Orthopaedic Trauma

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Outline

* Compartment Syndrome
* Open Fractures
* Pelvic Fractures

Compartment Syndrome
Definition

* Elevated tissue pressure within a closed fascial space
* Reduces tissue perfusion
* Results in cell death
* Pathogenesis
  * Too much inflow (edema, hemorrhage)
  * Decreased outflow (venous obstruction, tight dressing/cast)

Compartment Syndrome...

Tissue Survival

* Muscle
  * 3-4 hours - reversible changes
  * 6 hours - variable damage
  * 8 hours - irreversible changes

* Nerve
  * 2 hours - decreased nerve conduction
  * 4 hours - neuropraxia
  * 8 hours - irreversible changes

Compartment Syndrome...

Etiology

- Fractures-closed and open
- Blunt trauma
- Temp vascular occlusion
- Cast/dressing
- Closure of fascial defects
- Burns/electrical
- Exertional states
- GSW
- IV/A-lines
- Hemophiliac/coagulopathy
- Intraosseous IV(infant)
- Snake bite
- Arterial injury

Compartment Syndrome...
Diagnosis

- Pain out of proportion to injury
- Pain with passive stretch
- Palpably tense compartment
- Paresthesia/hypoesthesia
- Paralysis
- Pulselessness/pallor

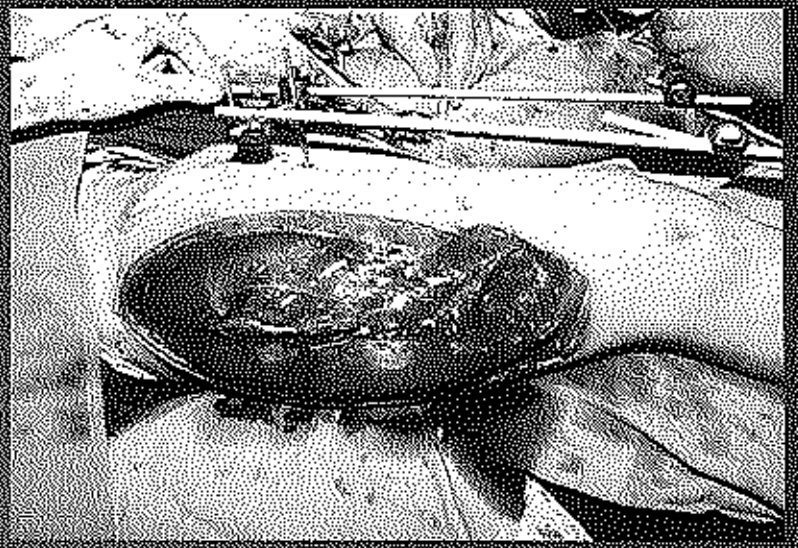
Compartment Syndrome...
Emergent Treatment

- Remove cast or dressing
- Place limb at level of heart

  (DO NOT ELEVATE to optimize perfusion)
- Alert OR and Anesthesia
- Bedside procedure
- Medical treatment
  - Consider coexistent crush
  - ? Renal 'prophylaxis'
  - Maximize cardiac output

Compartment Syndrome...
Surgical Treatment

* Fasciotomy –
  * prophylactic release of pressure before permanent damage occurs.
  * Will not reverse injury from trauma.
  * GOAL: RESTORE PERFUSION



* Fracture care –
  * Rigid stabilization
  * Ex-fix
  * IM Nail (locking optional)

Compartment Syndrome…

Indications for Fasciotomy

- Unequivocal clinical findings
- Pressure within 15-20 (30) mm hg of DBP
- Rising tissue pressure
- Significant tissue injury or high risk pt
- > 6 hours of total limb ischemia
- Injury at high risk of compartment syndrome
- CONTRAINDICATION –
  - ***Missed CS (>24-48 hrs)***

Leg Fasciotomies

- Generous skin incisions (Mubarak 1977)
  - medial
  - lateral
- Release completely all 4 fascial compartments
- Beware of neurovascular structures to prevent iatrogenic injury

Compartment Syndrome…
Other Areas

* Can occur anywhere in the body
* Hand
* Arm
* Buttock/thigh
    * BEWARE arterial injury…consider angiogram
* Abdominal
    * With you general surgeons!

