D14 Quantification of Forces Generated by Volunteers in Stabbing Trials

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After attending this presentation, attendees will understand the different levels of force that can be generated by volunteers stabbing a dynamometer. Attendees will appreciate the differing levels of force generated by men and women and will understand how these stabbing forces relate to the force necessary to penetrate the skin.

This presentation will impact the forensic science community by showing how engineering measurements of force can be used by forensic pathologists to help interpret the levels of force required in stabbing attacks.

Stabbing is the most common way of committing murder in the United Kingdom. The Crime Survey for England and Wales released in July 2015 revealed that the police recorded 26,370 offenses involving a knife or sharp instrument, which was a 2% increase for the year ending March 2015 over the previous year. Most of the increase was in the category of "assault with injury and assault with intent to cause serious harm," which was up 13%, but this was partially offset by a 14% decrease in robbery offenses using knives or sharp weapons. Knives and sharp weapons are therefore a major crime problem in the United Kingdom and other countries where guns are not readily available.

Some of the key forensic questions that are relevant to stabbing are how much force is required to create a particular stab wound and, in particular, how much force does a person stabbing with a particular instrument generate and how does this relate to everyday actions that can be communicated to juries.

In order to address these questions, this presentation reports on the development of a dynamometer for the measurement of force during stabbing with various implements into pork skin (a human skin analogue) or a skin simulant system. The dynamometer consists of two aluminum plates that are instrumented by force cells. The peak force generated by male and female volunteers was recorded for a range of scenarios using different implements and with different stabbing methods.

To analyze the data collected from the dynamometer, mixed effects linear regression was used. Since the experiment involved collecting multiple independent and continuous variables, mixed effects linear regression allows statistical analyses to be performed to understand whether the different variables had a statistically significant influence on the recorded results. Mixed effects models allow the use of both fixed and random effects in which the variables are inter-dependent rather than independent. This means that simple linear regression methods are inappropriate.

The results of these investigations demonstrated that men typically generate twice as much force as women when stabbing and that in the majority of cases, people generate higher forces with their dominant hand. The force generated in stabbing events is much greater than that required for penetration by a knife and, in almost all cases, volunteers were able to stab and penetrate both pork and the skin simulant system with a small amount of force.

In conclusion, the key issue in deciding whether a weapon creates a sharp force injury (stab wound) during a stabbing attack is whether the threshold force for penetration with that particular implement is met; therefore, it is critical to understand whether or not the tip of the weapon permits penetration. If the weapon penetration force is less than the force generated by stabbing, the victim's skin and underlying fat and muscle will always be penetrated.

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Figure 1: A volunteer performing a stab into the dynamometer. Force data is taken from three load cells and the system was calibrated with known applied forces to ensure the peak forces that were recorded were accurate.

Stab, Force, Penetration

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