

Steven A. Koehler,¹ M.P.H, Ph.D.; Todd M. Luckasevic,¹ D.O.; Leon Rozin,¹ M.D.; Abdulrezzak Shakir,¹ M.D.; Shaun Ladham,¹ M.D.; Bennet Omalu,¹ M.D.; Joseph Dominick,¹ R.N., L.F.D.; and Cyril H. Wecht,¹ M.D., J.D.

Death by Chainsaw: Fatal Kickback Injuries to the Neck

ABSTRACT: Each year over 3 million new chainsaws are sold in the United States. The operation of these newer saws combined with the millions of older chainsaws in circulation results in over 28,000 chainsaw-related injuries annually. The majority of the injuries involve the hands and lower extremities with less than 10% involving injuries to the head and neck regions. Deaths while operating a chainsaw are extremely rare. The most common hazards associated with chainsaws are injuries caused by kickback, pushback, and pull-in. Kickback is the most common and poses the greatest hazard. Kickback occurs when the rotating chain is stopped suddenly by contact with a more solid area throwing the saw rapidly backward toward the operator. The cause of most injuries can be traced to improper use of the saw or poor judgment on part of the operator. We present two fatal chainsaw deaths; one with an older style saw, and the other with a modern type. In both cases the victims died from fatal injuries received to the neck region from a chainsaw kickback. The first case involved a 49-year-old white male operating an older style chainsaw with limited safety features. The second case involved a 38-year old white male who was operating a newer model chainsaw equipped with a low kickback chain in an unsafe manner.

KEYWORDS: forensic science, chainsaw, deaths, accident, kickback

Historically, the ownership and operation of chainsaws were reserved to professional lumberjacks. In recent years, because of their low cost and ease of operation, chainsaws have become popular among homeowners and farmers for cutting firewood and trimming trees (1). Today there are over 3 million chainsaws sold annually in the United States (2), while countless millions of older models still are in use.

All chainsaws, old and new, have some inherent dangers associated with their operation that could result in serious and sometimes fatal injuries. According to the U.S. Consumer Product Safety Commission (USCPSC), the number of chainsaw injuries increased from 19,590 in 1973 to 51,676 in 1978. (3). The USCPSC reported 28,543 chainsaw-related injuries in 1999 with associated medical costs of about \$350 million (4). Among these injuries, 35.7% involved the hands, 42.6% involved the lower extremities, 8.6% involved the upper body, and 9.4% involved the head region. Injuries to the head were located most commonly on the forehead and upper facial area (4). Penetrating neck trauma is responsible for 5 to 10% of all trauma admissions. The operation of a chainsaw while inherently dangerous, rarely results in death (4,5).

The principal hazards associated with the operation of a chainsaw are the reactive forces associated with kickback, pushback, and pull-in. Kickback represents the most serious risk. It is the reactive force that occurs when the nose or tip of the guide bar, specifically, the upper quadrant of the tip, comes into contact with a solid object (6), causing the rotating chain to suddenly stop, thereby resulting in the saw moving backward and upward toward the operator (7). Studies have shown the speed of the kickback to be over 30 miles per hour; this allows the operators only 0.06 sec. to react (8). These actions may result in the saw striking the operator in the head or neck (8),

thus causing significant injuries (3). Nearly 25% of all chainsaw injuries were caused by a kickback (2).

Pushback occurs when the top of the chain engages a solid object that suddenly stops the chain's clockwise rotation. This reaction drives the chainsaw straight back toward the operator (9). In contrast, a pull-in occurs when the bottom of the chain suddenly stops, resulting in pulling the saw forward (9). All three forces result in the operator losing control of the saw.

The basic anatomy of a typical gasoline powered chainsaw is shown in Fig. 1. The hand guard is the bar in front of the hand grip to keep the left hand from slipping onto the chain. The bumper spikes are large spikes on the front of the engine housing that grips the wood and helps hold the saw in place during cutting. The throttle controls the speed of the chain. The chain brake is an internal feature designed to stop the chain in a fraction of a second if a kickback occurs. A safety tip guard covers the chain as it passes around the nose of the guide bar. It was designed to reduce kickback by keeping the chain from contacting anything at the guide bar tip (1). The arrows indicate the direction on the chain (Fig. 1).

