

Extremity Trauma

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Approach to the Evaluation of the Patient with an Extremity Injury

- Blood Supply
- Skeleton
- Neurologic Function
- Risk for Compartment Syndrome?
- Coverage (Skin and Soft Tissue)



History

- Height
- Weight
- Handedness
- Occupation
- Avocations
- MECHANISM OF INJURY



Skin and Soft Tissue

Tidy vs Untidy Injury



Tidy Injury



- Clean cut
- No necrosis
- No dirt or greese ground into soft tissues

<http://www.arenbe.org/pics/hand.html>



Untidy Injury



- Extensive loss of or damage to soft tissue
- Skin or soft tissue necrosis
- Poor blood supply

<http://www.trauma.org/imagebank/imagebank.html>

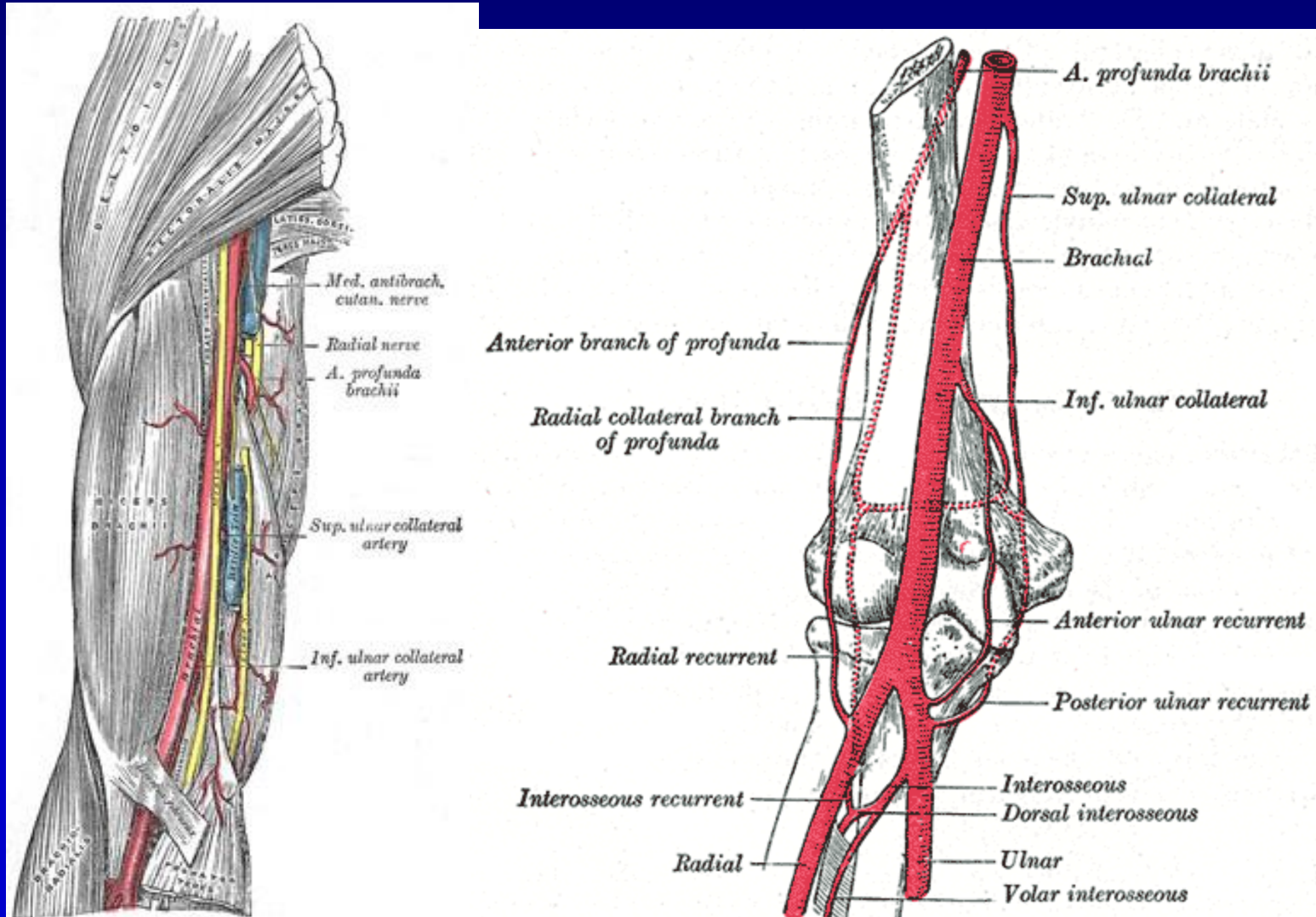


Options for Skin and Soft Tissue Coverage

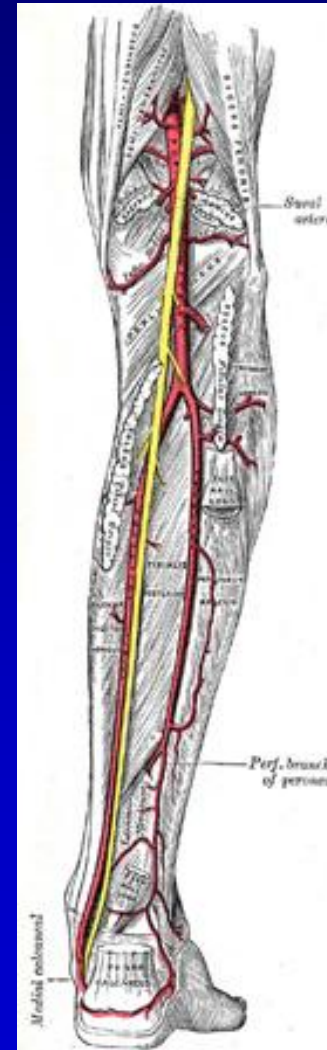
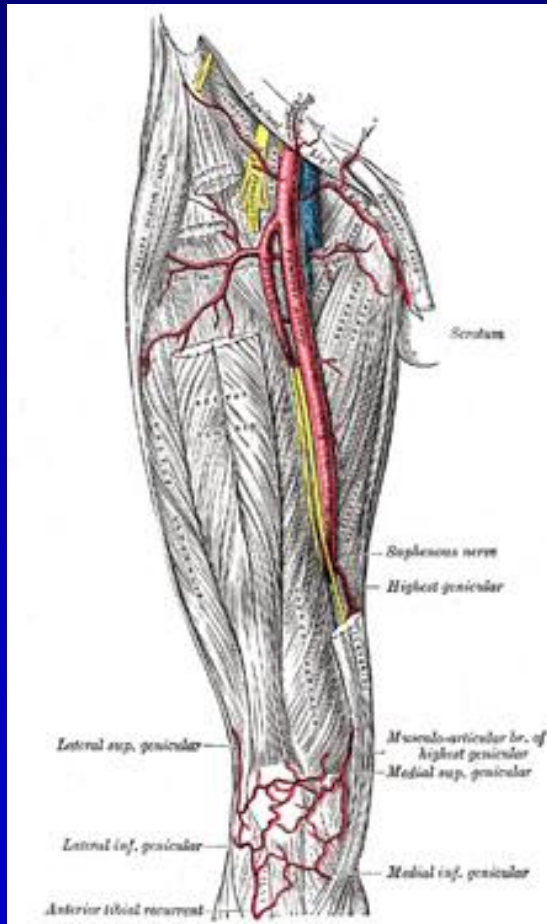
- Primary Closure
- Delayed Primary Closure
- Closure by Secondary Intention
- Skin Graft
- Flap
 - Random
 - Pedicle
 - Myocutaneous
 - Free



