Vascular trauma

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Vascular trauma

- **most vascular diseases** may be observed and treated during **prolonged periods**
- **Vascular trauma is the opposite**
- **very short time intervals** for diagnosis and intervention
- often **incomplete and imperfect information**

Vascular trauma an its evolution

- **The advances and developments** are related to **major conflicts or war**

- vascular trauma is associated with **hemorrhage**
  - surgical practice evolved around the **control of bleeding**

- **Ligation of both arterial and venous injuries**
  - the standard of care through World War II
  - World War I - repair attempted in **3.2 %** of injuries
  - World War II - repair attempted in **5 %** of injuries

Vascular trauma an its evolution

- **Korean War**
  - **88 %** of injuries undergoing a **vascular repair** attempt
- **Vietnam War**
  - **repair** attempted in **93%** of injuries
- **Iraq and Afghanistan**
  - **high rate of extremity injury** (53 %)
  - **decreased rate of major truncal injury** (15 %)
  - **devastating nature** of the extremity injuries **and** the inclusion of **distal arterial injuries** probably **explain** the **increase in vascular ligations** (35 %)

Vascular trauma in the civilian setting

- **historically** relatively **rare**

- the development of machinery and motorized vehicles
- the increase in urban violence and weaponry
- **increased incidence of civilian vascular trauma**

- **incidence 1-4% of all injuries** (likely an underestimate)
  - does not include patients who die at the trauma scene or before or immediately after hospital arrival

- **The majority of immediate deaths** from vessel disruption are **due to aortic injury** (55%)
  - 78% leading to death within 15 minutes of injury

Source: http://www.secondscount.org/heart-condition-centers/info-detail-2/cardiac-embolism-stroke

Current Epidemiology of Vascular Injury

- **trauma as a cause of death** (USA 2010)
  - 63% of patients aged 1 – 24 years
  - 42 % of patients aged 25 – 44 years

- **incidence of vascular injury**
  - 1.6 % for adults
  - 0.6 % for children

  - **60 – 90 % due to penetrating mechanisms** (mainly guns)
  - blunt vascular injuries are uncommon

- **iatrogenic injuries**
  - percutaneous endovascular procedures
  - laparoscopy

Source: http://www.secondscount.org/heart-condition-centers/info-detail-2/cardiac-embolism-stroke

Current Epidemiology of Vascular Injury

- **Epidemiologic trends**
  - The average **age** of all trauma patients is **increasing**
  - "young and healthy" trauma patient replaced with elderly patients with a **preexisting vascular disease**
  - **more severely injured patients** with major vascular injury reaching a hospital alive
  - damage control surgery
  - endovascular techniques

Mechanism of Injury

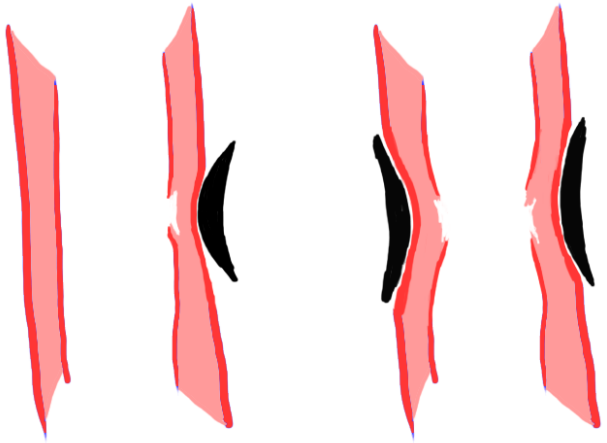
- **Direct**
  - penetrating injury (sharp)
  - blunt injury
- **Indirect**
  - traction injury
  - deceleration injury

