

Management of panurethral strictures

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ABSTRACT

Introduction: Treatment of panurethral stricture is considered a surgical challenge. We searched the literature to present a comprehensive review.

Materials and Methods: A review of literature was performed using MEDLINE/PubMed database using terms “urethral stricture” and “urethroplasty.” Only articles published between 1990 and 2009 and written in English language were included in the review.

Results: The main causes of panurethral strictures are previous catheterization, urethral surgery, and lichen sclerosus. The treatment of each individual case has to be tailored according to the etiology, history of previous urethral surgeries, availability of local tissues for flap harvesting, availability of appropriate donor tissue, and the expertise of the treating surgeon. In patients with complicated strictures, previously failed urethroplasties and in patients with poor quality of urethral plate two-stage surgery is a better option. In all other situations, either a flap or graft urethroplasty or if adequate tissue is not available then combination of flap and graft gives reasonable success rates.

Conclusions: Panurethral strictures are relatively less common. For successful results, the surgeon should be experienced and should be familiar with all the treatment modalities.

Key words: Buccal mucosa, flap, graft, panurethral stricture, urethral stricture, urethroplasty, urethral stenosis

INTRODUCTION

Anterior urethral stricture disease is a fairly common problem encountered by urologists [Figure 1]. The bulbous urethra is probably the commonest site of narrowing^[1] and the treatment options is relatively well defined.^[1] Panurethral strictures are relatively less common and the literature about this condition is scant. Panurethral strictures are a surgical challenge for the reconstructive urologist as many times there is shortage of tissue to cover long segments of narrowing and these strictures are also more likely to be associated with complications.^[2] Moreover, as these strictures are often due to inflammatory pathologies,^[2-4] there is

significant spongiofibrosis and accordingly the results of repair are unsatisfactory.^[1,5] Also, some of the surgical repairs used for the treatment are labor-intensive and therefore can be performed at tertiary centers only.^[1] Therefore, for successful results the treating surgeon should be experienced and be familiar with the various methods of reconstructions.

MATERIALS AND METHODS

A review of literature was performed using MEDLINE/

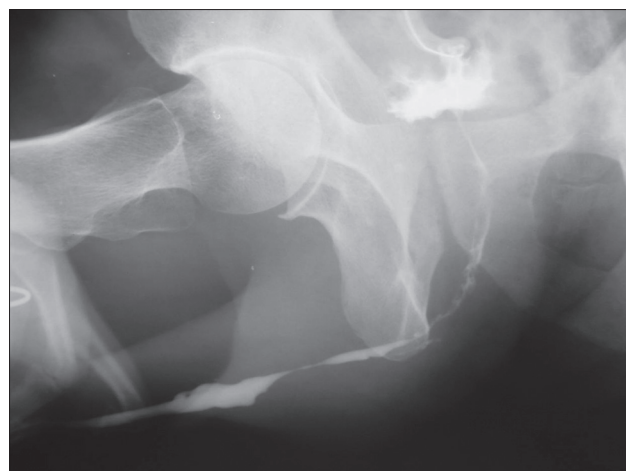


Figure 1: Retrograde urethrogram showing panurethral stricture

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PubMed databases using terms “urethral stricture” and “urethroplasty.” Only articles published between 1990 and 2009 and written in English language were included in the review. This review has also been supplemented by the authors’ personal experience.

ETIOLOGY

The etiology of panurethral strictures may be different in developed and developing countries. In a large series of 175 men with anterior urethral strictures, Fenton *et al.* described the etiology of strictures. However, as panurethral strictures are uncommon there was no description about its etiology.^[6] In a recent article from the developed world including 268 men, panurethral or multifocal anterior urethral stricture was found in 36 patients (13.4%). The causes included urethral catheterization (9 cases), TUR (9 cases), idiopathic (5 cases) and other rare causes like prostatectomy, hypospadias, pelvic fracture, urethritis, lichen sclerosus (LS), cystoscopy, and tumor.^[3] In the developing world, it is believed that these long strictures are inflammatory in nature (due to previous catheterization, instrumentation, or infection) and LS.^[4] It is not clear whether penile strictures in LS develop as a result of extension of glanular disease into penile urethra or whether they are due to chronically obstructed voiding or to instrumentation.^[1]

