★ ★ ★ ★ ★

BEARAMEDICS INTERNSHIP SHIFT REVIEWS

TRAUMA BLOCK · SHIFTS 11 TO 15

Bearamedics Trauma Anatomy Cards

The why under the wound · Five cards for the trauma block

Thomas Moore, EMT-P

Bearamedics Reference · not a treatment protocol

CONTENTS

T1	**Bleeding** Vessels, junctions, and where blood hides	**Shift 11** Trauma Basics #706 · #706-A · #660
T2	**Pelvis and Belly** The ring, the binder, solid organs, seat belts, the aortic isthmus	**Shift 12** Major Trauma #713 · #714 · #153
T3	**Head, Spine, and Neck** Scalp to brain, the three bleeds, cord levels, three shocks, the airway	**Shift 13** Head and Spine Trauma #702 · #704 · #660
T4	**Chest and Skin** The cardiac box, the rib bundle, three chest killers, burn depth and size	**Shift 14** Penetrating Trauma and Burns #705 · #633
T5	**Special Bodies and the Whole Picture** Children and older adults, the body map, traumatic arrest	**Shift 15** Trauma Mega Day #661 · #153 · #601

How to use them

Each card is two pages: a front and a back. Learn the anatomy, then tie every structure to a field decision. Bring the card to the shift it supports and work the anatomy station on a partner.

The protocol always wins

Gray numbers like #706 are SLO County EMS documents. Ⓟ marks a Bearamedics pearl, not county protocol. Base means a base hospital order. Where sources disagree on a number, the card says so.

Using This Set

Print, laminate, and carry · **v1.1 adds image sheets**

★ ★ ★ ★ ★
Trauma Anatomy Cards
Bearamedics Reference · not a treatment protocol

What changed in v1.1

Each card now has a second sheet behind it: **Images A** and **Images B**. The card teaches the decision; the image sheet shows the anatomy under it, with large labels you can read at arm's length. Every card is now **two sheets, four pages**.

The set

T1	**Bleeding** Arm, armpit, neck, leg, groin	Shift 11	4 pages 2 sheets
T2	**Pelvis and Belly** Pelvic ring, aorta down to the pelvis	Shift 12	4 pages 2 sheets
T3	**Head, Spine, and Neck** Meninges, spine levels, larynx and cric	Shift 13	4 pages 2 sheets
T4	**Chest and Skin** Rib count and landmarks, skin layers, rule of nines	Shift 14	4 pages 2 sheets
T5	**Special Bodies** Newborn skull, the older spine	Shift 15	4 pages 2 sheets

Printing

1. Print all 22 pages **double-sided, flip on long edge**.
2. Pages pair in order: this page backs the cover, then each card front backs to its card back, and Images A backs to Images B.
3. White background on purpose: no ink wasted on fills.
4. Print at **100% / actual size**, not "fit to page", so the labels stay their designed size.

Laminating

1. 11 sheets total: cover, then two per card.
2. Colored tabs sit on the outside edge, so a stack fans out by card.
3. Bring the card to the shift it supports and work the hands-on boxes on a partner.
4. The protocol always wins. Gray numbers like #706 are SLO County EMS documents.

Image credits

OpenStax, *Anatomy & Physiology 2e* (Betts et al.), licensed CC BY 4.0. Access free at openstax.org/books/anatomy-and-physiology-2e. All figures modified: original labels removed and relabeled, some cropped, some marks added.

- Fig. 5.2, Layers of the skin (T4)
- Fig. 5.23, Rule of nines (T4)
- Fig. 7.22, Osteoporosis (T5)
- Fig. 7.32, Thoracic cage (T4)
- Fig. 8.12, Pelvis (T2)
- Fig. 13.17, Meninges (T3)
- Fig. 20.26, Arteries of the neck (T1)
- Fig. 20.28, Abdominal aorta (T2)
- Fig. 20.31, Arteries of the upper limb (T1)
- Fig. 20.33, Arteries of the lower limb (T1)
- Fig. 22.7, Larynx (T3)

Henry Gray, *Anatomy of the Human Body* (1918), public domain. Modified: relabeled, colored highlights added.

- Fig. 111, Vertebral column (colored version, Wikimedia Commons) (T3)
- Fig. 197, Skull at birth, from above (T5)
- Fig. 198, Skull at birth, from the side (T5)

Labels, layout, and teaching text: Thomas Moore, EMT-P. These sheets are free and stay free.

BLEEDING

Vessels, Junctions, and Where Blood Hides · **Shift 11**

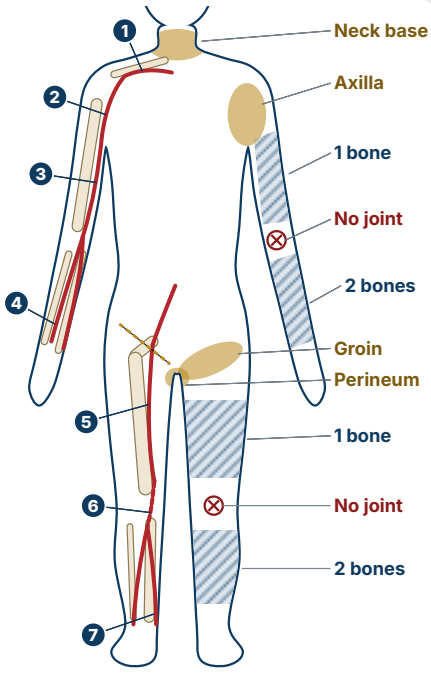
★ ★ ★ ★ ★
Trauma Anatomy Reference
Bearamedics Reference · not a treatment protocol

T1 BLEEDING

THE WHY UNDER THE WOUND

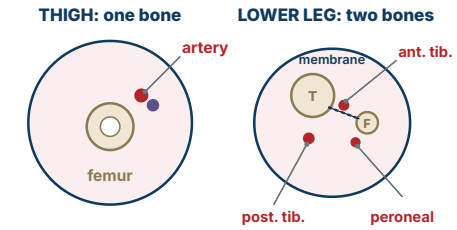
- Limb arteries run beside bone: on the upper arm and thigh, a band pins one artery against one bone.
- **County:** tourniquet usually 2 to 4 in above the wound; never over a joint, angulation, open fracture, or penetrating wound #706.
- Tighten fast to the least pressure that stops the bleeding. The time goes **on the device** #706.
- **Junctional zones** (neck base, axilla, shoulder, groin, buttock, perineum) cannot take a limb tourniquet: pack and press.
- Pressure points are **no longer recommended**: collateral flow keeps the wound fed.
- Above the inguinal ligament the artery is inside the pelvis. Press below it, over the femoral head.

STEP 1: Arteries Ride the Bones



Schematic, front view. Patient's right: arteries over bone, keyed to the table. Patient's left: where a tourniquet can and cannot go.

	Artery	Where to find it	Why it matters
1	**Subclavian**	Behind the clavicle, over the 1st rib	No band reaches it. Digital pressure into the wound.
2	**Axillary**	Deep in the armpit, wrapped by the brachial plexus	Junctional. A distal pulse does not rule out injury.
3	**Brachial**	Inner arm along the humerus; pulse above the elbow crease, medial to the biceps tendon	One bone: a tourniquet pins it to the humerus.
4	**Radial / ulnar**	Thumb side / pinky side of the wrist; joined by two palmar arches	One cut vessel can still leave a pink hand.
5	**Femoral**	External iliac becomes femoral under the inguinal ligament; pulse at the mid-inguinal point. Lateral to medial: nerve, artery, vein, empty, lymph (NAVEL)	Superficial here: groin wounds bleed fast. The femoral head is your backstop.
6	**Popliteal**	Behind the knee, tethered by the soleus arch	Knee dislocation tears it in 4% to 20%. Pulses before and after realignment.
7	**Post. tibial / DP**	Behind the medial malleolus / top of the foot	DP is absent in about 10% of normal people. Compare sides; check the PT.



Cross-sections, front at top. Not to scale.

The two-bone debate

The old "one bone only" rule (vessels hiding between two bones on the interosseous membrane) likely came from pig models (UK FPHC 2017). In 16 volunteers, every design occluded forearm and calf arteries; the calf took more pressure (Wall 2015). Follow the county's 2 to 4 in #706. Success means the bleeding stopped.

STEP 2: Junctions: Where a Tourniquet Cannot Reach

Zone	Why no tourniquet works	What works
Groin	Above the inguinal ligament the vessel is the **external iliac, inside the pelvis**	Pack; press below the ligament against the femoral head
Axilla, shoulder	Subclavian under the clavicle; axillary deep in the armpit with the brachial plexus	Digital pressure into the wound; pack the cavity
Base of neck	A band would close the airway and both carotids	Direct pressure; never squeeze both sides or wrap it Ⓟ. Open vein: occlusive dressing Ⓟ
Buttock, perineum	Too close to the trunk for any band to sit above the wound	Pack and hold. Think pelvic and retroperitoneal bleeding

Why packing works

Surface pressure cannot reach a vessel at the bottom of a cavity; packing carries the pressure down to it. Hemostatic gauze: hold **at least 3 min** (CoTCCC). Junctional tourniquets exist; evidence is inconsistent and most civilian EMS is not trained on them. Junctional bleeding caused 19.2% of potentially preventable prehospital combat deaths, 2001 to 2011.

#706 ESSENTIALS: HEMORRHAGE CONTROL, TOURNIQUET, HEMOSTATICS

The protocol wins. Read the full page.

THE LADDER

- **Direct pressure**, firm and focused.
- **Tourniquet:** life-threatening extremity bleeding not controlled by other means.
- **Hemostatic:** bleeding over 3 min despite all other measures; onto the bleeding site, then pressure dressing.
- **ALS:** hypotension per #660; ongoing bleeding, 15 or older: consider TXA #714.

TOURNIQUET (BLS)

- Check and document distal circulation, motor, sensation.
- Approved device, usually 2 to 4 in proximal, per manufacturer.
- Tighten rapidly to the least pressure that stops bleeding and/or affects distal pulses.
- Cover the wound, never the tourniquet. Reassess distal bleeding.
- Time ON the device; tell receiving staff.

DEVICES AND REMOVAL

- C-A-T, SOFT, MAT, TK4 #706-A. Remove improvised ones once an approved device works.
- QuikClot, Celox, HemCon ChitoFlex Pro; **no granules** #706-A.
- Not for non-extremity or junctional bleeding.
- Removal: ALS with base consult only Base.

FRONT

WHERE BLOOD HIDES

Blood Volume, Hemorrhage Classes, and Five Hiding Places · **Shift 11**

★ ★ ★ ★ ★

Trauma Anatomy Reference

Bearamedics Reference · not a treatment protocol

VOLUME, CLASSES, AND HIDING PLACES

- Adult blood volume is about 70 mL/kg: **about 5 L** in a 70 kg adult.
- Children: about 70 mL/kg over 3 months; 80 to 90 mL/kg in term infants. A 20 kg child has about 1.4 L.
- Pulse pressure narrows and heart rate climbs in Class II while systolic is still normal.
- Systolic does not fall until Class III: **30% to 40%, 1.5 to 2 L, already gone**.
- Children hold their pressure until 35% to 45% is lost. Hypotension is late.
- County fluid trigger: SBP 90 or less, or no palpable peripheral pulses #660. Over 65, SBP under 110 may represent shock #153.
- Hypotensive with no obvious external bleeding: search all five places before blaming anything else.
- An isolated closed femur rarely explains hypotension by itself. Keep looking.

STEP 1: How Much They Have, and What Losing It Looks Like

	Class I	Class II	Class III	Class IV
Blood loss (mL)	Up to 750	750 to 1,500	1,500 to 2,000	Over 2,000
% blood volume	Up to 15%	15% to 30%	30% to 40%	Over 40%
Pulse	Under 100	100 to 120	120 to 140	Over 140
Systolic BP	Normal	Normal	**Decreased**	**Decreased**
Pulse pressure	Normal or up	**Decreased**	Decreased	Decreased
Respirations	14 to 20	20 to 30	30 to 40	Over 35
Urine (mL/h)	Over 30	20 to 30	5 to 15	Negligible
Mental status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic

Classic ATLS teaching table, healthy 70 kg adult (reprinted in Spahn 2013); the newest edition's exact wording could not be checked. Beta blockers, baseline hypertension, and age change the picture, and registry data show many patients past 40% loss with slower pulses and higher pressures than Class IV predicts. A scaffold, not a decision rule.

