

Skin Flaps Utilization for Urethroplasty: Review Article

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ABSTRACT

Background: As there is no dedicated artery to the flaps used in urethroplasty, a big dartos pedicle must be produced to ensure the skin stays alive. These flaps are typically made from the penile or scrotal skin. Flaps can be used to repair damage, but they need considerable dissection and a significant amount of time to harvest. When the dartos layer of the penis is redistributed from some or all of its typical circumference, scarring and loss of normal shape result.

Objective: This review article aimed to assess different roles of skin flaps for urethroplasty.

Methods: Skin flap, and Urethroplasty were all looked for in PubMed, Google scholar, and Science direct. References from relevant literature were also evaluated by the authors, but only the most recent or complete studies from January 2000 to May 2021 were included. Due to the lack of sources for translation, documents in languages other than English have been ruled out. Papers that did not fall under the purview of major scientific investigations, such as unpublished manuscripts, oral presentations, conference abstracts, and dissertations, were omitted.

Conclusion: Because of its high success rate and low risk of complications, urethroplasty flaps are an excellent choice for treating urethral strictures.

Keywords: Skin flaps, Urethroplasty.

INTRODUCTION

Pseudostratified columnar epithelium is the primary lining of the normal urethra. Vascular sinusoids and smooth muscles are abundant in the spongiosum, a connective tissue layer that lies beneath the basement membrane. Fibroblasts with an extracellular matrix made up of collagen, proteoglycans, glycoproteins, and elastic fibers make up the majority of connective tissue⁽¹⁾.

Stricture of the urethra is caused by a fibrotic process characterized by variable degrees of spongiofibrosis and resulting in diminished tissue compliance and a narrowed urethral lumen. Significant alterations in connective tissue are the hallmark of urethral strictures on the histologic front. Strictures, in conclusion, develop from epithelial harm and spongiofibrosis⁽¹⁾. It was reported by **Ueshima et al.**⁽²⁾ that injured epithelium developed ulcers and a covering of stratified columnar cells. Myofibroblasts and gigantic multinucleated giant cells were seen in abundance in the stricture. Collagen and strictures are products of both cell types.

Treatment options such as urethral dilatation and internal urethrotomy are underutilised because they are not curative when spongiofibrosis is present. Since the goal of treating urethral stricture disease is to cure the patient, urethral reconstruction has become the standard treatment⁽³⁾.

Skin Flaps of Urethroplasty:

Since there is no dedicated artery to the penile or scrotal skin flaps utilized in urethroplasty, a big dartos pedicle must be established in order to maintain the skin alive during the procedure. Harvesting a flap and performing the necessary amount of dissection can take a significant amount of time, which is a major drawback when employing a flap to do a repair. When the dartos layer of the penis is redistributed from some or all of its

circumference, scarring and a change in the penis's usual shape occur⁽⁴⁾.

Because they need to be revascularized, grafts are theoretically less dependable. Additionally, they require less time in the grafting procedure, making them more convenient for harvesting and deployment⁽⁴⁾. Multiple series of short- and medium-term graft and flap follow-up data show little difference in re-stricture rate between the two. For this reason, graft urethroplasty is favoured over open surgery whenever possible⁽⁵⁾.

There are occasions where a flap is better than a transplant, such when there has been local devascularization (due to radiotherapy or severe peripheral vascular disease), or when there is an infection at the site of the surgery. All of these problems make it impossible to perform a graft⁽⁴⁾.

Flap characteristics:

The perfect flap is defined by four main characteristics. The ideal flapping creature is (1) hairless, (2) at home in water, (3) versatile, and (4) Cosmically minded^(6,7).

a- Hairless:

Flaps should be made from skin that does not naturally produce hair. Urine that sits in touch with hair for long periods of time can cause bacterial colonization of the urethra, stone formation, and irritation. That's why you shouldn't settle for scrotal skin or skin closer to the proximal penile shaft, go for the prepuce instead⁽⁷⁾.

b- Aqueous environment:

Tissue that is native to or easily adapted to water should be given preference when deciding on a urethral graft. Skin that is not adapted to the climate will experience irritation and even squamous metaplasia. Stricture recurrence and malignant transformation are both

accompanied by chronic inflammation and metaplastic alterations, which is cause for concern. Infected, inflamed skin is also included ⁽⁷⁾.

c- Adaptable:

A flexible flap that can treat strictures in different parts of the urethra is preferable, as is one that can provide proper urethral caliber in different areas. Included in this category are skip lesion strictures. There are other areas of the groin that don't have hair, but they can't compare to the versatility of penile skin ⁽⁷⁾.

