C20 Forces Required for Stabbing Through a Variety of Clothing Types

Gary Nolan, MSc*, University of Leicester, University Road, Leicester, LE1 7RH, UNITED KINGDOM; Sarah V. Hainsworth, Beng, PhD, University of Leicester, Department of Engineering, Leicester, LE1 7RH, UNITED KINGDOM; and Guy N. Rutty, MD, Forensic Pathology Unit, University of Leicester, Robert Kilpatrick Bldg, Leicester, LE2 7LX, UNITED KINGDOM

The goal of this presentation is to show how single and multiple layers of fabric influence the force required for stabbing. The presentation will show that for a variety of blunt and sharp weapons, the force required for penetration can be changed significantly depending upon the items of clothing worn. The educational message is that the clothing should be given consideration when estimating the force required for a stabbing incident.

This paper will influence the way in which forensic evidence related to knife crime is interpreted. This presentation will impact the forensic science community by demonstrating how often, the effect of clothing is disregarded but depending on the type and number of layers worn, the forces required for knife penetration can change significantly.

In the United Kingdom, murder by stabbing is the most common form of homicide. Previously, the forces required for stabbing with knives have been considered and shown that the tip radius is important for defining the sharpness of the stabbing implement. Further, recent work has shown 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. A related factor for

understanding the forces required for stabbing is to consider how much the victims clothing influences the results. Thus, as part of a program of work to determine the forces required for stabbing with sharp and blunt implements, the effect of clothing in changing the forces required for penetration with a weapon were considered. Often, the effect of clothing is considered to have a minimal effect on the forces required for penetration. However, the forces required can be significantly altered, particularly when multiple layers of clothing are worn. A series of experiments have been conducted using a silicone rubber/foam skin simulant and a Materials Testing System. The knife is pressed into a skin simulant block and the load and displacement curve recorded. A load drop is seen when penetration of the skin simulant occurs. This has allowed the maximum force for penetration with single and multiple layers of clothing to be established. A range of clothing materials including t-shirts, cotton shirts, jeans, jumpers, and leather jackets have been tested both alone and also with layering as is typical of the clothing worn by victims in knife attacks. As an example, figure 1a shows an example of a load-displacement curve for a sharp knife into a skin simulant test block. The point at which the knife penetrates the silicone skin is arrowed and occurs at 15N. Figure 1b shows a similar load- displacement curve for a test with a three layer clothing system, a plain cotton T-shirt with two sweatshirt layers on top. The penetration force is again arrowed and it can be seen that the force required for penetration of the clothing system has increased to over 40N for the same knife.

The results show that the victims clothing should be considered in trying to answer the question as to degree of force involved in a particular stabbing incident.
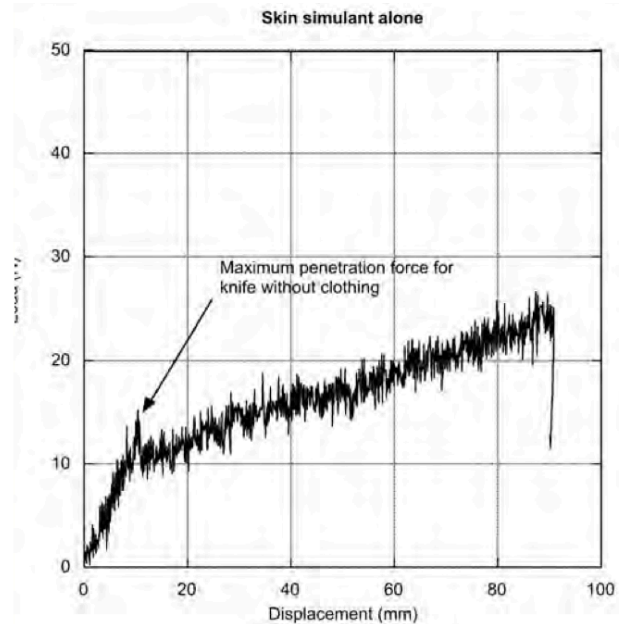
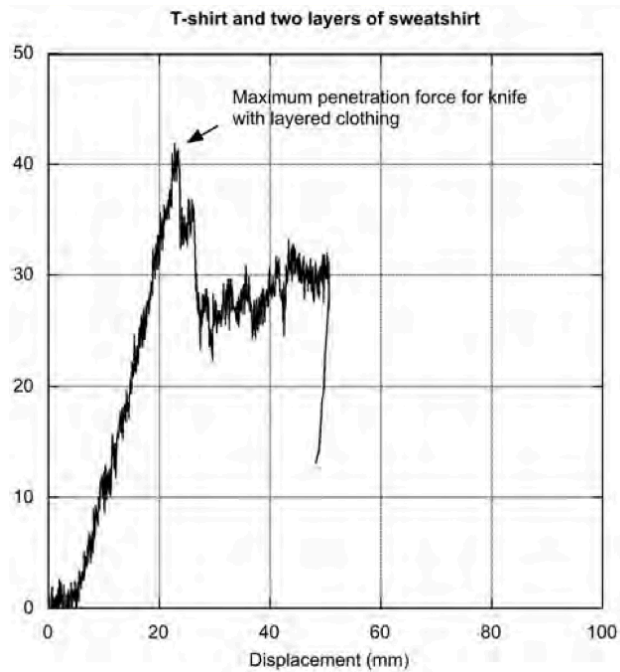Fiure 1a: Load-displacement curve for a sharp knife penetrating a skin simulant test block.

Figure 1b: Load-displacement for knife penetrating through three layers of clothing into a skin simulant test block.

Knife, Stabbing, Penetration Force