




Irreducible Locked Symphysis Pubis Disruption Caused by Incarcerated Urinary Bladder in a 14-year-Old Boy, a Case Report and Review of the Literature

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Abstract: Urinary bladder entrapment or incarceration within pelvic fracture have been described in many reports in the literature, most of which were reported in adult patients. We describe a case of a 14-year-old boy presented with isolated locked symphysis pubis disruption after falling from a height. His initial evaluation was negative for any other associated injuries. The decision was made to treat him surgically by open reduction and internal fixation using a symphyseal plate; however, upon completing the Pfannenstiel incision, the surgeon faced a soft tissue mass hindering bony fragment dissection; upon careful examination, the soft tissue mass turned out to be entrapped urinary bladder within the symphyseal disruption. After careful soft tissue dissection, and with the help of Jungbluth distractor, the disruption was over-distracted, the bladder was freed entirely (which was intact) and reduced to its position, followed by the application of a symphyseal plate in a reduced symphysis pubis position. The patient did well postoperatively, and at three months follow up, the disruption and fracture united, and there were no urinary-related symptoms. Although rare, urinary bladder entrapment within an element of anterior pelvic fracture could be a reason for the difficult reduction; careful evaluation and steady soft tissue dissection are paramount for avoiding undue iatrogenic urinary bladder injury.

Keywords: pediatric pelvic fracture, bladder entrapment, case report

Introduction

Pediatric pelvic fractures (PPF) are rare injuries; their incidence ranges from 1.6 to 20% of pelvic fracture patients.^{1,2} As it entails a vulnerable population with possible long-term sequelae, the management decision should be based on the nature of the fracture and the patient's condition to obtain excellent outcomes.^{3,4}

Owing to the skeleton immaturity, the pediatric pelvis differs from the adult pelvis in its inherent flexibility secondary to the lax symphysis pubis and sacroiliac joint; moreover, the abundant cartilaginous coverage serves as a shock absorber, so a pelvic fracture in pediatric patients signifies a significant injury and sometimes indicate multisystem trauma.^{1,5-7} Furthermore, pediatrics with pelvic injuries are vulnerable to long-term sequels, including growth disturbance, pelvic asymmetry, leg-length discrepancy, limping, secondary scoliosis, and chronic pain with subsequent affection of the patient function and quality of life.^{3,4,8}

Management options could be broadly divided into nonoperative or operative; the latter should be selected in cases with severely displaced fractures, grossly unstable fractures, and cases where nonoperative management could not achieve acceptable fracture reduction.^{3,9,10}

One possible factor related to displaced pelvic ring fracture irreducibility, including symphyseal disruption, is soft tissue entrapment at the fracture site, such as entrapment of the intestine or urinary bladder, which, if not diagnosed

preoperatively or even noticed intraoperatively, could lead to undue soft tissue iatrogenic injuries with subsequent complications.^{11–13}

Most of the reports on urinary bladder incarceration after symphyseal disruption included adult patients;^{14–23} in the current case report, we described a case of bladder entrapment within symphyseal disruption in a 14-year-old boy, which was discovered intraoperatively and managed effectively.

Case Report

This case report was prepared according to the CARE guidelines.²⁴

Patient Details and Initial Assessment

A 14-year-old boy presented to our emergency department after a fall from a height (from the second floor, about four meters height); his main complaint was abdominal and pelvic pain with an inability to bear weight. Initial assessment and management were carried out in accordance with ATLS guidelines and our institutional protocol for managing suspected pediatric pelvic fractures.²⁵

Upon completion of the primary ATLS survey, the pelvic anterior-posterior (AP) view showed symphyseal pubis disruption with fracture of the right pubic rami. Pelvis inlet and outlet plain radiographic views and a pelvic CT scan confirmed the diagnosis and excluded the presence of other concomitant injuries (Figure 1). Furthermore, the abdominal and pelvic ultrasound showed no abnormality.

The decision was made to manage the patient operatively, and he was admitted to the inpatient ward after having a urinary catheterization in the emergency department.

