



A Technique of Anterior Urethroplasty Using the Tunica Albuginea of the Corpora Cavernosa

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OBJECTIVE: To describe a technique of anterior urethroplasty using the tunica albuginea of the corpora cavernosa.

METHODS: We performed this technique on 99 male patients with anterior urethral stricture with follow-up at 6, 12 and 18 months. We assessed preoperative and postoperative patient satisfaction rate based on symptoms along with preoperative and postoperative urethrograms, urethrosonographies and uroflowmetry and labelled outcomes as good, fair and poor.

RESULTS: Good and fair results were considered successful. The overall success rate was 95.9%. In our series of patients, the overall success rate of urethroplasty remained the same at 6 months, but decreased to 94.9% at 12 months and 88.1% at 18 months.

CONCLUSION: These observations show that anterior urethroplasty by using the tunica albuginea of the corpora cavernosa produced satisfactory results and is comparable with the other techniques of urethroplasty. The merits of using the tunica albuginea for urethroplasty are local availability of tissues, so that there is no need to use anatomically and structurally dissimilar distant tissue such as the buccal mucosa, preputial, penile, or scrotal skin or Teflon grafts. It can be used in our area where most of the patients come with dyskeratotic changes in their buccal mucosa. [*Asian J Surg* 2008;31(3):134-9]

Key Words: anterior urethral stricture, male urologic surgery, tissue grafts, tunica albuginea, urethroplasty

Introduction

Urethral stricture can be defined as “a decrease in the calibre of the urethra due to a scar resulting from tissue injury or inflammation”. Usually, fibrosis involves the corpus spongiosum also.¹

As urethral stricture presents a very complex problem, various modalities of treatment ranging from simple dilatation, end-to-end anastomosis, and various urethroplasties have been advocated over the years, and even today there is not much agreement as to the best mode of tackling this problem. Stricture excision and anastomotic repair is appropriate only for short and untreated lesions

of traumatic origin. End-to-end urethroplasty for bulbar urethral stricture has over 95% durable cure rates and low complication rates.²

Urethroplasty, with different grafts, usually requires technical expertise and recurrence rates are high. We introduce a technique of anterior urethroplasty by using locally available tunica albuginea of the corpora cavernosa. The anatomical and histological similarity of the tunica albuginea of the corpora cavernosa to the covering of the urethra and its local availability prompted us to use it for urethroplasty. Furthermore, it has been observed that in other cases of urethroplasties with dorsal onlay grafts after necrosis, it is the tunica albuginea that maintains the urethral patency.

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Materials and methods

After obtaining consent from patients and permission from the local ethics committee, we operated on 99 patients, mean age 46 years (range, 18–65 years), with anterior urethral stricture (stricture length > 2.5 cm to stricture involving entire anterior urethra), using the tunica albuginea of the corpora cavernosa, over a period of 5 years.

The aetiology of the anterior urethral stricture was trauma in 69 patients, instrumentation in 19, infection in six and unknown in five. The location of the stricture was penile in 41 (41.4%), multiple sites in 16 (16.2%), and the penobulbar junction and bulbar urethra in 42 (42.4%).

A detailed preoperative assessment along with careful history-taking and physical examination was carried out. A voiding cystourethrogram, retrograde cystourethrogram, urethrosonography and uroflowmetry (if possible) were done, both preoperatively and postoperatively, to aid in determining the precise site and length of the stricture. Anterior urethroplasty, using the tunica albuginea of the corpora cavernosa, was then performed. After decatheterization, patients were assessed by patient satisfaction based on relief of symptoms, a postoperative urethrogram, urethrosonography and uroflowmetry, and the results were labelled as good, fair and poor (Table).

Surgical technique

Anatomical remarks

The male urethra can be divided into two different portions: the posterior urethra, which includes the membranous

and the prostatic regions, and the anterior urethra. The anterior urethra includes the navicularis, penile and bulbo-bulbous regions, and is surrounded by the corpus spongiosum. The corpus spongiosum, along with the urethra, lies in a groove between two cavernosa that is covered by the tunica albuginea of the corpora cavernosa (Figure 1).

