

## Pelvic Fractures Types and Urinary System Injuries

### Abstract

**Introduction:** Pelvic fractures, although comprising a small proportion of musculoskeletal injuries, are clinically significant due to their proximity to vital anatomic structures. These injuries may carry a mortality rate of up to 20%. The location of the bladder and ureters within the pelvic cavity makes them highly vulnerable to trauma. Urological injuries are reported in approximately 6–15% of pelvic fracture cases. This study aimed to investigate the association between the type of pelvic fracture and the pattern of lower urinary tract symptoms.

**Materials & Methods:** In this study, medical records of patients diagnosed with pelvic fractures who were admitted to a tertiary referral hospital within 5 years were reviewed. Patients with a history of prior pelvic fractures or urological surgeries were excluded. Data were analyzed using SPSS25 software.

**Results & Discussion:** A total of 134 patients were included, of whom 86 (64.2%) were male. The mean age was  $40.7 \pm 21.5$  years. The most common fracture type was LC (Lateral Compression) (82.8%), followed by anterior-posterior compression (9.7%) and vertical shear (7.5%). A statistically significant association was found between fracture type and urinary symptoms ( $P=0.047$ ). Gross hematuria was more frequent in anterior-posterior compression fractures, while microscopic hematuria was more common in vertical shear fractures. Patients with LC fractures were less likely to exhibit urinary symptoms.

**Conclusion:** The type of pelvic fracture is associated with the presence and nature of lower urinary tract symptoms. Early recognition of this relationship may improve diagnostic accuracy and guide appropriate management in trauma settings.

**Keywords:** Pelvic bones, bone fractures, urinary tract, hematuria, prevalence

Accepted: 32 days before printing

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### Introduction

Pelvic ring fractures typically result from high-energy trauma such as motor vehicle accidents or falls from height. Although they constitute only approximately 2–3% of all skeletal fractures, their clinical consequences are significant, and injury-related mortality has been reported in some centers to reach up to 15%.<sup>(1, 2)</sup>

The complex anatomy of the pelvic ring and its proximity to major vessels and visceral organs, particularly the genitourinary system, make pelvic fractures frequently associated with urologic injuries. Recent meta-analyses indicate that the overall prevalence of urinary tract injuries in patients with pelvic fractures is approximately 9.6%, although the bladder is particularly susceptible due to its anterior pelvic location and its attachment to the pubic symphysis. Intra-abdominal ruptures usually occur when a direct blow is delivered to a full bladder, whereas extra-abdominal ruptures are more commonly associated with structural injuries of the pelvic ring, especially fractures of the pubic symphysis. Multiple studies have also reported a strong correlation between pubic symphysis diastasis or displacement of anterior pelvic fractures and the occurrence of bladder rupture and urethral injury.<sup>(3)</sup> Early diagnosis of these injuries using modalities such as cystography and retrograde urethrography in the presence of warning signs—hematuria, blood at the urethral meatus, perineal hematoma, or dysuria—and appropriate selection among catheterization, cystostomy, or surgical repair are vital for reducing long-term complications such as urethral stricture and infection.<sup>(4)</sup>

Iranian studies have also shown that a proportion of trauma patients and individuals with pelvic fractures experience urologic injuries, with some requiring urologic intervention. These findings underscore the need for a multidisciplinary approach and a detailed analysis of the relationship between fracture patterns and the type and severity of bladder injury. Therefore, the present study aimed to determine the prevalence and pattern of bladder and urethral injuries in patients with pelvic ring fractures and to examine their association with fracture type, age, and sex.<sup>(5, 6)</sup>

## Materials & Methods

This study was a retrospective, cross-sectional analytical study including all patients admitted to Shahid Rahmehoon Hospital, Yazd, between 2015 and 2020 with a diagnosis of pelvic ring fracture (based on ICD-10 code S32.89XA). Inclusion criteria comprised a confirmed diagnosis of pelvic fracture in medical records and imaging documentation, while exclusion criteria included a history of prior pelvic fracture, previous urologic injury or surgery, and records with insufficient key information.

