

PRELIMINARY COMPARISON OF PROJECTILE SIZE AND MATERIAL FOR PENETRATION THRESHOLDS IN PORCINE LEG TISSUE

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ABSTRACT

Improvised explosive devices are ideal weapons for terrorist groups due to the low-level of sophistication they require to build. Many readily available objects can be used – such as rocks, nails, and glass – and can cause all types of injuries to those affected by the blast. These injuries are common in modern combat and account for a large majority of blast-related injuries experienced by soldiers and civilians. The current study focuses on how penetration threshold varies when projectiles of different sizes (1/16”, 3/16”, and 3/8”) and material (stainless steel, silicon nitride, and Delrin plastic) impact post-mortem porcine legs. Results have shown that both projectile size and material are significant variables. A larger projectile size was shown to penetrate at lower velocities compared to smaller projectile sizes. Materials with higher density are shown to penetrate at lower velocities compared to lower densities.

Keywords: IED, penetration threshold, porcine, secondary blast injury, projectile

INTRODUCTION

Combat injuries have occurred for centuries during all types of war and have evolved with the times – modern combat injuries are more commonly blast injuries as opposed to gunshot wounds [1]. All types of blast injuries – from primary to quaternary – can occur from an improvised explosive device (IED) detonation, which accounts for about two-thirds of all combat injuries [2]. However, soldiers are no longer the only people affected by IEDs, more and more often civilians are exposed to the dangers and difficulties of blast injuries [3], [4]. Many studies have shown that these types of events have greatly increased over time all over the world, specifically during Operation Iraqi Freedom and Operation Enduring Freedom in the Eastern hemisphere [5]–[8]. Increased prevalence of IEDs can be traced to their ability to be made from easily obtainable materials, their simplistic design, and the magnitude of their destructive capabilities [5], [7]. IEDs become increasingly lethal with the addition of various materials including nails, glass, screws, rocks, ball bearings, and other debris into the bomb [5], [7], [9]–[11]. The addition of these objects exponentially increases the radius of the blast zone – as the objects become energized, flying projectiles with great velocities – and increases the risk of secondary blast injuries in people who may otherwise not be affected by the blast wave [4], [9], [12]. Secondary blast injuries are considered ballistic wounds caused by flying fragments, which include traumatic amputations, laceration, and penetrating injuries; these are the leading cause of explosion-related injuries and death [5], [8], [13].