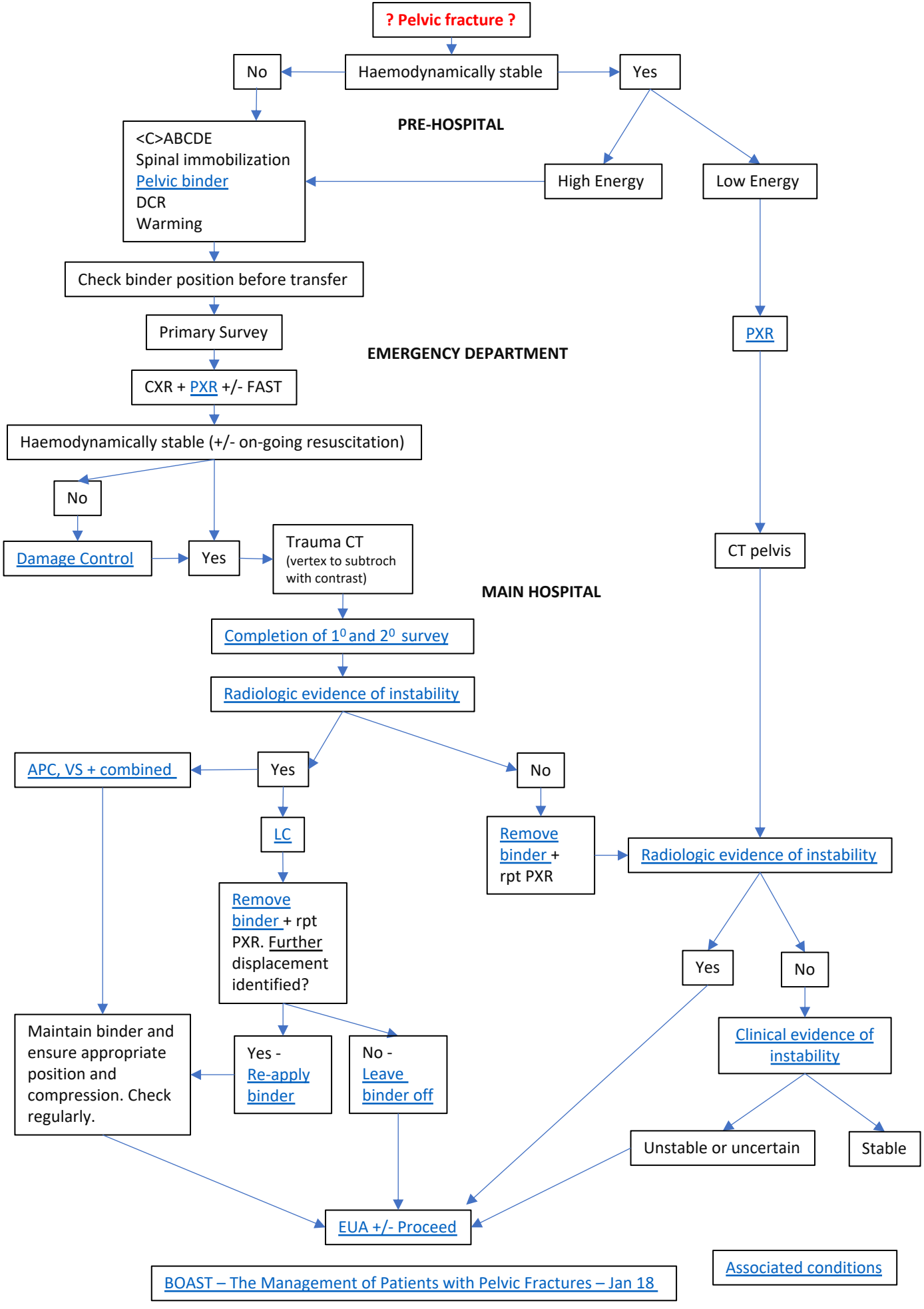
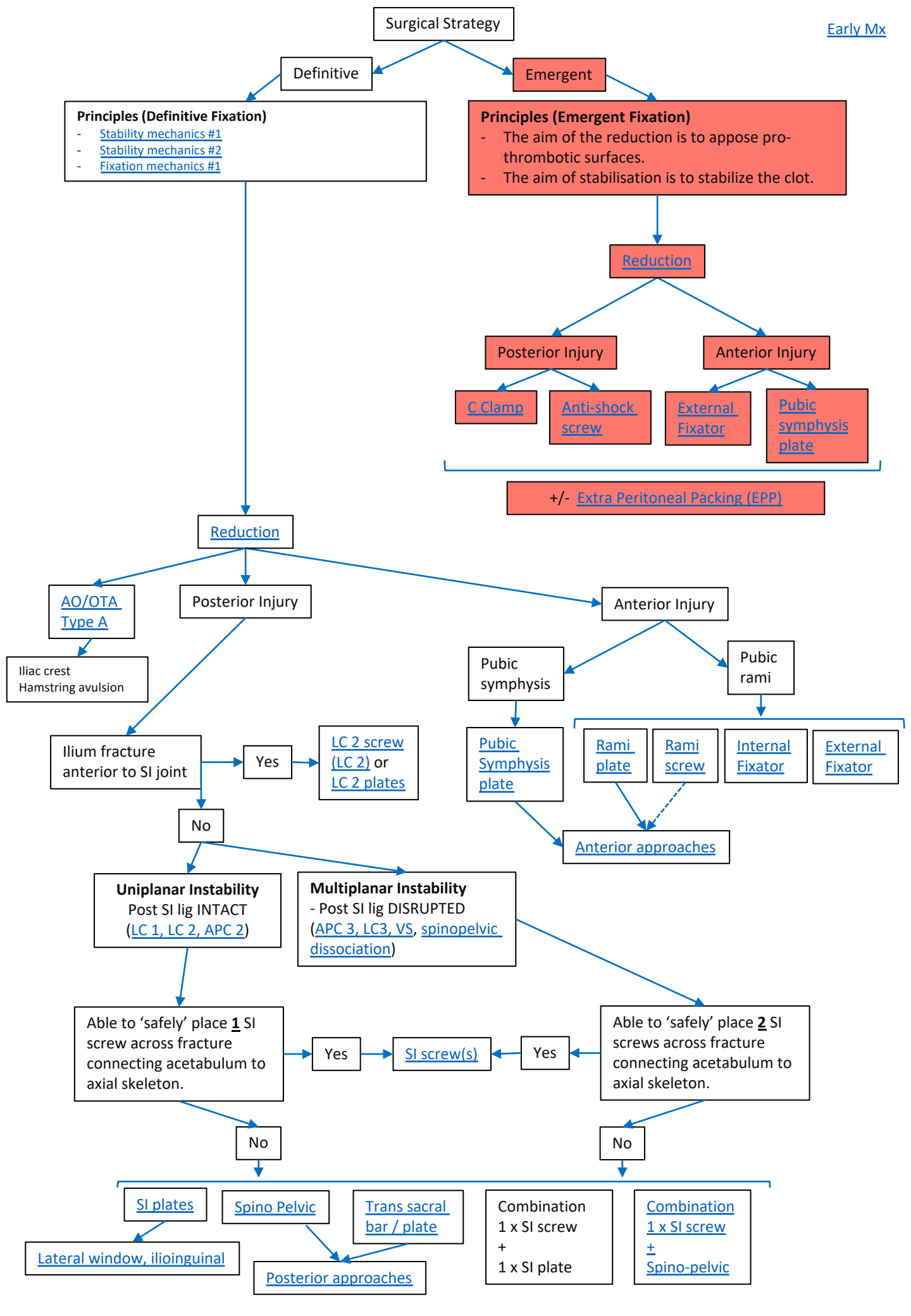

? Pelvic fracture ?
Haemodynamically stable
No
Yes
PRE-HOSPITAL
<C>ABCDE
Spinal immobilization
Pelvic binder
DCR
Warming
High Energy
Low Energy
Check binder position before transfer
Primary Survey
EMERGENCY DEPARTMENT
CXR + PXR +/- FAST
Haemodynamically stable (+/- on-going resuscitation)
No
Damage Control
Yes
Trauma CT
(vertex to subtroch with contrast)
PXR
CT pelvis
MAIN HOSPITAL
Completion of 1⁰ and 2⁰ survey
Radiologic evidence of instability
APC, VS + combined
Yes
No
LC
Remove binder + rpt PXR
Radiologic evidence of instability
Remove binder + rpt PXR. Further displacement identified?
Yes
No
Maintain binder and ensure appropriate position and compression. Check regularly.
Yes - Re-apply binder
No - Leave binder off
Clinical evidence of instability
Unstable or uncertain
Stable
EUA +/- Proceed
BOAST – The Management of Patients with Pelvic Fractures – Jan 18
Associated conditions


Surgical Strategy
Early Mx
Definitive
Emergent
Principles (Definitive Fixation)
- Stability mechanics #1
- Stability mechanics #2
- Fixation mechanics #1
Principles (Emergent Fixation)
- The aim of the reduction is to appose pro-thrombotic surfaces.
- The aim of stabilisation is to stabilize the clot.
Reduction
Posterior Injury
Anterior Injury
C Clamp
Anti-shock screw
External Fixator
Pubic symphysis plate
+/- Extra Peritoneal Packing (EPP)
Reduction
AO/OTA Type A
Posterior Injury
Anterior Injury
Iliac crest
Hamstring avulsion
Pubic symphysis
Pubic rami
Ilium fracture anterior to SI joint
Yes
LC 2 screw (LC 2) or LC 2 plates
Pubic Symphysis plate
Rami plate
Rami screw
Internal Fixator
External Fixator
No
Anterior approaches
Uniplanar Instability
Post SI lig INTACT
(LC 1, LC 2, APC 2)
Multiplanar Instability
- Post SI lig DISRUPTED
(APC 3, LC3, VS, spinopelvic dissociation)
Able to 'safely' place 1 SI screw across fracture connecting acetabulum to axial skeleton.
Yes
SI screw(s)
Yes
Able to 'safely' place 2 SI screws across fracture connecting acetabulum to axial skeleton.
No
No
SI plates
Spino Pelvic
Trans sacral bar / plate
Combination 1 x SI screw + 1 x SI plate
Combination 1 x SI screw + Spino-pelvic
Lateral window, ilioinguinal
Posterior approaches

British Orthopaedic Association | OTS | Association of Surgeons of Great Britain and Ireland | The Association of Coloproctology of Great Britain and Ireland

BRITISH ORTHOPAEDIC ASSOCIATION AUDIT STANDARDS for TRAUMA

JAN 2018

The Management of Patients with Pelvic Fractures

Background and justification
Pelvic fractures must be managed within a trauma system with defined referral pathways. They can be associated with significant haemorrhage, urological injury and other injuries. Specialist units, based at Major Trauma Centres, should have the ability to provide multidisciplinary care for these patients as well as specialist orthogeriatric care for those sustaining fragility fractures.

Inclusions:
Patients of all ages with fractures of the pelvic ring.

Exclusions:
Isolated acetabular fractures, isolated low energy pubic rami fractures and pathological fractures.

Standards for Practice

1. When there is a suspected active bleeding from a pelvic fracture, apply a pelvic binder in the correct position. Thisshould be applied pre-hospital.
2. Patients with suspected pelvic fractures with signs of haemodynamic instability should be transported directly to aMajor Trauma Centre in accordance with network guidelines. If received into a trauma unit then resuscitation shouldbe commenced followed by immediate transfer to the Major Trauma Centre for definitive treatment of active bleeding.
3. All patients require IV Tranexamic Acid as soon as possible and ideally within an hour of injury. In the presence ofhaemodynamic instability, patients should be urgently resuscitated using blood products according to MassiveTransfusion Protocols.
4. Patients with suspected pelvic fractures from high-energy trauma should have a CT scan with IV contrast including head,chest, abdomen and pelvis on admission. This should include a head to toe scanogram.
5. All patients with blunt polytrauma undergoing damage control laparotomy should have imaging of the pelvis beforesurgery (X-ray or CT). All patients should have a pelvic binder in-situ during surgery and this should not be removed fora post binder pelvic X-ray until the patient is haemodynamically stable.
6. Active bleeding from the pelvis in patients who do not respond to resuscitation can be managed by surgical packing ofthe pelvis or interventional radiology with selective embolization of active arterial bleeding vessels. Major TraumaCentres must have a clear protocol in place for managing this situation.
7. All polytraumatised patients require a post-binder X-ray after resuscitation, even in the presence of a 'negative' CT scanbecause a well-applied pelvic binder can mask a catastrophic pelvic ring injury.
8. Each trauma network must have a clear protocol for binder removal but, ideally, it should be removed within 24-hoursof injury.
9. External fixation should be considered for temporary mechanical stabilisation when early definitive surgery cannot beperformed.
10. In displaced vertical shear fractures, traction should be considered when early definitive surgery cannot be performed.
11. Potential injury to the bladder or urethra should be suspected, diagnosed and managed according to The Managementof Urological Trauma Associated with Pelvic Fractures BOAST.
12. Open pelvic fractures associated with wounds to the lower abdomen, groin, buttocks, perineum, anus (includingsphincters) and rectum require urgent assessment by a consultant general or colorectal surgeon and wounddebridement as per the Open Fractures BOAST. Clinically and/or radiologically proven or suspected injuries to the anusand/or rectum may initially require construction of a defunctioning stoma. Nursing care of wounds to the perineum orbuttocks may also require a defunctioning stoma, although this is unlikely to be necessary for open pelvic fracturesassociated with wounds to the groin or lower abdomen alone. Please see over for further guidance.
13. Patients who are admitted to Trauma Units and require surgical stabilisation should be referred and safely transferredto a specialist centre within 24 hours.
14. Reconstruction of the pelvic ring should occur within 72 hours of the stabilisation of the patient's physiological state ifassociated injuries allow.
15. Patients who suffer displaced low energy fragility fractures of the pelvic ring, who are unable to mobilise due to pain,should be discussed with the specialist centre for consideration of surgical stabilisation.
16. Specialised units should have written local policies for thromboprophylaxis for patients with pelvic fractures, whichshould be followed and documented in the medical records.
17. Each network should submit appropriate data to the TARN, monitor performance against national standards and auditttheir outcomes.
18. Patient follow-up should occur in a specialist pelvic trauma unit or rehabilitation clinic, to ensure full advice is availablefor the pain, physical, psychological, and urological disabilities, which are common adverse outcomes.
19. All patients who may be sexually active should receive written advice on sexual dysfunction in accordance to theguidelines from the British Association of Urological Surgeons.Each hospital should submit data to national databases (NHFD, FLS-DB and TARN) to monitor its performance against national benchmarks and quality standards.

Evidence base:
Professional Consensus. NICE Complex Trauma Guidelines: www.nice.org.uk/guidance/ng37; The Management of Urological Trauma Associated With Pelvic Fractures BOAST

Guidance for stoma formation with open pelvic fractures from the Association of Coloproctology of Great Britain and Ireland and the Association of Surgeons of Great Britain and Ireland:

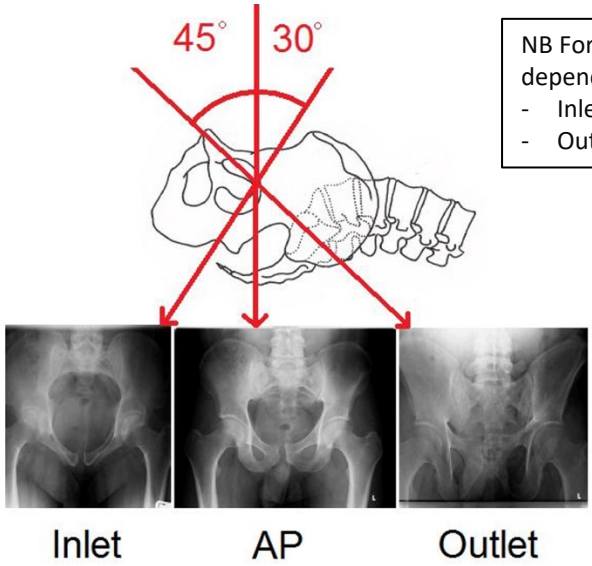
- Each case should be considered carefully on its merits with regard to both the need for a stoma and optimum timing, as stoma formation is not without morbidity.
- Whenever possible, arrangements should be made to obtain and document informed consent beforehand. Stoma formation is usually not appropriate at initial damage control laparotomy.
- When a defunctioning colostomy is required simply for diversion after distal injury, the stoma may be created laparoscopically, depending upon available surgical expertise.
- A double barrelled, or a loop stoma with the distal end stapled off (to minimise overspill) is acceptable. In either case, the gastrointestinal tract distal to the stoma should be irrigated thoroughly, in order to reduce the risk of contamination resulting from retained stool.
- The position of the stoma should be determined, whenever possible, in conjunction with the orthopaedic surgical team. It should usually be sited in the upper abdomen, to ensure that it is sufficiently remote from the site of potential definitive pelvic surgical fixation.
- Injuries to the colon or rectum associated with open pelvic fractures should be treated, where possible, by resection or repair, defunctioning, irrigation of the distal bowel segment and pelvic drainage.