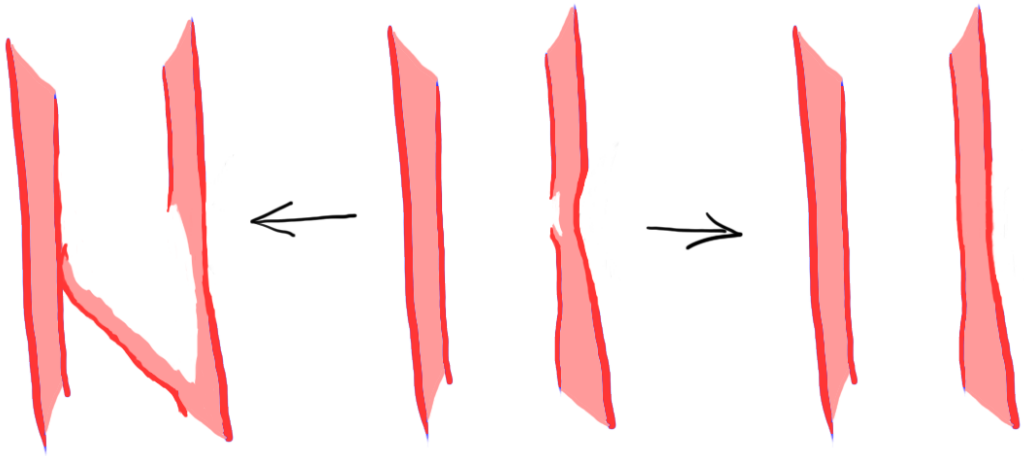
Penetrating injury (sharp)

- **grade I**
  - no bleeding
  - no peripheral ischemia
  - aneurysm might develop
- **grade II**
  - bleeding
  - pseudoaneurysm formation
  - with or without peripheral ischemia
- **grade III**
  - bleeding
  - peripheral ischemia

Blunt injury

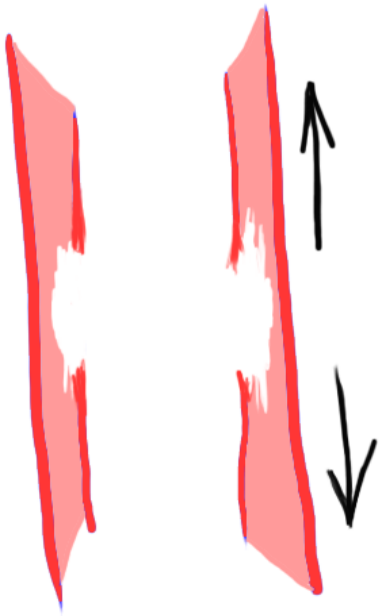
- contusion
- compression/strangulation





Indirect injury

- **traction injury**



- **deceleration injury**

Vascular Injury Classification and Scoring

- has yet to be developed
- Three-tier system
  - **tier 1** (peripheral or extremity)
    - distal to axillary of common femoral vessels
  - **tier 2** (proximal groin or axillary wounds)
    - junctional wounds
  - **tier 3** (intracavitary wounds)
    - thorax, abdomen, pelvis

Clinical presentation

- **highly variable**
  - **hard signs of vascular injury**
    - arterial bleeding
    - pulsatile hematoma
    - absence of pulses or limb ischemia
    - bruit or thrill indicative of arteriovenous fistula
  - **soft signs**
    - non-pulsatile hematoma
    - decreased pulses or pressure index
    - unexplained anemia or hypotension
    - injury to closely associated structures (typically nerves)
    - injury close to the vessel

Clinical presentation

- **hard signs of vascular injury**
  - **100 % specific**, particularly with penetrating **limb** trauma
  - **nearly 100 % specific** in penetrating **neck** trauma but present in only 20 % of patients

  - much **less applicable in intracavitary** vascular injury
  - hypotension will be the primary indicator

  - are **present in less than 10 % of vascular injuries**
  - majority will have soft signs, delayed presentation or be asymptomatic

Clinical presentation

- **Head**
  - intracranial injury is typically a combination of vessel and brain parenchyma injury

- **Face**
  - penetrating injuries to branches of external carotid artery
  - blunt trauma associated with major facial fractures
  - usually obvious with external or intraoral/intranasal bleeding

Clinical presentation - **neck**

- Vascular injury **incidence** is
  - **20 % in penetrating trauma**
  - clinical examination is very reliable
  - missed injury rate 0.7 %

  - **1 % in blunt trauma**
  - usually no hard signs
  - immediate neurological deficits (up to 28 %)
  - delayed neurological deficits (up to 78%)
  - entirely asymptomatic (up to 40 %)
  - **CT angiography** is study of choice

Clinical presentation - **torso**

- **Noncompressible truncal hemorrhage (NCTH)**
  - high associated mortality

- Critical concepts for NCTH
  - **minimize delays in transfer** to operating room
  - **permissive hypotension** until vascular control
  - **balanced resuscitation** with early use of plasma
  - use of **procoagulant drugs**
  - use of **damage control surgery**