Generally, chainsaw wounds are characterized by one main cut, with multiple smaller adjacent parallel cuts. These side-by-side parallel cuts vary in depth, resulting in tissue loss, surface abrasions, and incisions in the affected tissue (3). The chainsaw cuts a groove $\frac{1}{4}$ to $\frac{3}{8}$ of an inch wide by means of gouged-shaped teeth on each side of the chain. The cuts usually are straight but produce some tags of tissue in the wound (8). Chainsaw injuries of the head and neck typically are produced by the motion of the blade from below upward (8). The depth of the wound varies greatly depending on the duration and the force of the saw to the head and neck area. The width of the cuts varies with the lateral motion of the saw. The wound often is contaminated with wood chips, bark, oil, grease, bacteria, and fungi (8).

Chainsaw-related injuries and deaths have been cited in the medical literature (3,8,10,11). A non-scientific survey taken at the 1974 American College of Surgeons Clinical Congress reported six facial

¹ Allegheny County Coroner's Office, 542 Fourth Avenue, Pittsburgh, PA. Received 16 Aug. 2003; and in revised form 28 Oct. 2003; accepted 30 Oct. 2003; published 19 Feb. 2004.

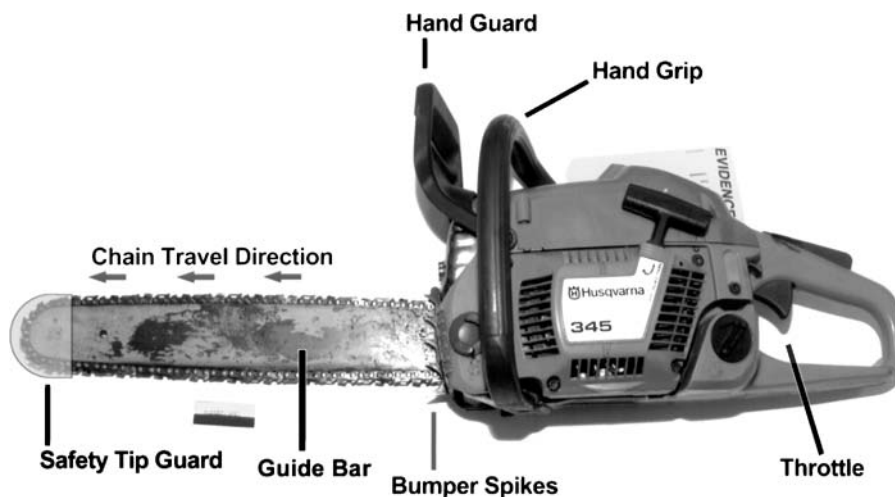


FIG. 1—The anatomy of a chainsaw.



FIG. 2—The undistributed death scene, chainsaw to the left of the decedent.

injuries resulting from the upward recoil (kickback) of the chainsaw, 138 other facial injuries, and two deaths associated with injuries received from a chainsaw (10). A 1979 in-depth review of 955 cases of chainsaw injuries showed that over 90% involved the extremities, less than 6% involved the head and neck, and approximately 1% involved the abdomen or trunk (3). Pratt cited a fatal case involving a 51-year-old male victim of a kickback that struck the victim's left lower neck just above the sternoclavicular notch and produced a vertical cut measuring 10×1.5 cm in the lower left neck region. The main cut was 2.5 cm deep and severed both the carotid and jugular vessels (8). In 1995, a 32-year-old man sustained a major cut to the neck from a chainsaw that kickbacked after hitting a knot in a branch (11). The examination of the victim's injury revealed that the sternocleidomastoid muscle was divided, the external and internal jugular veins were severed, the hyoid bone was fractured, and the thyroid cartilage was split. In this case, the saw was not equipped with a tip guard (11).

Injuries associated with the operation of a chainsaw have been well cited in the literature; however, the reporting of deaths

resulting from the operations of a chainsaw is rare. We present the circumstance of two fatal chainsaw accidents.

