ORIGINAL ARTICLE

Surgical treatment options in bulbar urethral stenosis


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KEYWORDS
Urethra; Urethroplasty; Urethral stricture; Reconstructive urethral surgical procedures

Abstract
Objective: To review the outcome of bulbar urethroplasty using two stage surgical techniques. Material and methods: Twenty-two of the 35 patients studied corresponded to end-to-end urethroplasty (ATT) and 13 to dorsal onlay graft (DOG) in preputial skin or oral mucosa variants. Clinical outcome was considered a failure when postoperative surgery was needed or the uroflowmetry was less than 15 ml/s. The following variables were studied: age, previous surgery, number of urethrotomies and stricture length. The curves and log-rank curves using the log-rank were elaborated for follow-up and comparison, with the Cox regression model for risk factors. Results: Mean follow-up was 40.02 months. Of all the cases, 85.71% were successful. Of these, 86.36% were in the ATT group and 84.61% in the DOG group. There were no significant differences in the comparative LR test based in stricture length, previous surgery between both group and individualized for each management. The Cox regression model showed a risk of failure in the technique for the elderly patients (OR 2.2), it is not achieving statistical significance in the remaining variables. Conclusions: The success rate achieved with the ATT technique is verified a gold standard option in short strictures. The DOG is shown as a valid option in long strictures in bulbar urethral in medium follow-up, using an oral mucosa or preputial onlay graft. More long-term follow-up must be performed with a greater number of patients to better evaluate these results.

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PALABRAS CLAVE
Uretra; Urethroplastía; Estenosis de uretra; Procedimientos reconstructivos de uretra

Opciones de tratamiento quirúrgico en la estenosis de uretra bulbar

Resumen
Objetivo: Revisar los resultados de la uretroplastía bulbar utilizando dos técnicas quirúrgicas. Material y métodos: De 35 pacientes estudiados, 22 corresponden a técnica de anastomosis término-terminal (ATT) y 13 a técnica de injerto libre dorsal (ILD) en sus variantes preputial y bucal. En el seguimiento clínico se consideró fallo la necesidad de tratamiento quirúrgico o una fluometría inferior a 15 ml/s. Se estudian las variables: edad, cirugía previa, número de urethrotomías previas y longitud de estenosis. Se elaboran curvas de seguimiento y comparativas de log-rank (LR), con modelo de regresión Cox para factores de riesgo.

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Introduction
The treatment of urethral stenosis includes various techniques such as dilation, internal urethrotomy, catheter–stent–prosthesis, anastomotic urethroplasty, and techniques using free and pedicled grafts. There are procedures to be performed in two stages. No technique is suitable for all types of stenosis, but the urologist should be familiar with all of them to perform them in the development of surgery.

The surgical technique in the bulbar urethra must be based on the length of the stenosis, the etiology thereof, and the amount of spongiosis. The removal of the stenosis and the primary anastomosis is useful in short pathology of traumatic origin, remaining as the ideal procedure with a 95% success rate and few complications. Unmanageable lesions with end-to-end anastomosis (ETEA), for being of greater length, require replacement with dorsal free grafts (DFG) or pedunculated ones. Buccal mucosa grafts have replaced the use of penile preputial, posterior ear, or bladder skin grafts. There is sufficient evidence to believe that it is the right tissue for a substitution urethroplasty, mainly due to its characteristics and easy fixing.

The description of the dorsal urethroplasty with free graft was a further step. Devine in 1979 described the use of free grafts of genital or extragenital skin. Monsieur defined in 1980 open dorsal urethroplasty with fixation without graft to the cavernous bodies, allowing for regeneration of the mucosa on a maintained urethral probe. Barbagli put both techniques together and surprised in 1996 with the description of his three procedures: dorsal technique, dorsal anastomosis, and increased anastomosis. The rotation of the bulbar urethra after release allows for the dorsal interposition of a free graft, with published results and subsequent changes.

We reviewed our clinical experience in 35 patients undergoing one-stage procedures for bulbar urethral stenosis, with ETEA and DFG as a reconstruction in those that, because of their length, performing the first procedure was not feasible.

Material and methods
Patients
A total of 35 patients with a mean age of 43.20 years (range: 16–80) underwent urethroplasty for bulbar urethral stenosis in the period from January 2005 to December 2010.

