

REVIEW ARTICLE

Rational and selective management of patients with anterior urethral stricture disease

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KEYWORDS

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Abstract

Introduction: The management of anterior urethral stricture is controversial. A review article was written, which updates the current situation of the surgical treatment of anterior urethral stricture.

Materials and methods: We review the experience of the Hospital del Trabajador in Santiago de Chile regarding its different surgical approaches, as well as scientific literature on the topic.

Results: Traditionally, anterior urethral stricture has been treated using minimally invasive techniques (dilatation and internal urethrotomy), which are unable to cure more than 30%–35% of patients. On the other hand, urethral reconstructive surgery (urethroplasty) is more complex and requires training, however it can cure the vast majority of patients in a single surgical procedure. Due to a lack of experience and training in reconstructive surgery, non-invasive methods are overused and abused, to the detriment of the patients' quality of life. There is substantial evidence that internal urethrotomy is an excellent method for treating stricture of up to 1 cm in length, however its efficacy decreases drastically above 1.5 cm. Notwithstanding, urethroplasty is directly indicated for larger strictures, especially if prior urethrotomy failed.

Conclusion: This procedure must be managed selectively, applying the appropriate treatment aimed at curing and not only palliating the disease. Urologists must be better trained in urethroplasty and/or centers of excellence must be established to be able to offer the best treatment in each case.

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PALABRAS CLAVE

Uretra;
 Estenosis uretral;
 Uretroplastia;
 Estrechez uretral;
 Uretrotomía interna

Manejo racional y selectivo de los pacientes con estenosis de uretra anterior**Resumen**

Introducción: El manejo de la estenosis de la uretra anterior es controvertido. Se lleva a cabo un artículo de revisión que pone al día el estado actual del tratamiento quirúrgico de la estenosis de uretra anterior.

Material y métodos: Se revisa la experiencia del Hospital del Trabajador en Santiago de Chile respecto a las diferentes modalidades de tratamiento quirúrgico para esta entidad y se revisa la literatura científica al respecto.

Resultados: Tradicionalmente la estenosis de uretra anterior se ha tratado con métodos mínimamente invasivos (dilataciones y uretrotomía interna), que no son capaces de curar a más del 30-35% de los pacientes. Por otro lado la cirugía de reconstrucción uretral (uretroplastia) es más compleja y requiere entrenamiento, pero puede curar a la vasta mayoría de los pacientes en un solo procedimiento quirúrgico. Debido a falta de experiencia y entrenamiento en cirugía reconstructiva, existe sobreuso y abuso de los métodos no invasivos, en perjuicio de la calidad de vida de los pacientes. Existe amplia evidencia de que la uretrotomía interna es un excelente método para tratar estenosis de hasta 1 cm de longitud, pero su efectividad disminuye drásticamente por encima de 1,5 cm. Ahora bien, las estenosis más largas tienen indicación directa de uretroplastia, sobre todo si ya ha fallado una uretrotomía previa.

Conclusión: El manejo de este proceso debe ser selectivo, empleando el tratamiento apropiado orientado a curar y no sólo a paliar la enfermedad. Es necesario mejorar el entrenamiento de los urólogos en uretroplastia y/o establecer centros de referencia para poder ofrecer un tratamiento óptimo a cada caso.

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Introduction

The urethra is a tube that extends from the bladder neck to the urethral meatus. The perineal membrane divides it into two sections, anterior and posterior. The anterior urethra is located distal to the membrane and consists of the bulbar urethra, penile or pendulous urethra, navicular fossa and meatus. Diseases and injuries of the posterior urethra have very different characteristics and will not be included in this review.

The anterior urethra consists of a mucosa lined with transitional epithelium and a thick submucosa layer, which continues directly with the trabeculae of the corpus spongiosum. Likewise, it has no muscular layer, which causes it to defend itself badly from scarring and fibrous processes, whether of the urethra itself or of the surrounding tissues.¹ Different types of damage to the urethral epithelium or mucosa can cause a scar that extends variably to the corpus spongiosum, compromising the lumen and causing stricture.

