Update in Orthopaedic Trauma

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Update in Orthopaedic Trauma

Outline

- Pelvic fracture
- Spinal cord injury
- Open fractures
- Compartment syndrome

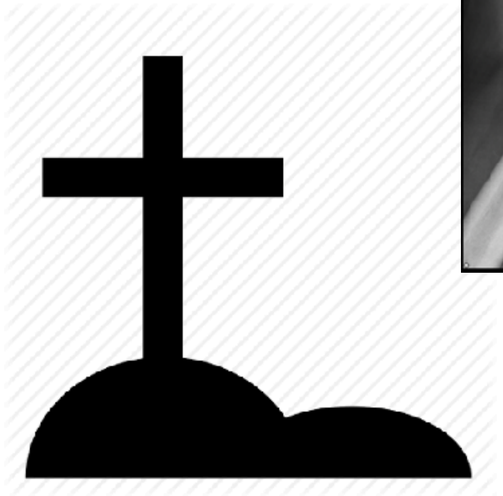
Pelvic fracture

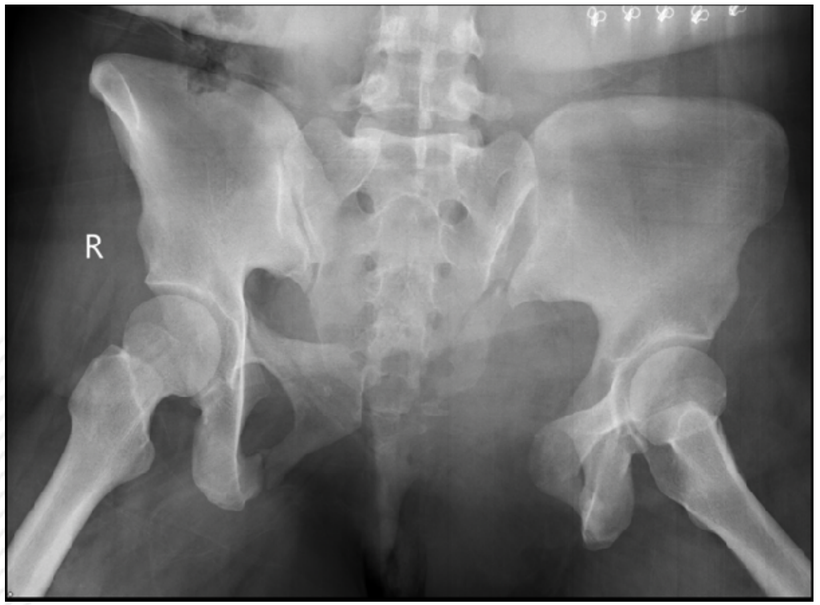
Pelvic fracture

- **Mortality rate** 15-25% for CLOSED fracture

and

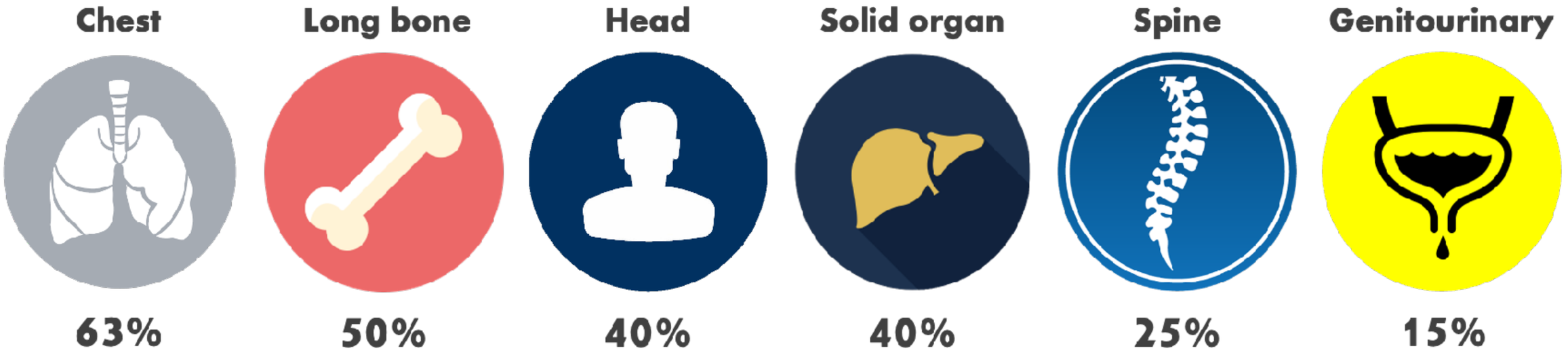
50% for OPEN fracture!!





