SURGICAL TECHNIQUE

Treatment for long bulbar urethral strictures with membranous involvement using urethroplasty with oral mucosa graft

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Abstract

Introduction: Urethroplasty with oral mucosa grafting is the most popular technique for treating nontraumatic bulbar urethral strictures; however, cases involving the membranous portion are usually treated using progressive perineal anastomotic urethroplasty. We assessed the feasibility of performing dorsal (or ventral) graft urethroplasty on bulbar urethral strictures with mainly membranous involvement using a modified Barbagli technique.

Materials and methods: This was a prospective study of 14 patients with bulbar membranous urethral strictures who underwent dilation urethroplasty with oral mucosa graft between 2005 and 2013, performed using a modified technique Barbagli, with proximal anchoring of the graft and securing of the graft to the tunica cavernosa in 12 cases (85.7%) and ventrally in 2 (14.3%). The minimum follow-up time was 1 year. We evaluated the subjective (patient satisfaction) and objective (maximum flow [Qmax] and postvoid residual volume [PVRV]), preoperative and postoperative results and complications. Failure was defined as the need for any postoperative instrumentation.

Results: A total of 14 patients (median age, 64 ± 13 years) underwent surgery. The main antecedent of note was transurethral resection of the prostate in 9 cases (64.3%). The median length of the stenosis was 45 ± 26.5 mm. Prior to surgery, 50% of the patients had been subjected to dilatations and 4% to endoscopic urethrotomy. The mean surgical time and hospital stay were 177 ± 76 min and 1.5 ± 1 day, respectively. The preoperative Qmax and PVRV values were 4.5 ± 4.45 ml/s and 212.5 ± 130 cc, respectively. The postoperative values were 15.15 ± 7.2 ml/s and 6 ± 21.5 cc, respectively (p < 0.01 for both comparisons). Surgery was successful in 13 cases (92.9%). None of the patients had major complications. There were minor complications in 1 (7.1%) patient, but reintervention was not required.

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Conclusions: The repair of long bulbar urethral strictures with membranous involvement using urethroplasty with free oral mucosal grafts represents a viable alternative for patients with nontraumatic etiology and little fibrosis. The dilation of the urethral lumen achieves good results with minimum failure rates and little probability of complications. For many of these patients, the length of the stricture is too long to perform the tension-free anastomosis technique.

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Introduction

Urethral strictures have been traditionally treated with different methods ranging from the more conservative dilations to more complex techniques using grafts and flaps, including endoscopic therapies. The choice of one technique or another depends on the patient’s characteristics and, above all, on stenosis length and location. Etiology plays a key role in strategy planning since, for instance, in the case of strictures of inflammatory origin there is an increased trend toward relapse.

Bulbar urethral or bulbomembranous strictures which require urethroplasty, but are too long for anastomotic techniques, benefit from replacement techniques where the stenotic segment is removed and replaced by a graft which can provide an acceptable urethral calibration so that the patient achieves a good voiding condition. Urethroplasty with oral mucosal grafts has become a really popular technique over the last decade due to its excellent long-term results, favored by the characteristics of this easily obtained tissue.

Bulbar urethral stenosis with involvement of the membranous portion, especially in cases of post-traumatic origin, has been preferentially treated with transperineal bulboprostatic anastomotic repair, also known as progressive perineal urethroplasty. This technique implies a high success rate, depending in a way on the length of the bulbar defect extension to be treated. Nonetheless, the success of grafting techniques with urethral enlargement has led to an expansion of the indication for urethroplasty with oral mucosal grafts to cases of long strictures with bulbar or membranous involvement, avoiding the separation of the corpora

Tratamiento de la estenosis de uretra bulbar larga con afectación membranosa mediante urethroplastia con injerto de mucosa bucal

Resumen

Introducción: Las uretroplastia con injerto de mucosa bucal es la técnica más popular en el tratamiento de la estenosis de uretra bulbar no traumática; no obstante, los casos con afectación de la porción membranosa suelen tratarse mediante uretroplastia anastomótica perineal progresiva. Se evaluó la viabilidad de llevar a cabo uretroplastia con injerto dorsal (o ventral) en estenosis de uretra bulbar y afectación principalmente membranosa con técnica de Barbagli modificada.

Material y métodos: Estudio prospectivo sobre 14 pacientes con estenosis de uretra bulbomembranosa sometidos a uretroplastia de ampliación con injerto de mucosa bucal entre 2005 y 2013, según la técnica de Barbagli modificada con anclaje proximal del injerto y fijación del mismo sobre la albugínea cavernosa en 12 casos (%) y ventralmente en 2 (%). El tiempo de seguimiento mínimo fue de un año. Se evaluaron resultados subjetivos (satisfacción del paciente) y objetivos (Qmax y RPM pre y postoperatorios) y complicaciones. Se consideró fracaso la necesidad de cualquier instrumentación postoperatoria.

