

Compartment Syndrome

Compartment syndrome is when swelling or bleeding trapped inside a tight sleeve of tissue squeezes the blood vessels shut.

THE ONE-LINE TRUTH

Pressure inside a muscle compartment rises so high that blood cannot flow in, starving the muscle and nerve of oxygen.

The chain — how it unfolds

1. Injury causes bleeding or swelling inside a closed fascial compartment. — why: Broken bone, crush, burn, or restored blood flow after blockage dumps fluid or blood into a space wrapped by tough, non-stretchy fascia—volume goes up but the container cannot expand.
2. Compartment pressure rises above the pressure in the veins (usually above 20–30 mm Hg). — why: Veins are low-pressure tubes, so even a small pressure increase squeezes them flat and blocks blood from leaving—used blood and extra fluid get trapped, making swelling even worse.
3. Pressure climbs further and pinches capillaries, stopping oxygen delivery to muscle and nerve. — why: When pressure nears or exceeds capillary pressure (roughly 30–40 mm Hg), fresh blood cannot reach the tissue—muscle and nerve cells begin starving for oxygen within minutes.
4. Severe pain begins, much worse than the original injury, and stretching the muscle makes it sharper. — why: Dying muscle releases acid and toxins that fire nerve pain signals; stretching pulls on the blood-starved (ischemic) (oxygen-starved) tissue and squeezes out the last bit of blood, intensifying the pain.
5. Tingling or numbness (Paresthesias) (tingling, numbness) appear as nerves start to fail. — why: Nerves need constant oxygen; when supply drops, they misfire or stop firing—you feel pins and needles first, then numbness as the nerve shuts down completely.
6. Muscle weakness progresses to paralysis. — why: Without oxygen, muscle cells cannot contract; the nerve cannot tell the muscle what to do because the nerve itself is dying—voluntary movement disappears.

7. Pulse becomes weak or absent, and the limb feels tight and swollen. — why: Arterial flow finally stops when compartment pressure exceeds arterial diastolic pressure (roughly 60–80 mm Hg)—by this point, muscle and nerve have been dying for hours and permanent damage is likely.
8. Muscle dies (necrosis) after four to six hours of starved blood flow (ischemia), releasing myoglobin and potassium into the bloodstream (rhabdomyolysis). — why: Dead muscle cells burst open, dumping myoglobin (a protein that clogs kidney filters) and potassium (which disrupts heart rhythm)—this can cause kidney failure and fatal arrhythmia if not treated.

Spot it — what you see, and why

- Very bad pain that gets much worse when you stretch the muscle: Pressure inside the muscle compartment (the tissue wrapping around the muscle) is crushing the muscle and nerves, so any stretch pulls on already-damaged tissue and sends sharp pain signals to your brain.
- The compartment feels firm and tight, like a blown-up balloon: Swelling or bleeding inside the compartment has nowhere to go, so pressure builds up and the tissue stretches tight against its wrapping.
- Numbness or tingling in the area past the swelling: High pressure squeezes the nerves that carry feeling signals, blocking them like pinching a phone cable so the message cannot get through.
- Weakness or trouble moving the fingers or toes beyond the injury: Pressure is crushing the nerves that tell muscles to move, so the brain's commands cannot reach those muscles anymore.
- Pale or shiny skin over the area: Swelling stretches the skin tight and squeezes tiny blood vessels near the surface, so less blood reaches the skin and it looks paler or shiny.
- Pain that does not get better with rest or usual pain medicine: The source of pain is ongoing pressure and tissue damage inside the compartment, not simple inflammation, so normal pain relievers cannot fix it.

Red flags — act now

- Pain that keeps getting worse even after rest, ice, or pain medicine
- Numbness, tingling, or cannot feel light touch in the fingers or toes beyond the swelling
- Cannot move fingers or toes, or movement is very weak
- Skin looks very pale, blue, or feels cold past the injury
- Pulse is weak or cannot be felt below the injured area

Treat it — in this order

1. Remove or loosen any tight cast, dressing, splint, or wrap immediately → Cuts external pressure on the limb right away so blood can flow back into the compartment. This buys time before tissue dies and may prevent the need for surgery if caught very early.
2. Emergency fasciotomy (surgical cuts through the fascia to open all compartments) → Opens the tight compartment so pressure drops instantly below the blood pressure level. Oxygen and nutrients can reach the muscle again, stopping the chain of cell death. This is the only treatment that fixes the core problem.
3. Keep the limb at heart level (NOT elevated) → Keeps blood pressure inside the limb as high as possible so blood can still push into the compartment against the rising pressure. Elevating the limb lowers the driving pressure and worsens starved blood flow (ischemia).
4. Give aggressive IV fluids (normal saline or lactated Ringer's at 200–300 mL/hour) and monitor urine output closely → Flushes myoglobin through the kidneys before it clogs the tubules and causes kidney failure. Keeps urine output above 200–300 mL/hour to prevent myoglobin from crystallizing in the kidney.
5. Treat high potassium (hyperkalemia) if potassium is dangerously high (calcium gluconate 1 g IV, insulin 10 units + dextrose 25 g IV, sodium bicarbonate if acidotic) → Calcium stabilizes the heart muscle so high potassium cannot trigger a fatal arrhythmia. Insulin and dextrose drive potassium back into cells temporarily. Bicarbonate shifts potassium intracellularly if the blood is acidic.

Your top priorities at the bedside

1. Remove or loosen any cast, splint, tight bandage, or wrap down to the skin immediately and notify the provider right away. — why: External pressure from tight dressings adds to the pressure inside the compartment, so removing them may lower the pressure enough to restore some blood flow and buy time before surgery.
2. Assess and document pain level, firmness of the compartment, ability to move fingers or toes, sensation to light touch, skin color, skin temperature, and pulses distal to the injury every 15 to 30 minutes. — why: Compartment syndrome gets worse quickly, and frequent neurovascular checks (nerve and blood vessel checks) catch changes early so the surgeon can operate before permanent muscle and nerve death happen.
3. Keep the affected limb at heart level—do NOT elevate it above the heart. — why: Elevating the limb lowers the blood pressure going into the compartment and makes starved blood flow (ischemia) (lack of oxygen) worse, while keeping it at heart level maintains the best possible blood flow into the damaged area.