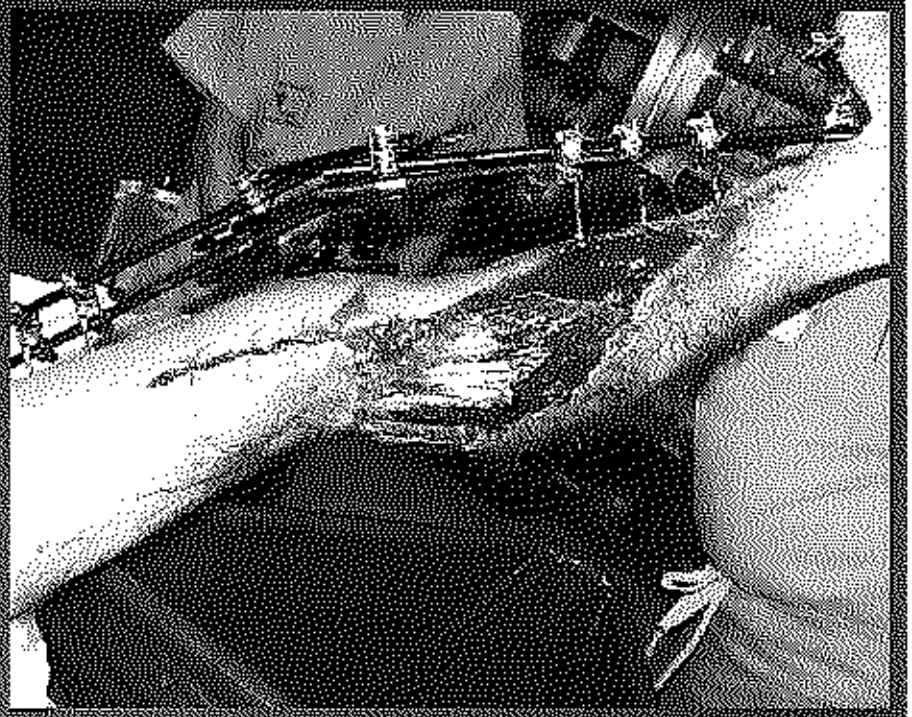
Outcomes...

- Heemskerk et al, World J Surg, 2003
  - 40 successive cases
  - 6 cases; ACS from Gen Surg procedures in lithotomy position
  - Majority trauma/vascular cases
  - 15% MORTALITY
  - 12% amputation
  - Dysfunctional limb; 27%
    - Functional; 45%
  - AGE most significant factor
- Finkelstein et al
  - Fasciotomy for 'missed' compartment syndrome
  - 50% incidence; death, sepsis, deep infection

Open Fractures

Open Fractures

* All fractures have some degree of soft tissue injury
  * Prognosis determined by:
    * Amount of energy transferred to the soft tissue and bone
    * Degree of contamination and type of bacteria
    * Patient factors



Skin Lesions

* Blisters
  * Clear
  * Sanguineous
* Abrasions
* Degloving
  * Morel-Lavalle

Open Fracture

* Definition
  * A break in the skin and soft tissues communicating with a fracture or its hematoma.

Gustilo-Anderson Grade I

Gustilo-Anderson Grade II

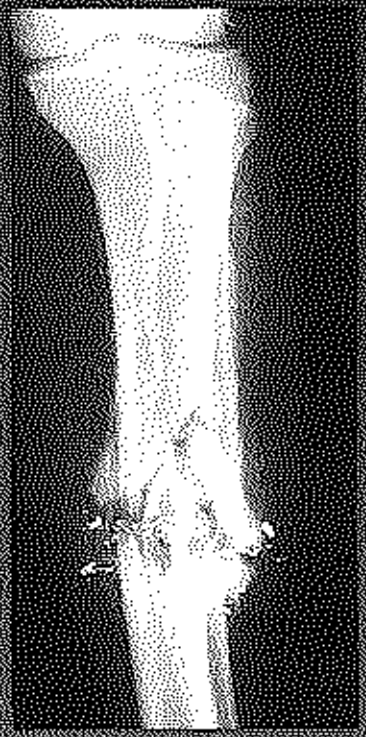
Gustilo-Anderson Grade IIIA

Gustilo-Anderson Grade IIIA

IIIA Includes severe comminution despite size of skin wound.

