

Emergency Management of Pelvic Fractures

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Abstract

Hemorrhage is leading cause of death following pelvic fractures. 15-25% of patients of closed pelvic fractures and 50% of open pelvic fracture patients die as a result of haemorrhage. The main source of hemorrhage is the shearing injury of posterior thin walled venous plexus (80%). Other sources of bleeding include the bleeding cancellous bone and arterial injury. Injury to the pelvic viscera is also quite common because of the close proximity. Perineal lacerations make a closed injury into an open injury thereby more than doubling the risk of morbidity and mortality. Adequate fluid replacement and application of a pelvic Binder or Sheet can markedly reduce the mortality associated with this fracture. A linen sheet folded onto itself to make it about 20-30 cms wide applied tightly over the pelvis and centered over the trochanters can significantly reduce the mortality figures.

Keywords: Acetabulum fractures, pelvis fracture, emergency management

Introduction

The basic principles of emergency management, Airway, breathing and circulation hold true for pelviacetabular fractures too. However there are certain practical tips and principles that will help in getting better results in these situations. These principles and tips are detailed below.

Hemorrhage is Leading Cause of Death

15-25% for closed pelvic fractures and 50% for open pelvic fractures are fatal secondary to exsanguination following either external or internal occult bleeding [1,2]. Increased mortality associated with

- systolic BP <90 on presentation
- age >60 years
- increased Injury Severity Score (ISS)
- need for transfusion > 4 units
- Head and neck injuries

Sources of Major Bleeding

- intrathoracic
- intraabdominal
- retroperitoneal
- extremity (thigh compartments)

- pelvic
- Common source of hemorrhage
- venous injury (80%)
- shearing injury of posterior thin walled venous plexus
- bleeding cancellous bone

solution is given rapidly if the patient is in shock. Crystalloid is administered until type-specific blood of non-cross-matched universal donor (O-negative) is available

- Packed RBC:FFP:Platelets should ideally be transfused in the ratio 1:1:1



Figure 1: Firm end points at distraction or compression indicates that there is no gross instability

- Less common sources of hemorrhage
- arterial injury (10-20%)
- superior gluteal most common (posterior ring injury, APC pattern)
- internal pudendal (anterior ring injury, LC pattern)
- obturator (LC pattern)

• this ratio has been shown to decrease mortality in patients requiring massive transfusion

D) Disability

Clinical Examination

Pelvis: NO firm endpoint on rotation or traction indicates that there is no gross instability (Fig 1). Pelvic compression and distraction test can detect gross instabilities, however these may at times be dangerous and can dislodge clots leading to further bleeding [3,4]. These test have been reported to have poor sensitivity and specificity and are no longer recommended in cases of pelvic fractures [4]

Blood Transfusion

Replacement volume is estimated by using the formula of 3 ml of crystalloid for each 1 mm of blood loss. A minimum of 2 litres of crystalloid

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Figure 2: Perineal lacerations may be associated with pelvic injuries. They can be repaired well to achieve good results

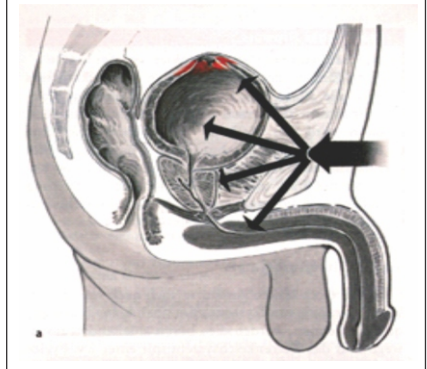


Figure 3: Bladder and urethral injuries are common.

Perineum (Fig 2): Look for

- lacerations of perineum
- degloving injuries
- flank hematoma
- scrotal, labial or perineal hematoma, swelling or ecchymosis
- urethral bleeding

Rectal Examination

mandatory to rule out occult open fracture

- rectal blood
- anal sphincter tone
- bowel wall integrity
- bony fragments
- prostate position

Vaginal Examination

mandatory to rule out occult open fracture

Presence of blood in vaginal vault

Vaginal lacerations

Urogenital Examination (Fig 3)

Bladder and the urethra are most frequently injured (25-30% of major pelvic fractures). 66% male versus 34% females patients difficulty in voiding urine or blood at the urethral meatus.