Pelvic fracture

Associated injuries

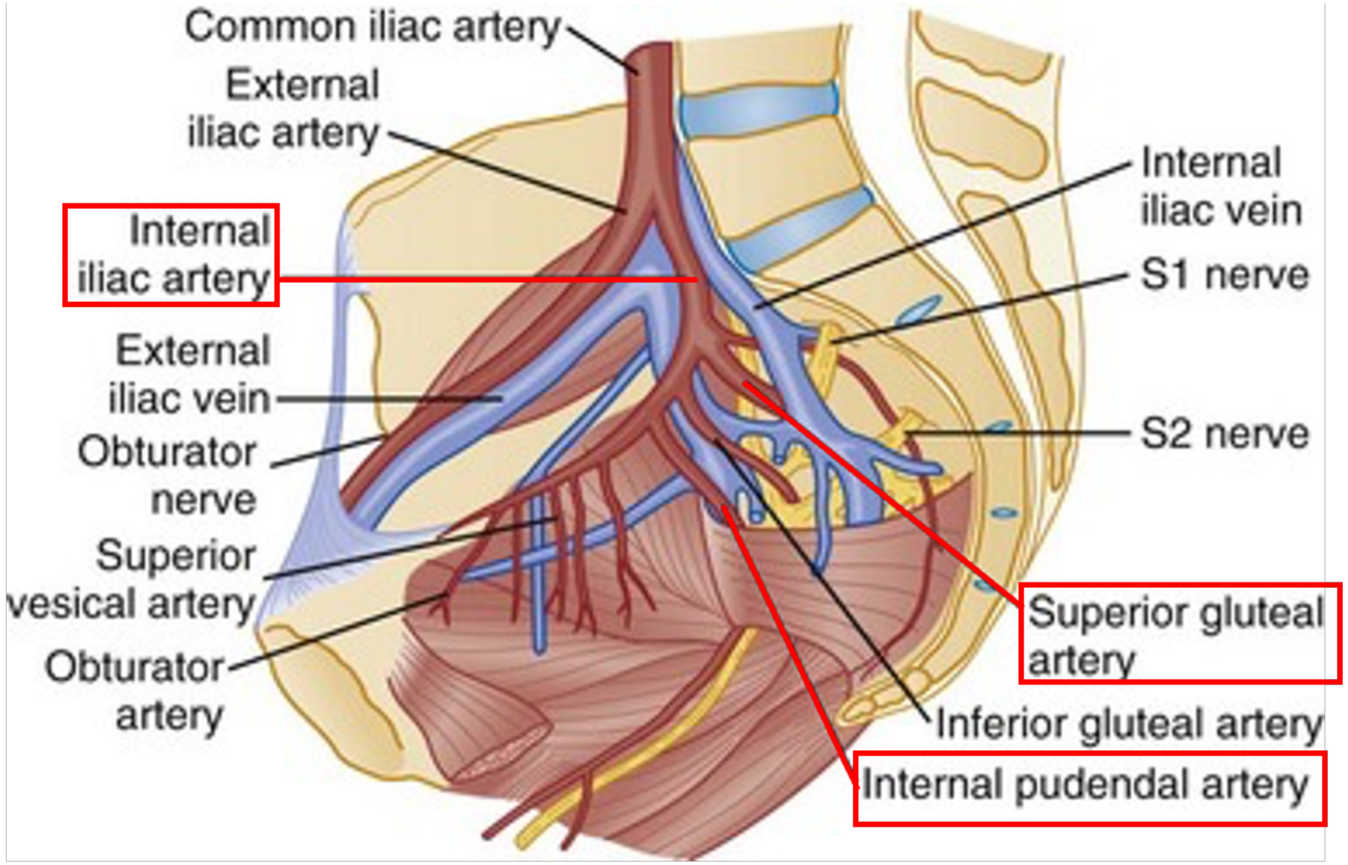


- **APC III** – Circulatory shock (67%)
- **Vertical shear** – Hypovolemic shock, High mortality 25 %

Gross hematuria or UA RBC > 30 – 50 = GU Injury

Pelvic fracture

Pelvic hemorrhage



Sources of bleeding

- 90% : Venous plexus + Bone
- 10% : Artery

- Venous plexus - most common
- Internal iliac artery
  - Superior gluteal artery
  - Corona mortis artery
- APC and Vertical shear: greater risk of hemorrhage

Pelvic fracture

Physical examination

Malrotation of lower limb

FIGURE 44-2 Clinical photograph showing external rotation and leg length discrepancy in a patient with an open book pelvic fracture.

Pelvic fracture

Physical examination

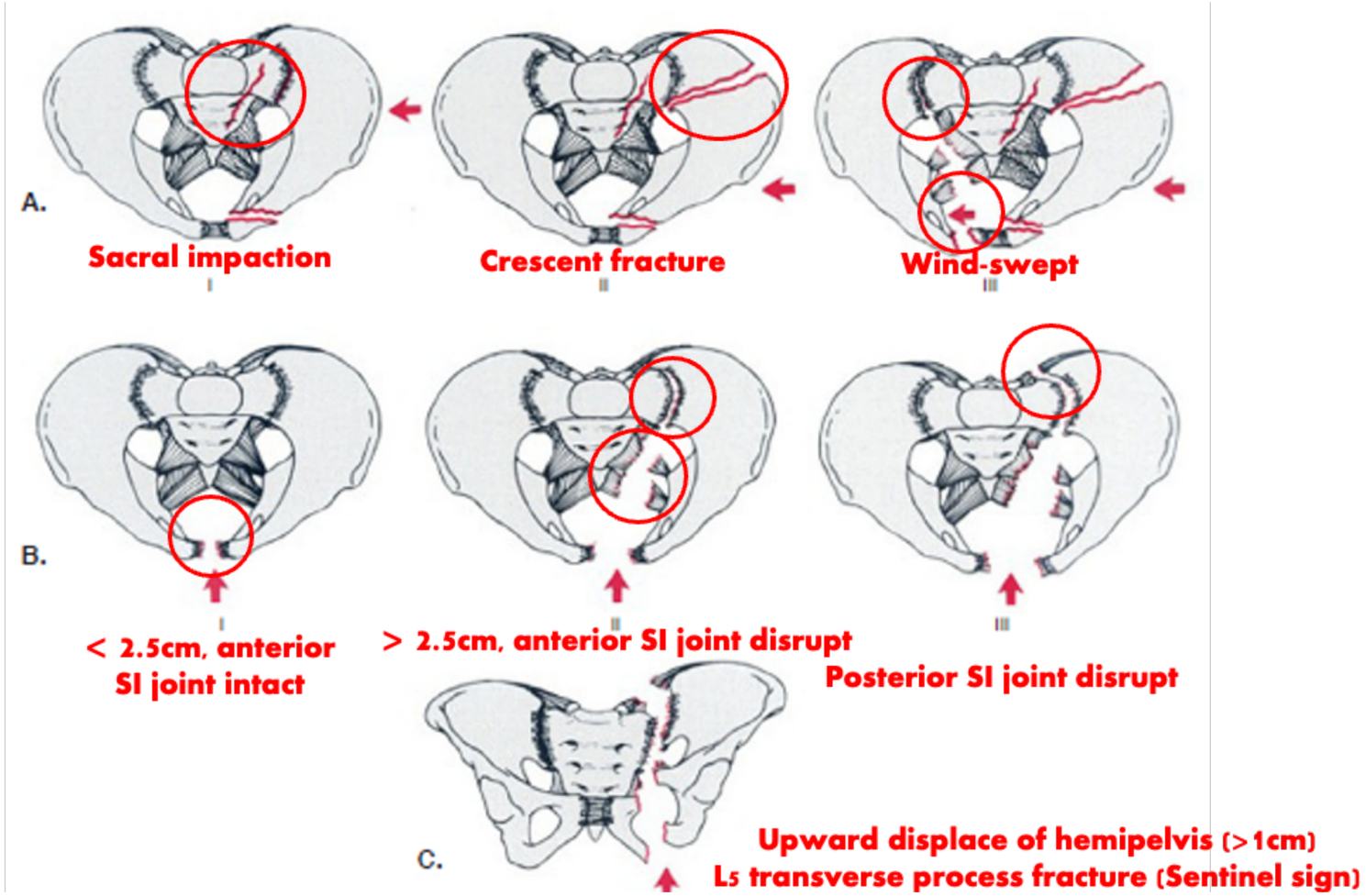
Pelvic fracture

Young and Burgess classification

Lateral compression
(Internal rotation)

AP compression
(External rotation)

