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Trauma/Reconstruction/Diversion

ON THE ART OF ANASTOMOTIC POSTERIOR URETHROPLASTY: A 27-YEAR EXPERIENCE

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ABSTRACT

Purpose: We determined the various operative details of anastomotic posterior urethroplasty that are essential for a successful result.

Materials and Methods: We reviewed the medical records of 155 patients who had undergone anastomotic repair of posterior urethral strictures or distraction defects between 1977 and 2003. Patient age ranged from 3 to 58 years (mean 21) and all except 1 had sustained a pelvic fracture urethral injury as the initial causative trauma. Repair was performed with a perineal procedure in 113 patients, elaborated perineal in 2 and perineo-abdominal in 40. Followup ranged from 1 to 22 years.

Results: The results were successful in 104 (90%) cases after perineal (including 2 elaborated perineal) and in 39 (98%) after perineo-abdominal repair. Successful results were sustained for up to 22 years after surgery. Urinary incontinence did not develop in any patients while 2 lost potency as a direct result of anastomotic surgery.

Conclusions: Of the operative details 3 constitute the gold triad that assures a successful outcome, namely complete excision of scarred tissues, fixation of healthy mucosa of the 2 urethral ends and creation of a tension-free anastomosis. When the bulboprostatic urethral gap is 2.5 cm or less, restoration of urethral continuity may be accomplished with a perineal procedure after liberal mobilization of the bulbar urethra. For defects of 2.5 cm or greater the elaborated perineal or perineo-abdominal transpubic procedure should be used. In the presence of a competent bladder neck, anastomotic surgery does not result in urinary incontinence. Impotence is usually related to the original trauma and rarely (2%) to urethroplasty itself.

KEY WORDS: anastomosis, surgical; urethral stricture, wounds and injuries

Strictures of the posterior urethra continue to represent a real surgical challenge and pose 1 of the most difficult management problems encountered in urology. There are problems involved in repairing these strictures not only because of the awkward location behind the pubic bone, but more importantly because urosexual problems may result from inappropriate management. Various endoscopic and surgical methods of repair have been described which range from the extremely simple to the extremely radical, including optical urethrotomy, urethral anastomosis by perineal, elaborated perineal and perineo-abdominal transpubic procedures and substitution urethroplasty.[1–7]

Posterior urethral strictures are almost always posttraumatic, usually as a complication of a pelvic fracture urethral injury. Rarely are these in the form of a genuine strictured segment of the urethra with preservation of continuity. Such strictures usually result from incomplete urethral rupture and, in the absence of dense fibrosis, optical urethrotomy may be the appropriate first line of treatment.[1] Much more commonly posterior strictures are in the form of a bulboprostatic urethral gap or defect which results from complete urethral disruption. This gap is occupied by a fibrosed organized hematoma formed between the distracted 2 ends of the urethra at the time of pelvic fracture injury.[6]

As a group the latter cases seem to achieve the maximum benefit from excision of the fibrosed segment and restoration of urethral continuity by end-to-end anastomosis. If performed properly success rates after a sufficiently long followup have been reported to be in excess of 90%.[1,4,6,7] However, other reports have a modest success rate of about 70% after the same operation of urethral anastomosis when performed for strictures of the same etiology and location.[8] Therefore, apart from the factor of surgical expertise, one is forced to conclude that this difference in success rates among various reports is primarily related to the details of the operative technique adopted by various investigators. The operation of anastomotic posterior urethroplasty, in reality, comprises various surgical components, and the importance of each of these should not be underestimated. In this study we determined the operative components essential for a successful outcome.

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PATIENTS AND METHODS

Patients. The medical records of 155 consecutive patients who had undergone anastomotic posterior urethroplasty between 1977 and 2003 by 1 surgeon were reviewed with a focus on surgical technique. Patient age ranged from 3 to 58 years (mean 21) with the most common age group being 10 to 30 years old (115 patients, 74%). All patients, except 1 with a gunshot injury, had sustained a pelvic fracture urethral injury with a motor vehicle as the causative agent in 143 (93%). Most of the patients were referred and had mitigating adverse conditions such as urethral fistulas opening into the skin (9), bladder base (3) or rectum (1), bladder neck incompetence (5), periurethral abscess (2) and chronic retention (3). Of the patients 56 (36%) had undergone failed urethro-

plasty and/or endoscopic attempt at cure (1 to 9 procedures in each patient). The intervals between original trauma and repair in new cases, and interval since the last attempt at repair in recurrent cases varied from 6 to 15 months, except for 3 patients who had been dependent on a suprapubic catheter for 12 to 18 years after the original trauma.