D- Cosmesis:

Anatomical skin marks must be taken into account while selecting the flap so that suture lines can be created that are approximations of the real thing. Flap placement should also take into account the presence of any concomitant skin disorders, such as vitiligo. When using flaps for tissue transfer, there is also the risk of crippling another structure ⁽⁷⁾.

Penile Skin Flaps:

Urethroplasty Utilizing a Skin Graft from the penile skin:

Pedicled skin grafting concepts were first reported for use in a novel one-stage urethroplasty for the treatment of penile and bulbar urethral strictures. Specifically, after incising the stricture site and making a ventral incision in the midline of the urethra, the patient's selected penile skin transplant is trimmed to fit the stricture's length and then inverted and sutured over the urethral defect ⁽⁹⁾. However, the inverted skin transplant will still have adequate mobility because of its broad connections to the dartos fascia ⁽⁹⁾. Reporting on 21 patients, one had a return of the stricture, and two developed hair and stones over the grafted area, both of which required transurethral excision and revision ⁽⁸⁾.

However, **Mahmoud et al.** ⁽¹⁰⁾ mentioned a similar procedure for repairing penile strictures in infants by permitting the formation of a skin island connected to the mainland by a dartos fascia that has been pedicled, thus Orandi's description isn't entirely novel ⁽¹¹⁾. As early, it was described significant developments in Orandi's method ⁽¹²⁾.

Although vascularized skin flap urethroplasties have been demonstrated to be effective in treating penile strictures, they have not been widely used to treat bulbar or membranous strictures due to the risks of pseudo-diverticula and stone formation, as reported by **Blanc et al.** ⁽¹³⁾.

Regardless, Orandi's approach was the standard for a long time for dealing with penile urethral strictures. Single-stage urethroplasty using a transverse distal penile-preputial cutaneous island flap, a technique identical to that described by Duckett for hypospadias repair described by **Pederzoli et al.** ^(14, 15).

When it comes to repairing complex anterior urethral strictures in a single procedure, **Heo et al.** ⁽¹⁶⁾

demonstrated the long-term success of using a circular fascio-cutaneous flap from the distal penile. Median follow-up was 7.3 years (range 1 month to 19.5 years), median stricture length was 8.2 cm (range 0-24), and overall success rates at 1, 3, 5, and 10 years were 95%, 89%, 84%, and 79%, respectively. The study comprised 124 patients.

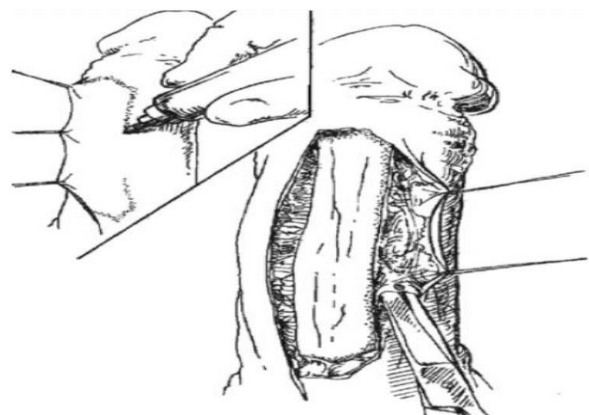
Repair of a hypospadias that had been caused by smoking was more likely to fail if the stricture had been longer than 7 centimeters. Among the most commonly reported side effects were hemorrhage, urinary extravasation, necrosis of the penile skin, and a loss of penile feeling. Repair of long, difficult penile or peno-bulbar urethral strictures continues to be one of McAninch's most often performed surgeries ⁽¹⁶⁾.

Types of penile skin flaps:

Flaps of skin on the penile are categorised anatomically. In line with what **Liang et al.** ⁽¹⁷⁾ have described, in order to describe the harvest flap's orientation (longitudinal vs. transverse), the location of the skin island's origin (proximal vs. distal penile skin), the flap's vascular supply (dorsal vs. ventrolateral pedicle), and the flap's incorporation into the urethra. We divided the urethra into four sections (onlay vs. tube vs. combined tissue transfer). In addition to the physical description, the eponym of the describing surgeon is often included when referring to flaps in the literature.

Longitudinal ventral penile skin flap with lateral pedicle ⁽⁸⁾:

Stretching the penis, an incision is made across the strictured area, running vertically down the ventral penile shaft for a distance approximating the stricture length. Flap harvesting necessitates a deep incision, which should be made lateral to the corpus spongiosum. An incision is performed laterally along the contralateral urethra until normal urethral mucosa is met at both the proximal and distal urethrotomy sites. Finally, the urethrotomy defect is matched with a skin island that has been dissected to fit the opening. The flap is then sutured to the urethrotomy in a tension-free anastomosis after the superficial incision is performed



and carried laterally to free the skin island ⁽⁸⁾.