Arterial Supply of Upper Extremity



Arterial Supply of Lower Extremity



<http://education.yahoo.com/reference/gray/213.html#36>



Evaluation of Arterial Inflow

- The 5 P's
 - Pulse
 - Pallor ?
 - Pain ?
 - Perfusion ?
 - Paresthesia ?
- Doppler
 - Ankle-Brachial Index
- Duplex U/S exam
- Angiogram



How to Record the Vascular Exam

Car	SC	Ax	Rad	Ao	Fem	Pop	DP	PT	
2+	2+	2+	2+		2+	2+	2+	2+	
2+	2+	2+	2+		2+	2+	2+	2+	

Scale: 2+ normal, 1+ diminished, 0 absent

*Listen for bruits over the carotid, renal, iliac and femoral arteries
record their presence or absence*

Listen for bruits over penetrating wounds to identify A-V fistulas



Ankle Brachial Index for Lower Extremity Injuries

	Dorsalis Pedis Pressure	Brachial Pressure	Ankle/Brachial Index = Pedal Pressure/ Brachial Pressure
Left	110	100	1.1
Right	110	100	1.1

0.9 or greater acceptable

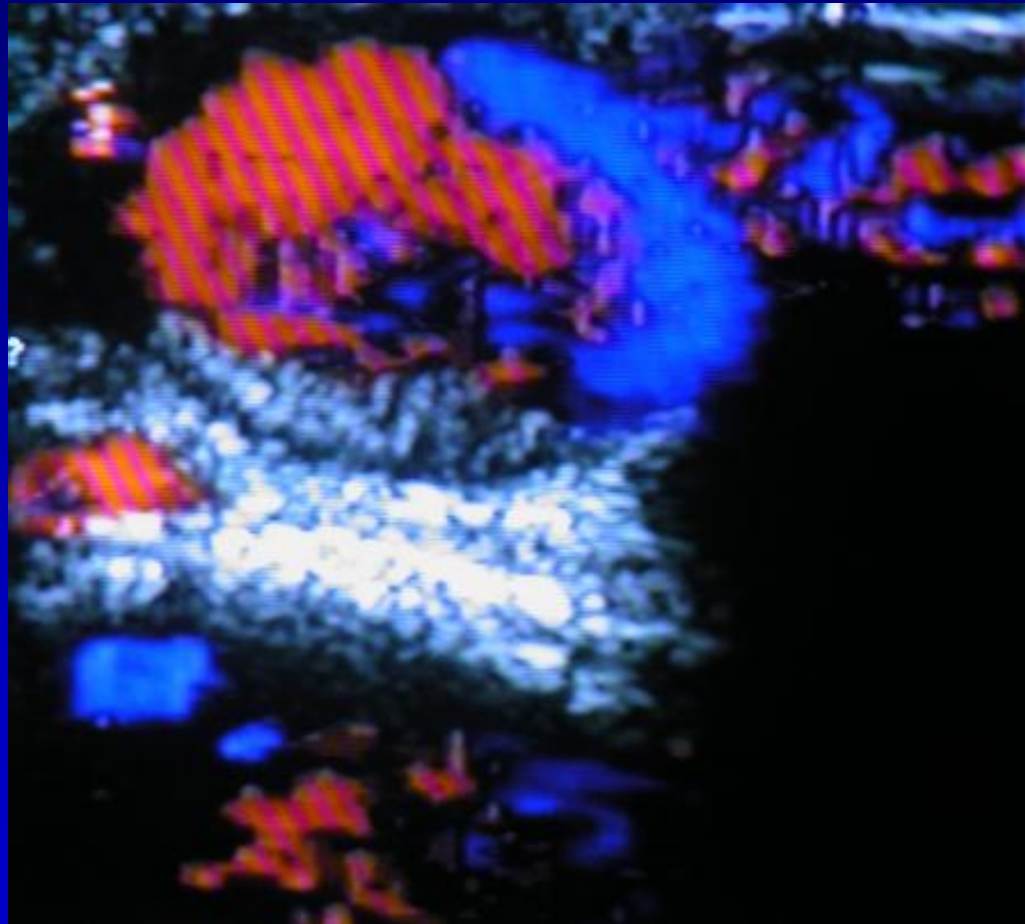


Indications for further study and/or surgical exploration

- The 5 P's
- Hematoma at sight of penetrating injury
- Auscultable bruit
- Diminished Pulse or Decreased ABI
- Penetrating Injury near major vessel



Duplex Ultrasound of false aneurysm, femoral artery



*Picture provided
by Samuel Zhou,
Burnley General
Hospital,
Burnley, United Kingdom*