Pelvic X-ray (PXR)

Purpose of **AP PXR on Primary Survey**
- Should be performed at same time as CXR.
- If patient crashes before CT, it aids decision making.
- Allows pelvic fracture to excluded fracture to allow removal of binder for vascular access in extremis. Follow instructions for removal of binder. Unless essential for vascular access the binder should be maintained until the CT.

Inlet + Outlet PXR on Secondary Survey
- Not necessary if CT available

AP, Inlet + Outlet PXR should be performed
- Post operation
- Follow-up

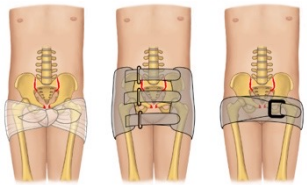


NB For intra-op II views the angles vary depending on pelvic orientation.
- Inlet approximately 5-20 degrees
- Outlet approximately 60-65 degrees

Early Mx

Surgical Strategy

Pelvic Binder



Application / Re-application of binder

The purpose of the pelvic binder is to oppose pro-thrombotic surfaces and stabilise the clot. There are many ways to achieve this goal including 2-person manual pelvic immobilization (pressure on trochanters) for the duration of essential procedures and until re-application of binder. Use common sense rather than ATLS dogma.

- Ensure binder at level of greater trochanters
- Internally rotate legs and consider applying padded bandage to feet and thighs. NB peroneal nerve.
- Consider applying traction if there is vertical displacement
- Have binder applied to recommended tension
    - SAM - until 'click' (150N circumferential pressure).
    - T-Pod - leave hand over ASIS and tighten until maximum comfortable pressure.

Pre-hospital pelvic binder check

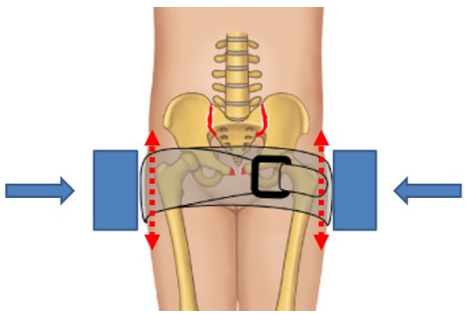
Check pelvic binder position before patient is transferred by scoop from ambulance trolley. Have spare pelvic binder positioned appropriately on resus bed to allow patient to be transferred on top. This avoids unnecessary movement and wasted time.
The correctly positioned new binder can then be applied over top of the previous binder if necessary. The incorrectly positioned binder can then be cut and slid out if necessary.

Removal of pelvic binder in Emergency Department

- Use Acute Management pathway to help decision making.
- Has the patient had evidence of hypovolaemia?
    - If no, consider removal of pelvic binder.
    - If yes, have they demonstrated subsequent haemodynamic stability without the need for on-going resuscitation?
    - Is their clotting normal?
    - Do you have access to further Major Haemorrhage Protocol (MHP) products?
- Position digital x-ray cassette.
- One person gradually releases binder while second (senior) person holds on to ASIS bilaterally.
- If clinical evidence of gross instability, re-apply.
- Following release, leave in situ loose and perform digital PXR immediately
- If radiologic evidence of gross instability, re-apply.
- Patient to be observed in monitored environment for evidence of on-going bleeding.

Removal of pelvic binder in Operating Theatre

- Patient on radiolucent operating table.
- Apply table attached 'hip bolsters' against greater trochanters.
- Cut off front of pelvic binder.



Damage Control - Strategy

See **Trauma Education Polytrauma Donut Round e-mail for Dropbox folder access to relevant papers**

Damage Control Resuscitation

Adequate IV access (peripheral, central, IO)
Permissive hypotension / balanced resuscitation (if appropriate, NB head injury, elderly)
IV fluids
- Saline boluses
- Major Haemorrhage Protocol (MHP – OUHFT Adult + Paed)

Warming
TXA (1g stat, followed by 1g 8hr infusion)

Damage Control Interventions

Decision will be made based on **3 Ts** and availability of **Interventions**.

Time
How much does the patient have?
Are my resources dependent on the time of day?
How long do these resources take to implement?
Trend
What is the effect of the current interventions?
Tempo
How quickly is the situation changing?

Interventions (not geographically specific – make use of Damage Control Trolley in ED)
- Pelvic binder
- Damage Control Resuscitation
- Emergent fixation (external fixator / C clamp / anti-shock screw / symphyseal plate)
- Packing
    - Open wound (Celox™)
    - Extra-peritoneal packing
- REBOA / Angiographic embolization

	Interventional Radiology (IR)	Extra Peritoneal Packing (EPP)
Speed	+	+++
Effective	>90% of haemodynamically unstable pelvic fractures will have a significant arterial bleed. Greater post intervention fluid requirements	Immediate effect on arterial AND venous bleeding. A proportion will also require angio-embolization. Mechanical pressure more effective in coagulopathy.
Complications	Necrosis associated with non-selective procedures.	Infection

Damage Control - Equipment

This is not the time to be working out detail and giving people long lists of kit to remember.
Phone theatre and say:

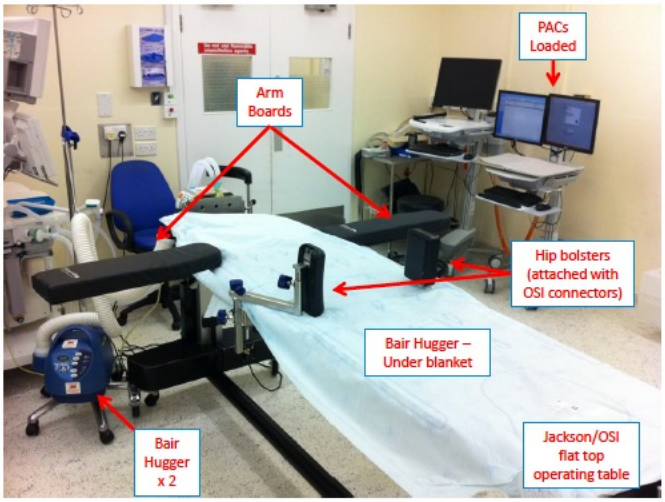
"Damage Control Trolley to ED" (it will arrive with scrub nurse + ODP)
or
"Damage Control Set Up in Theatre" + specify trays to augment Damage Control Trolley
(you will be given whichever theatre is available)

TVTN — Oxford University Hospitals NHS NHS Trust — OxTRAUMA

Damage Control Trolley

- Ortho basic
- 10 large and 10 small swabs
- 1 L warm Hartman's
- Bladder syringe
- 4 x 22 blades
- Blue liga clips + long applicator
- Vascular slings
- 10 artery clips
- 4 x no 1 nylon
- 2 x 2/0 vicryl ties
- Skin staples
- 1 x large loban
- Sterile gloves:
  - 2 pairs x Size 7
  - 2 pairs x Size 7.5
  - 2 pairs x Size 8
- Swab count sheet
- Reminder: take own "lead coat" from theatre to Resus

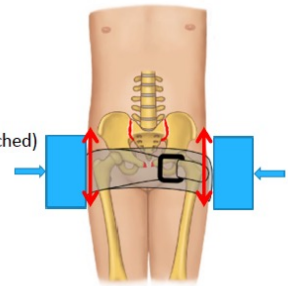
Basic specialty specific equipment (vascular, laparotomy, thoracotomy) on a separate trolley in theatre unopened, to remain within the Theatre complex.



TVTN — Oxford University Hospitals NHS NHS Trust — OxTRAUMA

Damage Control Default Theatre Set Up

- Theatre 1 (if available) - **Thermostat set to max**
- 1 x large basin with diluted chlorhexidine, LABELLED
- 2 scrubbing brushes and 2 x Huck towel packs
- Image Intensifier
- Pat slide
- Jackson table (flat top)
  - 2 x Jackson arm supports
  - 2 x Jackson side connectors
  - 2 x hip bolsters (Patient Right attached)
- 2 x Bair Huggers (over and under)
- 2 suction units
- Diathermy
- Heel jellies
- Flowtron calf compression devices
- 4 x plastic u-drapes



Trauma Thoracotomy

Opening the chest is easy! It is what comes next that needs to be understood and planned.

Indications

- Deteriorating trauma patient despite optimum available resuscitation (fluid + interventions). The chest is being opened:
    - To treat a known specific problem
        - Tension pneumothoraces (start with generous bilateral thoracostomies and then connect if necessary)
        - Penetrating injury
    - To obtain proximal control of descending aorta (best done digitally rather than fiddling around with clamps) to isolate / prioritise supra-diaphragmatic circulation while fluid resuscitation can catch up before reinstating the bleeding distal circulation.
- Traumatic Cardiac Arrest (easy decision, the patient is already technically dead) - Ask yourself the question ”Are my intentions honourable?”, Dr John Hinds 1980-2015

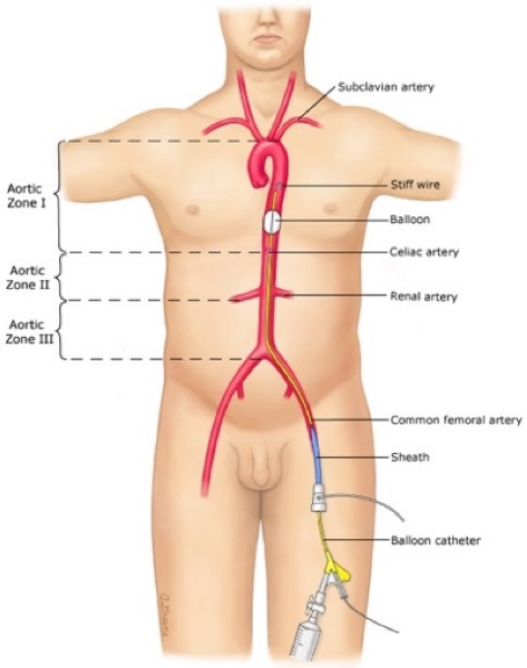
You now have <30 mins before the kidneys are dead, the clock is running!

Don’t be a ResusWanker

- https://emcrit.org/emcrit/how-not-to-be-a-resuswanker/
- https://emcrit.org/emcrit/john-hinds-on-crack-the-chest-get-crucified/

Interventional Radiology

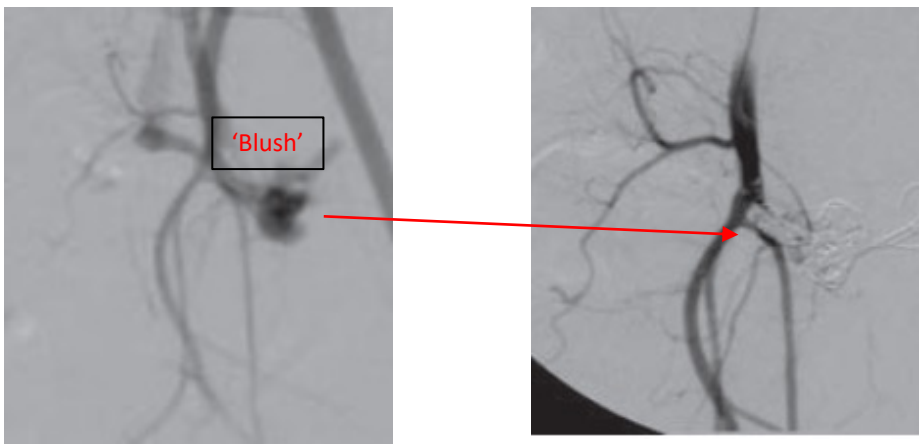
REBOA – **R**etrograde **B**alloon **O**cclusion of the **A**orta



Pro Tips

- A balloon in Zone 1 or 2 can only remain fully inflated for < 30 mins. Zone 1 approx. 45cm, 8ml balloon inflation.
- Zone 3 can be considered the equivalent of bilateral high lower limb tourniquets. Approx. 30cm, 5ml balloon inflation. Safe duration unknown.
- After 10-20mins occlusion consider PARTIAL REBOA (pREBOA). Remove 0.5mls and wait 30 seconds. Repeat until distal pulsatile flow or distal MAP increases 10mmHg.
- If a 4Fr catheter is placed initially then this can accommodate a 7Fr REBOA guidewire to allow exchange.
- It all sounds good but there are complications.

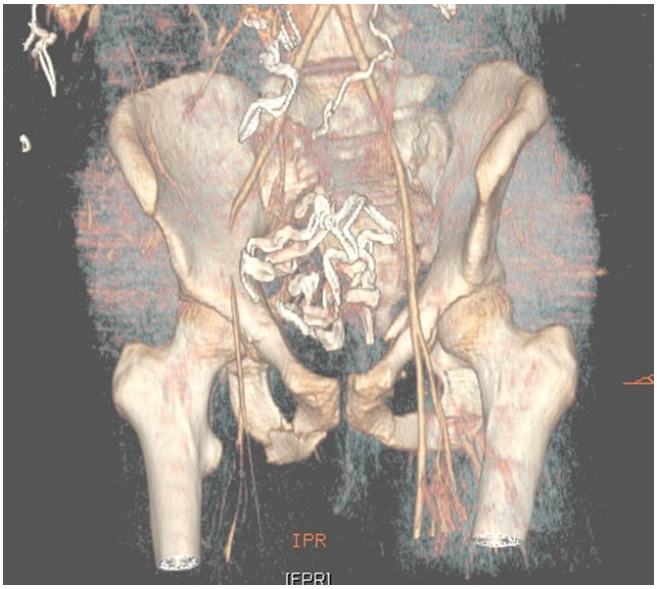
AE – **A**ngio **E**mbolisation



Do you know how long this takes? In your institution at this time of day.
Do you really have the time for this?

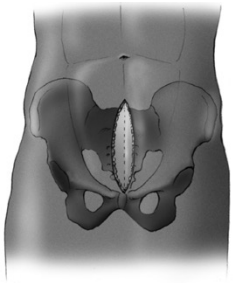
- Yes – Proceed, but
  - Have theatres ready and prepared to proceed
  - Perform it in theatres using Damage Control Set Up
- No – EPP
  - Send for Damage Control Trolley (+staff) and perform in ED
  - In theatre

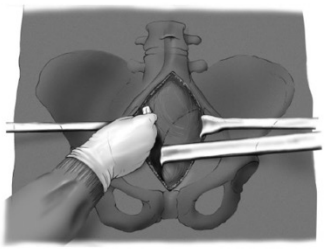
Extra Peritoneal Packing (EPP)

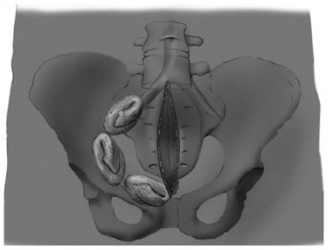


Use ‘Gynae roll’ rather than abdo swabs. Easier to tightly pack into apex and only 1 swab to retrieve.

Yes you can stop arterial bleeding! NB Right external iliac occlusion. We had to release the binder to restore perfusion to the leg.