Gustilo-Anderson Grade IIIB

Gustilo-Anderson Grade IIIC



Assessment

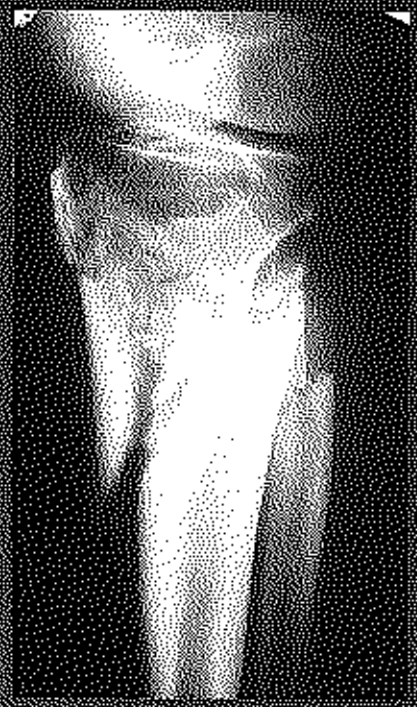
* History
  * Mechanism
    * High or low energy?
  * Time since injury
  * Pre-morbid conditions
  * Other injuries

Assessment

* Physical Exam
  * One look soft tissue exam
  * Neurological status
  * Vascular status
  * Compartments

Assessment

* X-rays
  * Standard two 90° views
  * Joint above and below fracture



Emergent Treatment

- One Look Exam
- Sterile Dressing
- No ER Cultures
  - Poor indicator of probability of infection and organism
  - expensive
- Realign and Splint

Tetanus Toxoid

Tetanus Toxoid 2.5 cc to all poly-trauma patients, otherwise:

IMMUNIZATION HISTORY	NON-TETANUS PRONE	TETANUS PRONE*
UNKNOWN	YES	YES
>3 IMMUNIZATIONS (<5 YEARS)	NO	NO

***Tetanus Prone: >6 hours old, complex soft tissue injury, wound >1 cm deep, missile, crush, burn, frostbite, devitalized tissues, soil contaminants, denervated, ischemic, early infection.**

Tetanus Immune Globulin

250-500 units IM:

IMMUNIZATION HISTORY	NON-TETANUS PRONE	TETANUS PRONE*
UNKNOWN	NO	YES
>3 IMMUNIZATIONS (<5 YEARS)	NO	NO

Bacteriology of Open Fractures

Blunt Trauma, Low Energy GSW	Staph, Strept
Farm Wounds	Clostridia
Fresh Water	Pseudomonas, Aeromonas
Sea Water	Aeromonas, Vibrios
War Wounds, High Energy GSW	Gram Negative

Recommended Antibiotic Treatment

	1 Gen Ceph	Gent	PCN
Grade I	✔		
Grade II	✔	+/-	
Grade III	✔	✔	+/-
Farm/War Wounds	✔	✔	✔

(Gustilo, et al; JBJS 72A 1990)

