

SEXUAL FUNCTION OUTCOMES AND RISK FACTORS OF ERECTILE DYSFUNCTION AFTER SURGICAL REPAIR OF PENILE FRACTURE

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ABSTRACT

Objective: To evaluate the sexual function outcomes and risk factors of erectile dysfunction after surgical repair of penile fracture.

Methods: This prospective observational study was conducted at Bacha Khan Medical College–Mardan Medical Complex, MTI, Mardan. All surgically repaired penile fracture patients were enrolled after informed consent. Baseline demographic, clinical, and intraoperative variables were recorded. Postoperative erectile function at five months was assessed using the IIEF-5. Univariate analysis and multivariate logistic regression were performed to identify independent predictors of erectile dysfunction.

Results: The age mean of 45 patients was 32.8 years with majority of the patients being married (82.2%). Sexual intercourse (71.1%) was the most frequent cause of injury. Erectile dysfunction was found in 31.1%, penile curvature in 20.0% and palpable nodules in 15.6% at the age of 6 months. The results of the multivariate logistic regression showed that age 35 years and above (AOR 3.12, $p=0.037$), comorbidities (AOR 2.94, $p=0.048$), delayed repair more than 12 hours (AOR 4.25, $p=0.015$), and urethral injury (AOR 3.67, $p=0.043$) were significant independent predictors of erectile dysfunction.

Conclusion: The early surgical intervention is an important factor to minimize the likelihood of erectile dysfunction but age, comorbidities, and urethral involvement are also important predictors.

KEYWORDS: Erectile Dysfunction; Logistic Models; Penile Diseases; Penile Erection.

INTRODUCTION

Penile fracture is a tragic, rare, and dramatic urological emergency, often resulting in the rupture of tunica albuginea of an erect corpora cavernosa that usually happens in the midst of intense sexual intercourse or other blunt trauma of an erect penis [1]. Occurrence of classic clinical presentation of audible crack, instant detumescence, pain, swelling and hematoma will tend to initiate urgent surgical assessment; however, patterns of presentation, related urethral trauma, and time to intervention differ significantly across series and regions [2]. The usual practice of surgical exploration and primary repair of the tunical defect was implemented since it helps to lower the number of complications in the long term as opposed to the conventional system of conservative management [3].

Though immediate surgical repair usually restores anatomy and function in the majority of patients, sexual sequelae, particularly the erectile dysfunction (ED), penile angulation, palpable scar / nodule, and painful intercourse still continue to be of significance to the patients and clinicians [4]. Reported rates of post-repair ED differ amongst studies which reflect case mix, follow-up, outcome measures (subjective vs validated) as well as definition of dysfunction and present cohort. Studies of contemporary single centers and multicenter series report ED rates in the low single digits to the low teens and older or conservatively managed cohorts report much higher rates of complications [5,6].

There is an accumulated literature that aims at quantifying sexual outcomes following penile fracture and predicting factors of poor erectile functioning. Large series of cases retrospective series and multicenter reports note several common risk factors including advanced age of the patient, bilateral involvement of the corpora or larger tunical defects, mid-shaft fractures, and co-excision urethral injury as well as post-injury intervals until surgery. On the other hand, functional recovery has been consistently linked to early operative repair (most authors recommend intervention within 24 hours) and accurate surgical technique. However, other studies have found less strong effect of timing, which suggests that delay-ED relationship can be subtle and potentially defect size, related injury or underlying vascular risk-dependent [6-8].

Mechanistically, postpenile fracture ED may be caused by a complex of factors: direct corporal cavernosal tissue injury, insult to the subtunical penile vasculature, neurogenic damage at the site of injury, or during the course of inflammation, and posttraumatic fibrosis or plaque formation in the tunica that disturbs penile hemodynamics and mechanics. The urethral disturbance or bilateral corporal involvement commonly associates with increased energy damage and increased tissue defect which could be plausibly associated with poor erectile performance. These

pathophysiologic observations are in line with collections that indicate poorer erectile scores among patients with bilateral lacerations, urethral injury, or longer defect length [9,10].

