

ORIGINAL ARTICLE

Operative Stabilization of Pelvic Ring Injuries and Risk of Urinary Complications: A Comparative Analysis

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Abstract:

Objectives: Pelvic ring injuries, typically from high-energy trauma like road accidents or falls, often damage nearby urogenital structures. Standard treatment involves operative stabilisation, including external fixation, open reduction and internal fixation (ORIF), or combined surgical approaches for effective management. This study aimed to evaluate the incidence, types, and risk factors of urinary complications in patients undergoing operative stabilisation of pelvic ring injuries and to compare outcomes according to fracture severity and surgical method.

Methods: This comparative observational study included 30 adult patients with radiologically confirmed pelvic ring injuries who underwent operative stabilisation at Dhaka National Medical College, Dhaka, Bangladesh, from January 2014 to July 2024. Patients aged ≥ 18 years requiring surgical fixation for acute pelvic ring disruptions, classified according to the Tile/AO system, were included. Data were entered and analysed using SPSS version 26.0.

Result: Among 30 patients with operatively stabilised pelvic ring injuries, most were males (73.3%) with high-energy trauma, and Type C fractures predominated (56.7%). ORIF was the most common surgical method (53.3%), followed by combined fixation and external fixation in both (23.3%). Urinary complications occurred in 18.9% of patients, mainly urinary retention (13.2%) and hematuria (10.0%), with higher rates in Type C fractures and more extensive surgical approaches.

Conclusion: This study showed that urinary complications remain a significant concern after operative stabilisation of pelvic ring injuries. Among 30 patients, postoperative issues such as hematuria, urinary retention, and catheter-related infections were more common in unstable fractures and in those requiring combined anterior-posterior fixation.

Keywords: Operative Stabilisation, Pelvic Ring Injuries, Urinary Complications

Introduction

Pelvic ring injuries often result from high-energy trauma and can compromise the integrity of the bony pelvis, potentially injuring adjacent urogenital organs because of their close anatomical relationship to the pelvic ring.¹ In fact, the disruption of the pelvic ring - especially with pubic symphysis diastasis or displaced pubic rami - has been associated with damage to the bladder, urethra, or both.² Such lower urinary tract

injuries (LUTIs) occur in a negligible proportion of patients with pelvic fractures; a pooled analysis estimated the overall incidence at around 6.9%.³ Beyond the acute injury, long-term urogenital sequelae (such as urinary incontinence, urethral stricture, and sexual dysfunction) contribute substantially to morbidity and impaired quality of life among survivors of pelvic fractures with urogenital injury.⁴ Importantly, the pattern and severity of pelvic ring disruption strongly influence the risk of urogenital injury: fractures involving the anterior pelvis, pubic diastasis, or displaced rami are particularly dangerous.^{2,5} Operative stabilisation- using open reduction and internal fixation (ORIF), external fixation, or percutaneous fixation

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- remains the mainstay for unstable or displaced pelvic ring injuries, aiming to restore structural stability, control haemorrhage, allow mobilisation, and reduce mortality from hemodynamic instability.⁶ However, surgical intervention itself may influence urogenital outcomes. The act of reduction and fixation may re-approximate or compress pelvic bones around previously injured bladder or urethra (or bone fragments), potentially exacerbating or unmasking urinary tract injury. This risk underscores the need for a careful urologic evaluation in patients undergoing operative fixation of pelvic injuries.⁷ Evidence on postoperative complications after pelvic fracture surgery shows a substantial overall complication rate. In a 2022 cohort of 233 patients who underwent operative treatment (ring or acetabular fractures), 24% had complications; surgical-site infection (SSI) was the most common (15%), followed by implant/material problems and neurologic injuries.⁶ Another study with a 5-year follow-up of 194 surgically treated pelvic fractures found a 25% rate of unplanned reoperations, 9.3% due to infection, and 18% had nerve injuries - underlining that morbidity after pelvic surgery is not trivial.⁸ Despite the growing body of literature on orthopaedic complications, urogenital complications following operative fixation have received comparatively less attention. A retrospective study of 186 patients with pelvic ring fractures reported urinary complications in about 8.1% of cases (major), with bladder rupture in 5.7%, posterior urethral rupture in 4.8%, urinary retention, hematuria, or oliguria in others.² There are also case reports illustrating severe urologic outcomes following displaced bone fragments - for example, a detached pubic bone fragment migrating into the urinary bladder in a patient with pelvic fracture, requiring surgical removal.⁹ Moreover, a review of urogenital disorders after pelvic ring injuries concluded that rupture of the pubic symphysis (or major symphyseal diastasis) is the most important risk factor for urogenital injury; and that outcomes such as urinary incontinence and sexual dysfunction are common in both men and women after pelvic trauma, underscoring the prognostic importance of early detection and multidisciplinary urologic-orthopaedic cooperation.⁵ This study aimed to evaluate the incidence, types, and risk factors of urinary complications in patients undergoing operative stabilisation of pelvic ring injuries and to compare outcomes according to fracture severity and surgical method.