Blood volume

70 kg adult	about 5 L (70 mL/kg)
Child over 3 mo	about 70 mL/kg
Term infant	about 80 to 90 mL/kg
20 kg child	about 1.4 to 1.6 L total

"80 mL/kg" for kids is often quoted but not verified; sources vary by age.

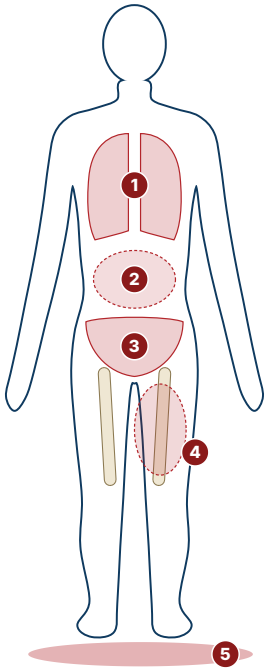
The cuff lies late

Rising heart rate, narrowing pulse pressure, pale cool skin, and anxiety come first. EtCO2 drifting down at a steady breathing rate is another early tell Ⓟ. Fit young adults and children compensate hard, then fall fast.

#660 FLUIDS

Trigger: SBP 90 or less, or no palpable peripheral pulses (child: hypotension for age, #601-A).
Adult: NS up to 500 mL, may repeat once. **Child:** 20 mL/kg, max 500 mL, may repeat once. More: Base.
Large bore, 18 G or larger, saline lock.

STEP 2: The Five Places Blood Hides



1 chest · 2 abdomen · 3 pelvis and retroperitoneum · 4 long bones · 5 the street

	Place	How much it can hold (verified)	Clues	Field move
1	**Chest**	About **40% of blood volume per hemithorax**: about 2 L a side in a 70 kg adult. Massive hemothorax: about 1,500 mL.	Shock, diminished breath sounds, dull percussion, hypoxia, flat neck veins	Oxygen, limited fluids #660, TXA if indicated #714, go. A needle does not drain blood.
2	**Abdomen**	A lethal volume, often with **little or no early distension**. No reliable single number.	Mechanism, seat belt sign, lower rib fractures, Kehr's sign, unexplained tachycardia	Step and destination per #153; TXA if SBP 90 or less #714. Card T2.
3	**Pelvis and retroperitoneum**	Retroperitoneum **up to about 4 L**; the pelvic cavity can hold the **entire blood volume**.	High-energy mechanism, pelvic, low back, or groin pain, leg length or rotation difference	Binder only when all three criteria are met #713. Never rock the pelvis.
4	**Long bones**	Femur about 1 to 1.5 L commonly cited (to 2 L in TCCC tables); tibia 0.5 to 1 L; humerus 0.5 to 0.7 L. Femur and tibia roughly double if open.	Deformity, swelling, a shortened thigh	Splint; traction only for isolated mid-shaft femur without pelvic pain #660-A.
5	**The street**	Unlimited. Eyes overestimate small spills (under 300 mL) and underestimate 400 to 1,500 mL.	Ground, clothing, car seat, under the patient	Look under them. Tourniquet or pack #706.

Femur caveat: does a femur really hold 1 to 2 L?

Measured data run lower. In 53 patients, mean loss before surgery was about 741 mL (Lieurance 1992). A 2025 NAEMSP position statement holds that a hypotensive patient with an isolated femoral shaft fracture is **more likely bleeding somewhere else**. Splint the leg, then hunt in places 1 to 3.

Small bodies, big percentages

A 20 kg child carries about 1.4 to 1.6 L. A loss that is trivial for an adult can be a Class II or III bleed for them, with a normal pressure the whole way. Trust heart rate, skin, and mental status; use the age-based values in #153.

Number check: you may hear "3 L per hemithorax" (including Platinum Ten ch. 6). The figure we could verify is about 40% of blood volume per side; teach "about 2 L or more in an adult."

For field education only. Treat per patient presentation, vitals, and SLO County EMS protocols.

BLEEDING: IMAGES

Arteries of the arm, armpit, and neck · **Shift 11**

★ ★ ★ ★ ★
Trauma Anatomy Images
Bearamedics Reference · not a treatment protocol

IMAGE 1: The Arm and the Armpit

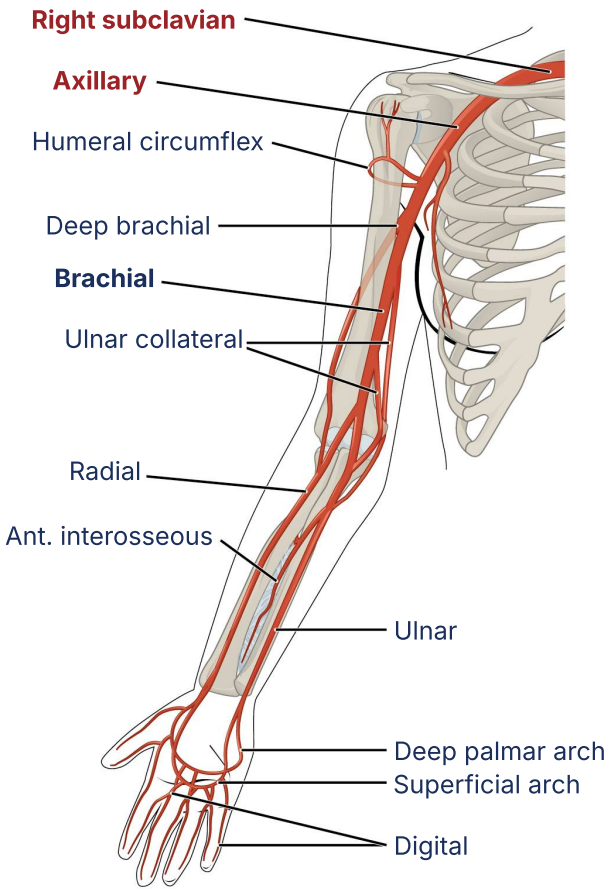


Figure 20.31 (modified: relabeled), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- **Subclavian and axillary** (red) run under the collarbone and deep in the armpit. A tourniquet can't reach them: **junctional**. Pack and press.
- **Brachial** runs down the inside of the upper arm against one bone. A band high on the upper arm pins it.
- Below the elbow the artery splits into radial and ulnar between two bones, so a band there has more to squeeze.
- **Neck (below):** the carotids are junctional too. Direct pressure; never a circumferential wrap.

HANDS-ON: on your partner

1. Find the radial pulse, then the brachial on the inside of the upper arm.
2. Find the carotid beside the windpipe. One side at a time.
3. Point to where a tourniquet stops working: the top of the arm into the armpit.

IMAGE 2: The Neck



Figure 20.26 (modified: relabeled, cropped), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

BLEEDING: IMAGES

Arteries of the leg and groin · **Shift 11**

★ ★ ★ ★ ★
Trauma Anatomy Images
Bearamedics Reference · not a treatment protocol

IMAGE 3: The Leg and the Groin

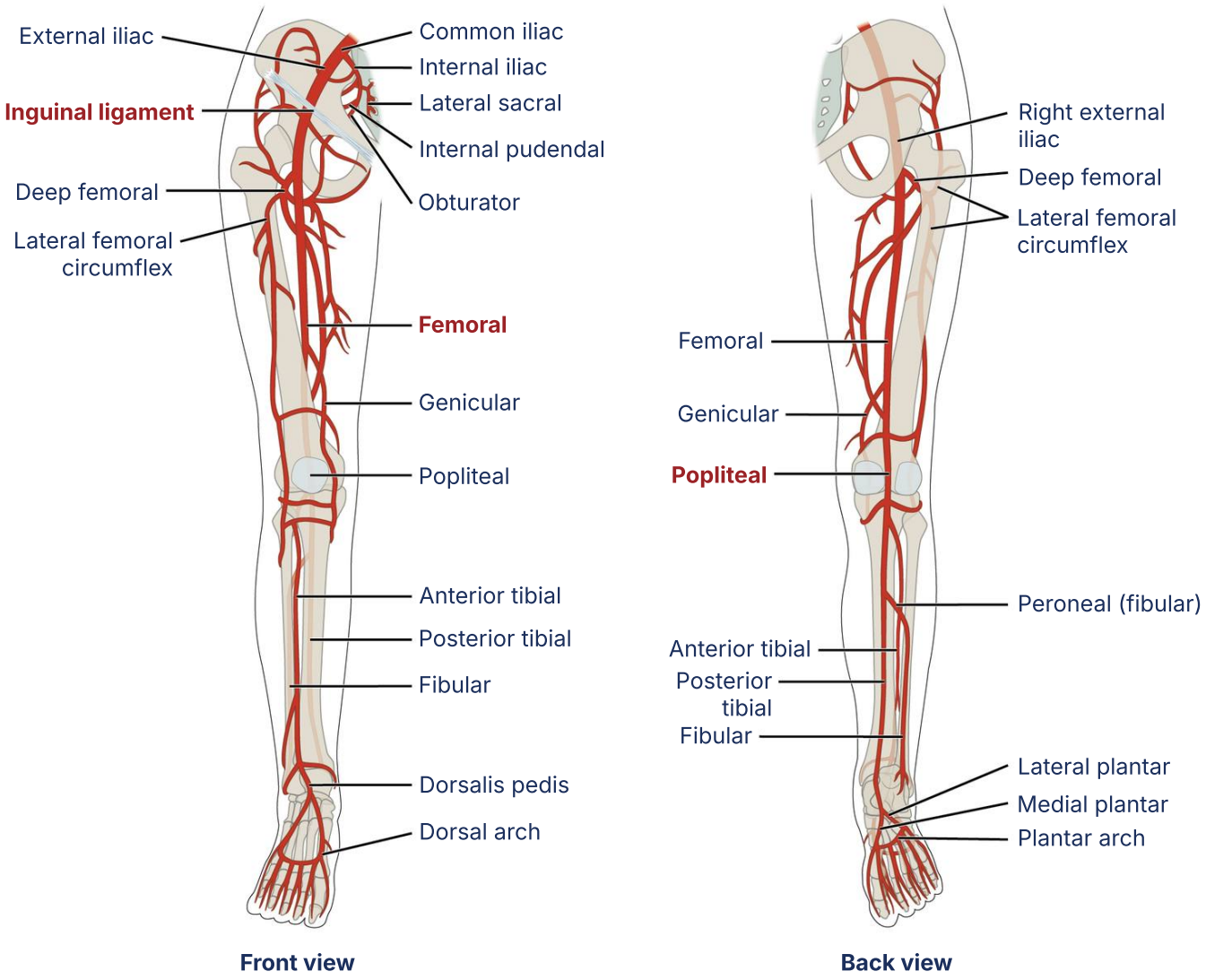


Figure 20.33 (modified: relabeled), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- The **external iliac** becomes the **femoral** as it passes under the **inguinal ligament** (red). Above the ligament the vessel is inside the pelvis; the groin crease is **junctional**: pack and hold hard pressure (#706).
- Below the groin the femoral runs beside one bone, so a tourniquet high on the thigh pins it.
- The **popliteal** runs behind the knee. The band goes above the knee, never over the joint (#706).

HANDS-ON: on your partner

1. Find the femoral pulse in the groin crease.
2. Find the popliteal behind the bent knee.
3. Find the posterior tibial behind the inner ankle and the dorsalis pedis on top of the foot.

PELVIS

The Ring, the Veins, and the Binder · **Shift 12**

★ ★ ★ ★ ★

Trauma Anatomy Reference

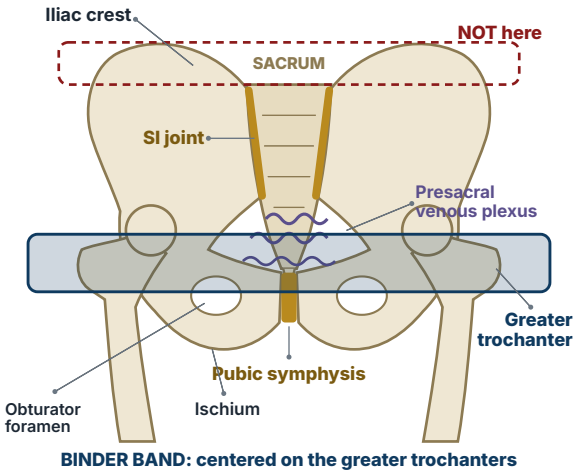
Bearamedics Reference · not a treatment protocol

T2 PELVIS AND BELLY

THE RING, THE VEINS, AND THE BAND

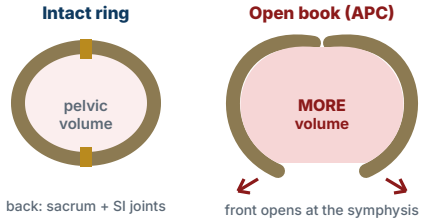
- The pelvis is a **ring**: sacrum plus two hip bones, joined at the SI joints in back and the symphysis in front.
- Stability lives in the **back**: the posterior SI ligaments. A posterior break makes it unstable and bloody.
- Most pelvic bleeding is **venous** (80% to 90%): presacral plexus and prevesical veins, plus raw bone.
- The retroperitoneum can hold **up to about 4 L**; the pelvic cavity can hold the entire blood volume.
- Binder on the **greater trochanters**, not the iliac crests #713. Never rock or spring the pelvis #713.
- **#713 needs all three:** high-risk mechanism, pelvic, low back, or groin pain, and SBP 90 or less.