Resultados: Se intervinieron 14 pacientes, con una mediana de edad de 64+13 años. El antecedente principal detectado fue RTU de próstata en 9 casos (64,3%). La mediana de longitud de la estenosis fue 45+26,5 mm. Antes de la cirugía el 50% de los pacientes había sido sometido a dilataciones y el 4% a uretrotomía endoscópica. El tiempo quirúrgico fue 177+76 min y la estancia hospitalaria 1,5+1 d. Qmax y RPM preoperatorios fueron 4,5+4,45 ml/seg y 212,5+130 cc, y postoperatorios 15,15+7,2 ml/seg y 6.21,5 cc (<0,01 ambas comparaciones). La cirugía resultó exitosa en 13 casos (92,9%). Ningún paciente presentó complicaciones mayores. Hubo complicaciones menores en uno (7,1%), sin precisar reintervención.

Conclusión: La reparación de estenosis largas de uretra bulbar con afectación membranosa mediante uretroplastia con injerto libre de mucosa bucal supone una alternativa viable en pacientes de etiología no traumática con escasa fibrosis. La ampliación de la luz uretral consigue buenos resultados con mínima tasa de fracaso y escasa probabilidad de complicación. En muchos de estos pacientes la longitud de la estenosis es demasiado larga para realizar técnica anastomótica sin tensión.

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cavernosa and pubectomy, sometimes necessary to perform perineal anastomosis.

We present a favorable experience derived from performing replacement urethroplasty with free oral mucosal grafts, ventrally or dorsally placed, in complex strictures of the bulbar urethra with membranous involvement. More studies are needed to clarify the role of elongation and luminal elastic enlargement of the urethra in the success of this kind of surgery, when compared with excision of diseased tissue in anastomotic repair.

Materials and methods

Prospective study analyzing the characteristics and results of a series of cases affected by bulbar urethral strictures with membranous involvement and who underwent augmentation urethroplasty with oral mucosal grafts, according to the modified Barbagli technique, at the University Hospital of Getafe. All patients were operated on over the 2005–2013 period. Patients had been contacted by telephone in January 2014. They all showed a minimum follow-up of one year.

The clinical course of the patients was revised, paying special attention to subjective data on patient satisfaction and objective data on bladder voiding, including maximum flow ($Q_{\text{max}}$) and post-void residual (PVR), both pre- and postoperative for each case. We also assessed cystourethrography images, both retrograde (Fig. 1) and voiding (Fig. 2). We registered operative data, duration of the surgical intervention, hospital stay time, and complications according to the Clavien–Dindo scale and EAU
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Figure 3 Obtaining of the oral mucosa graft. Hydro-dissection of the mucosa and section of the demarcated area provided by traction sutures is conducted.

recommendations.8,9 A descriptive statistical analysis was carried out. We used the median and the interquartile range for quantitative variables, and percentages for qualitative variables.

Surgical technique

The technique used is a variant of the original Barbagli technique with oral mucosal grafts,10 the main modifications being the following: (a) really proximal graft-anchorage; (b) graft fixation on the albuginea of the corpora cavernosa once urethral enlargement has been performed with stitching of the graft; (c) the use of a hemostatic agent as a sealant of the self-expandable gelatinous matrix and a thrombin base. Additional material is presented with a representative video of this surgery.

The patient is placed in lithotomy position. The suprapubic, scrotal, and perineal regions are shaved and disinfected with chlorhexidine. Ureteroscopy is performed by placing a guidance sensor and a 4-Ch ureteral catheter which surpasses the stricture and gains access to the bladder. Immediately thereafter, with the patient in the dorsal lithotomy position, a perineal-scrotal incision is made on the middle line. The dissection of subcutaneous cell tissue and the incision of Colles’ and Gallaudet’s fascia allow for the exposure of the bulbospongius muscles. Due to the proximal nature of strictures, it is necessary to section the central tendon of the perineum. The bulbospongius muscles are cut on the middle line in a cranio-caudal direction and are laterally separated to expose the corpus spongiosum in its full extent. The corpus spongiosum is subsequently released from dorsal attachments to the albuginea of the corpora cavernosa.

Simultaneously, another surgical team proceeds to obtain the buccal mucosa graft (Fig. 3). Demarcation of both Stenon’s canals and the selected area is done to get the graft. A saline solution with diluted adrenaline is injected on the edges of the marked area, thus performing hydrodissection of the mucosa, to subsequently section the demarcated area using a cold scalpel. Two traction points on the proximal edge of the graft area make their subsequent dissection easier. Once the graft has been removed, the hemostasis is carefully examined and the edges are approximated with reabsorbable 4-0 suture. The graft is made thinner with some scissors and permanent manual contact. Its extraction is simplified by the administration of topical adrenaline. Identifying the parotid canal is particularly important at the moment of extraction.