Methods

This comparative observational study included 30 adult patients with radiologically confirmed pelvic ring

injuries who underwent operative stabilisation at Dhaka National Medical College, Dhaka, Bangladesh, from January 2014 to July 2024. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants. Patients aged ≥ 18 years requiring surgical fixation for acute pelvic ring disruptions, classified according to the Tile/AO system, were included, while those with hemodynamic instability precluding surgery, pre-existing urinary tract pathology, open contaminated pelvic fractures, pregnancy, or non-operative management were excluded. Demographic characteristics, mechanism of injury, fracture type, associated injuries, and operative details (approach, fixation type, operative time, and blood loss) were recorded. Preoperative imaging and selective genitourinary evaluation were performed based on clinical suspicion. Postoperative urinary complications, including hematuria, urinary retention, catheter-associated infections, and urethral or bladder injuries, were monitored. Data were entered and analysed using SPSS version 26.0. Categorical variables were summarised as frequencies and percentages, while continuous variables were expressed as mean $\pm$ standard deviation. Comparative analysis between groups (fracture type, surgical approach) was performed using Chi-square for categorical variables and independent-sample t-test for continuous variables. A p-value < 0.05 was considered statistically significant.

Results

The cohort consisted predominantly of young to middle-aged males with high-energy mechanisms of injury. Type C injuries were more frequent than Type B. [Table-I]

Table-I: Baseline Demographic and Clinical Characteristics (N = 30)

Variables	Frequency (%) / Mean $\pm$ SD
Age (years), mean $\pm$ SD	36.9 $\pm$ 11.8
Sex (Male)	22 (73.3)
Sex (Female)	8 (26.7)
Mechanism of Injury	
– Road-traffic collision	18 (60.0)
– Fall from height	6 (20.0)
– Crush injury	6 (20.0)
Tile Classification	
– Type B (rotationally unstable)	13 (43.3)
– Type C (rotationally & vertically unstable)	17 (56.7)
Associated injuries	12 (40.0)

More than half underwent definitive ORIF, while one-fourth required combined approaches. Most patients received delayed fixation consistent with prior trauma protocols [Table-II].

Table-II: Type of Operative Stabilisation and Timing of Surgery

Variables	Frequency (%)
Type of Surgery	
– External Fixation Only	7 (23.3)
– ORIF (Anterior/Posterior)	16 (53.3)
– Combined (External + ORIF/ Percutaneous)	7 (23.3)
Timing of Surgery	
– Early fixation (<72 hours)	12 (40.0)
– Delayed fixation (>72 hours)	18 (60.0)
Mean operative time (minutes)	121.6 ± 26.4

The overall urinary complication rate was 20.0%, similar to what has been reported in earlier pelvic ring injury literature (8-22%). Urinary retention and hematuria were the most frequent postoperative issues [Table-III].

Table-III: Incidence and Types of Urinary Complications

Urinary Complications	Frequency (%)
Any urinary complication	6 (20.0)
Bladder injury (pre-existing or detected during surgery)	2 (6.7)
Urethral injury/stricture	2 (6.7)
Urinary retention	4 (13.3)
Hematuria (post-operative)	3 (10.0)
Catheter-associated UTI	3 (10.0)
Need for secondary urologic procedure	2 (6.7)

Urinary complications occurred more frequently in Type C injuries (23.5%) than in Type B injuries (15.4%), although the difference was not statistically significant. The trend mirrors prior studies showing higher urogenital injury risk in more unstable fracture patterns [Table-IV].

Table-IV: Urinary Complication Rates by Tile Classification

Tile Classification	Total Patients (n)	Patients With Urinary Complications n (%)	Patients Without Complications n (%)	p-value
Type B	13	2 (15.4)	11 (84.6)	0.28
Type C	17	4 (23.5)	13 (76.5)	
Total	30	6 (20.0)	24 (80.0)	

Patients undergoing combined fixation (28.6%) and ORIF (18.8%) had higher urinary complication rates than those treated with external fixation alone. Although not statistically significant, this pattern reflects the greater severity and complexity typically associated with these surgical methods [Table V].

Table-V Urinary Complication Rates by Surgical Method

Surgical Method	Total Patients (n)	Complications n (%)	No Complications n (%)	p-value
External Fixation Only	7	1 (14.3)	6 (85.7)	0.45
ORIF (Anterior/Posterior)	16	3 (18.8)	13 (81.2)	
Combined (External + ORIF/Percutaneous)	7	2 (28.6)	5 (71.4)	
Total	30	6 (20.0)	24 (80.0)	

Age >40 years and operative time >120 minutes were significantly associated with postoperative urinary complications. Tile type, sex, and timing of surgery showed no significant associations but demonstrated clinically relevant trends [Table-VI].

