

## REVIEW

# The presentation and outcomes of penile fracture with associated urethral injury: A systematic literature review

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**Summary** *Purposes: Penile fracture (PF) with associated urethral injury has been described as a rare condition yet a serious urological emergency. We conducted this systematic review to address the current literature concerning the etiology, presentations, intra-operative findings, site of injury, and complications of PF with associated urethral injury, Materials and Methods: The present systematic review was limited to human-based studies published in English language, and reporting clinical data on PF cases with associated urethral injuries. A comprehensive search of the literature was conducted on five electronic databases from their inception to May 2022: Medline via PubMed, Web of Science, Google Scholar, Scopus, and EBSCO host.*

*Results: A total of 15 studies were included encompassing 1671 patients with PF. Out of 1665 patients with PF retrieved from the case series studies, 65 patients had associated urethral injuries giving a point prevalence of 3.9%. The vast majority of the patients had blood on the meatus and hematuria suggestive of urethral injury (57/59; 96.6%). Forty patients had partial urethral disruption and the rest of the patients had a complete rupture. All patients received primary urethroplasty as the main modality of treatment. The median hospital stay was two days and the median duration of transurethral catheterization was 21 days. Five patients (8.5%) developed urethral stricture; other complications included penile curvature (6.7%), palpable fibrosis (6.7%), and erectile dysfunction (3.4%).*

*Conclusions: Urethral injuries are uncommon, but serious findings, in patients with PF. Primary urethroplasty appears to achieve satisfactory outcomes with a low incidence of short and long-term complications.*

**KEY WORDS:** Penile fracture; Urethra; Urethral injury; Systematic review.

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## INTRODUCTION

Penile fracture (PF) with associated urethral injury has been described as a rare condition yet a serious urological emergency (1). PF is characterized by signification injury of corpus cavernosum anatomy due to profound trauma or manipulation of an erect penis; while traumas to the flaccid penis or the suspensor ligament are not usually considered as PF (2, 3). Commonly, PF is caused by severe bending of the erect penis during sexual intercourse, masturbation, rolling over during sleep, and powerful methods of sexual arousal. To a lesser extent, PF can result from direct trauma or fall onto the erect penis. The basal and

midshaft penis are the most commonly affected sites by PF (1, 4). Clinically, the onset of PF is usually accompanied by a loud cracking sound, followed by penile localized swelling, bruises, pain, and immediate detumescence. Many reviews report that the diagnosis of penis fractures can depend exclusively on clinical findings, based on patient history and physical examination (2, 5).

Multiple studies have reported that a wide diversity of investigations are useful in the diagnosis of PF as X-ray imaging, Doppler ultrasound, *retrograde urethrocytography* (RGU), flexible cystoscopy, and magnetic resonance imaging (MRI) (6-8). However, it is unnecessary to use radiological investigations in most cases where the history and the clinical examination are sufficient to confirm the diagnosis. The X-ray imaging may still be required in some cases, especially in patients with atypical clinical presentation (9). Some authors consider the Doppler ultrasound as the preferred radiological tool for investigating penile trauma cases given that it is a non-invasive and inexpensive procedure. On the other hand, MRI is the most accurate test in diagnosing the PF as it shows high contrast resolution between tissues and identifies the pathological processes of soft tissues. Studies also reported that it can be used in the evaluation of the urethral injury, although it is not commonly used because of its low cost-effectiveness and long execution time (10, 11). RUG is the gold standard for urethra evaluation. The RUG is easy to perform on trauma patients at the bedside: 20 to 30 mL of diluted water-soluble contrast is injected into the urethral meatus, before x-raying. A positive RUG will show contrast outside the urethral serpentine cylinder. Retrograde urethrograms are sensitive in detecting urethral injuries but can't pinpoint their location and are operator-dependent (12).

