The Management of Peripheral Arterial Injuries

February in Phoenix - Trauma Symposium
February 15th, 2019

- No disclosures.

Objectives

- Identify peripheral arterial injuries.
- Basic management of arterial injuries.
- Identify common pitfalls when managing peripheral arterial injuries

Outline

- History
- Mechanisms
- Types of injuries
- Diagnosis
- Management
- Repairs
- Special Topics (shunts, fasciotomies, endovascular repair)

History

Valentine Mott (1785-1865)

- Father of American vascular surgery.
- Known for experimenting with ligations and amputations.

Vascular Repair

1759 - Hallowell attempted a brachial artery repair.

1891 - Jassinowsky demonstrated the first repair of an artery with preserved patency.

1896 - Jaboulay and Briau describe a successful end-to-end anastomosis of the carotid.

1896 - J.B. Murphy of Chicago performed the first successful human femoral artery and vein repair.

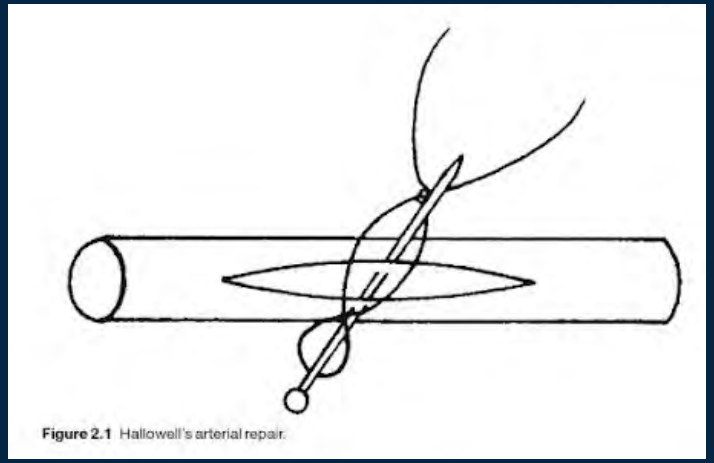


Figure 2.1 Hallowell's arterial repair.

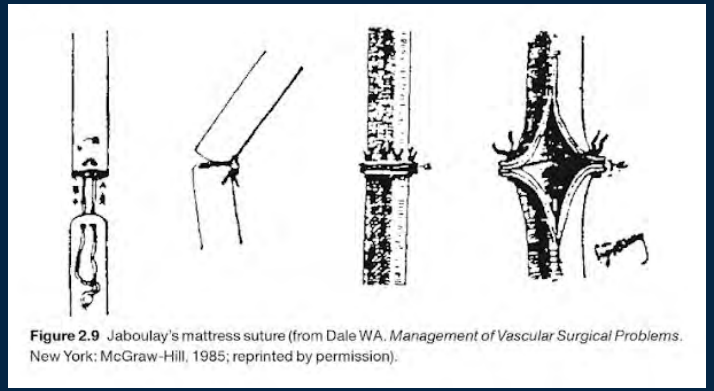


Figure 2.9 Jaboulay's mattress suture (from Dale WA. *Management of Vascular Surgical Problems*. New York: McGraw-Hill, 1985; reprinted by permission).

Alexis Carrel (1873-1944)

French surgeon

Moved to the US in 1905.

Developed advances in grafting and vessel preservation.

Awarded the Nobel Prize in Physiology or Medicine.

Military Conflict

WWI - Ligation wa

WWII - DeBakey c

Korean War - Rest by direct anastomosis, later

Vietnam War - Vie nes and Normal Rich

Iraq/Afghanistan - es with a shift to peripheral injuries.

Mechanisms

- Blunt
  - High velocity impact.
  - Areas receiving high kinetic forces.
- Penetrating
  - Low velocity: stab, puncture
  - High velocity: missile, projectile
- Intraluminal entry

Types of Injury

- Intimal injuries
- Wall defects with pseudoaneurysms or hemorrhage
- Complete transection with hemorrhage or occlusion
- Arteriovenous fistulas
- Spasm

Management

ABCs

Hemorrhage control

Triage of other injuries

Examine and decision to operate is appropriate with occlusion or major bleeding

** Pitfall: missed peripheral vascular injury.

Diagnosis

Clinical presentation

Injury patterns

Hard signs for vascular injury

- Arterial bleeding
- Pulsatile hematoma
- Absent pulse
- Limb ischemia: pulseless, pallor, paresthesia, pain, paralysis, poikilothermy.
- Bruit/thrill

Soft signs for vascular injury

- Nonpulsatile hematoma
- Decreased pulses or pressure index
- Hypotension
- Anemia, unexplained
- Injury to closely associated structure (nerve)

Common Patterns

Clavicle, Sternum, Manubrium → subclavian artery/vein, thoracic duct, brachial plexus

