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INCIDENCE AND PATTERN OF PELVIC FRACTURE URETHRAL INJURIES WITH CORRELATION TO FRACTURE CONFIGURATION: A RETROSPECTIVE CROSS-SECTIONAL STUDY

Dr. Shivcharan D. Bhalge*	Assistant Professor, Department of Urology, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha *Corresponding Author
Dr. Jay Dharamshi	Professor, Department of Urology, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha
Dr Abhijit Dhale	Professor, Department of Urology, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha
Dr. Apurva Vaidya	MCH PG, Department of Urology, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha
Dr. Yashraj Jain	MCH PG, Department of Urology, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha

ABSTRACT **Introduction:** Pelvic fracture urethral injury (PFUI) is a serious complication of high-energy pelvic trauma and may result in significant long-term morbidity if not promptly recognized. These injuries are most commonly associated with blunt trauma due to road traffic accidents, falls from height, or crush injuries. Early diagnosis requires a high index of clinical suspicion and appropriate radiological evaluation. **Materials & Methods:** This hospital-based retrospective study included 32 adult male patients with urethral injury associated with pelvic trauma. Medical records were reviewed to analyse demographic characteristics, mechanism of injury, clinical presentation, pelvic fracture configuration (Tile classification), extent and location of urethral injury, and associated urological injuries. Diagnosis was established using computed tomography (CT) and/or ascending urethrography (AUG). Statistical analysis was performed using the chi-square test, with $p < 0.05$ considered statistically significant. **Results:** The overall incidence of urethral injury among patients with pelvic fractures was 3.1%. The most commonly affected age group was 25–44 years. Road traffic accidents were the predominant mechanism of injury. Posterior urethral injuries accounted for the majority of cases (84.4%), and complete urethral disruption was observed in 68.7% of patients. Although complete disruptions were more frequently associated with unstable pelvic fractures (Tile types B and C), no statistically significant association was identified between pelvic fracture configuration and extent of urethral injury ($p > 0.05$). Concomitant urological injuries were observed in a subset of patients, most commonly involving the urinary bladder. **Conclusion:** PFUI should be systematically excluded in all patients presenting with pelvic fractures, particularly following high-velocity trauma. Early imaging with ascending urethrography or CT facilitates timely diagnosis and appropriate management, thereby reducing the risk of long- term complications such as urethral stricture and urinary dysfunction.

KEYWORDS : Pelvic Fracture; Pelvic Fracture Urethral Injury (PFUI); Posterior Urethral Injury; Ascending Urethrography; Pelvic Trauma.

INTRODUCTION

Pelvic fracture urethral injury (PFUI) is a serious and potentially debilitating consequence of high-energy pelvic trauma. Historically, these injuries were described as pelvic fracture urethral distraction defects (PFUDDs), a term introduced by Turner-Warwick based on the premise that most injuries represented complete urethral disruptions with distraction of the urethral ends (2). However, subsequent evidence demonstrated that urethral injuries associated with pelvic fractures are not uniformly complete, nor invariably distracted. Consequently, the International Consultation on Urological Diseases recommended adoption of the more inclusive term pelvic fracture urethral injury (PFUI), which better reflects the spectrum of injury patterns encountered in clinical practice (1).

Pelvic fractures most commonly result from high-velocity trauma, including road traffic accidents—particularly involving motorcyclists and pedestrians—falls from height, and crush or entrapment injuries at construction or industrial sites (3). Less frequent mechanisms include low-energy falls, animal-related injuries, and machinery-related trauma (4). The substantial force required to disrupt the pelvic ring often transmits energy to adjacent soft tissue structures, including the posterior urethra, resulting in partial or complete urethral disruption.

Pelvic fractures account for approximately 9–10% of blunt trauma cases presenting to emergency departments (3). Among these patients, the reported incidence of associated urethral injury ranges from 5% to 25% (1,3,5). The wide variation in incidence across studies likely reflects differences in study design, diagnostic protocols, patient populations, and the heterogeneous nature of both pelvic fracture patterns and urethral injury severity (5,6). PFUI occurs predominantly in males, with reported rates significantly higher than in females (approximately 25% vs. 4–5%), largely due to anatomical differences such as the longer male urethra and its fixed attachment to the puboprostatic ligaments (6). In contrast, the shorter and more mobile female urethra confers relative protection against injury.