Previous reports demonstrated that urethral injuries are present in 1-38% of the PF cases. Patients with an associated urethral injury can present with blood at the meatus, leading to hematuria and urinary retention (5, 13, 14). However, these findings are not specific as previous case reports indicated that some PF cases with associated urethral injuries had no suspected symptoms. Thus, investigations, particularly urine analysis and *retrograde urethrogram* (RGU), are of paramount importance for identifications of associated urethral injuries (15). Accurate identification of urethral injuries is critical before PF repair to avoid the risk of postoperative complications, including urethral stricture and urethrocutaneous fistula (16). However, due to the rarity of the disease, little literature has been published so

far concerning the presentation and outcomes of PF with associated PF. Therefore, we conducted this systematic review to address the current literature concerning the etiology, presentations, intra-operative findings, site of injury, and complications of PF with associated urethral injury.

## MATERIALS AND METHODS

The present systematic review receives PROSPERO ID 342298 and adhered to the recommendations of the recent version of the *Cochrane Collaboration Handbook* and the MOOSE statement (17, 18).

### Eligibility criteria and literature search

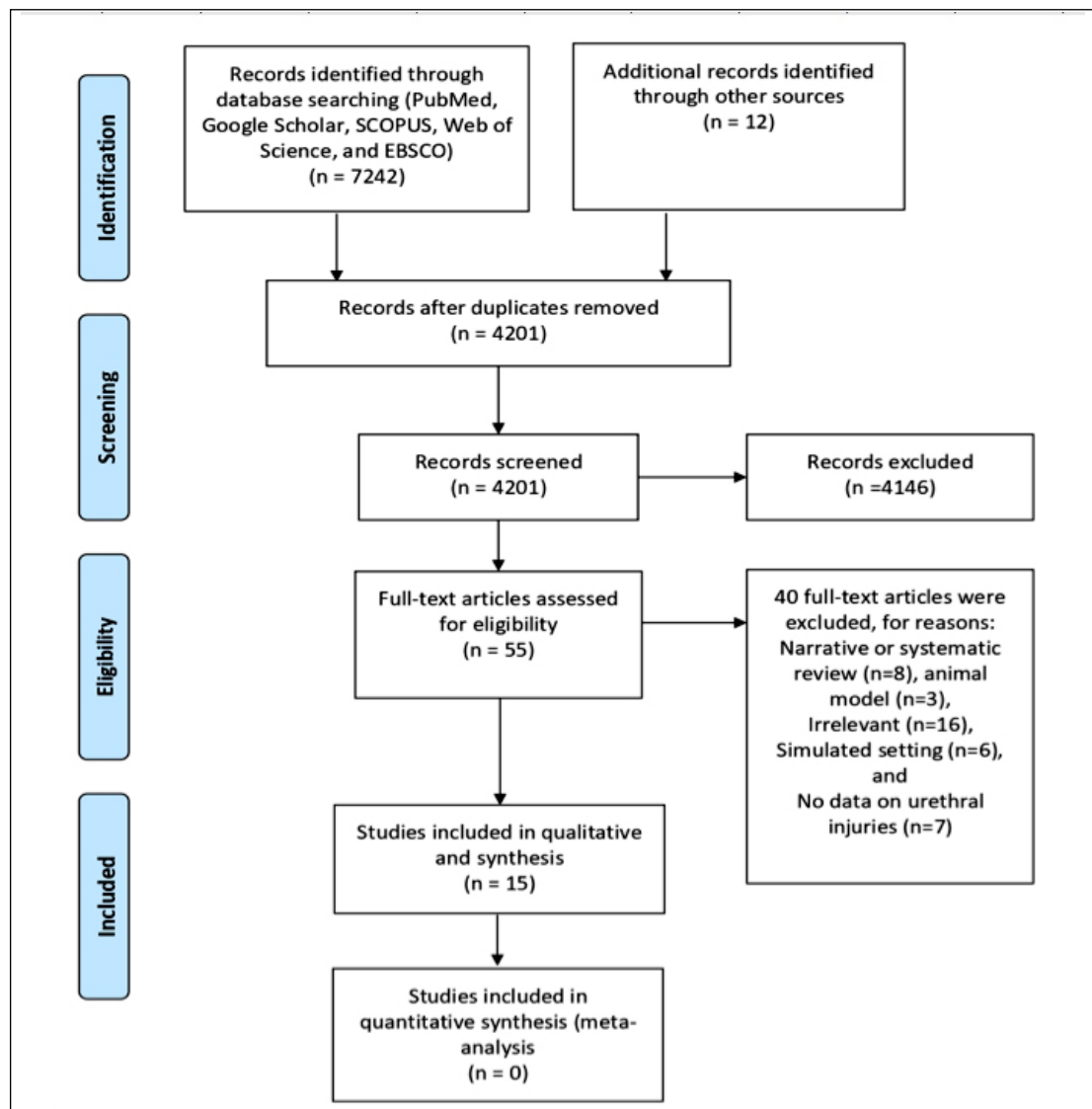
The present systematic review was limited to human-based studies, published in the English language, and reporting clinical data on PF cases with associated urethral injuries. There were no limitations regarding the date of publication or study design. Studies were excluded if they were review articles, duplicate datasets, or they had no separate data on patients with associated urethral injuries. Besides, we excluded conference abstracts with no available full texts.