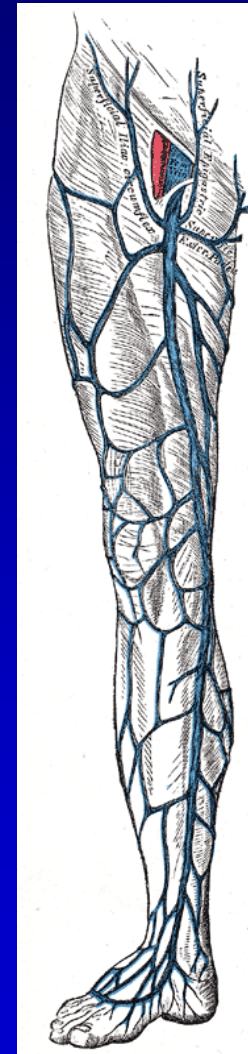
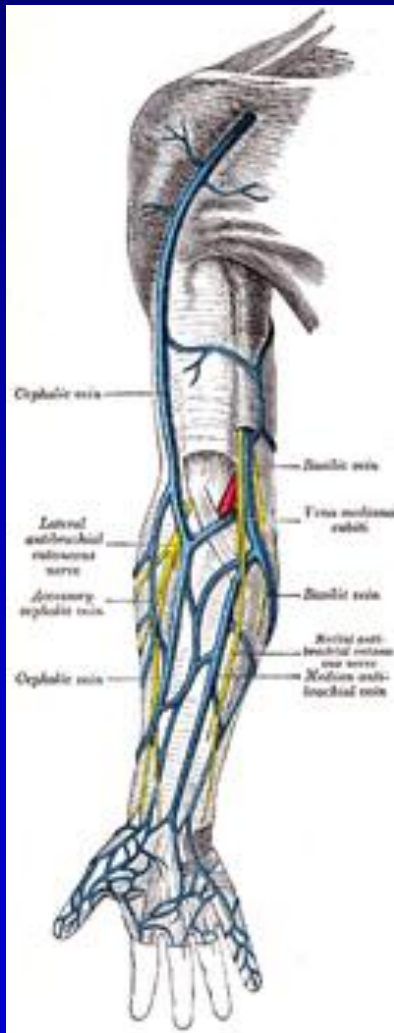


Indications for Angiography after Trauma

- Possible Vascular Injury, situation unclear after vascular exam, ABI, and/or duplex U/S
- Proximal and/or Distal Control likely to be a problem during surgery
- Stent procedure being considered as definitive treatment



Venous Drainage of Extremities

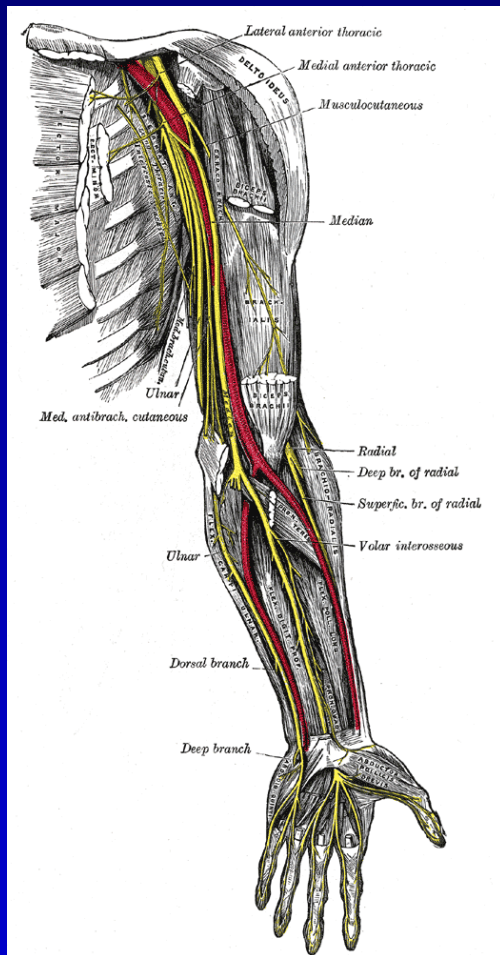


Prevention of Impaired Venous Drainage

- No tourniquets
- Elevate the Leg or Arm
- **NO TIGHT DRESSINGS!!!!**
- If extremity is swollen and tissues tense to palpation, consider the possibility of compartment syndrome



Neurologic Evaluation of Upper Extremity



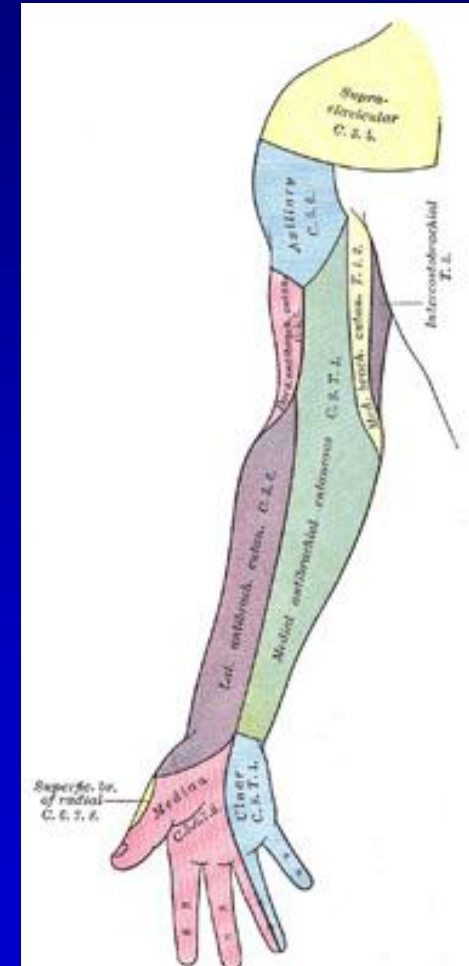
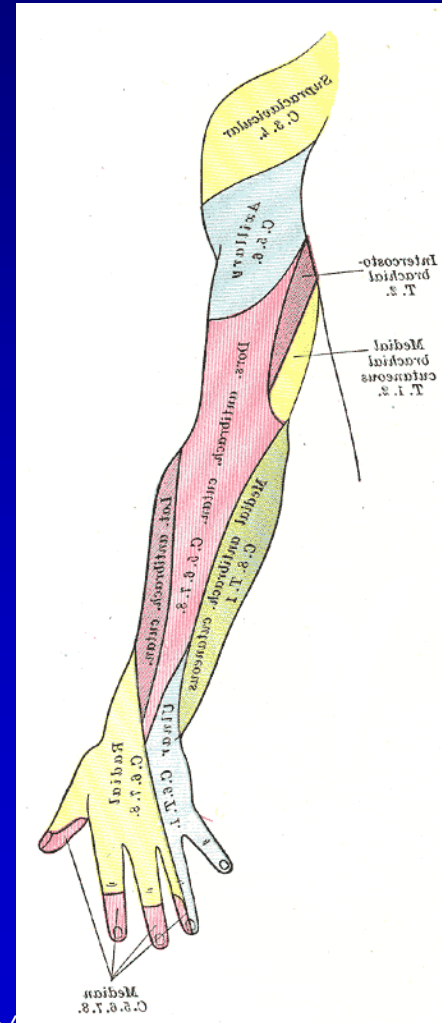
- The brachial plexus terminates in 3 nerves: median, ulnar and radial nerves