Although reporting methods have improved, numerous methodological weaknesses remain consistent among existing literature: many articles are retrospective, single-center, and with heterogeneous follow-up periods; not all tools are validated such as IIEF-5; some cohorts are older than current surgical practice; and power is limited due to small sample sizes. In addition, recent reviews and specific analyses indicate that the literature continues to be insufficiently powered prospective cohorts with standardized baseline and longitudinal sexual function measures, which adversely affects accurate risks estimation and problem-specific counseling [11].

Lastly, there are differences in presentation by region (e.g. lagging behind due to stigma or lack of access to emergency urology), differences in surgical technique, and partial reporting of rehabilitation strategies (early sexual rehabilitation, use of PDE5 inhibitors or penile physiotherapy) to make translation of published outcomes into practice more complicated. Recent comparative studies of immediate and delayed repair emphasize the importance of timely identification and surgical treatment as the foundations of care although they also raise unresolved questions regarding intervention limits and use of adjunctive treatments to stop fibrosis and ED [12]. Although rare, penile fracture has tremendous psychological and functional implications on the affected men with erectile dysfunction (ED) being the most dreaded of the long-term effects. Although surgical repair is the standard of care, inconsistency in the study design, surgical technique and methods of assessment has led to variation in the reported rates of postoperative ED. Moreover, the risk factors including age, repair time, degree of tunical injury, bilateral corporal injury, and urethral damage have been inconsistently associated with sexual dysfunction, and clinical practitioners have no unambiguous advice to give to patients and stratify risks. In many low- and middle-income settings, delays in presentation due to stigma and limited emergency access further compound the risk of adverse outcomes. Given these uncertainties, there is a pressing need for contemporary evidence that employs validated tools to assess erectile function and systematically identifies modifiable and non-modifiable predictors of dysfunction.

This study aimed to evaluate the sexual function outcomes and risk factors of erectile dysfunction after surgical repair of penile fracture.

MATERIALS AND METHODS:

The purpose of this prospective observational study was to determine the sexual functions outcome and risk factors of erectile dysfunction among patients who had penile fracture and were undergoing surgical repair. The research was carried out at the department of urology, Bacha Khan Medical College (BKMC), Mardan Medical Complex (MMC), MTI, Mardan, Pakistan. The study was planned to last 8 months, between 10 February 2025 and 10 October 2025. Before commencing the study, the ethical approval was granted by the Institutional Review Board of BKMC (Approval No: 604/25/BKMC, dated 6 th February 2025). All eligible participants were enrolled after informed written consent was taken. The study was conducted in confidence and the patients were anonymous and their participation in the study was fully voluntary.

The openEpi software was used to calculate the sample size. Using a prevalence of 15.4% erectile dysfunction sensor after repair of penile fracture reported by Avci et al. (2023), with a 95% confidence level and 10.5% of precision, it was then determined that the required sample size would be 45 participants [8]. To conduct sampling, a non-probability consecutive method was utilized according to which all eligible patients presented within the study period were approached to participate in it until the necessary number was met.

The inclusion criteria were that patients had to be male individuals aged 18 to 60 years, with a clinically established diagnosis of penile fracture and had surgery to repair the fracture in the Department of Urology at MMC. Only individuals who gave consent to take part and accepted to be followed up were registered. The patients were eliminated in the case they experienced erectile dysfunction in the pre-injury period, which was identified using the baseline International Index of Erectile Function-5 (IIEF-5) score of less than 22. Similarly, people with marked comorbidities that have been known to impair erectile functioning like uncontrolled diabetes mellitus, high blood pressure, heart diseases, or spinal cord injury were excluded. Conservatory patients or those who declined surgical intervention were also excluded and so were patients who were not willing to attend the planned follow-ups.