Vertical shearing



Pelvic fracture

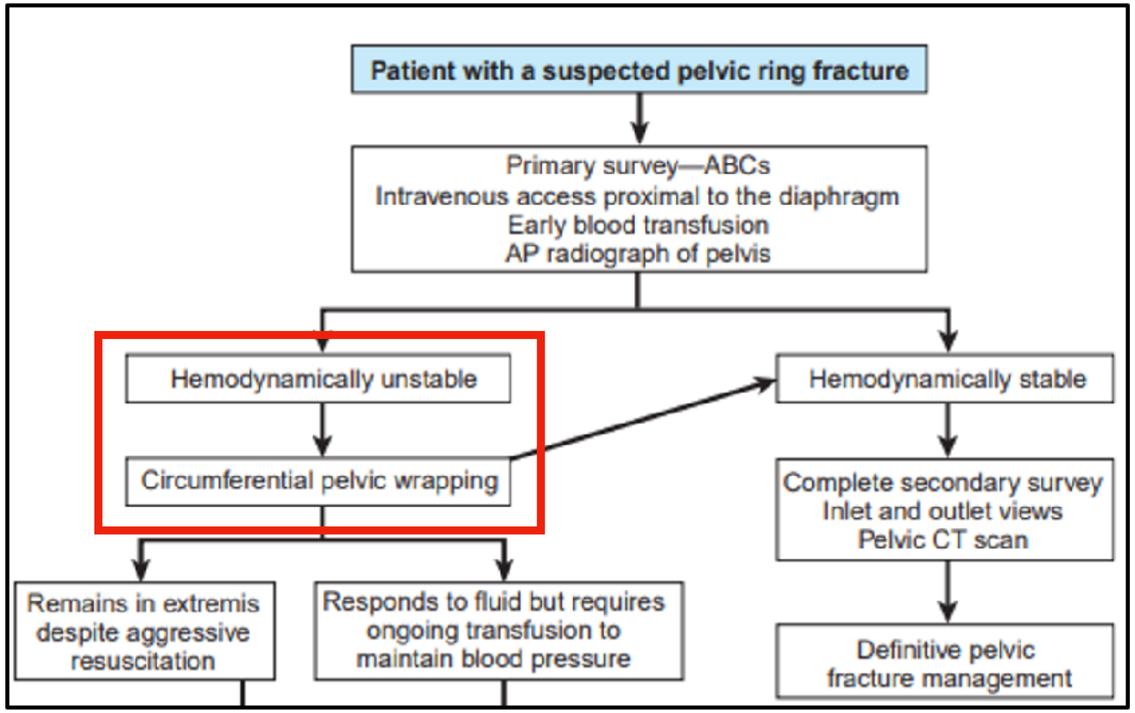
Initial management

WSES Grade	Description	Young-Burgess Classification	Hemodynamic Status	Mechanics	Early Treatment
I	Minor	APC I LCI	Normal	Stable	Routine evaluation
II	Moderate	LC II/III APC II/III	Normal	Unstable	Pelvic binder, possible angioembolization; possible external fixation or operative management
III	Moderate	VS	Normal	Unstable	Pelvic binder, possible angioembolization; operative management
IV	Severe	Any	Shock	Any	Pelvic binder, perperitoneal packing, mechanical fixation, REBOA, angioembolization

LC, lateral compression; APC, Anterior posterior compression; VC, Vertical shear; REBOA, Retrograde endovascular balloon occlusion of the aorta.

Pelvic fracture

Initial management

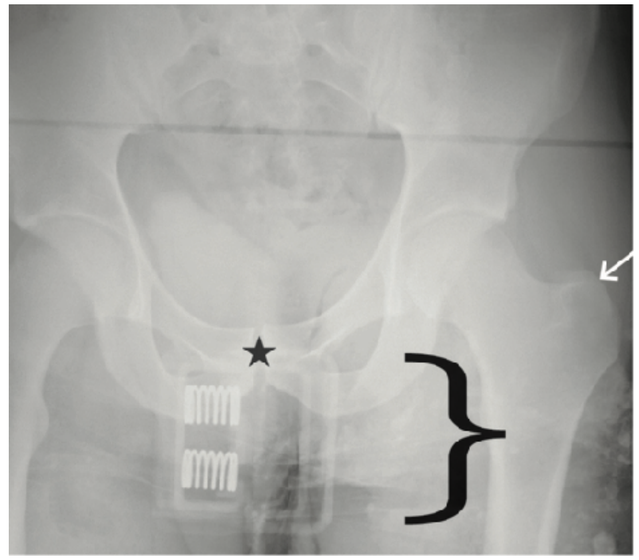


- ATLS - Primary survey
- Life threatening injury
- Hemodynamic and Mechanical unstable
- ** Hemodynamic unstable SBP < 90 mmHg
  - Identify cause emergently
  - Pelvic binder - Routine

Pelvic binder

Recommend by ATLS for “Undiagnosed pelvic injury”

- Overreduction in LC type: Bladder/ Vessel injury
  - No study confirming these hazard
- Removed as soon as hemodynamic stable (24 - 48 hr.)
- Landmark
  - Center of Greater trochanter
  - Adduction and Internal rotation



Purpose

1) Clot formation by stabilize pelvic injury
2) Tamponade effect by reduce pelvic volume
3) Autotransfusion by return Blood from lower extremities

Pelvic binder

1. สอดผ้าให้เป็นแผ่นใต้ก้นผู้ป่วยโดยผ้าควรมีความกว้างอย่างน้อย 10 นิ้ว โดยให้บริเวณ greater trochanter อยู่กึ่งกลางระหว่างขอบบนและล่างของผ้า

2. ให้ผู้ปฏิบัติการคนแรกดึงผ้าจากด้านตรงข้ามเข้าหาตัวดังรูปค้างไว้

Pelvic binder

3. ให้ผู้ปฏิบัติการอีกคนดึงชายผ้าอีกด้านพับทบเข้ามาเข้าหาตัวดังรูปโดนทั้งสองคนดึงผ้าในแนวตรงข้ามกันให้แน่นพอประมาณ

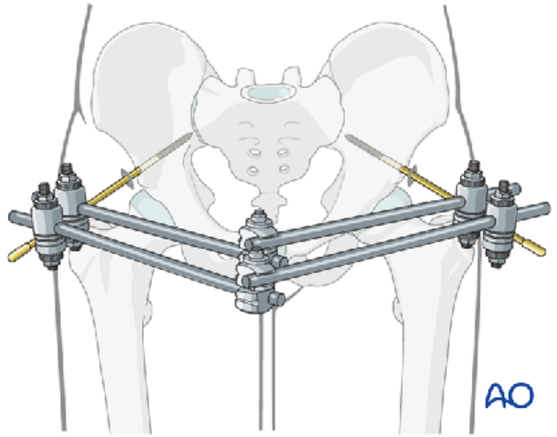
4. นำ Kocher's clamp หนีบผ้าส่วนบนและล่างให้ชายผ้าสองด้านอยู่ด้วยกัน

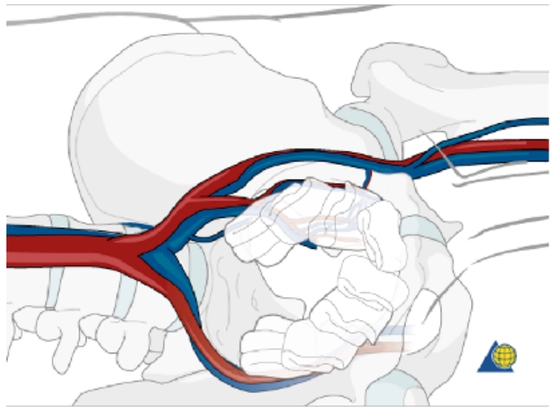
5. ผู้ปฏิบัติการปล่อยผ้า

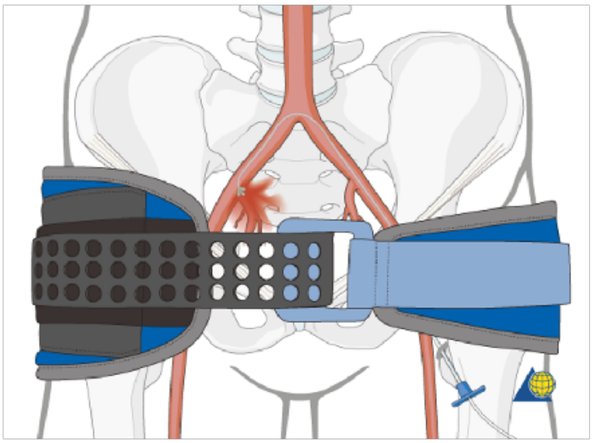
Innitial management

Hemodynamic unstable

- Intraperitoneal hemorrhage control
- External stabilization
- Pelvic packing
- Angiography
  - Contrast extravasation on CT
  - Other source have been ruled out
  - Patient age > 60 year