In paediatric populations, PFUI is less common but often more severe when present. Children sustaining high-energy trauma, particularly falls from height, frequently exhibit more complex pelvic fractures, which may predispose them to extensive urethral injury and long- term sequelae (7).

Despite advances in trauma care and imaging modalities, PFUI remains associated with significant morbidity, including urethral stricture, urinary incontinence, erectile dysfunction, and psychological distress. Early recognition, accurate assessment of injury severity, and correlation with pelvic fracture configuration are critical in guiding acute management and predicting long-term outcomes. Given the variability in reported incidence and the potential functional consequences, retrospective evaluation of PFUI in patients with pelvic fractures is essential to better understand its epidemiology, mechanisms, and relationship to fracture patterns.

MATERIALS AND METHODS

This retrospective cross-sectional study was conducted in the Department of Urology Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha, between December 2022 and January 2026. Adult male patients with pelvic trauma associated with urethral injury were included. Patients who were brought dead, declared dead on arrival, discharged against medical advice, referred from the emergency room, had unclear medical records, had no urethral injury, below 18 years of age, and female were excluded.

Hospital medical records were reviewed retrospectively. Among 9,328 trauma admissions, 1,026 patients sustained pelvic fractures, of whom 32 had associated urethral injuries and constituted the final study population. Data regarding age, mechanism of injury, clinical presentation, and pelvic fracture configuration were collected and analysed.

All trauma patients were initially resuscitated and stabilized. Pelvic

fracture urethral injury (PFUI) was suspected in patients presenting with pelvic fracture and clinical signs such as blood at the urethral meatus, inability to void with bladder distension, perineal or penile injury, or perineal hematoma. Evaluation was performed using contrast-enhanced computed tomography (CT) and/or ascending urethrography (AUG). Upon radiological confirmation of urethral injury, a single gentle attempt at per-urethral Foley catheterization was made; suprapubic catheterization was performed in cases of failed catheterization.

In selected patients who later developed urethral stricture, opposing urethrography (combination of AUG and voiding cystourethrography) or magnetic resonance urethrography (MRU) was performed after 6–8 weeks to assess the location, extent of injury, and periurethral spongiofibrosis prior to definitive management. AUG was performed using diluted water- soluble iodinated contrast injected via an 8 Fr feeding tube with oblique radiographic imaging. Opposing urethrography involved retrograde urethral contrast injection combined with bladder filling through a suprapubic catheter. MRU was conducted using a 1.5 Tesla MRI system with T1- and T2-weighted sequences in axial, coronal, and sagittal planes after bladder distension and urethral instillation of sterile jelly.

Image analysis was primarily based on AUG and CT findings to determine the presence, location, and extent of urethral injury. Injuries were graded according to the 2010 European Association of Urology (EAU) guidelines (Grades I–V). MRU was used to measure stricture length, posterior distraction defects, prostatic apex displacement (superoinferior, anteroposterior, and lateral), and severity of spongiofibrosis, which was classified as mild (<1/3), moderate (1/3–1/2), or severe (>1/2) involvement of the corpus spongiosum.

The primary objectives were to determine the incidence, mechanism, site, and extent of urethral injuries in pelvic fracture patients and to evaluate the association between urethral injury severity and pelvic fracture configuration, classified according to Tile's system (Type A: stable; Type B: rotationally unstable and vertically stable; Type C: rotationally and vertically unstable). Statistical analysis was performed using SPSS version 20. The association between urethral injury severity and pelvic fracture type was assessed using the chi-square test, with a p-value <0.05 considered statistically significant.

RESULTS

Our study was based on the retrograde evaluation of 32 cases of pelvic trauma with urethral injuries

Table 1: Mechanism of Injury

Mechanism	Count (n)	Percentage (%)	95% CI
Road Traffic Accident	21	65.6	49.2 – 82.1
Fall from Height	5	15.6	3.0 – 28.2
Entrapment Injury	4	12.5	1.0 – 24.0
Others	2	6.2	-2.1 – 14.6
Total	32	100	-

The overall incidence of urethral injuries with pelvic fractures was 3.1%. The most common mechanism is road traffic accidents (65.6%). Road traffic accidents constituted the predominant mechanism (65.6%; 95% CI: 49.2–82.1). The wide confidence intervals reflect the limited sample size.

