Revisão
Review

Urethroplasty in Phalloplasty: Surgical Outcomes and Complications a Critical Review

Uretroplastia em Faloplastias: Uma Revisão Crítica de Resultados Cirúrgicos e Complicações

Afonso Morgado[1], Nuno Tomada[1,2]

Abstract

Phalloplasty can be either performed as a penile reconstructive or phallic constructive procedure, mainly in penile trauma victims or female-to-male gender reassignment. After the introduction of the radial artery-based forearm free flap and with the further awareness of patient desire to void while standing, urethral reconstruction became a standard procedure and a main goal to attain in phalloplasty. Urethroplasty techniques can be broadly split in two main groups: as part of a tube-within-a-tube skin flap or as an independent other-than-skin graft. Urethral complications, such as fistula, stricture, or stones, are common and often recur after treatment. In this review, the main techniques of urethral reconstruction in phalloplasty are reviewed and compared. Urethral complications are also reviewed as well as their management.

Keywords: *Penis/surgery; Reconstructive Surgical Procedures; Surgical Flaps; Urethra/surgery.*

Resumo

A faloplastia pode ser realizada como um procedimento de reconstrução peniana ou construção fálica, sobretudo em vítimas de traumatismo ou em cirurgia de reatribuição de sexo de feminino para masculino. Com o aparecimento da técnica de retalho livre de antebraço baseada na artéria radial e o reconhecimento da vontade de micção em ortostatismo pelos pacientes, a reconstrução da uretra tornou-se um procedimento padrão associado á faloplastia. Complicações como fístulas urinárias, estenoses uretrais ou cálculos uretrais são comuns e frequentemente recorrem após tratamento. Neste artigo de revisão as principais técnicas de reconstrução da uretra na faloplastia são revistas e comparadas. As complicações uretras são também revistas, bem como o seu tratamento.

Palavras-chave: Penis/cirurgia; Procedimentos Cirúrgicos Reconstrutivos; Retalhos Cirúrgicos; Uretra/cirurgia.

Introduction

Phalloplasty can be either performed as a penile reconstructive or phallic constructive procedure, mainly in penile trauma victims, penile congenital absence and/or hypotrophy, or female-to-male (FTM) gender reassignment. It was first described by Nikolai Bogoraz in 1936 in war-injured patients and soon after by Gillies and Harrison in 1948 as part of the first FTM gender reassignment procedure. At that time, phalloplasty was based on a random-pattern suprapubic abdominal tube-within-tube flap. However, the reconstructed penis or constructed phallus goals were reduced to fulfilling body image expectations and allowing a penetrative sexual intercourse. However, voiding was still performed through a proximal urethrostomy. This procedure remained "state of the art" for the next 40 years, until 1972 when Orticochea described the first total penile reconstruction, providing normal voiding while standing. Unfortunately, the high urinary fistula and urethral stricture rates led some authors to abandon urethroplasty, limiting phalloplasty again to external genitalia construction or reconstruction. After the introduction of radial artery-based forearm tube-within-tube free flap (RFFF) with the original "Chinese" design by Chang and Hwang in 1984 as well as further awareness of patient desire to void while standing,[1,2] urethral reconstruction became a standard procedure and a main aim to attain. Nonetheless, the RFFF method's lower but significant urethral stricture and urinary fistula rates as well as donor-site residual scarring led to flap design modifications, such as the Biemer and cricket bat modifications, and to the use of other flap donor sites, such as the anterolateral thigh pediculated flap (ALTF) and the *latissimus dorsi* free flap. Lastly, alternatives to the tube-within-a-tube principle have been proposed, with urethroplasty being performed as a secondary procedure using different graft tissues such as buccal and vaginal mucosa or even a separate full-thickness skin flap.

