



Sexual function outcomes and risk factors of erectile dysfunction after surgical repair of penile fracture

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Cite this article as: Sharma G, Mandal S, Bhowmik P, Gupta P, Bahal B, Sharma PK. Sexual function outcomes and risk factors of erectile dysfunction after surgical repair of penile fracture. Turk J Urol 2021; 47(2): 106-12.

ABSTRACT

Objective: To determine the erectile dysfunction (ED), overall sexual function, and risk factors for developing ED after surgical repair of penile fracture.

Material and methods: This was an ambispective observational study conducted from September 2014 to August 2019, which included 68 patients with a clinical diagnosis of penile fracture. The clinical presentation, etiology, and surgical details were recorded. Patients were contacted via telephone and called for follow-up. Their sexual function was objectively recorded using the sexual health inventory for men questionnaire, erection hardness grading scale, and the brief male sexual function inventory (BMSFI). Patients were categorized in 2 groups on the basis of ED. These 2 groups were compared on the basis of preoperative and intraoperative factors to determine the predictors of postoperative ED.

Results: The mean age at presentation was 33.64±9.46 (range, 19–54) years. The most common mode of injury was injury during the sexual intercourse (78%). All the patients underwent surgical exploration through subcoronal degloving incision. On follow-up, 7 patients (11.3%) developed ED (mild ED, 5 patients; mild-to-moderate ED, 2 patients). Per BMSFI, 58 (93.5%) patients had no bothersome issues with their sexual life, and they were mostly satisfied. The significant risk factors for ED were age >50 years and bilateral corporal involvement.

Conclusion: Penile fracture is a true urological emergency, and prompt diagnosis by clinical acumen and emergent surgical exploration provide good functional results with low morbidity. The main predictors of postsurgical ED are increasing age (>50 years) and bilateral corporal involvement.

Keywords: Erectile dysfunction; penile fracture; risk factors; sexual function.

Introduction

Penile fracture is a rare urological emergency and is defined as the rupture of tunica albuginea of the penile corpora cavernosum in the erect state.^[1] The reported incidence of penile fracture is 1 in 1,75,000.^[2] It most commonly occurs during vigorous sexual intercourse.^[3] However, few noncoital etiologies (masturbation, direct blunt trauma, rolling over in bed, and so on.) are also reported.^[4] Patients usually give a history of a popping sound during sexual activity, followed by immediate pain, penile detumescence, penile edema, and hematoma leading to a classical “eggplant deformity.”^[5] These patients usually present late owing to fear and embarrassment, and this delay may result in long-term functional

and cosmetic impairment. Penile fracture is usually diagnosed by history, mode of injury, and physical examination. To confirm the diagnosis, ultrasound, magnetic resonance imaging (MRI), and cavernosography are usually recommended, mainly for identification of the site of tunical tear before surgery.^[6,7] In the past, conservative treatment was the standard, but it resulted in complications, such as penile curvature, palpable nodules, and erectile dysfunction (ED) in up to 50% of patients. Thus, immediate surgical repair is now considered as the main treatment modality and is superior to conservative management in terms of excellent long-term outcomes.^[8-10] To date, the erectile and overall sexual function after surgical repair of penile fracture is under-reported.

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Submitted:
14.07.2020

Accepted:
09.09.2020

Available Online Date:
09.10.2020

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Available online at
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The main aim of our study was to describe the clinical presentation, etiology, surgical management, overall sexual function, and risk factors leading to ED after surgical repair of penile fracture.

Material and methods

This was an ambispective observational study. Our institutional ethical committee approved the study protocol (CNMC&H/2018/320). All the patients with a diagnosis of penile fracture from September 2014 to August 2019 were included. Written informed consent was obtained from all the patients before inclusion in this study. Retrospective data were obtained from the surgical records. The demographic details, mechanism of injury, time of presentation, clinical features, examination findings, imaging findings, and intraoperative details were recorded. During follow-up, patients were contacted via telephone and were asked to attend the urology outpatient department (OPD) for clinical and sexual health evaluation. They were followed up at 2 weeks, 3 months, and 6 months after repair, and at 6 months thereafter until 24 months. The patients were advised sexual abstinence for 6 weeks after the repair. At the first follow-up visit (2 weeks), the patients were clinically evaluated for acute complications, such as infection, hematoma, and skin necrosis. On subsequent visits, they were evaluated for plaque, nodules, and penile curvature. Sexual health assessment was performed using standard questionnaires at 6 months and during subsequent follow-up visits. The objective assessment of sexual and erectile function post-penile fracture was recorded using 3 recognized scoring systems.