Case Reports

Case 1

During the morning hours of August 2002, an employee of a natural gas company was driving through a scrap yard. He noticed an unresponsive white male lying face down behind a mini-van with a chainsaw on the ground next to him (Fig. 2). Local police and the Allegheny County Coroner's Office were dispatched to the location. The van contained neatly stacked firewood with the rear hatch and both doors in the open position. The chainsaw, a gas-powered Craftsman 2114, was lying diagonally forward and to the left of the victim's head (Fig. 3). Examination of the decedent at the scene revealed several cuts of the face and upper left torso. The deepest cut was noted in the neck region. Very little blood was present at the scene, except directly under the victim's head. There



FIG. 3—A close-up of the decedent and the chainsaw.



FIG. 4—A lateral view of the head and neck.

were heavy storms the prior evening and during the morning of the discovery of the body. The decedent's clothing was wet. A large tree trunk with 2"-deep cuts was noted nearby.

A complete forensic autopsy was performed on this 49-year-old well-developed, white male weighing 160 lb and measuring 72 in. The body was cool to the touch and rigor mortis was well-developed and present in all the joints. All physical injuries were confined to the head/neck and chest regions. There were four roughly linear parallel abrasions over the left lateral cheek ranging from 3.5 to 6 cm in length (Fig. 4). A gaping cut of the left anterolateral and lateral neck measuring 11.5 × 4.5 cm was noted (Fig. 4). The cut was located 4 cm below the left ear and 28.5 cm below the top of the head. There were cuts of the skeletal muscles, thyroid cartilage (4 × 0.5 cm), and a transection of the left carotid artery. The lar-

ynx exhibited a cut involving the internal aspect, measuring 1.5 × 1.5 cm. Additional injuries were noted on the chest. There were multiple roughly linear red abrasions over the left anterior shoulder/left upper chest measuring from 1.5 to 14 cm in length and 0.2 to 2 cm in width (Fig. 5). The remaining external examination and the internal organs were unremarkable. The whole blood alcohol level was 0.07%. The cause of death was chainsaw wounds of the neck and head, and the manner was ruled accidental.

Case 2

During the morning hours of April 2003, the decedent was seen repairing a weed eater in the garage by his wife. At 10:30 a.m. his wife left their residence. Based on circumstantial evidence it



FIG. 5—An anterior view of the neck and upper chest.

appears that the individual was using a chainsaw to cut down a tree that was growing at an angle over the driveway. The tree was located approximately 15 ft. up a steep ($>45^\circ$) embankment (Fig. 6) approximately 100 ft. from the right side of his house. The tree limb that was being cut appeared to be near the neck or head level of the decedent. There were fresh boot prints in the dirt near the base of the tree and fresh slide marks coming downhill from this spot. The decedent was operating the chainsaw in front of himself and over his head. The decedent was left-handed; therefore, it was most likely that his left hand was on the trigger with the right hand on the bar. It appeared that the saw “kicked” and swung back, striking the decedent on the right side of the neck. After the injury, the decedent either fell, rolled, or slid down the hill and dropped or laid the chainsaw approximately 17 ft. from the top of the hill. The decedent then proceeded to walk approximately 100 ft. to the rear of the house through a shed and into the garage. No blood trail was seen from the tree to the garage, likely as a result of the decedent applying firm pressure to his wound. This is supported by the fact that his shirt and gloves were saturated with blood. A glove was located inside the garage near the door leading to the basement. A blood smear indicated that the decedent stumbled in the garage. Blood spots were seen on the garage floor going toward the basement door. The distance from the basement door and the bottom of the stairs was approximately 20 ft. Blood also was located in a sink approximately 8 ft. from the bottom of the stairs.

When the wife returned home, she found her husband on the basement floor surrounded by a large pool of blood. She removed the phone from his hand and called 911 at 1:27 p.m. A check of regional 911 center records showed that no phone call was placed from that residence before 1:27 p.m. by the wife. A police officer arrived at 1:30 p.m. and found the victim lying face down on the floor. The EMS arrived and pronounced him dead at 1:45 p.m. Safety glasses were located next to his head.