95% of bladder injuries have gross haematuria
urethral injuries are suspected under following clinical scenario

- blood at the urethral meatus
- gross hematuria
- inability to spontaneously void
- high riding prostate on rectal examination
- retrograde urethrogram (RUG) should ideally be done before insertion of Urinary catheter in unstable patient with suspected urethral injury make only 1 attempt to pass the urinary catheter, if it fails do RUG

Neurologic Examination

- rule out lumbosacral plexus injuries (L5 and S1 are most common)
- rectal exam to evaluate sphincter tone and perirectal sensation

Whenever an unstable pelvic injury is suspected in a haemodynamically unstable patient, a pelvic binder/sheet should be applied to control bleeding

The goal of treatment for pelvic fracture stabilization is early control of life-threatening hemorrhage. Returning pelvic bones to correct position helps to reduce pelvic volume and control venous bleeding.

Pelvic Binder [5,6]

- Applies compression leaving less space for blood to accumulate. It decreases the pelvic volume and also reduces pelvic fractures
 - Tamponades bleeding sources, such as fractured bony surfaces or ruptured vessels
 - Reduces instability of the injured pelvis
 - Prevents further damage to pelvic organs and vessels
 - Reduces pain by limiting movement of pelvis
- Commercially available pelvic binder are also useful but use of lumbosacral belts is discouraged [6].

Pelvic Binder/sheet Indications



Figure 4: Pelvic binder created by folded linen, centered over the trochanters is good for indirect reduction and tamponade



Figure 5: Lumbosacral belt should not be used because it is Elastic

- initial management of an unstable pelvic ring injury

Contraindications

- hypothetical risk of over-rotation of hemipelvis and hollow viscus injury (bladder) in pelvic fractures with internal rotation component (LC)
- no clinical evidence exists of this complication occurring

Technique

- A linen sheet folded onto itself to make it about 20-30 cms wide is passed under the pelvis
- **Centered Over Greater Trochanters** to effect indirect reduction
- Applied very tightly over the pelvis
- do not place over iliac crest/abdomen as it makes the ineffective and precludes assessment of abdomen
- augmented with traction & internal rotation of lower extremities and taping at knees & ankles
- transition to alternative fixation as soon as possible
- prolonged pressure (>24 hours) from binder or sheet may cause skin necrosis
- working portals may be cut in sheet to place percutaneous fixation

Lumbosacral belt should not be used because it is elastic and cover abdomen. Important note. Binder should be centered over the TROCHANTERS and Not the ASIS

Because of their ease of use and fast application, Pelvic Binders have largely replaced the Pelvic C-Clamp and External Fixators for early mechanical stability in pelvic fracture [5].

Radiology & CT

X-ray Pelvis –AP

Pelvis Is Unstable When There Is

Sacro-Iliac joint Diastasis > 1 cm or Cephalad Displacement of Posterior Sacro-Iliac Complex > 1 cm

Usually associated with Avulsion fracture of ischial spine, ischial tuberosity, sacrum or transverse process of 5th lumbar vertebrae

High Risk Patients as per the Young and Burgess Classification:

- LC III
- APC II
- APC III
- VS
- CM

Ct Scan is the Gold Standard

CT scan is essential in determining:

Posterior ring instability
Helps define comminution and fragment rotation
Intra-articular fragments
Fractures of articular surface of acetabulum and femoral head

Ultrasonography

Allows Focused Assessment with Sonography for Trauma (FAST)
Four classic areas are examined quickly by ultrasonography for free fluid (Blood):
Perihepatic space (hepatorenal recess)
Perisplenic space
Pericardium
Pelvis

External Fixation/ Stabilization of Pelvic Ring Injury

These are temporary life saving measures in the acute stage to stabilize the pelvis in a haemodynamically unstable patient. However, None of these methods can fully stabilize the pelvis. These are put on till such time as more definitive fixation can be done.
Femoral traction pin with 10-12 kg weight should be applied to maintain the reduction of the hemipelvis.

Mode of Action of External Fixation

- Decreases pelvic volume
- Stabilizes bleeding bone surfaces and venous plexus in order to form clot
- Reduces Pain

Types

- A) Pelvic Binder/sheet
- B) Pelvic C Clamp
- C) External Fixator

A) Pelvic Binder/Sheet

Easily available everywhere and is easy to apply. Technique of application discussed previously

B) Pelvic C Clamp (Fig 6)

Indications

– Emergency stabilization of Sacroiliac joint disruptions and fractures of the sacrum with associated circulatory instability

Contraindications

Absolute contraindications are:

- Fracture lines within the ilium (transiliac fracture) as it bears the risk of pin perforation through the fracture line
- Hemodynamic stability in Pelvic fractures

Relative contraindications are:

- Hemodynamic stability of the patient after Unstable type injuries
- Comminuted sacral fractures with risk of compression of the sacral nerve plexus

In life threatening situations hemorrhage control takes priority over the potential risk of nerve root compression

One Pin is inserted on each side of pelvis at the level of the Sacro-iliac joint. This point corresponds to the intersection of the line drawn along the long axis of the femur and a vertical line drawn from the ASIS with the patient supine. The 2 pins are connected with a C Clamp.