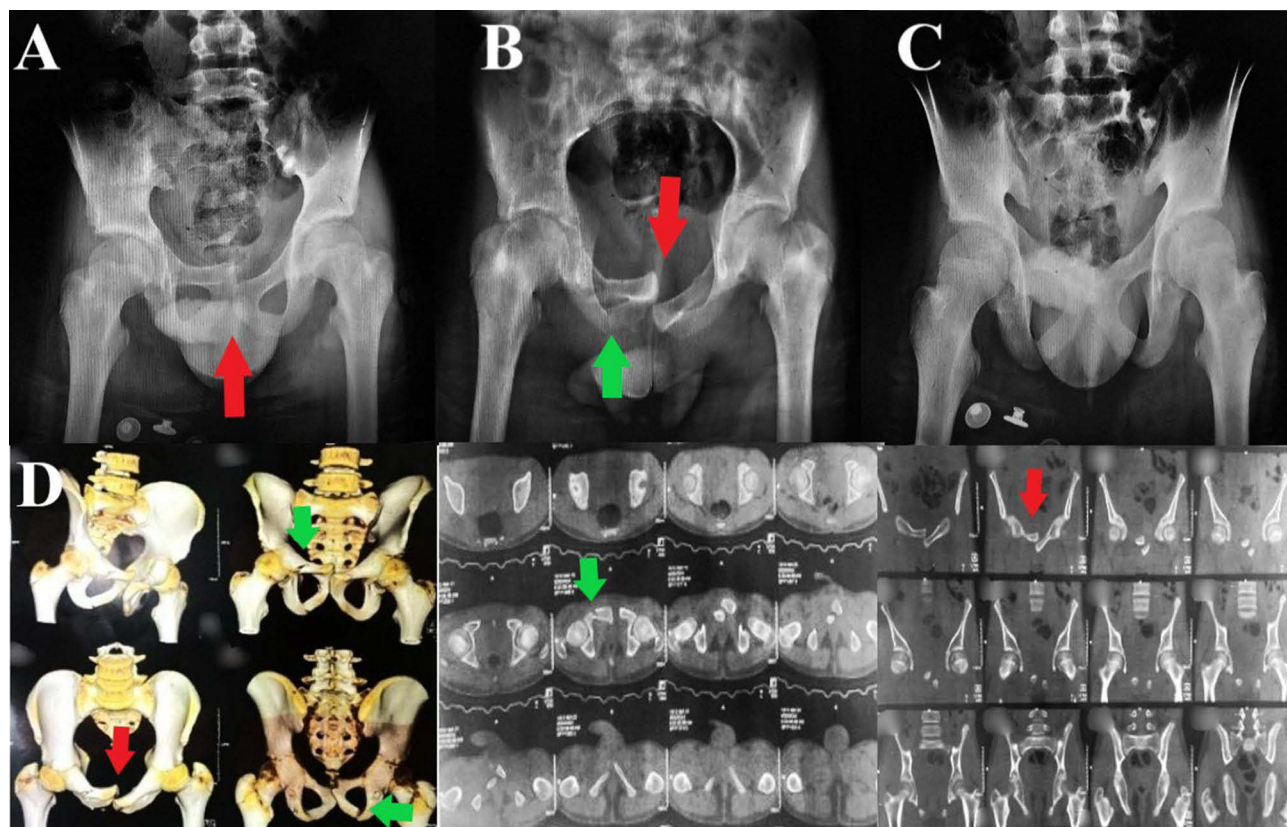


Figure 1 Preoperative imaging studies, plain radiographs: (A) anteroposterior view. (B) Inlet view. (C) Outlet view. (D) computed tomography different scans. The red arrowheads indicate the locked symphyseal disruption and the green arrowheads indicate the right pubic rami fractures.