A comprehensive literature search was conducted on five electronic databases from their inception to May 2022. These bibliographic databases were: *Medline via PubMed*, *Web of Science*, *Google Scholar*, *Scopus*, and *EBSCO host*. Various combinations of the following queries were utilized: penile, penis, fracture, injury, urethra. Following the literature search, retrieved citations were imported to EndNote X7 for duplicates removal. Unique records were then screened through two stages: the first stage was a screening by titles and abstracts, while the second stage was a full-text evaluation of potentially eligible abstracts for final inclusion in the present systematic review.

### Quality assessment

The quality assessment of the included case reports and case series was conducted using *Murad's tool* (19), which is specifically designed to evaluate the methodological quality of case reports and case series.

This tool consists of eight criteria that cover four primary domains: selection, ascertainment, causality, and reporting. Two independent reviewers conducted the quality assessment of the included studies, in case of any discrepancies



**Figure 1.**  
PRISMA flow diagram.

between the reviewers, a consensus was reached through discussion or, if necessary, by involving a third reviewer.

### Data extraction

Standardized data extraction was done using Excel software for data retrieval and processing. The following data were extracted from each eligible study: year of publication, country, study design, number of patients with PF, number of cases with confirmed urethral injuries, cause of PF, presentation of urethral injury, location of the injury, intraoperative findings, need for supra-pubic cystostomy tube, treatment, complications, hospital stay, and duration of follow-up.

## RESULTS

A total of 7242 records were retrieved from online search and 12 records were identified by manual searching. Of them, 4201 records were screened after duplicates removal. After the initial screening, 55 full texts were retained for a full evaluation. Out of them, 40 studies were excluded as they were narrative or systematic review ( $n = 8$ ), animal models ( $n = 3$ ), irrelevant ( $n = 16$ ), simulation-based studies ( $n = 6$ ), or they had no data on urethral injuries ( $n = 7$ ). Finally, 15 studies were included in the present systematic review (See PRISMA flow diagram; Figure 1).

### General characteristics of the included studies and prevalence of urethral injuries

Six retrospective studies (20-25), two prospective study (26, 27), and seven case reports were included in the present systematic review (21, 28-34). Two from India, two from Egypt, two from the United States, and one from Serbia, Italy, Slovenia, Canada, China, Peru, Tunisia, Brazil and UK each. The median time from injury to presentation was six hours (range 1-48.5 hours) and the median time of follow-up was 21 months (1-107 months). A total of 1671 patients with PF were retrieved from the included studies. Out of them, 65 patients had associated urethral injuries giving a point prevalence of 3.9% (Table 1).

### Quality assessment of included studies

The quality assessment of the included studies was conducted using Murad's tool. In terms of selection, eight studies did not report that this was their whole experience on penile fracture or provide a clear selection process. Regarding ascertainment, the majority of the studies (14 out of 15) adequately ascertained exposure and outcomes, while one study failed to do so. Alternative causes that could explain the observation were clearly ruled out in 12 of the included studies. Most studies (10 out of 15) adequately followed their patients, while five studies lacked sufficient follow-up period.

Reporting: The majority of the studies (11 out of 15) provided sufficient details to allow other investigators to replicate the research or practitioners to make inferences related to their own practice. However, four studies did not provide enough details in their reports. Overall, the quality assessment revealed that most studies had adequately ascertained exposure and outcome, and provided sufficient reporting details. However, some studies did not meet all the causality criteria (**Supplementary Table 1**).