TREATMENT

While planning the treatment of panurethral stricture, the concerns are whether to do single- or two-stage procedure and if single-stage repair is planned whether adequate tissue for reconstruction is available or not. Most authors would agree that if the disease has led to significant narrowing with unsalvageable urethral plate, there is history of multiple failed previous repairs or if stricture is associated with complications like abscess and stone then laying-open of the urethra is better,^[1,7,8] while in most other situations substitution urethroplasty should be preferred especially if expertise is there.^[9] Substitution urethroplasty can be done using either a flap or a free graft and sometimes by a combination of both. However, as prospective studies are lacking,^[10] there is no consensus about the best option and the surgeon has to tailor the treatment according to the merits of each individual case.

A problem in the interpretation of literature is that in many series the patient population is heterogeneous and includes isolated strictures of penile urethra and long bulbous strictures. Therefore, at times the results and follow-up details are not clear as the results are presented as a “whole.” We have tried, wherever possible, to evaluate and present the results of pananterior urethral stricture alone.

Using lap for reconstruction

Various flaps have been described for panurethral strictures.

Probably the most well-described and popular is the McAninch flap. McAninch and Morey described their results with the use of penile circular fasciocutaneous skin flap for one-stage reconstruction of complex anterior urethral strictures in 66 men.^[11] The average stricture length was 9.08 cm (up to 24 cm length). In 54 patients, onlay procedures were performed, while 12 others underwent flap tubularization for urethral substitution. Additional adjunctive tissue transfer was required in 18 patients, including a proximal graft for a panurethral stricture in 9 and excision with primary anastomosis for a focally dense stricture in 9. In all cases, follow-up was more than 1 year (range: 1-7, mean 41 months). The authors reported an initial success rate of 79%. After an additional procedure, the long-term follow-up success rate was 95%. In 14 men, recurrent stricture was seen usually at the proximal and distal anastomosis. A repeat urethroplasty done for recurrent strictures 1-2.5 cm long was successful in 5 of 7 cases. For shorter recurrences, single direct vision internal urethrotomy or dilatation was successful in 6 of 7 cases. The penile circular fasciocutaneous flap reliably provided 12-15 cm of length for reconstruction in most patients, although approximately 90% had previously been circumcised. The results of flap tubularization were poor and 7 of 12 men (58%) who underwent flap tubularization for urethral replacement required a repeat procedure for recurrent stenosis. For onlay repair, the initial success rate was 87% and the long-term success rate was 98% after additional procedure.

A major advantage of circular fasciocutaneous penile skin flap is its versatility, since it can be used in all areas of urethra from the membranous area to the meatus.^[11,12] If the flap falls short, then it can be combined with other tissue transfer techniques thus enabling one-stage reconstruction in majority of cases.^[11,12] The flap may also be partially tabularized or divided into two to cover two separate areas of stricture.^[11] The authors noted compartmental syndrome in two cases that was because of prolonged high lithotomy position (7 and 10 hours).^[11] This complication is difficult to predict but the risk increases if the patient remains for more than 5 hours in high lithotomy position. To prevent this complication, the authors begin all cases with flap harvesting while the patient is initially supine, thereby decreasing the time in lithotomy position by 2-3 hours.^[11]

The Q-flap is a modification of the McAninch flap and is so called because it incorporates an additional midline ventral longitudinal penile extension, thus resembling the letter Q [Figure 2]. Morey *et al.* reported the results of this procedure in 15 men with mean stricture length of 15.5 cm (range 12-21).^[2] All the men were uncircumcised and the flaps were dissected with the patient initially supine (to avoid compartment syndrome). This procedure was done even in men with LS where the fibrotic distal skin was excised and the Q-flap created from healthier-appearing skin several