Resultados: La media de seguimiento fue de 40,02 meses. Del total de casos el 85,71% fueron considerados éxito, un 86,36% en el grupo de ATT y un 84,61% en el grupo de ILD. No hubo diferencias significativas en las comparativas LR de longitud de estenosis, cirugía previa entre ambos grupos e individualizado para cada grupo de tratamiento. El modelo de regresión de Cox muestra un mayor riesgo de fallo en la técnica en aquellos pacientes de mayor edad (OR: 2,2), no alcanzando significación en el resto de variables.

Conclusiones: Las tasas de éxito alcanzadas con el procedimiento ATT la ratifican como técnica de elección en estenosis corta, mostrando las estenosis largas de uretra bulbar un buen manejo u opción válida a medio plazo mediante injerto dorsal libre preputial o bucal. Sería aconsejable realizar seguimientos a más largo plazo con mayor número de pacientes.

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tutored with a 16 Ch urethral catheter. The urethra is attached to its previous bed with interrupted sutures on the cavernous one. In all the patients, we maintained a suction drainage for 48 h.

**Postoperative management**

The discharge in a normal evolution is 2 days for the procedures without graft, and 4 days for free grafts. Three weeks later, a parallel voiding or retrograde urethrogram is performed. If leakage is observed, the entire radiological procedure is repeated within 2 weeks. The clinical outcome is considered successful or failed when a new surgical procedure is necessary to unblock the patient. Flowmetries are performed every 3 months in the first year, and then every 6 months. When the uroflowmetry falls below 15 ml/s, all the initial protocol of radiological and endoscopic diagnosis is performed. The mean follow-up was 40.02 months (range: 11–81), distributed in 43.31 months for ETEA surgery, and 34.12 months for DFG surgery.

**Statistical analysis**

The statistical study was conducted investigating which factors might correlate with the success or failure of the procedure. The variables: age, previous surgery, number of urethrotomies, and length of stenosis were studied. Kaplan Meier curves were made to achieve the survival rates of the procedure and the log-rank test was used to compare strata or factors within each variable. The use of a Cox regression model tried to get odds ratios with 95% confidence interval for procedural failure factors, including as covariates: age, length of stenoses, previous urethrotomies, and number of urethrotomies. Chi square and Student’s ‘t’ tests were used to compare the patient’s characteristics. \( p < 0.05 \) was considered statistical significance. All the calculations were performed using SPSS 15.00 for Windows.

**Results**

Of the total cases (35), 30 (85.71%) were considered successful, differentiating an 86.36% (19 patients) success in the ETEA group, and 84.61% (11 patients) in the DFG group. If we differentiate by age the success rates, they reach 91% (100% in DFG, 86.6% in ETEA) in the age group up to 50 years, 100% (60% in DFG, 83.33% in ETEA) in the 51–69 years, and 72.72% for those over 69 years. Based on the length of the stenosis, we differentiate 5–15 mm (88.88% success); 16–25 mm (75%), and 26–40 mm (80%), and >41 mm (87.5%).

Grouping by age the results of total success, ETEA and DFG were respectively 91.3, 86.6, and 100% for the age group below 50 years, 72.7, 100, and 60% in the age group of 51–69 years, and 100 and 83.3, null in the age group over 69 years (no DFG procedure in this group).

Given the fact of having received previous treatment, all the patients show an 85.6% success for those who have not received any treatment, differing in the ETEA group a respective success of 90 and 83.3% for those who have not received treatment and those who have been treated; and in the case of DFG, an 80% success for those who have received treatment, and 100% success for those who have not received treatment. The number of previous procedures shows a relation with the success rate as follows: <2 procedures (90% overall success rate; 85.7% ETEA success rate, 100% DFG success rate), and >2 previous procedures (60% overall success rate; 100% success rate at ETEA; 50% success rate using DFG).

We show the comparative log-rank curve for age (Fig. 1) with \( p = 0.028 \), log-rank comparison of long versus short stenosis (\( p = 0.243 \) (Fig. 2)), log-rank general comparison of prior surgery versus no prior surgery (\( p = 0.999 \) (Fig. 3), and long-rank comparison of ETEA versus DFG (\( p = 0.176 \)) (Fig. 4).

The Cox regression model to analyze the probability of failure showed 2.203 (95% CI: 1.051–4.615) OR for the patient age greater than 50 years. The length of the stenosis did not reach significance level (\( p = 0.08 \)), and it did not consider relative risk factors or previous surgery or the number of previous procedures.