Shoulder Dislocation → axillary artery injury

Supracondylar Humerus → brachial artery

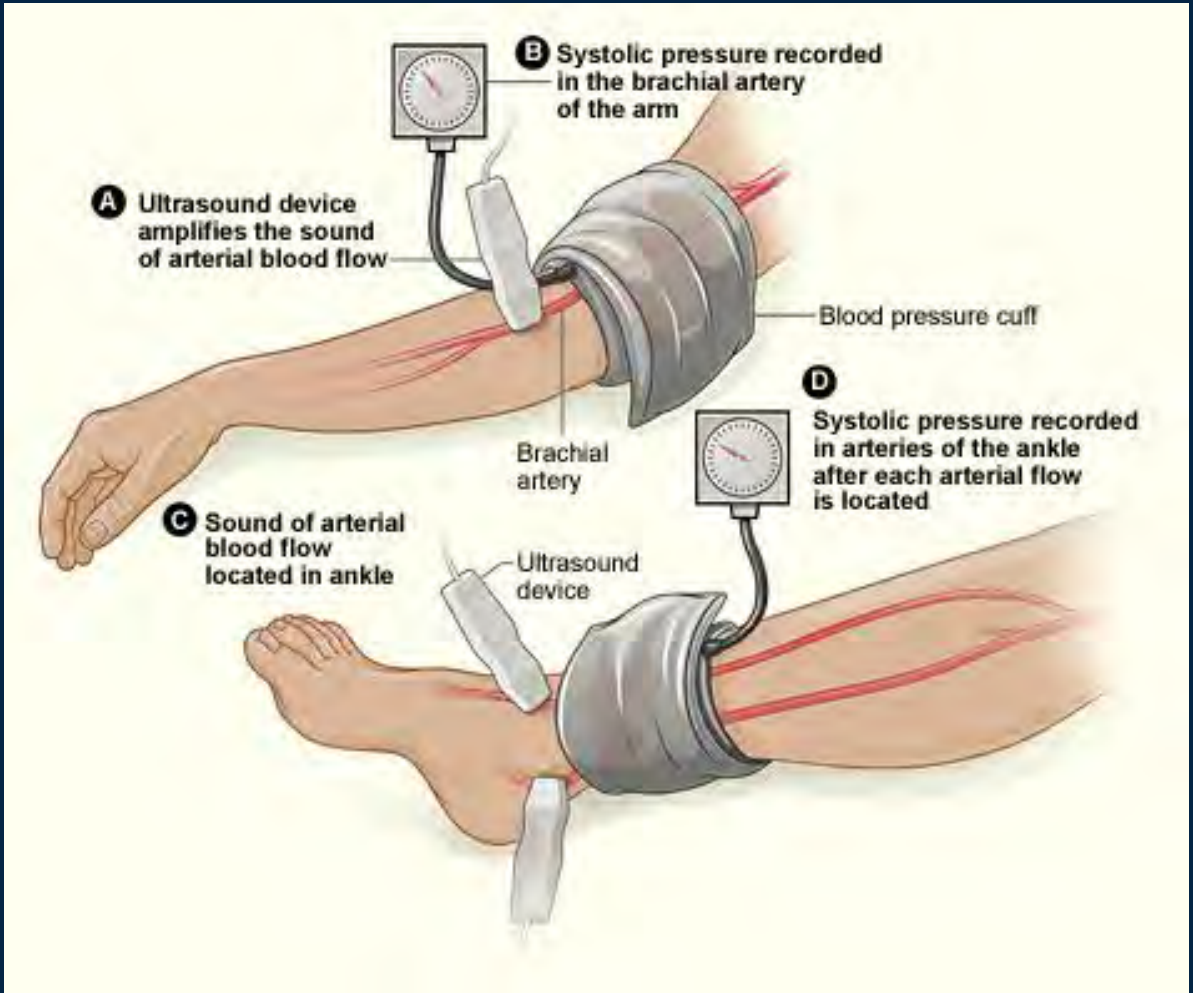
Pelvis, Sacrum → iliac vessels, cecum, sigmoid, bladder, ureter

Femur (distal), Tibial plateau, Knee Dislocation → popliteal vessels

Peripheral Injuries

- Physical Exam
- ABI, BBI, or API
- CT angiography
- Traditional angiography

ABI



National Heart Lung and Blood Insitute (NIH) - https://www.nhlbi.nih.gov/health/health-topics/topics/pad/diagnosis

BOX 160-1

Triage Categories and Management Guidelines for Wartime Extremity Vascular Injuries

CATEGORY I: ISOLATED VASCULAR INJURY

- One surgical team required
- Vascular injury, restoration of flow, reconstruction, and limb salvage take priority
- Extremity tourniquet may be removed in the operating room in coordination with the anesthesia team
- Venous injury should be repaired
- Complex or lengthy reconstructions acceptable

CATEGORY II: VASCULAR INJURY IN CONJUNCTION WITH OTHER NON–LIFE-THREATENING INJURIES

- Two-team approach preferable to treat vascular and other injury
- Vascular injury, restoration of flow, reconstruction, and limb salvage take priority
- Extremity tourniquet may be removed in the operating room in coordination with the anesthesia team
- Venous injury should be repaired
- Complex or lengthy reconstructions acceptable

CATEGORY III: MULTIPLE VASCULAR INJURIES

- Two-team approach preferable to treat multiple vascular injuries
- Vascular injury, restoration of flow, reconstruction, and limb salvage take priority
- Extremity tourniquet may be removed in the operating room in coordination with the anesthesia team
- Diminished role for venous injury repair
- Diminished role for complex or lengthy reconstructions

CATEGORY IV: VASCULAR INJURY IN CONJUNCTION WITH LIFE-THREATENING INJURIES

- Two-team approach optional after life-threatening injury is stabilized
- Life-threatening torso, neck, or head injury takes priority
- Extremity tourniquets should remain in place until the life-threatening injury* is stabilized
- Diminished role for venous injury repair
- Diminished role for complex or lengthy reconstructions

*Includes severe physiologic derangement from shock (e.g., severe acidosis, anemia, coagulopathy, hypothermia, electrolyte disorder).