The process of data collection was initiated by the detailed records of baseline demographic and clinical characteristics. Data about age, marital status, occupational activity, comorbidity, and smoking history were received. Clinical information, such as the injury mechanism, the delay between the trauma and the presentation to the hospital, clinical presentation, as well as intraoperative findings, were noted. Special emphasis was put on the location and the size of the tunical tear, the unilateral or bilateral involvement of the corpora, and the presence or absence of related urethral injury. The nature of incision, the method of suturing a tunical repair was also noted. Repair was done by surgery and using a spinal or general anesthesia. Depending on the place and size of injury, a circumferential or degloving incision was used. Hematoma was removed, and the location of tunical tear was localized thoroughly. To re-establish the integrity of the anatomy, closure of the tunica albuginea was done with absorbable sutures. Primary repair was done onto Foley catheter in patients with concomitant urethral injuries so that continuity and healing could be assured. Patients were encouraged to avoid sexual activity during the postoperative period at least in six or eight weeks, and provided with proper analgesics, antibiotics and supportive care where necessary.

At five months of the operation, the follow-up was made. During every follow up visit, erectile functioning was evaluated based on the International Index of Erectile Function-5 (IIEF-5) questionnaire, which is a valid instrument. Also, the patients were assessed of penile curvature, palpable nodules/fibrotic plaques, painful erections, and general level of satisfaction with sexual functioning. These were inclusive measures that offered a detailed assessment of the postoperative outcomes.

All the gathered data were typed and processed in SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Data distribution Continuous variables (age, time to surgery, IIEF-5 scores) were expressed as the mean + standard deviation (SD) or median (IQR). Categorical variables (e.g., presence of ED, urethral injury, bilateral involvement, etc.) were given as frequencies, percentages. It was determined as a rate of erectile dysfunction in the population of the study. Categorical variables were compared using Chi-square test. The multivariate logistic regression analysis was done to determine the independent predictors of erectile dysfunction and adjusting factors (age, comorbidities, time to repair, urethral injury, size/location of tear). A p-value of less than 0.05 was deemed as being statistically significant.

RESULTS

The average age of the patients was 32.81784 years. Most of them were married (82.2%), and the rest were not married (17.8%). The majority of the participants were working (64.4%), with 35.6% of the sample being unemployed and the rest being students. In 26.7 percent of the cases there was a history of smoking and comorbidities like hypertension or diabetes were present in 20.0 percent of the patients. Sexual intercourse became the leading cause of injury with 71.1 percent cases, then there was manual bending or manipulation with 17.8 percent and other events like accidental trauma with 11.1 percent. Mean hospital presentation time was 8.6 hours (4.3) following a trauma as shown in **Table 1**.

Intraoperative assessment revealed that the tunical tear was most frequently located in the right corpus cavernosum (46.7%), followed by the left corpus cavernosum (37.8%), while bilateral corporal involvement was noted in 15.5% of patients. The majority of tunical tears measured ≤ 2 cm in size (62.2%), whereas 37.8% were larger than 2 cm. The associated urethral injury was identified in 13.3% of cases, while the remaining 86.7% had no urethral involvement. A circumferential or degloving incision was the most common surgical approach, performed in 77.8% of patients, whereas a local incision was utilized in 22.2%. All repairs were performed using absorbable sutures (Vicryl) for closure of the tunica albuginea. These details are shown in **Table 2**.

Table 3 shows that at 5-month follow-up, erectile dysfunction as assessed by the IIEF-5 questionnaire was present in 31.1% of patients, while 68.9% maintained normal erectile function. Penile curvature was observed in 20.0% of cases, whereas 80.0% had no deformity. Palpable nodules or fibrotic plaques developed in 15.6% of patients, with the remaining 84.4% free of such findings. Painful erections were reported by 11.1% of participants, while 88.9% did not experience pain during erections. Overall, 75.6% of patients expressed satisfaction with their sexual function following repair, whereas 24.4% reported dissatisfaction.