The sexual health inventory for men (SHIM) questionnaire (also known as the International Index of Erectile Function-5) is a validated questionnaire for diagnosis and grading of ED.^[11] The ED severity was graded as none (22–25), mild (17–21), mild-to-moderate (12–16), moderate (8–11), and severe (5–7). The erection hardness grading scale is a 4-point scoring system for

the assessment of erectile hardness.^[12] The third scoring system, which we used was the brief male sexual function inventory (BMSFI), including 3 functional domains (sexual drive, erectile function, and ejaculatory function) and an overall satisfaction.^[13]

Patients were categorized into group I, without ED, and group II, with ED. The group II patients were evaluated by penile color Doppler ultrasonography (CDU), which was performed after intracavernous injection of prostaglandin E1. Serial measurements of peak systolic velocity, end-diastolic velocity, and resistive index were performed over cavernosal arteries at every 5-minute intervals for a maximum of 30 minutes. A dynamic peak systolic velocity of <30 cm/s was suggestive of arterial insufficiency, whereas a resistive index <0.85 and end-diastolic velocity >5 cm/s were assumed as veno-occlusive dysfunction (VOD).^[14] To determine the predictors of postoperative ED, both the groups were compared on the basis of preoperative (age, time of presentation, comorbidity, and etiology) and intraoperative factors (site and side of tunical tear and urethral injury).

Statistical analysis

Statistical analysis was performed using the IBM Statistical Package for the Social Sciences version 22.0 (IBM Corp., Armonk, NY, USA). Comparison between the groups was carried out using the chi-squared test, and $p < 0.05$ was considered statistically significant.

Results

A total of 70 patients with a suspicion of penile fracture underwent surgical exploration. Of them, 2 did not have fracture at exploration (pseudo-penile fracture) and were excluded. Thus, 68 patients were enrolled for the final analysis.

The mean age at presentation was 33.64 ± 9.46 (range 19–54) years. The time of presentation ranged from 2 hours to 5 days after trauma. A majority of the patients (56/68) presented within 24 hours. Of them, 78% of the injuries (53/68) were caused because of vigorous sexual intercourse, 8 (11.8%) patients had the penile fracture during masturbation, 4 (5.8%) had penile fracture due to rolling over the erect penis in bed during morning hours, and 3 (4.4%) patients sustained the injury because of direct blunt trauma. The clinical presentation included pain ($n=68$; 100%), classical eggplant deformity with ecchymosis of penis ($n=55$; 80.8%) (Figure 1), localized hematoma ($n=13$; 19.1%), popping sound with sudden detumescence of erect penis ($n=36$; 53%), and blood at the meatus ($n=6$; 8.8%). No patient in our study population had a past history of ED as assessed retrospectively using the SHIM questionnaire before the penile trauma, and 2 of them had comorbidities, such as diabetes mellitus in 1 patient and hypertension in another. After a thorough history and clinical examination, ultrasonography was performed in 32 patients; in 46.9% (15/32)

Main Points:

- There is a paucity of data regarding long-term sexual function or erectile function after penile fracture.
- This study was designed to analyze the clinical spectrum, overall sexual function, and risk factors of erectile dysfunction after penile fracture. The majority of the patients maintained their erectile ability and overall sexual function in the long term.
- To the best of our knowledge, this is the first study to objectively assess the sexual function (International Index of Erectile Function-5, brief male sexual function inventory, erection hardness grading scale) after penile fracture in the Asian society.
- The main predictors of deterioration of postoperative potency are aging (>50 years) and bilateral corporal involvement.