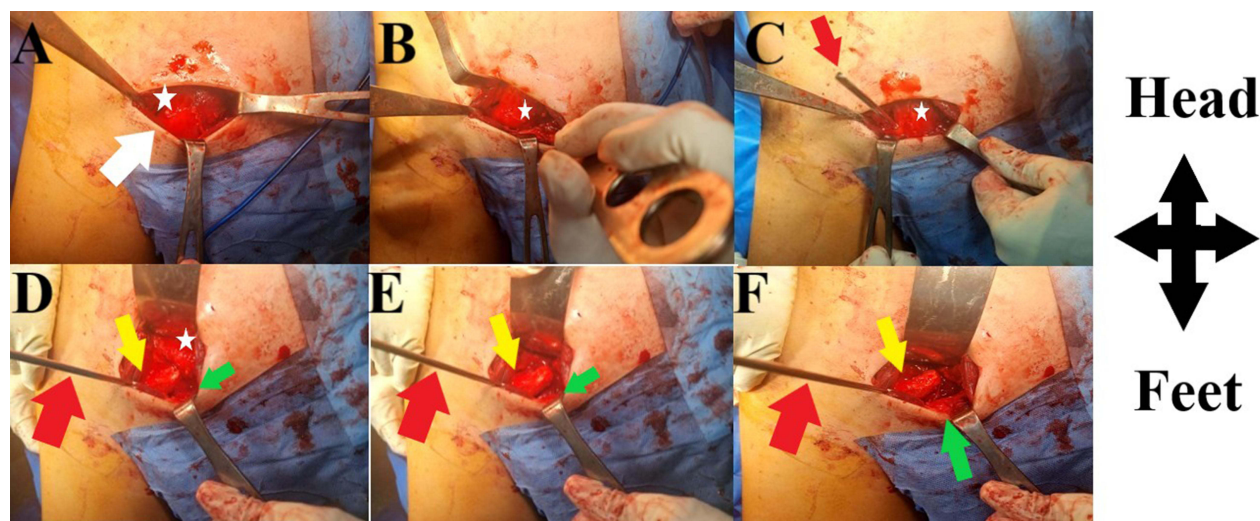


Figure 2 Intraoperative images. (A) after performing the Pfannenstiel incision (white arrowhead), initial soft tissue dissection, and retractor placement, a soft tissue mass (the urinary bladder) was evident in the field (white asterisk), hindering the fracture reduction. (B) after placement of more retractors, the urinary bladder (white asterisk) was dissected from the surroundings. (C) a Schanz screw (red arrowhead) was placed on the right pubic rami to ease fracture manipulation. (D) after gentle manipulation of the fracture, the right pubic rami (yellow arrowhead) and the left pubic rami (green arrowhead) started to be evident through the surgical approach, while the urinary bladder (white asterisk) is freed from the entrapment side and swept proximally. (E and F) after complete dissection and reduction of the urinary bladder, the overlapping of the locked symphyseal disruption is evident.

Surgical Intervention

Surgery was performed seven days after the injury and after obtaining informed consent from the patient's parents. The plan was to unlock the symphyseal disruption and anterior pelvic ring fixation using a symphyseal plate, and placing a retrograde trans-pubic screw was optional and to be determined intraoperatively based on the stability of the pelvis after placement of the plate.

While the patient was supine, under general anesthesia, and through the Pfannenstiel approach, steady soft tissue dissection was started to identify the urinary bladder (as part of the surgical approach, which should be then swept proximally); however, the surgeon was unable to identify the exact nature of the soft tissue structure (Figure 2).

Instead, the surgeon decided to start soft tissue dissection from as lateral as possible (from the intact left pubic rami) and proceed medially; upon reaching the right pubic rami, a soft tissue mass was found to be entrapped between the anteriorly displaced left pubic rami and the posteriorly displaced right pubic rami, which was the urinary bladder.

In the absence of posterior pelvic ring injury, it was difficult to over-distraction the pelvis at the fracture site to deliver the entrapped urinary bladder safely; instead, a Schanz screw was placed in the right superior pubic ramus and in the left supraacetabular area to help in inducing controlled external rotation to the pelvis, then two screws were applied, one on each superior pubic rami, and a Jungbluth distractor was applied to provide assisted symphyseal distraction and rotatory manipulation (Figure 3).

After achieving optimum distraction of the symphyseal disruption, an assistant held the distractor while the main surgeon carefully dissected the urinary bladder, making sure it was intact, swept it proximally, and placed an abdominal towel in the retropubic space of Retzius (Figure 3). At all steps, we ensured that the urine collecting bag showed clear urine and no hematuria.

Subsequently, the fracture was reduced and stabilized by a six-hole pre-contoured locked plate, and the last screw on the right side crossed the pubic rami fracture site.

On the immediate postoperative plain radiographs, diastasis of the right sacroiliac joint was noted (which we attributed to aggravation of a subtle injury after fracture reduction manipulation) (Figure 4), and the decision was made to perform percutaneous transiliac trans-sacral screw fixation, which was performed during the same hospital stay.