Isolated Vascular Injury

- Repair should be undertaken
- Restoration of flow with limb salvage as a priority

Vascular Injury with Non-Life-Threatening Injury

- Vascular injury takes priority
- Two team approach preferred in this setting
- For concomitant ortho injury, stepwise repair recommended

Multiple Vascular Injuries

- Repair should be undertaken
- Restoration of flow with limb salvage as a priority
- Proximal vessels take priority
- Lower extremities take priority
- Shunts can be used

Vascular Injury with Life Threatening Injuries

- Life-threatening injury takes priority
- Tourniquet application until life threatening injury stabilized
- Consider two team approach
- Decreased role for repair or complex, length reconstruction

Tourniquets

- Lowest effective pressure
- Minimize time
- Apply early
- Close monitoring for ischemia
- Wide area of tourniquet application

** Pitfall: failure to recognize who should be managed with a shunt.

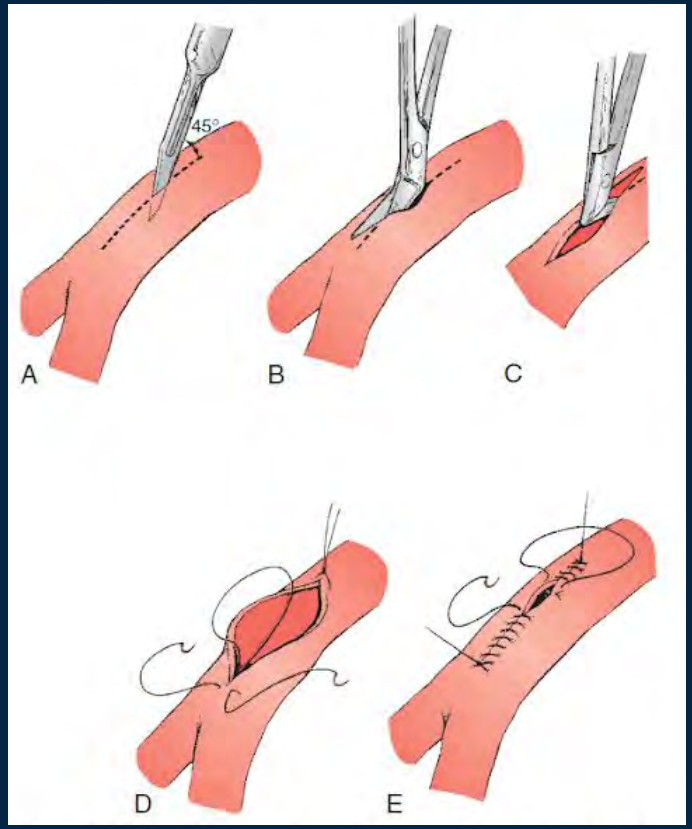
Repair

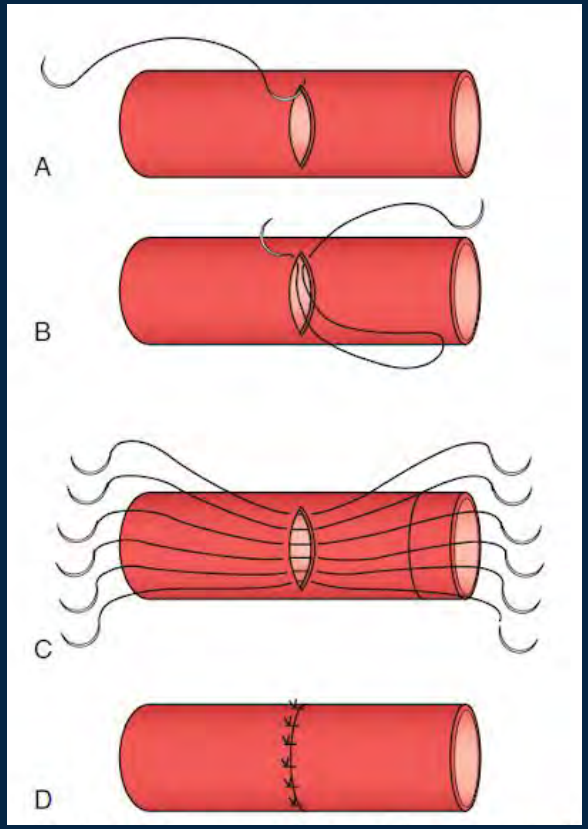
- Wide drape
- Proximal and distal control
- Debridement of unhealthy tissue
- Proximal and distal thrombectomy
- Systemic or regional heparin
- Coverage or closure
- Consider completion angiography
- Check pulses