Figure 1. Typical “eggplant deformity” of the penis

Table 1. Imaging modality and comparison of findings at surgical exploration

Investigation	n (%)	At surgical exploration
Ultrasonography	32/68	
Defect seen	15/32 (46.9)	68/68 (100%)
Average size of defect (mm)	7	15
MRI	2/68	
Defect seen	2/2	-
Defect size (mm)	8.5 & 11	12 & 16
Retrograde urethrogram	6/68	
Urethral injury seen	3/6	3/6

MRI: magnetic resonance imaging

patients, a tunical tear was delineated (Table 1), 6 patients underwent intraoperative retrograde urethrogram (RGU) with suspected urethral injury, and 3 patients (4.4%) showed evidence of concomitant urethral injury (partial superficial tear). In addition, MRI was performed in 2 patients who had delayed presentation.

All the patients underwent surgical exploration through a subcoronal degloving incision on an emergency basis. The mean size of the tunical tear was 1.5 ± 0.8 (range, 1–3) cm. A proximal shaft tear was found in 29 (42.7%) patients, mid-shaft injury in 35 (51.5%), and the rest of the patients (5.8%) had a tear in the distal shaft. A total of 39 (57.3%) patients had a tunical tear on



Figure 2. Tear in the ventral aspect of the tunica albuginea with rupture of corpus cavernosum



Figure 3. Defect in the tunica repaired with nonabsorbable sutures after subcoronal penile degloving incision

Table 2. Preoperative findings in patients with and without erectile dysfunction

Findings	Group without ED (55) n (%)	Group with ED (7) n (%)	p*
Age			
≤50 years	49 (89.1)	4 (57.2)	0.02
>50 years	6 (10.9)	3 (42.8)	
Time of presentation			
Early (≤24 hour)	46 (83.6)	6 (85.7)	0.8
Late (>24 hour)	9 (16.4)	1 (14.3)	
Comorbidity			
Diabetes mellitus	1	0	-
Hypertension	1	0	
Etiology			
Sexual intercourse	43 (78.2)	4 (57.1)	0.6
Masturbation	6 (11)	1 (14.3)	
Rolling over in bed	3 (5.4)	1 (14.3)	
Direct blunt trauma	3 (5.4)	1 (14.3)	

*Chi-squared test. ED: erectile dysfunction

Table 3. Intraoperative findings in patients with and without erectile dysfunction

Findings	Group without ED (55) n (%)	Group with ED (7) n (%)	p*
Site of tunical tear			
Proximal	23 (41.8)	2 (28.6)	0.6
Mid	29 (52.7)	4 (57.1)	
Distal	3 (5.5)	1 (14.3)	
Side of tunical tear			
Right	32 (58.2)	3 (42.9)	0.001
Left	21 (38.2)	1 (14.2)	
Bilateral	2 (3.6)	3 (42.9)	
Urethral injury			
Yes	2 (3.6)	1 (14.3)	0.2
No	53 (96.4)	6 (85.7)	

*Chi-squared test. ED: erectile dysfunction

the right corpus cavernosum, 24 (35.3%) had it on the left corpus cavernosum, and 5 (7.4%) had bilateral tears. All the tunical tears were on the ventral aspect of the penis (Figure 2). In all the patients, the tunical tear was repaired with 2-0 Prolene (Ethicon, Somerville, NJ, USA) suture in inverted knot fashion (Figure 3). The urethral injury was repaired using 3-0 Vicryl suture in all

the 3 patients over 14 French Foley's catheter. The patients were advised sexual abstinence for 6 weeks.

In the early postoperative period, 13 (19.1%) patients presented with complications, such as wound infection and skin necrosis. Wound infection was seen in 8 (11.8%) patients, and distal penile skin necrosis was seen in 5 (7.3%). All the early complications were managed conservatively with antibiotics and regular dressing.