Urethroplasty techniques can be broadly split in two main groups: as part of a tube-within-a-tube random-pattern full-thickness skin flap or as an independent other-than-skin graft. The former is more commonly performed, usually as part of a RFFF or ALTF. A tube-within-a-tube urethroplasty is performed

[1]Serviço de Urologia, Centro Hospitalar São João, Porto, Portugal

[2]Departamento de Doenças Renais, Urológicas e Infecciosas, Faculdade de Medicina da Universidade do Porto, Porto, Portugal

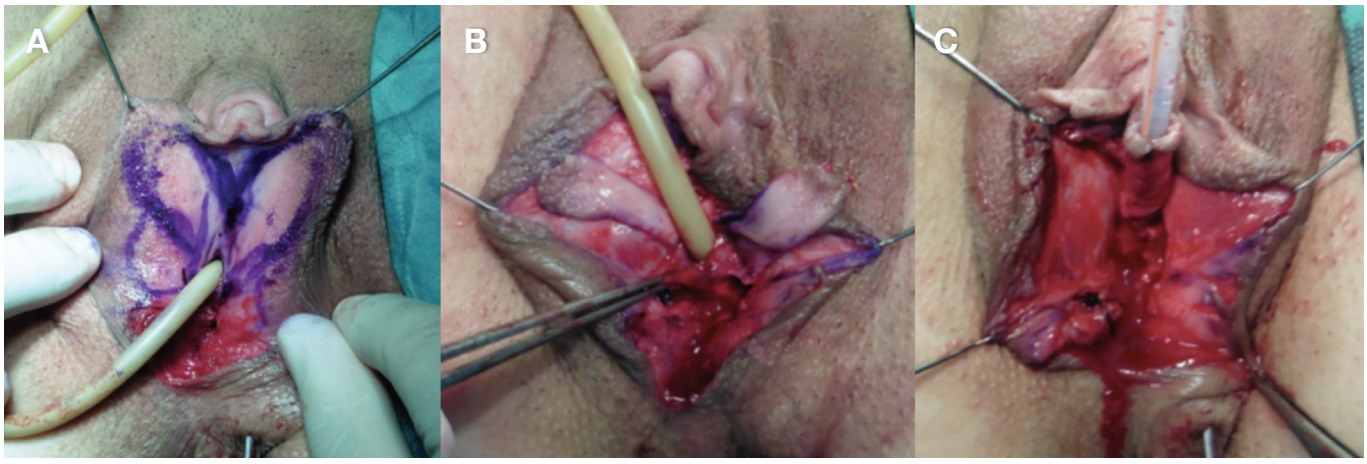

Figura 1: A 30-years-old female-to-male transgender was submitted to a one stage radial artery based forearm free flap with urethral fixed part lengthening using a minor labia fold. A-minor labia design. B-minor labia folds. C-urethra lengthen with minor labia.

through skin flap harvest and subsequent roll-upon-itself formation for the new urethra. Posteriorly, an anastomosis is performed to the original urethral meatus. Although impressive, single-stage procedures have a high complication rate, which is believed to be caused by several factors, such as poor vascular supply or a tense anastomosis. Hence, tube-within-tube flaps are often performed as a two-stage procedure with flap vascular maturation, either by prefabrication or prelamination, preceding the flap transfer. Prefabrication implies rerouting a vascular pedicle to the donor flap area before the flap harvest in a secondary procedure. On the other hand, prelamination implies flap preformation and later harvest and transfer once neovascularisation has been established.

Most urethral fistula are reported at the urethral anastomosis site, and one retrospective report regarding total penile reconstruction after penile avulsion injuries has stated that the more proximal the anastomosis is performed the higher the urinary fistula risk.[3] This has led some authors to perform minor labia (Fig. 1) and/or vaginal folds, lengthening the original urethral plate and allowing a more distal and less tense anastomosis. Moreover, the pendular part of the urethra is still performed as part of the tube-within-a-tube principle. There are also statements that in suprapubic pediculated flaps, the anastomosis site's urinary fistula is usually a consequence of a distal urethral stricture.[4] Whether this is still valid for other flaps or grafts is yet to be determined.

Modifications of the original "Chinese" RFFF design, such as the Biemer and cricket bat, placed the urethral segment in the flap centre, overlaying the radial artery, thus allowing a better vascular supply and lowering the risk of ischaemic urethral strictures. As previously stated, urethroplasty can also be performed as a separate free flap, independent of the phallic tubed flap.[5]

Vaginal and buccal mucosae are both naturally wet epithelia possessing a rich superficial vascular plexus with ideal characteristics for grafting. Graft urethroplasty using either mucosa has been described as part of a multiple-stage phalloplasty. It commonly requires at least two stages to perform the urethroplasty. Graft transfer is performed after phallic construction, while folding is then performed as a separate procedure. Ileal mucosa grafting has also been anecdotally reported as an alternative.[6]