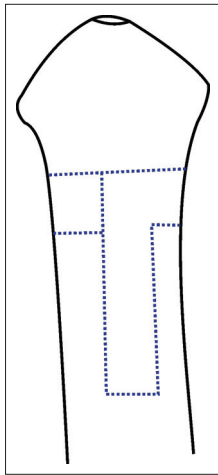


Figure 2: Incision for Q-flap

centimeters proximal to the corona. The operative duration was generally ≥ 5 hours and the Q-flap procedure provided a pedicled strip of skin with a mean (range) length of 17 cm (15-24). Of the 15 patients, 13 were followed for a mean (range) of 42.6 (12-102) months and the remaining two for only 6 months. There was only one failure. The Q-flap procedure provides the longest vascularized skin pedicle yet reported for a single-stage urethroplasty.^[2] Like the circular penile fasciocutaneous flap procedure of McAninch, the Q-flap is hairless, versatile, and reliable.^[2] However, this procedure is extremely labor-intensive and is among the most difficult and tedious in reconstructive urology.^[2] It is recommended that the repair should be reassessed 1 month after the surgery so that if extravasation occurs the catheter may be reinserted.^[2] The excessive length of the suturing may cause focal extravasations. As the suture lines are covered with redundant pedicle and the sleeve of residual foreskin, fistulae are unlikely. A major benefit of the Q-flap is that it eliminates the need for additional, potentially morbid and time-consuming tissue-transfer techniques that are otherwise necessary for reconstruction of panurethral strictures.^[2] For example, in the previous series of 66 men who underwent only the circular penile flap, 9 men required additional graft procedure to complete the urethroplasty.^[11]

A common problem encountered with the above two type of flaps is necrosis of penile skin proximal to the flap.^[11,12] It results when the vascular supply of the subdermal plexus is compromised. Usually, the necrosis heals by secondary intent and grafting is rarely needed.^[11,12] However, for novices penile skin necrosis can be a major problem. It predisposes to wound infection and in my experience may lead to disruption of the flap. Although this complication can be avoided by taking meticulous care while dissecting the flap we believe that penile circular flaps are ideally suited for patients with intact prepuce. These men can be circumcised after flap harvesting to eliminate un-needed skin that may be at risk for ischemic injury. The redundant prepuce is of limited value from reconstructive standpoint after these flap

procedures and buccal mucosa can be used for subsequent substitution urethroplasty if required.^[11]

An important technical point is that the flaps should not be more than 20 mm wide when performing onlay reconstruction to prevent pseudodiverticulum formation.^[11] After the flap the urethral lumen should be approximately 26F in adults. El Dahshoury described a zigzag shape modification of annular penile flap and used it in 30 men with stricture lengths between 15 and 20 cm. After mean follow-up of 24 months, the resticture occurred in four cases.^[13]

Another flap described for urethroplasty is the biaxial epilated scrotal flap.^[14] For reconstruction of the whole anterior urethra from the bulbomembranous portion to the meatus, the authors describe a 20×2.5 cm central skin flap drawn on the biaxial scrotal flap that is extended on the anterior and posterior scrotal faces [Figure 3]. The constituents include the scrotal skin, dartos, external spermatic fascia, cremasteric fibers and fascia, internal spermatic fascia and the scrotal septum (tunica vaginalis is excluded). Thus, vascular anastomoses between the cremasteric (deep) and scrotal (superficial) circulation are included in the flap. The authors used this technique in 37 men including 10 men with panurethral disease. There were 2/10 failures due to graft shrinkage, necessitating perineal urethrostomy. Other problems reported were dermoepidermal sclerosis due to incorrect epilation technique, deep vascularization lesion and skin lengthening Z-plasty at the penoscrotal angle to relieve penile bending during erection. These authors feel that correctly epilated scrotal skin possesses ideal characteristics for reconstructive urethral surgery from the penoscrotal angle to the prostatic apex.^[14] Because of anatomical contiguity, excellent tissue availability, and tolerance in contact with urine due to abundance of sebaceous glands it is always their first option for urethroplasty. They feel that scrotal skin has a lesser chance to develop LS as compared to penile skin. It is generally felt that bringing a penile flap into the bulbo-membranous area is technically difficult. The reason is the lack of contiguity and the precariousness of vascular pedicle with thin axial vessels. In circular penile flaps, the delicate pedicle of these flaps are extensively dissected and mobilized to reach the perineoscrotal area and there is always a risk of stretching and twisting the pedicle. Gil-Vernet *et al.* propose that where penile skin is of poor quality due to repeated traumatic and infectious processes caused by urine collection devices (like in men with paraplegia) biaxial scrotal flap can be performed. Insufficient scrotal size can be resolved by the previous use of tissue expanders.^[14] However, epilation, deepithelialization and mobilization may not be so straightforward.