### Presentation of the included cases

Among the 65 patients with associated urethral injuries, the most common cause of fracture was sexual intercourse (41/65; 69%), followed by masturbation (8/65; 13.5%) and rolling over (6/65; 10.1%). With regard to the classic presentation of PF, the most common presentations were hematoma (34/65; 57%) and penile swelling (33/65; 55.9%), followed by Aubergine sign/egg-plant deformity (30/65; 50.8%) and crackling sound (29/65; 49.1%). The vast majority of the patients had blood on the meatus and hematuria suggestive of urethral injury (57/65; 87.6%). The most commonly affected location of the included patients was proximal shaft (21/65; 35.5%) followed by midshaft (19/65; 32.2%). The vast majority of the patients had unilateral corporal involvement (54.2%), mainly on the right side (30.5%). Forty patients had partial urethral disruption and the rest of the patients

Authors, Year	Country	Study design	Median time from the time of injury to the time of presentation to the Hospital	Mean follow-up (months)	Hospital stay (days)	Total cases of penile fracture	Confirmed urethral injury
Amit et al, 2013 (20)	India	Retrospective case series	NA	34.3	2	34	8
Kasaraneni et al, 2019 (27)	India	Prospective observational	6	24	2	75	12
Derouiche et al, 2007 (22)	Tunisia	Retrospective case series	10	18	14	312	10
Raheem et al, 2014 (6)	Egypt	Retrospective case series	5.5	72.6	2.1	246	12
Ibrahiem et al, 2010 (23)	Egypt	Retrospective case series	48.5	107	2.3	155	14
Barros et al, 2018 (26)	Brazil	Prospective observational	NA	NA	NA	175	27
Mercado-Olivares et al, 2018 (34)	Peru	Case Report	19	NA	NA	281	1
Ouanes et al, 2021 (24)	Tunisia	Retrospective case series	1 to 5	12	NA	138	15
Hughes et al, 2021 (33)	UK	Case Report	NA	NA	NA	1	1
Boncher et al, 2010 (39)	USA	Case Report	8	48	NA	1	1
Tang et al, 2018 (25)	USA	Retrospective case series	1.2 ± 1.03	21 (1-73)	NA	62	13
Ge et al, 2021 (31)	China	Case Report	NA	12	NA	1	1
Garofalo et al, 2015 (30)	Italy	Case Report	1	12	2	1	1
Jagodic et al, 2007 (29)	Slovenia	Case Report	6	12	13	1	1
Hoag et al, 2011 (28)	Canada	Case Report	1	1	2	1	1

**Table 1.** General characteristics of the included studies.

**Table 2.**  
The distribution of causes and presentations among the included patients.

Authors, year	Causes of penile fractures					Presentation of penile fracture						
	Sexual intercourse	Rolling over	Blunt injury	Forced penile pending	Masturbation	Urethral bleed	Hematoma or ecchymosis	Crackling sound	Penile swelling	Bladder palpable	Aubergine sign/egg-plant deformity	Retention of urine
Amit et al, 2013 (20)	6	0	0	0	2	6	0	6	0	NA	6	NA
Kasaraneni et al, 2019 (27)	9	2	1	0	0	11	0	7	0	3	12	3
Derouiche et al, 2007 (22)	0	4	0	0	6	10	0	10	0	2	10	2
Raheem et al, 2014 (6)	11	0	0	1	0	12	12	0	12	0	0	3
Ibrahiem et al, 2010 (23)	7	NA	NA	0	NA	13	14	NA	14	0	0	NA
Barros et al, 2018 (26)	69	0	0	5	16	NA	NA	NA	NA	NA	NA	NA
Mercado-Olivares et al, 2018 (34)	1	0	0	0	0	0	1	0	0	0	0	0
Ouanes et al, 2021 (24)	47	NA	NA	62	NA	NA	NA	NA	NA	NA	NA	NA
Hughes et al, 2021 (33)	1	0	0	0	0	1	1	1	0	0	0	0
Boncher et al, 2010 (39)	1	0	0	0	0	0	1	1	1	0	1	0
Tang et al, 2018 (25)	41	0	0	19	2	12	44	34	62	0	0	0
Ge et al, 2021 (31)	1	0	0	0	0	1	1	1	1	0	0	0
Garofalo et al, 2015 (30)	1	0	1	0	0	1	1	1	1	0	0	0
Jagodić et al, 2007 (29)	1	0	0	0	0	1	1	1	1	1	0	1
Hoag et al, 2011 (28)	1	0	1	0	0	1	1	0	1	0	0	0