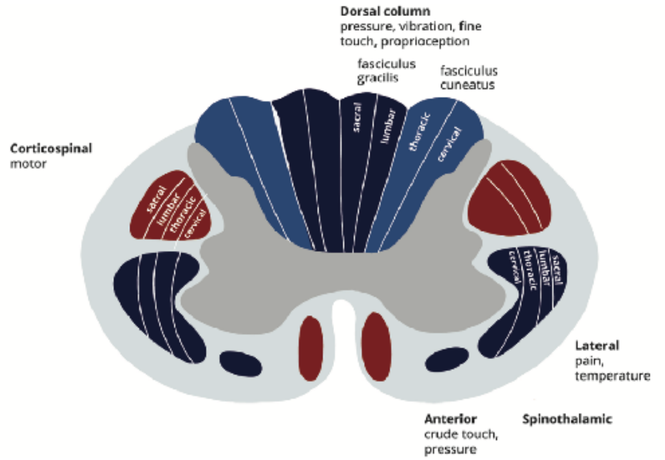




Spinal cord injury

Spinal cord injury

- Cause of injury : Motor vehicle crash (42%)
- Most common : Incomplete tetraplegia
- Most common site : Cervical spine (>50%)
- Cervical spine injuries carry higher rates of mortality and morbidity



Relative Frequencies of Types of SCI	
Common types of SCI	**Percentage**
Incomplete tetraplegia	31%
Complete paraplegia	25%
Complete tetraplegia	20%
Incomplete paraplegia	19%

SCI = Spinal cord injury

Spinal cord injury

Spinal shock

- Temporary dysfunction spinal cord
- Loss reflexes sensory motor function caudal to the level of injury
- Bradycardia and hypotension (due to loss of sympathetic tone)
- Absent bulbocavernosus reflex
- Recovery 24-48 hrs (can persist for week or month)
- No specific treatment

Spinal cord injury

Spinal shock

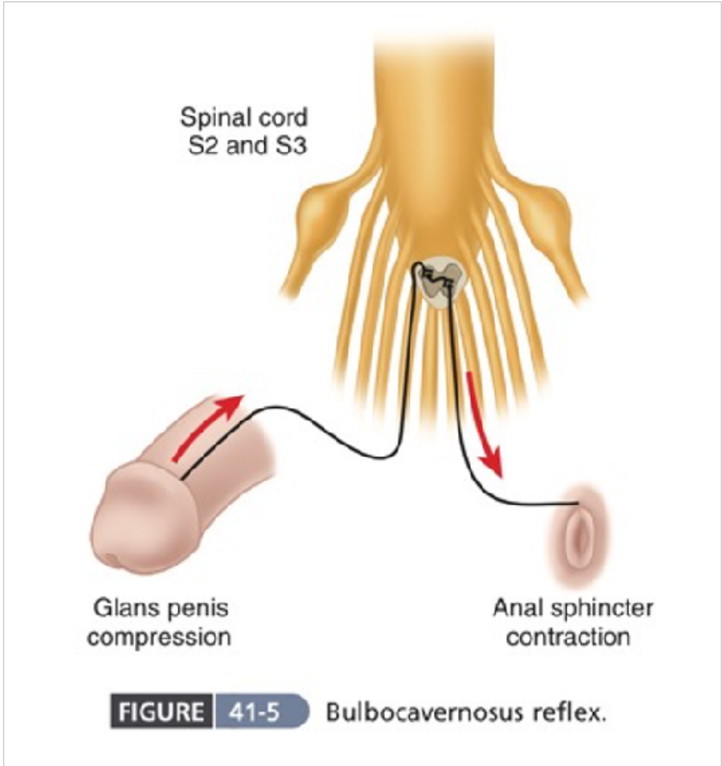


FIGURE 41-5 Bulbocavernosus reflex.

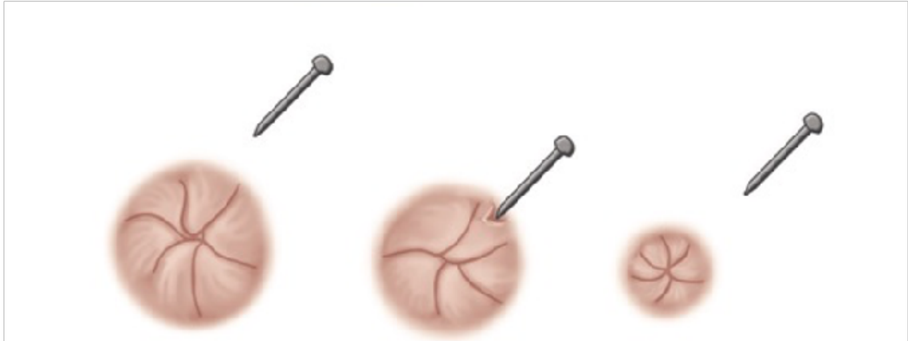


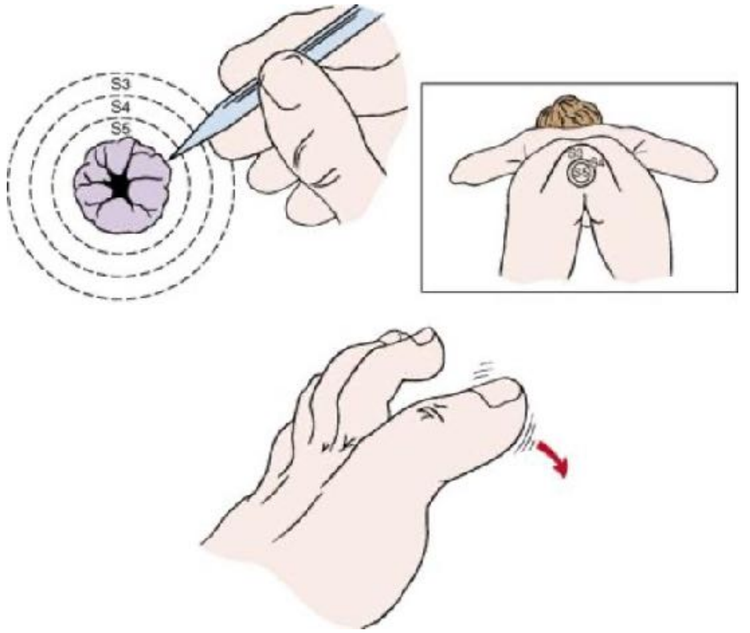
FIGURE 41-6 Anal wink. Contracture of external sphincter caused by pin prick.

Return of this reflex = out of spinal shock

Spinal cord injury

Sacral Sparing

- Big toe flexion (S1)
- Perianal Sensation (S4-5)
- Voluntary rectal sphincter contraction (S4)



Present of sacral sparing = incomplete cord injury
= Good prognosis

Spinal cord injury

Neurogenic shock

- Loss of vasomotor tone and cardiac sympathetic innervation above the T6 level cord injury
- Hypotension and bradycardia
- Low blood pressure can exacerbate primary cord injury due to decreased spinal cord perfusion

Spinal cord injury

Above T6

	Neurogenic Shock	Hypovolemic Shock
Etiology	Loss sympathetic outflow	Loss blood volume
BP	Hypotension	Hypotension
Heart rate	**Bradycardia**	Tachycardia
Temp	Warm	Cold
Urine output	Normal	Low
Treatment	Dopamine	Fluid volume

May be combined, DON'T miss !