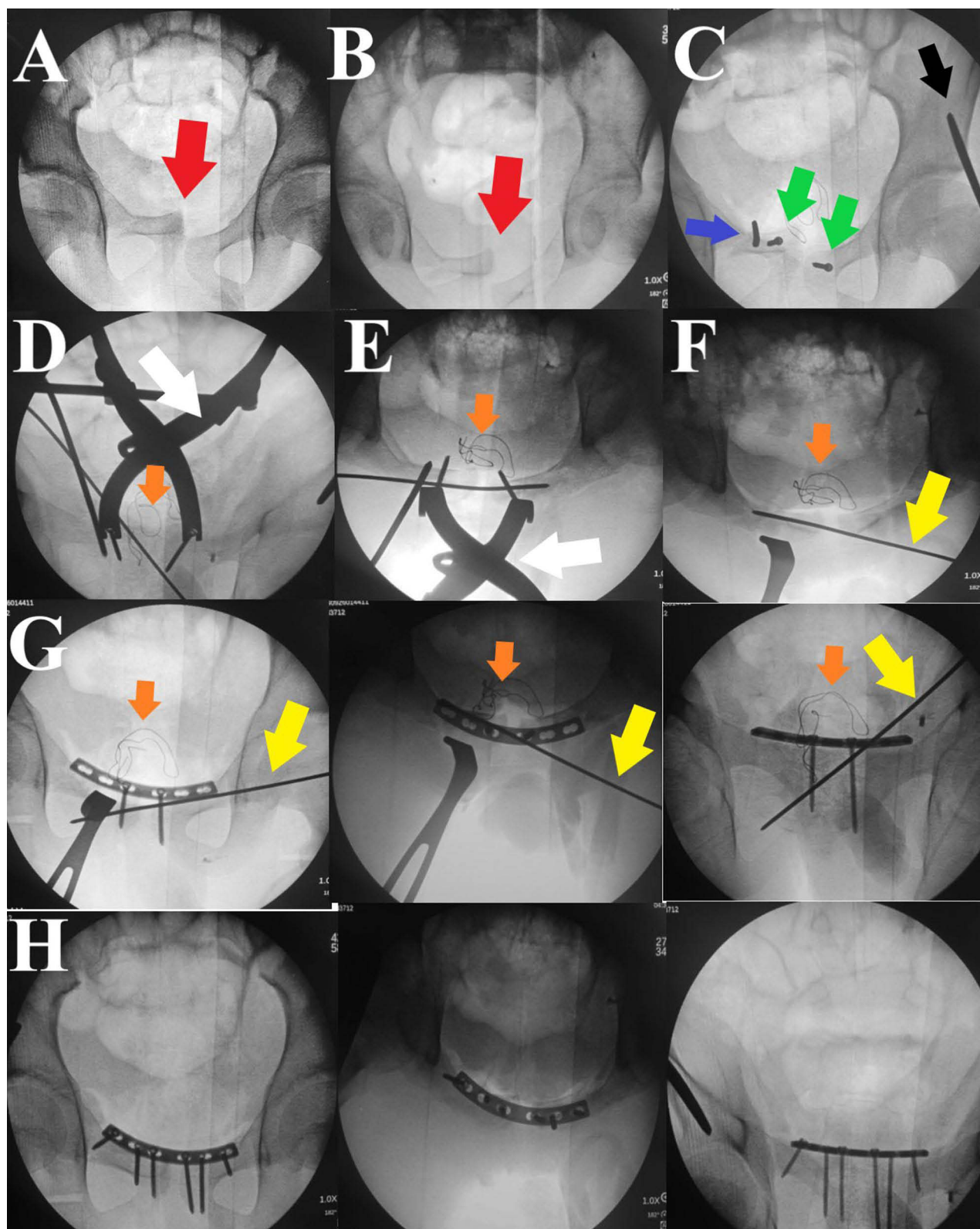


Figure 3 Intraoperative fluoroscopic images indicating the steps of symphyseal disruption reduction and internal fixation. (**A** and **B**) initial imaging before fracture manipulation showing the locked symphyseal disruption (red arrowheads). (**C**) a Schanz screw was placed in the right pubic rami (blue arrowhead), and another one was placed in the left supraacetabular area (black arrowhead). One screw was inserted in the pubic rami on each side (green arrowhead) for Jungbluth distractor assembly. (**D** and **E**) after attaching the Jungbluth distractor (white arrowhead), symphyseal disruption reduction was achieved; it is noted that the Orange arrowhead throughout the images indicates the abdominal towel placed in the retropubic space of Retzius. (**F**) after obtaining preliminary optimum reduction, it was held using a temporary K-wire (yellow arrowhead). (**G**) the initial plate application and initial fixation, while the K-wire (yellow arrowhead) is still in place. (**H**) after final internal fixation using a symphyseal plate.