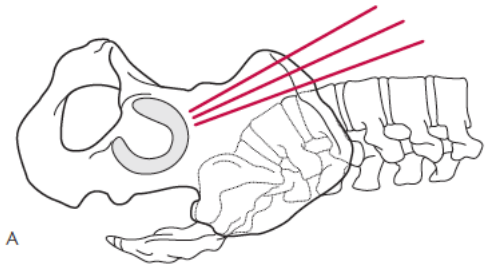




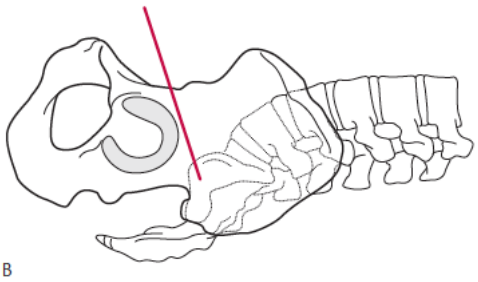


See **Trauma Education Polytrauma Donut Round e-mail for Dropbox folder access to relevant papers**

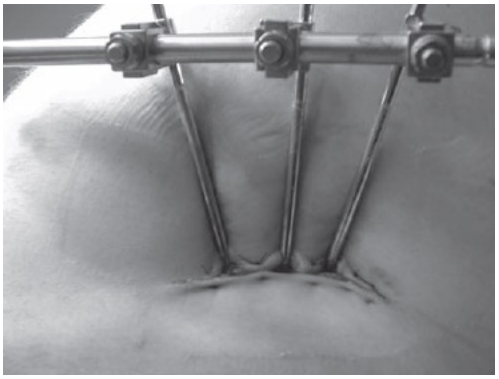
External Fixator



Iliac crest pins
- Orientation towards acetabulum

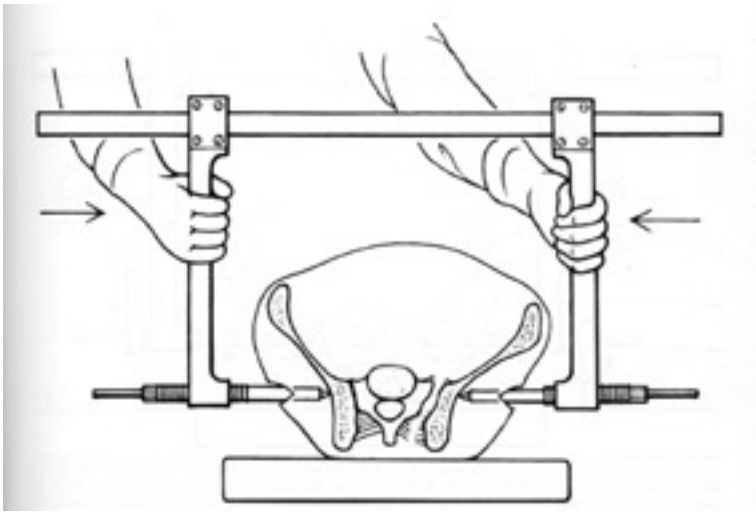


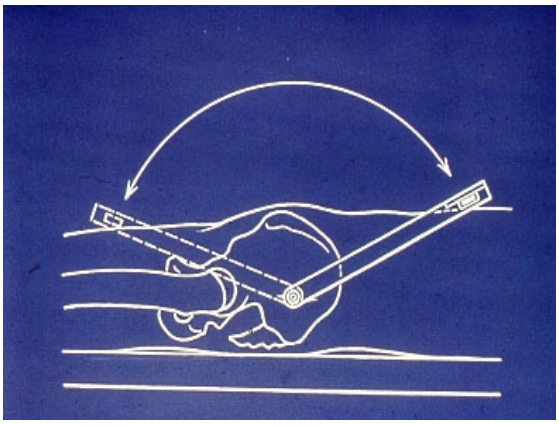
Supra acetabular pins
- Try to avoid as this corridor may be used in definitive fixation
- Useful when associated iliac crest fracture

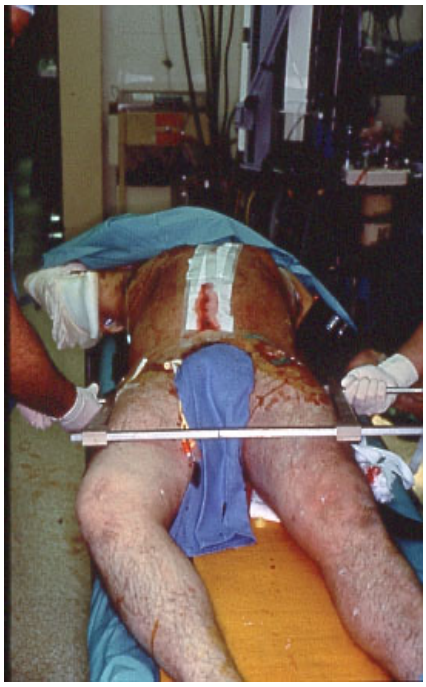


To avoid skin problems
- Radial incisions aiming at umbilicus
- Correct pin orientation
- Pelvis reduced with hip bolsters / binder before placement of pins

C Clamp







Not commonly used in UK practice. Considerable risk when used by inexperienced personnel eg visceral injury when spike slips through sciatic notch.

Radiologic Assessment of Stability

Classify fracture

- This will tell you the likely mechanism
    - From this you can get an indication of the likely residual soft tissue stability

Radiologic evidence of instability

- Pubic symphysis or SI joint diastasis
- Gross displacement in the vertical plane
- LC 1 (sacral compression) - With medialisation and internal rotation of the hemipelvis, the sacrospinous (SS) and sacrotuberous (ST) ligaments are de-tensioned. This allows flexion of the hemipelvis and subsequent potential for sitting imbalance / leg length discrepancy.
- LC2 fractures have been described as having relative 'vertical stability'. The SS and ST ligaments are intact. In undisplaced fractures they have maintained normal length and continue to contribute to vertical stability. In displaced fractures the SS and ST ligaments are shortened, allowing the potential for further displacement in the vertical plane secondary to flexion, as for LC1 fractures.
- LC 2 + 3 fractures
- Spino-pelvic dissociation (Y, H + U sacral fractures)

Additional findings that give an indication of potential instability

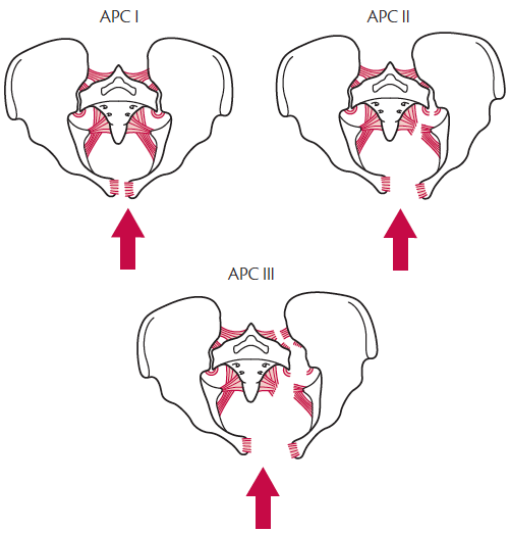
- Vertical pubic ramus fractures suggestive of vertical shear.
- Oblique pubic ramus fractures suggestive of lateral compression.
- Avulsion of lateral sacrum, ischial tuberosity or ischial spine (origins and insertions of ST and SS ligaments)
- Superior displacement of L5 transverse process fracture seen with vertical shear.
- Disruption of L5 / S1 facet joint seen with spino-pelvic instability.
- Pubic rami fractures displaced > 1cm, suggests disruption of obturator membrane
- LC 1 (sacral compression) with contralateral pubic rami fractures, more unstable than ipsilateral pubic rami fractures.

Pelvic Fracture Classification Systems

- Young + Burgess
- AO / OTA
- Denis
- Spinopelvic dissociation

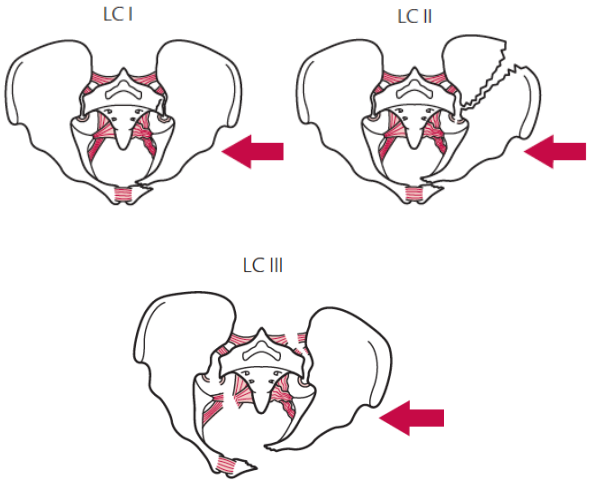
Young + Burgess Classification

Anterior Posterior Compression (APC)



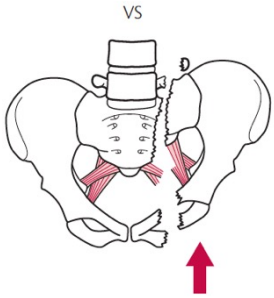
- Average blood replacement = 14.8 units
- Pelvic and visceral injury major cause of death

Lateral Compression (LC)



- Average blood replacement = 3 units
- Head injury major cause of death

Vertical Shear



- Average blood replacement = 9.2 units
- Associated with neurologic injury

Combined Mechanism

- Average blood replacement = 8.5 units

AO / OTA Classification

Types:
Pelvis, pelvic ring, **intact posterior arch**
61A

Type A

Pelvis, pelvic ring, **incomplete disruption of posterior arch**
61B

Type B

Pelvis, pelvic ring, **complete disruption of posterior arch**
61C

Type C

AO / OTA Type A Fractures

61A

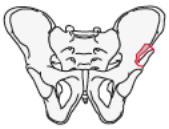
Type: Pelvis, pelvic ring, **intact posterior arch** 61A

Group: Pelvis, pelvic ring, intact posterior arch, **innominate bone avulsion fracture** 61A1

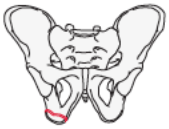
Subgroups:

Anterior superior iliac spine fracture
61A1.1

Anterior inferior iliac spine fracture
61A1.2



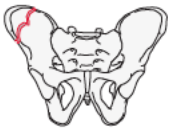
Ischial tuberosity fracture
61A1.3



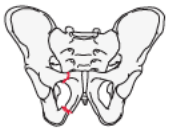
Group: Pelvis, pelvic ring, intact posterior arch, **innominate bone fracture** 61A2

Subgroups:

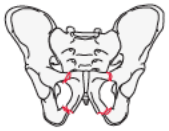
Iliac wing fracture
61A2.1



Unilateral fracture of the anterior arch
61A2.2



Bilateral fractures of the anterior arch
61A2.3



Group[1]: Pelvis, pelvic ring, **transverse fracture of sacrum (S3, S4, S5) and coccyx** 61A3

[1]Fracture of the upper sacral segments attached to sacroiliac joints (S1, S2) are classified as part of the pelvic ring injury. If a more detailed classification is required refer to sacral classification (54) in the Spine classification.

AO / OTA Type B Fractures

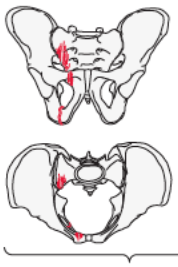
Management depends on the correct interpretation of stability and fixation mechanics

61B

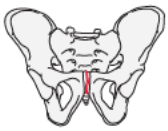
Type: Pelvis, pelvic ring, **incomplete disruption of posterior arch** 61B

Group: Pelvis, pelvic ring, incomplete disruption of posterior arch, **no rotational instability** 61B1

Subgroups:
Lateral compression fracture (LC1)
61B1.1*



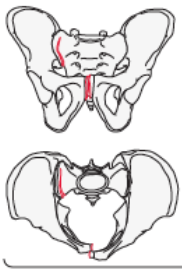
Open book fracture (APC1)
61B1.2



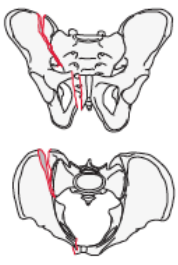
*Qualifications:
a **Ipsilateral or unilateral pubic ramus fracture**
b Bilateral pubic rami fracture
c Contralateral pubic ramus fracture
e Parasymphyseal fracture
f Tilt fracture
g Locked symphysis

Group: Pelvis, pelvic ring, incomplete disruption of posterior arch, **rotationally unstable, unilateral posterior injury** 61B2

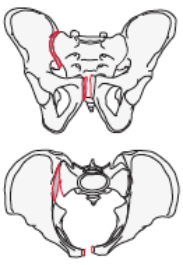
Subgroups:
Lateral compression fracture of the sacrum with internal rotation instability (LC1)
61B2.1*



Lateral compression fracture of the ilium (crescent) with internal rotation instability (LC2)
61B2.2*



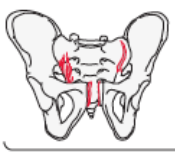
Open book or external rotation instability (APC2)
61B2.3*



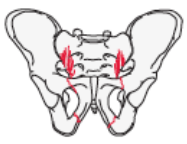
*Qualifications:
a Ipsilateral or unilateral pubic ramus fractures
b Bilateral pubic rami fractures
c Contralateral pubic ramus fractures
d Symphysis disruption
e Parasymphyseal fracture
f Tilt fracture
g Locked symphysis

Group: Pelvis, pelvic ring, incomplete disruption of posterior arch, rotationally unstable, **bilateral posterior injury** 61B3

Subgroups:
Internal rotationally unstable on one side and external rotationally unstable on the contralateral side (LC3)
61B3.1*



Bilateral lateral compression sacral fracture
61B3.2*



Open book or external rotation instability (bilateral APC2)
61B3.3*

*Qualifications:
a Ipsilateral or unilateral pubic ramus fractures
b Bilateral pubic rami fractures
d Symphysis disruption
e Parasymphyseal fracture
f Tilt fracture
g Locked symphysis

AO / OTA Type C Fractures

Management depends on the correct interpretation of stability and fixation mechanics

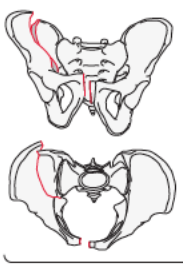
61C

Type: Pelvis, pelvic ring, **complete disruption of posterior arch** 61C

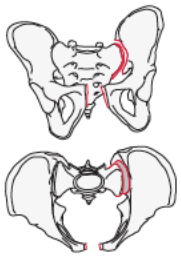
Group: Pelvis, pelvic ring, complete disruption of posterior arch, **unilateral posterior injury (APC3, vertical shear)** 61C1

Subgroups:

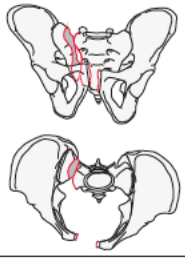
With iliac fracture
61C1.1*



Through the sacroiliac joint
61C1.2*



With a sacral fracture
61C1.3*

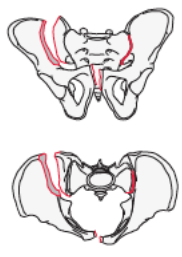


*Qualifications:
- a Ipsilateral or unilateral pubic ramus fracture
- b Bilateral pubic rami fracture
- c Contralateral pubic ramus fracture
- d **Symphysis disruption**
- e Parasymphyseal fracture
- f Tilt fracture
- g Locked symphysis
- j Sacroiliac joint fracture dislocation

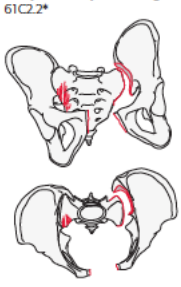
Group: Pelvis, pelvic ring, complete disruption of posterior arch, **bilateral posterior injury, one hemipelvis injury complete disruption, contralateral hemipelvis injury incomplete disruption (LC3)** 61C2

Subgroups:

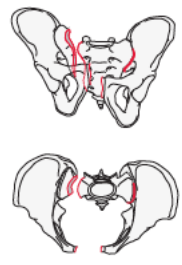
Complete disruption through ilium
61C2.1*



Complete disruption through sacroiliac joint
61C2.2*



Through the sacrum
61C2.3*

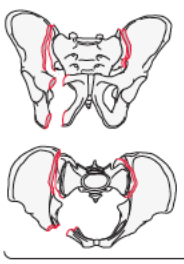


*Qualifications:
- a Ipsilateral or unilateral pubic ramus fracture
- b Bilateral pubic rami fracture
- c Contralateral pubic ramus fracture
- d **Symphysis disruption**
- e Parasymphyseal fracture
- f Tilt fracture
- g Locked symphysis
- k Contralateral posterior lateral compression lesion: sacrum
- l Contralateral posterior lateral compression lesion: ilium (crescent)
- m Contralateral posterior external rotation lesion: sacroiliac joint
- n Contralateral posterior external rotation lesion: fracture dislocation

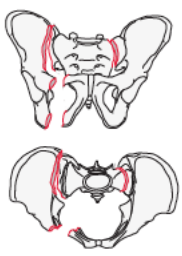
Group: Pelvis, pelvic ring, complete disruption of posterior arch, **bilateral posterior injury, both sides complete disruption (APC3, vertical shear)** 61C3

Subgroups:

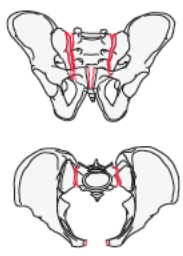
Extrasacral on both sides
61C3.1*



Sacral one side, extra sacral other side
61C3.2*



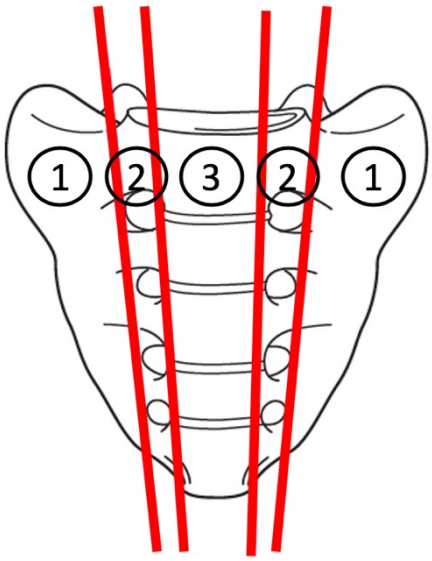
Sacral both sides
61C3.3*



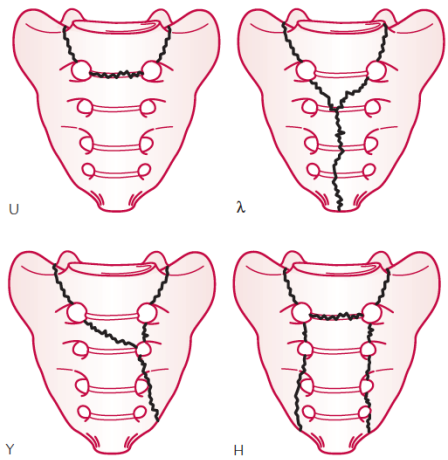
*Qualifications:
- a Ipsilateral or unilateral pubic ramus fracture
- b Bilateral pubic rami fracture
- c Contralateral pubic ramus fracture
- d Symphysis disruption
- e Parasymphyseal fracture
- f Tilt fracture
- g Locked symphysis
- h Iliac wing fracture
- j Sacroiliac joint disruption

Qualifications *are optional and applied to the fracture code where the asterisk is located as a lower-case letter within rounded brackets. More than one qualification can be applied for a given fracture classification, separated by a comma. For a more detailed explanation, see the compendium introduction.*

Sacral Fracture Classification



Denis Classification
Zones 1, 2 + 3



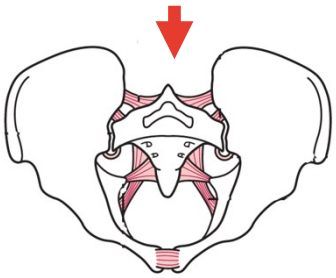
Spinopelvic Dissociation
- Types: U, Lambda, Y, H

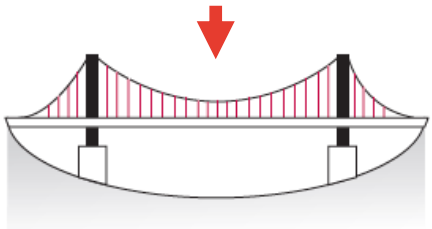
Stability Mechanics (Page 1 of 2)

The osseous pelvis has no inherent strength or stability. It is entirely reliant on the ligaments.