Operation

The patient was placed in the normal lithotomy position, and a midline penoscrotal incision was made (Figure 2A). The bulbar or penile urethra, along with the corpus spongiosum, was then freed and dissected from the corpora cavernosa (Figure 2B). The urethra was completely mobilized

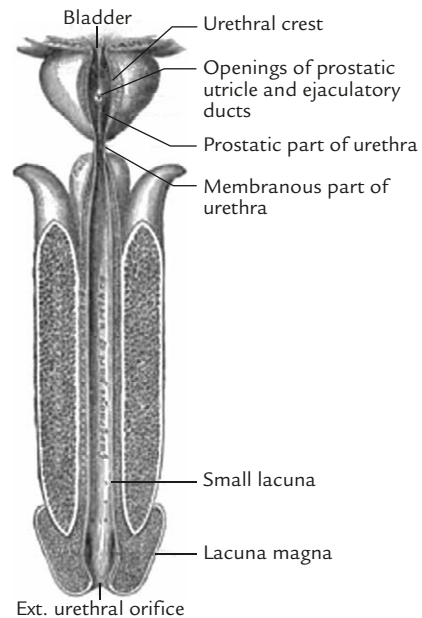


Figure 1. Urethral groove covered by the tunica albuginea.

Table. Postoperative result assessment criteria

	Good	Fair	Poor
Retrograde urethrogram	Anterior urethra of good calibre	Anterior urethra showing partial narrowing at stricture site	Stricture urethra
Urethrosonogram	No stricture at previous site, urethral lumen adequate & good distensibility	No stricture at previous site, adequate urethral lumen but decreased distensibility	Stricture present
Patient satisfaction	Satisfied, voiding well, no dilatation needed	Satisfactory voiding but needed few dilations (≤ 1 dilatation per year)	Not satisfied, not voiding well, required multiple dilatations or urethrotomies or another urethroplasty
Uroflowmetry (Q _{max} value)	Maximum urine flow rate (Q _{max}) = more than 20 mL/s	Maximum urine flow rate (Q _{max}) = more than 15 mL/s but less than 20 mL/s	Maximum urine flow rate (Q _{max}) = less than 15 mL/s

