CONDITION

Compartment syndrome

Learn how compartment syndrome raises pressure around muscles, how acute and exercise-related forms differ, and when symptoms need emergency care.

WHAT IT IS
Raised pressure inside a closed muscle group

BODY SYSTEM
Muscles, nerves and circulation

MAIN SYMPTOMS
Severe worsening pain, tense swelling, numbness or tingling, weakness

WHAT CAUSES IT
Bleeding, swelling or repeated exercise

HOW IT IS DIAGNOSED
Clinical examination, compartment pressure measurements

MAIN TREATMENT
Surgery to release pressure

CAN IT BE CURED?
Sometimes - pressure relieved, damage may remain

IS IT AN EMERGENCY?
Sometimes - severe worsening limb pain after injury

LONG-TERM OUTLOOK
Delayed acute treatment can cause permanent injury or amputation

Overview

Compartment syndrome happens when pressure rises inside a closed group of muscles. These muscle groups, called compartments, are surrounded by fascia, a strong tissue that does not stretch easily. If swelling or bleeding increases the pressure, blood may no longer flow normally through the compartment. Without enough blood and oxygen, muscles and nerves can become damaged.

The condition most often affects the lower leg or forearm, but it can occur in the hand, foot, thigh, buttock, or upper arm.

There are two main forms:

These forms have different patterns and treatments. Sudden, severe, or rapidly worsening

symptoms after an injury, procedure, or cast placement should not be treated as routine muscle soreness.

- Acute compartment syndrome develops suddenly, often after a fracture, crush injury, or other serious injury. It is a surgical emergency because lasting damage can occur if pressure is not relieved promptly.
- Chronic exertional compartment syndrome develops during repeated exercise. Symptoms usually improve with rest. It is generally not an emergency, but it may limit sports, work, or other activities.

Symptoms

Acute compartment syndrome usually causes pain that is more severe than expected for the injury. The pain may keep worsening even after the injured area has been supported or treated. Stretching the muscles within the affected compartment may make the pain much worse.

Other possible symptoms include:

A normal pulse does not rule out compartment syndrome. The larger arteries can continue carrying blood even while smaller blood vessels inside the compartment are being compressed.

Pain may be difficult to recognize in someone who is unconscious, heavily sedated, very young, or unable to describe symptoms. It can also be less obvious after a nerve injury. In these situations, clinicians may rely more on repeated examinations and pressure measurements.

Seek emergency medical care immediately for severe or increasing limb pain, tense swelling, new numbness, or weakness after an injury, operation, burn, cast, or tight dressing. Do not wait for the skin to become pale or for a pulse to disappear. Call emergency services if the person cannot reach an emergency department safely.

Chronic exertional compartment syndrome has a different pattern. Pain, aching, cramping, or tightness usually begins after a predictable amount of exercise. Symptoms often become worse as activity continues and then improve after stopping. Some people also develop tingling, numbness, weakness, or temporary difficulty lifting the foot.

Exercise-related leg pain has many possible causes. A clinician should assess symptoms that repeatedly interrupt activity, continue after rest, or are associated with weakness or loss of sensation.

- A firm, swollen, or very tight feeling in the limb
- Burning, tingling, or reduced sensation

- Increasing difficulty moving the fingers, toes, hand, or foot
- Muscle weakness
- Pale or cool skin, usually as a later sign
- A weak or absent pulse, which is also a late and unreliable sign

Causes and risk factors

Acute compartment syndrome can develop whenever bleeding or swelling increases pressure within a muscle compartment. Fractures are a major cause, especially fractures of the lower leg and forearm. The condition can also occur without a broken bone.

Other causes include crush injuries, severe bruising, blood vessel injuries, burns, and the return of blood flow after a blocked artery has been treated. Bleeding into a compartment may follow an operation or occur in someone with a bleeding disorder. Medicines that reduce blood clotting can increase bleeding after an injury, although most people taking these medicines do not develop compartment syndrome.

A cast, splint, bandage, or other external pressure can contribute if swelling develops beneath it. Fluids or medicines that accidentally leak from an intravenous line into surrounding tissue may also raise pressure, particularly in the hand or forearm.

People with major trauma may have several risk factors at once. Recognition can be harder when a person has received strong pain medicine, is unconscious, or has another injury that affects sensation.

Chronic exertional compartment syndrome is linked to repeated muscle expansion during exercise. Running and other activities involving repeated impact are common triggers. Training intensity, movement patterns, footwear, and anatomy may influence symptoms, but there is not always one clear cause.

Ordinary delayed muscle soreness after exercise is much more common than chronic exertional compartment syndrome. The predictable timing of symptoms during activity and their improvement with rest can help distinguish the condition from other causes, but an examination is still needed.

