

## Electrical Injuries

*An electrical injury occurs when a current passes through the body, interfering with the function of an internal organ or sometimes burning tissue.*

Electrical injury may result from contact with faulty electrical appliances or machinery or inadvertent contact with household wiring or electrical power lines. Electrical injury can also occur from lightning (see [Electrical and Lightning Injuries: Lightning Injuries](#)). The severity of the injury ranges from minor to fatal and is determined by the intensity of the current, the type of current, the pathway of the current through the body, the duration of exposure to the current, and electrical resistance to the current.

The intensity of the current is measured in volts. Ordinary household current in the United States is 110 to 220 volts. Anything over 500 volts is considered high voltage. High voltage can jump (arc) through the air anywhere from an inch up to several feet, depending on the voltage. Thus a person may be injured simply by coming too close to a high-voltage line. High voltage causes more severe injuries than low voltage and is more likely to cause internal damage. Kidney damage may result when high voltage burns large amounts of muscle, which releases a chemical into the blood (rhabdomyolysis (see [Burns: Complications](#))).

Electrical current is categorized as direct current (DC) or alternating current (AC). Direct current, such as current generated by batteries, flows in the same direction constantly. Alternating current, such as current available through household wall sockets, changes direction periodically. Alternating current, which is used in most households in the United States, is more dangerous than direct current. Direct current tends to cause a single muscle contraction often strong enough to force the person away from the current's source. Alternating current causes a continuing muscle contraction, often preventing people from releasing their grip on the current's source. As a result, exposure may be prolonged. Even a small amount of alternating current—barely enough to be felt as a mild shock—may cause a person's grip to freeze. Slightly more alternating current can cause the chest muscles to contract, making breathing impossible. Still more current can cause deadly heart rhythms.

The path that the current takes through the body determines which tissues are affected. The most common entry point for electricity is the hand; the second most common is the head. The most common exit point is the foot. A current that travels from arm to arm or from arm to leg may go through the heart and is much more dangerous than a current that travels between a leg and the ground. A current that travels through the head may affect the brain.

Tissues differ in susceptibility to electrical damage. For example, nerves, blood vessels, and muscle tend to be more easily damaged than bone and tendon. A current passing through a leg or an arm is likely to cause more internal damage than the same current passing across the trunk.

Resistance is the ability to impede the flow of electricity. Most of the body's resistance is concentrated in the skin. The thicker the skin, the greater its resistance. A thick, callused palm or sole, for example, is much more resistant to electrical current than an area of thin skin, such as an inner arm. The skin's resistance decreases when broken (for example, punctured or scraped) or when wet. If skin resistance is high, more of the damage is local, causing only skin burns. If skin resistance is low, more of the damage affects the internal organs. Thus, the damage is mostly internal if a person who is wet comes in contact with electrical current, for example, when a hair dryer falls into a bathtub or a person steps in a puddle that is in contact with a downed electrical line.

### Symptoms

Often, the main symptom of an electrical injury is a skin burn (see [Burns](#)), although not all electrical injuries cause external damage. High-voltage injuries may cause massive internal burns. If muscle damage is extensive, a limb may swell so much that its arteries become compressed (compartment syndrome (see [Fractures: Compartment Syndrome](#)), cutting off blood supply to the limb. If a current travels close to the eyes, it may lead to cataracts. Cataracts can develop within days of the injury or years later.

Toddlers who bite or suck on extension cords can burn their mouth and lips. These burns may cause facial deformities and growth problems of the teeth, jaw, and face. An added danger is that severe bleeding from an artery in the lip may occur when the scab falls off, usually 7 to 10 days after the injury.

A minor shock may cause muscle pain and may trigger mild muscle contractions or startle a person, causing a fall. Severe shocks can cause abnormal heart rhythms, ranging from inconsequential to immediately fatal. The heart's pumping may also become impaired. Severe shocks can also trigger powerful muscle contractions sufficient to throw a person to the ground or to cause joint dislocations, bone fractures, and other blunt injuries.

The nerves and brain can be injured in various ways, causing seizures, brain hemorrhages, poor short-term memory, personality changes, irritability, or difficulty sleeping. Damage to the nerves in the body or spinal cord may cause weakness, paralysis, numbness, tingling, uncontrollable loss of urine (incontinence), and chronic pain.

### Prevention

Education about and respect for electricity are essential. Making sure that all electrical devices are properly designed, installed, and maintained helps prevent electrical injuries at home and work. Electrical wiring should be installed and serviced by properly trained people.

Any electrical device that touches or may be touched by the body should be properly grounded. Three-pronged outlets are safest. Cutting off the lower (ground) prong of a power cord with 3 prongs (so that it will fit older two-pronged plugs) is dangerous and increases the chances of electrical injury. Circuit breakers that interrupt (trip) circuits when current as low as 5 milliamperes leaks are advisable in areas that get wet, such as kitchens, bathrooms, and outdoors.

To avoid injury from current that jumps (arcing injury), ladders should not be used near high-voltage power lines.

### Treatment

First the person must be separated from the current's source. The safest way to do so is to shut off the current—for example, by throwing a circuit breaker or switch or by disconnecting the device from an electrical outlet. *No one should touch the person until the current has been shut off, particularly if*


*high-voltage lines could be involved.* High-voltage and low-voltage lines are difficult to distinguish, especially outdoors. Shutting off current to high-voltage lines is done by the local power company. Many well-meaning rescuers have been injured by electricity when trying to free a person.

Once the person can be safely touched, the rescuer should check to see if the person is breathing and has a pulse. If the person is not breathing and has no pulse, cardiopulmonary resuscitation (CPR) should be started immediately (see [First Aid: First-Aid Treatment](#)). Emergency medical assistance should be called for anything more than a minor injury. At the hospital, a doctor checks the person for fractures, dislocations, and spinal cord or other injuries. People with rhabdomyolysis receive large amounts of fluids containing sodium bicarbonate, which is given intravenously. A tetanus shot is given if needed.

Because the extent of an electrical burn may be deceptive, medical assistance should be sought if any doubt exists regarding severity.

Skin burns are treated with burn cream (such as silver sulfadiazine, bacitracin, or sterile aloe vera) and sterile dressings. A person with only minor skin burns can be treated at home. If the injury is more severe, the person is admitted to the hospital, ideally a burn center. An electrocardiogram (ECG) is performed to monitor the heartbeat and to look for heart damage. If the results of the ECG are abnormal or if the person has lost consciousness, has symptoms of a heart problem (for example, chest pain, shortness of breath, awareness of heartbeats [palpitations]), or has other severe injuries, he is kept in the hospital for 12 to 24 hours. Toddlers who bite or suck on extension cords should be referred to an orthodontist, an oral surgeon, or a surgeon who specializes in burns for follow-up care.

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