Consider invasive hemodynamic monitoring

Patient Name _____

Examiner Name _____ Date/Time of Exam _____

AMERICAN SPINAL INJURY ASSOCIATION

STANDARD NEUROLOGIC CLASSFICATION OF SPINAL CORD INJURY

ISCOS

MOTOR

KEY MUSCLES (scoring on reverse side)

	R	L	
C5	☐	☐	Elbow flexors
C6	☐	☐	Wrist extensors
C7	☐	☐	Elbow extensors
C8	☐	☐	Finger flexsors (distal phalanx of middle finger)
T1	☐	☐	Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

Comments:

L2	☐	☐	Hip flexors
L3	☐	☐	Knee extensors
L4	☐	☐	Ankle dorsiflexors
L5	☐	☐	Long toe extensors
S1	☐	☐	Ankle plantar flexors

Voluntary anal contraction (Yes/No) ☐

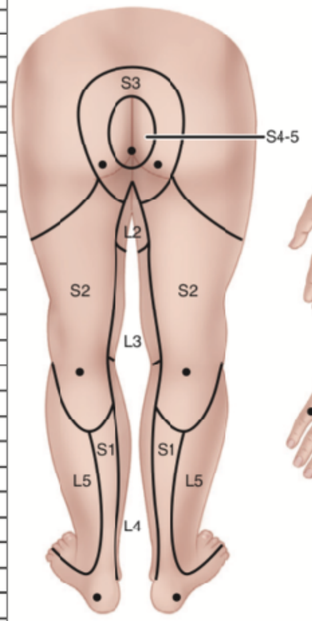
LOWER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

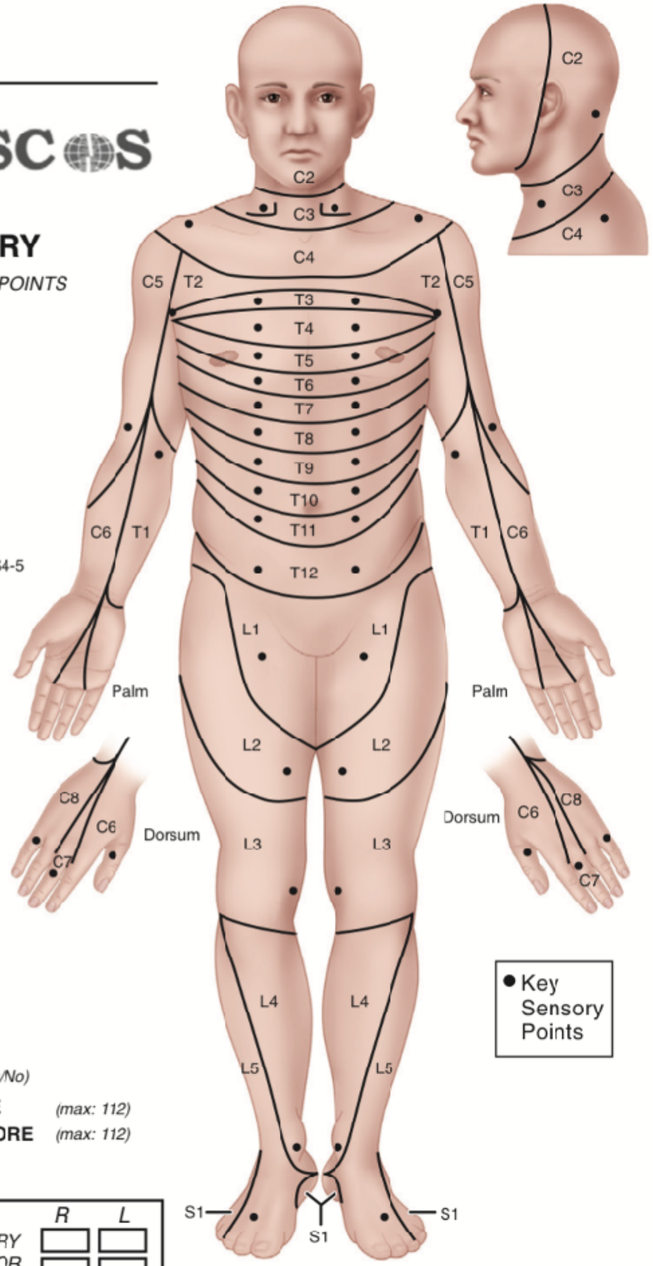
SENSORY

KEY SENSORY POINTS

	LIGHT TOUCH R	LIGHT TOUCH L	PIN PRICK R	PIN PRICK L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				

0 = absent
1 = impaired
2 = normal
NT = not testable





● Key Sensory Points

☐ Any anal sensation (Yes/No)

PIN PRICK SCORE (max: 112) ☐ + ☐ = ☐

LIGHT TOUCH SCORE (max: 112) ☐ + ☐ = ☐

TOTALS (MAXIMUM) (56) (56) (56) (56)

NEUROLOGIC LEVEL (The most caudal segment with normal function)	SENSORY	☐	☐	COMPLETE OR INCOMPLETE? ☐ (Incomplete = Any sensory or motor function in S4-S5)	ZONE OF PARTIAL PRESERVATION (Caudal extent of partially innervated segments)	SENSORY	☐	☐
	MOTOR	☐	☐	ASIA IMPAIRMENT SCALE ☐		MOTOR	☐	☐

REV 03/06

- ASIA score
- Neurologic level
- ASIA grade

Spinal cord injury

ASIA grade

A : complete	No motor or sensory function
B : sensory incomplete	Sensory preserve, Sacral sparing +
C : motor incomplete	Motor power <3 (>50% of key muscle)
D : motor imcomplete	Motor power >=3 (>=50% of key muscle)
E : normal	Motor and sensory function are normal

Spinal cord injury

	Motor power	Rt	Lt
C5	Elbow flex	5	5
C6	Wrist extend	5	5
C7	Elbow extend	2	2
C8	Hand grip	2	2
T1	Finger abduct	2	2
L2	Hip flex	3	3
L3	Knee extend	3	3
L4	Ankle dorsiflex	3	3
L5	Toe dorsiflex	3	3
S1	Ankle plantar flex	3	3

Sensory impaired : middle finger C7, medial forearm T1, body, leg

Sacral sparing preserved

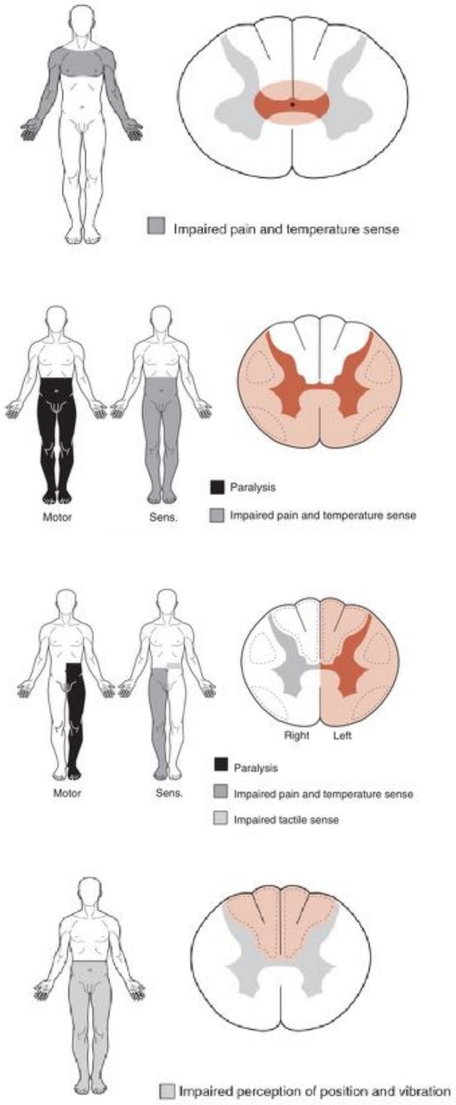
Neurological level injury
= levelต่ำสุดที่ motor&sensory ปกติ
= C6