Advantage

Can be applied in the emergency room
Laparotomy can be done with the C Clamp in place

Disadvantage

Costly and not available everywhere.
Efficacy similar to Pelvic Binder/ Sheet.

C) External Fixator

Indications

Pelvic ring injuries with an external rotation component (apc, vs, cm)
Provide only marginal stability in vertically unstable ring injury

APC II (OPEN BOOK injuries with posterior ligaments/hinge intact) :

All designs work

APC III injuries (Post Ligaments damaged)

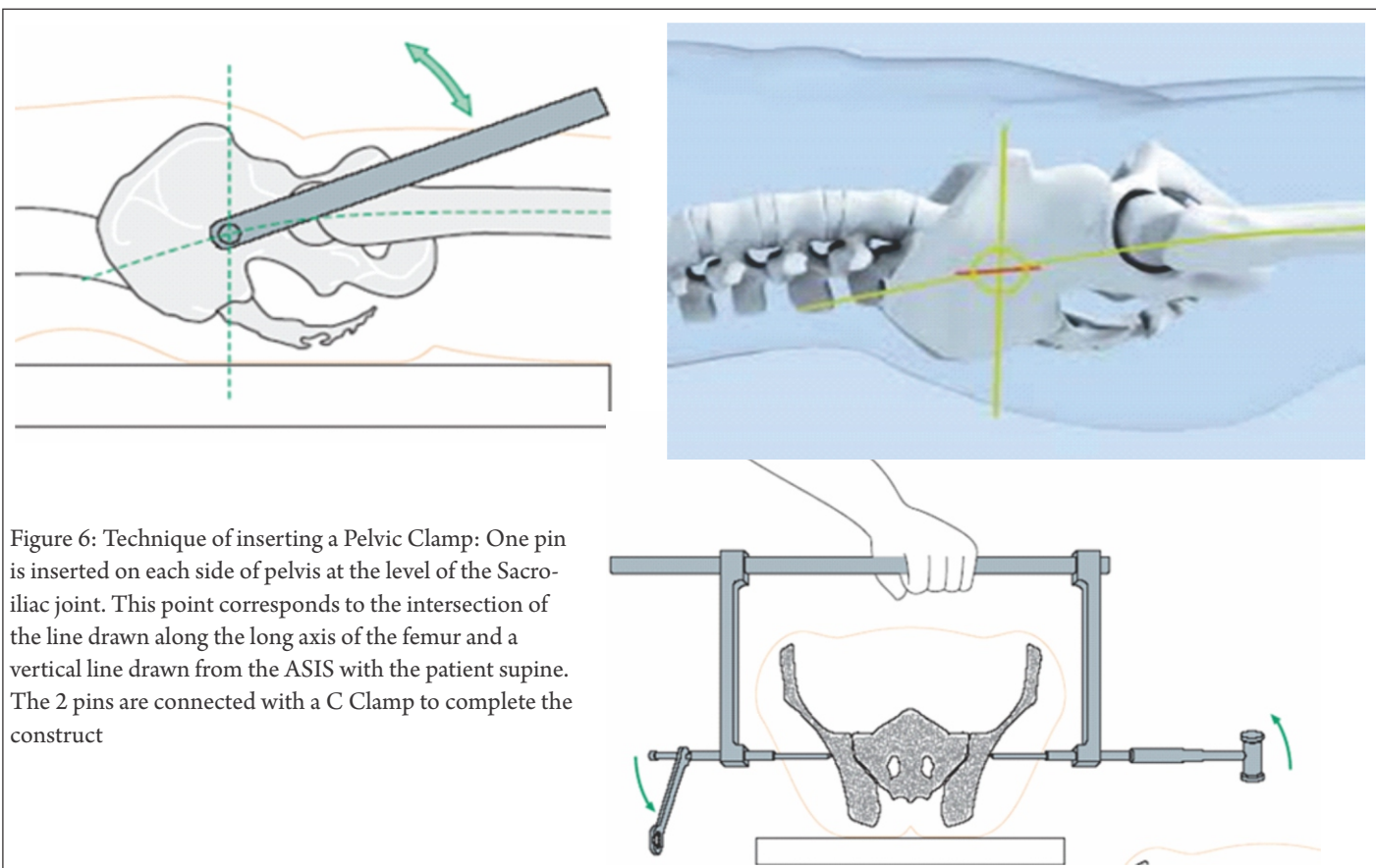


Figure 6: Technique of inserting a Pelvic Clamp: One pin is inserted on each side of pelvis at the level of the Sacroiliac joint. This point corresponds to the intersection of the line drawn along the long axis of the femur and a vertical line drawn from the ASIS with the patient supine. The 2 pins are connected with a C Clamp to complete the construct

