The chain saw is one of the most indispensable tools of modern tree work. About three-fourths of the sales volume in the average tree care company is made from pruning and removals, and this work is not being accomplished with just a handsaw. Of course, back in the day, handsaws were the only means of pruning, and they are still an important tool. Today, however, few arborists would choose to spend all day cutting large tree limbs with a handsaw.

Chain saws have increased work productivity, but chain saw misuse is also a factor in many injuries involving arborists and others who use them. While designed to cut wood, chain saws will cut through unintended objects as well. Operators should certainly have training before using this lightweight and efficient type of power equipment, but even experienced operators can sustain injuries as a result of chain saw accidents.

The number of chain saw injuries from all users (loggers, arborists, other professions, and even homeowners), ranges anywhere from 40,000 to 90,000 each year for severe, non-fatal accidents, with deaths occurring in another 40 to 60 accidents. Minor chain saw injuries—those that may only require simple on-site first aid provided by the crew—are the most common chain saw accidents. However, “there is no such thing as a minor chain saw cut,” is a good axiom to live by.

The Basics of Chain Saw Awareness

A chain saw operates through an endless loop that pulls material away in a series of chipping actions. “Laceration” is the medical term given to the majority of chain saw injuries. A laceration is an injury that breaks the skin, and this definition is sometimes expanded to mean a torn and ragged cut—precisely what might occur from a chain pulling on tissue. These lacerations can occur anywhere on the body, although they tend to predominate on the left side due to the way the saw is typically held. Lacerations involving a chain saw are often described as deep and multiple, usually a series of parallel cuts. Chain saw accidents can also result in fractures and amputations, as well as severed tendons and nerves. Tree workers have been left partially paralyzed as a result of saw cuts.

The left thigh is one of the most common locations for saw cuts, with the exception of one specialized group of users: climbers. The aerial environment is different from ground work in that aerial chain saw accidents occur more often to the upper body, head, neck, and shoulders than to the leg. A recent accident involved a middle-aged climber, who suffered kickback to the neck and face. The large, ragged lacerations on the neck of this victim resulted in non-arterial bleeding; however, the bleeding was continuous and resulted in considerable blood loss—about one liter. The hyoid bone was fractured and several muscles were severed. Interestingly, bone often slows the chain, which usually works to reduce the rate of damage. Fortunately, the worker in this accident survived, but penetrating neck trauma accidents involving chain saws frequently occur.

Accidents in which the carotid artery is severed are often fatal. A chain saw operator working in a tree should always consider where the chain saw would go if kickback occurred.

Chain Saw First Aid

In the event of a chain saw injury, the most important step is to stop any bleeding, and the most effective means to control external bleeding is to apply pressure—uninterrupted pressure. Place a sterile dressing on the cut and hold it for...
about five minutes. Pressure stops the flow of blood and allows for coagulation. Bleeding tends to stop within ten minutes, depending on the severity of the cut. To help the coagulation process, use blood-stopper bandages that contain chitosan, a substance that rapidly clots blood. If the bleeding still has not stopped, apply an additional dressing, but do not remove the first dressing. Place the second dressing over the first, and continue to apply pressure. Once dressings are in place to control the bleeding, a pressure dressing can be applied with a roller bandage to help maintain the pressure.

Remember to wear latex gloves to avoid the transmission of blood-borne pathogens when holding the dressing in place, and keep safety glasses on as well. Blood can splatter, and eyes should be protected from blood-borne diseases. If possible, elevate the extremity on which the cut is located. This can help stop venous bleeding. While bleeding is probably the most common and noticeable injury in a chain saw accident, do not skip the ABCs of first aid and focus immediately on the bleeding. Remember the basics of first-aid training: airway, breathing, and then circulation.