Figure (1): Orandi flap harvesting method ⁽⁸⁾.

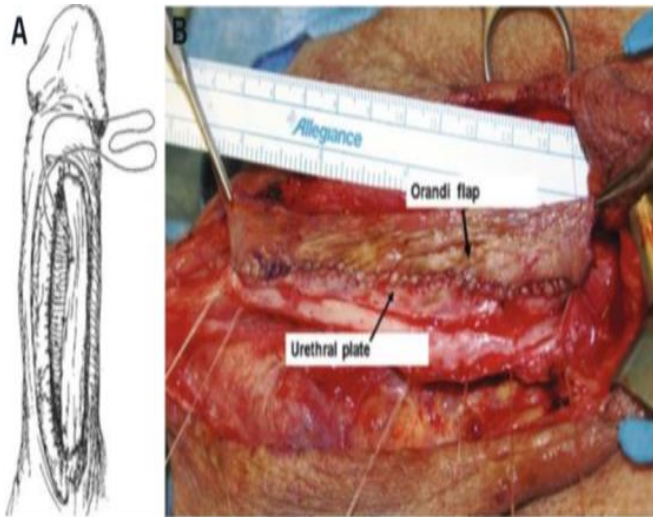


Figure (2): (A) The Orandi flap is rotated and an onlay anastomosis is performed. (B) Closing the urethral opening with an Orandi skin flap. Later, the flap's contralateral side is anastomosed, and a Foley's catheter was inserted ⁽⁸⁾.

Longitudinal ventral penile skin flap with ventral pedicle ⁽¹⁸⁾:

This is a ventral skin island flap, similar to the **Benson *et al.*** ⁽⁸⁾ method. The pedicle in the ⁽¹⁸⁾ procedure comes from the bilateral ventrolateral arteries and is typically used in the bulbar urethra. In most cases, the skin marking is done after the bulbar urethral stricture has been characterised through perineal dissection. It is the distal tip of the flap that develops into the skin island's deep plane, while the proximal tip develops into the skin island's superficial layer. Next, the island and pedicle are brought up and inverted through the scrotal tunnel and out the separate perineal incision so that they can be incorporated into the bulbar urethra. In the current medical literature, this procedure is most often discussed in the context of increased anastomotic urethroplasty ⁽¹⁸⁾.

Transverse circular penile skin flap with primary dorsal pedicle (McAninch flap) ⁽¹⁷⁾:

While the penis is stretched, a skin flap is taken from the inner prepuce or the distal penile area (width 2-2.5 cm depending on stricture diameter). Before moving on to the proximal skin island, the distal side of the flap should be dissected deeply to the pedicle. The glottis is then surgically excised from the penile shaft in this lower plane (superficial to bucks fascia). Following the exposure of the pedicle with a superficial proximal incision, a circular skin island is created that can be divided dorsally or ventrally and rotated 90-degrees to make room for the urethra. The flap is usually divided in the middle along the ventral axis. Additional length is achieved by modifying the traditional circular incision into a Q incision ⁽¹⁷⁾.

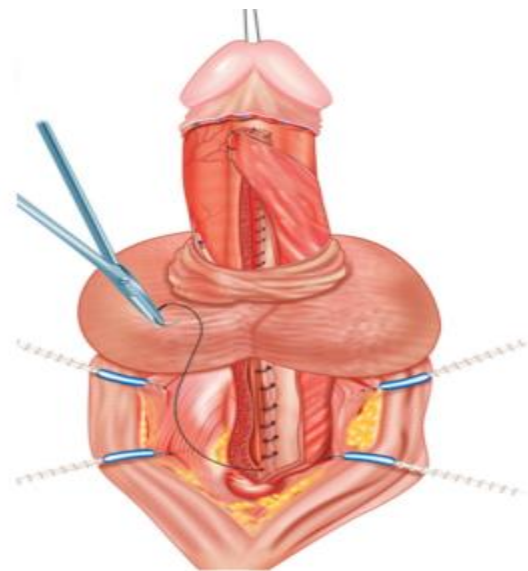
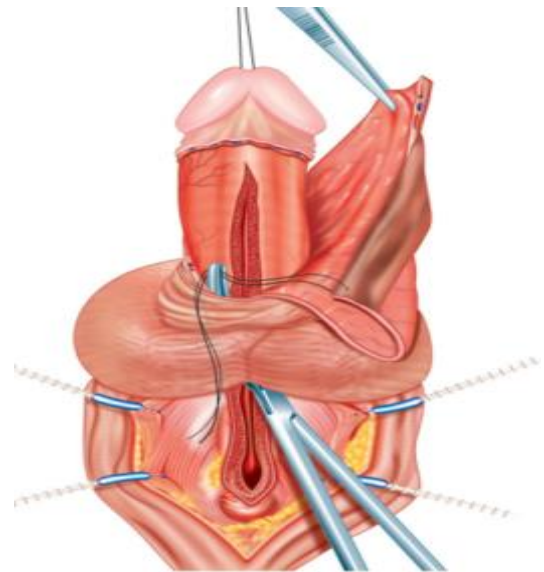


Figure (3): A McAninch flap with a 90-degree rotation, a ventral transposition, and an onlay anastomosis ⁽¹⁷⁾.