No designs work well (but AIIS frames better than ASIS frames)

Contraindications

- Ilium fracture that precludes safe application
- Acetabular fracture

Technique

Pin insertion in iliac crest (ASIS) (Fig 7)
multiple half pins inserted in the superior iliac crest placed in thickest portion of

anterior ilium or gluteus medius tubercle

Should be placed before emergent laparotomy

- Stab incision over iliac crest
- Pass 2 K-wires by hand 1 each on medial & lateral sides of iliac wing
- Drill hole started at junction of Medial 1/3 & lateral 2/3rd of iliac crest
- 45 degree inclination lateral to medial
- Cephalad to caudal direction – towards

acetabulum

- Drill 1 cm
- 5 mm Schanz pin inserted with hand
- Cortical walls to guide pin into position
- Obturator Oblique view on C-Arm /Outlet view

Pin Placement In Anterior Inferior Iliac Spine (AIIS) Fig 8,9)

single pin in column of supra-acetabular bone from AIIS towards PSIS. Obturator

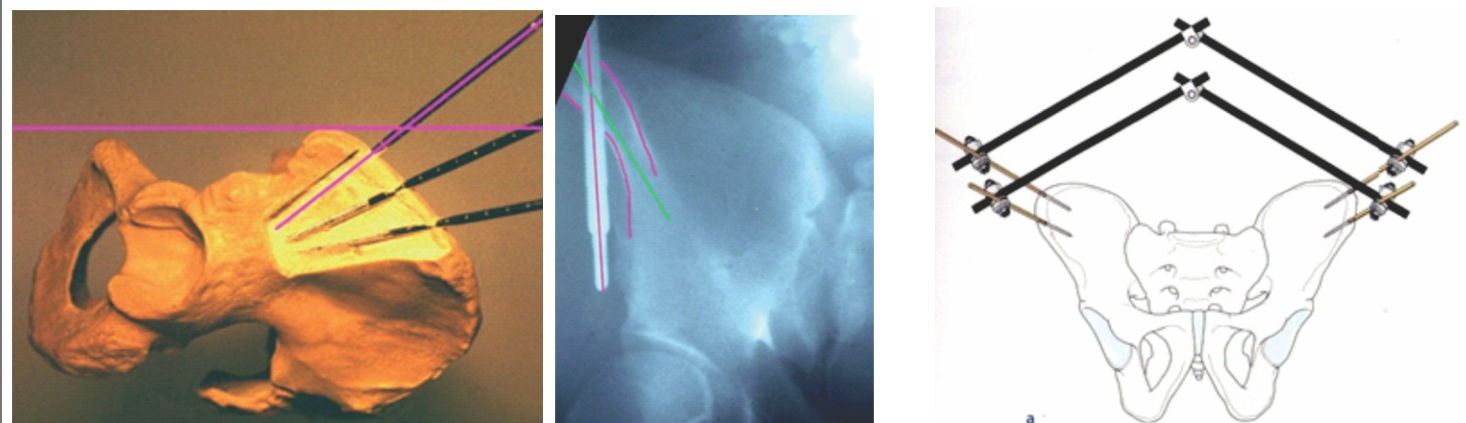


Figure 7: Pin insertion in iliac crest : Pass 2 K wires on either side of the iliac creast. Drill between the K wires with 45 degree inclination lateral to medial and cephalad to caudal direction towards acetabulum. Drill 1 cm and then insert the Schanz pin in same direction with C arm guide showing obturator view

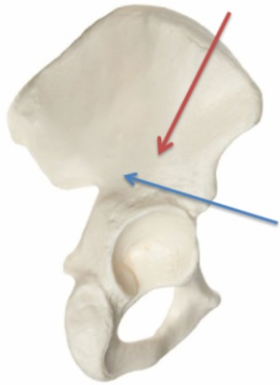


Figure 8: Durection of Schanz Pins:
ASIS pin (Brown) and AIIS Pin
(Blue)