The incidence of this disease varies in different regions of the globe, however it can affect up to 0.6% of the population in certain areas² and its health impact is notable. It is estimated that in the U.S., it is responsible for 5,000 hospitalizations and 1.5 million outpatient visits a year, costing over \$ 200 million per annum.³

Urethral stricture is a chronic and diverse disease, of varied etiology and is as old as the controversy regarding its treatment. It has existed since the dawn of humanity and is present in the origin of urology as a specialty.^{1,4} The introduction of urethral dilation to treat it is attributed

to Shusruta of India, 3,000 years BC.⁵ Dilatation was the standard treatment until the appearance some 200 years of internal urethrotomy. As of the beginning of the nineteenth century a wide variety of instruments with different designs (urethrotomes) were used profusely, which were introduced blindly and that opened the stricture using small knives. Urethrotomy intends to maintain the urethral lumen by re-epithelialization of the incision and scar remodeling. During the nineteenth century a large number of urologists developed their own urethrotome, the most notable of which was the Otis urethrotome.^{4,6}

However, even when these procedures are effective to extend the urethral lumen, they are unable to eliminate the fibrous tissue disease, which actually urethra heals by secondary intention, a process that most often leads to a progressive increase in fibrosis and recurrence of stenosis.

It is remarkable that these two procedures, dilation and urethrotomy, described and in use by hundreds and thousands of years, remain until today the most widely used treatments in the world for the management of urethral stricture, although not curative.

To cure urethral stricture, the pathological fibrous tissue must be removed and healthy tissue must be provided to replace the damaged urethral wall. To achieve this goal in the course of time, numerous alternatives of tissue transfer have been attempted, using practically all existing tissue and elements. Unfortunately, urethral reconstruction procedures (urethroplasty) in the mid-twentieth century had bad and disappointing results, mainly due to the use of inappropriate techniques and principles. For this reason, the appearance in the 70's of Sachse's optical urethrotome⁷

came to fill the void that reconstructive techniques had failed to fill, and this instrument was adopted universally with great enthusiasm. Since its introduction, the optical urethrotome has been used to treat all types of stenosis and is today the first-line treatment of urethral stricture in most urology departments. However, like the blind urethrotome of the nineteenth century, this instrument is not able to treat fibrosis, so its utility is limited and its results are usually temporary. In spite of this, it is often used repeatedly and indiscriminately, such that other alternatives are only considered when one or many urethrotomies have failed.

Fortunately, as of the 80's, the application in urethral stricture of reconstructive techniques (grafts and flaps), which were very successful in hypospadias surgery, began to offer other healing alternatives. Thus, a new era in urethral reconstruction emerged with urethroplasty, which was recovering with full force. It is however, a more complex and expensive surgical procedure that requires training, but unlike internal urethrotomy, it can heal and not only palliate the disease.

In this scenario a urologist of today who is faced with a case of anterior urethral stricture is at a crossroads: what to do? Endoscopic internal urethrotomy (EIU) or urethroplasty (UP)? This article reviews the evidence available to resolve this dilemma, based on it and in a rational manner.

Presentation of evidence

Endoscopic internal urethrotomy

The blind internal urethrotomy was transformed into an endoscopic procedure by the French surgeon, Antonin Jean Desormeaux in 1853,⁶ but it became popular from 1971 when Hans Sachse introduced the cold-cut knife urethrotome with direct vision, which continues to be used today.⁷

While this procedure has excellent early results with a 60% to 90% success rate at 12 months, this success drops dramatically after 3 years. In our experience, we reviewed 92 EIU performed between 1984 and 2004. With an average follow-up of 88 months, the overall failure rate was 65% (fig. 1).^{8,9} These same figures are repeated in literature. Pansadoro and Emiliozzi published a failure rate of 68% at 98 months and Heyns et al.¹⁰ a recurrence rate of 61% at 48 months.¹¹ This trend is also observed in other publications, so that is consistently accepted that the EIU is not capable of curing more than 30%-35% of patients.