STEP 1: The Ring and What Bleeds Inside It



Schematic front view. **Gold:** SI joints and symphysis, the ring's joints. **Purple:** venous plexus. **Navy band:** where the binder goes. **Red dashes:** where it does not.

Source	Share	Detail and why it matters
Veins	80% to 90%	Presacral plexus and prevesical veins. Low pressure: shrinking the ring and holding the ends still lets clot form. That is the binder's job.
Arteries	15% to 20%	Internal iliac branches; the superior gluteal is a common culprit. In unstable patients, 44% to 76% had arterial injury. Needs angiography or surgery.
Bone	Always	Broken cancellous bone surfaces ooze.



An open-book injury lets about four times as much fluid in at the same pressure (cadaver data). Volume is where the blood goes.

STEP 2: Fracture Patterns (Young and Burgess, by direction of force)

Pattern	Force	What breaks	Stability
LC I	Side impact	Oblique ramus fracture plus sacral compression on the impact side	Stable
LC II	Side impact	Ramus fracture plus posterior iliac crescent fracture	Rotationally unstable
LC III	Side impact	"Windswept": compression on one side, open book on the other	Unstable
APC I	Front to back	Symphysis widened under 2.5 cm	Stable
APC II	Front to back	"Open book": over 2.5 cm, anterior SI ligaments torn, posterior intact	Rotationally unstable
APC III	Front to back	Hemipelvis completely separated, front and back SI ligaments torn	Unstable
VS	Vertical: fall, landing on one leg	One hemipelvis shoved up	Unstable; most severe; visceral injury common

Read it in the field

Lateral compression is the most common pattern. A ring breaks in at least two places, so one obvious break means look for the second. Open book and vertical shear are the big bleeders.

Hands off

Do not rock or spring the pelvis #713. Move with a scoop or multi-person lift, not a log roll #713.

STEP 3: Why the Binder Goes on the Greater Trochanters

The anatomy

The greater trochanters are the widest bony points you can feel, level with the hip sockets and the symphysis. Squeezing there pushes the two halves of the ring back together. The iliac crests sit above the ring's center of rotation: squeezing them does not close the symphysis, can lever the back of the ring, and risks overtightening and skin injury.

Find them: the bony bumps at the top of the outer thigh. Slide the binder under the knees and up to that level, knees together.

High-risk mechanisms #713

MVC (front seat head-on, or side impact on the patient's side), auto vs pedestrian, motorcycle, falls from height. Age 65 and older: pelvic fractures even with low energy.

#713 ESSENTIALS: PELVIC BINDER

BLS procedure

INDICATIONS: ALL OF THE FOLLOWING

High-risk mechanism · pelvic, low back, or groin pain · **SBP 90 or less**.

APPLICATION

Remove clothing. Identify the greater trochanters. Center the sheet or binder at that level. Tighten per manufacturer; a sheet is twisted and secured. **Distal pulses before and after.**

CONTRAINDICATIONS

Isolated femoral neck fracture · suspected traumatic hip dislocation.

REMOVAL

Base order only Base. Pelvic injury with a high-risk mechanism is a Step 2 alert even before the pressure falls #153.

FRONT

BELLY

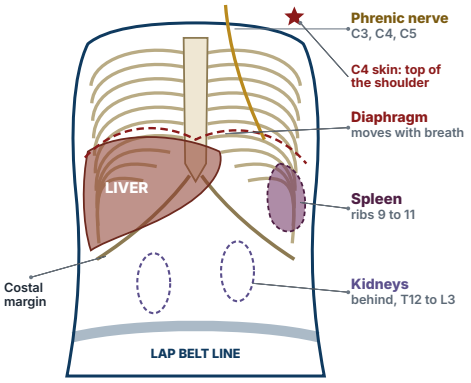
Solid Organs, Seat Belts, and the Aortic Isthmus · **Shift 12**

★ ★ ★ ★ ★
Trauma Anatomy Reference
Bearamedics Reference · not a treatment protocol

SOLID ORGANS BLEED. HOLLOW ORGANS LEAK.

- Liver and spleen are the **two most commonly injured solid organs** (sources disagree on which is first).
- Solid organ injury means shock early. Hollow organ injury means peritonitis that can take hours to show.
- Lower left rib fractures: up to **20%** of adults have a splenic injury. Kids can have one with no rib fracture.
- **Kehr's sign:** left shoulder pain, worse on breathing in, classically from the spleen.
- Seat belt sign: about **1 in 11** (9.2%) had a hollow organ injury. Add back pain and think Chance fracture.
- Blunt aortic injury: **80% to 85% die at the scene**. The survivors you meet have a contained tear.

STEP 1: What Sits Under the Ribs



Schematic front view. Patient's right is on your left. Dashed organs are behind (spleen posterior, kidneys retroperitoneal).

Organ	Where it sits	Field meaning
Liver	Right upper quadrant under the diaphragm; top near the 5th rib at the nipple line, bottom edge along the right costal margin	Largest solid organ; 20% to 30% of blood volume flows through it. Ribs can injure it even without a rib fracture.
Spleen	Left upper quadrant, behind ribs 9 to 11	Lower left rib tenderness or crepitus: think spleen. Kehr's sign.
Kidneys	Retroperitoneal, T12 to L3; the 12th rib crosses the upper pole; the right sits lower	Lower poles are less protected. Bleeding back here may give no belly signs.
Pancreas, duodenum, great vessels	Retroperitoneal, in front of the spine	Flank (Grey Turner) and periumbilical (Cullen) bruising are late. Do not wait for them.

Kehr's sign: why the shoulder hurts

The diaphragm is wired by the phrenic nerve, mostly **C3 to C5**. The C4 skin patch sits over the AC joint. Blood under the left hemidiaphragm is felt on top of the left shoulder. Right shoulder pain can do the same for the liver.

The belly lies

"Soft, non-tender" in the field rules nothing out, especially in intoxicated, head-injured, or distracted patients and children. Unexplained tachycardia after blunt trauma is belly or pelvis until proven otherwise Ⓟ.

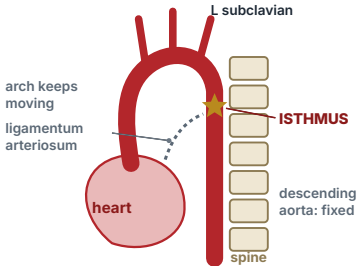
STEP 2: Two Mechanisms That Hide Injury

Seat belt sign and its partners

A lap belt riding **high on the soft belly**, not on the bony pelvis, becomes a fulcrum during deceleration. One mechanism explains three injuries:

- **Bowel and mesentery** crushed against the spine: 9.2% hollow organ injury in 754 adults with a seat belt sign (2022).
- **Mesenteric tears:** bowel loses its blood supply; signs come hours later.
- **Chance fracture:** the spine folds over the belt; a transverse break through the vertebra at the thoracolumbar junction. 40% of these flexion-distraction fractures had belly injuries.

Field: seat belt sign plus back pain means look for both. SMR for spine findings #702.



The aortic isthmus

Just past the left subclavian, the mobile arch meets the descending aorta, which is **fixed to the spine**. The ligamentum arteriosum anchors the spot. In a sudden stop, the heart and arch keep going and the isthmus shears.
Who: high-speed frontal or side impact, ejection, fall from height. **Clues:** few; unequal arm pressures or pulses Ⓟ.
Field: gentle handling, do not drive the pressure up with fluid, fast transport.

#714 ESSENTIALS: TRANEXAMIC ACID (TXA)

ALS standing order, age 15 and older

INDICATIONS (EITHER)

Blunt or penetrating injury with **SBP 90 or less**; or significant blood loss with ongoing bleeding not controlled by direct pressure, hemostatics, or tourniquet.

DOSE

1 g in 100 mL NS IV/IO over 10 min. No repeat. 10 mg/mL. Label the bag "TXA 1 g in 100 mL."

CONTRAINDICATIONS

- Over 3 hours since injury; under 15 years
- Isolated head injury; isolated spinal shock
- Non-blood-loss conditions
- Isolated limb bleeding, controlled, reimplant expected
- Traumatic arrest with over 5 min CPR, no ROSC
- Drowning or hanging
- Thromboembolic event in 24 h (stroke, MI, PE, DVT); TXA allergy

WHY THE BELLY CARES

TXA protects the clot your patient is already making inside a liver or spleen; it does not plug a hole. Pressure, binder, and speed first; TXA en route.

WATCH FOR

Hypotension with fast infusion, chest tightness, flushing, blurred vision. Tell the trauma team the start time.

BACK

PELVIS AND BELLY: IMAGES

The bony ring and what holds it shut · **Shift 12**

★ ★ ★ ★ ★
Trauma Anatomy Images
Bearamedics Reference · not a treatment protocol

IMAGE 1: The Ring

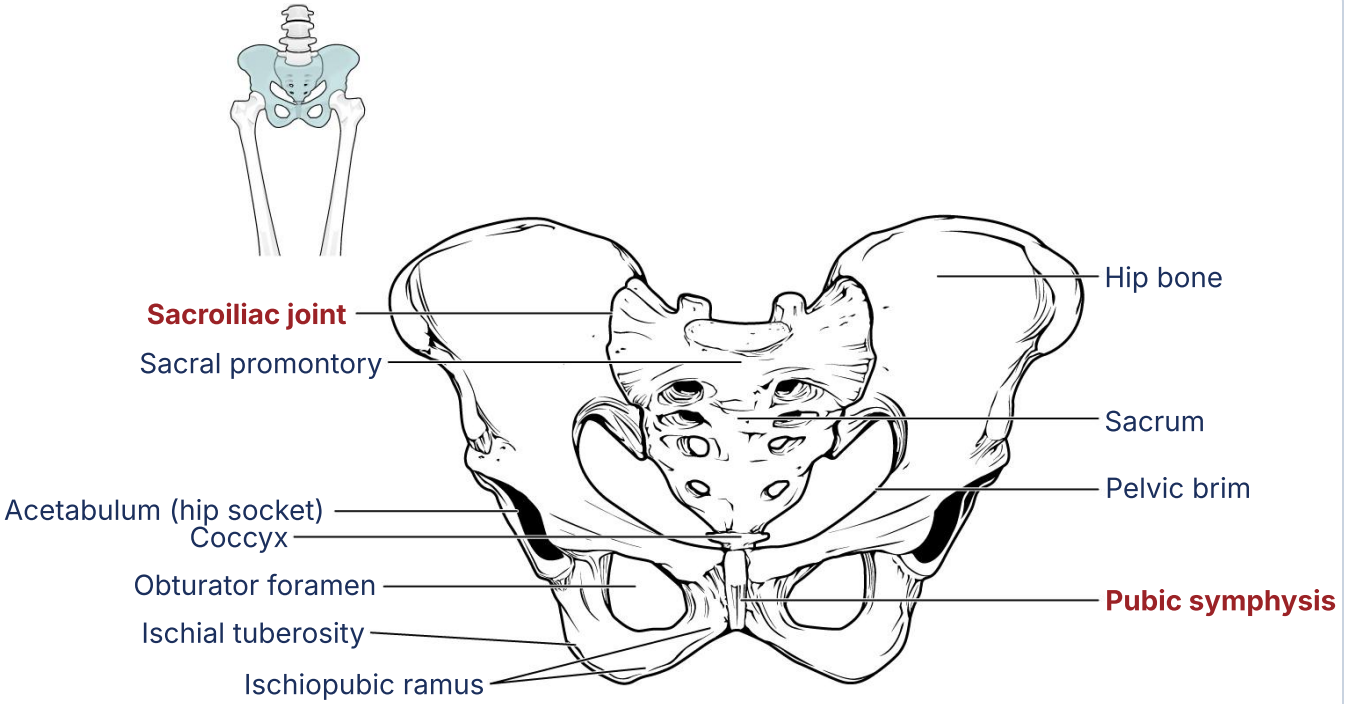


Figure 8.12 (modified: relabeled), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- The pelvis is a **ring** held shut in back by the **sacroiliac joints** and ligaments and in front by the **pubic symphysis** (red).
- A ring breaks in two places. When it opens like a book, the space inside grows and so does the bleeding.
- The binder closes the ring. It goes over the greater trochanters, the bony bumps on the side of the upper thigh, not the waist (#713).