Posterior SI ligaments

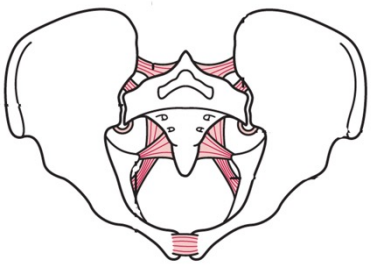
- Strong broad ligament
- Sacrum hangs from posterior ilium like a suspension bridge
- Provides vertical stability and because it is broad, some rotational stability in the sagittal plane

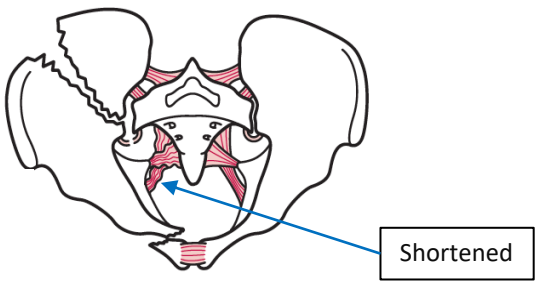




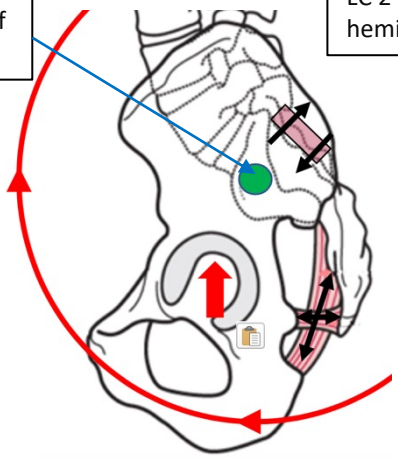
Sacrotuberous + Sacrospinous ligaments

- Components of the 'pelvic floor'
- Principal physiologic role is to prevent hemipelvis rotation in the sagittal plane
- The ST and TT ligament complex is disrupted in APC 2, APC 3 and VS fracture patterns
- With medialisation / internal rotation of the hemipelvis, the intact ST and TT ligament complex is shortened. This can allow flexion of the hemi pelvis with leg length discrepancy and sitting imbalance.

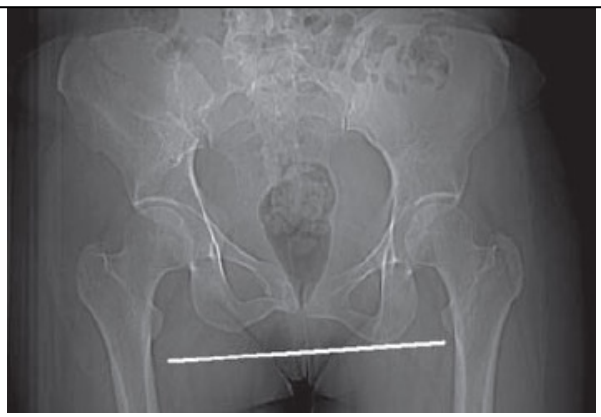




Centre of rotation



LC 2 fracture through the ilium and pubic rami. With internal rotation the hemipelvis flexes. Results in sitting imbalance + leg length discrepancy.

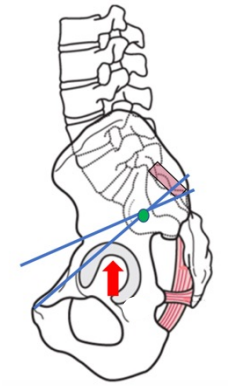


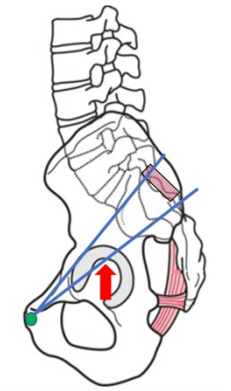
Other Physiologic Components

- The anterior SI ligaments are weak
- The pubic symphysis ligaments and joint resist external rotation / abduction of the hemipelves in double leg stance.
- The pubic rami act as a strut to resist internal rotation in single leg stance.

Stability Mechanics (Page 2 of 2)

The large lever arms need to be considered during reduction and when planning fixation.





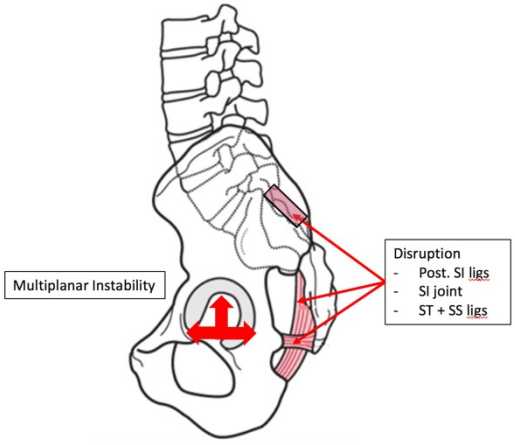
Reduction

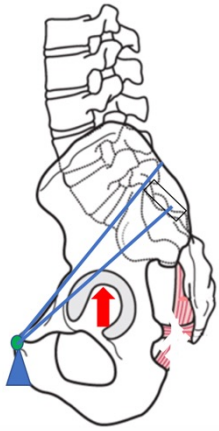
- You MUST understand and take advantage of the residual soft tissue stability to obtain reduction.
- Malreduction has a magnified effect on the other side of the pelvis due to the long lever arms involved. Small displacements in one part of the ring = large displacements on the other side.
    - For example: In a pelvis with a 12cm antero-posterior diameter a 2.5º rotational malreduction equates to a clinically significant 5mm displacement.
    - If you are going to reduce and fix the front first, use '**defeatable**' fixation eg clamp or recon plate.
- Reduction of the posterior pelvis is more important to outcome than the anterior pelvis
- In plastic deformation (commonly seen in children and young adults) it may NOT be possible to anatomically reduce the important parts of the pelvis without performing an osteotomy.
- Reduction of the anterior ring is important to prevent dyspareunia.

Fixation

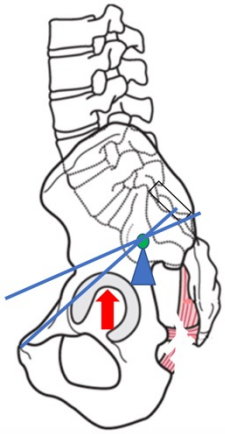
- You MUST understand the residual soft tissue stability and compensate for the fractured / ruptured structures.
- Due to the long lever arms, deforming forces generated from opposite side of ring are considerable. Fixation must be strong enough to resist this physiologic load.
- Trans-sacral fixation is less likely to fail than hemi sacral fixation, particularly in poor bone.
- Two points of fixation, widely separated, is the most effective method of resisting multiplanar instability eg S1 + S2 screws vs 2 x S1 screws or
- Interfragmentary compression contributes to rotational stability.
- Anterior fixation alone will be insufficient to control multiplanar posterior instability.
- Anterior fixation is a mechanically useful augmentation to posterior fixation but is not always needed.
- Anterior fixation can augment posterior fixation by controlling long lever arm.
- Uniplanar instability can be resolved with uniplanar fixation.
- Multiplanar instability requires multiplanar fixation.
- Some injuries (LC 1 + 2) can be considered to have multiplanar instability until the soft tissues (SS and ST ligaments) have been re-tensioned with uniplanar fixation.
- SI joint instability is a significant factor in long term pain. It is reasonable to have a low threshold to fix (fuse).

Fixation Mechanics #1

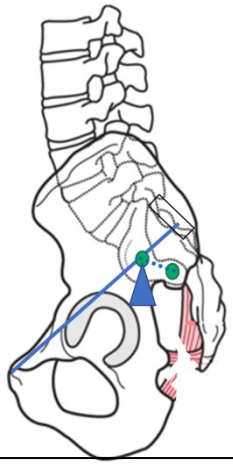




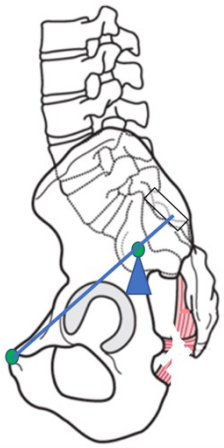
Anterior fixation only
- Anterior fixation (internal or external), in isolation, is ineffective at controlling rotational forces and posterior displacement.



Posterior fixation only
- Single point of reduction will act as a fulcrum and be unable to resist rotational forces in isolation (SI jt < Sacral fracture)
- Less movement posteriorly, as compared to anterior ONLY fixation



2 x Posterior fixation only
- Rotation controlled. Strength will depend on the implant and the distance between them eg 2 x S1 vs S1 + S2



1 x Anterior + 1 x Posterior fixation
- Rotation controlled. Anterior fixation can be relatively weak due to long lever arm.

Clinical Assessment of Stability

History

- Regardless of fracture pattern you should maintain a high suspicion of potential instability

All haemodynamically stable patients should have a clinical assessment of stability .

Examination

- Is the patient comfortable moving in bed, if not then EUA +/- proceed
- Palpation over posterior sacrospinal ligaments
- Palpation over pubic symphysis
- Push pull on straight legs from end of bed

If there is significant pain, have low threshould for EUA +/- proceed or early follow up x-rays at 1 week

Examination Under Anaesthesia (EUA)

If patient has been haemodynamically stable and is undergoing an emergency surgical procedure, perform EUA and save II pictures.

- AP / inlet / outlet (unstressed)
- AP / inlet / outlet ('figure 4' stressed)
- AP / inlet / outlet (push + pull stressed)

Trial of Mobilisation

In elderly patients, with low energy fractures, the extent of the stability provided by the residual soft tissues may be difficult to determine.
Minimally displaced LC and spino-pelvic dissociation sacral fractures may be suitable for non-operative treatment
Failure to mobilise within 3 days should warrant further clinical and radiologic assessment.

Clinical Examination of Pelvis

Primary Survey
- The pelvic examination is likely to be restricted by a pelvic binder.
- A PR +/- PV exam needs to be performed before insertion of the urinary catheter. Please see Pelvic Binder section. In emergent cases the pelvic examination and catheter can be delayed until the controlled environment of theatre.
- Log roll should be avoided in the haemodynamically unstable patient due to the potential for disrupting the clot. A PR can be performed in the supine position by bringing one leg into a figure 4.
- If you cannot perform a PR / PV please make it clear in the notes, so that it does not get forgotten.

Secondary Survey
- Log roll to allow complete inspection of pelvis and perineal skin.
- Be aware of Morel Lavallee lesions.
- Open wounds around perineum may necessitate de-functioning colostomy (see BOAST)
- Assessment of femoral and sciatic nerve function. Clear documentation of function, if you cannot elicit function document it. Do not assume it is due to pain inhibition.
- See radiologic and clinical assessment of stability.

PV bleeding (see BOAST)
- The presence of blood should not be assumed to be related to menstruation. Treat with antibiotics as per hospital open fracture protocols.
- Obtain gynaecological consult to perform urgent speculum examination, ideally in theatre.

PR bleeding (see BOAST)

- Obtain general surgery consult. A rigid sigmoidoscopy is the likely investigation but is not 100% sensitive for identifying tears. Other investigations may be requested. Decision to proceed with de-functioning colostomy can be difficult.
- Placement of de-functioning colostomy should take into consideration of future pelvic surgery.

Urologic Injury (see BOAST)

- Obtain urological opinion
- Placement of supra-pubic catheter should take into consideration of future pelvic surgery.

Pre-Operative Preparation

Imaging
The following 3D reformats of the pelvis should be available.

'Horizontal Spin' – Whole pelvis, 360 degree spin (10 degree increments) in the horizontal plane (aka **'pirouette'**)
'Vertical Spin' – Whole pelvis, 360 degree spin (5 degree increments) in the vertical plane (aka **'backflip'**)

If these re-formats cannot be generated from the data set provided by an external hospital there are only 2 options.
•Repeat CT
•Radiology arranges for referring hospital to perform reformats on their computer and send.

Analysis of Imaging
- Look at 3D horizontal + vertical spins to appreciate fracture pattern, displacement (6 degrees of freedom), appreciation of intact + disrupted soft tissues.
- Look at vertical spin to appreciate
    - Sacral dysmorphism
    - How the bone architecture (anterior sacral bodies, sacral ala, posterior sacral bodies) overlaps for optimal visualisation in intra-op Inlet View.
    - Position of pubic rami when S1 and S2 for optimal visualisation in intra-op Outlet View.
- Set up 4 box multi-plane reformat from 1mm bone window axials
- Adjust cross hairs so parallel to SI screw trajectory on axials and coronals
- Scroll through sagittal with cursor in position to perform 'fly through' of sacral bone corridor.
    - Stop in mid part of foraminal zone to appreciate bone morphology and relative position of trajectories.
    - Stop in midline to appreciate 'overhang' of sacral promontory / osteophyte. Refer back to vertical spin to assess relative position of overlapping bone architecture to accurately understand S1 and S2 trajectory in intra op Inlet View. This is particularly important to avoid placing an S2 screw in the sacral canal!

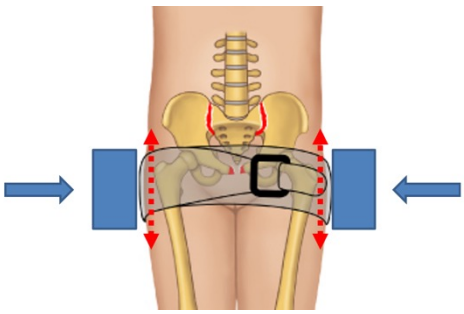
Blood
- Anticipate blood loss 600 - >2000mls)
- G+S and X-match if blood not available on electronic issue

Cell Salvage
- Useful for any lengthy procedures, Jehovah's witnesses and those with antibodies.
- John Radcliffe
    General enquiries and non urgent bookings: cell.salvage@ouh.nhs.uk
    Cell salvage coordinator bleep: **9759**
    Emergencies: Call 4444 and ask for cell salvage

You
- Do not under-estimate how much prep you may need (out of OR and in OR) to achieve you goal. You need to make sure you have enough mental energy left over for the 'crux' maneuver which can often take place towards the end of the operation. Having enough of your process automated will help preserve mental energy.
- Food + water

Emergent Reduction

Imaging | Open Approaches



Once bolsters are in position, the front of the binder can be cut off allowing access. The bolsters can also reduce the work of reduction clamps when applying symphyseal fixation.