Examination of Median Nerve

Dorsal View

Volar View



Median nerve

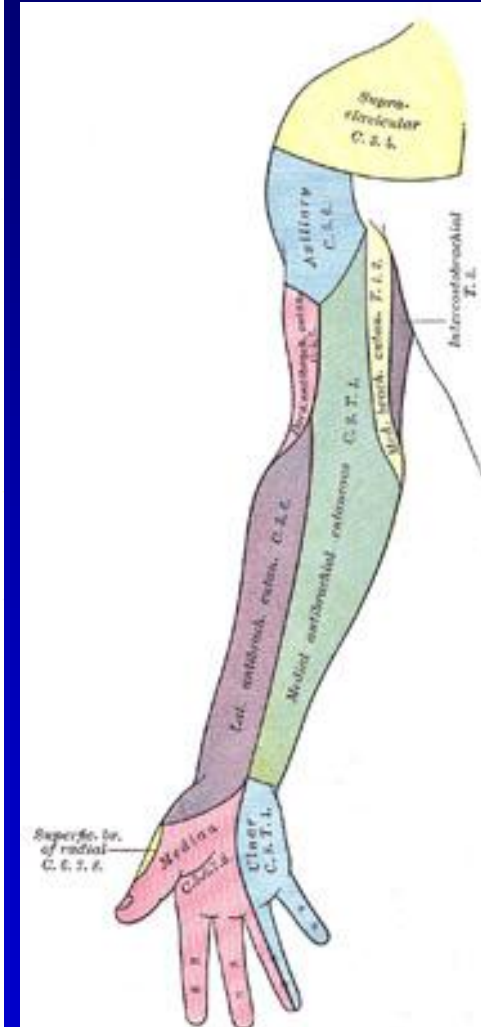
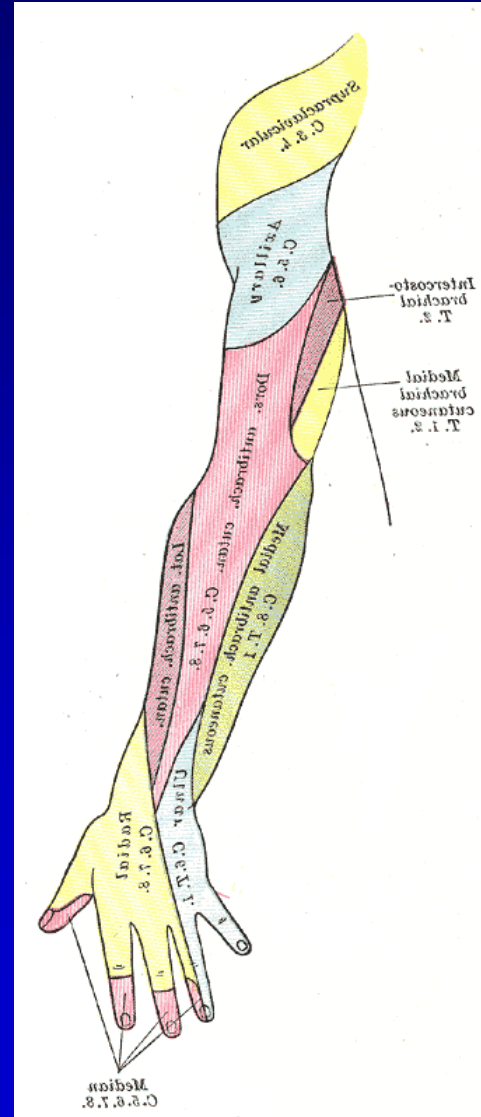
- Sensory Exam: Radial aspect of volar finger 4 and digits 1-3, dorsal fingers 1-3 to level of PIP joint
- Motor exam: Opposition of thumb to digit 4



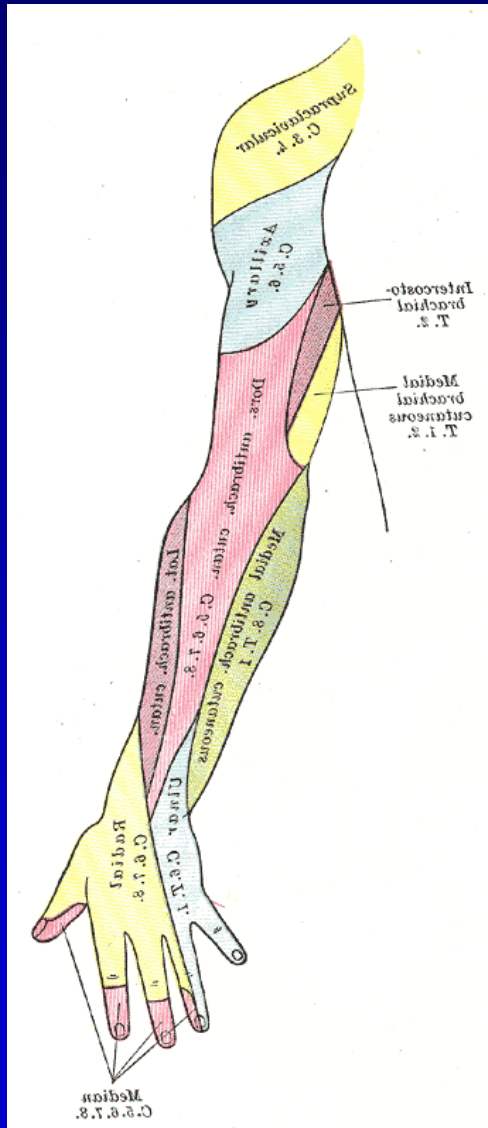
Examination of Ulnar Nerve

Ulnar nerve

- Sensory Exam: Ulnar aspect of volar digit 4 and volar digit 5, dorsum of hand and dorsal fingers 4 and 5
- Motor Exam: Abduction and Adduction of fingers (interosseous muscles), Adduct digit 2 against resistance and palpate 1st Dorsal Interosseous Muscle next to 2nd metacarpal bone