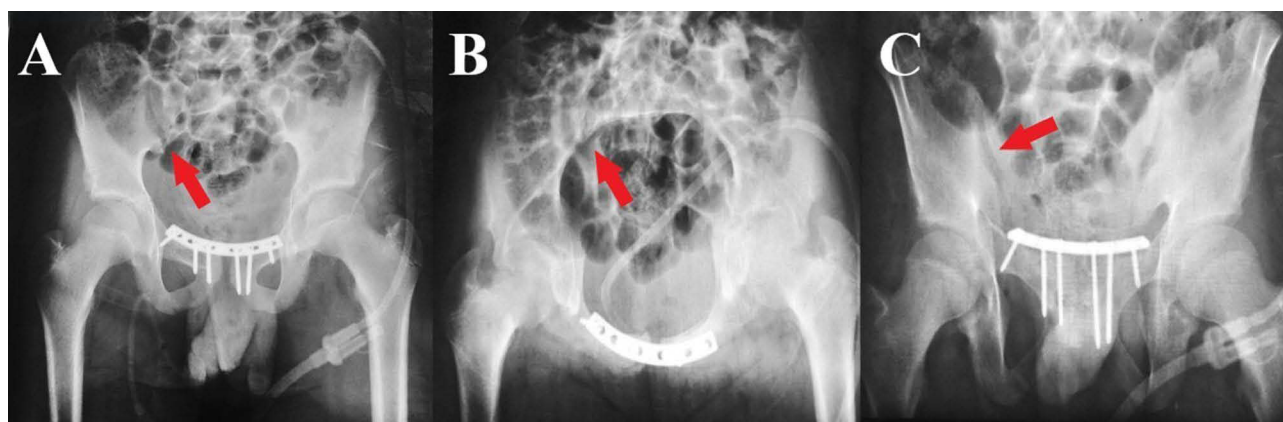


Figure 4 Immediate postoperative radiographs (A) anteroposterior. (B) inlet. (C) outlet views show symphysis pubis reduction, correct plate placement, and screws length; however, it was noted that the sacroiliac joint on the right side was disrupted (indicated by red arrowheads).

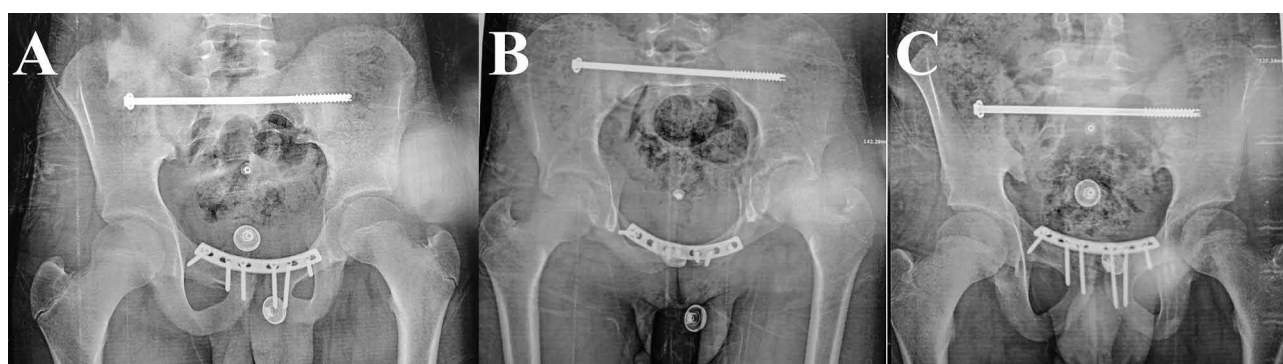


Figure 5 Plain radiographs (A) anteroposterior. (B) inlet. (C) outlet views obtained at the final follow up (at three months) showed the addition of a transiliac screw (which was inserted to fix the posterior element disruption), maintained symphyseal reduction, and union of the right pubic rami fracture.

Follow up Protocol and Outcomes

We sought advice from a urology consultant immediately postoperatively, who assured us that no particular intervention was needed and advised keeping the urinary catheter for two weeks in case an intimal injury had occurred during surgical manipulation. Furthermore, neurovascular evaluation was deemed normal.

During the hospital stay (five days), the radiographic assessment was obtained on the first postoperative day (pelvis AP, inlet, and outlet views) to ensure fracture reduction and hardware position. The suction drain was removed on the second postoperative day. The patient was discharged on the third postoperative day after counseling with a physiotherapy specialist who advised the patient and his parents on the postoperative rehabilitation protocol.

Follow-up visits were scheduled one week postoperative for wound assessment, and sutures were removed after two weeks. At a six-week visit, a new set of plain radiographs was obtained to assess fracture healing, and accordingly, the patient was advised to start partial weight bearing. Then, a follow up visit at three months showed complete fracture union (Figure 5), the patient was walking normally without support, and the functional status was excellent (score of 89 points), according to the modification of Majeed's functional scoring system.^{25,26}

Table I Summary of the Reports Published in the Literature Discussing Urinary Bladder Entrapment or Incarceration During Pelvic Fracture Management