Definitive Reduction

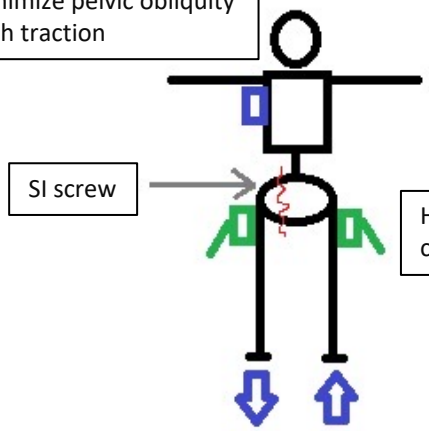
Imaging

Open Approaches

Pelvic post often not needed, body weight and contra-lateral counter traction

Prone or supine

Thoracic bolster to minimize pelvic obliquity with traction

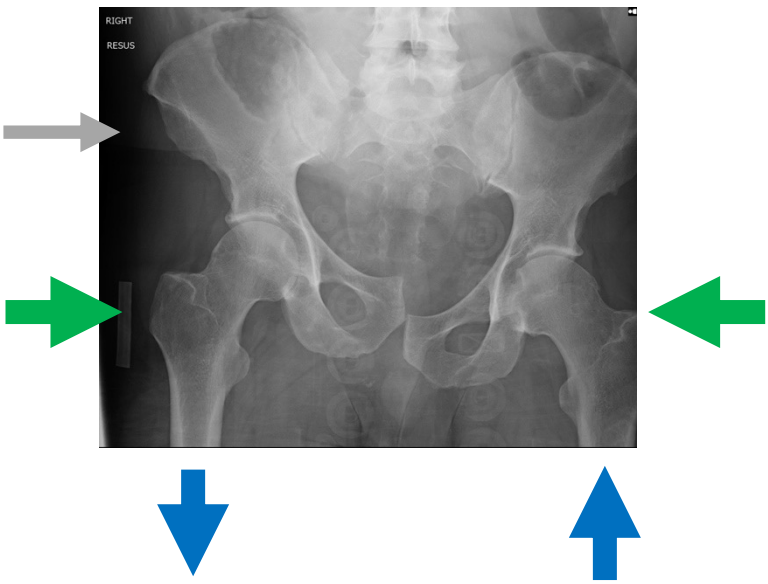


SI screw

Hip bolsters for lateral compression on GTs

Traction

Counter traction



Other adjuncts

- Radiolucent bump under one side to lift hemipelvis
- Shanz pins connected to
  - T-handle chucks
  - Ex-fix bars
    - Solid to mobile
    - 'Love handles'
  - Femoral distractor
  - Star frame
- Ball spike pusher
- 'Sloppy' SI screws using reduction trajectory
- Open
  - see Approaches
  - Clamp application

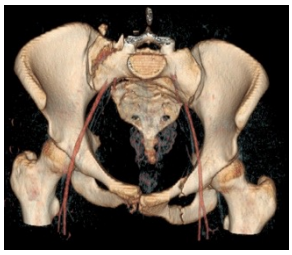
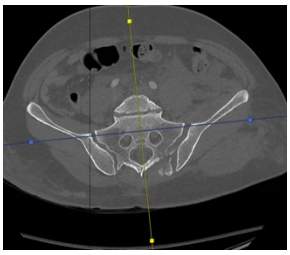
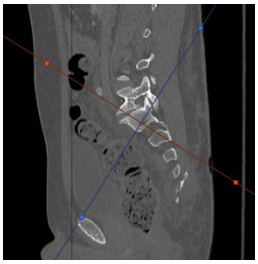
Patient, OR + PACS Set Up

Pro Tips

- Check suitability of imaging for planned procedure. Can you be confident about your landmarks? If not
    - Try different II settings.
    - 'Milk' the bowel / flatus tube
    - Displace the swollen scrotum with 'sleek' tape
    - Prepare to use the Force vs Come back another day
- Set up for your lateral view first. Due to the injury, one buttock is often more swollen than the other. You will need to compensate by using one small radiolucent bump under contralateral buttock or 'roll' the operating table. Place an indelible pen mark overlying S1 with the ilio cortical densities (ICDs) overlapping.
- In theory there is a base position and height for the II which allows the inlet and outlet to be obtained without any further movement, but it is not worth chasing!
- Mark the boundaries of your drapes.
- Mark the floor and the rest of the patient*, AFTER you have draped. I have never understood how the patient moves between these stages, but they do!

* Lines which show the orientation of the beam in both views. This helps you change trajectory by moving your hands perpendicular to one plane but maintain trajectory in the other.

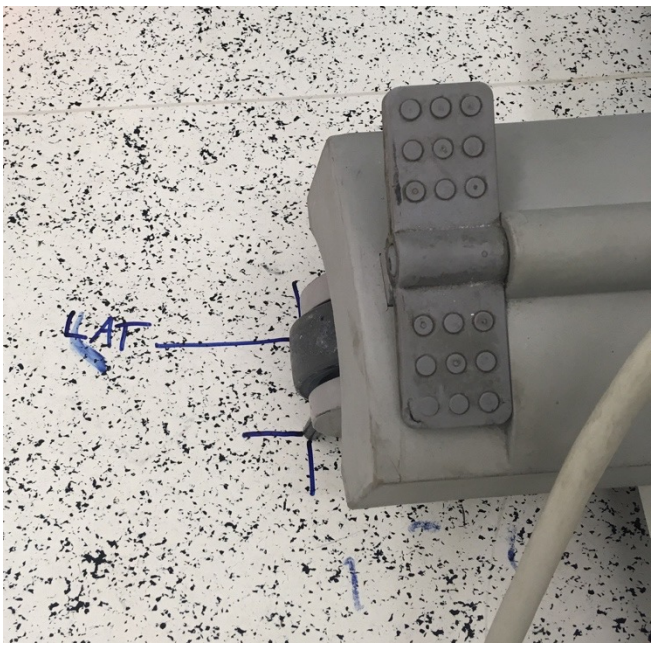
PACs Monitor Set Up – see Prep for SI Screws

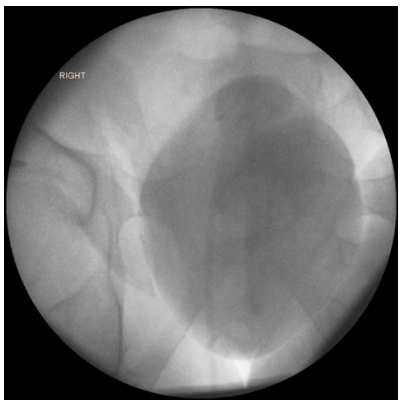
3D Horizontal (on cine scroll) 	**Axial (on cine scroll)** 
3D Vertical Spin static on optimum outlet position • Allows you to cross check position of intra-op outlet view 	**Mid Foraminal Sagittal View (with crosshairs in optimum trajectory)** • Allows adjustment relative to the lateral II view 

Imaging (1 of 7)

Pelvic + Acetabular II Matrix

VIEW					HEIGHT	BASE	EXPOSURE SETTINGS





Obscured view secondary to scrotal swelling

Worth performing all your required views before draping

- Is the view going to be adequate to allow safe placement of II guided fixation? Bowel gas can be improved with NG tube, Ryles tube or 'milking'.
- Is the table and patient set up to accommodate views?
- 'Light house views' – rotation of pelvis to achieve optimum intra-operative inlet and outlet views

II Settings (2 of 7)

Image Quality in Pelvis Trauma Theatre

Recommendations for theatre equipment:
These are based on a "single shot", as opposed to a case where the surgeon wants to continuously (live) screen.

First instance: ***"Trauma – ortho – pulsed 1p/s"*** should always be the initial setting.
Second instance: ***"Trauma – standard – pulsed normal 8p/s"*** this can be used in circumstances where the surgeon has indicated verbally that they are unhappy with the image quality (it is acceptable to use this setting throughout the case).
Third instance: ***"Trauma – standard – DR – normal"*** this is **only** to be used in extreme circumstances where the surgeon is aware of the dose implications.

Table 1

	II dose rate (uGy/s)	Skin dose rate (uGy/s)	Noise: Disc Variable Number	Image Quality Rating
Trauma – ortho – pulsed 1p/s	0.050	18.64	11	1
Trauma – standard – pulsed normal 8p/s	0.098	48.03	13	4
Trauma – standard – DR – normal	0.339	537.30	15	5

Table 1 indicates dose rates and image quality for each setting.

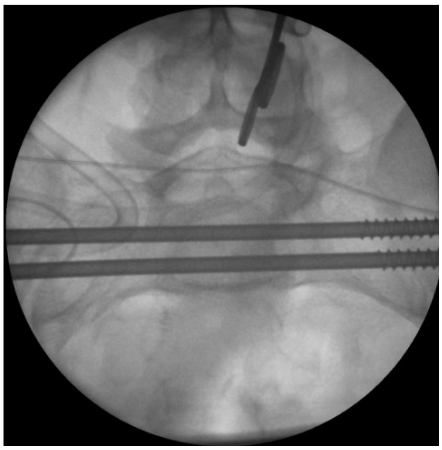
- "Noise: Disc Variable number" refers to the number of discs that can be visualised on the Leeds test object at that particular setting.
- "Image Quality Rating" refers to a scale of 1-5, 5 being high quality, 1 being low quality.
- Dose measurements are averages and are for comparison only, doses will change according to patient size and tube angulation etc.

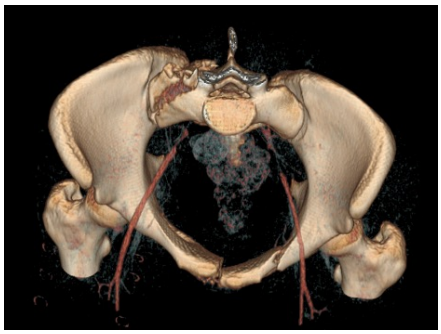
Further suggestions for improving image quality in theatre:

- In cases where the exposure is poor due to large amounts of metalwork, an appropriate exposure can be reached by screening over the adjacent side and freezing the mA. This means that early time out will not occur.
- Freezing the mA and manually increasing the exposure can also improve quality (however there will still be a kV/mA trade off).
- Saline can be used to equal out the tissue density in the pelvis (due to the effect of air in the wound cavity on image quality).
- Collimation/filtering where appropriate.

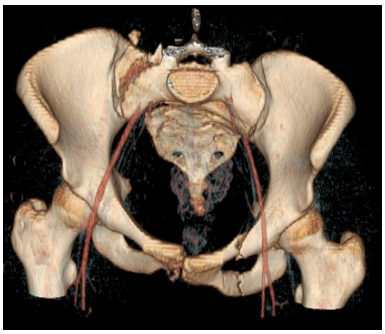
Imaging (3 of 7)

Inlet

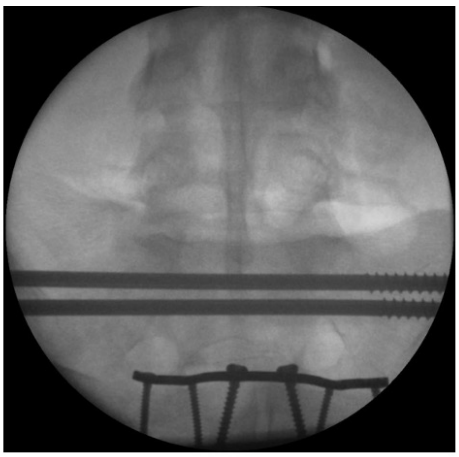




AP



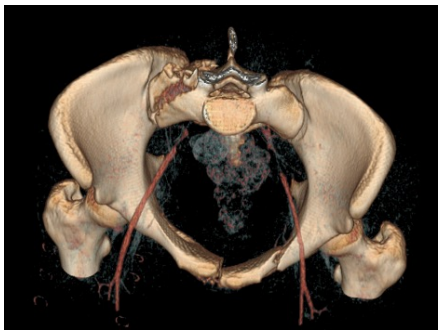
Outlet



Lateral

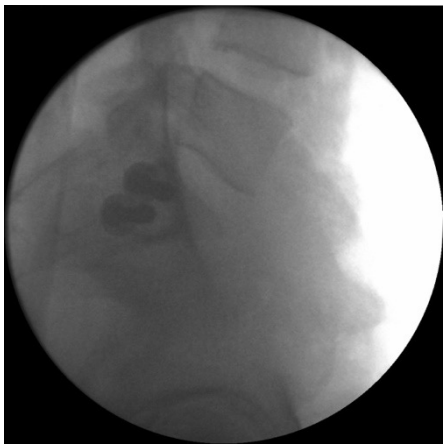
LC 2 Views

Imaging – Inlet (4 of 7)

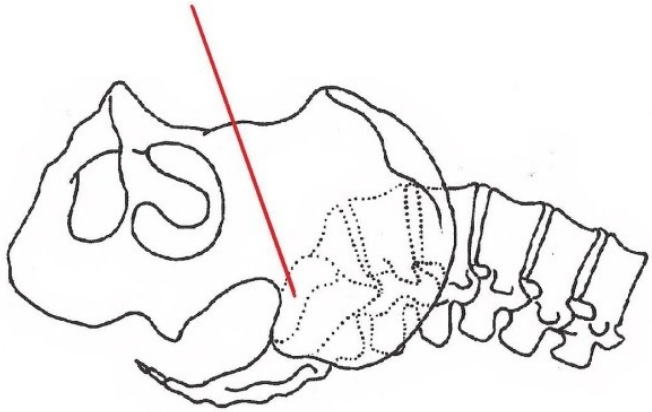


Imaging – Outlet (5 of 7)

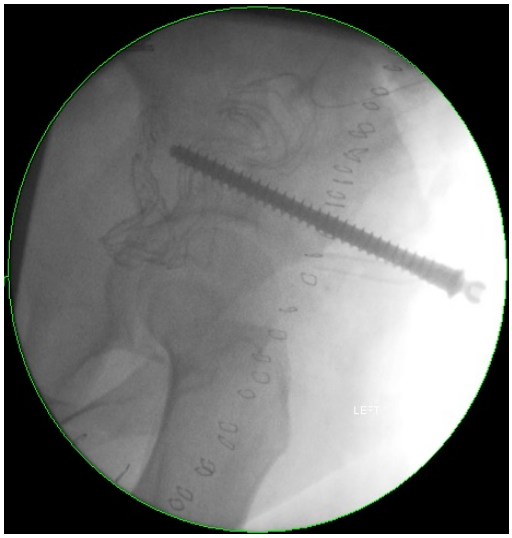
Imaging – Lateral (6 of 7)



Imaging – LC 2 views (7 of 7)



Teepee View

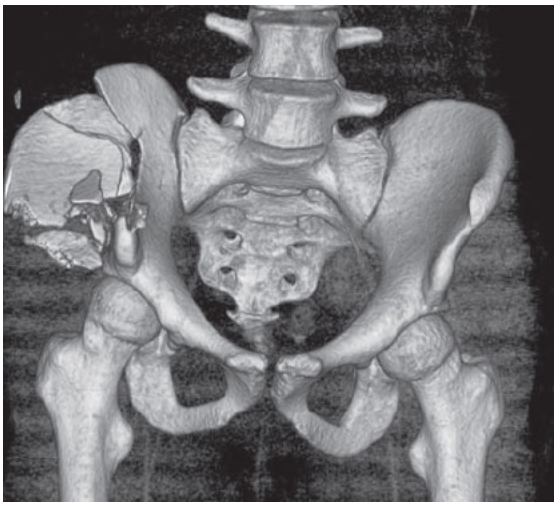


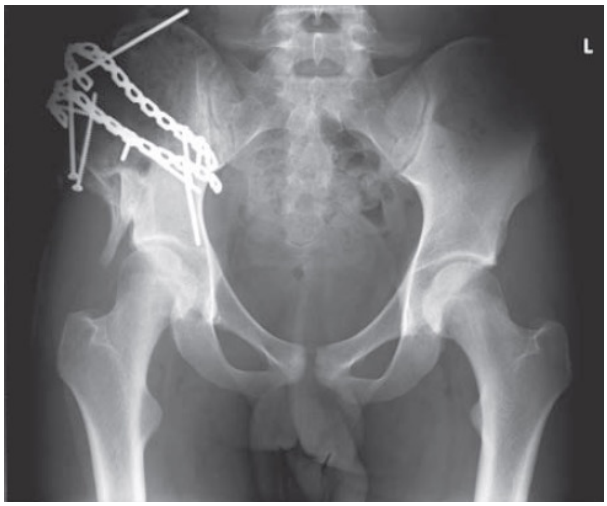
Iliac Oblique

Non-operative Treatment

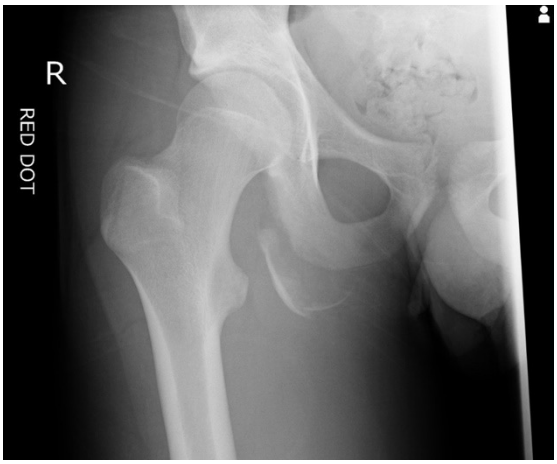
Once a pelvic fracture has been considered stable then mobilise weight bearing as tolerated.
If you are considering follow-up x-rays in a week, then consider whether you should be assessing with an EUA.
Start VTE prophylaxis 6 hours post injury and continue for 6 weeks.

Iliac Crest Fixation



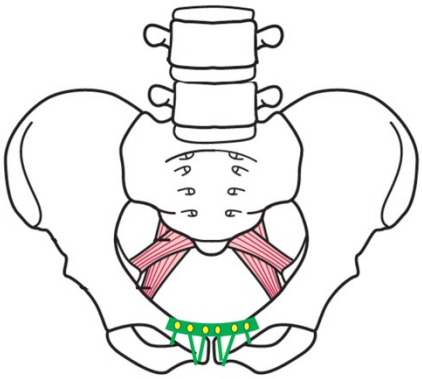


Hamstring Avulsion Fixation

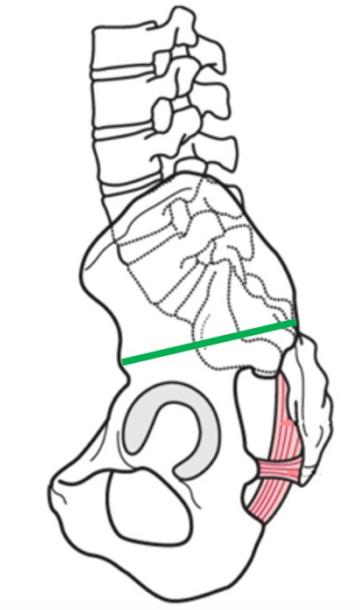


In adolescent avulsions' the bone fragment may be thin. Screw fixation alone is likely to be insufficient without draconian post op restrictions. Plate fixation is biomechanically weak and excessive. Treat as a soft tissue repair (see tightrope sutures). This patient was a sprinter and achieved a PB the following season, no reported sitting pain.