**Getting to Know Your PPE**

Considering the power of a chain saw, the aggressive nature of the chain, and the number of accidents each year, it is a wonder anyone would doubt the value of personal protective equipment (PPE). If patients arriving at the emergency room with chain saw injuries are divided into two classes—professionals (e.g., loggers, tree workers) and occasional users (e.g., homeowners, farmers)—one difference in the severity of the injuries is that the professionals were usually wearing PPE and the occasional users were not. The professional is less likely to have an accident due to training and skill, but if the saw kicks back, PPE can prevent or minimize the severity of the injury.

When PPE is mentioned, most arborists think of protective clothing, but there are two additional safety items that should be on every crew: a first-aid kit and a cellular phone. The former is required; the latter is a good idea. First-aid kits need to be checked periodically and updated. Training on the application of first aid should be current and periodic as well. A first-aid kit is of no value if a potential user is not aware of its content or how to use it.

A recommended PPE item that is not mandated but is still commonplace is the cellular phone. Some readers may remember when people taped a dime to the dashboard so they could call for help from a payphone. Now, almost everyone has a cell phone and coverage is increasing to include the more populated regions of every continent. A cell phone can literally be a lifesaver for an injured worker when response time is critical. At least one cell phone should be available to a work crew. Make sure the phone is not with the climber or the person feeding the chipper, because the phone is not going to be of any use if it is attached to an unconscious climber or on its way through the chipper.

Before commencing work, the supervising arborist should give a job briefing that includes noting the emergency response phone number and cell phone coverage for the worksite, or where someone may have to go to obtain cell phone coverage. Also, the worksite address should be clearly stated before starting work, or the work order can be posted so that everyone has access to address information. If one of the workers is bleeding out from a saw cut,
the energy of impact by crimping the shell and stretching the interior harness.

A concussion is the most common non-fatal, struck-by head injury that occurs when a worker is not wearing a helmet. A concussion is a type of traumatic brain injury that may result in a loss of consciousness. Branch struck-by injuries often result in a Grade III concussion, characterized by retrograde amnesia (forgetting events before the accident) and loss of consciousness for less than five minutes.

Other types of struck-by injuries include subarachnoid hemorrhage and skull fracture, a break in the cranial (skull) bone. This is generally a closed fracture, with no break to the skin. But open fractures, where there is a break to the skin and splintering of the bone, have occurred as well. Skull fractures can be fatal, but a helmet can alter the outcome to a minor injury (or even just a good story at the tailgate).

None of these injuries sound very pleasant, and they can result in considerable pain, loss of function, and lifestyle changes. A study of loggers found that about 70 percent of the head and face struck-by injuries were received by those not wearing helmets. These are all good reasons to put on a helmet before entering a work zone and to keep it on until leaving it.

Helmet choices are many these days, so finding one that is comfortable and practical should not be a problem. Regardless of the helmet style chosen (and as long as it meets the appropriate ANSI Z89.1 standard), consider selecting one with a chin strap to reduce the risk of the helmet coming off in a side impact. Not all objects fall directly on the head. Also, consider a helmet with a front brim that extends out from the shell. The brim provides more protection for the eyes and the nose. Helmet systems can also include a face shield and hearing protection.

Protecting Your Vision & Hearing
Eye protection is a requirement and a smart idea. Lacerations to the face, most often the left side of the face, do occur from chain saw kickback, and these ragged wounds can include the eye—usually the upper eyelid. The globe is rarely damaged, although there are instances where there is some loss of vision or even permanent damage to the globe.
Eye protection also reduces the potential for shrapnel-sized particles to make contact with the eye. There are even accounts of granulomas—small, hardened masses of tissue—in the faces of workers caused by fine metal fragments off the chain. These fragments are so tiny that they are often unnoticed until the worker, months later, wonders what caused a “wart.”

A wide variety of safety glasses and goggles are available. The best ones comply with ANSI Z87.1, provide UV protection, and are anti-fog and scratch-resistant. Buy a pair that have wraparound lenses or have side protection. Twigs and other debris can come from the side and scratch the cornea, the outer layer of the eyeball. These types of eye injuries, while not often serious, can be very painful. Fortunately, the eye can heal quickly from scratches, but in the process, every blink of the eye will hurt!