The distal edge of the stricture is marked with the help of a Beniqué sound and a dermographic marker. 3 traction points are applied on the urethral spongiosum at different levels. These points keep a precise 180° rotation to make exposure and a comfortable approach to the urethra on its dorsal side easier. A longitudinal incision is made on the dorsal surface of the spongiosum until reaching the cranial limit of the stenotic area (Fig. 4), with an excellent opening of the urethra being observed and sometimes even the veru montanum.

This incision enables the visualization of the Beniqué sound and a complete exposure of the urethral lumen through all the stenosed segment. It is advisable to cut 1 more cm, both at the proximal and dorsal levels of the stricture. The affected urethral segment shows a certain degree of fibrosis on the outside, which is removed with scissors, lightening the urethral lumen before proceeding to graft placement. Alternatively, the urethral incision can be made on the ventral side, which implies an easier exposure, though urethral release is equally required. Dorsal positioning implies less graft mobility, which is attached to the base of the crura of the corpora cavernosa and to the trapezoidal space.

The length of the stenotic area is determined with a tape measure and a Foley probe which will serve as a tutor is placed. The proximal part of the graft, which has been previously carved at the bank with reabsorbable 4-0 suture, is fixed. Anastomosis is subsequently completed between the graft and both edges of the urethral lumen in a distal direction, using interrupted stitches of the same suture (Fig. 5). Two parallel lines of reabsorbable suture stitches applied on the cavernous albuginea and the graft on both sides offer stability to it (Fig. 5). Once they have been tied in a distal direction without any tension, the urethral spongiosum is once again fixed to the albuginea of the corpora cavernosa.

The re-approximation of the bulbospongious muscles is performed with a 3-0 reabsorbable braided multifilament suture. Once this muscular structure has been reconstructed, we proceed with a FloSeal Hemostatic Matrix injection, 10 ml (Baxter Healthcare Corporation, Hayward, CA, USA) on the space located between the spongiosum and the muscular plane. The application of interrupted stitches at a distal level between the spongiosum and the cavernous albuginea further reinforces urethral stability.

Aspiration drainage of the Redon type, which will be kept for approximately 12 h after surgery, is placed in the surgical wound. The surgical intervention finishes with the approximation and closure of the planes cut. The endoscopic image at 6 months after surgery showed a perfect integration of the mucous graft, with no residual stenosis areas being observed.

Results

A total of 14 patients are described, 12 of whom had stenosis at the level of the bulbar and membranous urethra and 2 at the level of the membranous urethra exclusively. The median age was 64 ± 13 years. In 9 patients (64.3%) the
etiology was secondary to prostate transurethral resection performed over a period greater than 5 years before, in one (7.1%) secondary to traumatic bladder catheterization, in another one (7.1%) secondary to closed ureteral trauma-
tism, and in the remaining 3 cases (21.4%) it was idiopathic. In one case (7.1%) the length of the stenosis was 2–3 cm, in 5 (35.7%) 3–4 cm, in 4 (28.6%) 4–6 cm, and in 4 (28.6%) it exceeded 6 cm. The median length of the stenosis was 45 ± 26.5 mm.

A total of 7 patients (50%) had a history of previous urethral dilation and 4 (28.6%) of previous endoscopic ure-
throtomy. None of them showed genital lichen sclerosus or had previously undergone circumcision. Two patients (14.3%) showed previous incontinence and 3 (21.4%) recur-
rent infections of the urinary tract. 3 cases (21.4%) showed multiple stenosis and one patient (7.1%) showed involve-
ment of the penile urethra. The graft used for urethroplasty was oral mucosa in all cases. In 2 patients (14.3%) it was ventrally placed and in 12 (85.7%) dorsally. In 3 cases (21.4%) a double flap was obtained, one from each cheek. In these cases, nasal intubation hugely favors graft extraction.

The median surgical time was 177 ± 76 min (range 95–240) and the median hospital stay was 1.5 ± 1 days.
(range 1–6). At the time of discharge only one patient (7.1%) had a cystostomy catheter and the median time of bladder catheter was 23 ± 11.5 days (range 14–49). The median preoperative Qmax value was 4.5 ± 4.45 ml/min (range 1.7–9.7) and the median PVR 212.5 ± 130 cc (range 0–420). Qmax and PVR values at 3 months after surgery were 15.15 ± 7.2 ml/min (range 9.6–29.6) and 6 ± 21 ml (range 0–97), respectively. Improvement in both parameters was statistically significant (signed range test, p = 0.0001 and p = 0.0002; respectively) (Fig. 6).