Urethroplasty

The UP includes a wide variety of techniques aimed at restoring the urethral lumen, either by removing the diseased tissue and reconstructing the urethra by means of termino-terminal anastomosis or replacing the diseased tissue with healthy tissue. Techniques have evolved over time, but mainly provide for the use of genital skin flaps and / or of skin or mucous membranes grafts. Two-stage techniques have been replaced by one-stage reconstructions, with buccal mucosa grafts being the most

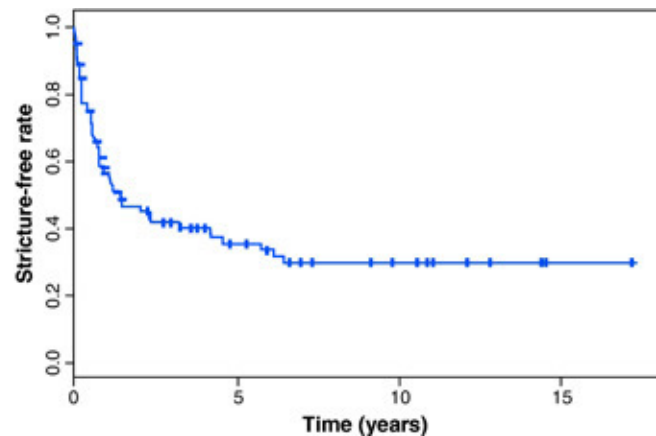


Figure 1 Recurrence-free survival curve for internal urethrotomy at 15 years.

widely accepted in the last decade. In any case, it is clear that the technique to be used should be individualized for each case and in many cases there is more than one alternative to choose from.

Many UP series have documented excellent results, with a success rate ranging from 70% to 95% depending on the type of reconstruction and follow-up period. Table 1 shows the results of 10 termino-terminal anastomosis in the anterior urethra up to 4 to 5 years and an average success rate above 90%.¹²⁻²¹ Although other techniques that require urethral replacement with grafts and flaps are not as successful, their success rate is at least twice that of EIU. While it requires training and experience, these results are perfectly possible to achieve at any trained center.

In 1994, our group published preliminary results in 24 patients, mostly post-traumatic, with a 79% final cure rate.²² This figure remained stable over time and in a recent update of our experience of 20 years, with an average follow-up of 75 months, the overall success was 78% in 99 consecutive patients of all kinds. This series includes our entire learning curve and confirms that it is possible to reproduce the international results, with figures that are at least double what EIU can offer.²³

Table 1 Results of resection and primary anastomosis for anterior urethral stricture

Author	Citation	No.	Follow-up (months)	Success (%)
Eltahawy et al	12	260	50.2	98.8
Santucci et al	13	168	72	95.2
Andrich et al	14	71	60	95
Micheli et al	15	71	60	93
Martínez-Piñero et al	16	69	44.4	88
Jakse et al	17	60	45	93.3
Lindell et al	18	49	12-48	95.9
Panagakos et al	19	42	3-72	95.2
Kessler et al	20	40	72	86
Barbagli et al	21	20	54.5	95

The healing potential of both techniques

To evaluate the potential of each procedure to permanently cure the disease with a single operation, we reviewed our experience selecting only those cases that were treated primarily with either EIU or with UP, excluding all patients who had received any prior surgical treatment. That is, if faced with an untreated case, answer the question how likely it is to be cured if we perform an EIU or UP? Complying with the premise to follow up the patients for at least 12 months, we selected 33 patients treated with EIU and 23 subjected to UP. With a mean follow-up of 4 years, the success rate was 48% vs. 87% for EIU vs. UP, respectively ($p < 0.01$) (fig. 2).^{24,25}

Who and who not to subject to urethrotomy?

Notwithstanding, despite having a limited healing potential, an EIU is an excellent procedure with numerous advantages, and undoubtedly about 35% (and up to 48%) of patients could be cured avoiding a more complex UP. The key is being able to identify them.