Preoperative assessment. This included plain and excretory urography, combined voiding and retrograde urethrography, urethroscopy and cystourethroscopy per preexisting suprapubic tract. Nonfilling of the proximal urethra during urethrography was overcome by repetition of the procedure without or with the patient under anesthesia especially in children. In 2 patients the proximal urethral segment could be visualized only after introducing the opaque medium via a ureteral catheter during suprapubic cystourethroscopy.

Operative technique. With the patient in the lithotomy position the perineum and subumbilical regions were prepared and draped as a single operating field. We do not use the exaggerated lithotomy position since we ordinarily limit the exposure of the prostate to the anterior aspect to reduce the risk of impotence attributable to injury to the residual elements of the nervi erigentes surviving the original trauma.[6]

First, through a midline perineal incision the bulbospongiosus muscles were incised in the midline and the bulbar urethra was circumferentially mobilized proximally up to the strictured segment. This segment was dissected in continuity with the mobilized urethra until the proximal end which led to the apex of the prostate where it was transected (figs. 1 and 2). The bulbar urethra was then trimmed back into healthy appearing tissue. The apex of prostate was incised over the tip of a Van Buren sound passed antegrade through the preexisting suprapubic tract. Then meticulous retrograde piecemeal resection of the sclerosed prostatic apex was done by the scalpel until a healthy pliable mucosa was reached. This was usually found at a level about 0.5 cm short of the verumontanum. The 2 urethral ends were spatulated and mucosae fixed laterally by 4 to 6 sutures of 4-zero chromic catgut (fig. 1). The bulbar urethra was then mobilized distally from the perineal membrane, usually up to but not beyond the penoscrotal junction. A tension-free end-to-end mucosa-to-mucosa bulboprostatic anastomosis was done by 6 to 8 sutures of 3-zero polyglycolic acid over a Foley catheter 8 to 16Fr according to patient age. The tension was further relieved off the suture line by fixing the bulbar urethra to the perineal fascia with 3 sutures of 3-zero chromic catgut on both sides (fig. 3). The bulbospongiosus muscles were closed over the bulbar urethra by figure-of-eight sutures of chromic catgut and a drain was left for 2 to 3 days. The operation was completed by inserting a suprapubic catheter through the tract ordinarily present in these patients.

Of 155 cases 113 could be repaired with the previously described procedure while in 42 the operation had to be adapted or modified to achieve tension-free anastomosis. In 2 of these cases a short incision was made into the angle of the crural bifurcation and the mobilized bulbar urethra was laid between the separated corporeal bodies to shorten the course to the high lying prostate. In the other 40 cases the perineal procedure was progressed to a perineo-abdominal procedure by a midline subumbilical incision extended over the symphysis and to 1 side of the root of the penis. The retropubic space was dissected and the undersurface of the symphysis exposed to the prostatic apex. The attachments of the rectus abdominis muscles were cleared off the outer surface of the pubis using a periosteal elevator for approximately 2 cm from each side of the symphysis. A wedge-shaped piece of bone was removed from the superior surface of the pubis using an osteotome. In some cases bone wax was used for hemostasis.

Now the widely exposed prostate could be dissected to disengage it from the usually extensive scar tissue while avoiding dissection of the retroprostatic plane. The previously incarcerated prostate became more supple and compliant for anastomosis. In 3 cases this could be achieved by passing the mobilized bulbar urethra up through the normal subpubic route. In the other 37 cases the mobilized urethra was rerouted around the left penile crus to take a shorter transpubic route to the upwardly dislocated prostate. The prostate, site of anastomosis and intra-abdominal segment of the bulbar urethra were then wrapped by an omental pedicle. After insertion of a suprapubic catheter the abdomen was closed with a drain in the retropubic space.

Bladder neck reconstruction was performed during perineo-abdominal urethroplasty in 4 patients. In another patient the bladder neck was repaired in a separate setting after successful perineal urethroplasty. The urethral catheter was removed 2 to 3 weeks postoperatively followed by voiding and retrograde urethrography. The suprapubic catheter was removed after confirmation of the absence of leakage or obstruction at the site of anastomosis. In the last few years we have been also performing pericatheter urethrography to exclude leakage before removing the urethral catheter. Followup by direct questioning and retrograde urethrography, when indicated, ranged from 1 to 22 years (mean 13).