** Pitfall: not prepping widely.

** Pitfall: incision directly over hematoma rather than over areas of proximal and distal control.

Simple Lateral Repair

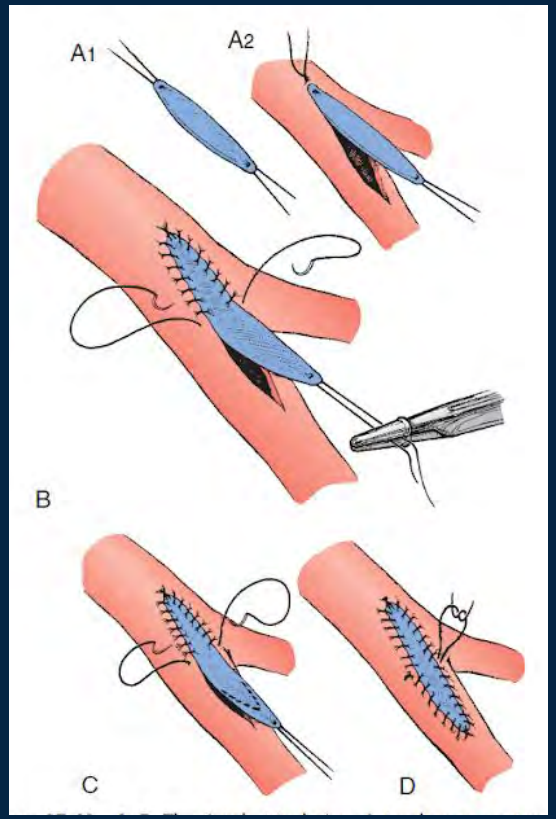


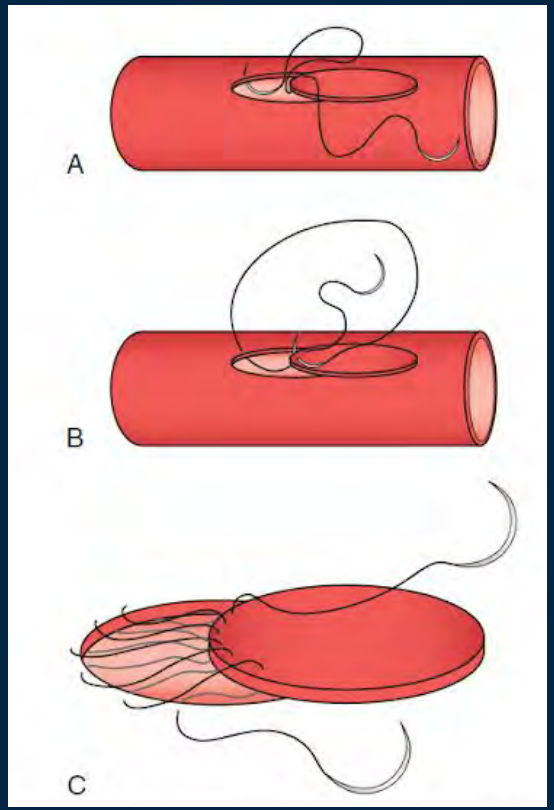


Other repairs

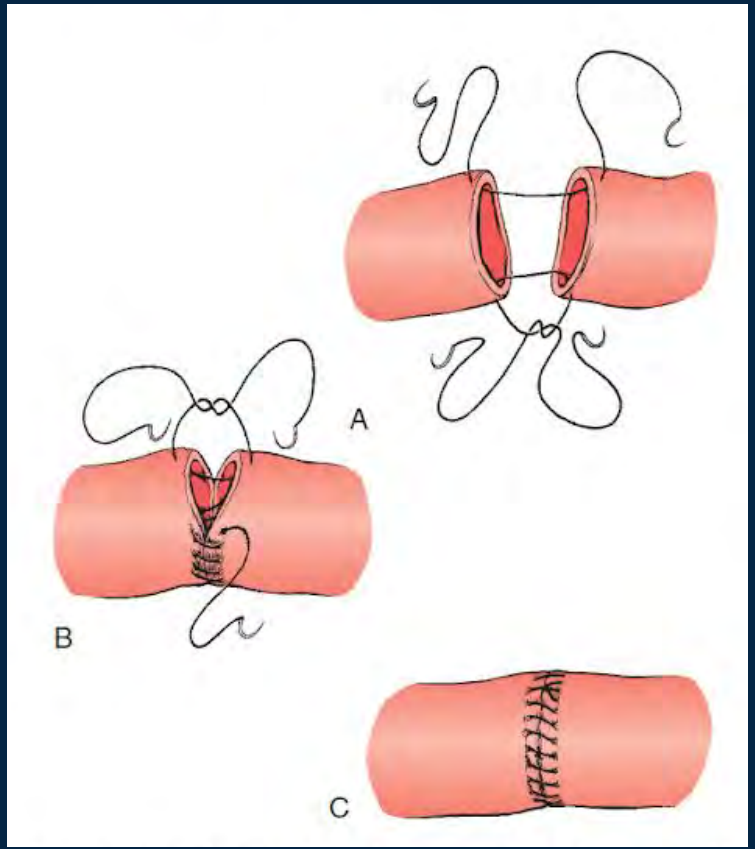
- Patch angioplasty
- End-to-end anastomosis
- Interposition graft
- Bypass graft
- Extra-anatomic bypass graft

