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Preliminary assessment of IED-related blast and fragmentation effects in ballistic gelatin

Luís Marques Fernandes [1,2,3], Beatriz Silva-Lopes [1,2], Manuela Oliveira [1,2,3,*] and Albina Dolores Resende [1,4,5]

[1] Associate Laboratory i4HB – Institute for Health and Bioeconomy, University Institute of Health Sciences - CESPU, 4585-116 Gandra, Portugal.
[2] UCIBIO – Applied Molecular Biosciences Unit, Forensics and Biomedical Sciences Research Laboratory, University Institute of Health Sciences (1H-TOXRUN, IUCS-CESPU), 4585-116 Gandra, Portugal.
[3] OSI – Homeland Security Observatory, 4585-116 Gandra, Portugal
[4] UCIBIO – Applied Molecular Biosciences Unit, Toxicologic Pathology Research Laboratory, University Institute of Health Sciences (1H-TOXRUN, IUCS-CESPU), 4585-116 Gandra, Portugal
[5] UNIPRO – Oral Pathology and Rehabilitation Research Unit, University Institute of Health Sciences, CESPU, CRL, 4585-116 Gandra, Portugal

* Correspondence: maria.oliveira@iucs.cespu.pt

Abstract

Background: Ballistic gelatin (BG) is widely used as a soft tissue surrogate in forensic and biomedical research, particularly in studies of projectile-related trauma, enabling controlled analysis of penetration, cavitation, and energy transfer [1–3]. Although its behaviour under ballistic impact is well characterised, its application to blast- and fragmentation-related phenomena remains underexplored. Recent studies have examined fragment–gelatin interactions under controlled conditions, emphasising energy transfer and cavity formation in trauma modelling; however, approaches approximating improvised explosive device (IED) scenarios remain limited. **Objective:** To assess whether standardised BG can serve as a preliminary model for qualitative evaluation of shrapnel-related trauma under different detonation conditions, focusing on cavity morphology, penetration characteristics, fragment dispersion, and structural integrity. **Methods:** Blocks of 10% ballistic gelatin (Bloom 250A) were prepared following Jussila's protocol and validated using established calibration procedures [3,4]. Three configurations were tested: (i) exposure to fragments from a simulated defensive grenade containing metallic spheres; (ii) placement of a commercial electric detonator adjacent to the BG surface; and (iii) placement of the same detonator within the gelatin block. Post-detonation effects were documented photographically and qualitatively assessed for cavity morphology, penetration depth, fragment distribution, and matrix preservation. **Results:** The simulated grenade produced marked surface disruption and wide dispersion of metallic fragments. Surface detonations generated shallow cavities with limited fragment retention. Internal detonations resulted in deeper, more centralised cavities and greater structural disruption. Distinct and reproducible patterns of matrix alteration were observed across configurations. **Conclusions:** These preliminary assays demonstrate the feasibility of BG in blast-related experimental settings and its ability to preserve sufficient structural integrity for comparative qualitative analysis of detonation patterns. Although no quantitative measurements or statistical analysis were performed, the findings support its use as an initial model for studying IED-related blast and fragmentation effects under controlled conditions, with potential forensic and experimental applications. Further work will incorporate quantitative metrics and high-speed imaging.

Keywords: ballistic gelatin; blast injury; improvised explosive devices (IEDs); shrapnel dispersion; wound ballistics

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