It is believed that flap procedure should provide better

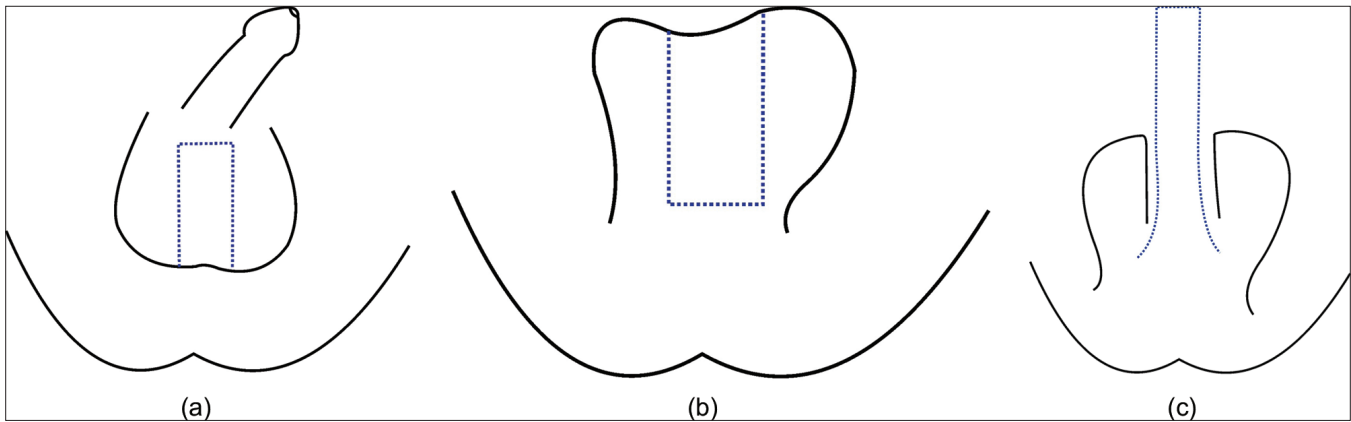


Figure 3: Incision for scrotal flap

results in patients with complex refractory strictures in whom previous urethroplasty has failed.^[11,15] In these cases, it is quite likely that the urethral bed is fibrotic and not suitable for free grafts. Flaps, with their own blood supply, would be more appropriate. As the results of flap tubularization are not so good, most authors prefer to maintain the urethral plate, using the flap as an onlay procedure whenever possible.^[11] Although flaps can be applied dorsally or ventrally, it is generally believed that the results in terms of postvoid dribbling of urine, ejaculatory dysfunction, and flap outpouching or pseudodiverticulum formation are better with dorsal flap placement.^[12]

Using grafts for reconstruction

Using grafts for reconstruction is probably a more popular method for urethroplasty. Various donor locations have been described (including ureter, saphenous vein, appendix, full-thickness skin, bladder mucosa, and buccal mucosa)^[16] but use of buccal mucosa and skin are the most common methods.^[17] Buccal mucosa graft urethroplasty has been reported for panurethral stricture by many authors.^[4,10,18-20] Xu *et al.* reported their results on 25 men with mean stricture length of 11.7 cm using double buccal mucosa graft in nine patients, double lingual mucosal graft in seven men, and combined lingual and buccal graft in nine men. At a mean follow-up of 26.8 months, they reported satisfactory outcomes.^[18] However, for panurethral stricture mucosal harvesting from the lip is also needed along with cheek mucosa and, therefore, have more morbidity in the form of scar contracture and lip deviation or retraction.^[17,21]

Various authors have described some surgical modifications for placement of grafts.^[20,22] Gupta *et al.* described dorsal graft placement by a ventral sagittal urethrotomy and minimal-access perineal approach and used this method in two cases of panurethral stricture also.^[20] Kulkarni *et al.* reported a new dorsal onlay graft technique called the one-sided anterior urethroplasty and used it in 12 men with panurethral stricture with mean length of 10 cm.^[22]

The graft characteristics of lingual mucosa is similar to that of the buccal mucosa.^[23,24] Das *et al.* reported the use of lingual mucosal graft alone in long anterior urethral strictures in 18 men.^[25] Most men had either LS or infection as the etiology. Overall success rate was 83.3% (the results include strictures of bulbous and penile urethra also; separate results of panurethral strictures have not been given). A particular advantage with lingual mucosa is that graft harvest from one side of the tongue can be extended to the opposite side in continuity across the midline, achieving a length sufficient to give coverage to panurethral strictures.