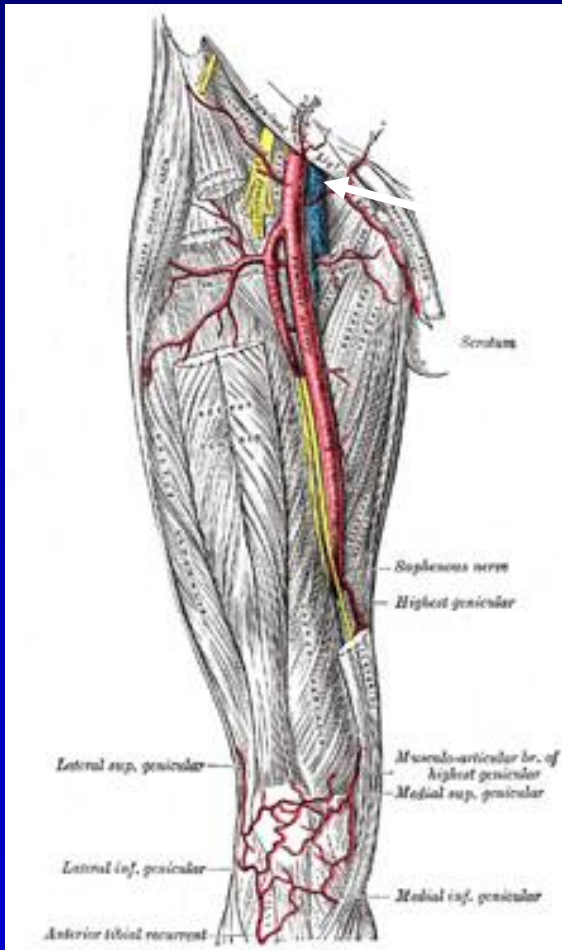
Examination of Radial nerve



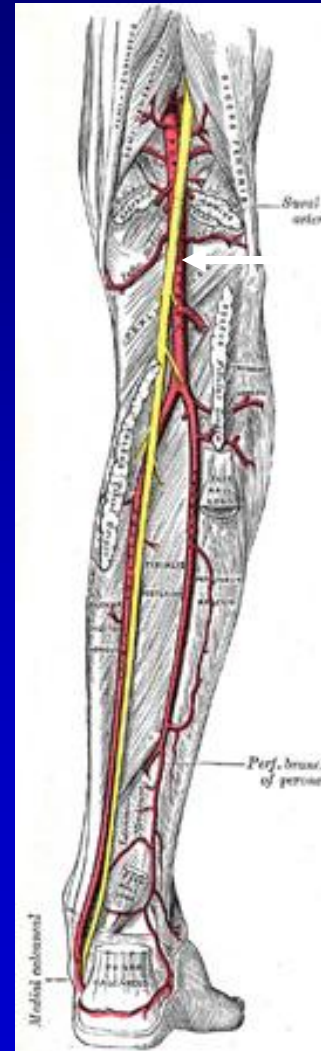
- Radial Nerve
 - Sensory Exam: Radial aspect of dorsal hand
 - Motor exam: Extend wrist, thumb and fingers



Innervation of Lower Extremity



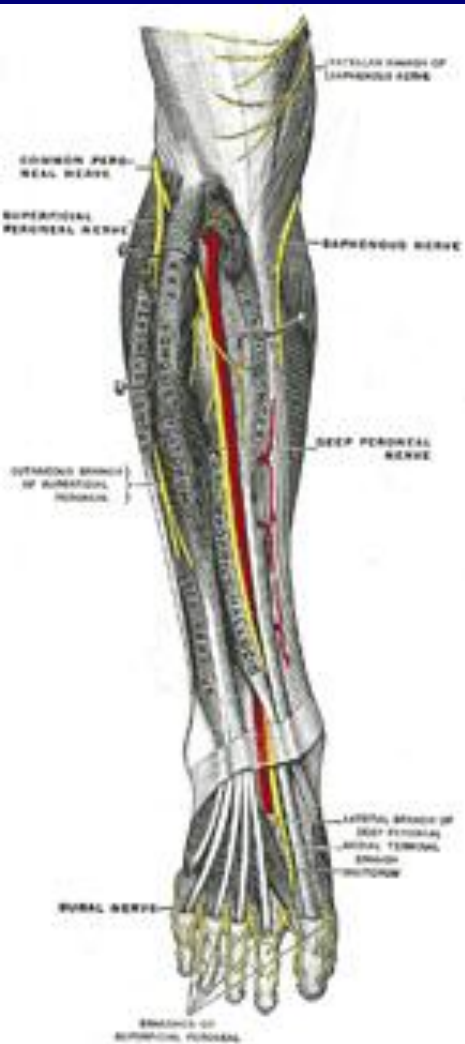
*Femoral Nerve
Innervates anterior
And medial thigh*



*Tibial Nerve
(branch of
Sciatic nerve)
innervates
Plantar and
dorsal aspect
Of foot*



