



D12 A Critical Assessment of Cutting — Slicing, Stabbing, Sawing, and Chopping: The Mechanisms of Separating and Penetrating Biomaterials and the Relevance of Sharpness

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The goal of this presentation is to introduce the four main categories of using edged or pointed instruments in forensic cases: slicing, stabbing, sawing, and chopping. Attendees will better understand the way in which biomaterials are divided or invaded by these implements and how this relates to implement edge and tip sharpness.

This presentation will impact the forensic science community by enhancing the competence of forensic scientists and engineers in understanding how each of these four categories of human tissue insult occurs with the various implements retrieved from a crime scene.

Knives, saws, axes, machetes, and other implements are often used in violent crime. Specifically, knives are often used in stabbing attacks in which the depth of the wound is long compared to the injury on the skin or in slashing attacks in which the length of wound on the skin is long, but the depth of the wound into the body is relatively shallow. Saws and axes may be used in dismemberment cases. Other implements (screwdrivers, chisels, etc.) are also used in violent attacks, and the challenge for the forensic scientist or engineer is to relate the particular implement used to the mechanism by which the injury is inflicted. The sharpness, or degree of pointedness, of these implements is a key variable in helping make the link between the implement and the injury. Thus, the goal of this presentation is to define the four different methods in which material can be separated, namely by slicing (or slashing), stabbing, sawing, and chopping, so that the importance of the key features of the implement being used can be investigated and the necessary or controlling forces understood. This presentation will help attendees understand the way in which biomaterials are separated by cutting and how this relates to the sharpness of the implement used.

In cases of slashing, the knife is usually used in a slicing mode in which the blade of the knife is drawn across the body. The lowest cutting force is required when a slice-push action is used. Often in slashing, the blade is presented “obliquely” to the surface being cut.

In stabbing attacks, the sharpness of the tip is important for initial penetration with sharper tips reducing the amount of force required. Once the implement has penetrated clothing or skin, the sharpness of the blade edge is also important for estimation of additional penetration depth. Another parameter that influences the amount of force required for cutting is the friction between the blade and the material being cut. The cutting forces are reduced when the size of the blade is smaller or the material is tougher.

Sawing typically uses a reciprocating motion that engages the series of narrow cutting edges typically found on each tooth of the saw. In contrast to knives, saw blades have parallel sides. Saw teeth are “set,” which means the cut is slightly wider than the thickness of the blade; this helps prevent “binding” of the saw blade in the material being cut and diminution (or cessation) of the essential reciprocating motion. Saws are designed with different teeth profiles to optimally cut different materials; however, saws used in crimes are usually those of convenience, not specific design.

Chopping is typically performed by wedge-shaped implements such as axes and machetes that are designed to cut through materials by a single forceful impact rather than a steady or reciprocating push or pull. The force delivered by a chopping impact is generally of greater magnitude than the force delivered by a push. The muscles of the arm and shoulder contribute to accelerating the fall of the implement and add to the total force of impact above what would be obtained by simple free-fall. The material is divided into two parts by driving the wedge-shaped chopping implement into the material, and a crack (or split) forms at the tip of the wedge. The wedge angle of the implement, along with implement weight, velocity, and material resistance, influences the ability to form the crack. The principle motion of implements used for chopping are perpendicular to the cutting edge of the implement.

This presentation will discuss the ways in which different implements cut through or penetrate materials and identify the important characteristics of the blades and edges that are key factors in controlling the separation of these materials.

Cutting, Sharpness, Penetration