Bapat *et al.* described dorsal onlay urethroplasty using preputial/distal penile skin in two men with panurethral stricture.^[26] In another series of 40 men, 22.5% strictures were panurethral.^[17] Penile/preputial skin was used in 31 men and at a mean followup of 23 months there were five failures and five were lost to followup. The authors noted that graft placement onto the penile urethra was more likely to fail.^[17] Circumcision does not necessarily preclude the use of penile skin, although buccal mucosa might be the best choice if the shaft skin is not abundant.^[17]

Manoj *et al.* used the postauricular skin in 15 men with panurethral strictures and with 80% (12 cases) success and suggest that this can be an option in circumcised men with submucosal fibrosis involving cheek mucosa.^[27] Postauricular skin is thin and has a dense subdermal plexus and therefore graft-take and functional results are much better than other nongenital skin grafts.^[28,29] However, Andrich and Mundy cautioned that as LS is a skin disease, any skin graft used for repair may also become diseased in due course and therefore this graft should be avoided in patients where LS is the etiology of stricture disease.^[28] Xu *et al.* used colonic mucosa as graft in 36 men with strictures 10-20 cm long (mean 15.1).^[30] They reported successful outcomes in 30 of 35 men who remained on followup (mean 53.6 months). Meatal stenosis, bulbar or bulbomembranous urethral stenosis, and proximal anastomotic site stricture developed in five patients.

Ventral graft placement in the pendulous portion is usually associated with poorer results and some authors therefore advocate either flap or two-stage procedure for these strictures.^[17] Dorsal graft placement, especially in the pendulous urethra, is associated with better results as compared to ventral graft placement.^[12]

Using combined tissue transfer techniques for reconstruction

Repairs using long flaps are technically challenging procedures and are associated with long operating times and morbidity. Moreover, sometimes sufficient length of skin may not be available especially in circumcised men or men with LS to make a long flap. Therefore, a good treatment option is combining a (shorter) flap with a graft with the graft placed proximally in the bulbous urethra.^[12]

Wessels *et al.* described the use of combined tissue transfer in seven men with mean stricture length of 18.3 cm.^[31] A penile circular fasciocutaneous flap was combined with a proximally placed graft. The flap length ranged from 10 to 15 cm (mean 12.6) and graft length ranged from 3 to 9 cm (mean 6.2). The overall success rate reported was 88% at followup of 16 months; however, the authors have not mentioned separately the results for panurethral strictures. The authors emphasize the fact that circumferential urethral replacement should be avoided because of postoperative strictures that tend to occur at the junction between tube and native urethra.

Two-stage procedure

Today, most anterior urethral strictures can be managed with single-stage surgery but approximately 10% of patients have at least one complicating factor that precludes safe one-stage surgery.^[7] A two-stage urethroplasty is more appropriate for complex strictures associated with adverse local conditions, such as extensive scarring, fistula or infection, graft factors, or flap survival.^[7] In such situations, the stricture tends to be long, previous urethroplasty has failed, or there is a lack of usable penile skin for flap or graft repair.^[7] A good method to assess the condition of the urethral plate is to perform urethroscopy using 6Fr pediatric endoscope.^[32] One-stage reconstruction should be done only if stricture caliber is greater than 6Fr and it appears feasible that the urethral plate would accept a flap or graft as an onlay;^[32] otherwise these men should be managed by the two-stage repair or if the patient desires then a permanent first-stage urethroplasty. First-stage urethroplasty is defined as the creation of a urethrostomy proximal to the coronal margin.^[8] Second-stage urethroplasty is defined as a tubularization of the urethra distal to the urethrostomy distal to the urethrostomy created in the first stage.^[8]