มี 5/8 levelที่ power >=3 (>50%)
ดังนั้น ASIA = D

Diagnosis : C 6 central cord injury
ASIA grade D

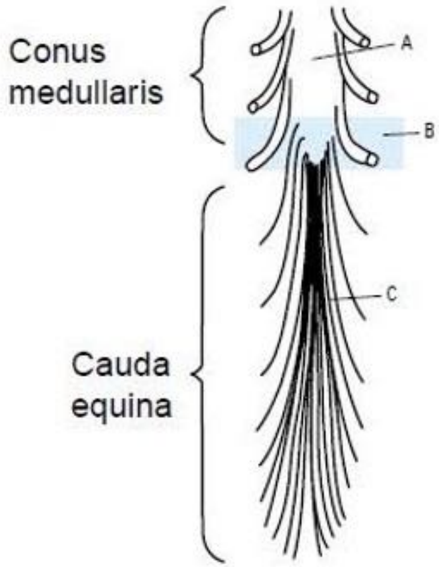
Spinal cord syndrome

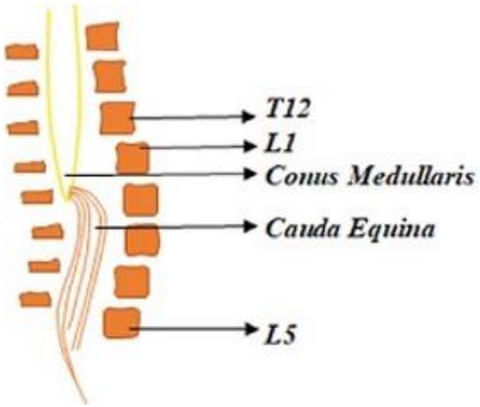
Type	Incidence	Mechanism	Clinical	Prognosis
Central	Most common	Hyperextension in elderly	Weak upper > lower	Fair
Anterior	Common	Hyperflextion	Weak lower > upper Preserve deep touch, propioception	Poor
Brown-Sequard	Rare	Penetrating, rotation	Loss ipsilateral motor Loss contralateral pain &temp	Good
Posterior	Very rare	Extension	Loss propioception preserve motor sensory	



Spinal cord syndrome

	Conus medullaris <cord>	Cauda equina <root>
Presentation	Sudden ,bilateral	Gradual , unilateral
Reflexes	Diminished at the level Brisk below the level	Diminished
Radicular pain	-	+
Back pain	More	Less
Impotence	Frequent	Absent
Numbness	Symmetrical	Asymmetrical
Motor	symmetrical	Asymmetrical
Sphincter dysfunction	Present Early Urinary and fecal incontinence	Present later Only urinary retention





Spinal cord injury

Treatment

Early stabilization

- Immediate reduction
- Keep MAP 85-90 mmHg in first 7day
- SBP > 100mmHg
- Keep oxygen 100%

Minimize secondary spinal cord injury

Definite treatment

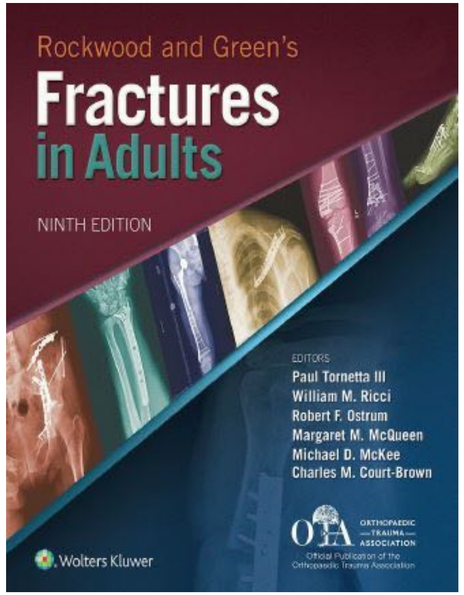
- Decompression within 24 hours is associated with improved neurologic recovery (only in stable patient)

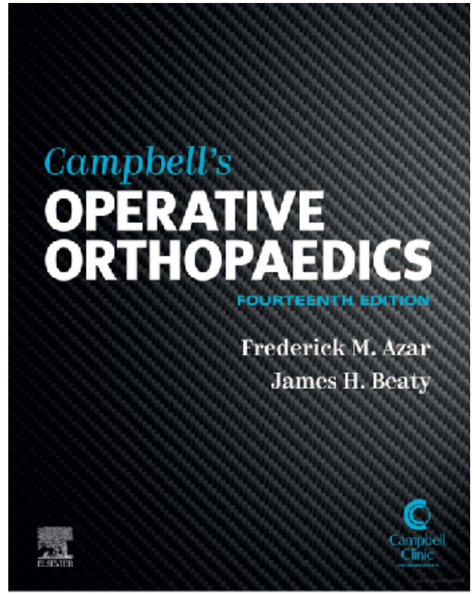
Methylprednisolone

- Risk > Benefit
- Insufficient evidence to support

American Association of Neurological Surgeons

Congress of Neurological Surgeons
The global leader in neurosurgical education





Open fracture

Open Fractures

Definition

- “ as an injury where the fracture and the fracture hematoma communicate with the external environment through a traumatic defect in the surrounding soft tissues and overlying skin ”

Open Fractures

Gustilo-Anderson Classification

TABLE 10-6 Gustilo and Anderson's Classification[84,85]

Type	Wound	Level of Contamination	Soft Tissue Injury	Bone Injury
I	<1 cm long	Clean	Minimal	Simple, minimal comminution
II	>1 cm long	Moderate	Moderate; some muscle damage	Moderate comminution
III A	Usually >10 cm	High	Severe with crushing	Usually communited; soft tissue coverage of bone possible
III B	Usually >10 cm	High	Very severe loss of cover	Bone cover poor; usually requires soft tissue reconstructive surgery
III C	Usually >10 cm	High	Very severe loss of cover and vascular injury requiring repair	Bone cover poor; usually requires soft tissue reconstructive surgery

Gustilo reported the infection rate
Type I 1.9%
Type II 8%
Type III 41 %

Open fracture

Initial management

- Gentle realignment of the limb, followed by splinting
- Early removal of contaminants using sterile instruments
- Covering the wound with a moist, sterile dressing
- Early IV antibiotics administered
- Tetanus prophylaxis
- Evaluating the soft tissue, circulation, and neurological status