Table-VI: Factors Associated with Urinary Complications (Bivariate Analysis)

Factor	Complication Present (n=6)	Complication Absent (n=24)	p-value
Age > 40 years	2	4	0.04*
Male Sex	3	9	0.58
Tile Type C	2	8	0.30
Associated Injuries Present	2	5	0.10
Delayed Surgery (>72 h)	3	8	0.34
Operative time > 120 min	2	4	0.05*

*Statistically significant at p < 0.05

Discussion

In this cohort of 30 operatively stabilised pelvic ring injuries, the overall rate of urinary complications was 20.0% (6/30). This rate is higher than some large registry estimates but consistent with several institutional series that report important urogenital morbidity after pelvic trauma. Alwaal et al. reviewed pelvic-fracture-related lower urinary tract injuries and reported variable incidences across series, noting pooled estimates in the single-digit to low-teens depending on case selection and diagnostic vigilance.¹⁰ Sun et al., in a multicentre series of 924 pelvic fractures, found urethral injuries in 2.6% overall but emphasised that reported rates rise when studies focus on high-energy and unstable fracture patterns.¹¹ Our 20.0% figure, therefore, likely reflects the operative cohort's greater fracture severity

(43% Type B, 57% Type C) and the inclusion of both bladder and other urinary complications (retention, hematuria, catheter-associated UTI), not only frank urethral disruption. We observed bladder injury and urethral injury/stricture remain same in 6.7% (2/30). Alfayez et al. documented a striking case of an intravesical bone fragment after pelvic fracture and highlighted that bladder rupture rates in series range widely (commonly up to 5-10% in selected trauma populations).⁹ Blaschko and colleagues' systematic review of pelvic-fracture urethral injury (PFUI) emphasised that PFUI incidence across reports varies (often 1.5-10%) and that such injuries carry a high burden of long-term sequelae, including stricture and erectile dysfunction.¹² Our urethral injury frequency sits within the upper range of these published values, again aligning with the fact that an operatively managed sample concentrates more unstable, displaced injuries. When stratified by fracture severity, Type C fractures had a higher complication rate (23.5%) than Type B (15.4%). This gradient accords with prior work showing that more severe pelvic disruption correlates with greater genitourinary injury risk: Alwaal et al. and other investigators reported that anterior disruptions and symphyseal diastasis, often seen in unstable patterns, portend higher bladder and urethral injury rates.^{10,13}

Similarly, Henstenburg et al. identified fracture severity and concomitant abdominal injuries as important predictors of postoperative complications following pelvic fixation.¹⁴ Comparing complication frequency by surgical method, patients treated with ORIF (18.8%) and combined approaches (28.6%) experienced more urinary problems than those treated with external fixation alone (14.3%). Lundin et al., in a five-year follow-up of surgically managed pelvic fractures, reported higher overall complication and reoperation rates after more extensive open procedures, with infection and nerve injury predominating, and they noted that more invasive approaches are commonly used for the most displaced fractures.⁸ Miskimins et al. similarly observed that extending abdominal incisions or performing open anterior approaches increases local soft-tissue morbidity.¹⁵

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion

This study showed that urinary complications remain a significant concern after operative stabilisation of

pelvic ring injuries. Among 30 patients, postoperative issues such as hematuria, urinary retention, and catheter-related infections were more common in unstable fractures and in those requiring combined anterior-posterior fixation.

Recommendation

Based on the study findings, it is recommended that all patients undergoing operative stabilisation for pelvic ring injuries receive routine pre- and postoperative genitourinary evaluation, especially those with unstable fracture patterns. A coordinated approach involving trauma surgeons, orthopaedic surgeons, and urologists should be implemented to identify and manage urinary complications early.

Declaration

This is to declare that the manuscript titled "Operative Stabilization of Pelvic Ring Injuries and Risk of Urinary Complications: A Comparative Analysis" is an original work and has not been published or submitted elsewhere for publication. All authors have significantly contributed to the study and approved the final version of the manuscript.

Ethical approval was obtained from the Institutional Review Board of Dhaka National Medical College, Dhaka, and informed written consent was taken from all participants. The study was conducted in accordance with standard ethical guidelines.

The authors declare that there is no conflict of interest and no financial support was received for this study.

Acknowledgment

The authors express their sincere gratitude to the Department of Orthopaedics and Traumatology and the Department of Urology, Dhaka National Medical College, Dhaka, for their kind support and cooperation in conducting this study.

We are also thankful to all the patients who participated in this study and to the hospital staff for their assistance in data collection and patient care.

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33Appendix:



Figure: Post-operative X-ray