On univariate analysis, several factors showed significant associations with the development of erectile dysfunction following penile fracture repair. Patients aged 35 years or older demonstrated a higher risk of erectile dysfunction compared to younger patients ($p = 0.021$). The presence of comorbidities was also significantly associated ($p = 0.033$), as was delayed surgical repair beyond 12 hours ($p = 0.014$). Similarly, patients with associated urethral injury ($p = 0.041$) and those with larger tunical tears >2 cm ($p = 0.048$) were more likely to develop postoperative erectile dysfunction. Bilateral corporal involvement did not show a statistically significant association ($p = 0.327$). (**Table 4**)

Multivariate logistic regression identified several independent predictors of postoperative erectile dysfunction. Patients aged 35 years or older had over threefold higher odds of erectile dysfunction compared to younger patients (AOR 3.12, 95% CI 1.08–9.04, $p = 0.037$). The presence of comorbidities also significantly increased the risk (AOR 2.94, 95% CI 1.01–8.58, $p = 0.048$). Delayed surgical repair beyond 12 hours emerged as the strongest predictor, with more than a fourfold increased likelihood of erectile dysfunction (AOR 4.25, 95% CI 1.32–13.64, $p = 0.015$). Similarly, patients with concomitant urethral injury were nearly four times more likely to develop erectile dysfunction (AOR 3.67, 95% CI 1.04–12.90, $p = 0.043$). Although larger tunical tears (>2 cm) showed a trend toward higher risk (AOR 2.18, 95% CI 0.89–6.47), the association did not reach statistical significance ($p = 0.091$). (**Table 5**)

DISCUSSION

This prospective cohort study involved surgery repairing penile fracture in 45 patients, however, erectile dysfunction (ED) has been noted to occur in 31.1% of the participants at 5 months. This rate is greater than several published series but corresponds to a group of reports that record significant rates of postoperative sexual morbidity. A retrospective study by Sharma et al. (2020) characterized a variable incidence of ED following repair, highlighting that the discrepancies between reports of different EDs is explicable by different follow-up time, measurement tools, and different case mixes; the higher rate of our study could be due to more aggressive application of IIEF-5 screening and extensive follow-up that identified milder dysfunction, which some retrospective series would have overlooked [5].

Lower crude ED proportions have been found in several large series and systematic reviews; however, postoperative ED rates have been found to be in the low teens or even lower when only major dysfunction was summed or when follow-up time was not long. Both reports by Ouanes and colleagues (2021) and Zhu et al. (2024) indicate a fairly encouraging overall outcome of the erection following operative repairs, but they both emphasize that the numbers differ by definition and follow-up period; the variation between the two and our cohort is presumably due to the severity of injuries (higher proportion of urethral injuries or bilateral tears in our sample) as well as thresholds (used to define ED) [14-16].

The timing of repair has been reported to be a significant outcome determinant repeatedly. Our multivariate model determined that delayed repair (>12 hours) had a strong independent effect on ED (AOR 4.25). This finding is supported by various previous studies which have found the longer period of time elapsing between injury and intervention to result in poorer erectile performance. The idea that delayed surgery may lead to the worse long-term functionality was supported by Haque et al. (2020), Ozturk, who observed more complications and lower erectile scores with increased delays to surgery, as well as worse long-term functioning. On the other hand, there are some minority of reports indicating that timing is not so significant when repair is eventually done, yet our data supports the expedient effect of early operative management [7,12].

In our cohort, age and medical comorbidity turned out to be independent predictors. Patients aged 35 and above were about three times more likely to have ED and patients with systemic comorbidity were almost three times more likely to have adverse sexual consequences after immediate repair, similar to findings by Avcu et al. (2023) in a multicenter study that found age to be a strong predictor of adverse sexual outcomes. Avcu, et al. suggested that age-related VR and preclinical EDS can make vulnerability more evident following traumatic corporal trauma; our comorbidities, impact as diabetes, hypertension, may serve the biologic plausibly that prior conditions of vascular health can influence the recovery of the erectile dysfunction post-traumatic [8].

Another predictor in our study was an associated urethral injury (AOR 3.67). This is consistent with a number of studies, such as Castro 2022 and Chaker 2024, which attribute urethral involvement, an indicator of greater energy trauma and more extensive tissue damage, to worse sexual outcomes and increased fibrosis and increased risk of curvature or painful erections. The presence of urethral disruption probably signifies the presence of more global damage to the corpora cavernosa and a more complicated reconstruction, which could also predispose impaired hemodynamics or spinal injury [1,17].