Clinical presentation

- **Extremities**
  - **vascular injury is common in penetrating or blunt mechanism**
  - incidence is 1 – 2 % of all trauma patients
  - more common on lower (66 %) vs. upper (34 %) extremities
  - clinical examination is very reliable in penetrating injuries
  - missed injury rate is of 0.7 %

  - **blunt trauma**
  - **hard signs in 66 % of patients**; mainly absent distal pulses / limb ischemia
  - in 95 % associated bone fracture or dislocation
  - **CT angiography** is study of choice

Clinical assessment

- **History**

- mechanism of trauma
- time interval
- vascular symptoms

- prior vascular injury
- anticoagulation therapy

- **Physical findings**
- hard and soft signs of vascular injury
- ankle-brachial index

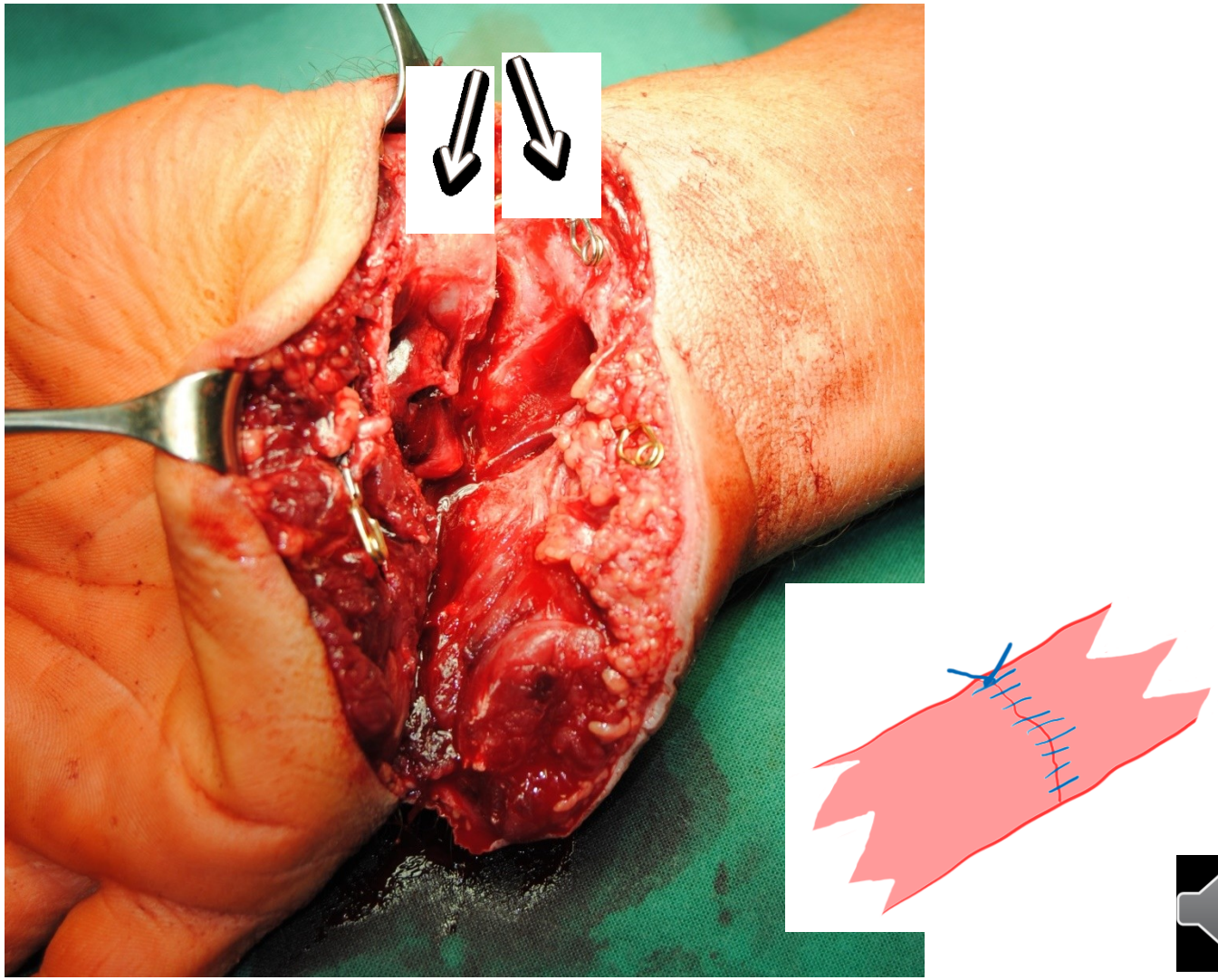
- **Imaging**
- none
- CT angiography
- duplex ultrasound