CONCLUSION

Because of its high success rate and low risk of complications, urethroplasty flaps are an excellent choice for treating urethral strictures.

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REFERENCES

1. **Elliot S, Brandes S (2014):** Etiology, histology, and classification of urethral stricture disease. *Advanced Male Urethral and Genital Reconstructive Surgery*. Springer, Pp: 95-102. https://link.springer.com/chapter/10.1007/978-1-4614-7708-2_8

2. **Ueshima E, Fujimori M, Kodama H et al. (2019):** Macrophage-secreted TGF- β 1 contributes to fibroblast activation and urethral stricture after ablation injury. *American Journal of Physiology*, 317 (7): 52–64.
3. **Barbagli G, Bandini M, Balò S et al. (2020):** Surgical treatment of bulbar urethral strictures: tips and tricks. *International Braz J Urol : Official Journal of the Brazilian Society of Urology*, 46 (4): 511–518.
4. **Mundy A, Andrich D (2011):** Urethral strictures. *BJU International*, 107 (1): 6-26.
5. **Ayoob A, Dawkins A, Gupta S et al. (2020):** Anterior urethral strictures and retrograde urethrography: An update for radiologists. *Clinical Imaging*, 67: 37–48.
6. **Brandes S, Morey A (2013):** Advanced male urethral and genital reconstructive surgery. Springer Science & Business Media, Pp: 289-305. <https://link.springer.com/content/pdf/10.1007/978-1-4614-7708-2.pdf>
7. **Erickson B, Breyer B, McAninch J (2012):** Singlestage segmental urethral replacement using combined ventral onlay fasciocutaneous flap with dorsal onlay buccal grafting for long segment strictures. *BJU Int.*, 109: 1392–6.
8. **Benson C, Li G, Brandes S (2021):** Long term outcomes of one-stage augmentation anterior urethroplasty: a systematic review and meta-analysis. *International Braz J Urol : Official Journal of the Brazilian Society of Urology*, 47 (2): 237–250.
9. **El-Sherbiny M, Abol-Enein H, Dawaba M et al. (2002):** Treatment of urethral defects: skin, buccal or bladder mucosa, tube or patch? An experimental study in dogs. *The Journal of Urology*, 167 (5): 2225–2228.
10. **Mahmoud M, Daboos M, Bayoumi A et al. (2021):** Different Techniques for Management of Problematic Urethral Catheterization in Male Children. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, 31 (1): 130–137.
11. **Baskin L, Shen J, Sinclair A et al. (2018):** Development of the human penis and clitoris. Differentiation; *Research in Biological Diversity*, 103: 74–85.
12. **Leach D, Gebhart J (2020):** Martius labial fat pad graft (use in rectovaginal fistula repair). *International Urogynecology Journal*, 31 (11): 2427–2429.
13. **Blanc T, Peycelon M, Siddiqui M et al. (2021):** Double-face preputial island flap revisited: is it a reliable one-stage repair for severe hypospadias?. *World Journal of Urology*, 39 (5): 1613–1624.
14. **Pederzoli F, Joice G, Salonia A et al. (2019):** Regenerative and engineered options for urethroplasty. *Nature reviews. Urology*, 16 (8): 453–464.
15. **Shittu O, Sotunmbi P (2015):** The transverse penile pedicled flap urethroplasty: description of a simplified technique for the dissection of the Fascio-cutaneous flap. *African Journal of Medicine and Medical Sciences*, 44 (2): 171–175.
16. **Heo J, Hong W, Kim Y et al. (2020):** Urethroplasty of extensive penile urethral strictures with a longitudinal ventral tubed flap of penile skin (modified Orandi urethroplasty): 20 years of follow-up of two cases. *Archives of Plastic Surgery*, 47 (6): 613–618.
17. **Liang W, Ji C, Chen Y et al. (2016):** Surgical Repair of Mid-shaft Hypospadias Using a Transverse Preputial Island Flap and Pedicled Dartos Flap Around Urethral Orifice. *Aesthetic Plastic Surgery*, 40 (4): 535–539.