Another advantage of two-stage procedure is that in strictures due to LS, there is a positive impact on the natural history of the disease.^[33-36] Urinary diversion via a perineal urethrostomy avoids continuous urine extravasation into the

corpus spongiosum and facilitates urethral tissue healing, as suggested by Blandy and Fowler,^[37] who pioneered the two-stage procedure. After stage 1 urethral marsupialization, the urethral plate can be observed for adequate healing and if needed local revision of the urethral roof strip can be performed.^[38] In severe LS, the meatus and fossa navicularis are almost completely obliterated and wood-hard fibrosis extends into the proximal urethra. The general principle here is to excise the diseased segment and to replace it with buccal mucosa.^[1] However, few authors have performed one-stage dorsal onlay buccal mucosal urethroplasty in selected cases of LS where the urethral plate is adequate with satisfactory intermediate-term results.^[32]

Elliott *et al.* reviewed their data retrospectively from 1977 and 2007 and found that first-stage urethroplasty was performed in 38 men.^[39] The indications were multiple prior urethroplasties, lichen sclerosis, and lack of locally available healthy tissue. At a median followup of 22 months (range 7.5 months to 27.6 years), only nine men (24%) opted for second-stage urethroplasty. The authors feel that this procedure produces unobstructive voiding with few complications and recommend this procedure for men with severe anterior urethral stricture disease who have failed prior repairs.^[39] Panurethral strictures are considered difficult to treat due to several reasons [Table 1]. The penile urethra is especially vulnerable and fails to single-stage repairs.^[17] Patterson and Chapple believe that for penile urethroplasty, two-stage dorsal onlay of buccal mucosa after complete excision of the scarred urethra still provides the best result, although in some cases a one-stage dorsal onlay procedure is possible.^[40]

The two-stage procedure can cause considerable inconvenience to some men and exposes them to increased risk of morbidity because of multiple anesthetic administrations.^[41] Moreover, revision is common after two-stage repairs and in one series in approximately 50% of cases a two-stage repair turned out in practice to be a three-stage repair.^[42]

Special situation: Obliterative strictures

Sometimes, panurethral stricture has some areas where the urethral lumen is totally lost. Often, the literature does not clearly mention about these patients. The results of standard patch urethroplasty are not satisfactory in

Table 1: Difficulty in repair

1.	Long length of narrowing/stricture
2.	Insufficient donor tissue for flap and graft
3.	Significant spongiofibrosis, poor bed for graft especially in penile urethra
4.	Frequent association with lichen sclerosis
5.	Association with complications
6.	Experienced surgeon needed

this situation, especially in the pendulous urethra, and should be avoided. However, if the obliterative segment is a relatively short component of a long stricture in which the caliber is otherwise better, the augmented anastomotic principle can be applied, excising the obliterative segment and augmenting the remaining segment with the relatively better caliber.^[1] If the length of obliterative segment is long, then the alternatives are a long flap repair preferably using a patch of penile shaft skin carefully prepared on a generous dartos pedicle, or, if there are complications such as periurethral infection, marsupialization of the urethra should be performed.^[1]

Overall prognosis

Data regarding the long-term results of urethroplasty is sparse. Andrich *et al.* presented their data of 84 men who had undergone substitution urethroplasty and had completed at least 10 years of followup. At 5, 10, and 15 years, they reported resticture rates of 21%, 31%, and 58%, respectively.^[43] Similarly, Hermanowicz *et al.* reported a 52.4% resticture rate after more than 5 years of followup in a series of 287 men, while de Jong reported a resticture rate of 67.9% in 56 men.^[44,45] Kessler *et al.* predicted the long-term outcomes of various urethroplasties using statistical analysis. They reported 6.5-year success rate of 86% using flaps and of 56% by graft urethroplasty.^[46] All these data suggest that stricture recurrence is common on long-term followup.

Summary of treatment

Panurethral strictures are difficult to treat and are associated with relatively poorer outcomes as compared to the results for other segments of urethra. Clearly, there is no one technique that has superior outcomes. Even after meticulous planning and with experienced surgeon, sometimes the reconstructive urologist has to admit failure and keep the patient on permanent urethrostomy proximal to the coronal margin.