Treatment

- **Conservative** (observation + surveillance)
- **Vessel repair**
  - suture
  - patch repair
  - interposition graft / bypass
  - endovascular repair

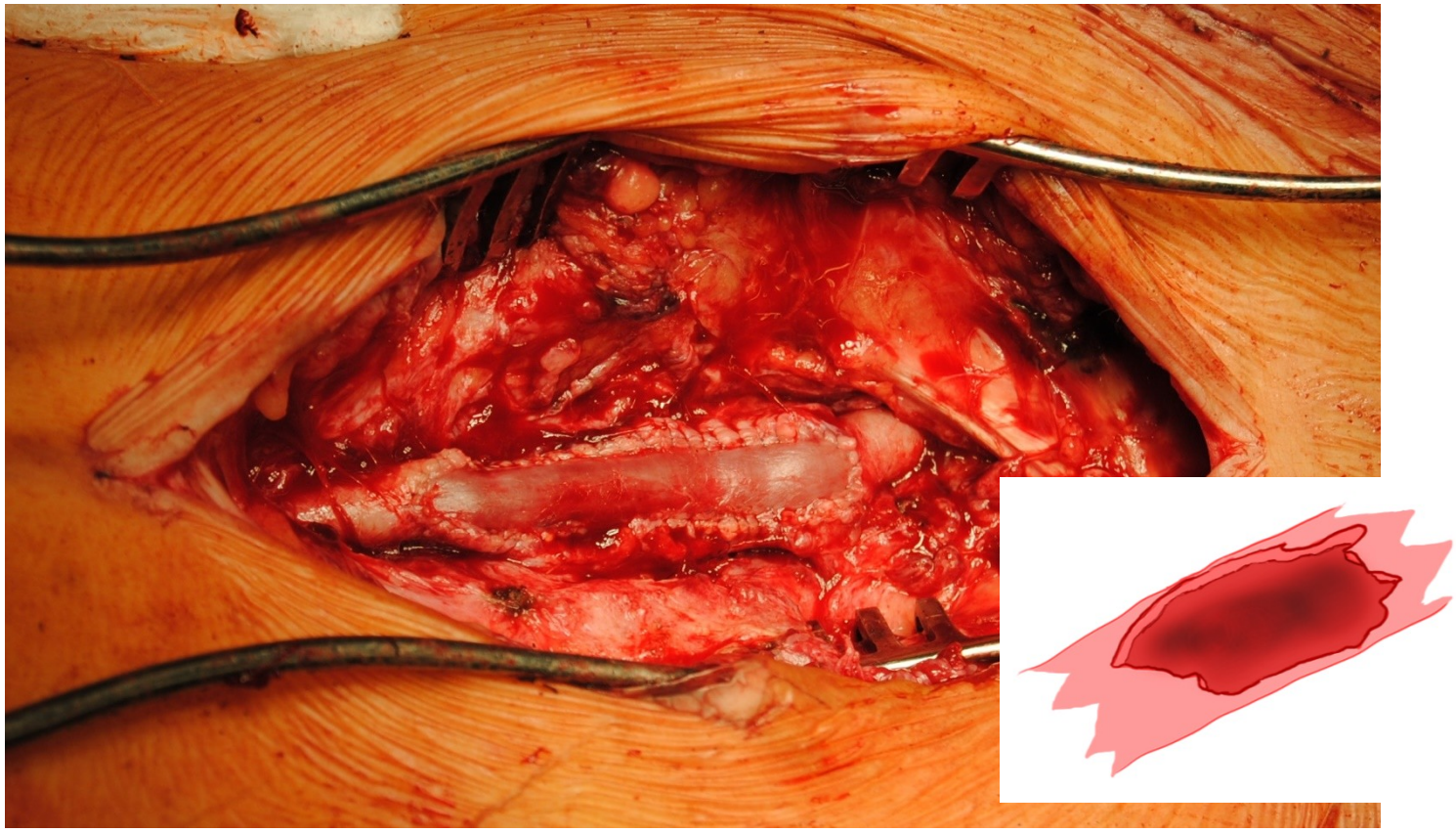
Vessel repair

- **suture**