Table 2: Age Distribution and Location of Urethral Injury

Age Group (years)	Anterior n (%)	Posterior n (%)	Total n (%)
18–24	1 (3.1)	2 (6.3)	3 (9.4)
25–44	2 (6.3)	13 (40.6)	15 (46.9)
45–60	1 (3.1)	7 (21.9)	8 (25.0)
61–75	0 (0)	4 (12.5)	4 (12.5)
>75	1 (3.1)	1 (3.1)	2 (6.2)
Total	5 (15.6)	27 (84.4)	32 (100)

The 25–44 years age group was most commonly affected (46.9%). Posterior urethral injuries predominated (84.4%), underscoring the close anatomical relationship between pelvic fractures and posterior urethral disruption.

Table 3: Extent and Location of Urethral Injury

Extent of Injury	Anterior n (%)	Posterior n (%)	Total n (%)
Complete Disruption	0 (0)	22 (68.7)	22 (68.7)
Partial Disruption	2 (6.3)	8 (25.0)	10 (31.3)
Total	2 (6.3)	30 (93.7)	32 (100)

There were 22 complete disruption urethral injuries (68.7 %) and 10 partial disruptions of the urethra (32.3%). So, most of the urethral injuries associated with pelvic injuries are complete and are located in the posterior urethra.

Table 4: Pelvic Fracture Configuration and Extent of Urethral Injury

Tile Classification	Partial n (%)	Complete n (%)	Total n (%)	p-value
Type A (Stable)	3 (9.4)	1 (3.1)	4 (12.5)	0.193
Type B (Rotationally Unstable)	6 (18.7)	14 (43.8)	20 (62.5)	
Type C (Rot./Vert. Unstable)	1 (3.1)	7 (21.9)	8 (25.0)	
Total	10 (31.3)	22 (68.7)	32 (100)	

Table 4 demonstrates the relationship between the configuration of pelvic fractures and the extent of urethral injuries. Type B was the most common pelvic fracture associated with urethral injury, which was seen in 20 cases (62.7%). Unstable pelvic fractures are most commonly responsible for PFUI, and the risk of complete disruption of the urethra was higher in patients with unstable pelvic fractures.

However, this result was not statistically significant (p=0.193). There was no definitive relationship between the extent of urethral injury and the specific type of pelvic fracture

Table 5: Concomitant Other Urological Injuries in PFUI

site		Count	Total count
Bladder	Peri-vesical hematoma	7	9
	Bladder neck injury	1	
	Bladder rupture	1	
Kidney	Peri-renal hematoma	4	6
	parenchymal laceration	1	
	PUJ avulsion	1	
Penile injury	Laceration	1	2
	Cavernosal disruption	1	
Scrotal injury		1	1

PFUI may be associated with concomitant injury to the kidney, bladder, penis, or scrotum. The urinary bladder was the most common organ sustaining concomitant injury in PFUI, which was seen in 9 (28.1%) cases.

DISCUSSION

Our study evaluated the incidence, mechanism, location, and extent of urethral injuries in relation to the pelvic injury.

PFUI is an uncommon but potentially devastating complication of pelvic fracture. Pelvic fracture-associated urethral injuries occur in 1.6% to 25% of pelvic fractures, corresponding to 0.32–5/100,000 males [6-9]. Combined urethral and bladder injuries occur in 1–33% of patients with pelvic fractures [6,8-11]. This wide variation is due to the use of either Ascending Urethrography or computed tomography in the initial evaluation of the patients. In our study, we found that the overall incidence of urethral injuries in males from blunt pelvic trauma was 3.1 % of all pelvic fractures.

