

THE TREATMENT OF POSTERIOR URETHRAL DISRUPTION ASSOCIATED WITH PELVIC FRACTURES: COMPARATIVE EXPERIENCE OF EARLY REALIGNMENT VERSUS DELAYED URETHROPLASTY

VLADIMIR B. MOURAVIEV, MICHAEL COBURN AND RICHARD A. SANTUCCI*

From the Prostate Centre, Vancouver General Hospital, Vancouver, British Columbia, Canada (VBM), War Surgical Department, Kirov Military Medical Academy (VBM), St. Petersburg, Russia, Urology, Ben Taub General Hospital (MC) and Department of Urology, Baylor College of Medicine (MC), Houston, Texas, and Urology, Detroit Receiving Hospital (RAS) and Wayne State University School of Medicine, Detroit, Michigan

ABSTRACT

Purpose: Urological treatment of the patient with severe mechanical trauma and urethral disruption remains controversial. Debate continues regarding the advisability of early realignment vs delayed open urethroplasty. We analyzed our experience with 96 patients to determine the long-term results of the 2 approaches.

Materials and Methods: We retrospectively reviewed the records of 191 men with posterior urethral disruption after severe blunt pelvic injury between 1984 and 2001, of whom 96 survived. Data on 57 patients who underwent early realignment were compared to those on 39 treated with delayed urethroplasty with an average 8.8-year followup (range 1 to 22). All patients were evaluated postoperatively for incontinence, impotence and urethral strictures.

Results: The majority of patients had severe concomitant organ injuries (78%) and severe pelvic fractures (76%). The overall mortality rate was 51%. Diagnosis of urethral rupture was based on clinical findings and retrograde urethrography. Strictures developed in 49% of the early realignment group and in 100% of the suprapubic tube group. Impotence (33.6%) and incontinence (17.7%) were less frequent in the early realignment group than in the delayed reconstruction group (42.1% and 24.9%, respectively). Patients with delayed reconstruction underwent an average of 3.1 procedures compared with an average of 1.6 in the early realignment group.

Conclusions: Early realignment may provide better outcomes than delayed open urethroplasty after posterior urethral disruption. Increased complications are not seen and, although it can be inconvenient in the massively injured patient, it appears to be a worthwhile maneuver.

KEY WORDS: urethra, wounds and injuries, urethral stricture, pelvis, fracture

The management of posterior urethral disruption secondary to blunt pelvic injury remains controversial. While many groups have recommended early realignment of urethral distraction injuries,¹⁻⁷ these series are often relatively small and followup is relatively short. Doubts persist concerning this somewhat new approach and the adoption of early realignment has not been universal. Some experts have even reported that this technique is unhelpful, although they tend to be in the minority.⁸

Classic reports advocate a suprapubic cystostomy at the time of injury with delayed, perineal approach urethral reconstruction 4 to 6 months after injury.⁹ Because of the high degree of skill in perineal surgery at centers where urethral stricture is commonly treated, this has good success rates despite being technically demanding.¹⁰ However, virtually 100% of patients treated with a suprapubic tube and delayed reconstruction require urethroplasty, while early realignment might obviate the need for about half of these operations (table 1). This decrease in the need for surgery has a large positive impact because perineal approach anastomotic urethroplasty can be lengthy and arduous for the surgeon and patient.

Series that advocate primary realignment show a lower rate of urethroplasty as well as the formation of potentially less significant strictures than those treated expectantly.

They may be more amenable to endoscopic core through treatments, which often fail in the longer strictures seen with delayed therapy. We and others also believe that subsequent open repair is simpler when realignment has been done.^{11,12} To confirm the initial reports of good results seen with early realignment we compared 2 populations of patients with posterior urethral injury in what is to our knowledge the largest such series.

MATERIALS AND METHODS

We performed a retrospective chart review of all patients with posterior urethral disruption injuries seen at a single trauma center, that is Kirov Military Medical Academy, St. Petersburg, Russia, from September 1980 to May 2001. A total of 191 patients were seen but due to extremely serious injuries in this cohort only 96 survived the injury. Urethral injury was suspected in those with blood at the meatus, a high-riding prostate, inability to pass a urethral catheter, perineal butterfly hematoma or significant pubic rami fracture. Definitive diagnosis was made by retrograde urethrogram (RUG).