HANDS-ON: on your partner

1. Find the greater trochanters on both sides.
2. Find the iliac crests above them. That is where a binder should **not** go.
3. Never rock or spring the pelvis to test it.

PELVIS AND BELLY: IMAGES

Where the big vessels run · **Shift 12**

IMAGE 2: The Aorta Down to the Pelvis

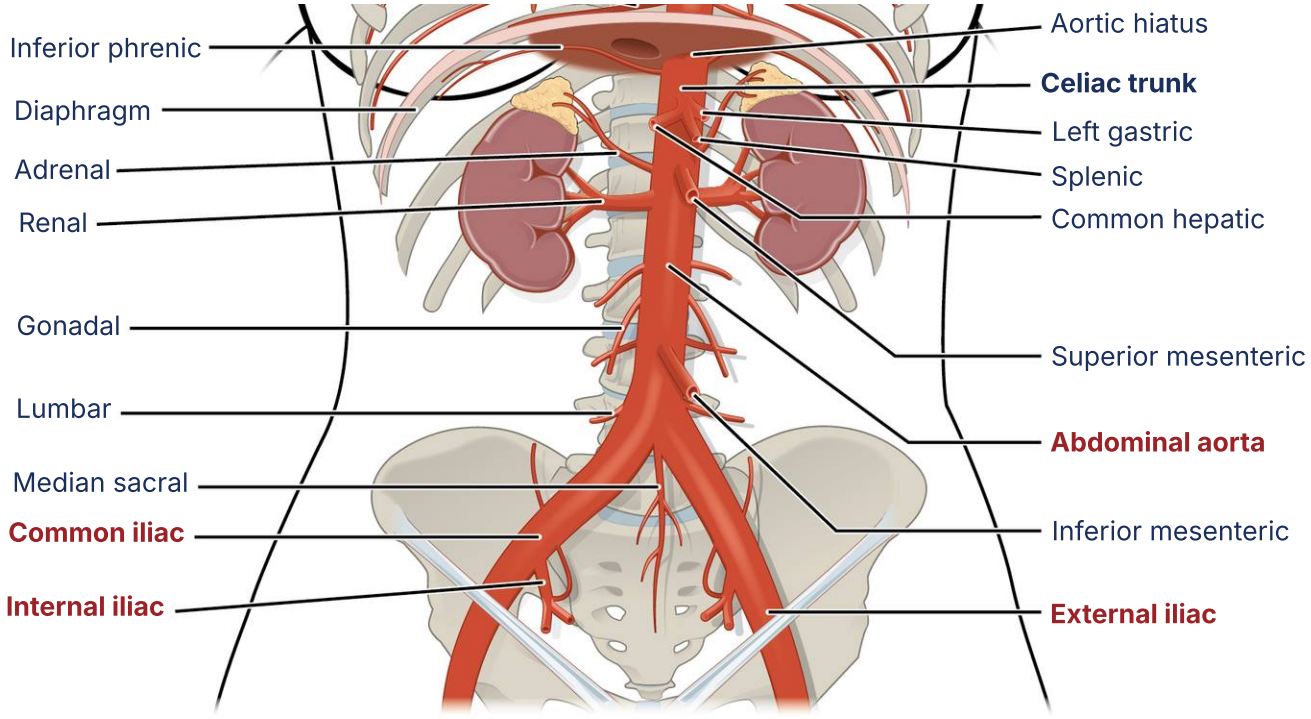


Figure 20.28 (modified: relabeled, cropped), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- The **abdominal aorta** sits on the spine and splits into the **common iliacs** at about the level of the navel.
- The **internal iliacs** and the veins beside them line the inside of the pelvic ring. A displaced fracture tears them, and the bleeding hides in the pelvis.
- **Celiac** and **superior mesenteric** branches feed the liver, spleen, and bowel: solid organs bleed fast and quietly.

HANDS-ON: on your partner

1. Trace the aorta from the diaphragm to the split on your partner's belly.
2. Point to where the liver and spleen sit under the lower ribs.
3. Say which of these bleeds you can press on (none).

HEAD

Scalp, Skull, the Three Bleeds, and Pressure · **Shift 13**

★ ★ ★ ★ ★

Trauma Anatomy Reference

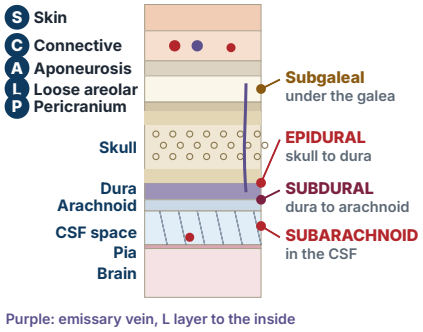
Bearamedics Reference · not a treatment protocol

T3 HEAD, SPINE, NECK

PRESSURE IN A CLOSED BOX

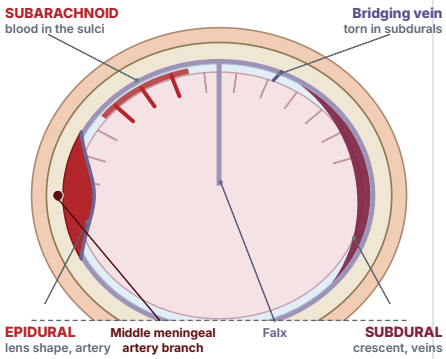
- Scalp wounds pour: the dense connective layer holds vessels open so they cannot retract. **Direct pressure.**
- The skull holds brain, blood, and CSF. Add a bleed and something must leave; when the buffers run out, **ICP climbs steeply**.
- **CPP = MAP minus ICP.** High ICP needs more blood pressure, not less, and oxygen in that blood.
- **County:** SpO2 94% or higher #602; treat SBP 90 or less per #660; waveform EtCO2 #701.
- Blown pupil: the uncus squeezes **CN III on the same side** as the mass. Cushing's triad means herniation is coming.
- Only **about 14% to 21%** of epidurals show a lucid interval. Talking does not rule it out.

STEP 1: Skin to Brain: the Layers and the Three Bleeds



Purple: emissary vein, L layer to the inside

SCALP, skull, dura, arachnoid, CSF, pia, brain. Each bleed is named for the space it fills.



Schematic coronal section of the upper head. Not to scale.

Why the scalp pours

The **C** layer binds tightly to its vessels, so a cut artery cannot retract and clamp down. A big scalp laceration can bleed a lot, especially in a child. Press it.

THE DANGER LAYER

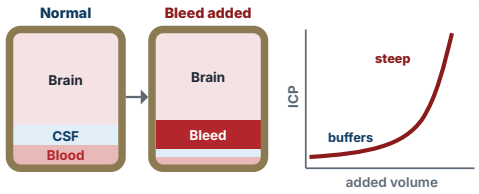
The **L** layer holds valveless emissary veins that connect to the inside of the skull. Blood under the galea is a **subgaleal hematoma**: a boggy scalp.

THE PTERION

The thin, H-shaped junction of four skull bones at the temple. The middle meningeal artery runs in a groove just inside it.

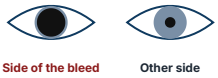
	Epidural (EDH)	Subdural (SDH)	Traumatic subarachnoid
Space, CT	Inner skull to dura. Lens shape; rarely crosses sutures	Dura to arachnoid. Crescent; crosses sutures	Under the arachnoid, in the CSF. Blood in the sulci
Vessel	Mostly **arterial**: a middle meningeal branch, usually at the pterion. Venous in up to 10%.	Torn **bridging veins**. Atrophy stretches them and widens the space.	Small surface vessels
Typical patient	Young: mean age 20 to 30. Temple strike. Rare over 50. About 75% temporal; skull fracture in about 75%.	Older brain, anticoagulants, alcohol, low platelets, seizure falls. A ground-level fall is enough.	Any significant head blow. Headache, vomiting, seizure, agitation (Platinum Ten ch. 14).
Course	**Lucid interval in a minority** (about 14% to 21%): out, awake, then a fast crash, blown pupil on the bleed side.	Slow, fluctuating confusion over hours to days. Atrophy leaves room, so raised ICP signs show late.	Variable. Often travels with contusions and other brain injury.

STEP 2: Monro-Kellie, Herniation, and Perfusion



Monro-Kellie: rigid skull, constant volume. CSF and blood leave first; then ICP rises steeply. Normal adult ICP is about 7 to 15 mmHg.

Herniation: act now



Uncal herniation: the medial temporal lobe slides through the tentorial notch and pins **CN III**. Its pupil-constricting fibers ride on the outside and fail first: a dilated pupil on the **same side**. The squeezed peduncle gives weakness on the **opposite** side (Kernohan notch can flip it). **Cushing's triad:** hypertension, bradycardia, irregular respirations. Then posturing.

CPP = MAP minus ICP

MAP 80, ICP 25: CPP is 55. Let MAP fall to 65 and CPP is 40. Same ICP, less brain blood flow. Evidence target in severe TBI: **CPP 60 to 70** (BTF 2016). Fast bagging drops CO2, which constricts brain arteries and cuts flow further.

TBI TARGETS (PLATINUM TEN CH. 14)

County first. Evidence lines are not standing orders.

OXYGEN

County: SpO2 **94% or higher** with the simplest method #602.

Evidence: hypoxemia under 90% is a secondary insult (BTF 2023).

DESTINATION #153

GCS 13 or less from injury: **Step 1 alert**. Open or depressed skull fracture, paralysis: **Step 2 alert**. Anticoagulant (not aspirin) plus a head injury that is not minor: Step 4 consult.

PRESSURE

County: fluid trigger **SBP 90 or less** #660; treat it without hesitation. In polytrauma with TBI, avoiding hypotension outranks fluid restriction.

Evidence: treat SBP under 100 as hypotension in TBI (BTF 2023); no permissive hypotension with a head injury (NAEMSP 2024). In EPIC, each 10 mmHg higher SBP meant 18.8% lower odds of death.

CO2

County: monitor with **waveform EtCO2** #701.

Evidence: EtCO2 35 to 45, about 10 breaths a minute in adults. Only with herniation signs: brief 30 to 35 as a bridge, never under 30 (BTF 2023).

ALSO

TXA: isolated head injury is a contraindication #714. Glucose if altered. Head up about 30 degrees if spine and pressure allow Ⓟ. GCS and pupils every reassessment.

FRONT

SPINE AND NECK

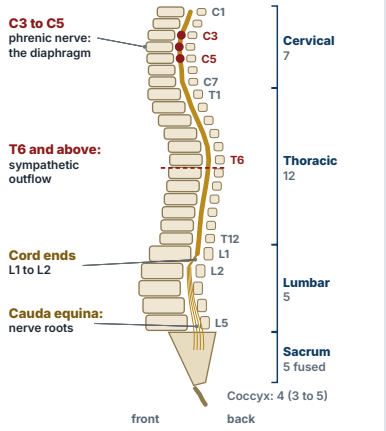
Cord Levels, Three Shocks, and the Airway Landmarks · **Shift 13**

★ ★ ★ ★ ★
Trauma Anatomy Reference
Bearamedics Reference · not a treatment protocol

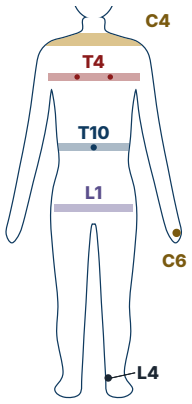
LEVELS DECIDE THE CALL

- 33 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 fused sacral, 4 coccygeal (3 to 5). 31 pairs of spinal nerves.
- The cord ends at **L1 to L2** in adults. Below that, a fracture hits nerve roots (cauda equina), not cord.
- **"C3, 4, 5 keeps the diaphragm alive."** At or above C3: apnea. C4 to C5: weak belly breathing that tires out.
- Landmarks: **C4** top of the shoulder, **T4** nipple line, **T10** umbilicus. Test from below the nipples up.
- **Neurogenic shock is warm and slow**; spinal shock is reflexes gone. Rule out bleeding first.
- Cricothyroid membrane: the dip just above the cricoid, **about 6 to 10 mm tall**. Needle cric #704.