A total of 62 patients agreed to attend the urology OPD for clinical evaluation and follow-up. The average time to return to sexual activity was 4.2 months. The mean SHIM score was 22.12±1.48. A total of 7 (11.3%) patients demonstrated evidence of ED, 5 patients reported mild ED (SHIM, 17–21), and 2 patients reported mild-to-moderate ED (SHIM, 12–16). The mean erection hardness score (EHS) was 3.61±0.48. On stimulation, 38 (61.3%) patients reported an EHS of 4 (completely hard and rigid penis), 24 (38.7%) reported an EHS of 3 (incompletely hard penis, but sufficient enough for penetration) with no reported case of EHS less than 3. As before per BMSFI, 58 (93.5%) patients were mostly satisfied or very satisfied with their sexual life, 2 patients showed equivocal score, and other 2 patients were dissatisfied with their sexual life. There was no complication in 47 (75.8%) patients, 2 (3.2%) patients complained of penile curvature on erection which was <20° but did not affect penetration during sexual intercourse, and 2 (3.2%) patients complained of painful erection. On examination, small penile nodules measuring 4–5 mm were found in 4 (6.5%) patients. None of the patients had plaques or difficulty during sexual intercourse owing to nodules. All 7 patients who had ED underwent CDU. Among them, 4 showed normal penile duplex findings, 2 patients showed VOD, and 1 patient showed penile artery insufficiency.

All the preoperative and intraoperative findings of the patients with ED are highlighted in Tables 2 and 3. Among the evaluated variables, age >50 years (p=0.02) and bilateral corporal involvement (p=0.001) have a detrimental effect on erectile function.

Discussion

Penile fracture was first reported by Malis and Zur in 1924.^[15] It occurs mainly during the erectile phase. The tunica albuginea layer gets thinned out from a resting thickness of 2 mm to 0.25–0.5 mm because of a marked increase in the intracavernous pressure. It may exceed the tensile strength of the tunica and eventually causes rupture.^[16]

The etiology of trauma is also different in various geographical areas. Trauma during sexual intercourse is reported as the main cause of penile injury in America, manipulating the erect penis (a practice known as “taghaandan”) in an attempt to achieve detu-

mesence is reported as the major cause in the Middle East,^[17,18] and rolling over an erect penis in bed and masturbation are the most common causes in Japan.^[19] The meta-analysis by Amer et al.^[2] found sexual intercourse as the cause of penile fracture in 46% of the patients, followed by forced flexion (21%) and masturbation (18%) in a pooled data of over 3,000 patients. In our series also, the most common cause was sexual intercourse (78%). However, we could not establish a significant relationship between the etiology of the penile fracture and postoperative erectile function.

Penile fracture classically presents with sudden onset of a popping sound followed by pain, rapid detumescence, swelling, and eggplant deformity.^[20] In our series, 53% of the patients reported a popping sound and a sudden detumescence, 80.8% of the patients presented with typical deformity with diffuse ecchymosis, and 19.1% of the patients presented with a localized hematoma.

Asgari et al.,^[21] in a study with 32 patients with penile fracture, found that a delay of 48 hours was associated with penile curvature and painful intercourse postoperatively. In another study, where definitive therapy was delayed for periods of 24–40 hours, they found no such complications in the postoperative period, and all the patients did well with normal erection postoperatively.^[22] In our study, erectile function of patients with delayed presentation compared favorably with those who presented immediately after trauma, with no statistically significant difference.

In the majority of cases, the diagnosis can be made clinically. Radiological investigations are time consuming and should not be the alternative to clinical diagnosis because they may cause unnecessary delay in surgical intervention.^[7,23] In our series, clinical diagnosis of penile fracture was made in all the patients, and the ultrasound had a sensitivity of 46.9%. The average defect size detected on ultrasound was 7 mm, which was much smaller than the actual size of the defect on surgical exploration (median 1.5 cm). MRI was performed in 2 patients who showed the defect size closer to the size seen on surgical exploration. Amer et al.^[2] suggested that a urethral injury should be suspected in patients with gross hematuria, microscopic hematuria, or urinary retention and they reported the incidence of urethral injury with penile fracture 6.1%. In our study, urethral injury was suspected in 6 patients who presented with blood at the meatus, and all of them underwent RGU. A total of 3 (4.4%) patients showed evidence of concomitant urethral injury. The probable reason for the blood at the meatus could be a contusion injury to the urethra.

In the past, a conservative approach in the form of cold compress, anti-inflammatory medicines, antibiotics, and anti-androgens was considered as the standard treatment for penile frac-

tures. However, it was associated with a high complication rate, such as infected hematoma, penile curvature, palpable nodule, and ED in up to 50% of the patients.^[4,9] Hence, surgical repair has been proven to be the main treatment modality, which was first described by Fetter and Gartman in 1936.^[24] Our results support this approach with good functional outcome in 75.8% of the cases with no complications.