Duration of Antibiotic Treatment

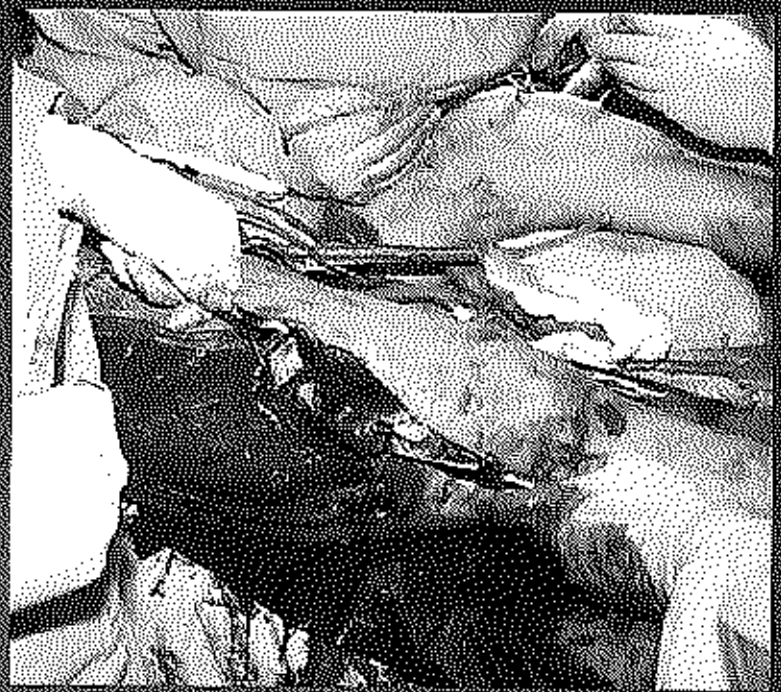
- Initial 72 hours
- 48 hours after each subsequent procedure

Treatment

* Principles
  * Limb Salvage?
  * Vascular Injury?

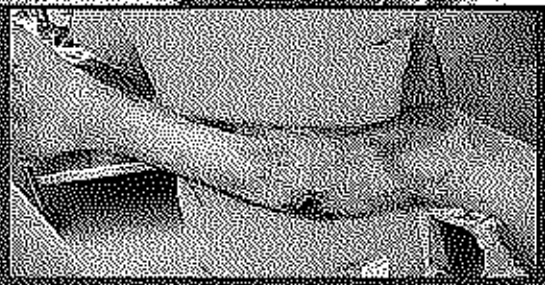
Principles of I&D

- Longitudinal incisions- extensile exposures
- Excise non viable tissue
  - Systematic and detailed approach
- Irrigation
- Stabilize fracture



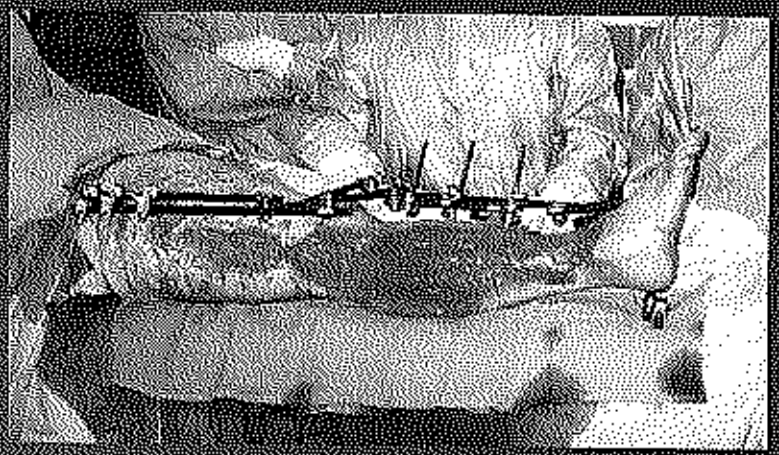
I&D

- Systematic
  - Skin
  - Fascia and fat
  - Muscle: 4 C's of muscle viability
    - Contractility
    - Capacity to bleed
    - Consistency
    - Color



Stable Fixation

* Reduces infection
  * Options:
    * External fixation
      * +/- delayed internal fixation
    * IM Nail
    * ORIF



Wound Closure

* Primary Closure?
* Delayed closure/coverage
  * STSG
  * Flaps
  * VAC

Pelvic Ring Injuries

Epidemiology

* Pelvic fractures account 1-3% of all fxs
* 60% Male
* Mechanism
  * MVC (57-71%)
  * Collision w/ pedestrian (13-18%)
  * Motorcycle accident (5-9%)
  * Falls (4-9%)
  * Crush injury (4-5%)

Epidemiology

* Overall reported mortality figures for pelvic injuries range from 8%-13%
  * Higher energy injuries greater mortality
  * Peds vs car (23%)

Poole GV, Ward EF: Causes of mortality in patients with pelvic fractures, *Orthop* 17:691, 1994.