REFERENCES

- Andrich DE, Mundy AR. What is the best technique for urethroplasty? *European Urol* 2008;54:1031-41.
- Morey AF, Tran LK, Zinman LM. Q-flap reconstruction of panurethral strictures. *BJU International* 2000;86:1039-42.
- Lumen N, Hoebek P, Willemsen P, Troyer BD, Pieters R, Oosterlinck W. Etiology of urethral stricture disease in the 21st century. *J Urol* 2009;182:983-7.
- Dubey D, Kumar A, Mandhani A, Srivastava A, Kapoor R, Bhandari M. Buccal Mucosal urethroplasty: A versatile technique for all urethral segments. *BJU International* 2005;95:625-9.
- Breyer BN, McAninch JW, Whitson JM, Eisenberg ML, Mehdizadeh JF, Myers JB, *et al.* Multivariate analysis of risk factors for long-term urethroplasty outcome. *J Urol*. 2009.
- Fenton AS, Morey AF, Aviles R, Garcia CR. Anterior urethral strictures: Etiology and characteristics. *Urology* 2005;65:1055-8.
- Carr LK, Webster GD. Urethral strictures. In: Krane RJ, Siroky MB, Fitzpatrick JM, editors. *Operative Urology: Surgical skills*. Philadelphia: Churchill Livingstone; 2000. p. 287.
- Elliott SP, Eisenberg ML, McAninch JW. First-stage urethroplasty: Utility in the modern era. *Urology* 2008;71:889-92.
- Palminteri E, Lazzeri M, Guazzoni G, Turini D, Barbagli G. New 2-stage buccal mucosal graft urethroplasty. *J Urol* 2002;167:130-2.
- Dubey D, Vijjan V, Kapoor R, Srivastava A, Mandhani A, Kumar A, *et al.* Dorsal onlay buccal mucosa versus penile skin flap urethroplasty for anterior urethral strictures: Results from a randomized prospective trial. *J Urol* 2007;178:2466-69.
- McAninch JW, Morey AF. Penile circular fasciocutaneous skin flap in 1-stage reconstruction of complex anterior urethral strictures. *J Urol* 1998;159:1209-13.
- Dubey D, Kumar A, Bansal P, Srivastava A, Kapoor R, Mandhani A, *et al.* Substitution urethroplasty for anterior urethral strictures: A critical appraisal of various techniques. *BJU International* 2003;91:215-18.
- El Dahshoury ZM. Modified annular penile skin flap for repair of pan-anterior urethral stricture. *Int Urol Nephrol* 2009;41:889-94.
- Gil-Vernet J, Arango O, Gil-Vernet A, Gil-Vernet Jr J, Gelabert-Mas A. A new biaxial epilated scrotal flap for reconstructive urethral surgery. *J Urol* 1997;158:412-20.
- Morey AF, Duckett CP, McAninch JW. Failed anterior urethroplasty: Guidelines for reconstruction. *J Urol* 1997;158:1383-7.
- Dessanti A, Rigamonti W, Merulla V, Falchetti D, Caccia G. Autologous buccal mucosa graft for hypospadias repair: an initial report. *J Urol* 1992;147:1081-4.
- Wessells H, McAninch JW. Use of free grafts in urethral stricture reconstruction. *J Urol* 1996;155:1912-5.
- Xu YM, Sa YL, Fu Q, Zhang J, Si JM, Liu ZS. Oral mucosal grafts urethroplasty for the treatment of long segmented anterior urethral strictures. *World J Urol* 2009;181:954-5.
- Datta B, Rao MP, Acharya RL, Goel N, Saxena V, Trivedi S, *et al.* Dorsal onlay buccal mucosal graft urethroplasty in long anterior urethral stricture. *International Braz J Urol* 2007;33:181-87.
- Gupta NP, Ansari MS, Dogra PN, Tandon S. Dorsal buccal mucosal graft urethroplasty by a ventral sagittal urethrotomy and minimal-access perineal approach for anterior urethral stricture. *BJU International* 2004;93:1287-90.
- Humby G. A one-stage operation for hypospadias. *Br J Surg* 1941;29:84-92.
- Kulkarni S, Barbagli G, Sansalone S, Lazzeri M. One-sided anterior urethroplasty: A new dorsal onlay graft technique. *BJU Int* 2009;104:1150-5.
- Das SK, Kumar A, Sharma GK, Pandey AK, Bansal H, Trivedi S, *et al.* Lingual mucosal graft urethroplasty for anterior urethral strictures: Our technique of graft harvesting. *World J Urol*. 2007.
- Barbagli G, De Angelis M, Romano G, Ciabatti PG, Lazzeri M. The use of lingual mucosal graft in adult anterior urethroplasty: Surgical steps and short-term outcome. *Eur Urol* 2008;54:671-6.
- Das SK, Kumar A, Sharma GK, Pandey AK, Bansal H, Trivedi US, *et al.* Lingual mucosal graft urethroplasty for anterior urethral strictures. *Urology* 2009;73:105-8.
- Bapat SS, Padhye AS, Yadav PB, Bhavne AA. Preputial skin free graft as dorsal onlay urethroplasty: Our experience of 73 patients. *Indian J Urol* 2007;23:366-8.
- Manoj B, Sanjeev N, Pandurang PN, Jaideep M, Ravi M. Postauricular skin as an alternative to oral mucosa for anterior onlay graft urethroplasty: A preliminary experience in patients with oral mucosa changes. *Urology* 2009;74:345-8.
- Andrich DE, Mundy AR. Surgical treatment of urethral stricture disease. *Contemp Urol* 2001;13:32-44.
- Nitkunan T, Johal N, Qteishat A. A two-staged repair with postauricular skin produces the best results in revisional hypospadias surgery. *J Urol* 2004;171:17.
- Xu YM, Qiao Y, Sa YL, Zhang J, Fu Q, Song LJ. Urethral reconstruction using colonic mucosa graft for complex strictures. *J Urol* 2009;182:1040-3.