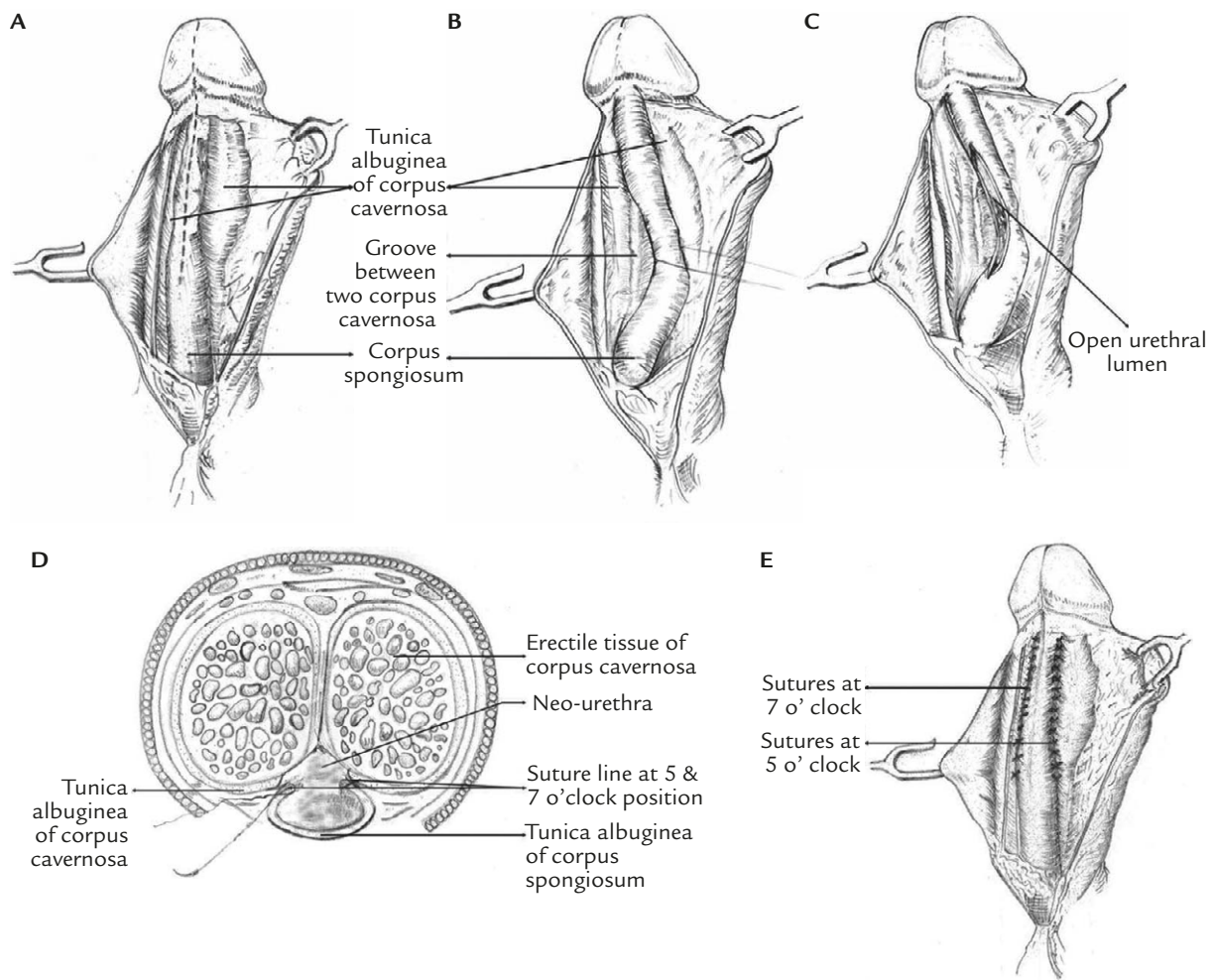


Figure 2. Technique of tunica albuginea urethroplasty.

from the tunica albuginea of the corpora cavernosa, then rotated and cut along its dorsal surface. The stricture was opened along its whole length (Figure 2C).

Thus, the lumen of the strictured segment faced the ventral aspect of the tunica albuginea of the corpora cavernosa. A silicone urethral catheter was passed through the meatus into the bladder and retained *in situ*. Then the walls of the slit urethra, along with the tunica albuginea of the corpus spongiosum, were stitched to the tunica albuginea of the corpora cavernosa using interrupted vicryl 2-0 sutures at the 5 and 7 o'clock positions (as seen in the transverse section of the penis; Figure 2D). After attaining haemostasis, the fascia and skin were closed in layers (Figure 2E). In this technique, the ventral aspect of the tunica albuginea of the corpora cavernosa formed the roof of the neourethra and the floor was formed by the strictured portion of the urethra, along with the corpus spongiosum, which was cut dorsally.

Results

Urethrosonography detected a correct length in 89 (89.9%) cases of penile urethral stricture as compared with conventional radiography, which detected the correct length in 60 (60.6%) cases, and this was confirmed intraoperatively.

According to urethrosonography, most strictures, i.e. 54 (54.5%), had a length between 30 mm and 45 mm, 20 (20.2%) were less than 30 mm and 17 (17.2%) had strictures at multiple sites or were more than 40 mm in length. In eight (8.1%) cases, the length could not be estimated exactly. Fourteen (14.1%) patients had mild, 51 (1.6%) had moderate and 34 (34.3%) had severe lumen occlusion.

Forty-seven (47.7%) patients had a severe degree of spongiofibrosis. A total of 72 (72.7%) had undergone some previous intervention including multiple urethrotomies, dilations or some form of urethroplasty.

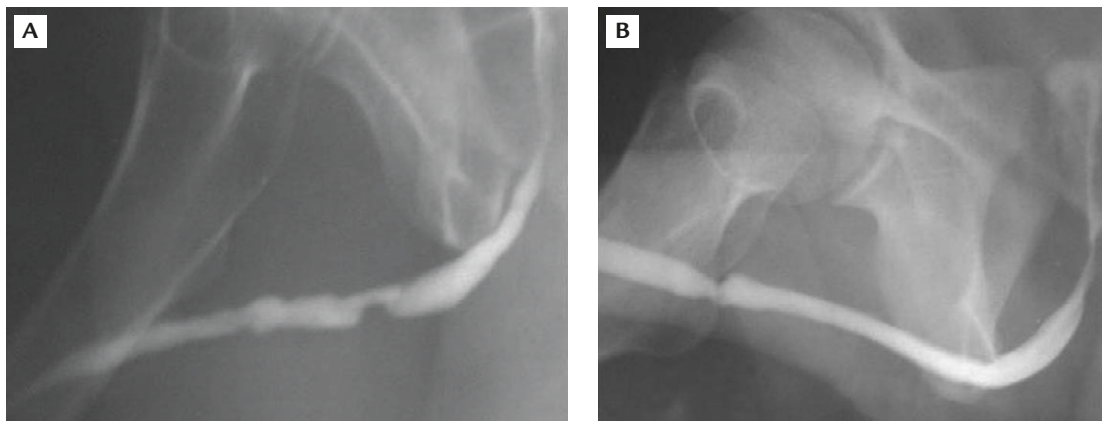


Figure 3. Retrograde urethrograms: (A) preoperative; (B) postoperative.