Early realignment. All patients underwent a trial of primary passage of a urethral catheter into the bladder. When this failed, patients were selected for early realignment based on hemodynamic stability and associated injuries. Realignment was often performed immediately after exploratory laparotomy for intra-abdominal injuries or the orthopedic fixation of pelvic fractures. In cases of hemodynamic instability or life threatening injuries initial urological man-

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* Correspondence: Urology, Detroit Receiving Hospital, 4160 John R., Suite 1017, Detroit, Michigan 48201 (telephone: 313-745-1712; FAX: 313-745-0464; e-mail: rsantucc@med.wayne.edu).

TABLE 1. Series of early alignment and its effect on subsequent stricture formation

	No. Evaluable Realigned Pts	% Stricture	
		After Early Realignment	After Suprapubic Tube
Present series	57	49	100
Al-Ali and Husain ¹	14	36	
Asci et al ²	20	45	83
Elliott and Barrett ³	57	68	
Herschhorn et al ⁴	16	54	
Kielb et al ⁵	8	50	
Moudouni et al ⁶	29	41	
Patterson et al ⁷	29	38	
Mean		47	92

agement consisted of suprapubic drainage with subsequent delayed (2 to 3 months) repair.

Realignment was performed using Davis interlocking sounds. If 2 gentle attempts failed, the procedure was aborted and a suprapubic cystostomy tube was placed. After successful realignment the urethral catheter was left in place for 4 to 6 weeks and it was removed when pericatheter RUG showed no extravasation. A voiding cystourethrogram was performed when the catheter was removed to ensure urethral patency.

Monitoring. Patients were monitored for stricture by voiding history, flow rate measurement and post-void residual urine volume determination. Suspected strictures were further investigated using RUG. Patients were seen monthly for 6 months, every 6 months for 1.5 years and yearly thereafter. After 2 years if patients had no problems, mandatory followup was stopped and patients returned only on an as needed basis. Because this was a military hospital, patient followup was almost 100% since patients were not eligible to be seen elsewhere. We defined a lack of significant stricture as no stricture on RUG, a mean urinary flow rate of greater than 10 ml per second and a post-void residual urine of less than 50 cc.

Continence was defined as no pads needed to protect against urinary leakage. Erectile function was determined by subjective patient report. Men who were unable to achieve intercourse with vaginal penetration were considered impotent.

Treatment of stricture. Although many modern series advocate open perineal anastomotic urethroplasty for strictures resulting from urethral distraction, at the time that these patients were seen a different treatment algorithm was followed. They were started on prophylactic weekly urethral self-hydrodilation with 200 ml antiseptic solution in the belief that this might decrease or delay stricture formation beginning 1 month after hospital discharge. Patients in whom stricture developed began self-dilation with a urinary catheter starting 1 month after hospital discharge. Symptomatic strictures were treated with 2 attempts at endoscopic repair before open urethroplasty, that is urethral dilation first and then direct visual internal urethrotomy (DVIU). If stricture persisted, anastomotic urethroplasty was done. Statistical analysis with the Student t test was performed using proprietary software.

RESULTS

Patient characteristics. The etiology of injury was motor vehicle accident in 47% of cases, crush injury in 26%, a fall in 9%, train accident in 6% and other diverse injuries in 12%. Of the 191 men with urethral injuries 92% had associated pelvic fractures (table 2). The majority of patients (78%) had associated injuries and 67% presented in hypovolemic shock. The mortality rate was high. Of the patients 107 (50.7%) died,

TABLE 2. Pelvic fracture type with urethral distraction injury and pelvic fracture