STEP 1: The Column, the Cord, and the Skin Map



Schematic side view. Gold: the cord.



C4 shoulder · **T4** nipples · **T10** navel · **L1** groin · **C6** thumb · **L4** inner ankle

Level	What runs there	If it is cut
C3 and above	All of the phrenic roots	No diaphragm: apnea. Bag now.
C4 to C5	Part of the phrenic supply	Weak, abdominal breathing that fatigues. Watch rate and EtCO2 trend (P).
Above T6	Sympathetic outflow to the heart and gut vessels	Neurogenic shock: low BP, normal or slow HR, warm pink skin.
L1 to L2	Conus medullaris: the cord ends	Below it: nerve roots. As low as L3 to L4 in newborns.

Test from the bottom up

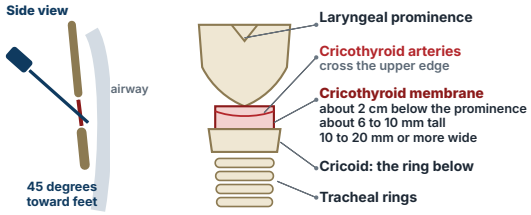
The C4 patch spreads onto the upper chest, so a high neck injury can feel "normal" there. Start below the nipple line and work up. #702 motor screen: wrist and hand extension, foot plantarflexion and dorsiflexion, both sides #702.

STEP 2: Three Shocks That Look Alike

	Neurogenic shock	Spinal shock	Hemorrhagic shock
What it is	A **blood pressure** problem: lost sympathetic tone. Cervical or upper thoracic, especially above T6. About 19% of isolated cord injuries	A **reflex** problem: all cord function below the injury lost for now, days to weeks. Often coexists with neurogenic shock	A **volume** problem: the five places (Card T1). The usual cause of shock after trauma
BP, HR, skin	Low BP, **normal or slow** HR (unopposed vagus), **warm, pink** skin	Flaccid paralysis, no reflexes, no bowel or bladder control. Not a BP problem by itself	Fast HR, narrowing pulse pressure, **cool, pale** skin; BP falls late
Field move	SMR #702; NS per #660; still low: push-dose epinephrine Base #660	SMR, document the neuro exam, keep warm. Isolated spinal shock: no TXA #714	Stop bleeding #706, binder #713, NS #660, TXA #714, go

Bleeding first. A cord injury hides the fast pulse and pale, cool skin of hemorrhage. Neurogenic shock is a **diagnosis of exclusion**: search the five places first.

STEP 3: The Neck for the Airway



Left: side view, front of the neck to the left. Right: the larynx from the front.

Find it in three touches

1. Up the midline to the laryngeal prominence. **2.** Down off its lower edge into the dip. **3.** The firm ring below is the cricoid. Go low in the dip, just above the cricoid, below the cricothyroid arteries.

WHY KIDS GET A NEEDLE

A small membrane and a funnel-shaped, pliable larynx make a surgical cric risky (subglottic stenosis). Age cut-offs for surgical cric vary, 5 to 12 years; sources vary. The county procedure is **needle** cric for adult and pediatric patients #704.

#702 SMR AND #704 NEEDLE CRICOTHYROTOMY ESSENTIALS

The protocol wins. Read the full pages.

#702 SMR IF ANY IS PRESENT

- **Unreliable:** uncooperative, any GCS under 15, cannot communicate, intoxicated, distracting injury.
- **Spine:** under 65, midline pain or tenderness; 65 and older, any spinal-area pain; deformity.
- **Neuro:** cannot extend wrists and hands, or plantarflex and dorsiflex feet, both sides; abnormal sensation.
- **Final step:** pain, weakness, or tingling with self-initiated head movement.
- Negative for all: no SMR. Penetrating head, neck, torso: none unless a neuro deficit. Thoracic or lumbar only: no collar.

#704 NEEDLE CRIC (ALS)

- **When:** upper airway obstruction, severe distress, conventional maneuvers fail #602: epiglottitis, fractured larynx, facial burns with upper airway involvement, laryngeal edema or spasm, massive facial trauma.
- Supine. Clean the membrane (povidone-iodine, alcohol). Finger on it; stabilize the trachea.
- IV catheter 10 to 12 Ga (**max 10 Ga**) with syringe, **45 degrees toward the feet**, aspirating. Air means trachea.
- Remove the needle; attach a cut 3 mm ETT (about 2 in); BVM. Secure, hold, reassess lung sounds. Early notification. Complication: remove and repeat.

For field education only. Treat per patient presentation, vitals, and SLO County EMS protocols.

HEAD: IMAGES

Skull, dura, and the spaces between · **Shift 13**

★ ★ ★ ★ ★
Trauma Anatomy Images
Bearamedics Reference · not a treatment protocol

IMAGE 1: The Layers Over the Brain

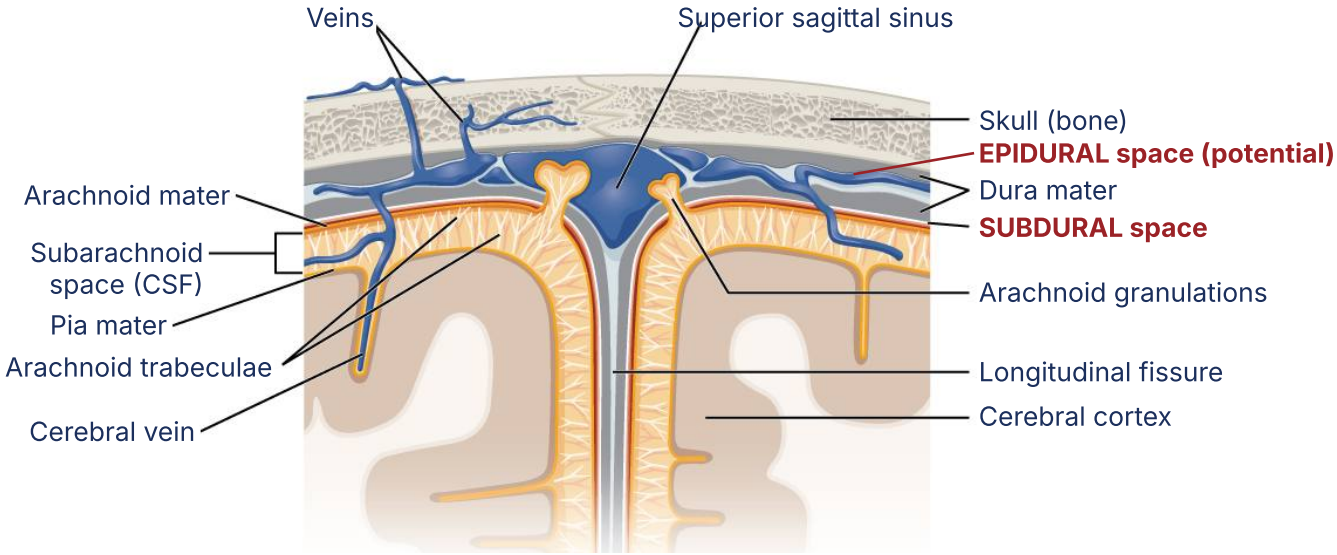


Figure 13.17 (modified: relabeled), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- **Epidural** blood collects between the skull and the dura. It is usually arterial (the middle meningeal artery under the temple), so it can build fast. Some patients talk before they crash, but a lucid interval is the exception, not the rule.
- **Subdural** blood collects under the dura from torn bridging veins. It builds slower and is common in older and anticoagulated patients.
- Both press on the brain from inside a closed box. Rising pressure shows as a falling GCS first.

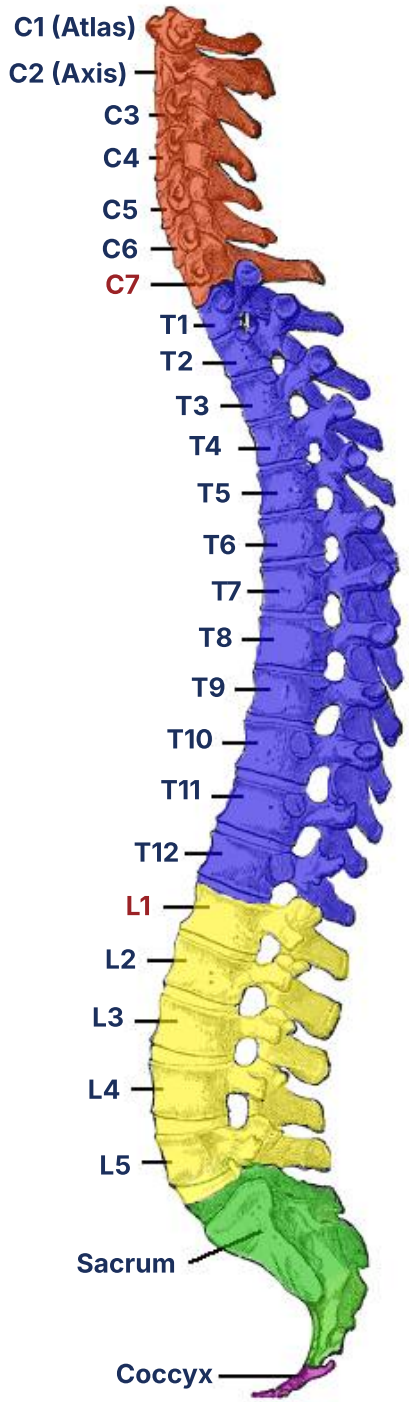
HANDS-ON: on your partner

1. Find the pterion: about two finger widths above the cheekbone arch, a thumb's width behind the outer eye.
2. Say which bleed lives under it.
3. Draw skull to brain in order and mark both spaces.

SPINE AND NECK: IMAGES

The column and the airway landmarks · **Shift 13**

IMAGE 2: Count the Spine, Find the Cric



Gray's Anatomy (1918), Fig. 111, colored version via Wikimedia Commons (modified: relabeled). Public domain.

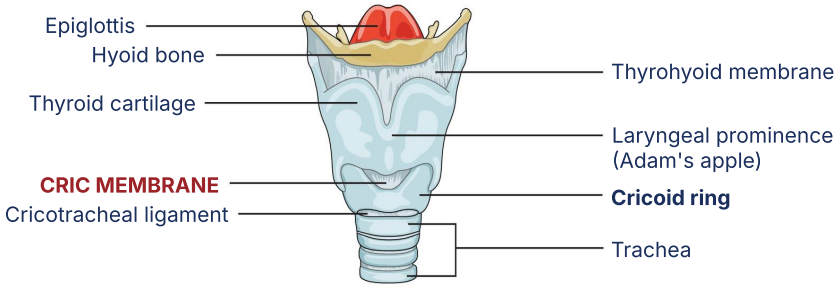


Figure 22.7 (modified: relabeled, cropped), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- **C7** is the bump that sticks out most at the base of the neck. Count down from there.
- **L1** is about where the spinal cord ends in most adults.
- Sensory levels like T4 (nipple line) and T10 (umbilicus) name nerve segments, not the vertebra at that height.
- C3, 4, and 5 drive the diaphragm. A high neck injury can stop the breathing.
- The **cric membrane** is the soft gap between the thyroid cartilage and the cricoid ring: the needle cric site (#704).

HANDS-ON: on your partner

1. Find C7, then count down three.
2. From the Adam's apple, slide down to the next soft dip: the cric membrane. Then the cricoid ring below it.

CHEST

The Box, the Bundle, and Three Chest Killers · **Shift 14**

★ ★ ★ ★ ★

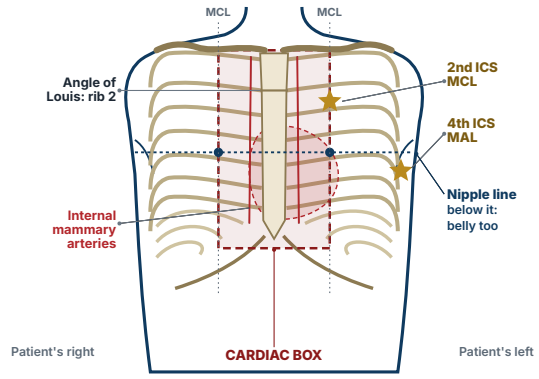
Trauma Anatomy Reference

Bearamedics Reference · not a treatment protocol

UNDER THE RIBS AND OVER THE TOP

- **Cardiac box:** clavicles, midclavicular lines, costal margins. A fair concern zone for knives.
- **Bullets ignore the box:** 31% of gunshot wounds inside it and 21% outside it hit the heart.
- Every rib hides its **vein, artery, and nerve** in a groove along its bottom edge. The needle goes **over the top** of the rib below #705.
- A wound **below the nipple line** (about the 4th ICS) in front, or below the scapular tip in back, may be in the belly too.
- **Tension is obstructive shock:** the heart is fine but starved of returning blood.
- The fibrous pericardium cannot stretch fast. A **small** amount of blood can tamponade the heart.