**Discussion**

The exact incidence of urethral stenosis in our country is unknown, and its etiology remains unknown in a large percentage of cases (57%). Its prevalence in patients under 50 is high (65%), leading to a significant impact on their quality of life and sexual activity. Another striking fact is the management of this disease with minimally invasive procedures in 33% of the cases, despite its high failure rate, keeping urethroplasty as the procedure after
failed urethrotomies.\textsuperscript{1} In our study, 57\% of the patients had prior surgery, reaching in some cases several attempts of internal urethrotomy. We might think that 62\% of the cases are stenoses smaller than 3 cm, and it would explain the previous attempt of urethrotomy use by the urologist.

A urethral stenosis can be defined from an anatomical, etiological, pathological, radiological, and surgical view. Within it, not only infectious stenosis fits, but also those related to lichen sclerosus or balanitis xerotica obliterans (BXO), with failed and repaired hypospadias and pelvic trauma.\textsuperscript{2} Many studies have focused mainly toward technical aspects, and there are few articles on long-term results.\textsuperscript{3-5} Urethral surgery evolves continuously; the first types of dorsal graft surgery were described in 1996\textsuperscript{6,7} and they have changed over the time.\textsuperscript{8-10} Until 2000, the penile skin was the preferred one, and currently the oral mucosa is the most used substitution material: we have it in all the patients, it is easy to get both from the lower lip and from the cheek, maintaining proper healing and no oral morbidity.\textsuperscript{11} The oral mucosa is free of hair, has a thick epithelium rich in elastin, which makes it very manageable, and a highly vascularized lamina propria that facilitates its inosculation and imbibition. Furthermore, its use prevents cosmetic problems arising from poor healing on the skin of the penis.

In urethral reconstruction, removal of the stenotic segment and ETEA enable a 95\% success rate in patients with untreated lesions of the bulbar urethra below 2 cm.\textsuperscript{12} We reserve the use of free grafts and flaps of penile and/or mouth skin for complex stenoses of pendulous and bulbar urethra. The outcome of the procedure depends on the vascularization of the receptor and the graft revascularization; a good bed will enable graft neovascularization. The length of the graft, the graft bed location, and the age of the patient might indirectly report the quality of the graft bed.\textsuperscript{13} The bulbar urethra is the most suitable support due to its rich vascularization.\textsuperscript{14} For some authors,\textsuperscript{13} the failures in the technique cannot be attributed to the graft donor site, history of previous surgery, or causes of stenosis.

De Sy and Oosterlinck described\textsuperscript{15} the use of preputial graft by means of circumcision because of proximity, thin, elastic, and hairless skin. The time for acquisition is short and the esthetic result is suitable. If it is missing, the oral mucosa of the cheek is preferred to that of the lower lip, although it increases the operative time in 1 h.\textsuperscript{16} It is therefore useful to have two teams, one for the perineal time that evaluates and calibrates the perineal stenosis, and another one simultaneously obtaining the oral graft.\textsuperscript{14,17} Reducing this time will help prevent problems resulting from prolonged lithotomy position.\textsuperscript{14} In our series, we have two oral graft failures of a total of 8 performed and of the total of 13 of DFG, with a follow-up time of 34 months. The success rate of DFG ranges in the literature from 50 to 95\%.\textsuperscript{13,18} Although our overall success rate is comparable to other series, a longer follow-up would make it possible to detect more faults, as restenoses have been described up to 15 years after the initial procedure.\textsuperscript{3}

Dorsal graft placement has advantages over ventral placement.\textsuperscript{6,7} It can also be used in reoperations,
avoiding the area occupied by scars, and use the contralateral side. Its use must be onlay, preserving the urethral plate serving as graft bed, allowing for a regeneration of the urethral mucosa according to the principles of Weaver and Schulte. Some authors advocate the use of ventral grafting, showing excellent results. The advantages of the DFG technique are: simple and rapid to perform, it does not increase the diverticula or urethral sacculations, it does not increase the fistula or graft necrosis, it decreases spongy bleeding, it is a versatile procedure combined with other techniques which does not require a special training. There are potential advantages for the dorsal use in stenoses affecting the proximal bulb extending the graft without difficulty to the membranous urethra. In this situation, it is easier to place the graft in dorsal than ventral placement, which would require the opening of the bulb in its most vascular segment. The oral mucosa is similar to the stratified squamous epithelium of the penis and glandular urethra. In our study, the DFG with oral and preputial mucosa provide 100 and 75% success rates, respectively, although the number of patients is low.

Comparing the follow-ups in 95 urethroplasties with oral mucosa and 24 with penis skin, the respective success rates were 87 versus 84%, although with lower follow-up periods for the oral group. Other authors collected a 2% restenosis rate. In a way, comparing penile skin and oral mucosa grafts is speculating if there are no prospective randomized or case-control trials.

