

Trauma/Reconstruction/Diversion

CADAVERIC ANATOMY OF PELVIC FRACTURE URETHRAL DISTRACTION INJURY: MOST INJURIES ARE DISTAL TO THE EXTERNAL URINARY SPHINCTER

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ABSTRACT

Purpose: The anatomy of posterior urethral distraction injuries is controversial. We present a cadaver study of posterior urethral distraction injuries. To our knowledge this is the first study that establishes that the most common location is distal to the external urinary sphincter.

Materials and Methods: We performed an autopsy review of 10 male patients with posterior urethral distraction injuries.

Results: Urethral disruption occurred distal to the external urinary sphincter in 7 of 10 patients. It appeared to occur when the anterior pelvic ring and urogenital diaphragm complex were displaced caudal and rostrally, tearing the urogenital diaphragm off of the urethra. The average inner mucosal defect \pm SD was 3.5 ± 0.5 cm, while the defect between the outer urethral layer (tunica of the spongiosum) was 2.0 ± 0.2 cm due to mucosal retraction. Simple and complex injuries could be observed, according to the clinical classification proposed by Turner-Warwick in 1989. Simple injuries had less significant dislocation of the symphysis, general maintenance of urethral continuity and slightly shorter mucosal distraction (3.3 cm). Complex disruptions had significant symphyseal dislocation, complete disassociation of the urethral ends (often with interposition of other tissues) and a slightly longer mucosal distraction (3.8 cm).

Conclusions: Posterior urethral distraction injuries appear to most commonly occur distal to the urogenital diaphragm, contrary to classic teaching. These injuries are on average between 3 and 4 cm, and they are more significant dorsal than ventral. They appear to occur as simple or complex injuries, mirroring the clinical findings seen in clinically simple and complex urethral strictures.

KEY WORDS: urethra, wounds and injuries, fractures, pelvis, anatomy

The anatomy of posterior urethral distraction injuries is a source of controversy. Older, classic teaching suggests that the prostatic urethra is torn off of the urogenital diaphragm at a location proximal to the striated urinary sphincter.^{1,2} Diagrams propounding this have been widely published (fig. 1). This proximal urethral injury is said to result in striated sphincter incompetence after urethral distraction injuries.³ However, more modern series have shown that urethrographically,⁴ urodynamically,⁵ cystoscopically⁵ and surgically⁶ injury appears to be distal to the striated sphincter in a majority of cases. The most modern texts are only recently describing this finding.⁷ To our knowledge this is the first report of autopsy evidence for a distal location of most posterior urethral distraction injuries, which should greatly bolster the believability of evidence previously determined by more indirect means.

Clinical evidence for a distal location of most urethral injuries has been previously published. Of the 17 continent

patients with posterior urethral distraction injury treated with perineal urethroplasty reported on by Andrich and Mundy the internal sphincter was cystoscopically visible proximal to the injury in 13 (65%).⁵ This was confirmable on urodynamics in 11 of the 17 patients (55%). The sphincter usually appeared 1 to 2 cm proximal to the urethroplasty scar.

Surgical data also support this assertion. During perineal approach urethroplasty for the repair of strictures resulting from posterior urethral distraction injury, Mundy maintained that 100% of 17 patients had injuries distal to the sphincter (fig. 2).⁶ Also, patients with urethral distraction injury usually have a visible verumontanum well proximal to the area of injury,⁸ further supporting the distal location of most urethral distraction injuries. However, despite these data many practitioners and groups persist in the belief that these injuries are posterior, that is proximal to the external sphincter.

To our knowledge autopsy data on the subject have been absent to date. Accordingly we began autopsy investigations in patients with posterior urethral distraction injury to prove or disprove the assertion that urethral distraction injuries occur distal to the sphincter.

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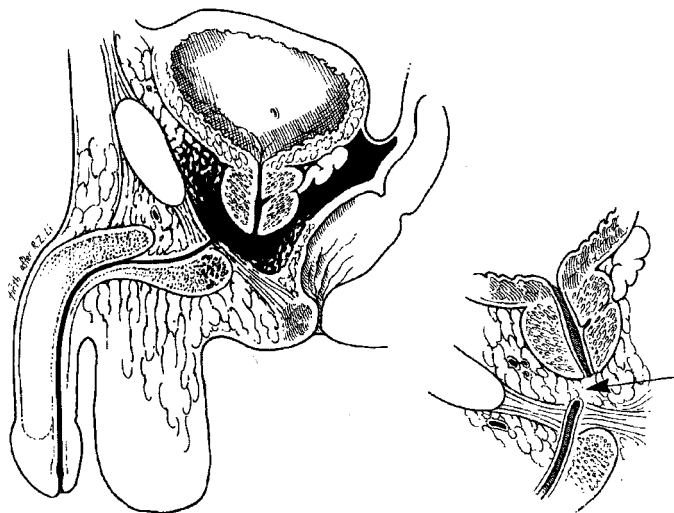


FIG. 1. Classic teaching suggested that urethra is torn proximal to urogenital diaphragm. This is likely incorrect in light of more recent understanding.