STEP 1: Lines Drawn on the Chest



Schematic front view. **Red:** cardiac box. **Stars:** #705 sites on the patient's left. **Blue:** nipple line.

Mediastinum	What lives there
Superior	Thymus, aortic arch and its three branches, SVC and brachiocephalic veins, trachea, esophagus, thoracic duct, vagus and phrenic nerves
Anterior	Thymus remnants, internal thoracic artery branches, lymph nodes
Middle	Heart in its pericardium, ascending aorta, pulmonary trunk, SVC, pulmonary veins, main bronchi, phrenic nerves
Posterior	Descending aorta, esophagus, thoracic duct, azygos veins, vagus nerves

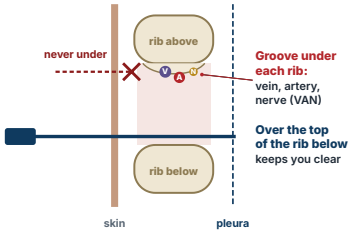
The box, and its limits

For stabs, one study's best "cardiac area" ran from the right MCL to the left anterior axillary line, 2nd to 6th ICS. For gunshots: **think outside the box**. A wound across the mediastinum can hit heart, vessels, airway, and esophagus.

Internal mammary arteries

Behind the cartilages, about **1 to 3 cm** from the sternal edge (sources vary). A parasternal stab can cause a massive hemothorax with no heart injury. Keep the 2nd ICS needle **at the MCL**.

STEP 2: Under Every Rib, and Below the Nipple Line



Two ribs, side view. Not to scale.

Why over the top

Each intercostal vein, artery, and nerve runs in the costal groove under the lower border of its rib, top to bottom **V, A, N**. Enter just over the **upper** border of the rib below your space and the bundle stays above you. A cut intercostal artery can cause a hemothorax.
2nd space: rib 2 attaches at the angle of Louis; the space is just below it.

The thoracoabdominal zone

The diaphragm moves with breathing, up to about the nipple line in front. Stabs below the nipple (about the 4th ICS) or below the scapular tip (about the 7th ICS) need a diaphragm workup. Most holes are **under 2 cm**; chest x-ray is non-diagnostic in up to 40%; left more often. **Field:** a chest stab below the nipple line is also a belly stab.

STEP 3: Three Chest Killers Side by Side

	Tension pneumothorax	Cardiac tamponade	Massive hemothorax
What happens	One-way valve: air in, not out. Lung collapses, mediastinum shifts away, great veins kink. **Obstructive** shock	Blood in a pericardium that cannot stretch fast. The heart cannot fill. Normal fluid is only 15 to 50 mL	Blood in the pleural space: about 40% of blood volume per side (about 2 L). Massive: about 1,500 mL
Neck veins, lungs	JVD (flat if also bleeding). Diminished and **hyperresonant** on that side	JVD (flat if also bleeding). Lung sounds equal	**Flat** veins. Diminished and **dull** on that side
Other tells	Rising BVM resistance; tracheal shift away (late)	Beck's triad: JVD, hypotension, **muffled tones**; pulsus paradoxus over 10 mmHg	Shock plus hypoxia
Field fix	**Needle thoracostomy** #705	Needs a surgeon: rapid transport, early notification; fluid may buy minutes	O2, limited fluid #660, TXA if indicated #714, go. **A needle does not drain blood**

#705 ESSENTIALS: NEEDLE THORACOSTOMY

ALS standing order · The protocol wins

INDICATIONS

Tension pneumothorax with significant respiratory compromise. Trauma patient who arrests after EMS arrival, under 20 min from a trauma center or hospital, with suspected chest trauma: **bilateral** #661.

SIGNS

Worsening breathing; falling SBP, rising pulse; diminished sounds and hyperresonance on that side; JVD; tracheal shift; rising ventilation resistance.

SITE AND GEAR

2nd ICS, midclavicular line, or **4th ICS, midaxillary line**, affected side. IV catheter 10 to 12 Ga (**max 10 Ga**), syringe, one-way valve (Asherman seal), povidone-iodine and alcohol.

You may read "5th ICS, anterior axillary line" in StatPearls. The county site is the 4th ICS MAL #705.

STEPS

- Prep. Syringe on; in at **90 degrees, just over the top of the rib**.
- Loss of resistance; air and/or blood returns.
- Hold the needle, advance the catheter, remove the needle.
- Secure; one-way valve; reassess lung sounds. Signs return: decompress again. Catheters over 8 cm reach thick chest walls Ⓟ.

FRONT

SKIN AND BURNS

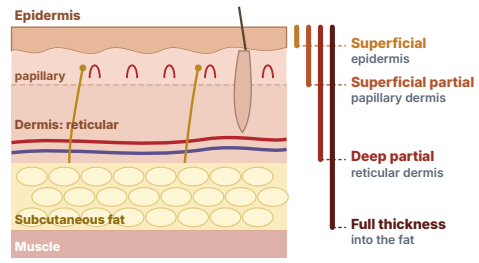
Layers, Depth, Size, and the Burned Airway · **Shift 14**

★ ★ ★ ★ ★
Trauma Anatomy Reference
Bearamedics Reference · not a treatment protocol

DEPTH, SIZE, AND WHAT KILLS QUIETLY

- Nerve endings and capillaries live in the **dermis**. Deeper burns have fewer of both: **less pain, no blanching**.
- Count only **partial and full thickness** toward TBSA. Sunburn-type burns do not count.
- Adult rule of nines; children 0 to 2 have a **head about 18%** and **legs about 14%** each.
- The patient's palm with fingers is **about 1%**. Use their hand, not yours.
- Heat injury mostly stops in the **upper airway**, and that swelling can close it suddenly. Decide early.
- Circumferential full-thickness eschar: a **tourniquet** on a limb, a **corset** on the chest.

STEP 1: Skin Layers and Burn Depth



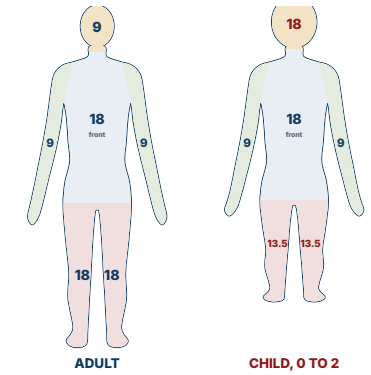
Gold: nerve endings. Red loops: capillaries.

Schematic. Bars: how deep each burn reaches. The epidermis holds fluid in.

Depth	Layers hit	Looks like	Blanch, pain	Heals
Superficial (1st)	Epidermis only. **Does not count**	Pink to red, dry, no blisters	Painful	5 to 10 days, no scar
Superficial partial (2nd)	Into the papillary dermis	Blisters; moist, evenly red or pink base	Blanches; very painful	2 to 3 weeks, minimal scar
Deep partial	Into the reticular dermis	Mottled base; blisters may be intact	Sluggish blanch; pain only with deep pressure	Longer; scarring
Full thickness (3rd)	Through the dermis into fat	Leathery, stiff, dry	No blanch, no feeling	Over 8 weeks; surgery

A painless, white, or leathery center is the deep part, not the good part.

STEP 2: How Big Is It?



% TBSA per whole region. Red: changes in a small child.

Region	Adult %	Child 0 to 2 %
Head and neck	9	**about 18**
Each arm	9	9
Front of trunk	18	18
Back of trunk (not shown)	18	18
Each leg	18	**about 14** (13.5 on the chart)
Perineum	1	1

The palm

Patient's palm plus fingers: about 1%, handy for scattered burns. It can overestimate: measured palms run about 0.7% to 0.8%.

Small kids

Use a Lund-Browder or pediatric chart when you have one. Under 10 kg, one "rule of eights": head 20, trunk about 32, each leg 16, each arm 8.

STEP 3: Two Burns That Kill Quietly

The burned airway

Look for: facial burns, singed facial or nasal hair, soot in the mouth or sputum, hoarseness or voice change, stridor, cough, wheeze, an enclosed space, loss of consciousness.
Why it is high: the nose and throat cool superheated air, so heat injury stays up high, and that swelling can close the airway suddenly. Stridor: act now. Pulse ox reads falsely normal with CO; think cyanide in closed spaces.

The circumferential burn

Full-thickness eschar cannot stretch. As edema builds (peaking within about 48 hours), pressure under it rises. On a limb it **acts like a tourniquet**: check distal pulses. On the chest or belly it **restricts breathing**, worst in belly-breathing infants. Escharotomy is a hospital procedure: report it early and reassess.

#633 ESSENTIALS: BURNS (EFFECTIVE 08/07/2026)

Newest date wins: #633 replaced the retired #662

BLS

- Remove burning, smoldering, or constrictive clothing and jewelry.
- **Cool running water** if under 30% BSA, no inhalation injury, not electrical. Goal: **20 min cumulative**, bystander time counts. Not ice.
- Leave blisters intact; then a **dry sterile dressing** or sheet. Leave tar.

ALS

- Pain per #603.
- Wheezing: albuterol 2.5 to 5 mg plus ipratropium 500 mcg (pediatric 250 mcg); ipratropium may repeat once after 20 min.
- Fluids: consider NS up to 500 mL IV/IO (peds 20 mL/kg, max 500); repeat once if still low, or once (ALS discretion) if BP normal.
- Airway: needle cric for facial burns with upper airway involvement when maneuvers fail #704.

BURN CENTER CRITERIA

Partial thickness over 10% TBSA; face, hands, feet, genitalia, perineum, major joints; any third degree; electrical (incl. lightning); chemical; inhalation; preexisting disease; burn plus trauma; children; special needs.

DESTINATION

Burn plus trauma: Step 4 #153. Criteria met: consider air #155. **Confirm the burn center with base and air medical.** Grossman (Bakersfield) closed June 30, 2026.

BACK

CHEST: IMAGES

Ribs, spaces, and the needle landmarks · **Shift 14**

★ ★ ★ ★ ★
Trauma Anatomy Images
Bearamedics Reference · not a treatment protocol

IMAGE 1: Count the Ribs

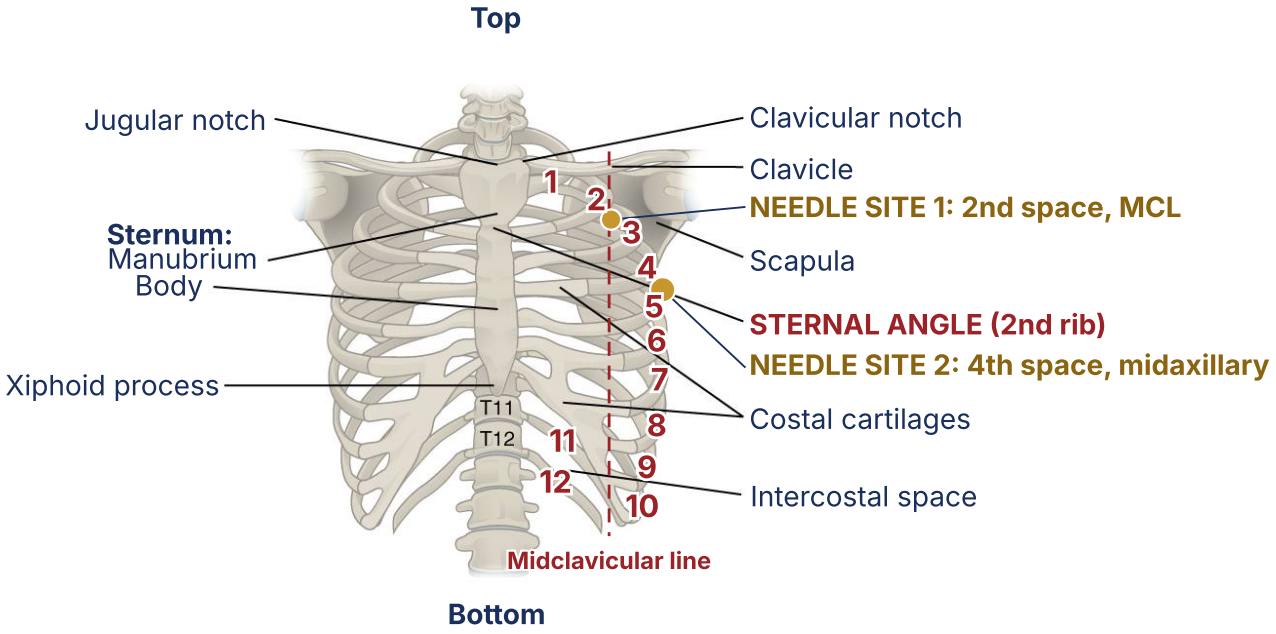


Figure 7.32 (modified: relabeled, cropped, rib numbers enlarged, midclavicular line added), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- The **sternal angle** is the ridge where the manubrium meets the sternal body. The **2nd rib** attaches there.
- The space just below the 2nd rib is the **2nd intercostal space**. Follow it out to the **midclavicular line**: needle site one (#705).
- Site two is the **4th intercostal space** at the midaxillary line, on the side of the chest (#705).
- The vessels and nerve run under each rib, so the needle goes in just **over the top** of the rib (#705).