The chainsaw was a Husqvarna Model No 345 (Fig. 7). Model 345 was introduced in 1998 and comes standard with a low kick chain; however, a tip guard was not a standard feature. The saw had a chain length of 39.4 cm and weighed 6045 g (13.3 lb.). The chain is controlled by a throttle. The saw was found at the bottom

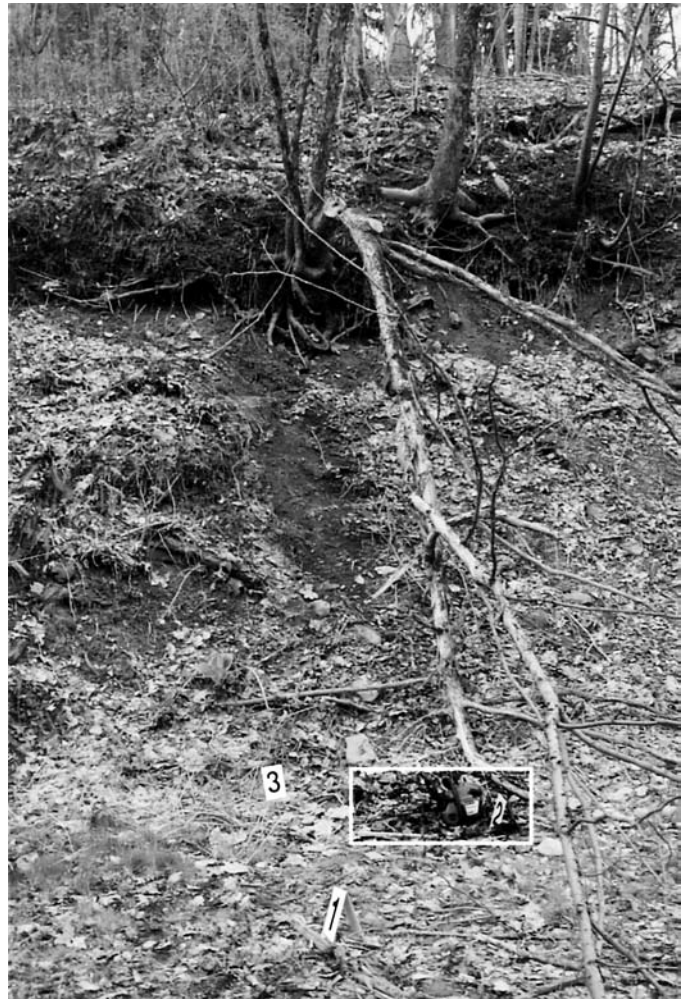


FIG. 6—The accident scene. The box shows the location of the chainsaw.

Anatomically, however, the horizontal cut/abrasions seen in this case are atypical and inconsistent with those described in the literature (7–9). Typically, the injuries associated with a chainsaw have been found to be vertical or nearly vertical wounds (7–9) located in the neck region. Kickback usually results in these types of wounds. In this case, the decedent suffered horizontal wounds to the neck. After a thorough review of all the facts, the preponderance of the evidence supported the ruling of the manner of death as accidental. This was based on the lack of a chainsaw safety device.

After 1985, all manufactured chainsaws were equipped with antikickback features (6) such as chain brakes, throttle interlock, and hand guards (12). Modern chainsaws also are being equipped with the following safety features such as: spark arrest and vibration reduction system, designed to minimize the inherent dangers of the chainsaw (1,3). In addition, tip guards can be added to increase safety. Recent improvements in the design of chainsaws have led to the production of low kickback consumer replacement chains that reduce chainsaw kickback. The USCPSC strongly recommends that individuals purchasing a new chainsaw should make certain it is equipped with a low kickback chain. Older chainsaws should be replaced with the new low kickback type. Generally, there is a low kickback replacement chain for virtually every model of chainsaw. According to the manufacturer of Husqvarna chainsaws, their model was equipped with a low kickback chain. These safety features, however, do not ensure that the saw is completely kickback safe. This is illustrated by the second case.