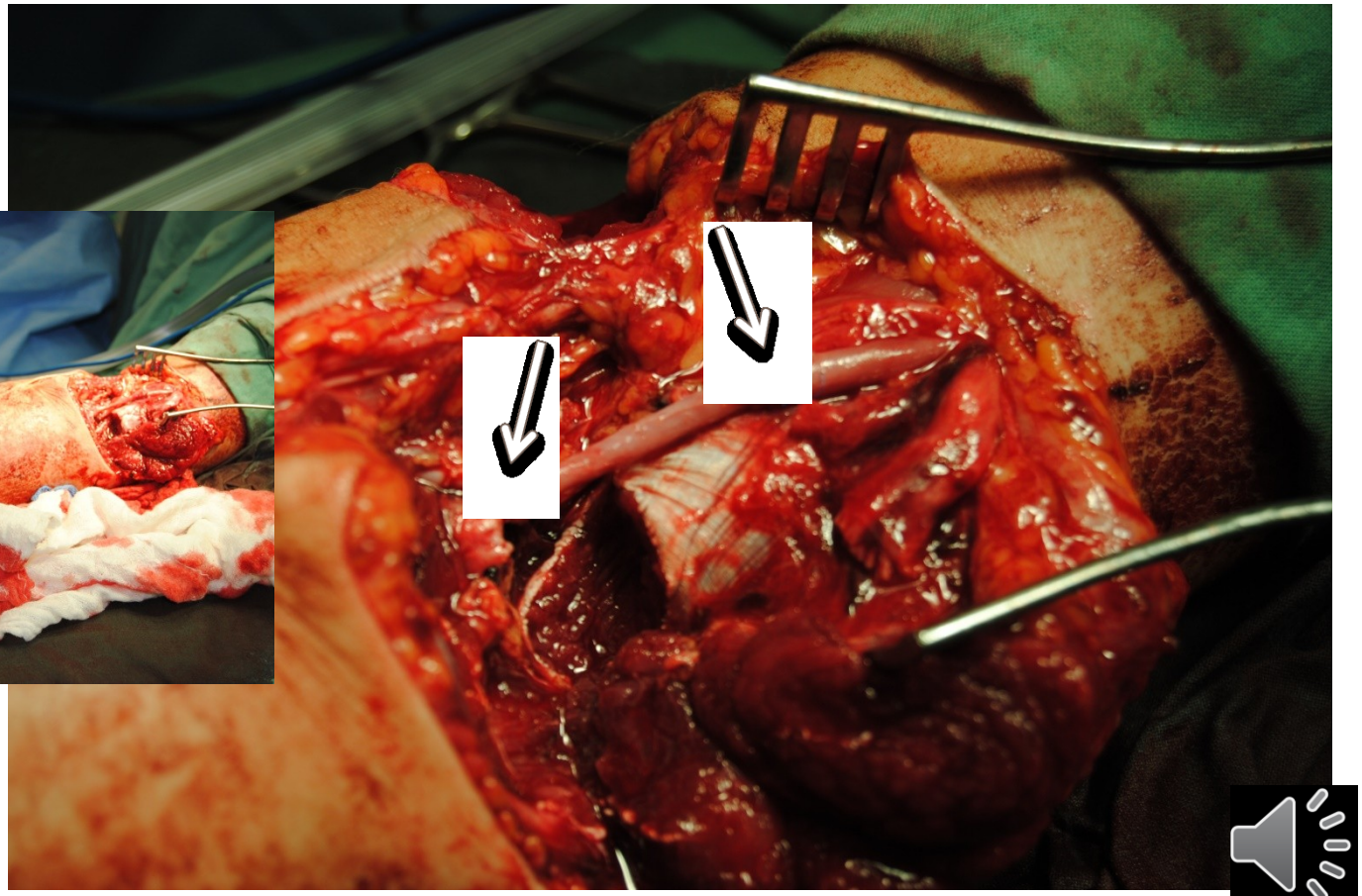
Vessel repair

- **vein patch angioplasty**



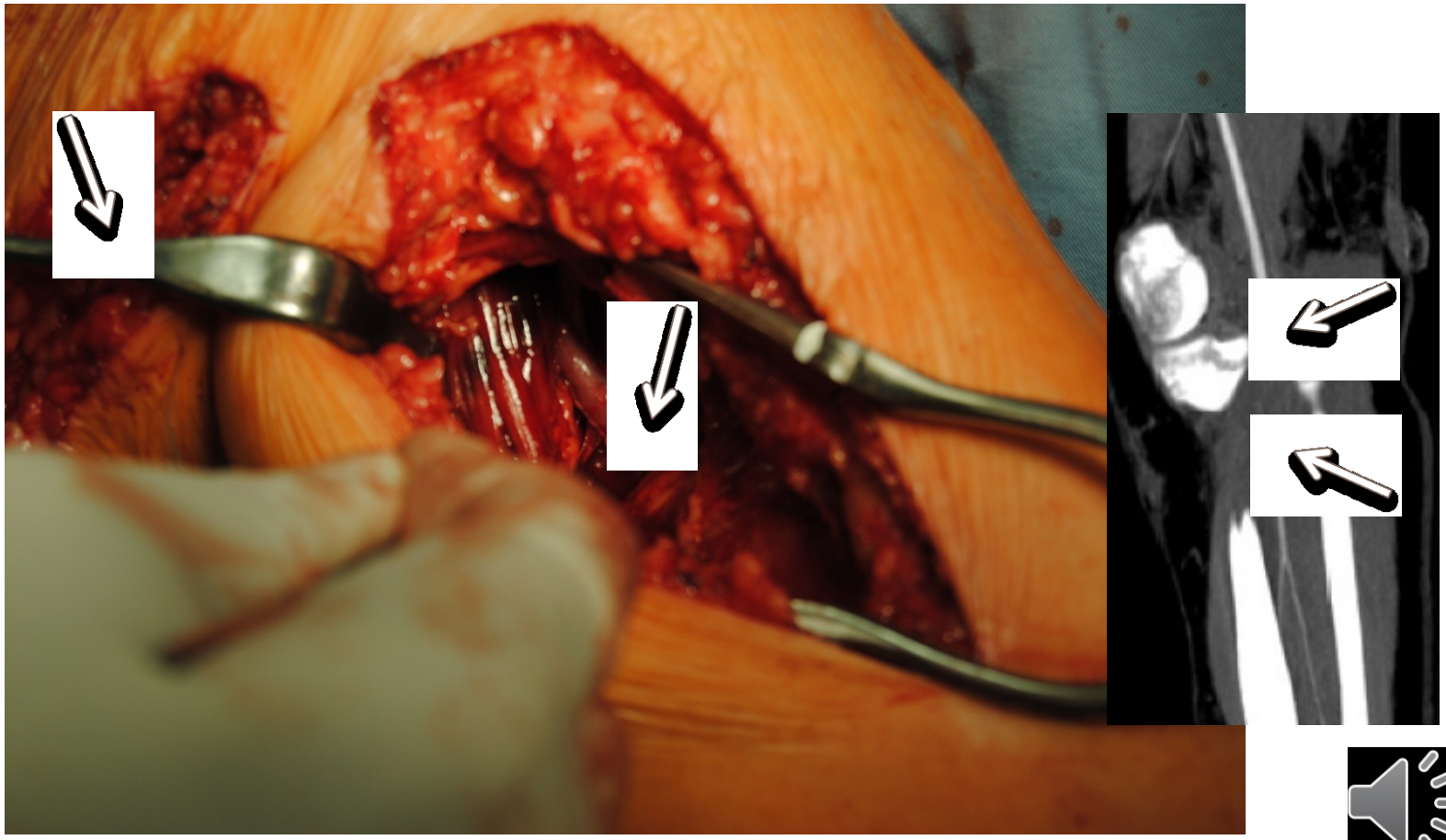
Vessel repair

- **interposition graft**



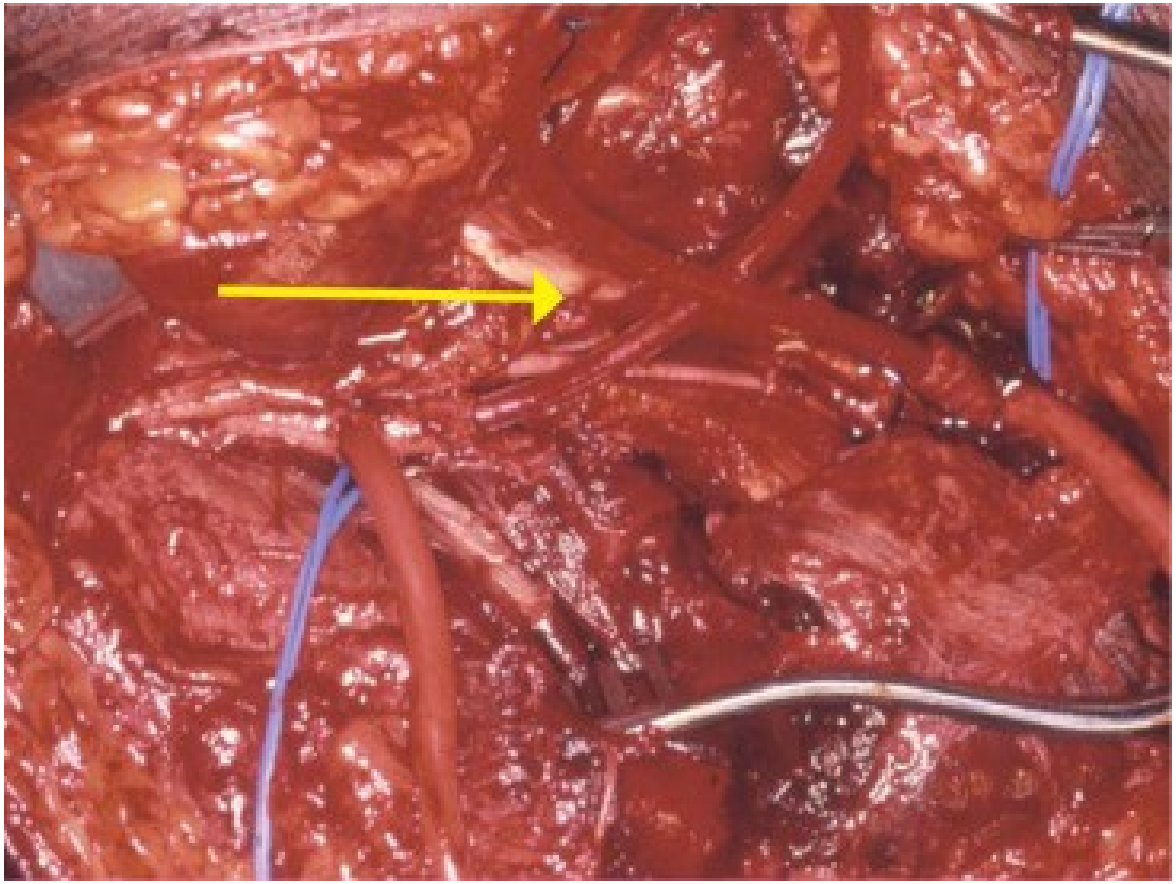
Vessel repair