31. Wessells H, Morey AF, McAninch JW. Single stage reconstruction of complex anterior urethral strictures: Combined tissue transfer techniques. *J Urol* 1997;157:1271-74.
32. Dubey D, Sehgal A, Srivastava A, Mandhani A, Kapoor R, Kumar A. Buccal mucosal urethroplasty for balanitis xerotica obliterans related urethral strictures: The outcome of 1 and 2-stage techniques. *J Urol* 2005;173:463-6.
33. Barbagli G, Lazzeri M, Palminteri E, Turini D. Lichen sclerosis of male genitalia involving anterior urethra. *Lancet* 1999;354:429.
34. Barbagli G, Palminteri E, Lazzeri M. Lichen sclerosus of male genitalia. *Contemp Urol* 2001;13:47.
35. Andrich DE, Mundy AR. Substitution urethroplasty with buccal mucosa free graft. *J Urol* 2001;165:1131.
36. Depasquale I, Park AJ, Bracka A. The treatment of balanitis xerotica obliterans. *Br J Urol* 2000;86:459.
37. Blandy J, Fowler C. Urethra and penis: inflammation. In: *Urology*, 2nd ed. Oxford: Blackwell Science; 1996. p. 472.
38. Carr LK, Maediarmid SA, Webster GD. Treatment of complex anterior urethral stricture disease with mesh graft urethroplasty. *J Urol* 1997;157:104.
39. Elliott SP, Metro MJ, McAninch JW. Long-term followup of the ventrally placed buccal mucosa onlay graft in bulbar urethral reconstruction. *J Urol* 2003;169:1754.
40. Patterson JM, Chapple CR. Surgical techniques in substitution urethroplasty using buccal mucosa for the treatment of anterior urethral strictures. *Eur Urol* 2008;53:1162-71.
41. Palminteri E, Lazzeri M, Guazzoni G, Turini D, Barbagli G. New 2-stage buccal mucosal graft urethroplasty. *J Urol* 2002;167:130-2.
42. Andrich DE, Greenwell TJ, Mundy AR. The problems of penile urethroplasty with particular reference to 2-stage reconstructions. *J Urol* 2003;170:87-9.
43. Andrich DE, Dungleison N, Greenwell TJ, Mundy AR. The long-term results of urethroplasty. *J Urol* 2003;170:90-2.
44. Hermanowicz M, Massande J, Rossi D, Serment G, Richaud C, Ducassou J. Long-term evaluation of the treatment of male urethral stenosis. *Ann Urol* 1990;24:68.
45. de Jong Z, Fouda PJ, Pontonnier F, Plante P. Long-term results of the treatment of male urethral stricture. *Ann Urol* 1990;24:167.
46. Kessler TM, Schreiter F, Kralidis G, Heitz M, Olanas R, Fisch M. Long-term results of surgery for urethral stricture: A statistical analysis. *J Urol* 2003;170:840-4.

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