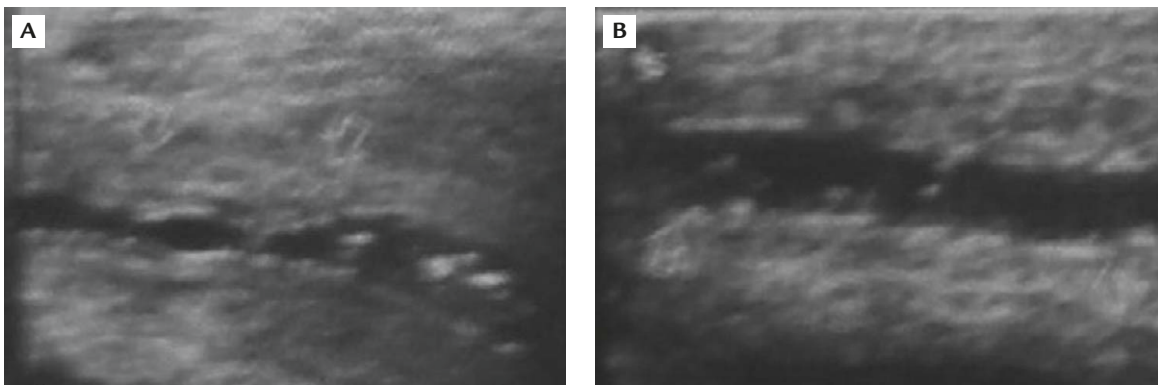


Figure 4. Urethrosonograms: (A) preoperative; (B) postoperative.

Preoperative uroflowmetry was possible in only 39 patients as others had suprapubic cystostomy *in situ* and maximum flow rates (Q_{max} value) were < 15 mL/s.

Eighty-three (83.8%) patients out of 99 showed good results, 12 (12.1%) had fair results, and four (4.1%) patients had poor results. Good and fair results were considered to be successful. Overall, the success rate was 95.9% (83 + 12).

Our criteria for classifying results were based on patient satisfaction with postoperative relief of symptoms, their urethrograms, urethrosonography and uroflowmetry (Table). Those patients who were voiding well postoperatively, with a urethrogram showing no residual strictures (Figure 3), urethrosonography showing no stricture at a previous site, an adequate urethral lumen and good distensibility (Figure 4) and uroflowmetry showing maximum flow rates (Q_{max} value > 20 mL/s), were considered to have a good result. This group also included the patients who were not voiding preoperatively, but were satisfied with their postoperative status.

Patients with fair results were those who showed some improvement postoperatively, and the dye study showed

narrowing at the strictured site, but patency of the urethra in the region of the repair, and urethrosonography showing no residual stricture at the previous site, an adequate urethral lumen but decreased urethral distensibility, uroflowmetry showing maximum flow rates (Q_{max} value) of < 20 mL/s but > 15 mL/s, and these patients required fewer dilatations. This group included patients who had undergone multiple urethrotomies and multiple dilatations with dense fibrosis of the corpus spongiosum.

In the poor result group, the patients showed no improvement over their preoperative state and needed reoperation. These patients had multiple urethral strictures or recurrent strictures after any other method of urethroplasty.

Any technique of urethroplasty deteriorates over time. In our series of patients, the overall success rate of urethroplasty remained the same at 6 months, i.e. 95.9%, but decreased to 94.9% (83 + 11) at 12 months. Fifteen patients who showed good results after 12 months did not turn up for the follow-ups after that. Out of the remaining 84 patients, 88.1% (67 + 7) patients showed good results at the 18-month follow-up.

Discussion

Urethral strictures occur after an injury to the urothelium of the corpus spongiosum leading to scar tissue formation. Any process that injures the urethral epithelium, or the underlying corpus spongiosum, to the point that healing results in a scar can cause an anterior urethral stricture.^{3,4}

Anterior urethral strictures are caused mostly by the use of indwelling catheters, especially the red rubber and straddle types. Traumatic strictures commonly involve the mucosa and submucosal layers where an inflammatory stricture may also extend into the erectile tissue of the corpus spongiosum or the surrounding layers. Seventy percent of the inflammatory strictures occur in the bulbo-membranous urethra. The pendulous urethra is next most commonly involved while the glandular urethra is least often involved. Traumatic incidence, especially with transurethral resection has increased the incidence of pendulous, vesical neck and meatal stricture.¹

After clinical diagnosis, a proper imaging to delineate the site, length, involvement of periurethral tissue and distensibility of the urethra is needed. Until recently, retrograde and antegrade urethrography with voiding cystourethrography were the standard imaging studies for the urethra. However, their limitation in the accurate evaluation of urethral stricture are well recognized as they both produce static images, and may poorly define the length of the stricture and depth of scar formation, because they are two-dimensional images.

