. 2010;26(3):305-8.
2. Neilson AG, Nicholls G. Repair of hypospadias fistula using a penile skin advancement flap with penile dartos interposition. J Pediatric Urol. 2013;9(6 Pt A):890-4.
3. Rathod K, Loyal J, More B, Rajimwale A. Modified PATIO repair for urethrocutaneous fistula post-hypospadias repair: operative technique and outcomes. Pediatr Surg Int. 2017;33(1):109-12.
4. Richter F, Pinto PA, Stock JA, Hanna MK. Management of recurrent urethral fistulas after hypospadias repair. Urology. 2003;61(2):448-51.
5. Elbakry A. Management of urethrocutaneous fistula after hypospadias repair: 10 years' experience. BJU Int.2001;88(6):590-5.

6. Sunay M, Dadali M, Karabulut A, Emir L, Erol D. Our 23 year experience in urethrocutaneous fistulas developing after hypospadias surgery. Urology.2007;69(2):366-8.

7. Seo S, Ochi T, Yazaki Y, Okawada M, Doi T, Miyano G, Koga H, Lane GJ, Yamataka A. Soft tissue interposition is effective for protecting the neourethra during hypospadias surgery and preventing postoperative urethrocutaneous fistula: a single surgeon's experience of 243 cases. Pediatr Surg Int.2015;31(3):297-303.

8. Fahmy O, Khairul-Asri MG, Schwentner C, Schubert T, Stenzl A, Zahran MH, Gakis G. Algorithm for optimal urethral coverage in hypospadias and fistula repair: A Systematic Review. Eur Urol. 2016;70(2):293-8.

9. Routh JC, Wolpert JJ, Reinberg Y. Tunneled tunica vaginalis flap is all effective technique for recurrent urethrocutaneous fistulas following tubularized incised plate urethroplasty. J Urol.2006;176(4 Pt 1):1578-80.

10. Holland AJ, Abubacker M, Smith GH, Cass DT. Management of urethrocutaneous fistula following hypospadias repair. Pediatr Surg Int.2008;24(9): 1047-51.

11. Hayashi Y, Kojima Y, Kurokawa S, Mizuno K, Nakane A, Kohri K. Scrotal dartos flap for the prevention of the urethrocutaneous fistula on hypospadias urethroplasty. Int J Urol.2005;12(3):280-3.

12. Snyder CL, Evangelidis A, Hansen G, St Peter SD, Ostlie DJ, Gatti JM, Gittes GK, Sharp RJ, Murphy JP. Management of complications after hypospadias repair. Urology.2005;65(4):782-5.

13. Kiss A, Pirót L, Karsza L, Merksz M. Use of buccal mucosa patch graft for recurrent large urethrocutaneous fistula after hypospadias repair. Urol Int.2004; 72(4):329-31.

14. Waterman BJ, Renschler T, Cartwright PC, Snow BW, DeVries CR. Variables in successful repair of urethrocutaneous fistula after hypospadias surgery. J Urol.2002;168(2):726-30(discussion 729-30).

15. Chen W, Ma N, Wang W, Ju M. The application of multilayer direct closure with a longitudinal relaxing incision in urethrocutaneous fistula repair. Ann Plast Surg. 2020; 84(3): 317-21.

16. Feng J, Yang Z, Tang Y, Chen W, Zhao MX, Ma N, Wang WX, Xu LS, Li YQ. Risk factors for urethrocutaneous fistula repair after hypospadias surgery: a retrospective study. Ann Plast Surg.2017; 79(6): e41- e44.

17. Hardwicke JT, Bechar JA, Hodson J, Osmani O, Park AJ. Fistula after single stage primary hypospadias repair - a systematic review of the literature. J Plast Reconstr Aesthet Surg.2015; 68(12):1647-55.

Tables

Table 1. Patient characteristics and treatment success rates
| Character                      | No. Patients | Success (%) |
|-------------------------------|--------------|-------------|
| **Etiology**                  |              |             |
| hypospadias repair           | 24           | 19(79.2%)   |
| indwelling catheter          | 2            | 1(50%)      |
| urethral calculus            | 2            | 2(100%)     |
| urethral diverticulum        | 2            | 2(100%)     |
| circumcision                 | 2            | 2(100%)     |
| congenital anal atresia      | 1            | 1(100%)     |
| urethral injuries            | 3            | 3(100%)     |
| **Fistula number**           |              |             |
| Single                       | 33           | 28/33 (84.8%) |
| two                          | 3            | 2/3 (66.7%)  |
| **Fistula diameter**         |              |             |
| 1cm                          | 27           | 23/27 (85.2%) |
| >1cm                         | 9            | 7/9 (77.8%)  |
| **Site**                     |              |             |
| Coronal sulcus               | 2(5.5%)      | 2/2 (100%)  |
| penile                       | 26 (72.2%)   | 21/26 (80.8%) |
| penoscrotal junction         | 6 (16.7%)    | 5/6 (83.3%)  |
| perineum                     | 2(5.5%)      | 2/2 (100%)  |