Pubic Symphysis Plate

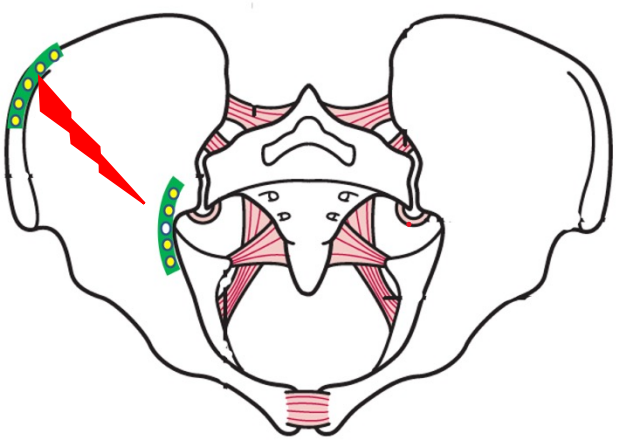


LC 2 Screw

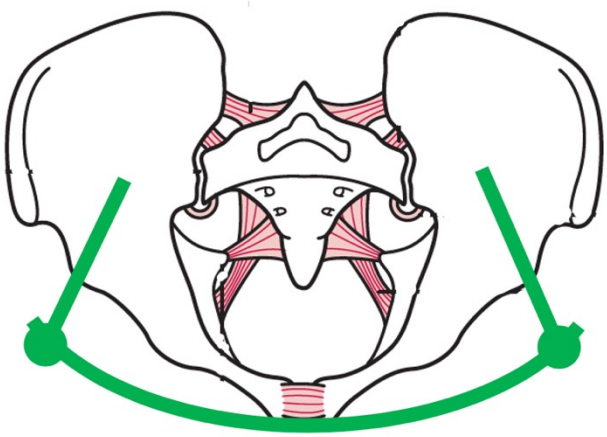


Retrograde or Antegrade

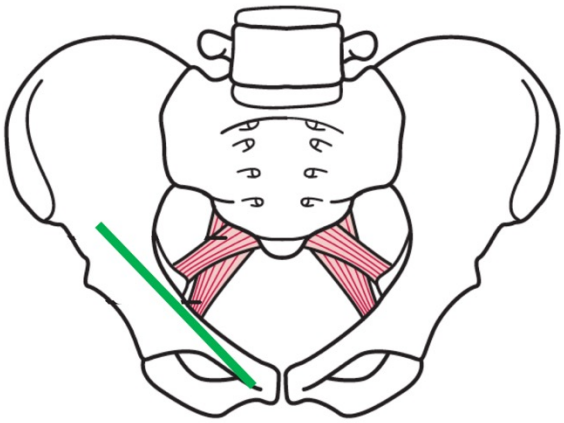
LC 2 Plates



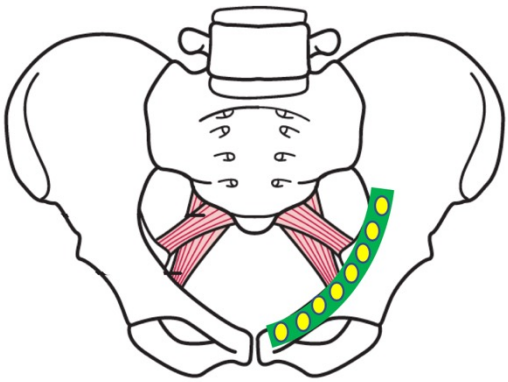
Internal Fixator



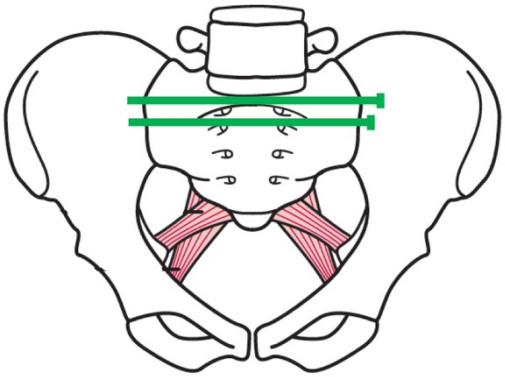
Rami Screw



Rami Plate

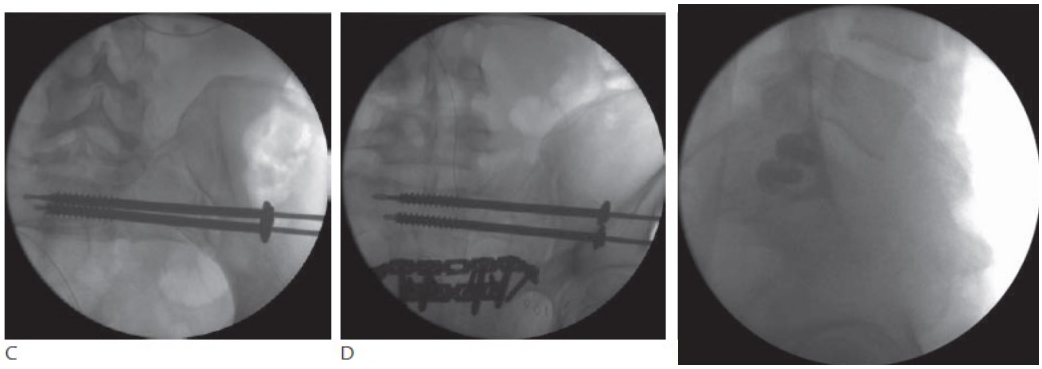


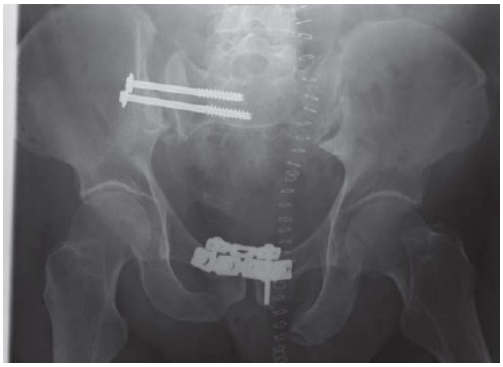
SI Screws



Pro Tips

- SI screws are a very effective tool at restoring posterior stability. Their strength and durability is proportional to their length. In multi-planar instability trans sacral screws are desirable. Placement of these screws in narrow bone corridors can be time consuming. In the emergent setting a short **anti- shock screw** across the disrupted SI joint but not extending beyond the foramen can be placed quickly.
- Successful placement relies on being able to fully understand the 3d anatomy and then correctly interpret the 2d II anatomy.

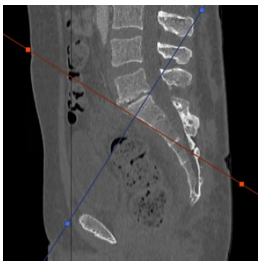
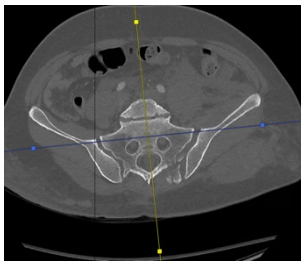




Uni sacral screws have a high incidence of failure in Type C fractures

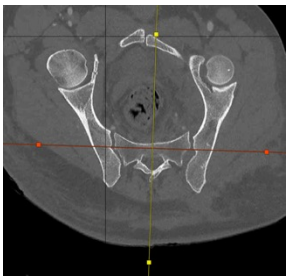
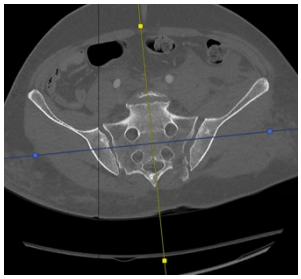
Prep for SI screws

1) CT Set Up – align crosshairs with S1+ S2 bodies in sagittal view.

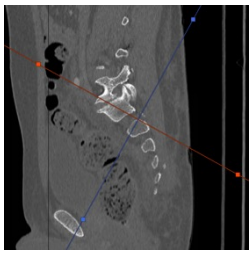



MDT recon and re-align 3 axes
1st Axis -Parallel to anterior body of S1 on sagittal view.
2nd Axis - Trans sacral axis on coronal view.
3rd Axis - Trans sacral axis on axial view.

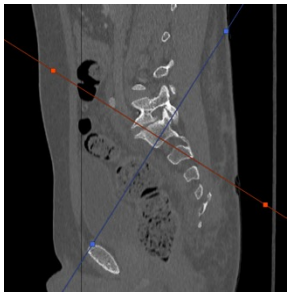
2) Adjust position of cross hairs to align with potential screw trajectories

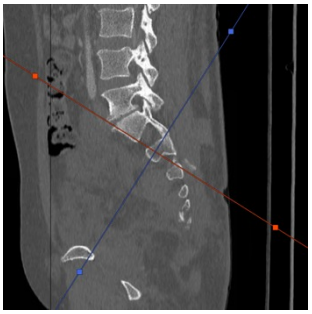
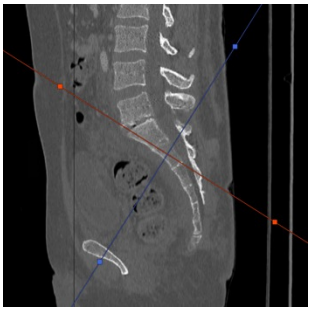
'Fly' potential screw trajectories and fine adjust centre of cross hairs, to determine viability of trans sacral screw



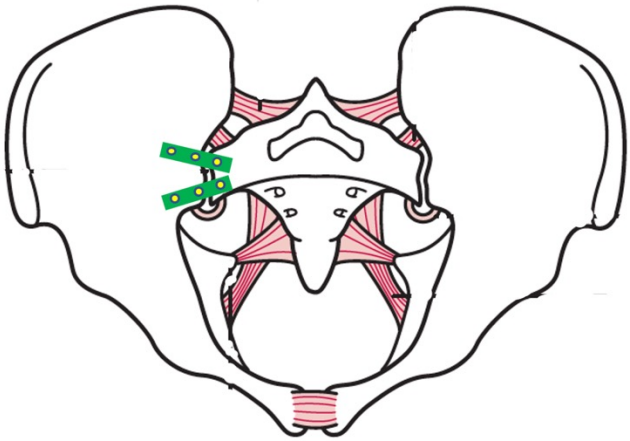
S1

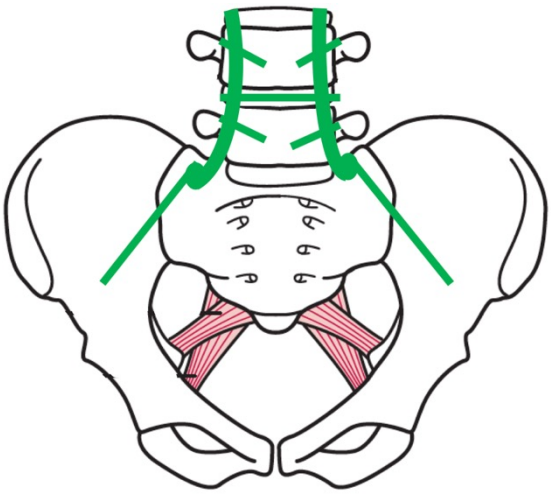

S2

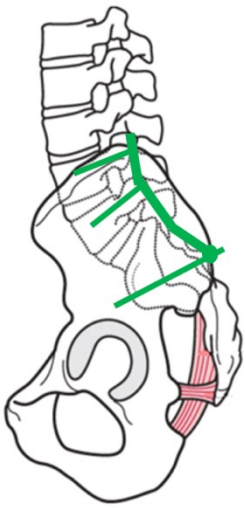




SI Plates

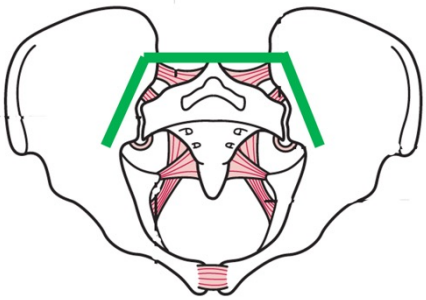


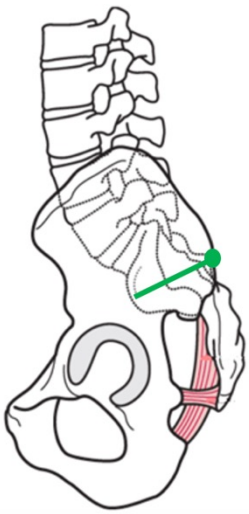
Spino Pelvic Fixation





Trans Sacral Bar / Plate

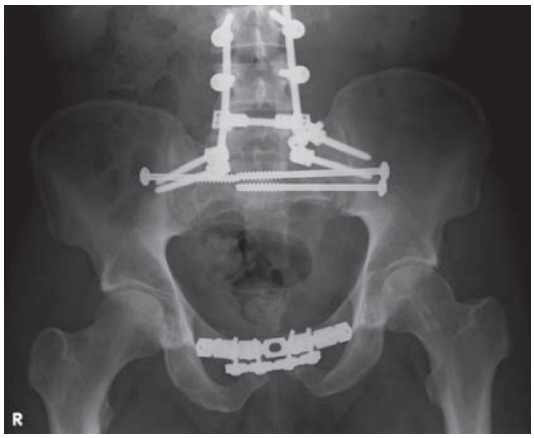




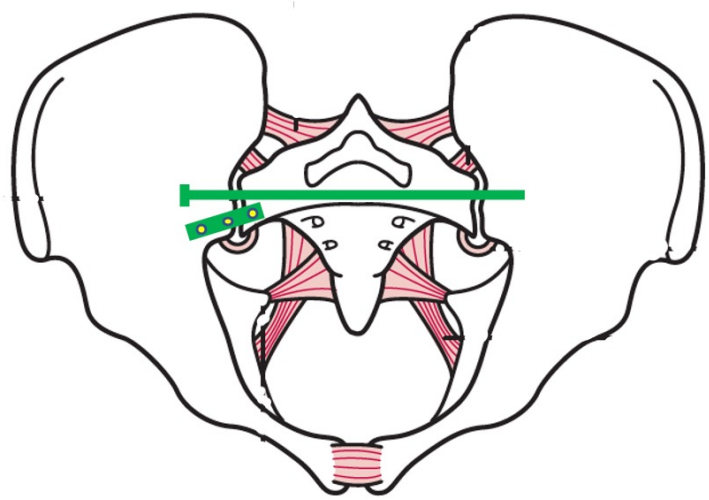
Posterior Sacral Body Plates

Transverse sacrum

Combination
- Spino pelvic + SI screws



Combination
- SI plate + SI screw



Associated Conditions

Early

- Skin
- Fat
- Muscle
- Arteries
- Veins
- Nerves
- GI Tract
- Bladder + Urethra
- Reproductive Organs
- Osteoporosis
- Rest of the body
  - Spine
    - Cervical
    - Thoracic
    - Lumbar
  - Abdomen
  - Thorax
  - Head
  - Extremities
    - Upper
    - Lower

Late

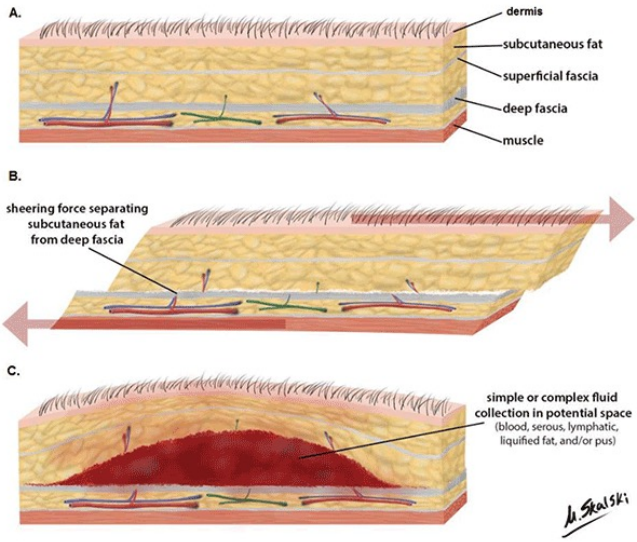
- Persistent pain
- Mental health
- Infection

Skin

- Early
  - Abrasions
  - Skin loss
  - Open fracture
  - Pressure sores
- Late
  - Infection (posterior approaches 15-20%)
  - Scarring