With this effort we review our EIU seeking predictors of success. With a median follow-up of 88 months, the overall success of our series of patients treated with urethrotomy was 34.8%.⁸ Unsurprisingly, we found that key factors are the length of the stricture and the degree of fibrosis. The average length of patients with recurrent stenosis was 2.03 cm versus 1.26 cm in those without recurrence ($p < 0.05$). Success in stenosis of less than 1 cm was 60% at 18 years, but falls below 20% in stenosis over 1 cm (fig. 3).^{8,9} As regards the degree of fibrosis evaluated by the surgeon in surgical protocol, the success rate was 62%, 35% and 22% for mild, moderate and severe degrees of fibrosis, respectively. Combining factors, the success rate in patients with stenosis of 1 cm or less and mild fibrosis was 73%, but fell to 20% in stenosis over 1 cm and moderate or severe fibrosis.^{8,9} These figures are consistent with those that other authors have described in literature^{9,10,26-30} (table 2).

If the objective sought with this surgery is the definitive cure of the disease, then the EIU should be reserved

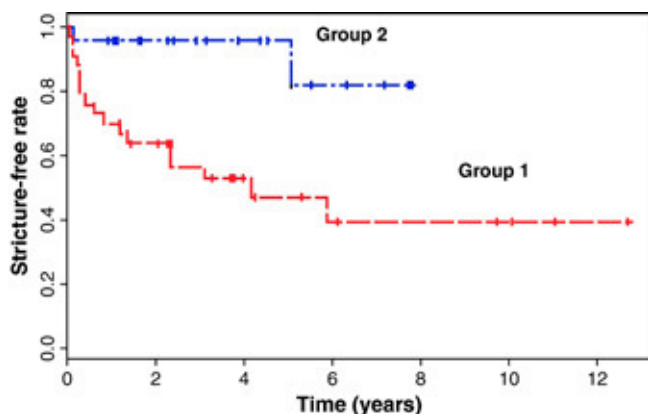


Figure 2 Recurrence-free survival curve: urethroplasty (blue line); urethrotomy (red line).

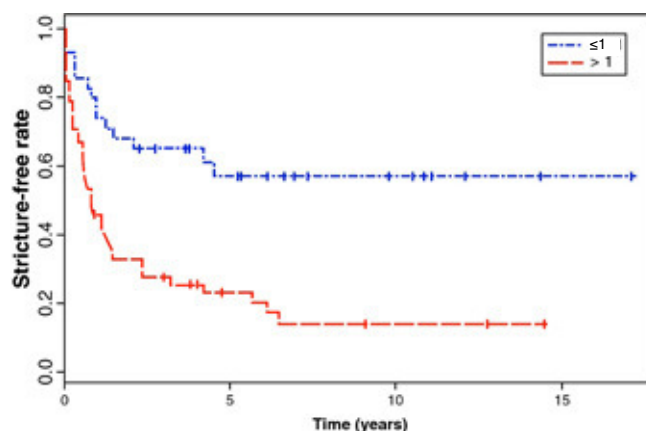


Figure 3 Recurrence-free survival curve according to length of stricture: < 1 cm (blue line); ≤ 1 cm (red line).

exclusively for stenosis of 1 cm or less and a mild degree of fibrosis. The curative indication for EIU in stenosis longer than 1.5 cm cannot be considered. However, it is an excellent alternative for elderly patients at high surgical risk or those who reject a UP. It may also be useful as a “retouch” of a UP for recurrent stenosis, as the failure of a UP often consists of short and localized stenosis, which can be salvaged with an EIU.

Intraurethral stent

The use of stents was conceived as an attempt to improve the results of internal urethrotomy. The procedure involves the opening of the stricture with the urethrotome, then subsequently endoscopically placing a self-expandable metal stent, designed to prevent the recurrence of the stricture. The most commonly used device has been the *UroLume Wallstent* (American Medical Systems, Inc., Minnetonka, Minnesota).