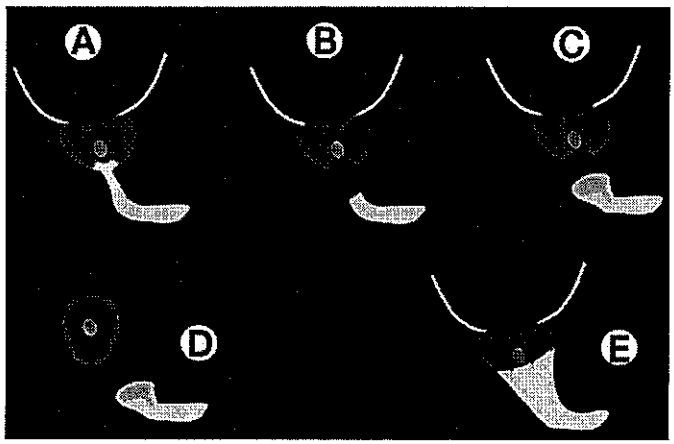

FIG. 1. Anastomotic posterior urethroplasty. *A*, bulbar urethra (yellow) and strictured segment (grey) are dissected in continuity to apex of prostate (blue). *B*, complete excision of scarred tissue including prostatic apex to level just short of verumontanum (red). *C*, spatulation of 2 urethral ends. *D*, fixation of mucosa of bulbar and prostatic urethral ends. *E*, wide caliber bulboprostatic anastomosis.

RESULTS

Preoperative urethrography showed a bulboprostatic urethral gap in 152 cases and a true strictured segment in 3. The length of urethral gaps and strictures varied from 1 to 8 cm and 1.5 to 2.5 cm (by roengenographic measurement), respectively. A total of 155 procedures were performed including 113 perineal, 2 elaborated perineal and 40 perineo-abdominal. Mean operative time for the perineal procedure was 3.5 hours (range 2.5 to 6) and for the perineo-abdominal procedure 6 hours (range 5 to 10.5). Average blood loss for the 2 procedures was 750 and 1,250 ml, respectively. Hospital stay was recently shortened to 1 week or less instead of 2 to 3 weeks as it was previously. All patients were ambulatory within a few days after surgery and none experienced pelvic instability, abnormal gaits or pelvic girdle pain. There were no operative complications apart from temporary peroneal nerve dysfunction which was encountered in 9 patients.

In this study we adopted rather strict criteria for success versus failure. The result was classified as successful when the patient voided as before original trauma and the urethrogram showed a wide caliber urethra at the site of repair. The need for periodic dilation or optical urethrotomy was consid-

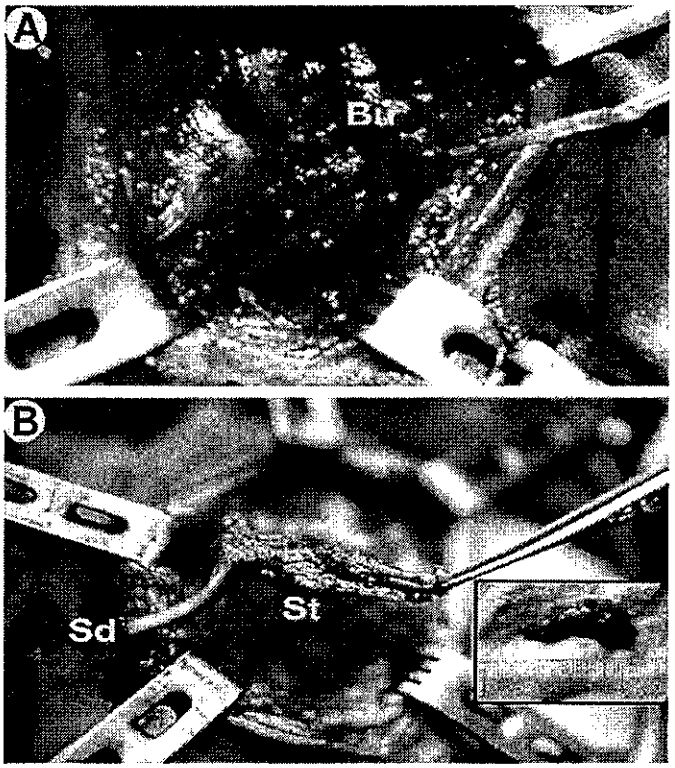

FIG. 2. *A*, dissection of mobilized bulbar urethra (Bu) is continued into strictured segment until proximal end (arrow) which leads to prostatic apex. *B*, strictured segment (St) after transection at proximal end which is held by forceps. Sound (Sd) passes from end of bulbar urethra. Strictured segment (inset).