- **bypass**



Vessel repair

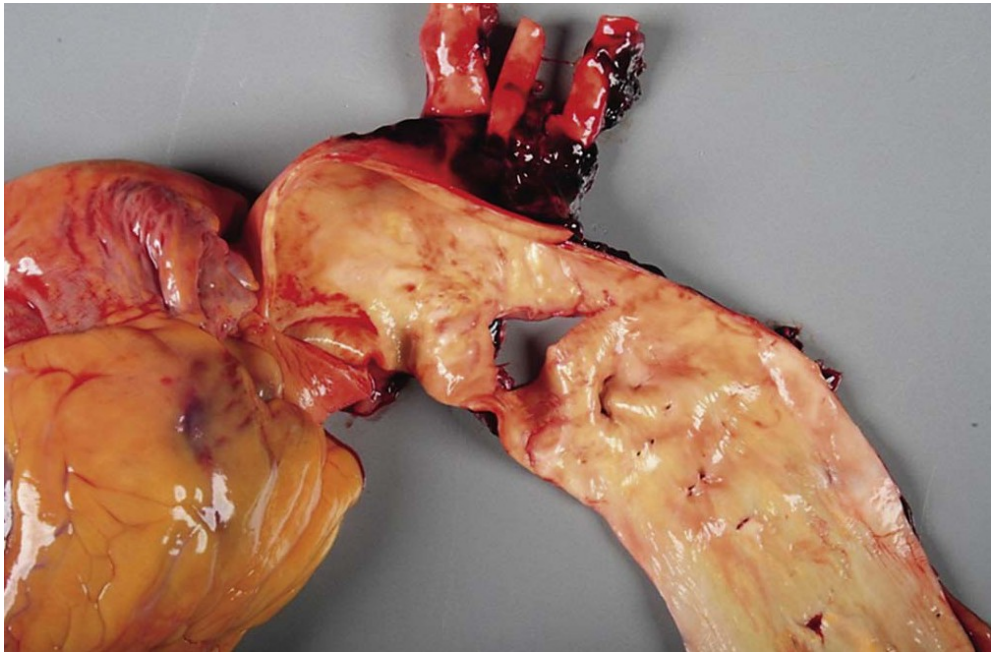
- **temporary shunting**

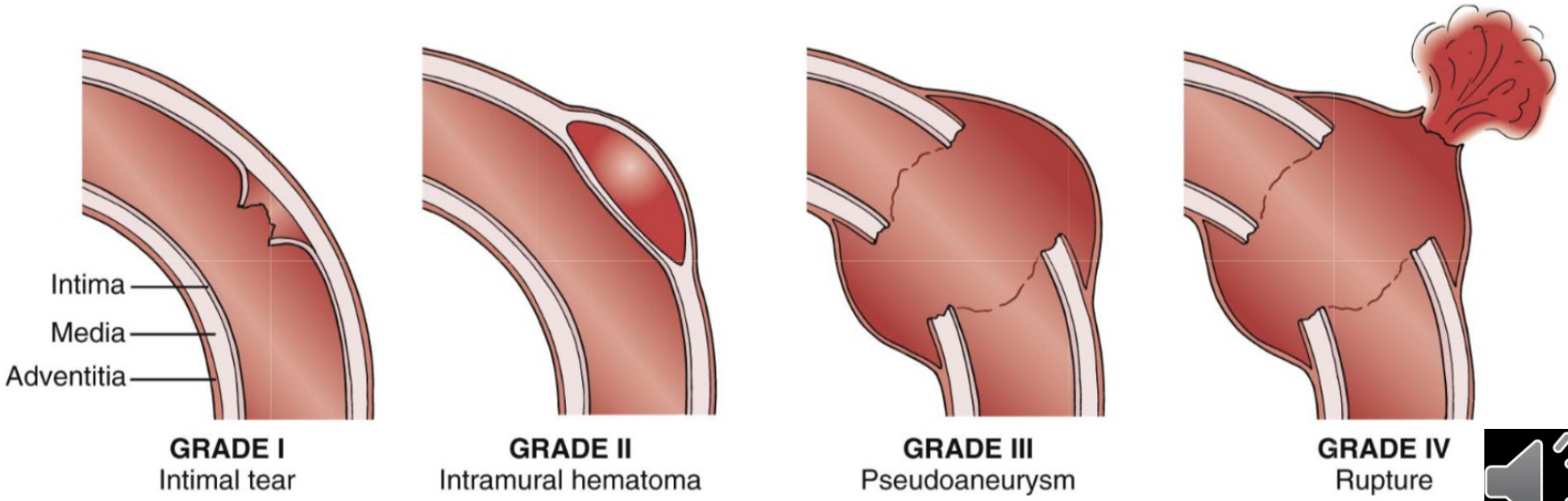


Source: Cristián Salas, D. Trauma vascular, visión del cirujano vascular. https://doi.org/10.1016/S0716-8640(11)70481-3

Vessel repair

- **endovascular repair**





Source: Ruhterford's Vascular Surgery 8th Edition

Vessel repair

- **endovascular repair**

Source: Ruhterford's Vascular Surgery 8th Edition

Treatment

- **Conservative (observation)**
- **Vessel repair**
  - direct arterial repair (suture)
  - patch repair
  - interposition graft repair
  - bypass repair
  - endovascular repair
- **Vessel ligation**
- **Amputation**

Thank you for your attention!