The preliminary and short-term results were very promising, with mean improvement in maximum flow of 9.5 to 20.8 ml per second. However, in the long-term hyperplastic tissue may grow through the stent, which once again obstructs the urethra. A large number of patients require dilation, new urethrotomies, endoscopic resection of hyperplastic tissue or insertion of a new stent.^{31,32} Up to 10% eventually require removal of the stent associated with urethroplasty, which is often very complex and has a higher risk of recurrence. In the experience of Kessler et al., the risk of failure of UP was 3.69 times greater in patients previously treated with stent implantation than in those without prior implantation.²⁰ Other non-surgical complications include significant dribbling in 32% and recurrent urinary tract infections in 16%.³³⁻³⁵ Table 3 describes the results of 3 series with good follow-up, noting that the ultimate long-term success is equal to or lower than EIU.

It is deemed that there is limited indication for the use of this type of devices in recurrent stenosis that is difficult to treat, especially in severely debilitated patients or those that reject a UP. We have no personal experience with the use of stents in urethral stenosis.

Table 2 Urethrotomy recurrence rate according to length of stricture

Author	Citation	Year	Length (mm)	Recurrence (%)
Holm-Nielsen et al	26	1984	< 5	41
			> 5	55
Boccon-Gibod y Le Portz	27	1982	> 5	85
Pansadoro and Emiliozzi	10	1996	< 10	18
			> 10	71
Albers et al	28	1996	< 10	28
			> 10	51
Hafez et al	29	2005	< 10	6.6
			> 10	50
Steenkamp et al	30	1997	< 20	40
			> 20	75
Gómez et al	9	2006	< 10	20
			> 10	73

Discussion focused on the recommendation

Faced with a case of urethral stricture, the dilemma is basically to choose between an EIU or UP. On the one hand, an EIU is a minimally invasive operation; it is simple, easy to learn, inexpensive, repeatable and can sometimes even be performed on an outpatient basis. However, it is not free of complications (urethral and perineal hematoma in up to 20% of cases)^{36,37} and is only capable of curing the disease in no more than 30%–35% of patients.^{8–11}

On its part, a UP is a far more complex alternative, with a higher cost, which includes a variety of surgical techniques that require experience and training and also have increased morbidity. However, it has a high rate of permanent cure, which can exceed 90% in selected cases and in trained hands.^{12–23}

In many countries, EIU has been the first-line treatment, such that the vast majority of patients that underwent UP has multiple prior UIE, and in reality, UP is only considered as a salvage alternative when one or several EIU have failed. This is frankly questionable, given that, as with all diseases, the primary goal of surgery should be to try to cure the disease and not just settle for a palliative alternative. Moreover, urethral stricture is a disease that can have very different characteristics depending on its location, length, etiology and degree of fibrosis, which is why it would be ingenuous to apply the same procedure in all cases indiscriminately. It is common to “attempt” an EIU in long and complex stenoses, in which it will obviously fail.

Interestingly, this treatment pattern is not only observed therapy in our country but also prevails in non-academic U.S.

centers. Bullock and Brandes recently sent questionnaires to 1,262 certified urologists, members of the AUA, to investigate urethral stenosis treatment patterns by North American urologists. On average a urologist treats 11 cases per year, which indicates that it is an uncommon but not rare pathology. The vast majority of urologists used only minimally invasive procedures: 92.8% dilation, 85.6% internal urethrotomy and 23.4% stent. 57.8% do not perform urethroplasty. Only 4.2% had experience using buccal mucosa grafts. In cases of a long stenosis or a short stenosis in which minimally invasive methods have failed, a third of urologists insist on the same methods despite new failures being totally predictable. Only 20–29% refer such cases to other more experienced urologist. Finally, 74% of urologists surveyed mistakenly believe that literature indicates a gradual approach (“therapeutic ladder”) in which reconstructive surgery is reserved only for cases in which prior endoscopic management failed.³⁸

It has been argued that urethrotomy is so simple that it is better to carry it out repeatedly from time to time, instead of considering a complex UP. This behavior is non-founded, as studies have shown that there is no additional benefit in repeating a failed EIU.¹¹ Moreover, other cost-effectiveness studies that compared EIU with urethral dilation, concluded that there is no economic advantage in a repeated EIU, and therefore, after a failed EIU, a UP should be considered.^{39,40}

This policy of “testing” an endoscopic treatment and if it fails, then to perform further reconstructive surgery is risky and could be iatrogenic, as it is not clear whether or not repeated urethrotomies worsen the prognosis of a subsequent

Table 3 Results described for Urolume Wallstent

Author	Citation	No.	Follow-up (years)	Complications (%)	Surgical check-up (%)	Success (%)
Shah et al	32	24	11	68	33	32
De Vocht et al	34	15	10	87	-	13
Hussain et al	35	60	6.4	55	32	45

Figure 4 Selective treatment proposal for anterior urethral stricture.