Hearing protection is not to prevent lacerations to the ear, but to reduce noise-induced hearing loss (NIHL). The noise generated by a chain saw can have a significant impact on physical health. The chamber in the middle ear, the cochlea, is filled with fluid and lined with thousands of tiny hair cells (visualize a harp). The movement of these hairs creates a nerve signal that is transmitted to the brain, which interprets the signal as sound. Loud or prolonged noise can damage or kill these hair cells. (Visualize cutting out strings in that harp; certain songs cannot be played with missing strings.) And unlike other hairs, the cochlea’s tiny hairs do not grow back. The damage is generally permanent.

When tree workers say they have just gotten used to the sound of the running chain saw, it really means they have suffered hearing loss.

Sound intensity is measured by pressure levels in a logarithmic decibel (dB) scale, often adjusted to higher frequencies (sometimes referred to as dBA), since the ear is more sensitive to these sounds. Normal conversation is about 60 dB. The sound of a running lawn mower is near 90 dB, but a chain saw is about 110 dB. Sounds with an intensity of more than 85 dB are considered potentially hazardous, but this is not just a simple threshold. It is the combination of intensity and duration that results in NIHL. Since dB is measured on a logarithmic scale, doubling the decibels does more than double the sound intensity. It has a far greater impact. Only a three decibel increase doubles the sound intensity. Looking at it another way, about two hours of exposure at 90 dB (e.g., running the lawn mower) has an injury potential equivalent to running a chain saw for one minute.

The recommendation from the Environmental Protection Agency is to limit unprotected exposure of 110 dB to less than a minute or two per day. Chain saws under load may operate at more than 110 dB, and not much wood will be cut in a minute or two; therefore, hearing protection is essential for long-term health. NIHL is gradual and usually painless, but it is also permanent. NIHL is not treatable, but it is 100 percent preventable. A muff, soft plugs, or banded plugs are all good means of protection, but only if they are used regularly as PPE.

Guarding the Extremities

Gloves are not essential PPE, but they are still a good idea. It is an especially good idea to wear gloves when sharpening a chain. A sharp chain can still get its licks in, even when it is not running. Even worse, fuel and oil chemicals are harmful when they enter through puncture wounds. Gloves should fit the hand snugly. Gauntlet gloves (gloves with long cuffs), are not a good choice as debris can get caught in the wide opening. Never use them when chipping brush. Some chain saw operators wear gloves that have more padding on the back of the left hand, the most frequent site for chain saw injuries to the hand.

Since almost four out of ten chain saw injuries occur on the leg, protecting this part of the body makes perfect sense. Now there are protective materials that provide a fair degree of protection, although they are only cut resistant, not cut proof. Most leg protection is designed to jam the chain, but only a chain moving at less than the maximum revolutions per minute (rpm). A chain running at full rpm may still penetrate the protection and move into the leg. The first layer the chain hits is the outer shell; the chain
Boots are another requirement for safer chain saw use. Remember, the majority of injuries occur to the lower extremities of the body. While the legs are the major concern, about one in twenty chain saw injuries occur to the foot, most commonly to the left foot at the base of the big toe. Boots should be cut resistant and have a good non-skid tread.

**Summary**

The fact that chain saws can cut wood at the speed they do should clearly illustrate the importance of safety. Everyone who uses a chain saw should have training on its proper use. Sometimes, however, something goes wrong despite best efforts, and the chain follows a path that ends with human body contact. Personal protection equipment is the first, best, and last protection. Wear it at all times.

John Ball is a Professor of Forestry at South Dakota State University (Brookings, SD), where, in addition to other duties, he conducts research in tree worker safety. He is also an emergency medical technician.

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Next, complete the registration information, including your certification number, on the answer form and send it to ISA, PO Box 3129, Champaign, IL 61826-3129. Answer forms for this test, Preventing Chain Saw Injury: The Power of Training and Personal Protective Equipment, may be sent for the next 12 months.