In the second case, the operator was using a modern Husqvarna Model 345 chainsaw that he had purchased within the last year. The decedent was using a saw equipped with safety features such as chain breaks, hand guards, and chain catcher. However, he engaged in several risky procedures such as operating a saw with poor footing, placing a saw over his head and failing to install a tip guard. This resulted in a substantially increased risk of injury.

The risks of kickback can be reduced in a number of ways. The operator must hold the saw firmly with both hands and grip the top handle with the thumb wrapped tightly around the handle. The operator must make certain the saw is equipped with a chain-brake and kickback guard, and a tip guard should be installed if not present. The operator should watch for branches that can pinch the chain and take care to prevent the chain from being pinched while cutting a log. It is recommended that the operator saw with the lower part of the bar, close to the bumper, not on top near the nose (1). In other words, when cutting a tree on the ground, the saw should be positioned with the tree close to the bumper (motor housing), cutting with the first half of the bottom part of the bar (1). It is important to maintain a high saw speed when entering or leaving a cut in the wood and to keep the chain sharp. It is recommended that a chainsaw operator avoid reaching above shoulder height to cut, because this substantially reduces the amount of control an operator has

over the saw (12). Additionally, the chain is very close to the face in this position.

The most important safety recommendation for reducing kickback injuries is to use a chainsaw equipped with a tip guard. When in place, a tip guard makes it virtually impossible for the saw to be thrown up into the air. It also is important to keep the extended arm straight while using the saw, because this position keeps the saw from being thrown back toward the face during kickback.

In addition, when operating a chainsaw, safety measures such as wearing personal protective equipment such as eye and ear protection and a hard hat can reduce the chance of injury.

Acknowledgment

Special thanks to Marty Coyne and Lisa Leon for their assistance in preparing the photographs in this manuscript.

References

1. Baker DE, Day D. Chain saw safety (1993 October). University Extension, University of Missouri Columbia.
2. Commission approves mandatory approach toward reducing chainsaw injuries from "kickback;" <http://www.cpsc.gov/CPSC/PUB/PREREL/prhtml180/80023.html> 8/20/02 (accessed August 20, 2002).
3. Pratt LW. What you should know about chainsaw injuries. *Am Coll Surg* 1979;27–34.
4. Chainsaw injury statistics. Data from U.S. Consumer Products Safety Commission, <http://www.elvex.com.facts08.htm> (accessed May 2, 2003).
5. Demetriades D, Asensio JA, Velmahos G, Thal E. Complex problems in penetrating neck trauma. *Surg Clin North Am* 1996;6(4):661–83.
6. Lauren W. Farm bureau safety program-chainsaw safety. National ag safety database. 2002, <http://www.cdc.gov/nasd/docs/d000901.html>. (accessed January 31, 2003).
7. Cyr DL. Chainsaw safety. National ag safety database. April 2002, <http://www.cdc.gov/nasd/docs/d00090-d001000/d000926/d000926.html>. (accessed May 2, 2003).
8. Pratt LW. Chainsaw injuries of the head and neck. *Ear, Nose Throat J* 1985;64:215–22.
9. Marks, RB. Chainsaw injury of the maxillofacial region. *J Oral Maxillofac Surg* 1986;44:240–3. [\[PubMed\]](#)
10. Macfarland I, Harry N. Severe chainsaw injuries. *Aust N Z J Surg* 1977;47:183–5. [\[PubMed\]](#)
11. Brown AFT. Chainsaw penetrating neck injury. *J Accid Emerg Med* 1995;12:134–7. [\[PubMed\]](#)
12. Hetzel GH, Butler J. Safety with chainsaws. 1996, <http://www.cdc.gov/nasd/docs/d001201-d001300/d0001289/d0001289.html> (accessed August 20, 2002).

Additional information and reprint requests:

Steven A Koehler, Ph.D.
Allegheny County Coroner's Office
542 Fourth Avenue
Pittsburgh, PA 15219
(412) 350-4819
(412) 350-4899
E-mail: skoehler@county.allegheny.pa.us