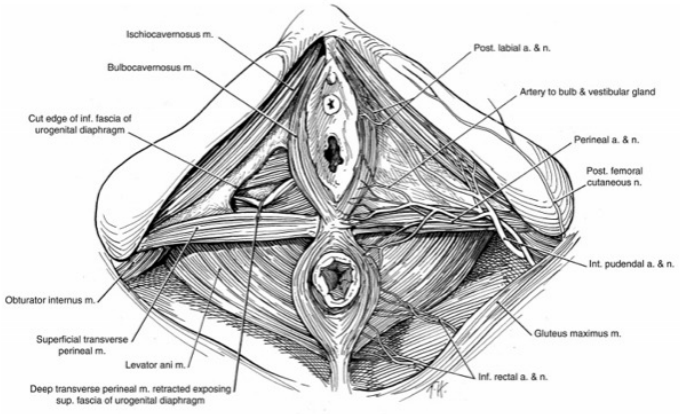
Fat

- Early
  - De-gloving / Morel Lavallee
- Late
  - Cosmetic



Muscle

- Early
  - Pelvic floor disruption
- Late
  - De-conditioning



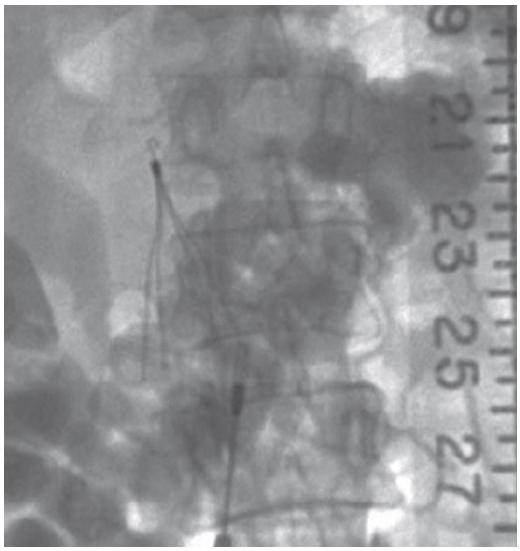
Arteries

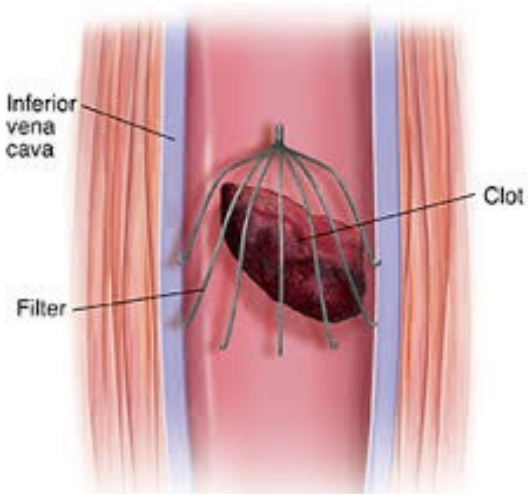
- Late
  - Gluteal necrosis secondary to non selective angio embolisation
  - Intra operative arterial intimal damage
    → delayed post op occlusion

Veins

- Late
  - DVT (2.6%)
  - PE (1.8%)

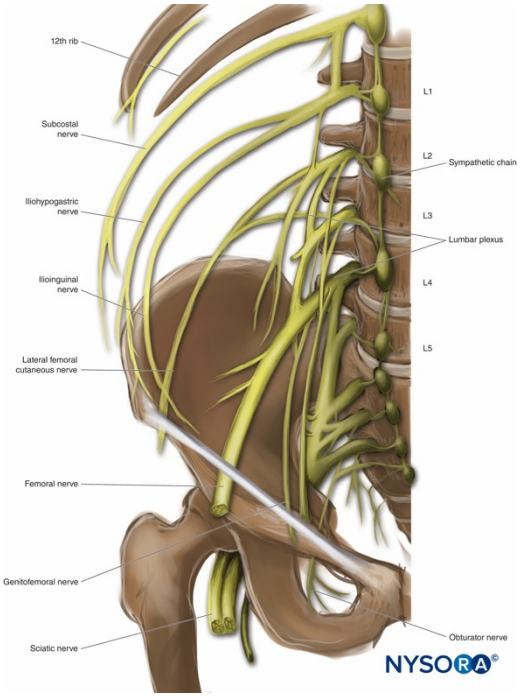
- Treatment
  - Chemical prophylaxis
    (6hrs post haemodynamic stability)
  - Mechanical pumps ASAP
  - Early mobilisation
  - IVC filter





Nerves

- Early
  - Traumatic damage
- Late
  - Iatrogenic
  - Permanent loss of function
    - Bladder / Bowels / Genitals
    - Lower extremity



GI tract

- Early
  - Occult open fracture
  - Stoma
  - Constipation
- Late
  - Adhesions

Bladder + Urethra

- Early
  - Rupture
    - Bladder
    - Urethra
  - Catheters
    - Urethral
    - Supra-pubic
- Late
  - Strictures
  - Delayed reconstruction

BOAST: The management of urological trauma associated with pelvic fractures

BOAST: The management of urological trauma associated with pelvic fractures

British Orthopaedic Association

The British Association of Urological Surgeons

BRITISH ORTHOPAEDIC ASSOCIATION AUDIT STANDARDS for TRAUMA AUG 2016

The Management of Urological Trauma Associated with Pelvic Fractures

Background and justification
Urological trauma is rare and the incidence of severe urethral trauma is 1/million population/year. The majority of cases are due to blunt high-energy trauma with associated multi-system injuries and 80% of these cases are associated with pelvic fractures. Urological injuries are potentially fatal and can result in severe long-term disability.

Inclusions
Patients of all ages with potential bladder or urethral trauma.

Standards for Practice

1. All Major Trauma Centres and Trauma Units should have agreed written guidelines for the management of suspected urological trauma and these must be easily available within the Emergency Department.
2. All patients suffering high-energy trauma must have examination of the perineum and genitalia plus a rectal examination and the findings recorded in the medical records.
3. A single, gentle attempt at catheterization, by an experienced doctor, is permissible, even if the clinical or CT findings suggest urethral injury. In adults a 16F soft, silicone catheter should be used. The procedure and the presence of clear or blood stained urine must be recorded in the medical records.
4. The finding of blood stained urine mandates a retrograde cystogram via the catheter.
5. If the catheter will not pass or passes and drains only blood, do NOT inflate balloon. Withdraw catheter and perform a retrograde urethrogram.
6. If there is a urethral or bladder injury, the on-call urologist should be informed immediately so that a treatment plan can be formulated and recorded in the notes.
7. If a urethral catheter cannot be passed, a suprapubic catheter is required. This can be inserted during emergency laparotomy but otherwise a percutaneous suprapubic catheter should be placed.
8. A percutaneous, suprapubic catheter should be placed using a Seldinger technique under ultrasound control by a doctor experienced in this technique. The skin insertion point MUST be in the midline and should be 3 to 4 fingers-breadths above the symphysis. A 16F silicone catheter should be used.
9. The placement of a suprapubic catheter may alter the timing of pelvic fracture surgery and so the pelvic fracture service should be involved at an early stage.
10. If there is a urine leak from either the bladder or urethra, the pelvic fracture should be treated like an open long-bone fracture with appropriate antibiotics for 72 hours and early fracture fixation if the patient's physiology allows.
11. Intraperitoneal bladder rupture requires emergency laparotomy and direct repair.
12. Extraperitoneal rupture of the bladder may be treated by catheter drainage alone. However, in the presence of an unstable pelvic fracture, it is recommended that fracture reduction and fixation is performed along with primary repair of the bladder.
13. Extraperitoneal rupture of the bladder neck continues to leak even in the presence of a catheter and requires primary repair.
14. Bladder injuries identified during pelvic fracture surgery should be repaired at the same time and bladder drainage (via urethral or suprapubic catheter, as appropriate) ensured.
15. Bladder injury in children is rare but often more complex than adults. A paediatric urologist should always be involved early in the care of these injuries.
16. All urethral injuries in females and children must be discussed at a very early stage with the appropriate supra-regional specialist in urology.
17. The indications for primary (within 48 hours) urethral repair are: associated ano-rectal injury, perineal degloving, bladder neck injury, massive bladder displacement and penetrating trauma to the anterior urethra.
18. The recommended definitive treatment for urethral rupture in adult males is delayed repair at 3 months post injury. Each MTC should have a clear referral pathway to a recognised centre for reconstructive urethral surgery with a named urological lead consultant.
19. Primary re-alignment of the urethra during fracture surgery is not recommended as, in the hands of an inexperienced (urethral) surgeon, the risk of additional damage probably out-weighs the benefits. Accurate reduction of the bony pelvic ring indirectly re-aligns the urethra and facilitates delayed repair.
20. Male and female patients suffering displaced anterior pelvic fractures or urethral injury have a high incidence of urinary and sexual dysfunction. All patients should be provided with a written information sheet on this issue.
21. All Major Trauma Centres must have a linked Andrological service and all patients with displaced anterior pelvic fractures should be offered access to this service.
22. Hospitals receiving patients with these severe injuries must be part of the Trauma Audit and Research Network (TARN) and all centres performing delayed urethral reconstruction should participate in the national audit of this procedure.

Evidence base:
Consensus meeting BOA and BAUS 2015. www.nice.org.uk/guidance/ng37

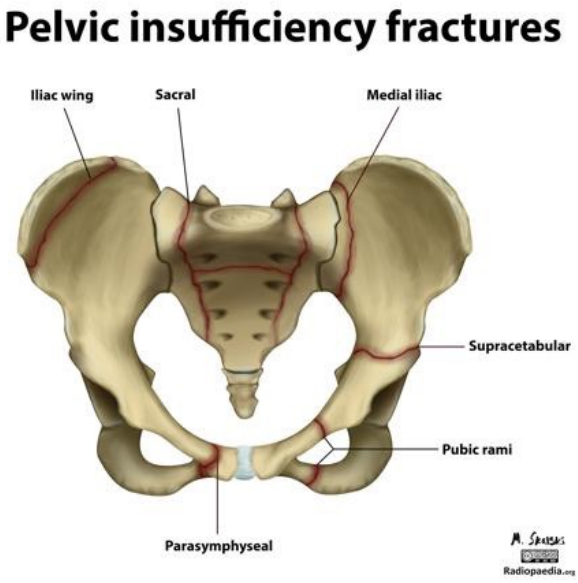
Reproductive organs

- Early
  - Occult open fracture
- Late
  - Sexual dysfunction (up to 50%)
  - Pregnancy
    - Re-assure
    - NOT mid wife only unit

Rest of Body

- Spine
  - Cervical
  - Thoracic
  - Lumbar
- Abdomen
- Thorax
- Head – High % in Lateral Compression
- Extremities – think mechanism!
  - Upper
  - Lower

Osteoporosis



BOAST: The care of the older or frail orthopaedic trauma patient

British Orthopaedic Association

National Hip Fracture Database (NHFD)

BOAST: BOA Standard

MAY 2019

The care of the older or frail orthopaedic trauma patient

Background

The care of orthopaedic trauma in the older or frail patient is dependent on coordinated multidisciplinary working to manage the physical injury, co-morbidities and rehabilitation, including measures to prevent further injury. Previously, patients with a hip fracture have been the focus of such collaboration but the need extends to patients sustaining other injuries. The frail patient with severe injuries is at risk of under-triage, delayed diagnosis and consequent sub-optimal care. The Trauma Audit Research Network (TARN) Elderly Trauma report[1] showed in that, in this group, it is not high energy mechanisms but falls from a standing height that predominate.

Inclusion:

All patients admitted having sustained a fragility fracture and patients sustaining major trauma who have a Clinical Frailty Scale (CFS) of 5 or more.

Standards for Practice

1. All patients should be managed in a frailty pathway which includes Comprehensive Geriatric Assessment (CGA)[2] commencing within 72 hours of injury. The pathway should demonstrate collaboration between pre-hospital services, Emergency Departments, Orthopaedic, Anaesthetic and Orthogeriatric clinicians. A written policy should define how the teams cooperate to manage ward-based patients in the peri-operative period (from admission to 24 hours post-op), including at weekends and on bank holidays.
2. Networks should have pathways to guide which patients should be discussed and transferred to a Major Trauma Centre (MTC) within 24 hours of admission. These pathways should include MDT review of all patients with ISS>15 who are not transferred. Network clinicians should be able to review imaging and utilise teleconferencing when appropriate.
3. When indicated, cross-sectional imaging should be obtained at initial presentation in the emergency department. Instances of later cross-sectional imaging should be the subject of an on-going audit. Imaging of the head should also include the cervical spine. When an unstable spinal injury is identified or cannot be excluded, the method of cervical spine protection must be clearly communicated and recorded.
4. Ceilings of treatment, including transfer, escalation and the appropriateness of cardiopulmonary resuscitation (CPR), should be discussed jointly by the treating teams. This should be documented and include the patient and those close to them, considering advanced directives, lasting powers of attorney and safeguarding issues. These decisions should be made at consultant level and prior to any surgery.
5. Protocols for the reversal of anticoagulation must be available and all patients should be assessed and treated for their risk of venous thromboembolism. Each hospital should have a guideline that is consistent across the Trauma Network.
6. Patients with a serious head injury (GCS 8 or less) should be considered for transfer to a neuroscience unit.
7. There must be a pathway for the management of chest wall trauma that includes early access to regional analgesia. There must be network guidelines for the selection and transfer of patients who may benefit from early surgery to stabilise the chest wall. These transfers must take place within 48 hours of the decision for surgical management.
8. Pain management must be through a defined strategy utilising patient-specific tools and incorporating peripheral nerve blockade when appropriate. Each hospital should have a specific pain guideline for this population with an emphasis on limitation of opioids, guidance in renal impairment and avoidance of non-steroidal medications.
9. All patients should have a multifactorial falls risk assessment and should be referred to falls prevention services if indicated.
10. All patients should have a bone health review, be investigated and prescribed appropriate medication when indicated.
11. All patients should have a nutritional assessment. No patients should be made nil by mouth unless immediate surgery is planned. Drinking fluids in the preoperative period should be encouraged, in line with local policies.
12. Units should routinely be using a validated delirium assessment tool (such as the 4AT) and have a delirium policy which describes preventative measures, ensures rapid identification of potentially reversible causes and delivers individualised interventions in line with NICE CG103.
13. Patients should not be nursed flat unless it is documented that this is essential. Early sitting up / bed tilt to decrease risks of recumbency should be encouraged.
14. All surgery in the frail patient should be performed to allow full weight-bearing for activities required for daily living and within 36 hours of admission, in line with current hip fracture care. Patients should be seen by a physiotherapist on postoperative day one with early identification of functional rehabilitation goals as detailed in the rehabilitation BOAST.
15. All patients with complex peri-articular or peri-prosthetic fractures should be discussed with specialist fracture surgeons within robust network pathways.
16. All patients must be entered into a discharge-planning pathway with a rehabilitation prescription and clear coordination between inpatient and outpatient therapists. All patients should receive information regarding expected functional recovery and rehabilitation, including advice about return to normal activities such as work and driving.
17. Each hospital should submit data to national databases (NHFD, FLS-DB and TARN) to monitor its performance against national benchmarks and quality standards.

[1] https://www.tarn.ac.uk/content/downloads/3793/Major%20Trauma%20in%20Older%20People%202017.pdf

[2] A comprehensive geriatric assessment is an inter-disciplinary diagnostic process to determine the medical, psychological and functional capability of someone who is frail and old. The aim is to develop a coordinated, integrated plan for treatment and long-term support. https://www.nice.org.uk/guidance/qs136/chapter/quality-statement-2-comprehensive-geriatric-assessment

BOAST: Fracture Liaison Service

British Orthopaedic Association

Royal Osteoporosis Society
Better bone health for everybody

Arthritis and Musculoskeletal Alliance

BRITISH ORTHOPAEDIC ASSOCIATION STANDARDS for TRAUMA

Fracture Liaison Services

Background and justification
Fracture Liaison Services (FLS) provide secondary prevention for fragility fractures (defined as a fracture following a fall from standing height or less). These services systematically and proactively identify patients in secondary and/or primary care who have suffered a fragility fracture and assess the patient's risk of future fragility fracture in a timely fashion. FLS then provide advice and/or therapy to reduce that risk. There is now good evidence that these services are cost-effective and can result in a reduction in the incidence of fragility fractures in the local population.

Inclusions
All patients aged 50 years or older with a fragility fracture that present to an Emergency Department or fracture clinic or have a fragility fracture, such as pelvic or vertebral compression, that is identified in primary care.

Standards for Practice

1. A Fracture Liaison Service should be available to all hospitals that provide definitive fracture care, either as an inpatient or an outpatient e.g. fracture clinic,acute spinal clinic.
2. Fracture Liaison Services should be led by a consultant physician or general practitioner with appropriate training and expertise in osteoporosis management.
3. Fracture Liaison Services should have systems in place that identify all patients 50 years old and over presenting with a fragility fracture, including vertebral fractures. There must be clear entry criteria into the pathway and this should include patients presenting to, and managed within, primary care.
4. All patients presenting with a fragility fracture must be provided with written information giving advice on the nature of fragility fractures, bone health, lifestyle, nutrition and bone protection treatment.
5. Patients must be offered a multifactorial bone health assessment within 3 months of the incident fracture.
6. Fracture Liaison Services must have a system to identify patients at risk of falls and ability to either assess and recommend treatment(s) or refer rapidly to an appropriate service.
7. Fracture Liaison Services must have timely access to DEXA scanning. Patients who need DEXA should be offered a date for scan within 12 weeks of their fracture.
8. Fracture Liaison Services should have a linked metabolic bone service that allows patients timely access to expert medical advice when required.
9. Fracture Liaison Services should maintain good communication with the patients and their General Practioner who must be informed of all test results and theraputic recommendations.
10. Fracture Liaison Services should have a system in place to review patient compliance with treatment.
11. Fracture Liaison Services should undertake routine audit and submit data to the National FLS-Database once this is established.