Diagnosis

Acute compartment syndrome is mainly a clinical diagnosis. A clinician asks about the injury and symptoms, then checks pain, swelling, sensation, muscle function, skin temperature, and

circulation. Because findings can change over time, repeated examinations are important when the condition is suspected.

A handheld device may be used to measure pressure inside the compartment through a needle or small catheter. The result is interpreted together with the person's blood pressure, symptoms, examination, and changes over time. No single pressure reading should be considered in isolation.

Imaging may help identify a fracture or another injury, but an X-ray, CT scan, or MRI does not reliably exclude acute compartment syndrome. When the diagnosis is clear, testing should not delay emergency treatment.

Chronic exertional compartment syndrome is assessed differently. The clinician reviews which activities bring on symptoms, how long symptoms take to begin, and how quickly they improve with rest. The examination may be normal when the person is not exercising. An examination immediately after the triggering activity may reveal tightness, tenderness, weakness, or changes in sensation.

Pressure measurements taken before and after exercise have traditionally been used to support the diagnosis. Specialists may also consider MRI or other tests in selected cases. Testing can help exclude stress fractures, tendon injuries, nerve compression, reduced blood flow, and other causes of exercise-related pain.

Treatment and management

Acute compartment syndrome requires immediate hospital treatment. The first steps may include checking for restrictive casts, splints, or dressings and treating low blood pressure or other injuries. These measures are performed by healthcare professionals and are not a substitute for surgery when dangerous pressure is present.

The main treatment is an operation called a fasciotomy . During this procedure, the surgeon opens the tough fascia around the affected muscles. This releases pressure and restores space for blood flow.

The surgical wounds are often left open at first because swelling may continue. The person may need another operation to inspect the muscles and close the wounds later. A skin graft may be needed if the skin edges cannot be brought together safely. Tissue that has been badly damaged may need to be removed.

Treatment also addresses the underlying cause, such as a fracture, blood vessel injury, or bleeding problem. Hospital teams monitor kidney function, fluid balance, infection risk, and the health of the affected muscles and nerves.

Chronic exertional compartment syndrome does not usually require emergency surgery. Initial management may involve reducing or temporarily stopping the activity that causes symptoms. A sports medicine clinician, physical therapist, or other specialist may assess training load, running form, strength, flexibility, and footwear.

Changing activity can help some people. Low-impact exercise may be an option while symptoms are being evaluated. Anti-inflammatory pain medicines may reduce discomfort from some exercise-related conditions, but they do not correct pressure inside a compartment and should not be used to delay assessment of persistent symptoms.

If symptoms remain limiting despite non-surgical care, an elective fasciotomy may be considered. The surgeon opens the affected compartment or compartments to create more room during exercise. Results vary depending on which compartments are involved and whether another condition is contributing. A specialist can explain expected benefits, recovery, scars, and possible complications.

Complications

Delayed treatment of acute compartment syndrome can cause permanent muscle and nerve injury. Weakness, numbness, chronic pain, and reduced movement may remain even after pressure is relieved.

Damaged muscle can shorten and stiffen as it heals. In the forearm, this may lead to a fixed bending deformity of the wrist and fingers called Volkmann contracture .

Severely injured muscle may release myoglobin, a muscle protein, into the bloodstream. This process, called rhabdomyolysis , can contribute to kidney injury and dangerous changes in body salts. Extensive tissue damage can also lead to infection, additional operations, or amputation.

Fasciotomy itself may result in scars, altered sensation, infection, wound-healing problems, or muscle weakness. These risks must be weighed against the much greater risk of leaving acute compartment pressure untreated.

Chronic exertional compartment syndrome usually does not cause the rapid tissue death seen in the acute form. However, ongoing symptoms can limit exercise and affect performance, mobility, or work. Symptoms can also return after treatment.

Follow up

After an emergency fasciotomy, follow-up depends on the original injury and the amount of

muscle, nerve, skin, or bone damage. Early visits may focus on wound care, later closure or skin graft healing, fracture treatment, and signs of infection.

Rehabilitation may include physical or occupational therapy. Therapy can help restore joint movement, strength, coordination, and function. Recovery may take longer when the condition involved nerve damage, a major fracture, a vascular injury, or several operations.

Contact the treating team promptly about increasing wound redness, drainage, fever, worsening swelling, or pain that is not following the expected recovery pattern. Follow the surgical team's instructions about dressings, movement, weight-bearing, and return to work or sports.

Return to emergency care for rapidly worsening pain, a newly tight or swollen limb, new numbness or weakness, or a pale or cool hand or foot. These are not routine follow-up symptoms.

For chronic exertional compartment syndrome, follow-up may include a gradual return to activity and reassessment of symptoms. After elective surgery, the timing of exercise depends on wound healing, strength, and the surgeon's rehabilitation plan. Recurrent pain should be reviewed rather than pushed through, because other exercise-related conditions can cause similar symptoms.

Sources

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