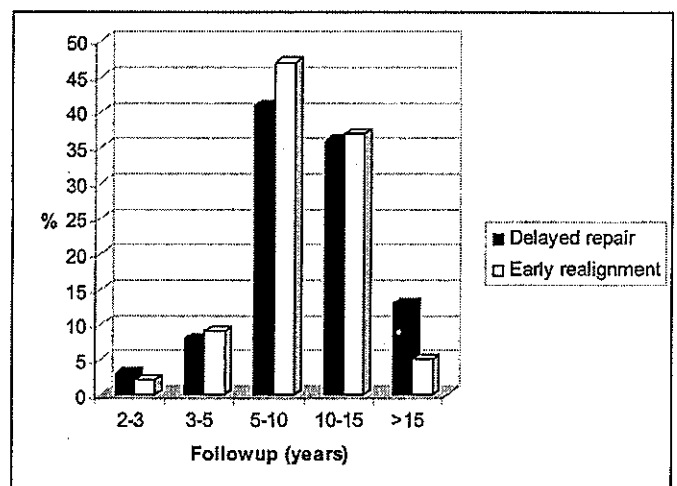
Classification	% Pts
Isolated unilat pubic rami	5
Bilat pubic rami	19
Malgaine + variants (pelvic ring disruption)	46
Multiple severe crushing (pelvic ring disruption in at least 3 locations)	30
Total	100 (73/96 pts, 76%)

mostly as a result of crushed pelvic injury with uncontrollable intrapelvic hemorrhage. This was a referral population of the most severely traumatized patients.

Urethral injury. The most common symptom of urethral injury was urethrorrhagia (blood at the meatus) in 87% of cases and urinary retention in 91%, while 64% showed a high-riding prostate. Bladder catheterization via the urethra was successful in 29% of patients with confirmed urethral rupture. Of the men with extravasation on retrograde urethrogram 37% had some passage of contrast medium into the bladder, which we took to indicate partial urethral rupture. Extravasation of contrast material above or below the urogenital diaphragm without signs of bladder contrast medium was present in the remaining 63% of cases and it suggested complete disruption. The location of injury was the proximal bulbar urethra in 72% of cases, membranous urethra in 10%, distal bulbar urethra in 9% and prostatic urethra in 9%. Prostatic urethral injuries seemed to be associated with the most severe pelvic fracture injuries.

Treatment. A total of 96 patients lived beyond the acute injury phase, of whom 57 underwent early realignment and were compared to the 39 treated with delayed urethroplasty. Average followup was 8.8 years (range 1 to 22) and it was lengthy in the majority of patients (see figure).

Development of urethral stricture and complications. Of patients with realignment 49% had clinically significant urethral stricture, while in 100% of those with a suprapubic tube stricture developed. Patients usually presented in urinary retention, including 95% within 3 months after the catheter was removed. All strictures were treated with 1 dilation and DVIU, which was successful in approximately half of the patients per group (49% for primary realignment vs 47% for the suprapubic tube, t test $p < 0.05$). However, patients with early realignment required an average of 1.6 procedures per patient compared with 3.1 for delayed repair. The final inci-



Followup was in general quite long in this cohort

dence of those who ultimately required urethroplasty was 24% in the primary realignment group and 47% in the suprapubic group. Impotence and incontinence were less frequent in the realignment group (34% vs 42% and 18% vs 26% respectively, t test $p < 0.05$).

DISCUSSION

Treatment for posterior urethral distraction injuries should be directed toward minimizing the risk of undesirable outcomes. In this series early realignment appeared to have a significant benefit over classic management with a suprapubic tube and delayed urethroplasty with the largest one being the decrease in the number of patients in whom stricture developed (100% vs 49%). The strictures that formed seem to be more mild and require fewer procedures to achieve cure (1.6 vs 3.1 procedures). Finally, men treated with early realignment had favorable impotence and incontinence rates (table 3).

We acknowledge that there are at least 2 potential sources of selection bias in this series. The first one is that the early realignment group was more clinically stable and, thus, they may have been less seriously injured than the group that was too unstable to undergo early realignment. The second one is that patients who underwent a failed attempt at realignment followed by suprapubic tube placement and urethroplasty might have had a more seriously damaged urethra than those who underwent successful realignment. We believe that, while these effects are potentially confounding, they are unlikely to explain fully the 50% decrease in stricture formation. Accordingly, we believe that this series shows that early urethral realignment can be helpful in a cohort of the most severe pelvic injuries. This series is unique in that it includes the most ill type of patients, that is 76% had a crushed pelvis with gross instability and 50% ultimately died of the injuries.

