D23 Toward a Practical Standard for Quantification of the Edge and Tip Sharpness of Knives and Other Sharp Weapons

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Learning Overview: After attending this presentation, attendees will understand how to assess the sharpness of knives and other implements on an objective scale and assess whether or not they would easily penetrate skin in a stabbing or slashing attack.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by allowing pathologists and other forensic science professionals to objectively assess the penetration ability of weapons in a quantitative and repeatable way that changes the assessment from an opinion-based assessment to an objectively based assessment.

Since the publication of the National Academies' Report on *Strengthening Forensic Science in the United States: A Path Forward* in 2009, there has been a strong call internationally for the development of relevant high-quality forensic standards.[1] In addition, many courts examine testimony based on the *Daubert* standard that requires experts to understand the basic theory, any standards pertaining to the experimental technique, the sources and likely magnitudes of error, as well as a number of other criteria aimed at improving the quality of forensic evidence provided to the courts.

Sharp instruments such as knives are commonly used in violent crime, including homicides, street-based and armed robberies, sexual assaults, and terrorism, particularly in those countries where guns are not common. Previous work has shown that forces generated by volunteers stabbing skin simulants and porcine samples with knives and screwdrivers generate a range of results. Men generate approximately twice the force of women. Forces generated by volunteers who were asked to stab with mild, moderate, and severe forces were in almost all cases significantly greater than the force required to penetrate skin for stabbing with sharp knives. The conclusion from this work was that in order to understand a stabbing attack, it is important to understand the tip radius of the weapon, the sex of the assailant, the minimal force for penetration, and whether the force required for penetration is greater than that which can be generated by the assailant.

The work in this presentation is aimed at quantifying the sharpness of the edge and tip of a knife by combining separate industry-standard approaches. This is then related to the ability of the knife to penetrate skin and clothing in a reproducible way that can be readily used by the forensic community.

Edge sharpness was measured for a range of knives using a Brubacher edge sharpness test. This study measured the edge sharpness at several different points on the blade profile, from near the tip to toward the hilt of the blade. This study also performed reproducibility tests to understand the level of scatter in the results.

Tip sharpness was assessed by using a series of rectangular openings and assessing the depth to which the tip penetrates. If the tip penetrates an opening to sufficient depth, an indicator light will illuminate to allow the pathologist or scientist to record the result. A blade tip profile factor is also introduced to generate an assessment of the ability of a knife to penetrate.

The combination of the tests is then collated to allow the pathologist/scientist to assess the implement as being very sharp, sharp, moderate, blunt, or very blunt. This can then be used to quantitively support the subjective scale they have chosen to use when proposing the minimal force that may have been required for the knife to penetrate the body.

The proposed tests will allow forensic practitioners to develop a common understanding of knife/implement sharpness that will assist the courts in having a consistent approach to understanding the sharpness of knives and other implements used in violent crime without the need for more complex laboratory weapon testing.

Reference(s):

1. National Research Council (NRC), Committee on Identifying the Needs of the Forensic Science Community. (2009). *Strengthening Forensic Science in the United States: A Path Forward.* Washington, DC: The National Academies Press.

Sharpness, Knives, Quantification