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Ricochet of AK bullets (7.62 MM X 39 MM) on glazed ceramic tiles: An empirical study in support of shooting incident reconstructions

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ABSTRACT

Indoor environments provide numerous hard surfaces and nearby objects which facilitate the shots fired to ricochet off and hit victims. Out of many surface types, ceramic tile surfaces are considered to be one of the most commonly available and encountered surface type in indoor shootings. However, no studies had attempted to understand the ricochet behaviour and surface evidence of ceramic tiles with any bullet type. This study explores the ricochet behaviour of one of the most commonly reported bullet type in recent shooting incidents; AK bullets (7.62 mm × 39 mm/ M43) on two glazed ceramic tile samples used for indoor walls and flooring. The study's results present the critical angles of glazed ceramic floor and wall tile samples along with a few significant and currently not reported ricochet-surface mark characteristics with greater forensic significance for use in AK gun-related ricochet investigations. This study further emphasises the need for case-by-case empirical approaches to understanding the ricochet behaviour of different bullet-target combinations during ricochet investigations. The study also opens up a new research area to explore whether the observed results are common to steel core AK bullets or common to other ammunition types and tile surfaces with different compositions.

1. Introduction

Bullet ricochet is a common occurrence in indoor shooting incidents. Due to the close proximity of different hard objects, shots fired during indoor shooting incidents have a greater potential to miss the intended targets and ricochet off [4,17,19]. These ricocheting bullets sometimes cause deaths or injuries to individuals in the scenes who are related to the incidents or not. Consequently, investigations of bullet ricochet incidents are challenging and demand special attention due to the complex and indirect nature of the occurrence.

Bullet ricochet incidents usually occur instantly and unexpectedly during the rapid unfolding of the series of events in shooting incidents. Therefore, on most occasions, eyewitnesses are not able to correctly explain what exactly happened [8]. These different and unreliable eyewitness accounts can greatly mislead investigations as well as judges and juries during the subsequent court hearings. Therefore, special emphasis has always been given in bullet ricochet incidents to correctly reconstruct the events using the available physical evidence in the scene. Science-based scene reconstruction is considered the only independent witness to an incident which also allows evaluation of different eyewitness accounts for accuracy [8]. Existing literature highlights many such instances where reconstruction of ricochet related investigations unrevealed what exactly occurred and provided justice to the parties involved [14,21,25].

Ricochet analysis is one such scientific approach employed during scene reconstruction of incidents involving bullet ricochets. Ricochet analysis aims to understand the pre- and post-trajectories of ricocheted bullets, or to establish the possibilities of a bullet to ricochet during an incident for the given conditions of the case. For this purpose, investigators refer to theoretical knowledge on the bullet ricochet phenomena in the existing literature and empirical results of ricochet-related scientific studies, along with the physical evidence found in a scene such as ricochet marks, trace evidence, recovered bullets, wounds from ricocheted bullets etc. However, recent studies have highlighted that the ricochet behaviour of different bullet-target combinations is affected by an array of factors leading to their unique behavioural patterns and evidence productions [8,16–18]), therefore, empirical results are considered the most

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