Complications

URETHRAL FISTULA

One-stage tube-within-a-tube procedures have the highest reported urethral fistula rate (Fig. 2). The suprapubic abdominal pediculated flap has a reported rate of 55% occurrence of urethral fistula,[4] while the one-stage RFFF has a reported fistula rate of 78.9% in phallic construction[7] and 22% to 26.6% in penile reconstruction after trauma or penile amputation.[3,8] The most recently introduced pediculated anterolateral thigh and groin flaps have the lowest reported fistula rates, less than 10% and 8.3%, respectively.[9,10] However, both reports have a shorter mean follow-up time when compared to the original report by Leriche *et al* on the RFFF (29 *vs* 110 months). Additionally, FTM gender reassignment patients were not included. Currently, there are no reports regarding the mean time from surgery to urethral fistula diagnosis, although Leriche *et al* reported that the mean time from surgery to perineal urethrostomy was 72 months at their institution.[7] They further added that half of the late complications were urethral. These previous statements could indicate that the urethral complications might be underreported due to the short follow-up times observed.

As expected, lower fistula rates are reported when prelamination is used. Osteocutaneous RFFF preceded by flap prelamination had a reported 22% urethral fistula rate.[11] Lower fistula rates were also reported when fixed urethral lengthening is per-

Figura 2: A 32-year-old female-to-male transgender was successfully submitted to a one stage radial artery based forearm free flap phalloplasty in the past. The patient reported a newly developed urethral fistulae 31 months after. A dorsal urethral (arrow) fistula following a one stage free radial artery-based forearm skin graft. A primary fistula repair distally was successfully performed previously.

Figura 3: A 36-year-old female-to-male was submitted multiple staged suprapubic pediculated phalloplasty complicated with a proximal urethral fistulae successfully corrected with a buccal mucosa graft urethroplasty. The patient presents with two distal urethral fistulae (arrow) following a second urethroplasty with buccal mucosa after a proximal fistula.

formed in addition to a standard RFFF in FTM gender reassignment cases (36.8% *vs* 21.9% urethral fistula rate).[12] Minor labia and/or vaginal folds despite direct urethral plate anastomosis were used separately or in combination in the aforementioned reports. Notwithstanding, these papers compare pre-2001 with post-2001 data; thus, other factors might play a role in the lower complication rate.[12] In dorsal clitoral skin, flaps have also been experimentally used for urethral plate lengthening, although with a higher fistula rate when compared with minor labia folds.[13] Meanwhile, in their 2003 report on urethral lengthening rates, Rohrmann and Jakse reported urethral lengthening 2003 retrospective report states a 69% and 60% urethral fistula rates for vaginal and labia minor flaps, respectively, while no fistula was reported in the control group.[14]

Most authors prefer primary fistula closure, although watchful waiting can be successful. A 55% resolution rate with conservative treatment was reported by Lerich *et al.*[7] A radical alternative to urethral fistula treatment is perineal urethrostomy. A second urethroplasty using either buccal mucosa graft or a separate skin flap can also be attempted (Fig. 3). Nonetheless, there is almost no data regarding fistula treatment outcomes or long term fistula recurrence.

URETHRAL STRICTURE

Phalloplasty using a suprapubic abdominal flap also has the highest noted urethral stricture rate at 64%[4] while RFFF has a reported 15.7% to 20% stricture rate.[3,7] Much the same as urethral fistula rates, stricture rates are reportedly lower in groin pediculated flaps (4.15%).[9] Furthermore, grafting techniques, whether using vaginal or buccal mucosa, also have a low urethral stricture rate, at 4.5% and 0%, respectively.[15,16]

Much knowledge regarding urethral stricture is based on reports by Lumen *et al.*[17,18] Their original papers indicated that the urethral anastomosis site is the most common location for stricture. Other indicated sites were the meatus, phallic urethra, fixed part urethra, and combined complex strictures, in descending order of incidence. Different types of urethroplasty were used for urethral stricture surgical treatment and