Our model indicated a trend in terms of risk on tear size (AOR 2.18, $p=0.091$) but failed to become significant after adjustment. Larger or bilateral ruptures have been reported to be associated with poorer outcomes (Sharma 2020 and Ouanes et al. 2021) but the sample sizes are smaller, and their covariate adjustment is not clearly defined, whereas the more precise comparison of unilateral versus bilateral ruptures by Keskin et al. (2024) indicates worse erectile and ejaculatory outcomes in bilateral ruptures, which confirms the hypothesis that laterality and extent do matter, albeit our adjusted estimate was not significant. Combined, the literature indicates a stable direction of effect of size/bilaterality despite the potential differences in statistical power of individual studies [9,5].

Our results are further contextualized when they are set in comparison to systematic reviews and rehabilitative studies. Schmid et al. (2021) also determined that patients with penile fractures are mostly at a higher risk of ED compared to the general population and that penile rehabilitation (early PDE-5 inhibitors) can potentially ameliorate the condition. Even though our protocol lacked formalized postoperative rehabilitation, the size of the ED burden is in support of the fact that formal rehabilitation pathways should be considered in future practice to potentially reduce long-term dysfunction [18].

Lastly, the discrepancies in our ED incidence with certain published cohorts highlight the presence of a number of methodological shortcomings common to the literature: most studies are retrospective in nature, use diverse outcome definitions, and have differing levels of follow-up. The long-term cohorts by Castro et al. (2022) and others also emphasize that longer surveillance will show more morbidity manifesting later (curvature, plaque, evolving ED) and thus one should not overrule short-term follow-up and underestimate morbidity. The sensitivity of our prospective design and application of IIEF-5 was presumably higher as compared to older or administrative-data studies [14,17].

Overall, the trend in current literature and in our cohort narrows on a few specific aspects: in most patients, operative repair does not affect functioning; however, delayed repair, advanced age, underlying comorbidity, involvement of the urethra, and severe corporal damage represent significant risk factors of postoperative ED [19,20]. Such consistent results in different contexts reinforce the clinical message that early diagnosis, immediate surgical intervention, reconstructive attention, and postoperative penile rehabilitation should be considered to minimize the morbidity associated with sex in the long-term.

The research results have significant clinical implications on penile fracture treatment. The relationship between late surgical repair and greater incidences of erectile dysfunction as observed is very crucial and gives grounds to the importance of early diagnosis and early operative correction. This implies that in the suspected cases, clinicians ought to emphasize the importance of rapid assessment and surgical intervention to reduce sexual dysfunction in the long term. The close relationship of comorbid conditions like diabetes and hypertension and postoperative erectile dysfunction also indicate the importance of comprehensive preoperative evaluation and optimization of underlying structures. The use of a multidisciplinary care consisting of urologists, endocrinologists, and cardiologists can potentially change the outcomes of patients with systemic diseases. The study also emphasizes the necessity of counseling patients regarding possible postoperative complications, including erectile

dysfunction, penile curvature, and fibrosis, enabling realistic expectations and better postoperative compliance. From a surgical perspective, the findings reinforce the importance of meticulous repair techniques and consideration of tear size and urethral involvement when planning operative strategies. These insights may contribute to refining clinical guidelines for penile fracture management and improving patient-centered outcomes in urological practice.

Notwithstanding the findings' strength, a number of caveats should be noted. The study's comparatively modest sample size may have limited how broadly the findings can be applied. Because it was a single-center study, the results might represent local patient demographics, surgical proficiency, and management procedures that are different from those in other contexts. Although sufficient for early results, the study's five-month follow-up period might not adequately capture long-term issues or late-onset erectile dysfunction. Despite being validated, self-reported assessments like the IIEF-5 questionnaire may be impacted by response bias and personal opinions about sexual performance. Furthermore, the analysis did not properly account for several potential confounding variables, such as psychological aspects, partner-related problems, or differences in surgical technique. Longer follow-up periods and bigger, multicenter cohorts in future research would be helpful in validating these results and bolstering the body of data supporting clinical recommendations.