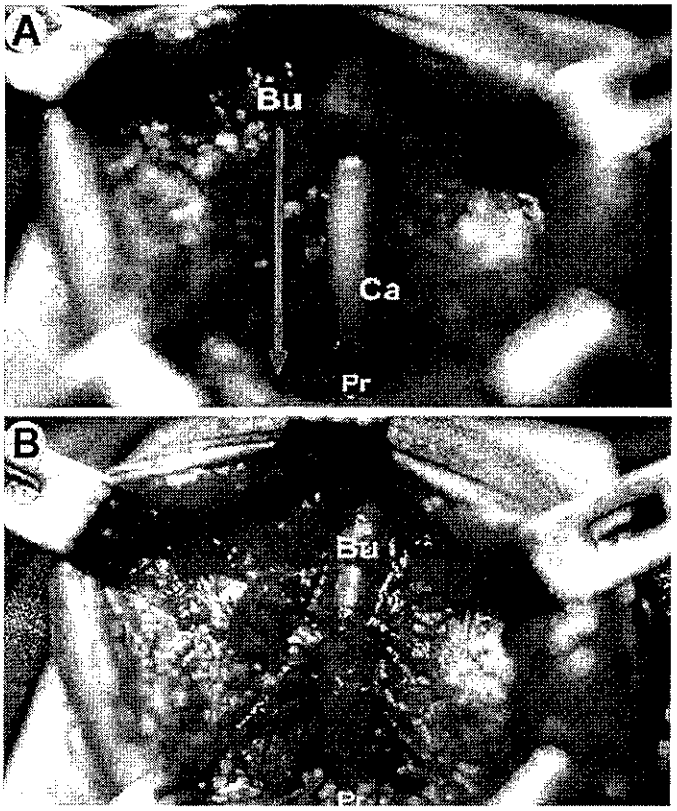

FIG. 3. *A*, gap (arrow) between bulbar (Bu) and prostatic (Pr) urethra to be bridged by elastic lengthening of mobilized bulbar urethra. Note complete excision of scarred tissues (strictured segment plus prostatic apex). Catheter (Ca) is shown indwelling in bladder. *B*, tension-free wide bulboprostatic anastomosis (long arrow). Bulbar urethra (Bu) is fixed to perineal fascia by 3 sutures on each side (short arrows).

ered treatment failure. Thus, the results were successful in 104 (90%) patients after perineal repair (including 2 elaborated perineal) and in all except 1 who was lost to followup and treatment considered to have failed after the perineo-abdominal procedure (success in 39 patients, 98%, see table). Successful results were sustained for up to 22 years after surgery as have been subjectively and objectively documented (fig. 4).

Urinary incontinence did not develop in any patients as a direct result of the anastomotic surgery. Of the 5 patients who underwent bladder neck repair 1 became completely continent, 2 had satisfactory results with minimal stress incontinence and 2 had treatment failure. Of these 2 patients 1 underwent repeat bladder neck repair that was ultimately successful. The other patient lives in Baghdad and is scheduled for repeat surgery when circumstances there become suitable. All 5 patients had free urinary passage on urethrography.

Of the 110 patients who had been sexually potent 66 (60%) remained potent, and 44 (40%) became impotent after pelvic fracture urethral injury and before urethroplasty. Of the potent group 64 are still potent after surgery, and 2 became impotent after a complex and lengthy (9 and 10.5 hours) transpubic procedure. However, 29 (66%) patients in the impotent group regained potency after urethroplasty while 15 (34%) are still impotent.

DISCUSSION

Our results indicate that success rates after anastomotic posterior urethroplasty range between 90% and 98%, which are in line with those of other studies demonstrating success rates of 96% and 97%.[4,7] These high success rates were achieved whether the approach for urethral anastomosis was perineal, elaborated perineal or perineo-abdominal. Also noteworthy is that followup is currently sufficiently long to allow valid conclusions regarding the sustenance of the initially successful results. An analysis of the findings of this study suggests that meticulous technique and careful attention to certain operative details are essential to the success of posterior urethral anastomotic repair. Of these details 3 constitute the gold triad assuring successful outcome, namely complete excision of scarred tissues, lateral fixation of healthy mucosa of the 2 urethral ends and creation of a tension-free anastomosis.