Table 1: Urethroplasty complication rates in different phalloplasty techniques

	Procedure (number of patients)	Urethral stenosis	Urethral fistula	Ability to void while standing	Urethral stone	Mean follow-up (months)
Garaffa *et al*[4]	Radial artery forearm free flap in FTM (n=112)	8.0%	17.8%	99%	Not reported	26
Leriche *et al*[6]	Radial artery forearm free flap in FTM (n=19)	15.7% "urinary retention"	78.9%	Not reported	Not reported	110
Bettocchi *et al*[3]	Suprapubic abdominal pediculated flap with minor labia fold in FTM (n=32 for one stage and 48 for two stage)	94% for one stage 44% for two stage	94% for one stage 19% for two stage	50% (30% "satisfactorily" and 20% "but with")	6% for both	"had a long term follow-up"
Rashid and Sarwar[7]	Radial artery forearm free flap in avulsion injuries (n=36)	22.2%	16.6%	Not reported	Not reported	Not reported
Perovic *et al*[10]	Pedicle groin flap in paediatric patients (n=24)	8.3%	4.2%	Not reported	Not reported	29
Perovic *et al*[15]	*Latissimus dorsi* free flap (n=11)	18.1%	0%	Not reported	"good in all patients"	31
Papadopulos *et al*[11]	Prefabricated free fibula flap in FTM (n=32)	31.3%	21.8%	Not reported	Not reported	Not reported

FTM = female-to-male gender reassignment

included meatotomy, stricture excision, and direct anastomosis as well as tissue grafting or flap transfer. Endoscopic incision, in the form of internal urethrotomy, was later reported as a minimally invasive alternative with similar outcomes, though its use was limited to short (less than 3 cm) stenosis.[17] They further stated that there is no reason to go beyond two incisions and that better results are to be expected if the incision is performed a long period after phalloplasty. Reported recurrence rates were still high and ranged from 40% to 61.9%, with the exception of meatotomy performed for meatal stenosis at a 25% recurrence rate.[18] Some patients' urethral strictures are successfully managed with periodic urethral dilations.

URETHRAL STONES

Usually associated with the use of a hair-bearing skin flap, it is an uncommon complication, usually unreported in most papers. Eviction of hair-bearing flap donor sites or prior definitive hair removal are valid alternatives when a hair-free flap is not available. When urethral stones occur, endoscopic lithofragmentation and periodic hair removal are usually required and successful. Excessive hair growth can also cause diminished urinary stream.

VOIDING FUNCTION

Lastly, there is limited information regarding post-urethroplasty voiding function. The ability to void while standing is usually used as a surrogate of success regarding voiding. Even though acceptable results are universally expected, they are infrequently reported (Table 1). Only a small questionnaire-based report of FTM transgender by Hoebeke *et al* exists. Although there are no stated changes in voiding habits, 79% of patients report post-void dribbling as well as a noted mean non-significant 2 mL/s decrease in uroflowmetry maximum flow.[19]

COMPLICATION PREVENTION

As mentioned, the high complication rate of urethroplasty is multifactorial. Poor vascular supply is said to be the leading cause of urethral strictures. This belief led to the modification of the original Chinese design of the RFFF and introduction of flap maturation previous to the flap transfer. A short urethral donor skin segment due to the flap's donor area limitations is also believed to cause tense anastomosis, contributing to urethral fistula formation at the anastomosis site. Hair-bearing skin grafts, as expected, provide a nidus for urethral lithiasis; thus, they should be avoided whenever possible. Graft use in urethroplasty can overcome both the two former constraints.

As a rule, multistage pediculated tube-within-a-tube or grafted urethroplasty have lower urethral complication rates, although direct comparisons are still lacking.

Conclusion

Successful and complication-free urethroplasty in phalloplasty is an important goal to attain for both doctor and patient. Nonetheless, in the current state of the art, it still carries a significant urethral stenosis and fistula risk, for which treatment also has a high recurrence rate (Table 1). The ability to void while standing is an attainable although challenging goal. Urethral complications might be underreported due to short follow-up times. Multiple-stage and pediculated procedures seem to have a lower risk of urethral complications.

Ethical Disclosures
Conflicts of Interest: The authors report no conflict of interest.

Funding Sources: No subsidies or grants contributed to this work.

Responsabilidades Éticas
Conflitos de Interesse: Os autores declaram a inexistência de conflitos de interesse na realização do presente trabalho.

Fontes de Financiamento: Não existiram fontes externas de financiamento para a realização deste artigo.