We preferred the subcoronal circumferential incision because it aided in proper visualization of all the 3 corporal bodies along with underlying urethral and tunical injuries.^[25] The right corpora cavernosa was the commonly affected (57.3%), as reported in many studies.^[4,5] Ateyah et al.^[5] explained the fact that most patients are right-handed and during manipulation of penis, it usually bends toward left, resulting in tear on the right side. In our study, the patients with unilateral right or left corporal involvement had 8.5% and 4.2% incidence of ED, respectively; whereas the risk of developing ED was found to be statistically significant in bilateral corporal involvement (60%). The reason behind it may be explained by the fact that VOD might be a coexistent pathology at the fracture site, which increased by 2 folds in case of bilateral tears. According to some authors, the proximal third of the penile shaft is the most common site of injury.^[5] However, in our study, the mid shaft was the most common location because this is the weakest part of the tunica during erection. There was no statistically significant impact of the site of tear on the postoperative *de-novo* ED. All the tunical tears in our series were on the ventral aspect of the penis because the dorsal aspect is supported by neurovascular bundles with thick tunica albuginea, which is less liable to stretch beyond its limit during erection.^[26]

Urethral injury is associated in approximately 10%–33% of penile fractures.^[27] The incidence of urethral injury varied from 0% to 3% in studies from Iran, the Persian Gulf countries, and Japan to 20%–38% in studies from the European countries.^[27,28] In our series, urethral injury was found in 3 (4.4%) patients, but erectile function was preserved on long-term follow-up.

Inadequate data are available in the literature for analysis of sexual function after penile fracture till date. The mean SHIM score was 22.12±1.48. A total of 7 (11.3%) patients demonstrated evidence of ED, 5 reported mild ED, and 2 reported mild-to-moderate ED. The mean EHS was 3.61±0.48. Zargooshi et al.^[4] reported good long-term sexual function outcomes in their study. The EHS was 4 in 203 patients and 3 in 11 patients. In our series, we noted similarly high EHS (almost 100% with EHS 3 or 4). The BMSFI, designed by O'Leary et al.^[13] in 1995, was used for grading of overall sexual function. Our study revealed higher BMSFI scoring after the repair of penile fracture because all the parameters were maintained after recovery.

In our series, among 7 patients with ED, 2 had incompetent veno-occlusive mechanism, 4 had normal color duplex penile indices, and 1 showed penile artery insufficiency on CDU. The patients with normal duplex findings were thought to have psychogenic elements as the causative factor of ED, and ED in patients with penile artery insufficiency was attributed to increased age.

The limitations of our study were cross-sectional follow-up and small sample size.

In conclusion, penile fracture is a true urological emergency, and prompt diagnosis mainly by the surgeon's clinical acumen and emergent surgical exploration provide good functional results with low morbidity. The main predictors of postsurgical ED are increasing age (>50 years) and bilateral corporal involvement. Although most patients maintained their erectile and overall sexual function on long-term basis, the remaining patients might have underlying psychological or vascular components, which may pose as adjunctive factors for developing ED in the long term. Therefore, regular follow-up is required in a number of patients although the overall outcome of surgery is satisfactory.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Calcutta National Medical College (CNMC&H/2018/320).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – G.S., S.M., P.B., P.G., B.B., P.K.S.; Design – G.S., S.M., P.B., P.G., B.B., P.K.S.; Supervision – S.M., P.K.S.; Materials – G.S., P.B., P.G., B.B.; Data Collection and/or Processing – G.S., P.B., P.G., B.B.; Analysis and/or Interpretation – G.S., P.B., P.G., B.B.; Literature Search – G.S., P.B., P.G., B.B.; Writing Manuscript – G.S., P.B., P.G., B.B.; Critical Review – S.M., P.K.S.

Acknowledgements: Dr. Sumantra Dey & Dr. Piyush Patawari, Mch residents of Department of Urology, Calcutta National Medical College & Hospital.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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