Pohlemann T et al: Pelvic fractures: epidemiology, therapy and long term outcome. Overview of the multicenter studey of the pelvis study group, *Unfallchirurg* 99:160, 1996.

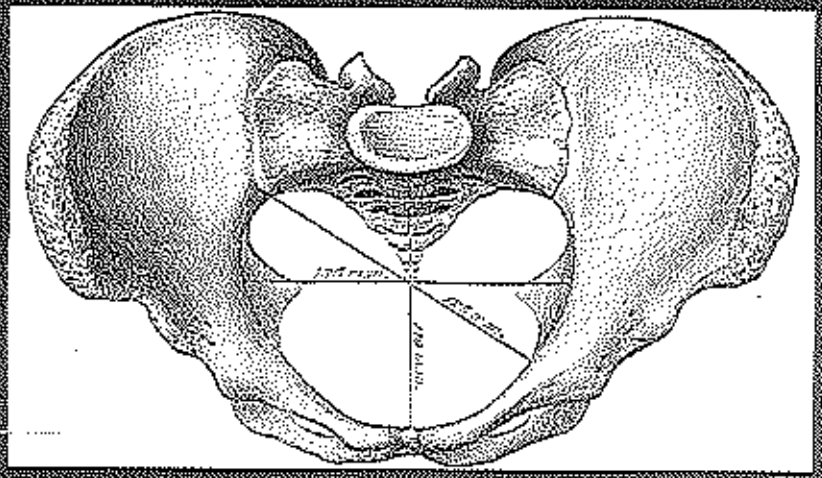
Key Point

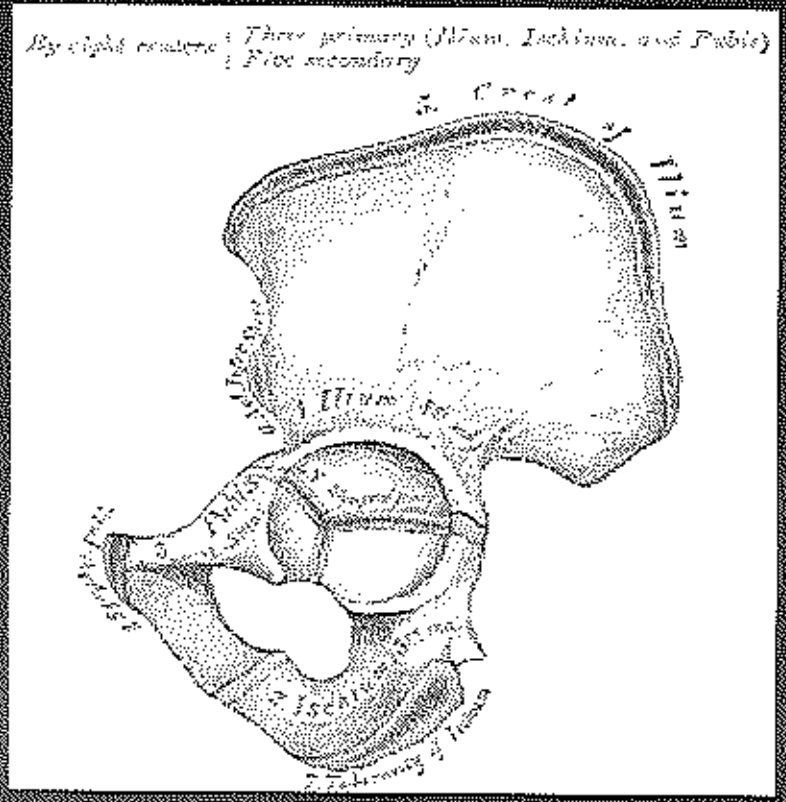
- Presence of a pelvic fracture indicates the profound magnitude of disruptive energy at the time of injury
- Alerts to likelihood of major injury to other body systems

Pelvic fractures bad, associated injuries very bad!