Author (Publication Year)	Patients no.	Age	Sex	Mode of Trauma	Pelvic Fracture Description	Diagnosis of Bladder Injury	Bladder Injury Description	Management	Follow up Time	Outcome
Kumar et al, (1980) ¹⁴	1	32	M	MCA	Pubic arches bilaterally and left iliac bone	Preoperative: retrograde cystogram showed the bladder entrapment.	<ul style="list-style-type: none"> - Entrapment of a portion of the urinary bladder along its base into the superior left pubic ramus fracture. - The bladder was intact. 	<ul style="list-style-type: none"> - Open surgical reduction of the bladder. - Fracture management was not described. 	NR	Unremarkable
Wright et al, (1996) ¹⁵	1	40	F	MCA	Superior and inferior left pubic rami fractures	<ul style="list-style-type: none"> - Gross hematuria was noted on the Foley catheter. - Hematoma of the labia minora and majora. - IV urogram with follow-through cystogram while the Foley catheter was clamped showed extrinsic bladder displacement (no extravasation) - A repeat computed tomographic (CT) cystogram 1 week after injury showed a bone spike adjacent to the left lateral extraperitoneal space, and contrast extravasation was noted into the fracture site. A cystoscopy was performed. 	<ul style="list-style-type: none"> - Immediately after trauma, a laparotomy was performed to perform splenectomy, during which the bladder was intact after direct examination. - Cystoscopy showed a mucosal lesion in the left anterolateral bladder wall was evident, and an area of dimpling caused by a bone edge within the lumen of the bladder. 	<ul style="list-style-type: none"> - a portion of the bladder wall was freed from its entrapment over a bone spike and between the fragments of the pelvic fracture. The area of penetration of the bladder was repaired. A suprapubic tube was inserted. 	14 days	A repeat voiding cystogram on the 11th day after surgery showed an intact bladder without extravasation

Bartlett et al, (1998) ¹⁶	I	37	M	MCA	Open-book pelvic fracture with a pubic diastasis of 8 cm and bilateral sacroiliac joint disruption (Tile C2).	<ul style="list-style-type: none"> - After initial external fixation, A postoperative CT revealed persistent opening of the right sacroiliac joint and incarceration of the bladder within the closed pubic symphysis. - CT cystogram confirmed the previous finding. - Scrotal swelling and ecchymosis. - Urinalysis revealed microhematuria. - MRI of abdomen and pelvis 	<ul style="list-style-type: none"> - During open surgery, the bladder was noted to be adherent to the posterior aspect of the pubis and herniating through the symphysis and over the rectus defect superiorly. - MRI showed a complete avulsion of the rectus abdominis muscles, with persistent anterior herniation of the bladder through this defect and incarceration in the symphyseal diastasis. 	<ul style="list-style-type: none"> - ORIF of the symphyseal disruption and percutaneous cannulated screw fixation of both sacroiliac joints. - The bladder was reduced to its place, and the rectus abdominis were reattached to their respective superior pubic ramus. 	12 months	No complaints regarding the bladder or sexual dysfunction. But persistent right sacroiliac pain, groin pain
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(Continued)

Table 1 (Continued).

Author (Publication Year)	Patients no.	Age	Sex	Mode of Trauma	Pelvic Fracture Description	Diagnosis of Bladder Injury	Bladder Injury Description	Management	Follow up Time	Outcome
Finnan et al, (2008) ¹⁷	1	38	M	MCA	Unstable open-book pelvic ring disruption (right, non-displaced superior and inferior ramus fractures, a symphyseal diastasis of 4 cm and complete disruption of the right sacroiliac joint; Young-Burgess APC III; Tile C1.2	<ul style="list-style-type: none"> - Admission urinalysis showed 100–150 red blood cells/high-power field. - A CT scan of the abdomen and pelvis showed bladder herniation into the symphyseal diastasis. - The fracture was not completely reduced after an attempt of manual reduction and initial fracture stabilization using external fixation. A postoperative CT scan revealed incomplete reduction and persistence of the bladder incarceration within the pubic symphysis. 	Intraoperatively, the bladder was intact.	<ul style="list-style-type: none"> - Initial External fixation, which failed and was followed by open reduction and internal fixation of the pubic symphysis dislocation and percutaneous screw fixation of the right sacroiliac joint. - The bladder was reduced during the same procedure. 	12 months	<ul style="list-style-type: none"> - No urinary complaints, moderate discomfort with sexual activity. - Short Musculoskeletal Function Assessment showed a dysfunction Index of 27.94 and a Bother Index of 31.25. - SF-36 Physical and Mental Component were 34.3 and 36, respectively - Residual displacement of the symphysis and SI joint without obvious failure of the hardware.