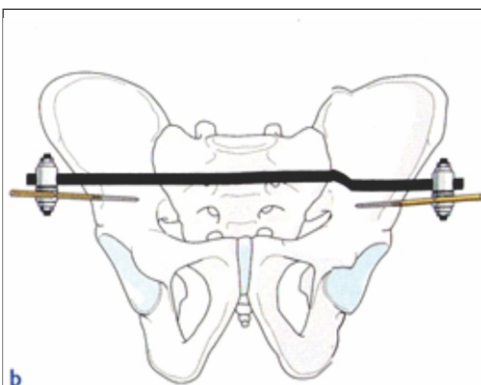


Figure 9: Pin placement in anterior inferior iliac spine

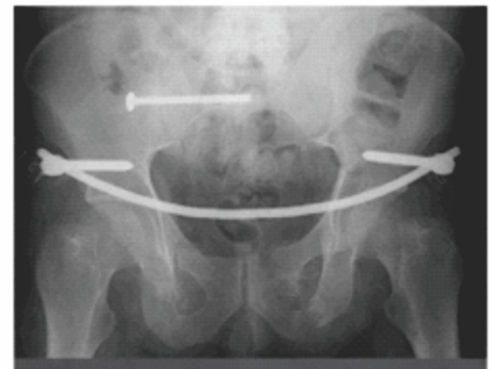


Figure 10: Subcutaneous Pelvic Internal Fixator (INFIX)

outlet or "teepee" view can be used to visualize this column of bone. AIIS pins can place the lateral femoral cutaneous nerve at risk

Transverse skin incision at or below AIIS

- Muscles split longitudinally to avoid lateral femoral cutaneous nerve injury
- Drill through trocar under image intensifier towards greater sciatic notch
- Pins directed 30-45° towards midline in frontal plane
- Pins directed perpendicular to body axis or slightly cephalad
- Schanz pins of 50-70mm thread length required
- Fixator bar connects the pins on both sides
- Permits easy access for laparotomy

Subcutaneous Pelvic Internal Fixator (INFIX) (Fig 10)

One pedicle screw is fixed in the supra-acetabular bone of the ilium on each side. The pedicle screws are connected to each other by a rigid, anteriorly bowed fixation rod passed subcutaneously superficial to the sartorius muscles [7]
Less infection and wound site morbidity

After Stabilization/ External Fixation Of Pelvic Ring Injury

- A) Control Hemorrhage
- B) Control Contamination

A) Control of Haemorrhage

1) Pelvic Packing (Fig 11)

Make Midline Incision, pack the wound

with sponges. Apply External Fixator. **DON'T TRY TO LIGATE THE BLOOD VESSELS.** Re-open wound after 24-48 hours and then ligate the vessels if possible or required.

2) Angiography

Indications

- Small bore artery (sup gluteal or obturator) can be controlled by embolization
 - No role in Venous or bony bleeding
- Available only in select centres and success based on multiple variables including: stability of patient, proximity of angiography suite, availability and experience of staff
CT angiography useful for determining presence or absence of ongoing arterial hemorrhage (98-100% negative predictive value)

Contraindications

- not clearly defined

Technique

- selective embolization of identifiable bleeding sources
- if uncontrolled bleeding even after selective embolization, bilateral temporary internal iliac embolization may be effective
- complications include gluteal necrosis and impotence

B) Control of Contamination

- Debridement & Packing of Open Wounds
- Suprapubic Catheterization

- Diverting Colostomy

Conclusion

Principles of pelvis fracture damage control

- External Fixation
- Pelvic Binder
- Pelvic C-clamp
- External Fixator

Control of Haemorrhage

- Pelvic packing
- Angiography

Control of Contamination

- Debridement & packing of Open Wounds
- Suprapubic catheterization

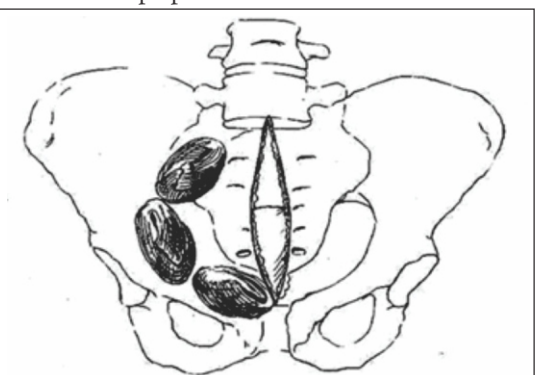


Figure 11: Pelvic Packing with central incision and sponges packed inside the pelvis to achieve tamponade

- Diverting colostomy

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