C43 Design and Development of a Dynamometer for Quantifying Force Related to Stabbings

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The goal of this presentation is to show how dynamometers have a role to play in relating force levels in stabbings to injuries.

This presentation will impact the forensic science community by presenting the design and novel use of a dynamometer that can be used to relate the forces used in stabbings to common actions such as a punch or push. The ultimate goal is to help those in the legal system (judges/barristers/jurors) understand how a force required for stabbing relates to a real life situation, i.e., does the force equate to a hard punch or a slap? The paper discusses whether a scale can be developed that can allow a better appreciation of how engineering data relates to common perceptions about level of force.

In the United Kingdom, murder by stabbing is the most common form of murder. Previously, the forces required for stabbing with knives were considered and shown that the tip radius is important for defining the sharpness of the stabbing implement. Recent work has showed that for blunter instruments such as screwdrivers, the cross-sectional area is important for determining the forces required for penetrating a silicone rubber/foam skin analogue. More recent work has considered how much force is required to penetrate a skin simulant with broken glass bottles and also how much the victim's clothing influences the force required for penetration with knives. Work so far has focused on the force required for penetration of a skin simulant in an effort to identify the most important factors in relation to penetration. The mechanism of knife penetration is controlled initially by the tip sharpness as a knife penetrates the skin, once penetration has occurred, the edge sharpness becomes important for further penetration. Figure 1 shows the sequence of events as a knife penetrates a foam block. In A, the knife is just at the point of contact with the foam; in B, the foam is deflecting elastically but the foam is not penetrated; and, C shows a knife where the tip has penetrated the foam block. This current work furthers the understanding of knife wounding by focusing on the quantification of forces involved in 'real life' stab events.

A series of experiments were conducted using a skin simulant and a dynamometer. A series of everyday actions (such as a push) were carried out and also a series of stabbing actions (such as a thrust or overhand) using a purpose built dynamometer, by a group of volunteers of varying body types, ages, etc. As contact is made with the skin simulant the dynamometer records the load. For the everyday actions the maximum force is recorded during the impact. We will take similar data for the knife penetrating the skin simulant. Previously, stabbing simulations have been conducted using instrumented knives, these have the disadvantage that the knife has been modified to include the instrumentation which makes it more difficult for the person stabbing to use a natural action. In this work, the instrumentation is in the dynamometer and the knife was as manufactured without the additional encumbrance of the instrumentation. This should provide more realistic data to be recorded.

The results should provide quantified force data for both everyday actions and stabbing by volunteers that are representative of the population. These results allow a comparison of forces and are the first stage in an effort to compose a scale that could be used by forensic practitioners in court to explain the forces involved in stabbings to jurors more clearly.

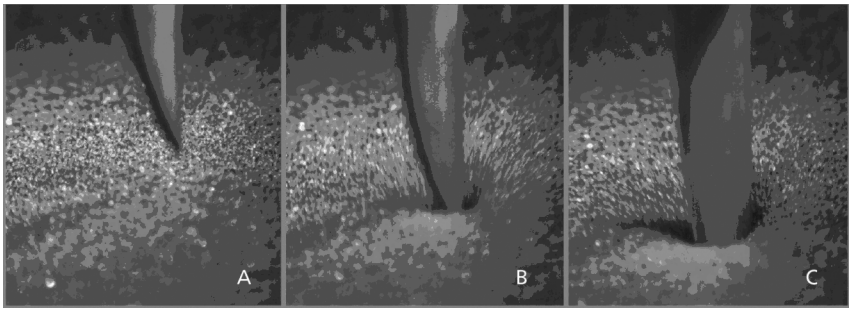

Figure 1: The sequence of events in a knife penetrating a foam block. A shows the tip as it first contacts the foam. B shows elastic deformation of the foam block. C shows both elastic deformation of the block but also the knife penetrating the foam.

Stabbing, Force, Knife

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