Complete excision of scar tissue is essential before urethral anastomosis to achieve a successful result. Actually, an increasing emphasis has been given to this issue by many authors.[3,4,6,7] In addition to the site of urethral gap scar tissue usually implicates most of the inframontanal prostatic urethra. This requires meticulous and complete resection until healthy appearing tissue is reached.[9] It is fundamentally important to appreciate that incomplete excision of scar tissue will necessarily result in anastomosis of the anterior urethra into a fibrosed prostatic apex which is the best predictor of failure. The widely adopted strategy for performing anastomosis once the lumen of prostatic urethra is seen, after

Postoperative results of 3 procedures in 155 anastomotic posterior urethroplasties

	No. (%)		
	Success	Failure	Totals
Perineal	102 (90)	11 (10)	113
Elaborated perineal	2 (100)	0 (0)	2
Perineo-abdominal	39 (98)	1 (2)	40

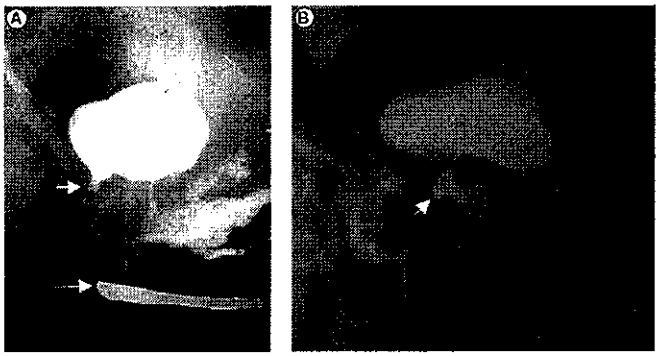

FIG. 4. *A*, combined antegrade and retrograde urethrogram shows long gap between 2 distracted ends of prostatic (short arrow) and bulbar (long arrow) urethra. Transpubic urethroplasty was performed on April 30, 1985. *B*, retrograde urethrogram of same patient on March 16, 2002. Note shorter course of anterior urethra to prostate and wide bulboprostatic anastomosis (arrow).

cutting on the tip of a sound passed tranvesically and without excision of scar tissue, should be abandoned.

Aside from complete excision of scar tissue, nothing is more important than fixation of a healthy looking supple prostatic mucosa to the prostatic edge. Only then can a mucosa-to-mucosa urethral anastomosis be guaranteed. This component of the operative technique is particularly emphasized because it is surprisingly ignored by most authors. Upon resecting the fibrosed prostatic apex, including the adherent mucosa, the free cut edge of the all-important normal mucosa has the tendency to retract upward.[9] It should be pulled down by a forceps and anchored laterally to the prostatic edge. Unless this is done mucosal narrowing at the repair site is inevitable. Our findings are corroborated by the observations of others that a substantial number (11% to 32%) of patients undergoing urethroplasty require endoscopic urethrotomy because of soft mucosal weblike narrowing in the area of repair.[3,4] It is likely that in these cases urethral anastomosis had been performed while the prostatic mucosa was retracted up proximal to the suture line. In such cases the chances of success after a single urethrotomy are high because the scar tissue was already excised during urethroplasty.[4]

A determinant of success after anastomotic urethroplasty is to approximate the 2 urethral ends over the bulboprostatic gap without tension. In this regard we would like to reaffirm our belief that the gap to be bridged is not due to a loss of urethral segment inasmuch as to a proximal dislocation of the prostate as well as distal retraction of the bulbar urethra.[1] Obviously the dislocated prostate cannot be mobilized downward and the only way to go is to mobilize the bulbar urethra from its attachment to the perineal membrane and bring it up into the prostate. The length necessary to bridge the urethral gap is offered by the inherited high elasticity of the mobilized bulbar urethra which normally provides an extra 4.5 cm.[6] This length is sufficient to bridge a gap of up to 2.5 cm considering that another 2 cm are dispensed for trimming and spatulation of the 2 urethral ends. Thus, for such urethral gaps and in the presence of a normal anterior urethra, restoration of urethral continuity may be accomplished with an ordinary perineal approach. However, when the urethral gap is longer than 2.5 cm (3 cm radiographically) as a result of a high lying prostate or a shortened anterior urethra from previous surgical operations, this approach has to be adapted or elaborated to achieve a tension-free anastomosis. In such cases 2 surgical solutions have been proposed that reflect the innovations of urological surgeons.