Results in other series of a total of approximately 200 patients with early realignment in a 20-year period largely agree with our findings (table 1). Most published studies show that early realignment can decrease the incidence of stricture formation, usually in the same 50% range that we found. Incontinence and impotence also appeared to be limited in an early realignment population (tables 4 and 5). Finally, strictures that form after successful early urethral realignment appear to be less significant than those that form after suprapubic urinary diversion alone.^{11,12} Ku et al found that strictures treated with realignment were more often mild than those treated with a suprapubic tube only.¹² Moudouni et al reported on 29 patients and found that DVIU was more likely curative after endoscopic realignment.⁶

Not all series have seen a benefit of early realignment. Husmann et al reported that 16 of 17 patients (94%) had recurrent stricture after realignment.⁸ Asci et al reported a slightly increased incontinence rate of 10% in patients treated with early realignment compared to 6% in those treated with a suprapubic tube.² However, the majority of reports indicate better outcomes than this.

Methods of realignment. Advances in endourological and radiological techniques have led to several recommended methods of early realignment, such as Davis interlocking

TABLE 3. Outcome in patients treated with suprapubic tube and delayed urethroplasty vs early urethral realignment

	Realignment	Tube + Urethroplasty
% Urethral stricture	49	100
% Impotence	34	42
% Incontinence	18	25
% Initial dilation/DVIU success	49	47
No. dilation/DVIU procedures before definitive urethroplasty	1.6	3.1

TABLE 4. Series of early realignment and its effect on subsequent impotence

	No. Evaluable Realigned Pts	% Impotence	
		Early Realignment	After Suprapubic Tube
Present series	59	34	42
Asci et al ²	20	20	
Elliott and Barrett ³	57	21	
Follis et al ¹⁷	20	20	50
Herschorn et al ⁴	16	42	
Jepson et al ¹⁸	8	38	
Moudouni et al ⁶	29	14	
Patterson et al ⁷	29	15	
Porter et al ¹⁴	10	14	
Mean		24	46

TABLE 5. Series of early realignment and its effect on subsequent incontinence

	No. Evaluable Realigned Pts	% Incontinence	
		Early Realignment	Suprapubic Tube
Present series	59	18	25
Asci et al ²	20	6	10
Elliott and Barrett ³	57	4	
Herschorn et al ⁴	16	0	
Moudouni et al ⁶	29	0	
Patterson et al ⁷	29	3	
Porter et al ¹⁴	10	0	
Mean		4	18

sounds,³ flexible cystoscopy,¹³ retrograde pediatric feeding tubes,⁴ magnetic sounds,¹⁴ fluoroscopic techniques,¹⁵ and a combination of sounds and cystoscopy.¹⁶ We favor a single gentle attempt with an 18Fr retrograde Foley catheter, which was successful in 29% of cases in this series. If this fails, we attempt flexible cystoscopy at the bedside or in the operating room with passage of a wire through the cystoscope and we then use a Council catheter, if successful. Operative endoscopic realignment is possible in a surprisingly high number of cases, namely 78% in 1 small series.⁴ We then achieve punch suprapubic tube access, if it is not already present. We dilate the suprapubic tract using nephrostomy dilators, place a safety wire and pass a flexible cystoscope through the suprapubic cystostomy and then through the bladder neck. Often a wire can be passed anterograde across the disruption when it would not pass from below. Failing this, we perform simultaneous cystoscopy from above and below in an attempt to bring the cystoscopes together. Turning off the light from the suprapubic cystoscope may allow the endoscopist to guide the suprapubic cystoscope toward the light from the urethral cystoscope and, thus, toward the correct direction. If we fail, we abort the procedure and plan another attempt, if appropriate, in 2 or 3 days.

CONCLUSIONS

Early realignment of urethral disruption is possible in most patients with trauma and it may decrease the requirement for subsequent urethral stricture therapy by 50%. This procedure does not appear to increase the rate of impotence or incontinence and strictures that occur after early realignment may be easier to treat. Despite the difficulties of taking acutely injured patients to the operating room in the peri-injury period early endoscopic urethral realignment is a worthwhile procedure.