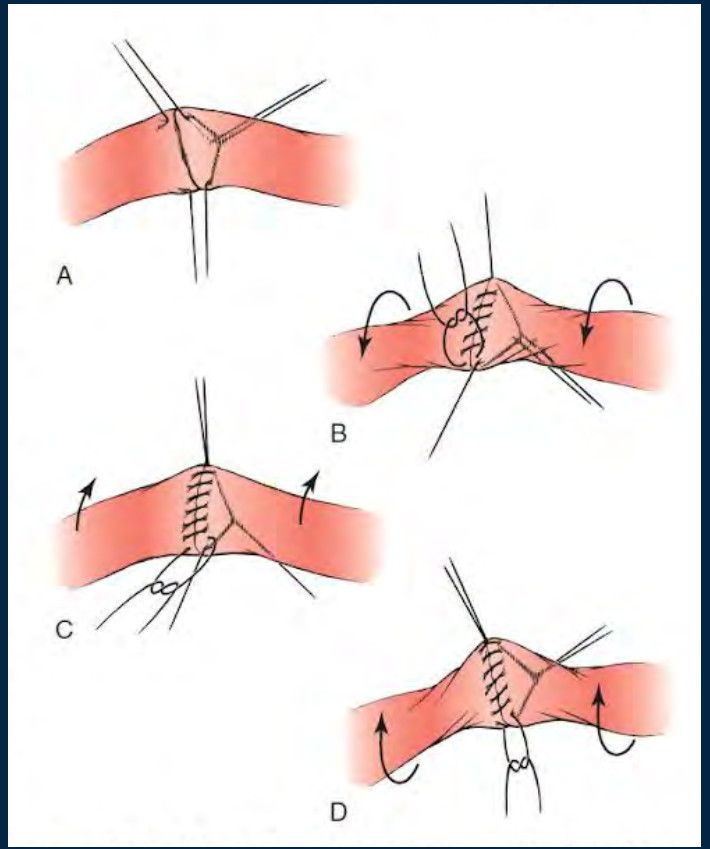
Patch Angioplasty

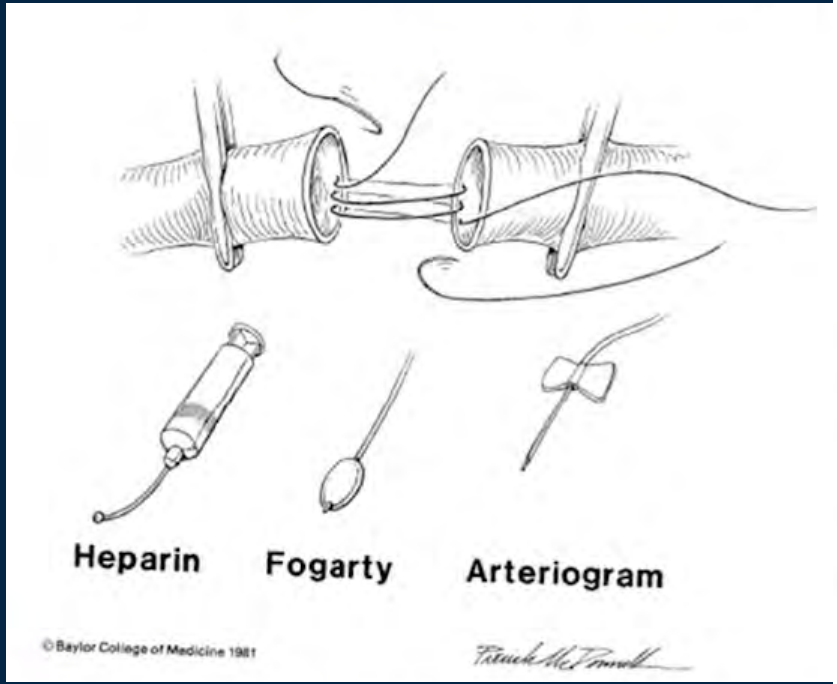


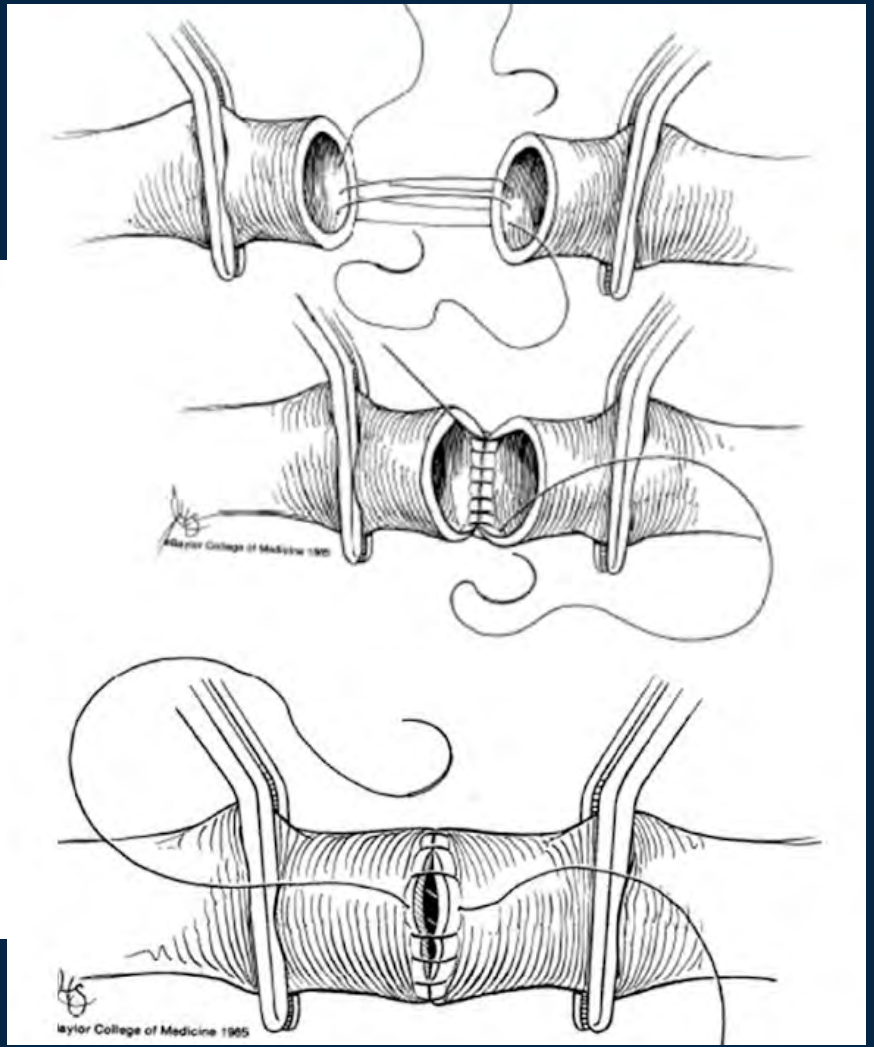


End-to-End






Heparin
Fogarty
Arteriogram