If you do not pass the quiz, ISA will send you a retake answer sheet. You may take the quiz as often as necessary to pass. If you pass, you will not be notified; rather, you will see the credit on your CEU report (available online). Processing CEUs takes 4 to 6 weeks.

CEUs for this article apply to Certified Arborist, Utility Specialist, Municipal Specialist, Tree/Worker Climber, and the BCMA management category.

1. Hearing protection is needed for any sound intensity greater than
   a. 25 dB
   b. 65 dB
   c. 85 dB
   d. 105 dB

2. Leg protection should be washed and cleaned on a regular basis (about once a month) following manufacturer’s recommendations to
   a. make the worker look more professional
   b. keep oil or gasoline from penetrating the outer shell
   c. keep the saw from sliding up as it hits the leg
   d. ensure they remain entirely cut proof

3. The ideal length for leg protection is
   a. just below the knee
   b. about mid-calf
   c. about two inches below the top of the boot
   d. covering the boot and just touching the ground

4. The area of the body that receives the most chain saw injuries in ground work is the
   a. right shoulder
   b. left side of head
   c. left leg
   d. right foot

5. The most common head injury to tree workers from being struck by a falling object is
   a. concussion
   b. open fracture
   c. closed fracture
   d. subarachnoid hemorrhages

6. The portion of the eye most often lacerated by a chain saw is the
   a. cornea
   b. upper eye lid
   c. lower eye lid
   d. iris

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7. Hearing injury from exposure to loud noise is completely reversible in time.
   a. True
   b. False

8. Leg protection is designed to stop a chain running at full throttle.
   a. True
   b. False

9. The most common injury from a chain saw is a
   a. laceration
   b. fracture
   c. amputation
   d. concussion

10. Which component of PPE is not mandated by any regulation or standard, but is still an excellent item to have on hand?
    a. helmet
    b. hearing protection
    c. cellular phone
    d. eye protection

11. The most common fatal accident scenario from felling a tree is
    a. being struck by the chain saw in the face
    b. tripping and being impaled by a fallen branch or log
    c. being struck by the chain saw in the leg
    d. being struck by a branch or the falling tree

12. Laceration is the medical term for
    a. a clean surgical incision
    b. eye surgery with a laser beam
    c. a torn, ragged cut
    d. removal of body fat with suction

13. Chain saw cuts may occur
    a. while on the ground
    b. in the aerial lift
    c. while aloft in the tree
    d. all of the above

14. PPE stands for
    a. Personnel Protective Equipment
    b. Personal Protective Equipment
    c. Protective Personnel Equipment
    d. none of the above

15. The medical term for a mass of hardened, inflamed tissue, usually as a result of infection such as a splint of material in the body, is
    a. granola
    b. granules
    c. granulomas
    d. eye warts

16. NIHL stands for
    a. National Hockey League
    b. National Industrial Hearing Level
    c. Noise Induced Hearing Loss
    d. Noise Induced Heavy Lifting

17. Appropriate footwear for operating a chain saw is:
    a. heavy leather work boots with non-slip tread.
    b. cowboy boots with leather soles
    c. sneakers
    d. steel-toed with a smooth sole.

18. The cavity in the ear where sound vibrations are converted to a nerve signal transmitted to the brain.
    a. cochlea
    b. conch shell
    c. ear drum
    d. echo chamber

19. The type of gloves that should not be worn, particularly if the wearer will be chipping brush.
    a. snug fitting gloves
    b. gauntlet gloves
    c. leather gloves
    d. Kevlar® gloves

20. One of the major factors why professional saw users such as loggers and arborists, have fewer serious injuries from chain saws compared to occasional users such as homeowners is that
    a. professionals have more training in saw use
    b. professionals have more skill at operating a chain saw
    c. professionals are typically wearing PPE
    d. professionals are working in less hazardous trees

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