HANDS-ON: on your partner

1. Find the sternal angle with your fingertip, slide out to the 2nd rib, drop into the space below it.
2. Walk out to the middle of the collarbone and stop.
3. Find the 4th space at the side of the chest, in the middle of the armpit line.

SKIN AND BURNS: IMAGES

How deep, how big · **Shift 14**

IMAGE 2: Skin Layers and Burn Depth

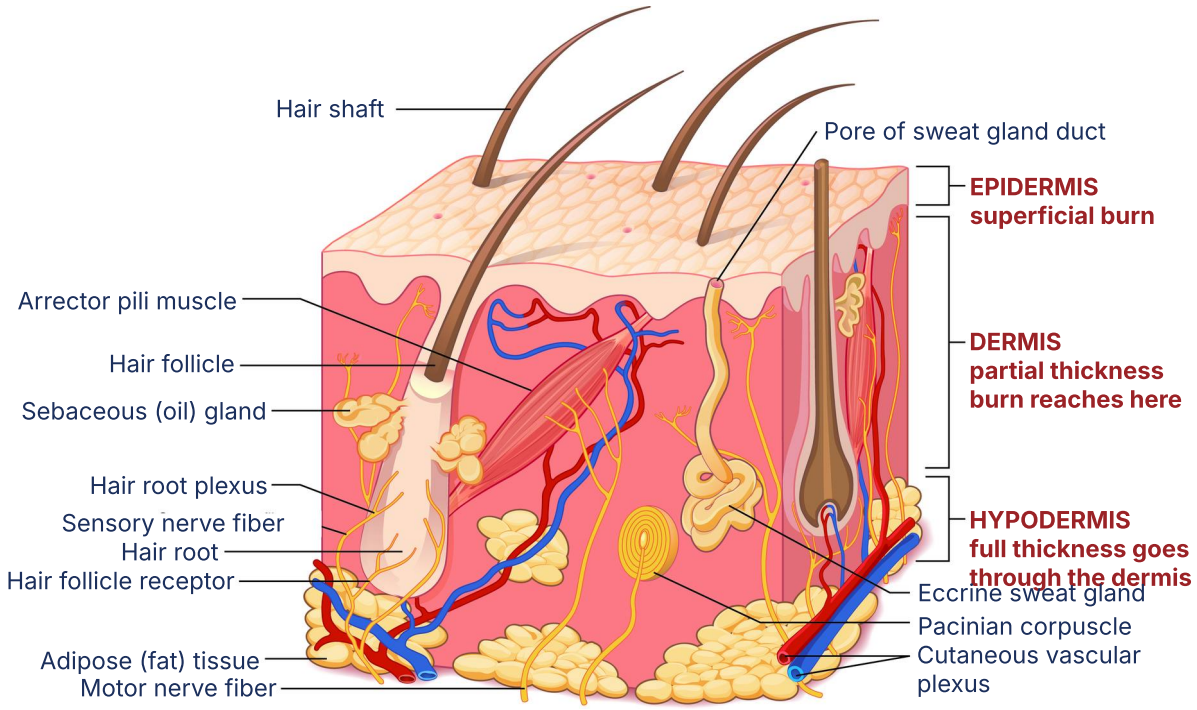


Figure 5.2 (modified: relabeled), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

IMAGE 3: Adult Rule of Nines

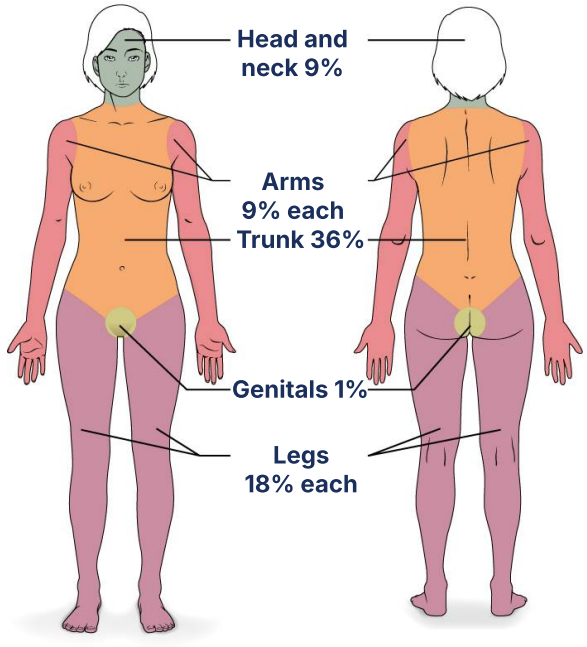


Figure 5.23 (modified: relabeled), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- **Superficial** burns stay in the epidermis: red, no blisters. They don't count toward TBSA.
- **Partial thickness** reaches into the dermis: blisters, wet, and very painful.
- **Full thickness** goes through the dermis: white, brown, or leathery, and may not hurt.
- This chart is for adults. Children use the child chart on Card T4. The patient's palm with fingers is about 1% for scattered burns.

HANDS-ON: on your partner

1. Estimate TBSA for: one whole arm plus the front of the chest.
2. Then for a child with the same burns, using the child chart.

SPECIAL BODIES

Children and Older Adults: Same Force, Different Anatomy · **Shift 15**

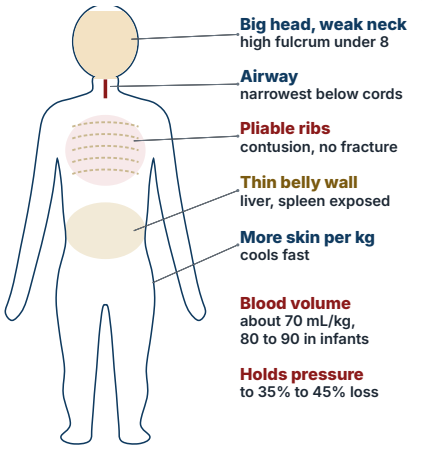
★ ★ ★ ★ ★
Trauma Anatomy Reference
Bearamedics Reference · not a treatment protocol

T5
SPECIAL BODIES, WHOLE PICTURE

SAME FORCE, DIFFERENT BODY

- County: **pediatric means 34 kg or less**; weight picks the protocol side, not age #601.
- Children hold their pressure until **35% to 45%** blood loss. Hypotension in a child is a pre-arrest sign.
- Pliable ribs: **lung contusion with no rib fracture**. A child with rib fractures took a big hit.
- Over 65: **SBP under 110 may represent shock** #153. Beta blockers can hide the tachycardia.
- Atrophy stretches bridging veins: **ground-level fall plus blood thinner** is a subdural until proven otherwise.
- 65 and older: any spinal-area pain gets SMR #702; pelvic fractures happen with low energy #713.

STEP 1: Children: Smaller Bodies, Bigger Heads

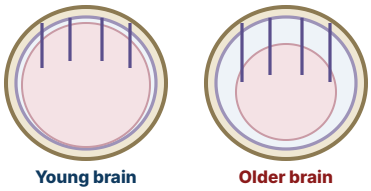


Schematic child. Gold: big head. Red bar: high neck fulcrum.

Child	Anatomy	What it changes in the field
Head and neck	Big head, prominent occiput, weak neck. Spine fulcrum is high: C1 to C3 under age 8, C3 to C5 at 8 to 12, C5 to C6 over 12. Lax ligaments	Head injury is common in falls. Cord injury can occur with a normal x-ray under 8 (SCIWORA): trust the exam. Pad under the shoulders for neutral alignment; a car seat can be used #702
Airway	Large tongue, short neck, larynx higher and more anterior. Narrowest part is **below the cords**	A little swelling or blood blocks a lot. Position and suction first; BVM is the mainstay. ETI only over 34 kg #717. Needle, not surgical, cric #704
Chest	Thin, incompletely ossified ribs; very compliant wall; mobile mediastinum	Contusion with no fracture. Tension shifts the mediastinum fast. Watch oxygenation closely
Belly	Thin wall, little fat, weak muscle; flexible ribs pass the energy to liver and spleen	Handlebar marks and seat belt signs matter. A soft belly is not reassurance
Circulation	About 70 mL/kg over 3 months (80 to 90 in term infants): a 20 kg child has about 1.4 L	Heart rate, skin, and mental status first. Fluid 20 mL/kg, max 500 mL, may repeat once #660. No TXA under 15 #714
Temperature	Thin skin, more surface area per kg	Cools faster once exposed. Cover them; heat the compartment early

STEP 2: Older Adults: Less Reserve, Hidden Shock

Older adult	Anatomy and physiology	What it changes in the field
Brain	Atrophy stretches the bridging veins and leaves extra room inside the skull	A small fall can tear a vein. Raised ICP signs show late: serial GCS. Anticoagulant (not aspirin) plus a head injury that is not minor: Step 4 consult #153
Bones	Lower bone density and muscle mass	Hip, pelvis, wrist, rib, spine fractures from low energy. Pad and support a curved spine #702
Heart and meds	Stiffer heart, blunted responses. Beta blockers, calcium channel blockers, digoxin	Heart rate and pressure mislead. Shock index (HR/SBP) over 0.7 suggests shock Ⓟ
Blood	Anticoagulants, antiplatelets, fewer clotting factors and platelets	Bleeds start easier and stop harder. Get the drug, dose, and last dose
Lungs and ribs	Lower reserve. 65 and older with 3 to 4 rib fractures: 19% higher mortality, 31% pneumonia; worse with each rib	Pain control is lung protection #603. Fentanyl over 65: consider 25 mcg initial and maintenance doses #603
Mechanism	Falls first, then crashes, then burns	Ask why they fell: syncope, stroke, bleed, low sugar, a new drug. Glucose; 12-lead if cardiac is possible #707



Same skull, smaller brain: the bridging veins (purple) stretch across a wider gap.

110 is the new 90

An 82-year-old on metoprolol with HR 72 and BP 108 after a fall is not "stable." By county definition that pressure may be shock #153. Look at skin, mental status, mechanism, and trend.

Epidural or subdural?

Epidurals are rare over 50. Subdural risk climbs with age and atrophy.

COUNTY NUMBERS FOR SPECIAL BODIES

The protocol wins. Read the full pages.

PEDIATRIC (34 KG OR LESS) #601

- **Step 1 alert** #153**:** GCS 13 or less; poor perfusion; RR over 60 or respiratory distress, or under 20 in infants under 1; HR under 80 or over 180 (5 and under, under 22 kg), under 60 or over 160 (6 and up, 23 to 34 kg).
- **Hypotension:** SBP under 60 newborn, under 70 infant, under 70 + (2 × age) ages 1 to 10, under 90 ages 11 to 14.
- Fall over 10 ft or twice the child's height: Step 3 consult. Any pediatric patient: Step 4 consult on judgment.
- Pain: fentanyl 1.5 mcg/kg IN or 1 mcg/kg IV/IM; no ketamine #603.

AGE 65 AND OLDER

- Over 65: Step 4 consideration; **SBP under 110 may represent shock** #153.
- Anticoagulant (not aspirin) or bleeding disorder with a head injury that is not minor: Step 4 consult. Ground-level fall with GCS 14 or more (or normal for them): no consult required #153.
- SMR: any spinal-area pain at 65 and older; assess even after low-energy falls #702.
- Pelvic fractures even with low energy #713. Ask early and kindly about POLST Ⓟ.