Min et al, (2010) ¹⁸	I	58	F	FFH	<ul style="list-style-type: none"> - At initial presentation: lateral compression injury with an impacted Denis zone I sacral fracture and ipsilateral inferior and superior rami fractures without vertical displacement. - At 8 months post-injury, a malunited pelvic ring with internal rotation. The left superior pubic ramus crosses the midline 	<ul style="list-style-type: none"> - At initial injury, microscopic hematuria. Cystography was performed, and no extravasation or filling defect was Demonstrated - 6 months after the injury, she began complaining of urinary dysfunction and dyspareunia. - 7 months after injury: cystogram - 8 months after the initial injury: transvaginal ultrasound and MRI Intraoperatively: direct Inspection of the bladder. 	<ul style="list-style-type: none"> - Bladder contusion after initial injury. -Cystogram at 7 months: showed no extravasation or filling defect. - Transvaginal ultrasound and MRI revealed that the anterior portion of the bladder was entrapped between the displaced superior ramus and the contralateral pubic body. - At the surgery (8 months post-injury), the spike of the left superior pubic ramus had penetrated the bladder wall, causing a 1.5-cm defect along its anterior wall 	<ul style="list-style-type: none"> - Initially, she was treated non-operatively. - At 8 months, open reduction through Pfannenstiel incision, bladder wall repair using 0-Prolene in a running fashion. 	In-hospital and up to 6 months	<ul style="list-style-type: none"> - On the third postoperative day, the patient experienced bladder spasms and an uncomplicated urinary tract infection that was successfully treated with antibiotics. - At the last follow-up (6 months post-repair), the patient's urinary dysfunction and dyspareunia have resolved.
Zamzow and Zimmerman (2011) ¹⁹	I	42	M	MCA	Pubic rami fracture	<ul style="list-style-type: none"> - Foley catheter showed hematuria - Preoperative CT: bladder entrapment without perforation 	Intact bladder entrapment within pubic bone fracture	Operative fracture stabilization and reduction of the bladder entrapment.	NR	Successful reduction, no complications
Ghuman et al, (2014) ²⁰	I	NR	M	MCA	Comminuted displaced fracture of the left superior pubic ramus	Preoperative CT: part of the urinary bladder was seen herniating in between the gaping bony margins of the fracture.	NR	ORIF	NR	NR

(Continued)

Table 1 (Continued).

Author (Publication Year)	Patients no.	Age	Sex	Mode of Trauma	Pelvic Fracture Description	Diagnosis of Bladder Injury	Bladder Injury Description	Management	Follow up Time	Outcome
Jain et al, (2017) ²¹	1	60	M	FOG	Pubic diastasis- middle and anterior sacroiliac ligament disruption	– 12 hours post In-Fix the patient complained of severe pain in the lower abdomen, and urinary frequency with hematuria. CT scan confirmed bladder incarceration.	The bladder was found incarcerated in the pubic symphysis gap	<ul style="list-style-type: none"> - Initial management of the pelvic fracture was performed using InFix. - After diagnosing the bladder incarceration, Pfannenstiel incision to clear and reduce the bladder 	In- hospital and up to 3 months	<ul style="list-style-type: none"> - Postoperatively, the urine was clear, and the catheter was removed after 48 h. - At three months, the patient was pain-free with full range of hips bilaterally.
Stenquist et al, (2019) ²²	1	37	M	FFH	Crescent fracture of the left ilium with left superior and inferior pubic rami fractures.	Preoperative CT cystogram	<ul style="list-style-type: none"> - CT showed bladder entrapment in pubic ramus fracture with no contrast extravasation - Intraoperatively: there was a tear in the bladder wall extending into the muscularis layer. 	ORIF using a reconstruction plate for the anterior injury and percutaneous fixation for the posterior injury (sacroiliac screws). The bladder tear was repaired	18 months	<ul style="list-style-type: none"> - Fracture union by 6 weeks. - Returned to full work after 4 months. - No urinary symptoms or dysfunction at any follow up point.

Taylor et al, (2021) ²³	I	44	F	FFH	<ul style="list-style-type: none"> - Presented initially with non-displaced complete Denis zone I sacral fracture, right ramus root fracture and left para-symphyseal fractures. - At 4 months follow up she was diagnosed with sacrum and pubic rami fracture nonunion 	<ul style="list-style-type: none"> - Urinary incontinence - Preoperative nonunion surgery CT scan 	<ul style="list-style-type: none"> - CT scan at follow up showed bladder entrapment within the anterior ring with no rupture- - The Methylene blue irrigation challenge showed bladder thinning, which was evident as an outpouching of the urothelium. No rupture. 	<ul style="list-style-type: none"> - Initially, she was treated non-operatively. -For the nonunion, ORIF via Pfannenstiel incision, InFix construct, sacral and ramus screw fixation. - The bladder was bluntly dissected and reduced to its place. 	10 months	<ul style="list-style-type: none"> - Cystogram at seven days was negative, and the foley was removed, followed by spontaneous voiding - Improved pelvic pain with no sensations of instability and resolution of urinary symptoms.
Current case (2024)	I	14	M	FFH	Locked symphyseal pubis disruption	<ul style="list-style-type: none"> - Diagnosis was made intraoperatively by direct inspection. 	Entrapment of the bladder between locked symphysis pubis, and it was intact.	<ul style="list-style-type: none"> - Open reduction and internal fixation of the symphyseal disruption using a symphyseal plate. - The bladder was dissected free from the entrapment site and reduced to its position - Later on, the patient had transiliac screws fixation. 	3 months	<ul style="list-style-type: none"> - Fracture united and no displacement of the hardware - excellent functional score per the modification of Majeed's functional scoring system. - No urinary symptoms.