UP. On the one hand, Andrich and Martínez-Piñero found a higher recurrence rate in reconstructive surgery of patients with previous multiple failed urethrotomies^{16,41} and on the other hand, in our experience, both EIU and UP had better results in previously untreated patients. On their part, Kessler et al. reported that the risk of recurrence of a urethroplasty was 2.25 times greater in patients previously treated with two or more urethrotomies.²⁰ However, other authors have not confirmed these findings^{27,42}

Prior repeated urethrotomies probably have little impact on the success of reconstructive surgery in short bulbar strictures, but we cannot rule out that a short initial stenosis may become a long stricture after repeated urethrotomies have been performed⁴³

The real difficulty in offering different UPs lies in the limited training urologists have to carry out these techniques. Unfortunately, urethral stenosis is rare, and therefore the learning curve lasts longer. However, if all cases the urologist receives are treated primarily endoscopically, there will be even fewer opportunities to master the techniques of reconstruction.

It is necessary to enhance training in urethral pathology in training programs and to consider the definition of centers of excellence that, because they have a higher volume, may have more experience, better results and provide adequate training to new generations. This has proven to be effective in Europe where social health systems facilitate the existence of such centers of excellence, but it has also been recently considered for the North American system.⁴⁴

Our own experience of 20 years as a specialized center confirms this need. The results that we obtained at the Hospital del Trabajador de Santiago support the evidence we present throughout this review. The overall success rate of urethrotomy was 35% at 15 years. When the stenosis

has a length equal to or smaller than 1 cm the success rate is 73% but drops to 20% for stenosis longer than 1 cm. Similarly, when fibrosis is mild, the success rate is 62% but when the fibrosis is severe, it drops to 22%. All these figures refer to a 15-year follow-up period. Our experience regarding cases that have undergone primary urethrotomy, thus excluding recurrences or prior failures, has a success rate of 48% with an 8-year follow-up period. On the other hand, the overall success rate in patients that underwent UP is 78% with an 8-years follow-up period. If we focus only on the population that underwent UP as primary treatment, then the result is an 87% success rate at 8 years.

Therefore, based on our own experience and taking into account the views and evidence in literature, we postulate that the treatment of urethral strictures should be selective and not indiscriminate: every technique has its purpose and precise indications. In figure 4, we propose a selective and rational management algorithm, in which we include both urethrotomy and UP, in accordance with the evidence we have discussed.

In summary, urethral stricture is a surgically curable disease, just like acute appendicitis. This means that we must attempt to subject the patient to a single surgical procedure so he forgets about the problem once and for all. High dependency maneuvers, which include calibration, autodilatation, cystoscopy, periodic outpatient urethrotomy... must therefore be considered as failures.

The guidelines for the treatment of urethral stricture must be revised in the various Departments of Urology and selective management must be established. There are patients whose first indication is reconstructive surgery and who should not undergo urethrotomy "just in case." Obviously, this approach requires reinforcing training in reconstructive urethral surgery and considering the definition of centers of excellence.

The main role of an endoscopic resolution approach should be reserved for soft strictures with little spongiositis and no more than 1 cm in length, in which the probability of success is about 75%. An EIU could be attempted between 1 and 1.5 cm, however the success rate falls to below 50%. Above 2 cm, the failure rate is unacceptable and these patients should undoubtedly be treated with primary UP, like all strictures of any length in which urethrotomy has already failed.

Endoscopic treatment plays an important role as salvage therapy for retouching a stenotic segment of a prior UP, in which indication it has proven to be notably successful. Finally, urethrotomy obviously continues to be indicated in elderly, debilitated or surgically high-risk patients and in informed patients that reject UP.