© Baylor College of Medicine 1981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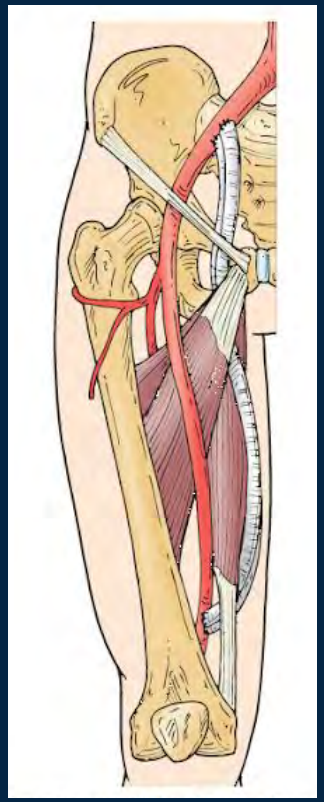
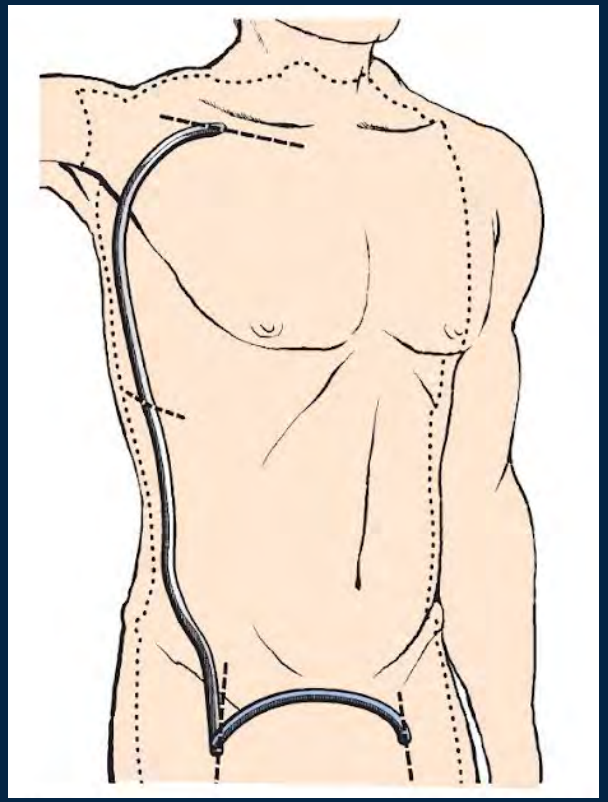
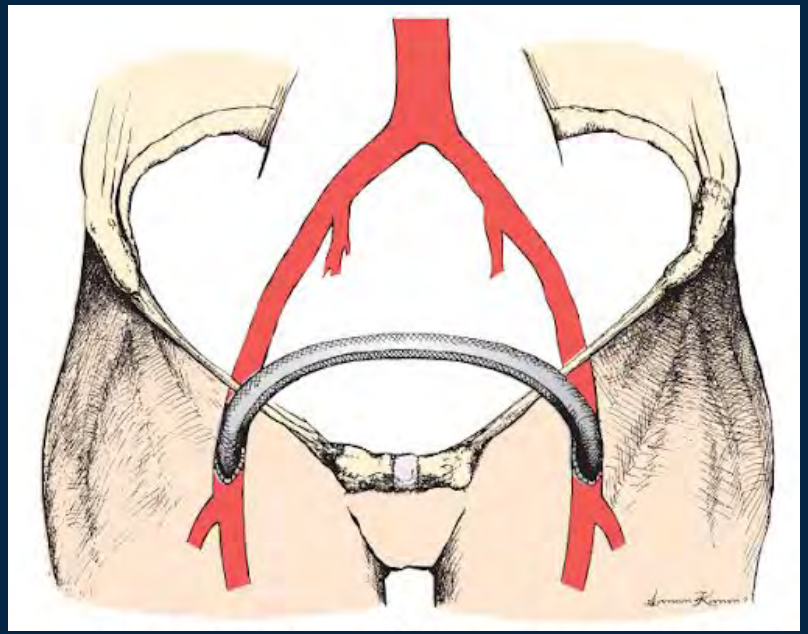
Bypass