Urethral injuries usually occur in the setting of significant pelvic fractures, often from motor vehicle collisions or crush injuries [5]. Motor vehicle collisions (MVCs) are the most common cause of pelvic fracture (68–84%). MVCs are four times more likely to cause a PFUI than the second most common cause, falling from a height (6–25%) [9,14,16–18]. Typically, pedestrians involved in MVCs are more likely than the occupants of the motor vehicle to sustain a severe pelvic fracture and PFUI [14,19]. In our study, the most common mechanismof PFUI was seen in road traffic accidents, which account for 65.6 % of all cases, the second most common mechanism being a fall from height (12.6%). Our observation was consistent with most of the other studies on pelvic fracture urethral trauma.

Urethral injuries in pelvic fracture are associated with mechanisms that rupture the puboprostatic ligament with or without shearing forces to the perineal membrane [6]. Martínez- Piñeiro L et al. in their study on urethral injury showed that Pelvic fractures can be associated with either partial or complete urethral disruption. However, the latter is

more common [12]. Complete urethral disruption occurs when a significant pelvic fracture causes upward displacement of the bladder and prostate. Avulsion of the puboprostatic ligament is followed by stretching of the membranous urethra, resulting in complete disruption at the anatomic weak point, the bulb membranous junction [5]. This is the reason for the complete disruption of the urethra, which is mostly associated with an unstable pelvic fracture. The above findings were consistent with our study, where the risk of complete disruption of the urethra was higher in patients with unstable pelvic fractures (77.2% vs 22.5%) than in those with partially unstable or stable fractures, while partial disruption of the urethra can be seen in the unstable, partially unstable, and stable pelvic fractures.

Aihara et al. [23] retrospectively assessed 362 pelvic fractures and showed that a widened symphysis with a sacroiliac joint involvement was predictive of bladder injury, while a widened symphysis and an inferior pubic ramus fracture were predictive of a urethral injury. Although these results were statistically significant, their predictive value was low. Another study by Koraitim et al. [14] reported that straddle fractures combined with sacroiliac joint diastasis were far more likely associated with urethral injury than either a straddle fracture alone, or even less commonly, a Malgaigne's fracture. In our study, 9 out of 17 cases of unstable pelvic fracture with complete urethral disruption had bladder injury in the form of perivesical hematoma, bladder neck injury, and one case with intraperitoneal rupture of the bladder.

Battaloglu et al. [24] reported that urethral injuries were associated with unstable pelvic fractures, but not with a specific pelvic fracture type. This is consistent with our study finding, where most of the urethral injuries were associated with Tile type B pelvic fracture, and unstable pelvic ring was commonly related to complete disruption of urethral alignment, but there was no statistically significant relationship between the extent of urethral injury and the severity of pelvic injury.

In an acute setting, the flexible cystoscopy with primary endoscopic re-alignment has been increasingly used with promising results, but sufficient data are lacking to support the superiority of flexible cystoscopy over ascending urethrography as an initial diagnostic approach for pelvic fracture urethral injury.

This study was confined to patients at a single tertiary care center, and our study mostly includes the urban population. The frequency and severity of pelvic injury associated with urethral injuries at an urban tertiary care center and a rural hospital are likely to be different. Our retrospective analysis was confined to a single district hospital with a limited number of patients. Therefore, a larger number of randomized, multi-institutional, and prospective studies involving larger sample sizes will be necessary to support our findings.

CONCLUSIONS

This 3-year single tertiary care center-based retrospective study involved patients with pelvic fractures associated with urethral injuries. The incidence of PFUI was 3.1 % in our study. The middle-aged working population was the most commonly affected age group, and most of the cases of PFUI sustained injury to the posterior urethra. Complete disruption was more common than partial urethral injuries. The risk of complete disruption was found to rise as stability declined, and unstable pelvic fractures were mostly responsible for complete disruption of urethral alignment. However, the relationship between the extent of urethral injury and the severity of pelvic injury was statistically insignificant.

Despite many reports describing this pelvic fracture urethral injury, further prospective and retrospective studies are still needed to specify the incidence, mechanism of PFUI, and to establish the relationship between the extent of urethral injuries and the configuration of pelvic fractures for optimal management of these patients.

From this study, our recommendation is to have a high index of clinical suspicion of urethral injury in patients with pelvic injury, especially in those with unstable pelvic fractures. And if feasible, early management with endoscopic realignment should be considered to avoid long-term complications of urethral injuries.

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