FRONT

THE WHOLE PICTURE

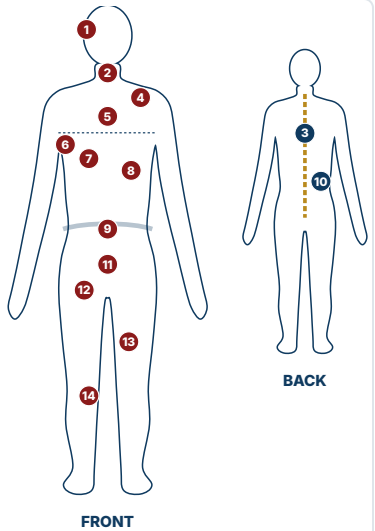
Body Map to Field Decision, and Traumatic Arrest · **Shift 15**

★ ★ ★ ★ ★
Trauma Anatomy Reference
Bearamedics Reference · not a treatment protocol

LOCATION, THEN STRUCTURE, THEN DECISION

- Every wound has an address. Name what lives under it before you name the treatment.
- The torso has no safe zone: **below the nipple line** the chest is also the belly.
- Junctions (neck base, axilla, groin) take **packing and pressure**, not a tourniquet #706.
- Hypotensive with no obvious bleeding: the **five places** first, neurogenic shock last.
- Traumatic arrest is a **different arrest**: fix HOTT first; compressions come second.
- Under 20 minutes to a trauma center: **go**, and treat en route #661.

STEP 1: The Body Map: Where, What, and Then What



Red: front. Navy: back (3 spine, 10 flank). Dashed line: nipples; band: lap belt.

	Where	What is underneath	Field decision
1	**Temple**	Pterion; middle meningeal artery	Epidural: a lucid interval in only a minority. GCS and pupils every check. GCS 13 or less: Step 1 alert #153
2	**Front of neck**	Larynx, trachea, carotid, jugular	Pressure on one side; never wrap. Penetrating: Step 2 alert #153. Fractured larynx: needle cric #704
3	**Spine (back)**	Cord: C3 to C5 phrenic; above T6 sympathetic	SMR per #702. Watch the breathing. Neurogenic shock only after bleeding is excluded
4	**Clavicle, axilla**	Subclavian, axillary, brachial plexus, lung apex	Junctional: pack and press; no tourniquet reaches #706
5	**Cardiac box**	Heart, great vessels, mediastinum	Tamponade: rapid transport, early notification. Gunshots: anywhere in the chest counts
6	**Side of chest**	Lung, pleura; VAN bundle under every rib	Tension: needle over the top of the rib #705. Blood: a needle will not drain it
7	**Below right nipple**	Diaphragm and liver	Chest and belly wound. TXA if SBP 90 or less #714
8	**Lower left ribs**	Spleen, ribs 9 to 11	Kehr's sign. Up to 20% of adults with these fractures have a splenic injury
9	**Lap belt line**	Bowel, mesentery, lumbar spine	Seat belt sign: about 1 in 11 hollow organ injury. Plus back pain: think Chance fracture
10	**Flank (back)**	Kidneys T12 to L3; retroperitoneum to about 4 L	Can bleed with no belly signs. Flank and navel bruising come late
11	**Pelvis**	The ring; presacral veins	Binder on the greater trochanters when all three criteria are met #713. Never rock it
12	**Groin**	Femoral artery below the ligament; external iliac above	Pack and press over the femoral head. Junctional
13	**Thigh, upper arm**	One bone, one main artery	Tourniquet 2 to 4 in above the wound #706. A closed femur alone rarely explains shock
14	**Knee**	Popliteal artery, tethered	Dislocation tears it in 4% to 20%: pulses before and after

#661 ESSENTIALS: TRAUMATIC CARDIAC ARREST (PLATINUM TEN CH. 28)

The protocol wins. Read the full page.

THE RULE

- **BLS:** obvious death per #125. Otherwise HPCPR 10:1, pauses under 5 seconds.
- **Absent signs of life on arrival** (pulseless, apneic, no heart or lung sounds, fixed dilated pupils): consider non-initiation #125.
- **Arrest after EMS arrival, under 20 min** from a trauma center: do not delay transport; ALS en route. NS up to 500 mL, repeat once if no ROSC or SBP under 90 (pediatric 20 mL/kg, reassess, repeat).
- **No epinephrine or amiodarone** unless the arrest may be medical.
- **Over 20 min:** contact the SLO Trauma Center for treatment and destination Base. Termination by base order.

TRAPS

- TXA after over 5 min of CPR without ROSC is contraindicated #714. Consider not using the AED unless a cardiac event caused it #708.
- Older patient, minor crash: maybe medical first. Treat per #641.
- Trauma center preferred if equal or near-equal distance; otherwise closest ED is allowed for traumatic arrest #153.

HOTT	Share	The anatomy	Field action
Hypovolemia	About 48%	The five places; the street	Tourniquet, packing, binder, fluids per #661, fastest route to a surgeon
Oxygenation	About 13%	Airway, face, neck	Open, clear, ventilate with O2; least invasive airway that works
Tension	About 13%	Pleural space, both sides	Suspected chest trauma: **bilateral** needle thoracostomy #705
Tamponade	About 10%	Pericardium	Needs a surgeon: rapid transport, early notification

Approximate shares from a 2024 narrative review, as cited in Platinum Ten ch. 28.

Why compressions come second

Compressions move blood that is already in the heart. In hemorrhage the heart is empty; in tension and tamponade it cannot fill. Stop the bleed, open the airway, decompress the chest, and drive.

For field education only. Treat per patient presentation, vitals, and SLO County EMS protocols.

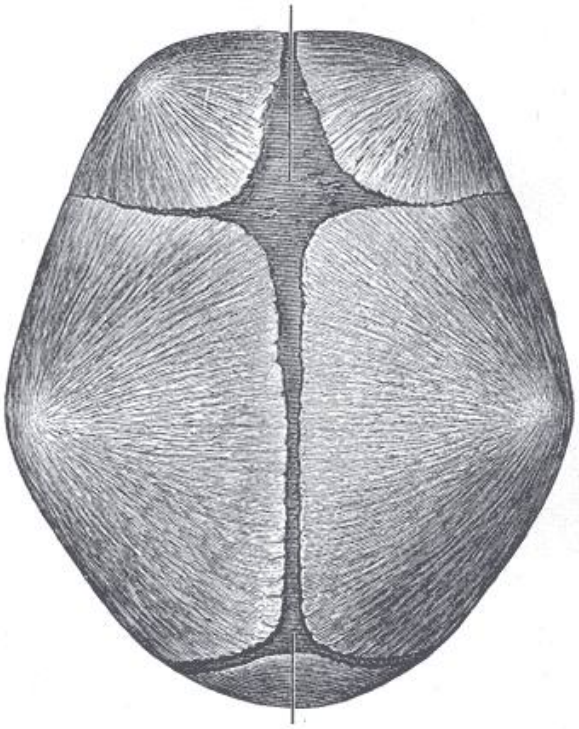
SPECIAL BODIES: IMAGES

The infant skull · **Shift 15**

★ ★ ★ ★ ★
Trauma Anatomy Images
Bearamedics Reference · not a treatment protocol

IMAGE 1: The Newborn Skull

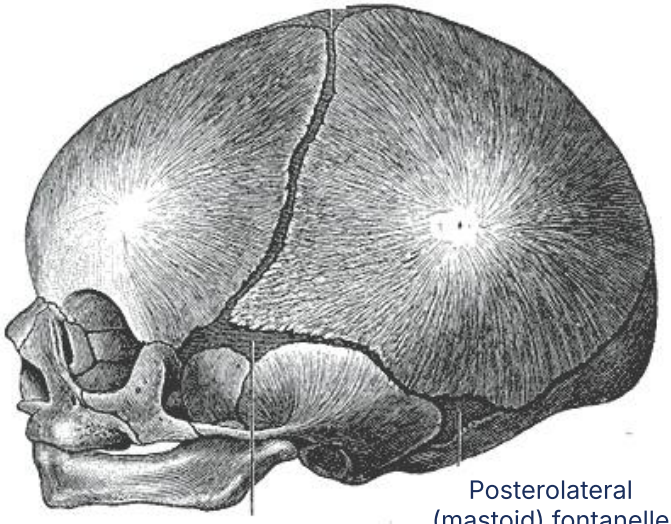
ANTERIOR fontanelle



Posterior fontanelle

Gray's Anatomy (1918), Fig. 197, skull at birth from above (modified: relabeled). Public domain.

Anterior fontanelle



Posterolateral (mastoid) fontanelle

Anterolateral (sphenoid) fontanelle

Gray's Anatomy (1918), Fig. 198, skull at birth from the side (modified: relabeled). Public domain.

WHY IT MATTERS

- The **anterior fontanelle** is the soft spot you can feel on top of an infant's head. It usually closes by about 18 months; the posterior one closes much earlier.
- Check it with the infant upright and calm. **Bulging** can mean raised pressure inside the skull; **sunken** can mean dehydration.
- A big head on a small neck: infants and toddlers need padding under the shoulders to keep the airway in line (#702).

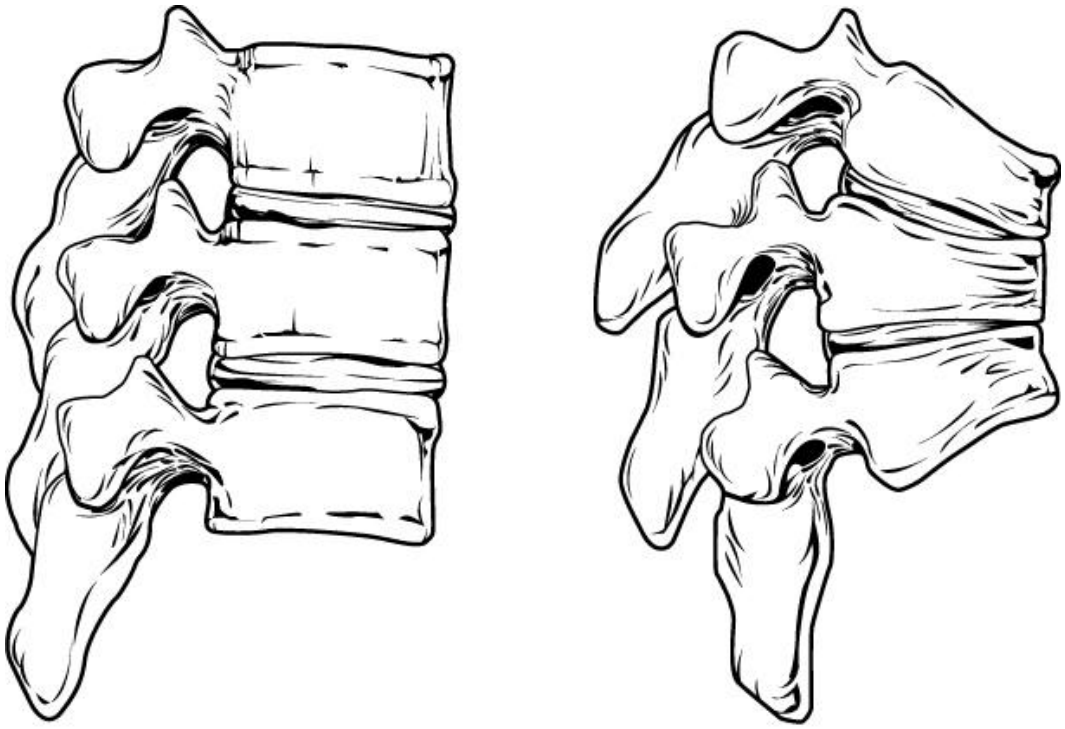
HANDS-ON: on your partner

1. On an infant manikin or by description: find the anterior fontanelle.
2. Say what bulging and sunken each suggest.

SPECIAL BODIES: IMAGES

Bone loss and the curved spine · **Shift 15**

IMAGE 2: The Older Spine



Normal vertebrae

Bone loss makes the curve worse

Figure 7.22 (modified: relabeled), *Anatomy & Physiology 2e*, OpenStax, CC BY 4.0. openstax.org/books/anatomy-and-physiology-2e

WHY IT MATTERS

- Bone loss lets vertebrae collapse at the front, which bends the upper back forward (kyphosis).
- Brittle bones break from small forces: a ground-level fall can fracture a hip, a wrist, or a vertebra.
- A curved spine won't lie flat. Pad behind the head and shoulders to keep the patient in their own normal alignment during SMR (#702).
- Older patients hide shock: beta blockers blunt the heart rate, and a "normal" pressure may be low for them (#153 Step 4).

HANDS-ON: on your partner

1. Lay your partner flat and build a pad stack that would support a curved upper back.
2. Say why forcing the head flat to the board can hurt.