had a complete rupture. Two studies reported the utilization of RGU for the evaluation of PF and associated urethral injuries (Tables 2 and 3).

#### Treatment and outcomes of the included cases

All patients received primary urethroplasty as the main modality of treatment.

Besides, 15 patients needed a supra-pubic cystostomy tube. Fifty-one patients received medications to prevent erection in the form of estradiol, diazepam, sildenafil, and amyl nitrite. The median hospital stay was two days and the median duration of transurethral catheterization was 21 days. Five patients (8.5%) developed urethral stricture; other complications included penile curvature (6.7%),

palpable fibrosis (6.7%), and erectile dysfunction (3.4%) (Table 4).

#### DISCUSSION

Urethral injuries can concurrently occur in patients with PF and a considerable proportion of these injuries are missed at initial diagnosis, despite being widely considered as a serious complication. If not discovered and managed early, associated urethral injuries can dramatically lead to short and long-term complications in patients with PF (2). However, due to the rarity of the disease, little literature has been published so far concerning the presentation and outcomes of PF with associated urethral injury.

Authors, year	Intra operative findings		Location of injury						
	Partial urethral disruption	Complete urethral disruption	Proximal shaft of penis	Midshaft	Distal shaft of penis	Bilateral corporal involvement	Unilateral corporal involvement	Right corporal involvement	Left corporal involvement
Amit et al, 2013 (20)	7	1	6	NA	NA	1	7	5	2
Kasaraneni et al, 2019 (27)	11	1	6	2	4	1	11	4	6
Derouiche et al, 2007 (22)	10	0	5	4	1	0	10	6	4
Raheem et al, 2014 (6)	1	11	0	12	0	12	0	0	0
Ibrahiem et al, 2010 (23)	11	3	NA	NA	NA	NA	NA	NA	NA
Barros et al, 2018 (26)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercado-Olivares et al, 2018 (34)	NA	NA	0	0	1	0	1	1	0
Ouanes et al, 2021 (24)	NA	NA	118	0	20	0	138	NA	NA
Hughes et al, 2021 (33)	NA	NA	0	0	1	0	1	0	1
Boncher et al, 2010 (39)	NA	NA	0	0	1	0	1	1	0
Tang et al, 2018 (25)	NA	NA	23	18	21	NA	NA	NA	NA
Ge et al, 2021 (31)	0	1	1	0	0	NA	NA	NA	NA
Garofalo et al, 2015 (30)	0	1	1	0	0	0	1	1	0
Jagodić et al, 2007 (29)	0	1	1	0	0	NA	NA	NA	NA
Hoag et al, 2011 (28)	0	1	1	0	0	1	0	0	0