Innervation of Foot

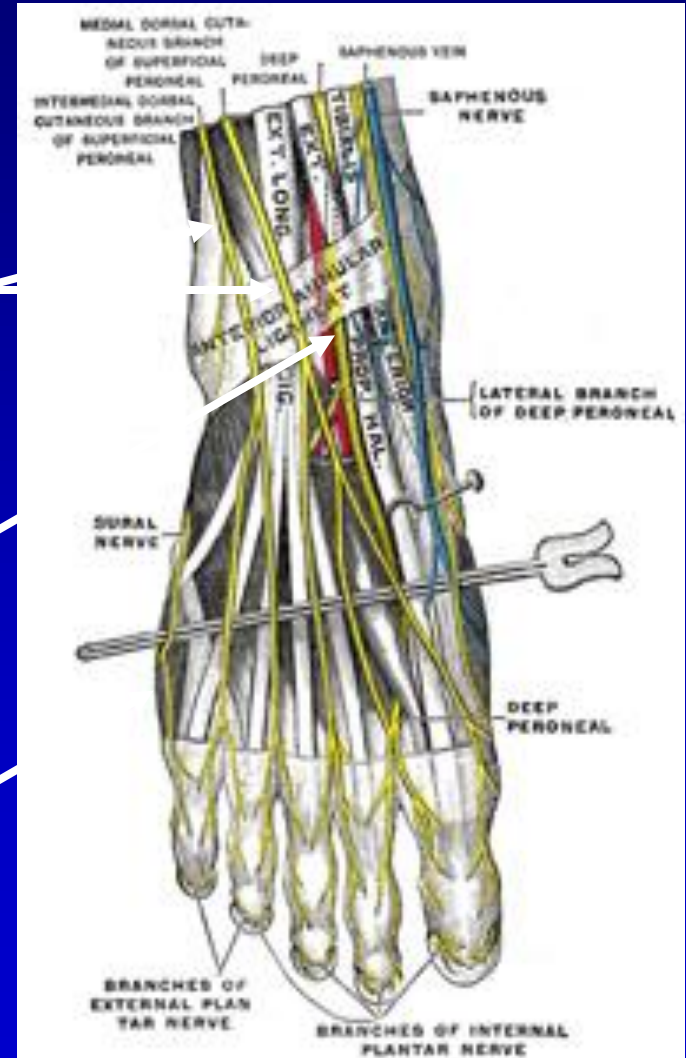


Common Peroneal Nerve

Superficial Peroneal Nerve, (innervates dorsum Of foot)

Deep Peroneal Nerve
Innervates skin
Between toes 1 and 2

Sural Nerve (innervates
Skin of lateral foot)



Clinical Significance

- Peroneal Nerve Injury: Weak or absent foot dorsiflexion
- Anterior Compartment Syndrome: 1st sign is numbness or paresthesia in webspace between 1st and 2nd toes



Goal of Treatment of Skeletal Injury

Stable Soft Tissue Coverage

Intact nerve and blood supply

Anatomic reduction of bone fragments

Stable internal fixation

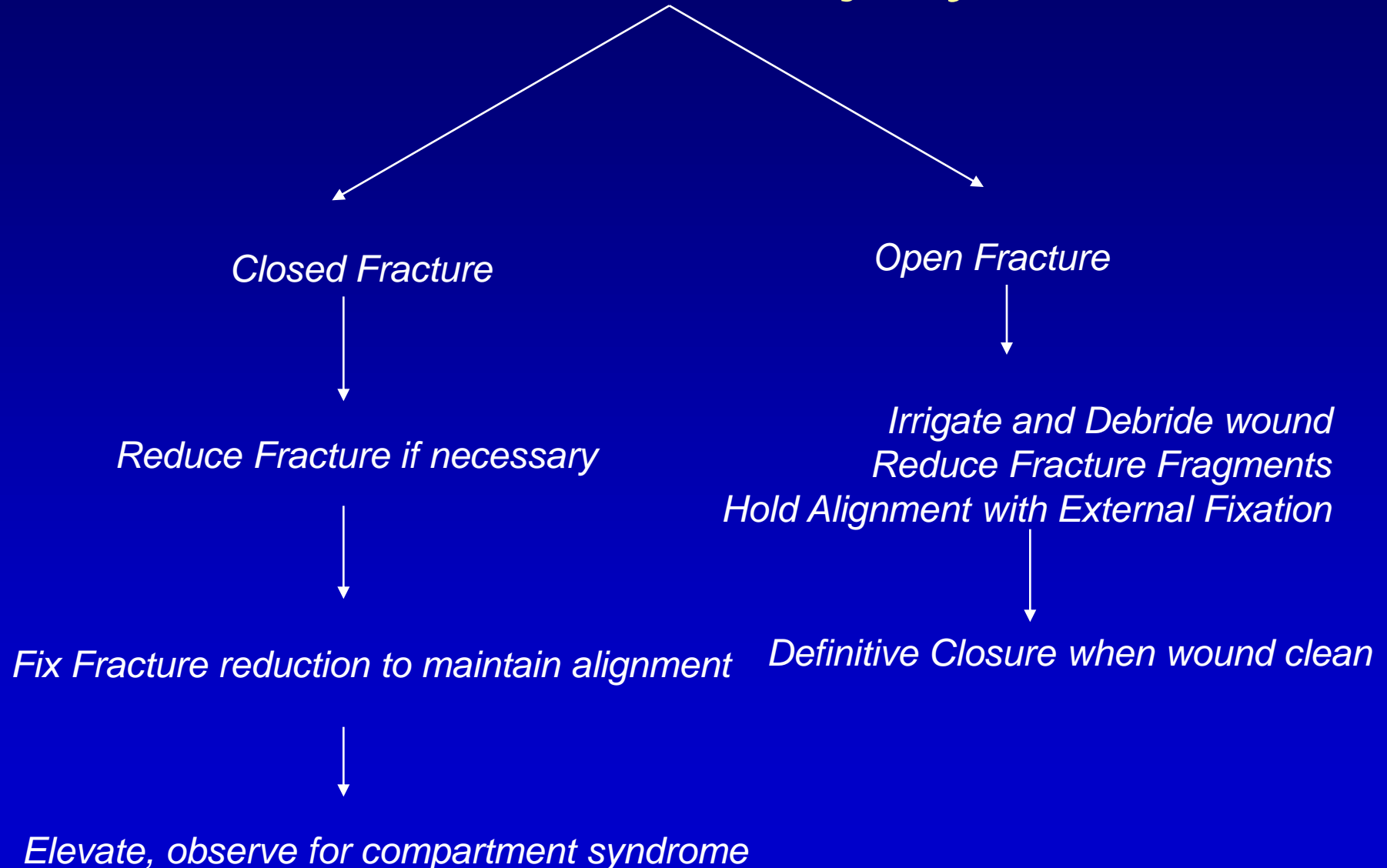
Full range of motion of joints

Absence of infection

Pain free fully mobile and functional patient



Skeletal Injury



Options for Stabilization of the Skeleton

- Splint
- Cast
- Traction
- External Fixation
- Internal Fixation



Splint/Cast for Immobilization and External Fixation

- NO CIRCUMFERENTIAL DRESSINGS in significant extremity trauma until swelling has subsided
- Splints and casts MUST be WELL PADDED to avoid pressure sores