Conflict of interest

The authors declare that they have no conflict of interest.

References

1. Blandy J. Urethroplasty en uno y dos tiempos. In: Libertino J, Zinman L, editors. Cirugía Urológica Reconstructiva. Barcelona: Salvat Editores; 1982.
2. Tonkin JB, Jordan GH. Management of distal anterior urethral strictures. *Nat Rev Urol.* 2009;6:533-8.
3. Santucci RA, Joyce GF, Wise M. Male urethral stricture disease. *J Urol.* 2007;177:1667-74.
4. Thompson H. Maladies des Voies Urinaires. Cap VIII. Paris: Librairie Baillière et Fils; 1874. p. 214-30.
5. Das S. Shusruta of India, the pioneer in the treatment of urethral stricture. *Surg Gynecol Obstet.* 1983;157:581-2.
6. Schultheiss D, Truss MC, Jonas U. History of direct vision internal urethrotomy. *Urology.* 1998;52:729-34.
7. Sachse H. Zur Behandlung der Harnrohreinstriktur: die transurethrale Schitzung unter Sch mit scharfem Schnitt. *Fortschr Med.* 1974;92:12-24.
8. Gómez R, Marchetti P, Ramos C. Uretrotomía interna endoscópica: ¿A quién sí y a quién no? *Rev Chil Urol.* 2006;71:107-9.
9. Gómez R, Ramos C, Marchetti P. Direct vision internal urethrotomy: Predictors of success. *Urology.* 2006;68:165-6.
10. Pansadoro V, Emiliozzi P. Internal Urethrotomy in the management of anterior urethral strictures: Long term follow-up. *J Urol.* 1996;156:73-5.
11. Heyns C, Steenkamp J, De Kock M, Whitaker P. Treatment of male urethral strictures: is repeated dilation or internal urethrotomy useful? *J Urol.* 1998;160:356-8.
12. Eltahawy EA, Virasoro R, Schlossberg SM, McCammon KA, Jordan GH. Long-term follow-up for excision and primary anastomosis for anterior urethral strictures. *J Urol.* 2007;177:1803-6.
13. Santucci RA, Mario LA, McAninch JW. Anastomotic urethroplasty for bulbar urethral stricture: analysis of 168 patients. *J Urol.* 2002;167:1715-9.
14. Andrich DE, Leach CJ, Mundy AR. The Barbagli procedure gives the best results for patch urethroplasty of the bulbar urethra. *BJU Int.* 2001;88:385-9.
15. Micheli E, Panieri A, Peracchia G, Lembo A. End-to-end urethroplasty: long-term results. *BJU Int.* 2002;90:68-71.
16. Martínez-Piñero JA, Cárcamo P, García Matres MJ, Martínez-Piñero L, Iglesias JR, Rodríguez Ledesma JM. Excision and anastomotic repair for urethral stricture disease: experience with 150 cases. *Eur Urol.* 1997;32:433-41.
17. Jakse G, Marberger H. Excisional repair of urethral stricture. Follow up of 90 patients. *Urology.* 1986 Mar;27:233-6.
18. Lindell O, Borkowski J, Noll F, Schreiter F. Urethral stricture repair: results in 179 patients. *Scand J Urol Nephrol.* 1993;27:241-5.
19. Panagakos A, Smith JC, Williams JL. One-stage excision urethroplasty for stricture. *Br J Urol.* 1978;50 Oct:410-4.
20. 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.
21. Barbagli G, Palminteri E, Bartoletti R, et al. Long-term results of anterior and posterior urethroplasty with actuarial evaluation of the success rates. *J Urol.* 1997;158:1380-2.
22. Gómez R, González P, Velasco A, Ramos C, Günther E. Cirugía reconstructiva de la uretra. *Rev Chil Urol.* 1994;59:56-9.
23. Gómez R, Ramos C, Marchetti P, González P. Twenty years of urethroplasty: fate of each option. *Urology.* 2006;68:166.
24. Gómez R, Marchetti P, Ramos C, Sánchez C. Análisis del potencial curativo de la uretrotomía interna endoscópica y de la uretroplastia a cielo abierto. *Rev Chil Urol.* 2005;70:43-6.
25. Gómez R, Marchetti P, Ramos C. Comparison of the curative potential of direct vision internal urethrotomy versus open urethroplasty. *Urology.* 2006;68:248.
26. Holm-Nielsen A, Schultz A, Moller-Pedersen V. Direct vision internal urethrotomy. A critical review of 365 operations. *Br J Urol.* 1984;56:308-12.
27. Boccon-Gibod L, Le Portz B. Endoscopic urethrotomy: does it live up to its promises? *J Urol.* 1982;127:433-5.
28. Albers P, Fichtner J, Brühl P, Müller SC. Long-term results of internal urethrotomy. *J Urol.* 1996;156:1611-4.
29. Hafez AT, El-Assmy A, Dawaba MS, Sarhan O, Bazeed M. Long-term outcome of visual internal urethrotomy for the management of pediatric urethral strictures. *J Urol.* 2005;173:595-7.
30. Steenkamp JW, Heyns CF, De Kock ML. Internal urethrotomy versus dilation as treatment for male urethral strictures: a prospective, randomized comparison. *J Urol.* 1997;157:98-101.
31. Badlani GH, Press SM, Defalco A, Oesterling JE, Smith AD. Urolume endourethral prosthesis for the treatment of urethral stricture disease: long-term results of the North American Multicenter Urolume Trial. *Urology.* 1995;45:846-56.
32. Shah DK, Paul EM, Badlani GH. 11-year outcome analysis of endourethral prosthesis for the treatment of recurrent bulbar urethral stricture. *J Urol.* 2003;170(4 Pt 1):1255-8.
33. Ashken MH, Coulange C, Milroy EJ, Sarraon JP. European experience with the urethral Wallstent for urethral strictures. *Eur Urol.* 1991;19:181-5.
34. De Vocht TF, Van Venrooij GE, Boon TA. Self-expanding stent insertion for urethral strictures: a 10-year follow-up. *BJU Int.* 2003;91:627-30.
35. Hussain M, Greenwell TJ, Shah J, Mundy A. Long-term results of a self-expanding wallstent in the treatment of urethral stricture. *BJU Int.* 2004;94:1037-9.
36. Quint HJ, Stanic TH. Above and below delayed endoscopic treatment of traumatic posterior urethral disruptions. *J Urol.* 1993;149:484-7.
37. Giannakopoulos X, Grammeniatas E, Gartzios A, Tsoumanis P, Kammenos A. Sachse urethrotomy versus endoscopic urethrotomy plus transurethral resection of the fibrous callus (Guillemin's technique) in the treatment of urethral stricture. *Urology.* 1997;49:243-7.