Proprietary statistical software was developed at the Department of Statistics, Moscow University, Moscow, Russia.

REFERENCES

1. Al-Ali, I. H. and Husain, I.: Disrupting injuries of the membranous urethra—the case for early surgery and catheter splinting. *Br J Urol*, **55**: 716, 1983
2. Asci, R., Sarikaya, S., Buyukalpelli, R., Saylik, A., Yilmaz, A. F. and Yildiz, S.: Voiding and sexual dysfunctions after pelvic fracture urethral injuries treated with either initial cystostomy and delayed urethroplasty or immediate primary urethral realignment. *Scand J Urol Nephrol*, **33**: 228, 1999
3. Elliott, D. S. and Barrett, D. M.: Long-term followup and evaluation of primary realignment of posterior urethral disruptions. *J Urol*, **157**: 814, 1997
4. Herschorn, S., Thijssen, A. and Radomski, S. B.: The value of immediate or early catheterization of the traumatized posterior urethra. *J Urol*, **148**: 1428, 1992
5. Kielb, S. J., Voeltz, Z. L. and Wolf, J. S.: Evaluation and management of traumatic posterior urethral disruption with flexible cystourethroscopy. *J Trauma*, **50**: 36, 2001
6. Moudouni, S. M., Patard, J. J., Manunta, A., Guiraud, P., Lobel, B. and Guille, F.: Early endoscopic realignment of post-traumatic posterior urethral disruption. *Urology*, **57**: 628, 2001
7. Patterson, D. E., Barrett, D. M., Myers, R. P., DeWeerd, J. H., Hall, B. B. and Benson, R. C., Jr.: Primary realignment of posterior urethral injuries. *J Urol*, **129**: 513, 1983
8. Husmann, D. A., Wilson, W. T., Boone, T. B. and Allen, T. D.: Prostatomembranous urethral disruptions: management by suprapubic cystostomy and delayed urethroplasty. *J Urol*, **144**: 76, 1990
9. McAninch, J. W.: Traumatic injuries to the urethra. *J Trauma*, **21**: 291, 1981
10. Flynn, B. J., Delvecchio, F. C. and Webster, G. D.: Perineal repair of posterior urethral stricture and defect: experience in 79 cases in the last 5 years. *J Urol*, suppl., **167**: 15, abstract 60, 2002
11. Gheiler, E. L. and Frontera, J. R.: Immediate primary realignment of prostatomembranous urethral disruptions using endourologic techniques. *Urology*, **49**: 596, 1997
12. Ku, J. H., Kim, M. E., Jeon, Y. S., Lee, N. K. and Park, Y. H.: Management of bulbous urethral disruption by blunt external trauma: the sooner, the better? *Urology*, **60**: 579, 2002
13. Cohen, J. K., Berg, G., Carl, G. H. and Diamond, D. D.: Primary endoscopic realignment following posterior urethral disruption. *J Urol*, **146**: 1548, 1991
14. Porter, J. R., Takayama, T. K. and Defalco, A. J.: Traumatic posterior urethral injury and early realignment using magnetic urethral catheters. *J Urol*, **158**: 425, 1997
15. Londergan, T. A., Gundersen, L. H. and van Every, M. J.: Early fluoroscopic realignment for traumatic urethral injuries. *Urology*, **49**: 101, 1997
16. Melekos, M. D., Pantazakos, A., Daouaher, H. and Papatsoris, G.: Primary endourologic re-establishment of urethral continuity after disruption of prostatomembranous urethra. *Urology*, **39**: 135, 1992
17. Follis, H. W., Koch, M. O. and McDougal, W. S.: Immediate management of prostatomembranous urethral disruptions. *J Urol*, **147**: 1259, 1992
18. Jepson, B. R., Boullier, J. A., Moore, R. G. and Parra, R. O.: Traumatic posterior urethral injury and early primary endoscopic realignment: evaluation of long-term follow-up. *Urology*, **53**: 1205, 1999