Barbagli includes a comparison between both types of graft, with 85% success in cases of oral mucosa and 73% in cases of penile skin. Urethroplasty with skin showed a high failure rate (27%) when compared to the oral one (15%), although the follow-up times are different. Also, in adults with complex urethroplasties after failed hypospadias, the use of oral mucosa showed a high success rate when compared to the use of genital skin. The experience of using oral mucosa for meatal, pendulous urethra stenosis, or panestenoses has been limited. The navicular fossa and penile stenoses have been reconstructed using penile skin flaps. Some authors have questioned the use of free grafts in the pendulous urethra due to the vascular spongy deficiency, which could prevent graft fixation. This fact would be only valid when applying the free graft in ventral position, as in dorsal position, its nutrition and fixing would depend on the cavernous body. There are excellent results with dorsal oral mucosa graft in the pendulous urethra, where the urethral plate is viable. Grady collected an 87% success rate in the treatment of 24 pendulous urethras using oral graft.

Dubey shows a 90% success rate in bulbar urethroplasty, similar to other authors. The use of oral mucosa should be adapted to the exact location of the stenosis and its characteristics. Placing this graft in the dorsal side is easier and safer in distal bulbar stenoses, while the ventral situation would be more appropriate in proximal stenosis, where the spongy tissue is thicker and better vascularized. A stenosis located throughout the bulbar urethra affecting all its length would enable the lateral opening thereof and avoid having to make a ventral or dorsal urethroplasty. The studies show that the stenosis can recur even in selected patients who underwent a meticulous technique. The replacement graft urethroplasties worsen over time and require reassessment due to restenosis, although in this study, different substitution materials, different techniques, and etiologies are mixed as the cause of stenosis, different lengths, and anatomical situation of the stenotic problem. The evaluation of the rate of deterioration of urethroplasties requires evaluating the same technique, the same graft material in similar locations, with equal etiology and length. This difference in the type of patients might explain the results of our study.

We reviewed the results taking into account factors that may influence the success of the surgery: patient age, etiology, length of stenosis, and previous treatments. Our results show that the factor that most influences the outcome is a young age below 50 years. The influence of the length of stenosis is controversial due to an oscillating final success rate between 88 and 75%, depending on the length thereof. Receiving previous treatment or not provides very similar success rates. The lack of significance is explained by the small number of patients. In the study by Cox, the only factor showing predictability of failure is the patient’s age greater than 50 years.

In our experience, with follow-up from 2005 to 2010, the DFG overall success rate reaches 84.61%, varying depending on ages from 90 to 72%. The mean follow-up time in this procedure is 34.12 months. Our study shows urethroplasty in its 3 described procedures as an effective option, with similar success to that reported by other authors.

In our series of patients, restenosis occurs in 5 patients in the whole series, divided into 3 ETEA and 2 DFG, appearing in endoscopy as a white fibrous ring no greater than 1 cm in total length at the site of the prior proximal or distal anastomosis. This morphological type of stenosis has been described by many authors. Its new treatment will be based on the dilation and urethroplasty. The graft failure in the distal region might be related to the decreased vascularization of the corpus spongiosum, which would lead to poor inosculolation. Failure in the proximal part is a staging technical error of the stenosis, where due to its depth, it is technically difficult to get an epithelium–urothelium alignment. There is a lack of studies to clarify the true etiology of these restenoses (ischemia, poor suture, poor suture material). Our series shows 85% success rates, although some authors collect 90% in DFG after use of oral mucosa, reaching success rates of 97% when handling the residual fibrous ring with urethroplasty.

Our follow-up technique, based on symptoms and flowmetry lower than 15 ml/s, could lose some restenoses, but we avoid serial instrumental techniques for being patients that in the initial stage of diagnosis have been subjected to multiple handleings and invasive radiological tests, thereby improving their quality of life after urethroplasty. Furthermore, there are abnormal urethroographies that do not affect the patient’s clinical status. As over time the technique can deteriorate, lifelong follow-up is required.

A long-term evaluation would require a larger number of patients, with a minimum follow-up of 5 years, as the graft has a tendency to deteriorate over time.
describing this fact in tubular grafts more frequently than in free grafts.\(^\text{11,35,46}\)

The main weakness of this study is the small number of patients and the fact of being retrospective, and not prospective. It is a non-homogeneous population with two different techniques described. We can consider the mean follow-up in the medium term.

Conflict of interest

The authors declare that they have no conflict of interest.

References