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G28 Electrocutation by Arcing: A Non Fatal Case Study

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The goal of this presentation is to report an unusual case of electrocution by “arcing” from overhead high-voltage power lines.

This presentation will impact the forensic community and humanity in general, as it provides information about a case of accidental electrocution during working activities that occurred due to dielectric breakdown, so that the current from a high-tension overhead cable (30000V) ran down an aluminium pole grasped by a farmer who was thrashing an olive tree.

An ancient rural tradition is called “battitura”, whereby farmers in South Italy thrash the branches of the olive trees with a pole or stick, causing the olives to drop into sheets placed under the trees. This is a case of a 25-year-old Caucasian male, who suddenly collapsed while he was thrashing an olive tree in front of him, using an aluminium pole 2 metres long. The olive tree was dangerously situated underneath (but at no less than 7 meters distance) a high-voltage power cable. These cables transmit very high voltages (30000-60000V) and in Italy they are built at least 10 metres above ground level, thus it should not be possible to come in contact with the power lines. The patient underwent loss of consciousness and bleeding from the mouth. He was taken to the ER where, on examination for injuries, he was found to have “electrical burns” with peculiar pits on the hands and on the soles of the feet. He developed cardiac arrhythmia with high levels of CPK and CK, requiring electrical defibrillation. Dental radiography and CT scan demonstrated fractures of the mandibular symphysis and condyles, along with the left tubercle of the upper jaw, with no evidence of external wounds. Many teeth were injured, with avulsion of the first and second incisors of the upper right jaw (11, 12), the first incisor of the upper left jaw (21), the second pre-molar of the lower right jaw (45), coronal fractures of the first pre-molar of the upper right jaw (14), the second molar of the lower left jaw (37), and the first pre-molar of the lower right jaw (44). At the moment of electrocution, the worker was wearing shoes that were sold as safety footwear, and inspection revealed characteristic burn defects on the sole, which corresponded to the electrical burns of the feet. Therefore, the safety shoes did not prove effective.

A review of the literature reveals few data or case reports specifically addressing the issue of electrocution by arcing, with no direct contact with the wire, especially at so great a distance between the energy source and the victim. In this case the farmer was standing vertically below the power lines in front of the olive tree, grasping the aluminium pole. There was a gap of about 6-7 metres from the upper end of the pole to the high-voltage power lines. It has been reported that a sparking gap larger than 50 cm is sufficient to transmit a voltage of about 30-40000V. However, in the reported case there were behavioral and environmental factors, equally distributed, that can explain the near fatal accident. Firstly, in high voltage accidents it is known that direct contact with the wire is not necessary because when the body is near the voltage lines an electric arc may jump from the lines to the body. Moreover, the resistance opposed by the skin and the air has an important role in electrical conduction. In particular, the humid weather present at the time of the farmer's electrocution, a cloudy and drizzling morning at the end of November, boosted the electric current discharge. Another important environmental factor is the part played by the tree, known to be an excellent energy conductor, which in this case was growing just beneath the cable. This situation allowed the accumulation of energy on every branch, thus representing a potential risk of electrocution in itself. In addition, there were some behavioral aspects to be considered. The tool used by the victim for thrashing is ideal for the conduction of electric power. Aluminium or graphite, used in staff or pole manufacture, both have superconductor qualities. The current flowing from the metal staff through the hands would probably not have been able to electrocute the farmer if he had been wearing good quality safety shoes. Finally, the great human error was that of working under a tree situated so close beneath the high voltage power lines. This is commonly a great hazard for workers, especially those in industrial fields, as this is one of the most common reasons for accidents at the workplace in Italy. Each one of the above described factors likely contributed to dielectric breakdown and conduction of the current from the high voltage power lines to the end of the metal staff and then through the farmer's body. Identification of all behavioral and environmental causative factors may lead to future adjustments in design, to reduce the risk of electrocution in working environments. Photographic documentation illustrates the results of the case investigation.

Electrocution, Arcing, Accident at Work