38. Bullock T, Brandes S. Adult Anterior Urethral Strictures: A National Practice Patterns Survey of Board Certified Urologists in the United States. *J Urol*. 2007;177:685-90.
39. Bourke KF, Jordan GH. Primary urethral reconstruction: the cost minimized approach to the bulbous urethral stricture. *J Urol*. 2005;173:1206-10.
40. Greenwell TJ, Castle C, Andrich DE, MacDonald JT, Nicol DL, Mundy AR. Repeat urethrotomy and dilation for the treatment of urethral stricture are neither clinically effective nor cost-effective. *J Urol*. 2004;172:275-7.
41. Andrich DE, Duglison N, Greenwell TJ, Mundy AR. The long-term results of urethroplasty. *J Urol*. 2003;170:90-2.
42. Barbagli G, Palminteri E, Lazzeri M, Guazzoni G, Turini D. Long-term outcome of urethroplasty after failed urethrotomy versus primary repair. *J Urol*. 2001;165:1918-9.
43. Elliott SP, McAninch JW. The Current Role of Urethrotomy in Anterior Urethral Stricture Disease. *Curr Urol Rep*. 2006;7:339-40.
44. Santucci RA. Should we centralize referrals for repair of urethral stricture? *J Urol*. 2009;182:1259-60.