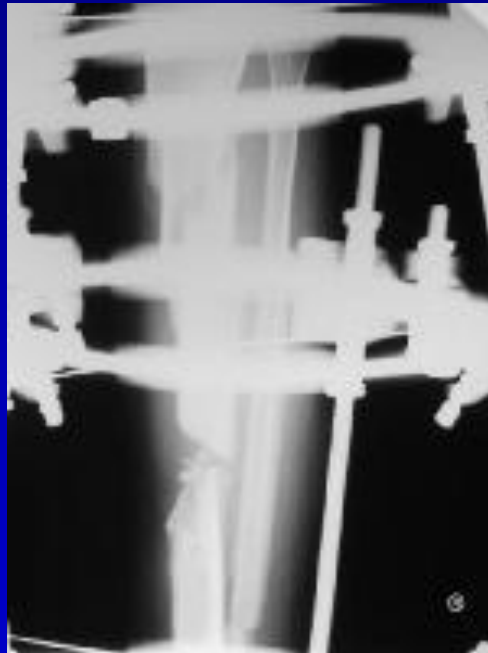
Traction



- Used to reduce, align and immobilize fracture
- Previously used as definitive treatment
- Currently used in most patients as temporary immobilization until internal fixation



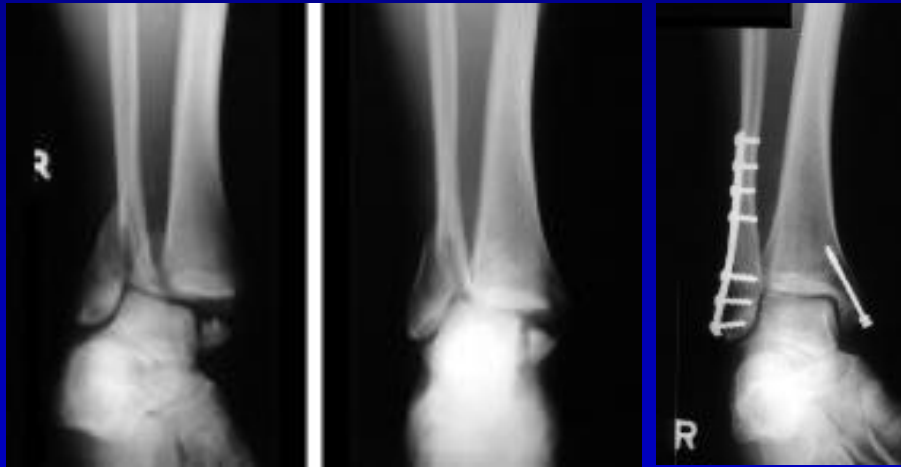
External Fixation



<http://www.emedicine.com/plastic/topic199.htm>



Internal Fixation of Fractures



ORIF of Ankle Fracture



Internal Fixation
Midshaft Fracture of Femur



Compartment Syndrome

- Elevation of pressure within a closed anatomic space resulting in decreased perfusion of the soft tissues located within that space.
- Examples of compartments
 - Skull
 - Abdomen
 - Extremity
 - Cast
 - Circumferential dressing
 - Burn eschar
 - Skin
 - fascia



Treatment of Compartment Syndrome: Release of Pressure

- Skull – Craniectomy
- Cast – Splitting the cast and cast padding
- Burn – Escharotomy
- Skin – Incision
- Fascia – Fasciotomy