Open fracture

Preventive antibiotic regimens

	Absence of potential soil or water contamination	Presence of potential soil contamination (in absence of water contamination)	Presence of water contamination
Gustilo-Anderson fracture type I or II			
Preferred regimen	Cefazolin 2g IV Q8H	Cefazolin 2 IV Q8H **PLUS** metronidazole 500mg IV Q8H **or** Ceftriaxone 2g IV Q24h **PLUS** metronidazole 500mg IV Q8H	No modifications needed to recommendations to left
Alternative regimen for beta-lactam hypersensitivity	Vancomycin • Loading dose 20mg - 35mg/kg • Maintenance dose 15mg–20mg/kg Q8-12H (dose based on patient-specific factors and adjust to trough levels)	Clindamycin 900 mg IV Q8H	No modifications needed to recommendations to left

Gustilo 1 or 2

	Absence of potential soil or water contamination	Presence of potential soil contamination (in absence of water contamination)	Presence of water contamination
Gustilo-Anderson fracture type III			
Preferred regimen	Cefazolin 2g IV Q8H **PLUS** gentamicin 5mg/kg IV Q24H **or** Ceftriaxone 2g IV Q24H	Ceftriaxone 2g IV Q24H **PLUS** metronidazole 500mg IV Q8H **or** Cefazolin 2g IV Q8H **PLUS** gentamicin 5mg/kg IV Q24H **PLUS** metronidazole 500mg IV q8H	Fresh water contamination: Piperacillin/Tazobactam 4.5g IV Q6H Salt-water contamination: Piperacillin/Tazobactam 4.5g IV Q6H **PLUS** doxycycline 100mg IV/PO Q12H
Alternative regimen for beta-lactam hypersensitivity	Clindamycin 900mg IV Q8H	Clindamycin 900mg IV Q8H **PLUS** gentamicin 5mg/kg IV Q24H	Fresh water contamination: Imipenem 500mg IV Q6H **or** Meropenem 1g IV Q8H Salt-water contamination: Imipenem 500mg IV Q6H **or** Meropenem 1g IV Q8H **PLUS** Doxycycline 100mg IV/PO Q12H

Gustilo 3

Open fracture

Time to Antibiotic Administration

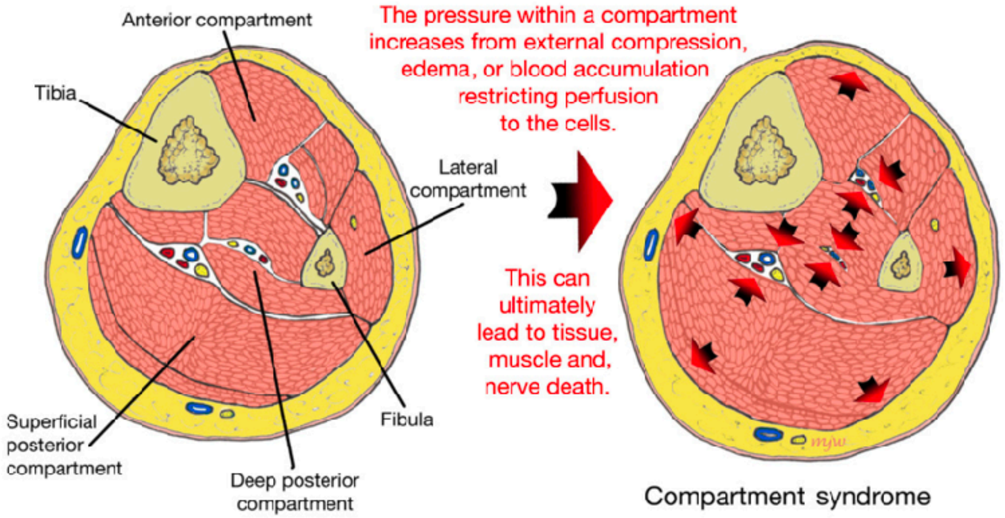
- Delaying antibiotic treatment beyond 3 hours postinjury increases the risk of infection.
- Ideally, antibiotics should be administered within 1 hour of arrival to the emergency department.

Compartment syndrome

Compartment syndrome

Definition

- Elevation of intracompartment pressure causing reduction of tissue perfusion (ischemia) and cell death (necrosis)
- Extensive muscle and nerve death > 4 hours

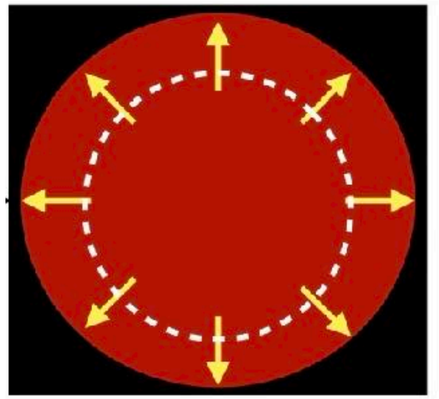


Compartment syndrome

Etiology

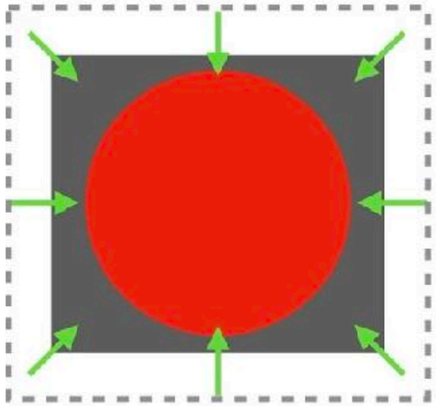
1. **Increased compartmental content**

   - Bleeding, fracture, vascular injury, trauma, burn, exercise, snake bite



2. **Decreased compartmental size**

   - Tight dressing, localized external pressure, closure of fascial defect



Compartment syndrome

Risk factor

- Youth has been found to be the most important risk factor
- 3 times greater in the patients who are under 35 years old

TABLE 29-3 Risk Factors for Development or Late Diagnosis of Acute Compartment Syndrome

Demographic	Altered Pain Perception
Youth	Altered conscious level
Tibial fracture	Regional anesthesia
High-energy forearm fracture	Patient-controlled analgesia
High-energy femoral diaphyseal fracture	Children
Bleeding diathesis/anticoagulants	Associated nerve injury
Polytrauma with high base deficit, lactate levels, and transfusion requirement	

Compartment syndrome

Clinical sign and symptoms

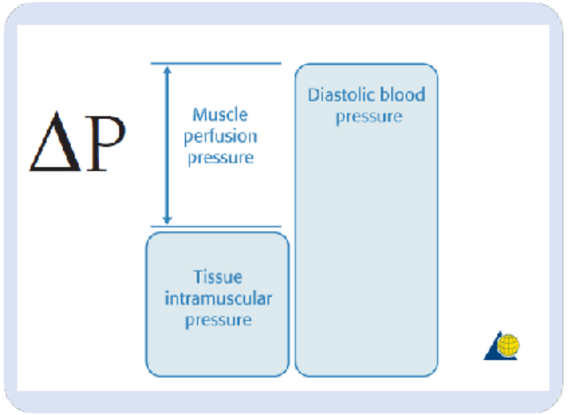
The 5P's

1. Pain: Out of proportion with passive stretch (most significant early sign)
2. Pressure: Tense swelling (early consistent finding)
3. Paresthesia: Sensory deficit (usually Late)
4. Paralysis: Muscle weakness (very late sign)
5. Pulselessness: The present of distal pulse does not exclude compartment syndrome