Evidence Base
NICE Clinical Guidance CG146. Osteoporosis: assessing the risk of fragility fracture
https://www.nice.org.uk/guidance/CG146

NICE Technology Appraisal TA161. Secondary prevention of osteoporotic fragility fractures.
https://www.nice.org.uk/Guidance/TA161

NICE Quality Standard QS16. Quality standard for hip fracture
http://www.nice.org.uk/guidance/QS16

Persistent pain

- Posterior pain
- Late instability

Treatment

- Very difficult, no good solutions

Mental Health

- Pre-existing (20-30%)

- Most important factor in polytrauma long term outcomes!

BOAST: Rehabilitation and communication with trauma patients

British Orthopaedic Association

BRITISH ORTHOPAEDIC ASSOCIATION STANDARDS for TRAUMA AUG 2016

Rehabilitation and Communication with Trauma Patients

Background and justification
Rehabilitation is the process of restoration of a patient to their pre-injury state. A rehabilitation Prescription starts by identifying the components of the injury and the interventions required. These interventions may include acute management, surgery and therapies. Trauma can be a sudden and life changing event that may have a devastating effect on patients, their families and friends. Since the advent of trauma networks, the most appropriate care may require transfer and treatment away from the nearest hospital. It is recognised that recovery from injury requires multidisciplinary coordinated care including good communication and rehabilitation from the time of injury.

Inclusions
All patients admitted to hospital after trauma.

Standards for Practice

1. A rehabilitation prescription should be initiatied within 24 hours of admission and would be anticipated to evolve.
2. A rehabilitation prescription should be standardised to include information such as diagnosis, treatment, management plan, transfer/ discharge plan, medication, thromboprophlyaxis, expected goals, therapy requirements, out-patient visits, wound care and referral for further care (including psychological support).
3. The rehabilitation prescription should accompany the patient on transfer or discharge. In addition when interhospital transfer occurs, there must be documented liaison between trauma coordinators and treating specialty teams.
4. The patient's management plan, and any changes to this, should be communicated to the patient and relatives/ carers in a timely fashion.
5. Each unit should have a designated coordinator, who is responsible for communication and liaison. This person should be identified to the patient and or relatives/carers, within 12 hours of admission.
6. Within 24 hours of admission there should be a written summary which gives the diagnosis, management plan and expected outcome, aimed at the GP but written in plain English, understandable by patients and carers, and available in the patients records.
7. Issues with regard to safeguarding, comorbidities, falls risk and future bone health should be addressed.
8. After major trauma, all patients and carers should have at least one face-to-face meeting with the Major Trauma Coordinator.
9. Written information should be provided about ward and hospital services, including visiting hours, parking, where to eat, rest areas, in-house and local hotel services and religious support. If requested, additional information on travel expenses from social services must be available.
10. Patients should be given advice on when they would be expecting to return to previous function, including employment, driving and recreational activities.
11. There should be a contact number made available if there are further queries.
12. All healthcare practitioners must have access to all records to ensure consistent information is provided, respecting patient confidentiality at all times.
13. A system should be in place to identify and contact patients with complex needs, within 14 days of discharge, to discuss their progress and on-going physical, psychological and social needs. Issues identified must be communicated with their general practitioner.

Evidence base
Consensus statement based upon the views of patients, families and carers plus professional guidelines for doctors and nurses.
www.nice.org.uk/guidance/ng40

Infection

- BOAST
  - Open fractures
  - Fracture related infection

BOAST: Open fractures

British Orthopaedic Association

BAPRAS
British Association of Plastic Reconstructive and Aesthetic Surgeons

BRITISH ORTHOPAEDIC ASSOCIATION & BRITISH ASSOCIATION OF PLASTIC, RECONSTRUCTIVE & AESTHETIC SURGEONS AUDIT STANDARDS for TRAUMA

DEC 2017

Open Fractures

Background and justification
Open fractures may require timely multidisciplinary management. The consequences of infection, can be great both for the individual patient and the community. Trauma networks and hospitals require the appropriate pathways and infrastructure, to manage these patients, to enable optimum recovery and to minimise the risk of infection.

Inclusions:
All patients with open fractures of long bones, hind foot or midfoot (excluding hand, wrist, forefoot or digit).

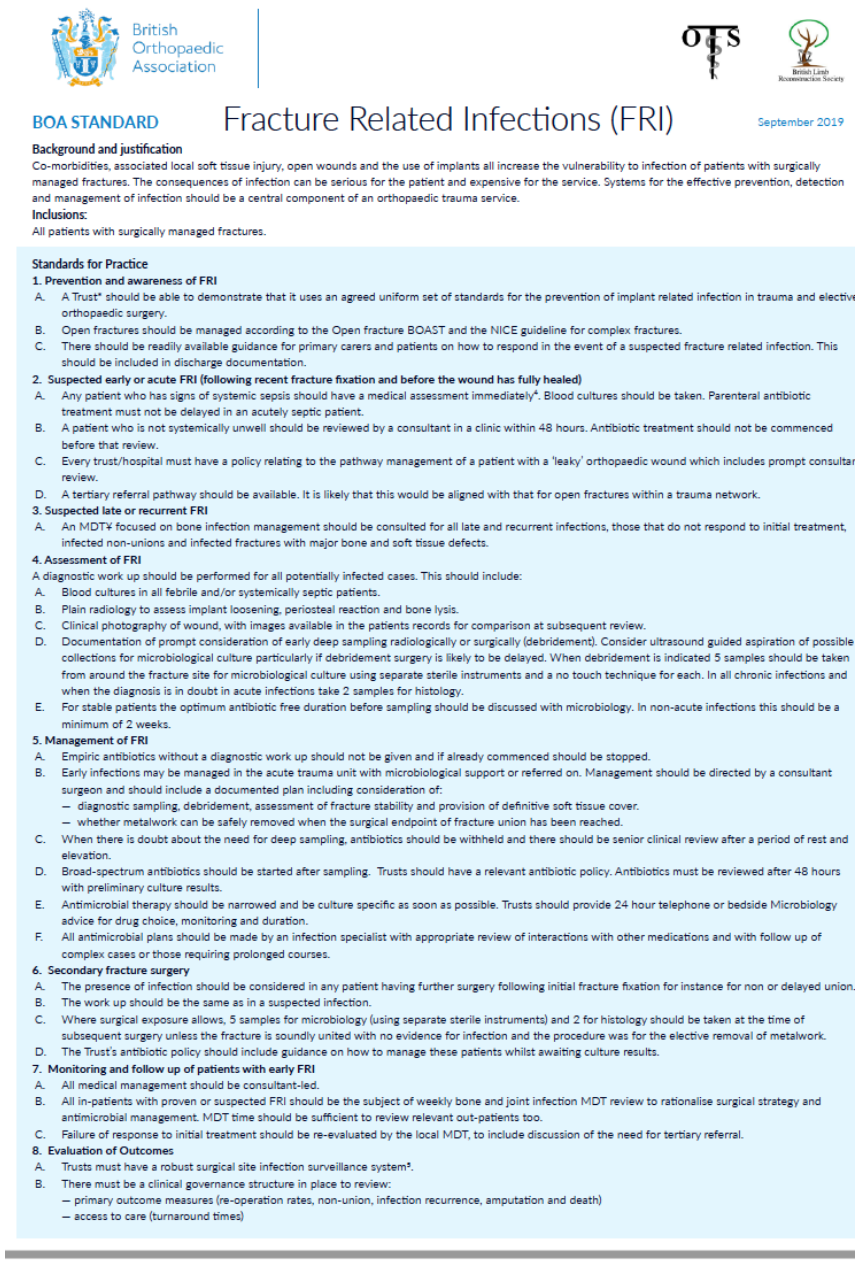
Standards for Practice

1. Patients with open fractures of long bones, hind foot or midfoot should be taken directly or transferred to a specialist centre that canprovide Orthoplastic* care. Patients with hand, wrist, forefoot or digit injuries may be managed locally following similar principles.
2. Intravenous prophylactic antibiotics should be administered as soon as possible, ideally within 1 hour of injury.
3. There should be a readily accessible published network guideline for the use of antibiotics in open fractures.
4. The examination of the injured limb should include assessment and documentation of the vascular and neurological status. This shouldbe repeated systematically, particularly after reduction manoeuvres or the application of splints. Management of suspectedcompartment syndrome should follow BOAST guidelines.
5. The limb should be re-aligned and splinted.
6. Patients presenting with arterial injuries in association with their fracture should be treated in accordance with the BOAST for arterial injuries.
7. In patients where an initial "Trauma CT" is indicated there should be protocols to maximise the useful information and minimise delay:
   - The initial sequence should include a head to toes scanogram. This should be used with clinical correlationto direct further specific limb sequences during that initial CT examination.
   - There should be a local policy on the inclusion of angiography in any extremity CT related to open fractures.
8. Prior to formal debridement the wound should be handled only to remove gross contamination and to allow photography, thendressed with a saline-soaked gauze and covered with an occlusive film. 'Mini-washouts' outside the operating theatre environmentare not indicated.
9. All trauma networks must have information governance policies in place that enable staff to take, use and store photographs of openfracture wounds for clinical decision-making 24 hours a day.
10. Photographs of open fracture wounds should be taken when they are first exposed for clinical care, before debridement and at otherkey stages of management. These should be kept in the patient's records.
11. The formation of the management plan for fixation and coverage of open fractures and surgery for initial debridement should be undertaken concurrently by consultants in orthopaedic and plastic surgery (a combined orthoplastic approach).
12. Debridement should be performed using fasciotomy lines for wound extension where possible (see overleaf for recommendedincisions for fasciotomies of the leg)
    - Immediately for highly contaminated wounds (agricultural, aquatic, sewage) or when there is an associatedvascular compromise (compartment syndrome or arterial disruption producing ischaemia).
    - within 12 hours of injury for other solitary high energy open fractures
    - within 24 hours of injury for all other low energy open fractures.
13. Once debridement is complete any further procedures carried out at that same sitting should be regarded as clean surgery; i.e. thereshould be fresh instruments and a re-prep and drape of the limb before proceeding.
14. Definitive soft tissue closure or coverage should be achieved within 72 hours of injury if it cannot be performed at the time ofdebridement
15. Definitive internal stabilisation should only be carried out when it can be immediately followed with definitive soft tissue cover.
16. When a decision whether to perform limb salvage or delayed primary amputation is indicated, this should be based on amultidisciplinary assessment involving an orthopaedic surgeon, a plastic surgeon, a rehabilitation specialist, the patient and theirfamily or carers.
17. When indicated, a delayed primary amputation should be performed within 72 hours of injury.
18. Each trauma network should submit appropriate data to the TARN, monitor its performance against national standards and audit its outcomes.
19. All patients should receive information regarding expected functional recovery and rehabilitation, including advice about return to normal activities such as work and driving.

*The BAPRAS/BOA group recommend that for clarity the narrative description of an Orthoplastic Service by NICE is broken into its component parts as follows: a combined service of Orthopaedic and Plastic Surgery Consultants; sufficient combined operating lists with consultants from both specialties to meet the standards for timely management of open fractures; scheduled, combined review clinics for severe open fractures; specialist nursing teams able to care for both fractures and flaps. In addition, an effective orthoplastic service will also: submit data on each patient to the national trauma database (TARN) and hold regular clinical audit meetings with both orthopaedic and plastic surgeons present. Please note: the definition of an Orthoplastic Centre was updated in November 2019.

Evidence base:
NICE Complex fracture guideline https://www.nice.org.uk/guidance/NG37/chapter/recommendations

BOAST: Fracture related infection



British Orthopaedic Association

BOA STANDARD

Fracture Related Infections (FRI)

September 2019

Background and justification

Co-morbidities, associated local soft tissue injury, open wounds and the use of implants all increase the vulnerability to infection of patients with surgically managed fractures. The consequences of infection can be serious for the patient and expensive for the service. Systems for the effective prevention, detection and management of infection should be a central component of an orthopaedic trauma service.

Inclusions:

All patients with surgically managed fractures.

Standards for Practice

1. Prevention and awareness of FRI

A. A Trust* should be able to demonstrate that it uses an agreed uniform set of standards for the prevention of implant related infection in trauma and elective orthopaedic surgery.
B. Open fractures should be managed according to the Open fracture BOAST and the NICE guideline for complex fractures.
C. There should be readily available guidance for primary carers and patients on how to respond in the event of a suspected fracture related infection. This should be included in discharge documentation.

2. Suspected early or acute FRI (following recent fracture fixation and before the wound has fully healed)

A. Any patient who has signs of systemic sepsis should have a medical assessment immediately[4]. Blood cultures should be taken. Parenteral antibiotic treatment must not be delayed in an acutely septic patient.
B. A patient who is not systemically unwell should be reviewed by a consultant in a clinic within 48 hours. Antibiotic treatment should not be commenced before that review.
C. Every trust/hospital must have a policy relating to the pathway management of a patient with a 'leaky' orthopaedic wound which includes prompt consultant review.
D. A tertiary referral pathway should be available. It is likely that this would be aligned with that for open fractures within a trauma network.

3. Suspected late or recurrent FRI

A. An MDT¥ focused on bone infection management should be consulted for all late and recurrent infections, those that do not respond to initial treatment, infected non-unions and infected fractures with major bone and soft tissue defects.

4. Assessment of FRI

A diagnostic work up should be performed for all potentially infected cases. This should include:

A. Blood cultures in all febrile and/or systemically septic patients.
B. Plain radiology to assess implant loosening, periosteal reaction and bone lysis.
C. Clinical photography of wound, with images available in the patients records for comparison at subsequent review.
D. Documentation of prompt consideration of early deep sampling radiologically or surgically (debridement). Consider ultrasound guided aspiration of possible collections for microbiological culture particularly if debridement surgery is likely to be delayed. When debridement is indicated 5 samples should be taken from around the fracture site for microbiological culture using separate sterile instruments and a no touch technique for each. In all chronic infections and when the diagnosis is in doubt in acute infections take 2 samples for histology.
E. For stable patients the optimum antibiotic free duration before sampling should be discussed with microbiology. In non-acute infections this should be a minimum of 2 weeks.

5. Management of FRI

A. Empiric antibiotics without a diagnostic work up should not be given and if already commenced should be stopped.
B. Early infections may be managed in the acute trauma unit with microbiological support or referred on. Management should be directed by a consultant surgeon and should include a documented plan including consideration of:
   — diagnostic sampling, debridement, assessment of fracture stability and provision of definitive soft tissue cover.
   — whether metalwork can be safely removed when the surgical endpoint of fracture union has been reached.
C. When there is doubt about the need for deep sampling, antibiotics should be withheld and there should be senior clinical review after a period of rest and elevation.
D. Broad-spectrum antibiotics should be started after sampling. Trusts should have a relevant antibiotic policy. Antibiotics must be reviewed after 48 hours with preliminary culture results.
E. Antimicrobial therapy should be narrowed and be culture specific as soon as possible. Trusts should provide 24 hour telephone or bedside Microbiology advice for drug choice, monitoring and duration.
F. All antimicrobial plans should be made by an infection specialist with appropriate review of interactions with other medications and with follow up of complex cases or those requiring prolonged courses.

6. Secondary fracture surgery

A. The presence of infection should be considered in any patient having further surgery following initial fracture fixation for instance for non or delayed union.
B. The work up should be the same as in a suspected infection.
C. Where surgical exposure allows, 5 samples for microbiology (using separate sterile instruments) and 2 for histology should be taken at the time of subsequent surgery unless the fracture is soundly united with no evidence for infection and the procedure was for the elective removal of metalwork.
D. The Trust's antibiotic policy should include guidance on how to manage these patients whilst awaiting culture results.

7. Monitoring and follow up of patients with early FRI

A. All medical management should be consultant-led.
B. All in-patients with proven or suspected FRI should be the subject of weekly bone and joint infection MDT review to rationalise surgical strategy and antimicrobial management. MDT time should be sufficient to review relevant out-patients too.
C. Failure of response to initial treatment should be re-evaluated by the local MDT, to include discussion of the need for tertiary referral.

8. Evaluation of Outcomes

A. Trusts must have a robust surgical site infection surveillance system[5].
B. There must be a clinical governance structure in place to review:
   — primary outcome measures (re-operation rates, non-union, infection recurrence, amputation and death)
   — access to care (turnaround times)

***TRUST** = the term Trust is used for brevity and should be interpreted as "Hospital Trust or equivalent responsible body".
¥ MDT = multidisciplinary team which should include orthopaedic and plastic surgeons experienced in infection management with access to joint operating list, infection specialists and musculoskeletal radiologists.

References

1. NICE quality standard [QS61] Infection prevention and control, April 2014
2. Open fracture BOAST
3. NICE complex fracture guidelines 2016
4. NICE guideline: The recognition, diagnosis and management of sepsis, 2016
5. https://www.gov.uk/government/collections/surgical-site-infection-ssi-guidance-data-and-analysis

Anterior Approaches

Posterior Approaches

Ilioinguinal

Medial window / Stoppa
Middle window
Lateral window