Abbreviations: M, male; F, female; MCA, motor car accident; FFH, fall from a height; FOG, fall on ground; CT, computed tomography; CM, centimeter; NR, not reported.

Discussion

Associated urinary bladder injury with pelvic fracture ranges in severity from just contusion to complete rupture.²⁷ The injury could occur by direct penetration by the fracture end, or by shearing forces through its ligamentous attachment, and it could be an iatrogenic injury if the surgeon did not anticipate such a situation.^{22,28}

Various authors reported on urinary bladder incarceration or entrapment preventing pelvic fracture reduction (Table 1). The current case report is one of the few reports describing urinary bladder entrapment preventing pelvic fracture reduction in a pediatric patient. We were able to diagnose such bladder entrapment intraoperatively, which caused irreducibility of the symphyseal disruption, and it was managed successfully using specific pelvic fracture tools (Jungbluth distractor) and Schanz screws around the fracture to ease fracture manipulation and to ease safe bladder reduction to its position.

Clinical signs raising suspicion of a concomitant urinary bladder or urethral injury include blood at the urethral meatus, difficult or failed urinary catheterization (in case of urethral injury), a high-riding prostate gland, scrotal ecchymosis, gross hematuria after successful catheterization, and microscopic hematuria on urinalysis.^{17,27,29} However, diagnosing such injuries can be challenging, but if suspected, a retrograde urethrogram before catheterization and CT with contrast could be helpful.²⁷ Furthermore, some authors diagnosed this injury after obtaining an MRI.^{16,18}

Such an injury could pass unnoticed preoperatively;³⁰ in the current case, we reviewed the preoperative CT images and sought a radiology consultant's opinion, and we could not define any abnormality confirming the diagnosis of bladder entrapment.

In the report by Stenquist et al,²² the authors reported that the physical exam was negative (no blood at the urethral meatus and no scrotal ecchymosis) and negative FAST examination; however, the bladder tear was diagnosed intraoperatively under direct vision, the reason for that was attributed to the nature of the bladder tear which affected the outer layer only without deep penetration. The same normal clinical evaluation was also reported in a report by Finnan et al.¹⁷

The management of concomitant bladder entrapment or injury relies on the extent and location of the injury and whether it is intra- or extraperitoneal. A Foley catheter for a few days or weeks is enough for an extraperitoneal rupture, while intraperitoneal ruptures require surgical repair.^{28,31}

The incarcerated urinary bladder could be a cause for non-reducible pelvic fractures, including symphyseal disruption, especially when the initial management was nonoperative or closed reduction and external fixation. The previous scenario was reported in some cases in the literature and should be anticipated from the fracture pattern.^{17,18,21} This injury necessitates relieving the external fixation and reducing the bladder through open surgery or even converting the external fixation into open reduction and internal fixation with a concomitant bladder repair (if required) and reduction.

We admit that the current report has some limitations. First, the management details could not be generalized as we reported only a single case. Second, we did not provide longer follow up to detect any growth disturbance or long-term sequels of pediatric pelvic injuries.

Conclusion

Urinary bladder entrapment within pelvic fractures, including symphyseal disruption, could be the cause of fracture or symphyseal irreducibility. Suspicion of such a situation could be based on clinical examination preoperative imaging studies, and sometimes, it could only be anticipated and discovered intraoperatively. Careful soft tissue dissection and using appropriate fracture reduction tools and techniques are required to achieve gentle reduction of the incarcerated bladder wall and correct reduction and stable fixation of the pelvic disruption.

Data Sharing Statement

All the data related to the case report are mentioned within the manuscript.

Ethical Approval

This article does not contain any experimental studies with human participants or animals performed by any of the authors, and the procedures performed were according to the patient's usual care plan per our institution's protocol. The

ethical committee of our institution waived the approval: Assiut Faculty of Medicine, Assiut University, Egypt (I.R. B. no.: 17101010) (ethics-committee12@yahoo.com, IRB-Asyut@aun.Edu.eg, <http://afm.edu.eg>).

Consent for Publication

The patient's parents signed an informed consent regarding anonymously publishing their son's data and photographs.

Consent to Participate

Informed consent was obtained from the patient's parents to participate in the current report by anonymously including their son's clinical and radiological data in the study.

Study Setting

Pelvis Trauma unit, Orthopaedic Department, Assiut University Hospital, Assiut, Egypt.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest in this work.

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