Data were systematically extracted from hospital records, radiology reports (plain radiographs and pelvic CT scans), operative notes, and urology consultations. Supplementary information was obtained through telephone contact with patients or their relatives when necessary.

Fractures were classified according to the Young–Burgess system into three patterns: anteroposterior compression (APC), lateral compression (LC), and vertical shear (VS). The presence and type of urinary tract injury were determined based on laboratory findings (urinalysis) and urology consultation. Statistical analysis was performed using SPSS version 25 and the independent t-test. A significance level of 0.05 was considered, and the study power was 80%.

## Results

A total of 134 patients were included in the study, of whom 86 (64.2%) were male and 48 (35.8%) were female. The mean age of all patients was  $40.7 \pm 21.5$  years; the mean age of men was  $35.6 \pm 19.2$  years, and the mean age of women was  $49 \pm 22.7$  years, with the difference being statistically significant ( $P < 0.001$ ) (Table 1). Regarding fracture patterns, the most frequent type was LC, with 111 patients (82.8%). APC and VS fractures were observed in 13 (9.7%) and 10 (7.5%) patients, respectively. The mean ages of the LC, APC, and VS groups were  $42.8 \pm 22.06$ ,  $25.3 \pm$

$10.7$ , and  $38.1 \pm 19.2$  years, respectively, and the differences in mean age between groups were statistically significant ( $P = 0.02$ ), indicating that the LC group had a higher mean age. Concerning urinary symptoms, 54 patients (40.3%) were asymptomatic, 48 patients (35.8%) had gross hematuria, and 32 patients (23.9%) had microscopic hematuria.

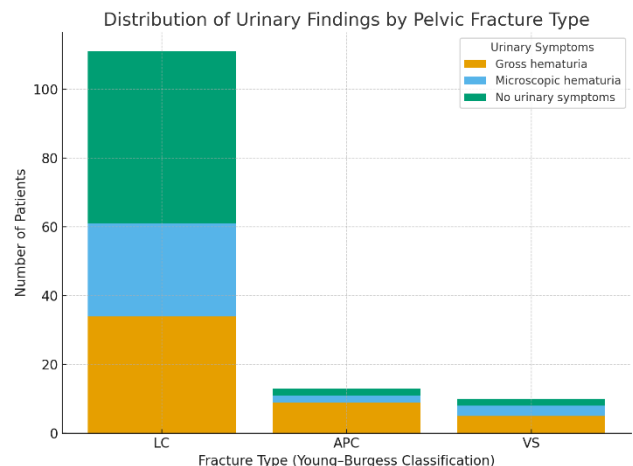


Figure 1: Distribution of urinary symptoms according to fracture type

The relationship between fracture type and urinary symptom pattern was analyzed across the entire sample: among the 111 patients with LC fractures, 34 (30.6%) had gross hematuria, 27 (24.3%) had microscopic hematuria, and 50 (45%) were asymptomatic. In the APC group ( $n = 13$ ), 9 patients (69.2%) had gross hematuria, while in the VS group ( $n = 10$ ), 5 patients (50%) exhibited gross hematuria (Figure 1).

In summary, in this series, the LC pattern was the most prevalent, and patients with LC fractures were, on average, older. Furthermore, fracture type was significantly associated with the pattern of hematuria occurrence, although this association was not statistically significant in sex-specific analysis for men, whereas it was significant for women.