One solution is the perineo-abdominal progression approach of Turner-Warwick.[6] In this multi-procedure operation the mobilized bulbar urethra is rerouted around a corporeal body and passed transpubically to be anastomosed to the apex of the prostate from the abdominal side. Thus, the original curved course of the anterior urethra to the perineum and back into the prostate is circumvented, resulting in a shorter course direct from the penoscrotal junction to the prostate. With this maneuver a urethral gap longer than 2.5 cm may be bypassed and a tension-free anastomosis is achieved by the same 4.5 cm of elastic lengthening provided by the mobilized bulbar urethra.[9] More recently Webster and Ramon introduced the progressive perineal elaboration technique as another solution for long urethral gaps.[7] It consists of corporeal body separation, inferior pubectomy and supracrural rerouting of the mobilized urethra performed in a sequential manner as needed from the same perineal approach.[7]

The perineo-abdominal procedure has a number of advantages other than shortening the course of a mobilized bulbar urethra to an upwardly displaced prostate. It provides a wide and excellent exposure that greatly facilitates disengagement of an incarcerated prostate and suture placement for urethral anastomosis.[10] In addition, it allows synchronous repair of bladder neck incompetence and urethral fistula to the bladder base or rectum. Furthermore, it permits the use of a pedicled omental graft to envelop the site of anastomosis and the transpubic part of bulbar urethra so that they remain supple and protected from any fibrosis or callus formation.[6]

On the other hand, in the elaborated perineal procedure surgical access to the anastomosis is relatively restricted. This led to the suggestion of suture placement with Turner-Warwick needles which were originally devised to fix the tough skin flaps in scrotourethral inlay procedures.[7,11] However, the use of these traumatic needles goes against the principles of fine tissue handling in reconstructive surgery. Also, the mobilized urethra is rerouted through the bony defect created by inferior pubectomy and is at great risk for being secondarily encased with callous. Although it has been suggested that the bulbospongiosus muscles can be rotated to be interposed around the urethra,[7] it may be difficult to bring these transversely oriented muscles with their far posteriorly based blood supply to the pubic bone anteriorly. Furthermore, during inferior pubectomy the penile neurovascular structures are most at risk.[2] In addition, the mobilized urethra is directly exposed to the cavernous tissue where it is at some risk for erosion by penile prosthesis if subsequently proven necessary.[6]

Our opinion has been and remains that opening the abdomen as an extension of the perineal approach and 2 to 3 more hours of operative time may be regarded as a reasonable price to pay for a success rate of 98% because it seems unlikely that any other procedure will give a significantly better result, at least in our hands. It is worth mentioning that most of the perineo-abdominal procedures included in the largest 2 series of posterior urethroplasty reported in the literature had been performed many years before the introduction of the elaborated perineal procedure.[1,6]

Urinary incontinence as a direct result of anastomotic surgery has not been encountered in this series which is consistent with results reported in a number of clinical series.[4,6,7] After posterior urethroplasty patients maintain urinary continence by the bladder neck mechanism alone without a functioning distal urethral sphincter mechanism. Even if it had survived the original accident and ensuing fibrosis, the distal mechanism would be completely extirpated or bypassed during the subsequent surgical excision and urethral anastomosis. This has been proved by urodynamic studies after perineal and transpubic urethroplasty.[12,13] However, associated bladder neck incompetence, which is usually secondary to missed or neglected bladder neck injury from the original trauma, will result in incontinence.[14] In these cases bladder neck repair may be performed synchronously with perineo-abdominal urethroplasty, or deferred until the re-

sumption of urethral voiding after perineal urethroplasty when incontinence can be documented.[15,16]

Impotence is usually related to the original pelvic fracture urethral injury and rarely to the urethroplasty itself.[1,6] In this study permanent failure to achieve erection was the result of original trauma in 15 (14%) patients and of surgical repair in 2 (2%). Preservation of potency was paramount but this mishap was almost unavoidable since each of these 2 patients really underwent an extraordinarily complex transpubic procedure. Regaining potency after a successful urethroplasty occurred in 29 (66%) patients of 44 who had been impotent before surgery, a finding similarly reported by Morey and McAninch.[4] This finding may be partly attributed to the delayed recovery of potency which is typical after urethral disruption, and partly attributed to improvement of patient morale since he regained urethral voiding after being dependent on a suprapubic catheter for several months.[1,13]

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