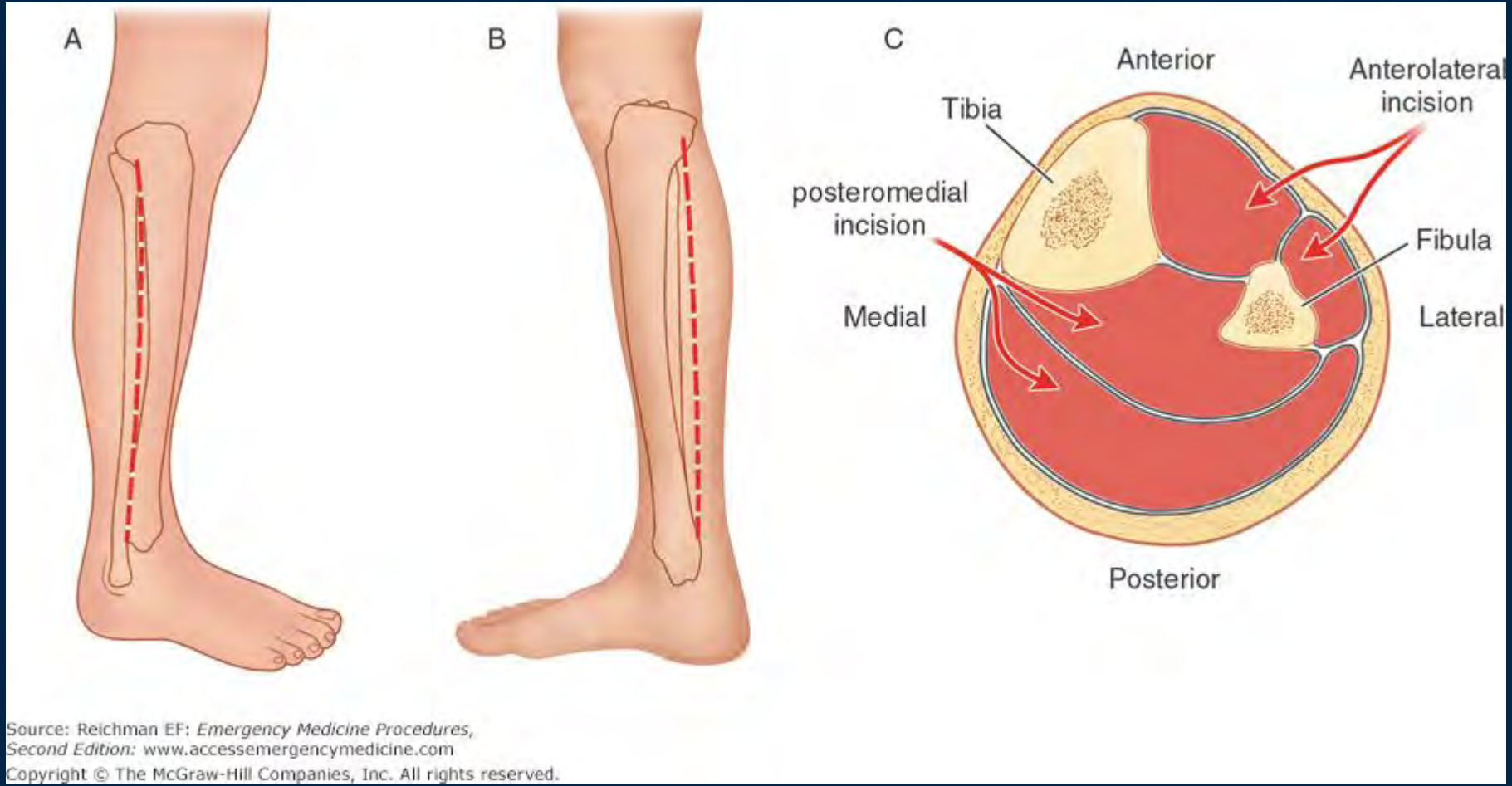


Shunts

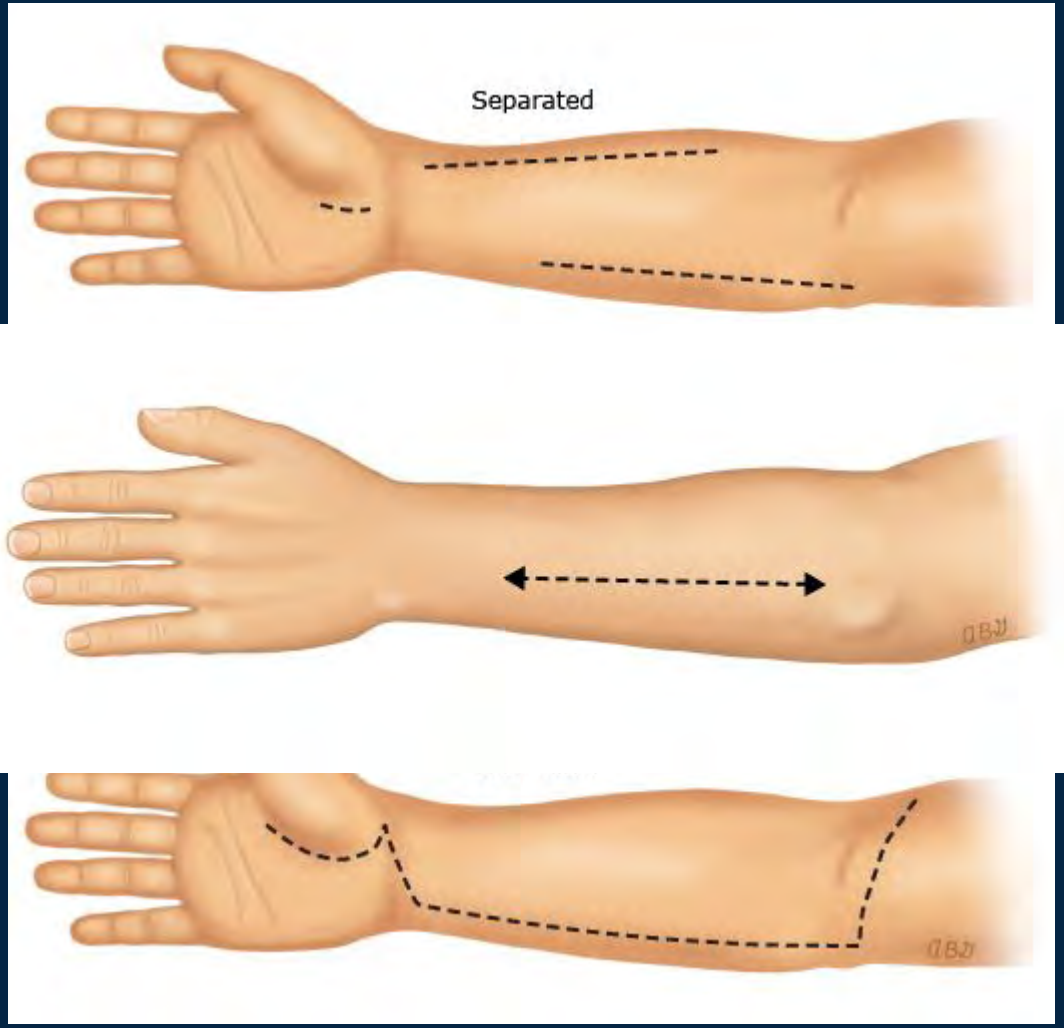
- Gustilo IIIC open fracture
- Need for distal perfusion as a complex revascularization is performed
- Damage control
- Perfusion of an amputated part of an upper extremity prior to replantation.

Fasciotomy

- Hypotension in the field
- Delay in reperfusion for 4-6 hrs
- Disproportionate pain in an extremity
- Crush injuries
- Combined arterial and venous injuries



Source: Reichman EF: *Emergency Medicine Procedures, Second Edition:* www.accessemergencymedicine.com


Separated

Outcomes after endovascular repair of arterial trauma

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Association for Academic Surgery

Applying peripheral vascular injury guidelines to penetrating trauma

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Endovascular Management of Peripheral Vascular Trauma

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Endovascular management of traumatic peripheral arterial injuries

Endovascular management for peripheral arterial trauma: The new norm?

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Endovascular Treatment

- Endovascular repairs have increased from 2.2% (1994-2003) to 6% (2007-2009)
- Absolute contraindication is inability to cross the lesion
- Decreased intraoperative blood loss
- No clear role although may be helpful for neck, subclavian, and iliac lesions in a stable patient.

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