Pelvic Anatomy

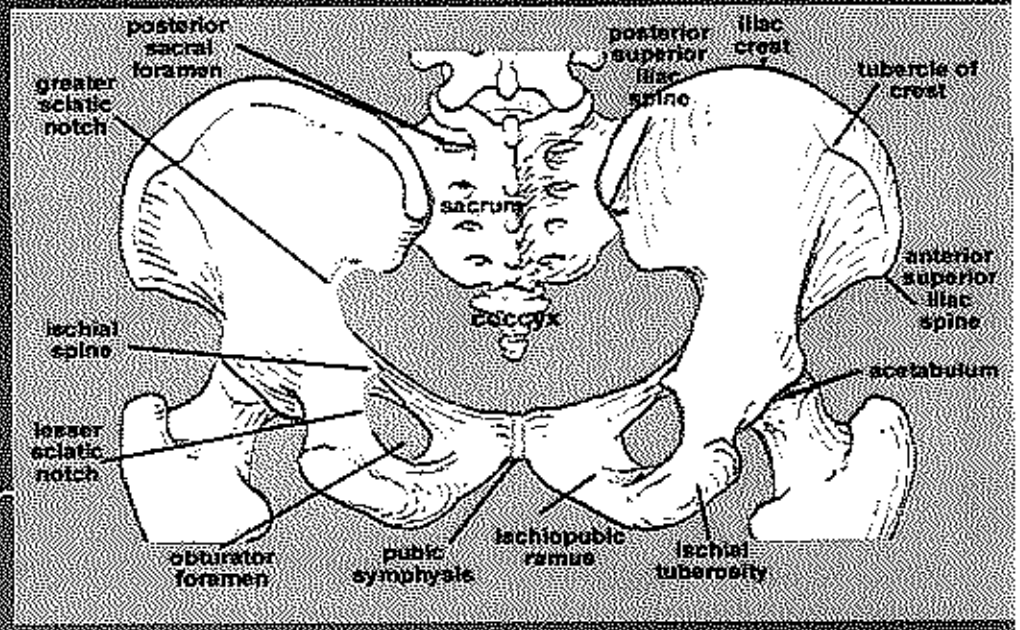
* Inominate bones (2)
  * ilium, ischium & pubis
* Sacrum
* Coccyx





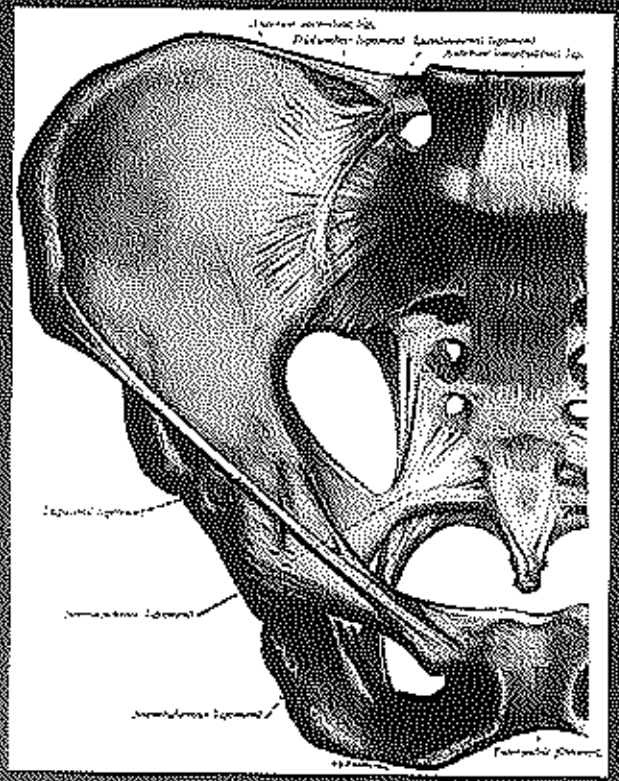
Pelvic Anatomy

- Pelvis contains 5 joints
  - * Lumbosacral
  - * Sacroiliac
  - * Sacrococcygeal
  - * Symphysis pubis
  - * Acetabulum *movemer