For better results of surgery for urethral stricture, it is said that we should accurately know the length of the stricture, the thickness of the stricture and extent of periurethral spongiofibrosis. Urethrosonography of the anterior urethra offers a dynamic three-dimensional study, which can be performed easily without ionizing radiation to the gonads, and holds the promise of defining accurately not only the exact length and severity of the strictured urethral segment but also the extent of urethral fibrosis and the anatomy of periurethral tissue.⁵

Extensive spongiofibrosis in severe stricture disease is also readily diagnosed. As these lesions are unlikely to respond to any surgical management other than open urethroplasty, preoperative evaluation is an asset. Indeed, stricture length and the degree of spongiofibrosis are critical to the selection of optimal treatment, i.e. those with severe spongiofibrosis would benefit from urethroplasty

and those with minimal scarring are likely to be cured with internal urethrotomy.⁵⁻⁷

If both urethrography and urethrosonography are used in combination, it is believed that they will have much more sensitivity in diagnosis.⁸

Surgical repair of anterior urethral stricture is based on end-to-end anastomotic repair for short lesions. Internal urethrotomy (IU) has the advantages of ease, simplicity, speed and short convalescence but is successful only for strictures of short length (<2 cm) and in cases with minimal spongiofibrosis.⁹

Augmented anastomotic urethroplasty is a useful technique for strictures that are too long to be managed by excision and primary anastomosis.¹⁰ A buccal mucosa graft represents a simple surgical option, which has recently produced encouraging results.¹¹ In some studies, results using penile skin or buccal mucosa grafts were comparable.^{12,13}

The success of free graft apposition depends on neovascularization from the surrounding structures, failure of which leads to necrosis of the graft and formation of an urethroperineal fistula. Current techniques adopt graft (buccal mucosa, bladder mucosa) or flap apposition (pedicled skin flaps, skin island onlay flaps). However, this graft often lacks the mechanical support of a fixed bed, which allows it to fold on itself, reducing the opportunity for neovascularization, and decreasing the calibre of the reconstructed urethra.¹⁴

Moreover, sacculation at the graft site or flap may occur, causing postvoiding dribbling and ejaculatory failure. Sequestration of semen and residual infected urine inside the pseudodiverticulum may further compromise the state of the adjacent urethra and facilitate recurrent stricture disease.¹⁴⁻¹⁹

Urethroplasty of the anterior urethral stricture by using locally available similar structures such as the tunica albuginea, in a single-stage procedure, is easy to perform, and is more feasible. In addition, anatomically similar tissues are used for approximation, as the fibres of the tunica albuginea of the corpora cavernosa and corpus spongiosum are histologically similar except that the tunica of the latter is a bit thinner²⁰ in composition and has different fibre orientation. Both have a circular inner layer that support and contain the respective cavernous and spongiosal tissues. From this inner layer radiate intercavernosal and spongiosal pillars respectively that act as struts to augment the septum, which provides essential support, thus facilitating healing

without the danger of excessive fibrosis, which could lead to recurrence of the stricture.

The advantages of doing urethroplasty by using the tunica albuginea of the corpora cavernosa are:

1. Locally available tissue (tunica albuginea of corpora cavernosa) is used.
2. The postoperative resticture rates are very low.
3. The disadvantages of using hair-bearing skin are not a factor.
4. It can be used for fairly long strictures (including panurethral stricture) without formation of chordae postoperatively.
5. The formation of urethroperineal fistula is not seen.
6. Does not require much technical expertise.
7. Cosmetically, the penis looks normal without any bending or curvature.
8. Most patients in this part of the world have the habit of chronic chewing of tobacco or some other form of local irritants such as betel nut, and their buccal mucosa invariably shows dyskeratotic changes so it cannot be used for urethroplasty.

Urethroplasty, using anatomically distant and histologically dissimilar grafts, requires great expertise and the chances of recurrent stricture are high, especially with long strictures. Urethroplasty of anterior urethral stricture using locally available similar tissue in a single-stage procedure is easy to perform, and the postoperative results in this study showed satisfactory results in 95.4% of the patients, which is comparable to any other technique. Moreover, this technique can be used in this part of world, where the buccal mucosa cannot be used because most of the patients have dyskeratotic changes as a result of chronic tobacco chewing. Thus, we strongly recommend the use of the tunica albuginea of the corpora cavernosa, which is histologically similar and anatomically located near the stricture, rather than using distant and histologically dissimilar tissues like buccal mucosa or skin, for anterior urethroplasty.

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