

Lethal Gaps: Anatomic Distribution of Fatal Torso Injuries in Shielded Combatants During the "Swords of Iron" War

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Introduction

- Penetrating thoracoabdominal trauma remains a major cause of combat mortality. Although modern body armor protects the central thorax, fatal injuries may shift toward unshielded regions.
- Experience from the "Swords of Iron" War suggests that injury distribution is strongly influenced by current armor geometry.
- This study used post-mortem analysis to evaluate body-armor protection and identify lethal gaps where fatal injuries cluster and hemorrhage control is limited.

Methods

- A retrospective analysis of forensic post-mortem reports, images, and CT scans from the "Swords of Iron" War (2023-2024) was conducted.
- The dataset included 50 fatality events and 109 penetrating injuries, averaging 2.2 injuries per event. Injury locations were mapped by anatomical region and compared with a 50th-percentile male anthropometric model to estimate expected surface-area distribution.
- Because of incomplete documentation, data cleaning was required. The final surface-area analysis included 91 torso injuries after excluding records with unspecified locations.
- Pearson's chi-square test was used to assess whether injury distribution was random or associated with armor geometry.

Results

- Most injuries were gunshot wounds (51.4%) or fragmentation injuries (47.7%), and 85.3% of casualties wore ceramic body armor.
- Torso injury distribution differed significantly from that expected by surface area ($p=0.0041$). The largest excess was in the lower abdomen, with 14 observed injuries versus 6.7 expected.
- Additional injury clusters occurred in the upper back (20.9%), lower back (18.7%), and upper abdomen (9.9%). These areas represent potential lethal gaps where non-compressible hemorrhage may occur, and standard tourniquets cannot be applied.

Torso Region	Observed Count (%)	Expected Count (%)	2 χ Contribution	Tactical Interpretation
Lower Abdomen	14 (15.4%)	6.73 (7.4%)	7.84	Lethal Gap: Injuries >2x higher than expected; unprotected junctional zone below front plate.
Upper Abdomen	9 (9.9%)	6.73 (7.4%)	0.76	Vulnerable Margin: Slight elevation; partial coverage depending on posture and vest movement.
Chest	32 (35.2%)	25.48 (28%)	1.67	High Threat Zone: High absolute frequency; primary plate zone facing direct frontal engagements.
Upper Back	19 (20.9%)	25.48 (28%)	1.65	Protected Zone: Below expectation; shielded effectively by posterior plate and tactical load.
Lower Back	17 (18.7%)	26.48 (29.1%)	3.39	Protected Zone: Below expectation; benefits from posterior plates and low-back structural overlap.
Total	91 (100%)	91 (100%)	15.31	Overall Model Fit: Pearson $\chi^2 = 15.31$, $df = 4$, $p = 0.0041$ (Highly Significant).

Table 1: Observed vs. Surface-Area Expected Torso Injuries

Conclusions

- Torso injury distribution was non-random and reflected limitations in current rigid body armor.
- Fatal injuries clustered in junctional and lateral gap zones, identifying areas where armor geometry or supplemental protection may require improvement.
- These findings may also help clinicians prioritize rapid examination of high-risk regions during the primary survey of shielded casualties.

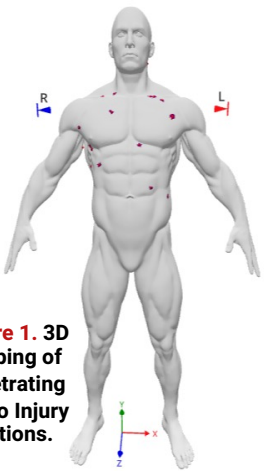


Figure 1. 3D Mapping of Penetrating Torso Injury Locations.



Disclosures: The authors declare that they have no conflicts of interest or disclosures relevant to the content of this abstract. All research procedures were conducted in accordance with established ethical guidelines and with the approval of the appropriate institutional review board. The findings presented are based on the data available at the time of submission and may be subject to further analysis or refinement.