**Table 3.**  
The distribution of intraoperative findings and location of injury among the included patients.

**Table 4.**  
The treatment and outcomes of injury among the included patients.

Authors, year	Treatment	Supra-pubic cystostomy tube	Medication to prevent erection	Median duration of transurethral catheterization (days)	Hospital stay (days)	Complications				
						Penile curvature	Palpable fibrosis	Erectile dysfunction	Stricture urethra	UTI
Amit et al, 2013 (20)	Primary urethroplasty	Not used	Estradiol	21	2	0	0	1	0	0
Kasaraneni et al, 2019 (27)	Primary urethroplasty	Not used	Estradiol	21	2	1	0	0	1	2
Derouiche et al, 2007 (22)	Primary urethroplasty	Used	Diazepam	13	14	0	0	0	0	0
Raheem et al, 2014 (6)	Primary urethroplasty	Used in 5 patients	Sildenafil®	22.5	2.1	2	3	1	1	0
Ibrahiem et al, 2010 (23)	Primary urethroplasty	Not used	PGE1	NA	2.3	NA	1	NA	1	0
Barros et al, 2018 (26)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercado-Olivares et al, 2018 (34)	Primary urethroplasty	NA	NA	NA	NA	0	0	0	0	0
Ouanes et al, 2021 (24)	Primary urethroplasty	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hughes et al, 2021 (33)	Primary urethroplasty	NA	NA	NA	NA	NA	NA	NA	NA	NA
Boncher et al, 2010 (39)	Primary urethroplasty	NA	Diazepam	28	NA	0	0	0	0	0
Tang et al, 2018 (25)	Primary urethroplasty	Used	amyl nitate	NA	NA	0	0	0	0	0
Ge et al, 2021 (31)	Primary urethroplasty	NA	NA	12	NA	NA	NA	NA	NA	NA
Garofalo et al, 2015 (30)	Primary urethroplasty	Used	NA	NA	2	1	0	0	1	0
Jagodić et al, 2007 (29)	Primary urethroplasty	Used	Diazepam	12	13	0	0	0	1	0
Hoag et al, 2011 (28)	Primary urethroplasty	Used	NA	28	2	NA	NA	NA	NA	NA

Therefore, we conducted this systematic review to address the current literature concerning the PF with associated urethral injury. Our results highlighted that there are currently 65 published cases of PF with associated urethral injuries giving a point prevalence of 3.9%. Such findings are in line with a large case-series of 312 PF cases from the Middle East, in which ten cases had associated urethral injuries (22). Other reports from the Middle East reported similar findings (35). On the contrary, reports from Europe and the United States demonstrated a much higher prevalence of associated urethral injuries, affecting up to one-third of PF cases (36-38). It is not clear why patients from the Middle East had a lower prevalence of associated urethral injuries; however, it was reported that a large number of PF in the Middle East is attributed to the widespread practice of “*taghaandan*”, which is a low-energy trauma with a low possibility of urethral injuries (35, 32). We also postulated that the low prevalence of associated urethral injuries can be attributed to a large number of pooled cases with PF from the Middle East and the dependence on clinical examination, without further investigations, which might have led to under-detection of associated urethral injuries.

As previously mentioned, the proximal and midshaft penis are the most commonly affected sites by PF; while sexual intercourse and masturbation account for the vast majority of PF (1, 4). These findings appear to apply also to patients with associated urethral injuries; in this review, we found that the most common cause of fracture was sexual intercourse, followed by masturbation and rolling over; while the majority of the cases had proximal and midshaft fractures. Clinically, the presence of urethral injuries is suspected when there is blood at the meatus, with or without hematuria, on examination; besides, urine analysis and RGU can be useful for identifications of associated urethral injuries (15). However, as demonstrated by this systematic review, some PF cases may not exhibit specific symptoms for urethral injuries (see Table 3). Besides,

urine analysis and RGU exhibited false-negative results in some case-series (15, 39). Thus, a careful intraoperative inspection of the urethra is recommended in all cases with PF to avoid missed injuries.

To our knowledge, there is no published systematic review that has attempted to explore the presentation and outcomes of PF cases with associated urethral injuries; nonetheless, we acknowledge the existence of several limitations in our review. All included studies suffered from substantial methodological flaws that can affect the quality and generalizability of our findings. The outcome measurements are subjective and postoperative erectile and voiding functions have not been assessed using validated tools.

In conclusion, urethral injuries are uncommon, but serious findings, in patients with PF. The clinical presentation of patients with urethral injuries usually involves urethral bleeding and hematuria. The diagnosis of associated urethral injuries can be established by clinical examination with the limited role of imaging studies. Thus, a careful intraoperative inspection of the urethra is recommended in all cases with PF in order to avoid missed injuries. Primary urethroplasty appears to achieve satisfactory outcomes with a low incidence of short and long-term complications. Nonetheless, the current published literature is still limited by the low number of published cases and low quality of published reports; thus, further studies are needed to characterize the presentation and outcomes of PF with association urethral injuries.

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**Conflict of interest:** The authors declare no potential conflict of interest.