MATERIALS AND METHODS

We performed an autopsy study in 10 fresh male cadavers with pelvic fracture and posterior urethral distraction injuries who died of their multiple injuries. Average time from injury to death was 3 days. Specimens were obtained by en bloc evisceration of the anterior pelvic bones and viscera, including the urogenital diaphragm, urethra, bladder, penis and surrounding soft tissues. After precise visual inspection to determine the exact nature of gross tissue disturbances the intact urethra was removed. The external urethral surface was coated with India ink and fixed in 10% formalin solution for 24 hours. Microscopic preparations were stained with hematoxylin and eosin, and examined microscopically. The exact location and length of each urethral injury was noted and injuries were classified as simple and complex, as proposed by Turner-Warwick.³

RESULTS

Simple vs complex. Complete urethral disruption was found in 9 patients, while partial rupture was seen in 1. Of the complete disruptions there were 6 simple and 3 complex injuries. Simple injuries involved modest dislocation of the symphysis backward and upward, which was associated with the general maintenance of urethral continuity, and slightly shorter mean mucosal distraction \pm SD (3.3 ± 0.7 cm). Complex disruptions showed significant symphyseal dislocation, complete disassociation of the urethral ends (often with interposition of other tissues) and slightly longer mucosal distraction (3.8 ± 0.7 cm) (fig. 3). In each case the extent of external urethral distraction was less than the distraction of the urethral mucosa due to retraction of the mucosal tissues. Average retraction of the urethral mucosa was 1.9 ± 0.5 cm for simple injuries vs 2.0 ± 0.2 cm for complex injuries.

All patients had unstable pelvic fractures. The most frequent fracture was a bilateral pubic ramic fracture (butterfly fracture) with associated dislocation of the pubosymphysis upward and backward (32% of cases).

Mechanism and location. The mechanism of urethral disruption appeared to be separation of the anterior pelvic ring (symphysis) together as a unit with the urogenital diaphragm. Backward and upward displacement of this unit tore the urethra off of the urogenital diaphragm, as described in 1980 by Pennal et al,⁹ at a location distal to the sphincter.¹⁰ The urethra appeared tightly adherent to the urogenital diaphragm, making the site of separation at the weaker proximal bulbar urethra more likely.

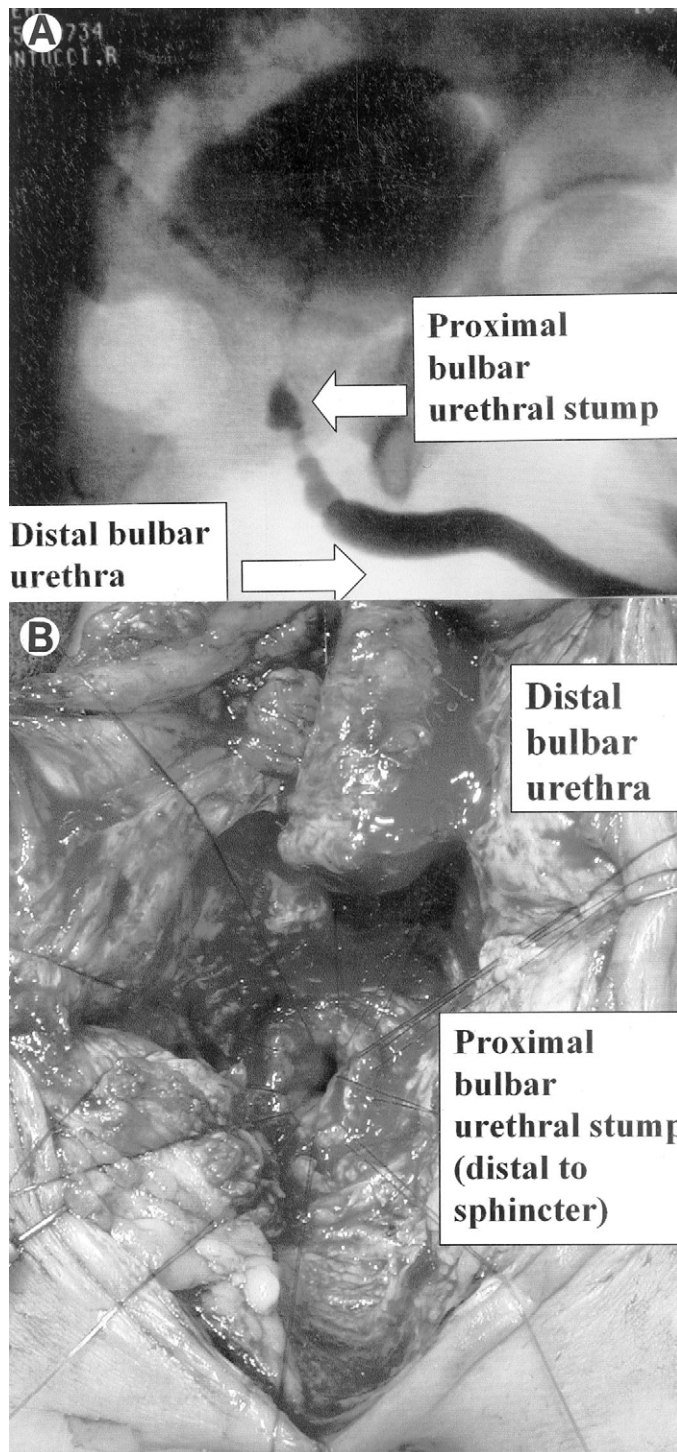


FIG. 2. Patient with previous posterior urethral distraction injury. A, retrograde urethrogram clearly shows injury distal to striated sphincter. B, intraoperative photograph reveals injury distal to striated sphincter.

In 7 of 10 cases urethral injury was distal to the membranous urethra. In 3 of 10 cases it involved the membranous urethra or was proximal to it (fig. 4). In 7 of 10 cases the urethral defect was greater on the dorsal than on the ventral urethra (fig. 5).

DISCUSSION

Location of injury. The existing literature appears adequately to establish that most posterior urethral distraction injuries occur distal to the striated sphincter using clinical

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