No patient within this series showed major complications. One patient (7.1%) showed a minor complication in the first postoperative month, consisting of a urinary fistula which was resolved with bladder catheterization. No case developed incontinence after surgery. There were no complications associated with the extraction of the free graft from the oral mucosa. Throughout follow-up, 3 patients (21.4%) showed endoscopic or radiologic data suggestive of partial stenosis, though with clinical improvement in all cases. One case required dilation maneuvers 4 years after surgery, thus being considered a failure. All the other patients confirmed good voiding function and showed objective data (PVR and Qmax) of improvement in bladder voiding without instrumentation. Therefore, with a median follow-up of 54.5 ± 23.7 months, we can consider that the procedure was successful in 92.9% of patients.

Stenosis length is a prognostic factor as well as a factor used to decide on the type of urethroplasty14–16 and, consequently, it may be a source of confusion when analyzing the healing power of each technique.1 In the case of bulbar or membranous urethral strictures, termino-terminal urethroplasty is considered to have better results than augmentation urethroplasty, though this fact could be biased by the own definition of its indication.1 That is why, in the case of strictures smaller than 2 cm in length, termino-terminal anastomosis is considered the technique of choice. However, for strictures greater than 2 cm, when the urethral lumen is well preserved and the area of spongiosis is small, augmentation urethroplasty with grafting in the dorsal or ventral position is the ideal technique, with long-term success rates up to 90%.14–16

We can use grafts or flaps for augmentation techniques. There is a historical controversy on which of the 2 is the most appropriate one, though nowadays it is clearly established that the recurrence rate of stenosis is 14–15.7%, with no apparent differences between grafts and flaps.17 However, the complication rate is higher in the donor area when flaps are used. These complications include penile hematoma, skin necrosis, fistula formation, and a higher risk of urethral diverticulum formation.16

Regarding graft origin, there is currently an increasing trend to use oral mucosa as donor tissue, although historically the preferred tissue has been preputial mucosa or penile skin due to their easier extraction and their histological characteristics. With regard to the use of preputial skin or oral mucosal grafts, the literature shows mixed results. Whereas Alkisafi et al.18 found no differences among them, Barbagli et al. detected a higher failure rate with preputial mucosa.14 Our experience is favorable to the use of oral mucosa in all cases. Oral mucosal grafts are resistant and easy to obtain and to handle. They have a thick epithelium with their own thin layer and a dense panlaminar

![Figure 6](image_url) Changes in (A) maximum flow (Qmax; ml/s) and (B) in post-void residual (PVR; cc) according to the signed rank test with the difference between the end point and baseline (p = 0.0001 and p = 0.0002; respectively).
vascular plexus. It is a moist tissue resistant to skin conditions, such as lichen sclerosus. Oral mucosa also has a privileged immunology, having shown in preclinical studies a large number of fibroblasts which reduce fibrosis. In those patients who require the extraction of several free grafts, labial and/or lingual mucosa can also be used, though these tissues are thinner than buccal mucosa.

The development of urethroplasty with oral mucosal grafts in the dorsal position implies an evolution of the techniques used for the treatment of urethral stenosis. In 1979, Devine et al. made the use of genital and extragenital grafts popular for urethral reconstruction.\(^{20}\) Monsieur described in 1980 a new technique where the dorsal surface of the urethra was opened and fixed to the underlying corpora cavernosa, leaving the urethral catheter in place for a long period of time until the regeneration of the oral mucosa.\(^{21}\) In 1996 Barbagli et al. combined both concepts, thus developing a new treatment paradigm for urethral stenosis based on the placement of a free oral mucosal graft on the dorsal side of the urethra, either with augmented anastomosis or with dorsal onlay grafting without urethral sectioning.\(^{22}\) The latter technique has become the most commonly used one due to its good, long-lasting results,\(^{14}\) and it has inspired the experience we present. Most recently, Barbagli et al. have also shown their wide experience with the use of ventral onlay grafting in long strictures of the proximal urethra with a non-traumatic etiology,\(^{12}\) quite similar to the cases presented here where the graft was ventrally placed.

In short, dorsal urethroplasty with free buccal mucosa graft is a technique which achieves satisfactory results in the repair of long complex strictures of the bulbar urethra with involvement of the membranous urethra. It is a substitute alternative to transperineal bulboprostatic anastomotic repair, traditionally recommended in those cases secondary to urethral trauma which show extensive fibrosis. The aim of the non-anastomotic technique we describe is to enlarge the urethral lumen without causing any shortening. Its results are satisfactory, particularly in patients with limited fibrosis, but with urethral lumen retraction due to thermal injuries, which are possibly secondary to a previous transurethral resection with poor isolation quality. The probability of success is very high and the number of complications is limited. Patients also benefit from early discharge from hospital.

Conflict of interest

The authors declare that they have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.acuroe.2014.07.006.

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