## Discussion

The present study was conducted to examine the relationship between pelvic fracture patterns and the occurrence of urinary symptoms in trauma patients. The findings demonstrated that the prevalence of urinary symptoms, particularly hematuria, in patients with pelvic fractures is considerable. International studies have generally reported the prevalence of urinary tract injuries in pelvic fractures to be approximately 5–7%. For instance, a recent meta-

analysis of 22,700 pelvic fracture patients estimated the cumulative prevalence of urinary tract injuries at approximately 9.6%.<sup>(3)</sup> In this study, the male-to-female ratio was 66.14% to 33.86%, and the overall prevalence in men was 34.5% and in women 62.3%. The study by Rehné Jensen et al. (2023) in Denmark also reported that 5% of pelvic fracture patients had lower urinary tract injuries.<sup>(7)</sup>

**Table 1: Demographic characteristics of the study population**

Sex	Number	Mean Age (years)
Male	86 (64.2%)	35.6
Female	48 (35.8%)	49
Total	134	40.7

These figures vary in similar domestic studies: Pourmirzaei et al. found that approximately 4.33% of patients with pelvic fractures had genitourinary injuries. In the present study, measured by hematuria, 35.8% of patients had gross hematuria, and 23.9% had microscopic hematuria, which is higher than international statistics. The observed differences in this study are likely due to variations in the definition of urinary injury, data recording methods, and the sensitivity of the diagnostic techniques employed. In this study, the mere presence of hematuria was considered a warning sign of potential injury, whereas many other studies only counted injuries confirmed by imaging or surgery.

Regarding the distribution of fracture types, the lateral compression (LC) pattern was the most common fracture type among patients. However, the highest incidence of gross hematuria was observed in patients with anteroposterior compression (APC) fractures. Previous studies have also emphasized the role of unstable fractures: Zhao et al. demonstrated that unstable fractures (Tile B and C) were associated with a higher risk of urinary tract injury, with type C3 fractures (equivalent to severe vertical compression) being the most common pattern in patients with urinary injury.<sup>(8)</sup> This finding is clinically significant, as APC fractures typically involve opening of the pelvic ring and stretching of the pubic symphysis, bladder, and urethra, which can increase the risk of bladder rupture or urethral injury. Therefore, although LC fractures are more prevalent, APC and vertical shear fractures are more significant regarding potential injury to urinary structures.

Regarding sex distribution, men constituted the majority of patients, consistent with the global pattern of severe trauma cases.<sup>(8, 9)</sup> Notably, in this study, the association between fracture type and urinary injury was significant in women, whereas no such association was observed in men. This discrepancy

may be attributable to the small sample size of this study.

Overall, the results of this study highlight the importance of attending to urinary symptoms even in apparently stable pelvic fractures. It is recommended that in patients with unstable fractures, especially in the presence of gross hematuria, a dedicated evaluation of the urinary system via CT cystography or retrograde urethrography be performed. Furthermore, early urology consultation can help prevent long-term complications such as urethral stricture, fistula, or bladder rupture.

### Clinical Implications and Recommendations

Based on the findings and existing evidence, it is recommended that patients with anterior pelvic ring fractures (particularly APC or pubic symphysis diastasis) and any patient with gross hematuria or warning signs (blood at the urethral meatus, perineal hematoma, dysuria) undergo dedicated urologic imaging (CT cystography or cystographic radiography). Clinical guidelines also recommend performing CT cystography for high-risk groups. Moreover, even in cases with an initially negative test, active clinical follow-up is necessary, as some ruptures may present late.

### Limitations and Research Suggestions:

Limitations of the present study include its retrospective design, symptom-based recording instead of mandatory imaging in all patients, and the small sample size in the APC/VS groups. The lack of imaging data related to urinary tract injuries complicated data collection for this study. Future prospective, multicenter studies with standardized imaging protocols (CT cystography with adequate bladder filling and urethrography in suspected cases) and recording of quantitative radiologic criteria (e.g., pubic diastasis, ramus displacement) are recommended to develop more accurate predictive models for urologic injury. Long-term follow-up to assess outcomes such as urethral stricture, incontinence, or sexual dysfunction is also essential.

### Conclusion

The results of our study demonstrated that LC was the most common fracture pattern in this series, whereas APC fractures were most strongly associated with gross hematuria. Enhancing diagnostic protocols in pelvic trauma units and systematic follow-up of high-

risk patients may help reduce long-term complications.

### Conflicts of Interest

The authors declare no conflicts of interest in this study.

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