Compartment syndrome

Diagnosis

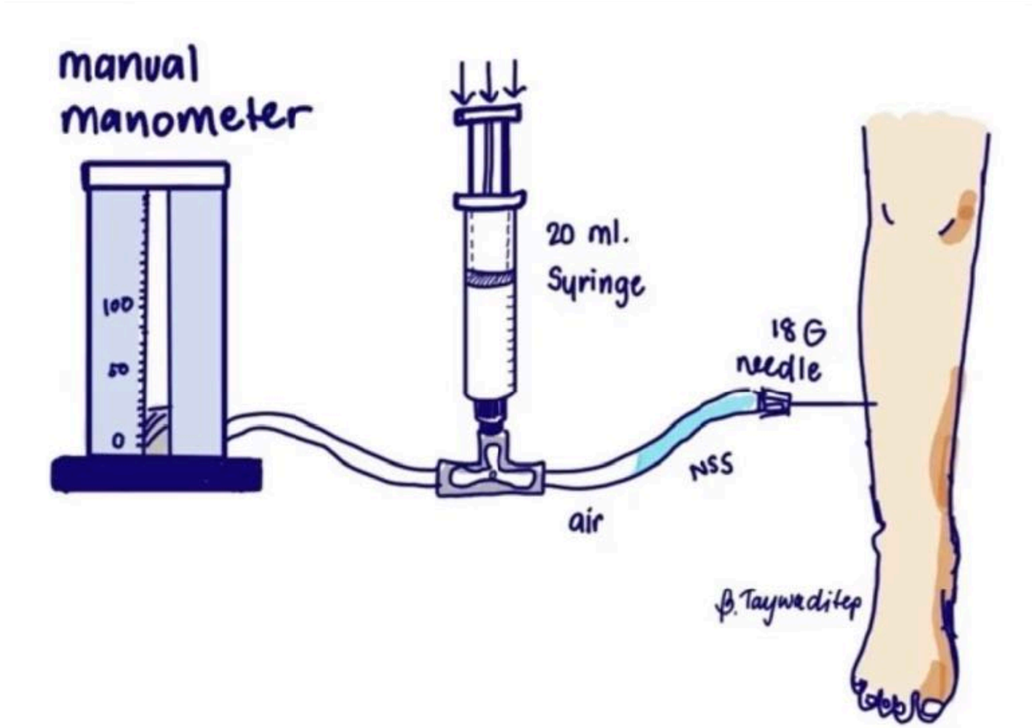
1. **Absolute pressure theory**: closed to capillary pressure
   - > 30 mmHg as absolute number (Mubarak et al.)
2. **Pressure gradient theory**: relative ischemia
   - < 30 mmHg (Diastolic pressure - compartment pressure; McQueen)

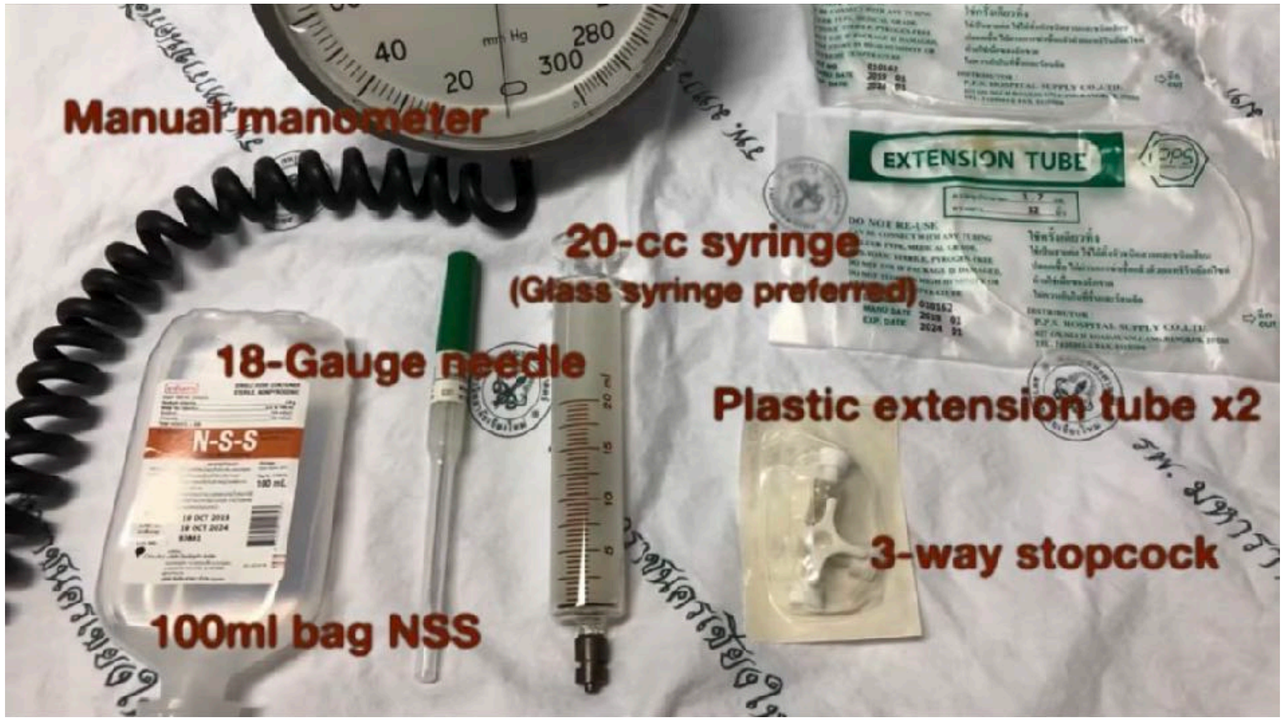


Compartment syndrome

Compartment pressure measurement

Whiteside method

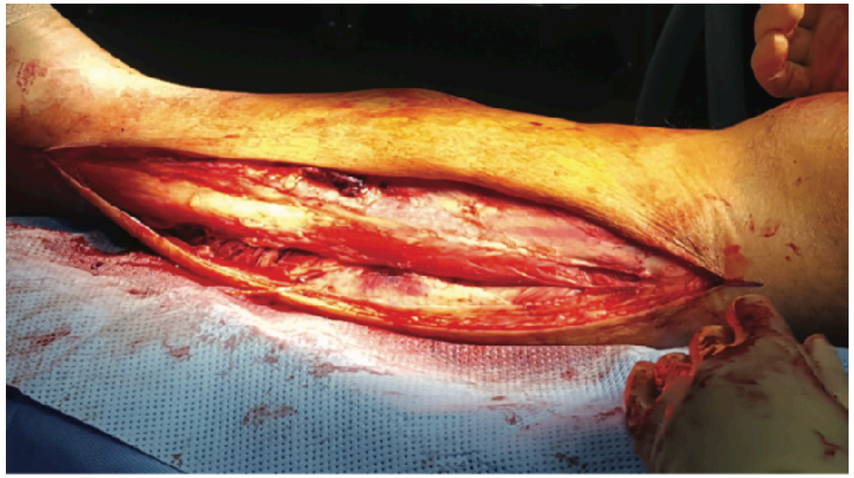




Compartment syndrome

Urgent fasciotomy

- Indication
  - $\Delta P \leq 30$ mmHg more than 2 hours
- Fasciotomy shouldn’t be performed based on a single pressure need differential pressure over time



Thank you