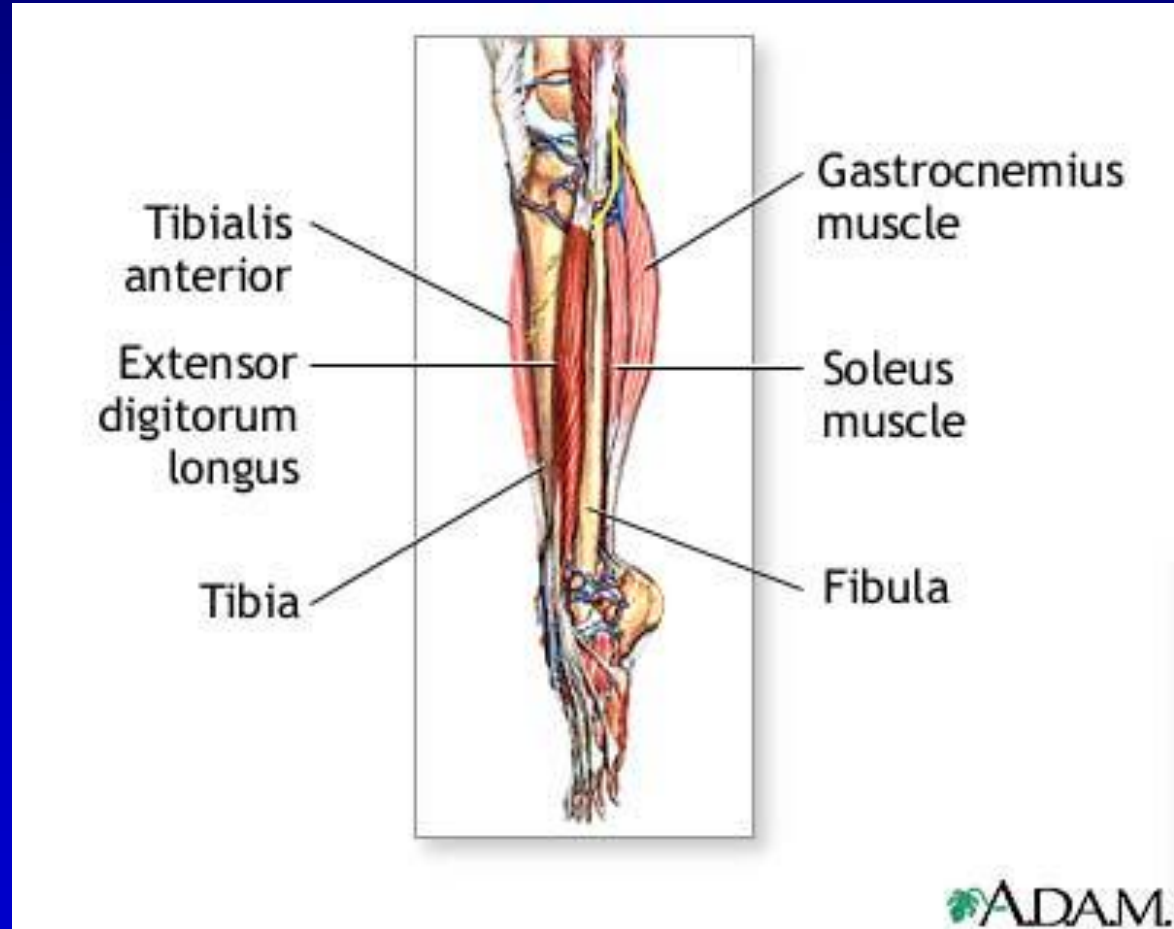
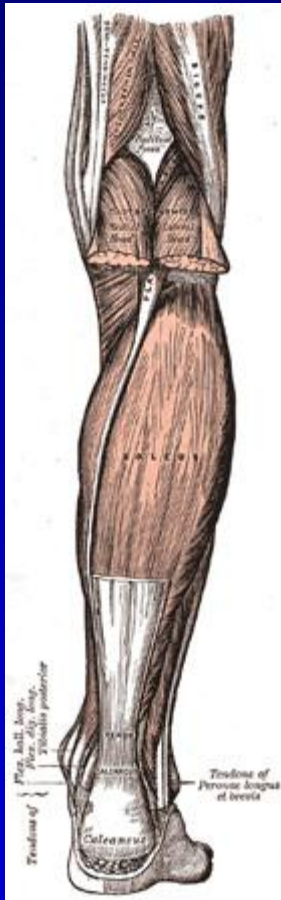
Anterior Compartment



- Contains the Tibialis Anterior Muscle, the Extensor hallucis muscle, Extensor Digitorum, the Tibial artery and the Deep Tibial Nerve (which innervates the space between the 1st and 2nd toes)
- Pain on dorsiflexion of foot and numbness between 1st and 2nd toes



Superficial and Deep Posterior Compartments



Lateral Compartment



Measure compartment pressure



- A compartment pressure above 30 mm Hg requires decompression



Significant Extremity Injury

- THINK: Compartment Syndrome
- No circumferential tight dressings
- Elevate Extremities
- Palpate compartments
- Evaluate neurovascular status of the limb
 - REMEMBER: an absent pulse is the last physical finding
 - Search for hypesthesia and pain on motion
- Measure compartment pressures
- Timely fasciotomy is an emergency procedure!!!



The Mangled Extremity

Reconstruction vs. Amputation?



The Mangled Extremity Score

• Type	• Characteristics	• Injuries	• Points
<ul style="list-style-type: none"> • Skeletal/Soft Tissue Group • 2&1 	<ul style="list-style-type: none"> • Low energy 	<ul style="list-style-type: none"> • Stab wound, simple fracture 	<ul style="list-style-type: none"> • 1
<ul style="list-style-type: none"> • 3 	<ul style="list-style-type: none"> • Medium energy 	<ul style="list-style-type: none"> • Open or multiple-level fractures, dislocations, moderate crush injuries 	<ul style="list-style-type: none"> • 2
<ul style="list-style-type: none"> • 4 	<ul style="list-style-type: none"> • High energy • Crush 	<ul style="list-style-type: none"> • Crush • Explosion, High speed 	<ul style="list-style-type: none"> • 3-4



Mangled Extremity Score

Shock Group			Points
	Normotensive	BP stable in field and in Or	0
	Transient Hypotension	Initial BP low but responds to fluids	1
	Prolonged Hypotension	BP < 90 mm Hg in field responds to fluids only in OR	2



Mangled Extremity Severity Score

Ischemia Score			Points
	None	Pulsatile Limb, no ischemia	0
	Mild	Diminished Pulses	1
	Moderate	No pulse or Doppler Signal , Sluggish capillary refill	2
	Severe	Pulseless cool paralyzed Extremity no capillary refill	3



Mangled Extremity Severity Score

A MESS \geq or equal to 7
associated with 100% incidence of
amputation



Mangled Hand



<http://www.eatonhand.com/complic/figures/crush.htm>





<http://www.emedicine.com/med/topic2812.htm>



Crushed Leg



<http://www.dcmsonline.org/jax-medicine/1998journals/may1998/lowerextremity.htm>



Jean Dominique de Larrey



Clinical Approach to the Patient with an Extremity Injury

- Primary Survey
 - Airway
 - Breathing
 - Circulation STOP EXTERNAL HEMORRHAGE
 - Disability
 - Exposure/Environment
- REMEMBER – Unless the patient is exsanguinating, the Extremity Injury which looks impressive will not threaten the patients life immediately. Rule out life threatening injuries first!!!!



Secondary Survey

Detailed Examination of extremities •

Palpate all extremities –

Examine and RECORD all pulses –

Do a careful sensory exam of all 4 extremities. –

RECORD results

Do a careful motor exam of all 4 extremities. –

RECORD results

If pulse absent distal to a fracture, carefully reduce –

fracture by gentle in line traction. RECORD pulse status and neuro status after reduction of fracture

Immobilize and Elevate Extremity •



Care of Extremity Injuries

- Open fracture

- Wound toilet and debridement in OR –
ASAP

- Antibiotics –

- Delayed wound closure –

- R/O Compartment Syndrome

- Complex Injuries may require vascular, peripheral nerve as well as orthopedic and soft tissue reconstructive surgery. A team leader is essential