Corresponding Author/Autor Correspondente
Afonso Morgado - luisafonsomorgado@gmail.com
Serviço de Urologia, Centro Hospitalar São João
Alameda Prof. Hernâni Monteiro, 4200-319 Porto, Portugal

Recebido/Received: 10 Jan 2016
Aceite/Accepted: 11 Abr 2017

REFERENCES

1. Chang TS, Hwang WY. Forearm flap in one-stage reconstruction of the penis. Plast Reconstr Surg. 1984;74:251-8.
2. Hage JJ, Bout CA, Bloem JJ, Megens JA. Phalloplasty in female-to-male transsexuals: what do our patients ask for? Ann Plast Surg. 1993;30:323-6.
3. Rashid M, Sarwar SU. Avulsion injuries of the male external genitalia: classification and reconstruction with the customized radial forearm free flap. Br J Plast Surg. 2005;58:585-92.
4. Bettocchi C, Ralph DJ, Pryor JP. Pedicled pubic phalloplasty in females with gender dysphoria. BJU Int. 2005;95:120-4.
5. Garaffa G, Christopher NA, Ralph DJ. Total phallic reconstruction in female-to-male transsexuals. Eur Urol. 2010;57:715-22.
6. Liu CY, Wei ZR, Jiang H, Zhao YZ, Zhang YF. Preconstruction of the pars pendulans urethrae for phalloplasty with digestive mucosa using a prefabricated anterolateral thigh flap in a one-arm patient. Plast Reconstr Surg Glob Open. 2013;1:e53.
7. Leriche A, Timsit MO, Morel-Journel N, Bouillot A, Dembele D, Ruffion A. Long-term outcome of forearm flee-flap phalloplasty in the treatment of transsexualism. BJU Int. 2008;101:1297-300.
8. Garaffa G, Raheem AA, Christopher NA, Ralph DJ. Total phallic reconstruction after penile amputation for carcinoma. BJU Int. 2009;104:852-6.
9. Perovic S. Phalloplasty in children and adolescents using the extended pedicle island groin flap. J Urol. 1995;154:848-53.
10. Rashid M, Aslam A, Malik S, Tamimy MS, Ehtesham ul H, Aman S, et al. Clinical applications of the pedicled anterolateral thigh flap in penile reconstruction. J Plast Reconstr Aesthet Surg. 2011;64:1075-81.
11. Papadopulos NA, Schaff J, Biemer E. The use of free prelaminated and sensate osteofasciocutaneous fibular flap in phalloplasty. Injury. 2008;39 Suppl 3:S62-7.
12. Kim SK, Moon JB, Heo J, Kwon YS, Lee KC. A new method of urethroplasty for prevention of fistula in female-to-male gender reassignment surgery. Ann Plast Surg. 2010;64:759-64.
13. Djordjevic ML, Bizic MR. Comparison of two different methods for urethral lengthening in female to male (metoidioplasty) surgery. J Sex Med. 2013;10:1431-8.
14. Rohrmann D, Jakse G. Urethroplasty in female-to-male transsexuals. Eur Urol. 2003;44:611-4.
15. Perovic SV, Djinovic R, Bumbasirevic M, Djordjevic M, Vukovic P. Total phalloplasty using a musculocutaneous latissimus dorsi flap. BJU Int. 2007;100:899-905.
16. Zhang YF, Liu CY, Qu CY, Lu LX, Liu AT, Zhu L, et al. Is vaginal mucosal graft the excellent substitute material for urethral reconstruction in female-to-male transsexuals? World J Urol. 2015;33:2115-23.
17. Lumen N, Oosterlinck W, Decaestecker K, Monstrey S, Hoebeke P. Endoscopic incision of short (<3 cm) urethral strictures after phallic reconstruction. J Endourol. 2009;23:1329-32.
18. Lumen N, Monstrey S, Goessaert AS, Oosterlinck W, Hoebeke P. Urethroplasty for strictures after phallic reconstruction: a single-institution experience. Eur Urol. 2011;60:150-8.
19. Hoebeke P, Selvaggi G, Ceulemans P, De Cuypere G, T'Sjoen G, Weyers S, et al. Impact of sex reassignment surgery on lower urinary tract function. Eur Urol. 2005;47:398-402.