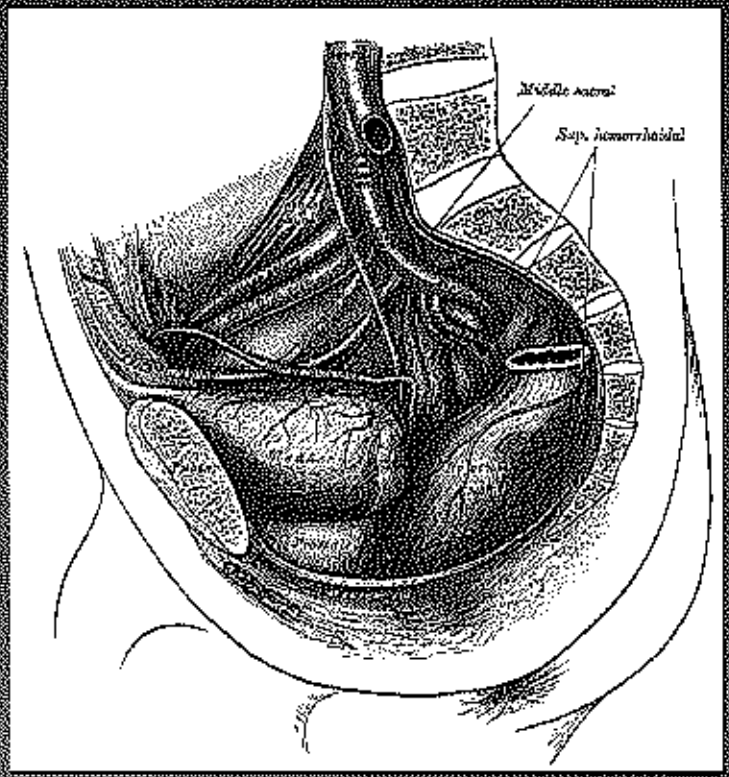
Pelvic Amatomy

* Ring structure is basis for stability
* Stability via ligaments
  * Iliolumbar
  * Sacroiliac
  * Sacrotuberous
  * Sacrospinous



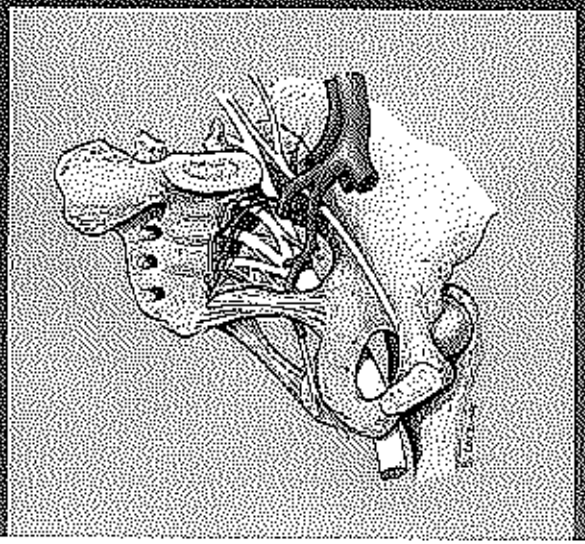
Pelvic Anatomy

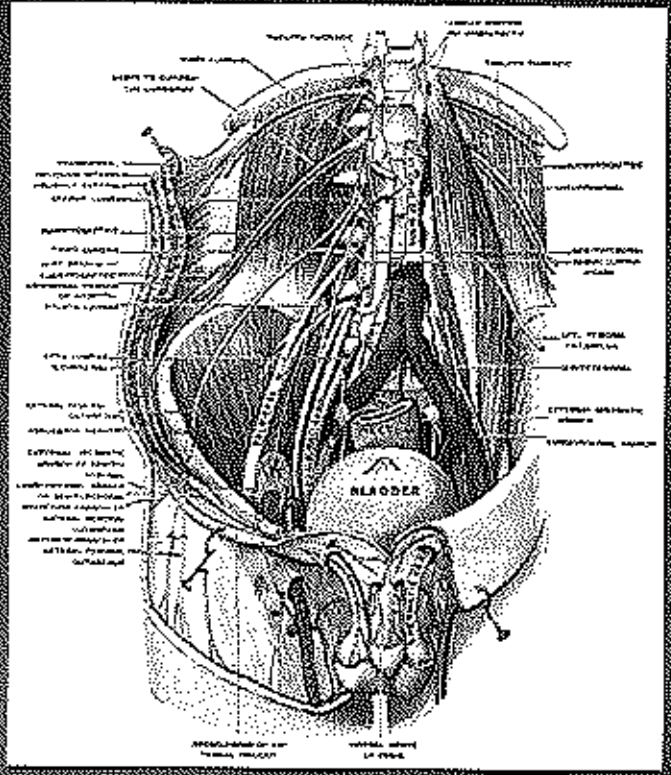
- Pelvis is extremely vascular
- Majority of blood from hypogastrics (internal iliac)
- Proximity to pelvic arch
- Superior gluteal: largest branch, commonly injured in posterior fxs
- Obturator & internal pudendal often injured in fxs involving pubic rami