CONCLUSION

This study emphasizes that erectile dysfunction is still a major postoperative concern in patients with penile fractures, especially in those with urethral involvement, advanced age, underlying comorbidities, and delayed surgical intervention. It has been demonstrated that prompt repair within a key window significantly lowers the risk of long-term sexual dysfunction, highlighting the need of early diagnosis and prompt surgical treatment. In order to address potential issues and maximize results, the results also highlight the significance of thorough preoperative evaluation and patient counseling. This research advances our knowledge of surgical sequelae and offers guidance for bettering patient treatment by illuminating important determinants of erectile dysfunction. In the end, addressing penile fractures with a proactive, multidisciplinary strategy can maintain both functional and psychological well-being, improving the quality of life for those who are impacted.

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TABLES

Table 1. Baseline Demographic and Clinical Characteristics of Patients (n = 45)

Variable	Categories	Frequency (%) / Mean $\pm$ SD
Age (years)		32.8 $\pm$ 8.4
Marital Status	Married	37 (82.2%)
	Unmarried	8 (17.8%)
Occupation	Employed	29 (64.4%)
	Unemployed/Student	16 (35.6%)
Smoking history	Yes	12 (26.7%)
	No	33 (73.3%)
Comorbidities	Present	9 (20.0%)
	Absent	36 (80.0%)
Mechanism of injury	Sexual intercourse	32 (71.1%)
	Manual bending/manipulation	8 (17.8%)
	Others (fall/trauma)	5 (11.1%)
Mean time from trauma to hospital (hours)		8.6 $\pm$ 4.3

Table 2. Intraoperative Findings and Operative Details (n = 45)

Variable	Categories	Frequency (%)
Site of tunical tear	Right corpus cavernosum	21 (46.7%)
	Left corpus cavernosum	17 (37.8%)
	Bilateral	7 (15.5%)
Size of tunical tear	≤ 2 cm	28 (62.2%)
	> 2 cm	17 (37.8%)
Associated urethral injury	Yes	6 (13.3%)
	No	39 (86.7%)
Incision type	Circumferential (degloving)	35 (77.8%)
	Local incision	10 (22.2%)
Suturing material	Absorbable (Vicryl)	45 (100%)

Table 3. Postoperative Outcomes at 5 Months (n = 45)

Outcome	Categories	Frequency (%)
Erectile dysfunction (IIEF-5)	Present	14 (31.1%)
	Absent	31 (68.9%)
Penile curvature	Yes	9 (20.0%)
	No	36 (80.0%)
Palpable nodules/fibrosis	Yes	7 (15.6%)
	No	38 (84.4%)
Painful erections	Yes	5 (11.1%)

	No	40 (88.9%)
Patient satisfaction with sexual function	Satisfied	34 (75.6%)
	Dissatisfied	11 (24.4%)

Table 4. Univariate Analysis of Factors Associated with Erectile Dysfunction (n = 45)

Variable	Erectile Dysfunction		p-value
	Present	Absent	
Age (≥ 35 years)	9 (64.3%)	5 (35.7%)	0.021*
Comorbidities present	6 (42.9%)	3 (9.7%)	0.033*
Time to repair >12 hrs	8 (57.1%)	4 (12.9%)	0.014*
Urethral injury present	4 (28.6%)	2 (6.5%)	0.041*
Tear size >2 cm	7 (50.0%)	10 (32.3%)	0.048*
Bilateral involvement	3 (21.4%)	4 (12.9%)	0.327
*Chi-square/Fisher's exact test, *p < 0.05 statistically significant			

Table 5. Multivariate Logistic Regression Analysis of Independent Predictors of Erectile Dysfunction

Variable	Adjusted OR	95% CI	p-value
Age ≥ 35 years	3.12	1.08 – 9.04	0.037*
Comorbidities present	2.94	1.01 – 8.58	0.048*
Time to repair >12 hrs	4.25	1.32 – 13.64	0.015*
Urethral injury	3.67	1.04 – 12.90	0.043*
Tear size >2 cm	2.18	0.89 – 6.47	0.091
*p < 0.05 statistically significant			