Pelvic Anatomy

* Nerve supply from lumbar & sacral plexi
* Proximity to posterior arch of pelvic ring



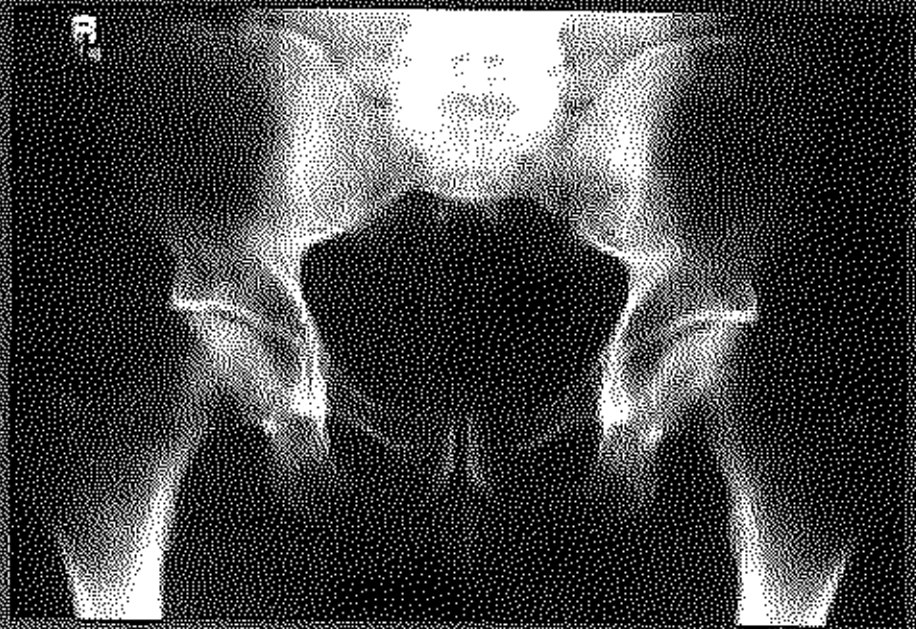


Pelvic Radiography

* Unique skeletal evaluation in trauma setting
  * Only one view is obtained
    * AP Pelvis
* Most injuries can be identified
* More commonly missed
  * Acetabulum, sacroiliac joints, sacrum
* May not define the extent of the injury

AP Pelvis

* Adequacy:
  * Both iliac crests
  * Proximal femurs
  * Lower lumbar spine
  * No rotation
  * Pubic symphysis aligns midline with sacral spinous processes



Pelvic CT

- CT has replaced supplementary plain-films
- Greater anatomic detail
- The best study for acetabular & sacral fxs
- Assesses extent of instability
- Evaluates retroperitoneal hematoma

Pelvic CT

- Specific indications for pelvic CT
  - * Acetabular fractures
  - * Dislocations of the hip
  - * All potential or recognized sacral fractures
  - * All potential or recognized SI injuries
  - * Question of instability
- Patient must be hemodynamically stable

Hunter JC, Brandser EA, Tran KA. Pelvic and acetabular trauma. Radiol Clin North Am. 1997;35:559-590.

Angiography

* Method of diagnosing & controlling life-threatening arterial hemorrhage in pelvic fractures
* Indicated in hemodynamic instability when…
  * Thoracic source r/o
  * External source r/o
  * Negative DPL
  * Presence of pelvic fx
* Use in conjunction with mechanical fracture stabilization (Ex-Fix)